Sensor Network Module Evaluation Kit
Application Note
Command Guide

Introduction

This document explains the operation of the Sensor Network Module Evaluation kit. Before using, please read and ensure understanding of the function, operation etc. of the kit.

Precautions

- General Terms
  1. For the export of products which are controlled items subject to foreign and domestic export laws and regulations, you must obtain approval and/or follow the formalities of such laws and regulations.

  2. Products must not be used for military and/or antisocial purposes such as terrorism, and shall not be supplied to any party intending to use the products for such purposes.

  3. Unless provided otherwise, the products have been designed and manufactured for application to equipment and devices which are sold to end-users in the market, such as AV (audio visual) equipment, home electric equipment, office and commercial electronic equipment, information and communication equipment or amusement equipment. The products are not intended for use in, and must not be used for, any application of nuclear equipment, driving control equipment for aerospace or any other unauthorized use. With the exception of the above mentioned banned applications, for applications involving high levels of safety and liability such as medical equipment, burglar alarm equipment, disaster prevention equipment and undersea equipment, please contact an Alps sales representative and/or evaluate the total system on the applicability. Also, implement a fail-safe design, protection circuit, redundant circuit, malfunction protection and/or fire protection into the complete system for safety and reliability of the total system.

  4. Before using products which were not specifically designed for use in automotive applications, please contact an Alps sales representative.

  5. Any disassembly, remodeling, repair etc., of the Module is not covered by this specification and performance thereafter is not warrantied or guaranteed.

Disclaimer

- UNDER NO CIRCUMSTANCES SHALL THE COMPANY TAKE OR ASSUME TO TAKE ANY RESPONSIBILITY OR LIABILITY FOR ANY DAMAGES, EITHER DIRECTLY OR INDIRECTLY, TO THE CUSTOMER OR ANY THIRD PARTY, INCLUDING BUT NOT LIMITED TO SPECIAL DAMAGES, LOST PROFIT, LOST OPPORTINITIES, DAMAGES TO SUBJECT DEVICES, APPLICATIONS, LOSS OF DATA, ETC.

Safety Precautions

This portion of the document describes safety precautions classified by Warning and Caution.

Warning：If mishandled, dangerous situations leading to fatal or serious injuries may occur.

- This product may not be disassembled, remodeled or repaired. Do not attempt to replace batteries while power is on.
- Ensure power is off (switch is OFF) before replacing batteries. Electric shock, fire or failure may occur.
- Do not replace batteries with wet hands.
- Place the module out of reach of small children.
- Ensure battery is not exposed to heat or placed near a fire. (There is a danger or rupture, explosion, leakage etc. occurring)

Caution: In the case of mishandling, the following issues may occur leading to property damage or personal injury.

In some cases, the following described situations may lead to serious consequences. Please ensure to observe the following without fail.

- When removing the product cover, to avoid injury from the cover or case edge, please handle with special care (wear protective gloves etc.).
- Please avoid prolonged use or storage in high-temperature, direct sunlight or high humid environment which can be a cause of failure or malfunction.
- To avoid damage or destruction due to static electricity, do not touch any part of the metal on this part directly (connector etc.). To avoid an electric shock, before handling the product please touch house/ office metal objects, such as a door knob etc.
- This product is not designed to be dust-proof, water-proof or drip-proof. Please refrain from using in an environment where it is brought into contact with dust, oil or water.
- Please ensure to avoid situations where condensation can occur (move product from a cold to warm place quickly etc.).
- Please avoid applying strong force to this product, including striking, dropping, stepping on the product etc.
- For areas where use is forbidden, e.g. in airplanes or hospitals, please refrain from using this product. Do not use any battery besides the specified coin cell battery CR2032. Failure to do so could lead to accidents occurring. Ensure the battery ＋/－ direction is correctly inserted. Failure to do so could lead to accidents occurring.
- Disassembly or remodeling is not permitted.
- This product adheres to Global Radio Laws. Please refer to the “Radio Laws” section of the StartupGuide to confirm the Certification applying to this product. For the Certification already obtained, re-applying for Certification is not necessary. When using this product, please ensure to undertake the following without fail.

Restrictions

- When using this product outside Japan, please confirm in advance whether it has obtained the certification required by Global radio laws.
- Under no circumstances shall the company take or assume any responsibility for any damages, either directly or indirectly, related to this use of this product.
- The contents of this manual are subject to change without notice.
- This product is intended as an evaluation kit, and used in general environment. We do not provide any warranty or guarantee for application specific customer environments.

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Sensor Name

- Accelerometer Sensor
- Geo-Magnetic Sensor
- Pressure Sensor
- Humidity Sensor
- Temperature Sensor
- UV Sensor
- Ambient Light Sensor

There are different versions of the Sensor Network Module.
Please refer to the ”SensorNetwork_Usersmanual_EVK_StartupGuide” to see how to confirm this.

In this document, 16 decimals are 0xXX, while 2 decimals are (bin) XX.
(Example) 0x0A (16 decimals) = 10 (decimals) = (bin) 1010 (2 decimals).

1. About Commands

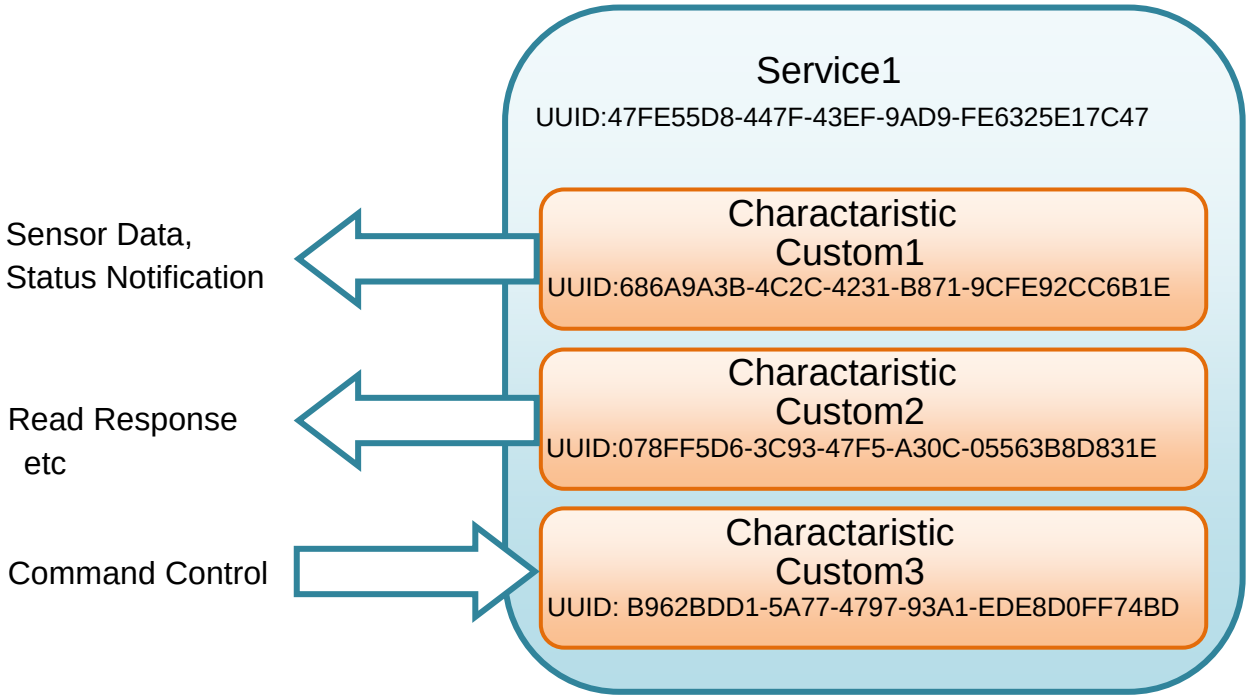
1.1 Command Control

The Sensor Network Module (hereafter Module) connects to a Device (smartphone, tablet etc.) utilizing Bluetooth® low energy communication. (Bluetooth® is a registered trademark of Bluetooth SIG, Inc.). The Module operates in the peripheral role, while the Device acts as the Central role.

The Module is controlled by commands sent from the Device side.
Selection and measurement of each sensor, as well as each data notification type is possible. This command is divided into 3 major types of functions.
Sensing Settings: commands for sensor selection, measurement interval settings etc.
Bluetooth® Settings: commands for settings for the Bluetooth® communication.
Operation Instruction/ System Configuration: command for settings such as measurement and sleep, time and error detection.

1.2 Bluetooth® Services

Command control and each sensors notifications are in Service1 after connection completion, utilizing Charactaristic Custom1~Custom3 as shown.



Service	UUID
Service1	0x47FE55D8-447F-43ef-9AD9-FE6325E17C47

Characteristics	Protcol	UUID	Max Data Size
Custom 1	Notification/Read	0x686A9A3B-4C2C-4231-B871-9CFE92CC6B1E	20byte
Custom 2	Notification/Read	0x078FF5D6-3C93-47F5-A30C-05563B8D831E	20byte
Custom 3	Write /WriteWithoutResponse	0xB962BDD1-5A77-4797-93A1-EDE8D0FF74BD	20byte

Custom1: This notifies the Device side of sensor data measurement and Module internal status.
Notification Protocol is used to send the notification to the Device side.
For details on Custom1 notification packet structure, please refer to 5. Notification Data Construction (Custom1).

