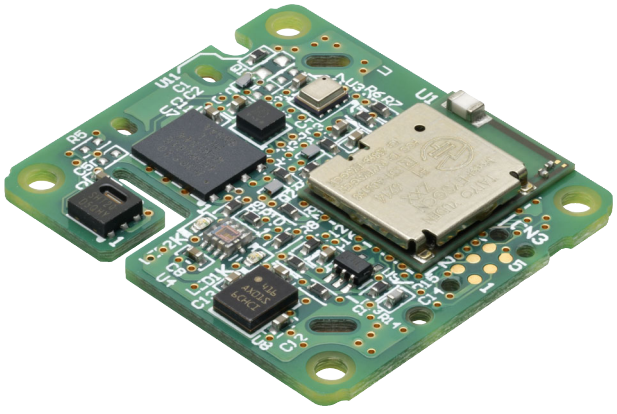
OMRON

Environment Sensor (PCB Type)

2JCIE-BL01-P1

User's Manual

Environment Sensor (PCB Type)



A280-E1-01

Table of Contents

1. Introduction

1.1. **Scope**

This Communication I/F Manual applies to Environment Sensor (PCB Type) 2JCIE-BL01-P1 (hereinafter, referred to as Environment sensor).

1.2. **Communication Interface**

Environment sensor communicates with a smartphone, tablet, etc. via Bluetooth® low energy.

Table 1. GAP Role

GAP Role	
Environment Sensor	Peripheral
Smartphone, Tablet or others	Central

1.3. **Operation flow**

According to set Beacon Mode, there are two operation patterns with and without measured data recording. The sensor data measurement and recording to flash memory are carried out regardless of whether they are connected or disconnected to/from the Central device. Further details of Beacon Mode are described in 3. Advertise format.

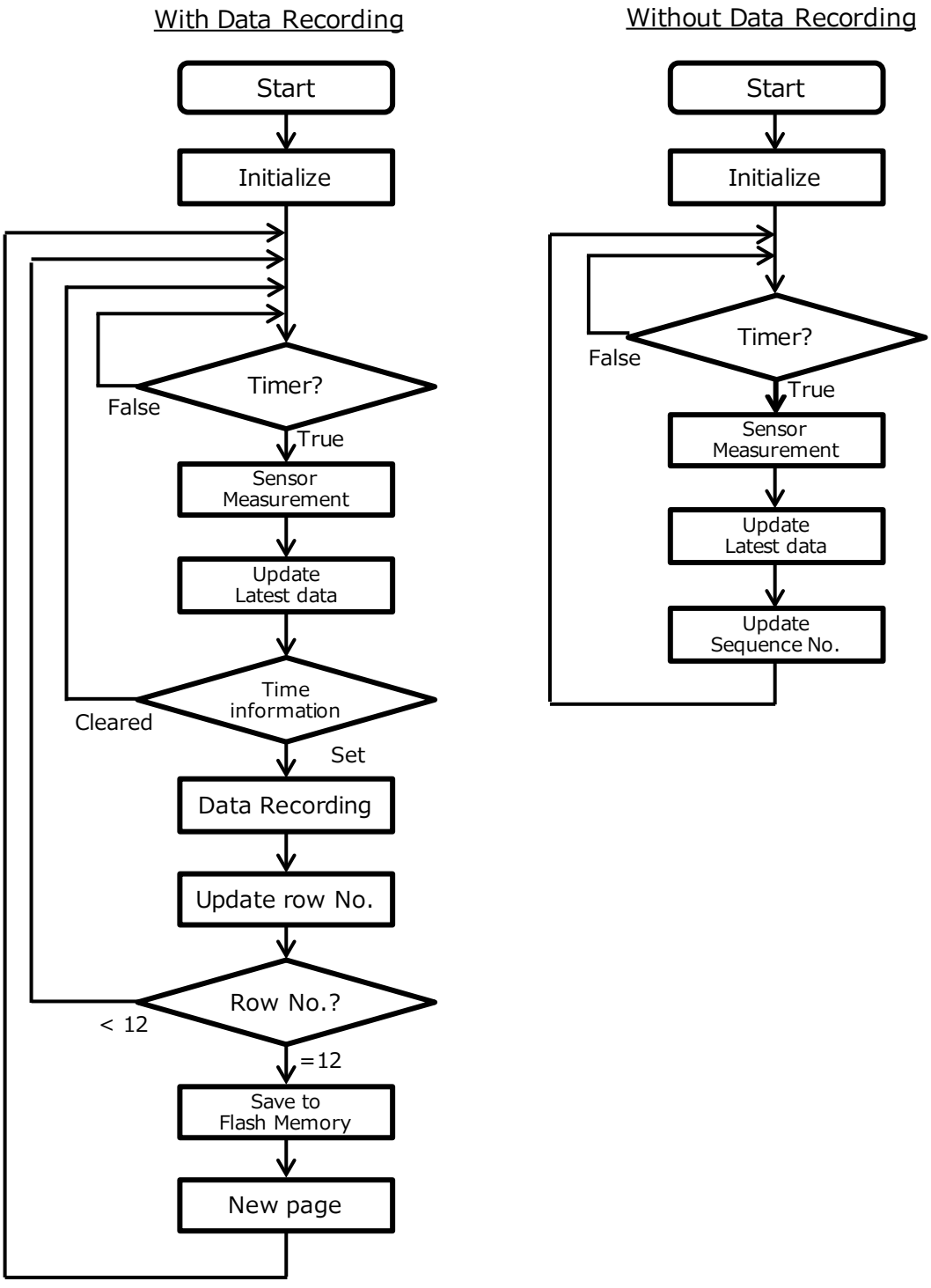


Figure 1 Operation flow

1.3.1 With Data Recording mode

The following Beacon Modes operate with data recording to the flash memory. To activate data recording, 2.3.1 Time Information must be set from the Central device first. Time information is cleared to zero (0) again when the Measurement Interval is changed, Beacon Mode is changed or power is reset. In these cases, it is necessary to set Time Information again to restart data recording.

