OMRON

Environment Sensor (USB Type)

2JCIE-BU01

User's Manual

Environment Sensor (USB Type)

A279-E1-01

Table of Contents

1. Introduction

1.1. Scope

This communication interface manual is applicable to the communication interface of the Environment Sensor USB Type (2JCIE-BU01).

1.2. Communication interface

The Environment Sensor USB Type can communicate with smartphones, tablets, gateways, and other devices (referred to as "Central device" in this manual) via Bluetooth® Low Energy (BLE) using its built-in wireless communication interface or USB 2.0. The Environment Sensor USB Type is equipped with the BLE peripheral feature.

Table 1 GAP Role

GAP Role	
2JCIE-BU01	Peripheral
Smartphone, Gateway etc.	Central

1.3. **Operation mode**

The Environment Sensor USB Type is equipped with normal mode and acceleration logger mode, which can be selected to match the application. The mode can be changed as desired.

1.3.1 Normal mode

This mode is used to get sensing data such as the temperature, relative humidity, ambient light, barometric pressure, sound noise, eTVOC, eCO2, discomfort index, and heat stroke and has a function that determines earthquakes/vibration using acceleration sensors to calculate the SI value, PGA, and measured seismic intensity equivalent value. It can save the sensing data to the built-in flash memory at an arbitrary interval and automatically save raw acceleration data to the flash memory when an earthquake/vibration occurs.

* Discomfort index: Expresses the heat and humidity of summer in a quantitative manner. It is calculated from temperature and humidity.
* Heat stroke: Expresses the risk of heat stroke in a quantitative manner. It is calculated from temperature and humidity.
* SI value: An index that expresses the effect a certain vibration has on a structure. It has a correlation with seismic intensity. It is calculated from the acceleration values of 2 horizontal axes.
* PGA: Peak acceleration value of a certain interval. It is calculated by resultant acceleration of 2 horizontal axes.
* Measured seismic intensity equivalent value: A value correlated with seismic intensity that is calculated from the SI value.

1.3.2 Acceleration logger mode

This mode is specifically for getting the acceleration and gets and saves raw acceleration data for specified operating frequencies and periods. It does not calculate the SI value, PGA, etc.

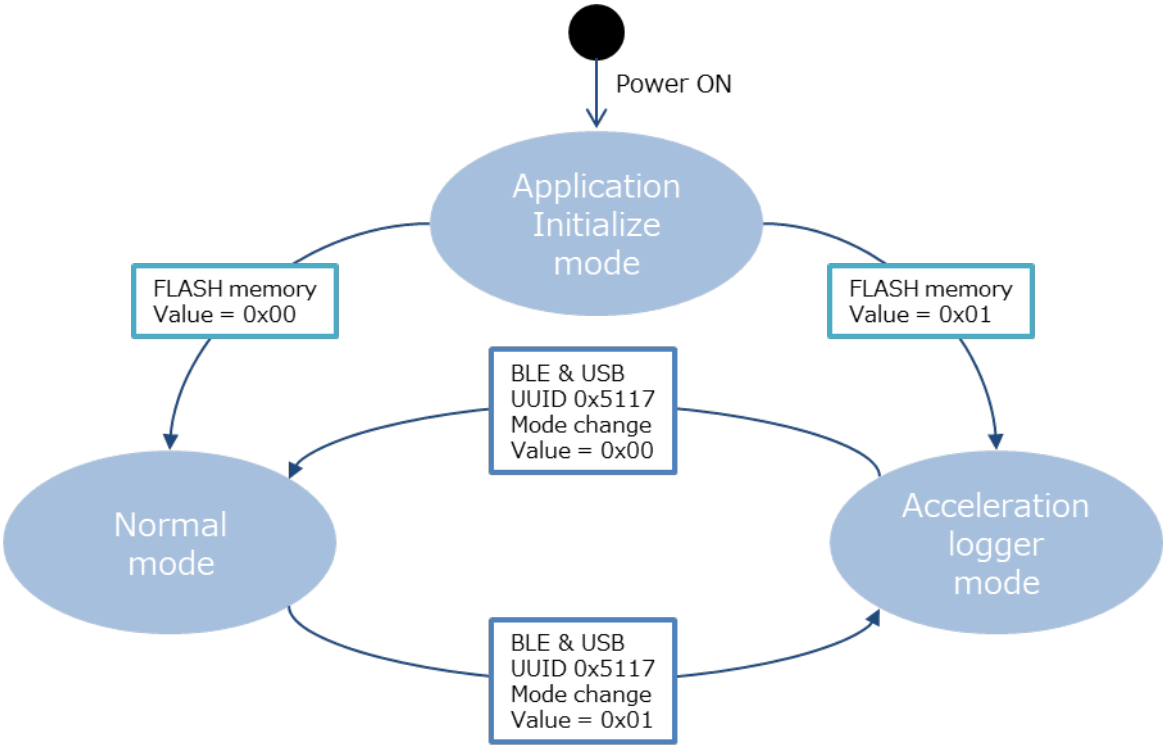

Figure 1 Mode transition

1.4. **Use case**

This section describes representative use cases.

1.4.1 BLE connection

This case enables getting and saving sensing data, getting acceleration data when earthquakes occur, and configuring various settings such as LED lighting and mode switching by connecting with a central device via BLE communication. For details, refer to "2. BLE GATT Services."

Figure 2 BLE connection image

1.4.2 Receive advertising data (BLE non-connection)

This case uses the gateway on the other device and is suitable for applications such as collecting the data of multiple Environment Sensor USB Type. There are eight types of advertising packet, and sensing data acquisition, acceleration data acquisition, sensor event results, etc. can be selected. For details, refer to "3. Advertising packet."

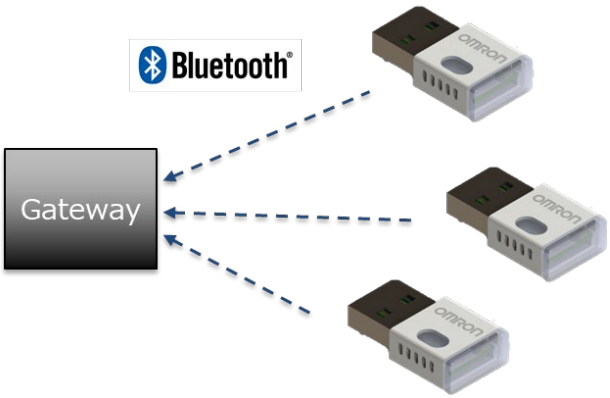

Figure 3 BLE non-connection image

1.4.3 USB communication

This case enables getting and saving sensing data, getting acceleration data when earthquakes occur, and configuring various settings such as LED lighting and mode switching via USB communication. The basic commands are the same as with BLE communication. For details, refer to "4. USB communication."

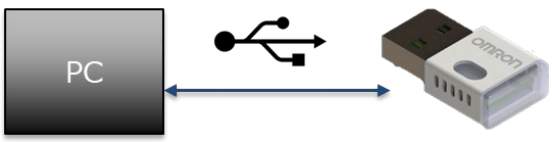

Figure 4 USB communication image

2. BLE GATT Services

Set the UUIDs that will be used for BLE communications to the values given below. The base UUID is set to the portion of the below UUID that is not the bold **XXXX**, and then it is given the common values of the service UUIDs and characteristics for the CUSTOM services. Characteristics data that is 2 bytes or longer is all little-endian.

Base UUID: AB70**XXXX**-0A3A-11E8-BA89-0ED5F89F718B

Table 2 List of supported GATT Services

Service UUID	Service Name	Number of Characteristics
0x5000 (CUSTOM)	Memory Data Service	7
0x5010 (CUSTOM)	Latest Data Service	5
0x5030 (CUSTOM)	Acceleration Service	4
0x5110 (CUSTOM)	Control Service	9
0x5200 (CUSTOM)	Time Setting Service	3
0x5210 (CUSTOM)	Event Setting Service	24
0x5400 (CUSTOM)	Information Service	3
0x1800	Generic Access Service	4
0x180A	Device Information Service	5

2.1. **Memory Data Service (Service UUID: 0x5000)**

This is a service used to get sensing data saved in flash memory.

Table 3 List of Characteristics in Memory Data Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5004	Memory index information	Memory index information	√			8
0x5005	Request memory index	Specify memory index		√		9
0x5006	Memory status	Status of read memory	√			11
0x500A	Memory sensing data	Read sensing data			√	20
0x500B	Memory calculation data	Read calculation data			√	15
0x500C	Memory sensing flag	Read sensing flag			√	18
0x500D	Memory calculation flag	Read calculation flag			√	11

* Definition of properties (R: Read, W: Write, N: Notify)

***Memory data acquisition procedure**

The Environment Sensor USB Type starts saving data to flash memory by writing a value to the time setting (UUID: 0x5202). Memory index is a control number that is updated each time sensing data is saved. Flash memory save up to a maximum of 60,000 items of sensing data. When 60,000 items is exceeded, the sensing data is automatically deleted in order from the oldest data. To read the data in flash memory, perform the following procedure.

1. ***Read*** Memory index information (Characteristics UUID: 0x5004)
   Get the memory index where the sensing data is saved.
2. ***Write*** Request memory index (Characteristics UUID: 0x5005)
   Specify the data to read.
3. ***Read*** Memory status (Characteristics UUID: 0x5006)
   Check whether reading is possible.
4. ***Notify*** Memory sensing data etc. (Characteristics UUID: 0x500A)
   Receive the data as notifications.

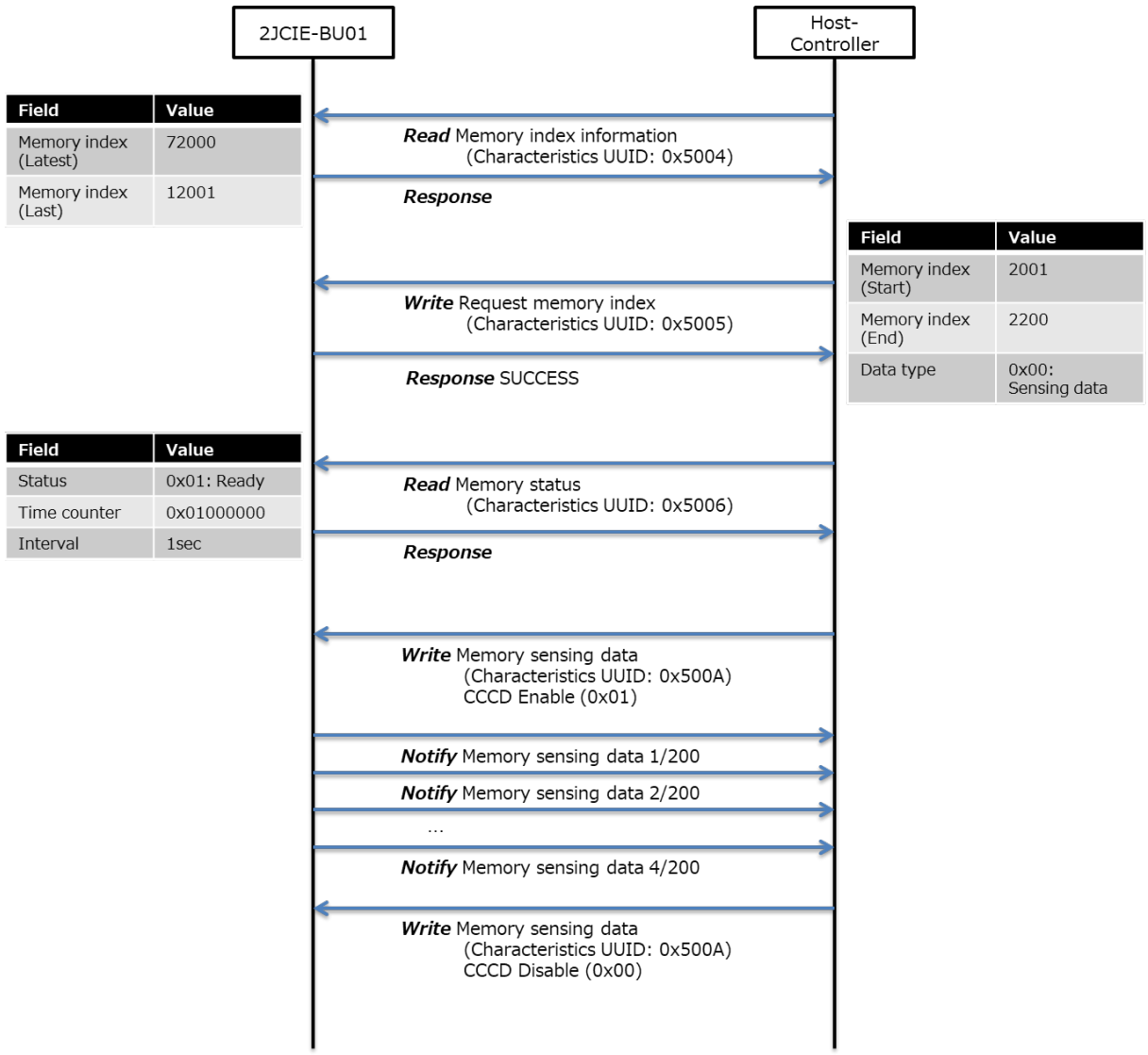

Figure 5 Procedure for acquiring memory data

2.1.1 Memory index information (Characteristics UUID: 0x5004)

This characteristic is used to get the number of indexes of sensing data saved in flash memory.
The maximum amount of saved data is 60,000 items of data between memory index (latest) and memory index (last). If the memory indexes exceed 60,000 items, the data will be overwritten in order from the oldest data. Only the data between memory index (latest) and memory index (last) can be acquired.

Table 4 Memory index information format

Byte	Field	Format	Contents
0-3	Memory index (Latest)	UInt32	Range: 0x00000001 to 0x7FFFFFFF
4-7	Memory index (Last)	UInt32	*0x00000000: Before storage

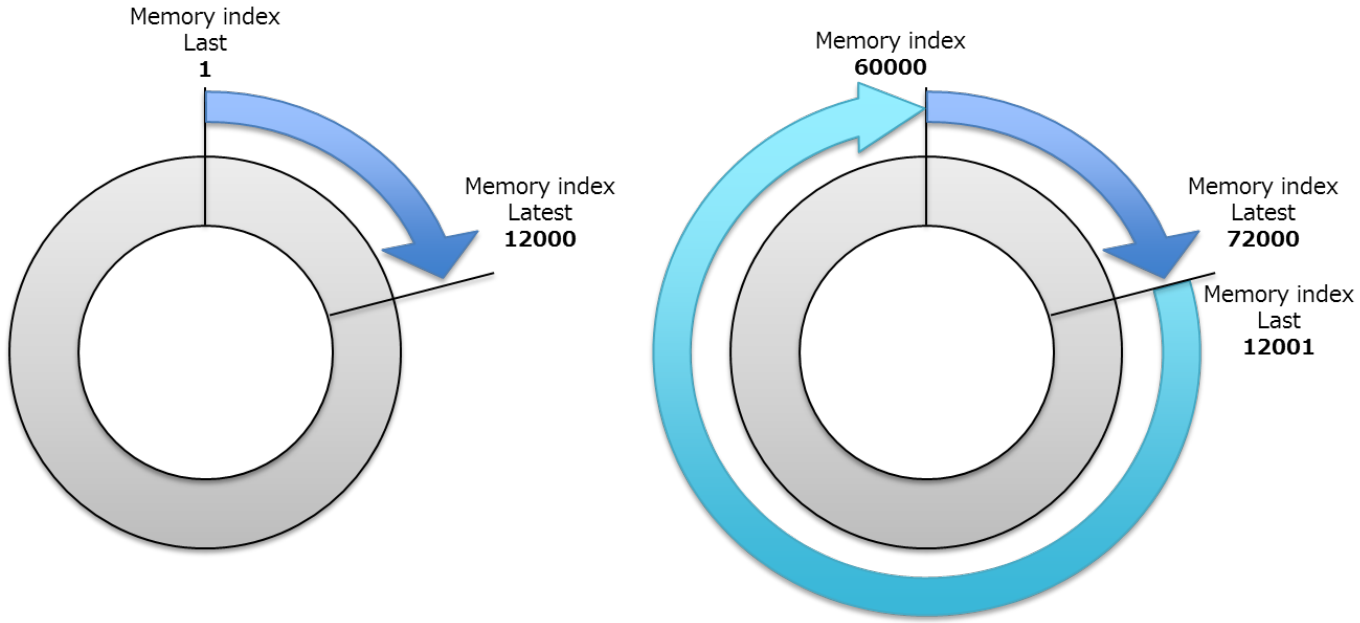

Figure 6 Memory index update

2.1.2 Request memory index (Characteristics UUID: 0x5005)

This characteristic is used to configure the settings to get the sensing data saved in flash memory.
The Environment Sensor starts getting ready to transfer a notification by setting the memory index range and data type of the data you wish to get.

Table 5 Request memory index format

Byte	Field	Format	Contents
0-3	Memory index (Start)	UInt32	Range: 0x00000001 to 0x7FFFFFFF *Last index <=Start index *End index <= Latest index *Start index <= End index
4-7	Memory index (End)	UInt32	
8	Data type	UInt8	0x00: Sensing data 0x01: Calculation data 0x02: Sensing flag 0x03: Calculation flag

***Data type**

1. Sensing data
   Select when getting the values for temperature, relative humidity, ambient light, barometric pressure, sound noise, eTVOC, and eCO2.

2. Calculation data
   Select when getting the discomfort index, heat stroke, and values related to earthquakes such as vibration information.

3. Sensing flag
   Select when getting the event flags for temperature, relative humidity, ambient light, barometric pressure, sound noise, eTVOC, and eCO2.

4. Calculation flag
   Select when getting the event flags for the discomfort index, heat stroke, and values related to earthquakes such as vibration information.

2.1.3 Memory status (Characteristics UUID: 0x5006)

This characteristic is used to get the read status of the sensing data saved in flash memory.
The data get request is issued with request memory index (UUID: 0x5005), and the data is ready to transfer if the status is ready to transfer (0x01). If there is a send preparation error, such as the specified range being incorrect, the status is Error (0x03).

Table 6 Memory status format

Byte	Field	Format	Contents
0	Status	UInt8	0x00: Waiting 0x01: Ready to transfer 0x02: Transferring 0x03: Error
1-8	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF
9-10	Memory storage interval	UInt16	Range: 0x0001 to 0x0E10 (1 to 3600sec) Unit: 1sec

***Time counter**
Time counter of the specified memory index (Start) will be returned. The transfer packet of each item of data does not include time counter information, so time counter of the data that was received as notifications must be assigned by central device by utilizing these information (Time Counter and Memory storage interval).

Example)
Time counter = 0x00010000
Memory storage interval = 0x000A (10sec)

Data 1: 0x00010000 (Time counter)
Data 2: 0x0001000A (Time counter + Memory storage interval * 1)
Data 3: 0x00010014 (Time counter + Memory storage interval * 2)
Data 4: 0x0001001E (Time counter + Memory storage interval * 3)
...
Data 20: 0x000100BE (Time counter + Memory storage interval * 19)

*** Points to note on updating of time setting**

Since only the time counter of memory index (start) can be acquired with memory status, identification will not be possible if the time setting is updated part way through the data. As shown in figure 7, the time counter becomes 30 following 18 when the time setting is updated part way through. If the specification position of memory index (start) differs, the data will be linked with different time settings as shown in figures 8 and 9. When updating the time setting, you need to grasp the memory index at the time of update to enter a value after the update in memory index (start).

