

INSTRUCTION MANUAL

MRS-100 Series

Digital Telemeter

MRS-111A

MRS-101A-S

MRS-101A-SE

MRS-101A-V

Thank you for purchasing KYOWA's product MRS-100 Series.
Read this Instruction Manual carefully in order to make full use of the high performance capabilities of the product.
Do not use the product in methods other than described in this Manual.

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The contents of the Instruction Manual are subjected to change without prior notice.

We assume no responsibility whatever for any damage resulting from the use of this product.

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STANDARD ACCESSORIES

The following accessories are packed with the MRS-111A.

When unpacking, check the contents to ensure that all accessories are enclosed.

MRS-10A Control Software	1 (CD-R)
BNC-BNC cable (U-59)	1
USB cable (N-38)	1
AC adapter	1
Ground wire (P-72)	1
Receiving antenna (W1030)	2
Extension cable for receiving antenna (2m)	2
Ferrite core (E04SR170730A)	1
Side hole suction cup (55mm)	2
Cable tie	2
Product Warranty	1

The following accessories are packed with the MRS-101A-S.

When unpacking, check the contents to ensure that all accessories are enclosed.

Adapter board (ADP-01)*	1
JCIS10-70 Miniature Screw (M2x4)*	1
Battery holder (AAA cell×2) for checking operation	1
ID label	1
Product Warranty	1

*Attached to the transmitter body

The following accessories are packed with the MRS-101A-SE.

When unpacking, check the contents to ensure that all accessories are enclosed.

Adapter board (ADP-01)*	1
JCIS10-70 Miniature Screw (M2x4)*	1
Battery holder (AAA cell×2) for checking operation	1
External antenna(W1030)	1
Antenna harness(E-04)	1
ID label	1
Product Warranty	1

*Attached to the transmitter body

The following accessories are packed with the MRS-101A-V.
 When unpacking, check the contents to ensure that all accessories are enclosed.

Voltage Adapter (ADP-03)*	1
JCIS10-70 Miniature Screw (M2x4)*	1
Battery holder (AAA cell×2) for checking operation	1
ID label	1
Product Warranty	1

*Attached to the transmitter body

OPTIONAL ACCESSORIES

Small planar antenna	EXT-ANT1
Planar diversity antenna	EXT-ANT2
Extention cable for receiving antenna (6m)	E-03*
DC power cable (2m)	P-76

*E-03 cannot be used in Europe.

SAFETY PRECAUTIONS (Do not forget to read the safety precautions prior to use.)
 The MRS-111A is designed to be used according to "SPECIFICATIONS". Do not use the product in an environment exceeding the specifications. Or, it may cause troubles.

PRIOR TO USE

For safe use of the product, do not forget to read the "SAFETY PRECAUTIONS" prior to use.
 KYOWA assumes no liability for any damage resulting from the user's failure to comply with the safety precautions.
 For safety operation of the product, the following symbol marks are used in the Instruction Manual.

	Indicates "PROTECTIVE GROUND TERMINAL". Be sure to connect the GND terminal to the ground.
---	---

SAFETY SYMBOLS

For safety operation of the product, the following symbol marks are used in the Instruction Manual.

 WARNING	Improper operation of the system may result in death or severe injury of the operator.
 CAUTION	Improper operation of the system may result in injury of the operator and physical damage of the system.


WARNING

- Warning
Be sure to observe the safety precautions described in the MRS-101A-S Instruction Manual.
- Power supply
To prevent a fire hazard, ensure that the power supply voltage specified for the product matches the local line voltage before connecting the system to the power supply.
- Avoid using in environment with inflammable gas, etc.
To prevent the risk of fire hazard or explosion, do not use the product in environment with inflammable gas, vapor, or dust.
- If any trouble occurs
To prevent a fire hazards, if smoke is emerging from the product, immediately disconnect the USB cable or AC adapter to terminate the system operation.
- Protective ground
Be sure to connect the GND terminal to the ground. Or, it may cause an electric shock hazard, lower the performance, and cause trouble.
- To avoid secondary system damage from product failure, always follow a maintenance plan with separate technical measures.
- Never use the product in medical facilities.
Doing so may interfere with medical devices, posing a life-threatening risk.
- Never use the product at airports or in aircrafts.
Doing so may cause airport equipment to malfunction, posing a life-threatening risk.
- Do not use the product where use of wireless devices, such as mobile phones, is prohibited.



CAUTION

- Caution

Be sure to observe the safety precautions described in the MRS-111A Instruction Manual.

- Do not turn ON the power switch immediately after turning it OFF.

After turning OFF the power switch, wait (5 seconds) until the power supply is shut OFF before turning ON the power switch again.

To disconnect the product, turn controls to off, then remove plug from wall outlet.

- Use within the operating temperature range.

Use at temperatures exceeding the specified range may lower the performance and cause trouble.

- Use within the operating humidity range (however, without condensation).

Use in a humid place exceeding the specified range or where it is exposed to splashing water may lower the performance and cause trouble.

- Use the product at the altitude up to 2,000m.

- Do not use the product immediately when the ambient temperature and humidity change suddenly.

Leave the product as it is until it becomes adaptable to the environment.

Abrupt change in ambient temperature due to transportation, etc. may cause dew condensation, which may result in lower performance and troubles.

- Use the product under environment without excessive vibration or high impact.

Use the product in an area where vibration and impact can be kept within the scope of specifications.

Continuous vibration or severe impact may cause deteriorated performance and system failure.

In case of installing the product at high place, prepare enough measures for prevention of its drop.

- This product operates on the 2.4 GHz band, which wireless LAN, Bluetooth®, and microwave ovens also use.

Devices on the wireless LAN or on other radio waves may generate electromagnetic interference that causes wireless communication errors in this product.

Before using this product, check to confirm that there are no such devices nearby.

In addition, note that the wireless LAN and Bluetooth® functions of the computer on which the Control Software for this product is installed may generate electromagnetic interference. When controlling this product via the computer, turn off the computer's wireless LAN and Bluetooth® functions.

Use the product as far away from other signal lines and noise sources as possible, in order to prevent it from malfunctioning due to noise.

Keep this product far away as possible from equipment which generates strong electromagnetic wave.

- Do not use the product under poor conditions.

Operate the product within the range of power supply specs. The power supply used for the product should not experience an instantaneous power failure and be free from noise.

- Do not pull cords and cables.

Lay cords and cables with a certain allowance so that unreasonable force is not applied to the connections.

Or, it may interrupt the measurements, break the cables, and damage the connectors.

- Avoid installing sensors and products near a welding machine. Failure to do so will pose the risk of erroneous data, malfunction and failure.

- Do not disassemble or remodel the product. Or, it may cause electric shock hazards or damage the product. This warranty does not cover any damaged or defective parts that results from disassembling or remodeling.

- Do not use or storage the product under dusty or fine particles or corrosive gas environment.

Use or storage under these environment, may result in lower performance and troubles.

- Do not expose the product to the air if it is used and stored nearby sea. Air exposure nearby sea may cause lower performance and products failure.

- Take care when handling the CD-R.

Do not expose the CD-R to direct sun light, high temperature, or high humidity.

Do not apply pressure to the CD-R by laying object or bending.

Dust, scratches, and fingerprints on either side of the CD-R can cause write errors.

- Preheat the product before use.

After the power ON, always preheat the product for approximately 1 hour.

- Cleaning.

When the product gets dirty, clean the product with a dry soft cloth. When dust exists inside the MRS-111A, clean it by using an air blow gun. Do not touch electronic parts.

- Do not use the products (MRS-101A-S, MRS-101A-SE or MRS-101A-V) outside, in a humid place where it is exposed to splashing water without conducting the waterproof treatment to the transmitter, battery and wiring.
- Do not place the products (MRS-101A-S, MRS-101A-SE or MRS-101A-V) on an uneven surface.
- Turn off the transmitter, when removing the External antenna and Antenna harness from it.

LIMITED LIDE PARTS AND PREVENTIVE MAINTENANCE

The product consists of various electronic components and those components, if not all, have a useful life. Using them exceeding the years specified according to each part type (useful life) may affect the characteristics of the product, resulting in a malfunction or a failure.

Limited life parts used with the product are as follows.

- Aluminum electrolytic capacitor
The signal-noise ratio will lower due to capacity low or smoke will be emitted due to liquid leak, resulting in a malfunction of the product.
- AC adapter (optional accessories)
Heat and smoke will be emitted, resulting in an unstable voltage.

To operate the product normally, finding a sign of the product failure early by daily/periodic inspections and taking the corrective action are required. For inspection, contact KYOWA or our representatives.

- * Limited life parts used with the product are aluminum electrolytic capacitor.
- * All components do age and will fail.

MRS-100 Series REPLACEMENT BEFORE THE END OF SERVICE LIFE

Preventive maintenance and replacement parts are a cost-effective way of keeping the performance and extending the service life of the product. Regardless of the replacement parts, the product itself gradually deteriorates with age. Before the expected service life is reached, consider replacing the product with a new one or the latest series as preventive maintenance.

NOTATIONS USED IN THE INSTRUCTION MANUAL

The following notations are used in the Instruction Manual for convenience.

- Names described on the panel surface
Names described on the panel surface are expressed in double quotation mark " ".
- Informational notes
Certain notations are used as necessary to attract your attention to information that requires special care when handing the product, and to information provided for reference purposes.

Examples of Notations.

NOTE

Essential precautions required when handling the product.

MEMO

Reference items required when handling the product.

NOTE

IMPORTANT REGULATORY INFORMATION

The product is for use only in Japan, India, Thailand, the United States and the European Union. Use in other countries or regions is prohibited.

JAPAN

Type certification

The product has been certified as a low-power data communications system in the 2.4 GHz band (Technical Regulations Conformity Certification System: Ordinance of MPT No. 37, 1981, Article 2, paragraph 1, item (19)) according to the Radio Law of Japan.

Accordingly, no radio equipment license is required to use this product. However, the following actions may be punishable under law:

- Disassembling or modifying the product.
- Removing the certification label on the product.

Name of radio equipment: MR-2400M Number of type certification: 007-AE0235

FCC

COMPLIANCE WITH ELECTRIC DIRECTIVES & REGULATIONS

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

[CAUTION]

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Contains Transmitter Module

FCC ID: 2AJE9, MR-2400MA

INDIA

REGULATORY NOTRICE FOR Radio Frequency module

This manual contains regulatory information for the following Kyowa's product:

- Notice for users in India
For model: MR-2400MA
ETA-210/2017/RLO (SR)

THAILAND

REGULATORY INFORMATION in Thailand

เครื่องโทรคมนาคมและอุปกรณ์นี้ มีความสอดคล้องตามข้อกำหนดของ กสทช.

1. OUTLINE OF PRODUCT

1-1. OUTLINE

Wireless measurements (telemeters) have long been desired to measure the torque of rotation shafts or to measure data at a place where wiring is difficult. The MRS-100 series is a telemeter to meet the strict system requirements and conditions (vibration resistance, impact resistance, centrifugal acceleration resistance, small size for narrow space, high stability over the wide operating temperature range, low current consumption to get long time battery usage, and high-speed sampling).

1-2. FEATURES

- Radio-signal condition inspection by the dedicated control software.
- Easy operation without PC after initial settings.
- RSSI checking, transmitter's battery voltage checking, and communication error checking.
- Diversity receiving system.

(Dual antennas improve the communication reliability.)

1-3. Combination models

MRS-111A (1ch-Receiver) is used in combination with MRS-101A-S (1ch-Strain Transmitter), MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna)), or MRS-101A-V (1ch-Voltage Transmitter).

Connect to a power supply that matches the power specifications.

Receiver		Transmitter	
MODEL	Product name	MODEL	Product name
MRS-111A	1ch-Receiver	MRS-101A-S	1ch-Strain Transmitter
		MRS-101A-SE	1ch-Strain Transmitter (EXT Antenna)
		MRS-101A-V	1ch-Voltage Transmitter

NOTE

Some combinations cannot be used depending on the MRS-10A software Ver. and Transmitter and Receiver Firmware Ver.

Please refer to the following table during use.

○: usable ×: not usable

MRS-10A		Ver.1.00		Ver.2.00	
MRS-111A		Ver.1.00	Ver.2.00	Ver.1.00	Ver.2.00
MRS-101A-S/SE	Ver.1.00	○	×	○	○
	Ver.2.00	×	×	○	○
MRS-101A-V	Ver.2.00	×	×	○	○

If already using MRS-10A Ver.1.00, uninstall Ver.1.00, upgrade to Ver.2.00, and then respecify the Transmitter and Receiver [Pairing settings].

The latest version of MRS-10A can be downloaded from our company' s website.

MEMO

The MRS-10A software Ver. is displayed on the toolbar.

MEMO

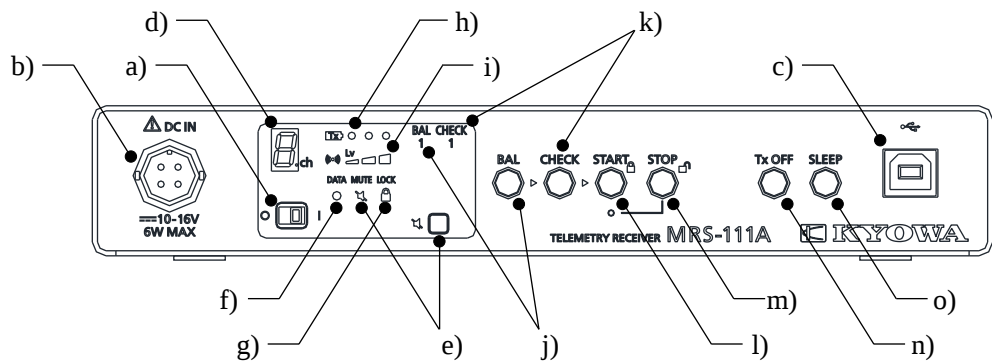
The Transmitter and Receiver Firmware Ver. can be confirmed from MRS-10A.

The Receiver Firmware Ver. can be confirmed from Receiver information displayed on the [Connect] tab, and the Transmitter Firmware Ver. can be confirmed from Transmitter information displayed on the [Transmitter settings] tab.

2. CONTROLS AND FUNCTIONS

2-1. 1ch-Receiver

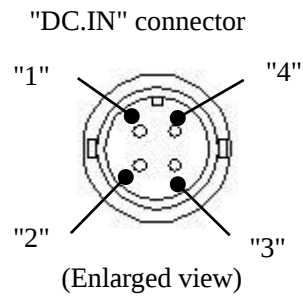
2-1-1. FRONT PANEL



a) POWER switch
" o " position: Power OFF , " | " position: Power ON

b) "DC.IN" connector (RM12BRD-4PH)
Connects to the power supply.
Use either the included AC adapter or an external DC power supply to provide 10 to 16 V DC power.
Receptacle (Receiver Side) : RM12BRD-4PH (HIROSE)
Plug (Cable Side) : RM12BPG-4S (HIROSE)

Pin No.	Signal Name
1	Positive(+) power supply
2	Positive(+) power supply
3	Negative(-) power supply
4	Negative(-) power supply



c) "USB" connector
Connects an accessory USB cable.

d) "Frequency CH" LED
Indicates one of 16 channel numbers (0–9, A–F) currently set.
The default is "F".

e) "MUTE" switch, "MUTE" LED
Can be pressed to switch the buzzer on/off.
When the "MUTE" switch is set to off, the "MUTE" LED lights up in green, and the buzzer does not sound.
The "MUTE" switch can be switched in either Command Mode or Measuring Mode.
Immediately after starting up the product, the "MUTE" switch is set to on. The buzzer sounds for three seconds if a wireless communication error occurs even in a single packet.

"MUTE" LED	buzzer
Green(Light up) 	OFF
Light out 	ON

MEMO

●Packetizing measurement data

The transmitter groups sampled measurement data into packets, each of which contains a certain quantity of data, and sends them intermittently by wireless communication.

f) "DATA" LED

Indicates the wireless communication status.

- Lights up in green for normal wireless communication.
Remains lit in green while in Measuring Mode during normal wireless communication.
- Lights up in red for three seconds if a wireless communication error occurs even in a single packet.

g) "LOCK" LED

Lights up in green when the product enters Measuring Mode. (Measuring Mode begins when the "START" switch is pressed and the "START" LED is lit.)

In Measuring Mode, no switches other than "STOP" and "MUTE" are available.

h) "Transmitter's battery voltage checking" LED

Indicates the transmitter power supply level in four levels by lighting up zero to three of the LEDs.

For more information, refer to "6. Transmitter power supply."

LED illumination settings can be changed using the Control Software.

For instructions, refer to the MRS-10A instruction manual.

LED Display	Power Level
● ● ●	High ↑
● ● ●	
● ● ●	↓ Low
● ● ●	

i) "RSSI(Received Signal Strength Indicator)" LED

Indicates RSSI from the transmitter in four levels by lighting up zero to three of the LEDs.

Serves as a guideline when finding the best place for installation.

For stable wireless communication, choose an installation location where three "RSSI" LEDs are lit.

The receiver receives data via both "MAIN" and "SUB" antennas but prioritizes data received from the "MAIN" antenna.

"ANTENNA SUB" data is used in case a wireless communication error occurs in the "ANTENNA MAIN" data to reduce the data defect rate.

LED Display	Description	RSSI
■ ■ ■	This is the recommended level.	Strong ↑
■ ■ ■	Try to install the product in a different location with a better wireless signal.	
■ ■ ■	Environments susceptible to wireless communication errors. Install the product in a different location.	↓ Weak
■ ■ ■	Environments where connecting to wireless communication is difficult. Install the product in a different location.	

MEMO

The receiver receives via both "MAIN" and "SUB" antennas but prioritizes data received from "MAIN." For this reason, even if there are no wireless communication receiving errors, the "RSSI" LEDs may switch between all lit and off depending on the sending/receiving environment.

This situation occurs when there is minimal "MAIN" RSSI (enough to avoid receiving errors) but ample "SUB" RSSI (LEDs all lit).

In this case, adjust the "MAIN" antenna direction or take other measures to improve RSSI.

j) "BAL" switch, "BAL" LED

The "BAL" switch is for Balance adjustment and is available in Command Mode.

●If using the MRS-101A-S (1ch-Strain Transmitter) or MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna))

Pressing the switch negates the transmitter's bridge unbalance value and performs Balance adjustment.

The specification for the Balance Adjustment Range is $\pm 10000 \times 10^{-6}$ strain, but the product is designed to support Balance adjustment of approximately $\pm 14000 \times 10^{-6}$ strain.

• When Balance adjustment is successful:

- 1) When the "BAL" switch is pressed, both the "BAL" LED and "DATA" LED light up in green.
- 2) The "BAL" LED remains lit in green, the "DATA" LED turns off, and Balance adjustment is complete.

Because the bridge unbalance value is negated, the receiver's analog output becomes approximately 0 V.

• When Balance adjustment fails (due to poor sensor connection, etc.):

- 1) When the "BAL" switch is pressed, both the "BAL" LED and "DATA" LED light up in green.
- 2) The "BAL" LED turns red, and the "DATA" LED turns off.

Because the bridge unbalance value cannot be negated, the receiver's analog output remains as the bridge unbalance value.

When no bridge is connected to the transmitter, the receiver's analog output is approximately -5.4 V (negative saturation voltage).

• When a wireless communication error occurs during Balance adjustment:

- 1) When the "BAL" switch is pressed, the "BAL" LED flashes in green.
- 2) The "DATA" LED lights up in red, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 3) Both the "BAL" LED and "DATA" LED turn off.

Because Balance adjustment was not performed, the receiver's analog output does not change.

"BAL" LED	"DATA" LED	Receiver Analog Output	Status
Lit in green 	Lit in green  (Lit for three seconds)	Approximately 0 V output	• If Balance adjustment is successful
Lit in red 	Lit in green  (Lit for three seconds)	Output of a value corresponding to the bridge unbalance value	• If Balance adjustment fails
Flashing in green  ↓ Off 	Lit in red  (Lit for three seconds)	No change	• If Balance adjustment cannot be performed Try again in an environment that enables normal wireless communication.

●If using the MRS-101A-V (1ch-Voltage Transmitter)

Pressing the switch negates the transmitter's initial input voltage value and performs Balance adjustment. The specification for the Balance adjustment range is ± 5 V, but the product is designed to support Balance adjustment of about ± 6 V.

• **When Balance adjustment is successful:**

- 1) When the "BAL" switch is pressed, both the "BAL" LED and "DATA" LED light up in green.
- 2) The "BAL" LED remains lit in green, the "DATA" LED turns off, and Balance adjustment is complete.

Because the initial input voltage value is negated, the receiver's analog output becomes approximately 0 V.

• **When Balance adjustment fails (When its value is outside the Balance Adjustment Range):**

- 1) When the "BAL" switch is pressed, both the "BAL" LED and "DATA" LED light up in green.
- 2) The "BAL" LED turns red, and the "DATA" LED turns off.

Because the initial input voltage value cannot be negated, the receiver's analog output corresponds to the input voltage to the transmitter.

• **When a wireless communication error occurs during Balance adjustment:**

- 1) When the "BAL" switch is pressed, the "BAL" LED flashes in green.
- 2) The "DATA" LED lights up in red, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 3) Both the "BAL" LED and "DATA" LED turn off.

