Technical Information

Sushi Sensor System
Setup Guide
MultiConnect Conduit IP67 Base Station
Manufactured by Multi-Tech Systems

Sushi Sensor

LoRaWAN

TI01W06A51-50EN

Contents

Introduction

This document describes how to set up a LoRaWAN gateway to be used in a Sushi Sensor system.

MultiConnect Conduit IP67 Base Station manufactured by Multi-Tech System is used as a LoRaWAN gateway. (hereinafter referred to as "gateway").

■ Notes Regarding this Document

- This document is based on gateway firmware version R5.0.1 and R5.3.0. When the version is upgraded, the screen layout and setup procedures may be changed. The contents of the LoRaWAN settings added by the version upgrade of the gateway firmware are described in the appendix. The gateway setting items described in this document are confirmed by Yokogawa when this document is created.

- The contents of this manual are subject to change without prior notice.

- All rights reserved. The information shown in this document cannot be reprinted without prior permission from Yokogawa.

- If any question arises or errors are found, or if any information is missing from this manual, please inform the nearest Yokogawa sales office.

- For the settings that comply with the latest radio laws and restrictions in each country or region, and the settings for the latest firmware version of the gateway, please contact to the nearest Yokogawa sales office.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or physical damage.It may also be used to alert against unsafe practices.

⚠ 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.

1.   Overview of the LoRaWAN Gateway

As shown in Figures 1 and 2, the gateway receives data from Sushi Sensors through LoRaWAN and sends it to the application software via LAN or the Internet. The gateway establishes communications with the data collection server.

In order to configure the gateway, one PC installed with a web browser is necessary.

Encryption key for ensuring LoRaWAN communication security is determined by the Sushi Sensor system administrator.

For the procedures of the gateway and encryption key settings, refer to the following chapters.
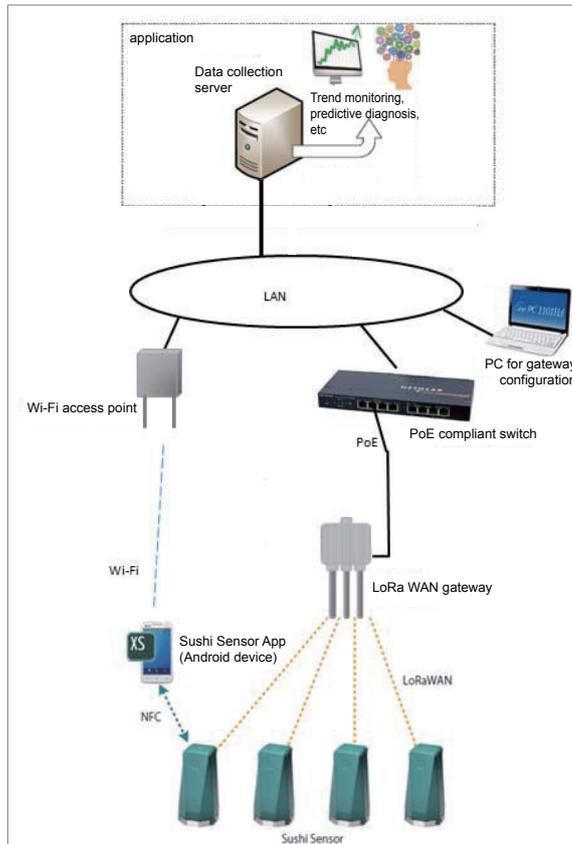
Figure 1   Sample: System architecture using LAN

Figure 2   Sample: System architecture using cloud network

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

This document covers only for scopes of the gateway. For details about Sushi Sensor engineering, refer to the manual of the Sushi Sensor.

● **Engineering workflow**

```
                         ┌─────────────────┐
                         │ Device delivery │
                         └─────────────────┘
                                  │
        ┌─────────────────────────┼─────────────────────────┐
        ▼                         ▼                          ▼
┌─────────────────┐    ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐   ┌──────────────────────┐
│   Application   │      ┌──────────────────┐  Scope of this TI    │   Sushi Sensor       │
│   engineering   │    │ │ GW installation  │                  │   │   engineering        │
└─────────────────┘      │   and wiring     │                      └──────────────────────┘
                       │ └──────────────────┘                  │
  Refer to                 • Wiring                              Refer to the manual of
  TI 01W06A51-01EN.    │   • Installation                     │  the Sushi Sensor to be used.

                       │ ┌──────────────────┐                 │
                         │ LoRaWAN network  │
                       │ │    settings      │                 │
                         └──────────────────┘
                       │                                       │
                           • Wireless network settings
                       │   • Log settings                     │
                           • Transmission data settings
                       │                                       │
                         ┌──────────────────┐
                       │ │ Host network     │                 │
                         │   settings       │
                       │ └──────────────────┘                 │

                       │   • LTE connection                   │
                           • Ethernet connection
                       └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                                  │
                         ┌──────────────────┐
                         │ Site Instruction │
                         └──────────────────┘
                                  │
                           Refer to the manual of the Sushi Sensor
                           to be used and the manual of
                           the application data collection server.
                                  │
          ┌───────────────────────┴───────────────────────┐
          ▼                                                ▼
┌──────────────────────┐                    ┌──────────────────────────┐
│    Target device     │                    │  Sushi Sensor wireless   │
│   data acquisition   │                    │  system device management│
└──────────────────────┘                    └──────────────────────────┘
  • Sensor data acquisition                    Refer to the manual of
                                               the Sushi Sensor to be used.
```
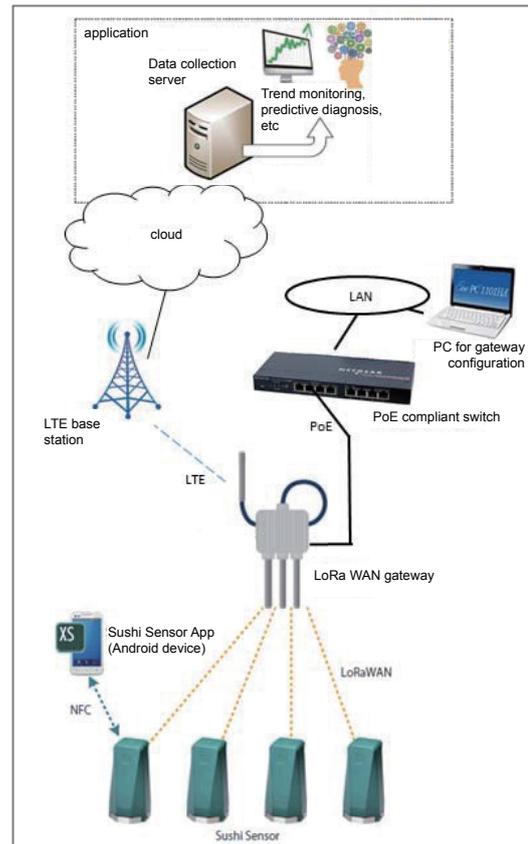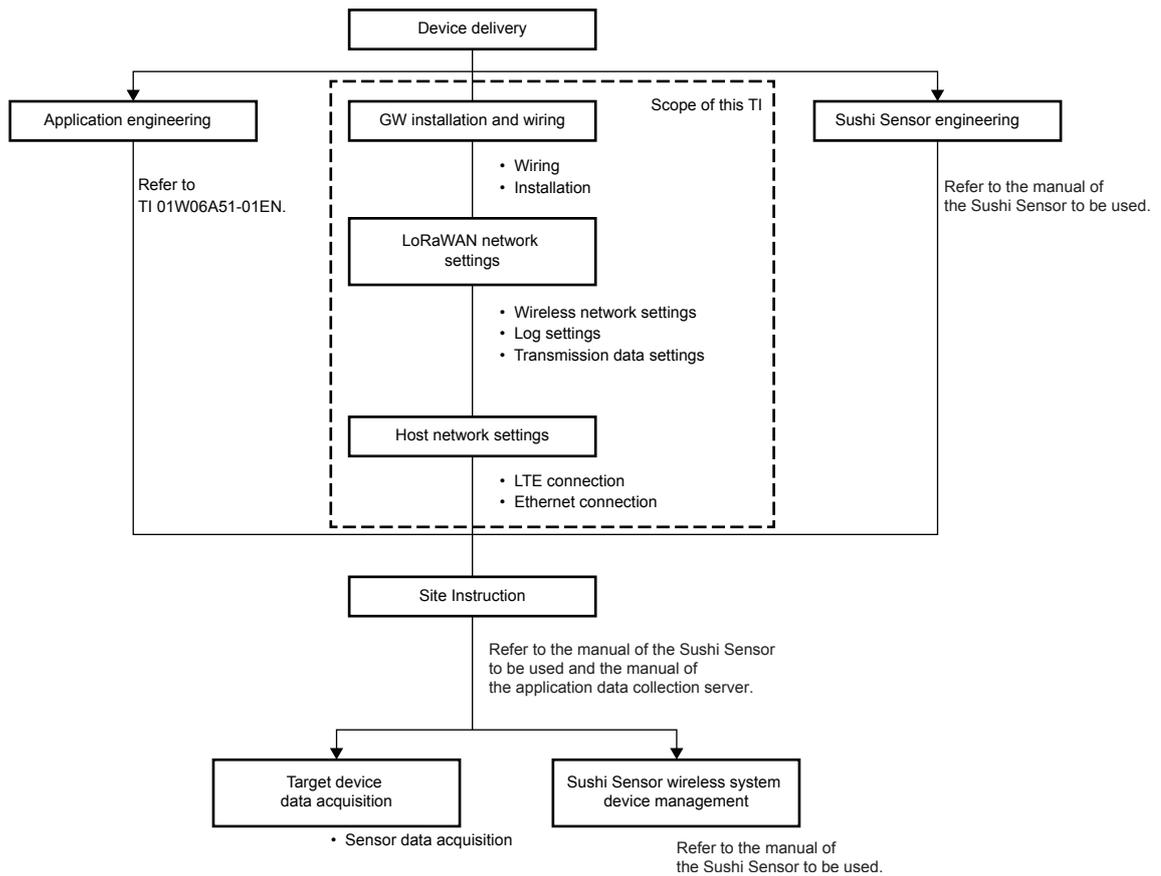
2.   Preparation

Make sure that you have all following items available when you receive the gateway package.

☐   Gateway and accessories

- Main unit

- Hardware Installation Guide

- Mounting bracket

- Stainless hose band x 2

- Cable gland

- LTE antenna x 2

- LoRa antenna x 1

- GPS antenna x 1

Figure 2-1 External view of gateway

For setup the gateway, following peripherals are needed additionally.

☐   Peripherals

- IEEE 802.3at-based PoE switch or PoE injector

- Ethernet cable

    Used to supply power to the gateway and connect to the gateway configuration PC.

    - Category: Category 5e or better

    - Environmental resistance: Outdoor use

    - Length: 100 m max.

- Gateway configuration PC

    Used to configure gateway settings and carry out maintenance.

    - Communication interface: Ethernet

    - Browser: Chrome, etc.

⚠ **NOTE**

"GW Custom App Generator for Sushi Sensor" used in "5.5.2 Use Custom App" has been confirmed to work on Windows 10 Professional 20H2 64 bit.

- SIM card (when connecting to a cellular network)

    - Carrier: Refer to the gateway specifications issued by Multi-Tech Systems.

    - Size: MicroSIM

⚠ **NOTE**

Since the gateway models for South Korea, Brazil and South Africa are not compatible with LTE, LTE antennas are not enclosed as the accessories. The following description regarding LTE configuration can be skipped.

3.   Assembly and Wiring

3.1   Connecting the Ethernet Cable

The gateway is powered from the PoE switch/injector through the Ethernet cable. Therefore, the connection of Ethernet cable must be required even if LTE communications are used. The attached cable gland must be installed whether the gateway is used indoors or outdoors.

(1)   Remove the cable gland from the main unit.

(2)   Put the Ethernet cable through the outermost screwing part of the cable gland, and attach the waterproof rubber and rubber holding part.