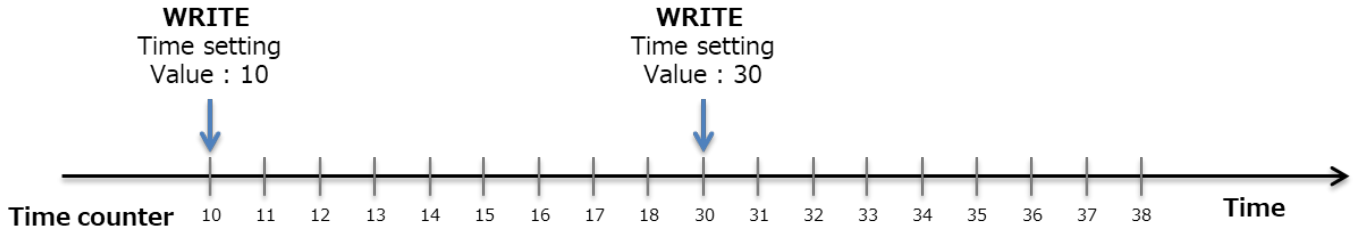

Figure 7 Time setting update

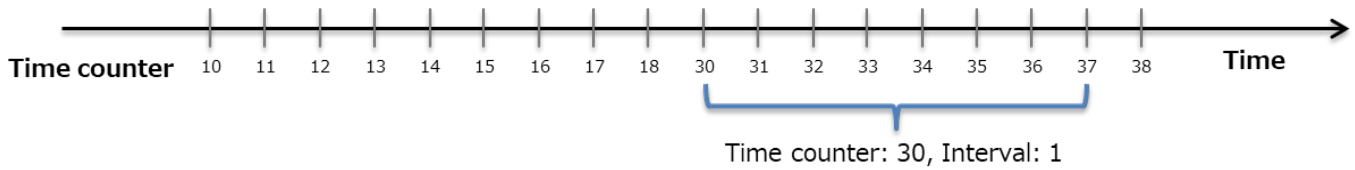

Figure 8 Read memory data

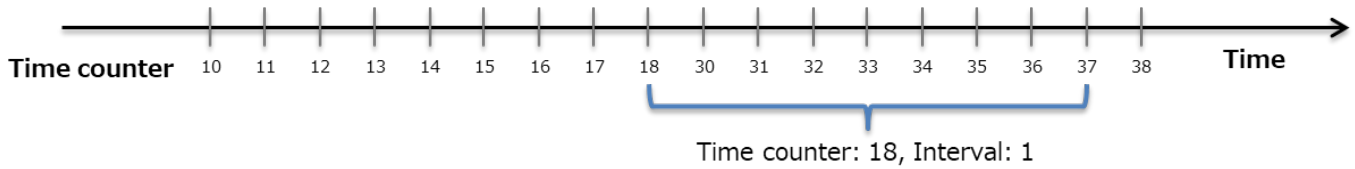

Figure 9 Read memory data

2.1.4 Memory sensing data (Characteristics UUID: 0x500A)

This characteristic is used to get sensing data saved to flash memory as notifications.
This is valid only when sensing data (0x00) is selected for the data type of request memory index. The transfer of data will begin as notifications when Client Characteristic Configuration Description (CCCD) is set to enable. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.

Table 7 Memory sensing data format

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-5	Temperature	SInt16	Reference: 5.1. Output range
6-7	Relative humidity	SInt16	
8-9	Ambient light	SInt16	
10-13	Barometric pressure	SInt32	
14-15	Sound noise	SInt16	
16-17	eTVOC	SInt16	
18-19	eCO2	SInt16	

2.1.5 Memory calculation data (Characteristics UUID: 0x500B)

This characteristic is used to get calculation data saved to flash memory as notifications.
This is valid only when calculation data (0x01) is selected for the data type of request memory index. The transfer of data will begin as notifications when Client Characteristic Configuration Description (CCCD) is set to enable. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.

Table 8 Memory calculation data format

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-5	Discomfort index	SInt16	Reference: 5.1. Output range
6-7	Heat stroke	SInt16	
8	Vibration information	UInt8	
9-10	SI value	UInt16	
11-12	PGA	UInt16	
13-14	Seismic intensity	UInt16	

2.1.6 Memory sensing flag (Characteristics UUID: 0x500C)

This characteristic is used to get sensing flags saved to flash memory as notifications.
This is valid only when sensing flag (0x02) is selected for the data type of request memory index. The transfer of data will begin as notifications when Client Characteristic Configuration Description (CCCD) is set to enable. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.

Table 9 Memory sensing flag format

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-5	Temperature flag	UInt16	Reference: 5.3. Event flag
6-7	Relative humidity flag	UInt16	
8-9	Ambient light flag	UInt16	
10-11	Barometric pressure flag	UInt16	
12-13	Sound noise flag	UInt16	
14-15	eTVOC flag	UInt16	
16-17	eCO2 flag	UInt16	

2.1.7 Memory calculation flag (Characteristics UUID: 0x500D)

This characteristic is used to get calculation flags saved to flash memory as notifications.
This is valid only when calculation flag (0x03) is selected for the data type of request memory index. The transfer of data will begin as notifications when Client Characteristic Configuration Description (CCCD) is set to enable. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.

Table 10 Memory calculation flag format

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-5	Discomfort index flag	UInt16	Reference: 5.3. Event flag
6-7	Heat stroke flag	UInt16	
8	SI value flag	UInt8	
9	PGA flag	UInt8	
10	Seismic intensity flag	UInt8	

2.2. **Latest Data Service (Service UUID: 0x5010)**

This is a service that can be used to get the latest values of sensing data.
The sensing data other than the acceleration data is updated every second and applied to the characteristics.
The acceleration data is updated every 320 msec.

Table 11 List of Characteristics in Latest Data Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5012	Latest sensing data	Sensing data	√		√	17
0x5013	Latest calculation data	Calculation data	√		√	18
0x5014	Latest sensing flag	Sensing flag	√		√	15
0x5015	Latest calculation flag	Calculation flag	√		√	8
0x5016	Latest acceleration status	Acceleration status	√		√	15

* Definition of properties (R: Read, W: Write, N: Notify)

***Sequence number**

The sequence number is a control number that is not synchronized with the memory index, and is incremented for every measurement (every second). It is updated automatically starting from 0x00 in the Environment Sensor USB Type after the power turns on. When 0xFF is reached, the next sequence number becomes 0x00, and this operation is subsequently repeated.

Table 12 Memory index and Sequence number

Description	Start trigger	Update condition	Update interval
Memory index	Time setting is set	Memory storage	Memory storage interval
Sequence number	Automatic start after boot	Measurement	1 sec

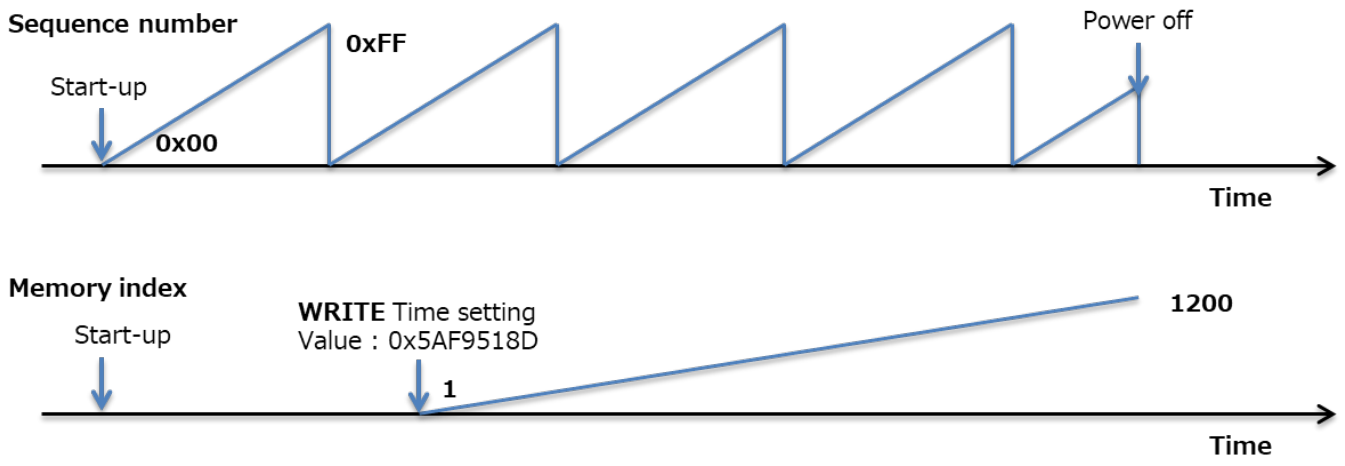

Figure 10 Memory index and Sequence number [Start-up]

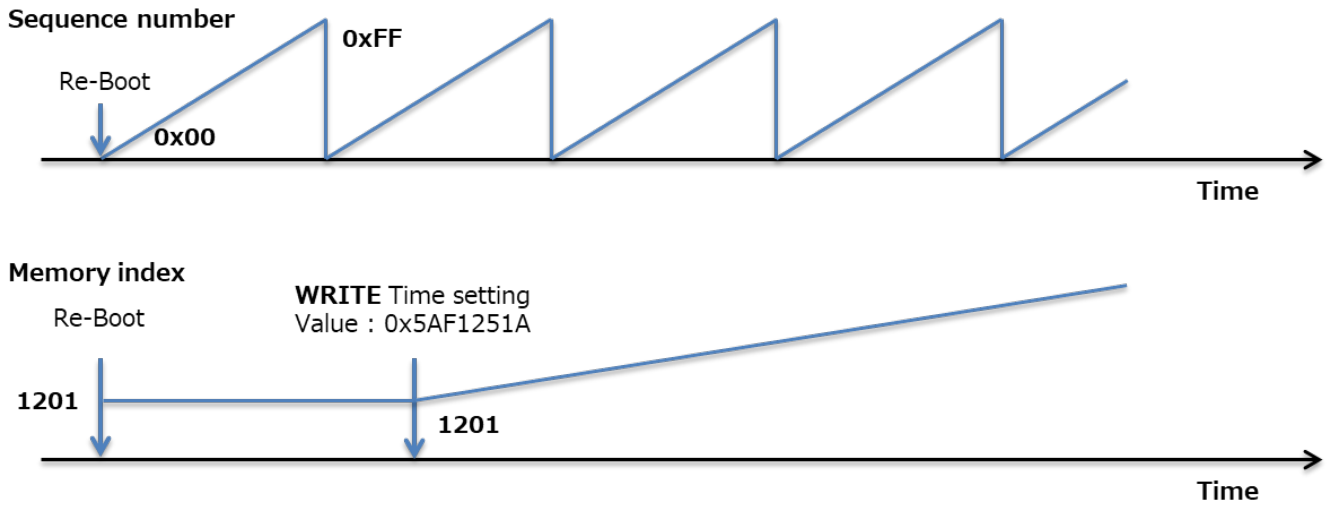

Figure 11 Memory index and Sequence number [Re-Boot]

2.2.1 Latest sensing data (Characteristics UUID: 0x5012)

This characteristic is used to get the latest sensing data.
When "Read," the latest values at the time of reading are returned, and when "Notify" is enabled, the values are transferred every time the data is updated.

Table 13 Latest sensing data format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature	SInt16	Reference: 5.1. Output range
3-4	Relative humidity	SInt16	
5-6	Ambient light	SInt16	
7-10	Barometric pressure	SInt32	
11-12	Sound noise	SInt16	
13-14	eTVOC	SInt16	
15-16	eCO2	SInt16	

2.2.2 Latest calculation data (Characteristics UUID: 0x5013)

This characteristic is used to get the latest calculation data.
When "Read," the latest values at the time of reading are returned, and when "Notify" is enabled, the values are transferred every time the data is updated.

Table 14 Latest calculation data format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Discomfort index	SInt16	Reference: 5.1. Output range
3-4	Heat stroke	SInt16	
5	Vibration information	UInt8	
6-7	SI value	UInt16	
8-9	PGA	UInt16	
10-11	Seismic intensity	UInt16	
12-13	Acceleration (X-axis)	SInt16	
14-15	Acceleration (Y-axis)	SInt16	
16-17	Acceleration (Z-axis)	SInt16	

2.2.3 Latest sensing flag (Characteristics UUID: 0x5014)

This characteristic is used to get the latest sensing flags.

When "Read," the latest values at the time of reading are returned, and when "Notify" is enabled, the values are transferred every time the data is updated.

Table 15 Latest sensing flag format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature flag	UInt16	Reference: 5.3. Event flag
3-4	Relative humidity flag	UInt16	
5-6	Ambient light flag	UInt16	
7-8	Barometric pressure flag	UInt16	
9-10	Sound noise flag	UInt16	
11-12	eTVOC flag	UInt16	
13-14	eCO2 flag	UInt16	

2.2.4 Latest calculation flag (Characteristics UUID: 0x5015)

This characteristic is used to get the latest calculation flag.

When "Read," the latest values at the time of reading are returned, and when "Notify" is enabled, the values are transferred every time the data is updated.

Table 16 Latest calculation flag format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Discomfort index flag	UInt16	Reference: 5.3. Event flag
3-4	Heat stroke flag	UInt16	
5	SI value flag	UInt8	
6	PGA flag	UInt8	
7	Seismic intensity flag	UInt8	

2.2.5 Latest acceleration status (Characteristics UUID: 0x5016)

This characteristic is used to get the latest acceleration status.

When "Read," the latest values at the time of reading are returned, and when "Notify" is enabled, the values are transferred every time the data is updated.

The acceleration offset is updated when an earthquake or vibration has not occurred.

Table 17 Latest acceleration status format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1	Vibration information	UInt8	Reference: 5.1. Output range
2-3	Maximum acceleration (X-axis)	SInt16	
4-5	Maximum acceleration (Y-axis)	SInt16	
6-7	Maximum acceleration (Z-axis)	SInt16	
8	SI value calculation axis	UInt8	
9-10	Acceleration offset (X-axis)	SInt16	
11-12	Acceleration offset (Y-axis)	SInt16	
13-14	Acceleration offset (Z-axis)	SInt16	

2.3. **Acceleration Service (Service UUID: 0x5030)**

This is a service that can be used to get acceleration data saved in flash memory.

Table 18 List of Characteristics in Acceleration Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5031	Vibration count	Accumulated earthquake/vibration count	√			8
0x5032	Request acceleration memory index	Specify acceleration memory index		√		6
0x5033	Acceleration memory status	Read status of acceleration memory	√			3
0x5034	Acceleration memory data	Read acceleration data			√	20

* Definition of properties (R: Read, W: Write, N: Notify)

***Acceleration memory data acquisition procedure [Normal mode]**

Data saving starts for an earthquake/vibration if vibration is detected even before a value is written to the time setting (UUID: 0x5202). There is a time counter for the acquisition data format, but it becomes 0 when the time setting is not written. To read the data in flash memory, perform the following procedure. The amount of earthquake data is fixed to 375 pages, but since the vibration data varies depending on the vibration time, the total number of pages can be checked by reading the header page.

1. ***Read*** Vibration count (Characteristics UUID: 0x5031)
   Get the count value for saved earthquake/vibration data.
2. ***Write*** Request acceleration memory index (Characteristics UUID: 0x5032)
   Specify the header page.
3. ***Read*** Acceleration memory status (Characteristics UUID: 0x5033)
   Check whether reading is possible.
4. ***Notify*** Memory sensing data etc. (Characteristics UUID: 0x500A)
   Receive the data as notifications.
5. ***Write*** Request acceleration memory index (Characteristics UUID: 0x5032)
   Specify the pages to get.
6. ***Read*** Acceleration memory status (Characteristics UUID: 0x5033)
   Check whether reading is possible.
7. ***Notify*** Memory sensing data etc. (Characteristics UUID: 0x500A)
   Receive the data as notifications.

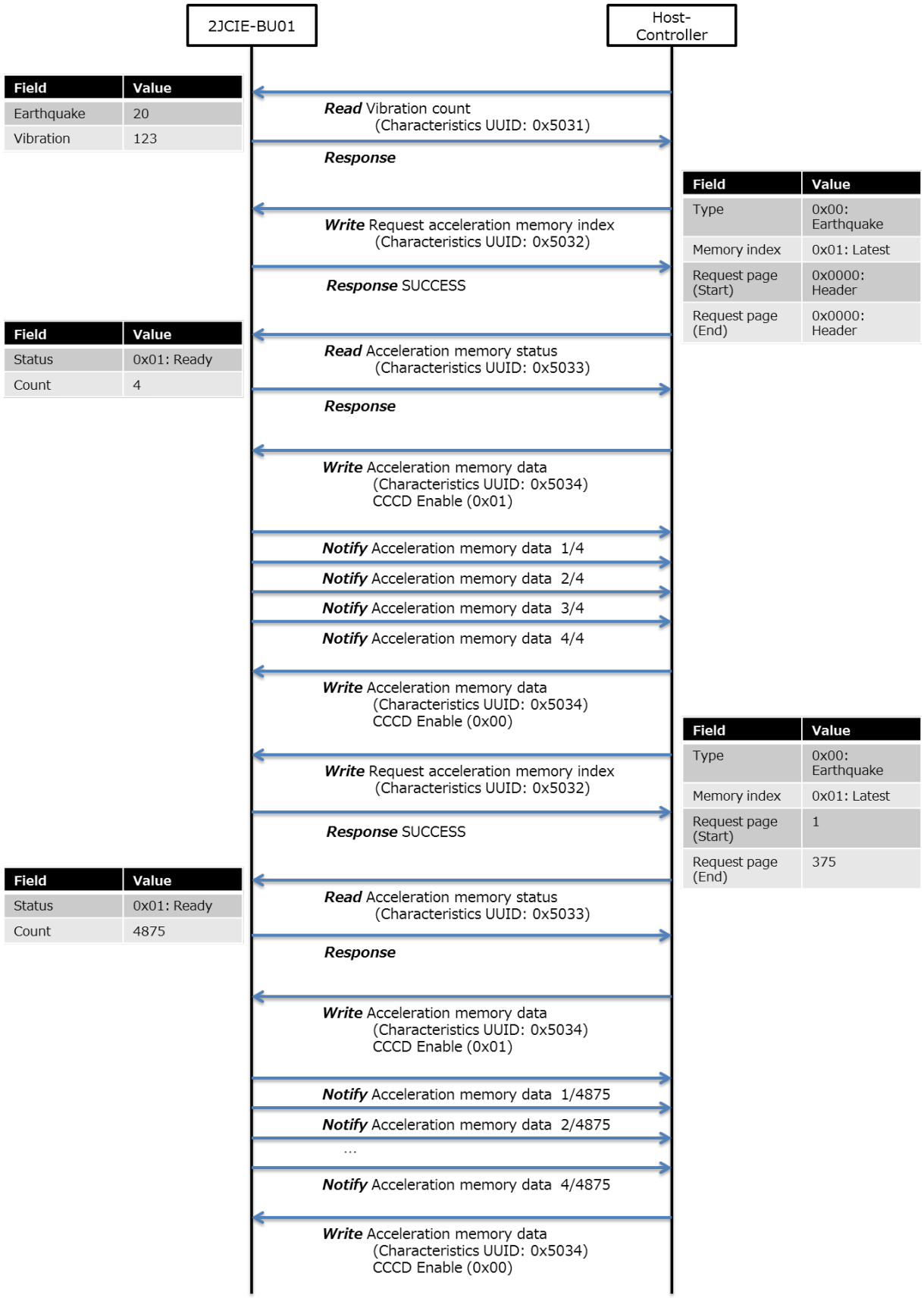

Figure 12 Procedure for acquiring acceleration memory data

***Acceleration memory data acquisition procedure [Acceleration logger mode]**

To read the data in flash memory when in acceleration logger mode, perform the following procedure.

1. ***Write*** Request acceleration memory index (Characteristics UUID: 0x5032)
   Specify the pages to get.
2. ***Read*** Acceleration memory status (Characteristics UUID: 0x5033)
   Check whether reading is possible.
3. ***Notify*** Memory sensing data etc. (Characteristics UUID: 0x500A)
   Receive the data as notifications.

