User's Manual

Sushi Sensor

Sushi Sensor Series Software Edition

IM 01W06C01-01EN

YOKOGAWA
Yokogawa Electric Corporation

IM 01W06C01-01EN
2nd Edition

Sushi Sensor Series
Software Edition

IM 01W06C01-01EN 2nd Edition

CONTENTS

Introduction

This manual describes the functions, configurations, operations and maintenance of Sushi Sensor. Before reading this manual, read the related documents in Table 1-1.

Table 1-1 Related Documents List

Title	Document No.
User's Manual XS770A Wireless Vibration Sensor	IM 01W06E01-01EN
User's Manual XS110A Wireless Communication Module	IM 01W06D01-01EN
User's Manual XS530 Pressure Measurement Module	IM 01W06F01-01EN
User's Manual XS550 Temperature Measurement Module	IM 01W06F02-01EN
Technical Information Sushi Sensor System Engineering Guide	TI 01W06A51-01EN
Technical Information Sushi Sensor System Key Card Creation Guide	TI 01W06A51-41EN

The User's Manual for each product contains important information for correct and safe use, as well as installation and maintenance. Read this manual before using the product and use it correctly.

Regarding This Manual

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- **The contents of this manual are subject to change without prior notice.**
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- **Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this manual at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.**

Precautions on safety and modifications

- To protect the operator, product, and system controlled by the product, observe the safety precautions described in this manual. If users handle contrary to these instructions, we cannot guarantee safety.
- Repair or modification to this instrument by customer will cause a malfunction of explosion protect function and hazardous situation. If you need to repair or modification, please contact the nearest Yokogawa office.
- The Modification of the product is strictly prohibited.
- The following safety symbols are used in this manual:

IMPORTANT

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

NOTE

Draws attention to information essential for understanding the operation and features.

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Documentation Conventions

Typographical Convention

The following typographical conventions are used throughout the User's Manual.

Conventions commonly used throughout the manuals

Character string to be entered

The characters to be entered are shown in one-byte characters as follows:

Example:

FIC100.SV=50.0

"△" mark

Indicates a space between character strings to be entered.

Example:

AL△PIC010△-SC

Character string enclosed in curly brackets ({ })

Indicates an optional character that can be omitted.

Example:

PR△TAG {△. Sheet name}

Conventions used to show key or button operations:

Characters enclosed in square brackets ([ ])

Characters enclosed in square brackets show the names of buttons used during the explanation of software operation.

Example:

To execute the command, click [OK].

Characters enclosed in angled brackets (< >)

Characters enclosed in angled brackets show the title of the screen during the explanation of software operation.

Characters enclosed in double quotation marks (" ")

Characters enclosed in double quotation marks show a tab or an item of the screen during the explanation of software operation.

Symbols

The symbols used in the manual are described in "IM 01W06C01-01EN". Refer to the document for details.

Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted for the convenience of description.
Some screen images depicted in the user's manual may have different display positions or character types (e.g., the upper/lower case). Also, note that some of the images contained in this user's manual is display examples.

1. Sushi Sensor System Overview

The Sushi Sensor system consists of Sushi Sensor, LoRaWAN gateway, the Application, and Sushi Sensor App. Sushi Sensor is an Industrial IoT intended for the trend monitoring of production equipment and instruments. The Application collects and utilizes the measurement values. Sushi Sensor App navigates settings and displays the status of Sushi Sensor. The Application is compatible with both cloud-based and on-premises environments.

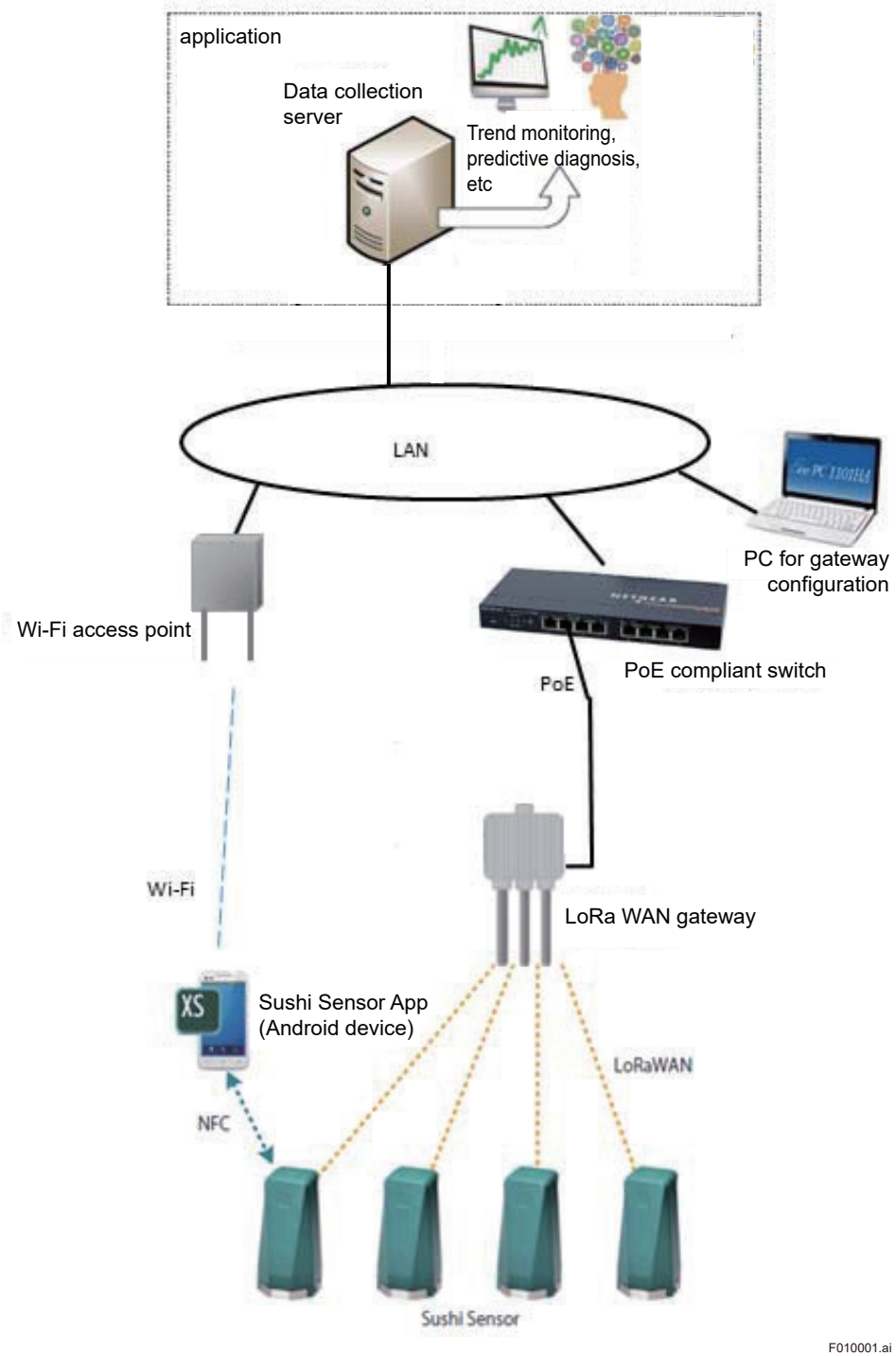


Figure 1-1 Sushi Sensor System Configuration

Sushi Sensor

Sushi Sensor is a sensor for Industrial IoT, intended for trend monitoring of production equipment and instruments. This sensor adopts LoRaWAN communication which actualizes long-distance communication. Setting and status check of the sensor is supported by the NFC function of Android devices.

LoRaWAN Gateway

LoRaWAN gateway relays Sushi Sensor sending data to the Application and manages the LoRaWAN network.

By installing multiple units of the gateways, the communication route between Sushi sensor and the gateway can be made redundant.

Application

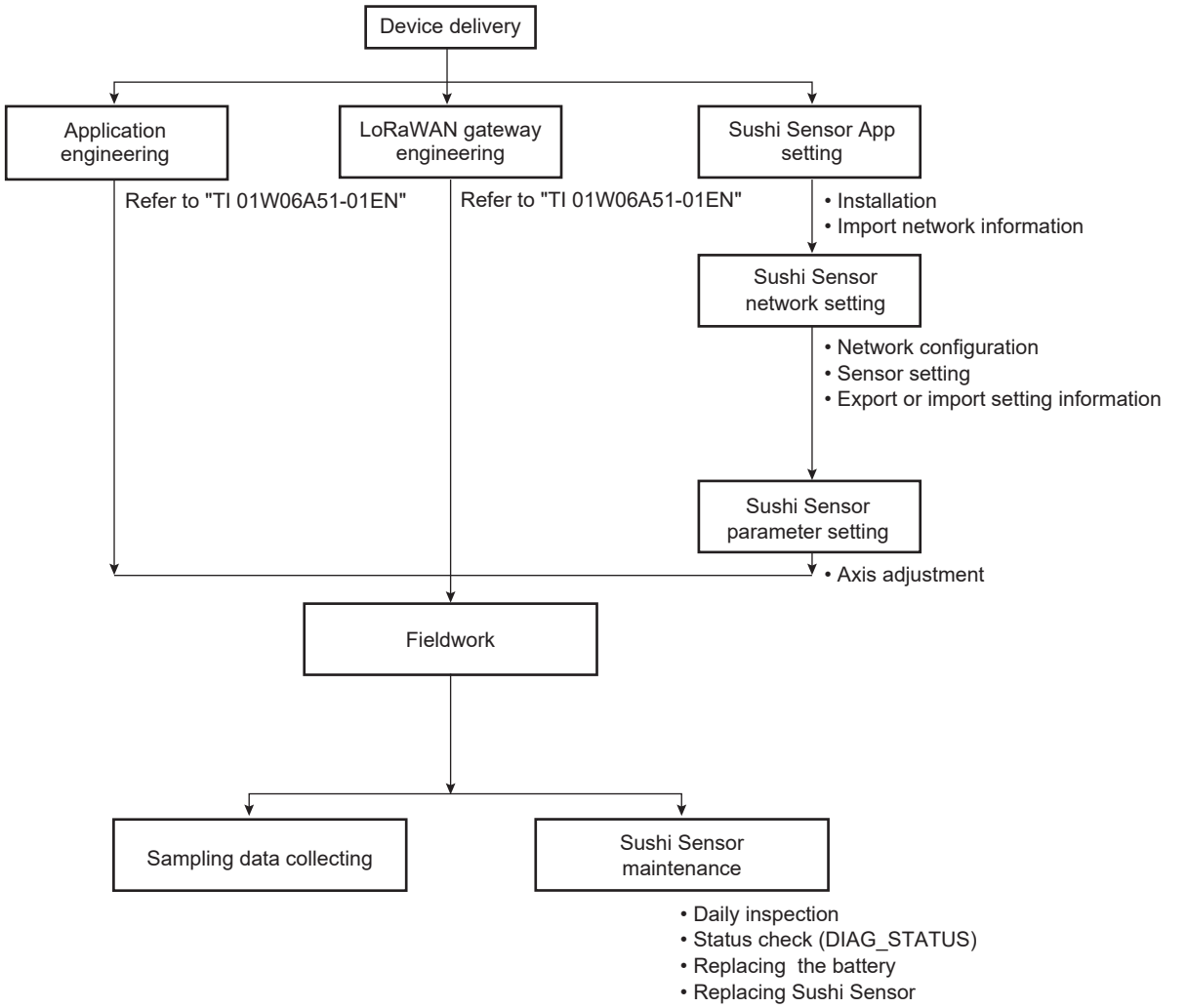
The Application consists of a data collection server. These servers can be installed in a single hardware host.

The data collection server collects data such as measurement data and device status sent from Sushi Sensor to monitor equipment and devices online. Maintenance timing can be determined by monitoring Sushi Sensor data. Data stored in this server can be output to other applications and can be used for trend monitoring and predictive maintenance of measurement targets.

This manual explains installation, setting, operation of Sushi Sensor and how to use of Sushi Sensor App. For information about the LoRaWAN gateway and the Application, refer to “TI 01W06A51-01EN”.

2. Engineering Flow

This chapter describes the engineering flow and tasks for building a Sushi Sensor system.



*1: The XS770A comes with a built-in battery. The XS110A is delivered without batteries. Install batteries before installation.
*2: The Sushi Sensor will start automatically when you insert the Power supply.

Figure 2-1 Engineering Flow for Construction of the Sushi Sensor System

Four types of engineering are required to build a Sushi Sensor system.

(1) Installation of Sushi Sensor, network configuration, and sensor setting

(2) LoRaWAN gateway engineering

(3) Setting Up and Adjusting the Sushi Sensor

(4) Startup and Maintenance Sushi Sensor

This document describes (3) the setting of the Sushi Sensor and (4) the field adjustment and maintenance (Working with the Thick Border in Figure 2-1) of the Sushi Sensor system using the Sushi Sensor App.

NOTE

The default key label included in this product package is not used for the setting of the XS770A Measurement Module (e.g. XS530, XS550) setting. Store it with the bundled manual.

3. Sushi Sensor App

3.1 Overview

Sushi Sensor App communicates with Sushi Sensor via NFC and sets the following items.

Table 3-1 List of Items Using the Sushi Sensor App

Items	Reference
Network Configuration	Section 4.1
Sensor Setting	Section 4.2
Fieldwork	Chapter 5
Operation and Maintenance	Chapter 6

3.2 System Requirements

The following are the system requirements for the Sushi Sensor App.

Table 3-2 Operating Environment

Item		Recommended System Requirements
System Requirements	OS	Android 5.1.1 or higher
	CPU	Snapdragon 800 or better
	Resolution	1280 x 720 dots or more
	NFC	reader, writer
	GPS	Optional
Supported Languages	Software	Japanese/English
	Documentation	Japanese/English

3.3 Sushi Sensor App Installation

Sushi Sensor App is a tool dedicated to the Android device. Install it from Google Play.

(1) Install Sushi Sensor App.

(1)-1 Install “Sushi Sensor App” from the Google Play store.

(1)-2 Check that Sushi Sensor App icon is shown on the Android home screen.

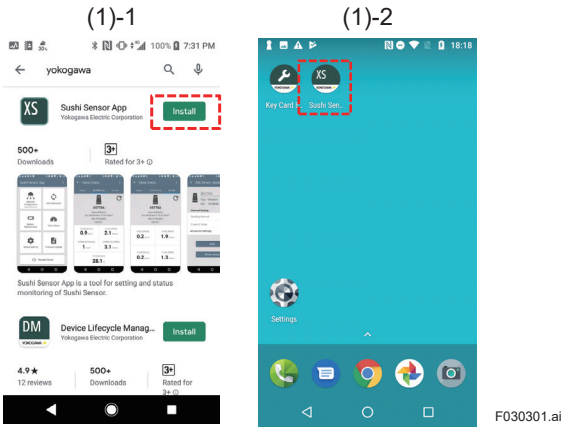


Figure 3-1 Sushi Sensor App Installation

NOTE

At the first use of Sushi Sensor App, a dialog to confirm the access to phones, media, and files is shown. Enable all permissions of those locations. If disable them, following effects will occur.

- Disable the file permissions makes you cannot save the setting data to the android device’s internal shared storage.
- Disable the file permissions makes you cannot register location information to the android devices to the Sushi Sensor.

3.4 NFC Communication Procedure

This section explains the procedure of NFC communication between the Android device and Sushi Sensor.

(1) Check the NFC detection area of the Android device and Sushi Sensor. For that of Android device, refer to the device's manual.

(2) Follow the instructions on the Sushi Sensor App, move the NFC detection area of Android device closer to Sushi Sensor.

(3) When NFC communication starts, and Android device notifies with sounds and vibrations once. Do not move Android device and Sushi Sensor until Sushi Sensor App notifies that the communication is completed or data updating indication is disappeared.

(4) After NFC communication is completed, Android device notifies with sounds and vibrations three times*1.

*1: If NFC communication is failed, Android device notifies with sounds and vibrations twice.