Custom2: This is used for the Command (EventCode) Read response、Bluetooth® connection parameter update status and the sequencer error notification.
Notification Protocol is used to send the notification to the Device side.
For details on Custom2 notification packet structure, please refer to 6. Notification Data Construction (Custom2).

Custom3: Used for command control characteristic.
Commands are transmitted to the Module by Write or WriteWithoutResponse Protocol.
Please refer to 2.1 Command Issue Procedure for details on issuing commands.
Please refer to 2.3 Configuration Command Example for details on command examples for configuration
Please refer to 4. Command Construction (Custom3) for command details and 3. Command List for a list of commands.

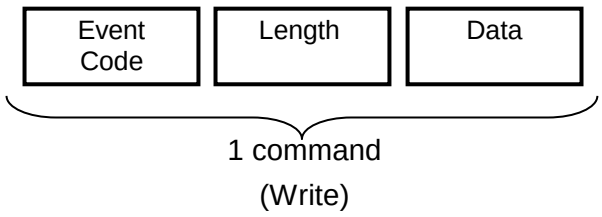
Please refer to Appendix1 for details on Service1 Data Base Construction.

Note：**Custom1, 2 need to have Notification enabled after connection is completed.**

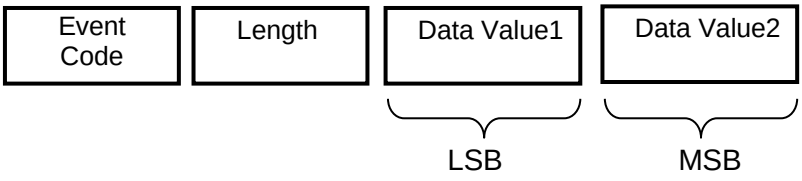
2. Using Commands

2.1 Command Issue Procedure

The Device (Smartphone、Tablet etc.) sends the Module the command settings through a service in Custom 3, in the order of Event Code, Length and Data, in one command format, and transmitted in one packet.

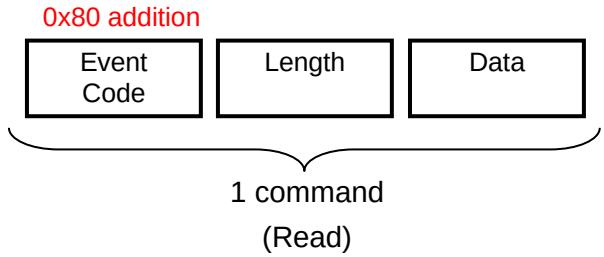


When handling numeric values with Data Value of 2 bytes or more, Data Value 1 is treated as LSB.



Points to Note
For issuing command, please send as one packet per command.
If multiple commands are transmitted by a single packet, it may not be recognized correctly.

In addition, you can also read the current Settings content.
Adding 0x80 in the Event Code and sending the command to Custom3, it can be determined as a Read request, and the contents of the relevant Event Code is returned to Custom2. In this case, please fill in 0x00 in the Data Field.



Example) Measurement Control: Read (EventCode=0x20)
In Custom3, the Measurement Control Read Request command is issued.

Event Code	Length	Data Value1
0xA0 (0x20+0x80)	0x03	0x00

In Custom2, the measurement control command Read Reply is notified.

Event Code	Length	Data Value1
0x20	0x03	0x01

The result of whether the command has been received is done by the status notification packet 11byte ACK / NACK Field to be notified in Custom1.

Incidentally, the response time of command reception notification, can vary depending on the connection Interval and radio wave environment, the Bluetooth® connection parameters etc.
Where the radio wave/ signal environment is poor, and Bluetooth® communication cannot be done, communication is disconnected by Supervision Timeout which is in the Bluetooth® connection parameters (default is 6 seconds). In this case, command acceptance response notification cannot be received.

2.2 Command Limitations

During measurement operations, the following commands only are possible.
For all other commands, status is No Action.

[Commands possible during measurement operation]
・Event Code 0x20 (measurement control)
・Event Code 0x21 (Bluetooth® communication operation settings)
・Event Code 0x23 (Data Up Disable)
・Event Code 0x2D (connection parameter update situation notification request)
・Event Code 0x2E (status request)
・Event Code 0x30 (Time settings) ※possible from Ver1.4 onwards
・Each Event Codes Read command

2.3 Examples of Settings using Command

Using examples, we will show the required commands for certain Settings. The Set-up procedure assumes that the Module connection is completed, and the Module is ready to receive the commands. For the command list, please refer to 3 Command List and for the command details please refer to 4 Command Constructions (Custom3).

The use case command examples are by application, and we will describe an example of using the command of each following applications (Case 1-4).

<Use Application>
Case 1: Environment measurement
Case 2: Motion
Case 3: Motion (Hybrid)
Case 4: Sensor Beacon

2.3.1 Case 1: Environment Measurment 1 Minute Intervals (For Environment Sensor only)

Environment Sensors (Pressure, Humidity/ Temperature, UV/ Ambient Light） measurement set at 1 minute intervals.

(1) Setting Conditions
The following list shows “Sensor Device Selection”, “Measurement Intervals” and “Measurement Mode”.
Chart 1 Settings List

Measurement Mode	Slow Mode
Measurement Intervals	1 minute
Acceleration	―
Geo-Magnetic	―
Pressure	○
Humidity	○
Temperature	○
UV	○
Ambient Light	○

(2) Command Setting Method

Settings are done in the following order.
① Settings Initialization

Event Code	Length	Data Value1
0x2F	0x03	0x03

If there has been no settings already saved, this step is set as a default and is not necessary。

② Environment Sensors (Pressure, Humidity/ Temperature, UV/ Ambient Light) are selected in Sampling Device Selection

Event Code	Length	Data Value1
0x01	0x03	0x7c

③ For measurement mmode intervals over 1 second, use「SlowMode」settings.

Event Code	Length	Data Value1
0x04	0x03	0x00

※These are initial/ default settings.

④ Measurement intervals commands are done in dedicated registry for Slow and Fast. For this example, we are using「SlowMode」so please select「SlowMode interval Settings」and adjust the seconds value. 60 seconds are 2bytes Setting so use（0x003C）、LSB 0x3C、MSB 0x00.

Event Code	Length	Data Value1	Data Value2
0x05	0x04	0x3C	0x00

This completes the measurement operation preparations.

⑤ Saving settings information uses the following commands.

Event Code	Length	Data Value1
0x2F	0x03	0x01

⑥ Starting Measurement Operation.

Event Code	Length	Data Value1
0x20	0x03	0x01

When Bluetooth® communication is being done, a data packet is sent to Custom 1.

For details on the data, please refer to 5. Notification Data Structure (Custom1).

2.3.2 Case2: Motion Detection at 100ms Intervals (Motion Sensors only)

Motion Sensors (Accelerometer/ Geo-Magnetic) measured in 100ms intervals.

(1) Setting Conditions
In the below chart 2, “Measurement Mode”, Measurement Intervals” and “Sensor Selection” are displayed.

Chart 2 Settings List

Measurement Mode	Fast Mode
Measurement Intervals	100ms
Acceleration	○
Geo-Magnetic	○
Pressure	―
Humidity	―
Temperature	―
UV	―
Ambient Light	―

(2) How to Set Commands
Settings are done in the following order.

① Settings Initialization

Event Code	Length	Data Value1
0x2F	0x03	0x03

If there have been no settings already saved, this step is set as a default and is not necessary.

② Sampling Device Selection, select Motion Sensors (Geo-Magnetic/ Accelerometer).

Event Code	Length	Data Value1
0x01	0x03	0x03

③ For measurement intervals of 100ms～999ms,「Fast Mode」is selected.

Event Code	Length	Data Value1
0x04	0x03	0x01

④ Measurement intervals are set in “Fast Mode Interval settings” in miliseconds (ms). 100～999 use 2 bytes so LSB 0x64、MSB 0x00 is used.

Event Code	Length	Data Value1	Data Value2
0x06	0x04	0x64	0x00

The above completes the measurement operation preparation. If settings need to be saved, please do it here.

⑤ Saving Settings uses the following commands.

Event Code	Length	Data Value1
0x2F	0x03	0x01

⑥ Start Measurement Operations.

Event Code	Length	Data Value1
0x20	0x03	0x01

While Bluetooth® communication is being established, data packets are sent to Custom 1.
For details on the data, please refer to 5. Notification data structure (Custom1).

2.3.3 Case3: Motion at 100ms and Environment at 1 Minute Intervals (Hybrid Mode)

Setting Motion Sensors (Accelerometer, Geo-Magnetic) at 100ms intervals and Environment Sensors (Pressure、Humidity/ Temperture、UV/ Ambient Light) at 1 minute interval measurements.

(1) Setting Conditions
The following chart shows “Measurement Mode”, Measurement Intervals” and “Sensor Selection”.
Chart 3 Settings List

Measurement Mode	Hybrid Mode
Measurement Intervals	100ms / 1min
Acceleration	○
Geo-Magnetic	○
Pressure	○
Humidity	○
Temperature	○
UV	○
Ambient Light	○

(2) How to Set Commands

The settings are done in the following order.

① Settings Initialization

Event Code	Length	Data Value1
0x2F	0x03	0x03

If there have been no settings already saved, this this step is set as a default and is not necessary.