Because Balance adjustment was not performed, the receiver's analog output does not change.

"BAL" LED	"DATA" LED	Receiver Analog Output	Status
Lit in green 	Lit in green  (Lit for three seconds)	Approximately 0 V output	• If Balance adjustment is successful
Lit in red 	Lit in green  (Lit for three seconds)	Output of a value corresponding to the initial value	• If Balance adjustment fails
Flashing in green  ↓ Off 	Lit in red  (Lit for three seconds)	No change	• If Balance adjustment cannot be performed Try again in an environment that enables normal wireless communication.

NOTE

For absolute voltage measurement and relative voltage measurement, caution is required for Balance Execution and the Connection Method.
For details, see "MRS-101A-V (1ch-Voltage Transmitter)_READ IN THE BEGINNING."

k) "CHECK" switch, "CHECK" LED

• If using the MRS-101A-S (1ch-Strain Transmitter) or MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna))

The "Check" switch is for checking the sensor and is available in Command Mode.

The bridge resistance value to be used must be entered in the Control Software.

Pressing the switch produces approximately +2.5 V of analog output from the receiver for five seconds.

Perform checking after successful Balance adjustment (after pressing the "BAL" switch).

• **When the sensor check is successful:**

- 1) When the "CHECK" switch is pressed, both the "CHECK" LED and "DATA" LED light up in green.
- 2) After the "DATA" LED turns off, the "CHECK" LED turns off and checking ends.

While the "CHECK" LED is lit in green, approximately +2.5 V of analog output is produced from the receiver for five seconds.

• **When the sensor check fails (due to poor sensor connection, etc.):**

- 1) When the "CHECK" switch is pressed, the "CHECK" LED lights up in red and "DATA" LED in green.
- 2) After the "DATA" LED turns off, the "CHECK" LED turns off and checking ends.

Analog output from the receiver does not change.

• **If a wireless communication error occurs when checking starts:**

- 1) The "CHECK" LED flashes twice.
- 2) The "DATA" LED lights up in red, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 3) Both the "CHECK" LED and "DATA" LED turn off, and the operation ends without checking.

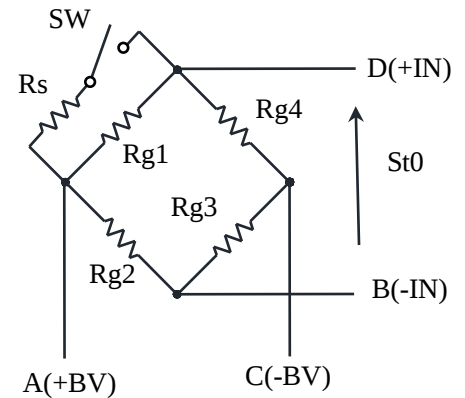
"CHECK" LED	"DATA" LED	Receiver Analog Output	Status
Lit in green  In ↓ approximately Seven seconds Off 	Lit in green  (Lit for three seconds)	For approximately five seconds Approximately 2.5 V output	• If the sensor check is successful
Lit in red  In ↓ approximately Seven seconds Off 	Lit in green  (Lit for three seconds)	No change	• If the sensor check fails Recheck the sensor connection, etc. Check to confirm that the value used does not differ greatly from the bridge resistance value set in the Control Software.
Flashing in green  ↓ Off 	Lit in red  (Lit for three seconds)	No change	• If the sensor check cannot be performed Try again in an environment that enables normal wireless communication.

MEMO

• Conditions for a successful sensor check

Sensor checking uses the tip parallel resistance method, as shown in the following bridge schematic diagram. The transmitter incorporates a parallel resistance value (R_s) and switch. Turning on the switch increases strain output. When this increase is within the range indicated in the last line of the following table, the sensor check is successful.

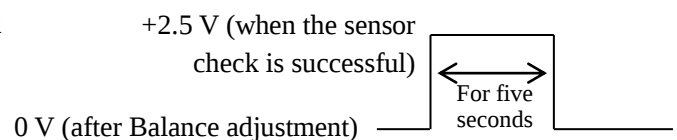
	Description	Remarks
R_g	bridge resistance	$R_g \doteq R_{g1} \doteq R_{g2} \doteq R_{g3} \doteq R_{g4}$ The bridge being used must be entered in the Control Software.
R_s	Parallel resistance value	$R_s = 361 \text{ kohm}$ (in the transmitter)
k	Gage Factor	$k = 2.00$
St	Generating strain value based on tip parallel resistance method	$St = \frac{R_g}{k} \times \frac{1}{(R_g + R_s)} \doteq \frac{R_g}{k \cdot R_s} \times \left(1 - \frac{R_g}{R_s}\right)$
SW	Switch for sensor check	On when a sensor check is performed (Switch is in the transmitter)
St_0	sensor check Strain output when off	When sensor check is off (Strain output for normal measurement)
St_1	sensor check Strain output when on	When sensor check is on (Switch is on [shorted])
$St_1 - St_0$	Increased strain output value	Additional strain output when a sensor check is performed
Conditions for a successful sensor check: $0.7 \times St < St_1 - St_0 < 1.3 \times St$ - When $R_g = 350 \text{ ohm}$: Based on $St = 484.3 \times 10^{-6} \text{ strain}$, $339.0 \times 10^{-6} < St_1 - St_0 < 629.6 \times 10^{-6} \text{ strain}$ - When $R_g = 120 \text{ ohm}$: Based on $St = 166.1 \times 10^{-6} \text{ strain}$, $116.3 \times 10^{-6} < St_1 - St_0 < 216.0 \times 10^{-6} \text{ strain}$		



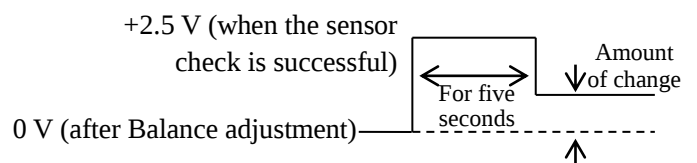
NOTE

• Analog output from a successful sensor check

- If S_{10} in the preceding **MEMO** has not been changed after Balance adjustment, the value will return from 2.5 V to 0 V as shown in the figure at right.



- If S_{10} has been changed after Balance adjustment, the value will not return from 2.5 V to 0 V as shown in the figure at right.



●If using the MRS-101A-V (1ch-Voltage Transmitter)

- The product does not have a sensor checking function for confirming the sensor connection.

Do not start measuring until you have confirmed that the input is connected.

- If the “CHECK” switch is pressed, the receiver operates differently depending on the firmware version as shown below.

Firmware version	"CHECK" LED	"DATA" LED	Receiver Analog Output
Ver.1.00	Lit in green  In ↓ approximately Seven seconds Off 	Lit in green  (Lit for three seconds)	For approximately five seconds Approximately 2.5 V output
Ver.2.00	Off 	Off 	No change

l) "START" switch, "START" LED

The "START" switch is for starting measurement. The "START" LED below the "START" switch lights up in green.

When the "START" switch is pressed, the product transitions from Command Mode to Measuring Mode and starts outputting measurement data from the receiver's analog output.

The "DATA" LED lights up in red for three seconds if a wireless communication error occurs even in a single packet.

Measurement can only be started in Command Mode, and after the product switches to Measuring Mode, no switches other than "STOP" and "MUTE" are available.

• **When measurement starts normally:**

- 1) When the "START" switch is pressed, the "DATA" LED, "LOCK" LED, and "START" LED light up in green.
- 2) The product transitions from Command Mode to Measuring Mode.
- 3) One to three "Transmitter's battery voltage checking" LEDs and one to three "RSSI" LEDs light up in green.
- 4) Outputting of measurement data begins from the receiver's analog output.

• **When measurement fails to start normally (due to a wireless communication error, etc.):**

- 1) When the "START" switch is pressed, the "DATA" LED lights up in red for three seconds, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 2) Measuring Mode does not begin, and the product remains in standby in Command Mode.

"START" LED	"DATA" LED	Status
Lit in green 	Lit in green 	Switched to Measuring Mode. Measurement has started. Begin outputting measurement data from the receiver's analog output.
Off 	Lit in red  (Lit for three seconds)	Cannot transition to Measuring Mode. The product remains in standby in Command Mode. Try again in an environment that enables normal wireless communication.

m) "STOP" switch

The "STOP" switch is for ending (stopping) measurement.

Press the "STOP" switch to transition from Measuring Mode to Command Mode.

• **When measurement ends normally:**

- 1) When the "STOP" switch is pressed, the "START" LED turns off.
- 2) Output of measurement data from the receiver's analog output stops.
- 3) The "LOCK" LED, "DATA" LED, "Transmitter's battery voltage checking" LEDs, and "RSSI" LEDs turn off.
- 4) The product transitions from Measuring Mode to Command Mode.

• **When measurement fails to end normally:**

- 1) When the "STOP" switch is pressed, the "DATA" LED lights up in red, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 2) The product remains in Measuring Mode, and output of measurement data continues.

"START" LED	"DATA" LED	Status
Off ●	Off ●	Switched to Command Mode. Measurement is finished normally.
Lit in green ●	Lit in red (Lit for three seconds) ●	Cannot transition to Command Mode, and the product continues to measure in Measuring Mode. Press the "STOP" switch again.

MEMO

• **When measurement cannot be ended promptly**

The first attempt to end measurement may not be successful if there are timing issues between the timing of packet transmission and "STOP" command transmission from the receiver.

In this case, try pressing the "STOP" switch repeatedly to end measurement, with a short interval between each attempt.

n) "Tx OFF" switch

Hold down the switch for at least three seconds to turn off the transmitter.

Once Tx OFF is executed, the transmitter remains off until it is manually restarted.

• **When executed normally:**

- 1) Hold down the "Tx OFF" switch for at least three seconds.
- 2) The "DATA" LED lights up in green.
One to three "Transmitter's battery voltage checking" LEDs and one to three "RSSI" LEDs also light up in green.
- 3) Tx OFF is executed, and the transmitter powers off.

• **If measurement fails to start normally (due to a wireless communication error, etc.):**

- 1) Hold down the "Tx OFF" switch for at least three seconds.
- 2) The "DATA" LED lights up in red, and the buzzer sounds.
(The buzzer does not sound if "MUTE" is off.)
- 3) Tx OFF is not executed, and the transmitter remains in standby in Command Mode.

"Battery voltage checking" "RSSI" LED	"DATA" LED	Status
Lit in green ● (Lit for three seconds)	Lit in green ● (Lit for three seconds)	Tx OFF was executed normally.
Off ●	Lit in red (Lit for three seconds) ●	Tx OFF was not executed normally. Try again in an environment that enables normal wireless communication.

o) "SLEEP" switch

To save battery life, hold down the switch for at least three seconds to transition the transmitter to sleep mode for the specified amount of time. In sleep mode, transmitter operations are not possible.

Once the specified period elapses, the transmitter returns to the same state it was in after turning on the power.

• **When executed normally:**

- 1) Hold down the "SLEEP" switch for at least three seconds.
- 2) The "DATA" LED lights up in green.

One to three "Transmitter's battery voltage checking" LEDs and one to three "RSSI" LEDs also light up in green.

- 3) The transmitter enters sleep mode.

• **When measurement fails to start normally (due to a wireless communication error, etc.):**

- 1) Hold down the "SLEEP" switch for at least three seconds.
- 2) The "DATA" LED lights up in red, and the buzzer sounds.

(The buzzer does not sound if "MUTE" is off.)

- 3) SLEEP is not executed, and the transmitter remains in standby in Command Mode.

"Battery voltage checking" "RSSI" LED	"DATA" LED	Status
Lit in green  (Lit for three seconds)	Lit in green  (Lit for three seconds)	SLEEP was executed normally.
Off 	Lit in red  (Lit for three seconds)	SLEEP was not executed normally. Try again in an environment that enables normal wireless communication.

MEMO

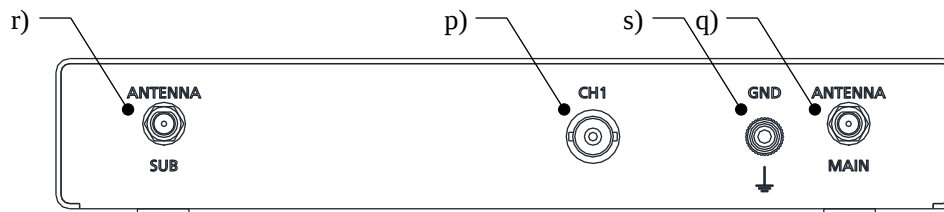
When the Transmitter is turned on again or the Sleep period elapses, the Transmitter's status upon resuming operation differs depending on its Firmware Ver. as follows:

- For Firmware Ver.2.00 or later, operation is resumed in the Measuring Mode.
- For Firmware Ver.1.00, operation is resumed in the Command Mode.

MEMO

Even if the transmitter is in the SLEEP or Tx OFF state, restarting the transmitter back on will cause it to return.

2-1-2. REAR PANEL



p) Analog output connector (BNC)

In Measuring Mode, the transmitter outputs measurement data as voltage as follows:

- Output sensitivity

The setting range for positive and negative rated output corresponds to ± 5 V.

For example, if the MRS-101A-S (1ch-Strain Transmitter) or MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna)) is being used and the device is set to the $5,000 \times 10^{-6}$ strain range, when $-4,000 \times 10^{-6}$ strain is input to the transmitter, -4 V is output from the analog output.

If the MRS-101A-V (1ch-Voltage Transmitter) is being used and the device is set to the 10 V range, when +5 V is input to the transmitter, +2.5 V is output from the analog output.

- DA Conversion Speed

Measurement data is output at a conversion speed of 4.8 kHz.

- Delay Time

From transmitter strain input to analog output, there is a constant delay of -11.1 ± 0.3 msec (at DC to 480 Hz).

- Communication Error Handling

Over +5V: To recognize receiving errors, the product forces a jump in output to over +5 V.

Over -5V: To recognize receiving errors, the product forces a jump in output to under -5 V.

Retain previous value: Measurement data immediately before the error is output as-is.

These three items can be adjusted in the Control Software.

The connector format is BNC. Use the included BNC cable or others to connect other equipment, such as a data logger.

q), r) Connectors (RP-SMA) for "ANTENNA MAIN" and "ANTENNA SUB" antenna connections

Used to connect the included antennas.

The connector format is SMA Reverse (characteristic impedance 50 ohm).

Use the product with the two included 2.4 GHz band antennas (EXT-ANT1) attached.

NOTE

- Not for use with receiving antennas except Kyowa-recommended models. Using nonrecommended antennas violates the Radio Law.
- When using an extension cable for receiving antenna, note "RSSI."
A long cable will cause the "RSSI" to be weaker. When setting up the equipment, watch the RSSI on the "RSSI" LEDs.

MEMO

Two extension cables for receiving antenna (2 m) are included with the product.
An extension cable for receiving antenna can be used to extend the distance between the receiving antenna and receiver in places where receiver installation is difficult or where connecting to wireless communication is difficult with the receiving antenna attached to the receiver.

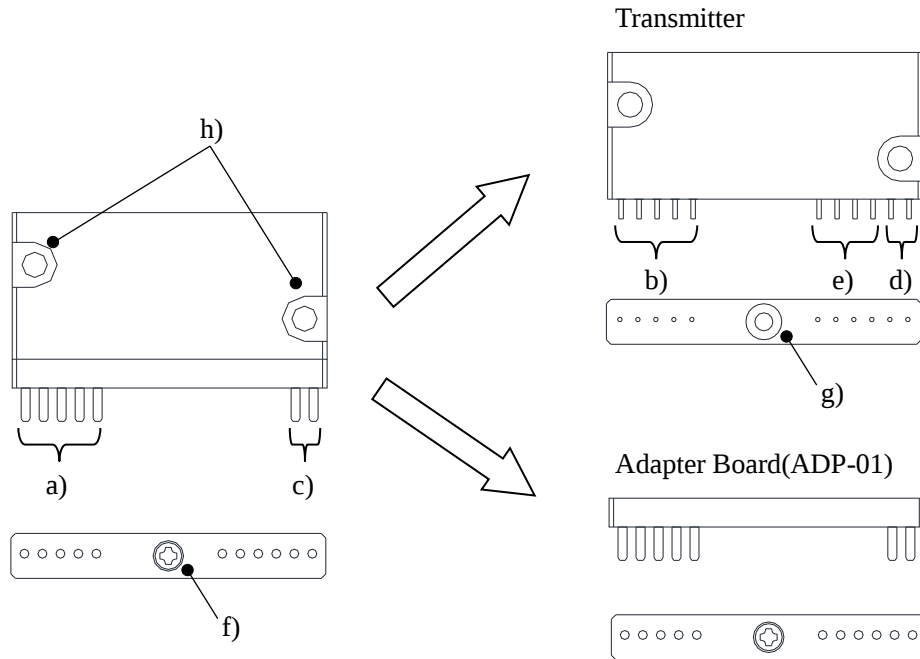
s) GND terminal

This terminal is used to ground the product. Use the included grounding wire to ground the product. When there is a lot of noise, etc., it can sometimes be reduced by grounding the product. When connecting a logger or other equipment, check the signal path of the target device.

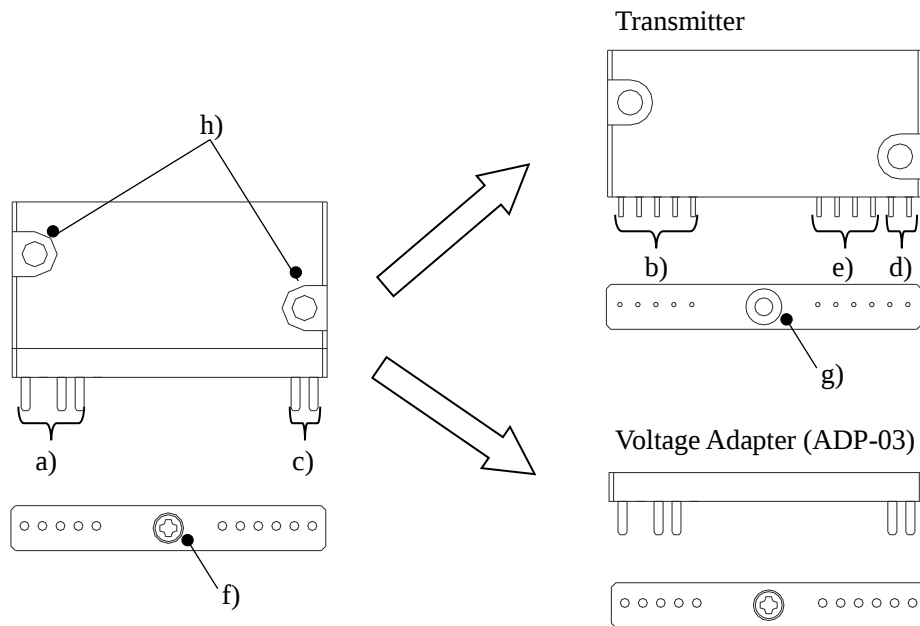
2-2. 1ch Transmitter

Normally, the transmitter is used with the Adapter.
The transmitter can also be used without the Adapter.

- If using the MRS-101A-S (1ch-Strain Transmitter) or MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna))



- If using the MRS-101A-V (1ch-Voltage Transmitter)



a), b) Bridge input pins (MRS-101A-S/SE) or voltage input pins (MRS-101A-V)

Pins for bridge input (MRS-101A-S/SE) or voltage input (MRS-101A-V).

For connection details, see "3-4.Wiring method of the transmitter."

c), d) Power input pins

Pins for power input.

For connection details, see "3-4.Wiring method of the transmitter."

Be careful not to use the wrong polarity, as it may damage the product.

e) Adjustment signal pins

Pins required during manufacturing. Not required during use.

Be careful not to short the pins or otherwise use them incorrectly.

f) Screw to fix the Adapter

Screw for affixing the transmitter and Adapter.

For more information on mounting screws, see the following table.

g) Screw hole to fix the Adapter

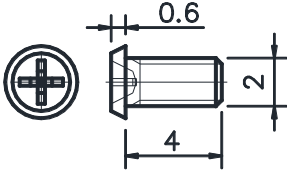
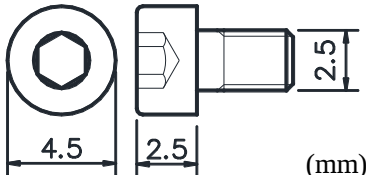
Screw hole for affixing the transmitter and Adapter.

h) Screw hole to fix the transmitter

Used for affixing the transmitter main unit and Adapter.

For more details on mounting screws, see the following table.

Mounting screws to the transmitter main body

Mounting object		Adapter	Fixing surface
Screw	Type	JCIS10-70 Miniature Screw(M2)	Hexagon socket head cap Screw (M2.5)
	Material	SWCH	
	Finish	Black Trivalent Chromate	
	Size	 (mm)	 (mm)
Max.Torque to the Transmitter Main Body		0.1N·m	0.5N·m
Mounting precautions		Exceeding the maximum torque or mounting the transmitter to a warped or uneven fixing surface may cause damage or cracking on the transmitter or prevent normal operation. Fix the transmitter on flat metal surface, etc. by the above mentioned screw (for Fixing surface) in using it on rotating shafts, moving obstacles, etc.	