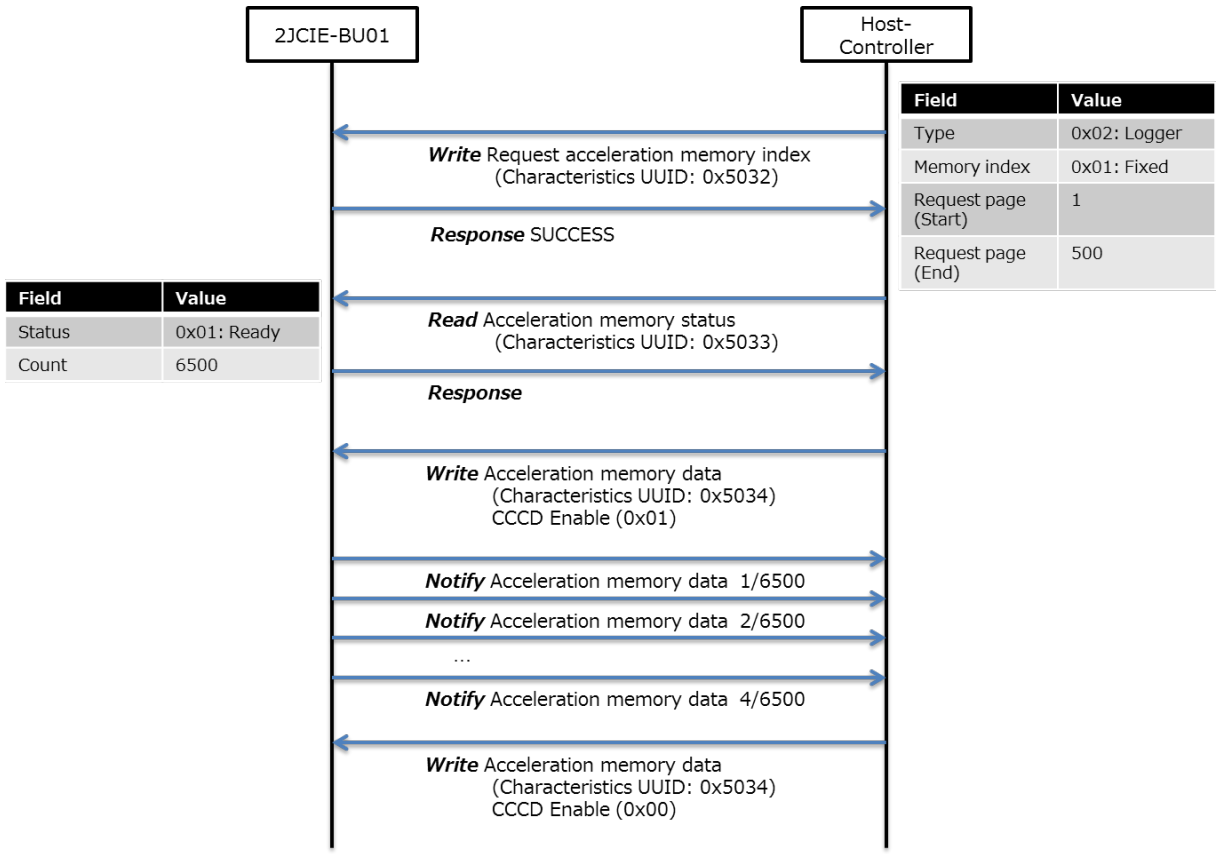

Figure 13 Procedure for acquiring acceleration memory data

2.3.1 Vibration count (Characteristics UUID: 0x5031)

This characteristic is used to get the accumulated earthquake/vibration count.
When the mode is changed or the acceleration area is erased by a memory reset, the accumulated count is reset.

Table 19 Vibration count format

Byte	Field	Format	Contents
0-3	Earthquake count	UInt32	Range: 0x00000000 to 0xFFFFFFFF
4-7	Vibration count	UInt32	Unit: 1count

2.3.2 Request acceleration memory index (Characteristics UUID: 0x5032)

This characteristic is used to configure the settings to get the acceleration data saved in flash memory.

1. Normal mode
   Select the data you wish to get for the data type (earthquake data or vibration data) and specify the memory index. The latest memory index is 1 and last memory index is 10. Calculation results such as the SI value and PGA and the number of pages of saved raw acceleration data can be acquired from the header page. To acquire raw data, check the storage total page in the header page and then specify the start page and end page and begin reading.

Table 20 Request acceleration memory index format [Normal mode]

Byte	Field	Format	Contents
0	Acceleration data type	UInt8	0x00: Earthquake data 0x01: Vibration data
1	Request acceleration memory index	UInt8	Range: 0x01 to 0x0A (1 to 10) *0x01: Latest data <---> 0x0A: Last data
2-3	Request page (Start)	UInt16	Range: 0x0000 to 0x01FF (0 to 511) *0x0000: Header page *Start page <= End page
4-5	Request page (End)	UInt16	

2. Acceleration logger mode
   Specify logger data as the data type, and then specify the start page and end page. The memory index is fixed to 0x01 because it is not used. The maximum value that can be specified for between Request page (Start) and Request page (End) is 1,000 pages. To get more data than that, split up the request.

Table 21 Request acceleration memory index format [Acceleration logger mode]

Byte	Field	Format	Contents
0	Acceleration data type	UInt8	0x02: Logger data
1	Request acceleration memory index	UInt8	0x01: Fixed value
2-3	Request page (Start)	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) *Start index <= End index *(Start index - End index) <= 1000
4-5	Request page (End)	UInt16	

2.3.3 Acceleration memory status (Characteristics UUID: 0x5033)

This characteristic is used to get the read status of the acceleration data saved in flash memory.
After the data in the request acceleration memory index is specified, the data is ready to transfer if the status is ready to transfer (0x01), and the total number of notifications to be transferred (total transfer count) from then can be checked.

Table 22 Acceleration memory status format

Byte	Field	Format	Contents
0	Status	UInt8	0x00: Waiting 0x01: Ready to transfer 0x02: Transferring 0x03: Error
1-2	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF

2.3.4 Acceleration memory data [Header] (Characteristics UUID: 0x5034)

This characteristic is used to get the header information of the acceleration data as a notification.
If the header page is specified in normal mode, the following packet is split into 4 parts and transferred as notifications. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the total transfer count is set to 1 and then the data is transferred.

Table 23 Acceleration memory data format [Header] 1/4

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Storage total page	UInt16	Range: 0x0001 to 0xFFFF
4-7	Earthquakes or vibration count	UInt32	Range: 0x00000001 to 0xFFFFFFFF Unit: 1count
8-15	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF
16	Earthquake flag	UInt8	0x00: Vibration data 0x01: Earthquake data
17	SI value calculation axis	UInt8	Reference: 5.1. Output range
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

Table 24 Acceleration memory data format [Header] 2/4

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Page number	UInt16	0x0000: Fixed value
4-5	SI value	UInt16	Reference: 5.1. Output range
6-7	PGA	UInt16	
8-9	Seismic intensity	UInt16	
10-11	Maximum acceleration (X-axis)	SInt16	
12-13	Maximum acceleration (Y-axis)	SInt16	
14-15	Maximum acceleration (Z-axis)	SInt16	
16-17	Temperature	SInt16	
18-19	Relative humidity	SInt16	

Table 25 Acceleration memory data format [Header] 3/4

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Ambient light	SInt16	Reference: 5.1. Output range
4-7	Barometric pressure	SInt32	
8-9	Sound noise	SInt16	
10-11	eTVOC	SInt16	
12-13	eCO2	SInt16	
14-15	Discomfort index	SInt16	
16-17	Heat stroke	SInt16	
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

Table 26 Acceleration memory data format [Header] 4/4

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Acceleration offset (X-axis)	SInt16	Reference: 5.1. Output range
4-5	Acceleration offset (Y-axis)	SInt16	
6-7	Acceleration offset (Z-axis)	SInt16	
8	Reserve for Future Use	UInt8	0xFF: Fixed value
9	Reserve for Future Use	UInt8	0xFF: Fixed value
10	Reserve for Future Use	UInt8	0xFF: Fixed value
11	Reserve for Future Use	UInt8	0xFF: Fixed value
12	Reserve for Future Use	UInt8	0xFF: Fixed value
13	Reserve for Future Use	UInt8	0xFF: Fixed value
14	Reserve for Future Use	UInt8	0xFF: Fixed value
15	Reserve for Future Use	UInt8	0xFF: Fixed value
16	Reserve for Future Use	UInt8	0xFF: Fixed value
17	Reserve for Future Use	UInt8	0xFF: Fixed value
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

2.3.5 Acceleration memory data [Data] (Characteristics UUID: 0x5034)

This characteristic is used to get the data information of the acceleration data as notifications.
If data page is specified in normal mode or acceleration logger mode is specified, the following packet is split into 13 parts and transferred as notifications. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the total transfer count is set to 1 and then the data is transferred. In acceleration logger mode, output is fixed to 0x0000 because the SI value, PGA, seismic intensity, and maximum acceleration are not calculation targets.

Table 27 Acceleration memory data format [Data] 1/13

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Page number	UInt16	[Normal mode] Range: 0x0001 to 0x01FF (1 to 511) [Acceleration logger mode] Range: 0x0001 to 0x2800 (1 to 10240)
4-5	SI value	UInt16	[Normal mode] Reference: 5.1. Output range [Acceleration logger mode] 0x0000: Fixed value
6-7	PGA	UInt16	
8-9	Seismic intensity	UInt16	
10-11	Maximum acceleration (X-axis)	SInt16	
12-13	Maximum acceleration (Y-axis)	SInt16	
14-15	Maximum acceleration (Z-axis)	SInt16	
16-17	Temperature	SInt16	Reference: 5.1. Output range
18-19	Relative humidity	SInt16	

Table 28 Acceleration memory data format [Data] 2/13

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Ambient light	SInt16	Reference: 5.1. Output range
4-7	Barometric pressure	SInt32	
8-9	Sound noise	SInt16	
10-11	eTVOC	SInt16	
12-13	eCO2	SInt16	
14-15	Discomfort index	SInt16	
16-17	Heat stroke	SInt16	
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

Table 29 Acceleration memory data format [Data] 3/13 to 12/13

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Acceleration (X-axis)	SInt16	Reference: 5.1. Output range
4-5	Acceleration (Y-axis)	SInt16	
6-7	Acceleration (Z-axis)	SInt16	
8-9	Acceleration (X-axis)	SInt16	
10-11	Acceleration (Y-axis)	SInt16	
12-13	Acceleration (Z-axis)	SInt16	
14-15	Acceleration (X-axis)	SInt16	
16-17	Acceleration (Y-axis)	SInt16	
18-19	Acceleration (Z-axis)	SInt16	

Table 30 Acceleration memory data format [Data] 13/13

Byte	Field	Format	Contents
0-1	Total transfer count	UInt16	Range: 0x0001 to 0x7FFF *Increment for each transmission *If data error, MSB is 1
2-3	Acceleration (X-axis)	SInt16	Reference: 5.1. Output range
4-5	Acceleration (Y-axis)	SInt16	
6-7	Acceleration (Z-axis)	SInt16	
8-9	Acceleration (X-axis)	SInt16	
10-11	Acceleration (Y-axis)	SInt16	
12-13	Acceleration (Z-axis)	SInt16	
14	Reserve for Future Use	UInt8	0xFF: Fixed value
15	Reserve for Future Use	UInt8	0xFF: Fixed value
16	Reserve for Future Use	UInt8	0xFF: Fixed value
17	Reserve for Future Use	UInt8	0xFF: Fixed value
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

2.4. **Control Service (Service UUID: 0x5110)**

This service is used to configure settings.

Table 31 List of Characteristics in Control Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5111	LED setting [normal state]	RGB color setting [normal state]	√	√		5
0x5112	LED setting [event state]	RGB color setting [event state]	√	√		5
0x5113	LED state [operation]	RGB color setting [operation]	√	√		3
0x5114	Installation offset	Offset correction	√	√		13
0x5115	Advertising setting	Interval and mode setting	√	√		3
0x5116	Memory reset	Memory reset		√		1
0x5117	Mode change	Mode change	√	√		1
0x5118	Acceleration logger control	Acceleration logger mode, measurement start command		√		7
0x5119	Acceleration logger status	Acceleration logger mode, status	√			3

* Definition of properties (R: Read, W: Write, N: Notify)

2.4.1 LED setting [normal state] (Characteristics UUID: 0x5111)

This characteristic is used to get or set the LED display status for the normal operation state.
For normally ON (0x01), specify the color to be displayed by the RGB (red, green, and blue) intensity set with intensity of LED. There are 255 steps, and 255 is the maximum, and the color will be white when all 255 (0xFF), and illumination will be off when all 0 (0x00). If a scale is selected, the color automatically changes according to sensor output. The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 32 LED setting [normal state] format

Byte	Field	Format	Contents
0-1	Display rule (normal state)	UInt16	0x0000: Normally OFF 0x0001: Normally ON 0x0002: Temperature value scales 0x0003: Relative humidity value scales 0x0004: Ambient light value scales 0x0005: Barometric pressure value scales 0x0006: Sound noise value scales 0x0007: eTVOC value scales 0x0008: SI value scales 0x0009: PGA value scales
2	Intensity of LED (Red)	UInt8	Range: 0x00 to 0xFF
3	Intensity of LED (Green)	UInt8	
4	Intensity of LED (Blue)	UInt8	

Figure 14 LED scales

Table 33 Upper and lower limits of LED scales

Display rule	Sensor type	Lower value	Upper value	Unit
0x0002	Temperature	10.00	35.00	degC
0x0003	Relative humidity	20.00	80.00	%RH
0x0004	Ambient light	0	10000	Lx
0x0005	Barometric pressure	950.000	1050.000	hPa
0x0006	Sound noise	35.00	80.00	dB
0x0007	eTVOC	0	1000	ppb
0x0008	SI value	0	60.0	kine
0x0009	PGA	0	300.0	gal

2.4.2 LED setting [event state] (Characteristics UUID: 0x5112)

This characteristic is used to get or set the LED display status when an event occurs.
For when an event occurs, specify the color to flash by the RGB (red, green, blue) intensity set with intensity of LED. There are 255 steps, and 255 is the maximum, and the color will be white when all 255 (0xFF), and illumination will be off when all 0 (0x00). Events are bit field settings so multiple events can be set at the same time. The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 34 LED setting [event state] format

Byte	Field	Format	Contents
0-1	Display rule (event state)	UInt16	Bit7: PGA event Bit6: SI value event Bit5: eTVOC event Bit4: Sound noise event Bit3: Barometric pressure event Bit2: Ambient light event Bit1: Relative humidity event Bit0: Temperature event
2	Intensity of LED (Red)	UInt8	Range : 0x00 to 0xFF
3	Intensity of LED (Green)	UInt8	
4	Intensity of LED (Blue)	UInt8	

2.4.3 LED state [operation] (Characteristics UUID: 0x5113)

This characteristic is used to get or set the LED display status of each operation.
Start up applies only after startup, Error applies when any error status (characteristics UUID: 0x5401) occurs, and Connection applies when connected via BLE communication. The setting values are written to flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 35 LED setting [operation] format

Byte	Field	Format	Contents
0	Start up	UInt8	0x00: Rainbow (default) 0x01: BLUE
1	Error	UInt8	0x00: NONE (default) 0x01: RED
2	Connection	UInt8	0x00: NONE (default) 0x01: GREEN ON 1 sec

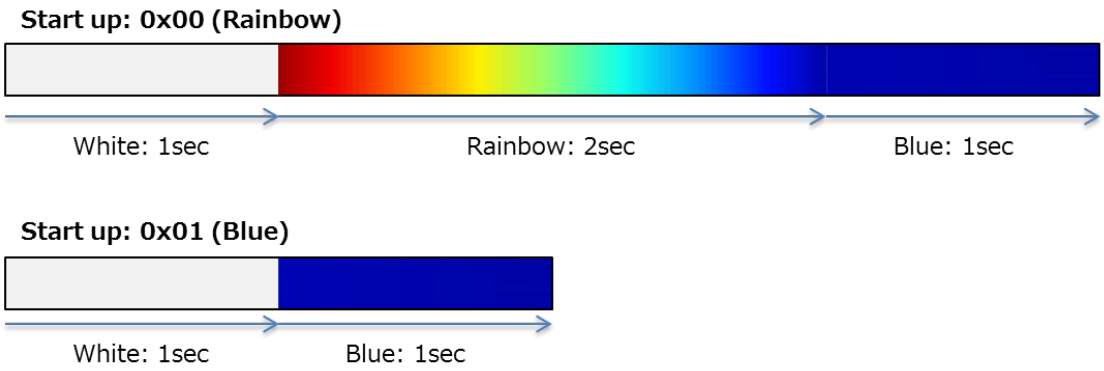

Figure 15 LED lighting [Start-up]

***Priority of LED lighting**

Since an event and error may occur at the same time, the priority order for LED lighting is as follows.

Table 36 Priority of LED lighting

Priority	Operation
1 (High)	Start up
2	Error
3	Event
4	Normal
5 (Low)	Connection

2.4.4 Installation offset (Characteristics UUID: 0x5114)

This characteristic is used to get or set the arbitrary offset and gain values after installation.
For the enabled installation offsets, the specified value can be added/subtracted. Gain correction is with ambient light only, and a set factor can be applied to raw output. The setting values are written to flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 37 Installation offset format

Byte	Field	Format	Contents
0	Installation offset enable/disable	UInt8	Bit4: Sound noise offset enable Bit3: Barometric pressure offset enable Bit2: Ambient light gain enable Bit1: Relative humidity offset enable Bit0: Temperature offset enable
1-2	Temperature installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01degC Default: 0x0000 (0.00degC)
3-4	Relative humidity installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01%RH Default: 0x0000 (0.00%RH)
5-6	Ambient light installation gain	SInt16	Range: 0x0000 to 0x2710 (0 to 10000) Unit: 0.001 Default: 0x0000 (0.000)
7-10	Barometric pressure installation offset	SInt32	Range: 0xFFF0BDC0 to 0x000F4240 (-1000000 to 1000000) Unit: 0.001hPa Default: 0x0000 (0.000hPa)
11-12	Sound noise installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01dB Default: 0x0000 (0.00dB)

Example)
Installation offset enable/disable = 0x01
Temperature installation offset = -5.00degC
Temperature raw value = 25.65 degC
↓
Temperature correct value = 20.65 degC

2.4.5 Advertise setting (Characteristics UUID: 0x5115)

This characteristic is used to get or set the BLE advertising transmission interval and data type.
For the configuration of advertising packets, refer to "3. BLE Advertising packet." If Reserved for Future Use (0x06 to 0x08) is selected for the advertising mode, the advertising packet of the sensor data (0x01) is selected. The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 38 Advertise setting format

Byte	Field	Format	Contents
0-1	Advertising interval	UInt16	Range: 0x00A0 to 0x4000 (100ms to 10.24s) Unit: 0.625 ms Default: 0x00A0 (100ms)
2	Advertising mode	UInt8	0x01: Sensor data (default) 0x02: Calculation data 0x03: Sensor data & Calculation data (Scan rsp) 0x04: Sensor flag & Calculation flag (Scan rsp) 0x05: Serial number 0x06: Reserve for Future Use 0x07: Reserve for Future Use 0x08: Reserve for Future Use

2.4.6 Memory reset (Characteristics UUID: 0x5116)

This characteristic is used to erase the flash memory data of the relevant area.
The sensing data area is a ring buffer so the old data is erased automatically, but if you wish to reset the memory index, clear the sensing data area by a memory reset. For the acceleration area, this is used to erase the data in the acceleration logger mode. The erase time is approximately 2 minutes and the LED lights blue. The status can also be checked by reading the flash memory status (characteristics UUID: 0x5403), and erasing is being performed while the status is Flash memory erasing (0x04), and complete when the status becomes NONE (0x00).

Table 39 Memory reset format

Byte	Field	Format	Contents
0	Memory reset	UInt8	0x01: Sensing data area 0x02: Acceleration area

2.4.7 Mode change (Characteristics UUID: 0x5117)

This characteristic is used to get the current mode or set the mode.
Since the flash memory in acceleration area is erased when the mode is switched, the state becomes the same as when the acceleration area is erased with a memory reset, and it takes approximately 2 minutes. The setting value is saved to flash memory, and startup is in the same mode even when the power is turned off and back on.

Table 40 Mode change format

Byte	Field	Format	Contents
0	Mode change	UInt8	0x00: Normal mode (default) 0x01: Acceleration logger mode

2.4.8 Acceleration logger control (Characteristics UUID: 0x5118)

This characteristic is used to start and stop the log of the acceleration logger mode.
When stopping the log, set the values for byte 1 to byte 6 to the same values as when starting the log. The start page and end page can be set arbitrarily by the user, but a memory reset needs to be performed before writing to the same page because data cannot be overwritten. Since the save time can be calculated from the ODR setting and number of pages, configure the settings from the following logging time.

Table 41 Acceleration logger control format

Byte	Field	Format	Contents
0	Logger condition	UInt8	0x00: Log stop 0x01: Log start
1	Range of detection	UInt8	0x00: ±2000 gal (fixed value)
2	ODR setting	UInt8	0x00: 1 Hz 0x01: 10 Hz 0x02: 25 Hz 0x03: 100 Hz 0x04: 200 Hz 0x05: 400 Hz
3-4	Start page	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) Unit: 1 page
5-6	End page	UInt16	

***Logging time**

Calculate the acceleration data save time from the following calculation formula. Acceleration data of 32 times is saved to one page.

$$\mathbf{Logging\ time(sec)} = \mathbf{32} \times {}^{\mathbf{1}}/_{\boldsymbol{ODR}} \times \boldsymbol{page}$$

Table 42 Example of acceleration logger setting

Example	ODR setting	Page	Logging time
1	10 Hz	10	32 sec
2	10 Hz	100	320 sec
3	100 Hz	100	32 sec
4	100 Hz	1000	320 sec
5	400 Hz	100	8 sec
6	400 Hz	1000	80 sec

***Sensing data**

Sensing data such as the temperature, humidity, and ambient light is also saved to memory in addition to the acceleration data. The save interval differs depending on the ODR setting.