② Choosing All Sensor`s Sampling in Device Selection。

Event Code	Length	Data Value1
0x01	0x03	0x7F

③ Use Measurement Mode for the following settings: Motion: Fast Mode/ Environment: Slow Mode and Hybrid Mode.

Event Code	Length	Data Value1
0x04	0x03	0x04

④ 2 measurement intervals setting, Slow and Fast, are required.
「Fast Mode Intervals Settings」 are in millisecond (ms) values. 100～999 are in 2 bytes settings so LSB 0x64、MSB 0x00 are used.

Event Code	Length	Data Value1	Data Value2
0x06	0x04	0x64	0x00

⑤ 「Slow Mode Interval Settings」are in seconds. 60 seconds uses 2 bytes, so LSB 0x3C、MSB 0x00 are used.

Event Code	Length	Data Value1	Data Value2
0x05	0x04	0x3c	0x00

This completes the measurement operation preparation. If settings need to be saved, it is done here.

⑥ To save the settings, use the following commands.

Event Code	Length	Data Value1
0x2F	0x03	0x01

⑦ Start Measurement Operation

Event Code	Length	Data Value1
0x20	0x03	0x01

While Bluetooth® communication is being established, data packets are sent to Custom1.

For details on data, please refer to 5. Notification data structure (Custom1).

2.3.4 Case 4: Environment 1 Second Intervals *When using Beacon Function

For the Sensor Beacon Mode, the Acceleration and Environment Sensors data are set at 1 second operation.

(1) Settings Conditions

Measurement Mode	Beacon
Measurement Interval	1 sec
Acceleration	○
Geo-Magnetic	-
Pressure	○
Humidity	○
Temperature	○
UV	○
Ambient Light	○

(2) Command Sequence
The settings are done in the following order.

① Settings Initialization

Event Code	Length	Data Value1
0x2F	0x03	0x03

② Beacon Operation use Sensor Beacon Operation、and output in Environment Format.
At this time, Major/ Minor values cannot be used, so 0x00.

Event Code	Length	DataValue1	Data Value2	Data Value3	Data Value4	Data Value5
0x16	0x07	0x01	0x00	0x00	0x00	0x00

③ Measurement Interval Settings
Measurement Intervals are the same as Advertising intervals. For General Beacon Mode, these are fixed at 100ms.
ADV Intermittant Settings（0x12） Advertising Interval parameters are 1000ms. At this time, setting values are 1.25ms, so 800 (=0x0320).

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4
0x12	0x06	0x20	0x03	0x00	0x00

Disconnect the module. By Disconnectingl, the Bluetooth® Smart starts operation as Beacon.
The Module will continue in Beacon mode until re-connection, or if the power is switched off
For more information about the Beacon data transmitted, please refer to 7. Beacon Format.

3. Command List

3.1 Commands from Device-side (1/3) Sensing Settings

Functions	Non volatile memory	Event Code	Items	Length	Function Field
Sensing Settings	○	0x01	Sampling Device Selection	0x03	Sampling Device Selection
	○	0x02	Acceleration Range Settings	0x03	Accelerometer Sensor range
	○	0x03	Data Changeover Timing (Acceleration) Settings	0x07	Data Changeover Timing (Acceleration) Settings
	○				Interrupt Settings
	○				Interrupt Threshold Settings
	—				Dummy
	—				Dummy
	○	0x04	Measurement Mode Settings	0x03	Measurement Mode Settings
	○	0x05	Slow Mode Interval Settings	0x04	Slow Interval Settings（LSB）
	○				Slow Interval Settings（MSB）
	○	0x06	Fast Mode Interval Settings	0x04	Fast Interval Settings（LSB）
	○				Fast Interval Settings（MSB）

3.2 Commands from Device-side (2/3) Bluetooth®Settings

Function	Non Volitile Memory	Event Code	Item	Length	Function Field
Bluetooth® Settings	○	0x10	Bluetooth® Operation Settings	0x04	Bluetooth® Power OFF OFF Time Settings (LSB)
	○				Bluetooth® Power OFF OFF Time Settings (MSB)
	—	0x11	Bluetooth® Communication Settings	0x0A	Connection Interval Max (LSB)
	—				Connection Interval Max (MSB)
	—				Connection Interval Min (LSB)
	—				Connection Interval Min (MSB)
	—				Slave Latency (LSB)
	—				Slave Latency (MSB)
	—				Supervision Timeout (LSB)
	—				Supervision Timeout (MSB)
	—	0x12	ADV Interval Settings	0x06	Advertising interval (LSB)
	—				Advertising interval (MSB)
	—				Advertising Issue Timing (LSB)
	—				Advertising Issue Timing (MSB)
	—	0x13	ADV Intermittent Settings	0x08	Intermittent Advertising interval（LSB）
					Intermittent Advertising interval（MSB）
	—				Intermittent Advertising issue timing（LSB）
					Intermittent Advertising issue timing（MSB）
	—				Intermittent Advertising Stop timing
	—				Intermittent Advertising repeat frequency
	—	0x14	Timer Sleep recovery	0x04	Recovery timing setting (LSB)
	—				Recovery timing setting (MSB)
	○	0x15	Device Name	Settting Character numbers +2	Character Settings (1 to 18 characters)
	—	0x16	Beacon Operation	0x07	Operation/ Format Settings
					Major (LSB)
					Major (MSB)
					Minor (LSB)
					Minor (mSB)
	—	0x17	General Beacon UUID Settings	0x12	UUID (16byte)

3.3 Command from Device Operation Instruction (3/3)/ System

Function	Non Volitile Memory	Event Code	Item	Length	Function Field
Operation instruction	—	0x20	Measurement control	0x03	Measurement control
	—	0x21	Bluetooth® communication Operation Settings	0x03	Bluetooth® Communication Operation Settings
	—	0x22	Sleep Settings	0x03	Sleep Operation
	—	0x23	Data Up Disable	0x03	Data Notification permission
	—	0x24	Automatic Status Issue Function	0x03	Automatic Status Issue Function
	—	0x29	Error Release	0x03	Error Release
	—	0x2D	Connection Parameter Update Information and Notification Request	0x03	Notification Request for Update state
	—	0x2E	Status Request	0x03	Instructions to issue status notification packet
	—	0x2F	Save Settings/ Initialize Settings	0x03	Instruct settings details
System	—	0x30	Current time	0x0A	Time: ms（LSB）
	—				Time: ms（MSB）
	—				Time: seconds
	—				Time: minutes
	—				Time: hour
	—				Time: Day
	—				Time: Month
	—				Time: Year (2 digits）
	○	0x31	H/W irregularity detection Settings	0x03	H/W irregularity detection settings

4. Command Explanation (Custom3)

4.1 Sensing Settings Command

4.1.1 Sampling Device Selection

Event Code: 0x01
Length: 0x03

Command Format

Event Code	Length	Data Value1

Sampling Device Selection (Data Value1)

bit	Initial Value	Function Explanation	
7	0x7F	Not used	Sensor Measurement Selection 0: OFF 1: ON
6		Ambient Light	
5		UV	
4		Temperature	
3		Humidity	
2		Pressure	
1		Geo-Magnetic	
0		Acceleration	

Select the sensors to measure. Initial setting has all sensors ON (0x7F).

Please refer to 6. Data Packet for each sensors output format.

※Where the measurement is less than 100ms measurement interval, only the Accelerometer and Geo-Magnetic sensors can be selected. If other sensors are selected, the operation cannot be saved.

Command Setting Example

When only the Acceleration sensor is ON.

Event Code	Length	Data Value1
0x01	0x03	0x01

4.1.2 Acceleration Range Settings

Event Code: 0x02
Length: 0x03

Command Format

Event Code	Length	Data Value1

Acceleration Sensor Range (Data Value1)

bit	Initial Values	Function Explanation
7..3	0x00	Not Used
2..0		(bin)000:±2G (bin)001:±4G (bin)010:±8G (bin)011:±12G (bin)100:±16G (bin)101: reserved (±2G) (bin)110: reserved (±2G) (bin)111: reservedc (±2G)

The full scale of the Accelerometer`s range (measurement range) is set. Initial settings are ±2G (0x00). When the measurement value is over the registry value, the measurement range in the setting expands.

In addition, if you use the Accel Wake function, this is disabled and the operation field is set fixed at ± 2G.

Command Settings Example

Acceleration sensor range value set at ±16G.

Event Code	Length	Data Value1
0x02	0x03	0x04

4.1.3 Data Conversion Timing (Acceleration) Settings

Event Code: 0x03
Length: 0x07

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Dummy 0x00	Dummy 0x00

Data Changeover Timing Settings (Acceleration) (Data Value1)

bit	Initial Values	Function Explanation
7..4	0x06	Not used
3..0		(bin)0000: 1Hz (bin)0001: 2Hz (bin)0010: 4Hz (bin)0011: 8Hz (bin)0100: 16Hz (bin)0101: 32Hz (bin)0110: 64Hz (bin)0111: 128Hz (bin)1000: 256Hz (bin)1001: 0.25Hz (bin)1010: 0.5Hz Besides above 1Hz

Used for Accel Wake (Refer to Acceleration Wake portion for reference). Initial settings are 64Hz (0x06). This sets the accelerometer sample rate. This is used to set the vibration needed to wake the Module. To detect a momentary shock, please increase the data conversion time setting. However, by increasing the data conversion time setting, power consumption will also be increased.