MEMO

The Transmitter mode after turning on the power differs depending on the Transmitter Firmware Ver.

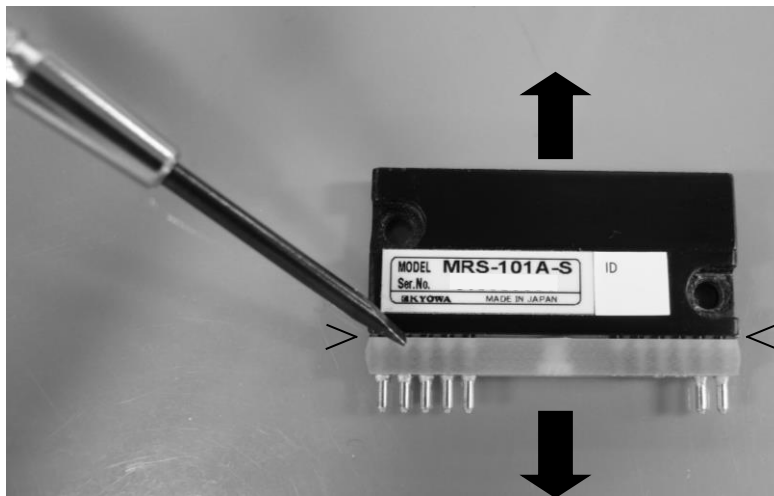
- For Firmware Ver.2.00 or later, it is the Measuring Mode.
- For Firmware Ver.1.00, it is the Command Mode.

MEMO

When removing the Adapter from the transmitter, after removing the small screw (M2), pull out the Adapter straight.

Be careful when handling the transmitter pins, as they can bend easily.

If the Adapter is difficult to pull out, insert a flat tool, such as a screwdriver blade, between the transmitter and Adapter and gradually separate both sides, one after the other.



If difficult to pull out,
insert a screwdriver
blade and gradually
separate both sides.

NOTE

If the pins become bent, use tweezers or similar tool to straighten them before use.

Be careful, because inserting the Adapter when the pins are bent may damage the transmitter pins.

3. Wiring method

3-1. Receiving antenna

The receiver conforms to radio equipment standards and regulations, specifically for low-power data communications systems (ARIB STD-T66) and involving the Code of Federal Regulations for radio modules (FCC Part 15C) and the Indian Wireless Act 1933 (WPC ETA).

Use it connected to the Accessory Receiving antenna (approximately 110 mm long).

The receiver can also be used with an optional compact receiving antenna (for the 2.4 GHz band, approximately 28 mm long) or Planar Diversity Antenna (antenna for the 2.4 GHz band: orthogonal polarization diversity planer antenna).

3-2. Transmitting antenna

The transmitter conforms to radio equipment standards and regulations, specifically for low-power data communications systems (ARIB STD-T66) and involving the Code of Federal Regulations for radio modules (FCC Part 15C) and the Indian Wireless Act 1933 (WPC ETA).

The MRS-101A-S and MRS-101A-V transmitter use a built-in antenna, and the MRS-101A-SE transmitter uses an external antenna (W1030).

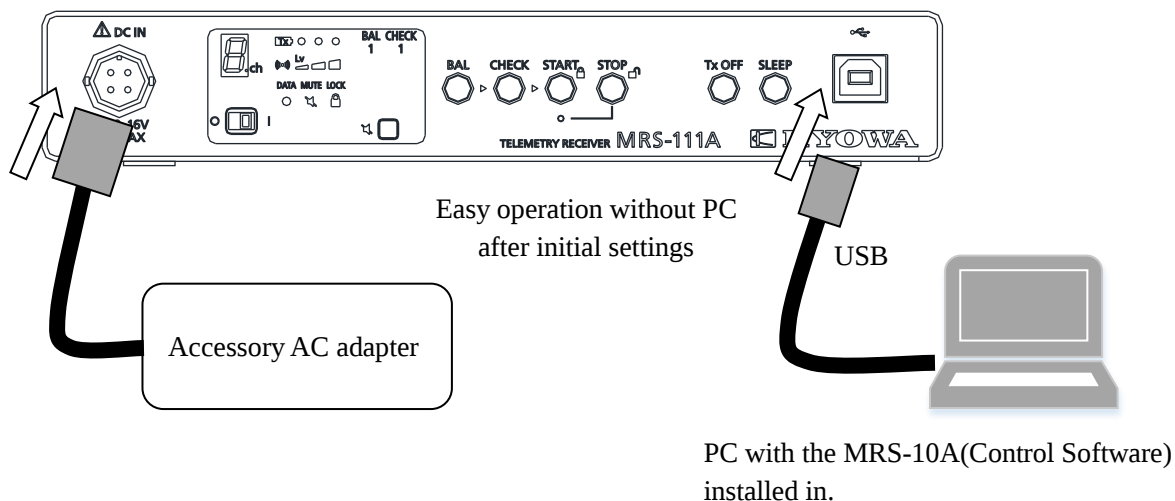
MEMO

As radio equipment conforming to low-power data communications system standards (ARIB STD-T66) and Code of Federal Regulations for radio modules (FCC Part 15C) and the Indian Wireless Act 1933 (WPC ETA), this system requires no license.

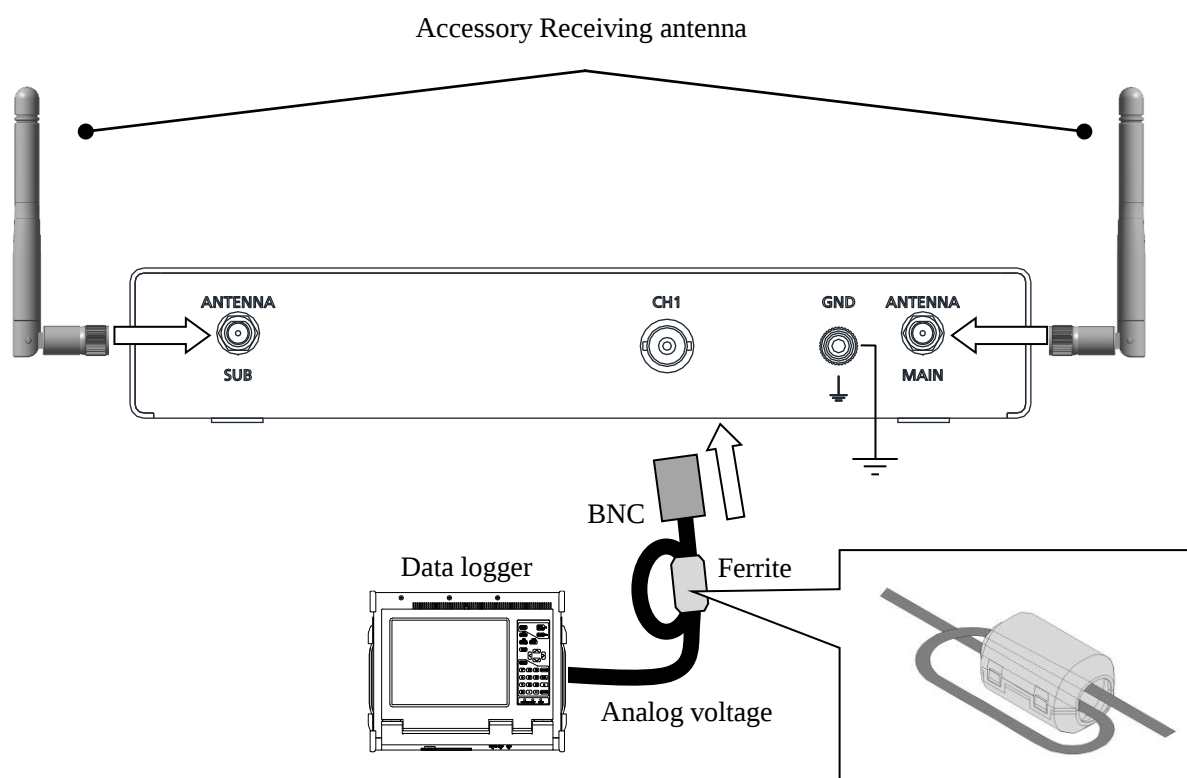
Accordingly, the system is intended for use only in Japan, the United States and India.

3-3. Wiring method of the receiver

FRONT PANEL



REAR PANEL

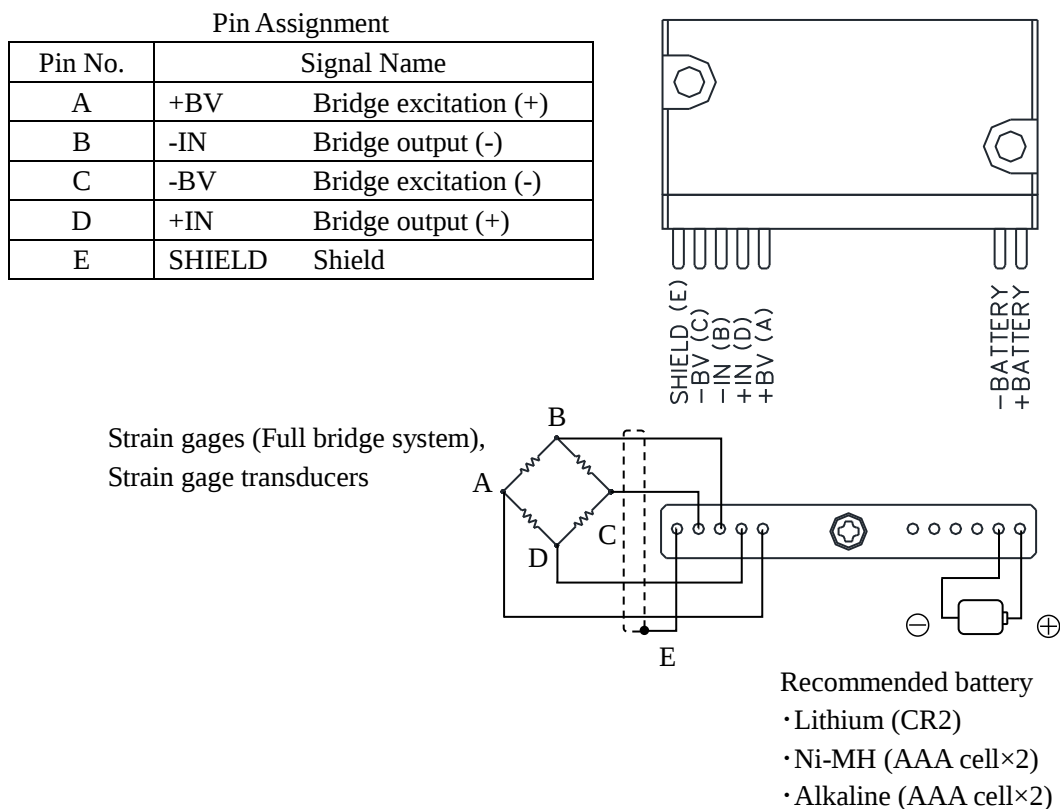


MEMO

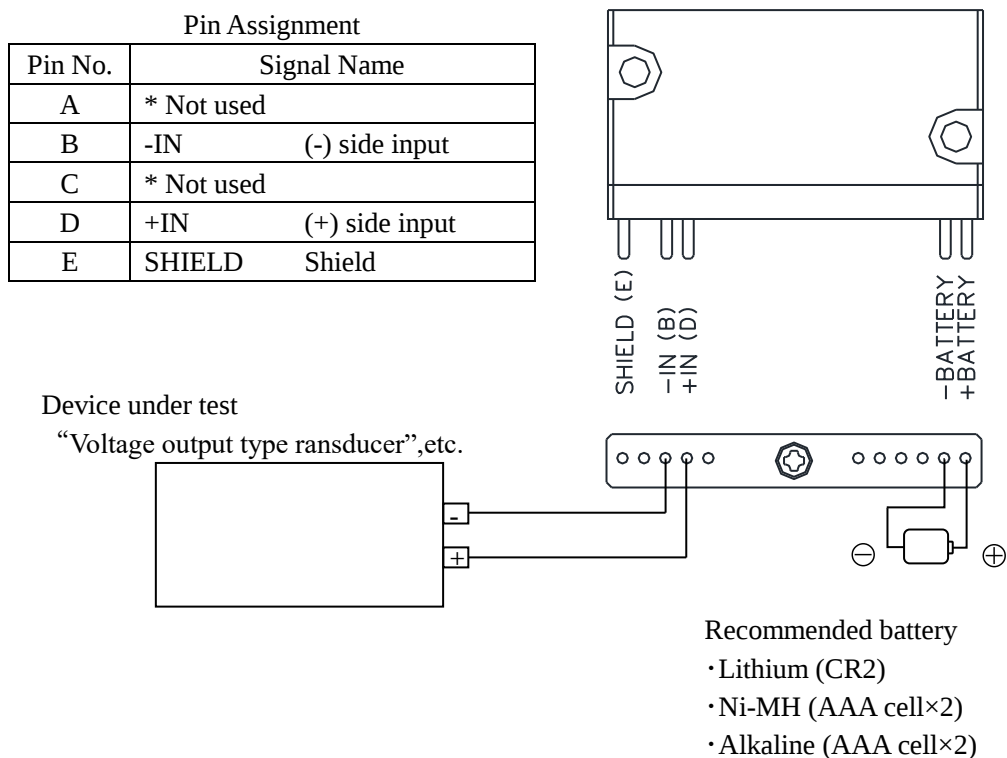
MRS-10A (Control Software) must be used to set the matching values for Frequency CH, ID, measurement range, and bridge resistance on the transmitter and its connected receiver. After setting the values, the computer on which the Control Software is installed no longer needs to be used. Switch on the receiver can be used for Balance adjustment, measurement, and other operations. Attach a ferrite core (E04SR170730A) to the BNC-BNC cable (U-59). Loop the BNC-BNC cable (U-59) once through the ferrite core, and lock it shut. Attach the ferrite core as closely as possible to the MRS-111A.

3-4. Wiring method of the transmitter

- If using the MRS-101A-S (1ch-Strain Transmitter) or MRS-101A-SE (1ch-Strain Transmitter (EXT Antenna))



- If using the MRS-101A-V (1ch-Voltage Transmitter)



NOTE

If using the SHIELD (E) terminal with the MRS-101A-V, caution is required.
For details, see "MRS-101A-V (1ch-Voltage Transmitter)_READ IN THE BEGINNING."

Avoid using a power supply with the wrong polarity, as it may damage the product.

Wire the devices so as to avoid disconnection if the transmitter, strain gage, battery, or respective wiring is twisted or vibrates.

NOTE

The Adapter can be removed for replacement. To reconnect it, solder the pins on the Adapter. Avoid exposing the Adapter to excessive solder and heat from the soldering iron.

NOTE

Keep the sensor wire short. Long wiring may introduce noise into sensor signals and negatively affect signal transmission and reception.

Keep the battery wire short. Long wiring may negatively affect signal transmission and reception.

The included battery holder, which houses two AAA-cell batteries, is not designed to withstand vibration, impact, or centrifugal force. Use the batteries in the holder only for checking operation.

MEMO

The Adapter Board (ADP-01) included with the MRS-101A-S/SE supports four-gage bridges.

Note that an Adapter Board (ADP-02-120) that supports a 2-wire 120 ohm gage is also available as an optional accessory, so use it if necessary.

4. Measuring Mode and Command Mode

4-1. Telemeter operating modes

The telemeter has two modes: Command Mode and Measuring Mode.

In Command Mode, control commands are sent from the receiver to the transmitter, which then responds to the receiver.

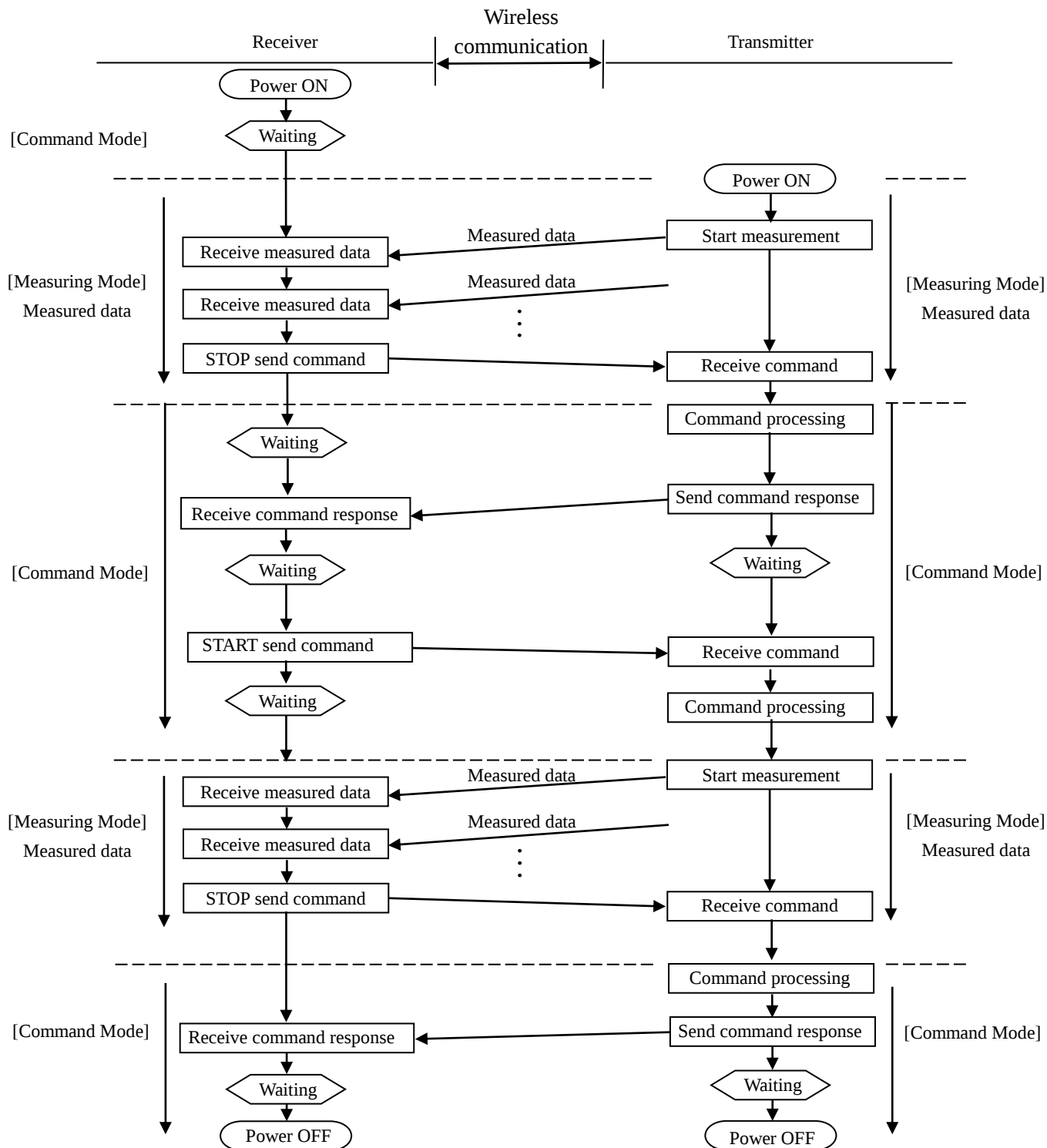
In Measuring Mode, the transmitter groups sampled measurement data into packets, each of which contains a certain quantity of data, and sends packets intermittently and continuously by wireless communication. The receiver receives these packets.

The receiver cannot execute control commands other than STOP at this time, so it is essentially only used for receiving data packets.

In Measuring Mode, the receiver can execute a STOP control command to return to Command Mode, after which control commands, such as BAL and CHECK, can be executed.

