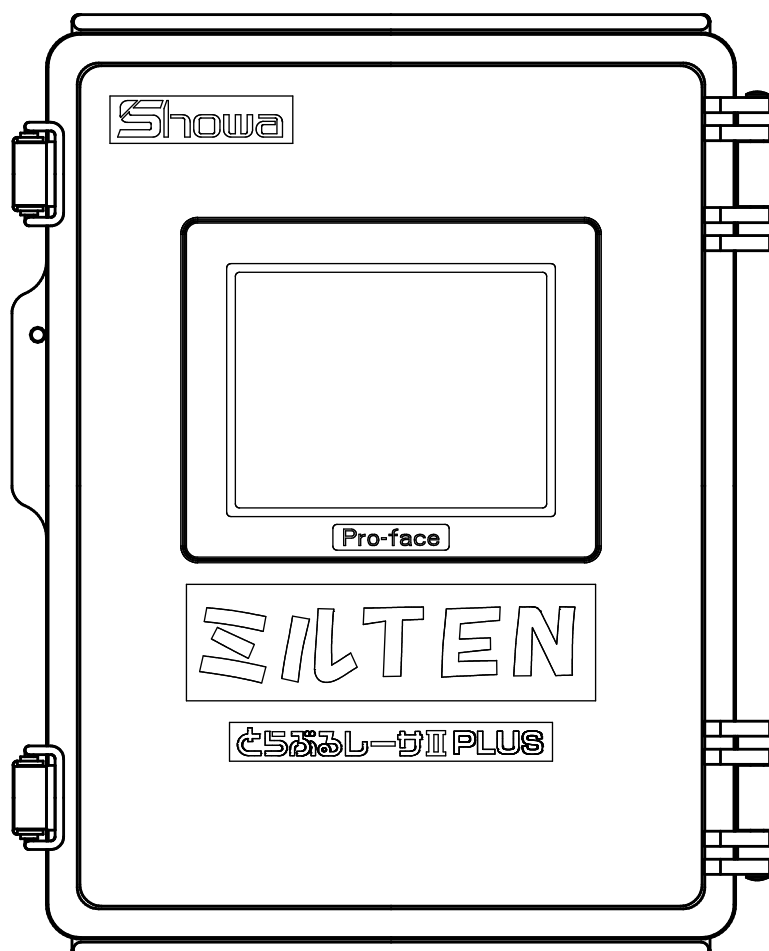


Troubleresa II PLUS

Instruction Manual

(MiruTEN)

Malfunction Detector for Rotating Machinery



Introduction

Thank you very much for purchasing Showa Denki's Troubleresa II PLUS MiruTEN Malfunction Detector for Rotating Machinery.



As a specialist manufacturer of blowers and dust collectors, Showa Denki is dedicated to creating products based on "flow technology" and "rotating machinery technology." The Troubleresa II PLUS is a simple diagnostic device for rotating machinery, developed utilizing our wealth of expertise in maintenance and repairs. To get the best performance from this product and to ensure safe use and a long, trouble-free life, please take the time to read this instruction manual carefully.

This manual is designed for use by the following persons.

Persons with knowledge of rotating machines and related peripheral equipment:

- Persons who install or connect control equipment
- Persons who perform routine management (inspection, maintenance) of rotating equipment
- Persons who manage work sites where rotating equipment is used

1. How to read the instruction manual

The parts of this manual denoted by the [ **Warning**] mark indicate that incorrect handling may result in [accidents leading to death or serious injury] or [outbreak of fire]. Parts denoted by the [ **Caution**] mark indicate that incorrect handling may result in [accidents leading to injury] or [product damage]

2. Meaning of graphical symbols



indicates actions that must be avoided (object is unspecified)



indicates instructions that should be followed.



indicates that incorrect handling may lead to an accident.



indicates that disassembly must be avoided.



indicates that an earth wire must be connected.




indicates the risk of electric shock.

Please take care to observe all warnings, cautions, and instructions.

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1. Cautions regarding use of the product

[ Warning] This product is designed for general industrial applications. It is not designed for use in applications that present the risk of serious human harm or property damage.



This product is designed for the purpose of detecting and reporting abnormalities that may lead to malfunction or failure of rotating equipment. It does not prevent or resolve abnormalities. Please note that abnormalities that cannot be detected by this product may occur.



This product is designed to support routine inspection work. It is assumed that when using this device, maintenance inspections are appropriately performed in accordance with the instructions provided in the manuals for the blower or on the connected rotating equipment.



If there is a risk that malfunction or failure of this product may cause serious damage or loss, make sure to provide systematic backup and failsafe※ 1 features.



Whenever the product detects an abnormality, make sure to stop operation of the rotating equipment and take the necessary corrective measures.



Installing each of the sensors requires specialist knowledge of electricity and rotating equipment. Make sure that sensors are installed only by technicians with the appropriate expertise.



Do not leave the MiruTEN and powered Remote Unit for a long time without communication enabled between the two. If the indicator Light that signals a communication problem is left flashing the life of the Remote Unit will be shortened.



Install the Remote Unit in a place where it will not be exposed to water or dust. For applications in which exposure to water or dust is unavoidable, we recommend use of the outdoor model(TCM-NF2PS).



If using the outdoor model(TCM-NF2PS) for applications that require IP65-level dust-resistance, water-resistance, and protection make sure to apply appropriate protective measures to electrical wiring outlets.















Make sure to connect sensors to terminals correctly. Electrical wiring errors or connecting sensors with output values beyond their usage range may not only cause a failure to detect abnormalities, but also lead to short-circuits or sensor damage.



Make sure to shut off the power supply when performing electrical wiring connections. Otherwise, there will be a risk of an accident or product damage.

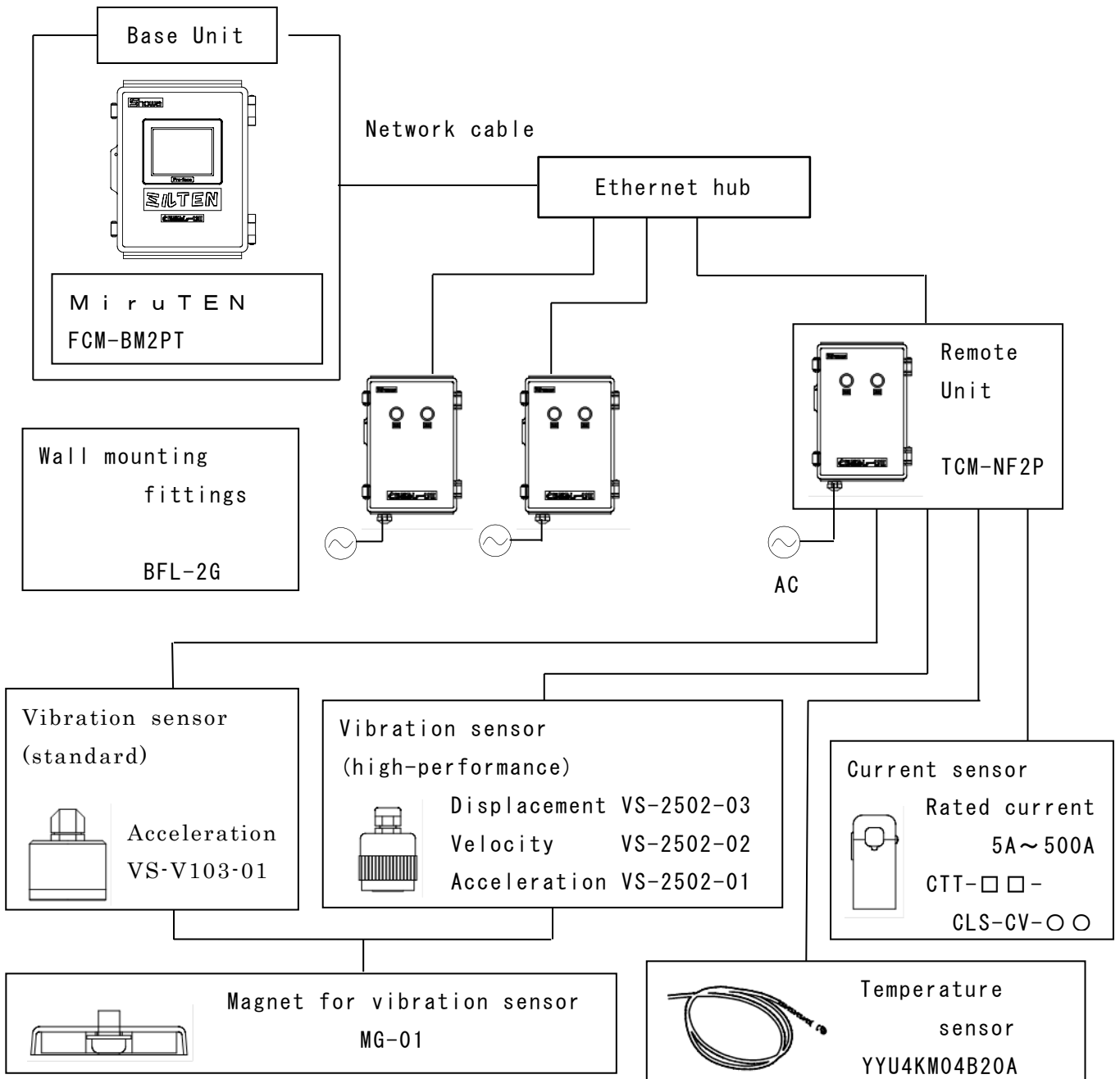
※ 1 : This means a design concept that aims to ensure safety in the event of a mistake by a worker or faulty operation of a sensor or device.

-  Do not install the product in a place exposed to radio waves or electromagnetic noise. Otherwise, there will be a risk of a communication malfunction or malfunction of the Remote Unit.
-  When using a wireless network for communication with this product, make sure to test operation in advance. If there is a high degree of electromagnetic noise or if there are other wireless networks in the area, communication may not work reliably.
-  Make sure to operate the touch controls on the screen only by hand. If excessive force is applied to the screen, or if the touch controls are operated using a hard or sharp object the touch screen may become damaged.
-  Take care not to drop this product or sensors, or subject them to excessive physical shock. Otherwise, their internal elements may be damaged or malfunction may result, even if they appear to be normal.
-  Take care to connect the sensor lead wires in a way that does not impose repeated bending stress or tension. Otherwise, the wires may break.
-  Do not bundle sensor cables with or place them near to the main electrical circuit or a power line. Otherwise, malfunction may occur due to noise.
-  Do not subject the product to any sudden change in temperature. Otherwise, insulation performance may deteriorate due to condensation, resulting in operation failure.
-  This product is a precision device, so make sure to avoid subjecting it to any strong physical shock, for example by dropping it.
-  Do not cover this product with a cloth or sheet, because this causes heat radiation performance to deteriorate.
-  Do not connect this product or a Toublerasa II PLUS Remote Unit to the same network used by any similar product by another company. Otherwise the product may malfunction or become damaged.
-  Do not expose the product directly to oil, chemicals, solvents, or salt of any kind.
-  If this product shows any signs of abnormal heat generation, cracks, deformation, or strange smells, stop using it immediately.

2. Overview of Troubleresa II PLUS

Rotating equipment often plays a very important function in industrial facilities. so the failure or malfunction of such equipment can force the shutdown of operations. For this reason, routine inspection and maintenance of rotating equipment is essential. However, since rotating equipment is often installed in places that are difficult to access, such as above machinery, on rooftops, or within enclosed areas, proper inspection is often neglected. The Troubleresa II PLUS is a device that enables constant monitoring of rotating equipment with any of various kinds of sensors, to prevent the occurrence of any significant breakdowns by indicating common abnormalities at any early stage. It is a device for constant monitoring and simple diagnosis. Previously, constant monitoring systems were typically large-scale and very expensive. This product delivers similar capabilities at a low cost by focusing on the most vital functions.

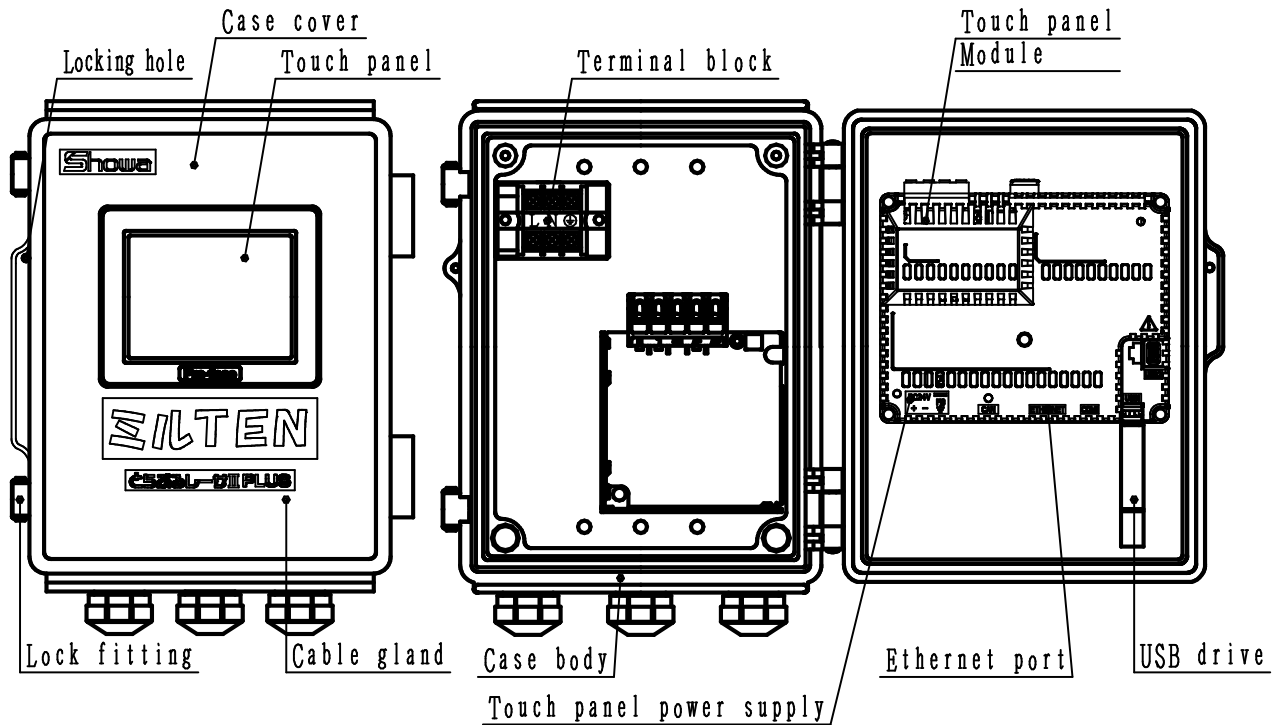
● System configuration example and peripheral equipment



● M i r u T E N (F C M - B M 2 P T)

This product controls Remote Units and displays and records measurement values. It should be installed and used in a place that allows for easy inspection.

● Part names



Front view

Internal view



Disassembly must be avoided, otherwise product failure may occur. So do not touch any parts other than those designated.