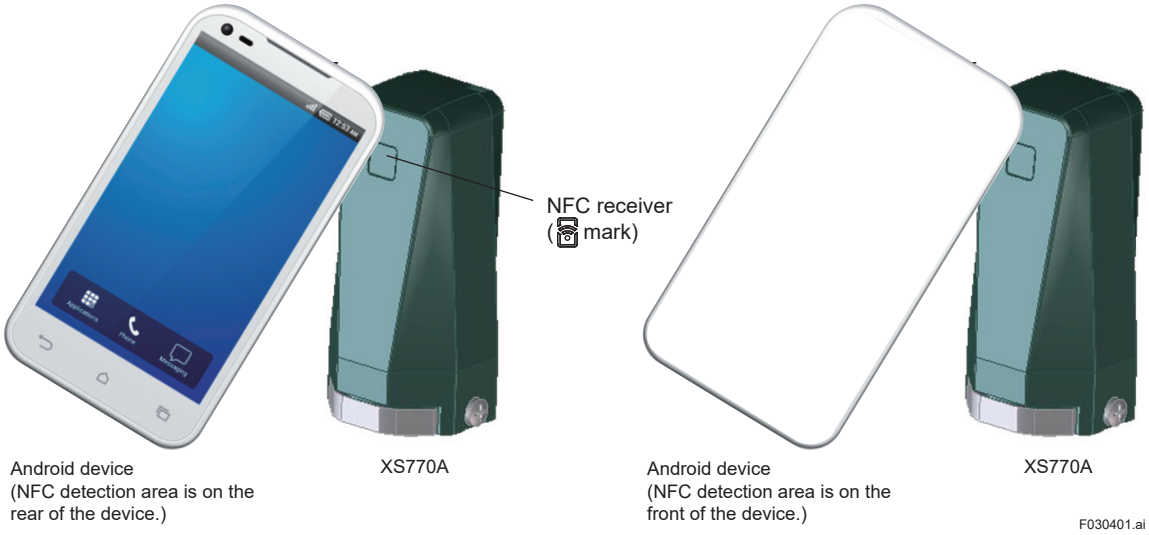


Figure 3-2 NFC Communication between Android and Sushi Sensor

IMPORTANT

After NFC communication is completed, don't remove to battery from Sushi Sensor about 20 seconds.

NOTE

- Enable NFC reader/writer of Android device before using Sushi Sensor App.
- When using the NFC communication function of the XS110A, connect the XS110A to the Measurement Module e.g. XS530, XS550. However, switch to ON or OFF mode (subsection 6.9.1) and initialize the battery life (section 6.7) without connecting the measurement module.
- If NFC communication is not available, perform a hardware reset of the Sushi Sensor. For detail on the hardware reset procedure, refer to section 6.4.
- If "Failure of measurement module" or "Connection failure" occurs in the diagnostic information after mounting XS110A with the Measurement Module, restart the Sushi Sensor.

3.5 Home Screen

When the Sushi Sensor App is launched, the home screen appears.

Table 3-3 Home screen of contents

Item		Description	Reference
Network Configuration		Configure the network information to Sushi Sensor	Section 4.1
Sensor Setting		Specify sensor settings for Sushi Sensor	Section 4.2
Fieldwork		Fieldwork verifies that sending data reaches data collection server correctly.	Chapter 5
Value Check		Inspection of Sushi Sensor status. .	Section 6.1
Battery Replacement		Initialize the battery life after replacing the battery of the Sushi Sensor.	Section 6.7
Firmware Update		Update the Sushi Sensor firmware.	Section 6.8
Sensor Restart		Restart the Sushi Sensor.	—
3-Point Menu [⋮]	Sensor ON/OFF	Select ON or OFF mode to reduce the battery consumption of the Sushi Sensor.	Section 6.9
	About	Display the Sushi Sensor App version.	—

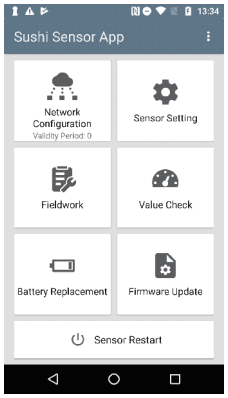


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Figure 3-3 Home Screen

4. Sushi Sensor Setting

This chapter describes the settings for the Sushi Sensor using the Sushi Sensor App.

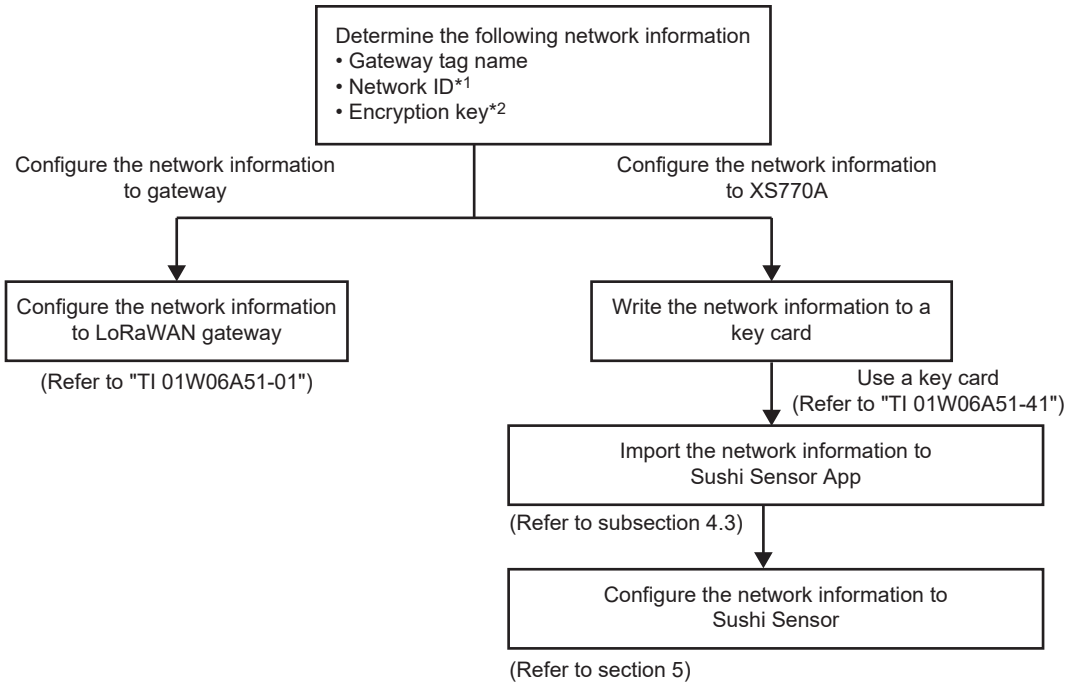
NOTE

When settings via NFC of the Sushi Sensor, be sure to connect the XS110A to the measurement module (e.g. XS530, XS550).

4.1 Network Configuration

4.1.1 Overview

In order to connect Sushi Sensor to gateway, the network information registered in the gateway must be written to Sushi Sensor. The procedure of network configuration is shown in Figure 4-1.



*1: Network ID is defined as App EUI in LoRaWAN specification. It represents the Application identifier to which Sushi Sensor is connected.
*2: Encryption key is defined as App Key in LoRaWAN specification.

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Figure 4-1 Procedure of network configuration

This manual explains the operations indicated by the bold flame in Figure 4-1 “ Import the network information to Sushi Sensor “ and “ Configure the network information to Sushi Sensor”.

4.1.2 Preparing Network Information

Network information written to the Sushi Sensor must be imported the Sushi Sensor App in advance.

4.1.2.1 Use a key card

This subsection explains how to import the network information from a key card.

(1) Specifies the source of the network information.

(1)-1 On the home screen of the Sushi Sensor App, press [Network Configuration] button.

(1)-2 Press the [Use Key Card] button.

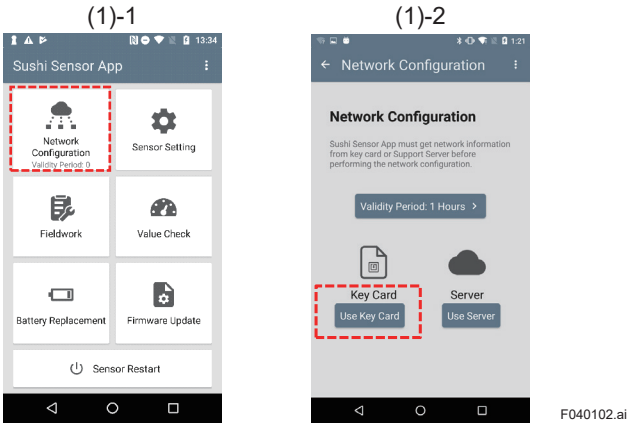

Figure 4-2 Select Key Card as Source of Network Information

(2) Import network information.

(2)-1 Move Android device and a key card closer.

(2)-2 “Network info. Acquisition Completed” message appears after reading the card successfully.
Press [Done] button.

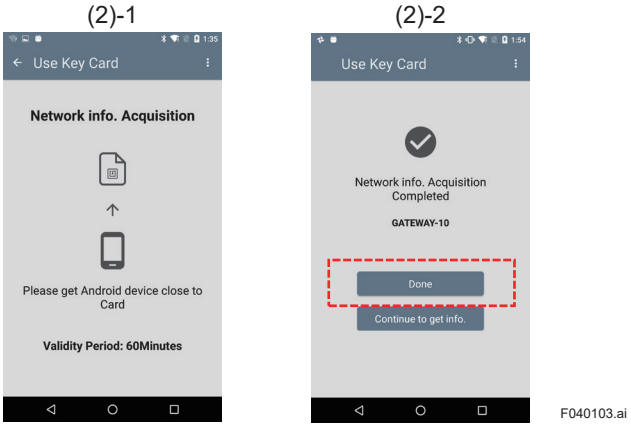

Figure 4-3 Import of Network Information Using Key Card

Press the [Done] button to display the <Network Settings> screen. Refer to step (2) in subsection 4.1.3 for details of the network setting procedure.

4.1.3 Sushi Sensor Network Configuration

Configure the network information to Sushi Sensor.

When [Location Information] of the Android device is set to ON, the location information (latitude and longitude) of the Android device records in Sushi Sensor.

By configuring at the actual installation point, Sushi Sensor can notify appropriate location information.

(1) Check the validity period of the network information.

(1)-1 On the home screen of the Sushi Sensor App, check the validity period displayed on the [Network Configuration] button.

(1)-2 If validity period is not 0, press [Network Configuration] button.

*1: When the validity period is 0, follow the procedure in Section 4.1 import network information in Sushi Sensor App.

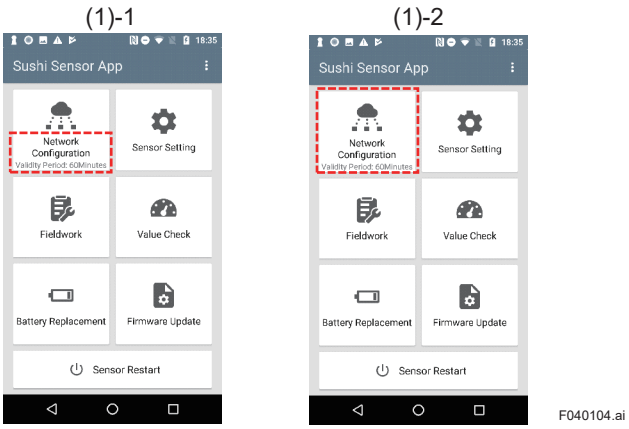

Figure 4-4 Check Validity Period

(2) Select the destination gateway.

(2)-1 Press [Change] button. A list of connectable gateway tag name appears.

(2)-2 Select destination gateway tag name from the list and press [OK] button.

(2)-3 Check selected gateway tag name is shown on the screen.

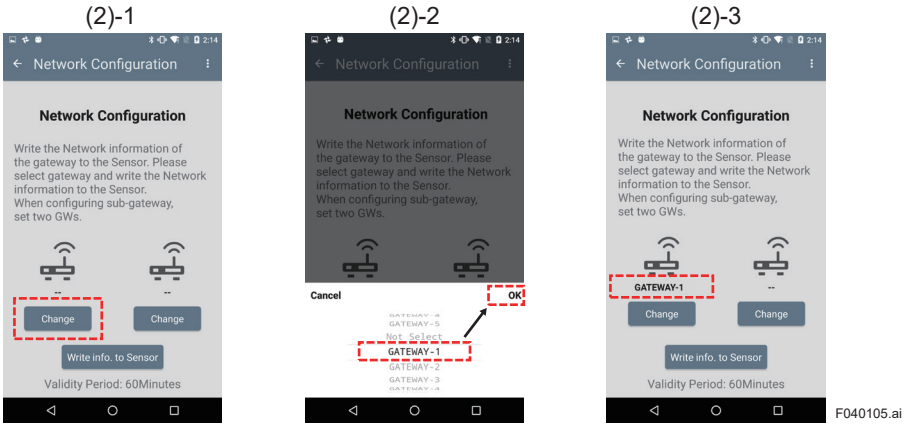

Figure 4-5 Select Destination Gateway

(3) Write the network configuration to Sushi Sensor.

(3)-1 Press [Write info. to Sensor] button.

(3)-2 Move the Android device closer to Sushi Sensor.

(3)-3 “Network Configuration Completed” message appears after writing the configuration. And press [Done] button.

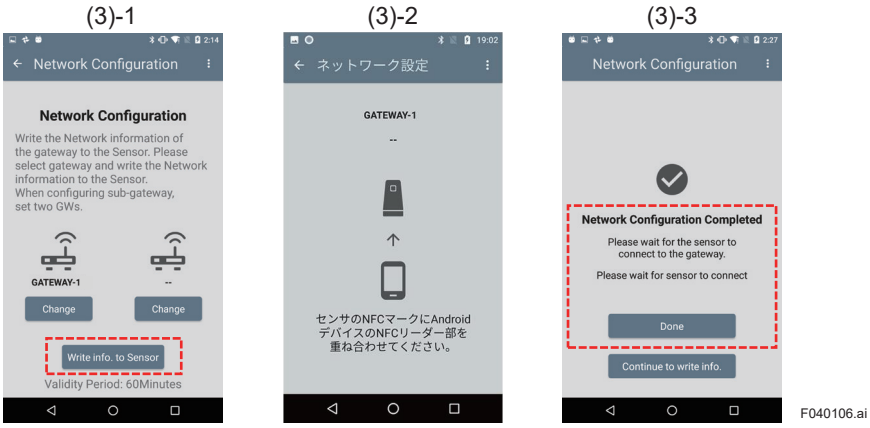

Figure 4-6 Write Network Configuration

The Sushi Sensor automatically reconnects to the network after completed to the network configuration.

IMPORTANT

Do not remove the battery for about 20 seconds after settings.

4.1.4 Gateway Redundancy Setting

The Sushi Sensor system supports gateway redundancy. When one gateway is out of service by failure, another gateway is used.

Registering network information of the two gateways in Sushi Sensor makes gateway redundancy.

The registered Sushi Sensor automatically selects the connectable gateway and sends data.

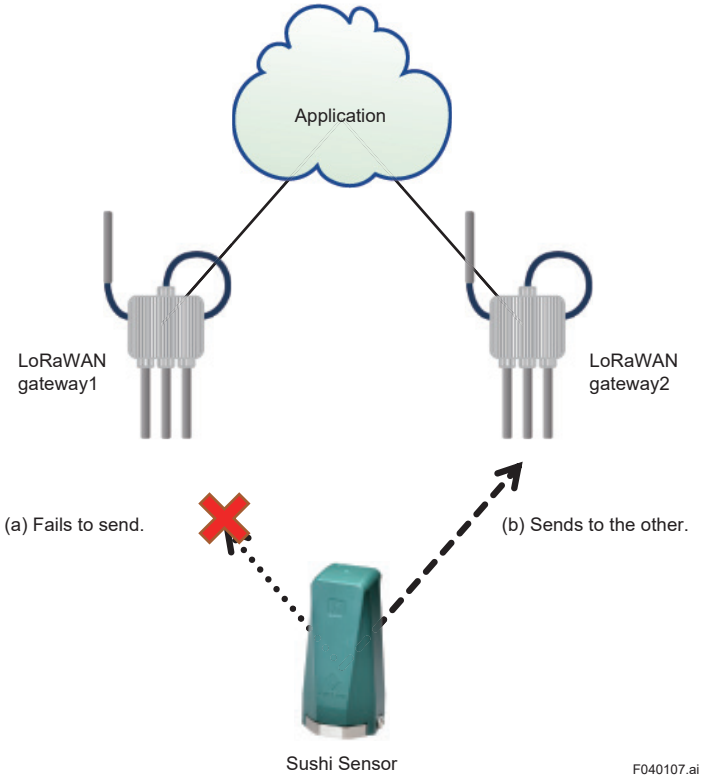

Figure 4-7 Gateway Redundancy Image

To register the network information of 2 gateways in Sushi Sensor, refer to subsection 4.1.3.