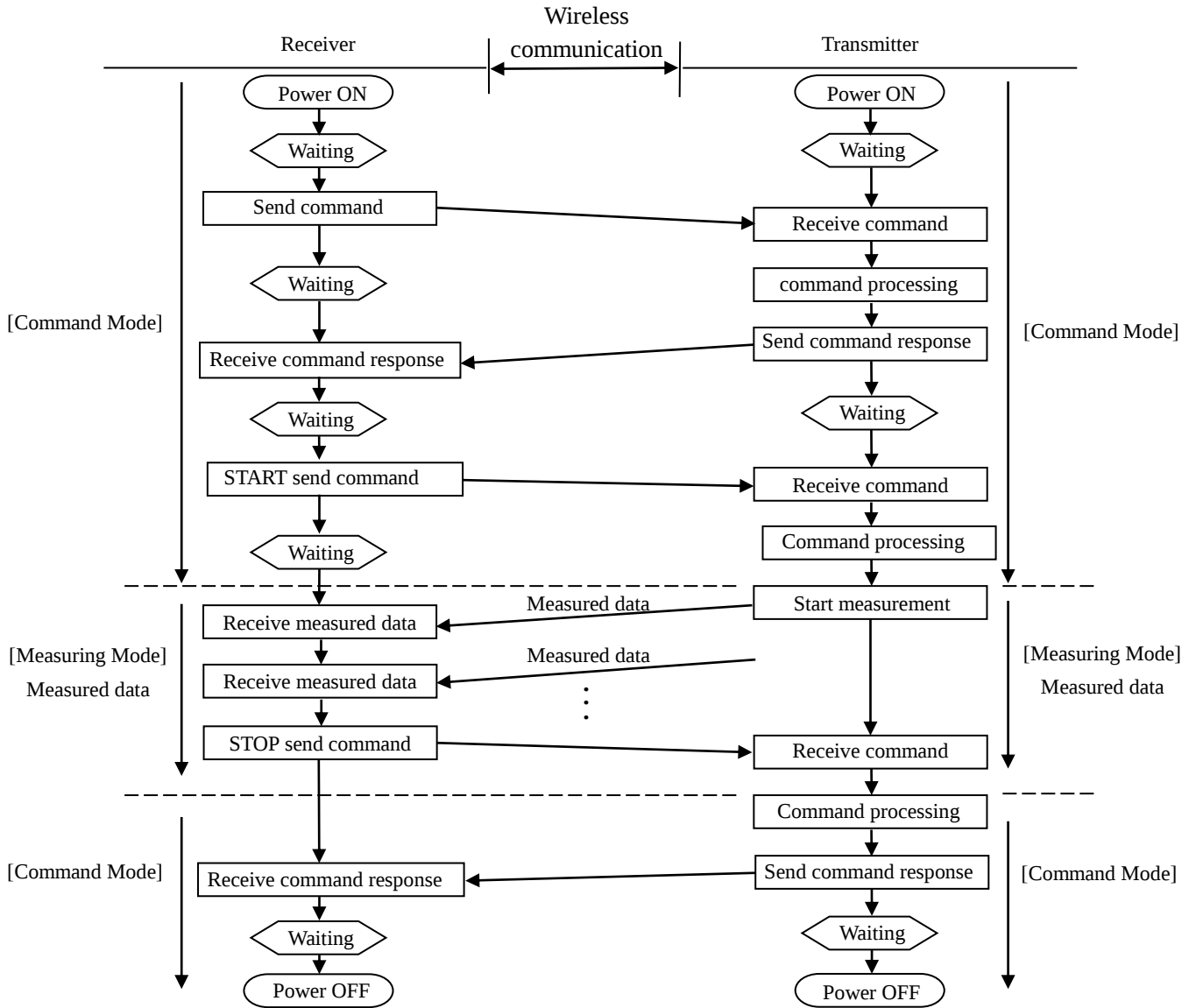
Operating Status	Contents of operations
Command Mode	The receiver sends commands to the transmitter. The transmitter sends responses to these commands to the receiver.
Measuring Mode	The transmitter continuously sends measurement data to the receiver. The receiver can only send STOP commands to the transmitter.

The following is a diagram that shows the communication sequence between the transmitter and receiver. However, the operation differs depending on the transmitter's Firmware Ver.

**MEMO**

- Instantaneous power failure and recovery on the receiver

Although not included in the aforementioned diagram that shows the communication sequence, if the receiver power instantaneously goes out for whatever reason while in Measuring Mode, after the receiver is restarted, Measuring Mode resumes on the receiver when it receives packets from the transmitter. However, when this occurs, the "BAL" LED and "MUTE" LED are not lit.



5. Actual Operation

To perform operations, the Frequency CH, ID, measurement range, bridge resistance (excluding the MRS-101A-V), and Transmitter type of the transmitter and receiver to be paired must match.

It is possible to record after connecting the transmitter and receiver and then connecting a data logger or other device prepared by the user.

For information on switch operations, see "2. CONTROLS AND FUNCTIONS."

NOTE

If the receiver is connected to a computer, the switches on the receiver cannot be used.

NOTE

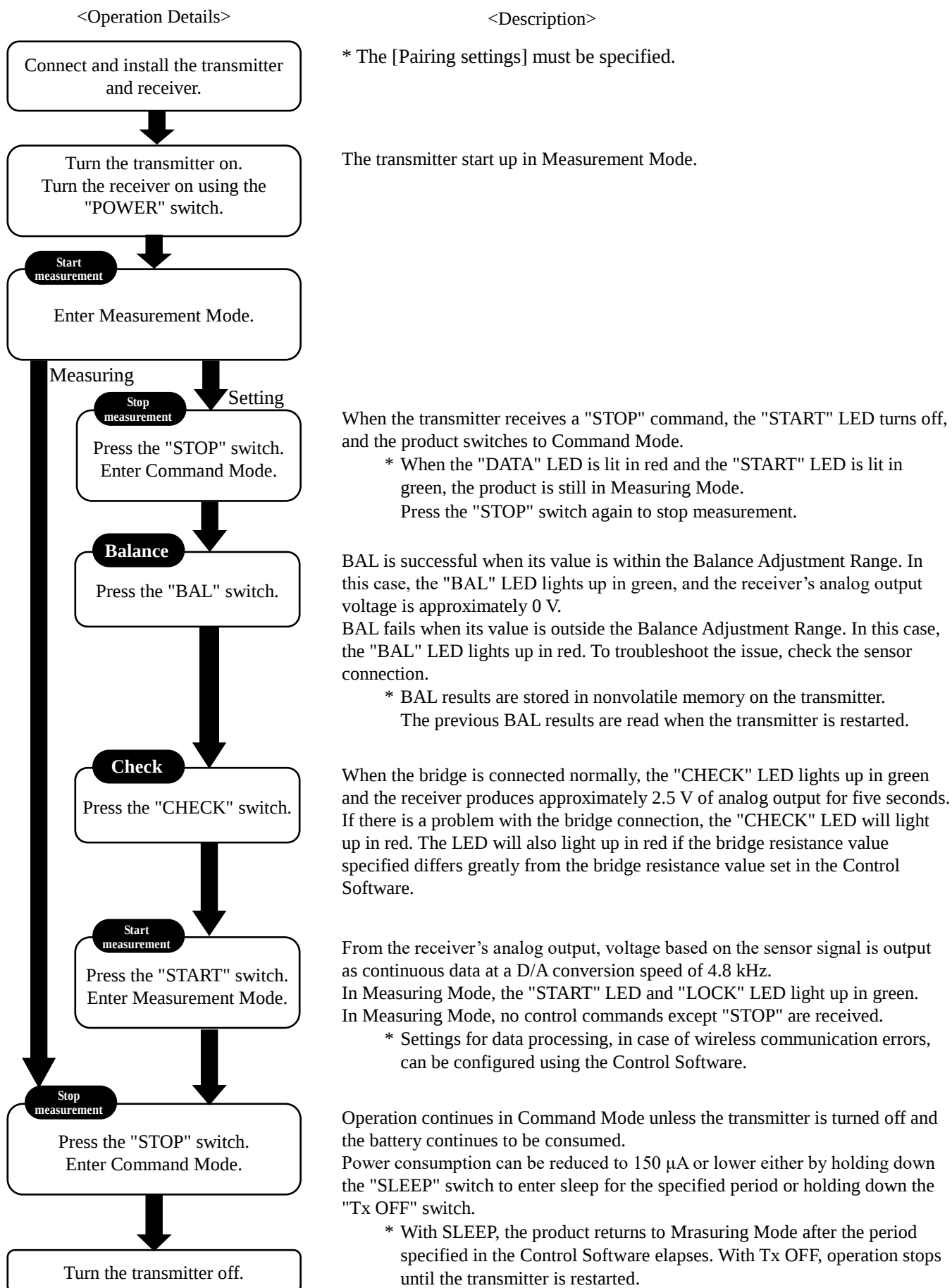
The product you purchased cannot be used unless the settings of the transmitter and receiver to be paired are registered ([Pairing settings]).

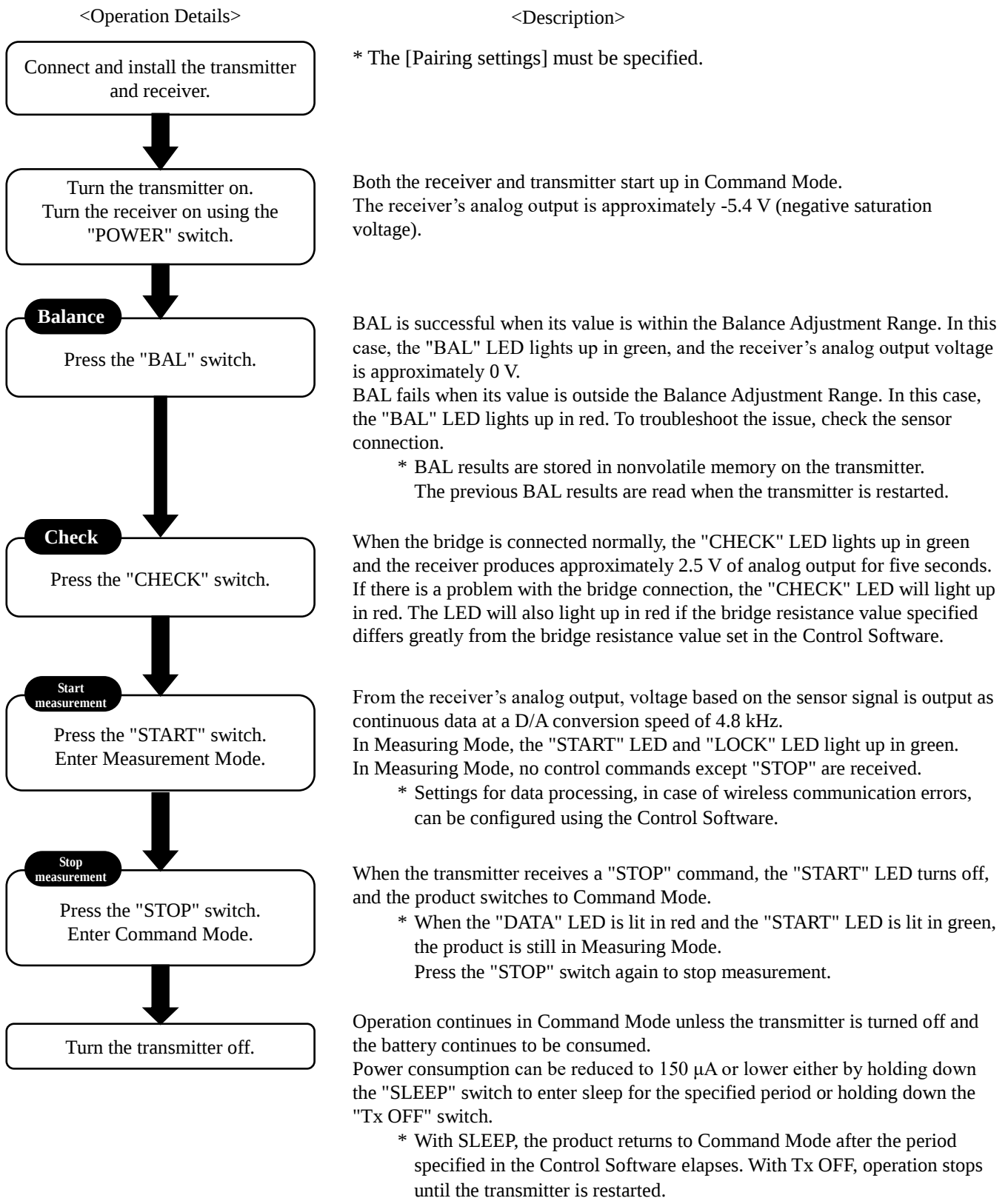
When using the product for the first time, specify the [Pairing settings] by using the MRS-10A Control Software.

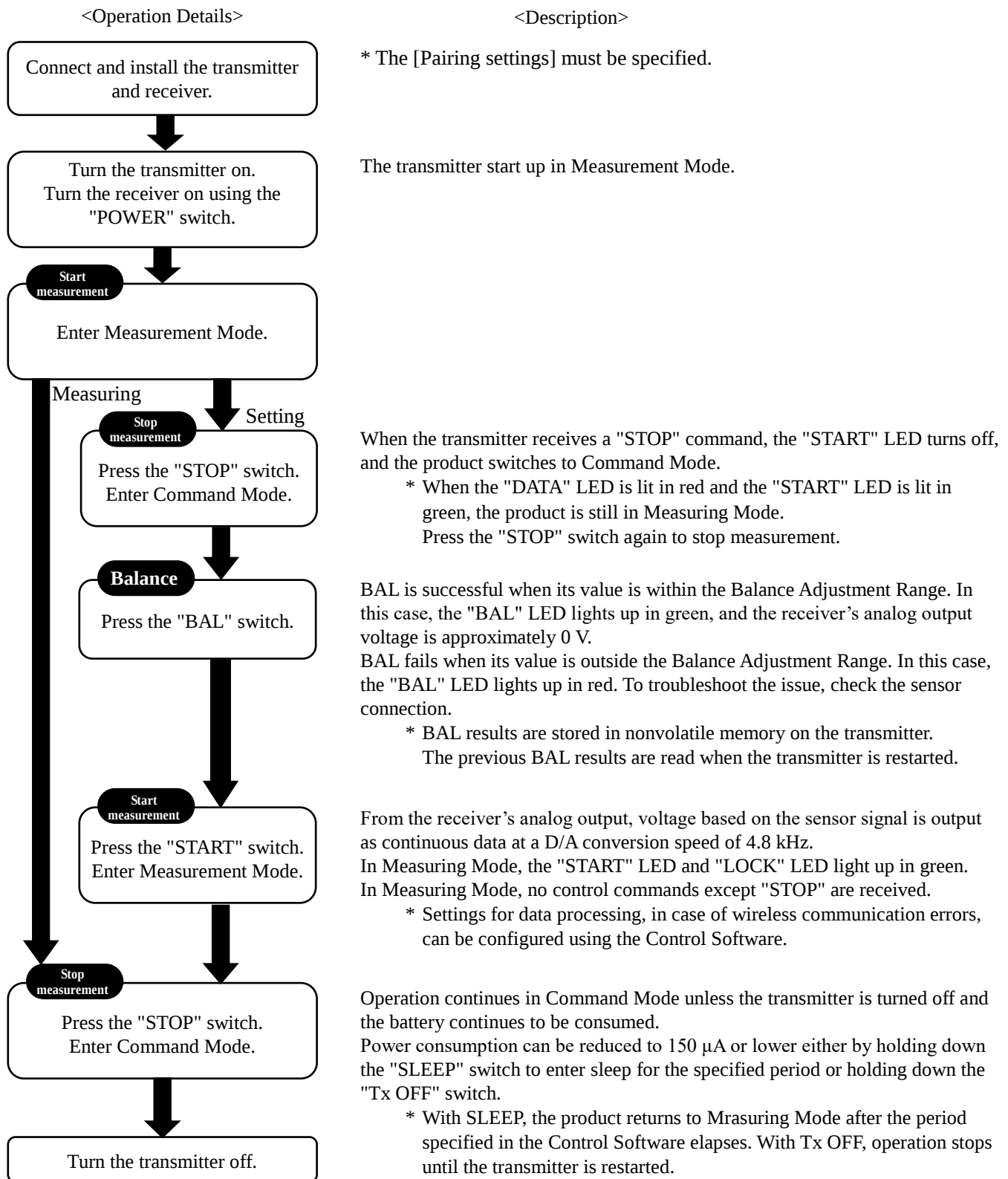
For details on the [Pairing settings] method, see the MRS-10A_INSTRUCTION MANUAL.

5-1. Operations before measurement

Transmitter's Firmware Ver. 2.00 or later (if using the MRS-101A-S/SE)







NOTE

The MRS-101A-V does not have a sensor checking function for confirming the sensor connection. Therefore, if using receiver Firmware Ver. 2.00 or later, even if the "CHECK" switch is pressed, the operation is ignored and nothing is executed.

However, if using receiver Firmware Ver. 1.00, the "CHECK" LED lights up in green, and about 2.5 V is output from the receiver's analog output for 5 seconds.

6. Transmitter power supply

6-1. Transmitter recommended battery

Specification values for continuous operating time for the transmitter using the recommended power supply are shown in the following table.

Specifications values for continuous transmitter operating time with the recommended power supply (MRS-101A-S/SE)

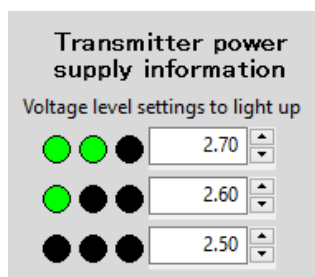
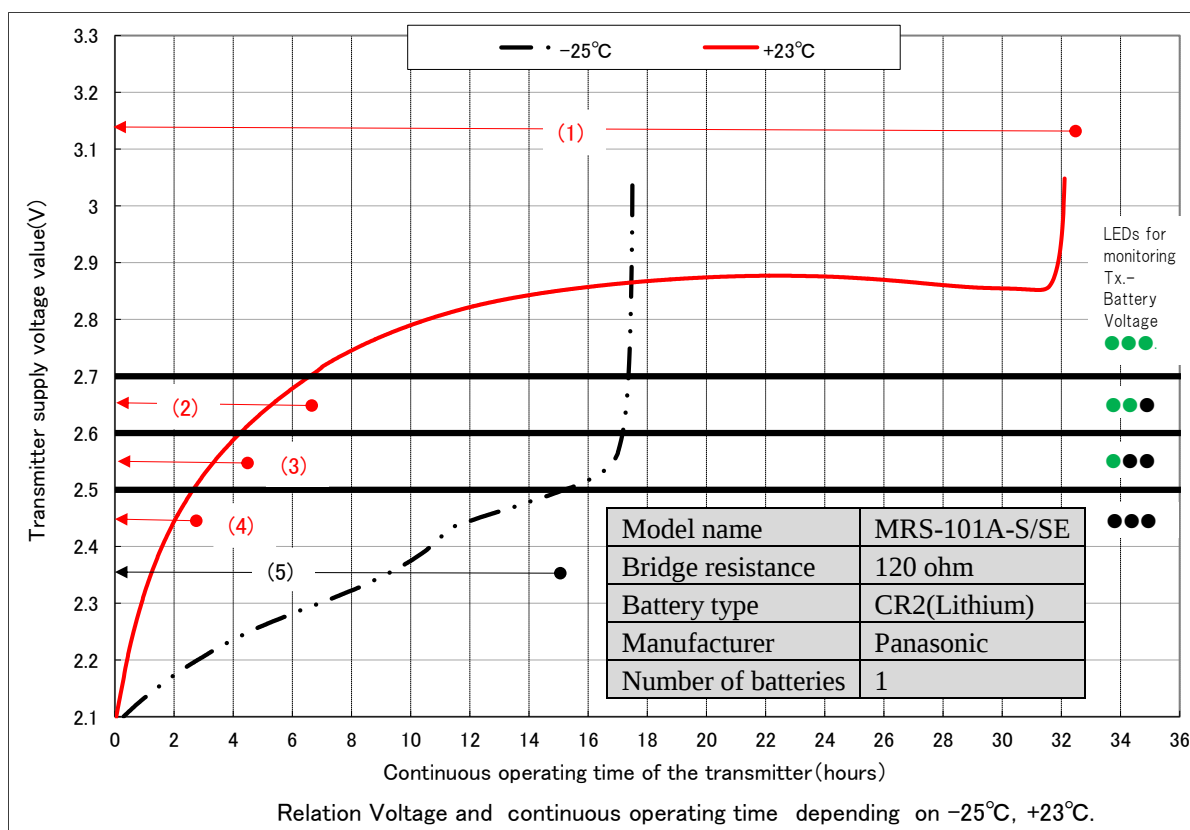
Transmitter model name	MRS-101A-S/SE		
Test conditions	Ambient temperature(+23°C), Bridge resistance(120 ohm)		
Battery type	Lithium	Ni-MH	Alkaline
Manufacturer	Panasonic	Panasonic(eneloop®)	Panasonic(EVOLTA)
Battery model name	CR2 (×1)	BK-4MCC (AAA cell×2)	LR03EJ (AAA cell×2)
Continuous operating time	Approx.28hours	Approx.24hours	Approx.34hours

Specifications values for continuous transmitter operating time with the recommended power supply (MRS-101A-V)

Transmitter model name	MRS-101A-V		
Test conditions	Ambient temperature(+23°C)		
Battery type	Lithium	Ni-MH	Alkaline
Manufacturer	Panasonic	Panasonic(eneloop®)	Panasonic(EVOLTA)
Battery model name	CR2 (×1)	BK-4MCC (AAA cell×2)	LR03EJ (AAA cell×2)
Continuous operating time	Approx.38hours	Approx.33hours	Approx.49hours

6-2. LEDs lighting conditions for monitoring transmitter power supply voltage

The following test measurements show how battery voltage relates to the continuous operating time of the MRS-101A-S/SE, with bridge resistance (120 ohm) connected as transmitter load and a CR2 battery used to power the transmitter at the indicated ambient temperatures (+23°C and -25°C).



