Ultra-Early Machine Failure Sign & QA

AE Logging System

# Early Observer MEL-E Freddo / Freddo Plus

Specifications & Instruction Manual

JCC Co., Ltd.

History

| Document No. | Date Revision | Description |
|---|---|---|
| FNF 0040 920 | 21, Nov., 2025 | 1st edition<br>Japanese document FNF 0040 901 |
| FNF 0040 921 | 24, Mar., 2026 | P3,4,7,15,22,30 Corrected typos<br>P3,20 Added I/O cable, P11 Added HPF/LPF setting |
| FNF 0040 922 | 5, Jun., 2026 | P24,27 Corrected typos |
| FNF 0040 923 | 10, Aug., 2026 | P10,28 Corrected typos |
| FNF 0040 924 | 11, Sep., 2026 | P11 Touch sensor function fix |
| FNF 0040 925 | 1, Oct., 2026 | P20 Added I/O cable wire colors. |
| | | |

# Safety precautions

(Be sure to read before use.)

Thank you for purchasing JCC product. Before using this product, be sure to read this manual carefully to acquire full knowledge of the equipment and understand all the safety information and precautions for correct use.

- This manual should be kept by the person who actually uses this product.
- Keep this manual handy for future reference.

## Description of signal words

In this manual, safety precautions are classified into two levels: "Warning" and "Caution."

| Indication | Meaning |
|---|---|
| Warning | Indicates a potentially hazardous situation that is caused by mishandling and could result in death or serious personal injury. |
| Caution | Indicates a hazardous situation that is caused by mishandling and could result in minor injury and/or property damage. |

Even instructions and precautions provided with the ⚠Caution sign may result in serious consequences depending on the situations.
Be sure to follow the instructions and precautions because they are all important.

## Description of symbols

| Indication | Meaning |
|---|---|
| | Indicates prohibited actions. |
| | Indicates mandatory actions. |

## 1. Usage precautions

| Warning | |
|---|---|
| | - Don't open the case of the amplifier. Otherwise, an electric shock may occur.<br>- Don't use the product without the terminal cover attached. Otherwise, an electric shock may occur. |
| | - Don't damage, apply excessive stress to, place a heavy object on, or pinch the cables. Otherwise, an electric shock may occur. |
| | - Be sure to turn off the power before moving the product, connecting cables, or performing inspections.<br>- Provide a safety circuit outside the amplifier so that the entire system can operate safely even in the event of a breakdown of the amplifier or sensor.<br>- Apply only the specified voltage to each terminal. Otherwise, a blowout, breakage, or fire may occur. |
| | - Connect FG to the ground. |

| ⚠ Caution | |
|---|---|
| | - Don't use the product in a corrosive or flammable atmosphere or near combustible materials.<br>- Don't use the amplifier where it is exposed to water splash. |

## 2. Storage

| ⚠ Caution | |
|---|---|
| | - Don't store the product where it is exposed to rain or water splash or where harmful gas or liquid exists. |
| | - Store the product within the specified temperature and humid ranges and where it isn't exposed to sunlight. |

## 3. Transfer

| ⚠ Caution | |
|---|---|
| | - Don't move the product by pulling the sensor cables. |

## 4. Installation

| ⚠ Caution | |
|---|---|
| | - Don't step on the product or don't place a heavy object on it.<br>- Prevent conductive foreign objects such as screws and metal chips or flammable objects such as oil from entering inside the amplifier. |
| | - To install the amplifier, use DIN rail and secure the amplifier on it firmly. Otherwise, the amplifier may fall, or a malfunction may occur.<br>- Install the sensors correctly and firmly in accordance with this manual because they are subject to an ambient magnetic field. |

## 5. Cables connection

| Warning | |
|---|---|
| | - Be sure to tighten the terminal board. Otherwise, a fire or malfunction may occur.<br>- Be sure to attach the terminal board cover before energizing or operating the product.<br>- Connect cables correctly and firmly. Otherwise, a fire, breakdown, or malfunction may occur. |

## 6. Operation

| Warning | |
|---|---|
| | - The sensors are subject to an ambient magnetic field. Ensure that other magnets than specified are not placed near the sensors. Otherwise, a malfunction may occur.<br>- The monitor terminal isn't insulated from the internal circuit. Don't connect anything to this terminal during operation. Otherwise, a malfunction may occur. |

## 7. Maintenance and inspection

| ⚠ Caution | |
|---|---|
| | - Don't disassemble, modify, or repair the product. Otherwise, an electric shock, breakdown, or fire may occur. |

## 8. Disposal

| ⚠ Caution | |
|---|---|
| | - Dispose of this product as industrial waste. |

# Contents

1. SUMMARY ..... 1
2. TRADEMARKS ..... 1
3. CONFIGURATION ..... 2
4. SPECIFICATIONS ..... 4
4-1. Specifications of AE amplifier ..... 4
4-2. Specifications of AE sensor ..... 6
4-3. Specifications of AE sensor cable ..... 6
5. EXTERNAL VIEW ..... 7
5-1. External view of AE amplifier ..... 7
5-2. External view of Touch sensor output cable ..... 7
5-3. External view of AE sensor ..... 8
5-4. External view of sensor bracket ..... 8
5-5. External view of waterproof relay connector set ..... 8
6. FUNCTIONS ..... 9
6-1. AE measurement function ..... 10
6-2. Measurement data calculation function ..... 11
6-3. Touch sensor function ..... 11
6-4. Threshold alarm function (Freddo Plus only) ..... 11
6-5. Frequency filter function ..... 11
6-6. Edge process time selection function ..... 12
6-7. Apportioned function ..... 12
6-8. Sensor signal check function ..... 13
6-9. micro SD storage function (Freddo Plus only) ..... 13
7. NAME OF EACH PART ..... 14
8. ATTACHMENT METHOD AND PRECAUTIONS ..... 16
8-1. How to attach AE amplifier and precautions ..... 16
8-2. How to attach AE sensor and precautions ..... 17
9. WIRING AND CONNECTION ..... 18
9-1. Wiring of AE sensor ..... 18
9-2. Relay and extension of AE sensor cable ..... 19
9-3. Input/output signal connections ..... 20
9-4. Touch sensor output connection ..... 22
10. AE MEASUREMENT ..... 23
10-1. AE measurement by sequencer ..... 23
10-2. AE measurement by PC ..... 25
10-3. AE measurement by standalone controller ..... 26
11. INSPECTION AND TROUBLESHOOTING ..... 29
11-1. Inspection ..... 29
11-2. Troubleshooting ..... 30
12. WARRANTY PERIOD AND SCOPE ..... 31