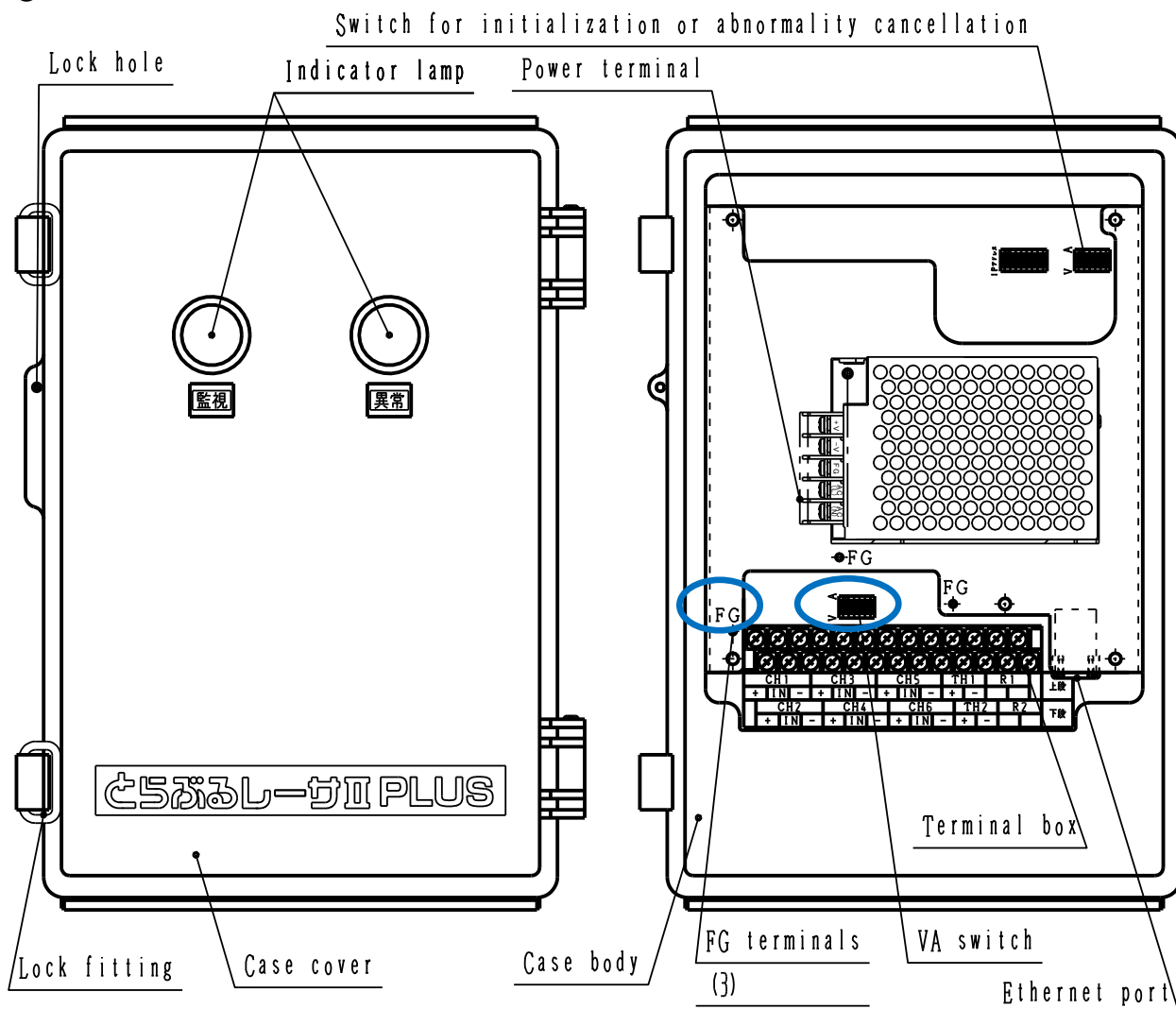
● Wall mounting fittings for MiruTEN (B F L - 2 G)

These are fittings to mount the MiruTEN to a wall. (See p14)
)

● Remote Unit (T C M - N F 2 P (S))

The Remote Unit is installed close to the item of equipment to be monitored.
Sensor measurements are transmitted to the MiruTEN (Base Unit) via an Ethernet cable.

● Part names



Front view

Internal view



Disassembly must be avoided, otherwise product failure may occur. So do not touch any parts other than those designated.

● Wall mounting fittings for Remote Unit (B F L - 2 G)

These are fittings to mount a Remote Unit to a wall. (See p15)

● Vibration sensors

Vibration sensor are fitted to a bearing stand or other suitable place to Detect vibration.

Abnormalities such as changes in vibration (compared to normal operation) or a vibration level that is outside the allowable range are detected.

The sensors VS-2502-01 and VS-V103-01 detect acceleration

The sensors VS-2502-02 detects velocity

The sensors VS-2502-03 detects displacement

● Magnet for vibration sensor (M G - 0 1)

This can be used for temporary placement of vibration sensors.

For long-term monitoring it is recommended that sensors are fixed securely using screws.

● Temperature sensors

Temperature sensors are fitted to bearing housings on both the load side and drive side to detect bearing temperature.

(Note that if the bearing housing is thick at the point where the sensor is Fitted, the displayed temperature may be lower than the real temperature.)

● Current sensors

A current sensor is installed on one of the motor power supply cables –R,S,or T—to detect an operation signal, insufficient load, excessive load, etc. Current sensor can also be used to measure operation time.

● Ethernet hub (network hub)

An Ethernet hub is used for connecting multiple Remote Units to the MiruTEN. (Recommended hub : Diatrend DEH-TX8)

● Wireless router

If it is difficult to install network cables, a wireless router can be used for wireless network connection.

The number of routers needed depends on the configuration of the system.

※The stability of communication can vary widely depending on the network Environment, so testing wireless network performance is strongly Recommended before commencing full-scale operation.

■ Set contents

- Body
- Instruction manual (MiruTEN)
- Screws for fixing cover
- USB drive

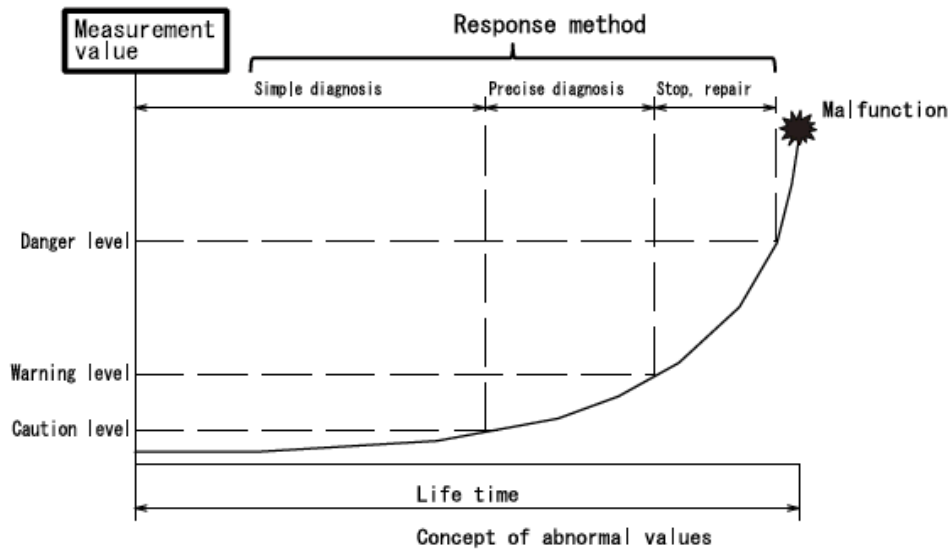
3. Threshold values Settings

A threshold value is the value at the boundary between normal and abnormal. with the Troublersesa II PLUS, the threshold value is the reference value for judging whether a measurement is normal or abnormal.

Typically, there are two ways used to judge abnormality of vibration level or temperature-with an absolute criterion or a relative criterion.

In the case of an absolute criterion, abnormality is judged by comparing the measurement value with an absolute reference value, determined by a JIS or other Standard.

In the case of a relative criterion, abnormality is judged by measuring the normal value and then judging whether the value exceeds (or falls below) a threshold value that is a specified amount higher (or lower) than the normal value. Generally when measuring vibration or temperature, before abnormality is reached The value varies as shown in the graph below.



This product detects and signals abnormalities at an early stage by means of a simple diagnosis. Therefore, when an abnormality is detected, the customer Needs to conduct a precise diagnosis, to identify the location and degree of Abnormality and take the necessary corrective measures.

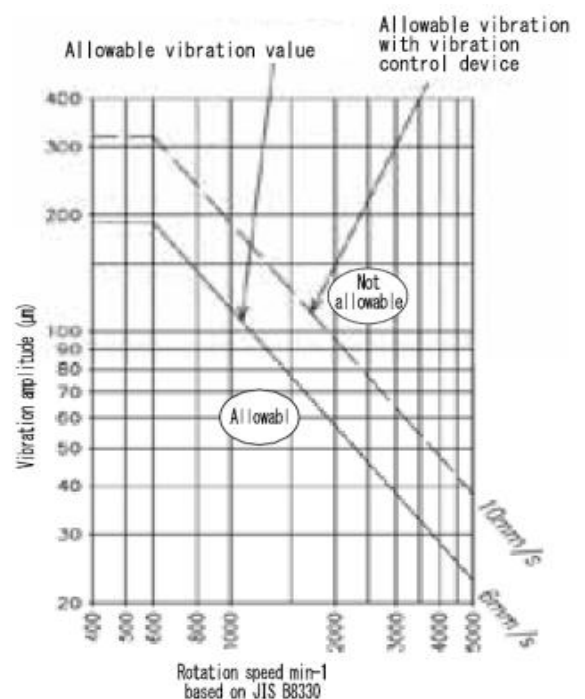
● Vibration threshold value

Generally, vibration values are judged to be abnormal if they fall outside a range of allowable values, as shown in the graph at right.

However, the suitable threshold value varies According to where and how the rotating equipment is installed. the balance of rotation, rotational speed, and other factors.

For this reason, a relative criterion is most suitable, With an appropriate setting of relative threshold value abnormalities can be detected for a wide variety of different equipment.(As a general yardstick, threshold values for vibration are set to around 1.6 to 2 times the normal value.)

Also, even in cases where the vibration value during normal operation is far lower than the allowable value specified by a standard, for example, it is not advisable to use an absolute criterion only a relative threshold value should also be set up.



Next, how to convert vibration amplitude values into velocity and acceleration is explained.

The vibration frequency is needed as a parameter for the conversion.

The formula for conversion is as follows.

$$\text{Velocity (V)} = \frac{2\pi fD}{2000} \qquad \text{Acceleration (A)} = \frac{(2\pi f)^2 D}{2 \times 10^6}$$

V : Velocity [mm/s]

A : Acceleration [m/s²]

D : Amplitude (peak to peak) [$\mu\text{m}^{\text{P-P}}$]

f : Frequency [Hz]

However, since acceleration may not match with the conversion value under some conditions. The threshold value for acceleration is generally defined as a relative value.

Ex) If amplitude = 30 μm 、frequency = 50 Hz (3000 min⁻¹),

Allowable acceleration will be :

$$\text{Acceleration (A)} = \frac{(2\pi f)^2 D}{2 \times 10^6} = \frac{(2 \times \pi \times 50)^2 \times 30}{2 \times 10^6} \approx 1.48[\text{m/s}^2]$$

Vibration sensors are not always able to accurately measure vibrations generated by transmission of external vibration or by resonance.

● Temperature threshold value (setting range 0 to 150°C)

The temperature of bearings increases gradually after the start of operation, reaching a stable value in 1 to 2 hours. Temperature threshold values are generally set according to the following procedure.

- (1) Bearing temperature rise = Bearing temperature after approx. 2 hours – Ambient temperature
- (2) Threshold value = Bearing temperature + 4.5°C

There may be a significant difference between the sensor temperature value and the actual bearing temperature, depending on the position where the sensor is fitted. So, at the time of initial adjustment, it is advisable to measure the surface temperature of the bearing housing and to take into account the difference between this and the sensor value in deciding the threshold value.

● Current threshold value (setting range : 5 to 500 A)

Changes in motor load are detected according to changes in electric current. If an overload protection device in the main control board is activated earlier, abnormality cannot be detected. Reductions in load, due to abnormalities in a drive transmission process, due to a cut or loose V-belt for example, are detected as a lack of current (undercurrent)

For undercurrent threshold value, the no-load current of the electric motor is used.

For the overload threshold value, the rated current of the electric motor is used.

- If an inverter is used to reduce speed, the no-load current at the operating frequency can be used as the undercurrent threshold value.
- If an inverter is used for variable speed operation, it may not be possible to use undercurrent (belt failure detection function) for the current threshold value.

● Lower and upper threshold values

In the case of lower threshold values, abnormality is detected when the value measured by the Remote Unit falls below the lower threshold. (If a lower threshold value is not needed, the lower threshold value should be set to 0)

In the case of upper threshold values, abnormality is detected when the value measured by the Remote Unit rises above the upper threshold.

● Operating time threshold value (setting range : 1 to 65535 hours)

This threshold value calculates cumulative operation time (whenever a load is applied to the motor). The proper threshold value depends on the type of lubricant (grease or oil), the surrounding environment, and usage conditions. Customers need to take into account all the operation conditions of their Rotating equipment to decide on a suitable value.

● Delay time (0 to 120 seconds)

To help prevent detection errors due to sudden increases in measurement values, an abnormality is not indicated until the measurement value is judged to remain abnormal for longer than the delay time setting.

Approximately 10 seconds is usually a suitable value.

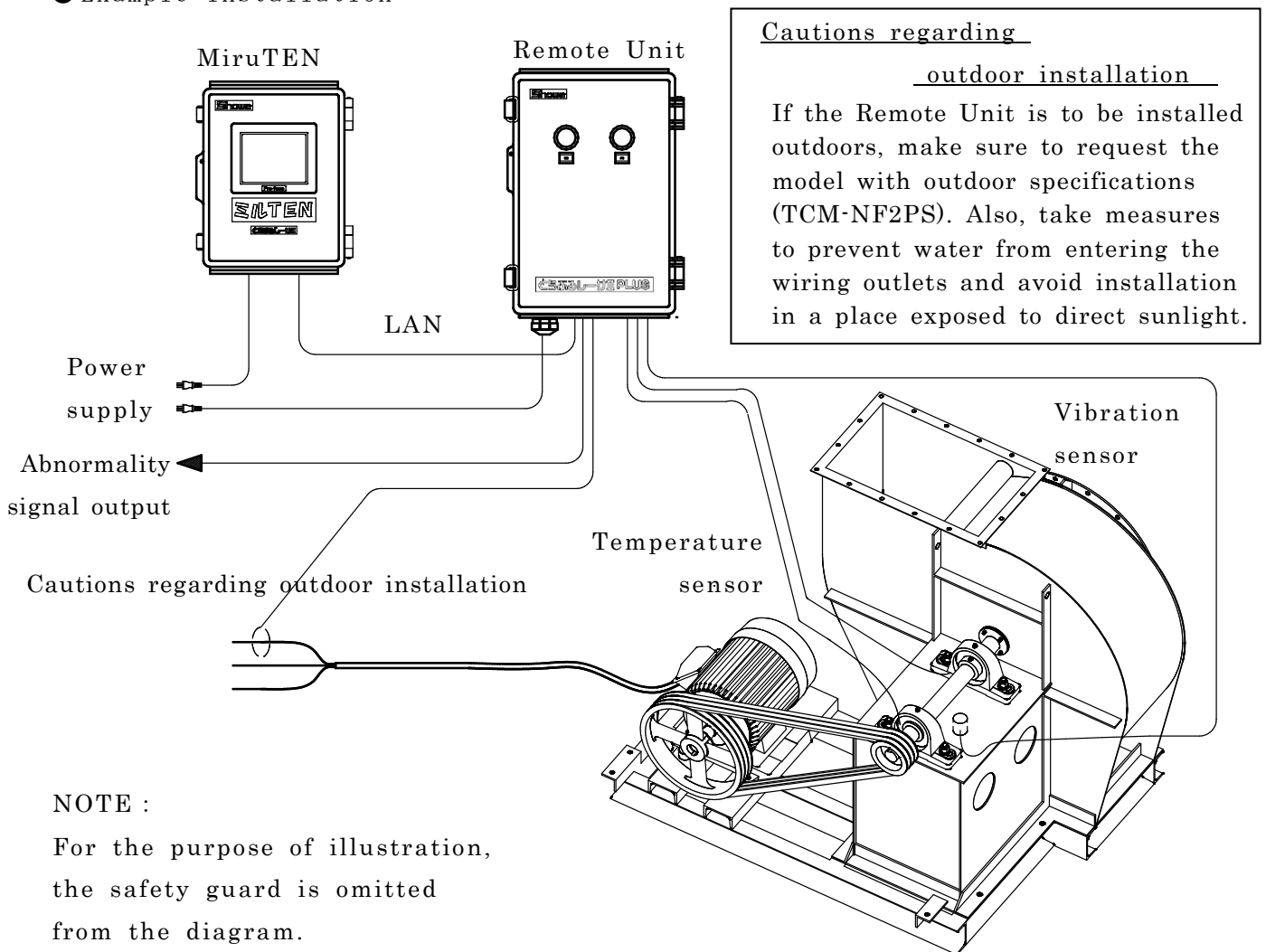
4. Installation Guidelines

- Install the Remote Unit in a place that is not subject to vibration or exposed to direct sunlight.