Interrupt Axis Setting (Data Value2)

bit	Initial Values	Fucntion Explanation
7	0x07	Not used
6		Z axis polarity 0:＋ direction 1:－direction
5		Y axis polarity 0:＋ direction 1:－direction
4		X axis polarity 0:＋ direction 1:－direction
3		Not used
2		Z axis interrupt 0: disabled 1: enabled
1		Y axis interrupt 0: disabled 1:enabled
0		X axis interrupt 0: disabled 1:enabled

Used when you want to start only when subjected to a shock from a particular direction. The XYZ axis are able to be set separately. Initial settings for all Axis and directions are set at (0x07). When all directions are designated, each axis is determined by size. Note it is not a composite value.

For the direction of shock, polarity is needed. Only one of Positive/ Negative can be selected at one time.

Interrupt Threshold Settings (Value 3)

bit	Initial Values	Function Explanation
7..0	0x60	Value

Each axis has the ±2 G range interrupt threshold settings in common. Initial values are set at 0x06
The values input here are the settings needed for the Module to wake up.

Dummy Data (Dummy)

For this Command、2 pcs of Dummy Data is needed.
Please add 0x00,0x00.

Command Setting Example

Data changeover timing (Acceleration) when using the following settings.

・Data changeover timing setting (acceleration)(Data Value1): 4Hz
・Interrupt axis settings (Data Value2)： all axis＋direction enabled
・Polarity axis setting (Data Value3) ：100(0x64)

Event Code	Length	Data Value1	Data Value2	Data Value3	Dummy	Dummy
0x03	0x07	0x02	0x07	0x64	0x00	0x00

4.1.4 Measurement Mode Settings

Event Code: 0x04

Length: 0x03

Command Format

Event Code	Length	Data Value1

Measurement Mode Settings (Data Value1)

bit	Initial Values	Function Explanation
7..3	0x00	Not used
2..0		(bin)000: Slow (bin)001: Fast (bin)011: Force (bin)100: Hybrid Besides above: Slow

Sets Measurement Mode. Initials settings are in Slow mode (0x00).

【Slow Mode】 Sets the measurement interval at 1 second intervals.
Regular data measurement is done with low power consumption.

【Fast Mode】 Sets the measurement interval at millisecond intervals.
Ideal for Motion detection, but increases power consumption greatly.
※Where the measurement is less than 100ms measurement interval, only the Accelerometer and Geo-Magnetic sensors can be selected.

【Force Mode】Performs one-time sampling operation. Ideal for very low-frequency or irregular measurement.
※Please set the Measurement Intervals at 1 second or more for Force Mode Measurements. If the intervals are too low, there is a possibility that the correct information cannot be communicated.

【Hybrid Mode】Fast/ Slow measurement Operation
Fast sampling：Geo-Magnetic/ Accelerometer
Slow sampling：Temperature/ Humidity, Pressure, UV/ Ambient Light、combinations are possible. Each measurement interval setting values may be used.

【Points to note】

When changing measurement modes, please first stop the current measurement operation. The current measurement will automatically stop if measurement modes changes are attempted during operation. The Event Code (0x20) “Measurement Control” (bit0) is cleared.

Command Setting Example

When setting Measurement Mode to Hybrid mode.

Event Code	Length	Data Value1
0x04	0x03	0x04

4.1.5 Slow Mode Interval Settings

Event Code: 0x05

Length: 0x04

Command Format

Event Code	Length	Data Value1	Data Value2

Slow Interval Settings (LSB) (Data Value1)

bit	Initial Values	Function Explanation
7..0	0x01	Value

Slow Interval Settings (MSB) (Data Value2)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Measurement intervals in Slow mode are in units of seconds. Initial values are 1 second (0x0001). Second values can be set at a range of 1-65535 seconds. Setting 0 seconds will have operations set at 1 second.

Command Setting Example

When setting Slow mode measurement intervals at 5 second intervals.

Event Code	Length	Data Value1	Data Value2
0x05	0x04	0x05	0x00

4.1.6 Fast Mode Interval Settings

Event Code: 0x06
Length: 0x04

Command format

Event Code	Length	Data Value1	Data Value2

Fast Interval Settings (LSB) (Data Value1)

bit	Initial Values	Function Explanation
7..0	0xC8	Value

Fast Interval Settings (MSB) (Data Value2)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Measurement intervals in Fast mode are in units of miliseconds. Initial values are 200ms (0x00C8). Milisecond values can be set at a range of 10-999ms. Setting anything under 10ms will automatically default to 10ms.

Command Setting Example

When Fast mode measurement intervals are set at 80ms.

Event Code	Length	Data Value1	Data Value2
0x06	0x04	0x50	0x00

【Points to note】

By default, the Bluetooth® low energy connection parameter is automatically having connection intervals at 50ms (max). For measurement of below 50ms, set EventCode 0x11 “Bluetooth® Communication Settings” and manually align with Event Code :0x21 “Bluetooth® communication operation settings” (bit7).

4.2 Bluetooth® Operation Setting Command

4.2.1 Bluetooth® Operation Setting

Event Code: 0x10
Length: 0x04

Command Format

Event Code	Length	Data Value1	Data Value2

Bluetooth® Power OFF Timing Settings (LSB) (Data Value1)

Bit	Initial Values	Function Explanation
7..0	0x0A	Value

Bluetooth® Power OFF Timing Settings (MSB) (Data Value2)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Settings are in units of minutes when the Bluetooth® power is OFF. Initial settings are 10 mins (0x000A). Minute values can be set at a range of 10-65535 mins. In the Event Code 0x21 field “Bluetooth® Smart Communication Operation Settings”, when <0bit>=1 is set, the power OFF timing for the Bluetooth® is set and the Bluetooth® power is turned off. (There is not any RF communication but the measurement operation continues. After the allotted time, the Bluetooth® Power turns ON automatically and Advertising begins). If the interval is set for less than 10 minutes, this automatically reverts to 10 mins. Please refer to Bluetooth® communication operation settings command Code 0x21 for details.

Command Setting Example

When Bluetooth® Power OFF timing is set at 20 minutes (0x0014).

Event Code	Length	Data Value1	Data Value2
0x10	0x04	0x14	0x00

4.2.2 Bluetooth® Communication Settings

Event Code: 0x11
Length: 0x0A

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6	Data Value7	Data Value8

Connection Interval Max (LSB) (Data Value1)

Bit	Initial Values	Function Explanation
7..0	0x28	Value

Connection Interval Max (MSB) (Data Value2)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

The maximum interval (Max) time is set at 1.25ms. Initial Values are 50ms (Settings value 40 = 0x28). Settings Range possible: 7.5~4000ms (Settings value 6 ~3200).

Connection Interval Min (LSB) (Data Value3)

Bit	Initial Values	Function Explanation
7..0	0x10	Value

Connection Interval Min (MSB）(Data Value4)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

The minimum interval (Min) time is set at 1.25ms.
Initial Values are 20ms (Settings value 16 = 0x10)
Settings Range possible: 7.5-4000ms (Settings value 6 -3200). However, the Interval Max > Min is required.

Slave Latency (LSB) (Data Value5)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Slave Latency (MSB) (Data Value6)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Slave Latency values are set. The initial settings are set at 0.
Settings range possible: 0-499.

Supervision Timeout (LSB) (Data Value7)

Bit	Initial Values	Function Explanation
7..0	0x58	Value

Supervision Timeout (MSB) (Data Value8)

Bit	Initial Values	Function Explanation
7..0	0x02	Value

The time out time is set at 10ms values. The initial Values are 6,000ms (Settings values 600 = 0x0258). Settings range possible: 100-32000 ms (Settings value 10-3200).

To enable this field, Event Code 0x21 “Bluetooth® communication Operation Settings” Field <7bit>=1 is selected and the Bluetooth® communication parameter needs be set manually.

Further, each parameter can be changed freely, but due to the limitations on the Device side, Bluetooth® communications may not update.

Command Setting Example

When Bluetooth® communication settings are as follows:

・Connection Interval Max：100ms (setting value 80 = 0x50)

・Connection Interval Min：40ms (setting value 32 = 0x20)

・Slave Latency：5

・Supervision Timeout：3000ms (setting value 300 = 0x12C)

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6	Data Value7	Data Value8
0x11	0x0A	0x50	0x00	0x20	0x00	0x05	0x00	0x2C	0x01

4.2.3 ADV Interval Settings

Event Code: 0x12
Length: 0x06

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4

Advertising Interval (LSB) (Data Value1)

bit	Initial Values	Function Explanation
7..0	0x50	Value

Advertising Interval (MSB) (Data Value2)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Advertising Interval is set at 1.25ms units. Initial Settings are 100ms(0x0050).
Settings Range possible: 30ms-10000ms (Settings value 0x0018-0x1F40).

Advertising Issue Timing (LSB) (Data Value3)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Advertising Issue Timing (MSB) (Data Value4)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Advertising issued interval selected in units of seconds. Initial value is set at 0.
Settings Range possible: 0-6500sec.
When settings are at 0, Module enters continuous advertising operation (no intervals).

When advertising issued time parameters other than 0, after advertising starts to when the set time has elapsed, the Module automatically transitions to the intermittent Advertising operation. For Interval advertising operation, please refer to Event Code 0x13 ADV intermittent Settings commands.