## 1. Summary

This material explains about specifications and handling of Early Observer MEL-E Freddo / Freddo Plus.

Please note that the described specifications or functions may be changed without notice for technological improvement.

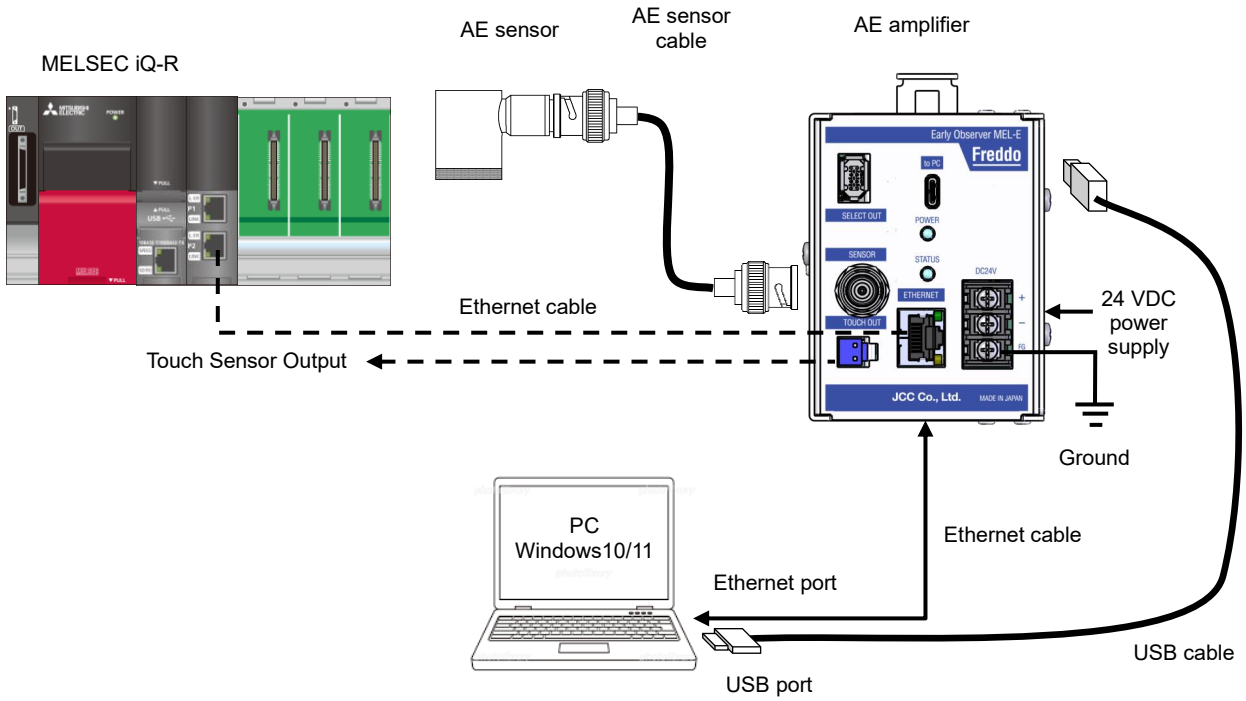
## 2. Trademarks

- Microsoft Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.
- Microsoft and Excel are registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
- Other product names and company names shown in this document are registered trademarks or trademarks of each company.