● Installation procedure

- (1) Installing the Remote Unit (see P15)
- (2) Fitting the sensors (see P16)
- (3) Wiring the Remote Unit terminals (see P19)
- (4) Connecting a network cable (see P21)
- (5) Remote Unit settings (see P22)
- (6) Connecting the power supply (see P23)
- (7) MiruTEN setting (see P23)

● Example installation

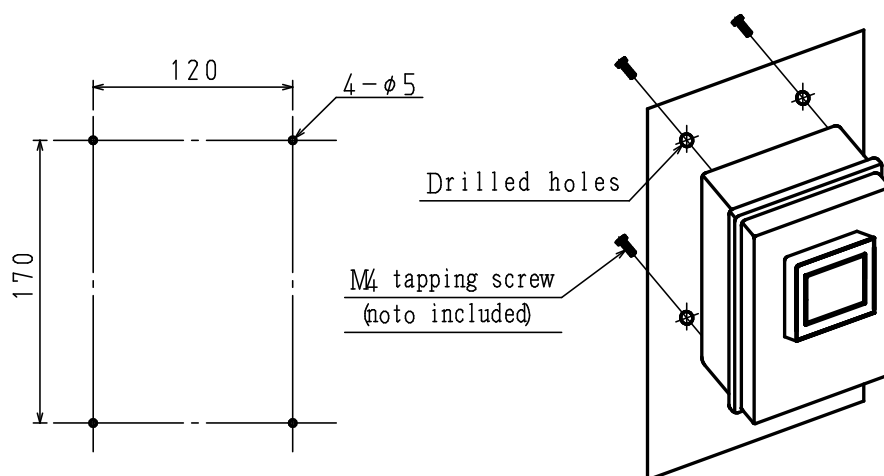


(1) Installing the MiruTEN and Remote Units

● Installing the MiruTEN

① If installing directly

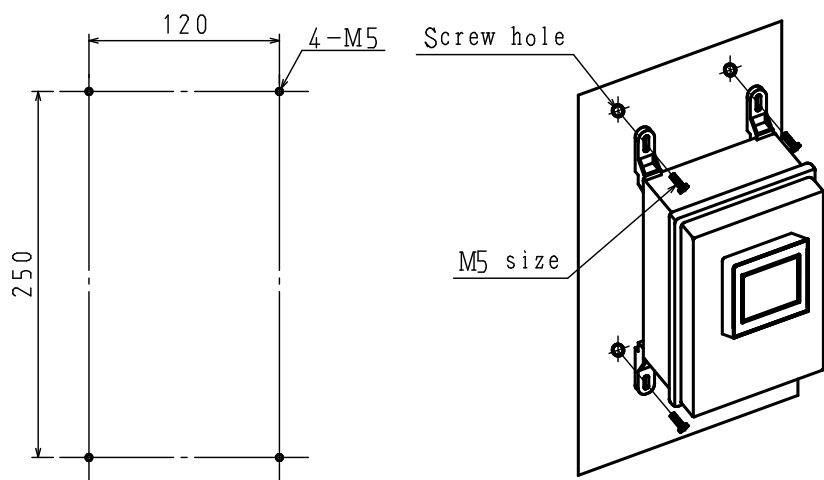
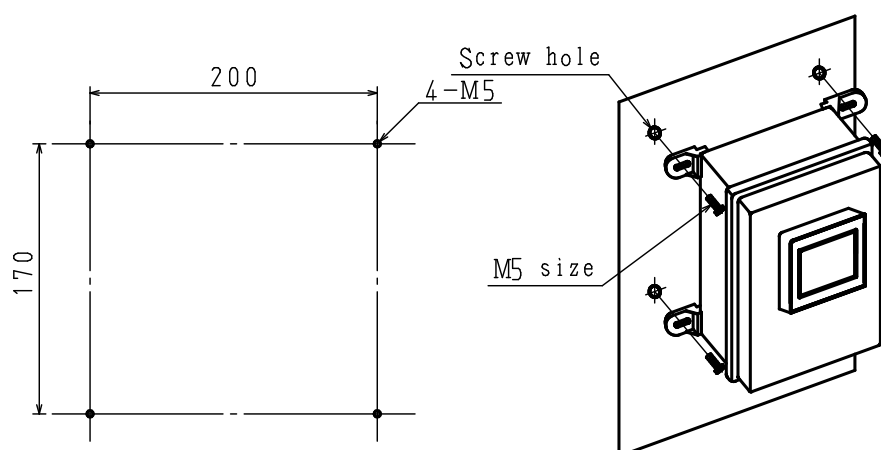
Prepare holes of the dimensions shown below and fix the MiruTEN from behind with screws. (tap depth of the MiruTEN body is 6mm.)



② Installing with fittings for wall mounting

Prepare holes of the dimensions shown below and fix the MiruTEN with attached wall mounting fittings from the front with screws.

(The thickness of the wall mounting fittings is 8.5mm.)

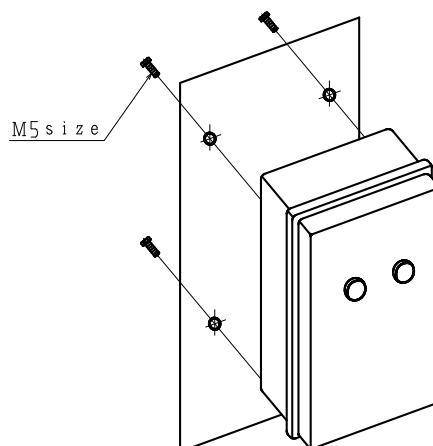
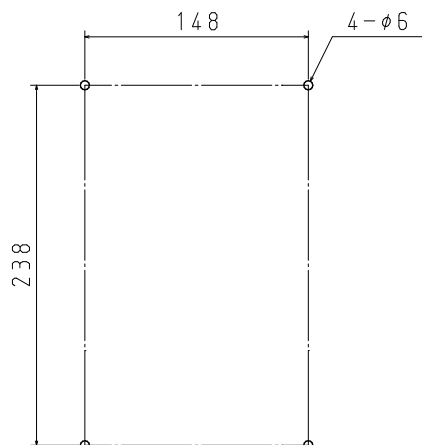


【 ⚠ Caution 】 Set up the MiruTEN in a cool place that is not exposed to direct sunlight. Using the product in a high-temperature environment will shorten its life.

● Installing the Remote Unit

① If installing directly

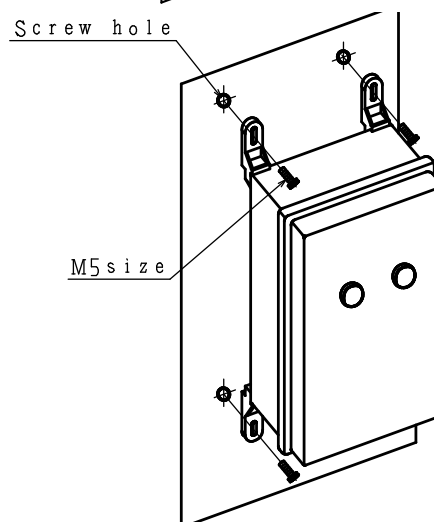
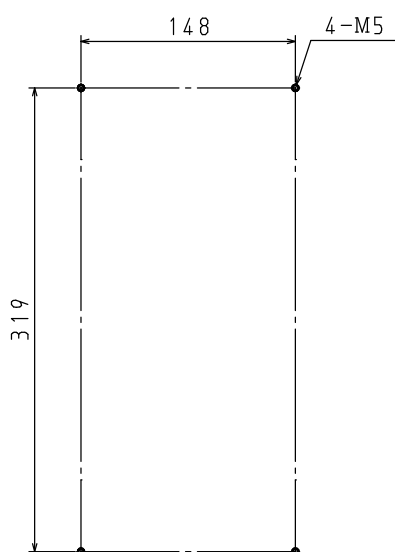
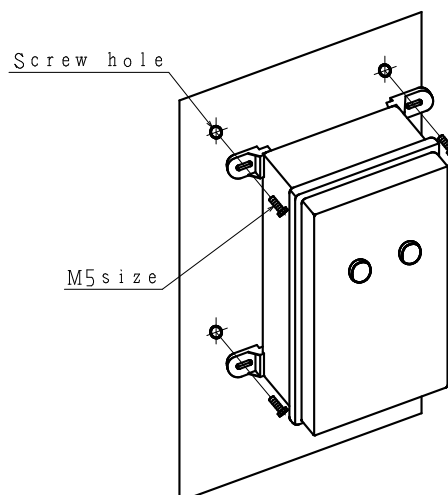
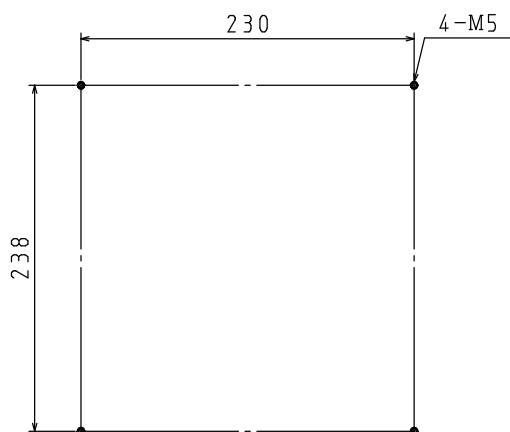
Prepare holes of the dimensions shown below and fix the Remote Unit form behind with screws. (The tap depth of the Remote Unit is 10mm.)



② Installing with fittings for wall mounting

Prepare holes of the dimensions shown below and fix the Remote Unit with attached wall mounting fittings from the front with screws.

(The thickness of the wall mounting fittings is 8.5mm)



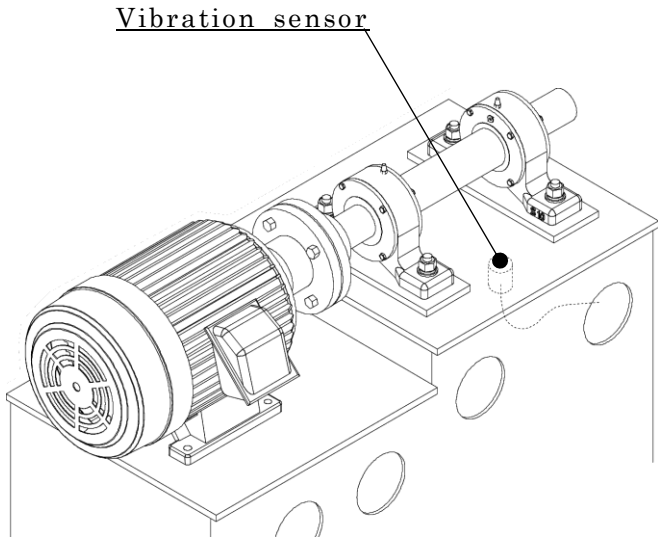
【 ⚠ Caution 】 Set up the Remote Unit in a cool place that is not exposed to direct sunlight. Using the product in a high-temperature environment will shorten its life.

(2) Fitting the sensors

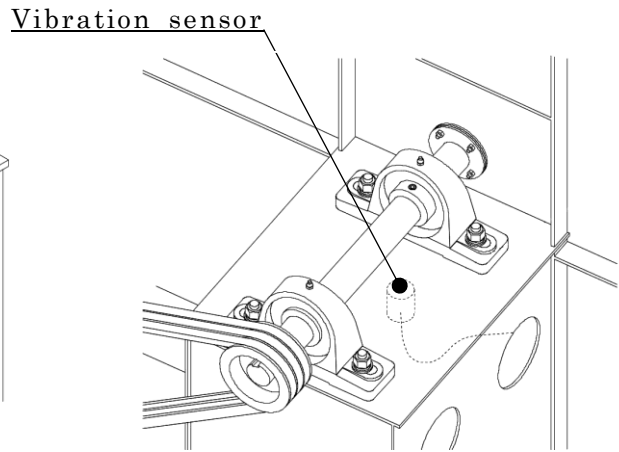
① Vibration sensor

Make a $\Phi 6.5$ hole in the bearing stand and secure the sensor surface shown with hatched lines tightly from underneath. (Optimum tightening torque is approx. $5N \pm 0.2$.)

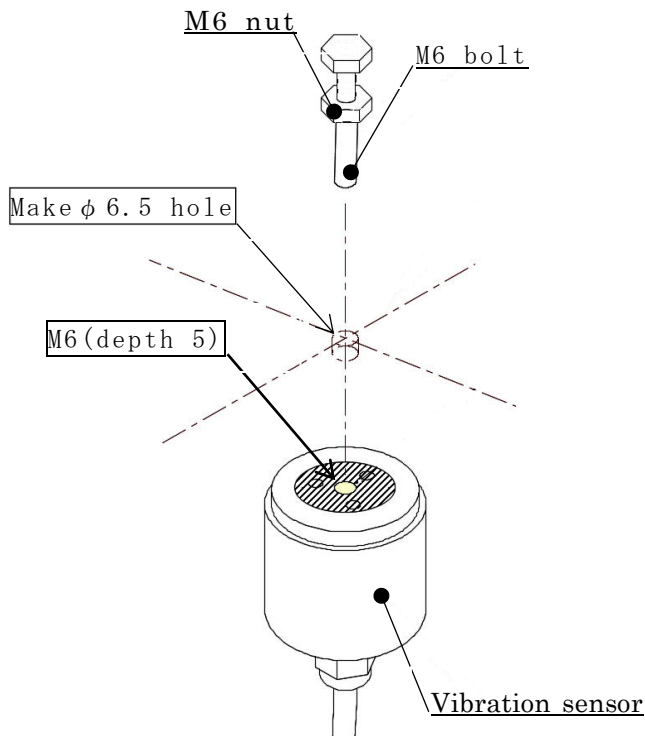
Install the sensor close to the bearing housing where resonance is not likely to occur. Fix the cable and connect it to the terminal block of the Remote Unit.



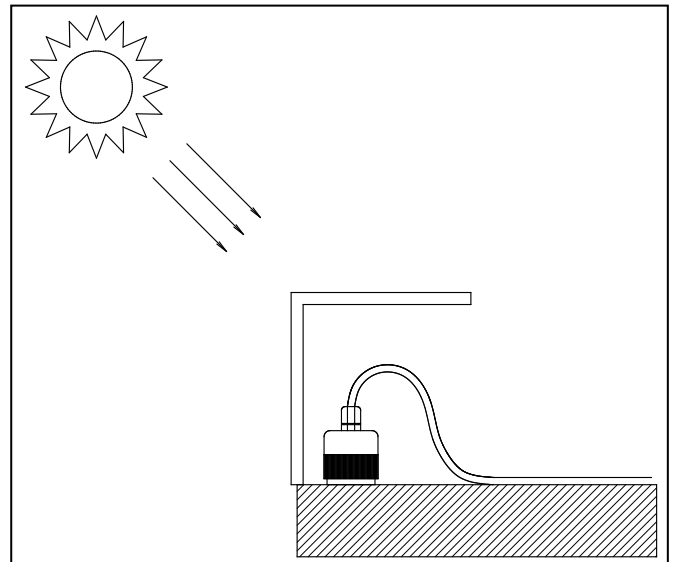
Coupling drive




V-belt drive

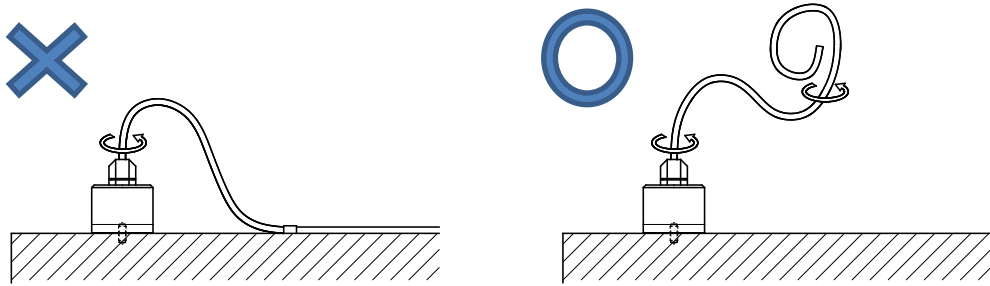



Details of fitting vibration sensor

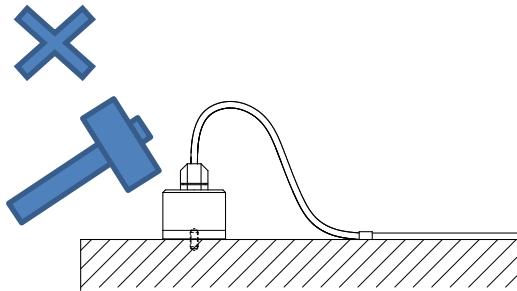


If the vibration sensor is positioned in a place that is exposed to direct sunlight, streaming water, or to external forces, make sure to take protective measures, e.g., fitting a protective cover.