Command Setting Example

When ADV interval is set as follows
・Advertising intervall: 50ms(0x0028)
・Advertising issue timing: 0 seconds

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4
0x12	0x06	0x28	0x00	0x00	0x00

4.2.4 Intermittent ADV Settings

Event Code: 0x13
Length: 0x08

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6

Intermittent Advertising interval (LSB) (Data Value1)

bit	Initial Values	Function Explanation
7..0	0x50	Value

Intermittent Advertising interval (MSB) (Data Value2)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Intermittent Advertising Intervals are set in units of 1.25ms units. Initial Values are 100ms.
Settings Range possible: 30ms-10000ms (Settings value 0x0018-0x1F40).

Intermittent Advertising Issued Timing (LSB) (Data Value3)

bit	Initial Values	Function Explanation
7..0	0x05	Value

Intermittent Advertising Issued Timing (MSB) (Data Value4)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Advertising issued is selected in units of seconds. The initial setting is 5 seconds.
Settings Range possible: 0-6500 sec.

Intermittent Advertising Stop Timing (Data Value5)

bit	Initial Values	Function Explanation
7..0	0x05	Value

Intermittent Advertising stop time is measured in units of seconds. Initial setting is 5 seconds.
Settings Range possible: 0-255 sec.

Intermittent Advertising Reply Timing (Data Value6)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Intermittent Advertising issue/ stop command is set here. Initial settings are 0. Settings Range possible: 0-255 times. When set at zero, there is not any limit to the number of replies.

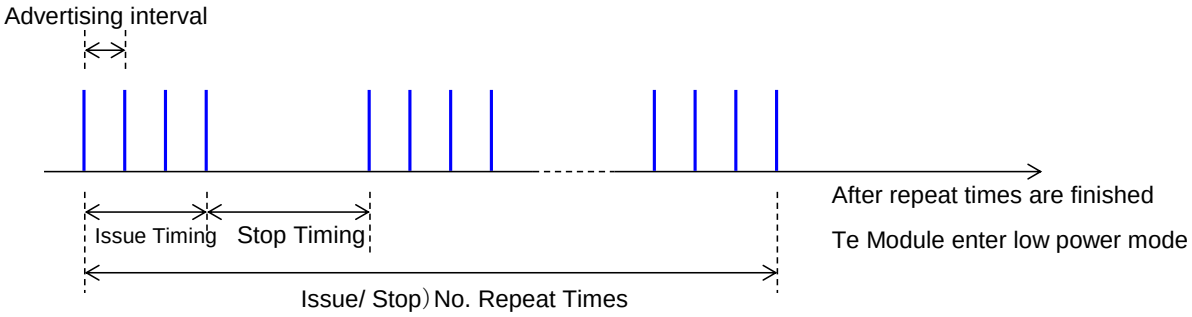
Command Setting Example

When Intermittent ADV is set as follows:

・Intermittent Advertising interval: 50ms (0x0028)
・Intermittent Advertising Issue Timing: 5 seconds
・Intermittent Advertising Stop Timing: 5 seconds
・Intermittent Advertising Reply Timing: 0 times

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6
0x13	0x08	0x28	0x00	0x05	0x00	0x05	0x00

After the time has elapsed in Event Code 0x12 “Advertising Issue Timing”, intermittent advertising operations start based on the data input in this field. After the repeat cycles are completed, all operations stop and the Module enters low power mode. To restart, the power switch needs to be switched off and then on again.



4.2.5 Timer Sleep Wake-up

Event Code: 0x14
Length: 0x04

Command Format

Event Code	Length	Data Value1	Data Value2

Wake-up Timing Setting (LSB) (Data Value1)

bit	Initial Values	Function Explanation
7..0	0x01	Value

Wake-up Timing Setting (MSB) (Data Value2)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Bluetooth® OFF time is set in units of Minutes. Initial settings are 1 min.
Settings Range possible: 0-65535 mins.
When Event Code 0x22 “SleepSettings” is set at 0x03, using the Wake-up Time Settings all the operations are stopped and the Module enters low power mode. After the specified time has elapsed, the Module wakes up and normal advertising begins automatically, so the connection to the Modules needs to be done from the Device side.

Command Setting Example

When timer sleep is set at 2 minutes.

Event Code	Length	Data Value1	Data Value2
0x14	0x04	0x02	0x00

4.2.6 Device Name

Event Code: 0x15
Length: number of setting character+2.

Command Format

Event Code	Length	Data Value1	Data Value2	・・・

When Bluetooth® communication is on-going, the device name is set in ASCII code.
Initial Values
[0x53]=”S” (Data Value1)
[0x4E]=”N” (Data Value2)
[0x4D]=”M” (Data Value3)
[0x30]=”0” (Data Value4)
[0x30]=”0” (Data Value5)
5 bytes is input.
Maximum name string length is 18 characters.

Further, this Field will be in the non-volatile storage in the command reception time. The save command for the settings values (Event Code 0x2F) saves the values changes automatically.

Command Setting Example

When device name is set at “SNM01”.

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5
0x15	0x07	0x53	0x4E	0x4D	0x30	0x31

4.2.7 Beacon Operation

Event Code: 0x16
Length: 0x07

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5

Operation/ Format Settings (Data Value1)

bit	Initial Values	Function Explanation
7	0x00	0: environment sensors 1: motion sensors
6..2		Not used
1..0		(bin)00, (bin)11: Beacon disabled (bin)01: Sensor Beacon (bin)10: General Beacon

Sensor Beacon: Sensor measurement is done, in the Beacon Format Notification, the sensors measured use 2 types of Format.
<7bit> = 0 : Environment Format (All sensors except Geo-Magnetic Sensors)
<7bit> = 1 : Motion (Geo-Magnetic, Accelerometer, Pressure Sensor)
The Sensor Measurement Interval follows the Event Code 0x12 “Advertise interval” field. However, the “Advertising Issue Timing” settings are disabled, and interval advertsing operation is not done.
The enablied Sensor follows Event Code 0x01 “Sampling DeviceSelection”.

General Beacon: Use ALPS Company ID, and sends the data in Apple's Beacon equivalent format. Major, Minor and UUID is possible to be designated by Data Value 2~5.
When setting General Beacon mode, regardless of the settings in Event Code 0x12 “ADV interval settings”, Advertising interval is fixed at 100ms.

For details of the transmission data for each Beacon mode, please refer to 7. Beacon Format.

In addition, Beacon related settings not saved in non-volatile memory will need to be reset (re-applied) after the power has been switched off and then turned on.
※Due to the concern that in beacon operation (Event Code 0x12 “ADV interval settings” and Event Code 0x16 “Beacon operation”), the connection rate will drop, the specification is set to revert to the initial setting after the power has been switched off and then turned on.

※Android Sample Project (Sensor Module Sample Code) has Sensor Beacon setting examples in Appendix 2

Major (LSB) (Data Value2)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Major (MSB) (Data Value3)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Using General Beacon Mode, Major code is specified. Initial values are 0x0000

Minor (LSB) (Data Value4)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Minor (MSB) (Data Value5)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Using General Beacon Mode, Minor code is specified. Initial values are 0x0000.

Command Setting Example

When Beacon operation is set as follows:

- ・Operation/ Format setting: Beacon disabled
- ・Major code: 0
- ・Minor code: 0

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5
0x16	0x07	0x00	0x00	0x00	0x00	0x00

4.2.8 General Beacon UUID setting

Event Code: 0x17
Length: 0x12

Command format

Event Code	Length	Data Value1	Data Value2	・・・	Data Value16

UUID (Data Value1 .. 16)

The General Beacon UUID to be transmitted from the LSB is in 16 bytes. Initial Values is set at 0.

Command Setting Example

When UUID is set at 12345678-1234-1234-1234123456789123

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6	Data Value7	Data Value8
0x17	0x12	0x12	0x34	0x56	0x78	0x12	0x34	0x12	0x34

Data Value9	Data Value10	Data Value11	Data Value12	Data Value13	Data Value14	Data Value15	Data Value16
0x12	0x34	0x12	0x34	0x56	0x78	0x91	0x23

4.3 Operation Instruction Command

4.3.1 Measurement Control

Event Code: 0x20
Length: 0x03

Command Format

Event Code	Length	Data Value1

Measurement Control (Data Value1)

bit	Initial Values	Function Explanation
7:1	0x00	Not used
0		0: Measurement Operation stop 1: Measurement Operation start

Measurement (sensor sampling) operation stop/ start. Initial settings is Stop. In Force Mode, once the operation starts, it is done one time.

After measurement operation is started and running, only the following commands are available.
・Event Code 0x20 (measurement control）
・Event Code 0x21 (BLE communication Operation Settings）
・Event Code 0x23（Data Up Disable）
・Event Code 0x2D（connection parameter update situation. Notification request）
・Event Code 0x2E (status request）
・Each Event Code lead Command

Command Setting Example

When measurement control is set at Start Operation.

Event Code	Length	Data Value1
0x20	0x03	0x01

4.3.2 Bluetooth® Communication Operation Settings

Event Code: 0x21
Length: 0x03

Command Format

Event Code	Length	Data Value1

Bluetooth® Communication Operation Settings (Data Value1)

bit	Initial Values	Function Explanation
7	0x00	0: Connection Parameter Auto setting 1: Connection Parameter Manual setting
6..1		Not used
0		0: Bluetooth® Power ON 1: Bluetooth® OFF Time Setting

Connection Parameter Settings

<bit7>=0

Bluetooth®connection parameters are automatically set.
In accordance with the measurement interval you have set, the following parameters are automatically updated (connection interval, slave latancy, Supervison Timeout).
※In measurement timing is less than 50ms, connection interval needs to be changed manually.