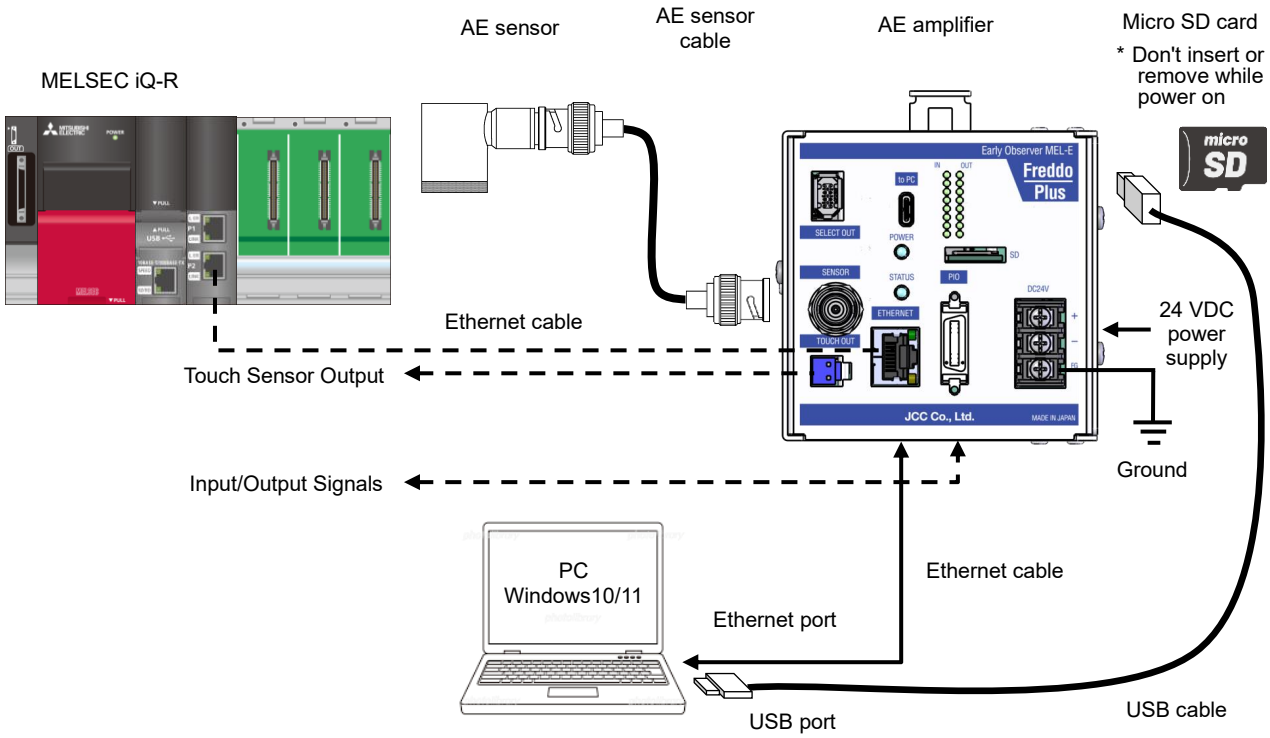
# 3. Configuration

## ■ Configuration of equipment

[ MEL-E Freddo ]




[ MEL-E Freddo Plus ]



■ List of items configuring the equipment

| No. | Item | | Model | Remark |
|---|---|---|---|---|
| 1 | AE amplifier | | EO-MEL-E-Freddo | |
| | | | EO-MEL-E-Freddo Plus | With PIO/microSD data recording function |
| 2 | AE sensor | Standard sensor | FAEN-S60I | Focus frequency: 60 kHz |
| | | | FAEN-S150I | Focus frequency: 150 kHz |
| | | | FAEN-S300I | Focus frequency: 300 kHz |
| | | Waterproof sensor | FAEN-S60WI-HRB5 | Focus frequency: 60 kHz : equipped with environmentally resistant cable (5 m) |
| | | | FAEN-S150WI-HRB5 | Focus frequency: 150 kHz : equipped with environmentally resistant cable (5 m) |
| | | | FAEN-S300WI-HRB5 | Focus frequency: 150 kHz : equipped with environmentally resistant cable (5 m) |
| 3 | Sensor bracket | | MGBKT No.2 | Simple Magnet bracket for standard sensor |
| | | | MGBKT No.5-S | Magnet bracket for standard sensor |
| | | | MGBKT No.5-W | Magnet bracket for waterproof sensor |
| 4 | AE Sensor cable | Standard | EO-ST-BNC-□m | □: Length 5/10/15/20 m |
| | | Environmentally resistant robot | EO-HRB-BNC-□m | □: Length 5/10/15/20 m |
| 5 | Waterproof relay connector set | | EO-CONCT-BNC-W | AE sensor cable relay connector |
| 6 | I/O cable | | EO-PPIO-C-3m | For Freddo Plus AWG28 20-core, 3m long |
| 7 | Touch sensor output cable | | EO-TOUCH-C-3m | AWG22 White/black twisted cable, 3m long |
| 8 | USB cable | | - | USB C-A or USB C-C<br>* Commercially available product) |
| 9 | AC adapter | | EO-AC/DC24V | 85 to 240 VAC 24 W |