Points (1)–(4) (+23°C) and (5) (-25°C) are defined as follows, as set in "Voltage level settings to light up" (shown at left) in the Control Software:

- (1): There is a continuous operating time of approximately 32 hours (specification value: approximately 28 hours).
- (2): After changing from ●●●● to ●●●●, approximately 6.6 hours of operating time remain.
- (3): After changing from ●●●● to ●●●●, approximately 4.2 hours of operating time remain.
- (4): After changing from ●●●● to ●●●●, approximately 2.6 hours of operating time remain.
- (5): At -25°C, after changing from ●●●● to ●●●●, approximately 15 hours of operating time remain.

NOTE

- As shown in the previous chart, ambient temperature has a significant impact on how the lighting status of the LEDs corresponds to the transmitter's remaining operating time.
- Even if the batteries are from the same manufacturing lot, the relationship between battery voltage and the continuous operating time of the transmitter (indicated by the curved lines in the chart) may vary depending on the following:
 - Under varying bridge resistance values, which represent load (a factor that makes values differ greatly)
 - Variation of battery manufacturing lots
 - Battery storage period and conditions

Considering these two points, the information on how the lighting status of the LEDs corresponds to the transmitter's remaining operating time should be viewed as reference data for the sake of estimates.

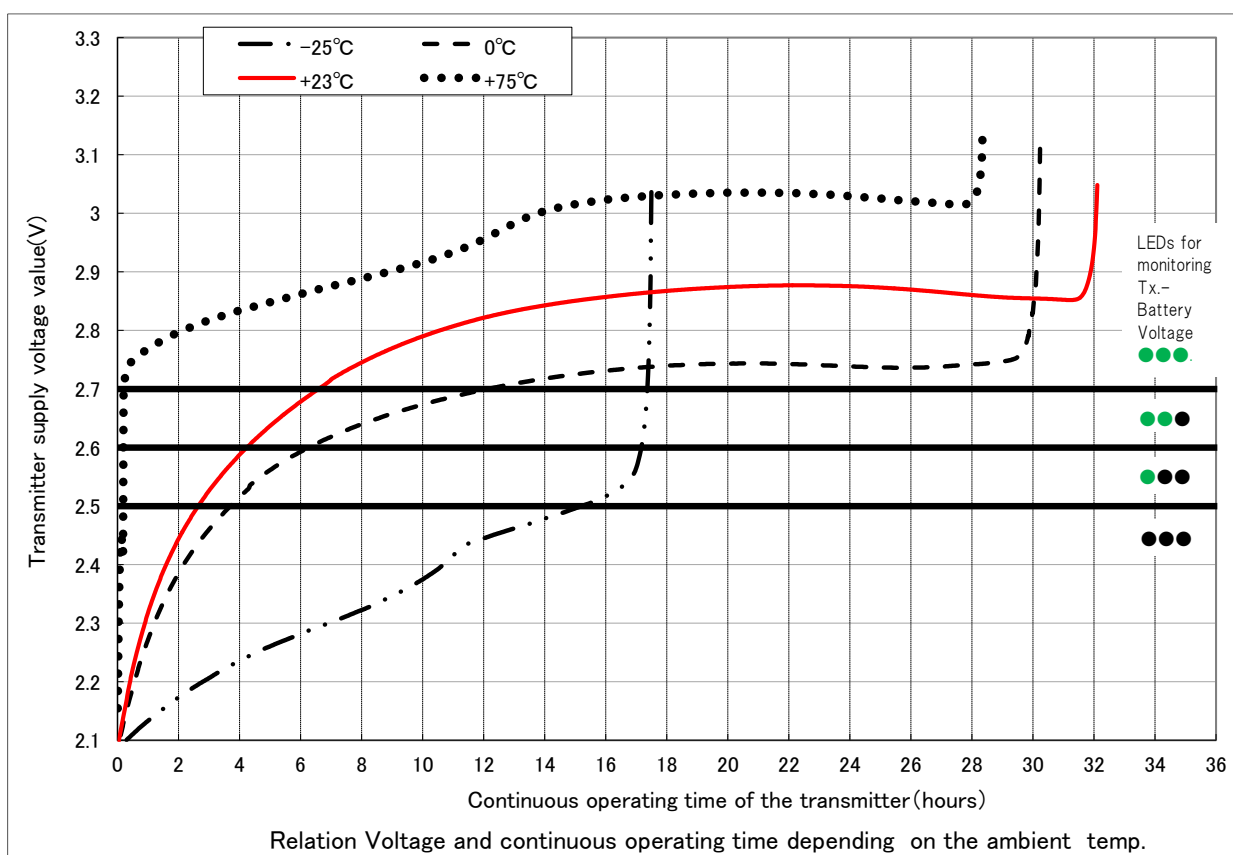
6-3. Estimated operating time of the recommended battery (if using the MRS-101A-S/SE)

The following curved line chart shows how battery voltage under ambient temperatures relates to the continuous operating time of the MRS-101A-S/SE, using recommended batteries in a MRS-101A-S/SE connected to bridge resistance (120 ohm). Based on the curved lines in the chart below, "Voltage level settings to light up" can be used to determine the remaining estimated operating time from the lighting status of the LEDs.

< 1 > In case of CR2

Transmitter model name	MRS-101A-S/SE
Bridge resistance	120 ohm
Battery type	Lithium
Manufacturer	Panasonic
Battery model name	CR2
Number of batteries	1

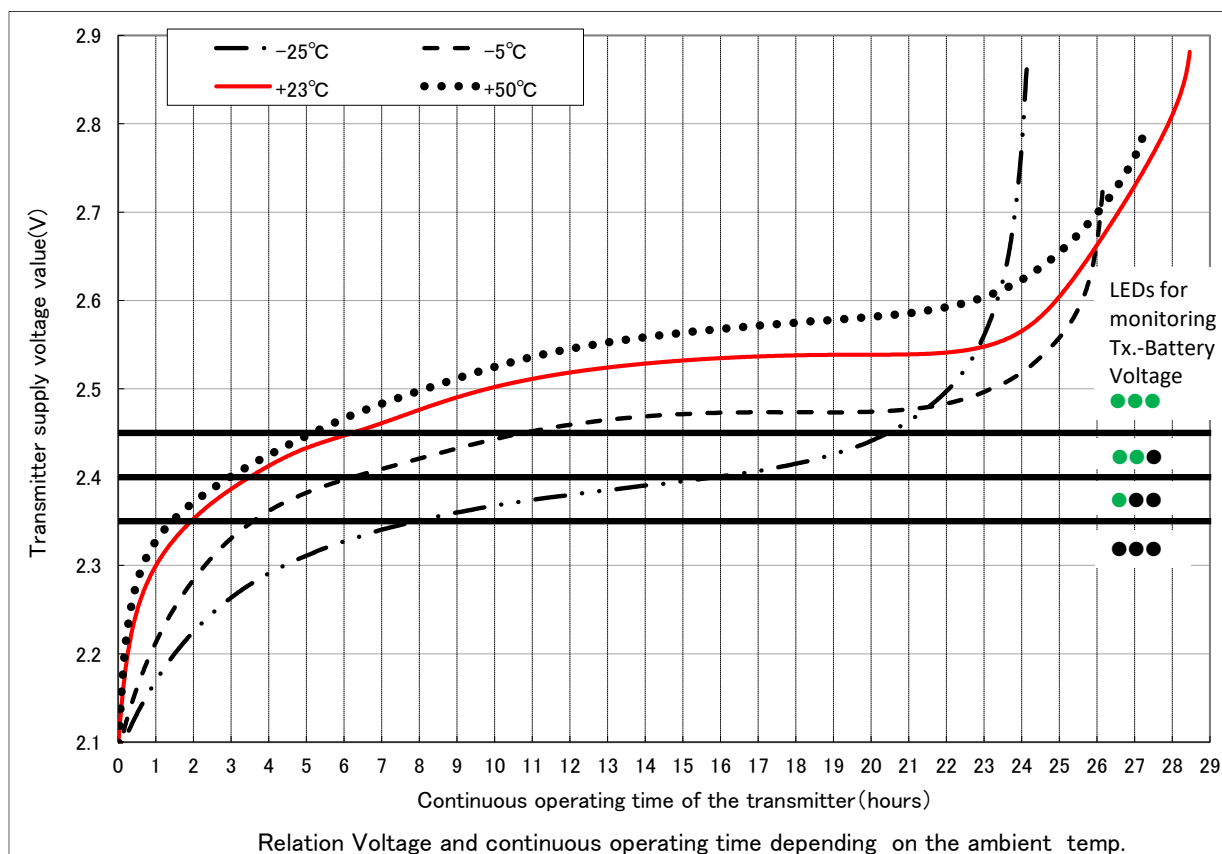
Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ● ●	2.70 V	Approx.6.6 hours
● ● ● ●	2.60 V	Approx.4.2hours
● ● ● ●	2.50 V	Approx.2.6 hours



< 2 > In case of eneloop®(AAA cell×2)

Transmitter model name	MRS-101A-S/SE
Bridge resistance	120 ohm
Battery type	Ni-MH
Battery Product name	eneloop®
Battery model name	BK-4MCC
Number of batteries	AAA cell×2

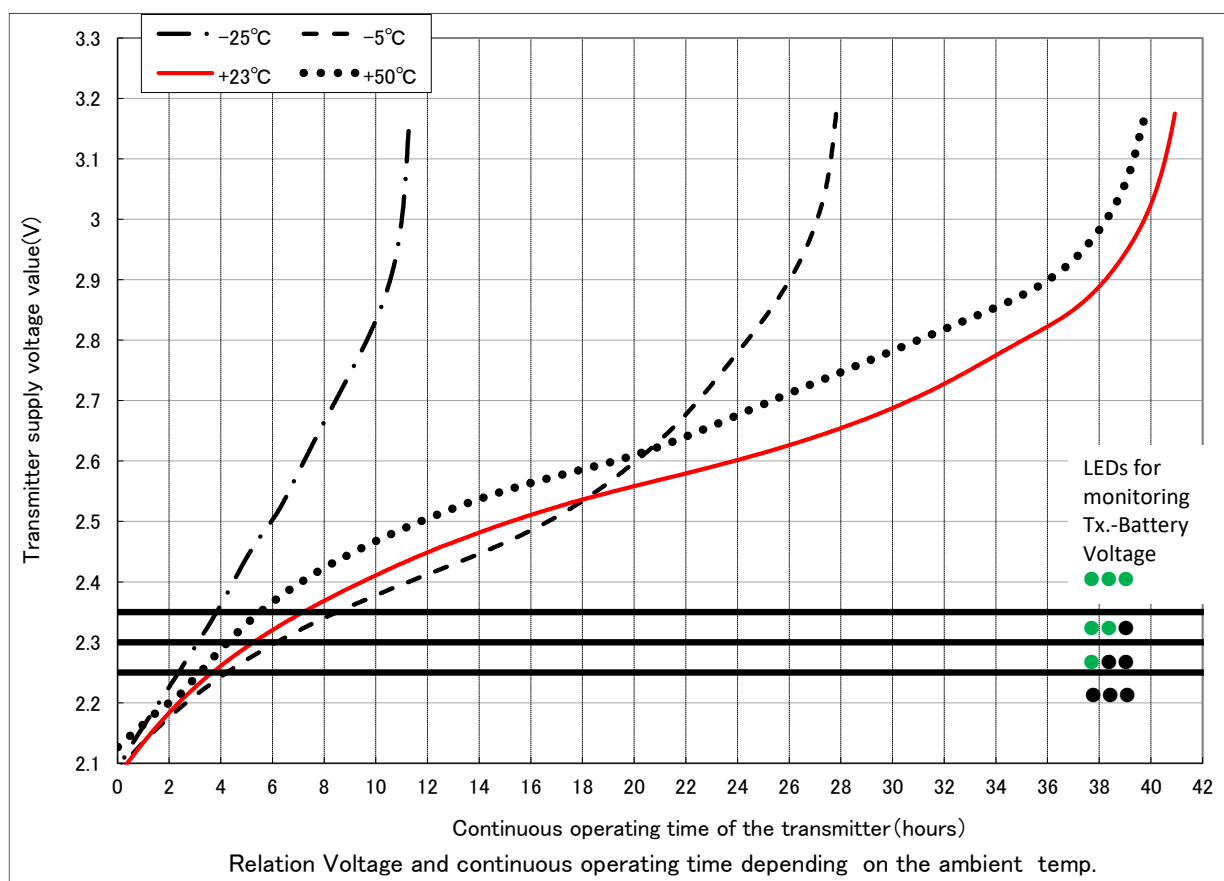
Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ●	2.45 V	Approx.6.2 hours
● ● ●	2.40 V	Approx.3.4 hours
● ● ●	2.35 V	Approx.2.0 hours



< 3 > In case of Alkaline (AAA cell×2)

Transmitter model name	MRS-101A-S/SE
Bridge resistance	120 ohm
Battery type	Alkaline
Battery Product name	EVOLTA
Battery model name	LR03EJ
Number of batteries	AAA cell×2

Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ●	2.35 V	Approx.7.1 hours
● ● ●	2.30 V	Approx.5.2 hours
● ● ●	2.25 V	Approx.3.6 hours



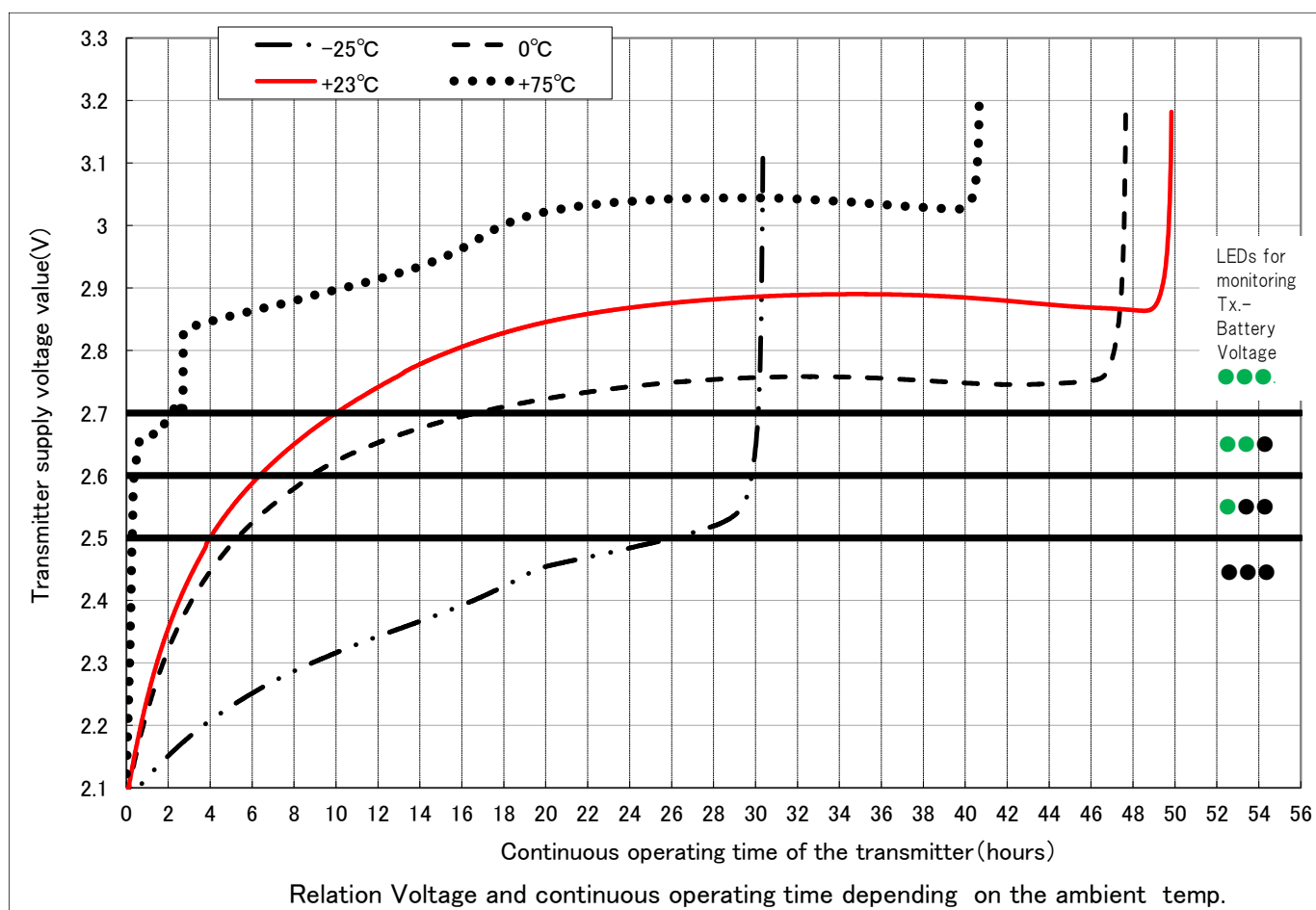
6-4. Estimated operating time of the recommended battery (if using the MRS-101A-V)

The following curved line chart shows how battery voltage under ambient temperatures relates to the continuous operating time of the MRS-101A-V, using recommended batteries. Based on the curved lines in the chart below, "Voltage level settings to light up" can be used to determine the remaining estimated operating time from the lighting status of the LEDs.

< 1 > In case of CR2

Transmitter model name	MRS-101A-V
Battery type	Lithium
Manufacturer	Panasonic
Battery model name	CR2
Number of batteries	1

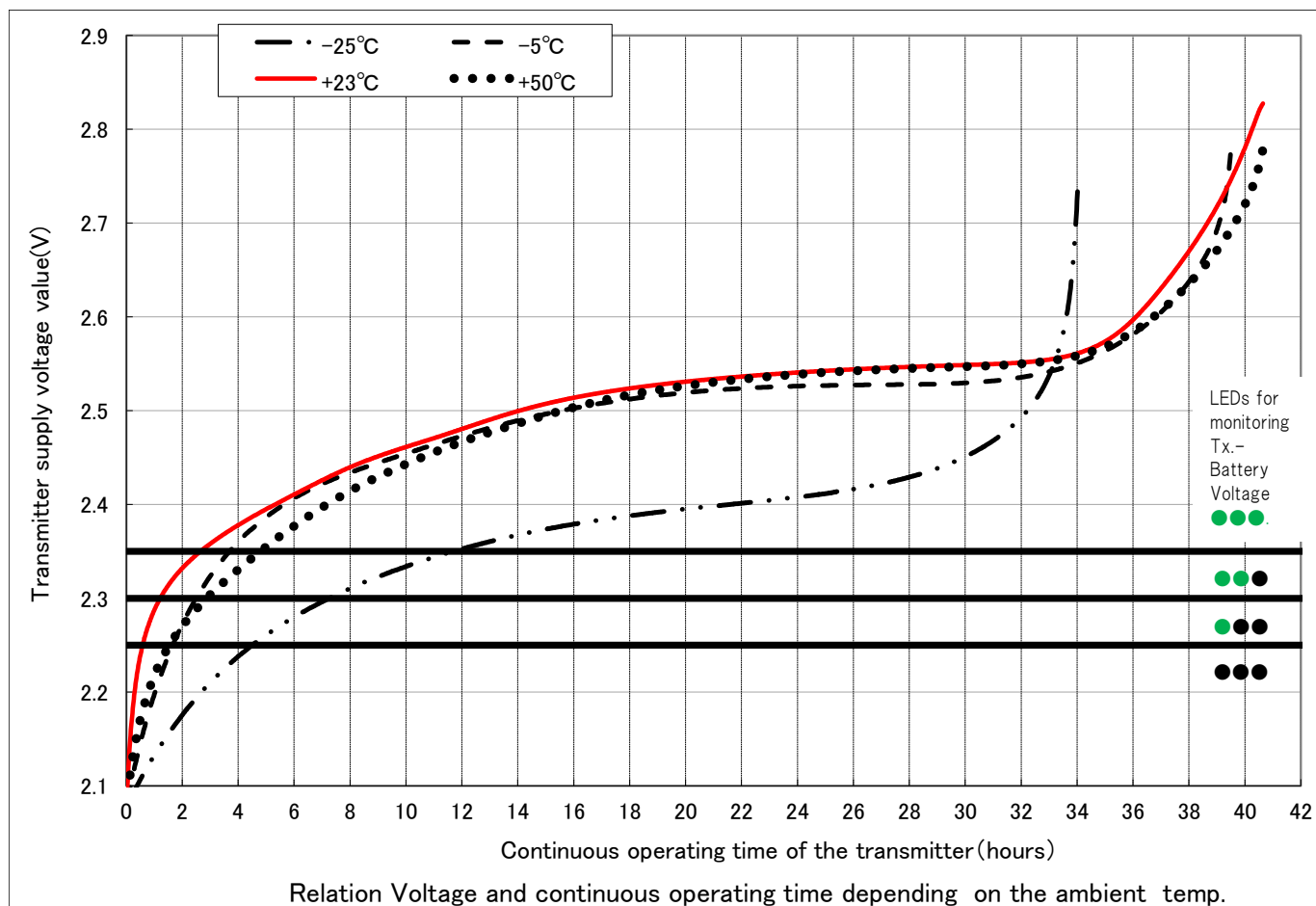
Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ●	2.70 V	Approx.10.0 hours
● ● ●	2.60 V	Approx.6.4hours
● ● ●	2.50 V	Approx.4.0 hours



< 2 > In case of eneloop®(AAA cell×2)