Connection Parameter		**Fast Mode (Measurement Time 10-999msec)**			**Slow Mode**	**Hybrid Mode**	**Force**
		Measurement Time			**Measurement Time**		
		10-399	**400-799**	**800-999**	**1-65535[sec]**		
Connection Interval	max	50msec	100msec	200msec	200msec	Along with Fast/ Slow Settings	50msec
	min	30msec	80msec	180msec	180msec		30msec
Slave Latency		4	4	4	4		4
Supervison TimeOut		6sec	6sec	6sec	6sec		6sec

<bit7>=1

Command Bluetooth® communication settings (Event code 0x11) designates and issues the update request for the specified connection parameters to the Device. To see whether the specified parameters has been accepted by the Device, after the Event Code, "Eventcode 0x2D" is “Issued”, and you can know by checking the contents of the "Eventcode 0x81" notified from Custom2.

Note: When changing the parameter settings manually（update Event Code 0x11）, even if there is no change to the Field, please change the settings again <bit7>=1 and perform Notification.
Also, please do not attempt to communicate timing change in the measurement.

Bluetooth® Power State Settings

<bit0> =0：Bluetooth® Power always ON

<bit0> =1: specified timing for Bluetooth® Smart power OFF instruction.
In the time the event code 0x10 (Bluetooth® power OFF time Settings), Bluetooth® power set at OFF (no data sending, but sensor measurement continues). After the specified time elapses, the Bluetooth® automatically powers on and communication (Advertising) restarts. If you want to turn off Bluetooth® power again, the settings in this Field need to be input again. E.g. When sensors are continuously measured once per hour, and Bluetooth® sends the data every 24 hours.

Command Setting Example

When Bluetooth® Communication operation is set as follows:

・Connection parameter setting: automatic

・Bluetooth® Power state setting: ON

Event Code	Length	Data Value1
0x21	0x03	0x00

4.3.3 Sleep Settings

Event Code: 0x22
Length: 0x03

Command format

Event Code	Length	Data Value1

Sleep Operation (Data Value1)

bit	Initial Values	Function Explanation
7..2	0x03	Not used
1..0		(bin)10: Accel Wake (bin)11: Timer Sleep

Set the Sleep operation. The initial value is Timer Sleep.
Except for the following, settings cannot be done in Data Value1: (bin)10 (2 decimal＝10 decimal ”2”) or (bin)11（2 decimal＝11 decimal ”3”）.
Once is sleep mode, communication and data measurement is not possible.

Accel Wake
After command input, only the Accelerometer Sensor is used, other components, including the Bluetooth® communication, are stopped and the Module enters a low power mode. Setting the condition in Event Code 0x03 (Data changeover timing settings), after a shock/ movement is detected, the Module wakes up and Advertising begins. At that time, the Accelerometer range is fixed at ±2G.

Timer Sleep
After the Command is input, all the components, including the Bluetooth® operation is stopped and the Module enters a low-power mode. Entering Event Code 0x14 (timer Sleep Settings) specifies the required time, and once this elapses the Bluetooth® automatically wakes up and Bluetooth® advertising restarts.

Once measurement is stopped, and it is desired to establish communication or measurement after 8 hours etc., the pre-determined time can enable low power consumption and reduce battery usage during that time.
After communication is established, as the measurement is in a stopped state, please restart measurement with Event Code 0x20 (measurement control).

Command Setting Example

When Accel Wake is set in Sleep Settings

Event Code	Length	Data Value1
0x22	0x03	0x02

4.3.4 Data Up Disable

Event Code: 0x23
Length: 0x03

Command Format

Event Code	Length	Data Value1

Data Notification Allow (Data Value1)

bit	Initial Values	Function Explanation
7..1	0x00	Not used
0		0: Allow 1: Not Allow

The setting allows the notification of data to the Device. Initial settings are to allow notification. When want to just send the command while doing measurement, it is possible to temporarily to not permit the data. The rejected measured data is accumulated in internal buffer and notification is done when it is permitted.

Command Setting Example

When setting Data Up Disable to Not Allow

Event Code	Length	Data Value1
0x23	0x03	0x01

4.3.5 Automatic Status Issue Function

Event Code: 0x24
Length: 0x03

Command Format

Event Code	Length	Data Value1

Automatic Status Issue Operation (Data Value1)

bit	Initial Values	Function Explanation
7..1	0x00	Not used
0		0: disabled 1: enabled

This setting is used for the automatically issuing the status packet. The initial settings are set to Disable. Once this function is enabled, the status packets are automatically sent 1 time per minute. This is a useful function if it is required to moitor the battery voltage periodically. However, when the measurement stops and the communication is interrupted, this will not work.

Issue Event Code 0x2E (status request) if you want to monitor the voltage only once.

Command Setting Example

When automatic Status issue operation is enabled.

Event Code	Length	Data Value1
0x24	0x03	0x01

4.3.6 Error Release

Event Code: 0x29
Length: 0x03

Command Format

Event Code	Length	Data Value1

Error Release (Data Value1)

bit	Initial Values	Function Explanation
7..1	0x00	Not used
0		1: error status release

Error status will launch when an error occurs. After examining the Device side, and fixing the problem, this command is issued to clear the error condition.
In the event of an Error where the Bluetooth® is switched off, automatically the transmission starts, and after the error is cleared, the operation will automatically continue.

Command Setting Example

To set error release

Event Code	Length	Data Value1
0x29	0x03	0x01

4.3.7 Connection Parameter Update Status Notification Request

Event Code: 0x2D
Length: 0x03

Command Format

Event Code	Length	Data Value1

Connection Parameter Update Status Notification Request (Data Value1)

bit	Initial Values	Function Explanation
7..1	0x00	Not used
0		1: Connection Parameter Update Status Notification request

It is a request to commands to notify the connection parameters update sequence status to the module. Information Updating / update completion / update disabled will be notified in the response of Custom2 EventCode 0x81.
Please refer to 6. Notification Data Construction (Custom 2) Event Code 0x81 (Connection parameter update status notification) for more details.

Command Setting Example

When requesting connection parameter update situation status.

Event Code	Length	Data Value1
0x2D	0x03	0x01

4.3.8 Status/ Request

Event Code: 0x2E
Length: 0x03

Command Foramt

Event Code	Length	Data Value1

Status Notification Packet Issue Instructions (Data Value)

bit	Initial Values	Function Explanation
7..1	0x00	Not used
0		1: Internal information request

This is an internal information packet request. After the command is issued, Module sends the Packet to Custom1. When this Command is issued, the operation and various settings are unchanged, but the latest information for the the RSSI value, battery values are obtained and the status notification packet is issued. Please refer to 5.3 Status Notification for details.

Command Setting Example

When requesting internal information

Event Code	Length	Data Value1
0x2E	0x03	0x01

4.3.9 Settings Data Save/ Initialization

Event Code: 0x2F
Length: 0x03

Command Format

Event Code	Length	Data Value1

Settings Detail Instruction (Data Value1)

bit	Initial Values	Function Explanation
7..2	0x00	Not used
1..0		(bin)01: Save current Settings (bin)11: Settings initialization

Setting details are saved, and revert to initial settings is possible.
The current settings can be saved and each sensor`s information is saved in non volatile memory, and these are the settings when the Module is powered on again after being turned off. In Settings initialization, you can revert to the factory default settings.
In the “3. Command List” part referring to saving non volatile memory “-“ item cannot be saved. The information relating to the Bluetooth® needs to be done when the Module is powered on.

Command Setting Example

When saving current settings

Event Code	Length	Data Value1
0x2F	0x03	0x01

4.4 System Settings Command

4.4.1 Timing Settings

Event Code: 0x30
Length: 0x0A

Command Format

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6	Data Value7	Data Value8

Time: ms (LSB) (Data Value1)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Time: ms (MSB) (Data Value2)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Ms timing settings are in the 0～999 range.

Time: seconds (Data Value3)

Bit	Initial Values	Function Explanation
7..0	0x00	Value

Second timing settings are in the0～59 range.

Time: minutes (Data Value4)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Minute timing settings are in the0～59 range

Time: hour (Data Value5)

bit	Initial Values	Function Explanation
7..0	0x00	Value

Hour timing settings are in the 0～23 range. Only 24-hour clock display is available.

Time: day (Data Value6)

bit	Initial Values	Function Explanation
7..0	0x01	Value

Day timing settings are in the 1～31 range.

Time: Month (Data Value7)

bit	Initial Values	Function Explanation
7..0	0x0A	Value

Month timing settings are in the 1～12 range.

Time: Year (Data Value8)

bit	Initial Values	Function Explanation
7..0	0x0F	Value

Year timing settings are in the 0～99 range, in 2 digit format.