(3)   Connect the Ethernet cable to the Ethernet connector of the gateway.

(4)   Attach the cable gland to the screwing part of the gateway. The standard tightening torque for the cable gland is 1.18 N•m.
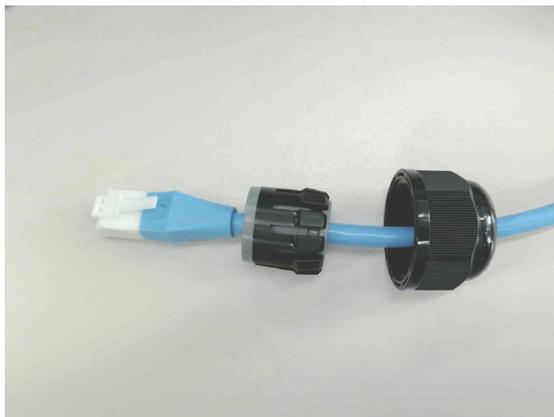

Figure 3-1 Cable gland components

Figure 3-2 Attaching the cable gland to the Ethernet cable

3.2   Mounting the LTE Antennas

For direct access to the Internet via LTE network, install the SIM card into the gateway.

Even if the LTE network is not used, two of LTE antennas must be mounted to the connectors of the gateway for protection purpose.

(1)   Prepare the LTE antennas. "LTE" is indicated on the side of each antenna.

(2)   Connect either of the LTE antennas to antenna connector "5" at the bottom of the gateway.

(3)   Connect the other LTE antenna to antenna connector "6" at the bottom of the gateway.

(4)   Use a tightening torque of 2 to 3 N•m to mount the antennas.

3.3   Inserting a SIM Card

When using LTE communications, a SIM card is required to set into the gateway. If you do not use LTE communications, skip the procedure shown in this chapter.

(1)   Remove the SIM/USB cover at the bottom of the gateway. The SIM card slot is located on the top of the USB port.

(2)   Orient the SIM card so that the cut-off notch in the corner comes to the front left, and insert it into the slot. When the card clicks into place, it has been inserted correctly.

(3)   Mount the SIM/USB cover. The tightening torque for the SIM/USB cover is 1.18 N•m.

Figure 3-3 Gateway with a SIM card inserted

3.4　Mounting the LoRa Antenna

Mount the LoRa antenna to establish LoRaWAN communications between Sushi Sensors and the gateway.

(1) Prepare the LoRa antenna. "806-960 MHz" is indicated on the side of the antenna.

(2) Connect the LoRa antenna to antenna connector "1" at the top of the gateway.

(3) Use a tightening torque of 2 to 3 N•m to mount the antenna.

3.5　Mounting the GPS Antenna

The GPS function of the gateway is not used in the Sushi Sensor system; however, the GPS antenna must be mounted to protect the connector.

(1) Connect the GPS antenna to antenna connector "3" at the top of the gateway.

(2) Use a tightening torque of 2 to 3 N•m to mount the antenna.

4.   Installation

This chapter describes how to install the gateway.

4.1   Precautions on Installation

- For information about the conditions of the installation location, refer to the gateway manual.

- For outdoor use, install the gateway at the location where there are less obstacles and higher level as long as possible.
  In the indoor use, carefully select the location not to be attenuate the radio by surrounding obstacles.

- Check that there are no anomaly at the installation points, such as material damage, deformation, adhesion of foreign objects and etc.

- Antennas of the gateway must be away from metallic objects sufficiently.

4.2   Mounting the Bracket on the Gateway

Follow the below procedure to install the mounting bracket.

(1)   Put the attached mounting bracket onto the back of the gateway. Make sure that the screw holes of the mounting bracket are correct positions.

(2)   Screw a M5 screw into each of the four mounting screw holes.

Figure 4-1 Gateway with the bracket mounted

4.3   Installing the Gateway

For installing the gateway, following items are needed.

- Flat blade screwdriver

- Stainless hose band (x 2)

- Gateway with the bracket mounted

⚠ CAUTION

- To mount the gateway, use a pipe with a diameter of 50 to 125 mm.
- The hose bands provided with the gateway can be used for a pipe with a diameter of 78 to 101 mm. When using a pipe that is wider or narrower than standard one, prepare appropriate hose bands separately.
- When installing the gateway in an elevated location, watch your step.

Follow the procedure below to carry out the work.

(1)   Use the two stainless hose bands that came with the gateway, and pass each of them through the gateway bracket.

(2)   Loop the hose band, and put the mounting pipe through the loop. Tighten the screw of the hose band using a flat blade screwdriver. As the screw of the hose band is tightened, the hose band is secured.

(3)   Be sure to use two hose bands to secure two sections of the mounting pipe.

Stainless hose band
(accessory)

Diameter: 50 to 125 mm

4.4　Grounding

Directly connect the ground terminal to class D grounding (third class grounding) with a grounding resistance of 100 Ω or less. The grounding screw is provided in the rear of the unit. For the grounding cable, use an electrical wire that has a conductor cross-sectional area of AWG14 or greater and that is based on outdoor specifications. Attach a round crimping terminal to the end of the cable. Pass the round crimping terminal through the grounding screw in the rear of the unit, and tighten it using a tightening toque of 1.69 N•m.

4.5　PoE Power Supply and Connection with the Gateway Configuration PC

PoE switch or PoE injector is powered to the gateway through the Ethernet cable.

⚠ CAUTION

The compatibility-confirmed PoE switches are based on indoor specifications. When installing the PoE switch outdoors, make sure that it will be enclosed in a waterproof box.

(1) Connect the Ethernet cable of the gateway to the PoE port. The gateway configuration PC can be connected to any port.

(2) Turn the PoE switch on.

(3) Make sure that the power indicator LED (indicated by "PR") lights up among the indicator LEDs under the transparent cover at the bottom of the gateway.

5. Gateway Setup

This chapter describes how to set up the gateway.

⚠ IMPORTANT

The DHCP server configuration is enabled on the default setting of the gateway. Before starting initial settings, ensure that this gateway is connected to the configuration PC only.

⚠ NOTE

For reflecting the changed configuration, ensure to click the [Save and Restart] in the menu.

5.1 User Account Registration

Before setting the gateway, user account registration is required. Web browser is used to access the gateway configuration screen. The followings are the procedure of the registration.

(1) Check IP address configuration of the PC is "Obtain an IP address automatically" or "Use the following IP address" with the IP address range shown in the below.
   - IP address: 192.168.2.2 – 192.168.2.99
   - Subnet mask: 255.255.255.0

⚠ NOTE

For more detail of IP address configuration on the PC, please refer to manuals of PC.

(2) Connect the gateway and the PC through a PoE injector.
(3) Access to http://192.168.2.1/ by a web browser.

⚠ NOTE

A security certification error window may be displayed when accessing the gateway. In the case, please continue web browsing by clicking "Continue to this website" or any same links.

(4) The following screen is shown only for the first access. Enter the user name used to setting the gateway and click "OK". Available characters as the user name are alphabets (case sensitive), numbers, dot (".") and hyphen ("-").

(5) Enter the password and click [OK]. The password must be at least 8 characters long and combine at least 3 of the following restrictions (Example: Admin123). After clicking [OK], the password re-enter screen will be shown. Enter the same password and click [OK].

- Uppercase alphabet (A-Z)

- Lower case alphabet (a-z)

- Number (0-9)

- Symbol (@% + \ / '! # $ ^?:, () {} [] ~ -_)

(6) User registration is completed when the login screen is shown.

⚠ NOTE

If you forget the user name and the password, you need to reset the gateway to factory default and lose all configuration shown in the below.

5.2   Login

Gateway is configured through web interface. User name and password which are configured the previous section are used to login the gateway.

(1)   Access the gateway through a Web browser. Default IP address of the gateway is 192.168.2.1.

(2)   After showing login screen, enter the user name and the password and Click [Login].

(3)   The following screen (First Time Setup Wizard) is shown only for the first access. Since this wizard is not used in the configuration procedure shown in this document, please close by clicking "X" of the upper right corner.

(4)   Confirm the home screen is shown.

⚠ **NOTE**

- A security certification error window may be displayed when accessing the gateway. In the case, please continue web browsing by clicking "Continue to this website" or any same links.
- Password can be changed by "Administration" – "User Accounts".

5.3　Basic Setting of the Gateway

This section describes how to disable the DHCP server, set the gateway time, and configure LoRaWAN settings.

> ⚠️ **NOTE**
>
> If there is not screen transition for a certain period while setting the gateway, the configuration screen is automatically logged out. This period is set to 5 minutes by default, but it can be changed to desired period. Please refer to "7.5 Changing automatic logout time" how to change the time.

5.3.1　Disabling the DHCP Server

The DHCP server function is enabled by default. In this section, disable the DHCP server. When using the DHCP server function of this gateway, proceed to the next section.

(1)　Access the gateway via the Web browser, and log in to the gateway.

(2)　Click [Setup] to display the sub menu. Click [DHCP].

(3)　Click [Pencil icon] in [Options].

(4)　Clear the [Enabled] check box, and click the [Submit] button.
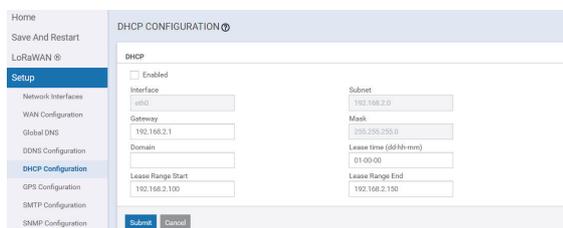
5.3.2 Time Settings

Set the system time of the gateway.

(1) Access the gateway via the Web browser, and log in to the gateway.

(2) Click [Setup] to display the sub menu. Click [Time Configuration].

(3) In [Date], pick up current date form the calendar shown in the screen. In [Time], type the time in 24-hour notation. As necessary, change [Time Zone] to the time zone of the region in which the gateway is to be used.

(4) Click the [Submit] button.

5.3.3 LoRaWAN Settings

In this section, configure the LoRaWAN settings. Specify App key required to connect from Sushi Sensors, and configure wireless parameter settings to comply with the radio laws applicable in each country or region.

⚠️ IMPORTANT

For the settings that comply with the latest radio laws and restrictions in each country or region, and the settings for the latest firmware version of the gateway, please contact the nearest Yokogawa sales office.

(1) Access the gateway via the Web browser, and log in to the gateway.

(2) Logging in to the gateway opens the [Device Information] page. Check the information of [MAC Address] in [Ethernet (eth0)] shown in [LAN]. This MAC Address is used in the next section.

(3) Click [LoRaWAN] to display the sub menu. Click [Network Settings].

(4) Change [Mode] from [DISABLED] to [NETWORK SERVER]. Then, detailed items are displayed.

(5) Set [Channel Plan] of [LoRaWAN Network Server Configuration] according to the region, and set [Network Mode] to [Public LoRaWAN]. Then, specify the items shown Appendix chapter to meet the regulations of the region in which the gateway is to be used. Items that can be set vary depending on the value selected in [Channel Plan] and [Country].

⚠ IMPORTANT

If you change the contents of [Country], there are items to return to the initial value. After setting, check that the settings are correct.

(6) Specify the log-related items. Change [Log Level] of the Network Server Logging to [MAXIMUM].

(7) When connecting a cybersecurity-enabled Sushi Sensor in area code 2, you must specify [ADR Nb Trans].

Set [ADR Nb Trans] in the "Datarate" to 3.

⚠ IMPORTANT

The [ADR NbTrans] setting all sensors under a gateway by determining the network server's transmission behavior.

(8) Click the [Submit] button.

(9) When connecting a gateway with Area Code 2 cybersecurity-enabled firmware, a profile for LoRaWAN v1.0.4 EU868 must be added.

Click [Profiles] in the [LoRaWAN] submenu and set the items as shown in the table below.

item	Value
Profile ID	LW104-OTA-EU868
MAC Version	V1.0.4
RF Region	EU868
Region Version	RP2-1.0.3

(10) Click the [Submit] button.