Table 43 Sensing data update interval

Value	ODR setting	Update interval
0x00	1 Hz	32 sec
0x01	10 Hz	3.2 sec
0x02	25 Hz	1.28 sec
0x03	100 Hz	0.96 s
0x04	200 Hz	0.96 s
0x05	400 Hz	0.96 s

2.4.9 Acceleration logger status (Characteristics UUID: 0x5119)

This characteristic is used to get the status of acceleration logger mode.
The status becomes 0x01: Running during logging. The last page is displayed during running for the running page.

Table 44 Acceleration logger status

Byte	Field	Format	Contents
0	Logger status	UInt8	0x00: Waiting 0x01: Running
1-2	Running page	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) Unit: 1 page

2.5. **Time Setting Service (Service UUID: 0x5200)**

This service is used to configure settings related to time.

Table 45 List of Characteristics in Time Setting Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5201	Time counter	Value being counted by the device	√			8
0x5202	Time setting	Count value that was set	√	√		8
0x5203	Memory storage interval	Save interval for sensing data	√	√		2

2.5.1 Latest time counter (Characteristics UUID: 0x5201)

This characteristic is used to get the latest time counter.
The latest time displays the elapsed time in 1-second units from the time that was written with the time setting characteristic.

Table 46 Latest time counter format

Byte	Field	Format	Contents
0-7	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF

2.5.2 Time setting (Characteristics UUID: 0x5202)

This characteristic is used to get or set the offset values for counting in the Environment Sensor.
The setting value is reset at power off because it is not saved to flash memory.

Table 47 Time setting format

Byte	Field	Format	Contents
0-7	Time setting	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF

* The specified time is arbitrary determined by the host system.
The time can be set to count the passage of time when 1 is written for the time as shown in the above figure, or the time can be set based on UNIX time as shown in the figure below.

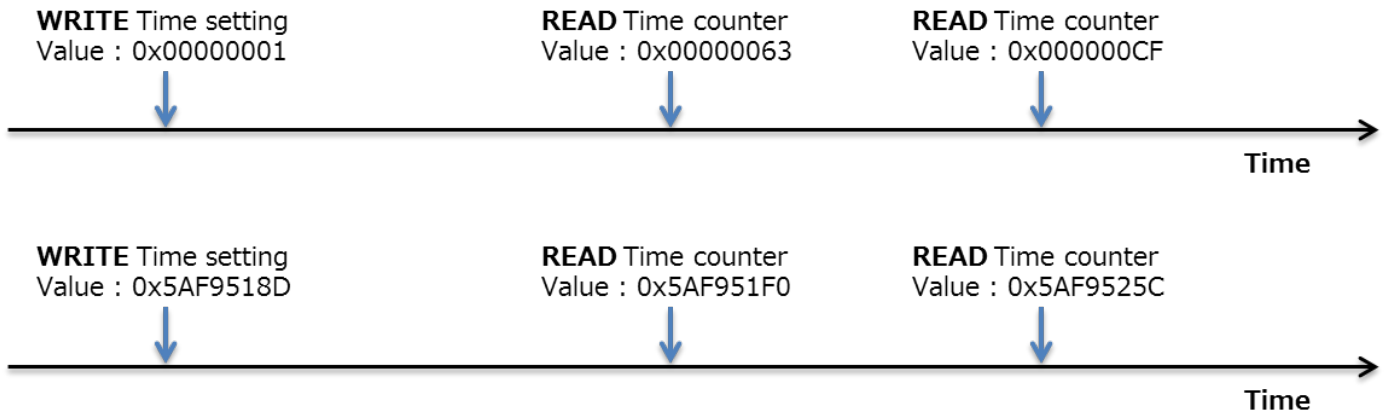

Figure 16 Time setting

2.5.3 Memory storage interval (Characteristics UUID: 0x5203)

This characteristic is used to get or set the interval to save the sensing data in flash memory.
When the storage interval is changed, the memory index is reset and the flash memory in the sensing data area is also erased. The state becomes the same as when the sensing data area is erased with a memory reset, and it takes approximately 2 minutes. The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 48 Memory storage interval format

Byte	Field	Format	Contents
0-1	Memory storage interval	UInt16	Range: 0x0001 to 0x0E10 (1 to 3600sec) Unit: 1sec Default: 0x0001 (1sec)

2.6. **Event Setting Service (Service UUID: 0x5210)**

This service is used to configure event settings.

Table 49 List of Characteristics in Event Setting Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5211	Temperature [Sensor 1]	Temperature event setting	√	√		20
0x5212	Temperature [Sensor 2]	Temperature event setting	√	√		20
0x5213	Relative humidity [Sensor 1]	Relative humidity event setting	√	√		20
0x5214	Relative humidity [Sensor 2]	Relative humidity event setting	√	√		20
0x5215	Ambient light [Sensor 1]	Ambient light event setting	√	√		20
0x5216	Ambient light [Sensor 2]	Ambient light event setting	√	√		20
0x5217	Barometric pressure [Sensor 1]	Barometric pressure event setting	√	√		20
0x5218	Barometric pressure [Sensor 2]	Barometric pressure event setting	√	√		20
0x5219	Sound noise [Sensor 1]	Sound noise event setting	√	√		20
0x521A	Sound noise [Sensor 2]	Sound noise event setting	√	√		20
0x521B	eTVOC [Sensor 1]	eTVOC event setting	√	√		20
0x521C	eTVOC [Sensor 2]	eTVOC event setting	√	√		20
0x521D	eCO2 [Sensor 1]	eCO2 event setting	√	√		20
0x521E	eCO2 [Sensor 2]	eCO2 event setting	√	√		20
0x521F	Discomfort index [Sensor 1]	Discomfort index event setting	√	√		20
0x5220	Discomfort index [Sensor 2]	Discomfort index event setting	√	√		20
0x5221	Heat stroke [Sensor 1]	Heat stroke event setting	√	√		20
0x5222	Heat stroke [Sensor 2]	Heat stroke event setting	√	√		20
0x5226	SI value [Acceleration]	SI value event setting	√	√		9
0x5227	PGA [Acceleration]	PGA event setting	√	√		9
0x5228	Seismic intensity [Acceleration]	Seismic intensity event setting	√	√		9

2.6.1 Event pattern [Sensor 1]

Get or set the enable/disable and threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 50 Event pattern [Sensor 1] format

Byte	Field	Format	Contents
0-1	Event enable/disable	UInt16	Reference: 5.2. Event enable/disable
2-3	Simple threshold [upper limit] 1	Sint16	Reference: 5.4. Event threshold
4-5	Simple threshold [upper limit] 2	Sint16	
6-7	Simple threshold [lower limit] 1	Sint16	
8-9	Simple threshold [lower limit] 2	Sint16	
10-11	Change threshold [rise] 1	Sint16	
12-13	Change threshold [rise] 2	Sint16	
14-15	Change threshold [decline] 1	Sint16	
16-17	Change threshold [decline] 2	Sint16	
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

2.6.2 Event pattern [Sensor 2]

Get or set the threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 51 Event pattern [Sensor 2] format

Byte	Field	Format	Contents
0-1	Average value threshold [upper]	Sint16	Reference: 5.4. Event threshold
2-3	Average value threshold [lower]	Sint16	
4-5	Peak to Peak threshold [upper]	Sint16	
6-7	Peak to Peak threshold [lower]	Sint16	
8-9	Interval difference threshold [upper]	Sint16	
10-11	Interval difference threshold [lower]	Sint16	
12-13	Base difference threshold [upper]	Sint16	
14-15	Base difference threshold [lower]	Sint16	
16	Average value count	UInt8	
17	Peak to Peak count	UInt8	
18	Interval difference count	UInt8	
19	Base difference count	UInt8	

2.6.3 Event pattern [Acceleration]

Get or set the enable/disable and threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on. Always check the flash memory status (characteristics UUID: 0x5403) after executing "Write" to confirm that flash writing is completed.

Table 52 Event pattern [Acceleration] format

Byte	Field	Format	Contents
0	Event enable/disable	UInt8	Reference: 5.2. Event enable/disable
1-2	Simple threshold [upper limit] 1	UInt16	Reference: 5.4. Event threshold
3-4	Simple threshold [upper limit] 2	UInt16	
5-6	Change threshold [rise] 1	UInt16	
7-8	Change threshold [rise] 2	UInt16	

2.7. **Information Service (Service UUID: 0x5400)**

This service is used to get sensor information.

Table 53 List of Characteristics in Information Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x5401	Error Status	Error information	√			11
0x5402	Installation direction	Sensor installation direction	√			1
0x5403	FLASH memory status	Flash memory status	√			1

* Definition of properties (R: Read, W: Write, N: Notify)

2.7.1 Error status (Characteristics UUID: 0x5401)

This characteristic is used to get the error status of the sensors and CPU.
The error status is cleared when this is read from the other device.

Table 54 Error status format

Byte	Field	Format	Contents
0	Temperature sensor error	UInt8	Bit3: Initialization error Bit2: Frozen output Bit1: Sensing data is out of range Bit0: Communication error
1	Relative humidity sensor error	UInt8	
2	Ambient light sensor error	UInt8	
3	Barometric pressure sensor error	UInt8	
4	Sound noise sensor error	UInt8	
5	Acceleration sensor error	UInt8	
6	eTVOC sensor error	UInt8	
7	eCO2 sensor error	UInt8	
8	CPU error	UInt8	Bit2: Reboot with watchdog Bit1: FLASH memory erase error Bit0: FLASH memory initialization error
9	Reserve for Future Use	UInt8	0xFF: Fixed value
10	Reserve for Future Use	UInt8	0xFF: Fixed value

2.7.2 Mounting orientation (Characteristics UUID: 0x5402)

This characteristic is used to get the mounting orientation.
The mounting orientation is updated at a 320-ms interval when the acceleration sensor does not detect vibration or earthquake.

Table 55 Mounting orientation format

Byte	Field	Format	Contents
0	Mounting orientation	UInt8	Range: 0x01 to 0x06

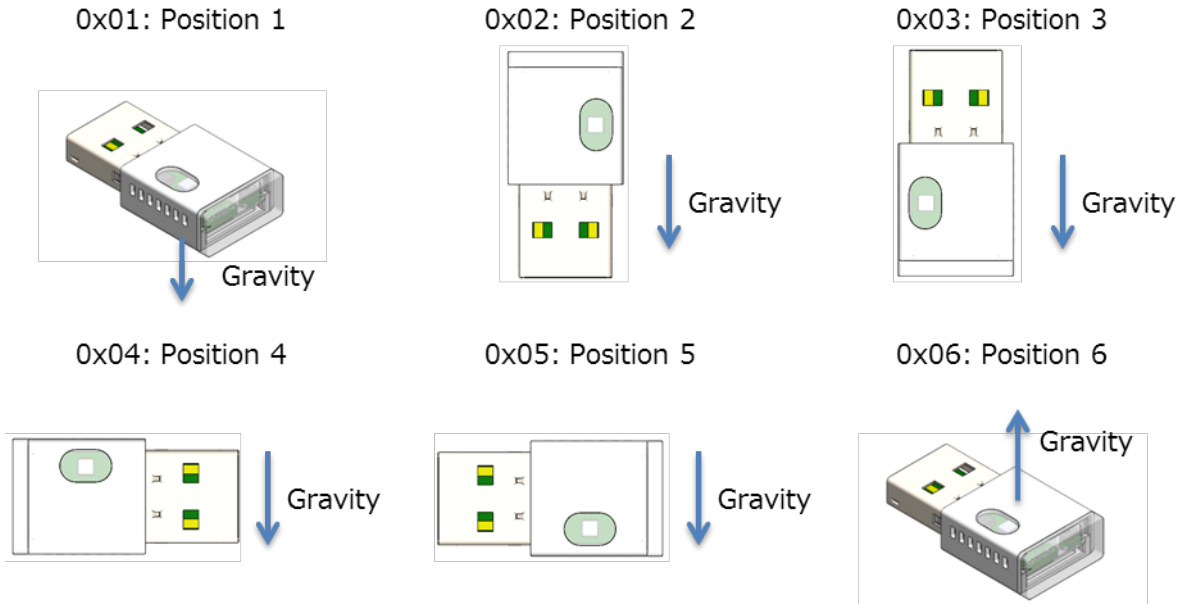

Figure 17 Mounting orientation

2.7.3 FLASH memory status (Characteristics UUID: 0x5403)

This characteristic is used to get the write status of the flash memory.

A status check must always be performed when writing to flash memory is executed via BLE. The status becomes Writing (0x01) immediately after writing is executed and Write success (0x02) or Write failure (0x03) when writing to flash memory completes. The status becomes NONE (0x00) when this is read from the other device. The status becomes Flash memory erasing (0x04) for 2 minutes during memory erasing with a memory reset (characteristics UUID: 0x5116), and NONE (0x00) after completion.

Table 56 FLASH memory status format

Byte	Field	Format	Contents
0	FLASH memory status	UInt8	0x00: NONE 0x01: Writing 0x02: Write success 0x03: Write failure 0x04: Flash memory erasing

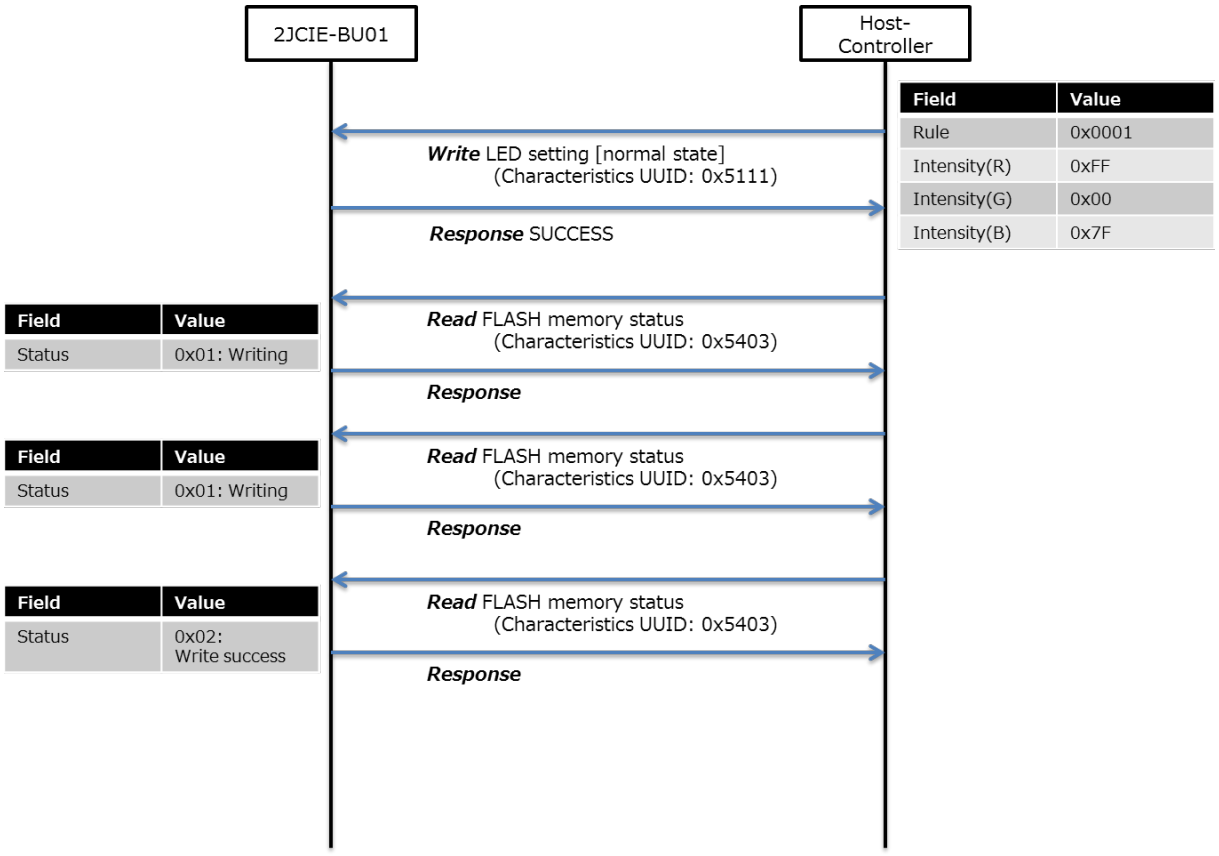

Figure 18 Procedure for acquiring flash memory status

2.8. **Generic Access Service (Service UUID: 0x1800)**

Table 57 List of Characteristics in Generic Access Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x2A00	Device name	Name	√			10
0x2A01	Appearance	Category	√			2
0x2A04	Peripheral preferred connection parameters	Minimum connection interval	√			2
		Maximum connection interval	√			2
		Slave latency	√			2
		Connection supervision timeout multiplier	√			2
0x2AA6	Central address resolution	Central address resolution support	√			1

2.8.1 Device name (Characteristics UUID: 0x2A00)

Table 58 Device name format

Byte	Field	Format	Contents
0	Name	Utf8s	"R" 0x52
1			"b" 0x62
2			"t" 0x74
3			"-" 0x2D
4			"S" 0x53
5			"e" 0x65
6			"n" 0x6E
7			"s" 0x73
8			"o" 0x6F
9			"r" 0x72

2.8.2 Appearance (Characteristics UUID: 0x2A01)

Table 59 Appearance format

Byte	Field	Format	Contents
0-1	Category	16 bit	0: Unknown

2.8.3 Peripheral preferred connection parameters (Characteristics UUID: 0x2A04)

Table 60 Peripheral preferred connection parameters format

Byte	Field	Format	Contents
0-1	Minimum connection interval	16 bit	Unit: 1.25 ms Default: 0x0010(20ms)
2-3	Maximum connection interval	16 bit	Unit: 1.25 ms Default: 0x0020(40ms)
4-5	Slave Latency	16 bit	Default: 0x0004(4)
6-7	Connection Supervision Timeout Multiplier	16 bit	Unit: 10 ms Default: 0x0190(4s)

2.8.4 Central address resolution (Characteristics UUID: 0x2AA6)

Table 61 Central address resolution support format

Byte	Field	Format	Contents
0	Central address resolution support	UInt8	1: Address resolution is supported in this device

2.9. **Device Information Service (Service UUID: 0x180A)**

Table 62 List of Characteristics in Generic Access Service

UUID	Characteristics	Contents	Properties			Byte
			R	W	N	
0x2A24	Model Number String	Model Number	√			10
0x2A25	Serial Number String	Serial Number	√			10
0x2A26	Firmware Revision String	Firmware Revision	√			5
0x2A27	Hardware Revision String	Hardware Revision	√			5
0x2A29	Manufacturer Name String	Manufacturer Name	√			5

2.9.1 Model number string (Characteristics UUID: 0x2A24)

Table 63 Model number string format

Byte	Field	Format	Contents
0	Model number	Utf8s	"2" 0x32
1			"J" 0x4A
2			"C" 0x43
3			"I" 0x49
4			"E" 0x45
5			"-" 0x2D
6			"B" 0x42
7			"U" 0x55
8			"0" 0x30
9			"1" 0x31

2.9.2 Serial number string (Characteristics UUID: 0x2A25)

Table 64 Serial number string format

Byte	Field	Format	Contents
0	Serial number	Utf8s	"0" to "3" 0x30 to 0x33
1			"0" to "9" 0x30 to 0x39
2			"0" to "9", "X", "Y", "Z" 0x30 to 0x39, 0x58, 0x59, 0x5A
3			"0" to "9" 0x30 to 0x39
4			"M" 0x4D
5			"Y" 0x59
6			"0" to "9" 0x30 to 0x39
7			"0" to "9" 0x30 to 0x39
8			"0" to "9" 0x30 to 0x39
9			"0" to "9" 0x30 to 0x39

2.9.3 Firmware revision string (Characteristics UUID: 0x2A26)

Table 65 Firmware revision string format

Byte	Field	Format	Contents
0	Firmware revision	Utf8s	"0" to "9" 0x30 to 0x39
1			"0" to "9" 0x30 to 0x39
2			"." 0x2E
3			"0" to "9" 0x30 to 0x39
4			"0" to "9" 0x30 to 0x39

2.9.4 Hardware revision string (Characteristics UUID: 0x2A27)

Table 66 Hardware revision string format

Byte	Field	Format	Contents
0	Hardware revision	Utf8s	"0" to "9" 0x30 to 0x39
1			"0" to "9" 0x30 to 0x39
2			"." 0x2E
3			"0" to "9" 0x30 to 0x39
4			"0" to "9" 0x30 to 0x39

2.9.5 Manufacturer name string (Characteristics UUID: 0x2A28)

Table 67 Manufacture name string format

Byte	Field	Format	Contents
0	Manufacture name	Utf8s	"O" 0x4F
1			"M" 0x4D
2			"R" 0x52
3			"O" 0x4F
4			"N" 0x4E

3. BLE Advertising packet

This section gives the configurations of advertising packets.