4.2 Sensor Setting

This section describes the setting method of the sensor.

4.2.1 Sensor Setting Method

This section describes how to load settings from the Sushi Sensor and write settings to the Sushi Sensor, save settings to the Sushi Sensor App, and recall settings saved to the Sushi Sensor App. Sushi Sensor needs to read and write settings.

4.2.1.1 Reading Settings to Sushi Sensor

(1) Check Sensor list registration.

(1)-1 On the home screen of the Sushi Sensor App, press [Sensor Setting] button.

(1)-2 Press [Read Setting] button.

(1)-3 Move the Android device closer to Sushi Sensor to be changed.

(1)-4 <Sensor Setting> screen appears after reading successfully. The item of <Sensor Settings> at the screen depend on the sensor type. For details, refer to subsection 4.2.3 and later for each sensor.

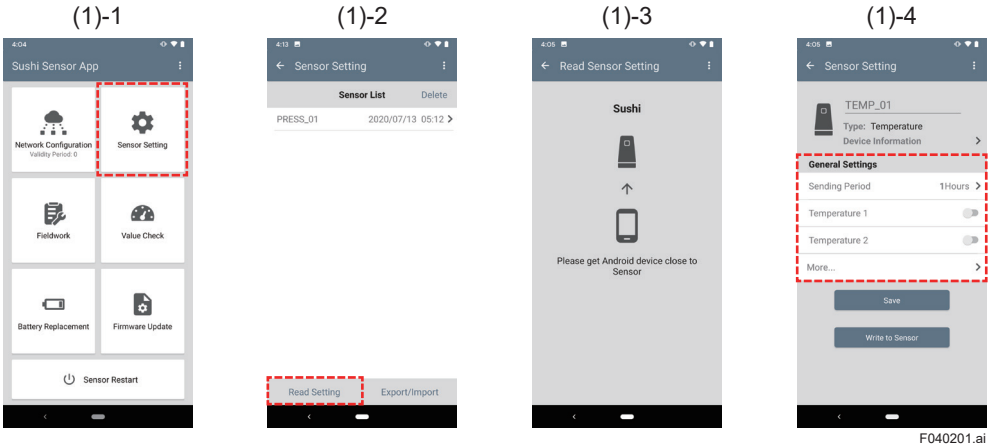

Figure 4-8 Reading Sushi Sensor Settings

4.2.1.2 Writing Settings to Sushi Sensor

(1) Display the <Sensor Setting>

(1)-1 Follow the steps for reading settings to Sushi Sensor (subsection 4.2.1.1) or retrieving the settings saved in the Sushi Sensor App (subsection 4.2.1.4) to display the <sensor setting> screen.

(2) Write setting information to Sushi Sensor.

(2)-1 Set the tag name of the Sushi Sensor. The first time is blank, so be sure to set it.

(2)-2 Press [Write to Sensor] button.

(2)-3 Move the Android device closer to Sushi Sensor.

(2)-4 “Write Sensor Setting Completed” message appears after writing the setting. Press [Done] button.

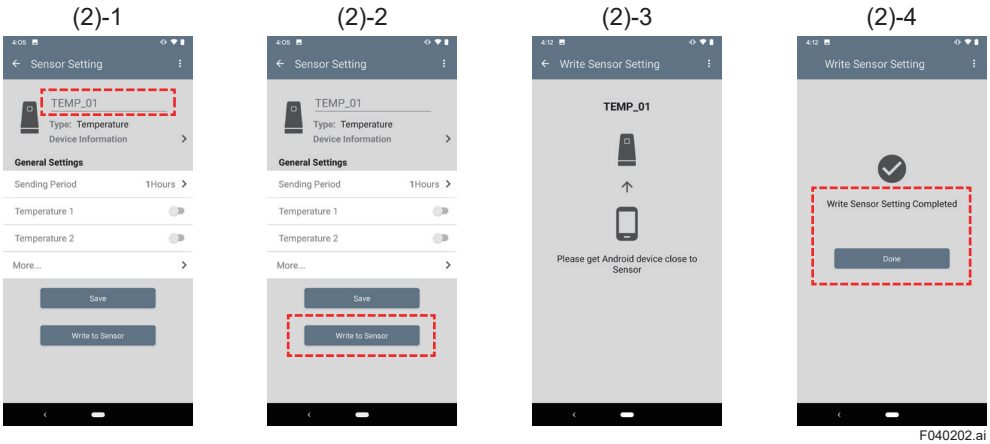

Figure 4-9 Write setting information to Sushi Sensor

IMPORTANT

Do not remove the battery for about 20 seconds after settings.

4.2.1.3 Saving Settings to the Sushi Sensor App

(1) Display the <Sensor Setting>.

(2) Save to the Sushi Sensor App

(2)-1 Press [Save] button.

(2)-2 Press [Yes] button in the <Save Sensor Setting> dialog.

(2)-3 The tag name of the registered Sushi Sensor is displayed in the sensor list.

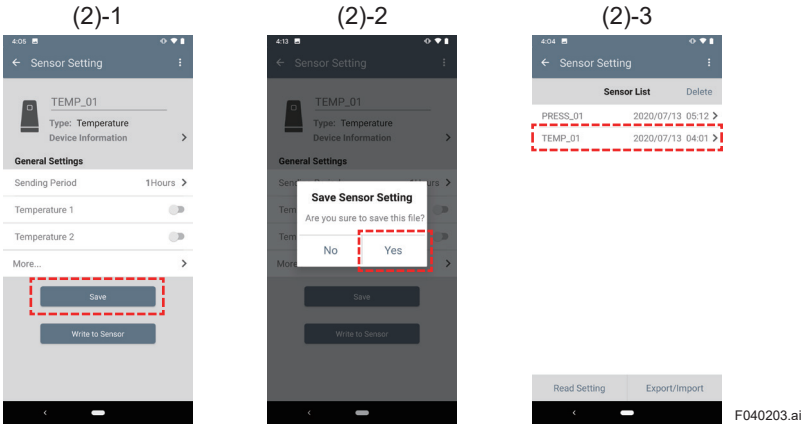

Figure 4-10 Save to Sushi Sensor App

Table 4-1 Contents of Sensor List

Item	Description
Sensor Tag Name	Refer to Table 4 -2.
Date	Date saved in Sushi Sensor App

4.2.1.4 Recall settings saved in the Sushi Sensor App

(1) Calls up the Sushi Sensor setting.

(1)-1 Press [Sensor Setting] button.

(1)-2 Select the Sushi Sensor from the sensor list.

(1)-3 Verify that the tag name of the selected sensor is displayed.

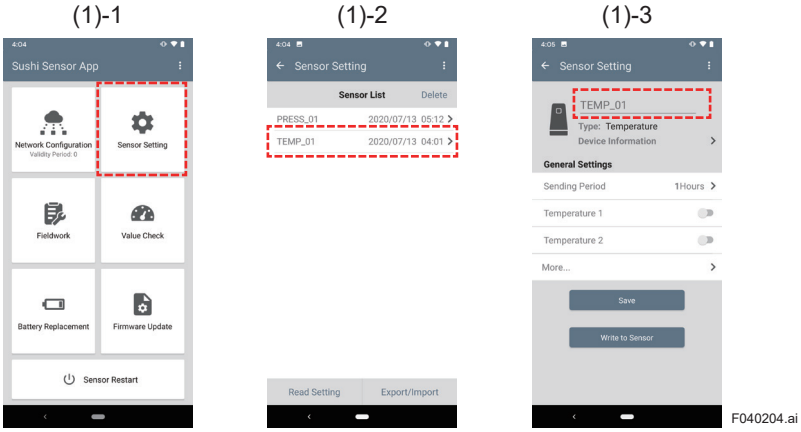

Figure 4-11 Calling the settings saved

4.2.2 Settings Common to Sushi Sensor

Table 4-2 shows the common setting items for the Sushi Sensor and Figure 4-12 shows a sample of the setting screen.

Table 4-2 Sushi Sensor common settings

Item	Description	Default	Possible Setting
Sensor Tag Name	This is the tag name of Sushi Sensor. Setting this item is mandatory.	Blank	Up to 10 characters Alphanumeric characters (A - Z, 0 - 9) and hyphen “-”, underscore “_”

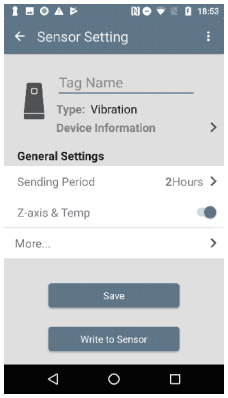

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Figure 4-12 Setting Screen

4.2.3 XS770A Sensor Setting

Specify sensor tag name, sampling data, sending period and transmission mode for XS770A. Possible and the default value of each item is shown below.

Table 4-3 XS770A Sensor Setting Items

Item			Description	Default	Possible Setting	#
General setting	Sensor Tag Name		Set the tag name of Sushi Sensor. Setting this item is mandatory.	Blank	-	1
	Sending Period		The sending cycle of sampling data	1[Hour]	1,10,30[Minutes] 1, 2, 3, 4, 5, 6, 12, 18, 24, 48, 72 [Hours]	2
	Sampling Data	Z-axis & temp	This sets Z-axis and temperature data are sent or not. Number of axes to be sent is 1 because these data are put in one packet. (Refer to section 7.1)	ON	ON/OFF	3
More		XYZ-axis & temp	This sets the composite value of XYZ-axis and temperature data are sent or not. Number of axes to be sent is 1 because these data are put in one packet. (Refer to section 7.2)	OFF	ON/OFF	4
		X-axis	This sets X-axis data are sent or not. For the packet format refer to section 7.3.	OFF	ON/OFF	5
		Y-axis	This sets Y-axis data are sent or not. For the packet format refer to section 7.4.	OFF	ON/OFF	6
	Transmission Mode	High Speed Mode	For details of this setting, refer to Table 4-4. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is EU.	ON	ON/OFF	7
	Axis Adjustment	XY Angle	This specifies the angle of the axis adjustment.	0	5 degrees increments in the range of -180 to 180 degrees	8
	Sub-band Setting		Specify the frequency band to be used when sending Sushi Sensor to LoRa Gateway. Set the same parameter as LoRa Gateway. For details of this setting refer to Table 4-5. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is US or AU.	1	All, 1, 2, 3, 4, 5, 6, 7, 8	9
	Unit Setting*1	Acceleration Unit	Select the acceleration, velocity, and temperature unit to be displayed on the Sushi Sensor App. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is US.	g	m/s^2, g	10
		Velocity Unit		in/s	mm/s, in/s	11
		Temperature Unit		°F	°C, °F	12

*1: When the Sushi Sensor firmware's regional parameter is other than US, the units used are as follows.
- Acceleration: m/s^2
- Velocity: mm/s
- Temperature: °C

Table 4-4 Transmission mode

Transmission mode	Description
High Speed mode is ON	The sending period can be set from 1 minute to 72 hours. However, if number of axes to be sent is multiple, please set the transmission cycle to 10 minutes or more.
High Speed mode is OFF	The sending period can be set from 4 hours to 72 hours. There is no limit on the sending period depending on number of axes to be sent.

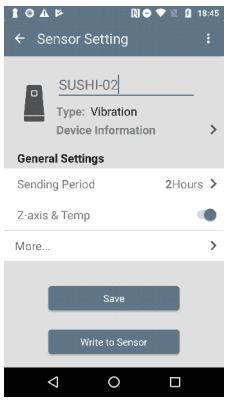
If you operate a Sushi sensor at a sending period 4 hours or less, set High Speed mode is ON.

Table 4-5 Sub-band Setting Parameter

Sub-band Setting Parameter		US Frequency [MHz]	AU Frequency [MHz]
1	All*	902.3 - 903.7	915.2 - 916.6
2		903.9 - 905.3	916.8 - 918.2
3		905.5 - 906.9	918.4 - 919.8
4		907.1 - 908.5	920.0 - 921.4
5		908.7 - 910.1	921.6 - 923.0
6		910.3 - 911.7	923.2 - 924.6
7		911.9 - 913.3	924.8 - 926.2
8		913.5 - 914.9	926.4 - 927.8

4.2.3.1 <Sensor Setting> screen

Set #1 to #3 in Table 4-3 on this screen.



F040206.ai

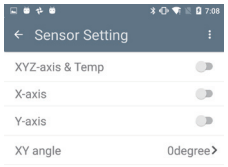
Figure 4-13 XS770A <Sensor Setting> screen

NOTE

When multiple axes data send, set the sending period to 10 minutes or more. If sending period is less than 10 minutes, the data may not reach the Application.

4.2.3.2 <Sensor Setting> screen more settings

Set #4 to #12 in Table 4-3 on this screen.



F040207.ai

Figure 4-14 XS770A more settings

4.2.3.3 Check or Change the Settings of XS770A Sending Data

Check or change XS770A sending data.

(1) Display the <Sensor Setting> screen.

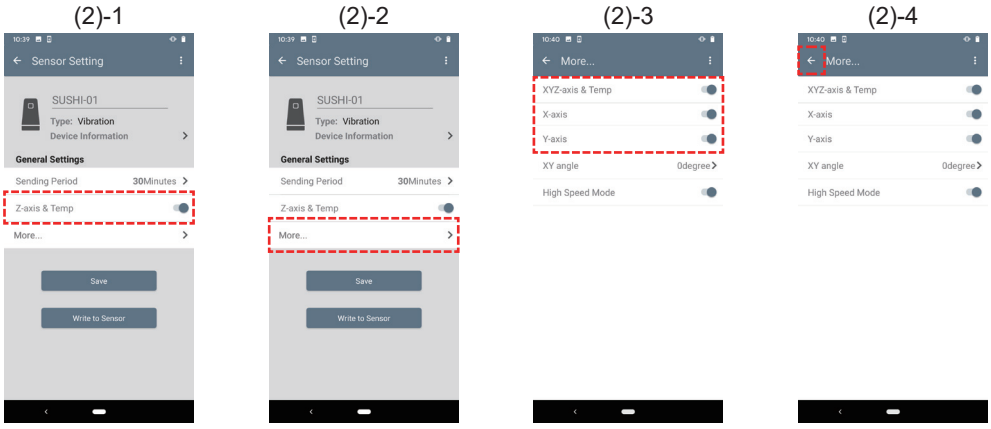
(2) Check or change the sending data.

(2)-1 Check or change ON/OFF “Z-Axis & Temperature”.

(2)-2 Press [More] button.

(2)-3 Check or change ON/OFF “XYZ-Axis & Temperature”, “X-Axis” and “Y-Axis”.

(2)-4 Press [Back] button.



F040208.ai

Figure 4-15 Selecting the XS770A sending data

(3) Write settings.

(3)-1 Write the settings as described in subsection 4.2.1.

NOTE

- Available data types are “Z-axis and temp”, “XYZ axes and temp”, “X-axis”, and “Y-axis”. Vibration measures acceleration (peak) and velocity (RMS) for each axis. XYZ axes is a composite value.
- The number of sending axes and its sending period affect battery life. Refer to section 6.6

4.2.3.4 Measurement Axis Adjustment

After installing XS770A, the direction of measurement axes (X-axis and Y-axis) can be adjusted using Sushi Sensor App.

With the X-axis of XS770A as the reference point, the axes can be adjusted by specifying a positive angle for counterclockwise rotation and a negative angle for clock rotation.