(11) Click [Key Management] in the sub menu of the [LoRaWAN] menu, and set [Location] of [Join Server] to [Local Join Server].

(12)-1 If you want to join Sushi Sensors by unifying the AppEUI and AppKey without registering an EUI for each Sushi Sensor, set the [Local Network Settings] items to the parameters shown below. For details about the Sushi Sensor settings, refer to the relevant manual.

Bulk Registration(V1.0.2)
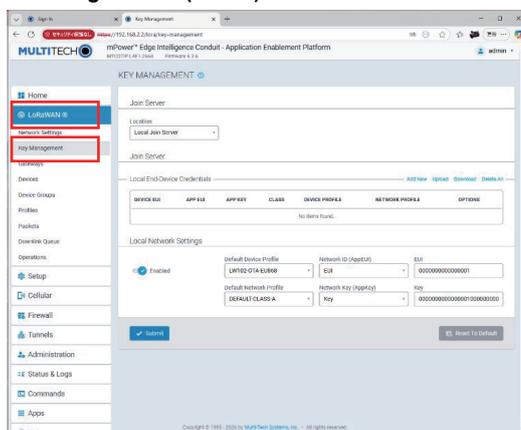
Bulk Registration(V1.0.4)
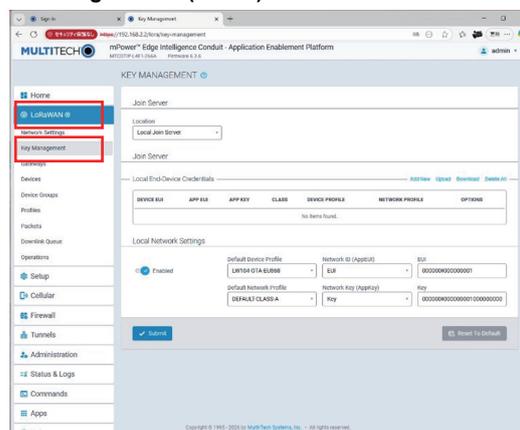
item	Bulk Registration (V1.0.2)	Bulk Registration (V1.0.4)
Enabled	On	
Default Device Profile*	LW102-OTA-EU868	LW104-OTA-EU868
Network ID(App EUI)	EUI	
EUI	Specify the EUI-64 address of the gateway. Hexadecimal notation. Delimit each byte using a colon (:).	
Default Network Profile	DEFAULT-CLASS-A	
Network Key (App Key)	Key	
Key	Sixteen arbitrary bytes. Hexadecimal notation. Delimit each byte using a colon (:).	

⚠ NOTE

App EUI is generated from the MAC address of the gateway. The MAC address is indicated as "NODE" on the [Device Information] page or the nameplate of the gateway. When the MAC address is set to "00:08:00:4A:3F:37", the EUI-64 address is "00:08:00:FF:FE:4A:3F:37" (insert "FF:FE" in the middle of the MAC address).

Gateway nameplate sample

(12)-2 V1.0.2 and V1.0.4 Sushi Sensors must be registered separately when used under the same gateway.

- Turn off the [Enabled] switch to off in the [Local Network Settings].

- Click [Add New] in the [Local End-Device Credentials].

- Set the [ADD END DEVICE KEY] items shown in the table below.

Individual Registration(V1.0.4)
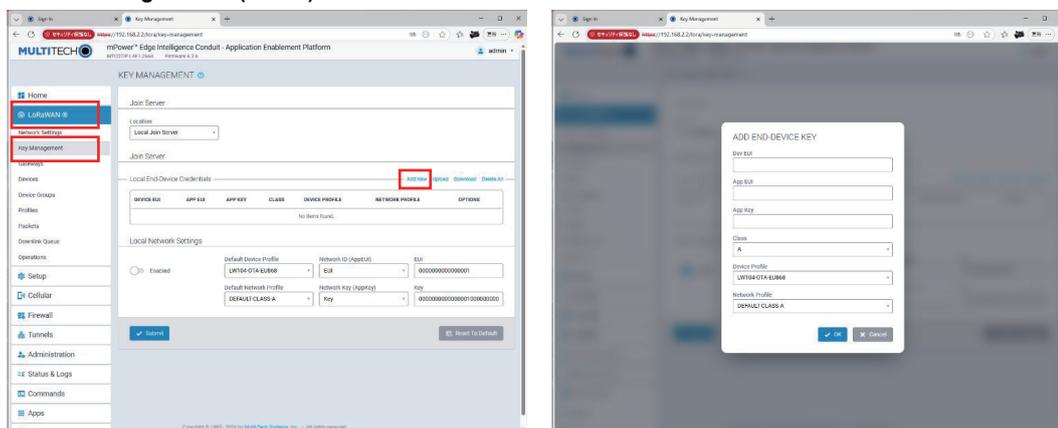
item	Individual Registration (V1.0.2)	Individual Registration (V1.0.4)
Dev EUI*	Specify the EUI-64 address of the Sushi Sensor. Hexadecimal notation. Delimit each byte using a colon (:).	
App EUI	Specify the EUI-64 address of the gateway. Hexadecimal notation. Delimit each byte using a colon (:).	
App Key	Sixteen arbitrary bytes. Hexadecimal notation. Delimit each byte using a colon (:).	
Class	A	
Device Profile	LW102-OTA-EU868	LW104-OTA-EU868
Network Profile	DEFAULT-CLASS-A	

*:   For "Dev EUI," use the EUI64 printed on the nameplate of each Sushi Sensor.
For sensors with smaller nameplate sizes, the shortened EUI64 is printed; refer to the respective sensor's user manual.

(13) Click the [Submit] button.

(14) Click [Save and Restart] to restart the gateway.

⚠ IMPORTANT

DevNonce is a value that increments with each Join Request from the Sushi Sensor. If the DevNonce is equal to or smaller than the value previously recorded on the gateway, the request is considered invalid, and no Join Response will be returned. As a result, the Sushi Sensor will fail to join the gateway.
JoinNonce is a value that increments with each Join Response from the gateway. If the JoinNonce is equal to or smaller than the value recorded on the sensor, the sensor will discard the response. As a result, the join process will not succeed until the counters on both sides are properly synchronized.

The DevNonce and JoinNonce held by Sushi Sensor are cleared under the following conditions:

- When initializing Sushi Sensor using Sushi Sensor App

- When a new App EUI is set (except when set with the same App EUI)

    The DevNonce and JoinNonce held by the gateway are deleted using the following procedure.

Click [Devices] in the [LoRaWAN] submenu and delete the target EUI displayed under End Devices
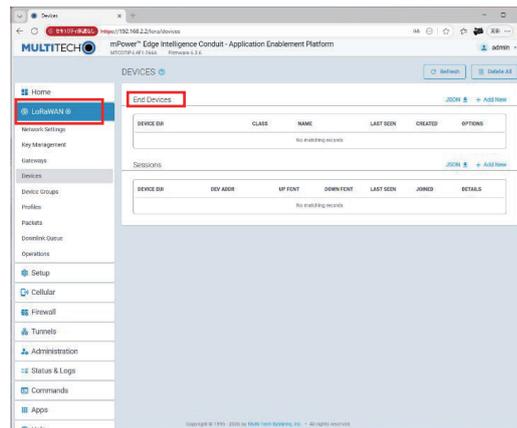
5.4   Data Collection Server Interface Settings

To transfer sensor data of a Sushi Sensor to the application, configure interface settings for connecting the gateway to the application. To transfer data to the application, use LTE or Ethernet.

5.4.1   LTE Settings

Configure LTE communication settings. If you do not use LTE communications, skip this procedure.

✋ NOTE

- Configure the LTE settings with the SIM card inserted.

(1) Access the gateway via the Web browser, and log in to the gateway.

(2) Click [Cellular] to display the sub menu. Click [Cellular Configuration].

(3) Configure APN information. Select the [Enabled] check box in [General Configuration], and specify [APN], [Authentication Type], [UserName], [Password], and other items according to the information you are notified of by the communication carrier.

(4) Click the [Submit] button.

(5) Click [Save and Restart] to restart the gateway.

✋ NOTE

Depending on the requirements of an application and/or a SIM card to be used, it is necessary to enable "Keep Alive" function of LTE communication. Before doing the procedure 4 and 5, the following procedure should be carried out.
- Enable "Enabled" check box at "ICMP/TCP Check".
- Enable "Radio Reboot Enabled" check box at "ICMP/TCP Check".
- Enter appropriate information provided by an application at "Interval (seconds)" and "Host Name".

5.4.2 Ethernet Configuration

IP address of the Ethernet interface is 192.168.2.1 as a default. Necessity of the configuration shown in this section depends on the system design. Please follow the below chart and conduct required settings.

<Procedure 1: Changing "br0" interface>

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Setup] to display sub menu and click "Network Interfaces".

(3) Change "br0" address. Click the [Pencil icon] in the "br0" line.

Name	Direction	Type	IP Mode	IP Address	Bridge	Options
eth0	LAN	ETHER	--	--	br0	✎
ppp0	WAN	PPP	PPP			✎
br0	LAN	BRIDGE	Static	192.168.2.1/24	br0	✎

(4) Change IP address to desired address and click [Submit] button.

NETWORK INTERFACE CONFIGURATION - BR0

Direction
LAN

Mode
Static

IP Address
192.168.2.1

Mask
255.255.255.0

Submit   Cancel

<Procedure 2: Change both "br0" and "eth0" IP address>

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Setup] to display sub menu and click [Network Interfaces].

(3) Change "br0" address. Click the [Pencil icon] in the "br0" line.

Name	Direction	Type	IP Mode	IP Address	Bridge	Options
eth0	LAN	ETHER	--	--	br0	✎
ppp0	WAN	PPP	PPP			✎
br0	LAN	BRIDGE	Static	192.168.2.1/24	br0	✎

(4) Change IP address from 192.168.2.1 to an unused network address (Example: 169.254.0.1) and click [Submit].

NETWORK INTERFACE CONFIGURATION - BR0 ⑦

Direction
LAN

Mode
Static

IP Address
169.254.0.1

Mask
255.255.255.0

Submit   Cancel

(5) Change "eth0" settings. Click [Pencil icon] in the "eth0" line.

(6) Change IP address to a gateway address and related parameters as the following table and click [Submit] button.

Item	Value
Direction	LAN
Mode	Static
IP Address	IP address of the gateway
Mask	Subnet mask of the gateway
Bridge	-
Gateway	IP address of default route
Primary DNS Server	IP address of primary DNS server
Secondary DNS Server	IP address of secondary DNS server

NETWORK INTERFACE CONFIGURATION - ETH0 ⑦

Direction
LAN

Bridge
--

Mode
Static

Gateway

IP Address

Primary DNS Server

Mask

Secondary DNS Server

Submit   Cancel

(7) Restart the gateway by clicking [Save and Restart].

⚠ NOTE

After changing the gateway IP address, the connection will lose from a configuration PC. Before reconnecting the gateway, IP address of the PC might have to be changed. The configuration of the DNS server addresses must be assigned if the data destination is specified by a host name.

5.5 Message Transfer Settings

This section describes the setting required to transfer Sushi Sensor data received by the gateway to the application.

The tool used depends on the firmware version of the gateway.

Firmware version of the gateway	Software name	description	Reference
Earlier than 5.3.0	Node-RED	Node-RED is software to enter settings for transferring Sushi Sensor data received by the gateway to the application that is the connection destination is required. This software runs on a web browser.	5.5.1 Use Node-RED
5.3.0 or later	Custom App with Sushi Sensor (Hereinafter referred to as Custom App.)	Custom APP is software generated by the tool "GW Custom App Generator For Sushi Sensor" provided by Yokogawa Electric Corporation and its designated subsidiaries. It is installed on the gateway. The settings for transferring Sushi Sensor data received by the gateway to the application that is the connection destination is required are made on the "GW Custom App Generator For Sushi Sensor". Operating conditions for "GW Custom App Generator For Sushi Sensor" are as follows. Windows 10 20H2 or later .NET 4.7.2 or later	5.5.2 Use Custom App

⚠ NOTE

- In order to configure the message transfer settings, configuration information (URL, user name, and password) of the application that is the connection destination is required. Before starting the gateway setting procedure, check the application setting.