Command Setting Example

When setting March 20th 2016, at 11 (hour):20 (minute):30 (second):0 (milisecond)

Event Code	Length	Data Value1	Data Value2	Data Value3	Data Value4	Data Value5	Data Value6	Data Value7	Data Value8
0x30	0x0A	0x00	0x00	0x1E	0x14	0x0B	0x14	0x03	0x10

4.4.2 H/W Irregularity Detection

Event Code: 0x31
Length: 0x03

Command Format

Event Code	Length	Data Value1

H/W Irregularity Detection Settings (Data Value1)

bit	Initial Values	Function Explanation
7	0x00	Irregularity Detection 0: OFF 1: ON
6		Not used
5		Not used
4		Air Pressure Irregularity Detection 0: disabled 1: enabled
3		UV Irregularity Detection 0: disabled 1: enabled
2		Humidity Irregularity Detection 0: disabled 1: enabled
1		Geomagnetic Irregularity Detection 0: disabled 1: enabled
0		Acceleration Irregularity Detection 0: disabled 1: enabled

For setting each Sensor`s irregularity detection function (I2C communication irregularity). The initial settings have all sensors and irregularity detection function disabled. Sensor units ON/OFF are specified, and for the entire mask, bit 7=1 to issue the error status when an irregularity occurs.
Ex. If the UV hardware irregularity is known but other sensors status is unknown, this can be used.
Initial Values is for the anomaly detection for all of Sensor becoming disabled.

Command Setting Example

When enabling all sensors for the H/W irregularity detection

Event Code	Length	Data Value1
0x31	0x03	0x9F

5. Data Packet Construction (Custom1)

There are 3 types of data packets in Custom 1 Notification (Data Packet 1, 2 and Status Notification), each structured in 20 bytes.

Data Packet 1、2 are Sensor measurement Data Packets, after measurement Notification is done.

- Data Packet 1: Accelerometer、Geo-Magnetic、time stamp (hour, minute, second, milisecond)
- Data Packet 2: UV/ Ambient Light、Humidity/Temp.、Pressure、time stamp (year, month, day).

For the sensors being measured, and where data packet 2 sensors are not included, Data Packet 2 will not issue a notification, so year, month and day time stamp data will not be obtained. However, if for the time stamp (hours, minutes, seconds and ms) each measurement will have a notification, even if you do not have the measurement the Accelerometer, Data Packet 1 notification is done.

In the 20th data line, a common Data Index will be granted in the Data Packet 1 and 2. For each measurement that is increased by 1、after 255 (0xFF), the next index returns to 0. To do this, when data Packet 1 and 2 are obtained, it is determined whether the same measurement data can be used, and further the state of the communication condition.

5.1 Data Packet 1

No	Field	Details
1	Event Code	0xF2
2	Length	0x14
3	Geo-Magnetic X LSB	
4	Geo-Magnetic X MSB	
5	Geo-Magnetic Y LSB	
6	Geo-Magnetic Y MSB	
7	Geo-Magnetic Z LSB	
8	Geo-Magnetic Z MSB	
9	Acceleration X LSB	
10	Acceleration X MSB	
11	Acceleration Y LSB	
12	Acceleration Y MSB	
13	Acceleration Z LSB	
14	Acceleration Z MSB	
15	Time Stamp0	Ms
16	Time Stamp1	Ms
17	Time Stamp2	S
18	Time Stamp3	M
19	Time Stamp4	H
20	Data Index	

Data of non-Selected Sensors will have the following values.
Geo-Magnetic: 0x8000
Acceleration: 0x8000

5.2 Data Packet 2

No	Field	Details
1	Event Code	0xF3
2	Length	0x14
3	Pressure LSB	
4	Pressure MSB	
5	Humidity LSB	
6	Humidity MSB	
7	Temperature LSB	
8	Temperature MSB	
9	UV LSB	
10	UV MSB	
11	Ambient Light LSB	
12	Ambient Light MSB	
13	(Reserve)	
14		
15		
16		
17	Date Stamp0	Day
18	Date Stamp1	Month
19	Date Stamp2	Year
20	Data Index	

Data of non-Selected Sensors will have the following values.
Pressure: 0x0000
Humidity: 0x8000
Temperature: 0x8000
UV: 0x8000
Ambient: 0x8000

Each Sensors Data conversion in Packet 1 and 2 is described below.
In the data Packet, Magnetic, Accelerometer are signed 2 byte integers.
In the data Packet, Pressure, Humidity, Temparature, UV, Ambient are unsigned 2 Byte integers.

Geo-Magnetic [uT] : Magnetic×0.15
Acceleration [G] : Acceleration / 4096 (when ±2G Range)
Acceleration / 2048 (when ±4G Range)
Acceleration / 1024 (when ±8G Range)
Acceleration / 682.7 (when ±12G Range)
Acceleration / 512 (when ±16G Range)
Pressure [hPa] : Pressure×860 / 65535 +250
Humidity [%RH] : (Humidity - 896) / 64
Temperature [degC] : (Temperature – 2096) /50
UV [mW/cm^2] : UV / (100×0.388)
Ambient [Lx] : Ambient / (0.05×0.928)
※ When sunlight and halogen lamp is the light source

【Points to note】
The Ambient conversion formula above is for when the light source is sunlight or halogen lamp light.
Please note the conversion formula below, and use the appropriate formula for light source used.
When light is an LED: Ambient / (0.05×0.928×0.58)
When light is from a flouresent lamp: Ambient / (0.05×0.928×0.44)

5.3 Status Notification

Event Code 0xE0 is used for notification.
This packet is used when issuing the control command, or Event Code 0x24 when the “Automatic Status issue operation” Field is enabled, notification in automatically done.

No	Field	Details
1	Event Code	0xE0
2	Length	0x14
3	Not used	
4	StERROR	Error status
5	Not used	
6	Not used	
7	RSSI	
8	Battery(L)	
9	Battery(H)	
10	MemFull	Check if memory is full or not
11	ACK/NACK	Command accept Ack/Nack
12	Not used	
13		
14		
15		
16		
17		
18		
19		
20		

StERROR: status display. When an error occurs, each sensor becomes 1 Bit, and all others are 0.

Bit	Function Explanation
7:5	Not Used
4	Pressure irregularity detection
3	UV irregularity detection
2	Humidity irregularity detection
1	Geomagnetic irregularity detection
0	Accelerometer irregularity detection

RSSI: Show reception of RSSI. Values are in dBm, signed 1 byte.
Battery: Shows the battery voltage in mVunits at 2 bytes’ notation.
MemFull: Flag to show Internal memory is full. When memory is full, 1, for other states 0. Issuing Event Code 0x29 (error release) keeps the flag until it is cleared.
ACK/NACK: Command acceptance (ACK) time is 1, non acceptance (NACK) is 2. For other commands (automatic issue), this is 0. When the RSSI and Battery values issue Event Code 0x2E "Status Notification Packet Issue Instructions", or when there is an automatic status issue, measurement and update restarts.

6. Notification Packet Structure (Custom2)

There are 3 types of notification data packet types (Event Code Read response, connection parameter update status notification, sequence error notification) saved and classified by the Event Code.

Event Code 0x01~0x31 Event Code Read Response

No	Field	Details
1	Event Code	Read Register Event code
2	Length	Variable length
3	Data Value	Read Register details
・	・	・
・	・	・
・	・	・
・	・	・
20	・	max 20

When you issue a Read request of the Event Code to Custom3, a Read response packet notification is sent to Custom2. In the Read response packet, EventCode, Length, DataValue follow the contents of the four command structure.

(Example) Measurement Control (Event Code=0x20) Read

Issue the measurement control command Read request to Custom3.

Event Code	Length	Data Value1
0xA0 (0x20+0x80)	0x03	0x00

Measurement control command notification sent to Custom2.

Event Code	Length	Data Value1
0x20	0x03	0x01

Event Code 0x81 Connection Parameter Update State Notification

No	Field	内容
1	Event Code	0x81
2	Length	0x03
3	Update Status	0x00: Update complete
		0x01: Updating
		0x02: Cannot update

This format issues the notification of the update status when the module sends the update request connection parameter. Once the update request is issued, firstly during updating ("Update Status" Field = 1) notification will be issued to the Device. After that, when the connection parameter update sequence is completed, the update is complete or update disabled notification is done.

The connection parameter update request from the Module has a different timing issue by EventCode 0x21 " Bluetooth® communication operation setting" Field value. In the case of automatic setting ("Bluetooth® communication operation setting" Field <0bit> = 0), it will be issued automatically from the module at the time of measurement mode change at the time of connection establishment.
In the case where settings are input manually, at the timing set in to the manual setting effective (EventCode 0x21 " Bluetooth® communication operation setting" Field <0bit> = 1), update request is issued from the module.

Event Code 0x82 Sequence Error Notification

No	Field	Details
1	Event Code	0x82
2	Length	0x03
3	Sequencer Error	0x00 : No Error 0x01 : Error

This packet notifies the confirmation result for the sensor measurement operation interval and enabled sensors matching and the sensor measurement sequence has not failed.
“No error” indicates all the enabled sensors and interval settings are working properly
When there is an error, it indicates that the enabled sensors and interval settings are not working properly.
(Ex. Measurement ModeFast Mode, to enable the environment-based sensor at less than 100ms measurement interval).
After checking the sensing setting details using (EventCode 0x01 ~ 0x06), then the settings need to be input again.