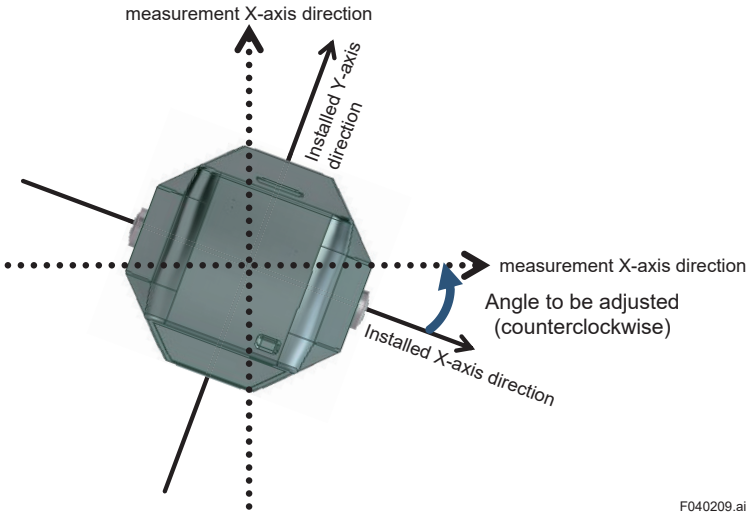


Figure 4-16 Measurement Axis Adjustment

(1) Display the <Sensor Settings> screen.

(1)-1 Press [More] button.

(2) Specify the X-Y angle to be adjusted.

(2)-1 Press [X-Y Angle] button. A list of selectable angles appears.

(2)-2 Select the angle from the list and press [OK] button.

(2)-3 Ensure that the selected angle for X-Y Angle Correction is displayed, then press [Back] button.

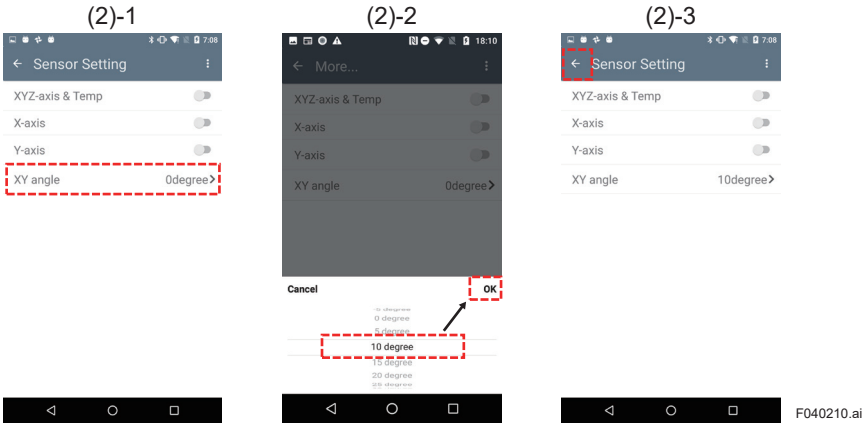


Figure 4-17 Specify X-Y Angle

(3) Write settings information to XS770A.

(3)-1 Follow the procedure in subsection 4.2.1.2, write the setting to XS770A.

NOTE

The adjustment value is valid after writing to Sushi Sensor. The setting is applied from the next measurement timing.

4.2.4 XS530 Sensor Setting

Specify sensor tag name, sampling data, sending period and transmission mode for XS530. Possible and the default value of each item is shown below.

Table 4-6 XS530 Sensor Setting Items

Item			Description	Default	Possible Setting	#
General setting	Sensor Tag Name		Set the tag name of Sushi Sensor. Setting this item is mandatory.	Blank	-	1
	Sending Period		The sending cycle of sampling data	1 [Hours]	1,10,30 [Minutes] 1, 2, 3, 4, 5, 6, 12, 18, 24, 48, 72 [Hours]	2
	Sampling Data	Pressure	Sets the measurement data to be sent. When transmitting pressure data, turn this setting ON and specify the unit of pressure to be transmitted on the extended setting screen.	ON	ON/OFF	3
		Temperature	Sets the measurement data to be sent. When sending the temperature data, turn this setting ON and specify the temperature unit to be sent on the extended setting screen.	OFF	ON/OFF	4
More	Transmission Mode	High Speed Mode	For details of this setting, refer to Table 4-9. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is EU.	ON	ON/OFF	5
	Sub-band Setting		Specify the frequency band to be used when sending Sushi Sensor to LoRa Gateway. Set the same parameter as LoRa Gateway. For details of this setting refer to Table 5-3. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is US.	1	All, 1, 2, 3, 4, 5, 6, 7, 8	6
	Unit Setting	Pressure Unit	Select the acceleration, velocity, and temperature unit to be displayed on the Sushi Sensor App.	MPa	MPa, kPa, hPa, bar, mbar, psi	7
		Temperature Unit		°C	°C, K °F, °R	8
	Pressure	Type	Displays the measurement range of the pressure sensor.	-	-	9
		Measurement Range	Displays the measurement range of the pressure sensor according to the unit set in pressure units.	-	-	10
	Temperature	Measurement Range	Displays the measurement range of the temperature sensor corresponding to the unit set in the temperature unit.	-	-	11

Table 4-7 Transmission mode

Transmission mode	Description
High Speed mode is ON	The sending period can be set from 1 minute to 72 hours. However, if number of axes to be sent is multiple, please set the transmission cycle to 10 minutes or more.
High Speed mode is OFF	The sending period can be set from 3 hours to 72 hours. There is no limit on the sending period depending on number of axes to be sent.

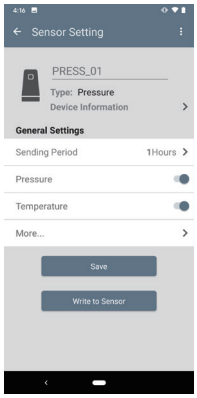
If you operate a Sushi sensor at a sending period 3 hours or less, set High Speed mode is ON.

Table 4-8 Sub-band Setting Parameter

Sub-band Setting Parameter		US Frequency [MHz]
1	All*	902.3 - 903.7
2		903.9 - 905.3
3		905.5 - 906.9
4		907.1 - 908.5
5		908.7 - 910.1
6		910.3 - 911.7
7		911.9 - 913.3
8		913.5 - 914.9

4.2.4.1 <Sensor Setting> screen

Set #1 to #4 in Table 4-6 on this screen.



F040211.ai

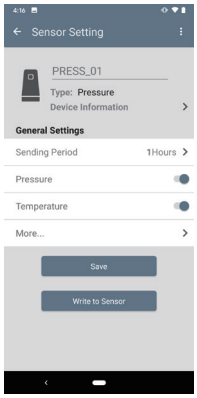
Figure 4-18 XS530 <Sensor Setting> screen

NOTE

When both pressure and temperature are turned ON in the basic setting, select a transmission cycle of 10 minutes or longer. If you specify 1 minute, the sending Measurement data may not reach the data Collection Server.

4.2.4.2 <Sensor Setting> screen more settings

Set #5 to #11 in Table 4-6 on this screen.



F040212.ai

Figure 4-19 XS530 more settings

4.2.4.3 Check or Change the Settings of XS530 Sending Data

Check or change XS530 sending data.

(1) Display the <Sensor Setting> screen.

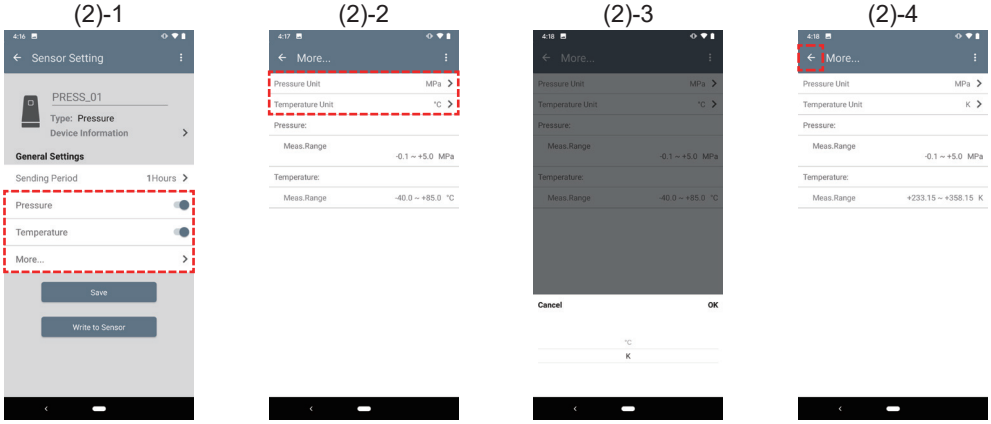
(2) Select the measurement data to be sent.

(2)-1 Check or change “Pressure” and “Temperature”. Press [More] button.

(2)-2 Confirm the unit of pressure or temperature to be transmitted.

(2)-3 To change units, press the “unit of pressure” or “unit of temperature” button. Select from the list of units. Refer to Table 4-13 for possible units.

(2)-4 Press [Back] button.



F040213.ai

Figure 4-20 Selecting the Measurement data

(3) Write settings.

(3)-1 Write the settings as described in subsection 4.2.1, “Sensor Setting Method”.

NOTE

The number of sending data and its sending period affect battery life. Refer to section 6.6

4.2.5 XS550 Sensor Setting

Specify sensor tag name, sampling data, sending period and transmission mode for XS550. Possible and the default value of each item is shown below.

Table 4-9 XS550 Sensor Setting Items

Item			Description	Default	Possible Setting	#
General setting	Sensor Tag Name		This is the tag name of Sushi Sensor. Setting this item is mandatory.	Blank	-	1
	Sending Period		This is the sending cycle of sampling data	1[Hours]	1,10,30[Minutes] 1, 2, 3, 4, 5, 6, 12, 18, 24, 48, 72 [Hours]	2
	Sampling Data	Temperature 1	Sets the measurement data to be sent. When sending 1 point of Temperature data, set Temperature 1 to ON and set the type of thermocouple, etc. on the extension setting screen.	ON	ON/OFF	3
		Temperature 2	Sets the measurement data to be sent. When sending 2 points of Temperature data, set Temperature 1 and Temperature 2 to ON, and set the type of thermocouple etc. on the extension setting screen.	OFF	ON/OFF	4
More	Unit Setting	Temperature Unit	Sets the temperature unit to send.	°C	°C, K, °F, °R	5
	Temperature 1	Type	Select the type of thermocouple to connect to Temperature 1.	Type K	Type B, Type E, Type J, Type K, Type N, Type R, Type S, Type T, Type C	6
		Measurement range	Displays the temperature measurement range for the selected Temperature unit and thermocouple type.	-200~ + 1372°C	-	7
		Serial Number	Serial number of the thermocouple can be entered.	Blank	Up to 10 characters Alphanumeric characters (A-Z, 0 ~ 9) and hyphen "-", underscore "_"	8
	Temperature 2	Type	Select the type of thermocouple to connect to Temperature 2.	Unused	Type B, Type E, Type J, Type K, Type N, Type R, Type S, Type T, Type C Not used	9
		measurement range	Displays the temperature measurement range for the selected temperature range and thermocouple type. Displays "-" if unused.	-	-	10
		Serial Number	Serial number of the thermocouple can be entered.	Blank	Up to 10 characters Alphanumeric characters (A-Z, 0 ~ 9) and hyphen "- ", underscore" _ "	11
	Transmission Mode	High Speed Mode	For details of this setting, refer to Table 4-15. This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is EU.	ON	ON/OFF	12
	Sub-band Setting		Specify the frequency band to be used when sending Sushi Sensor to LoRa Gateway. Set the same parameter as LoRa Gateway. For details of this setting refer to Table 4-16 This setting is displayed in the Sushi Sensor App if the Sushi Sensor firmware's regional parameter is US.	1	All, 1, 2, 3, 4, 5, 6, 7, 8	13

Table 4-10 Transmission mode

Transmission mode	Description
High Speed mode is ON	The sending period can be set from 1 minute to 72 hours. However, if number of axes to be sent is multiple, please set the transmission cycle to 10 minutes or more.
High Speed mode is OFF	The sending period can be set from 3 hours to 72 hours. There is no limit on the sending period depending on number of axes to be sent.

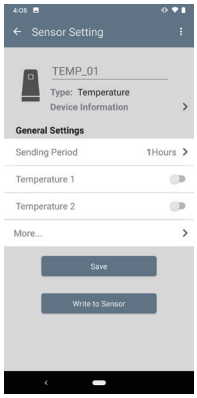
If you operate a Sushi sensor at a sending period 3 hours or less, set High Speed mode is ON.

Table 4-11 Sub-band Setting Parameter

Sub-band Setting Parameter		US Frequency [MHz]
1	All*	902.3 - 903.7
2		903.9 - 905.3
3		905.5 - 906.9
4		907.1 - 908.5
5		908.7 - 910.1
6		910.3 - 911.7
7		911.9 - 913.3
8		913.5 - 914.9

4.2.5.1 <Sensor Setting> screen

Set #1 to #4 in Table 4-9 on this screen.



F040214.ai

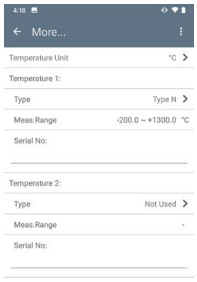
Figure 4-21 XS550 <Sensor Setting> screen

NOTE

When temperature 1 and temperature 2 are send, set the sending period to 10 minutes or more.
If sending period is less than 10 minutes, the data may not reach the Application.

4.2.5.2 <Sensor Setting> screen more settings

Set #5 to #13 in Table 4-9 on this screen.



F040215.ai

Figure 4-22 XS550 more settings

4.2.5.3 Check or Change the Settings of XS550 Sending Data

Check or change XS550 sending data.

(1) Display the <Sensor Setting> screen.

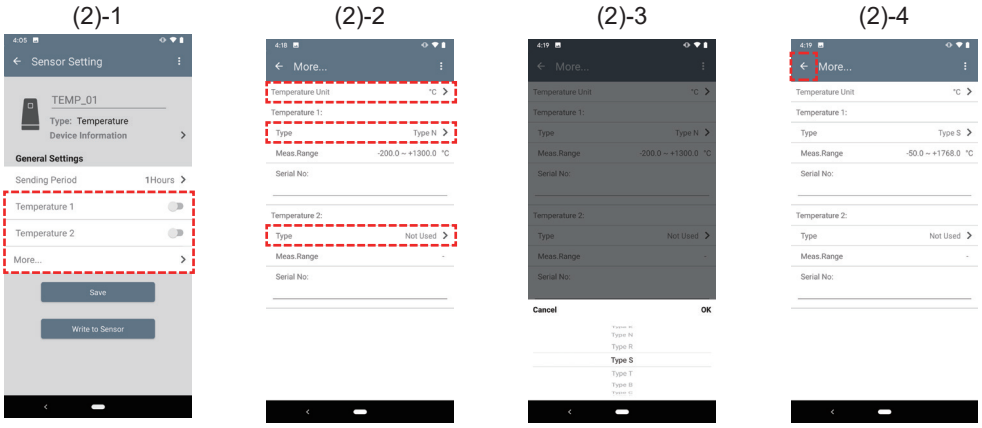
(2) Check or change the sending data

(2)-1 Check or change ON/OFF “Temperature 1” and “Temperature 2”.

(2)-2 Check the temperature unit to be transmitted and the type of thermocouple to be connected.

(2)-3 To change units, press the “unit of temperature” button and select from the list. To change the type of thermocouple to be connected, press the “Type” button and select from the list. See Table 4 -10 for possible units and thermocouple types.

(2)-4 Press [Back] button.



F040216.ai

Figure 4-23 Selecting the type of sending data

(3) Write settings.

(3)-1 Write the settings as described in subsection 4.2.1, “Sensor Setting Method”.

NOTE

- The number of sending axes and its sending period affect battery life. Refer to section 6.6
- Confirm the thermocouple to be connected and set the type correctly.

4.3 Import and Export Setting

Sushi Sensor setting data saved in Sushi Sensor App can be exported or import to/from PC.

4.3.1 Export Setting to PC

This section describes the procedure to export the Sushi Sensor to PC.

(1) Specify export destination

(1)-1 On the home screen of the Sushi Sensor App, press [Sensor Setting] button.

(1)-2 Press [Export/Import] button.

(1)-3 Press [Device] button.

(1)-4 <Sensor list> appears on the screen.
All the devices in this list are subject to export.