 When fitting the vibration sensor, do not rotate the sensor itself while the cable is fixed. Otherwise, the cable may break. Always rotate the sensor body and cable together.



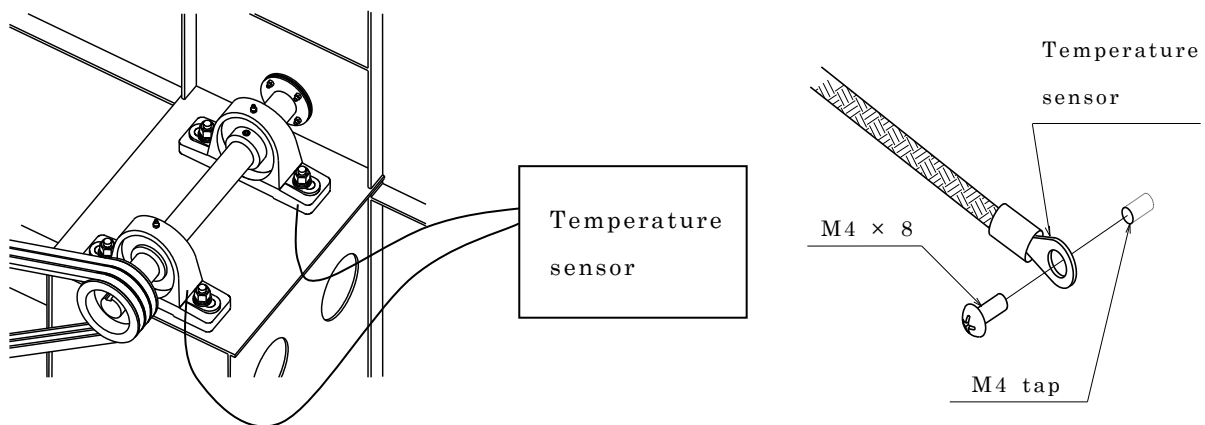
 This sensor is designed to detect minute vibrations. Excessive physical shock will ruin the sensor. Do not apply physical shock to the sensor to check that it is working.



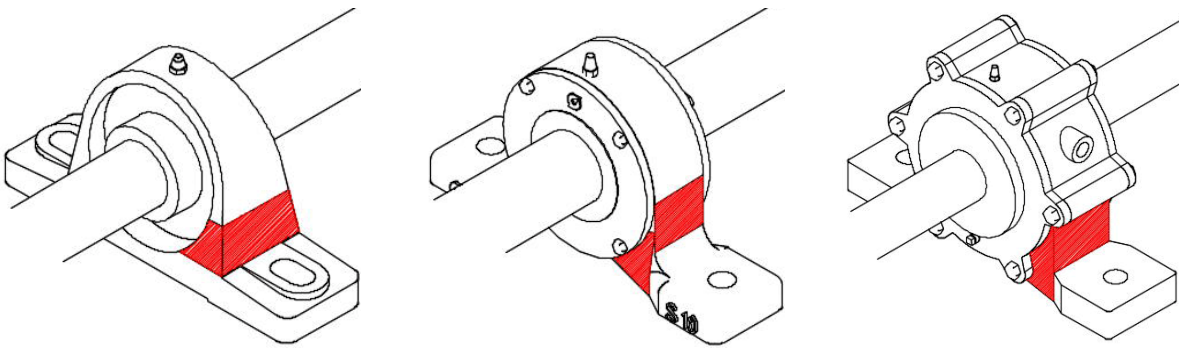
② Temperature sensor


Tap a hole in the bearing housing and fit the temperature sensor. Choose a position that allows easy transfer of heat from the bearing and where there is sufficient thickness for tapping a hole.

The temperature sensor is a Type K (CA) thermocouple, with a 2 m lead wire. To extend the lead wire use only a dedicated extension wire.



Details of fitting temperature sensor



Recommended position for temperature sensor ( part)



Take care to match polarity when connecting the temperature sensor.

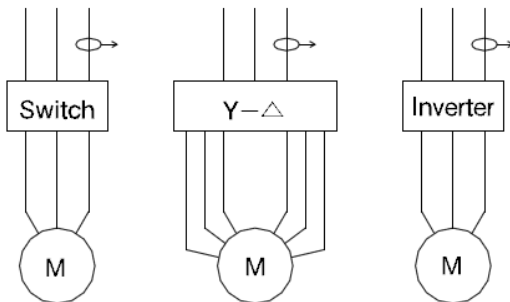


When tapping a hole in the bearing housing, take care not to penetrate through to the inside of the housing.

③ Current sensor

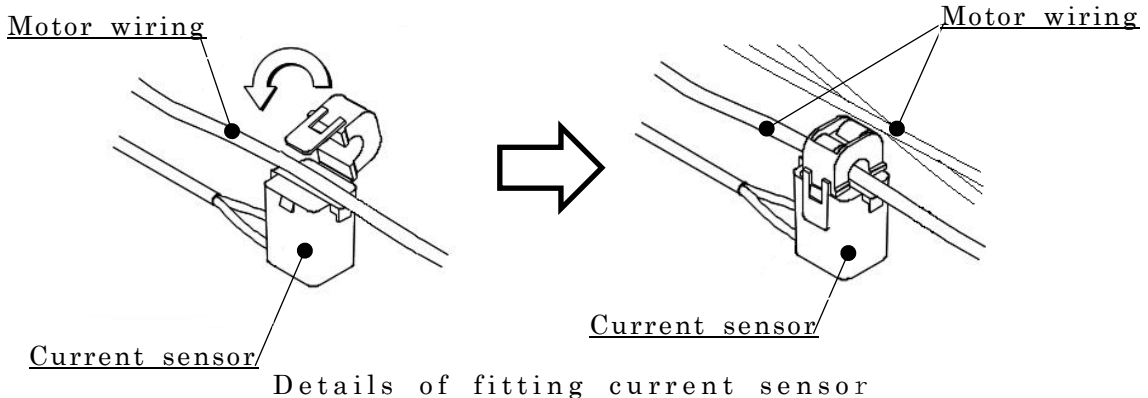
Fit the sensor by clipping one of the three motor wiring cables (R, S, T), as shown. For wiring, use 2-core signal wire of 0.75 to 2.0 mm².

When using a starting circuit (Y - Δ) or inverter, install the sensor on the primary side.



Current sensor wiring diagram

Current sensor is not water-resistant. Fit the sensor in a position where it is not exposed to water, e.g., in a motor terminal, box or switchboard.



Details of fitting current sensor



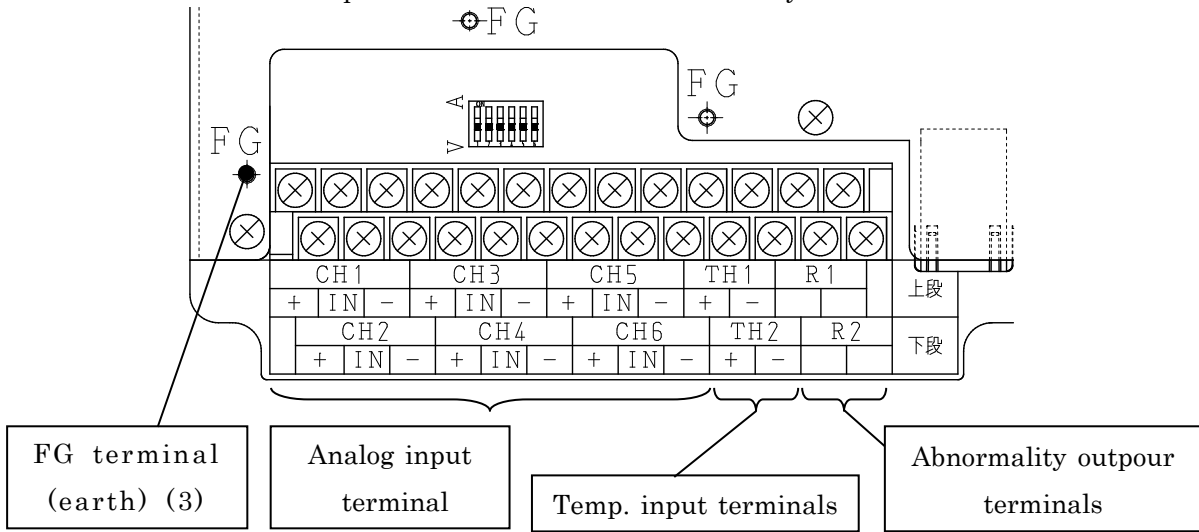
Signal wire for the current sensor must be provided by the customer.

Take care to match polarity when connecting the current sensor.

(3) Wiring of the Remote Unit

The terminal block, shown in the diagram below, includes 6 analog input terminals, 2 temperature input (Type K thermocouples) terminals, and 2 abnormality detection output terminals.

Also, to reduce the influence of electromagnetic noise, an FG terminal (earth connection) is provided for use when necessary.



① Wiring of analog input terminals

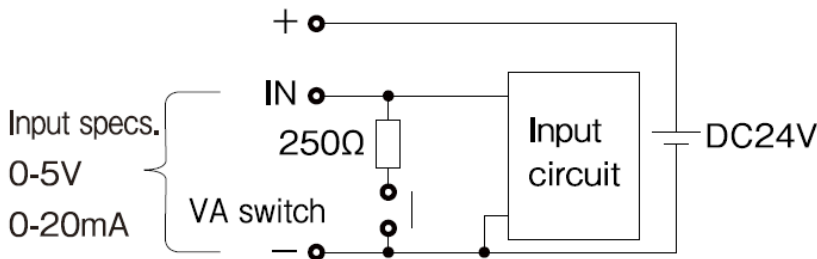
These are terminals for connecting sensors with analog output.

Vibration sensors, current sensors, and various other kinds of sensors can be connected, in accordance with monitoring objectives.

One set, consisting of three terminals, is called a channel (or "CH"). Six channels are provided, CH1 to CH6.

The function of terminals is shown by the circuit diagram below.

Terminal "+": 24V DC positive electrode
 Terminal "IN": Analog input terminal
 Terminal "-": 24V DC negative electrode; reference potential for analog input terminal



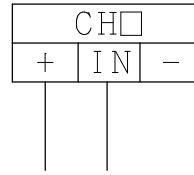
When performing wiring, always make sure the power supply is shut off, to avoid the risk of electric shock.

Analog input terminal circuit diagram

For details about the VA switch, refer to P19 (5) 1)
 "Analog CH input settings"

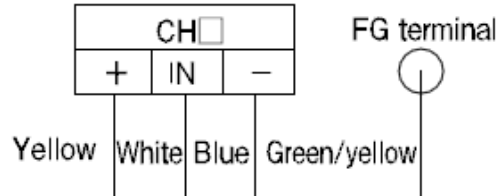
Some examples of sensor wiring connections are shown below.

- Connecting the vibration sensor VS-2502-□□ (*No polarity)
(Current output-type sensor)



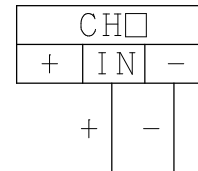
- Connecting the vibration sensor VS-V103-01 (3+1 lines)
(Voltage output-type sensor)

※ Take care not to make any wiring errors.



- Connecting the current sensor CTT-□□-CLS-CV (2 lines)
(Voltage output-type sensor)

※ Take care about the "+" and "-" polarities.



② Wiring of temperature input terminals

These terminals are for connecting temperature sensors (Type K thermocouples).

- Connect sensors to the "TH1" and "TH2" terminals.
- Take care to match polarity by connecting the "red" sensor lead wire to the "+" side and the "white" sensor lead wire to the "-" side.

③ Abnormality output terminals

The contacts "R1" and "R2" of the terminal block can each be used to convey signals associated with the occurrence of abnormalities.

They can be used to operate a buzzer or patlite, or as an abnormality input signal to the controller of a rotating machine.

These relay contacts (a contacts) can be connected to loads up to 250 V AC/5 A.

(4) Connection of network cables

The monitor (Base Unit) and Remote Unit are connected by a straight network cable (Category 5e or better).

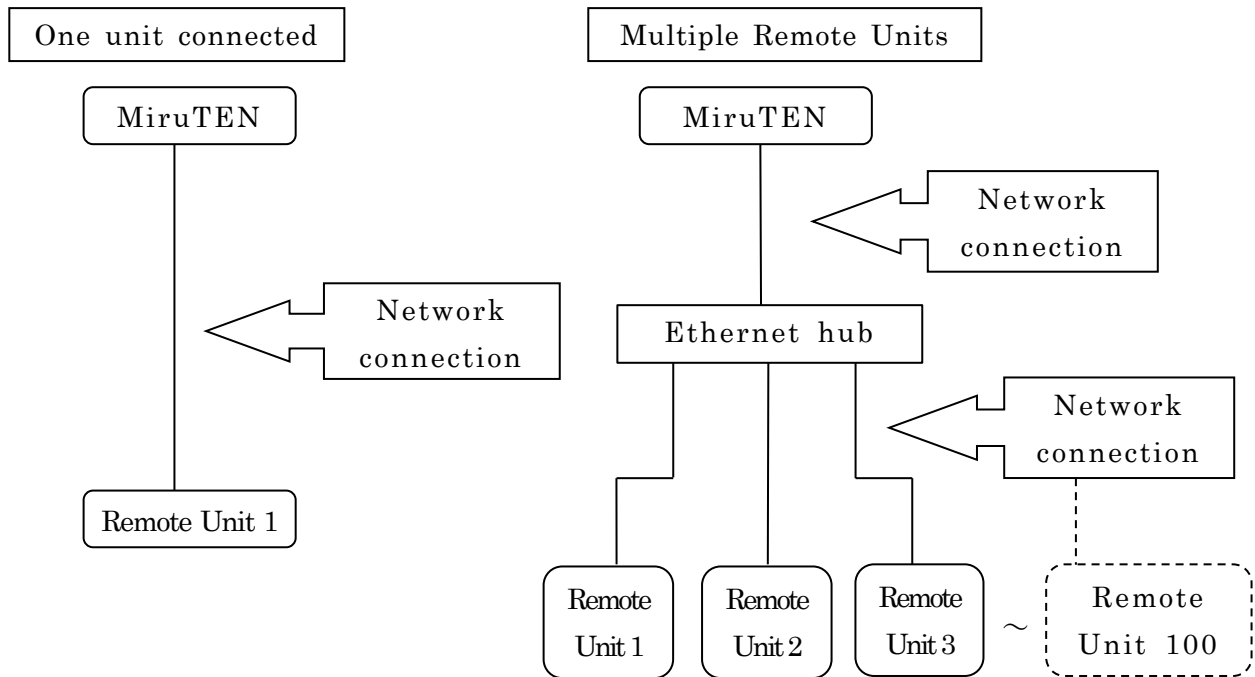
Network cables must be provided by the customer.

When connecting multiple Remote Units, they can be branched by inserting an Ethernet hub between the monitor (Base Unit) and Remote Units.

(Recommended hub : Diatrend DEH-TX8)

● Example connections

Make sure to use an Ethernet hub when connecting two or more Remote Units.