Table 68 List of Advertising packet

Description	Data type	Advertising	Scan response	AD Type		
				Flags(0x01)	16-bit Service UUIDs(0x02)	Manufacturer specific(0xFF)
Sensor data (default)	0x01	√		√		√
Calculation data	0x02	√		√		√
Sensor data & Calculation data	0x03	√	√	√		√
Sensor flag & Calculation flag	0x04	√	√	√		√
Serial number	0x05	√		√	√	√

3.1. **Sensor data**

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Advertising Data (31 octets)	AD 1	0	Length	0x02
			1	AD Type	0x01
			2	Flags	0x06
		AD 2	3	Length	0x17
			4	AD Type	0xFF
			5	Company ID	0xD5
			6		0x02
			7	Data Type	0x01
			8	Sequence number	-
			9	Temperature	-
			10		-
			11	Relative humidity	-
			12		-
			13	Ambient light	-
			14		-
			15	Barometric pressure	-
			16		-
			17		-
			18		-
			19	Sound noise	-
			20		-
			21	eTVOC	-
			22		-
			23	eCO2	-
			24		-
			25	Reserve for Future Use	0xFF
		AD 3	26	Length	0x04
			27	AD Type	0x08
			28	Local Name	"R"
			29		"b"
			30		"t"
	CRC				

3.2. **Calculation data**

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Advertising Data (31 octets)	AD 1	0	Length	0x02
			1	AD Type	0x01
			2	Flags	0x06
		AD 2	3	Length	0x17
			4	AD Type	0xFF
			5	Company ID	0xD5
			6		0x02
			7	Data Type	0x02
			8	Sequence number	-
			9	Discomfort index	-
			10		-
			11	Heat stroke	-
			12		-
			13	Vibration information	-
			14	SI value	-
			15		-
			16	PGA	-
			17		-
			18	Seismic intensity	-
			19		-
			20	Acceleration (X-axis)	-
			21		-
			22	Acceleration (Y-axis)	-
			23		-
			24	Acceleration (Z-axis)	-
			25		-
		AD 3	26	Length	0x04
			27	AD Type	0x08
			28	Local Name	"R"
			29		"b"
			30		"t"
	CRC				

3.3. **Sensor data & Calculation data (Scan rsp)**

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Advertising Data (31 octets)	AD 1	0	Length	0x02
			1	AD Type	0x01
			2	Flags	0x06
		AD 2	3	Length	0x17
			4	AD Type	0xFF
			5	Company ID	0xD5
			6		0x02
			7	Data Type	0x03
			8	Sequence number	-
			9	Temperature	-
			10		-
			11	Relative humidity	-
			12		-
			13	Ambient light	-
			14		-
			15	Barometric pressure	-
			16		-
			17		-
			18		-
			19	Sound noise	-
			20		-
			21	eTVOC	-
			22		-
			23	eCO2	-
			24		-
			25	Reserve for Future Use	0xFF
		AD 3	26	Length	0x04
			27	AD Type	0x08
			28	Local Name	"R"
			29		"b"
			30		"t"
	CRC				

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Scan Response Data (31 octets)	AD 4	0	Length	0x1E
			1	AD Type	0xFF
			2	Company ID	0xD5
			3		0x02
			4	Data Type	0x03
			5	Sequence number	-
			6	Discomfort index	-
			7		-
			8	Heat stroke	-
			9		-
			10	Vibration information	-
			11	SI value	-
			12		-
			13	PGA	-
			14		-
			15	Seismic intensity	-
			16		-
			17	Acceleration (X-axis)	-
			18		-
			19	Acceleration (Y-axis)	-
			20		-
			21	Acceleration (Z-axis)	-
			22		-
			23	Reserve for Future Use	0xFF
			24	Reserve for Future Use	0xFF
			25	Reserve for Future Use	0xFF
			26	Reserve for Future Use	0xFF
			27	Reserve for Future Use	0xFF
			28	Reserve for Future Use	0xFF
			29	Reserve for Future Use	0xFF
			30	Reserve for Future Use	0xFF
	CRC				

3.4. **Sensor flag & Calculation flag (Scan rsp)**

Link Layer packet format (47 octets)					
	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Advertising Data (31 octets)	AD 1	0	Length	0x02
			1	AD Type	0x01
			2	Flags	0x06
		AD 2	3	Length	0x17
			4	AD Type	0xFF
			5	Company ID	0xD5
			6		0x02
			7	Data Type	0x04
			8	Sequence number	-
			9	Temperature flag	-
			10		-
			11	Relative humidity flag	-
			12		-
			13	Ambient light flag	-
			14		-
			15	Barometric pressure flag	-
			16		-
			17	Sound noise flag	-
			18		-
			19	eTVOC flag	-
			20		-
			21	eCO2 flag	-
			22		-
			23	Reserve for Future Use	0xFF
			24	Reserve for Future Use	0xFF
			25	Reserve for Future Use	0xFF
		AD 3	26	Length	0x04
			27	AD Type	0x08
			28	Local Name	"R"
			29		"b"
			30		"t"
	CRC				

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Scan Response Data (31 octets)	AD 4	0	Length	0x1E
			1	AD Type	0xFF
			2	Company ID	0xD5
			3		0x02
			4	Data Type	0x04
			5	Sequence Number	-
			6	Discomfort index flag	-
			7		-
			8	Heat stroke flag	-
			9		-
			10	SI value flag	-
			11	PGA flag	-
			12	Seismic intensity flag	-
			13	Reserve for Future Use	0xFF
			14	Reserve for Future Use	0xFF
			15	Reserve for Future Use	0xFF
			16	Reserve for Future Use	0xFF
			17	Reserve for Future Use	0xFF
			18	Reserve for Future Use	0xFF
			19	Reserve for Future Use	0xFF
			20	Reserve for Future Use	0xFF
			21	Reserve for Future Use	0xFF
			22	Reserve for Future Use	0xFF
			23	Reserve for Future Use	0xFF
			24	Reserve for Future Use	0xFF
			25	Reserve for Future Use	0xFF
			26	Reserve for Future Use	0xFF
			27	Reserve for Future Use	0xFF
			28	Reserve for Future Use	0xFF
			29	Reserve for Future Use	0xFF
			30	Reserve for Future Use	0xFF
	CRC				

3.5. **Serial number**

Link Layer packet format (47 octets)	Preamble (1 octets)				
	Access Address (4 octets)				
	PDU Header (16bits)				
	AdvA (6 octets)				
	Advertising Data (31 octets)	AD 1	0	Length	0x02
			1	AD Type	0x01
			2	Flags	0x06
		AD 2	3	Length	0x03
			4	AD Type	0x02
			5	16-bit Service UUIDs	0x0A
			6		0x18
		AD 3	7	Length	0x12
			8	AD Type	0xFF
			9	Company ID	0xD5
			10		0x02
			11	Data Type	0x05
			12	Serial number	-
			13		-
			14		-
			15		-
			16		-
			17		-
			18		-
			19		-
			20		-
			21		-
			22	Memory index (Latest)	-
			23		-
			24		-
			25		-
		AD 4	26	Length	0x04
			27	AD Type	0x08
			28	Local Name	"R"
			29		"b"
			30		"t"
	CRC				

4. USB Communication

4.1. Communication specification

This section gives the communication settings for the USB serial port.

Table 69 Communication specification

Item	Spec
Baud rate	115200 bps
Data size	8 bit
Stop bit	1 bit
Parity	None
Flow control	None

4.2. Communication procedure

In USB communications, commands are sent from the Host-Controller, and the Environment Sensor responds according to the contents of the command. After a command is sent, if the Host-Controller cannot receive data within 1 second to receive the response, a timeout occurs and a new attempt should be made to perform communications.

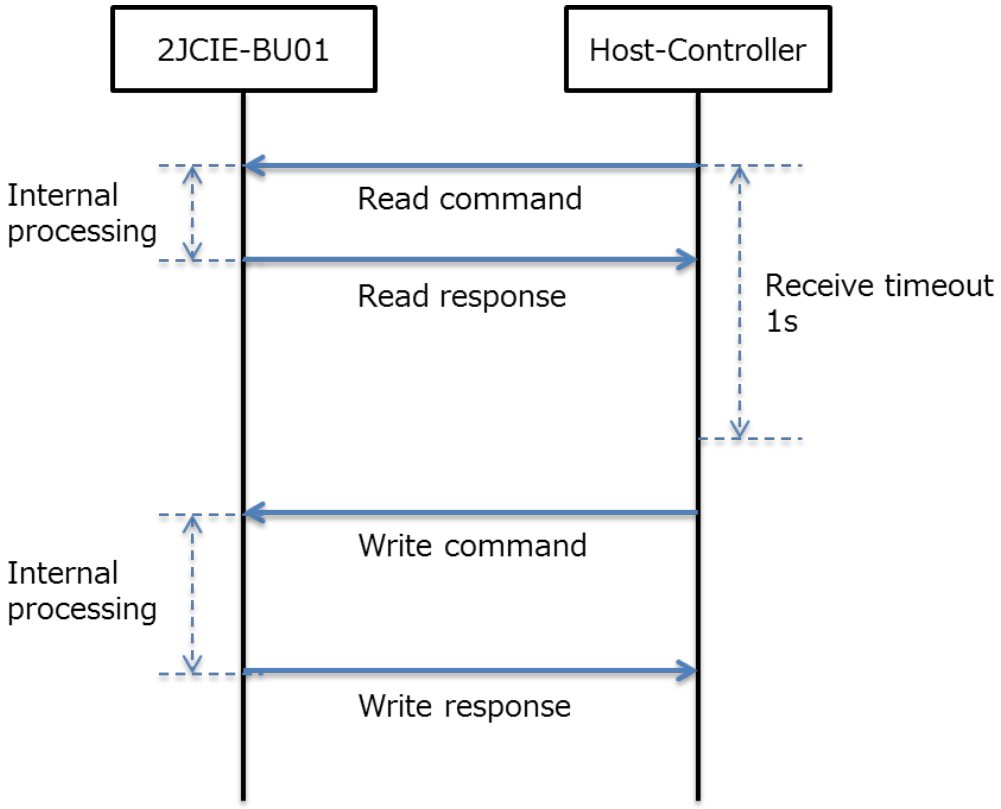

Figure 19 Procedure for USB communication

4.3. Frame format

4.3.1 Common frame format

This section describes the common frame format that is used to send and receive USB communications.
Data that is 2 bytes or longer is all little-endian.

Table 70 Common frame format

Header		Length		Payload	CRC-16	
2 byte		2 byte		N byte	2 byte	
0x52	0x42	L byte	H byte	-	L byte	H byte

(1) Header
Fixed to the ASCII code "BR" (0x4252).

(2) Length
Specify the data length from the payload to CRC.

(3) Payload
Set the frame according to the command.
The payload section will depend on the contents of a USB original request or BLE common request.

(4) CRC-16
Set the CRC result from the header to the end of the payload.

4.3.2 CRC-16 calculation

The error check result is calculated with CRC-16 (cyclic redundancy check calculation).

Example of calculating CRC-16

1. Set the initial value of the CRC register to 0xFFFF.
2. XOR the CRC register and the first 8 bits of data of the message, and then return the result to the CRC register.
3. Shift the CRC register 1 bit to the right while filling the MSB with 0.
4. If the bit shifted from the LSB is 0, repeat step 3.
   If the bit is 1, XOR the CRC register and 0xA001, and then return the result to the CRC register.
5. Repeat steps 3 and 4 until 8 bits of data are bit shifted.
6. If the packet was not processed to the end, XOR the CRC register and the next 8 bits of data in the packet, return the result to the CRC register, and repeat the procedure from step 3.

4.3.3 Payload frame format [Command from Host-Controller]

Table 71 Payload frame format [Command]

Command	Address		Data		
1 byte	2 byte		N byte		
-	L byte	H byte	L byte	…	H byte

(1) Command
Specify read or write.

Table 72 Command list

Command	Contents
0x01	Read
0x02	Write

(2) Address
Specify the address according to the contents to execute.

(3) Data
The contents will depend on the address.

4.3.4 Payload frame format [Normal Response from 2JCIE-BU01]

Table 73 Payload frame format [Response]

Command	Address		Data		
1 byte	2 byte		N byte		
-	L byte	H byte	L byte	…	H byte

(1) Command
Return the results of the read or write.

Table 74 Command list

Command	Contents
0x01	Read
0x02	Write

(2) Address
Specify the address specified with the command.

(3) Data
The contents will depend on the address.

4.3.5 Payload frame format [Error Response from 2JCIE-BU01]

Table 75 Payload frame format [Response]

Command	Address		Code
1 byte	2 byte		1 byte
-	L byte	H byte	-

(1) Command

Return the results of the read or write.

When an error is returned from the Environment Sensor, the MSB of the command is set to 1 (in other words, 0x80 is added to the value of the non-error command).

When a command other than a read or write command is received, Unknown (0xFF) is returned.

Table 76 Command list

Command	Contents
0x81	Read error
0x82	Write error
0xFF	Unknown

(2) Address

Specify the address according to the contents to execute.

(3) Code

Return the details of the error.

Table 77 Error code

Code	Description	Contents
0x01	CRC error	When the CRC-16 calculation is incorrect
0x02	Command error	When other than read or write is specified for the command In this case, the error for the command becomes Unknown.
0x03	Address error	When an address not contained in the address list is specified
0x04	Length error	When the length specified in the address is incorrect
0x05	Data error	When outside of the write range of Write is specified
0x06	Busy	When performing internal processing such as during flash memory access

4.4. **USB original address**

These are USB original addresses that are not linked to BLE services or characteristics.

Table 78 List of USB original address

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x500E	Memory data long	√		
0x500F	Memory data short	√		
0x5021	Latest data long	√		
0x5022	Latest data short	√		
0x503E	Acceleration memory data [Header]	√		
0x503F	Acceleration memory data [Data]	√		

4.4.1 Memory data long (Address: 0x500E)

This address is used to get the sensing data saved in flash memory.
The read command is equivalent to request memory index (UUID: 0x5005) in BLE.
Read responses are transferred for the specified memory index count. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.
The read response is equivalent to a format that combines the following 4 characteristics in BLE.

- Memory sensing data (UUID: 500A)
- Memory calculation data (UUID: 500B)
- Memory sensing flag (UUID: 500C)
- Memory calculation flag (UUID: 500D)

Table 79 Read command

Byte	Field	Format	Contents
0-3	Memory index (Start)	UInt32	Range: 0x00000001 to 0xFFFFFFFF *Last index <=Start index *End index <= Latest index *Start index <= End index
4-7	Memory index (End)	UInt32	

Table 80 Read response

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-11	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF
12-13	Temperature	SInt16	Reference: 5.1. Output range
14-15	Relative humidity	SInt16	
16-17	Ambient light	SInt16	
18-21	Barometric pressure	SInt32	
22-23	Sound noise	SInt16	
24-25	eTVOC	SInt16	
26-27	eCO2	SInt16	
28-29	Discomfort index	SInt16	
30-31	Heat stroke	SInt16	
32	Vibration information	UInt8	
33-34	SI value	UInt16	
35-36	PGA	UInt16	
37-38	Seismic intensity	UInt16	
39-40	Temperature flag	UInt16	Reference: 5.3. Event flag
41-42	Relative humidity flag	UInt16	
43-44	Ambient light flag	UInt16	
45-46	Barometric pressure flag	UInt16	
47-48	Sound noise flag	UInt16	
49-50	eTVOC flag	UInt16	
51-52	eCO2 flag	UInt16	
53-54	Discomfort index flag	UInt16	
55-56	Heat stroke flag	UInt16	
57	SI value flag	UInt8	
58	PGA flag	UInt8	
59	Seismic intensity flag	UInt8	

4.4.2 Memory data short (Address: 0x500F)

This address is used to get the sensing data saved in flash memory.
The read command is equivalent to request memory index (UUID: 0x5005) in BLE.
Read responses are transferred for the specified memory index count. If a reading failure occurred for the flash memory of the acquisition target, the most significant bit of the memory index is set to 1 and then the data is transferred.
The read response is equivalent to a format that combines the following 2 characteristics in BLE.

- Memory sensing data (UUID: 500A)
- A portion of memory calculation data (UUID: 500B)

Table 81 Read command format

Byte	Field	Format	Contents
0-3	Memory index (Start)	UInt32	Range: 0x00000001 to 0x7FFFFFFF *Last index <=Start index *End index <= Latest index *Start index <= End index
4-7	Memory index (End)	UInt32	

Table 82 Read response format

Byte	Field	Format	Contents
0-3	Memory index	UInt32	Range: 0x00000001 to 0x7FFFFFFF *If data error, MSB is 1
4-11	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF
12-13	Temperature	SInt16	Reference: 5.1. Output range
14-15	Relative humidity	SInt16	
16-17	Ambient light	SInt16	
18-21	Barometric pressure	SInt32	
22-23	Sound noise	SInt16	
24-25	eTVOC	SInt16	
26-27	eCO2	SInt16	
28-29	Discomfort index	SInt16	
30-31	Heat stroke	SInt16	

4.4.3 Latest data Long (Address: 0x5021)

This address gets the latest data.

There is no data frame in the read command.

The read response is equivalent to a format that combines the following 4 characteristics in BLE.

- ・Latest sensing data (UUID: 5012)
- ・Latest calculation data (UUID: 5013)
- ・Latest sensing flag (UUID: 5014)
- ・Latest calculation flag (UUID: 5015)

Table 83 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature	SInt16	Reference: 5.1. Output range
3-4	Relative humidity	SInt16	
5-6	Ambient light	SInt16	
7-10	Barometric pressure	SInt32	
11-12	Sound noise	SInt16	
13-14	eTVOC	SInt16	
15-16	eCO2	SInt16	
17-18	Discomfort index	SInt16	
19-20	Heat stroke	SInt16	
21	Vibration information	UInt8	
22-23	SI value	UInt16	
24-25	PGA	UInt16	
26-27	Seismic intensity	UInt16	
28-29	Temperature flag	UInt16	Reference: 5.3. Event flag
30-31	Relative humidity flag	UInt16	
32-33	Ambient light flag	UInt16	
34-35	Barometric pressure flag	UInt16	
36-37	Sound noise flag	UInt16	
38-39	eTVOC flag	UInt16	
40-41	eCO2 flag	UInt16	
42-43	Discomfort index flag	UInt16	
44-45	Heat stroke flag	UInt16	
46	SI value flag	UInt8	
47	PGA flag	UInt8	
48	Seismic intensity flag	UInt8	

4.4.4 Latest data short (Address: 0x5022)

This address gets the latest data.

There is no data frame in the read command.

The read response is equivalent to a format that combines the following 2 characteristics in BLE.

- Latest sensing data (UUID: 5012)
- A portion of latest calculation data (UUID: 5013)

Table 84 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature	SInt16	Reference: 5.1. Output range
3-4	Relative humidity	SInt16	
5-6	Ambient light	SInt16	
7-10	Barometric pressure	SInt32	
11-12	Sound noise	SInt16	
13-14	eTVOC	SInt16	
15-16	eCO2	SInt16	
17-18	Discomfort index	SInt16	
19-20	Heat stroke	SInt16	

4.4.5 Acceleration memory data [Header] (Address: 0x503E)

This address is used to get the acceleration data saved in flash memory.
The read command is equivalent to request acceleration memory index (UUID: 0x5032) in BLE.
The read response is equivalent to a format that combines the split packets of acceleration memory data [Header] (0x5034) in BLE.