Table 2. List of Beacon Mode with Data Recording

Beacon Mode	Name	Shortened Device Name	Device Name
0x00	Event Beacon (SCAN RSP)	Env	EnvSensor-BL01
0x01	Standard Beacon	Env	EnvSensor-BL01
0x07	Alternate Beacon	Env	EnvSensor-BL01
0x08	Event Beacon (ADV)	Env	EnvSensor-BL01

1.3.2 Without Data Recording mode

Since the measured data is not recorded to the flash memory in the following Beacon Modes, only Latest Data is updated.

Table 3. List of Beacon Mode without Data Recording

Beacon Mode	Name	Shortened Device Name	Device Name
0x02	General Broadcaster 1	IM	IM-BL01
0x03	Limited Broadcaster 1	IM	IM-BL01
0x04	General Broadcaster 2	EP	EP-BL01
0x05	Limited Broadcaster 2	EP	EP-BL01

1.3.3 Flash memory for data recording

The flash memory consists of 2048 pages in total (from Page 0 to Page 2047), and the content of single page consists of UNIX TIME and 13 rows of measured data. The UNIX TIME indicates the measurement time at the first row of the page (Row 0), and from the first line onwards, it is possible to calculate the measurement time by adding the measurement interval to the UNIX TIME. When data is stored 13 times (from Row 0 to Row 12) in single page, a new page is created for the next measurement.

Table 4. Example of Memory contents: Page 1

Items	Contents	Remarks
UNIX TIME	0x5685C180 (1451606400)	2016/1/1 0:00:00
Measurement Interval	0x12C (300sec)	5 min. interval
Row 0	Sensor data	2016/1/1 0:00:00
Row 1	Sensor data	2016/1/1 0:05:00
Row 2	Sensor data	2016/1/1 0:10:00
…	…	…
Row 12	Sensor data	2016/1/1 1:00:00

Table 5. Example of Memory contents: Page 2

Items	Contents	Remarks
UNIX TIME	0x5685D0BC (1451610300)	2016/1/1 1:05:00
Measurement Interval	0x12C (300sec)	5 min. interval
Row 0	Sensor data	2016/1/1 1:05:00
Row 1	Sensor data	2016/1/1 1:10:00
…	…	…

2. GATT Services

UUIDs of supported GATT services are shown below. Except public services defined by Bluetooth specification, full UUIDs of all the CUSTOM services and characteristics are based on the same Base UUID as follows.

Base UUID: 0C4C**XXXX**-7700-46F4-AA96D5E974E32A54

Table 6. List of supported GATT Services

Service UUID	Service name	Number of Characteristics
0x3000	Sensor Service	6
0x3010	Setting Service	9
0x3030	Control Service	4
0x3040	Parameter Service	2
0x3050	DFU Service	3
0x1800 (Public)	Generic Access Service	3
0x1801 (Public)	Generic Attribute Service	1
0x180A (Public)	Device Information Service	5

2.1. **Sensor Service (Service UUID: 0x3000)**

Sensor Service is the service for the sensor data acquisition.

Table 7. List of Characteristics in Sensor Service

Characteristics UUID	Characteristics	Properties				Byte
		R	W	N	I	
0x3001	Latest data	✓		✓		19
0x3002	Latest page	✓				9
0x3003	Request page	✓	✓			3
0x3004	Response flag	✓				5
0x3005	Response data	✓				19
0x3006	Event flag	✓		✓		9

*Properties（R：Read，W：Write，N：Notify，I：Indicate）

2.1.1 Latest data (Characteristics UUID: 0x3001)

Measured sensor data is updated every measurement interval and reflected in Latest data. The measurement interval can be changed in 2.2.1 Measurement interval.
In addition to regular update in set measurement interval, when sensor is disconnected from Central devices, the measurement is immediately carried out then the contents of this characteristics is updated. However, in case of immediate data measurement, this measured data is not saved to the memory and row number is not updated.

Table 8. Latest data format

Byte	Field		Format	Contents
0	Row number / Sequence number		UInt8	With Data Recording: Range : 0～12 *1 Without Data Recording: Range : 0～255
1	Temperature	L	SInt16	Unit : 0.01 degC
2		H		
3	Relative Humidity	L	SInt16	Unit : 0.01 %RH
4		H		
5	Light	L	SInt16	Unit : 1 lx
6		H		
7	UV Index	L	SInt16	Unit : 0.01
8		H		
9	Barometric Pressure	L	SInt16	Unit : 0.1 hPa
10		H		
11	Sound noise	L	SInt16	Unit : 0.01 dB
12		H		
13	Discomfort Index *2	L	SInt16	Unit : 0.01
14		H		
15	Heatstroke risk factor *2	L	SInt16	Unit : 0.01 degC
16		H		
17	Supply voltage	L	UInt16	Unit : 1 mV
18		H		

*1 In the operation with data recording mode, the value is always zero unless Time information is set.

*2 Discomfort Index, Heatstroke risk factor（WBGT approximation）are calculated only by temperature and humidity. These information is just a rough indication and for referential use only.

2.1.2 **Latest page** (Characteristics UUID: 0x3002)

The Latest page shows the latest page and row information of the memory as the progress status of data recording.
The Central device can acquire the past memory data by referring to the difference between the page information at the previous data retrieving and this latest page information.

Table 9. Latest page format

Byte	Field		Format	Contents
0	UNIX TIME	0	UInt32	Created time of the latest page. Unit : 1 sec Range : 1970/1/1 0:00:01～2106/2/7 6:28:15
1		1		
2		2		
3		3		
4	Measurement interval	L	UInt16	Unit : 1 sec Range : 1～3600 sec
5		H		
6	Latest page	L	UInt16	Range : 0～2047
7		H		
8	Latest row		UInt8	Range : 0～12

2.1.3 Request page (Characteristics UUID: 0x3003)

Specify the page number to retrieve the measured data from the flash memory.
The result of retrieving from the memory for the page specified in this Characteristic will be set in 2.1.4 Response flag and the past measured data will be set in 2.1.5 Response data.
* Note: Memory recording of measured data is not started unless 2.3.1 Time information is set.