# 4. Specifications

## 4-1. Specifications of AE amplifier

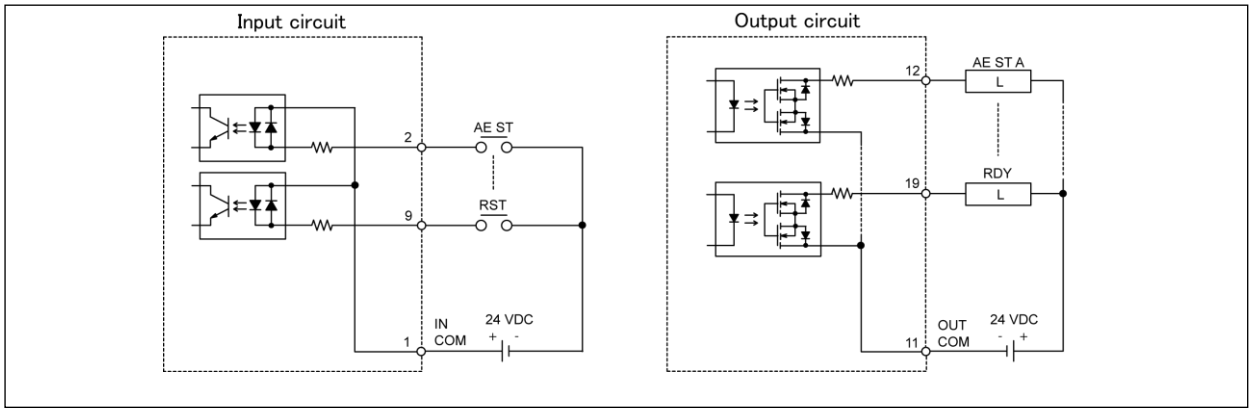
■ General/performance specifications

| Item | Specifications | |
|---|---|---|
| | Freddo | Freddo Plus |
| Data resolution | 14 bits | |
| Sampling frequency | 10 MHz | |
| Frequency filter | HPF: 20, 30, 50, 80, 100, 150, 200, 240 [kHz] (-12dB/oct)<br>LPF: 80, 100, 180, 200, 360, 400, 600, 1000 [kHz] (-12dB/oct) | |
| Amplification factor | 0, 10, 20, 30, 40, 50 [dB] (within ±2 dB)<br>* Accurate measurements cannot be made when 0dB is selected. | |
| Applied AE sensor | FAEN-S60(W)I / S150(W)I / S300(W)I | |
| Connector for AE sensor | BNC | |
| Edge process time | 1, 10, 20, 50, 100, 1000, 2000, 5000, 10000, 15000, 20000 [ms] | |
| Logging Time | Continuous / 1 to 20 (0.1s incr.) | |
| PC communication method | USB Type-C (USB 2.0 compliant) / Ethernet 100BASE-TX | |
| PLC communication method | Ethernet 100BASE-TX | |
| Recommended Ethernet interface unit | Ethernet interface unit made by Mitsubishi Electric Corporation<br>MELSEC iQ-R : RJ71EN71, RnENCPU (Port 1) | |
| | Simultaneous measurement by connecting multiple units via HUB, etc. is not covered by the warranty. | |
| Input/Output Signals | Touch Sensor Output: 1 point | |
| | - | PIO Inputs: 8 p, Outputs: 8 p |
| Internal storage device | eMMC (8GB) various setting data is stored (IP address, gain, etc.) | |
| External storage device | - | micro SDHC<br>(UHS-I U3 or V30 higher) |
| Ambient operating temperature | -10 to +55 °C | |
| Ambient humidity | 20 to 80 %RH (with no dew condensation) | |
| Storage temperature | -20 to +75 °C (with no dew condensation) | |
| Conforming standard | CE acquisition planned | |
| Power voltage | 11 to 26 VDC | |
| Power consumption | 10 W or less | |
| Measurement item | Following data within the edge processing period is measured.<br>- Amplitude-MAX [mV] : maximum amplitude value<br>- Energy [dBs] : energy value<br>- RMS [mV] : effective value<br>- Counts [pieces] : 0 V or number of intersection points of setting threshold value | |
| Mass | Approx. 550 g | Approx. 650 g |
| Outside dimensions<br>protruded part is excluded | W70 x H91 x D110 [mm] | W93 x H91 x D110 [mm] |
| Environment | Conforming to RoHS Directive | |

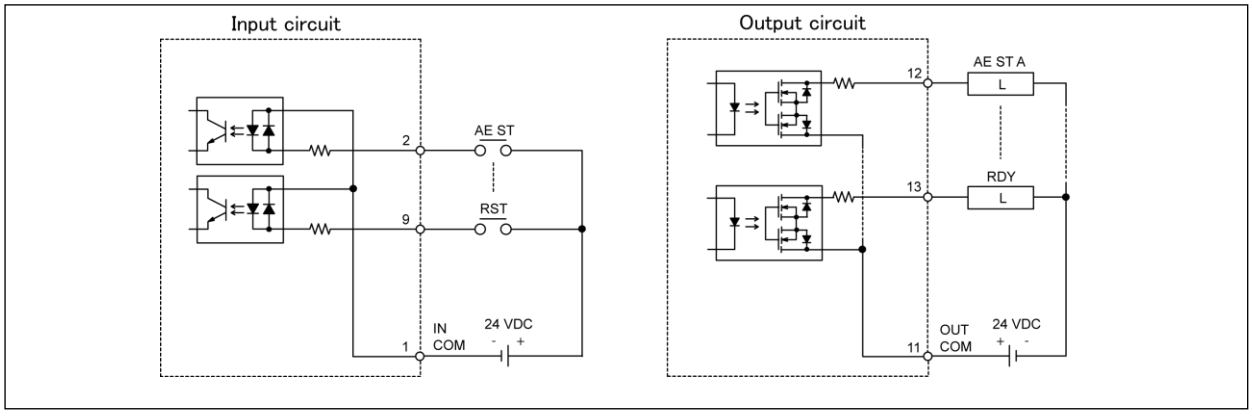
■Input/Output Specifications

| Item | | Specifications |
|---|---|---|
| Input | Input signals | 8 point |
| | Input circuit | Photo-coupler isolation (Sink/Source type) |
| | Curret voltage/current | 24 VDC / 10mA |
| Output | Output signals | 8 point |
| | Output circuit | Photo-coupler isolation/Open-drain (Sink/Source type) |
| | Rated Load Voltage | 12 to 24 VDC (48 VDC max.) |
| | Rated Load Current | 80mA / point |
| Touch Sensor Output | Output signal | 1 point |
| | Output circuit | Photo-coupler isolation / Nonpolar output |
| | Max. Load Voltage | 60 VDC max. |
| | Max. Load Current | 30mA |