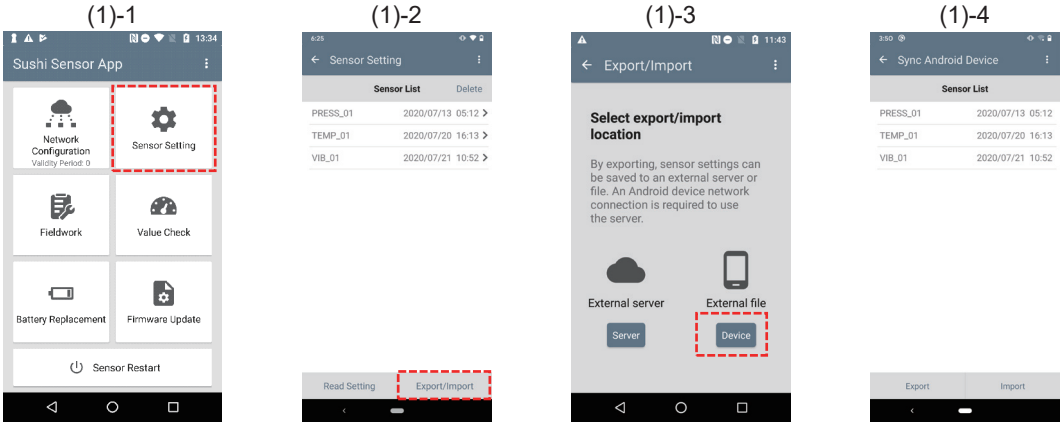


Figure 4-24 Specify Android Device as Export Destination

(2) Export setting of XS770A on Android Device.

(2)-1 Press the [Export] button.
Data export on the local storage is executed. After that, “Export Completed” message with data stored path is shown.

(2)-2 Press [Done] button.

(2)-3 Restart the Android device manually.

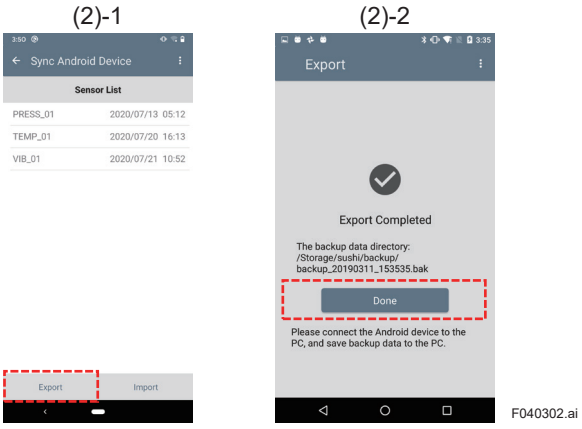


Figure 4-25 Export Setting on Android Device

NOTE

After restarting the android device, you can securely access the backup file from the PC.

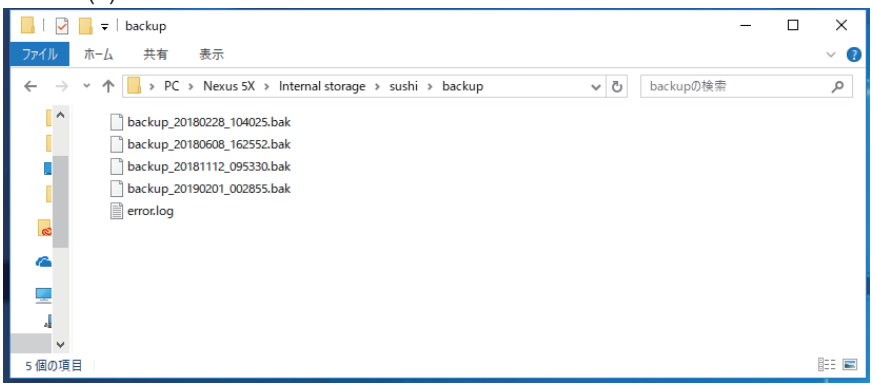
(3) Save to PC.

(3)-1 Connect Android device and PC.

(3)-2 Open “internal storage / sushi / backup” folder of the Android device.

(3)-3 Transfer the backup file (*.bak file) to PC.

(3)-2



F040303.ai

Figure 4-26 Saving the backup file to PC

NOTE

- Have to change the USB configuration of the Android device to file transfer. Tap the “Charging this device via USB” notification. Under “Use USB for,” select File Transfer.
- The “internal storage / sushi / backup” folder is created automatically after saving the setting of XS770A on Android device.

Backup filename is “backup_YYYYMMDD_HHmmss.bak”.

YYYYMMDD_HHmmss is the timestamp of the saved date. YYYY is a year, MM is a month, DD is a day, HH is a 24-hour notation, mm is a minute, and ss is second.

4.3.2 Import Setting from PC

This section describes the procedure to import Sushi Sensor setting from PC.

NOTE

Have to change USB configuration of Android device to file transfer. Tap the “Charging this device via USB” notification. Under “Use USB for,” select File Transfer.

(1) Load backup file from PC to Android device.

(1)-1 Connect PC and Android device.

(1)-2 Copy backup file (*.bak file) from PC to “internal storage / sushi / backup” folder of Android device.

(2) Specify the import source.

(2)-1 On the home screen of the Sushi Sensor App, press [Sensor Setting] button.

(2)-2 Press [Export/Import] button.

(2)-3 Press [Device] button.

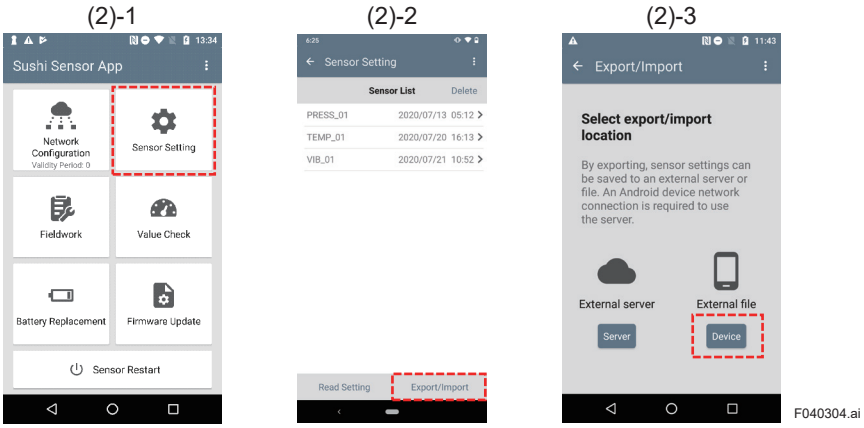


Figure 4-27 Specify Android Device as Import Source

(3) Import to Sushi Sensor App.

(3)-1 Press [Import] button. Sensor List (refer to Table 5-4) stored in backup file is listed on Sushi Sensor App.

(3)-2 Select XS770A to be imported from the list and press [Import] button.

(3)-3 Make sure that the selected sensor tag name is shown in <Sensor List>.

Figure 4-28 Import Setting to Sushi Sensor App

5. Fieldwork

5.1 Overview

Fieldwork verifies that Sushi Sensor sending data reaches data collection server and this server output values correctly. Fieldwork is executed by using the Sushi Sensor App.

5.2 Procedure

Provides step-by-step instructions on how to use the Sushi Sensor App for fieldwork.

(1) Check Sushi Sensor status.

(1)-1 On the home screen of the Sushi Sensor App, press [Fieldwork] button.

(1)-2 Move the Android device closer to Sushi Sensor.

(1)-3 Check the sensor tag name and status. When the status is “GOOD”, fieldwork can be executed.

Figure 5-1 Check Sushi Sensor Status

(2) Execute Fieldwork

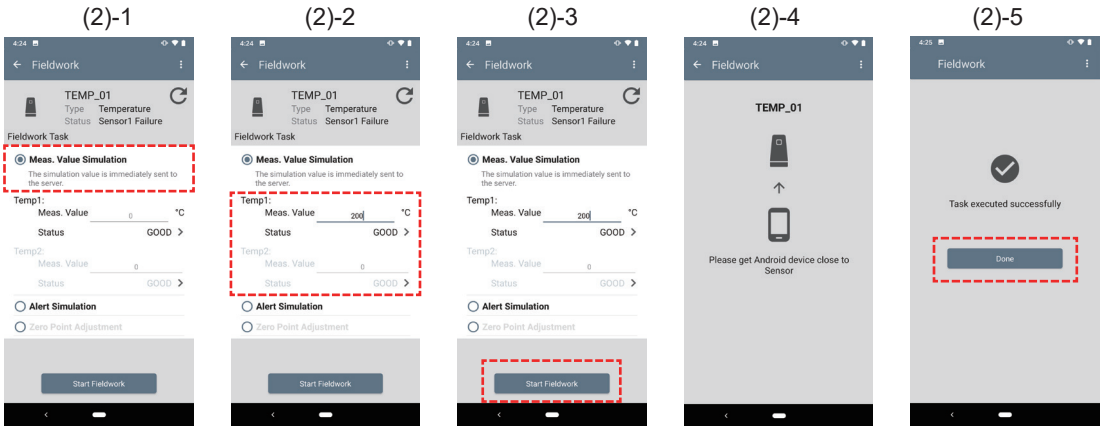
(2)-1 Select the task to be executed from the task list.

(2)-2 Enter task settings. The task setting depends on the type of sensor. See section 5.3 and subsequent chapters for details.

(2)-3 Press [Start Fieldwork] button.

(2)-4 Move the Android device closer to Sushi Sensor.

(2)-5 Press [Done] button.



F050202.ai

Figure 5-2 Execute Fieldwork

NOTE

When settings via NFC of the Sushi Sensor, be sure to connect the XS110A to the measurement module (e.g. XS530, XS550).

5.3 Fieldwork Operation for Each Sensor

5.3.1 Fieldwork Operation for XS770A

Fieldwork performs operations shown in Table 5-1.

Table 5-1 Fieldwork operation list for XS770A

Item	Description
Meas. Value Simulation	The sensor sends a specified value (selected from 0, 50, 75, or 100% of the measurement range) to the Data collection server once. Verify that the values are correct with this server
3-point Check	The sensor sends 0, 50 and 100% of the measurement range automatically every 10 minutes. Verify that the values are correct with this server.
Battery Life Estimation	Sushi Sensor App determines the communication quality between LoRaWAN gateway and Sushi Sensor and calculates estimated XS770A battery life. Verify the battery life with Sushi Sensor App. The procedure takes about 20 seconds to get the result.

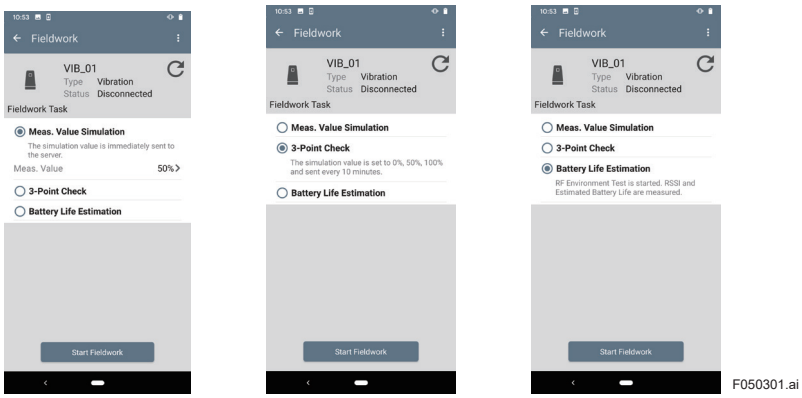


Figure 5-3 Fieldwork operation list for XS770A

5.3.2 Fieldwork Operation for XS530

Fieldwork performs operations shown in Table 5-2.

Table 5-2 Fieldwork operation list for XS530

Item	Description
Meas. Value Simulation	Sends user-entered pressure and temperature readings and status to the data collection server once. Input the measured pressure value in the range of -0.1 to 5.0 and measured temperature value in the range of -40 to 85. Select the status from GOOD, BAD (failure), or BAD (needs inspection). Verify that the values are correct with this server.
Alarm Simulation	Sends the user-entered alarm to the data collection server once. The alarm can be selected from GOOD, failure, OFF, measurement not possible, power drop, temperature error, no setting, no connection, Sim, and threshold error. Verify that the values are correct with this server.
Zero Point Adjustment*	After installing the XS530, you can adjust the pressure output value. For details of the zero point adjustment procedure, refer to the following.

*: The XS530 is adjusted at the factory shipped. This function corrects the calculation error due to atmospheric pressure fluctuation.

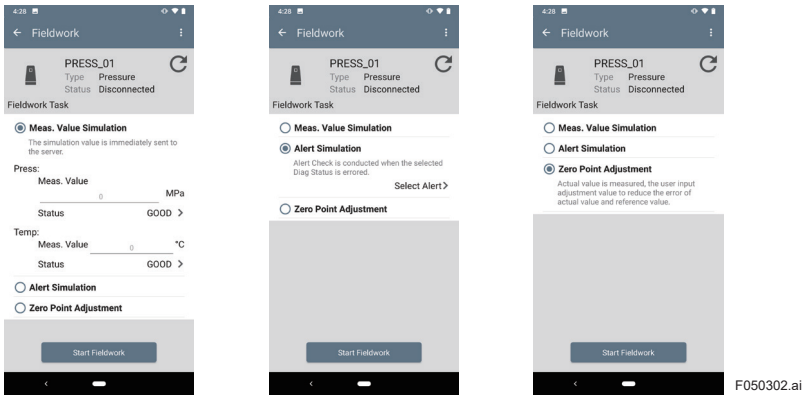


Figure 5-4 Fieldwork operation list for XS530

NOTE

Adjust the zero point while the measured value is stable.

Zero Point Adjustment Procedure

(1) Open air conditions or Apply pressure with measured value are measured with a precision pressure measuring instrument.

(2) Display the <Fieldwork> screen.

(3) Select [Zero Point Adjustment] button, then press [Start Fieldwork] button.

(4) Move the Android device closer to Sushi Sensor.

(5) Input the measured value to measure in (1) and press [Start Adjustment] button.

(6) Move the Android device closer to Sushi Sensor.

(7) Confirm that the zero point setting value is the value set in (5), and press [Done] button.

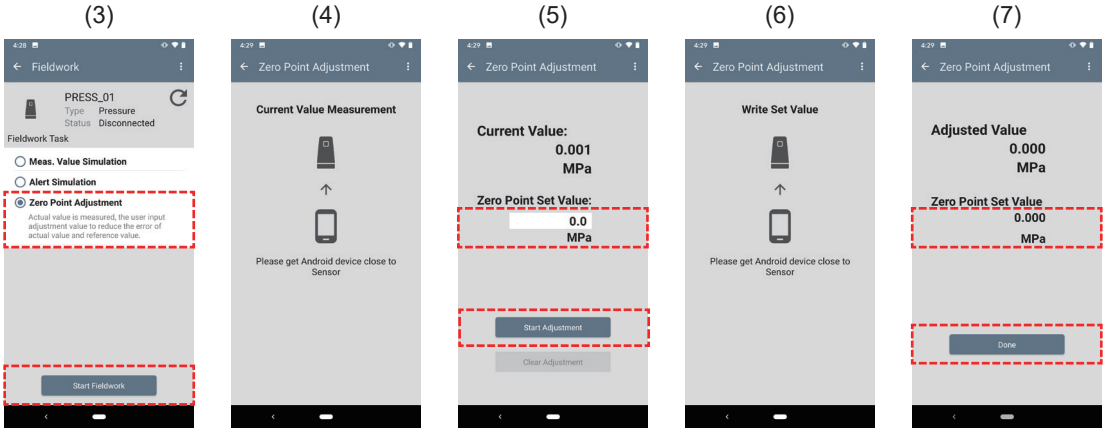


Figure 5-5 XS530 Zero Point Adjustment Procedure

Clear Adjustment

This paragraph describes the procedure for clearing the set zero point adjustment.

(1) Follow steps (2) and (3) of the zero point adjustment procedure described above to display the <zero point adjustment> screen.

(2) Press [Clear Adjustment] button.

(3) Move the Android device closer to Sushi Sensor.

(4) Press [Done] button.