Table 10. Request page format

Byte	Field		Format	Contents
0	Requesting Page No.	L	UInt16	Range : 0～2047
1		H		
2	Requesting Row No.		UInt8	Range : 0～12

2.1.4 Response flag (Characteristics UUID: 0x3004)

When requesting page and row number is set in 2.1.3 Request page, 2.1.5 Response Data will be updated with retrieved measured data. Whether the update is successfully completed or not can be known by the Update flag of this Characteristic.
In addition, updating of this Characteristic is done in the page basis, confirmation in the row basis is unnecessary.
* Note: Memory recording of measured data is not started unless 2.3.1 Time information is set.

Table 11. Response flag format

Byte	Field		Format	Contents
0	Update flag		UInt8	0x00: Retrieving 0x01: Completed 0x02: Failed to retrieve data
1	UNIX TIME	0	UInt32	Created time of this page. Unit : 1 sec Range : 1970/1/1 0:00:01～2106/2/7 6:28:15
2		1		
3		2		
4		3		

2.1.5 Response data (Characteristics UUID: 0x3005)

Retrieved memory data in the page and row specified in 2.1.3 Request page will be updated in this characteristic. Correct data acquisition can be made after the update flag becomes "Completed" in 2.1.5 Response flag. Also, by reading this Characteristic, the data of the next row in the same page is automatically set to this Characteristic (descending order Row 12 to Row 0).

Therefore, it is unnecessary to specify 2.1.3 Request page for each row, and all row in the same page can be read by continuous Read of this Characteristic. However, since automatic retrieving across pages is not performed, when moving to the next page, it is necessary to specify the page number again to 2.1.3 Request page and confirm the 2.1.4 Response flag each time.

* Note: Memory recording of measured data is not started unless 2.3.1 Time information is set.

Table 12. Response data format

Byte	Field		Format	Contents
0	Row number		UInt8	Range : 0～12
1	Temperature	L	SInt16	Unit : 0.01 degC
2		H		
3	Relative Humidity	L	SInt16	Unit : 0.01 %RH
4		H		
5	Light	L	SInt16	Unit : 1 lx
6		H		
7	UV Index	L	SInt16	Unit : 0.01
8		H		
9	Barometric Pressure	L	SInt16	Unit : 0.1 hPa
10		H		
11	Sound noise	L	SInt16	Unit : 0.01 dB
12		H		
13	Discomfort Index	L	SInt16	Unit : 0.01
14		H		
15	Heatstroke risk factor	L	SInt16	Unit : 0.01 degC
16		H		
17	Supply voltage	L	UInt16	Unit : 1 mV
18		H		

Operation flow of data retrieving from flash memory is shown below.

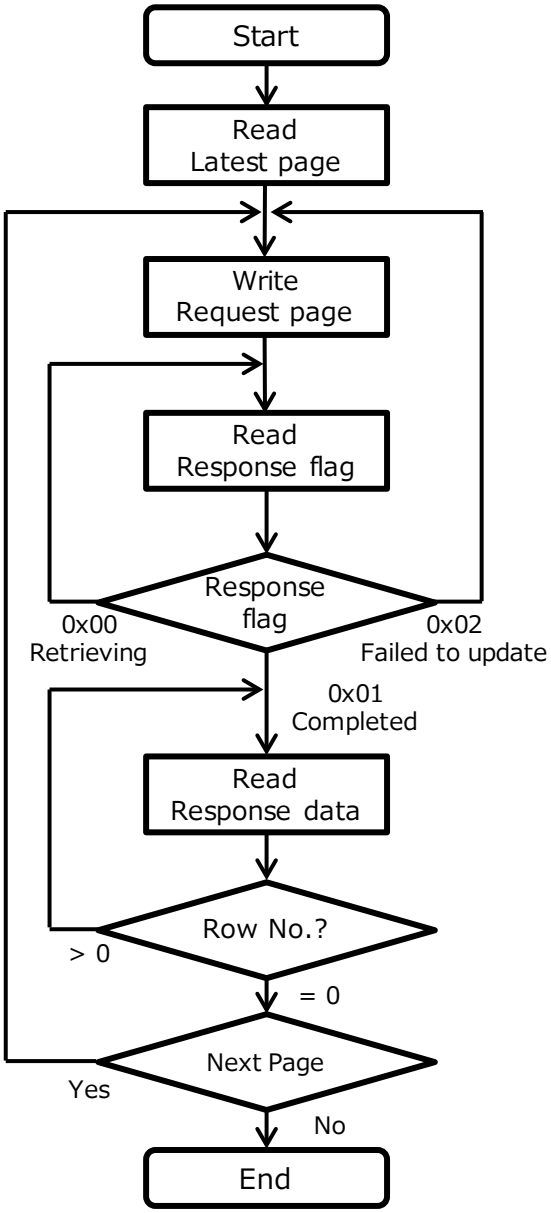


Figure 2 Operation flow of data retrieving from flash memory

*1 The information of the latest page can be acquire from 2.1.2 Latest page or the page information in advertisement data.

*2. While the result of reading Response flag is 0x00: Retrieving, try reading Response flag until updating is completed.

*3. If the result of reading Response flag is 0x02: Fail and updating is not completed after 3 times of retry, the data in the flash memory may be corrupted. In this case, skip the corresponding page and obtain the data of the next page.

2.1.6 **Event flag** (Characteristics UUID: 0x3006)

The state of occurrence of various events is represented by a bit field for each sensor.

Table 13. Event flag format

Byte	Field	Format	Contents
0	Temperature	UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous]
1	Relative Humidity	UInt8	
2	Light	UInt8	
3	UV Index	UInt8	
4	Barometric Pressure	UInt8	
5	Sound noise	UInt8	
6	Discomfort Index	UInt8	
7	Heatstroke risk factor	UInt8	
8	Other events	UInt8	Bit 7-1 : RFU Bit 0 : Low supply voltage

＊Simple threshold ： The state where the latest acquisition data exceeds the set threshold.