Transmitter model name	MRS-101A-V
Battery type	Ni-MH
Battery Product name	eneloop®
Battery model name	BK-4MCC
Number of batteries	AAA cell×2

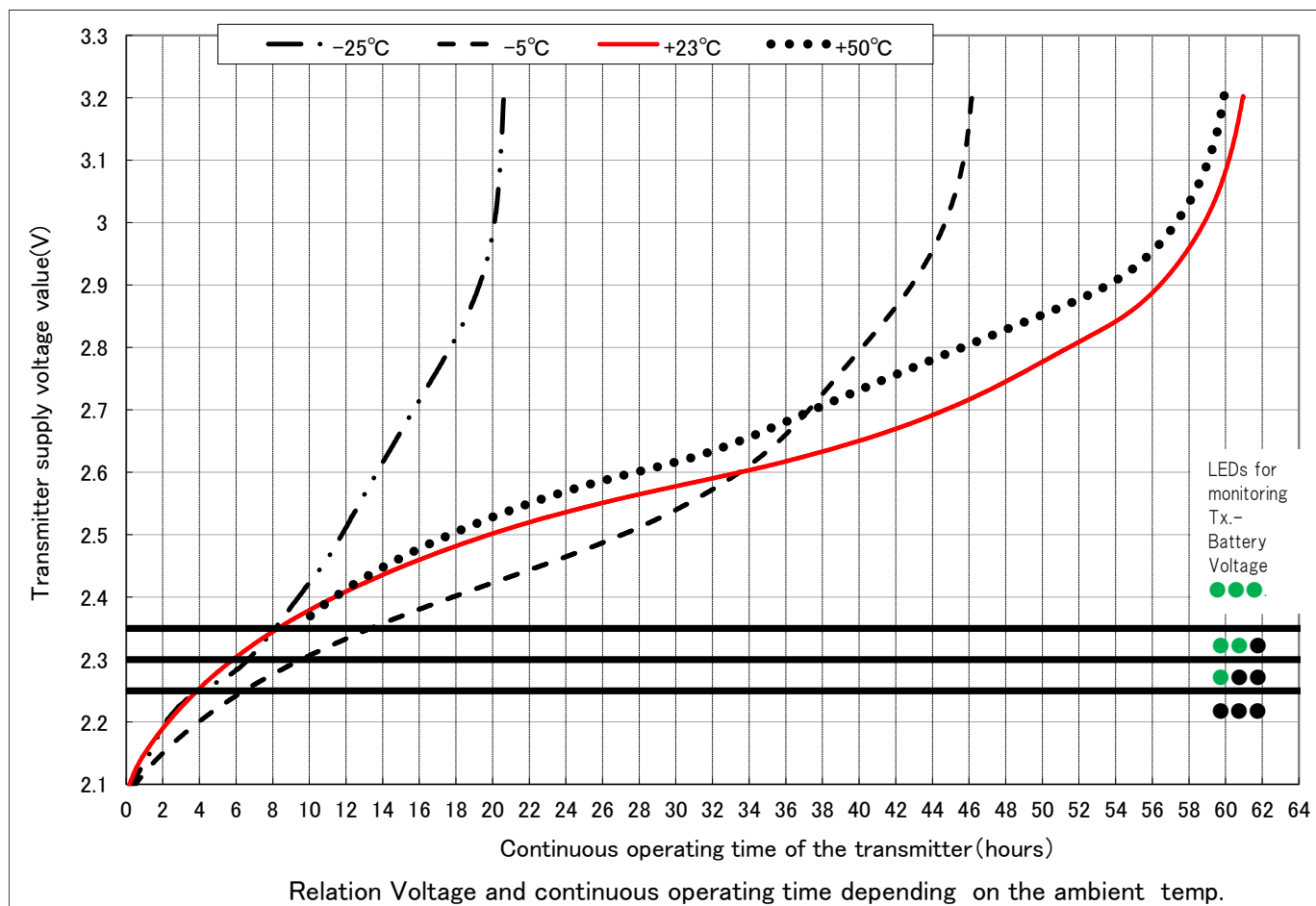
Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ●	2.45 V	Approx.2.7 hours
● ● ●	2.40 V	Approx.1.2 hours
● ● ●	2.35 V	Approx.0.6 hours



< 3 > In case of Alkaline (AAA cell×2)

Transmitter model name	MRS-101A-V
Battery type	Alkaline
Battery Product name	EVOLTA
Battery model name	LR03EJ
Number of batteries	AAA cell×2

Voltage level settings to light up		Remaining estimated operating time (ambient temperature at +23°C)
Lighting status of LEDs	Voltage setting value	
● ● ●	2.35 V	Approx.8.3 hours
● ● ●	2.30 V	Approx.5.9 hours
● ● ●	2.25 V	Approx.3.9 hours



7. Supplementary System Information

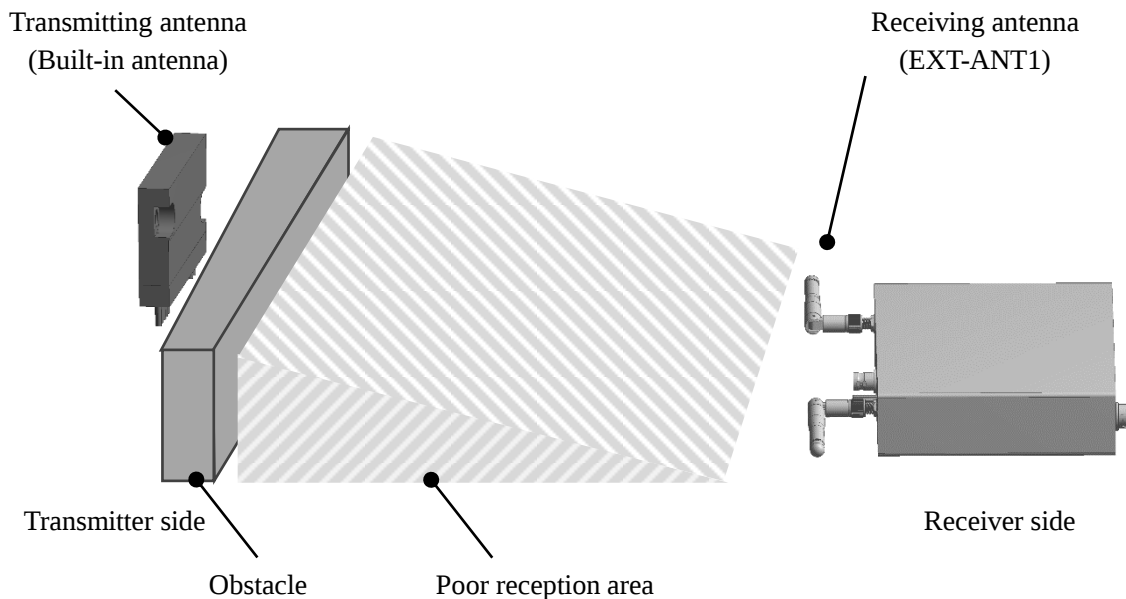
7-1. Antenna installation guide

For favorable wireless communication, the orientations and positions where the transmitting and receiving antennas are installed must be adjusted to prevent a decrease in received signal strength.

Wireless communication is greatly affected by the surrounding environment, such as the presence of obstacles, influence of reflected waves, and other wireless communication systems. Thus, installation in a suitable environment is necessary.

Before installing the antennas, refer to the following precautions on setting up the transmitter and receiver.

- a) Install the transmitting and receiving antennas so that there is a direct line of sight between the two units.

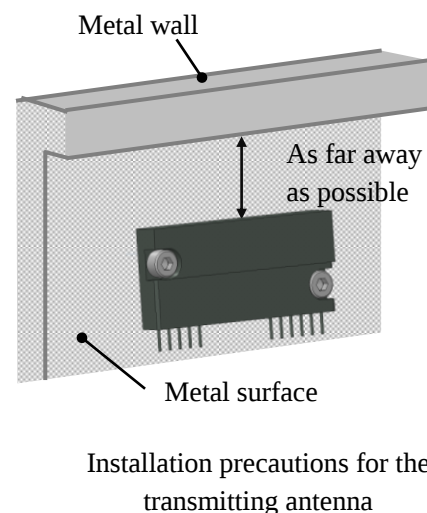
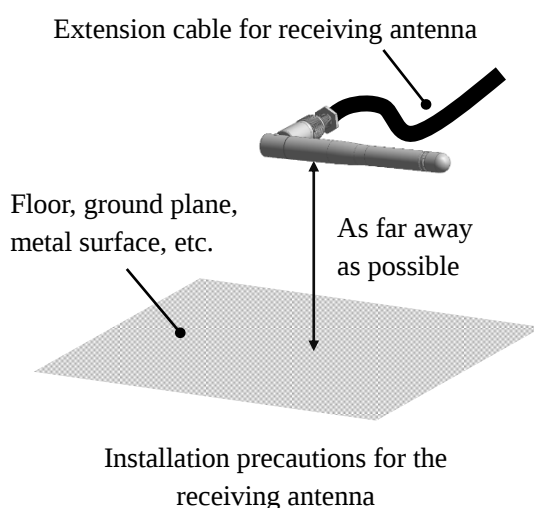


The telemeter uses the 2.4 GHz band radio frequency.

Radio waves in this frequency band have high straightness, so the waves are less likely able to maneuver around obstacles. For this reason, install the transmitting and receiving antennas so that each antenna is visible from the position of the other. In addition, if the transmitter or receiver is installed in a place that moves, ensure that the transmitting and receiving antennas are mutually visible throughout the path of movement.

- b) Avoid installing the antennas near the floor, the ground plane, and/or metal surfaces.

The antenna properties might worsen when the transmitting and receiving antennas are installed near the floor, the ground plane, and/or metal surfaces. Thus, to the extent possible, install the transmitting and receiving antennas away from those areas.



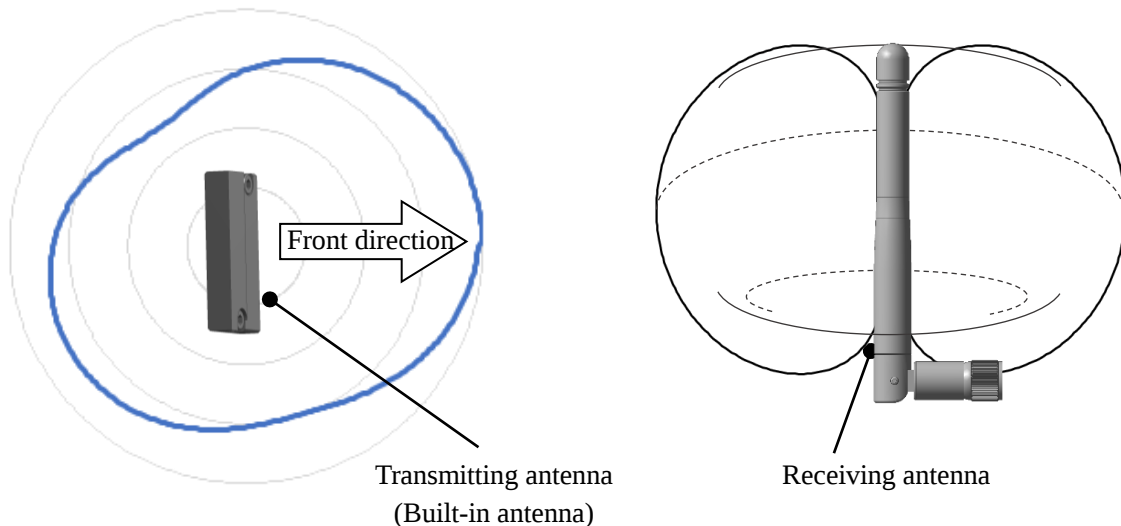
c) Align the direction/orientation of the antennas

The transmitting and receiving antennas can be positioned facing certain directions for reliable transmission and reception. This takes advantage of "radiation characteristics."

In addition, radio waves are sent from the transmitting and receiving antennas with a certain polarization, which makes it necessary to align their orientations. Doing so takes advantage of "polarization characteristics."

Considering both of these characteristics when installing the antennas enables the transmitting and receiving antennas to operate at optimal performance, which in turn can ensure adequate transmission distance and improve the reliability of wireless communication.

[Radiation characteristics]



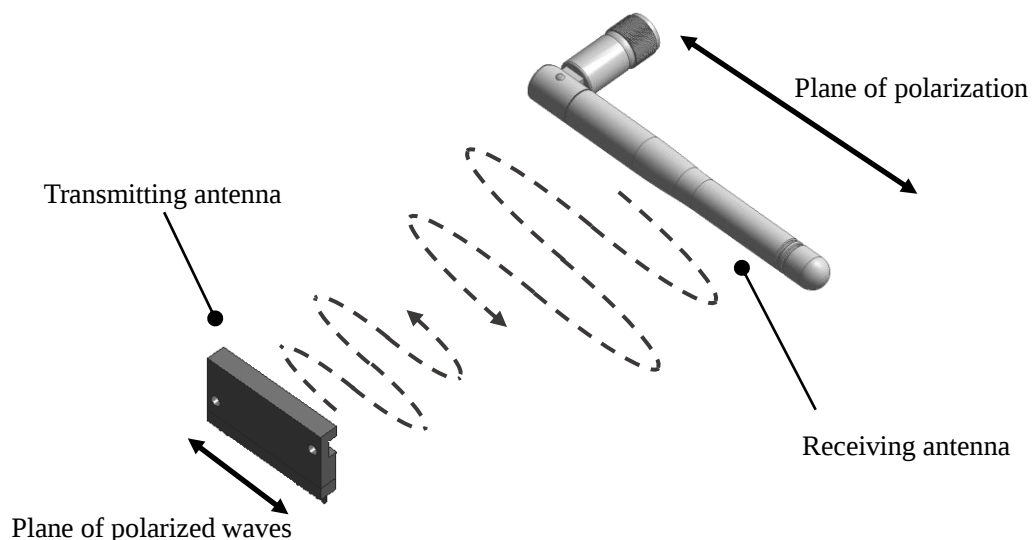
The transmitting antenna in the transmitter has high directivity toward the front. (Imagine that it provides gourd-shaped coverage.)

The receiving antenna in the receiver covers areas horizontally when installed upright. (Imagine that it provides doughnut-shaped coverage.)

Although radio waves spread out in every direction horizontally, they do not spread vertically, relative to the receiving antenna.

[Polarization characteristics]

Align the orientation of the transmitting and receiving antennas to form horizontal polarization. One way to comprehend this is to imagine a plane of polarization.



Polarization in the longitudinal direction is a characteristic of the transmitting antenna in the transmitter. Thus, installing the transmitter horizontally produces a plane of horizontal polarization, and installing it upright produces a plane of vertical polarization.

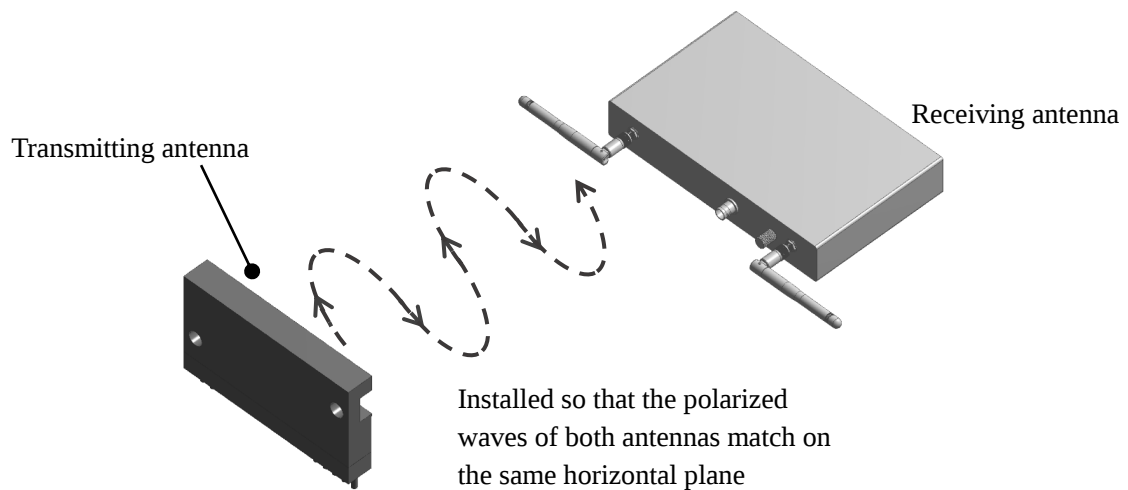
Similarly, polarization in the longitudinal direction is also a characteristic of the receiving antenna in the receiver. Placing the receiving antenna horizontally produces a plane of horizontal polarization, and placing it upright produces a plane of vertical polarization.

Thus, in radio communication with both antennas, the planes of polarization match when the antennas are parallel.

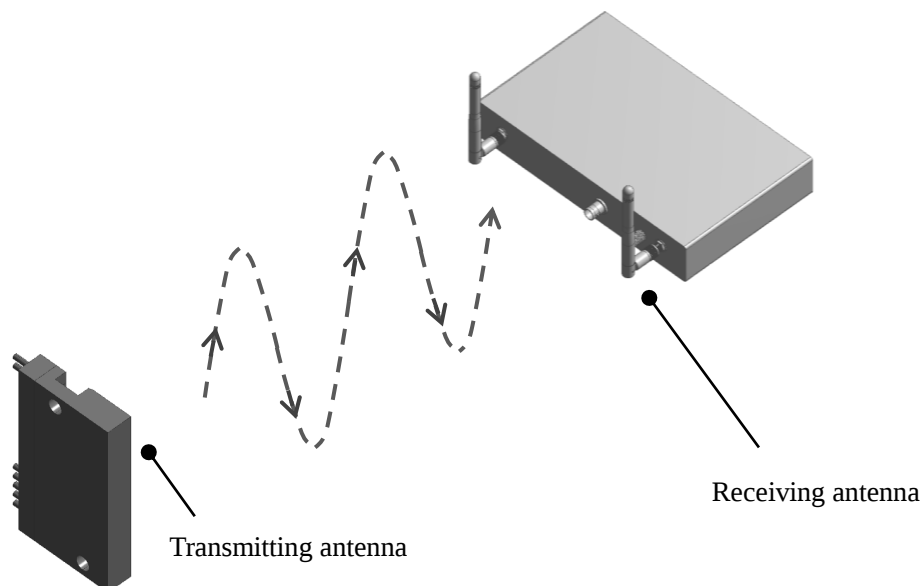
d) Set up the telemeter's transmitting and receiving antennas.

Before using the telemeter, install the transmitting and receiving antennas that account for radiation and polarization characteristics as described for full performance by the antennas and reliable radio communication.

[Example of installation for horizontal polarization by the transmitting and receiving antennas]



[Example of installation for vertical polarization by the transmitting and receiving antennas]



MEMO

Although the radiation and polarization characteristics of the transmitting and receiving antennas are important during installation, performance is also greatly affected by the actual environment, such as presence of obstacles, influence of reflected waves, other radio devices.

The characteristics of the transmitting and receiving antenna must be considered, and the antennas must be installed appropriately according to the usage environment.

7-2. Reception system using two receiving antennas (diversity reception techniques)

Reception techniques called “diversity reception methods” are used to increase the reliability of radio communication. For example, multiple receiving antennas may be used to prioritize signals from antennas with better receptions. Alternatively, radio signals from multiple receiving antennas may be combined. A few types of diversity reception methods are used.