5.5.1 Use Node-RED

To configure this setting, use the "Node-RED" software that runs on the Web browser. Node-RED, combined with functions called "nodes", off ers a visual programming environment. In this section, "nodes" are referred to as "blocks".

(1) Access the gateway via the Web browser, and log in to the gateway.

(2) Click [Apps].

(3) Check the [Enabled] check box, and click the [Launch Node-RED] button. Then, the screen changes to another page.

- Clicking the [Launch Node-RED] button may display a security certification error window. In such a case, continue to a site browsing.

(4) The Node-RED login page opens. The login user name and password are the same as those required to log in to the gateway.

(5) Drag and drop the "lora" block from the left pane to the sheet in the center. Double-click the "lora" block you have placed.

(6) Configure the following settings in the [Edit lora in node] window. After configuring the settings, click the [Done] button.

Item	Value
Name	Arbitrary character string (Example: lora)
Data Type	Bytes

(7) Drag and drop the "function" block from the left pane to the sheet in the center. Double-click the "function" block you have placed.

(8) Configure the following settings in the [Edit function node] window. After configuring the settings, click the [Done] button.

Item	Value
Name	Overwrite Payload
Function	```msg.payload = {
data: {
payload: msg.payload,
eui: msg.eui,
ack: msg.ack,
appeui: msg.appeui,
chan: msg.chan,
deveui: msg.deveui,
freq: msg.freq,
lsnr: msg.lsnr,
rfch: msg.rfch,
rssi: msg.rssi,
seqn: msg.seqn,
size: msg.size,
timestamp: msg.time,
tmst: msg.tmst
}
};
return msg;```

(9) Drag the connection point of the "lora" block to connect it to the "function" block with a line.
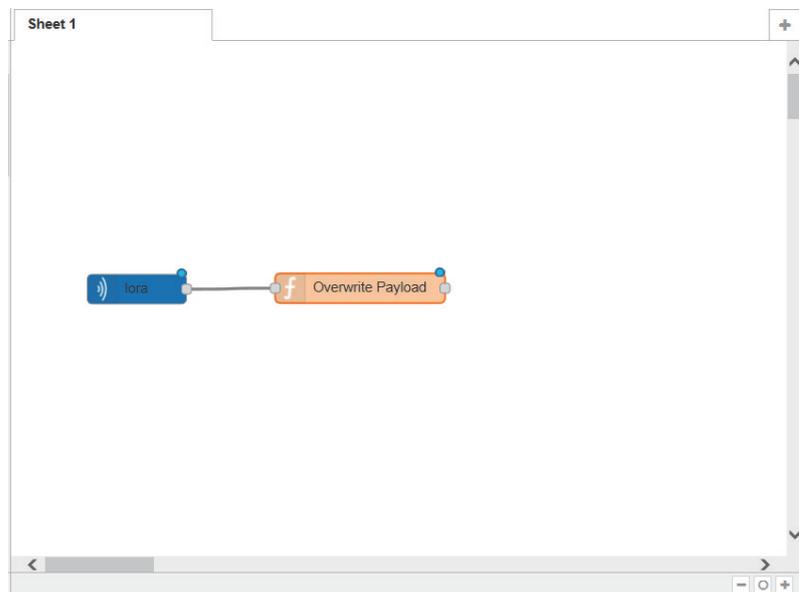
(10) Drag and drop the "http request" block from the left pane to the sheet in the center. Double-click the "http request" block you have placed.

(11) Configure the following settings in the [Edit http request node] window. After configuring the settings, click the [Done] button.

Item	Value
Method	POST
URL	*1
Use basic authentication?	Checked
Username	*1
Password	*1
Name	Arbitrary character string (Example: Send http POST)

*1: URL, Username, and Password are information required to transfer data to the application. These values must match the values specified for application engineering.

(12) Drag the connection point of the "function" block to connect it to the "http request" block with a line.
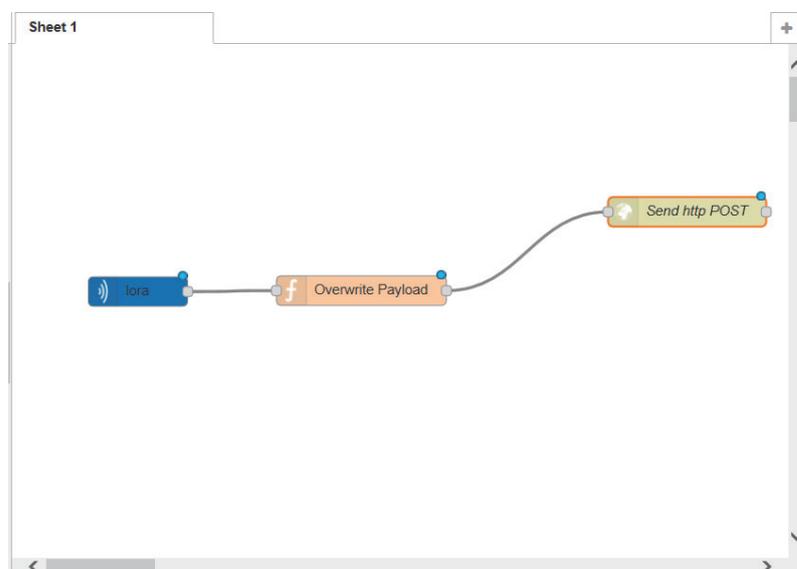
(13) Drag and drop the "debug" block from the left pane to the sheet in the center. Double-click the "debug" block you have placed.

(14) Configure the following settings in the [Edit debug node] window. After configuring the settings, click the [Done] button.

Item	Value
Output	msg.payload
To	debug tab
Name	Arbitrary character string (Example: DEBUG: LoRa input data)

(15) Drag the connection point of the "function" block to connect it to the "debug" block with a line.
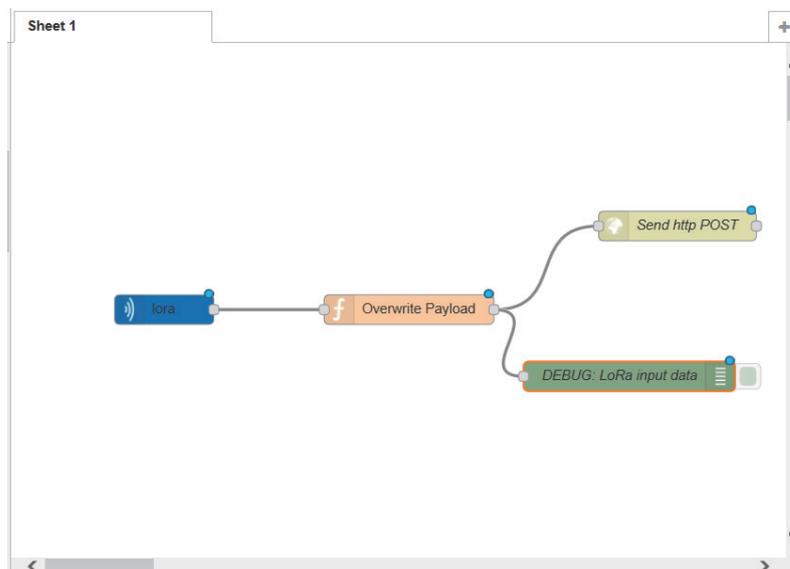
(16) Click the [Deploy] button. When "Successfully deploy" is displayed, the setting is completed.

5.5.2   Use Custom App

Create a Custom App containing configuration information by using the "GW Custom App Generator for Sushi Sensor" tool provided by YOKOGAWA, that supports the gateway message transfer settings on your PC and register the Custom Apps to the gateway. In order to obtain the tool, please contact the nearest Yokogawa sales office.

1.   Extract the "GW Custom App Generator for Sushi Sensor" (zip file) to any location on your PC. Select the suitable version of "GW Custom App Generator for Sushi Sensor" depending on the firmware version of the gateway.

Firmware version of the gateway	GW Custom App Generator for Sushi Sensor version
5.3.0 to 5.3.8s-s1	R1.01.01
6.0.0 or later	R2.01.01

2.   Run GWCustomAppGeneratorForSushiSensor.exe.

3. Enter the configuration information of the host system.

URL : Destination (host system) URL.

Basic Authentication : If user name and password are required, enable "Basic Authentication" check box and fill in the Username and Password.

App EUI : App EUI configured on the gateway.

Output Name : Prefix name of Custom App to be generated.

⚠ **NOTE**

Refer to 5.3.3. LoRaWAN Setting how to set the App EUI.

4. Click the [Generate] button. The following Custom App will be generated in the folder of this tool. (File name format: [Output Name].tar.gz)

app-connect-sushi.gz

5. Access the gateway via the Web browser and log in to the gateway.

6. Click [Apps].

7. Click [Add Custom App].
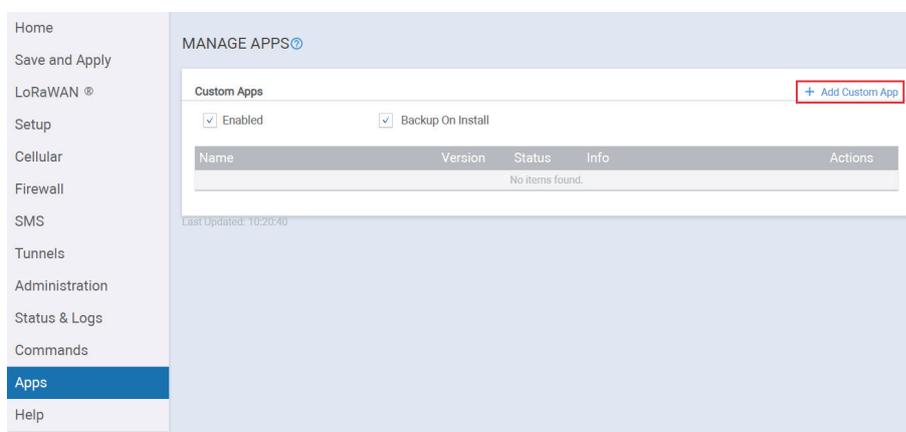
8. Fill in App ID and App Name.

    App ID: Identification number.

    App Name: Identification name.

App ID

| 1 |

App Name

| SushiSensor |

[📥 Choose File] No file selected

[✔ Install Custom App] [✖ Cancel]
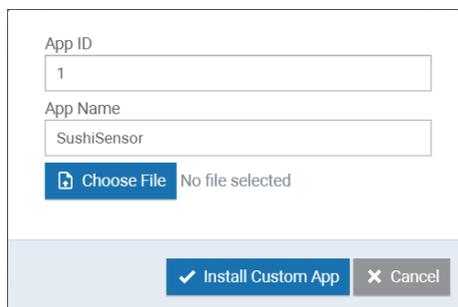
⚠️ **NOTE**

Please set App ID to 1.
App Name is used in Custom App list in step 11.