Table 85 Read command format

Byte	Field	Format	Contents
0	Acceleration data type	UInt8	0x00: Earthquake data (Normal mode) 0x01: Vibration data (Normal mode)
1	Request acceleration memory index	UInt8	Range: 0x01 to 0x0A (1 to 10) *0x01: Latest data <---> 0x0A: Last data

Table 86 Read response format

Byte	Field	Format	Contents
0-1	Storage total page	UInt16	Range: 0x0001 to 0xFFFF
2-5	Earthquakes or vibration count	UInt32	Range: 0x00000001 to 0xFFFFFFFF
6-13	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF
14	Earthquake flag	UInt8	0x00: Vibration data 0x01: Earthquake data
15	SI value calculation axis	UInt8	Reference: 5.1. Output range
16-17	Reserved for Future Use	UInt8	0xFF: Fixed value
18-19	Page number	UInt16	0x0000: Fixed value
20-21	SI value	UInt16	Reference: 5.1. Output range
22-23	PGA	UInt16	
24-25	Seismic intensity	UInt16	
26-27	Maximum acceleration (X-axis)	UInt16	
28-29	Maximum acceleration (Y-axis)	UInt16	
30-31	Maximum acceleration (Z-axis)	UInt16	
32-33	Temperature	SInt16	
34-35	Relative humidity	SInt16	
36-37	Ambient light	SInt16	
38-41	Barometric pressure	SInt32	
42-43	Sound noise	SInt16	
44-45	eTVOC	SInt16	
46-47	eCO2	SInt16	
48-49	Discomfort index	SInt16	
50-51	Heat stroke	SInt16	
52	Reserved for Future Use	UInt8	0xFF: Fixed value
53	Reserved for Future Use	UInt8	0xFF: Fixed value
54-55	Acceleration offset (X-axis)	SInt16	Reference: 5.1. Output range
56-57	Acceleration offset (Y-axis)	SInt16	
58-59	Acceleration offset (Z-axis)	SInt16	

4.4.6 Acceleration memory data [Data] (Address: 0x503F)

This address is used to get the acceleration data saved in flash memory.

The read command is equivalent to request acceleration memory index (UUID: 0x5032) in BLE.
The read response is equivalent to a format that combines the split packets of acceleration memory data [Data] (UUID: 0x5034) in BLE. In acceleration logger mode, output is fixed to 0x0000 because the SI value, PGA, seismic intensity, and maximum acceleration are not calculation targets.

Table 87 Read command format [Normal mode]

Byte	Field	Format	Contents
0	Acceleration data type	UInt8	0x00: Earthquake data 0x01: Vibration data
1	Request acceleration memory index	UInt8	Range: 0x01 to 0x0A (1 to 10) *0x01: Latest data <---> 0x0A: Last data
2-3	Request page (Start)	UInt16	Range: 0x0001 to 0x01FF (1 to 511) *Start page <= End page
4-5	Request page (End)	UInt16	

Table 88 Read command format [Acceleration logger mode]

Byte	Field	Format	Contents
0	Acceleration data type	UInt8	0x02: Logger data
1	Request acceleration memory index	UInt8	0x01: Fixed value
2-3	Request page (Start)	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) *Start index <= End index *(Start index - End index) <= 1000
4-5	Request page (End)	UInt16	

Table 89 Read response format

Byte	Field	Format	Contents
0-1	Page number	UInt16	[Normal mode] Range: 0x0001 to 0x01FF (1 to 511) [Acceleration logger mode] Range: 0x0001 to 0x2800 (1 to 10240)
2-3	SI value	UInt16	[Normal mode] 0x0000: Fixed value [Acceleration logger mode] Reference: 5.1. Output range
4-5	PGA	UInt16	
6-7	Seismic intensity	UInt16	
8-9	Maximum acceleration (X-axis)	UInt16	
10-11	Maximum acceleration (Y-axis)	UInt16	
12-13	Maximum acceleration (Z-axis)	UInt16	
14-15	Temperature	SInt16	Reference: 5.1. Output range
16-17	Relative humidity	SInt16	
18-19	Ambient light	SInt16	
20-23	Barometric pressure	SInt32	
24-25	Sound noise	SInt16	
26-27	eTVOC	SInt16	
28-29	eCO2	SInt16	
30-31	Discomfort index	SInt16	
32-33	Heat stroke	SInt16	
34	Reserved for Future Use	UInt8	0xFF: Fixed value
35	Reserved for Future Use	UInt8	0xFF: Fixed value
36-37	Acceleration (X-axis) 1	SInt16	Reference: 5.1. Output range
38-39	Acceleration (Y-axis) 1	SInt16	
40-41	Acceleration (Z-axis) 1	SInt16	
…	…	…	
222-223	Acceleration (X-axis) 32	SInt16	
224-225	Acceleration (Y-axis) 32	SInt16	
226-227	Acceleration (Z-axis) 32	SInt16	

4.5. **BLE common address**

These addresses are linked to BLE services and characteristics. The BLE UUID and USB address have a one-to-one correspondence.

Table 90 List of Address in Memory Data Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5004	Latest memory information	√		

Table 91 List of Address in Latest Data Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5012	Latest sensing data	√		
0x5013	Latest calculation data	√		
0x5014	Latest sensing flag	√		
0x5015	Latest calculation flag	√		
0x5016	Latest acceleration status	√		

Table 92 List of Address in Acceleration Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5031	Vibration count	√		

Table 93 List of Address in Control Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5111	LED setting [normal state]	√	√	
0x5112	LED setting [event state]	√	√	
0x5113	LED state [operation]	√	√	
0x5114	Installation offset	√	√	
0x5115	Advertising setting	√	√	
0x5116	Memory reset			√
0x5117	Mode change	√	√	
0x5118	Acceleration logger control			√
0x5119	Acceleration logger status	√		

Table 94 List of Address in Time Setting Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5201	Time counter	√		
0x5202	Time setting	√		√
0x5203	Memory storage interval	√	√	

Table 95 List of Address in Device Information Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x180A	Device information	√		

Table 96 List of Address in Event Setting Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5211	Temperature [Sensor 1]	√	√	
0x5212	Temperature [Sensor 2]	√	√	
0x5213	Relative humidity [Sensor 1]	√	√	
0x5214	Relative humidity [Sensor 2]	√	√	
0x5215	Ambient light [Sensor 1]	√	√	
0x5216	Ambient light [Sensor 2]	√	√	
0x5217	Barometric pressure [Sensor 1]	√	√	
0x5218	Barometric pressure [Sensor 2]	√	√	
0x5219	Sound noise [Sensor 1]	√	√	
0x521A	Sound noise [Sensor 2]	√	√	
0x521B	eTVOC [Sensor 1]	√	√	
0x521C	eTVOC [Sensor 2]	√	√	
0x521D	eCO2 [Sensor 1]	√	√	
0x521E	eCO2 [Sensor 2]	√	√	
0x521F	Discomfort index [Sensor 1]	√	√	
0x5220	Discomfort index [Sensor 2]	√	√	
0x5221	Heat stroke [Sensor 1]	√	√	
0x5222	Heat stroke [Sensor 2]	√	√	
0x5226	SI value [Acceleration]	√	√	
0x5227	PGA [Acceleration]	√	√	
0x5228	Seismic intensity [Acceleration]	√	√	

Table 97 List of Address in Information Service

Address	Description	Read	Write with FLASH storage	Write without FLASH storage
0x5401	Error status	√		
0x5402	Installation direction	√		

4.5.1 Latest memory information (Address: 0x5004)

This address is used to get the number of indexes of sensing data saved in flash memory.
The maximum amount of saved data is 60,000 items of data between memory index (latest) and memory index (last). If the memory indexes exceed 60,000 items, the data will be overwritten in order from the oldest data. Only the data between memory index (latest) and memory index (last) can be acquired.
There is no data frame in the read command.

Table 98 Read response format

Byte	Field	Format	Contents
0-3	Memory index (Latest)	UInt32	Range: 0x00000001 to 0x7FFFFFFF *0x00000000: Before storage
4-7	Memory index (Last)	UInt32	

4.5.2 Latest sensing data (Address: 0x5012)

This characteristic is used to get the latest sensing data.
The latest values at the time of reading are returned.
There is no data frame in the read command.

Table 99 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature	SInt16	Reference: 5.1. Output range
3-4	Relative humidity	SInt16	
5-6	Ambient light	SInt16	
7-10	Barometric pressure	SInt32	
11-12	Sound noise	SInt16	
13-14	eTVOC	SInt16	
15-16	eCO2	SInt16	

4.5.3 Latest calculation data (Address: 0x5013)

This characteristic is used to get the latest calculation data.
The latest values at the time of reading are returned.
There is no data frame in the read command.

Table 100 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Discomfort index	SInt16	Reference: 5.1. Output range
3-4	Heat stroke	SInt16	
5	Vibration information	UInt8	
6-7	SI value	UInt16	
8-9	PGA	UInt16	
10-11	Seismic intensity	UInt16	
12-13	Acceleration (X-axis)	SInt16	
14-15	Acceleration (Y-axis)	SInt16	
16-17	Acceleration (Z-axis)	SInt16	

4.5.4 Latest sensing flag (Address: 0x5014)

This address is used to get the latest sensing flags.
The latest values at the time of reading are returned.
There is no data frame in the read command.

Table 101 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Temperature flag	UInt16	Reference: 5.3. Event flag
3-4	Relative humidity flag	UInt16	
5-6	Ambient light flag	UInt16	
7-10	Barometric pressure flag	UInt16	
11-12	Sound noise flag	UInt16	
13-14	eTVOC flag	UInt16	
15-16	eCO2 flag	UInt16	

4.5.5 Latest calculation flag (Address: 0x5015)

This characteristic is used to get the latest calculation flag.
The latest values at the time of reading are returned.
There is no data frame in the read command.

Table 102 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1-2	Discomfort index flag	UInt16	Reference: 5.3. Event flag
3-4	Heat stroke flag	UInt16	
5	SI value flag	UInt8	
6	PGA flag	UInt8	
7	Seismic intensity flag	UInt8	

4.5.6 Latest acceleration status (Address: 0x5016)

This characteristic is used to get the latest acceleration status.
The latest values at the time of reading are returned. The acceleration offset is updated when an earthquake or vibration has not occurred.
There is no data frame in the read command.

Table 103 Read response format

Byte	Field	Format	Contents
0	Sequence number	UInt8	Range: 0x00 to 0xFF
1	Vibration information	UInt8	Reference: 5.1. Output range
2-3	Maximum acceleration (X-axis)	SInt16	
4-5	Maximum acceleration (Y-axis)	SInt16	
6-7	Maximum acceleration (Z-axis)	SInt16	
8	SI value calculation axis	UInt8	
9-10	Acceleration offset (X-axis)	SInt16	
11-12	Acceleration offset (Y-axis)	SInt16	
13-14	Acceleration offset (Z-axis)	SInt16	

4.5.7 Vibration count (Address: 0x5031)

This characteristic is used to get the accumulated earthquake/vibration count.
When the mode is changed or the acceleration area is erased by a memory reset, the accumulated count is reset.
There is no data frame in the read command.

Table 104 Read response format

Byte	Field	Format	Contents
0-3	Earthquake count	UInt32	Range: 0x00000000 to 0xFFFFFFFF
4-7	Vibration count	UInt32	

4.5.8 LED setting [normal state] (Address: 0x5111)

This address is used to get or set the LED display status for the normal operation state.
For normally ON (0x01), specify the color to be displayed by the RGB (red, green, and blue) intensity set with intensity of LED. There are 255 steps, and 255 is the maximum, and the color will be white when all 255 (0xFF), and illumination will be off when all 0 (0x00). If a scale is selected, the color automatically changes according to sensor output. The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 105 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Display rule (normal state)	UInt16	0x0000: Normally OFF 0x0001: Normally ON 0x0002: Temperature value scales 0x0003: Relative humidity value scales 0x0004: Ambient light value scales 0x0005: Barometric pressure value scales 0x0006: Sound noise value scales 0x0007: eTVOC value scales 0x0008: SI vale scales 0x0009: PGA value scales
2	Intensity of LED (Red)	UInt8	Range: 0x00 to 0xFF
3	Intensity of LED (Green)	UInt8	
4	Intensity of LED (Blue)	UInt8	

4.5.9 LED setting [event state] (Address: 0x5112)

This address is used to get or set the LED display status when an event occurs.
For when an event occurs, specify the color to flash by the RGB (red, green, blue) intensity set with intensity of LED. There are 255 steps, and 255 is the maximum, and the color will be white when all 255 (0xFF), and illumination will be off when all 0 (0x00). Events are bit field settings so multiple events can be set at the same time. The setting values are saved to the flash memory and are retained even when the power is turned off and back on. There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 106 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Display rule (event state)	UInt16	Bit7: PGA event Bit6: SI value event Bit5: eTVOC event Bit4: Sound noise event Bit3: Barometric pressure event Bit2: Ambient light event Bit1: Relative humidity event Bit0: Temperature event
2	Intensity of LED (Red)	UInt8	Range: 0x00 to 0xFF
3	Intensity of LED (Green)	UInt8	
4	Intensity of LED (Blue)	UInt8	

4.5.10 LED setting [operation] (Address: 0x5113)

This address is used to get or set the LED display status of each operation.
Start up applies only after startup, Error applies when any error status occurs, and Connection applies when connected via BLE communication. The setting values are written to flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 107 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0	Start up	UInt8	0x00: Rainbow (default) 0x01: BLUE
1	Error	UInt8	0x00: NONE (default) 0x01: RED
2	Connection	UInt8	0x00: NONE (default) 0x01: GREEN ON 1 sec

4.5.11 Installation offset (Address: 0x5114)

This address is used to get or set the arbitrary offset and gain values after installation.
For the enabled installation offsets, the specified value can be added/subtracted. Gain correction is with ambient light only, and a set factor can be applied to raw output. The setting values are written to flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 108 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0	Installation offset enable/disable	UInt8	Bit4: Sound noise offset enable Bit3: Barometric pressure offset enable Bit2: Ambient light gain enable Bit1: Relative humidity offset enable Bit0: Temperature offset enable
1-2	Temperature installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01degC Default: 0x0000 (0.00degC)
3-4	Relative humidity installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01%RH Default: 0x0000 (0.00%RH)
5-6	Ambient light installation gain	SInt16	Range: 0x0000 to 0x2710 (0 to 10000) Unit: 0.001 Default: 0x0000 (0.000)
7-10	Barometric pressure installation offset	SInt32	Range: 0xFFF0BDC0 to 0x000F4240 (-1000000 to 1000000) Unit: 0.001hPa Default: 0x0000 (0.000hPa)
11-12	Sound noise installation offset	SInt16	Range: 0xD8F0 to 0x2710 (-10000 to 10000) Unit: 0.01dB Default: 0x0000 (0.00dB)

4.5.12 Advertise setting (Address: 0x5115)

This address is used to get or set the BLE advertising transmission interval and data type.
For the configuration of advertising packets, refer to "3. BLE Advertising packet." If Reserved for Future Use (0x06 to 0x08) is selected for the advertising mode, the advertising packet of the sensor data (0x01) is selected.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 109 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Advertising interval	UInt16	Range: 0x00A0 to 0x4000 (100ms to 10.24s) Unit: 0.625 ms Default: 0x00A0 (100ms)
2	Advertising mode	UInt8	0x01: Sensor data (default) 0x02: Acceleration data 0x03: Sensor data & Acceleration data (Scan rsp) 0x04: Sensor flag & Acceleration flag (Scan rsp) 0x05: Serial number 0x06: Reserve for Future Use 0x07: Reserve for Future Use 0x08: Reserve for Future Use

4.5.13 Memory reset (Address: 0x5116)

This address is used to erase the flash memory data of the relevant area.
The sensing data area is a ring buffer so the old data is erased automatically, but if you wish to reset the memory index, clear the sensing data area by a memory reset. For the acceleration area, this is used to erase the data in the acceleration logger mode. The erase time is approximately 2 minutes and the LED lights blue. Even if USB communication is received during erasing, a response is not made.
Write command and write response share a common format.

Table 110 Write command and Write response format

Byte	Field	Format	Contents
0	Memory reset	UInt8	0x01: Sensing data area 0x02: Acceleration area

4.5.14 Mode change (Address: 0x5117)

This address is used to get the current mode or set the mode.
Since the flash memory in acceleration area is erased when the mode is switched, the state becomes the same as when the acceleration area is erased with a memory reset, and it takes approximately 2 minutes. The setting value is saved to flash memory, and startup is in the same mode even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 111 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0	Mode change	UInt8	0x00: Normal mode (default) 0x01: Acceleration logger mode

4.5.15 Acceleration logger control (Address: 0x5118)

This address is used to start and stop the log of the acceleration logger mode.
When stopping the log, set the values for byte 1 to byte 6 to the same values as when starting the log. The start page and end page can be set arbitrarily by the user, but a memory reset needs to be performed when data will be written to the same page because data cannot be obtained normally if a page with data written is overwritten.
Write command and write response share a common format.

Table 112 Write command and Write response format

Byte	Field	Format	Contents
0	Logger condition	UInt8	0x00: Log stop 0x01: Log start
1	Range of detection	UInt8	0x00: ±2000 gal (fixed value)
2	ODR setting	UInt8	0x00: 1 Hz 0x01: 10 Hz 0x02: 25 Hz 0x03: 100 Hz 0x04: 200 Hz 0x05: 400 Hz
3-4	Start page	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) Unit: 1 page
5-6	End page	UInt16	

4.5.16 Acceleration logger status (Address: 0x5119)

This address is used to get the status of acceleration logger mode.

The status becomes 0x01: Running during logging. The last page is displayed during running for the running page.

There is no data frame in the read command.

Read response, write command, and write response share a common format.

Table 113 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0	Logger status	UInt8	0x00: Waiting 0x01: Running
1-2	Running page	UInt16	Range: 0x0001 to 0x2800 (1 to 10240) Unit: 1page

4.5.17 Latest time counter (Address: 0x5201)

This address is used to get the latest time counter.

The latest time displays the elapsed time in 1-second units from the time that was written with the time setting characteristic.

There is no data frame in the read command.

Table 114 Read response

Byte	Field	Format	Contents
0-7	Time counter	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF Unit: 1sec

4.5.18 Time setting (Address: 0x5202)

This address is used to get or set the offset values for counting in the Environment Sensor.

The setting value is reset at power off because it is not saved to flash memory.

There is no data frame in the read command.

Read response, write command, and write response share a common format.

Table 115 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-7	Time setting	UInt64	Range: 0x1 to 0xFFFFFFFFFFFFFFFF Unit: 1sec

4.5.19 Memory storage interval (Address: 0x5203)

This address is used to get or set the interval to save the sensing data in flash memory.
When the storage interval is changed, the memory index is reset and the flash memory in the sensing data area is also erased. The state becomes the same as when the sensing data area is erased with a memory reset, and it takes approximately 2 minutes. The setting values are saved to the flash memory and are retained even when the power is turned off and back on. There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 116 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Memory storage interval	UInt16	Range: 0x0001 to 0x0E10 (1 to 3600sec) Unit: 1sec Default: 0x0001 (1sec)

4.5.20 Event pattern [Sensor 1] (Address: 0x5211 etc.)

This address is used to get or set the enable/disable and threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 117 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Event enable/disable	UInt16	Reference: 5.2. Event enable/disable
2-3	Simple threshold [upper limit] 1	SInt16	Reference: 5.4. Event threshold
4-5	Simple threshold [upper limit] 2	SInt16	
6-7	Simple threshold [lower limit] 1	SInt16	
8-9	Simple threshold [lower limit] 2	SInt16	
10-11	Change threshold [rise] 1	SInt16	
12-13	Change threshold [rise] 2	SInt16	
14-15	Change threshold [decline] 1	SInt16	
16-17	Change threshold [decline] 2	SInt16	
18	Reserve for Future Use	UInt8	0xFF: Fixed value
19	Reserve for Future Use	UInt8	0xFF: Fixed value

4.5.21 Event pattern [Sensor 2] (Address: 0x5212 etc.)

This address is used to get or set the threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 118 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0-1	Average value threshold [upper]	SInt16	Reference: 5.4 Event threshold
2-3	Average value threshold [lower]	SInt16	
4-5	Peak to Peak threshold [upper]	SInt16	
6-7	Peak to Peak threshold [lower]	SInt16	
8-9	Interval difference threshold [upper]	SInt16	
10-11	Interval difference threshold [lower]	SInt16	
12-13	Base difference threshold [upper]	SInt16	
14-15	Base difference threshold [lower]	SInt16	
16	Average value count	UInt8	
17	Peak to Peak count	UInt8	
18	Interval difference count	UInt8	
19	Base difference count	UInt8	

4.5.22 Event pattern [Acceleration] (Address: 0x5226 etc.)

This address is used to get or set the enable/disable and threshold values of various events.
The setting values are saved to the flash memory and are retained even when the power is turned off and back on.
There is no data frame in the read command.
Read response, write command, and write response share a common format.