• Space diversity technique

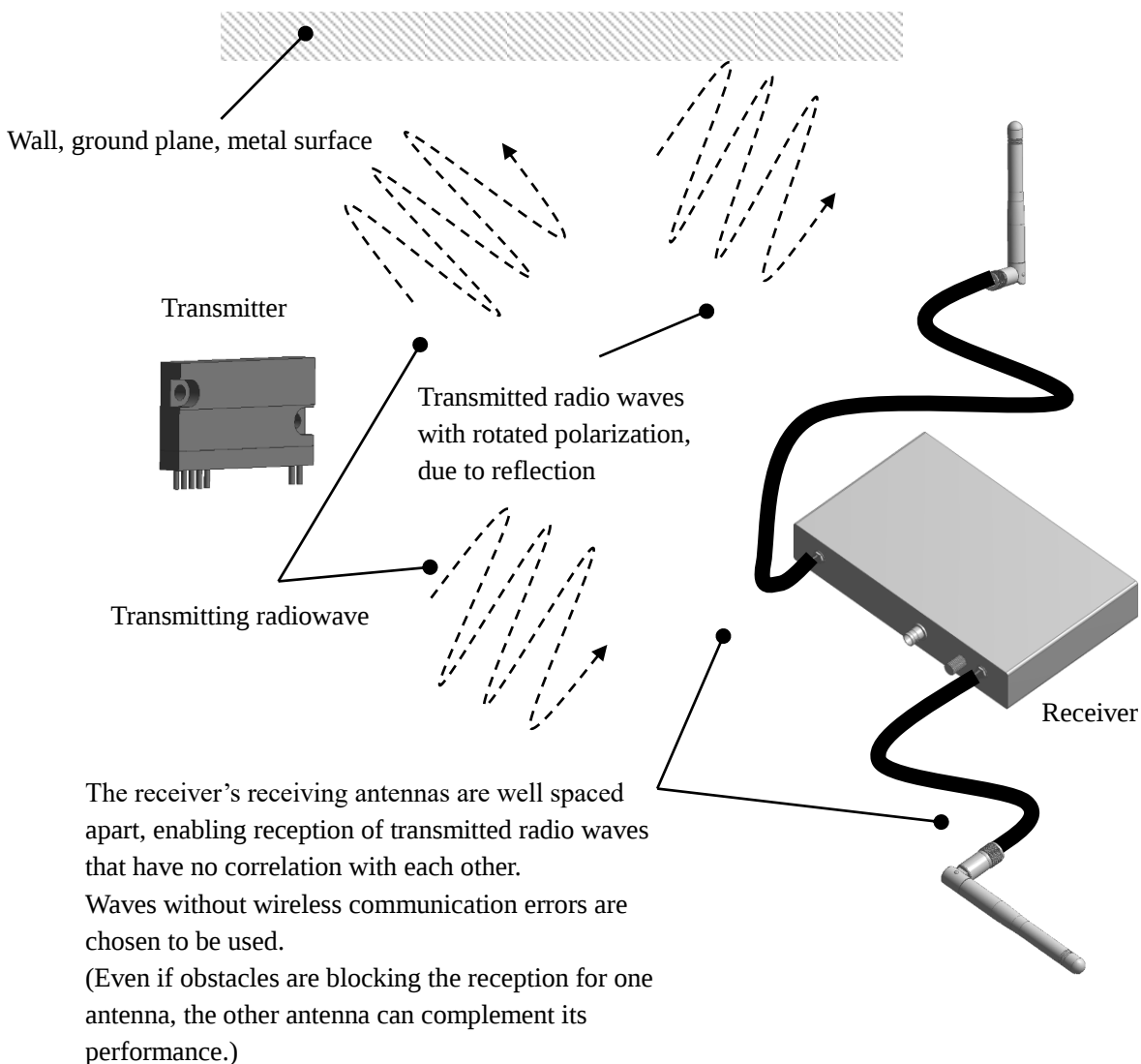
A reception technique in which the receiver’s two receiving antennas are positioned at least a half-wave length apart (approximately 63 mm for 2.4 GHz radio waves) to receive radio waves at the receiving antennas that have no correlation to each other. For this reason, when radio waves are received in environments with a weak signal, even if conditions are poor at one receiving antenna, the other antenna can still be relied on to have reception.

• Polarization diversity technique

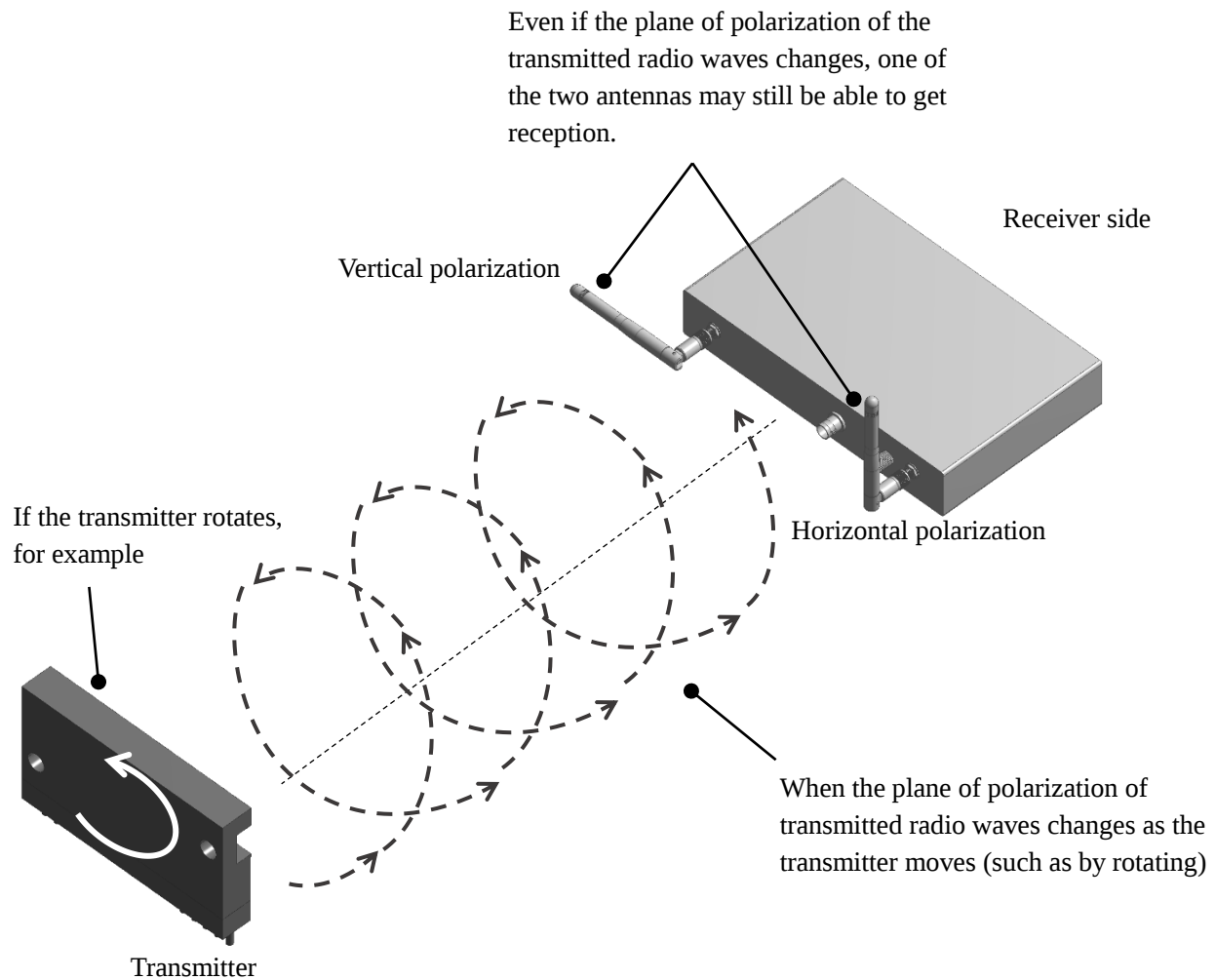
Radio waves sent from the transmitter may reach the receiver in a plane of polarization different from that of the transmitter’s transmitted polarization, due to reflection on metal walls and/or other obstacles. Alternatively, if the transmitter rotates because it is on a rotating object, the polarization as received by the receiver also rotates.

In such case, preparing a receiving antenna with a different plane of polarization enables the receiver to give precedence to the receiving antenna in a better receiving condition.

[Example of installation with the space diversity technique]



[Example of using the polarization diversity technique]



This telemeter supports both the space diversity and polarization diversity techniques.

When there is a direct line of sight between the transmitting and receiving antennas, use the space diversity technique, matching the plane of polarization of the transmitting and receiving antennas, for reception. However, the plane of polarization constantly changes, and there are times when the rotating objects or environments where reflected waves from obstructions cannot be avoided. In this case, use the polarization diversity technique for reception, differing the planes of polarization of two receiving antennas. Specifically, forming a 90° angle with the receiver's two receiving antennas enables reception by one receiving antenna even if the plane of polarization of the transmitter's transmitting antenna changes, such as when the transmitter moves or rotates.

MEMO

The receiver receives via both "MAIN" and "SUB" antennas but gives precedence to data from the "MAIN" receiving antenna.

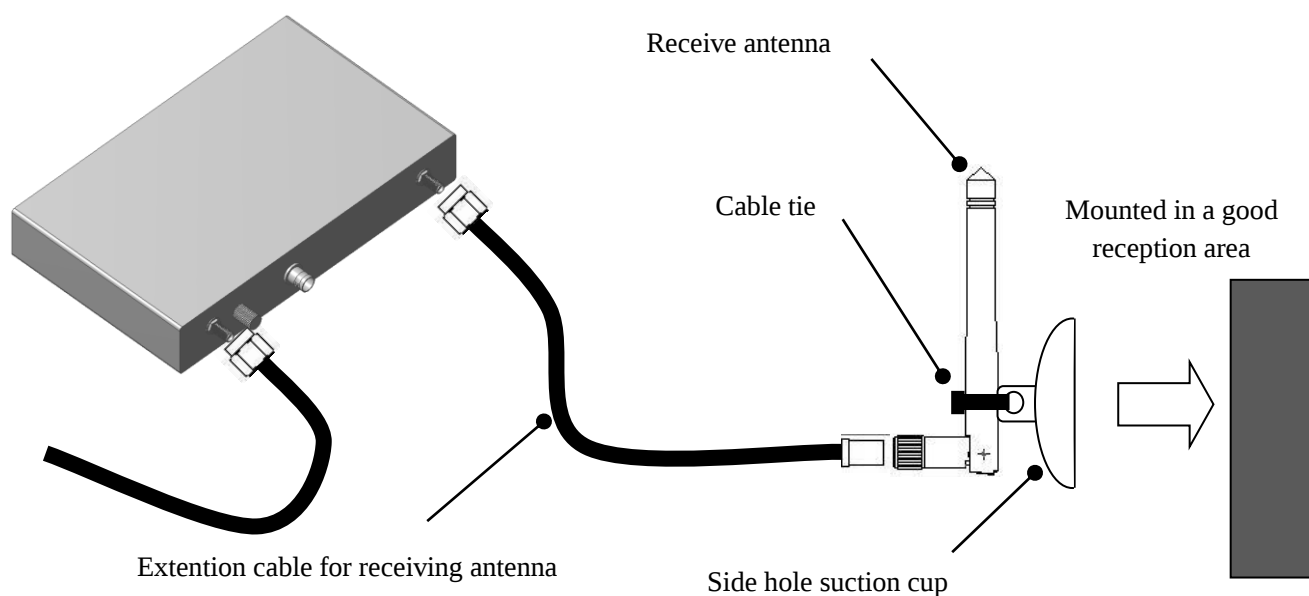
In other words, as long as the "MAIN" antenna does not encounter any wireless communication errors, data from this antenna will continue to be used, but data from the "SUB" antenna will be used if the "MAIN" antenna encounters wireless communication errors.

7-3. Using the extension cable for the receiving antenna

The receiving antenna can be set up away from the receiver by using the included extension cable.

Setting up the receiving antenna in a different location can be effective in poor reception areas, as when there are restrictions on where the receiver can be installed or when it would be difficult to install the transmitting and receiving antennas within sight of each other.

The receiving antenna can be mounted by using the side-hole suction cup on the included cable tie. When setting up the antenna, use a location that provides enough suction for the suction cup.



7-4. OPTIONAL ACCESSORIES

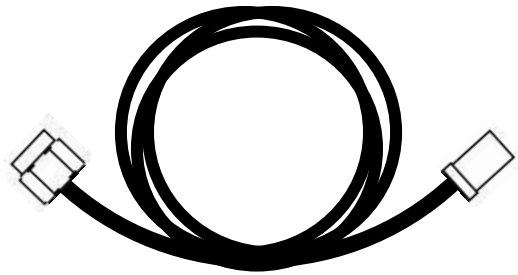
The following optional accessories are available for the telemeter:

E-03* [Extension cable for receiving antenna (6 m)]

The extension cable can provide an even longer extension for the receiver's receiving antenna.

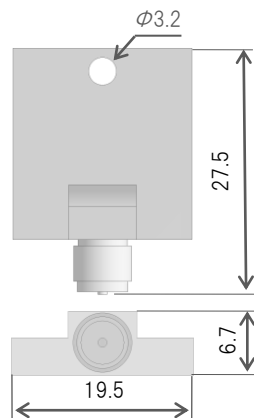
The external diameter of the cable is 2.7 mm, which is the same as that of the included extension cable for the receiving antenna (2 m).

*E-03 cannot be used in Europe.



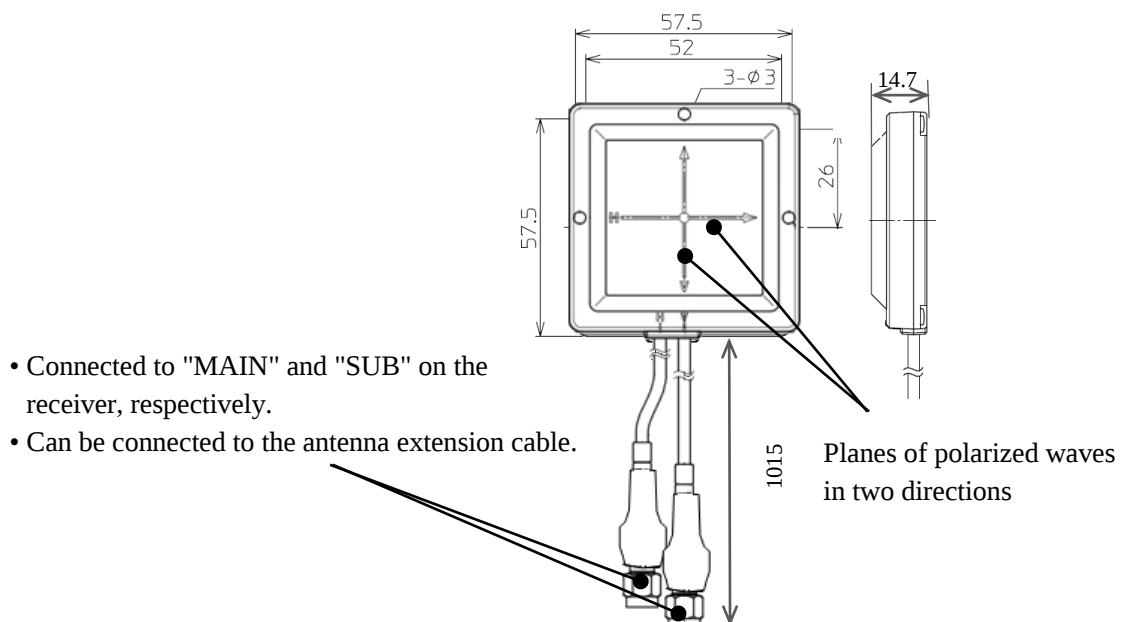
EXT-ANT1 [Small planar antenna]

This is effective when the receiving antenna must be installed in a narrow space.



EXT-ANT2 [Planar diversity antenna]

This single antenna has two orthogonal polarizations—vertical polarization (V-pol.) and horizontal polarization (H-pol.)—that enable reception even if the polarization changes.

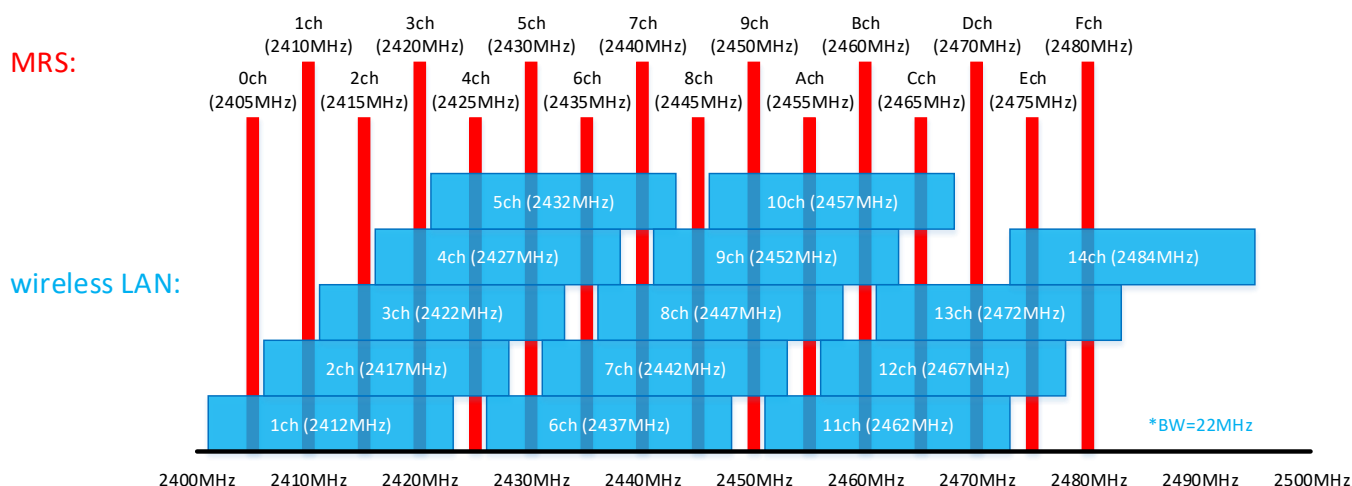


7-5. Radio interference

This telemeter operates on the 2.4 GHz band.

If there are multiple other wireless systems, such as those using wireless LAN or Bluetooth®, or radio equipment on the 2.4 GHz band in the same environment, the other radio equipment may cause radio jamming and result in communication becoming unstable.

The following figure shows the frequency channels and radio frequency used for communication by this telemeter and typical radio systems on the 2.4 GHz band. (Telemeter: MRS; wireless LAN and Bluetooth®) Normal radio communication can be interrupted if the transmitting and receiving radio frequency used by your radio equipment and the telemeter overlaps. Switching to a frequency channel that will not affect the transmission or reception of the telemeter may improve communication. Note that the telemeter is sensitive to wireless LAN communication.



Bluetooth: 2402 - 2480MHz (2402+kMHz, k=0, 1, 2, ..., 78)

7-6. Usage examples

The telemeter enables wireless communication over a line of sight of up to 50 m, enabling measurement of the torque of rotating shafts or other measurement where it would be difficult to wire the measurement device. There is a constant delay of 11.1 msec between transmitter strain input to analog output, which enables essentially real-time measurement in conjunction with a data logger.

Scenario (a): Measuring in a vehicle

In vehicles used for testing purposes, the telemeter can be used with a variety of Kyowa sensors. For instruments such as steering force/angle transducers and pedaling force transducers, installing recording equipment nearby is often difficult, so a long sensor cable may be needed. Using the telemeter eliminates the need for sensor cable wiring and simplifies setup.

Scenario (b): Measuring rotating objects

The transmitter offers centrifugal acceleration resistance (3,000 G), enabling the unit to measure while it is attached to rotating objects.

For stable communication, install the receiving antenna and transmitting antenna within sight of each other.

Scenario (c): Measuring moving objects

When measuring a moving object relative to the receiver, such as when measuring products moving on a production line, the receiving antenna can cover a broader area if it is connected to the extension cable and placed in another location.

Scenario (d): Simultaneously measuring up to 16 units

Although the telemeter is used with a single transmitter and receiver, which is considered a single measurement channel, up to 16 channels can be measured at the same time by setting up multiple transmitters and receivers. (In this case, a different Frequency CH and ID are set for each pair of transmitters and receivers.)

Scenario (e): Simplifying sensor check operations

Without using a computer, receiver switches can be used to perform Balance adjustment, conduct start and stop measurements, and execute other operations by pairing the settings for the transmitter and receiver in advance.

8. SPECIFICATIONS

8-1. MRS-111A (1ch-Receiver) specifications

■ Hardware Specifications

Number of Output Channels	1
Analog Output Accuracy	Within $\pm 0.1\%$ FS
DA Resolution	16 bits
DA Conversion Speed	4.8kHz
Operating Temperature, Humidity	0 to +50 °C, 20 to 85 % (Non condensing).
Vibration Resistance	29.42m/s ² (3G), 5 to 200Hz
Shock Resistance	294.2m/s ² (30G)
Power Supply	10 to 16VDC
Current Consumption	Within 250mA
Operating Switch	MUTE: Turn buzzer on/off. BAL: Execute balance adjustment. CHECK: Check sensor connection. START: Start measurement. STOP: Stop measurement. Tx OFF: Turn transmitter off. SLEEP: Set transmitter to sleep. Wake-up after the set time.
Indicator	Monitor transmitter battery in 3 steps. Monitor Received Signal Strength in 3 steps. 7-segment LED: Indicate a frequency channel (0 to F) DATA: Light up in response to radio communication error /non-error. Lock: Light up to indicate keys are locked.
Dimensions	210mm (W) ×35mm (H) ×157.5 mm (D)(Excluding protrusions)
Weight	Approx. 600g
Compliance	Directive 2014/53/EU (RED) Directive 2011/65/EU (RoHS)

■ RF Specifications

Transceiver Frequency Channel	1CH (Choose 1 channel from 16 channels using control software)
Antennas	Two external antennas (MAIN/SUB) for diversity reception.
Radio Communication Frequency Band	2.4GHz Band
Radio System	Digital Modulation System
Radio Certification	MIC(Japan), FCC(U.S.), WPC ETA(India), NBTC(Thailand)
Radio Environment of Usage	Environment where the wireless LAN and the Bluetooth®, etc. are not intermingled on the 2.4GHz

Frequency Channel and Central Frequency

Frequency Channel	CH 0	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9
Central Frequency (GHz)	2.405	2.410	2.415	2.420	2.425	2.430	2.435	2.440	2.445	2.450

Frequency Channel	CH A	CH B	CH C	CH D	CH E	CH F				
Central Frequency (GHz)	2.455	2.460	2.465	2.470	2.475	2.480				

■ Specifications in Combination with a transmitter

Refer to the specifications of each transmitter.