9. Click [Choose File].

10. Choose the generated Custom App (*.tar.gz).

App ID

| 1 |

App Name

| SushiSensor |

[📥 Choose File] app-connect-sushi.gz

[✔ Install Custom App] [✖ Cancel]
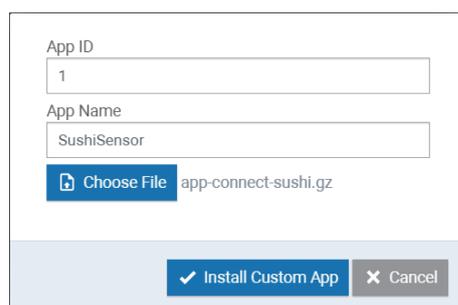
11. Click [Install Custom App]. Custom App will be registered and run automatically.
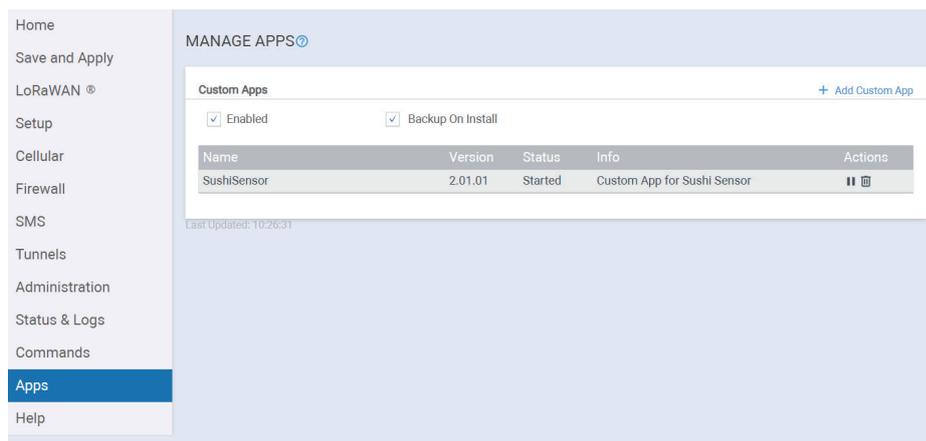
Home					
Save and Apply					
LoRaWAN ®	**MANAGE APPS** ⓘ				
Setup					
Cellular	**Custom Apps**				+ Add Custom App
Firewall	☑ Enabled	☑ Backup On Install			
SMS	Name	Version	Status	Info	Actions
Tunnels	SushiSensor	2.01.01	Started	Custom App for Sushi Sensor	�II 🗑
Administration	Last Updated: 10:26:31				
Status & Logs					
Commands					
Apps					
Help					

⚠️ **NOTE**

The Custom App is registered in this procedure. No re-installation is required when the gateway is restarted.
To modify the AppEUI, Server Address (URL), User name, and Password, delete the previous Custom App by clicking trash icon in Actions and create new Custom App and install it again.

5.6 Backup and Restore

Gateway configuration can be backed up to the file and it can be restored by the backup file.

5.6.1 Backup

Configuration data can be backed up by the following procedure.

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Administration] to display a sub menu and click [Save / Restore].

(3) Click [Save] button at the right of "Save Configuration To File".

(4) Wait for a while until a download complete message is shown.

(5) Save it to desired folder.

⚠ **NOTE**

Profile settings for the Mac Version (V1.0.4) and custom app settings are not included in the backup file. You will need to reconfigure them manually after restoring from the backup.

5.6.2　Restore

The configuration can be restored by using backup file which is stored in the previous section. All current configuration in the gateway will be overwritten by the backup file data.

⚠ IMPORTANT

Gateway firmware version at the backup and the restore must be identical. If the version is unmatched, unexpected system troubles may occur.

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Administration] to display sub menu and click [Save / Restore].

(3) Click [Browse...] button at the right of "Restore Configuration From File".
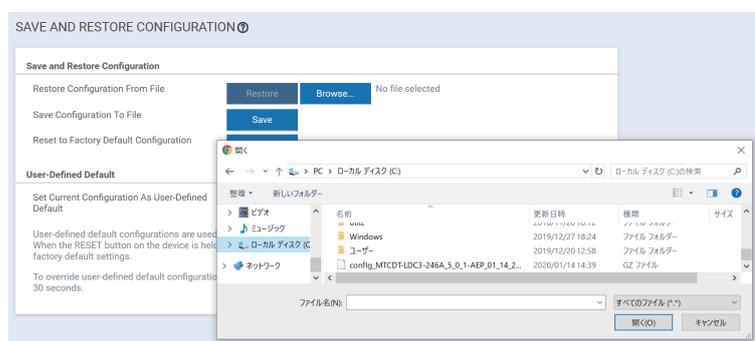
(4) Specify a backup file.

(5) Click [Restore] button at the right of "Restore Configuration From File".

(6) A message about overwrite configuration warning is shown and click [OK].

(7) The gateway restarts automatically after restoring the configuration.

⚠ NOTE

Profile settings for the Mac Version (V1.0.4) and custom app settings are not included in the backup file. You will need to reconfigure them manually after restoring from the backup.

6. Operation and Maintenance

This chapter describes how to carry out daily check of the Sushi Sensor system, carry out maintenance when a warning or error occurs, and add and replace wireless system components.

6.1 Daily Check

To ensure that the wireless communication system continues to operate correctly, it is important to monitor the communication stability even after the setup work has been completed and the system has started to operate normally. Wireless communication may become unstable if radio waves are affected by obstacles in the communication path. Extra attention must be paid when a new building is constructed, additional equipment is installed, a temporary structure is built for installation or maintenance purposes, or a crane or other heavy vehicle enters the site

6.1.1 Checking Wireless Communication Status

The application enables you to check the received signal strength indication (RSSI) and the packet error rate (PER) of Sushi Sensors. Based on these values, you can check the wireless communication status.

You can also use the Sushi Sensor configuration tool, "Sushi Sensor App", to check the RSSI value. For details, refer to the Sushi Sensor user's manual.

6.1.2 Gateway Inspection

During gateway inspections, check the installation of the gateway as well as its operation as a Sushi Sensor system component.

Check the installation, communication cable connection, and cleanliness of devices.

If any device is dirty or dusty, wipe off dirt or dust using a soft cloth moistened with water or mild soap

6.1.3 Handling a Device in a Warning State

If any device has been judged to be in a warning state, a communication error may occur if the status deteriorates if the application is currently able to acquire sensor values and status information.

If a warning message appears due to a low battery level of a Sushi Sensor, replace the battery as soon as possible regardless of the displayed number of days. For details about the replacement procedure, refer to the Sushi Sensor user's manual.

If a warning message appears due to a problem related to Sushi Sensor communication quality, check whether any phenomena causing a radio propagation failure has occurred in the communication path. In addition, check whether any additional structures or vehicles are on the path or around the device, and whether any new wireless communication system using the same frequency band has begun to be used in the vicinity. For a certain period of time, monitor the device for which a warning message is displayed due to a problem related to communication quality. If there are no signs that the device may return to the normal state by itself, adjust the device arrangement. Adjusting the installation location may cause the device to return to the normal state. In addition, when another wireless system is used, improvements can be made by changing the radio frequency.

6.2   Gateway Addition and Replacement

6.2.1   Adding a Gateway (Providing Redundancy)

To add a gateway, follow the procedure described in this document to set up and install a new gateway. The new gateway App EUI and App Key values must be different from those of the gateway that has already been used.

The gateway configuration can be made redundant by additionally registering a new gateway in Sushi Sensors via an Android device. To register a gateway, access the network setting of each Sushi Sensor. For details, refer to the Sushi Sensor user's manual.

6.2.2   Replacing a Gateway

To replace a gateway, configure a new gateway using the same information as that which was configured for the old gateway. The new gateway App EUI and App Key settings must be the same as those of the previous gateway. Setting the same information allows you to replace a gateway without changing the Sushi Sensor settings.

⚠ IMPORTANT

If the Sushi Sensor's MAC version is V1.0.4, replacing the gateway will cause a mismatch in the JoinNonce values between the Sushi Sensor and the gateway, and the join process will not be successful until the counters on both sides are properly synchronized. You can initialize the Sushi Sensor's JoinNonce by following the steps below.
  1. Exporting Sushi Sensor settings
  2. Sushi Sensor initialization
  3. Writing new network information to Sushi Sensor
  4. Importing Sushi Sensor settings

7. Tips and Troubleshooting

7.1 Checking Sushi Sensor Connection Status

This section describes how to check the Sushi Sensor connection status via the gateway.

(1) Access the gateway via the Web browser, and log in to the gateway.

(2) Click [Status & Logs] to display the sub menu. Click [Statistics].

(3) Click the [LoRa] tab to display the list of Sushi Sensors connected to the gateway.

(4) Check whether the target Sushi Sensor is displayed in the list and whether data is received from the Sushi Sensor.

Item	Description
EUI	EUI-64 address of the Sushi Sensor connected to the gateway.
Join Time	Time at which the Sushi Sensor has connected to the gateway.
PktsUp, PktDown	Message sending/receiving counter for the Sushi Sensor.

If the target Sushi Sensor is not found in the list or the message sending/receiving counter is not incremented, it is assumed that the Sushi Sensor battery power has been empty, the network setting is not correct, the distance between the Sushi Sensor and the gateway is too long, or there is a problem with the communication environment.

7.2   Changing the Radio Frequency

This section describes how to change the frequency the Sushi Sensor system uses.

If many wireless devices using the same frequency band are provided in the gateway communication area, it may be difficult to connect the Sushi Sensor to the gateway. Such a problem may be improved by changing the frequency of the Sushi Sensor system.

⚠ NOTE

In Australia, see 7.2.1 when using the AS923-1 channel plan and see 7.2.3 when using the AU915 channel plan.

7.2.1   For Japan, EU, South Korea, ASEAN countries, Australia, New Zealand, UAE, Saudi Arabia, Serbia, India, Philippines, Vietnam, South Africa, Qatar and Bahrain.

(1)   Access the gateway via the Web browser, and log in to the gateway.

(2)   Click [LoRaWAN] to display the sub menu. Click [Network Settings].

LoRaWAN Network Server Configuration

Channel Plan

Channel Plan	Additional Channels 1 (MHz)	Max EIRP (dBm)
AS923	922.6	13

Channel Mask [   ] [Edit]

☑ Enable LBT
Note: LBT requires FPGA v33 or v61

Dwelltime Up: 1 (400 ms)
Dwelltime Down: 1 (400 ms)

(3)   Change the value of [Additional Channels 1]. Select the appropriate setting value from the table shown below. Specify a value that is different from the frequency of the nearby wireless system if possible.

Region	Additional Channels (MHz)
EU	From 865.5 to 867.3 (0.2 MHz step), 867.5 (default), 869.5
UAE, Qatar	From 865.5 to 867.3 (0.2 MHz step), 867.5 (default)
Japan	922.6 (default), 924.2, 925.2, 926.2, 927.2
Malaysia	From 919.6 to 922.4 (0.2 MHz step), 922.6 (default)
New Zealand, Australia	From 915.6 to 922.4 (0.2 MHz step), 922.6 (default), From 924.2 to 927.4 (0.2 MHz step)
Singapore	From 920.6 to 922.4 (0.2 MHz step), 922.6 (default), 924.2, 924.4
South Korea	921.3, 921.5, 922.9 (default)
Thailand	From 920.6 to 922.4 (0.2 MHz step), 922.6 (default), 924.2, 924.4
Indonesia	920.6, 920.8 (Recommendation), 922.4
Saudi Arabia	867.5 (default)
Philippines, South Africa	Empty
Serbia Bahrain	869.4
India	866.385 (default)
Vietnam	920.6, 920.8 (Recommendation), 922.4

(4)   Click the [Submit] button.

(5)   Click [Save and Restart] to restart the gateway.

7.2.2 For United States and Canada

(1) Access the gateway via the Web browser and log in to the gateway.

(2) Click [LoRaWAN] to display the sub menu. Click [Network Settings].

(3) Change the value of [Frequency Sub-Band 1]. Select a desired frequency range to be used in this system by specifying sub-band number.

LoRaWAN Network Server Configuration

Channel Plan

Channel Plan
US915

Frequency Sub-Band 1
1

Channel Mask

Edit

Frequency Sub-Band 1	Frequency range (MHz)
1	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) Click the [Submit] Button.

(5) Click the [Save and Restart] to restart the gateway.

⚠ NOTE

The Sub-Band number must match sensor setting to be joined to the gateway. For the sensor configuration, please refer to sensor instruction manuals.

7.2.3 For Australia, Chile, Brazil, Argentina and Peru

(1) Access the gateway via the Web browser and log in to the gateway.

(2) Click [LoRaWAN] to display the sub menu. Click [Network Settings].