Table 119 Read response, Write command, and Write response format

Byte	Field	Format	Contents
0	Event enable/disable	UInt8	Reference: 5.2. Event enable/disable
1-2	Simple threshold [upper limit] 1	UInt16	Reference: 5.4. Event threshold
3-4	Simple threshold [upper limit] 2	UInt16	
5-6	Change threshold [rise] 1	UInt16	
7-8	Change threshold [rise] 2	UInt16	

4.5.23 Error status (Address: 0x5401)

This characteristic is used to get the error status of the sensors and CPU.
The error status is cleared when this is read from the other device.
There is no data frame in the read command.

Table 120 Read response

Byte	Field	Format	Contents
0	Temperature sensor error	UInt8	Bit3: Initialization error Bit2: Frozen output Bit1: Sensing data is out of range Bit0: Communication error
1	Relative humidity sensor error	UInt8	
2	Ambient light sensor error	UInt8	
3	Barometric pressure sensor error	UInt8	
4	Sound noise sensor error	UInt8	
5	Acceleration sensor error	UInt8	
6	eTVOC sensor error	UInt8	
7	eCO2 sensor error	UInt8	
8	CPU error	UInt8	Bit2: Reboot with watchdog Bit1: FLASH memory erase error Bit0: FLASH memory initialization error
9	Reserve for Future Use	UInt8	0xFF: Fixed value
10	Reserve for Future Use	UInt8	0xFF: Fixed value

4.5.24 Mounting orientation (Address: 0x5402)

This characteristic is used to get the mounting orientation.

The mounting orientation is updated at a 320-ms interval when the acceleration sensor does not detect vibration or earthquake.

There is no data frame in the read command.

Table 121 Read response

Byte	Field	Format	Contents
0	Mounting orientation	UInt8	Range: 0x01 to 0x06

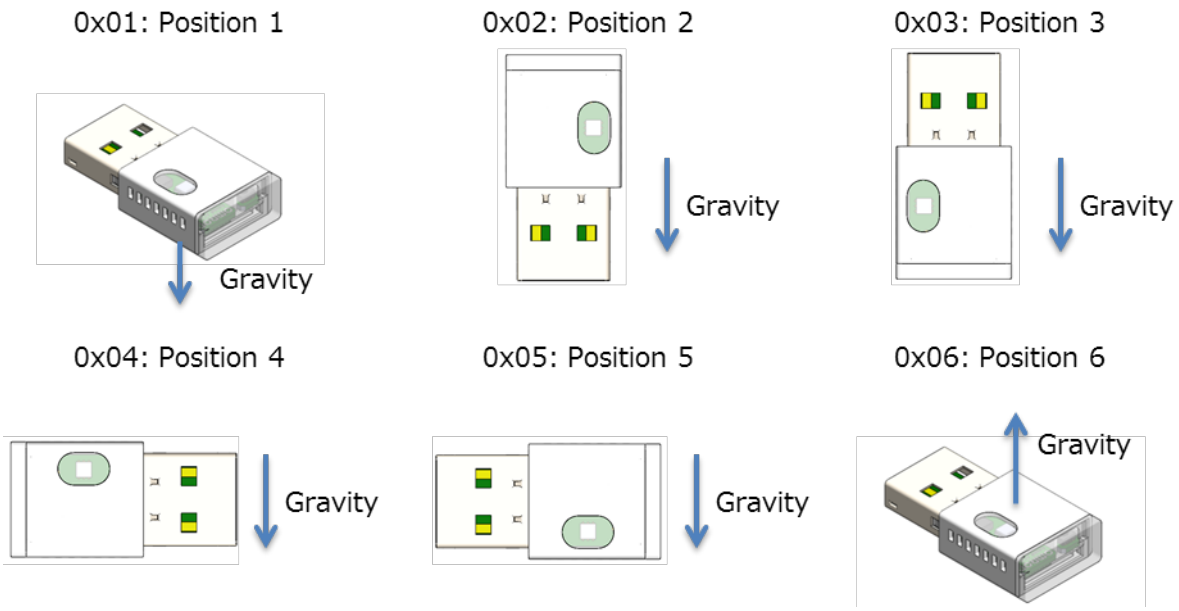

Figure 20 Mounting orientation

4.5.25 Device information (Address: 0x180A)

There is no data frame in the read command.

Table 122 Read response

Byte	Field	Format	Contents
0	Model number	Utf8s	"2" 0x32
1			"J" 0x4A
2			"C" 0x43
3			"I" 0x49
4			"E" 0x45
5			"-" 0x2D
6			"B" 0x42
7			"U" 0x55
8			"0" 0x30
9			"1" 0x31
10	Serial number	Utf8s	"0" to "3" 0x30 to 0x33
11			"0" to "9" 0x30 to 0x39
12			"0" to "9", "X", "Y", "Z" 0x30 to 0x39, 0x58, 0x59, 0x5A
13			"0" to "9" 0x30 to 0x39
14			"M" 0x4D
15			"Y" 0x59
16			"0" to "9" 0x30 to 0x39
17			"0" to "9" 0x30 to 0x39
18			"0" to "9" 0x30 to 0x39
19			"0" to "9" 0x30 to 0x39
20	Firmware revision	Utf8s	"0" to "9" 0x30 to 0x39
21			"0" to "9" 0x30 to 0x39
22			"." 0x2E
23			"0" to "9" 0x30 to 0x39
24			"0" to "9" 0x30 to 0x39
25	Hardware revision	Utf8s	"0" to "9" 0x30 to 0x39
26			"0" to "9" 0x30 to 0x39
27			"." 0x2E
28			"0" to "9" 0x30 to 0x39
29			"0" to "9" 0x30 to 0x39
30	Manufacture name	Utf8s	"O" 0x4F
31			"M" 0x4D

32			"R" 0x52
33			"O" 0x4F
34			"N" 0x4E

5. Data specification

5.1. Output range

This section gives the output range and units of the sensors.

Table 123 Output range [Sensor]

Sensor Type	Format	Range	Unit
Temperature	SInt16	-40.00 to 125.00	0.01 degC
Relative humidity	SInt16	0.00 to 100.00	0.01 %RH
Ambient light	SInt16	0 to 30000	1 lx
Barometric pressure	SInt32	300.000 to 1100.000	0.001 hPa
Sound noise	SInt16	33.00 to 120.00	0.01 dB
eTVOC (equivalent Total Volatile Organic Compound)	SInt16	0 to 32767	1 ppb
eCO2 (equivalent CO2)	SInt16	400 to 32767	1 ppm
Discomfort index	SInt16	0.00 to 100.00	0.01
Heat stroke	SInt16	-40.00 to 125.00	0.01 degC

* Discomfort index: Expresses the heat and humidity of summer in a quantitative manner. It is calculated from temperature and humidity.
* Heat stroke: Expresses the risk of heat stroke in a quantitative manner. It is calculated from temperature and humidity.

Table 124 Output range [Acceleration]

Sensor Type	Format	Range	Unit
Acceleration	SInt16	-2000.0 to 2000.0	0.1 gal
SI value	UInt16	0.0 to 6553.5	0.1 kine
PGA	UInt16	0.0 to 6553.5	0.1 gal
Seismic intensity	UInt16	0.000 to 65.535	0.001
SI value calculation axis	UInt8	0x00: YZ-axis 0x01: XZ-axis 0x02: XY-axis	
Vibration information	UInt8	0x00: NONE 0x01: during vibration (Earthquake judgment in progress) 0x02: during earthquake	

* SI value: An index that expresses the effect a certain vibration has on a structure. It has a correlation with seismic intensity. It is calculated from the acceleration values of 2 horizontal axes.
* PGA: Peak acceleration value of a certain interval. It is calculated by combining the acceleration values of 2 horizontal axes.
* Seismic intensity: A value correlated with seismic intensity that is calculated from the SI value.

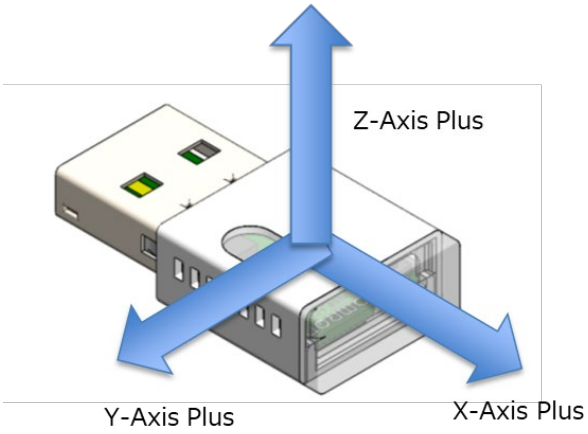

Figure 21 Acceleration axis

5.2. **Event enable/disable**

Set the following bit fields to enable or disable the event flags.

Table 125 Event enable/disable [Sensor]

Bit	Description	Contents
0	Simple threshold [upper limit] 1	Set 1 to enable and set 0 to disable.
1	Simple threshold [upper limit] 2	
2	Simple threshold [lower limit] 1	
3	Simple threshold [lower limit] 2	
4	Change threshold [rise] 1	
5	Change threshold [rise] 2	
6	Change threshold [decline] 1	
7	Change threshold [decline] 2	
8	Average value threshold [upper]	
9	Average value threshold [lower]	
10	Peak to Peak threshold [upper]	
11	Peak to Peak threshold [lower]	
12	Interval difference threshold [rise]	
13	Interval difference threshold [decline]	
14	Base difference threshold [upper]	
15	Base difference threshold [lower]	

Table 126 Event enable/disable [Acceleration]

Bit	Description	Contents
0	Simple threshold [upper limit] 1	Set 1 to enable and set 0 to disable.
1	Simple threshold [upper limit] 2	
4	Change threshold [rise] 1	
5	Change threshold [rise] 2	

5.3. **Event flag**

The event flag detection results are output in the following bit fields.

Table 127 Event flag [Sensor]

Bit	Description	Contents
0	Simple threshold [upper limit] 1	This compares the sensor output and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
1	Simple threshold [upper limit] 2	
2	Simple threshold [lower limit] 1	
3	Simple threshold [lower limit] 2	
4	Change threshold [rise] 1	This compares the data measured last time and the data measured this time and then judges whether the change is above or equal to or below or equal to the threshold value.
5	Change threshold [rise] 2	
6	Change threshold [decline] 1	
7	Change threshold [decline] 2	
8	Average value threshold [upper]	This compares the sensor output average value and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
9	Average value threshold [lower]	
10	Peak to Peak threshold [upper]	This compares the Peak to Peak of a specific period of sensor output and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
11	Peak to Peak threshold [lower]	
12	Interval difference threshold [rise]	This compares the difference between the sensor output latest value and the value of a specified number of times before and then judges whether above or equal to or below or equal to the threshold value.
13	Interval difference threshold [decline]	
14	Base difference threshold [upper]	This compares the difference between the sensor output average value and the value of a specified number of times before and then judges whether above or equal to or below or equal to the threshold value.
15	Base difference threshold [lower]	

Table 128 Event flag [Acceleration]

Bit	Description	Contents
0	Simple threshold [upper limit] 1	This compares the sensor output and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
1	Simple threshold [upper limit] 2	
4	Change threshold [rise] 1	This compares the data measured last time and the data measured this time and then judges whether the change is above or equal to or below or equal to the threshold value.
5	Change threshold [rise] 2	

5.3.1 Simple threshold

This compares the sensor output and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
Upper 1 and upper 2 are the upper limit judgments and lower 1 and lower 2 are the lower limit judgments, and each of them can be set to an arbitrary value.

Event judgment conditions

Simple threshold [upper limit] 1: data >= Upper threshold 1
Simple threshold [upper limit] 2: data >= Upper threshold 2
Simple threshold [lower limit] 1: data <= lower threshold 1
Simple threshold [lower limit] 2: data <= lower threshold 2

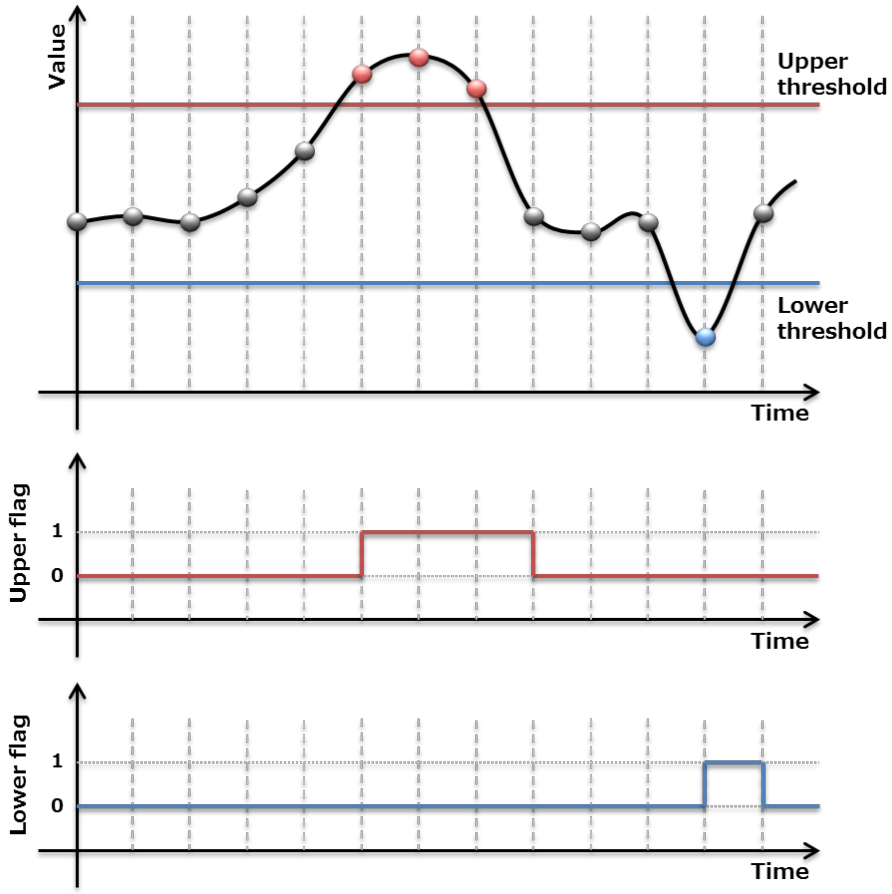

Figure 22 Simple threshold

5.3.2 Change threshold

This compares the data measured last time and the data measured this time and then judges whether the change is above or equal to or below or equal to the threshold value.
Rise 1 and rise 2 are the rise judgments and decline 1 and decline 2 are the decline judgments, and each of them can be set to an arbitrary value. In the calculation formula, data[0] is the latest value and data[1] is the data of one measurement before (one second before).

Event judgment conditions

Change threshold [rise] 1: (data[0] - data[1]) >= rise threshold 1
Change threshold [rise] 2: (data[0] - data[1]) >= rise threshold 2
Change threshold [decline] 1: (data[0] - data[1]) <= decline threshold 1
Change threshold [decline] 2: (data[0] - data[1]) <= decline threshold 2

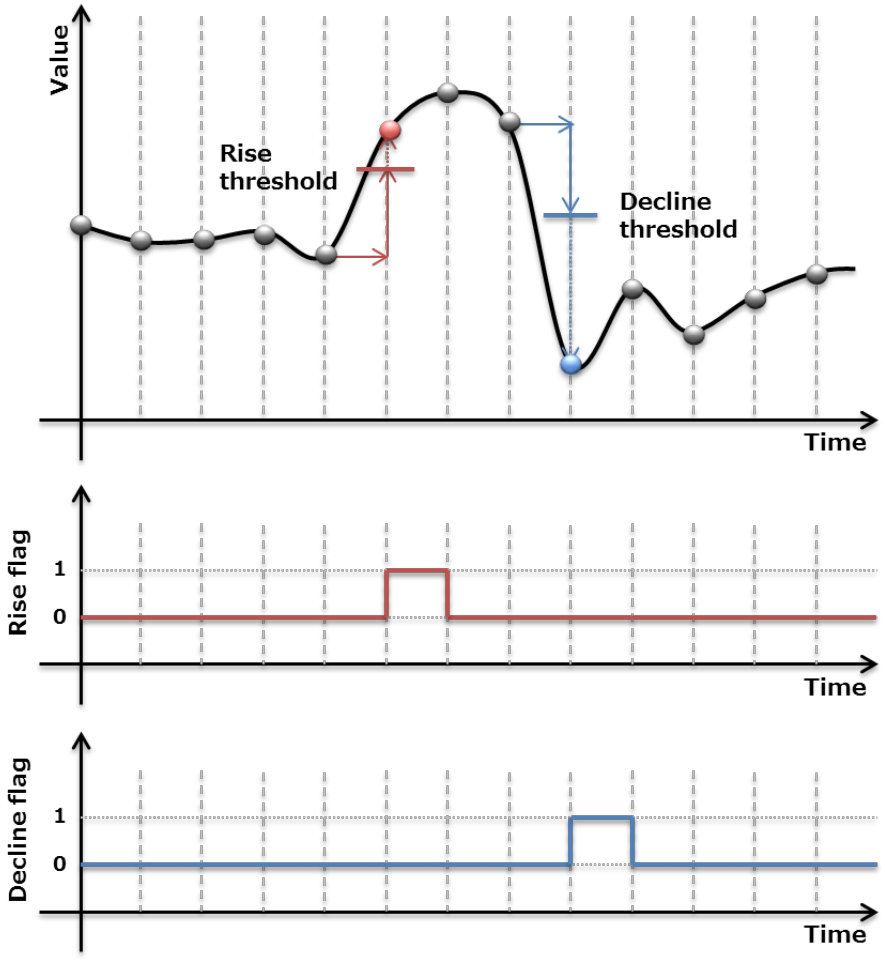

Figure 23 Change threshold

5.3.3 Average value threshold

This compares the sensor output average value and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
Set the average value to be for how many times in the past in Average value count. Upper is the upper limit judgment and lower is the lower limit judgment, and each of them can be set to an arbitrary value. In the calculation formula, data[0] is the latest value and data[x] is the measurement data of x times before.

Event judgment conditions (when Average value count = 4)

Ave data = (data[0] + data[1] + data[2] + data[3]) / 4

Average value threshold [upper]: Ave data >= upper threshold

Average value threshold [lower]: Ave data <= lower threshold

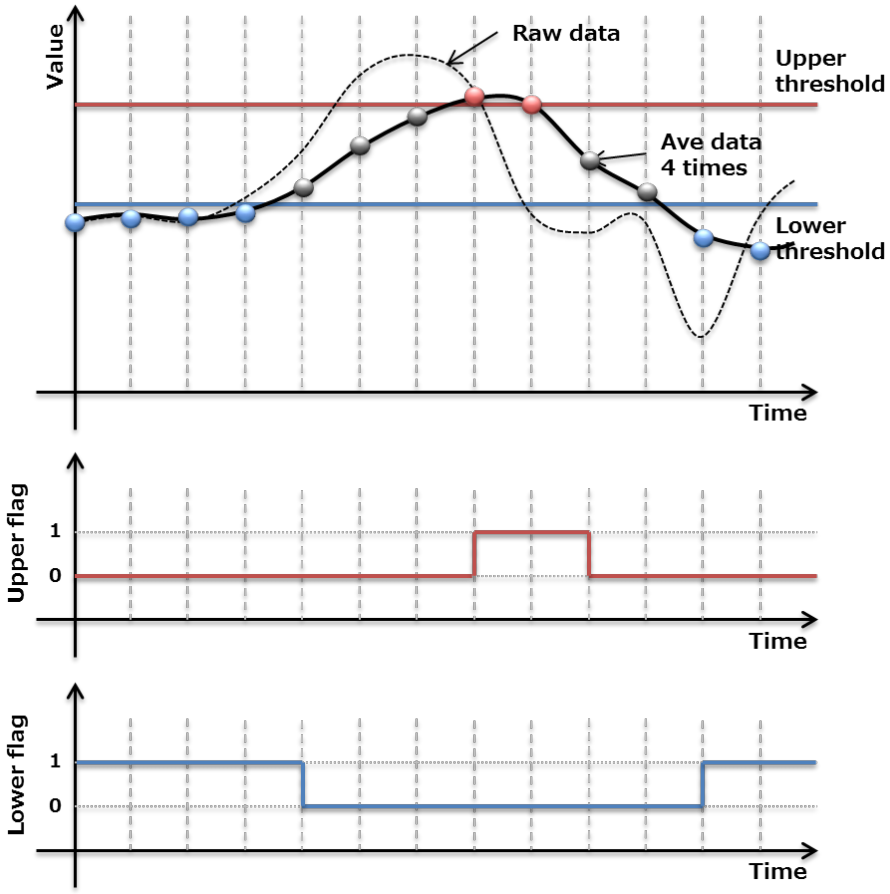

Figure 24 Average value threshold

5.3.4 Peak to Peak threshold

This compares the Peak to Peak of a specific period of sensor output and the threshold value and then judges whether above or equal to or below or equal to the threshold value.
Set the Peak to Peak to be for how many times in the past in Peak to Peak count. Upper is the upper limit judgment and lower is the lower limit judgment, and each of them can be set to an arbitrary value. In the calculation formula, data[0] is the latest value and data[x] is the measurement data of x times before.