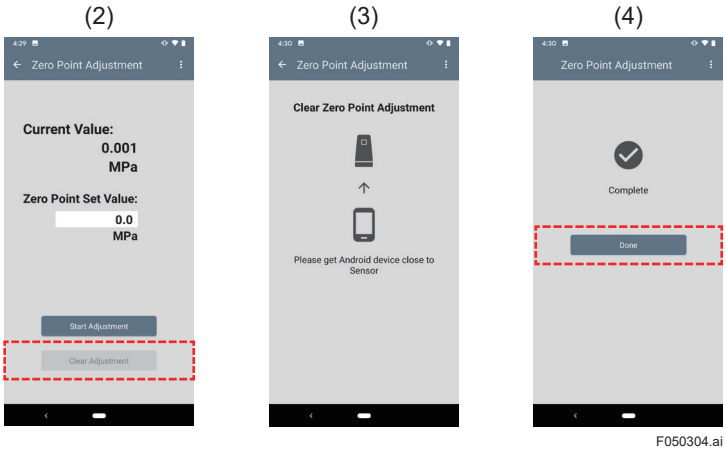


Figure 5-6 XS530 Zero Point Clearing Procedure

5.3.3 Fieldwork Operations for XS550

Fieldwork performs operations shown in Table 5-3.

Table 5-3 Fieldwork operation list for XS550

Item	Contents
Meas. Value Simulation	Sends user-entered temperature readings and status to the data collection server once. Input the measured pressure value in the range of -0.1 to 5.0 and measured temperature value in the range of -40 to 85. Select the status from GOOD, BAD (failure), or BAD (needs inspection). Verify that the values are correct with this server.
Alarm Simulation	Sends the user-entered alarm to the data collection server once. The alarm can be selected from GOOD, failure, OFF, measurement not possible, power drop, temperature error, no setting, no connection, Sim, and threshold error. Verify that the values are correct with this server.
Zero Point Adjustment*	After installing the XS530, you can adjust the pressure output value. For details of the zero point adjustment procedure, refer to the following.

*: The XS550 is adjusted at the factory-shipped. This function corrects the calculation error due to atmospheric pressure fluctuation.

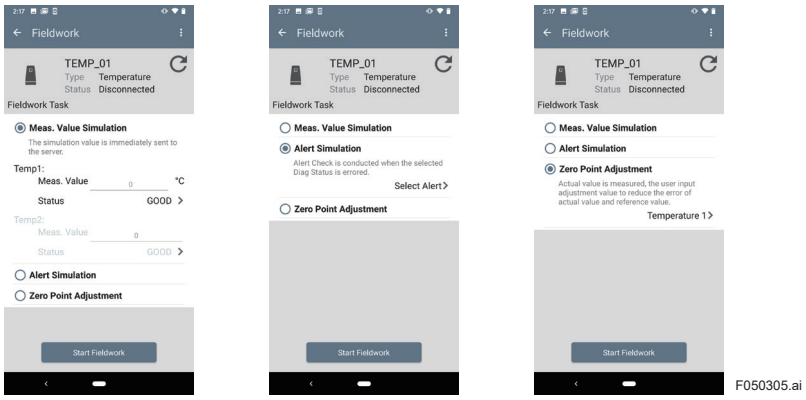


Figure 5-7 Fieldwork operation list for XS550

NOTE

Adjust the zero point while the measured value is stable.

Zero point adjustment procedure

(1) Measure the value of the thermocouple with a precision pressure measuring instrument.
(2) Display the <Fieldwork> screen.
(3) Select [Zero Point Adjustment] button, then press [Start Fieldwork] button.
(4) Move the Android device closer to Sushi Sensor.
(5) Input the measured value to measure in (1) and press [Start Adjustment] button.
(6) Move the Android device closer to Sushi Sensor.
(7) Confirm that the zero point setting value is the value set in (5), and press [Done] button.

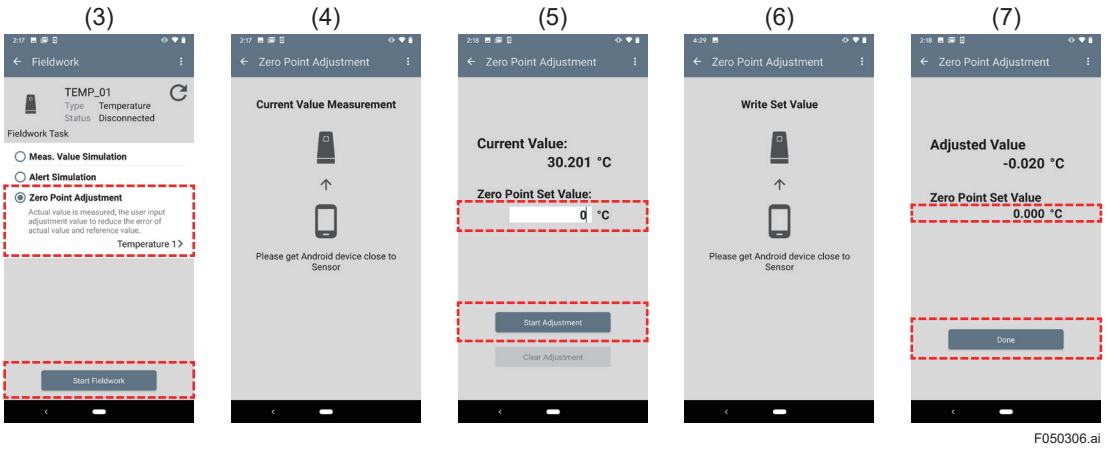


Figure 5-8 XS550 Zero Point Adjustment Procedure

Clear Adjustment

This paragraph describes the procedure for clearing the set zero point adjustment.

(1) Follow steps (2) and (3) of the zero point adjustment procedure described above to display the < Zero Point Adjustment > screen.
(2) Press [Clear Adjustment] button.
(3) Move the Android device closer to Sushi Sensor.
(4) Press [Done] button.

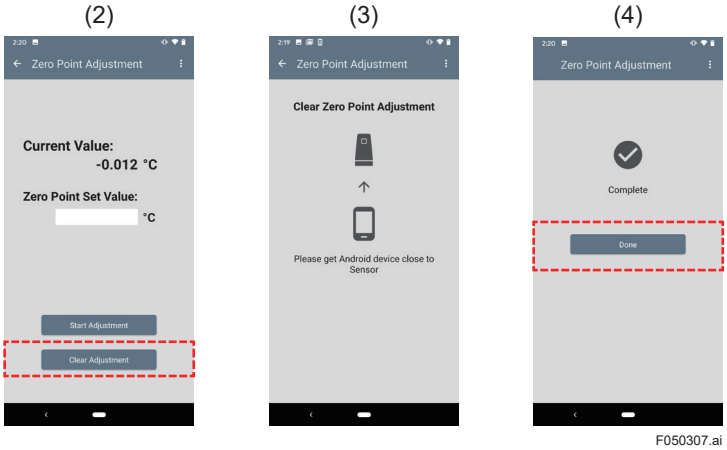


Figure 5-9 XS550 Zero Point Clearing Procedure

6. Operation and Maintenance

This section describes how to carry out daily inspection, a sensor indicates warning or error status.

NOTE

When using the NFC communication function of the XS110A, connect the XS110A to the Measurement Module e.g. XS530, XS550. However, switch to ON or OFF mode (subsection 6.9.1) and initialize the battery life (section 6.7) without connecting the measurement module.

6.1 Daily Inspection Using Sushi Sensor App

This section explains the procedure of daily inspection of Sushi Sensor status.

(1) Read the current status of Sushi Sensor.

(1)-1 On the home screen of the Sushi Sensor App, press [Value Check] button.

(1)-2 Move the Android device closer to Sushi Sensor.

(1)-3 <Value Check> screen appears after reading status. Make sure that the icons shown in Table 6-1 are not displayed. If the icon is displayed, check the <STATUS> display in step (2).

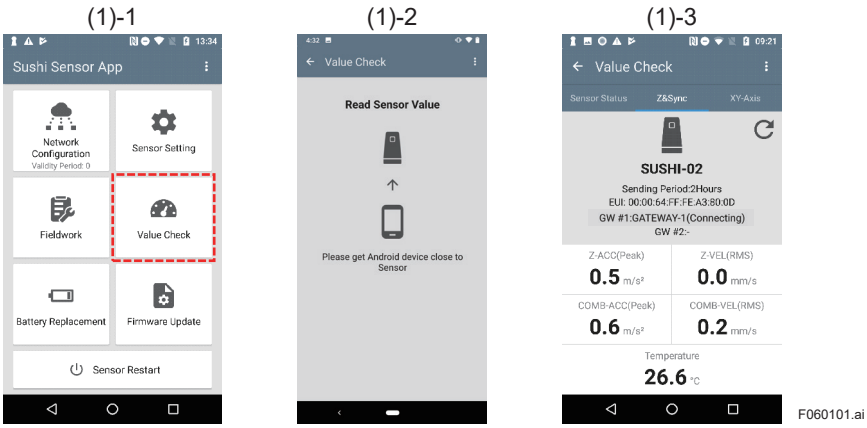


Figure 6-1 Read Current Status

Table 6-1 Types and descriptions of sensor caution marks

Mark	Description
	Failure of the Sushi Sensor is detected
	Over range of the sensor is detected.

If the thermocouple of Temperature 2 is not connected to the XS550 and “Unused” is selected as the type of thermocouple, the measured temperature value is displayed as “-”.

(2) Check the device status of Sushi Sensor.

(2)-1 Press “Sensor Status” tab and check the following items.

- Check any alarms are notified in the “STATUS” area.
- Check that RSSI has not decreased significantly compared with startup.

(2)-1

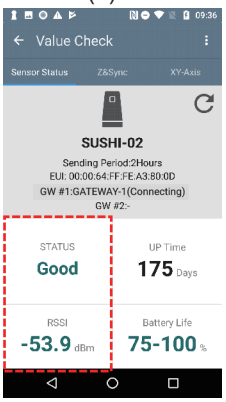


Figure 6-2 Check Device Status

6.2 Self-Diagnosis data

Sushi Sensor sends the device status to the data collection server once a day. Monitor the device status by using this server if necessary. For details of health report information (HRI) and self-diagnosis information (DIAG) refer to chapter 7.

6.3 Handling a Device in the Warning Status

If there is a device that indicates some warnings, a communication error may occur even if the data sending is continued. If a warning message appears due to the remaining battery life of Sushi Sensor, immediately replace the battery regardless of the displayed number of days.

When some warnings regarding a degradation of wireless communication are notified by monitoring Health Report Information (HRI), check whether there are any obstructs or interference sources around the communication path.

6.4 Errors and Countermeasures

This section explains what is displayed in “State” on the <Value Check> screen and how to deal with it.

6.4.1 Errors and Countermeasures for XS770A

IMPORTANT

If NFC communication is not available, perform a hardware reset of the XS770A.
Remove the battery from the XS770A and wait 30 seconds. Then, install the battery.
Refer to User's Manual of XS770A on how to install and remove the battery.

Table 6-2 XS770A status and action strategies

Status Display	DIAG STATUS	DIAG STATUS DETAIL	DATA_ STATUS	OUTPUT OPERATION	Description	Action
No setting	Bit25	Bit23	-		Network is not configured for XS770A.	Configure the network for XS770A. Refer to Section 4.1.
Unconnected	Bit25	Bit22	-		XS770A is not connected to the gateway.	Check whether there is any shielding object between XS770A and the gateway, or any object that interferes with radio waves.
OFF	Bit24	Bit16	-		XS770A is in OFF mode.	Perform the procedure to change ON mode (refer to subsection 6.9.2).
Low power	Bit20	Bit31	-	Normal measurement	Power is low.	Replace the battery. Refer to subsection 6.7 for the battery replacement procedure.
	Bit19	Bit30	-	Normal measurement	The battery life has dropped to 25% or less	
Temperature error	Bit22	Bit28	-	Normal measurement	CPU temperature is above + 85 degrees.	The XS770A operating environment is outside the specified range. A failure may occur if you keep using it without taking corrective actions. Use it in a location with an environment that meets the relevant specifications.
		Bit29		Normal measurement	CPU temperature is below -40 degrees.	
In failure	Bit27	Bit19	-	Normal measurement	A memory error has occurred	Replace the device. Export the XS770A setting if necessary.
	Bit26	Bit25	Bit15	Previous value	An error has occurred during acceleration measurement.	
			Bit14	Previous value	An error has occurred during velocity measurement.	
		Bit24	Bit13	Previous value	An error has occurred during temperature measurement.	
Sim	Bit17	Bit17	Bit8	Simulation value	Task check is running for XS770A.	The simulation value is being sent. Wait until the task check is completed.
threshold error	Bit23	Bit21	Bit12	Normal measurement	The vibration value measured by XS770A is outside the measurable range.	Check the installation status XS770A.
			Bit11	Normal measurement		
		Bit20	Bit10	Normal measurement	The temperature measured by XS770A is outside the measurable range.	
Good					XS770A is in a normal state.	None.

6.4.2 Errors and Countermeasures for XS530

IMPORTANT

If NFC communication is not available, perform a hardware reset of the XS110A.
Remove the battery from the XS110A and wait 150 seconds. Then, install the battery.
Refer to User's Manual of XS110A on how to install and remove the battery.

Table 6-3 XS530 status and action strategies

Status Display	DIAG STATUS	DIAG STATUS DETAIL	DATA_ STATUS	OUTPUT OPERATION	Description	Action
Failure of measurement module	Bit27	Bit24	Bit15	Previous value	XS530 memory failure.	Replace the XS530. Backs up settings as needed.
		Bit14	Bit15	Previous value	XS530 hardware failure.	
		Bit13	Bit15	Previous value	XS530 sensor failure	
Failure of communication module		Bit31	Bit15	Previous value	XS110A CPU failure	Replace the XS110A. Back up settings as needed
		Bit25	Bit15	Previous value	The XS110A memory failure	
OFF	Bit24	Bit16	Bit12		XS530 is in OFF mode.	Change to ON mode (See subsection 6.9.2).
Connection failure	Bit21	Bit21	Bit12	Previous value	XS530 is not connected	Check that the XS530 is connected.
Mismatch of the measuring module		Bit20	Bit12	Previous value	The latest firmware has not been downloaded.	Download the latest firmware.
Low power	Bit19	Bit30	-	Normal measurement	The battery life has dropped to 25% or less	Change the battery. Refer to the User's Manual of XS530 for the procedure of changing the battery.
Temperature error	Bit22	Bit29	-	Normal measurement	XS110A CPU temperature is above + 85 degrees.	Because the operating environment is out of specification, continued use may cause malfunction. Use in a location where the environment is within specifications
		Bit28	-	Normal measurement	XS110A CPU temperature is below - 40 degrees.	
No setting	Bit13	Bit23	-		Network is not configured for XS530.	Configure the network settings on the XS110A. Refer to section 4.1 for the procedure of the network setting.
Unconnected	Bit12	Bit22	-		XS530 is not connected to the gateway.	Check the radio path between the XS110A and the gateway for any obstructions or radio interference.
Sim	Bit17	Bit18	-	Normal measurement	Alarm simulation for fieldwork task in progress	The simulation value is being sent. Wait until the task check is completed.
		Bit17	Bit8	Simulation value	Fieldwork task measurement simulation in progress	

Status Display	DIAG STATUS	DIAG STATUS DETAIL	DATA_ STATUS	OUTPUT OPERATION	Description	Action
Threshold abnormal	Bit23	Bit10	Bit12	Normal measurement	The pressure measured by XS530 is outside the measurable range.	Check the installation status XS530.
		Bit4	Bit12	Normal measurement	The temperature measured by XS530 is outside the measurable range.	
Good					XS530 is in a normal state.	None.

6.4.3 Errors and Countermeasures for XS550

IMPORTANT

If NFC communication is not available, perform a hardware reset of the XS110A.
Remove the battery from the XS110A and wait 150 seconds. Then, install the battery.
Refer to User's Manual of XS110A on how to install and remove the battery.