＊Changing trend

[term] : The state in which there is at least one difference equal to or greater than set threshold between the latest data and the predetermined number of past data.

[previous] : The stat in which the difference between the latest data and the previous data is equal to or greater than the set threshold.

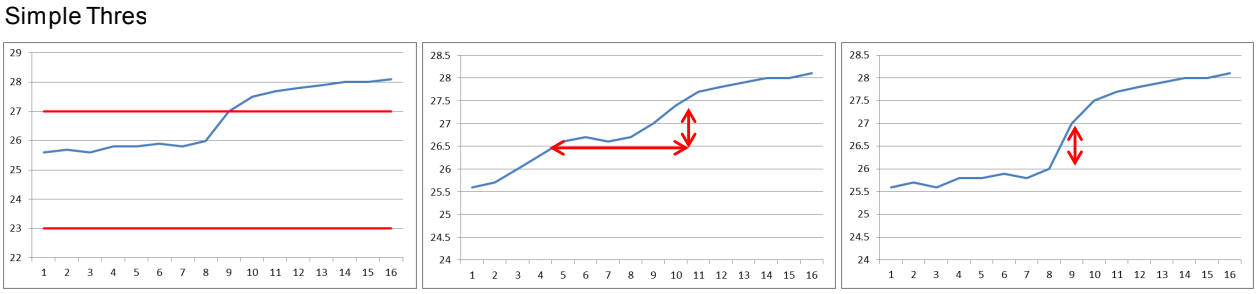


Figure 3 Event detection

2.2. **Setting Service (Service UUID: 0x3010)**

Read and Write the settings of each sensor.

Table 14. List of Characteristics in Sensor Setting Service

Characteristics UUID	Characteristics	Properties				Byte
		R	W	N	I	
0x3011	Measurement interval	✓	✓			2
0x3013	Temperature	✓	✓			15
0x3014	Relative humidity	✓	✓			15
0x3015	Ambient light	✓	✓			15
0x3016	UV Index	✓	✓			15
0x3017	Pressure	✓	✓			15
0x3018	Sound noise	✓	✓			15
0x3019	Discomfort index	✓	✓			15
0x301A	Heat stroke	✓	✓			15

2.2.1 Measurement interval (Characteristics UUID: 0x3011)

Specify measurement interval in seconds. (Common to all sensors)
Time information is cleared to zero (0) when changing the measurement interval, so it is necessary to set the time again to start data recording.

Table 15. Measurement interval format

Byte	Field		Format	Contents
0	Measurement interval	L	UInt16	Unit : 1 sec Range : 1～3600 sec Default : 300 sec (0x012C)
1		H		

The possible recording period are shown in Table 16.

Table 16. Relationship between Measurement interval and possible recording period

Measurement interval	Recording period (hour)	Recording period (day)
1 sec	7.4 hour	0.3 days
10 sec	74 hour	3.0 days
30 sec	222 hour	9.2 days
60 sec	444 hour	18 days
300 sec	2219 hour	92 days
600 sec	4437 hour	185 days
3600 sec	26624 hour	1109 days

2.2.2 **Temperature** (Characteristics UUID: 0x3013)

Temperature sensor related event settings.

Table 17. Temperature format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 degC Range : 0.01～30.00 degC Default : 0x00C8 (2.00 degC)
2		H		
3	Changing trend threshold [decline/previous]	L		
4		H		
5	Changing trend threshold [rise/term]	L		
6		H		
7	Changing trend threshold [decline/term]	L		
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 degC Range : -10.00～60.00 degC Default : 0x0DAC (35.00 degC)
10		H		
11	Simple threshold [lower limit]	L		Unit : 0.01 degC Range : -10.00～60.00 degC Default : 0x03E8 (10.00 degC)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.3 **Relative humidity** (Characteristics UUID: 0x3014)

Humidity sensor related event settings.

Table 18. Relative Humidity format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 %RH Range : 0.01～50.00 %RH Default : 0x01F4 (5.00 %RH)
2		H		
3	Changing trend threshold [decline/previous]	L		
4		H		
5	Changing trend threshold [rise/term]	L		
6		H		
7	Changing trend threshold [decline/term]	L		
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 %RH Range : 0.00～100.00 %RH Default : 0x1F40 (80.00 %RH)
10		H		
11	Simple threshold [lower limit]	L		Unit : 0.01 %RH Range : 0.00～100.00 %RH Default : 0x0DAC (35.00 %RH)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.4 **Ambient light** (Characteristics UUID: 0x3015)

Light sensor related event settings.

Table 19. Ambient Light format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 1 lx Range : 1～2000 lx Default : 0x00C8 (200 lx)
2		H		
3	Changing trend threshold [decline/previous]	L		
4		H		
5	Changing trend threshold [rise/term]	L		
6		H		
7	Changing trend threshold [decline/term]	L		
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 1 lx Range : 10～10000 lx Default : 0x07D0 (2000 lx)
10		H		
11	Simple threshold [lower limit]	L		Unit : 1 lx Range : 10～10000 lx Default : 0x00A (10 lx)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.5 UV Index (Characteristics UUID: 0x3016)

UV sensor related event settings.

Table 20. UV Index format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 Range : Index 0.00～11.00 Default : 0x012C (3.00)
2		H		
3	Changing trend threshold [decline/previous]	L		
4		H		
5	Changing trend threshold [rise/term]	L		
6		H		
7	Changing trend threshold [decline/term]	L		
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 Range : Index 0.00～11.00 Default : 0x0258 (6.00)
10		H		
11	Simple threshold [lower limit]	L		Unit : 0.01 Range : Index 0.00～11.00 Default : 0x0000 (0.00)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.6 **Pressure** (Characteristics UUID: 0x3017)

Barometric Pressure sensor related event settings.