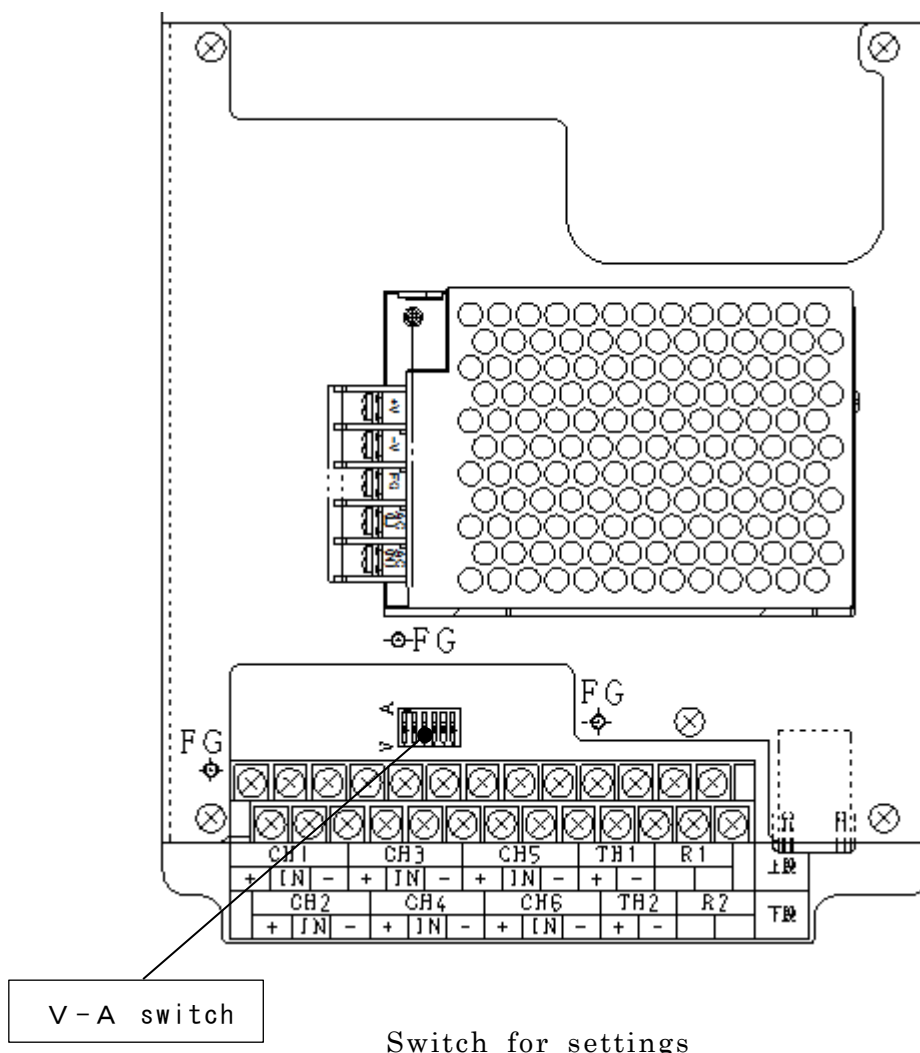


When using a wireless network for communication with this product, make sure to test operation in advance. If there is a high degree of electromagnetic noise or if there are other wireless networks in the area, communication may not work reliably.

(5) Remote Unit settings

In order to operate the Remote Unit correctly, it is necessary to configure settings for analog channel inputs. The settings are configured using the switches on the board.

To change switch settings use a precision screwdriver.



① Analog CH input settings

It is necessary to set the analog CH inputs of the Remote Unit to match the output specifications of the connected sensors. Settings are made at “VA switch”.

If the sensor output is a voltage output (0-5[V], 1-5[V]), set the switch to the “V (lower)” side. If the sensor output is a current output (0-20 [mA], 4-20 [mA]), set the switch to the “A (upper)” side.

The numbers written on the switch correspond to the CH No.

② Setting the IP address of the Remote Unit (Remote Unit No.)

Setting of the Remote Unit is performed using the “Browser settings.” (Refer to P. 21 or later page of the Instruction manual (Remote Unit Edition)).

After completing the settings, write down the Remote Unit No. in the “Remote Unit No.” field on the back of the box cover.

(6) Connecting the power supply

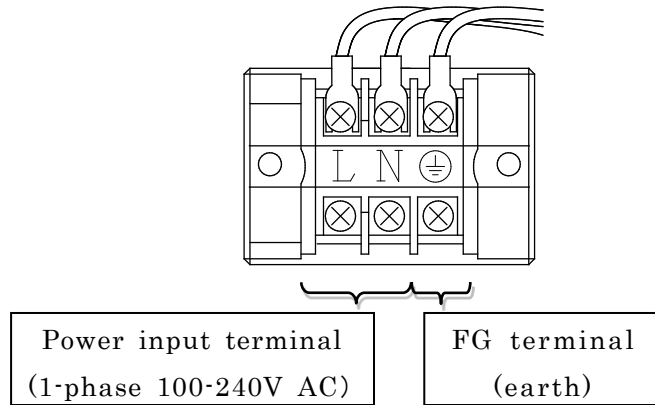
Connect the power supply cable (1-phase, 100-240 V) to each terminal.
Also, connect an earthing wire to the FG terminal (earth).

If an earth connection is not provided, malfunction may occur due to electromagnetic noise.

※ Power supply cable must be provided by the customer.

※ Make sure to connect the cables only to the designated positions.

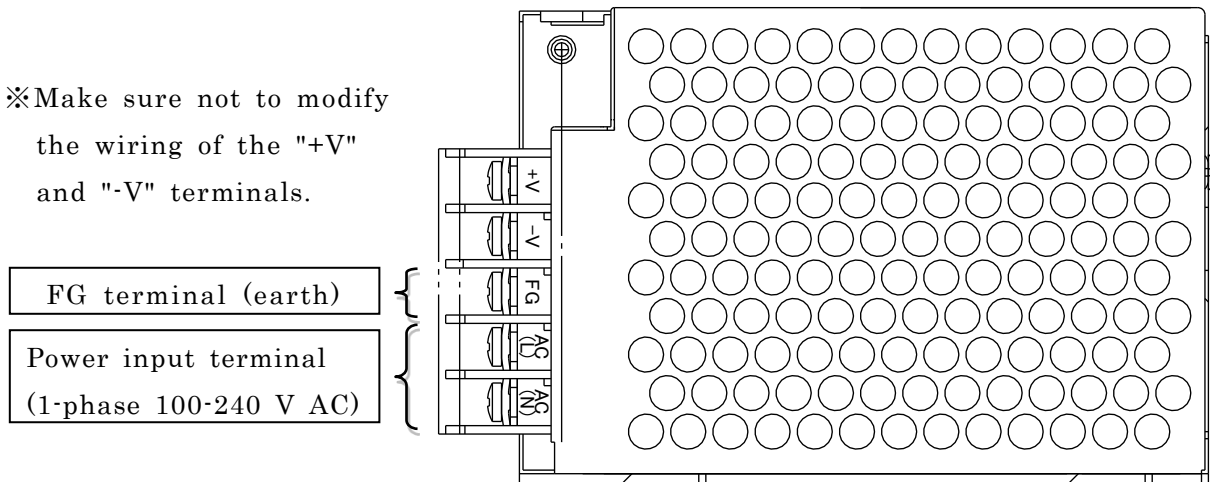
● MiruTEN



Power supply connection diagram (inside the MiruTEN)

● Remote Unit

※ Make sure not to modify the wiring of the "+V" and "-V" terminals.



Power supply connection diagram (inside the MiruTEN)



Warning

When performing wiring connection work, always shut off the power supply, to avoid the risk of electric shock.

After completing the work, replace the terminal cover as it was.

(7) Setting up the MiruTEN

After setting all the Remote Units, set the MiruTEN.

Details are provided on P25.

5. Using a Standard monitoring Set

"Standard monitoring" means monitoring equipment using a combination of sensors recommended by Showa Denki.

This method simplifies the setup process and allows threshold values to be set automatically.

The combination of sensors needed for one rotating machine is as follows.

- Vibration sensor 1
- Temperature sensor 1
- Current sensor 1

Up to two rotating machines can be connected to one Remote Unit for monitoring. The setup procedure is the same as that given in "4. Guidelines for installation", but there are some cautions to note. Check the following points before commencing work.

Cautions

● Wiring Remote Unit terminals

Connect each sensor to following channels.

First monitored item (Unit1)

- Vibration sensor : CH1
- Current sensor : CH2
- Temperature sensor : TH1

Second monitored item (Unit2)

- Vibration sensor : CH4
- Current sensor : CH5
- Temperature sensor : TH2

● Automatic setting of threshold values

(For details about threshold values, see "3. Setting threshold values" on P10)

Threshold values are set automatically based on the results of measurements of operation of the item initiate communication between the MiruTEN and Remote Unit.

(It takes about two hours of communication before the threshold values are Automatically set.)

※ Before performing automatic setting make sure to check that the item of equipment is operating normally. If threshold values are set automatically while the equipment is operating abnormally, the threshold values will not be appropriate.

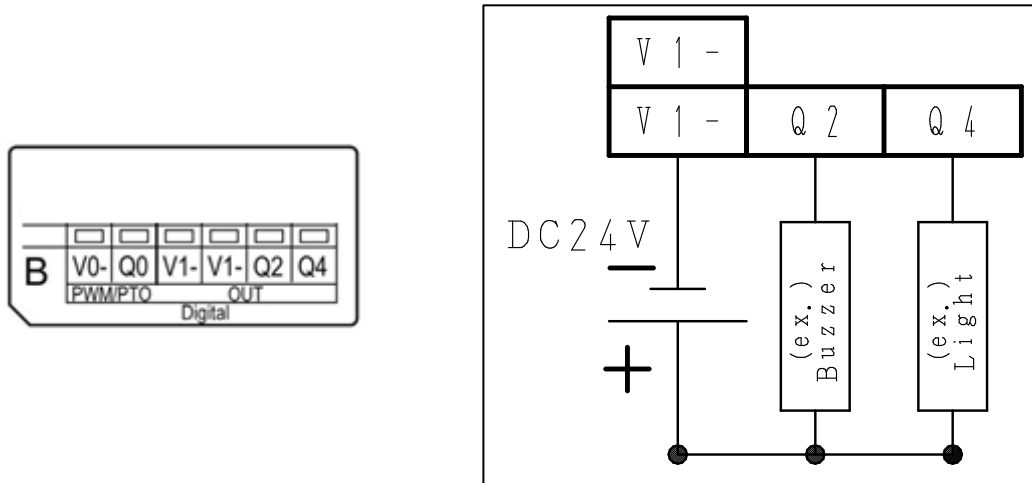
If the vibration value of the monitored item of equipment is high, an abnormality may be detected immediately after the threshold value is automatically set. If this happens, check that there is no problem with the equipment and then reset the threshold value manually. (See P26)

6. Output terminal of MiruTEN

Use the output terminal of the device in MiruTEN (back of the touch panel) to activate the DC24V driven lamp, etc.



Detailed view of the terminal (left) and wiring (right) is shown below.



※Note: Please prepare the power source (DC24V) separately.
The lights and buzzers are not included.

● Connection to the terminal

Please be sure to use a precision screwdriver. Connection procedures are as follows.

• Connection procedures

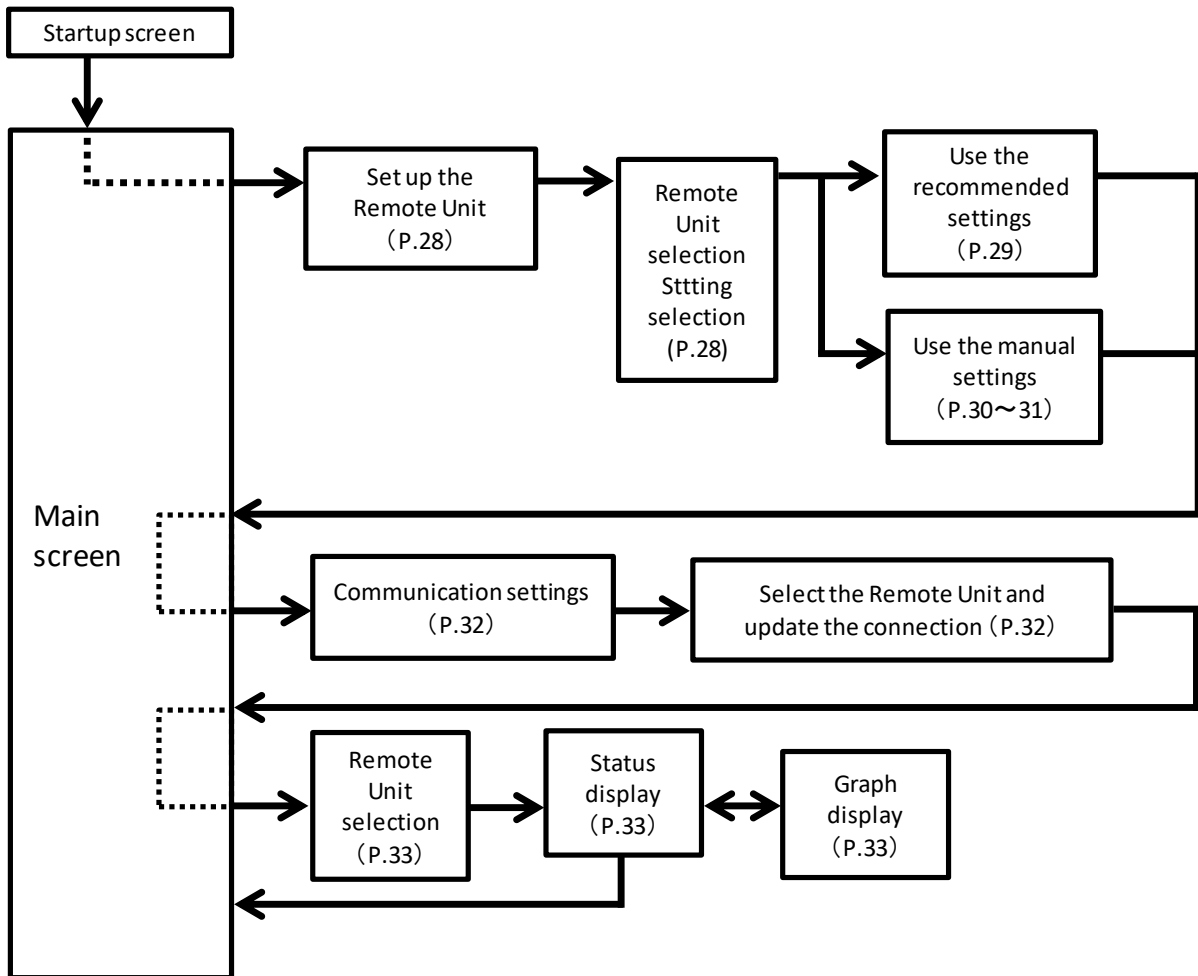
- ① Insert the screwdriver into the terminal hole. (Orange part of the terminal)
- ② With the screwdriver inserted as is, insert the electrical wire. (○ hole)
- ③ After the electrical wire is firmly inserted, remove the screwdriver.

※NOTE 1. Use 0.20 - 0.81mm² (AWG 24 - 18) electric wire.
2. Peel off only 7.0mm of the electrical wire coating.

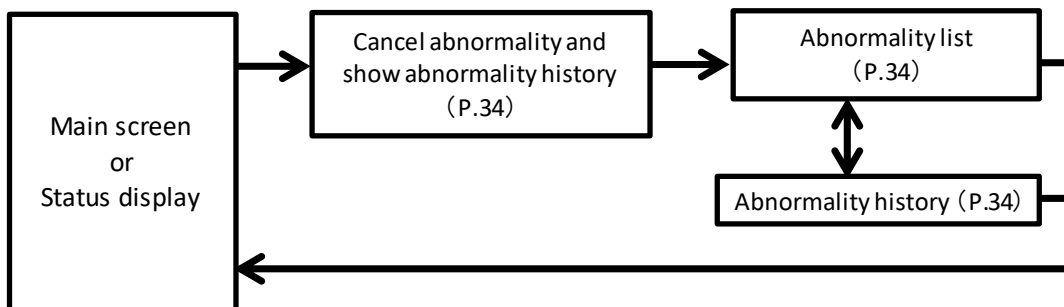
7. Operation method

MiruTEN (FCM-BM2PT)

● Product setting and screen flow



● Abnormality confirmation screen



(1) MiruTEN start up screen

When power is turned on for MiruTEN, the start-up screen is displayed. The screen changes to the main screen shown below (start-up takes 30 seconds).

Current time and date are displayed.