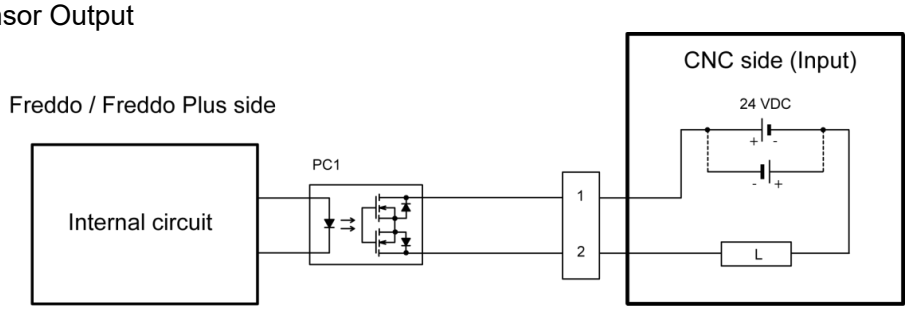
[1] Sink Connection




[2] Source Connection




■Touch Sensor Output



## 4-2. Specifications of AE sensor

| Item | | Specifications | | | | | |
|---|---|---|---|---|---|---|---|
| | | standard sensor | | | waterproof sensor | | |
| Model | | FAEN-S60I | FAEN-S150I | FAEN-S300I | FAEN-S60WI | FAEN-S150WI | FAEN-S300WI |
| Focus frequency | | 60 kHz ± 20 % | 150 kHz ± 20 % | 300 kHz ± 20 % | 60 kHz ± 20 % | 150 kHz ± 20 % | 300 kHz ± 20 % |
| Sensitivity | | 94 ± 3 dB | | | 93 ± 3 dB | | |
| Sensor size (Excluding the protruded part) | | Φ 20 x 26.5 mm | | | Φ 22 x 30 mm | | |
| Sensor mass (Excluding equipped cable) | | 49 g | 43 g | | 62 g | 56 g | |
| Operating temperature | | -20 to +80 °C | | | | | |
| Vibration resistance | | 1.0 × 10^2m/s^2 {10G} 50Hz up / down / forward / back each 2h. | | | | | |
| Shock resistance | | 5.0 × 10^3m/s^2 {500G} up / down / forward / back each 10 times. | | | | | |
| Material | Chassis | Stainless : SUS303 | | | Stainless : SUS304: NBR(O-ring) | | |
| | Receiving surface | Alumina | | | Stainless : SUS304 | | |
| Protection structure | | IP50 | | | IP67 | | |
| Connector | | BNC | | | BNC Equipped with environmentally resistant robot cable (5 m) | | |
| Max. cable length | | 20 m | | | | | |
| Extension cable | | 5 m, 10 m, 15 m, 20 m | | | 5 m, 10 m, 15 m | | |

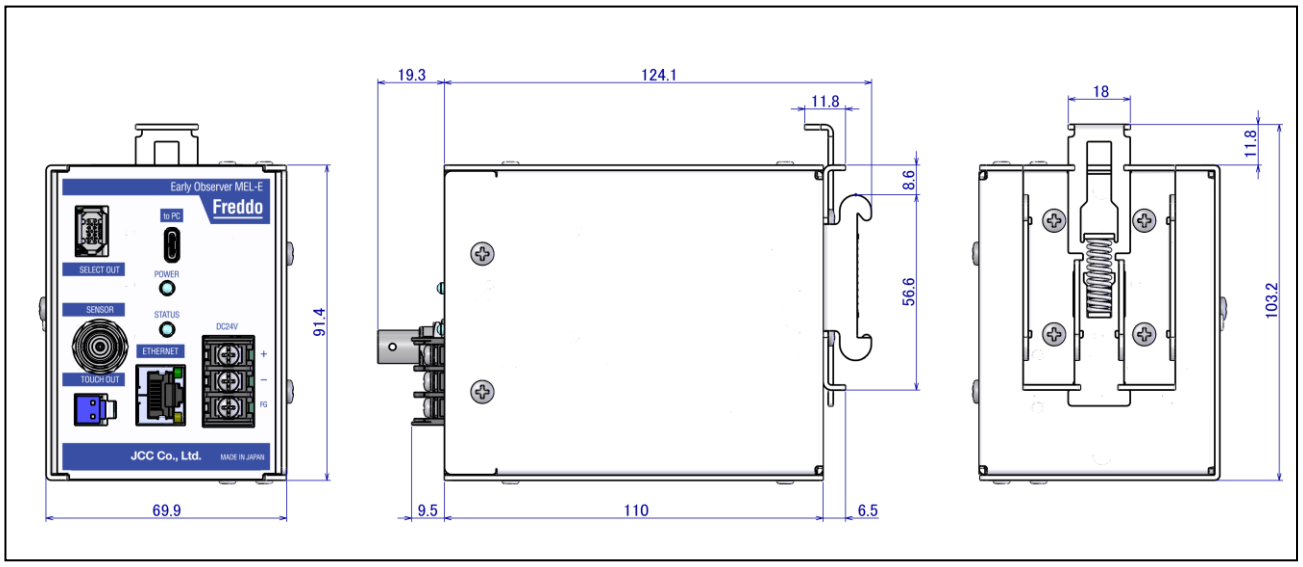
## 4-3. Specifications of AE sensor cable

| Item | Specifications | |
|---|---|---|
| Model | EO-HRB-BNC-□m<br>□: Length 5/10/15/20 m | EO-HRB-□m<br>□: Length 5/10/15/20 m |
| Type | Standard cable | Environmentally resistant robot cable |
| External diameter | Φ 5 | Φ 4 |
| Ambient operating temperature range | -20 to +60 °C | -253 to +200 °C |
| Characteristics | Low price | Superior in environmental resistance and flex resistance and usable for moving part |
| Insulator | Polyethylene | Fluorinated ethylene propylene |
| Sheath | Vinyl chloride | Fluorinated ethylene propylene (Teflon coating) |
| Number of cores | 1 (RG-58A/U) | 1 (coaxial cable) |
| Color | Black | Gray |