8-2. MRS-101A-S (1ch-Strain Transmitter) specifications

■ Hardware Specifications

Measuring Targets	Strain gages(Full bridge system), Strain gage transducers
Number of Channels	1
Applicable Bridge Resistance	120 to 1000 ohm
Gage Factor	2.00 fixed
Bridge Excitation	1 VDC
Measuring Range	1000,2500,5000,10000,25000×10 ⁻⁶ Strain
Range Accuracy	Within ±0.15%FS
Balance Adjustment Range	Within ±10000×10 ⁻⁶ Strain
AD Resolution	16 bits
Sampling Frequencies	4.8kHz
Stability Temperature	Zero point : Within ±0.05×10 ⁻⁶ Strain /°C Sensitivity : Within ±0.01 %/°C
Operating Temperature, Humidity	-25 to +75 °C, 20 to 85 % (Non condensing).
Vibration Resistance	294.2m/s ² (30G), 10 to 500Hz
Shock Resistance	980.7m/s ² (100G)
Centrifugal Acceleration Resistance	29420m/s ² (3000G)
Power Supply	2.2 to 4.4VDC
Current Consumption	Within 32mA (Test conditions: Power Supply 3.0V, Bridge resistance 120 ohm)
Hours of Continuous Use	Approx.28 hours(Lithium (CR2 manufactured by Panasonic)) Approx.24 hours(Ni-MH eneloop®(BK-4MCC,AAA cell×2)) Approx.34 hours(Alkaline EVOLTA(LR03EJ,AAA cell×2)) *Under the conditions of tests: +23 °C, Bridge resistance 120 ohm
Dimensions	35 mm (W)×5.5mm (H) ×19.5 mm (D)(Excluding protrusions)
Weight	Approx. 10g
Compliance	Directive 2014/53/EU (RED) Directive 2011/65/EU (RoHS)

■ RF Specifications

Transceiver Frequency Channel	1CH (Choose 1 channel from 16 channels using control software.)
Antenna	Built-in Antenna
Radio Communication Frequency Band	2.4GHz Band
Radio System	Digital Modulation System
Radio Certification	MIC(Japan), FCC(U.S.) , WPC ETA(India) , NBTC(Thailand), RED(E.U.)
Radio Communications Distance	Maximum line of sight distance: 50m
Radio Environment of Usage	Environment where the wireless LAN and the Bluetooth®, etc. are not intermingled on the 2.4GHz

Frequency Channel and Central Frequency

Frequency Channel	CH 0	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9
Central Frequency (GHz)	2.405	2.410	2.415	2.420	2.425	2.430	2.435	2.440	2.445	2.450

Frequency Channel	CH A	CH B	CH C	CH D	CH E	CH F				
Central Frequency (GHz)	2.455	2.460	2.465	2.470	2.475	2.480				

■ Specifications in Combination with MRS-111A(1ch-Receiver)

Analog Output Voltage	±5V/ (Full Scale Range)
Measurement Accuracy	Within ±0.2%FS
Frequency Response Range	DC to 480Hz, -3dB±1dB (at 480 Hz)
Delay Time	-11.1±0.3msec (at DC to 480Hz)

8-3. MRS-101A-SE (1ch-Strain Transmitter(EXT Antenna)) specifications

■ Hardware Specifications

Measuring Targets	Strain gages(Full bridge system), Strain gage transducers
Number of Channels	1
Applicable Bridge Resistance	120 to 1000 ohm
Gage Factor	2.00 fixed
Bridge Excitation	1 VDC
Measuring Range	1000,2500,5000,10000,25000×10 ⁻⁶ Strain
Range Accuracy	Within ±0.15%FS
Balance Adjustment Range	Within ±10000×10 ⁻⁶ Strain
AD Resolution	16 bits
Sampling Frequencies	4.8kHz
Stability Temperature	Zero point : Within ±0.05×10 ⁻⁶ Strain /°C Sensitivity : Within ±0.01 %/°C
Operating Temperature, Humidity	-25 to +75 °C, 20 to 85 % (Non condensing).
Vibration Resistance	29.42m/s ² (3G), 5 to 200Hz
Shock Resistance	294.2m/s ² (30G)
Power Supply	2.2 to 4.4VDC
Current Consumption	Within 32mA (Test conditions: Power Supply 3.0V, Bridge resistance 120 ohm)
Hours of Continuous Use	Approx.28 hours(Lithium (CR2 manufactured by Panasonic)) Approx.24 hours(Ni-MH eneloop®(BK-4MCC,AAA cell×2)) Approx.34 hours(Alkaline EVOLTA(LR03EJ,AAA cell×2)) *Under the conditions of tests: +23 °C, Bridge resistance 120 ohm
Dimensions	35 mm (W)×5.5mm (H) ×19.5 mm (D)(Excluding protrusions)
Weight	Approx. 10g
Compliance	Directive 2014/53/EU (RED) Directive 2011/65/EU (RoHS)

■ RF Specifications

Transceiver Frequency Channel	1CH (Choose 1 channel from 16 channels using control software.)
Antenna	External Antenna
Radio Communication Frequency Band	2.4GHz Band
Radio System	Digital Modulation System
Radio Certification	MIC(Japan), FCC(U.S.) , WPC ETA(India) , NBTC(Thailand), RED(E.U.)
Radio Communications Distance	Maximum line of sight distance: 50m (Using External Antenna(W1030) of Standard Accessory.)
Radio Environment of Usage	Environment where the wireless LAN and the Bluetooth®, etc. are not intermingled on the 2.4GHz

Frequency Channel and Central Frequency

Frequency Channel	CH 0	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9
Central Frequency (GHz)	2.405	2.410	2.415	2.420	2.425	2.430	2.435	2.440	2.445	2.450

Frequency Channel	CH A	CH B	CH C	CH D	CH E	CH F				
Central Frequency (GHz)	2.455	2.460	2.465	2.470	2.475	2.480				

■ Specifications in Combination with MRS-111A(1ch-Receiver)

Analog Output Voltage	±5V/ (Full Scale Range)
Measurement Accuracy	Within ±0.2%FS
Frequency Response Range	DC to 480Hz, -3dB±1dB (at 480 Hz)
Delay Time	-11.1±0.3msec (at DC to 480Hz)

8-4. MRS-101A-V (1ch-Voltage Transmitter) specifications

■ Hardware Specifications

Measuring Targets	Voltage
Number of Channels	1
Input Resistance	Approx. (1 + 1MΩ)
Absolute Input Voltage Range*1	Between D(+IN) and B(-IN) : Within ±32 V Between D and E(SHIELD), Between B and E : Within ±16 V
Measuring Range	5, 10V
Range Accuracy	Within ±0.15%FS
Balance Adjustment Range	Within ±5V
AD Resolution	16 bits
Sampling Frequencies	4.8kHz
Stability Temperature	Zero point : Within ±0.01 %FS/°C Sensitivity : Within ±0.02 %/°C
Operating Temperature, Humidity	-25 to +75 °C, 20 to 85 % (Non condensing).
Vibration Resistance	294.2m/s ² (30G), 5 to 500Hz
Shock Resistance	980.7m/s ² (100G)
Centrifugal Acceleration Resistance	29420m/s ² (3000G)
Power Supply	2.2 to 4.4VDC
Current Consumption	Within 22mA
Hours of Continuous Use	Approx.38 hours(Lithium (CR2 manufactured by Panasonic)) Approx.33 hours(Ni-MH eneloop®(BK-4MCC,AAA cell×2)) Approx.39 hours(Alkaline EVOLTA(LR03EJ,AAA cell×2)) *Continuous operation at an ambient temperature of +23 °C
Dimensions	35 mm (W)×5.5mm (H) ×19.5 mm (D)(Excluding protrusions)
Weight	Approx. 10g
Compliance	Directive 2014/53/EU (RED) Directive 2011/65/EU (RoHS)

*1 Exceeding the Absolute Input Voltage Range may cause permanent damage to this product.

■ RF Specifications

Transceiver Frequency Channel	1CH (Choose 1 channel from 16 channels using control software.)
Antenna	Built-in Antenna
Radio Communication Frequency Band	2.4GHz Band
Radio System	Digital Modulation System
Radio Certification	MIC(Japan), FCC(U.S.) , WPC ETA(India) , NBTC(Thailand), RED(E.U.)
Radio Communications Distance	Maximum line of sight distance: 50m
Radio Environment of Usage	Environment where the wireless LAN and the Bluetooth®, etc. are not intermingled on the 2.4GHz

Frequency Channel and Central Frequency

Frequency Channel	CH 0	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9
Central Frequency (GHz)	2.405	2.410	2.415	2.420	2.425	2.430	2.435	2.440	2.445	2.450

Frequency Channel	CH A	CH B	CH C	CH D	CH E	CH F				
Central Frequency (GHz)	2.455	2.460	2.465	2.470	2.475	2.480				

■ Specifications in Combination with MRS-111A(1ch-Receiver)

Analog Output Voltage	±5V/ (Full Scale Range)
Measurement Accuracy	Within ±0.2%FS
Frequency Response Range	DC to 480Hz, -3dB±1dB (at 480 Hz)
Delay Time	-11.1±0.3msec (at DC to 480Hz)

8-5. MRS-10A (Control Software) specifications

■ Software Functions

Setting Functions	Set the Measuring Range. Set the LEDs lighting level for monitoring transmitter supply voltage. Set the Minimum voltage for operating transmitter. Set frequency channel. Set the sleep time of transmitter. Set data processing at the time of radio communication error.
Operation Functions	Execute balance adjustment. Check sensor connection. Display graph.
Inspection Function	Radio condition inspection.

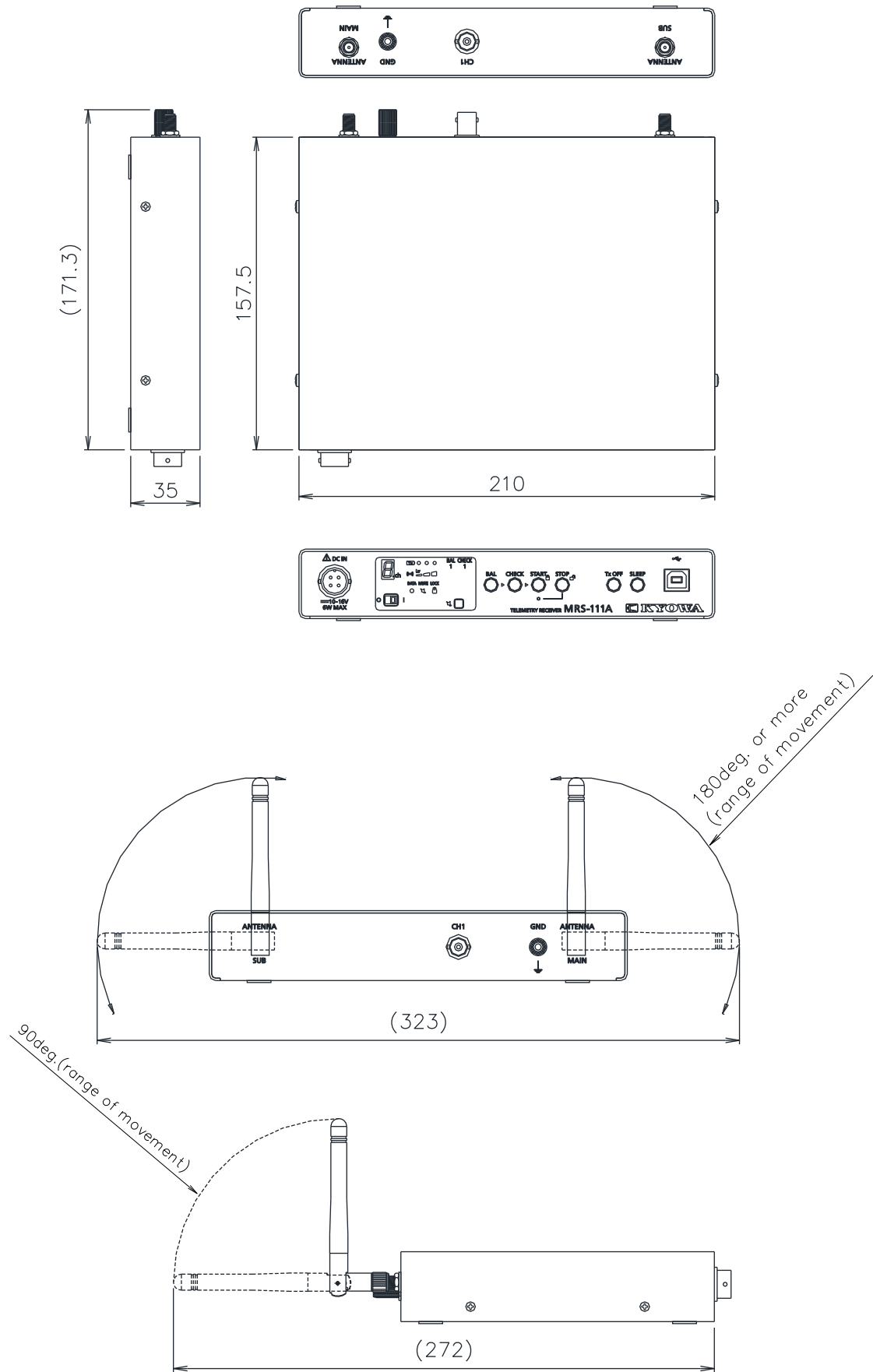
■ Operating Environment

OS	Windows 7, Windows 8/8.1, Windows 10 Japanese/English, 32/64 bit support
CPU	Intel Core2Duo,2GHz or advanced
Memory	4GB or more
Interface	USB2.0 (can also be operated in a USB3.0 port)
Display	1024*768 dots or more.

* There is no data acquisition function by this software.

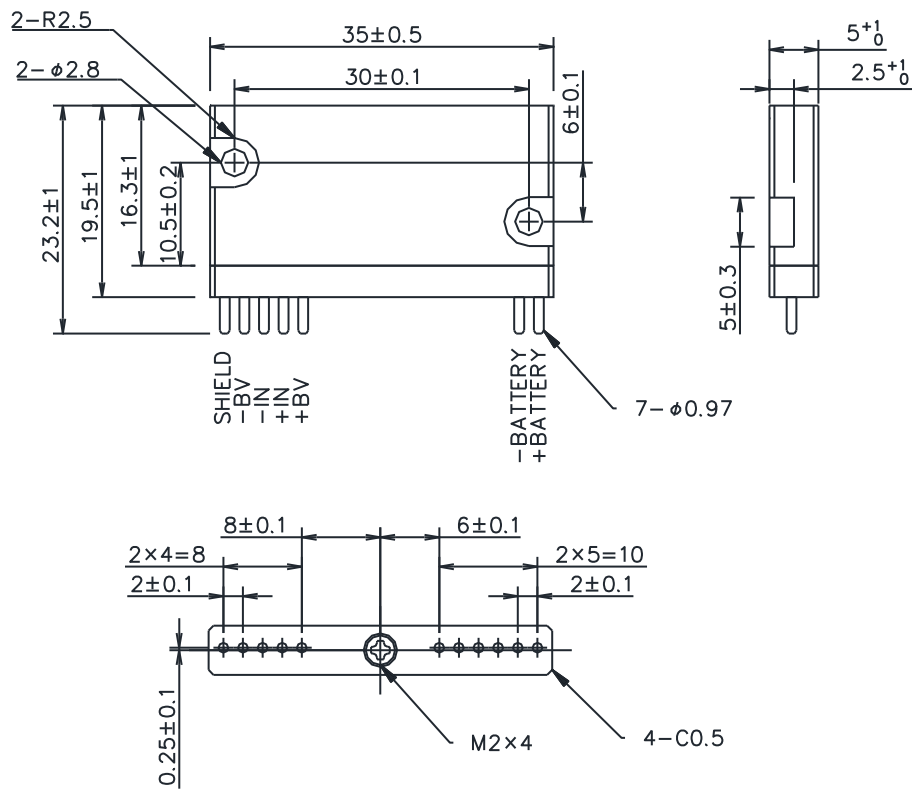
8-4. OUTSIDE DRAWING

8-4-1. MRS-111A (1ch-Receiver)

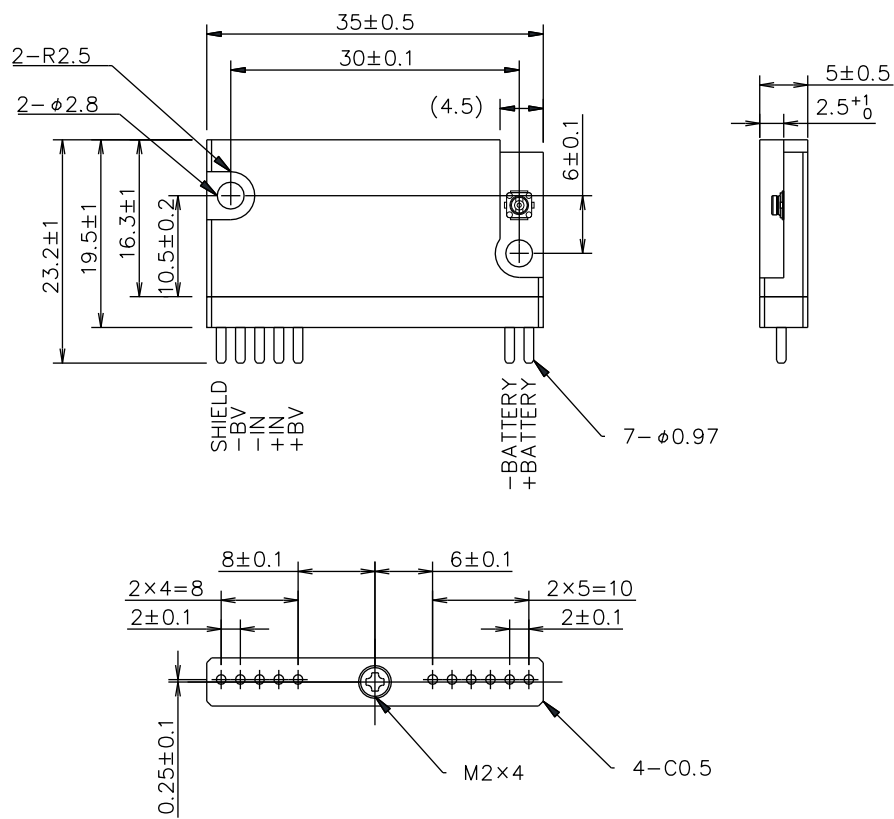


Antenna installation

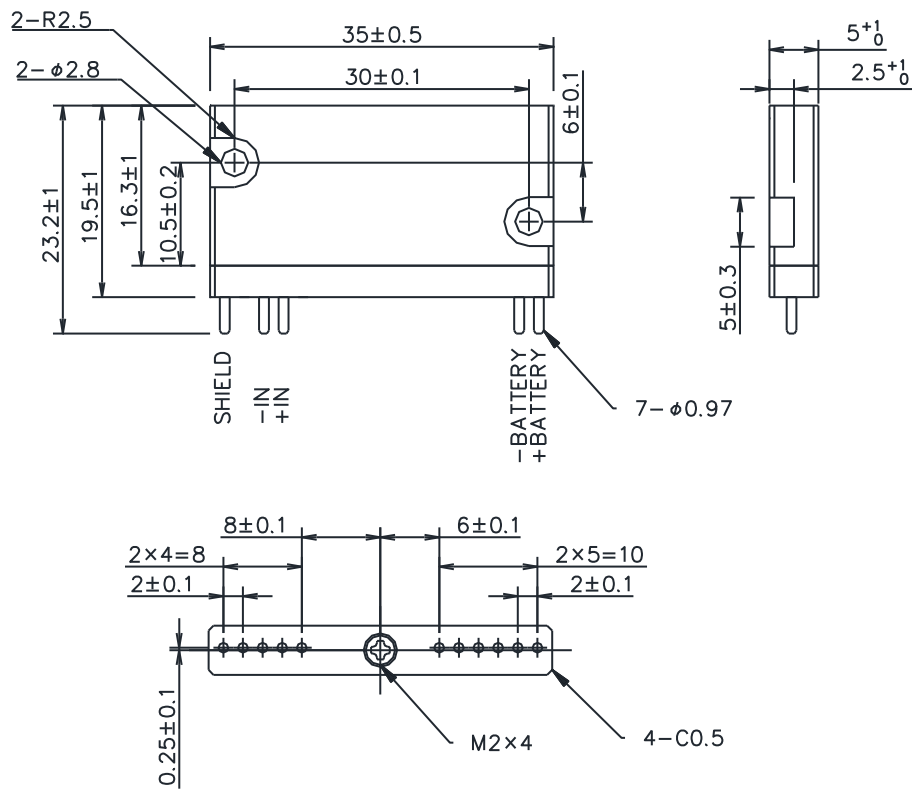
8-4-2. MRS-101A-S (1ch-Strain Transmitter)



8-4-3. MRS-101A-SE (1ch-Strain Transmitter(EXT Antenna))



8-4-4. MRS-101A-V (1ch-Voltage Transmitter)





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