Event judgment conditions (when Peak to Peak count = 4)

PtoP = max(data[0] + data[1] + data[2] + data[3]) - min(data[0] + data[1] + data[2] + data[3])
Peak to Peak threshold [upper]: PtoP >= upper threshold
Peak to Peak threshold [lower]: PtoP <= lower threshold

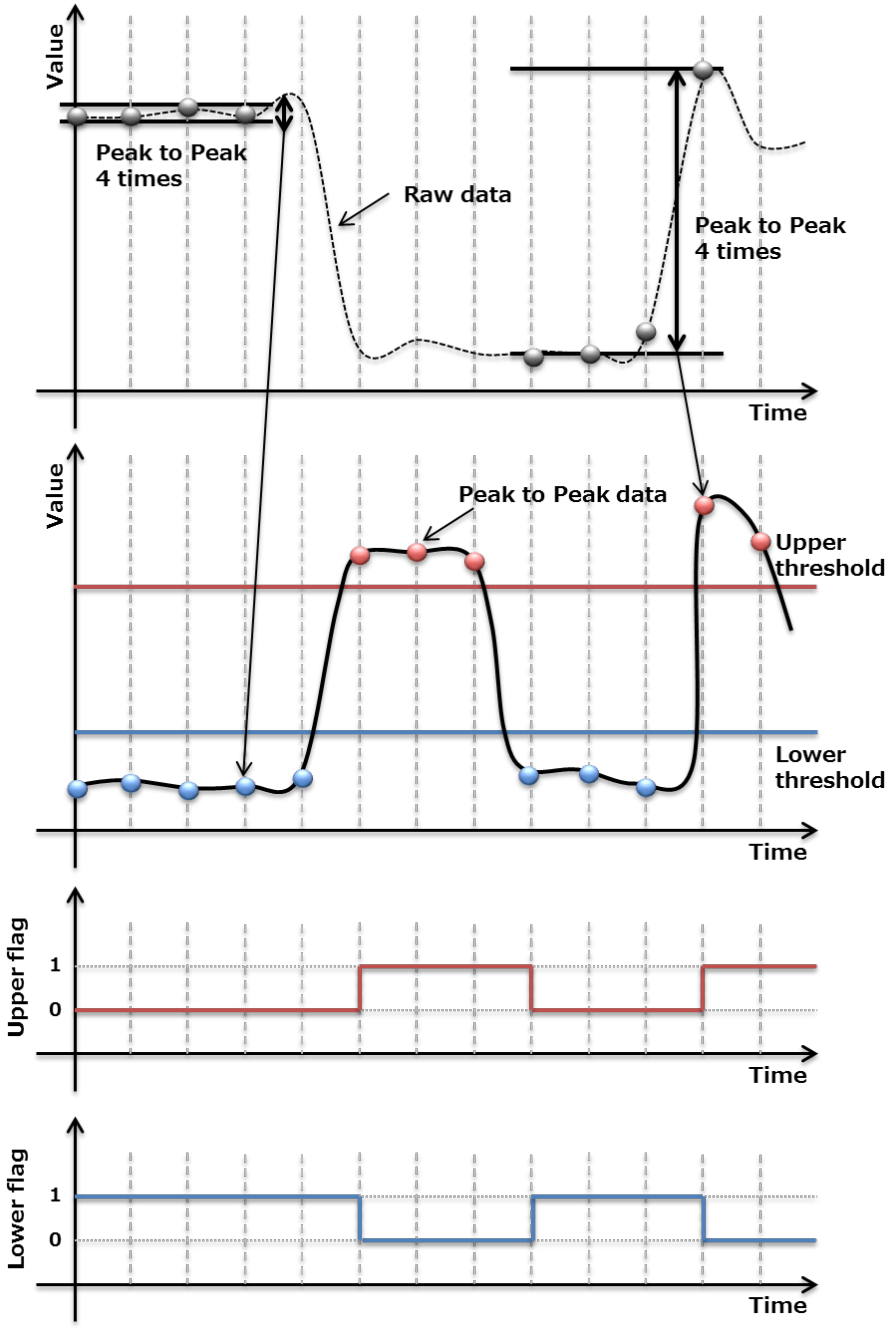

Figure 25 Peak to Peak threshold

5.3.5 Interval difference threshold

This compares the difference between the sensor output latest value and the value of a specified number of times before and then judges whether above or equal to or below or equal to the threshold value.
Set comparison to be with the values of how many times in the past in Interval difference count. Rise is the rise judgment and decline is the decline judgment, and each of them can be set to an arbitrary value. In the calculation formula, data[0] is the latest value and data[x] is the measurement data of x times before.

Event judgment conditions (when Interval difference count = 5)

Interval difference data = data[0] – data[5]

Interval difference threshold [upper]: Interval difference data >= rise threshold

Interval difference threshold [lower]: Interval difference data <= decline threshold

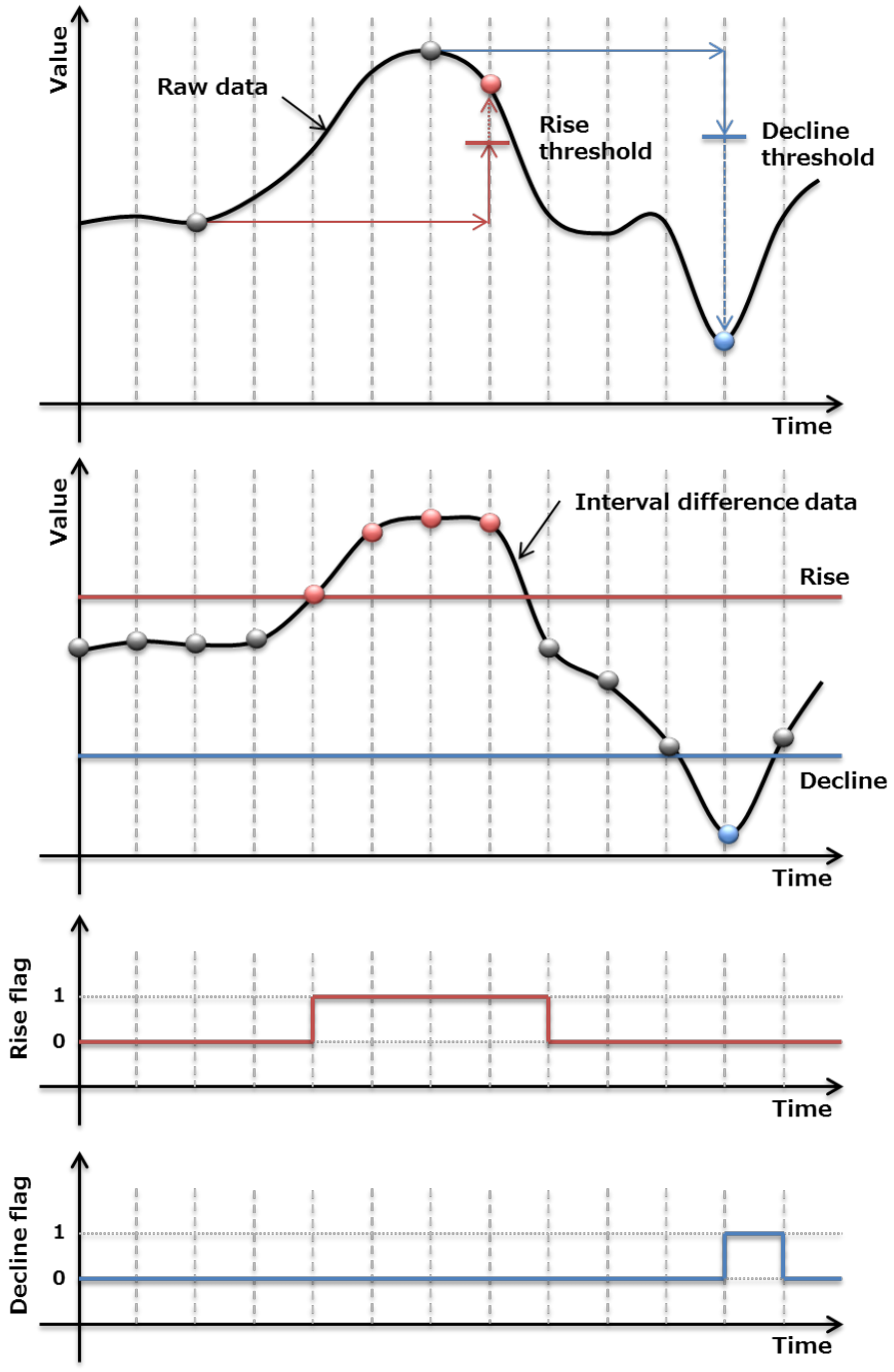

Figure 26 Interval difference threshold

5.3.6 Base difference threshold

This compares the difference between the sensor output average value and the average value of a specified number of times before and then judges whether above or equal to or below or equal to the threshold value.
Set comparison to be with the average value of how many times in the past in Base difference count. Rise is the rise judgment and decline is the decline judgment, and each of them can be set to an arbitrary value. In the calculation formula, ave data[0] is the latest value and ave data[x] is the measurement data of x times before. The value of Average value count is applied for the number of averaging times.

Event judgment conditions (when Base difference count = 5 and Average value count = 4)

Base difference data = ave data[0] – ave data[5]

Base difference threshold [upper]: Base difference data >= rise threshold

Base difference threshold [lower]: Base difference data <= decline threshold

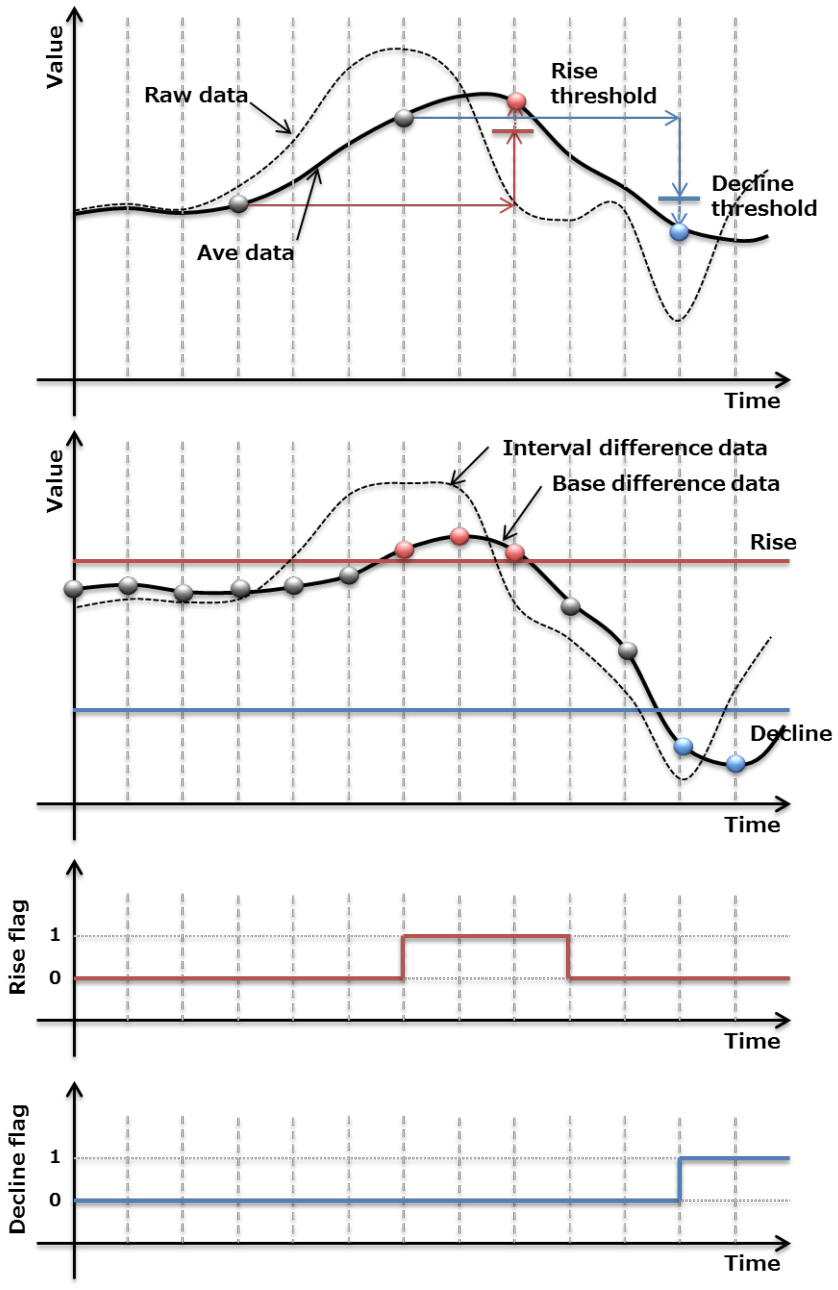

Figure 27 Base difference threshold

5.4. **Event threshold**

This section gives the threshold values of events.

Table 129 Event threshold [Temperature]

Temperature	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	3500	0xF060 to 0x30D4 (-4000 to 12500)	0.01degC
Simple threshold [upper limit] 2	SInt16	4000		
Simple threshold [lower limit] 1	SInt16	1000		
Simple threshold [lower limit] 2	SInt16	0		
Average value threshold [upper]	SInt16	3500		
Average value threshold [lower]	SInt16	1000		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 130 Event threshold [Relative humidity]

Relative humidity	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	8500	0x0000 to 0x2710 (0 to 10000)	0.01%RH
Simple threshold [upper limit] 2	SInt16	9500		
Simple threshold [lower limit] 1	SInt16	3500		
Simple threshold [lower limit] 2	SInt16	1000		
Average value threshold [upper]	SInt16	8500		
Average value threshold [lower]	SInt16	3500		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 131 Event threshold [Ambient light]

Ambient light	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	300	0x0000 to 0x7530 (0 to 30000)	1lx
Simple threshold [upper limit] 2	SInt16	1000		
Simple threshold [lower limit] 1	SInt16	100		
Simple threshold [lower limit] 2	SInt16	10		
Average value threshold [upper]	SInt16	300		
Average value threshold [lower]	SInt16	100		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x7530 (0 to 30000)	
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 132 Event threshold [Barometric pressure]

Barometric pressure	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	10300	0x0BB8 to 0x2AF8 (3000 to 11000)	0.1hPa
Simple threshold [upper limit] 2	SInt16	10500		
Simple threshold [lower limit] 1	SInt16	9700		
Simple threshold [lower limit] 2	SInt16	9500		
Average value threshold [upper]	SInt16	10300		
Average value threshold [lower]	SInt16	9700		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x2710 (0 to 10000)	0.001hPa
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 133 Event threshold [Sound noise]

Sound noise	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	7000	0x0CE4 to 0x2EE0 (33.00 to 12000)	0.01dB
Simple threshold [upper limit] 2	SInt16	9000		
Simple threshold [lower limit] 1	SInt16	5000		
Simple threshold [lower limit] 2	SInt16	4000		
Average value threshold [upper]	SInt16	7000		
Average value threshold [lower]	SInt16	5000		
Change threshold [rise] 1	SInt16	1000	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	2000		
Change threshold [decline] 1	SInt16	1000		
Change threshold [decline] 2	SInt16	2000		
Peak to Peak threshold [upper]	SInt16	1000		
Peak to Peak threshold [lower]	SInt16	1000		
Interval difference threshold [rise]	SInt16	1000		
Interval difference threshold [decline]	SInt16	1000		
Base difference threshold [upper]	SInt16	1000		
Base difference threshold [lower]	SInt16	1000		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 134 Event threshold [eTVOC]

eTVOC	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	250	0x0000 to 0x7FFF (0 to 32767)	1ppb
Simple threshold [upper limit] 2	SInt16	450		
Simple threshold [lower limit] 1	SInt16	100		
Simple threshold [lower limit] 2	SInt16	50		
Average value threshold [upper]	SInt16	250		
Average value threshold [lower]	SInt16	100		
Change threshold [rise] 1	SInt16	50	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	100		
Change threshold [decline] 1	SInt16	50		
Change threshold [decline] 2	SInt16	100		
Peak to Peak threshold [upper]	SInt16	50		
Peak to Peak threshold [lower]	SInt16	50		
Interval difference threshold [rise]	SInt16	50		
Interval difference threshold [decline]	SInt16	50		
Base difference threshold [upper]	SInt16	50		
Base difference threshold [lower]	SInt16	50		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 135 Event threshold [eCO2]

eCO2	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	1500	0x0190 to 0x7FFF (400 to 32767)	1ppm
Simple threshold [upper limit] 2	SInt16	2500		
Simple threshold [lower limit] 1	SInt16	1000		
Simple threshold [lower limit] 2	SInt16	600		
Average value threshold [upper]	SInt16	1500		
Average value threshold [lower]	SInt16	1000		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 136 Event threshold [Discomfort index]

Discomfort index	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	7500	0x0000 to 0x2710 (0 to 10000)	0.01
Simple threshold [upper limit] 2	SInt16	8000		
Simple threshold [lower limit] 1	SInt16	6000		
Simple threshold [lower limit] 2	SInt16	5500		
Average value threshold [upper]	SInt16	7500		
Average value threshold [lower]	SInt16	6000		
Change threshold [rise] 1	SInt16	200	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	500		
Change threshold [decline] 1	SInt16	200		
Change threshold [decline] 2	SInt16	500		
Peak to Peak threshold [upper]	SInt16	200		
Peak to Peak threshold [lower]	SInt16	200		
Interval difference threshold [rise]	SInt16	200		
Interval difference threshold [decline]	SInt16	200		
Base difference threshold [upper]	SInt16	200		
Base difference threshold [lower]	SInt16	200		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 137 Event threshold [Heat stroke]

Heat stroke	Format	Default	Range	Unit
Simple threshold [upper limit] 1	SInt16	2800	0xF060 to 0x30D4 (-4000 to 12500)	0.01degC
Simple threshold [upper limit] 2	SInt16	3100		
Simple threshold [lower limit] 1	SInt16	2500		
Simple threshold [lower limit] 2	SInt16	2200		
Average value threshold [upper]	SInt16	2800		
Average value threshold [lower]	SInt16	2500		
Change threshold [rise] 1	SInt16	100	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	SInt16	200		
Change threshold [decline] 1	SInt16	100		
Change threshold [decline] 2	SInt16	200		
Peak to Peak threshold [upper]	SInt16	100		
Peak to Peak threshold [lower]	SInt16	100		
Interval difference threshold [rise]	SInt16	100		
Interval difference threshold [decline]	SInt16	100		
Base difference threshold [upper]	SInt16	100		
Base difference threshold [lower]	SInt16	100		
Average value count	UInt8	8	0x01 to 0x08 (1 to 8)	1count
Peak to Peak count	UInt8	8		
Interval difference count	UInt8	8		
Base difference count	UInt8	8		

Table 138 Event threshold [SI value]

SI value	Format	Default	Range	Unit
Simple threshold [upper limit] 1	UInt16	100	0x0000 to 0xFFFF (0 to 65535)	0.1 kine
Simple threshold [upper limit] 2	UInt16	170		
Change threshold [rise] 1	UInt16	30	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	UInt16	50		

Table 139 Event threshold [PGA]

PGA	Format	Default	Range	Unit
Simple threshold [upper limit] 1	UInt16	500	0x0000 to 0xFFFF (0 to 65535)	0.1 gal
Simple threshold [upper limit] 2	UInt16	1000		
Change threshold [rise] 1	UInt16	200	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	UInt16	500		

Table 140 Event threshold [Seismic intensity]

Seismic intensity	Format	Default	Range	Unit
Simple threshold [upper limit] 1	UInt16	3500	0x0000 to 0xFFFF (0 to 65535)	0.001
Simple threshold [upper limit] 2	UInt16	5000		
Change threshold [rise] 1	UInt16	500	0x0000 to 0x2710 (0 to 10000)	
Change threshold [rise] 2	UInt16	1000		

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