Main screen



Starts and stops monitoring of the connected Remote Unit (P.32)

Abnormality detected by the Remote Unit can be confirmed (P.34)

Various data is stored and read in the USB drive connected to MiruTEN (P.35)

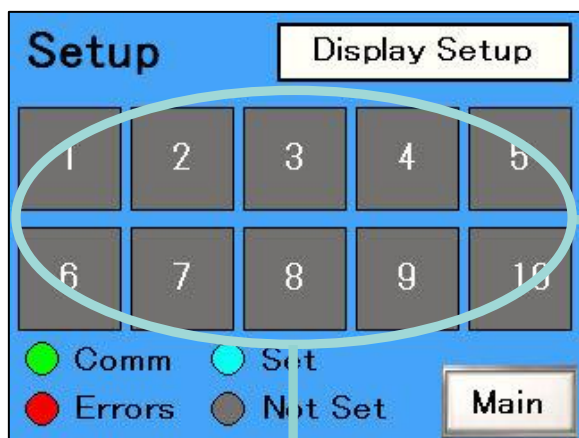
Sets the Remote Unit and MiruTEN (P.28)

- Current status for each Remote Unit No. is displayed.
 - Gray** : Remote Unit settings are not specified.
 - Blue** : Remote Unit settings are completed, but monitoring is not started.
 - Green** : MiruTEN is monitoring the Remote Unit according to the set condition.
 - Red** : Remote Unit has detected an abnormality. Please check it immediately.
(The number of a Remote Unit set with the recommended settings is displayed as white, and the number of the Remote Unit set with the manual settings is displayed as black. Refer to P.29 - P.31 for recommended settings or manual settings)
- When the Remote Unit in communication is selected, the status of the Remote Unit can be confirmed (P.33)

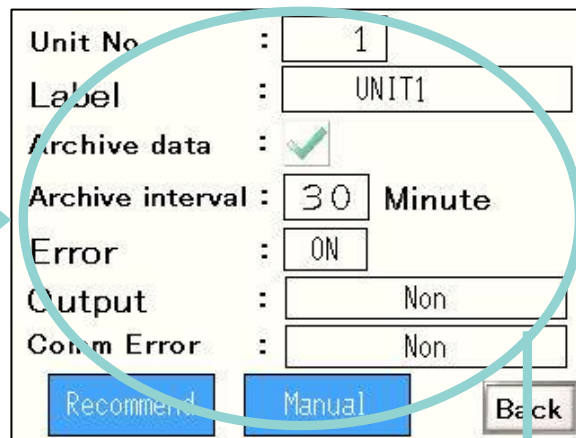
(2) Setting screen

To set the Remote Unit to be monitored (indication of abnormality values, etc.)
Touch "Settings" on the Main screen (P.27) and proceed to the settings menu as shown in the following figure.

Settings screen (Main)



Settings screen (Remote Unit)



Select the number of Remote Unit to be set

Initial settings of the IP address are as follows.

To change the IP address, refer to P.39.

MiruTEN : 192.168.0.150

Remote Unit : 192.168.0.1

Remote Unit No.

- Set the number of the selected Remote Unit.

Name of the Remote Unit

- Set the name of the selected Remote Unit.

Data save

- Save the collected data in the USB drive in CSV format. When saving data, connect to the USB drive, and check the check box.

Saving cycle

- Set the interval to "save data."
- If the saving cycle is 1 min, the data volume of the file will reach capacity in approx. 5 hours. Subsequently, a new file will be prepared every five hours. The saving cycle of the data and the interval of preparing a new file is shown below.

Saving cycle	1 min.	5 min.	10 min.	30 min.	60 min.
File Preparing interval	5 hours	25 hours	50 hours	150 hours	300 hours

External output

- Set the point of contact (on MiruTEN side) to be activated when the Remote Unit detects abnormality.

Communication error

- Set the contact (on MiruTEN side) to be activated when communication error occurs with the Remote Unit.

Recommended settings

- Set each channel of the Remote Unit using the recommended settings (P.29).

Manual settings

- Set each channel of the Remote Unit using the manual settings (P.30 - P.31).

(3) Recommended settings

This function measures the operational conditions of the rotating machinery, and automatically sets the threshold of the Remote Unit, according to our recommended method.

For the recommended settings, conditions of standard monitoring (P.24) must be satisfied. Moreover, abnormality judgment is not performed for two hours after the communication begins.

Recommended settings screen

When "Monitoring" is selected, the input items are displayed.

UNIT 1

Rated current 12.0 [A]
No-load current 1.2 [A]
Normal op temp 34.0 [°C]
Current sensor type 5A:CTT-10-CLS-CV-5
Vibe sensor used VS-V103-01

Back Next

Rated current

- Enter the rated current of the machine to be monitored.

No-load current

- Enter the no-load current of the machine to be monitored.

Ambient temperature at normal operation

- Enter the ambient temperature when the monitored machine operates normally.

Current sensor type

- Select the type of current sensor to be used.

Vibration sensor type

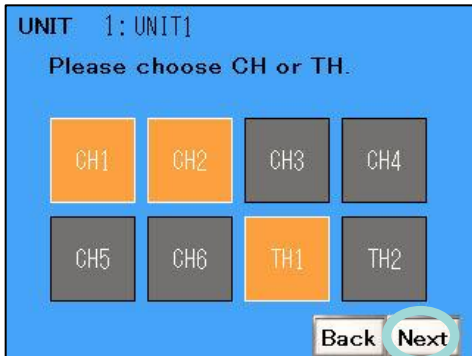
- Select the type of the vibration sensor to be used.

- ※The recommended settings are based on the premise of monitoring the air blower manufactured by our company.
- ※The recommended settings monitor normal operations of the rotating machinery, and set the Remote Unit based on these. Turn on the device to be monitored first, then confirm that each value are normal for at least two hours after starting communication with the Remote Unit. (When an abnormality is detected within two hours after communication begins, the abnormality value will be set as the normal value, afterwards)
- ※In the recommended settings, the threshold values of the operation time are automatically set at 1800 hours.
(Monitor 1 counts the operation time of CH2, Monitor 2 counts the operation time of CH5.)

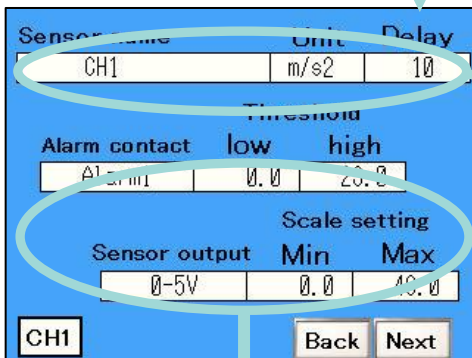
(4) Manual settings

Detailed settings of each sensor are set manually.

Manual settings screen



- Select the channel connected to the sensor in the Remote Unit.
- Press the "Next" button to set each selected channels individually.



Name

- Enter the name for each channel.

Unit

- Enter the unit for the value to be displayed.

Delay time

- Enter the time (0-120seconds) .
(For delay time, refer to P.12)

Abnormality contact

- Set the point of contact (Remote Unit side) to activate when an abnormality is detected.(For contact, refer to P.20)

Threshold value Lower limit Upper limit

- Set the threshold value (P.10) which will be the standard for abnormality judgment. If "0" (zero) is entered for the lower limit, abnormality judgment is not performed for the lower limit.

Sensor output

- Set the analog output of the sensor connected to the Remote Unit.

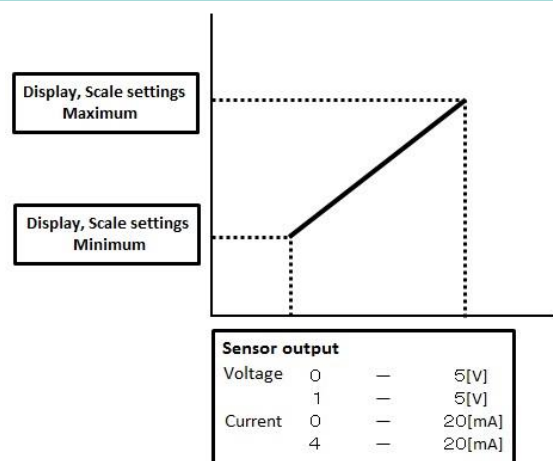
Scale settings Min Max

- Enter the minimum / maximum value of the sensor connected to the Remote Unit.

Lower and upper measurement limit values of the sensor

- The measurement value of the sensor is proportional to the output of the sensor itself.

For example, when a sensor with minimum output of 0 V, maximum output of 5V, and a measurement range of 0 to 100 is used, detection is carried out when voltage is 0V, 0 is determined as the measurement value, if it is 2.5V, measurement value is set at 50, when 5V, measurement value is set at 100.

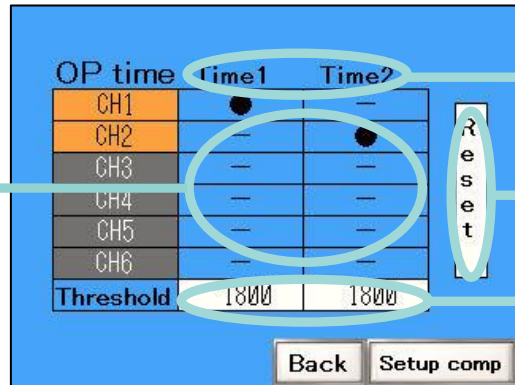


Operation time of the device is counted, and time of inspection and parts replacement is notified.

Check "●" for the channel to count operation time.

Every time monitoring begins, operation time is counted from the previous time.

Settings screen for operation time



The operation time of up to two channels can be counted simultaneously per one Remote Unit.

Long press "Reset" more than two seconds.

Set the time for notification.
(Default condition is 1800 hours)

Select the channel to monitor the operation time.
(Temperature sensor cannot be selected.)

- ※ The count of the operation time at the initial settings is "0 and higher" (if sensor connected to the Remote Unit reacts just a little, judgment of in operation is made).
(Settings can be changed by the touch panel settings (P.38))

(5) Start/stop of the monitoring of the Remote Unit

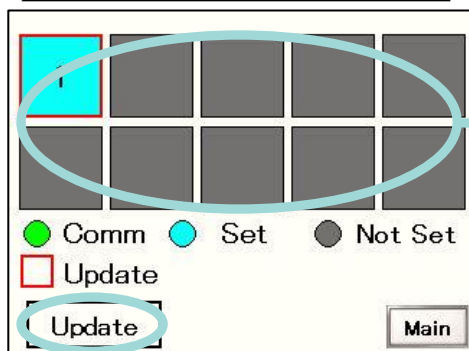
Monitoring of the Remote Unit can be started based on the set conditions. Moreover, the monitoring Remote Unit can be discontinued. Select the "Communication" button from the Main screen (P.27) and proceed to the screen.

Main screen



- Press the "Communication" button on the Main screen and go to the connection update screen.

Connection update screen



Select the Remote Unit No. to start/stop the communication. The selected number is framed in red.

After selecting the Remote Unit, press the "connection update" button. The "Set already" Remote Unit will be "in communication (start monitoring)" and a Remote Unit "in communication" will be in the "Set already" condition (monitoring stop).

< What to do if communication with the

Remote Unit is unintentionally cut >

If communication with the Remote Unit is unintentionally cut (during monitoring), the Remote Unit will automatically switch to single monitoring condition. After switching to single monitoring condition, reconnect the communication at the Base Unit side. Measurement data from single monitoring is stored in the main unit.

(6) Display of Remote Unit status

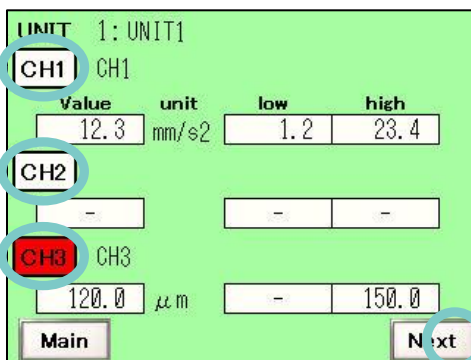
When the Remote Unit in communication is selected on the main screen (P27), each data of Remote Unit such as measurement values and operation time can be confirmed.

Main screen



- Select the communicating Remote Unit No. (displayed in green) on the main screen.

Remote Unit status screen



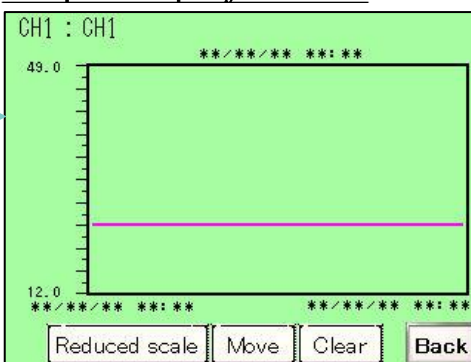
- When the Remote Unit No. is selected, the graph is displayed.

Operation time confirmation screen

UNIT 1: UNIT1	OP Time 1	OP Time 2
CH1	18	—
CH2	—	—
CH3	—	23
CH4	—	—
CH5	—	—
CH6	—	—
Threshold	1800	1800

- Operation time which was previously counted can be confirmed.

Graph Display Screen



Reduced scale

- Enlarges or minimizes the graph.

Move

- Moves the display range of the graph. A cross line is displayed on the touched position while moving, and can be used as an auxiliary scale mark.
- The position of the cross line (time) is displayed on the upper part of the graph.

Clear

- All collected data of the Remote Unit which is not saved (all channels) is deleted.

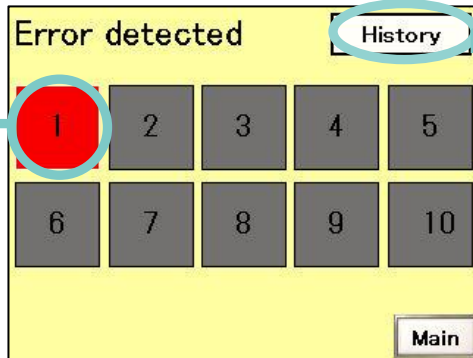
Graph display

- The red lines in the graph show the upper/lower limit threshold values.
- The plot interval of the graph is the same as the saving time interval (P.28).
- The vertical axis of the graph will be the minimum and maximum of the scale settings on P.30.
- To display the graph a USB drive is needed.
- When "Data save" on the setting screen (P.28) is off, the graph is not displayed.

(7) Display of the abnormality details and abnormality history

If an abnormality is detected, the screen is switched to abnormality occurrence screen. (The screen can also be displayed by pressing the "Errors" button on the main screen (P.27).) The Remote Unit (CH) on which the abnormality is detected is displayed in red until the abnormality is cancelled.

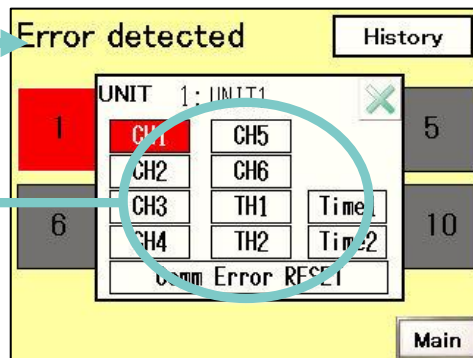
Abnormality occurrence screen



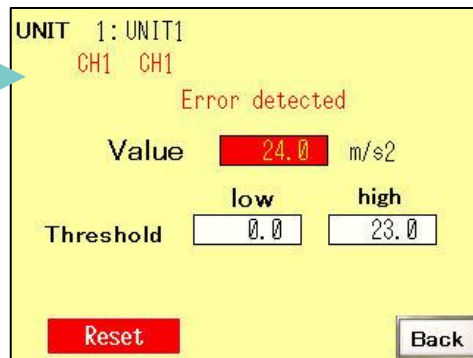
Abnormality history

Switch to the Abnormality History screen

- Select the Remote Unit (displayed in red) that detected the abnormality.

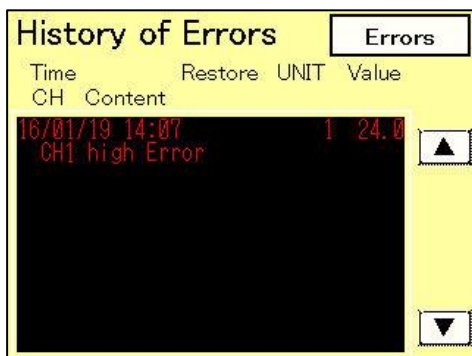


- To display the status of the Remote Unit, select the Remote Unit No. Then select the channel that detected the abnormality.



- After correcting the cause of the abnormality, reset the abnormality.
- To reset the abnormality, long press "Reset" for at least two seconds. (A beep sounds to indicate reset.)