Table 6-4 XS550 status and action strategies

Status Display	DIAG STATUS	DIAG STATUS DETAIL	DATA_ STATUS	OUTPUT OPERATION	Description	Action
Failure of measurement module	Bit27	Bit24	Bit15	Previous value	XS550 memory failure.	Replace the XS550. Backs up settings as needed.
		Bit14	Bit15	Previous value	XS550 hardware failure.	
		Bit13	Bit15	Previous value	XS550 sensor failure	
Failure of communication module		Bit31	Bit15	Previous value	XS110A CPU failure	Replace the XS110A. Back up settings as needed
		Bit25	Bit15	Previous value	The XS110A memory failure	
OFF	Bit24	Bit16	Bit12		XS550 is in OFF mode.	Change to ON mode (See subsection 6.9.2).
Connection failure	Bit21	Bit21	Bit12	Previous value	XS530 is not connected	Check that the XS550 is connected.
Mismatch of measurement module		Bit20	Bit12	Previous value	The latest firmware has not been downloaded.	Download the latest firmware.
Temperature 1 disconnection	Bit26	Bit11	Bit15	Previous value	Temperature sensor 1 is disconnected.	Replace temperature sensor 1.
Temperature 2 disconnection		Bit5	Bit15	Previous value	Temperature sensor 2 is disconnected.	Replace temperature sensor 2.
Low power	Bit19	Bit30	-	Normal measurement	The battery life has dropped to 25% or less	Change the battery. Refer to the XS550 User's Manual for the procedure of changing the battery.
Temperature error	Bit22	Bit29	-	Normal measurement	XS110A CPU temperature is above + 85 degrees.	Because the operating environment is out of specification, continued use may cause malfunction. Use in a location where the environment is within specifications
		Bit28	-	Normal measurement	XS110A CPU temperature is below - 40 degrees.	

Status Display	DIAG STATUS	DIAG STATUS DETAIL	DATA_ STATUS	OUTPUT OPERATION	Description	Action
No setting	Bit13	Bit23	-		Network is not configured for XS550.	Configure the network settings on the XS110A. Refer to section 4.1 for the procedure of the network setting.
Unconnected	Bit12	Bit22	-		XS550 is not connected to the gateway.	Check the radio path between the XS110A and the gateway for any obstructions or radio interference.
Sim	Bit17	Bit18	-	Normal measurement	Alarm simulation for fieldwork task in progress	The simulation value is being sent. Wait until the task check is completed.
		Bit17	Bit8	Simulation value	Fieldwork task measurement simulation in progress	
Threshold abnormal	Bit23	Bit12	Bit12	Normal measurement	The measured value of the terminal block temperature sensor exceeds the measurable range.	Check the installation status XS550.
		Bit10	Bit12	Normal measurement	The measured value of temperature sensor 1 exceeds the measurable range.	
		Bit4	Bit12	Normal measurement	The measured value of temperature sensor 2 exceeds the measurable range.	
Good					XS550 is in a normal state.	None

6.5 Device Replacement

The section explains the procedure to replace devices, but the following procedure is not required when replacing the XS110A. For instructions on replacing the hardware, refer to the User's Manual of each Sushi Sensor.

(1) Displays the <Sensor Setting> screen of the Sushi Sensor to be replaced.

(1)-1 Follow the procedure to writing settings from the Sushi Sensor in subsection 4.2.1 or the procedure to recall settings saved in the Sushi Sensor App to display the <sensor setting> screen.

(2) Write the settings to the new Sushi Sensor.

(2)-1 Prepare a new Sushi Sensor.

(2)-2 Import the sensor settings following the procedure for writing to the Sushi Sensor in subsection 4.2.1.

(2)-3 Import the network settings as described in section 4.1.

(3) Confirm connectivity with the gateway.

(3)-1 Make sure new Sushi Sensor connected to the gateway as described in section 6.1.

6.6 Estimated Battery Life

The Sushi Sensor battery life is affected by the sending period and the ambient environment. This section shows the battery life of each sensor.

6.6.1 Estimated Battery life of XS770A

The following shows the estimated battery life of XS770A at an ambient temperature of 23 ± 2 °C.

Table 6-5 Estimated Battery Life of XS770A

Sending Period	Number of axes to be sent	Battery Life
1 day	1	10 years
1 hour	1	4 years
1 hour	4	3 years
1 minute	1	2 months

6.6.2 Estimated Battery life of XS530

The following shows the estimated battery life of XS110A with XS530 at an ambient temperature of 23 ± 2 °C.

Table 6-6 Estimated Battery Life of XS530

Sending Period	Number of axes to be sent	Battery Life
1 day	1	10 years
1 hour	1	10 years
30 minutes	1	10 years
10 minutes	1	10 years
10 minutes	2	10 years
1 minute	1	5 years

6.6.3 Estimated Battery life of XS550

The following shows the estimated battery life of XS110A with XS550 at an ambient temperature of 23 ± 2 °C.

Table 6-7 Estimated Battery Life of XS550

Sending Period	Number of axes to be sent	Battery Life
1 day	1	10 years
1 hour	1	10 years
30 minutes	1	10 years
10 minutes	1	10 years
10 minutes	2	10 years
1 minute	1	4 years

6.7 Initializing the Battery Life

This section explains how to initialize the battery life after battery replacement. If the battery level is not initialized, the battery life will not be calculated correctly.

Refer to the User's Manual of each Sushi Sensor for the battery replacement method.

(1) Initializes battery life.

(1)-1 On the start screen of the Sushi Sensor App, press [Battery Replacement] button.

(1)-2 Press the [Start] button.

(1)-3 Move your Android phone closer to the Sushi Sensor.

(1)-4 "Battery Replacement Completed" message appears after initializing battery life. Press [Done] button.

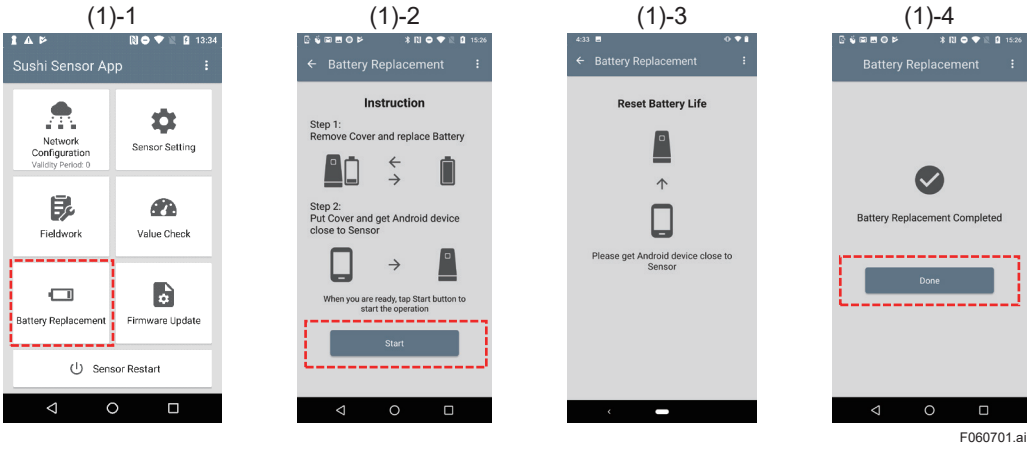


Figure 6-3 Initializing Battery Life

6.8 Firmware Update

The Sushi Sensor firmware can be updated by Sushi Sensor App. A new version of the Sushi Sensor firmware is provided through Sushi Sensor App.

IMPORTANT

It takes a few minutes to update the firmware. Before updating the firmware, the Android device should set to not to be entered sleep mode. If the Android device enters sleep mode during the update process, the firmware updating fails.

(1) Check the firmware version.

(1)-1 On the home screen of the Sushi Sensor App, press [Firmware Update] button.

(1)-2 Move the Android device closer to Sushi Sensor.

(1)-3 Check current and new firmware versions.

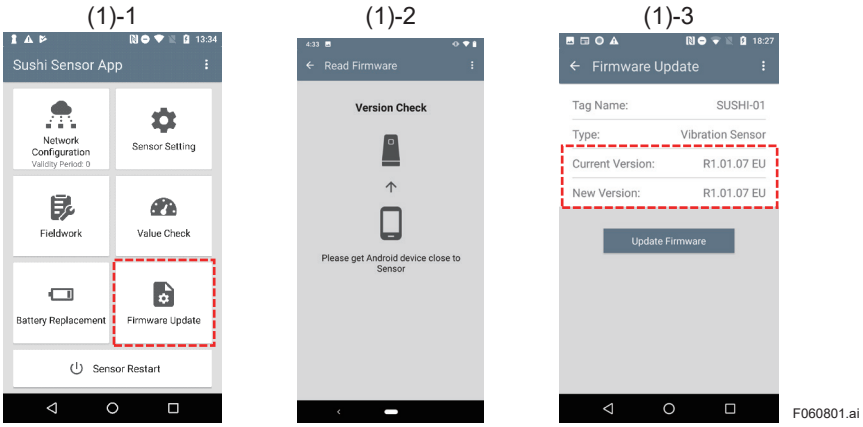


Figure 6-4 Check Firmware Version

(2) Update the new firmware.

(2)-1 Press [Update Firmware] button.

(2)-2 Check the new firmware version. And press [Yes] button.

(2)-3 Check the new firmware version and move the Android device closer to Sushi Sensor.

(2)-4 Do not move the Android device and Sushi Sensor until firmware writing is completed. It takes about 2 or 3 minutes.

(2)-5 “Firmware Update Completed” message appears after finishing it. Press [Done] button.
After firmware writing to Sushi Sensor, Sushi Sensor restarts automatically. It takes about 1 minute for the restart to complete.

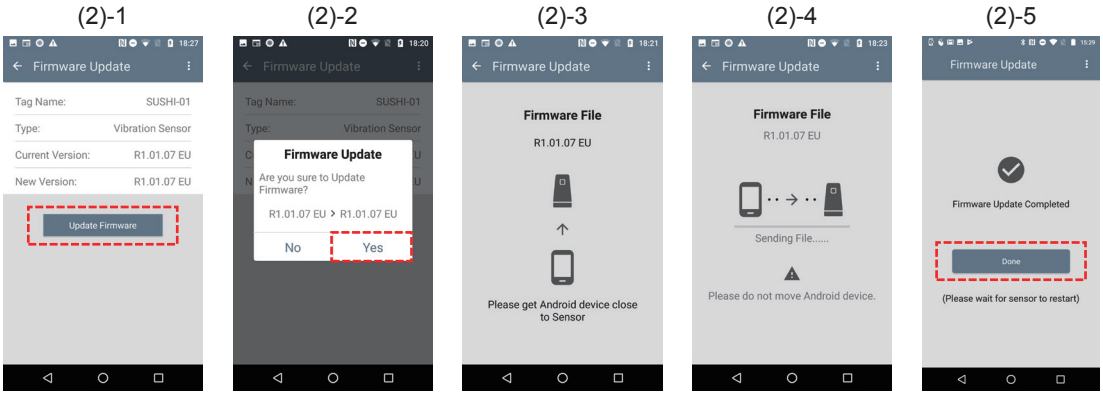


Figure 6-5 Firmware Update

6.9 Device Storage

When you store a Sushi Sensor or do not use it for a long period for transportation or other reasons, set the Sushi Sensor to OFF mode. OFF mode minimizes battery power consumption.

6.9.1 Change to OFF Mode

This section explains the procedure to change Sushi Sensor to OFF mode. After shifting to OFF mode, Sushi Sensor can be used only for NFC communication function.

(1) Check the current mode

(1)-1 Press [menu] button and [Sensor ON/OFF] button.

(1)-2 Move the Android device closer to Sushi Sensor.

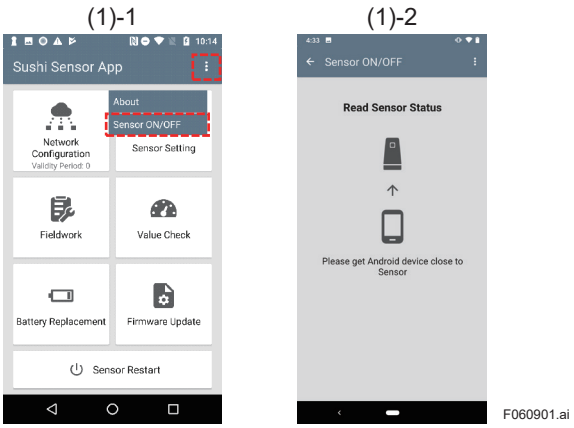


Figure 6-6 Sensor ON/OFF Menu

(2) Change to OFF mode.

(2)-1 Check “Current mode is “ON” “ message appears on the screen, press [Yes] button.

(2)-2 Move the Android device closer to Sushi Sensor.

(2)-3 After changing OFF mode, “Changed to “OFF Mode” “ message appears and press [Done] button.

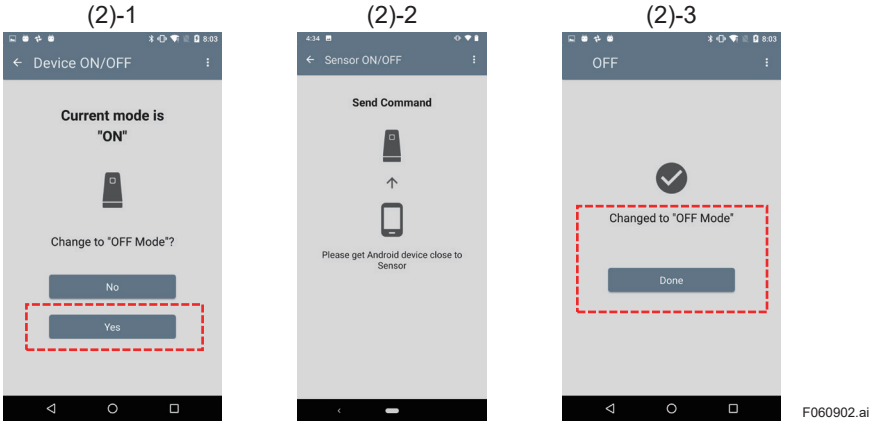


Figure 6-7 Shifting Sushi Sensor to OFF Mode

6.9.2 Change to ON mode

This section explains the procedure to return Sushi Sensor from OFF mode to ON mode.

(1) Check current mode

(1)-1 Press [menu] button and [Sensor ON/OFF] button.

(1)-2 Move the Android device closer to Sushi Sensor.

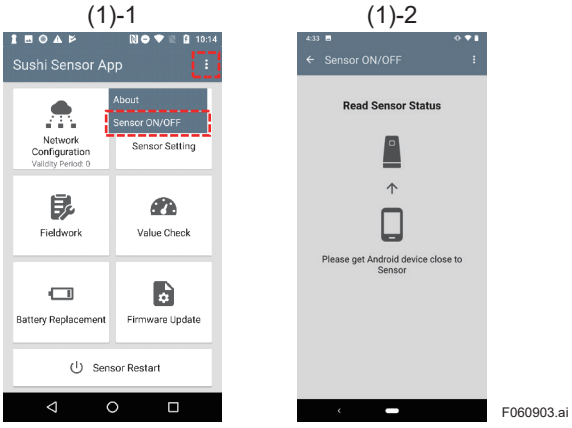


Figure 6-8 Sensor ON/OFF Menu

(2) Change to ON mode.

(2)-1 Check “Current mode is “OFF” “ message appears on the screen, press [Yes] button.

(2)-2 Move the Android device closer to Sushi Sensor.

(2)-3 After changing ON mode, “Changed to “ON Mode” “ message appears and press [Done] button.

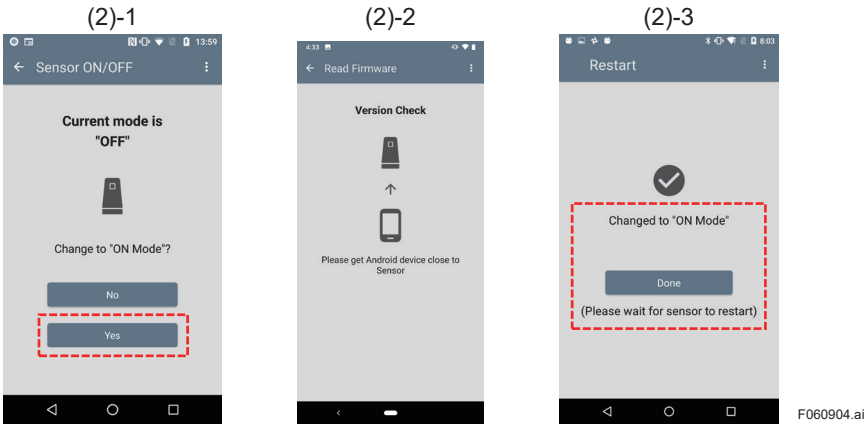


Figure 6-9 Shifting Sushi Sensor to ON Mode

NOTE

After executing network configuration, device setting, or firmware update during OFF mode, Sushi Sensor changes to ON mode automatically.