Table 21. Pressure format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.1 hPa Range : 0.1～200.0 hPa Default : 0x0032 (5.0 hPa)
2		H		
3	Changing trend threshold [decline/previous]	L	SInt16	
4		H		
5	Changing trend threshold [rise/term]	L	SInt16	
6		H		
7	Changing trend threshold [decline/term]	L	SInt16	
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.1 hPa Range : 700.0～1100.0 hPa Default : 0x2AF8 (1100.0 hPa)
10		H		
11	Simple threshold [lower limit]	L	SInt16	Unit : 0.1 hPa Range : 700.0～1100.0 hPa Default : 0x1B58 (700.0 hPa)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.7 **Sound Noise** (Characteristics UUID: 0x3018)

Microphone related event settings.

Table 22. Sound Noise format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 dB Range : 0.01～50.00 dB Default : 0x07D0 (20.00 dB)
2		H		
3	Changing trend threshold [decline/previous]	L	SInt16	
4		H		
5	Changing trend threshold [rise/term]	L	SInt16	
6		H		
7	Changing trend threshold [decline/term]	L	SInt16	
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 dB Range : 40.00～85.00 dB Default : 0x1B58 dB (70.00)
10		H		
11	Simple threshold [lower limit]	L	SInt16	Unit : 0.01 dB Range : 40.00～85.00 dB Default : 0x0FA0 (40.00 dB)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.8 Discomfort index (Characteristics UUID: 0x3019)

Discomfort Index related event settings.

Table 23. Discomfort index format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 Range : 0.01～50.00 Default : 0x03E8 (10.00)
2		H		
3	Changing trend threshold [decline/previous]	L	SInt16	
4		H		
5	Changing trend threshold [rise/term]	L	SInt16	
6		H		
7	Changing trend threshold [decline/term]	L	SInt16	
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 Range : 55.00～85.00 Default : 0x1F40 (80.00)
10		H		
11	Simple threshold [lower limit]	L	SInt16	Unit : 0.01 Range : 55.00～85.00 Default : 0x157C (55.00)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.2.9 **Heat stroke** (Characteristics UUID: 0x301A)

Heatstroke risk factor related event settings.

Table 24. Heat stroke format

Byte	Field		Format	Contents
0	Event Enable/Disable		UInt8	Bit 7-6 : RFU Bit 5 : Simple threshold [lower limit] Bit 4 : Simple threshold [upper limit] Bit 3 : Changing trend [decline/term] Bit 2 : Changing trend [rise/term] Bit 1 : Changing trend [decline/previous] Bit 0 : Changing trend [rise/previous] Enable: 1, Disable: 0 Default : 0x00
1	Changing trend threshold [rise/previous]	L	SInt16	Unit : 0.01 degC Range : 0.01～30.00 degC Default : 0x012C (3.00 degC)
2		H		
3	Changing trend threshold [decline/previous]	L	SInt16	
4		H		
5	Changing trend threshold [rise/term]	L	SInt16	
6		H		
7	Changing trend threshold [decline/term]	L	SInt16	
8		H		
9	Simple threshold [upper limit]	L	SInt16	Unit : 0.01 degC Range : 25～40 degC Default : 0x0AF0 (28.00 degC)
10		H		
11	Simple threshold [lower limit]	L	SInt16	Unit : 0.01 degC Range : 25～40 degC Default : 0x09C4 (25.00 degC)
12		H		
13	Term for changing trend (Number of Measurements)		UInt8	Unit : 1 count Range : 1～8 count Default : 0x06 (6 count)
14	Moving average number		UInt8	Unit : 1 count Range : 1～8 count Default : 0x01 (1 count)

2.3. **Control Service (Service UUID: 0x3030)**

Read and Write device control parameters.

Table 25. List of Characteristics in Control Service

Characteristics UUID	Characteristics	Properties				Byte
		R	W	N	I	
0x3031	Time information	✓	✓			4
0x3032	LED on duration		✓			1
0x3033	Error status	✓	✓			4
0x3034	Trigger		✓			2

2.3.1 Time information (Characteristics UUID: 0x3031)

Set UNIX TIME from the Central device for time adjustment of the recording data in the flash memory.
Time information based on this setting is recorded for each page of the flash memory.
* Note: Memory recording of measured data is not started unless time set to this Characteristic.

Table 26. Time information format

Byte	Field		Format	Contents
0	UNIX TIME	0	UInt32	Unit : 1 sec Range : 1970/1/1 0:00:01～2106/2/7 6:28:15
1		1		
2		2		
3		3		

2.3.2 LED on duration (Characteristics UUID: 0x3032)

With this setting, embedded LED lights for the specified time period.
It can be used for identifying the sensor which is currently connected, such as when there are a plurality of sensors.

Table 27. LED on duration format

Byte	Field	Format	Contents
0	LED on duration	UInt8	Unit : 1 sec Range : 1～10 sec

2.3.3 Error status (Characteristics UUID: 0x3033)

Various error conditions of the sensor are indicated by a bit field. The error state can be reset by writing 0 from the Central device.
*Just reading this characteristic does not reset the state.

Table 28. Error status format

Byte	Field	Format	Contents
0	Sensor Status	UInt8	Bit 7 : RFU Bit 6 : Error: Accelerometer* Bit 5 : Error: Microphone Bit 4 : Error: Barometric Pressure sensor Bit 3 : Error: UV sensor Bit 2 : Error: Light sensor Bit 1 : Error: Humidity sensor Bit 0 : Error: Temperature sensor *valid only with built-in Accelerometer type
1	CPU Status	UInt8	Bit 7-2 : RFU Bit 1 : Boot default setting Bit 0 : Flash memory verify error
2	Power Status	UInt8	Bit 7-2 : RFU Bit 1 : Error in reading supply voltage Bit 0 : Low voltage
3	RFU	UInt8	Bit 7-0 : RFU

2.3.4 Trigger (Characteristics UUID: 0x3034)

After setting 0x01 for DFU Service, subsequent Service Discovery operation can discover hidden DFU Service.

Table 29. Trigger format

Byte	Field	Format	Contents
0	RFU	UInt8	0x00 : None (Always set to 0x00)
1	DFU Service Enable / Disable	UInt8	0x00 : Disable 0x01 : Enable

2.4. **Parameter Service (Service UUID: 0x3040)**

Read and Write the settings on Bluetooth communication parameters.