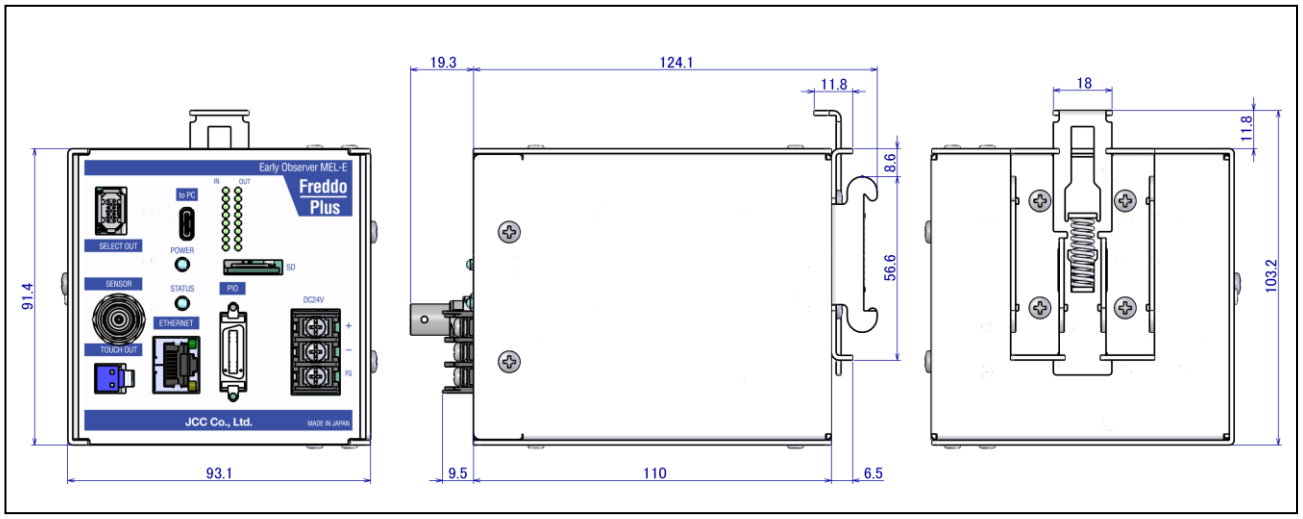
# 5. External view

## 5-1. External view of AE amplifier

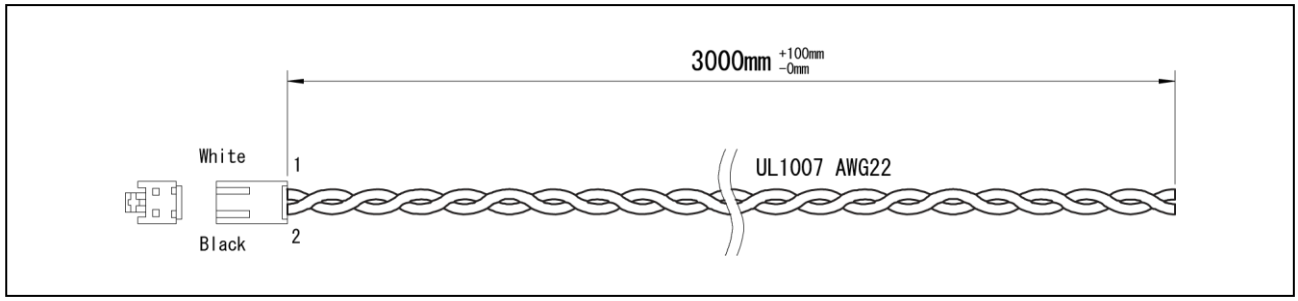
● EO-MEL-E-Freddo [mm]




● EO-MEL-E-Freddo Plus [mm]



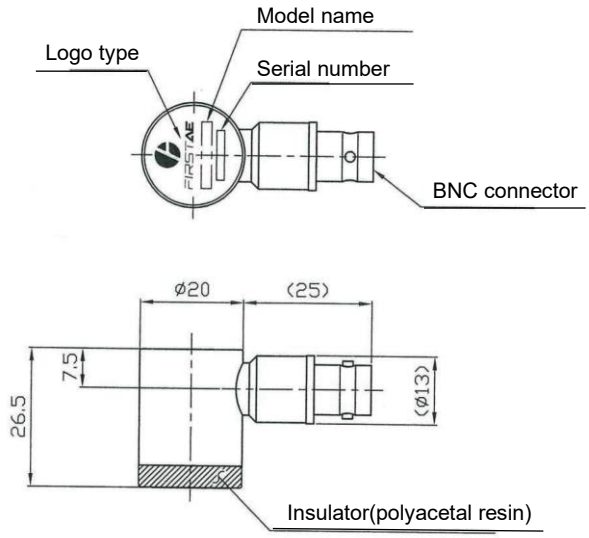

## 5-2. External view of Touch sensor output cable



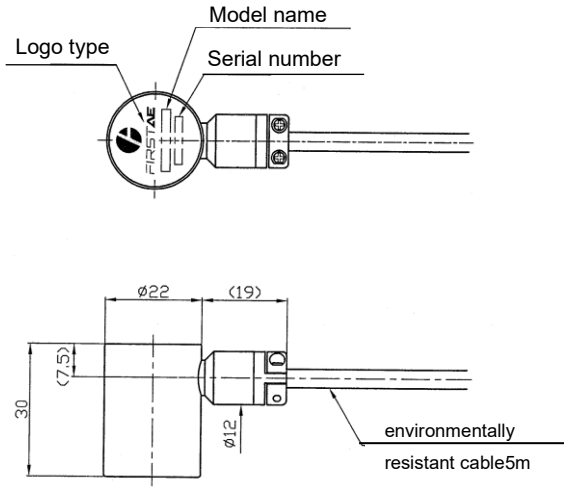
## 5-3. External view of AE sensor

[mm]

[Standard sensor]