異常履歴画面



- The detected abnormality is displayed in chronological order. (CH (details) for non-cancelled abnormalities are displayed in red)
- A maximum of 500 items can be stored in the abnormality history, and data is deleted from the oldest data.

(8) – 1 Saving and reading data to and from the USB drive

CSV data of measurement values collected during monitoring of the Remote Units, saving of the settings for all Remote Units, and reading of previously-saved setting data of Remote Units is possible.

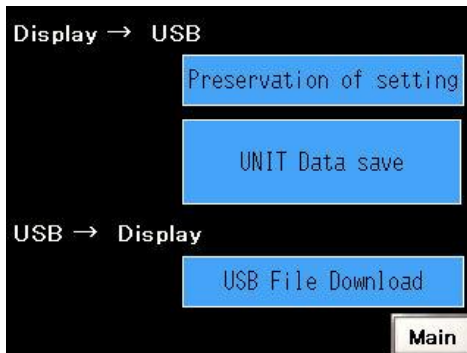
(CSV data of measurement values collected during monitoring of the Remote Units, are automatically saved when communication is complete (monitoring discontinued), and does not need to be saved manually.

Main screen



- Press the "USB" button on the main screen (P.27) to display the USB data processing screen.

USB operations screen



Saving Remote Unit settings

- Save the current settings of all Remote Units to the USB drive.

Saving communication data of the Remote Unit

- CSV data of collected measurement value including the abnormality history saved in the memory of the main unit and monitoring Remote Unit are saved on the USB drive.

Reading of the Remote Unit settings

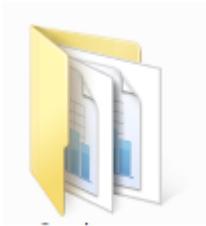
- To read settings of the Remote Unit which have been saved by "Saving Remote Unit settings"



Before removing the USB drive, make sure communication with all Remote Units has been discontinued, or wait until "USB saving complete" is displayed. If a USB drive is removed during communication, data loss or corruption may occur.

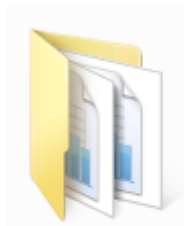
(8) – 2 Data in the USB drive

CSV data, abnormality history, and Remote Unit settings are saved in the following folders.



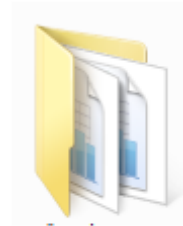
ALARM

ALARM folder
Abnormality History
is saved.



SAMP01

SAMP folder
Collection data is saved.



FILE

FILE folder
Remote Unit settings
are saved.

- CSV data is saved in the folder in the numerical sequence "SA00000.CSV" – "SA65535.CSV". When the upper limit is reached, data is overwritten from the oldest number.
(At a saving interval of 1 minute, overwriting would occur after 37 years.)
- 300 pieces of data can be saved in one file.
- Besides the above-mentioned, data for MiruTEN graph display, etc. are also saved.

※Files stored in the USB drive

Files (folders) saved in the USB drive can be confirmed from PC,
without removing the USB drive.

(Refer to P.37 for details)



Warning

If the case cover is opened while the power is on,
do not allow dirt, dust, or water inside the device,
to avoid electric shock and fire.



Warning

To avoid unexpected accident such as electric shock
and fire, do not place your hand inside the case
body when removing the USB drive.

● How to confirm collected data by PC

Files (folders) on the USB drive connected to MiruTEN can be confirmed by a PC connected to the same network.

Procedures

① Connect the PC to the same network as MiruTEN.

(ex.) For a MiruTEN IP address: 192.168.0.150,
Set the IP address of the PC as "192.168.0.123".

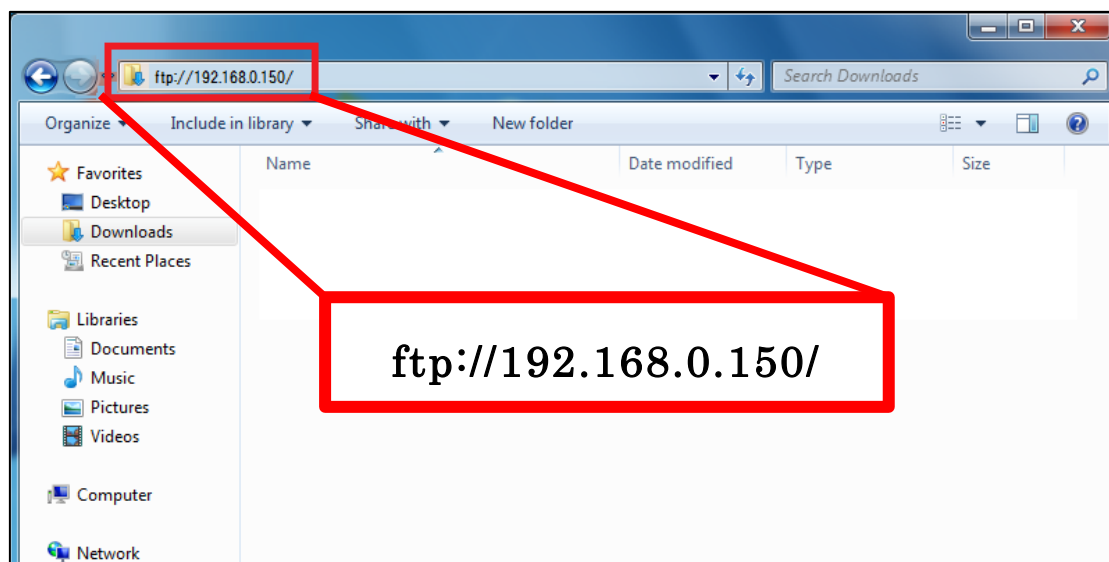
② Open "Start"→"Computer".

③ Enter "ftp://192.168.0.150/" in the address frame.

The default IP address of MiruTEN is "192.168.0.150".

The IP address of MiruTEN can be confirmed on the "Touch panel No. (IP address)" on the screen by pressing the main screen (P.28) → "Settings" button → "Touch panel settings" button. (refer to P.38))

④ Press "Enter" when input is complete.

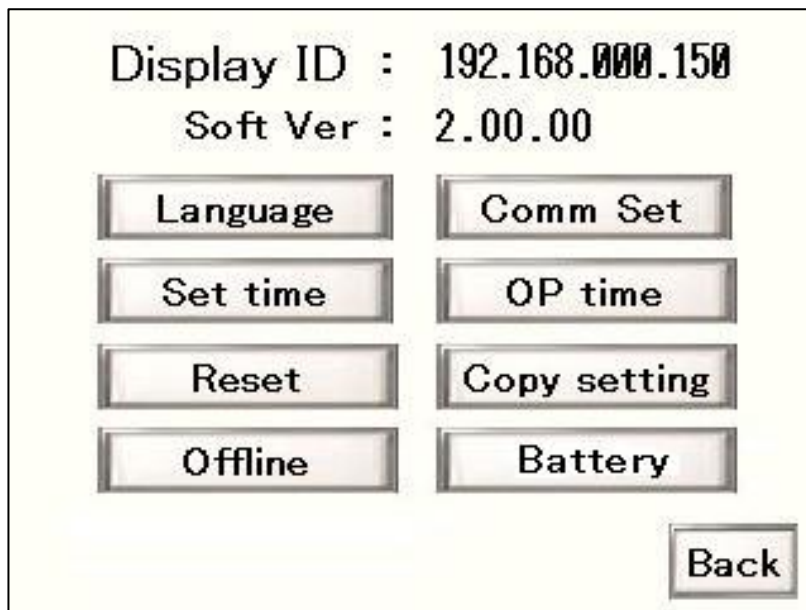


(9) MiruTEN main unit settings

Settings of the Miru-TEN main unit can be changed.

Select "Touch panel settings" from the settings screen (P.28).

Miru-TEN settings screen



Language

- Choose the operating language from "Japanese / English."

Communication setting

- When communication between MiruTEN and a Remote Unit is discontinued, the time to automatically reconnect can be set. Set the time (1min - 10min.) (Default setting is 2min.)

* While communication is off, values just before communication is discontinued are saved as log data.

Time setting

- The clock in MiruTEN can be set.

Operation time

- Conditions to count operation time can be set.

For "0 and higher", count is carried out only when the detection value of the sensor was 0 and higher (during operation).

For "Constant", count is always carried out while the Base Unit and the Remote Unit are communicating (monitoring).

Restart

- Restart MiruTEN.

All communication is cancelled, CSV data of Remote Unit in communication is not saved.

Diversion setting

- Settings of a Remote Unit are copied to another Remote Unit.

Off-line

- The IP address of MiruTEN and that of the Remote Unit (communication partner) can be changed.

Battery

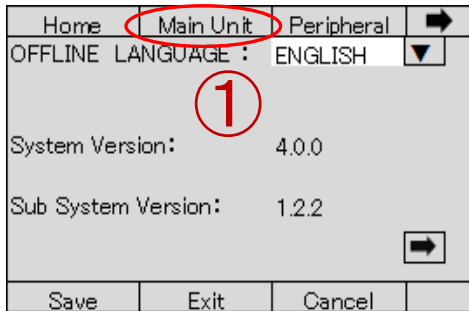
- Battery condition can be confirmed.

* The product includes a built-in battery for the clock function. As the battery nears its end of life, the error message: "Replace battery" will be displayed. For inquiries regarding battery replacement, contact your sales agent or our company.

8 . How to change IP address of MiruTEN and the RemoteUnit

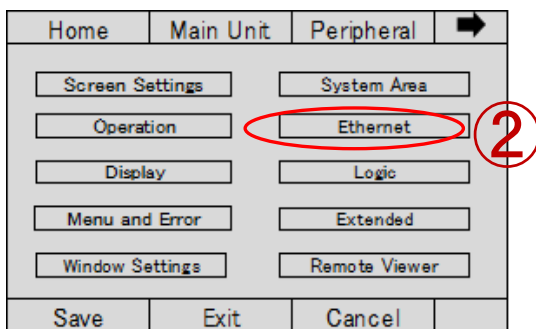
Open the settings screen by pressing "Offline" from the "MiruTEN settings screen" on P.38.

To set the IP address, carry out the following procedures.



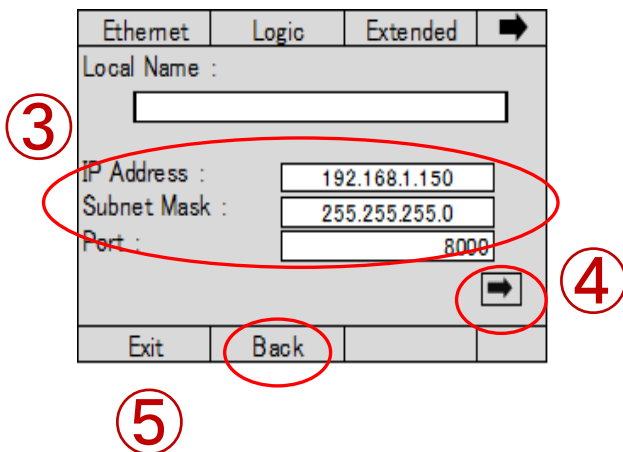
1. When the "Offline" button is pressed, this screen is displayed.

- ① Touch
"main unit".




2. When the "main unit settings", screen is touched, the screen on the left is shown.

- ② "Ethernet".



3. When the "Ethernet settings" is touched, the screen on the left is shown. Here,

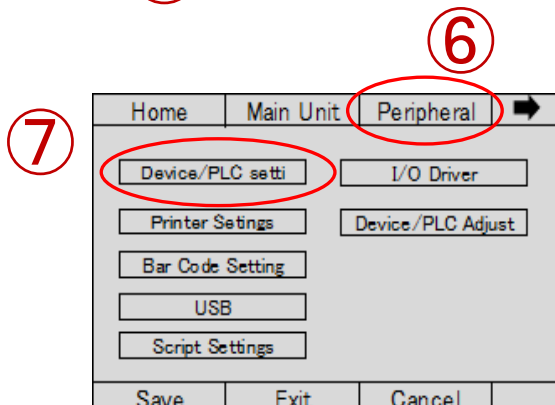
③ IP address of MiruTEN and the subnet mask can be set.

④ To set the default gateway, press  and go to the next screen.

After input is completed, press ⑤ "Back" button once.

※ Do not change other settings.

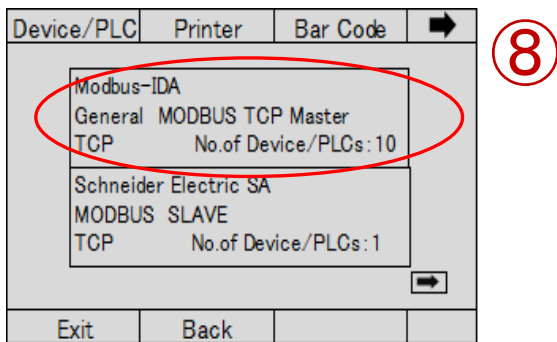
To do so may disrupt communication.



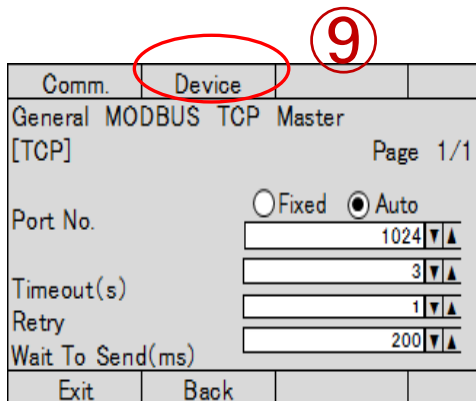
4. After pressing "Back", touch ⑥ "Peripheral device" in the upper right of the screen.

The screen on the left is shown.

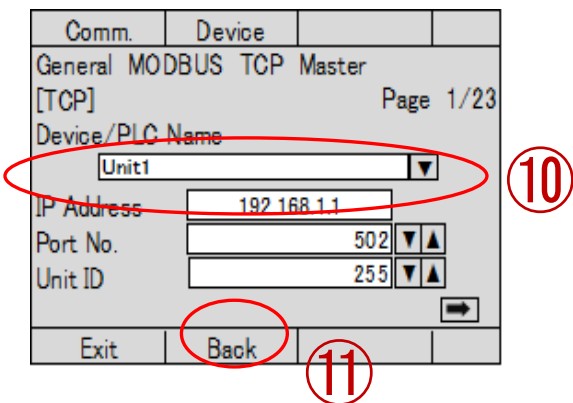
Touch ⑦ "device/PLC setti".



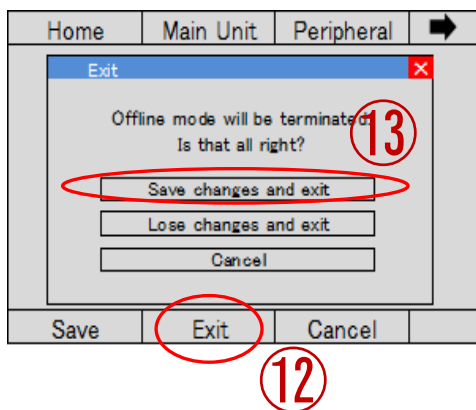
5 . When the screen shown on the left is displayed
 ⑧ touch
 "Modbus-IDA General –purpose
 MODBUS TCP master TCP
 Number of connected devices:10".



6 . ⑨Next, touch
 "Device"



7 . The IP address of the Remote Unit
 can be set on this screen.
 ⑩Select the Remote Unit No. by
 pressing "▼" on the right of
 "Name of the
 connected device",
 and enter the IP address of
 each number.
 ⑪After input is complete, press
 "Back" two times.



8 . Finally press ⑫ "Completed"
 button.
 When the display shown on the left
 appears, press ⑬ "Save changes and
 complete".
 The entered contents are saved and
 MiruTEN will restart.

9. Initialization of the Remote Unit

The following items can be returned to default settings.