(3) Change the value of [Frequency Sub-Band 1]. Select a desired frequency range to be used in this system by specifying sub-band number.

LoRaWAN Network Server Configuration

Channel Plan

Channel Plan	Frequency Sub-Band 1	Max EIRP (dBm)
AU915	1	13

Channel Mask		Dwelltime Up
	Edit	1 (400 ms)

Dwelltime Down

1 (400 ms)

Frequency Sub-Band 1	Frequency Range (MHz)
1	915.2 – 916.6
2	916.8 – 918.2
3	918.4 – 919.8
4	920.0 – 921.4
5	921.6 – 923.0
6	923.2 – 924.6
7	924.8 – 926.2
8	926.4 – 927.8

(4) Click the [Submit] Button.

(5) Click the [Save and Restart] to restart the gateway.

⚠ NOTE

The Sub-Band number must match sensor setting to be joined to the gateway. For the sensor configuration, please refer to sensor instruction manuals.

7.3 Initializing the Gateway

When it is necessary to reset the gateway settings to their factory defaults because, for example, the gateway cannot be accessed from the gateway configuration PC, gateway initialization is required.

(1) Remove the SIM/USB cover at the bottom of the gateway.

(2) Hold down the RESET button under the USB port for 30 seconds or more using a sharp object such as a needle.

(3) Mount the SIM/USB cover. The tightening torque for the SIM/USB cover is 1.18 N•m.

(4) When approximately 10 minutes have elapsed, the gateway starts in the factory default state.

7.4 Collecting Gateway Logs

This section describes how to acquire gateway logs. Logs can be collected from the gateway if necessary. However, the amount of log data that can be stored in the gateway is small, so it may not be possible to store logs that have been collected for a long period. In order to store logs that have been accumulated over a long period, use a function that stores logs outside the gateway. The following example describes how to store logs using free software named "Visual Syslog Server".

(1) Download Visual Syslog Server from the following URL, and install it on the PC you want to store gateway logs on. https://sourceforge.net/projects/syslogserverwindows/

(2) Launch Visual Syslog Server, and click the [Setup] button.

(3) Configure the log storage settings on the [Setup] page.

Definition enclosed in { }	Meaning	Value
d	Day	1 to 31
dd	Day (Two digit)	01 to 31
ddd	Day of the week	Sun to Sat
dddd	Day of the week (Full)	Sunday to Saturday
m	Month	1 to 12
mm	Month (2-digit)	01 to 12
mmm	Month	Jan to Dec
mmmm	Month (Full)	January to December
yy	Year (2-digit)	00 to 99
yyyy	Year (4-digit)	0000 to 9999
h	Hour	0 to 23
hh	Hour (2-digit)	00 to 23
n	Minute	0 to 59
nn	Minute (2-digit)	00 to 59
s	Second	0 to 59
ss	Second (2-digit)	00 to 59

(4) Click [OK].

Then, configure the log sending settings on the gateway.

(5) Access the gateway from the Web browser, and log in to the gateway.

(6) Click [Administration] to display the sub menu. Click [Debug Options].

(7) In [Remote Syslog], configure settings to send logs to the outside of the gateway.

Item	Value
Enabled	Checked
IP Address	IP address of the logging PC

(8) Click the [Submit] button.

(9) Click the [Save and Restart] button to restart the gateway.

After the gateway is restarted, gateway logs are sent. Check in Visual Syslog Sever that gateway logs have been received.

7.5 Changing automatic logout time

A timeout period is set on the gateway configuration screen. If configuration screen transition does not occur for a certain period, the screen is forced to log out. The default time out is 5 minutes, but the time may be short when the gateway initial setup. The following procedure allows to change the time out period.

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Administration] to display sub menu and click [Access Configuration].

(3) Set desired timeout period at "Session Timeout (minutes)".

(4) Click [Submit].

(5) Click [Save and Restart] to restart the gateway.

7.6 Gateway access from LTE network

Build-in firewall in the gateway is enabled to prevent access from LTE network to the gateway as a factory default. To manage the gateway from the Internet, the firewall configuration must be changed by the following procedures.

(1) Access the gateway through a web browser and log in to the gateway.

(2) Click [Firewall] to display sub menu and click [Settings].

(3) Click [Add Rule] in the line of "Input Filter Rules".

(4) After setting required configurations, click [Submit].

⚠ NOTE

Configurations should be set here are specified by an application administrator and/or LTE network carrier.

8.   Software License

8.1   GW Custom App Generator for Sushi Sensor License Agreement

GW Custom App Generator for Sushi Sensor Software License Agreement

IMPORTANT - PLEASE READ THIS AGREEMENT CAREFULLY:

THIS SOFTWARE LICENSE AGREEMENT ("AGREEMENT") IS A LEGALLY BINDING CONTRACT BETWEEN THE USER ("LICENSEE") AND YOKOGAWA ELECTRIC CORPORATION AND ITS DESIGNATED SUBSIDIARIES (COLLECTIVELY, "YOKOGAWA") FOR LICENSEE TO INSTALL OR USE YOKOGAWA GW Custom App Generator for Sushi Sensor SOFTWARE PRODUCT. BY INSTALLING THE ENCLOSED SOFTWARE PRODUCT LICENSEE AGREES TO BE BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT.

IF LICENSEE DOES NOT AGREE TO BE LEGALLY BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT, LICENSEE SHALL NOT INSTALL, COPY OR USE THE SOFTWARE PRODUCT AND PROMPTLY RETURN IT TO THE RESPONSIBLE DEPARTMENT OF YOKOGAWA.

1.   Grant of License

(1)   Subject to the terms and conditions of this Agreement, Yokogawa hereby grants to Licensee a non-exclusive and non-transferable right to use the enclosed "GW Custom App Generator for Sushi Sensor" and associated materials and documentation in printed or electronic format (collectively "Licensed Software") free of charge.

(2)   Licensee shall have the right to use the Licensed Software in the operating environment identified by Yokogawa, either (a) to the extent specified in the contract specification agreed upon by both parties, or (b) if not specified, on a single computer.

(3)   Licensee may use the Licensed Software solely for its setting up instruments having communication functions. Use of the Licensed Software for any purpose other than those as expressly specified in the documentation provided by Yokogawa shall be prohibited and any result or damage therefrom shall be at Licensee's own risk and responsibility.

(4)   In no event shall Licensee make any use of the Licensed Software in any other manner than stipulated hereunder.

(5)   The Licensed Software contains open source software ("OSS"), for which the special terms and conditions set forth in Appendix 1 shall take precedence over this Agreement.

The specification and the purpose of the Licensed Software are described detail in chapter 5.5 "Message Transfer Settings" of TI 01W06A51-50EN.

2.   Restriction

Licensee shall not: (a) remove any product identification, proprietary notices, or other notices or restrictions from the Licensed Software; (b) copy, transfer, sell, assign, sublicense or otherwise convey the Licensed Software to another party without Yokogawa's written consent; or (c) cause, permit or attempt the reverse engineering, disassembly, decompilation, translation or adaptation of the Licensed Software. Licensee shall not assign its rights or obligations under this Agreement without prior written consent of Yokogawa.

3.   Copyright / Ownership

The Licensed Software, including but not limited to any technology, algorithm, know-how, process and others contained therein, is the proprietary property and trade secret of Yokogawa and is protected by copyright and other intellectual property laws and treaties. Licensee acquires only the right to use the Licensed Software and does not acquire any rights, expressed or implied, in the Licensed Software or media containing the Licensed Software other than those specified in this Agreement. Yokogawa shall at all times retain all rights, titles, and interests, including intellectual property rights, in the Licensed Software and such media. The Licensee may not disclose or divulge the aforesaid proprietary property and trade secret to any other individual or entity than the Licensee's personnel who reasonably need to know and the Licensee shall impose strictly confidential obligations with respect to such proprietary property and trade secret on such Licensee's personnel.

4.   Warranty / Liability

(1)   THE LICENSED SOFTWARE SHALL BE PROVIDED TO LICENSEE ON AN "AS IS" BASIS. TO THE MAXIMUM EXTENT PERMITTED BY LAW, UNLESS OTHERWISE EXPRESSLY PROVIDED BY YOKOGAWA, YOKOGAWA HEREBY EXPRESSLY DISCLAIMS ALL WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION WARRANTY OF UNINTERRUPTED OR ERROR-FREE OPERATION, NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SOME JURISDICTIONS DO NOT ALLOW THE WAIVER OR EXCLUSION OF IMPLIED WARRANTIES SO THEY MAY NOT APPLY TO LICENSEE. TO THE MAXIMUM EXTENT PERMITTED BY LAW, IN NO EVENT SHALL YOKOGAWA BE LIABLE TO LICENSEE FOR ANY DAMAGE OR LOSS, WHETHER DIRECT OR INDIRECT, ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE OF THE LICENSED SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH LOSS OR DAMAGE, WHETHER BASED IN WARRANTY (EXPRESS OR IMPLIED), CONTRACT, STRICT LIABILITY, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER LEGAL OR EQUITABLE GROUNDS UNLESS OTHERWISE IT IS CAUSED BY YOKOGAWA'S GROSS NEGLIGENCE OR WILLFUL MISCONDUCT. THE LICENSED SOFTWARE IS FREE OF VULNERABILITY (INCLUDING BUT NOT LIMITED TO VULNERABILITY TO INTRUSION OR ATTACK CAUSED BY COMPUTER VIRUS OR UNAUTHORIZED ACCESS OR THE LIKE). YOKOGAWA SHALL NOT BE LIABLE FOR ANY DAMAGES CAUSED BY THE ENVIRONMENT (INCLUDING WITHOUT LIMTATION SOFTWARE AND HARDWARE) OF LICENSEE.

(2)   THIS PARAGRAPH 4 STATES THE ENTIRE WARRANTY AND LIABILITY OF YOKOGAWA IN CONNECTION WITH THE LICENSED SOFTWARE. THIS PARAGRAPH 4 ALLOCATES RISKS UNDER THIS AGREEMENT BETWEEN LICENSEE AND YOKOGAWA AND COMPRISES FUNDAMENTAL ELEMENTS OF THIS LICENSE.

(3)   LICENSEE SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS YOKOGAWA FROM ANY CLAIMS, DEMANDS, LIABILITIES, LOSSES, DAMAGES, JUDGMENTS OR SETTLEMENTS, INCLUDING ALL REASONABLE COSTS AND EXPENSES RELATED THERETO INCLUDING ATTORNEY'S FEES, DIRECTLY OR INDIRECTLY RESULTING FROM ANY CLAIM MADE OR POTENTIAL CLAIM BY A THIRD PARTY AGAINST YOKOGAWA ARISING OUT OF ANY ACT OR USE OF LICENSED SOFTWARE BY LICENSEE.

5. Term and Termination

(1) This Agreement shall become effective upon the Licensee installs the Licensed Software and remain in full force until and terminate when (a) Yokogawa terminates this Agreement according to paragraph 5 (2) or (3); or (b) the Licensee actually ceases to use the Licensed Software, whichever comes earlier.

(2) Yokogawa shall have the right to immediately terminate this Agreement without any notice to Licensee, if Licensee breaches any of the terms and conditions hereof.

(3) Yokogawa shall have the right to terminate this Agreement with or without cause at any time by giving at least thirty (30) days' prior notice in writing or by electromagnetic means.

(4) Upon termination of this Agreement, Licensee shall immediately, in accordance with instructions by Yokogawa, return all copies of the Licensed Software in its possession to Yokogawa or its designee and erase all copies of the Licensed Software installed in any computer hereunder.

(5) The provisions of the paragraphs 3, 4, 5 and 6 shall survive any expiration or termination of this Agreement.

6. General Provisions

(1) This Agreement shall be governed by and construed in accordance with the laws of Japan.

All disputes, controversies or differences which may arise between the parties hereto, out of or in relation to or in connection with this Agreement shall be finally settled by arbitration in Tokyo, Japan in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association. The award rendered by the arbitrator(s) shall be final and binding upon the parties hereto.