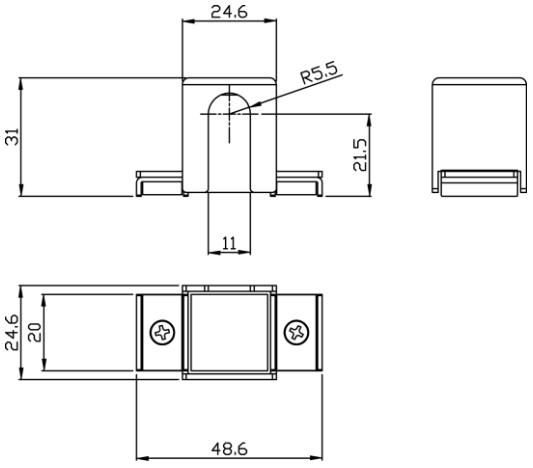

[Waterproof sensor]



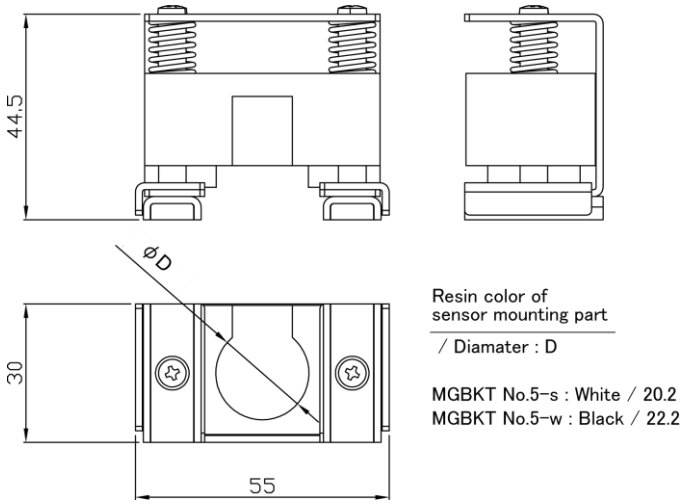

## 5-4. External view of sensor bracket

[mm]

[MGBKT No. 2]



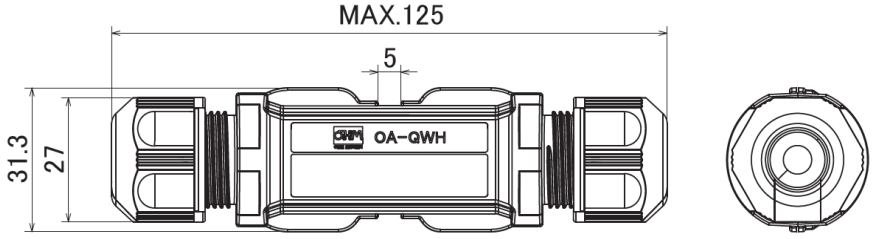

[MGBKT No.5]




## 5-5. External view of waterproof relay connector set

[mm]

[EO-CONCT-BNC-W]



## 6. Functions

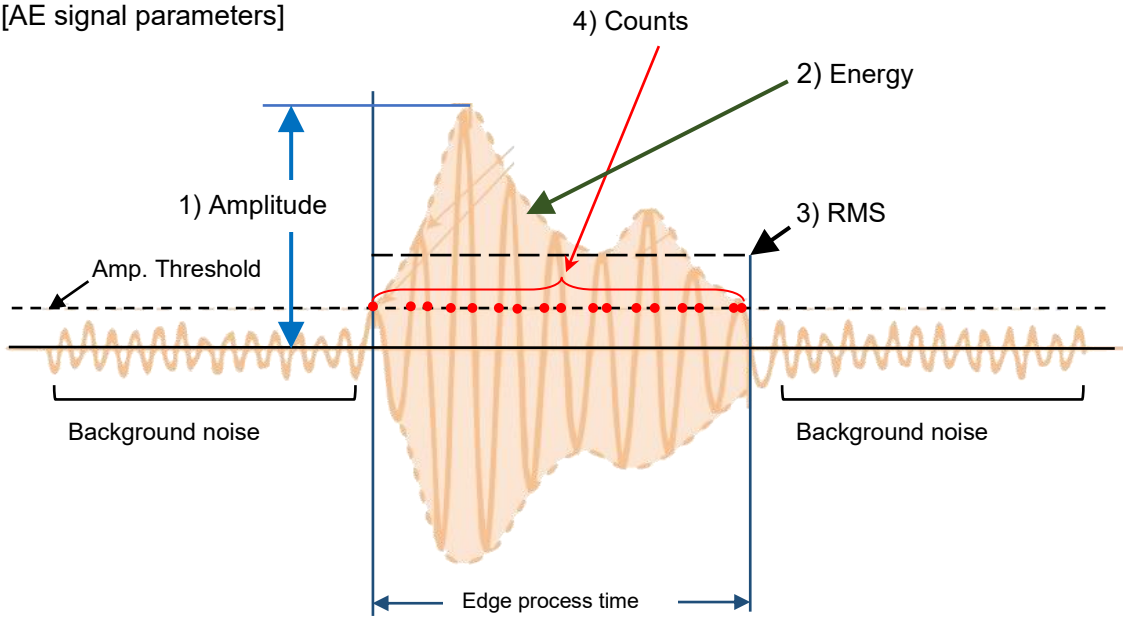
[List of functions]