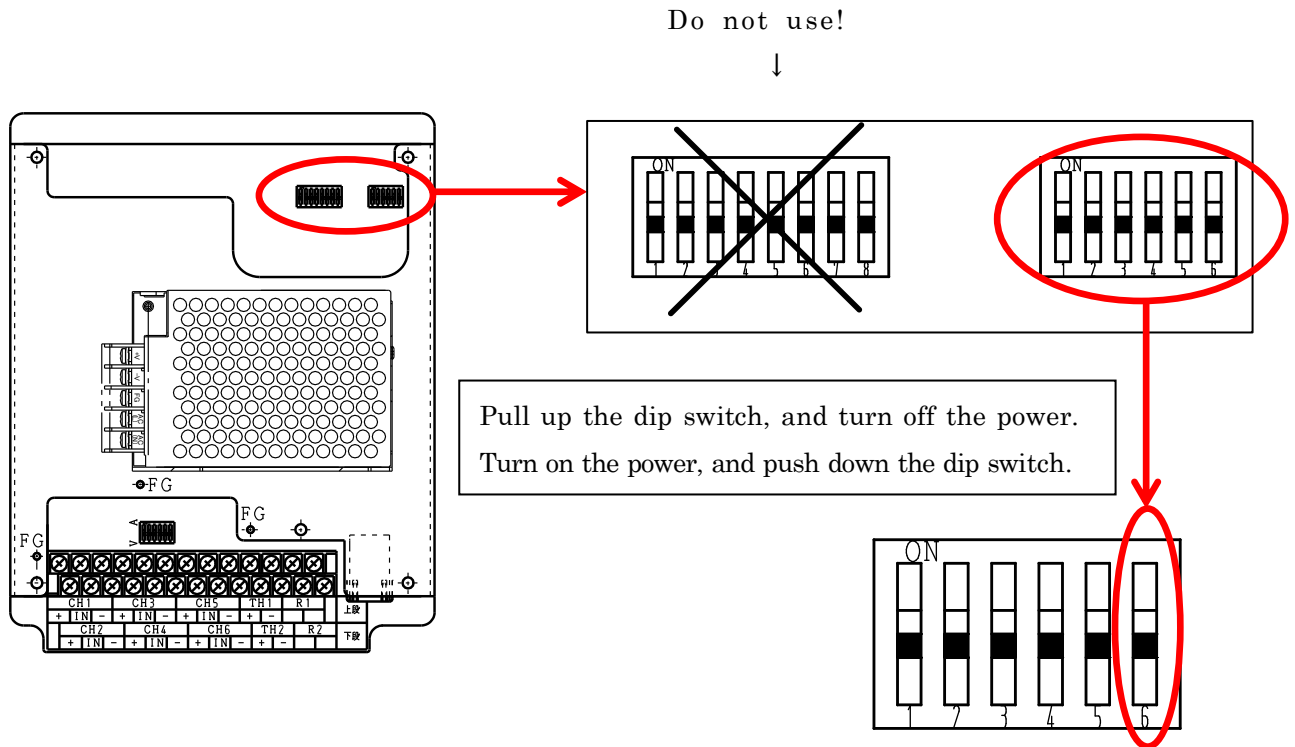
- 1 . IP address : 192.168.0.1
- 2 . Subnet mask : 255.255.255.0

Contents of other settings are not initialized.

Carry out initialization according to the following procedures.

[Initialization method]

- ① Turn on the power to the Remote Unit.
- ② Pull up the rightmost dip switch at the upper right of the Remote Unit circuit board (refer to the following diagram)



- ③ Turn off the power, and then turn it on again 2, 3 seconds later.
- ④ When the dip switch is pushed down again, initialization occurs.

10. Determining the Causes of abnormality

Examples of causes of abnormality	Vibration	Load-side Bearing temp	Drive-side bearing temp	Under current	Over current
Too little or too much grease		○	○		
Wrong type of grease		○	○		
Abnormal load		○	○		○
Misalignment	○	○	○		○
Bearing damage, bearing life	○	○	○		○
Contamination	○				○
Unbalanced rotation	○				
Loose fixing bolts	○				
Broken belt				○	
Resonance, dangerous speed	○				
Surging	○				
Inadequate heat release (heat build-up)		○	○		
Blockage in duct piping				○	
Contact with rotating parts	○				○
V-belt is too tight			○		○

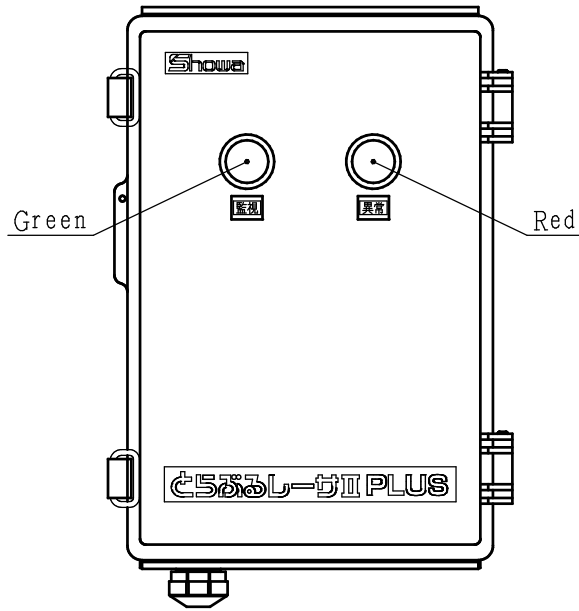
This table lists only the most likely causes of abnormalities that may occur after a period of normal operation.



Cautions

- If the rotating machine is operated beyond its specifications, abnormalities may not be detected in time and serious malfunction or damage may occur suddenly.
- Since vibration sensors and temperature sensors are constantly subject to vibrations, regularly check that the screws securing the sensors are properly tightened.

1 1 . Status of light on of the Remote Unit



Lamp color		Status
Green [Monitor]	Red [Abnormal]	
Light Off	Light off	Power is not on
Light on	Light off	Monitoring
Light on	Blinking	Abnormality occurred
Blinking	Light off	<ul style="list-style-type: none"> • <u>When only using the Remote Unit</u> Standby (not monitoring) • <u>When using it with the Base Unit</u> Communication with the Base Unit is turned off, and monitoring is carried out with the Remote Unit alone
Blinking	Blinking	<ul style="list-style-type: none"> • <u>When only using the Remote Unit</u> Standby (Abnormality occurs before standby, but abnormality is not canceled) • <u>When using it with the Base Unit</u> Communication with the main unit is turned off, and an abnormality occurs when the Remote Unit is monitoring alone. <p>* <u>For details when using the Base Unit,</u> <u>refer to P.32 of this manual</u> <u><What to do if communication with the Remote Unit is unintentionally cut></u></p>

12. Troubleshooting

Symptom	Cause	Countermeasure	Page reference
Remote Unit indicator light does not come on.(green)	The power supply voltage is not normal.	Check power supply voltage.	P. 23
	MiruTEN communication has not started.	Start communication on the MiruTEN.	P. 32
Indicator light is on (red), but the contact relay is not working.	Operation settings for the terminal used for abnormality detection have not been specified.	Specify operation settings for the terminal used for abnormality detection, using the Remote Unit settings of the MiruTEN.	P. 30
Communication with the Remote Unit does not start.	The Remote Unit No. is not correctly set.	Specify the Remote Unit No. correctly.	P. 25
	Network cable is not correctly connected.	Check the network cable.	P. 21
	Ethernet hub is not powered on.	Turn on the power to the Ethernet hub.	P. 21
Input values from sensor are abnormal.	The "VA switch" is not correctly set to match the sensor output.	Change the "VA swich" setting.	P. 22
	Sensor is not wired correctly.	Correct the sensor wiring error.	P. 19 P. 20

13. Inspection and maintenance

● Inspection

To ensure normal operation of the Troubleresa II PLUS so that it can detect abnormalities in rotating machinery, conduct a regular inspection at suitable interval of time, e.g., every three to six months, according to the intensity of use.

Inspection point	Inspection description
Appearance	Check for deterioration, cracks, or damage of resin parts of the box, external housing, etc. Check for accumulation of debris, dust, etc.
Packing	Check for deterioration or detachment.
Fitting	Check for looseness of fixing screws and check for piping is not wobbly.
Wiring	Check for looseness of terminal screws. Check for damage to electrical wiring and cables.
Sensor appearance	Check for looseness of fixing screws. Check for adhesion of debris or dust.
Sensor operation	Check that there is no significant difference relative to the values measured using a calibrated vibrometer and thermometer at the positions where the vibration sense and temperature sensor are fitted.

● Storage

Store the product in a place of appropriate temperature and humidity that is not exposed to direct sunlight, with protection against dust.

- MiruTEN (FCM-BM2PT)

Storage temperature : 0 ~ 50 °C

Storage humidity : 10 ~ 85 RH (no condensation)

- Remote Unit (TCM-NF2P(S))

Storage temperature : -10 ~ 50 °C

Storage humidity : 10 ~ 90 RH (no condensation)

14. Specifications

MirruTEN (FCM-BM2PT)

Function	Displaying Remote Unit status, specifying Remote Unit settings, saving data to a USB drive, displaying graphs, and indication of abnormalities
No. of connectable Remote Units	10
Power supply voltage	AC 100 ~ 240 V 50/60 Hz
Output point	2 point
Usable temp. range	0 ~ +50°C
Usable RH range	10 ~ 85% R H (no condensation)
Power consumption	MAX 10 W
Dimensions, weight	218D×160W×130H mm (excl. projections) , 1.33 kg

Remote Unit (TCM-NF2P)

Power supply voltage	AC 100 ~ 240 V 50/60 Hz	
No. of measurement points	8 CH (6 analog inputs, 2 Type thermocouple inputs)	
Output	Output point	2 point of a contact
	Contact capacity	AC 250 V / DC 30 V 5 A
Usable temp. range	-10 ~ +50°C	
Usable RH range	10 ~ 90% R H (no condensation)	
Power consumption	MAX 10 W (When sensor power supply is 36W)	
Dimensions, weight	280D×190W×100Hmm (excl. projections) , 1.5 kg	

Vibration sensor (VS-2502-□□)

Measurement mode	Amplitude	Velocity	Acceleration
Measurement range	0 ~ 200 μm (P-P)	0 ~ 50 mm/s (RMS)	0 ~ 100 m/s ² (Peak)
Frequency range	10 ~ 500 Hz	10 ~ 1000 Hz	5 ~ 1000 Hz
Output current	4 ~ 20 mA		
Measurement precisio	±5% (1/2 F.S.) at 20°C 80 Hz		
Cable	2-core cabtyre cable (ext. dia. 6.5mm) of 3m		
Dimensions, weight	φ45×H45, 105 g (excl. cable)		

Vibration sensor (VS-V103-01)

Measurement mode	Acceleration
Measurement range	0 ~ 5 G (0 ~ 49.0 m/s ²)
Frequency range	10 ~ 500 Hz
Output	0 ~ 5 V
Measurement precisio	±10%
Cable	4-core cabtyre cable (ext. dia. 4.5mm) of 3m
Dimensions, weight	φ48×H38, 110 g (excl. cable)

Current sensor (CTT-□□-CLS-CV-○○)

Max. measurement current	For 5A	For 10 A	For 25 A	For 50 A	For 100 A	For 250 A	For 500 A
Output	0 ~ 5 V						
Resolution	±2% (F.S.)						
Shape	2×M3 dedicated screws (with cover)						

Temperature sensor (YYU4KM04B20A)

Conductor type	K (C A)
Class	Class 2 (0.75 class)
Temperature Measurement range	0 ~ + 150 °C
Measurement precision	± 2.5 °C
Shape	M4 crimp ring terminals, lead wire 2m

15. Warranty Conditions

(1) Scope of warranty

If the product malfunctions or fails within the warranty period Showa Denki shall repair it free of charge, provided that it has been used in accordance with the instruction manual, the instructions on the product itself, and all other warnings and cautions.

However, if the product is incorporated into another system or device by the customer, the removal of the product from the other device and the reinstallation of the product into the device, any construction expenses resulting from this work, transportation expenses, and any opportunity loss, operation loss, or other indirect damages resulting to the client shall not be covered by the warranty.

(2) Warranty period

One year from the date of product delivery.

(3) In any of the following cases, even within the warranty period, repairs shall generally not be free of charge.

- ① If the product malfunctions or fails as a result of not being used in accordance with the instruction manual. The product specifications, and all other warnings and cautions, or if the product has been improperly repaired or modified.
- ② If the product malfunctions or is damaged as a result of being transported, dropped, etc. after purchase.
- ③ If the product malfunctions or is damaged as the result of fire, earthquake, wind or water damage, lightning, or any other natural disaster, abnormal voltage, or use of a power supply not within designated specifications (e.g., voltage, frequency).
- ④ If the product malfunctions or is damaged as a result of repairs or modifications (including tapping holes in the product) performed by anyone other than Showa Denki.
- ⑤ If the product malfunctions or is damaged as a result of using a part other than that designated by Showa Denki.
- ⑥ If the product malfunctions or is damaged as a result of contamination with any foreign substance.
- ⑦ If the product is discolored or scratched due to natural deterioration with age or to normal use, or if it malfunctions due to natural wear and tear of consumable parts.

(4) No warranty is provided for damage or loss caused by the malfunctioning of this product during use.

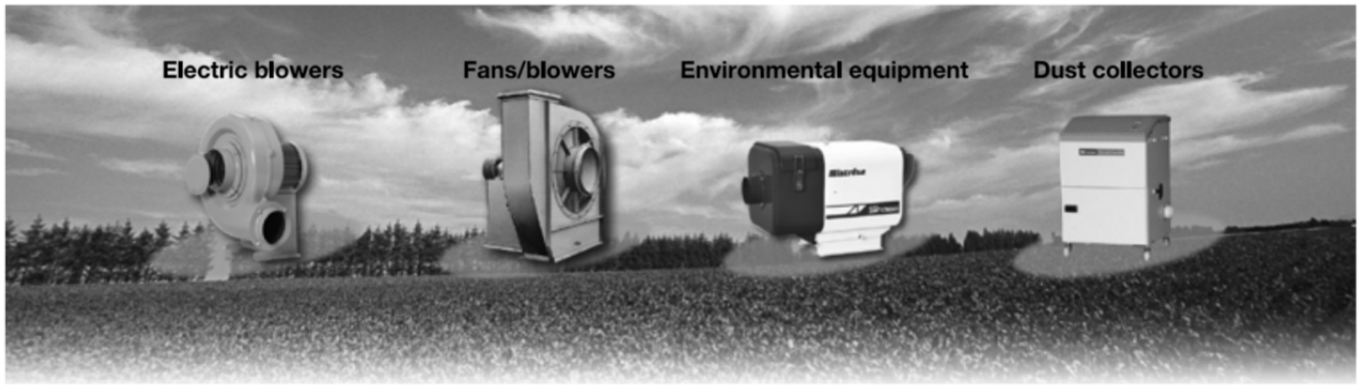
(5) It is assumed that this product is used only within Japan.

- This warranty applies only to use of the product within Japan.
- Use of the product outside Japan is not covered by this warranty.
- For information about use outside Japan, please inquire with your nearest branch office or sales office.

(6) The warranty may not be honored if the nameplate is removed from the product.

※NOTES

- (1) The content of this document is subject to change without prior notice.
- (2) When making inquiries to Showa Denki, please inform us of the model name and serial no. written on the nameplate of the product.



Business lines

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> ■ Electric blowers <ul style="list-style-type: none"> ● Low-noise series ● High-pressure series ● Multi-stage series ● Compact series ● General-purpose series ● Multi series ● Stainless steel · Steel plate series ● Explosion-proof series ● Large-sized series (Denchoku) ● High pressure vortex series (Gust Blower) ● Agitating/circulating series (Double volute) | <ul style="list-style-type: none"> ■ Fans/Blowers <ul style="list-style-type: none"> ● Turbo fan (Delturbo) ● Turbo blower ● Air foil fan ● Sirocco fan ● Plate fan ● Axial fan with a variable pitch (Kairyu) ■ Abnormality detector <ul style="list-style-type: none"> ● Troubleresa | <ul style="list-style-type: none"> ■ Environmental equipment <ul style="list-style-type: none"> ● Mist collectors (<i>Mistrésa</i>) ● Portable fan (<i>Windbag</i>) ● Windracer (<i>Windracer</i>) ■ Dust collectors <ul style="list-style-type: none"> ● Dustresa <ul style="list-style-type: none"> · Compact series · Small-size pulse-jet series · Portable open series · Pulse-jet series ● Fumeresa |
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