Table 30. List of Characteristics in BLE Parameter Service

Characteristics UUID	Characteristics	Contents	Properties				Byte
			R	W	N	I	
0x3041	UUIDs	UUID, Major, Minor	✓	✓			20
0x3042	ADV setting	Advertise setting	✓	✓			10

2.4.1 UUIDs (Characteristics UUID: 0x3041)

Specify UUID to be sent in Beacon Mode = Beacon(Advertise Format (A)).

Table 31. UUIDs format

Byte	Field		Format	Contents
0	UUID		Uint128	Default : 0C4C3000-7700-46F4-AA96D5E974E32A54
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16	Major	L	UInt16	Default : 0x0000 *Not used
17		H		
18	Minor	L	UInt16	Default : 0x0000 *Not used
19		H		

2.4.2 ADV setting (Characteristics UUID: 0x3042)

Set various Advertisement related parameters.
Time Information is cleared to zero (0) when Beacon Mode is changed, so Time Information must be set to start data recording again.
*After changing the settings of this characteristic, it is necessary to make power cycle.
* It makes difficult to establish a connection with the central device in a very short “Transmission period in Limited Broadcaster” setting.

Table 32. ADV setting format

Byte	Field		Format	Contents
0	ADV_IND Advertise interval	L	UInt16	Advertise interval Unit : 0.625ms Range : 0x0320(500ms)～0x4000(10.24s) Default : 0x0808 (1285ms)
1		H		
2	ADV_NONCON_IND Advertise interval	L	UInt16	Unit : 0.625ms Range : 0x00A0(100ms)～0x4000(10.24s) Default : 0x00A0 (100ms) *Not used
3		H		
4	Transmission period in Limited Broadcaster	L	UInt16	Set transmission period per cycle when Beacon Mode 0x03,0x05 Limited Broadcaster Unit : 1 sec Range : 0x0001(1s)～0x3FFF(16383s) Default : 0x000A (10s)
5		H		
6	Silent period in Limited Broadcaster	L	UInt16	Set silent period per cycle when Beacon Mode 0x03,0x05 Limited Broadcaster Unit : 1 sec Range : 0x0001(1s)～0x3FFF(16383s) Default : 0x0032 (50s)
7		H		
8	Beacon Mode		UInt8	Range : 0x00(0)～0x0A(10) Default : 0x08 (8) *Refer to Table 33. Beacon Mode for details
9	Tx Power		SInt8	Unit : dBm Range : -20, -16, -12, -8, -4, 0, 4 dBm Default : 0x00 (0 dBm)

Table 33. Beacon Mode

Beacon Mode	Name	Shortened Device Name	Device Name	Adv. Format	
				Normal condition	Event detected
0x00	Event Beacon (SCAN RSP)	Env	EnvSensor-BL01	(B)	(A)/(B) Alternate
0x01	Standard Beacon	Env	EnvSensor-BL01	(B)	
0x02	General Broadcaster 1	IM	IM-BL01	(D)	
0x03	Limited Broadcaster 1	IM	IM-BL01	(D)	
0x04	General Broadcaster 2	EP	EP-BL01	(E)	
0x05	Limited Broadcaster 2	EP	EP-BL01	(E)	
0x07	Alternate Beacon	Env	EnvSensor-BL01	(A)/(B) Alternate	
0x08	Event Beacon (ADV)	Env	EnvSensor-BL01	(C)	(A)/(C) Alternate

* (A∼E): refer to 3.Advertise Format for more details

2.5. **DFU Service (Service UUID: 0x3050)**

Perform Firmware update via BLE communication.

Table 34. List of Characteristic in DFU Service

Attribute UUID	Characteristics	Properties				Byte
		R	W	N	I	
0x3051	DFU Control Point		✓	✓		-
0x3052	DFU Packet		✓*			-
0x3053	DFU Revision	✓				2

*”W” in DFU Packet means Write Without Response

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

Table 35. List of Characteristics in Generic Access Service

Attribute UUID	Characteristics	Contents	Properties				Byte
			R	W	N	I	
0x2A00	Device Name	Name	✓				14
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

2.6.1 Device Name (Characteristics UUID: 0x2A00)

Table 36. Device Name format

Byte	Field	Format	Contents
0	Device Name	Utf8s	“E” 0x45
1			“n” 0x6E
2			“v” 0x76
3			“S” 0x53
4			“e” 0x65
5			“n” 0x6E
6			“s” 0x73
7			“o” 0x6F
8			“r” 0x72
9			"-" 0x2D
10			"B" 0x42
11			"L" 0x4C
12			"0" 0x30
13			"1" 0x31

＊ When in Beacon Mode 0x02, 0x03: IM-BL01 (7 Byte)

＊ When in Beacon Mode 0x04, 0x05: EP-BL01 (7 Byte)

2.6.2 Appearance (Characteristics UUID: 0x2A01)

Table 37. Appearance format

Byte	Field		Format	Contents
0	Category	L	16bit	0 : Unknown
1		H		

2.6.3 Peripheral Preferred Connection Parameters (Characteristics UUID: 0x2A04)

Connection parameter update is performed 5 seconds after Connection, and thereafter 3 times with 30 seconds interval.

Table 38. Peripheral Preferred Connection Parameters format

Byte	Field	Format	Contents
0	Minimum connection interval	16bit	Unit : 1.25ms Value : 0x0014(25ms)
1			
2	Maximum connection interval	16bit	Unit : 1.25ms Value : 0x0028(50ms)
3			
4	Slave Latency	16bit	Value : 0x0004 (4)
5			
6	Connection Supervision Timeout Multiplier	16bit	Unit : 10ms Value : 0x0190 (4s)
7			

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

Table 39. List of Characteristics in Device Information Service

Attribute UUID	Characteristics	Contents	Properties				Byte
			R	W	N	I	
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

2.7.1 Model Number String (Characteristics UUID: 0x2A24)

Table 40. 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			"L" 0x4C
8			"0" 0x30
9			"1" 0x31

2.7.2 Serial Number String (Characteristics UUID: 0x2A25)

Table 41. Serial Number String format

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

2.7.3 Firmware Revision String (Characteristics UUID: 0x2A26)

Table 42. Firmware Revision String format

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

2.7.4 Hardware Revision String (Characteristics UUID: 0x2A27)

Table 43. Hardware Revision String format

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

2.7.5 Manufacturer Name String (Characteristics UUID: 0x2A29)

Table 44. Manufacturer Name String format

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

3. Advertise format

The following Advertise format can be selected by Beacon Mode in ADV Setting.