(2) This Agreement shall supersede any prior representations, discussions, undertakings, communications or advertising with respect to the Licensed Software.

(3) If any part of this Agreement is found void or unenforceable under any laws or regulations and Yokogawa deems it is not reasonable to license without such void or unenforceable part, Yokogawa is entitled to modify the terms of this Agreement or terminate this Agreement at its option without owing any liability to Licensee.

(4) Licensee agrees to comply with the export control and related laws, regulations and orders of Japan, the United States of America, and any other applicable countries and, if Licensee exports or re-exports the Licensed Software, to obtain export/import permit and take all necessary procedures under Licensee's own responsibility and at Licensee's own expense.

Appendix 1

GW Custom App Generator for Sushi Sensor

Terms and Conditions of Open Source Software

1. Open Source Software License

The Licensed Software uses or contains software licensed or distributed under any of the following licenses ("Open Source Software"). Notwithstanding anything to the contrary stated in the GW Custom App Generator for Sushi Sensor Software License Agreement, installation or use of Open Source Software shall be subject to the following license terms and this Terms and Conditions of Open Source Software, which shall prevail over the GW Custom App Generator for Sushi Sensor Software License Agreement. Some of Open Source Software may, in its accompanying files, specify different version of the license terms and/or additional terms, which, if any, shall take precedence over the following license terms:

Open Source Software	Licenses
SharpZipLib	MIT License

The text of the above license terms is provided below and available in the above websites.

2. Limited Warranty

Each Open Source Software shall be provided on an "AS IS" basis without warranty of any kind, and any express or implied warranties, including without limitation, any warranties of title, non-infringement, merchantability or fitness for a particular purpose are disclaimed.

3. Limitation of Liability

IN ADDITION TO AND WITHOUT LIMITING THE GENERALITY OF THE LIMITATION OF LIABILITY PROVISIONS SET FORTH IN OPEN SOURCE SOFTWARE LICENSES OR THE GW CUSTOM APP GENERATOR FOR SUSHI SENSOR SOFTWARE LICENSE AGREEMENT, UNLESS OTHERWISE REQUIRED BY APPLICABLE LAW, IN NO EVENT SHALL YOKOGAWA, ITS AFFILIATES AND SUPPLIERS BE LIABLE, IN RELATION TO OPEN SOURCE SOFTWARE, FOR ANY CLAIM, LOSS OR DAMAGE BASED UPON OR RELATED TO, A THIRDPARTY CLAIM, ACTUAL OR ALLEGED INFRINGEMENT, MALFUNCTIONS OR LOSS OF DATA, OR ANY DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, EXEMPLARY OR PUNITIVE DAMAGES, WHETHER ARISING IN TORT, CONTRACT, OR OTHERWISE, EVEN IF YOKOGAWA, ITS AFFILIATES OR SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH CLAIMS OR DAMAGES.

-SharpZipLib

(https://github.com/icsharpcode/SharpZipLib/blob/master/LICENSE.txt)

icsharpcode/SharpZipLib is licensed under the

MIT License

A short and simple permissive license with conditions only requiring preservation of copyright and license notices. Licensed works, modifications, and larger works may be distributed under different terms and without source code.

Copyright © 2000-2018 SharpZipLib Contributors

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

8.2 Custom App with Sushi Sensor License Agreement

Custom App with Sushi Sensor Software License Agreement

IMPORTANT - PLEASE READ THIS AGREEMENT CAREFULLY:

THIS SOFTWARE LICENSE AGREEMENT ("AGREEMENT") IS A LEGALLY BINDING CONTRACT BETWEEN THE USER ("LICENSEE") AND YOKOGAWA ELECTRIC CORPORATION AND ITS DESIGNATED SUBSIDIARIES (COLLECTIVELY, "YOKOGAWA") FOR LICENSEE TO INSTALL OR USE YOKOGAWA Custom App with Sushi Sensor SOFTWARE PRODUCT. BY INSTALLING THE ENCLOSED SOFTWARE PRODUCT LICENSEE AGREES TO BE BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT.

IF LICENSEE DOES NOT AGREE TO BE LEGALLY BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT, LICENSEE SHALL NOT INSTALL, COPY OR USE THE SOFTWARE PRODUCT AND PROMPTLY RETURN IT TO THE RESPONSIBLE DEPARTMENT OF YOKOGAWA.

1. Grant of License

(1) Subject to the terms and conditions of this Agreement, Yokogawa hereby grants to Licensee a non-exclusive and non-transferable right to use the enclosed "Custom App with Sushi Sensor" and associated materials and documentation in printed or electronic format (collectively "Licensed Software") free of charge.

(2)   Licensee shall have the right to use the Licensed Software in the operating environment identified by Yokogawa, either (a) to the extent specified in the contract specification agreed upon by both parties, or (b) if not specified, on a single computer.

(3)   Licensee may use the Licensed Software solely for its setting up instruments having communication functions. Use of the Licensed Software for any purpose other than those as expressly specified in the documentation provided by Yokogawa shall be prohibited and any result or damage therefrom shall be at Licensee's own risk and responsibility.

(4)   In no event shall Licensee make any use of the Licensed Software in any other manner than stipulated hereunder.

(5)   The Licensed Software contains open source software ("OSS"), for which the special terms and conditions set forth in Appendix 1 shall take precedence over this Agreement.

The specification and the purpose of the Licensed Software are described detail in chapter 5.5 "Message Transfer Settings" of TI 01W06A51-50EN.

2.   Restriction

Licensee shall not: (a) remove any product identification, proprietary notices, or other notices or restrictions from the Licensed Software; (b) copy, transfer, sell, assign, sublicense or otherwise convey the Licensed Software to another party without Yokogawa's written consent; or (c) cause, permit or attempt the reverse engineering, disassembly, decompilation, translation or adaptation of the Licensed Software. Licensee shall not assign its rights or obligations under this Agreement without prior written consent of Yokogawa.

3.   Copyright / Ownership

The Licensed Software, including but not limited to any technology, algorithm, know-how, process and others contained therein, is the proprietary property and trade secret of Yokogawa and is protected by copyright and other intellectual property laws and treaties. Licensee acquires only the right to use the Licensed Software and does not acquire any rights, expressed or implied, in the Licensed Software or media containing the Licensed Software other than those specified in this Agreement. Yokogawa shall at all times retain all rights, titles, and interests, including intellectual property rights, in the Licensed Software and such media. The Licensee may not disclose or divulge the aforesaid proprietary property and trade secret to any other individual or entity than the Licensee's personnel who reasonably need to know and the Licensee shall impose strictly confidential obligations with respect to such proprietary property and trade secret on such Licensee's personnel.

4.   Warranty / Liability

(1)   THE LICENSED SOFTWARE SHALL BE PROVIDED TO LICENSEE ON AN "AS IS" BASIS. TO THE MAXIMUM EXTENT PERMITTED BY LAW, UNLESS OTHERWISE EXPRESSLY PROVIDED BY YOKOGAWA, YOKOGAWA HEREBY EXPRESSLY DISCLAIMS ALL WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION WARRANTY OF UNINTERRUPTED OR ERROR-FREE OPERATION, NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SOME JURISDICTIONS DO NOT ALLOW THE WAIVER OR EXCLUSION OF IMPLIED WARRANTIES SO THEY MAY NOT APPLY TO LICENSEE. TO THE MAXIMUM EXTENT PERMITTED BY LAW, IN NO EVENT SHALL YOKOGAWA BE LIABLE TO LICENSEE FOR ANY DAMAGE OR LOSS, WHETHER DIRECT OR INDIRECT, ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE OF THE LICENSED SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH LOSS OR DAMAGE, WHETHER BASED IN WARRANTY (EXPRESS OR IMPLIED), CONTRACT, STRICT LIABILITY, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER LEGAL OR EQUITABLE GROUNDS UNLESS OTHERWISE IT IS CAUSED BY YOKOGAWA'S

GROSS NEGLIGENCE OR WILLFUL MISCONDUCT. THE LICENSED SOFTWARE IS FREE OF VULNERABILITY (INCLUDING BUT NOT LIMITED TO VULNERABILITY TO INTRUSION OR ATTACK CAUSED BY COMPUTER VIRUS OR UNAUTHORIZED ACCESS OR THE LIKE). YOKOGAWA SHALL NOT BE LIABLE FOR ANY DAMAGES CAUSED BY THE ENVIRONMENT (INCLUDING WITHOUT LIMTATION SOFTWARE AND HARDWARE) OF LICENSEE.

(2) THIS PARAGRAPH 4 STATES THE ENTIRE WARRANTY AND LIABILITY OF YOKOGAWA IN CONNECTION WITH THE LICENSED SOFTWARE. THIS PARAGRAPH 4 ALLOCATES RISKS UNDER THIS AGREEMENT BETWEEN LICENSEE AND YOKOGAWA AND COMPRISES FUNDAMENTAL ELEMENTS OF THIS LICENSE.

(3) LICENSEE SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS YOKOGAWA FROM ANY CLAIMS, DEMANDS, LIABILITIES, LOSSES, DAMAGES, JUDGMENTS OR SETTLEMENTS, INCLUDING ALL REASONABLE COSTS AND EXPENSES RELATED THERETO INCLUDING ATTORNEY'S FEES, DIRECTLY OR INDIRECTLY RESULTING FROM ANY CLAIM MADE OR POTENTIAL CLAIM BY A THIRD PARTY AGAINST YOKOGAWA ARISING OUT OF ANY ACT OR USE OF LICENSED SOFTWARE BY LICENSEE.

5. Term and Termination

(1) This Agreement shall become effective upon the Licensee installs the Licensed Software and remain in full force until and terminate when (a) Yokogawa terminates this Agreement according to paragraph 5 (2) or (3); or (b) the Licensee actually ceases to use the Licensed Software, whichever comes earlier.

(2) Yokogawa shall have the right to immediately terminate this Agreement without any notice to Licensee, if Licensee breaches any of the terms and conditions hereof.

(3) Yokogawa shall have the right to terminate this Agreement with or without cause at any time by giving at least thirty (30) days' prior notice in writing or by electromagnetic means.

(4) Upon termination of this Agreement, Licensee shall immediately, in accordance with instructions by Yokogawa, return all copies of the Licensed Software in its possession to Yokogawa or its designee and erase all copies of the Licensed Software installed in any computer hereunder.

(5) The provisions of the paragraphs 3, 4, 5 and 6 shall survive any expiration or termination of this Agreement.

6. General Provisions

(1) This Agreement shall be governed by and construed in accordance with the laws of Japan.

All disputes, controversies or differences which may arise between the parties hereto, out of or in relation to or in connection with this Agreement shall be finally settled by arbitration in Tokyo, Japan in accordance with the Commercial Arbitration Rules of the Japan Commercial Arbitration Association. The award rendered by the arbitrator(s) shall be final and binding upon the parties hereto.

(2) This Agreement shall supersede any prior representations, discussions, undertakings, communications or advertising with respect to the Licensed Software.

(3) If any part of this Agreement is found void or unenforceable under any laws or regulations and Yokogawa deems it is not reasonable to license without such void or unenforceable part, Yokogawa is entitled to modify the terms of this Agreement or terminate this Agreement at its option without owing any liability to Licensee.

(4) Licensee agrees to comply with the export control and related laws, regulations and orders of Japan, the United States of America, and any other applicable countries and, if Licensee exports or re-exports the Licensed Software, to obtain export/import permit and take all necessary procedures under Licensee's own responsibility and at Licensee's own expense.

Appendix 1

Custom App With Sushi Sensor

Terms and Conditions of Open Source Software

1. Open Source Software License

The Licensed Software uses or contains software licensed or distributed under any of the following licenses ("Open Source Software"). Notwithstanding anything to the contrary stated in the Custom App with Sushi Sensor Software License Agreement, installation or use of Open Source Software shall be subject to the following license terms and this Terms and Conditions of Open Source Software, which shall prevail over the Custom App with Sushi Sensor Software License Agreement. Some of Open Source Software may, in its accompanying files, specify different version of the license terms and/or additional terms, which, if any, shall take precedence over the following license terms:

Open Source Software	Licenses
lorawan-app-connect	Apache License version 2.0

The text of the above license terms is provided below and available in the above websites.