7. Sushi Sensor Sending Data

This chapter describes the data sent by Sushi Sensor.

Sushi Sensor sends data according to the format described in Table 7-1. The Data_Type field shows the formats of the sending data. The sending period varies depending on Data_Type.

For the Data_Type fields for each sensor, refer to section 7.7.

Table 7-1 Sending data format (Common)

Parameter Name	Size (Byte)	Description
Data_Type	1	0x40 Health report information (HRI) 0x41 Self-diagnosis information (DIAG) 0x42 Initialization Information (INI) 0x43 GPS Information (GPS) 0x44 Accurate GPS Longitude Information 0x45 Accurate GPS Latitude Information 0x46 Accurate GPS Altitude Information 0x47 Equipment Information
Data	Variable length	Varies depending on Data_Type

Table 7-2 Data_Type and sending period (Common)

Data_Type	Sending period
0x42 initialization information 0x43 GPS information 0x47 equipment information	When connected to the network, and one and two hours later, or when parameters are changed.
0x40 Health Information 0x41 Self-diagnostic Information	Once every 24 hours and after 15 minutes after network connection.
0x44 Precision GPS Latitude Information 0x45 Precision GPS Latitude Information 0x46 Precision GPS Altitude Information	When connected to the network, and one and two hours later, or when parameters are changed. Once a successful transmission, every 24 hours.

7.1 Health Report Information (HRI)

Table 7-3 Health report information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x40
UpTime	UINT24	3	Time elapsed after power-on Up to approximately 31 years. Unit: minute
BatteryLeft	UINT8	1	A value obtained by doubling the remaining battery level. Unit: % (Example: When 150, 150 ÷ 2 = 75%)
RSSI	UINT8	1	Receiving strength. Handled as a negative number. Unit: dBm
PER	UINT8	1	Packet error rate detected by the device. Unit: %
SNR	UINT8	1	A value obtained by multiplying the device-detected SN ratio by 4. Unit: dB (Example: When 27, 27 ÷ 4 = 6.75 dB)

7.2 Self-diagnostic Information (DIAG)

DIAG_STATUS is classified into four categories complying with NE107* of NAMUR (F: Failure, C: Function Check, O: Out of specification, M: Maintenance required), and each category is assigned to Bit27-1. When any Bit in each category is 1, the representative value of the category defined in Bit31-28 turns to 1. Also, when any Bit of DIAG_STATUS_DETAIL is ON, Bit0 of DIAG_STATUS turns to 1.

Each Bit turns to 1 when the status is detected.

* NAMUR NE107 “Self-Monitoring and Diagnosis of Field Devices”

The categories of Diagnostic Status and Diagnostic Status Detail differ depending on the sensor type. For details, refer to section 7.7.

Table 7-4 LoRaPayload format of self-diagnosis information

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x41
Diagnostic Status	UINT32	4	Diagnostic Information (outline)
Diagnostic Status Detail	UINT32	4	Diagnostic Information (detail)

7.3 Initialization Information

Table 7-5 Initialization information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x42
Tag_Name	STRING	10	Tag name defined in the device (up to ten ASCII characters)

7.4 GPS Information

GPS information is used by the XS770A.

Table 7-6 GPS information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x43
Longitude	FLOAT32	4	Use plus for East Longitude and minus for West Longitude.
Latitude	FLOAT32	4	Use plus for north latitude and minus for south latitude.

7.5 High-Precision GPS Information

High-precision GPS information is used by XS530 and XS550.

Table 7-7 High-precision GPS (Longitude) information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x44
Accurate_Longitude	DOUBLE	8	Use plus for East Longitude and minus for West Longitude.

Table 7-8 High-precision GPS (Latitude) information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x45
Accurate_Latitude	DOUBLE	8	Use plus for north latitude and minus for south latitude.

Table 7-9 High-precision GPS (Altitude) information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x46
Accurate_Altitude	DOUBLE	8	Altitude

7.6 Equipment Information

Equipment information includes sensor vendor information and version information. It is used in XS530 and XS550.

Table 7-10 Equipment Information sending data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x47
Vendor_ID	UINT32	4	Vendor Information Number
Dev_Type	UINT16	2	Indicates the type of measurement module for the Sushi Sensor. Temperature Measurement Module: 3 Pressure Measurement Module: 5
Dev_Rev	UINT16	2	Parameter Revision for Sushi Sensor equipment information.

7.7 Sensor Sending data

This section describes the sending data for each sensor type.

7.7.1 XS770A Sending data

The XS770A Data_Type is shown in Table 7-11. For the sending data format to Sushi Sensor, refer to Table 7-1.

Table 7-11 XS770A Data_Type

Parameter Name	Size (Byte)	Description	Sending Period
Data_Type	1	0x10 XS770A vibration (Z-Axis & Temperature) 0x11 XS770A vibration (XYZ-Axis & Temperature) 0x12 XS770A vibration (X-Axis) 0x13 XS770A vibration (Y-Axis)	Depending on the user's settings

7.7.1.1 XS770A Vibration (Z-Axis & Temperature)

Table 7-12 XS770A vibration (Z-axis & temperature) data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x10
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Acceleration error Bit14: Velocity error Bit13: Temperature error Bit12: Acceleration overrange Bit11: Velocity Overrange Bit10: Temperature Overrange Bit9: (Reserved) Bit8: Simulation Mode Bit0 to 7: (Reserved)
PV_Acceleration	FLOAT16	2	Z-axis acceleration peak value (m/s^2)
PV_Velocity	FLOAT16	2	Z-axis velocity RMS value (mm/s)
PV_Temperature	FLOAT16	2	Temperature measurement value (°C)

7.7.1.2 XS770A Vibration (XYZ-Axis & Temperature)

Table 7-13 XS770A vibration (XYZ-axis & temperature) data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x11
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Acceleration error Bit14: Speed error Bit13: Temperature error Bit12: Acceleration overrange Bit11: Speed Overrange Bit10: Temperature Overrange Bit9: (Reserved) Bit8: Simulation Mode Bit 0 to 7: (Reserved)
PV_Acceleration	FLOAT16	2	XYZ composite axis acceleration peak value (m/s^2)
PV_Velocity	FLOAT16	2	XYZ compound axis velocity RMS value (mm/s)
PV_Temperature	FLOAT16	2	Temperature measurement value (°C)

7.7.1.3 XS770A Vibration (X-Axis)

Table 7-14 XS770A vibration (X-axis) data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x12
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Acceleration error Bit14: Speed error Bit13: (Reserved) Bit12: Acceleration overrange Bit11: Speed Overrange Bit9 to 10: (Reserved) Bit8: Simulation Mode Bit 0 to 7: (Reserved)
PV_Acceleration	FLOAT16	2	X-axis acceleration peak value (m/s^2)
PV_Velocity	FLOAT16	2	X-axis velocity RMS value (mm/s)

7.7.1.4 XS770A Vibration (Y-Axis)

Table 7-15 XS770A vibration (Y-axis) data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x13
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Acceleration error Bit14: Speed error Bit13: (Reserved) Bit12: Acceleration overrange Bit11: Speed overrange Bit9 to 10: (Reserved) Bit8: Simulation mode Bit0 to 7: (Reserved)
PV_Acceleration	FLOAT16	2	Y-axis acceleration peak value (m/s^2)
PV_Velocity	FLOAT16	2	Y-axis velocity RMS value (mm/s)

7.7.1.5 XS770A Diagnostic Status

Table 7-16 XS770A Diagnostic Status data format

Bits	Contents	NAMUR Category
Bit31 (MSB)	F: Failure status	—
Bit30	C: Function check status	—
Bit29	O: Out of specification status	—
Bit28	M: Maintenance required status	—
Bit27	(Reserved)	F
Bit26	(Reserved)	F
Bit25	Installation, calibration problem	C
Bit24	Out of Service	C
Bit23	Outside Sensor Limits	O
Bit22	Environmental conditions out of device specification	O
Bit21	Fault prediction: Maintenance required	M
Bit20	Power is critical low: maintenance need short-term	M
Bit19	Power is low: maintenance need mid-term	M
Bit18	(Reserved)	—
Bit17	Simulation is active	C
Bit16 - 1	(Reserved)	—
Bit0	Detail information available	—

7.7.1.6 XS770A Diagnostic Status Detail

Table 7-17 XS770A Diagnostic Status Detail data format

Bits	Contents	Diagnostic Status
Bit31 (MSB)	Voltage is low	Bit20
Bit30	Battery Left is low	Bit19
Bit29	Temp High	Bit22
Bit28	Temp Low	Bit22
Bit27	Electrical Failure - RF Circuit	Bit27
Bit26	Electrical Failure – NFC	Bit27
Bit25	Electrical Failure – Vibration Sensor	Bit26
Bit24	Electrical Failure – Temperature Sensor	Bit26
Bit23	Sensor is not provisioned	Bit25
Bit22	Sensor is not joined	Bit25
Bit21	Sensor Over flow: Vibration Sensor	Bit23
Bit20	Sensor Over flow: Temperature Sensor	Bit23
Bit19	Memory Failure	Bit27
Bit18	Out of Service (Reserved for future use)	Bit24
Bit17	Simulation Mode	Bit17
Bit16	OFF Mode	Bit24
Bit15 – 0	(Reserved)	—

7.7.2 XS530 Sending Data

The XS530 Data_Type is shown in Table 7-18. For the sending data format to Sushi Sensor, refer to Table 7-1

Table 7-18 XS530 Data_Type

Parameter Name	Size (Byte)	Description	Sending Period
Data_Type	1	0x30 Pressure value 0x31 Temperature value	It depends on the user's settings.

7.7.2.1 XS530 Pressure

Table 7-19 XS530 pressure data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x30
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Pressure error Bit13 - 14: (Reserved) Bit12: Pressure over range Bit9 - 11: (Reserved) Bit8: Simulation Mode Bit0 - 7: (Reserved)
PV_Pressure	FLOAT32	4	Pressure value (MPa)

7.7.2.2 XS530 Temperature

Table 7-20 XS530 pressure data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x31
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Temperature error Bit13 - 14: (Reserved) Bit12: Temperature Overrange Bit9 - 11: (Reserved) Bit8: Simulation Mode Bit0 - 7: (Reserved)
PV_Temperature	FLOAT32	4	Temperature value (°C)

7.7.2.3 XS530 Diagnostic Status

Table 7-21 XS530 Diagnostic Status data format

Bits	Contents	NAMUR Category
Bit31 (MSB)	F: Failure status	—
Bit30	C: Function check status	—
Bit29	O: Out of specification status	—
Bit28	M: Maintenance required status	—
Bit27	Faults in electronics	F
Bit26	Faults in sensor or actuator element	F
Bit25	(Reserved)	—
Bit24	OFF Mode	C
Bit23	Outside Sensor Limits	O
Bit22	Environmental conditions out of device specification	O
Bit21	Fault prediction: Maintenance required	M
Bit20	(Reserved)	—
Bit19	Power is low: maintenance need mid-term	M
Bit18	(Reserved)	—
Bit17	Simulation is active	C
Bit16 -14	(Reserved)	—
Bit13	Network settings are not configured.	C
Bit12	Sushi Sensor is unable to connect to gateway	C
Bit11 – 0	(Reserved)	—

7.7.2.4 XS530 Diagnostic Status Detail

Table 7-22 XS530 Diagnostic Status Detail data format

Bits	Contents	Diagnostic Status
Bit31 (MSB)	CPU failure	Bit27
Bit30	Battery Left is low	Bit19
Bit29	Ambient temperature is outside Specification High Limit	Bit22
Bit28	Ambient temperature is outside Specification Low Limit	Bit22
Bit27 – 26	(Reserved)	—
Bit25	RF Module Memory Failure	Bit27
Bit24	Measurement Module Memory Failure	Bit27
Bit23	Network Settings are not configured	Bit13
Bit22	Sushi Sensor is unable to connect to Gateway	Bit12
Bit21	Measurement Module is Not Connected	Bit21
Bit20	Software is Not Found	Bit21
Bit19	(Reserved)	—
Bit18	Diagnostics Status Simulate Mode	Bit17
Bit17	Process Value Simulate Mode	Bit17
Bit16	OFF Mode	Bit24
Bit15	(Reserved)	—
Bit14	Measurement Module Hardware Failure	Bit27
Bit13	Sensor Failure	Bit27
Bit12 - 11	(Reserved)	—
Bit10	Pressure is Outside Specification	Bit23
Bit9 - 5	(Reserved)	—
Bit4	Temperature is Outside Specification	Bit23
Bit3 - 0	(Reserved)	—

7.7.3 XS550 Sending Data

The XS550 Data_Type is shown in Table 7-23. For the sending data format to Sushi Sensor, refer to Table 7-1.

Table 7-23 XS550 Data_Type and sending period

Parameter Name	Size (Byte)	Description	Sending Period
Data_Type	1	0x20 temperature value (Temperature 1) 0x21 temperature value (Temperature 2)	It depends on the user's setting.

7.7.3.1 XS550 Temperature

Table 7-24 XS550 pressure data format

Parameter Name	Type	Size (Byte)	Description
Data_Type	UINT8	1	0x20 or 0x21
Data_Status	UINT16	2	Shows the status of the measured value. All0: Good Bit15: Temperature error Bit13 - 14: (Reserved) Bit12: Temperature Overrange Bit9 - 11: (Reserved) Bit8: Simulation Mode Bit0 - 7: (Reserved)
PV_Temperature	FLOAT32	4	Temperature value (°C)

7.7.3.2 XS550 Diagnostic Status

Table 7-25 XS550 Diagnostic Status data format

Bits	Contents	NAMUR Category
Bit31 (MSB)	F: Failure status	—
Bit30	C: Function check status	—
Bit29	O: Out of specification status	—
Bit28	M: Maintenance required status	—
Bit27	Faults in electronics	F
Bit26	Faults in sensor or actuator element	F
Bit25	(Reserved)	—
Bit24	OFF Mode	C
Bit23	Outside Sensor Limits	O
Bit22	Environmental conditions out of device specification	O
Bit21	Fault prediction: Maintenance required	M
Bit20	(Reserved)	—
Bit19	Power is low: maintenance need mid-term	M
Bit18	(Reserved)	—
Bit17	Simulation is active	C
Bit16 - 14	(Reserved)	—
Bit13	Network settings are not configured	C
Bit12	Sushi Sensor is unable to connect to gateway	C
Bit11 - 0	(Reserved)	—

7.7.3.3 XS550 Diagnostic Status Detail

Table 7-26 XS550 Diagnostic Status Detail data format

Bits	Contents	Diagnostic Status
Bit31 (MSB)	CPU Failure	Bit27
Bit30	Battery Left is low	Bit19
Bit29	Ambient Temperature is Outside Specification High Limit	Bit22
Bit28	Ambient Temperature is Outside Specification Low Limit	Bit22
Bit27 - 26	(Reserved)	—
Bit25	RF Module Memory Failure	Bit27
Bit24	Measurement Module Memory Failure	Bit27
Bit23	Network Settings are not configured	Bit13
Bit22	Sushi Sensor is unable to connect to Gateway	Bit12
Bit21	Measurement Module is Not Connected	Bit21
Bit20	Software is Not Found	Bit21
Bit19	(Reserved)	—
Bit18	Diagnostics Status Simulate Mode	Bit17
Bit17	Process Value Simulate Mode	Bit17
Bit16	OFF Mode	Bit24
Bit15	(Reserved)	—
Bit14	Measurement Module Hardware Failure	Bit27
Bit13	Reference Junction Sensor Failure	Bit27
Bit12	Reference Junction Temperature is Outside Specification	Bit23
Bit11	Sensor 1 Failure	Bit26
Bit10	Sensor1 Temperature is Outside Specification	Bit23
Bit9 - 6	(Reserved)	—
Bit5	Sensor 2 Failure	Bit26
Bit4	Sensor2 Temperature is Outside Specification	Bit23
Bit3 - 0	(Reserved)	—

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