- (A) Beacon

  iBeacon equivalent format.
  Major = Latest Page number, Minor = Row number.

- (B) Connection Advertise 1

  This format contains Flag and Local Name.
  The latest sensor data, Latest page information, and event flag are included in SCAN_RSP Payload after receiving ADV_IND.

- (C) Connection Advertise 2

  This format contains Flag, Local Name, Latest page information, and event flag. There is no SCAN_RSP and sensor data is not included.

- (D) Sensor ADV 1

  This format contains the latest sensor data including Flag, Local Name, and acceleration information (with built-in Accelerometer type only).

- (E) Sensor ADV 2

  This format contains Flag, Local Name, and latest sensor data.

* Battery Voltage (= Supply voltage) in Advertise Format shall be expressed as follows.
  ((Acquired value + 100) x 10) mV
* Event flag (sensor name + Evt) in Advertise Format conforms to the bit field of 2.1.6 Event flag.

3.1. **(A) Beacon**

Table 45. (A) Beacon format

Link Layer packet format (46 octets)										
	0	Preamble (1 octets)								
	1	Access Address (4 octets)								
	2									
	3									
	4									
	5	PDU (38 octets)	0	PDU Header (16bits)						
	6		1							
	7		2	ADV_NONCONN_IND PDU Payload (36 octets)	0	AdvA (6 octets)				
	8		3		1					
	9		4		2					
	10		5		3					
	11		6		4					
	12		7		5					
	13		8		6	ScanRspData (30 octets)	AD 1	0	Length	0x02
	14		9		7			1	AD Type	0x01
	15		10		8			2	Flags	0x06
	16		11		9		AD 2	3	Length	0x1A
	17		12		10			4	AD Type	0xFF
	18		13		11			5	Company ID	0x4C
	19		14		12			6		0x00
	20		15		13			7	Beacon type	0x02
	21		16		14			8	Beacon type	0x15
	22		17		15			9	UUID	0x0C
	23		18		16			10		0x4C
	24		19		17			11		0x30
	25		20		18			12		0x00
	26		21		19			13		0x77
	27		22		20			14		0x00
	28		23		21			15		0x46
	29		24		22			16		0xF4
	30		25		23			17		0xAA
	31		26		24			18		0x96
	32		27		25			19		0xD5
	33		28		26			20		0xE9
	34		29		27			21		0x74
	35		30		28			22		0xE3
	36		31		29			23		0x2A
	37		32		30			24		0x54
	38		33		31			25	Major	
	39		34		32			26		
	40		35		33			27	Minor	
	41		36		34			28		
	42		37		35			29	Power	0xC3
	43	CRC								
	44									
	45									

3.2. **(B) Connection Advertise 1**

3.2.1 Advertise (ADV_IND)

Table 46. (B) Connection Advertise 1 - Advertise (ADV_IND) format

Link Layer packet format (28 octets)										
	0	Preamble (1 octets)								
	1	Access Address (4 octets)								
	2									
	3									
	4									
	5	PDU (20 octets)	0	PDU Header (16bits)						
	6		1							
	7		2	ADV_IND PDU Payload (18 octets)	0	AdvA (6 octets)				
	8		3		1					
	9		4		2					
	10		5		3					
	11		6		4					
	12		7		5					
	13		8		6	AdvData (12 octets)	AD 1	0	Length	0x02
	14		9		7			1	AD Type	0x01
	15		10		8			2	Flags	0x06
	16		11		9		AD 2	3	Length	0x03
	17		12		10			4	AD Type	0x02
	18		13		11			5	16-bit Service UUIDs	0x0A
	19		14		12			6		0x18
	20		15		13		AD 3	7	Length	0x04
	21		16		14			8	AD Type	0x08
	22		17		15			9	Local Name	"E"
	23		18		16			10		"n"
	24		19		17			11		"v"
	25	CRC (3 octets)								
	26									
	27									

3.2.2 Scan Response (SCAN_RSP)

Table 47. (B) Connection Advertise 1 - Scan Response (SCAN_RSP) format

Link Layer packet format (47 octets)											
	0	Preamble (1 octets)									
	1	Access Address (4 octets)									
	2										
	3										
	4										
	5	PDU (39 octets)	0	PDU Header (16bits)							
	6		1								
	7		2	SCAN_RSP PDU Payload (37 octets)	0	AdvA (6 octets)					
	8		3		1						
	9		4		2						
	10		5		3						
	11		6		4						
	12		7		5						
	13		8		6	ScanRspData (31 octets)	AD 3	0	Length	0x1E	
	14		9		7			1	AD Type	0xFF	
	15		10		8			2	Company ID	0xD5	
	16		11		9			3		0x02	
	17		12		10			4	Page information		
	18		13		11			5			
	19		14		12			6	Row information		
	20		15		13			7	Unique Identifier		
	21		16		14			8			
	22		17		15			9			
	23		18		16			10			
	24		19		17			11	Temperature Evt		
	25		20		18			12	Relative humidity Evt		
	26		21		19			13	Ambient light Evt		
	27		22		20			14	UV index Evt		
	28		23		21			15	Pressure Evt		
	29		24		22			16	Sound noise Evt		
	30		25		23			17	Discomfort index Evt		
	31		26		24			18	Heat stroke Evt		
	32		27		25			19	Misc Evt		
	33		28		26			20	Temperature		
	34		29		27			21			
	35		30		28			22	Relative humidity		
	36		31		29			23			
	37		32		30			24	Ambient light		
	38		33		31			25			
	39		34		32			26	Pressure		
	40		35		33			27			
	41		36		34			28	Sound		
	42		37		35			29			
	43		38		36			30	Battery voltage		
	44										
	45	CRC (3 octets)									
	46										