2. Limited Warranty

Each Open Source Software shall be provided on an "AS IS" basis without warranty of any kind, and any express or implied warranties, including without limitation, any warranties of title, non-infringement, merchantability or fitness for a particular purpose are disclaimed.

3. Limitation of Liability

IN ADDITION TO AND WITHOUT LIMITING THE GENERALITY OF THE LIMITATION OF LIABILITY PROVISIONS SET FORTH IN OPEN SOURCE SOFTWARE LICENSES OR THE CUSTOM APP WITH SUSHI SENSOR SOFTWARE LICENSE AGREEMENT, UNLESS OTHERWISE REQUIRED BY APPLICABLE LAW, IN NO EVENT SHALL YOKOGAWA, ITS AFFILIATES AND SUPPLIERS BE LIABLE, IN RELATION TO OPEN SOURCE SOFTWARE, FOR ANY CLAIM, LOSS OR DAMAGE BASED UPON OR RELATED TO, A THIRDPARTY CLAIM, ACTUAL OR ALLEGED INFRINGEMENT, MALFUNCTIONS OR LOSS OF DATA, OR ANY DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, EXEMPLARY OR PUNITIVE DAMAGES, WHETHER ARISING IN TORT, CONTRACT, OR OTHERWISE, EVEN IF YOKOGAWA, ITS AFFILIATES OR SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH CLAIMS OR DAMAGES.

- lorawan-app-connect

(https://github.com/MultiTechSystems/lorawan-app-connect/blob/master/LICENSE)

MultiTechSystems/lorawan-app-connect is licensed under the

Apache License 2.0

A permissive license whose main conditions require preservation of copyright and license notices. Contributors provide an express grant of patent rights. Licensed works, modifications, and larger works may be distributed under different terms and without source code.

Apache License

Version 2.0, January 2004

http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2.   Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3.   Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4.   Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

(a)   You must give any other recipients of the Work or Derivative Works a copy of this License; and

(b)   You must cause any modified files to carry prominent notices stating that You changed the files; and

(c)   You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and

(d)   If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5.   Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright 2020 Multitech Systems Inc.

Licensed under the Apache License, Version 2.0 (the "License");

you may not use this file except in compliance with the License.

You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS,

WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

Appendix: LoRaWAN Settings in each country or region.

In this appendix, configure the LoRaWAN settings to comply with the radio laws applicable in each country or region.

⚠ **IMPORTANT**

For the settings that comply with the latest radio laws and restrictions in each country or region, and the settings for the latest firmware version of the gateway, please contact the nearest Yokogawa sales office.

Item	Region						
	Japan	**EU**	**UAE**	**Malaysia**	**Thailand**	**Singapore**	**New Zealand Australia*4**
Channel Plan	AS923-1	EU868	EU868	AS923-1	AS923-1	AS923-1	AS923-1
Country*5	JAPAN2	N/A	N/A	MALAYSIA	*7	MANUAL	MANUAL
Max EIRP	13	N/A	N/A	13	13	13	13
Duty Cycle Period(min)	N/A	60	60	N/A	N/A	N/A	N/A
Enable Duty-Cycle Limit*5	Checked	Unchecked	Unchecked	Unchecked	Checked	Checked	Unchecked
Duty-Cycle Period*5	60	60	60	60	60	60	60
Duty-Cycle Ratio*5	0.1	(empty)	(empty)	0.01	*7	0.1	(empty)
Enable LBT	Checked	N/A	N/A	Checked	Checked*6	Checked	Checked*6
Dwelltime Up	1(400ms)	N/A	N/A	0 (no limit)	0 (no limit)	0 (no limit)	0 (no limit)
Dwelltime Down	1(400ms)	N/A	N/A	0 (no limit)	0 (no limit)	0 (no limit)	0 (no limit)
Network Mode	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN
Join Delay (sec)	5	5	5	5	5	5	5
Rx Delay (sec)	1	1	1	1	1	1	1
Max Tx Power	13	13	13	13	*7	13	13
Antenna Gain	3	3	3	3	3	3	3
Rx1 DR Offset	0	0	0	0	0	0	0
Rx2 Datarate	2 -SF10BW125	2 -SF10BW125*1	2 -SF10BW125*1	2 -SF10BW125	2 -SF10BW125	2 -SF10BW125	2 -SF10BW125
Min Datarate	2 -SF10BW125	2 -SF10BW125*1	2 -SF10BW125*1	2 -SF10BW125*2	2 -SF10BW125*2	2 -SF10BW125*2	2 -SF10BW125*2
Max Datarate	5 -SF7BW125	*10	6 -SF7BW250	5 -SF7BW125	5 -SF7BW125	5 -SF7BW125	5 -SF7BW125
ADR Nb Trans	-	*10	-	-	-	-	-

Item	Region					
	USA Canada	**South Korea**	**Australia*4 Peru**	**Chile**	**Brazil**	**Argentina**
Channel Plan	US915	KR920	AU915	AU915	AU915	AU915
Country*5	N/A	N/A	MANUAL	CHILE	MANUAL	MANUAL
Max EIRP	N/A	N/A	13	13	13	13
Duty Cycle Period(min)	N/A	N/A	N/A	N/A	N/A	N/A
Enable Duty-Cycle Limit*5	Unchecked	Unchecked	Unchecked	Unchecked	Unchecked	Unchecked
Duty-Cycle Period*5	60	60	60	60	60	60
Duty-Cycle Ratio*5	(empty)	(empty)	(empty)	(empty)	(empty)	(empty)
Enable LBT	N/A	Checked	N/A	N/A	N/A	N/A
Dwelltime Up	N/A	N/A	0 (no limit)	0 (no limit)	1(400ms)	1(400ms)
Dwelltime Down	N/A	N/A	0 (no limit)	0 (no limit)	1(400ms)	1(400ms)
Network Mode	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN
Join Delay (sec)	5	5	5	5	5	5
Rx Delay (sec)	1	1	1	1	1	1
Max Tx Power	13	13	13	13	13	13
Antenna Gain	3	3	3	3	3	3
Rx1 DR Offset	0	0	0	0	0	0
Rx2 Datarate	10 - SF10BW500	2 -SF10BW125*1	8 - SF12BW500	8 - SF12BW500	8 - SF12BW500	8 - SF12BW500
Min Datarate	0 -SF10BW125	2 -SF10BW125*2	2 -SF10BW125*2	2 -SF10BW125*2	2 -SF10BW125	2 -SF10BW125
Max Datarate	3 - SF7BW125	5 -SF7BW125	5 - SF7BW125	5 - SF7BW125	5 - SF7BW125	3 - SF9BW125

Item	Region			
	Vietnam	Indonesia	Saudi Arabia Serbia Philippines South Africa Qatar Bahrain	India
Channel Plan	AS923-2	AS923-2	EU868	IN865
Country*5	MANUAL	MANUAL	N/A	N/A
Max EIRP	13	13	N/A	N/A
Duty Cycle Period(min)	N/A	N/A	60	N/A
Enable Duty-Cycle Limit*5	Checked	Checked	Unchecked	Unchecked
Duty-Cycle Period*5	60	60	60	60
Duty-Cycle Ratio*5	0.1	*9	(empty)	(empty)
Enable LBT	Unchecked*8	Unchecked*8	N/A	N/A
Dwelltime Up	1(400ms)	1(400ms)	N/A	N/A
Dwelltime Down	1(400ms)	1(400ms)	N/A	N/A
Network Mode	Public LoraWAN	Public LoraWAN	Public LoraWAN	Public LoraWAN
Join Delay (sec)	5	5	5	5
Rx Delay (sec)	1	1	1	1
Max Tx Power	13	13	13	13
Antenna Gain	3	3	3	3
Rx1 DR Offset	0	0	0	0
Rx2 Datarate	2 -SF10BW125	2 -SF10BW125	2 -SF10BW125*1	2 -SF10BW125*1
Min Datarate	2 -SF10BW125*3	2 -SF10BW125*3	2 -SF10BW125*1	2 -SF10BW125*1
Max Datarate	5 -SF7BW125	5 -SF7BW125	5 -SF7BW125	5 -SF7BW125

*1: When connected Sushi Sensors are configured as "High Speed Mode = OFF", "0 - SF12BW125" has to be selected instead.

*2: When using DR0/1 as a data rate of LoRaWAN communication, "0 - SF12BW125" has to be selected instead. In the case, data sending period must be configured as 1 hour or longer.

*3: When using DR0/1 as a data rate of LoRaWAN communication, "0 - SF12BW125" has to be selected instead. In the case, data sending period must be configured as 1 hour or longer. (And set Dwelltime Up and Dwelltime Down to 0(no-limit))

*4: AS923-1 and AU915 channel plans are available in Australia. Set according to the specifications of the Sushi Sensor to be used.

*5: These items are not displayed in gateway firmware version R5.3.0 or earlier.

*6: "Unchecked" is also available.

*7: The settings for "Country", "Duty-Cycle Ratio", and "Max Tx Power" vary depending on the gateway model.
For the MTCDTIP-LEU1-266A-915 model, set the values to "THAILAND", "0.01", and "13", respectively.
For the MTCDTIP-L4E1-266A-915 model, set them to "MANUAL", "0.1", and "20", respectively.

*8: If the gateway model is MTCDTIP-266A-915 or MTCDTIP-L4E1-266A-915, the "Checked" option is also available.

*9: The setting values vary depending on the gateway model used.
For the model MTCDTIP-266A-915, set "0.1". For the model MTCDTIP-266A-915.R3, set "0.01".

*10: The setting values for "Max Datarate" and "ADR Nb Trans" depend on the LoRaWAN specification version. For V1.0.2, "Max Datarate" is set to "6 -SF7BW250", while for V1.0.4, it is "5 -SF7BW125". In the case of V1.0.4, enable ADR and set the value to "3".

Revision Information

Title : LoRaWAN Gateway Setup Guide
Manual number : TI 01W06A51-50EN

Edition	Date	Revised Item
1st	March 2019	New issue
2nd	June 2019	Updated a description about gateway version. Corrected a description about SIM card installation. Added descriptions about SIM card. Added descriptions about Thailand.
3rd	November 2019	Updated a description about gateway version. Added descriptions about Singapore, Malaysia, USA and Canada.
4th	April 2020	Added description about LoRaWAN settings for South Korea. Update descriptions about gateway initial setup, IP address configuration, etc.
5th	September 2020	Added descriptions about LoRaWAN settings for Australia and New Zealand.
6th	December 2020	Added description about LoRaWAN settings for Chile, Brazil and Argentina
7th	June 2021	Added descriptions about "Gateway firmware version R5.3.0" and "GW Custom App Generator for Sushi Sensor" and LoRaWAN settings for Indonesia, UAE and Saudi Arabia.
8th	September 2021	Added description about LoRaWAN settings for India, Serbia and AS923-1 in Australia.
9th	July 2022	Added description about LoRaWAN settings for Philippines and Vietnam. Added "Appendix: LoRaWAN Settings in each country and region". Added a description of the gateway firmware version to the introduction chapter. Added descriptions about "Additional channels" in Chapter 7.2.1.
10th	August 2022	Added description about GW Custom App Generator for Sushi Sensor version. Added description about LoRaWAN settings and the radio frequency for South Africa.
11th	June 2023	Added description about LoRaWAN settings for Peru and Thailand.
12th	December 2024	Added description about LoRaWAN settings for Qatar.
13th	December 2024	Added description of message transfer tools Revised software License
14th	December 2025	Update description about LoRaWAN settings for Indonesia, Vietnam and Thailand.
15th	March 2026	Updated LoRaWAN Settings procedure Added description about LoRaWAN settings for Bahrain.