7. Beacon Format

Operation Mode	**Sent interval**	**Send Information**	Beacon Operation (Event Code 0x16) “**Format Settings” Field**
Normal Advertising	30ms-10000ms	-	<1:0bit> = (bin)00
General Beacon	100ms 固定	UUID Minor/Major	<1:0bit> = (bin)10
Sensor Beacon	100～4000ms	Acceleration、Pressure Humidity、Temperature 、 UV、Ambient Light	<1:0bit> = (bin)01 <7bit> = (bin)0
		Geo-Magnetic 、 Acceleration、 Pressure	<1:0bit> = (bin)01 <7bit> = (bin)1

Beacon operation mode, once connection is established, can be selected by setting the Event Code 0x16 "format specification" Field. After setting, and by cutting the connection, the module will start Beacon operating in operating mode set.

Normal Advertising: this is the normal operation mode.

Normal advertising data of the following format is transmitted when disconnected.

AD Structure1		
Length	AD Type	Local Name
0x02～0x12	0x08	(1)～(18)

※Local Name has the same setting value as "Device name" of Event Code 0x15..
※Length changes depending on the number of characters set for the device name (Local Name).

General Beacon: Apple`s beacon Format.

The following format of Beacon data at the time of non-connection will be sent. Company ID (0x0272) is the Company ID of ALPS. Transmission interval is 100ms fixed. In addition to the Major / Minor, you can send an ID that was set in the Event Code 0x17 "UUID" Field.

Total Size	AD Type	Company ID	Data Type	Data Length	UUID	Major	Minor	Measured Power
0x1A	0xFF	0x0272	0x02	0x15	16byte	2byte	2byte	0xBF

Measured power value is fixed at -65dBm (0xBF).

Sensor Beacon: ALPS original Beacon format.

With the settings of Event Code 0x16 “Beacon Operation” Field <7bit>, 2 types of operation are possible.
<7bit> = 0: (1) Environment senors All sensors except Acceleration sensor
<7bit> = 1: (2) Motion sensors Geo-Magnetic/ Acceleration/ Pressure sensor measurement

When not connected, sensor data is sent as Beacon data in the following format.
Device name (Local Name), "Device name" uses Fields first 5 bytes of Event Code 0x15.
Sensor data conversion will be the same as the conversion equation in “5. Notification Data Structure (Custom1)”.

<7bit> = 0: (1) Environment Sensors Format

AD Structure1										
Length	AD Type	Company ID		ALPS Index	Data					
0x14	0xFF	0x72	0x02	0x00	Acc **X**(L)	Acc **X**(H)	Acc **Y**(L)	Acc **Y**(H)	Acc **Z**(L)	Acc **Z**(H)

AD Structure1									
Data continuation									
Pres (L)	Pres (H)	Humi (L)	Humi (H)	Temp (L)	Temp (H)	UV (L)	UV (H)	Ambi (L)	Ambi (H)

AD Structure2						
Length	AD Type	Local Name				
0x06	0x08	(1)	(2)	(3)	(4)	(5)

<7bit> = 1: (2) Motion Sensors Format

AD Structure1										
Length	AD Type	Company ID		ALPS Index	Data					
0x14	0xFF	0x72	0x02	0x00	Acc **X**(L)	Acc **X**(H)	Acc **Y**(L)	Acc **Y**(H)	Acc **Z**(L)	Acc **Z**(H)

AD Structure1									
Data continuation									
Geo-Mag **X**(L)	Geo-Mag **X**(H)	Geo-Mag **Y**(L)	Geo-Mag **Y**(H)	Geo-Mag **Z**(L)	Geo-Mag **Z**(H)	Pres(L)	Pres(H)	**0x80**	**0x80**

AD Structure2						
Length	AD Type	Local Name				
0x06	0x08	(1)	(2)	(3)	(4)	(5)

Appendix1 Service1 Database

	Attribute Handle	Attribute UUID	Attribute Type	Attribute Value	Propeties/ Permissions
Service1	0x10	0x2800	GATT_PRIMARY_SERVICE_UUID	0x47FE55D8447F43ef9AD9FE6325E17C47	READ
	0x11	0x2803	GATT_CHARACTER_UUID	char properties : READ/NFY char handle : 0x0012 char UUID : 0x686A9A3B4C2C4231B8719CFE92CC6B1E	READ
	0x12	0x686A9A3B4C2C4231B8719CFE92CC6B1E	Custom1 Characteristic UUID	20Byte	READ | NFY
	0x13	0x2902	Client Characteristic ConfigurationUUID	Notify Enable (0x0001) Notify Disable (0x0000 default)	READ | WRITE
	0x14	0x2803	GATT_CHARACTER_UUID	char properties : READ/NFY char handle : 0x0015 char UUID : 0x078FF5D63C9347f5A30C05563B8D831E	READ
	0x15	0x078FF5D63C9347F5A30C05563B8D831E	Custom2 Characteristic UUID	20Byte	READ | NFY
	0x16	0x2902	Client Characteristic ConfigurationUUID	Notify Enable (0x0001) Notify Disable (0x0000 default)	READ | WRITE
	0x17	0x2803	GATT_CHARACTER_UUID	char properties : WR/WWR char handle : 0x0018 char UUID : 0xB962BDD15A77479793A1EDE8D0FF74BD	READ
	0x18	0xB962BDD15A77479793A1EDE8D0FF74BD	Custom3 Characteristic UUID	20Byte	WRITE | WRITE WITHOUT RESPONSE

Appendix2 Android Sample Project Sensor Beacon Setting Example

Using Android Sample Project (SensorModuleSampleCode), the following is an example of the procedure to set Sensor Beacon mode automatically when connecting a Module.
The Beacon setting is using **2.3.4 Case4**.

① Create a CtrlCmdBeaconBehavior class that inherits the CtrlCmd class.

```
package com.alps.sample.sensorModule.command.control;

public class CtrlCmdBeaconBehavior extends CtrlCmd{
    private static final String TAG = "CtrlCmdBeaconBehavior";
    public static final int LENGTH_COMMAND = 7;
    public static final byte EVENT_CODE_SETTING_VALUE = 0x16;

    @Override
    public byte eventCode() {
        return EVENT_CODE_SETTING_VALUE;
    }

    public CtrlCmdBeaconBehavior() {
        super(LENGTH_COMMAND);
        commandBytes[INDEX_EVENT_CODE] += GETTING_MARKER;
        validCommand = true;
    }

    public CtrlCmdBeaconBehavior(byte[] data) {
        super(LENGTH_COMMAND);
        int len = data.length;
        int index = INDEX_EVENT_CODE + 2;
        System.arraycopy(data, 0, commandBytes, index, len);

        validCommand = true;
    }
}
```

② In the function “com/alps/sample/sensorModule/SensorModule.java” add “onCharacteristicEnabled(BLEConnect.NotifierType type)”

```
...

case ActivatedEnablingSensorDataNotification:
   if (type == BLEConnect.NotifierType.SensorDataAndStatus) {
      commander = new Commander();
      //add
      byte[] data= {0x01, 0x00, 0x00, 0x00, 0x00};
      commander.addCommand(new CtrlCmdBeaconBehavior(data));
      //end
      commander.addCommand(new CtrlCmdRequestStatus());
...
```

The application built with the above contents automatically sets to Sensor Beacon mode when connecting the module, and the module starts operation as Beacon by disconnecting. The measurement interval can be set by the same procedure.

※Beacon operation check and data acquisition are not supported by the Sample Project.
Please use the evaluation application (SensorModuleGraph) for Beacon operation check and data acquisition.

Revision History

Version	Date	Description
1.0	05.Oct.2015	Initial release
1.1	05.Feb.2016	All Pages: Clerical errors All Pages: Command Initial Values and possible operating ranges added/ updated P.6 Read command example added P.18 Data changeover timing settings explanation updated P.20【Force Mode】update explanation 【Points to Note】update explantion P.21 【Points to Note】Fast Mode Interval under 50ms explanation added P.22 Bluetooth Smart Power OFF timing setting explanation updated P.24 Advertising Issue Timing Parameter explanation updated P.25 Intermittent Advertising operation explanation updated Graph added P.26 Wake up timing setting, device name explanation updated P.27 General Beacon explanation added P.30 Bluetooth Smart power off designated timing OFF Instruction explanation updated Fast mode intervals at under 50ms point to note added P.31 Sleep settings explanation updated P.32 Data notification allow explanation updated P.33 Update situation notification explanation updated P.34 Status packet issue, setting detailsinstruction explanation updated P.38 UV changeover value and data items names update P.39 0 added to ACK/ NACK explanation P.41 Measurement sequence explanation added
1.2	24.Sep.2016	All Pages: Clerical errors All Pages Bluetooth® Smart changed to Bluetooth® 4. Example for each command ofCommand structure (Custom3) P.7 Command example added for handling more that 2 bytes P.8 Command restrictions added P.15~17 command list link update P.33 UUID explanation update
1.3	6.Feb.2017	All pages 2 decimal (bin) list updated Updated precautions and safety precautions Added notes for the Ver. 1.1 Command control: Bluetooth® low energy RF updated 2.2 Command Contorl Item: Event code 0x30 (time setting) *Added Ver.1.4 or later to [accept command during measurement operation] 4.2.7 Beacon Operation: Add explanation about Beacon resetting after power restart 5.2 Data Packet 2 ： Ambient conversion formula update Add【Points to Note】for Ambient

		7. Beacon Format: Add Normal Advertising Appendix 2: Add AndroidSampleProject`s SensorBeacon setting example