3.3. **(C) Connection Advertise 2 (ADV_IND)**

Table 48. (C) Connection Advertise 2 (ADV_IND) format

Link Layer packet format (47 octets)										
	0	Preamble (1 octets)								
	1	Access Address (4 octets)								
	2									
	3									
	4									
	5	PDU (39 octets)	0	PDU Header (16bits)						
	6		1							
	7		2	ADV_IND PDU Payload (37 octets)	0	AdvA (6 octets)				
	8		3		1					
	9		4		2					
	10		5		3					
	11		6		4					
	12		7		5					
	13		8		6	AdvData (31 octets)	AD 1	0	Length	0x02
	14		9		7			1	AD Type	0x01
	15		10		8			2	Flags	0x06
	16		11		9		AD 2	3	Length	0x03
	17		12		10			4	AD Type	0x02
	18		13		11			5	16-bit Service UUIDs	0x0A
	19		14		12			6		0x18
	20		15		13		AD 3	7	Length	0x12
	21		16		14			8	AD Type	0xFF
	22		17		15			9	Company ID	0xD5
	23		18		16			10		0x02
	24		19		17			11	Page(+row) information	
	25		20		18			12		
	26		21		19			13	Unique Identifier	
	27		22		20			14		
	28		23		21			15		
	29		24		22			16		
	30		25		23			17	Temperature Evt	
	31		26		24			18	Relative humidity Evt	
	32		27		25			19	Ambient light Evt	
	33		28		26			20	UV index Evt	
	34		29		27			21	Pressure Evt	
	35		30		28			22	Sound noise Evt	
	36		31		29			23	Discomfort index Evt	
	37		32		30			24	Heat stroke Evt	
	38		33		31			25	Misc Evt	
	39		34		32		AD 4	26	Length	0x04
	40		35		33			27	AD Type	0x08
	41		36		34			28	Local Name	"E"
	42		37		35			29		"n"
	43		38		36			30		"v"
	44	CRC (3 octets)								
	45									
	46									

* Page information = (UInt16_t)((page << 4) | row)

3.4. **(D) Sensor ADV 1 (ADV_IND)**

Table 49. (D) Sensor ADV 1 (ADV_IND) format

Link Layer packet format (47 octets)											
	0	Preamble (1 octets)									
	1–4	Access Address (4 octets)									
	5–6	PDU (39 octets)	0–1	PDU Header (16bits)							
	7–43		2–38	ADV_IND PDU Payload (37 octets)	0–36	AdvA (6 octets)					
						AdvData (31 octets)	AD 1	0	Length	0x02
								1	AD Type	0x01
								2	Flags	0x06
							AD 2	3	Length	0x17
								4	AD Type	0xFF
								5–6	Company ID	0xD5 0x02
								7	Sequence number	
								8–9	Temperature	
								10–11	Relative humidity	
								12–13	Ambient light	
								14–15	UV index	
								16–17	Pressure	
								18–19	Sound noise	
								20–21	Acceleration X	
								22–23	Acceleration Y	
								24–25	Acceleration Z	
								26	Battery voltage	
							AD 3	27	Length	0x03
								28	AD Type	0x08
								29–30	Local Name	"I" "M"
	44–46	CRC								

*Acceleration values are valid only with built-in Accelerometer type. Otherwise, these will be zero.

3.5. **(E) Sensor ADV 2 (ADV_IND)**

Table 50. (E) Sensor ADV 2 (ADV_IND) format

Link Layer packet format (47 octets)										
	0	Preamble (1 octets)								
	1	Access Address (4 octets)								
	2									
	3									
	4									
	5	PDU (39 octets)	0	PDU Header (16bits)						
	6		1							
	7		2	ADV_IND PDU Payload (37 octets)	0	AdvA (6 octets)				
	8		3		1					
	9		4		2					
	10		5		3					
	11		6		4					
	12		7		5					
	13		8		6	AdvData (31 octets)	AD 1	0	Length	0x02
	14		9		7			1	AD Type	0x01
	15		10		8			2	Flags	0x06
	16		11		9		AD 2	3	Length	0x17
	17		12		10			4	AD Type	0xFF
	18		13		11			5	Company ID	0xD5
	19		14		12			6		0x02
	20		15		13			7	Sequence number	
	21		16		14			8	Temperature	
	22		17		15			9		
	23		18		16			10	Relative humidity	
	24		19		17			11		
	25		20		18			12	Ambient light	
	26		21		19			13		
	27		22		20			14	UV index	
	28		23		21			15		
	29		24		22			16	Pressure	
	30		25		23			17		
	31		26		24			18	Sound noise	
	32		27		25			19		
	33		28		26			20	Discomfort index	
	34		29		27			21		
	35		30		28			22	Heat stroke	
	36		31		29			23		
	37		32		30			24	RFU	
	38		33		31			25		
	39		34		32			26	Battery voltage	
	40		35		33		AD 3	27	Length	0x03
	41		36		34			28	AD Type	0x08
	42		37		35			29	Local Name	"E"
	43		38		36			30		"P"
	44									
	45	CRC								
	46									

Revision history

#	Revision	Date	Changes
1	1.0	22/05/2018	Released
2	1.1	28/05/2018	Modified：Product name

Please check each region's Terms & Conditions by region website.

OMRON Corporation

Electronic and Mechanical Components Company

Regional Contact

Americas
https://www.components.omron.com/

Europe
http://components.omron.eu/

Asia-Pacific
https://ecb.omron.com.sg/

China
https://www.ecb.omron.com.cn/

Korea
https://www.omron-ecb.co.kr/

Japan
https://www.omron.co.jp/ecb/

Cat. No. A280-E1-01
0618 (0618)(O)