| Function | Description |
|---|---|
| AE measurement function | The data within edge process time is measured.<br>- Amplitude-MAX [mV] : maximum amplitude value<br>- Energy [dBs] : energy value<br>- RMS [mV] : effective value<br>- Counts [pieces] : 0 V or number of intersection points of setting threshold value |
| Measurement data calculation function | AE measurement data is internally calculated and output for each logging.<br>Effective for visualization of machining process and tool condition monitor.<br>- Amplitude : Maximum, Average, Variation(maximum - minimum)<br>- Energy/RMS : Maximum, Summed |
| Touch sensor function | It detects contact between the workpiece and tool and outputs a signal externally with a response speed of 2 ms.<br>Tool setter installation is unnecessary for finishing/additional machining. |
| Threshold alarm function<br>*Freddo Plus only | You can set a threshold value arbitrarily to generate an alarm signal.<br>Amplitude or energy can be set for each of two alarm thresholds.<br>In addition, two-stage alarm output can be performed by setting the same target data for two threshold alarm outputs. |
| Frequency filter function | Frequency components which are not necessary for AE measurement (vibration, ultrasonic waves, etc.) can be cut off. |
| Edge process time selection function | The edge process time (transmission interval) can be changed depending on the processing capability of the sequencer or the load factor of the software.<br>1, 10, 20, 50, 100, 1000, 2000, 5000, 10000, 15000, and 20000 ms are selectable. |
| Apportioned function | When the Energy value is too large, calculate and output the Energy value proportionally.<br>Select a large value for the edge process time (transmission interval), and when the Energy value becomes too large, calculate and output the proportional division. |
| Fail-safe function | Following errors are detected and transmitted by LED display and communication.<br>- Breaking / short circuit of sensor cable<br>- Drop in internal power voltage<br>- microSD card not inserted/insufficient capacity *Freddo Plus only |
| Sensor signal check function | The user can confirm the reliability of the AE sensor output.<br>- The initial AE sensor signal is memorized as a "reference value" in the amplifier.<br>- If "sensor signal check" is executed, the AE sensor signal is measured and saved in history 1. In addition, the reference value and AE sensor signal value at 10 measurements in the past are returned. |
| Logging function | AE measurement data is logged (saved).<br>The logging time can be set using the "Logging Timer." (1 to 20 seconds in 0.1 second increments/continuous) |
| micro SD storage function<br>*Freddo Plus only | AE measurement data is saved to the moicroSD card.<br>Note: Do not insert or remove microSD card while the power is on. |
| Clock function | Time (hour, minute, second, millisecond) is added to the measurement data.<br>Measurement time and measurement data can be related. |
| PC logging function | AE measurement can be performed by connecting the PC and Pegasus with a USB or LAN cable and using the dedicated software (AE SYSTEM SUPPORT TOOL for Pegasus_Freddo).<br>The measurement data can be displayed as a graph on the PC display and saved in CSV format in the memory of PC. |

## 6-1. AE measurement function

The AE signal is converted into four parameters and measured.

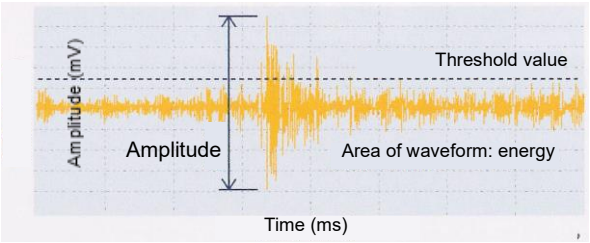
[AE signal parameters]




1) Amplitude-MAX : Max. amplitude value: Value of AE waveform within “edge process time”
2) Energy : Energy value: Integrated value of AE waveform within “edge process time”
3) RMS : Effective value: Value of AE signal acquired for each unit of “edge process time”
4) Counts : Count value: Number of intersections with OV or Amp. threshold within "edge process time”

[AE waveform and measurement points]

**Sudden type**




Source of occurrence: Crack growth, material transformation, etc.

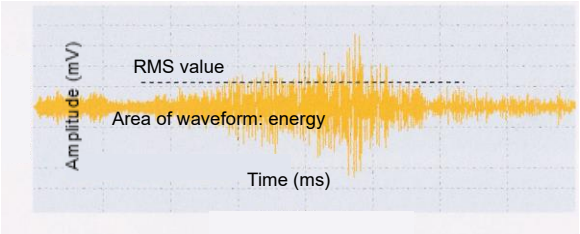
Waveform shape: Sharp rise

RMS (effective value): Correlation with Crack growth distance

Energy: Correlation with Crack growth distance

Frequency: Different characteristics for each object/material

**Continuous type**




Source of occurrence: Friction, wear, etc.

Waveform shape: Continuous signal

RMS (effective value): Correlation with Frictional force, Coefficient of friction

Energy: Correlation with Friction volume

Frequency: Different characteristics for each object / material

## 6-2. Measurement data calculation function

AE measurement data is internally calculated and output for each logging.
Effective for visualization of machining process and tool condition monitoring.

- After logging is complete, the internally processed AE measurement data is output as a logging data file and a summary file in CSV format.

| | |
|---|---|
| Amplitude-Maximum(mV) | : Maximum amplitude value |
| Amplitude-Average(mV) | : Average amplitude value |
| Amplitude-Variation(mV) | : Variation amplitude value (maximum - minimum) |
| Energy-Maximum | : Maximum energy value |
| Energy-Total | : Summed energy value |
| RMS-Maximum(mV) | : Maximum RMS value |
| RMS-Total | : Summed RMS value |

## 6-3. Touch sensor function

Detects and outputs the touch-out of the cutting tool (the moment of contact with the material) by receiving AE waves.
Detection is performed using either "Amplitude Count Mode" or "Energy Value Monitoring Mode"; select one of these modes and set the Signal output time. The touch sensor output is triggered within 2 ms of detection.

Tool setter installation is unnecessary for finishing/additional machining.

## 6-4. Threshold alarm function (Freddo Plus only)

You can set a threshold value arbitrarily to generate an alarm signal.
During AE measurement logging and upon logging completion, it detects threshold values and outputs a “Threshold Alarm”.

- Amplitude or energy can be set for each of two alarm thresholds.
  In addition, two-stage alarm output can be performed by setting the same target data for two threshold alarm outputs.
- Threshold and AE measurement settings can be registered in up to 8 types (1 to 8), and are switched using the input signal “Type”.

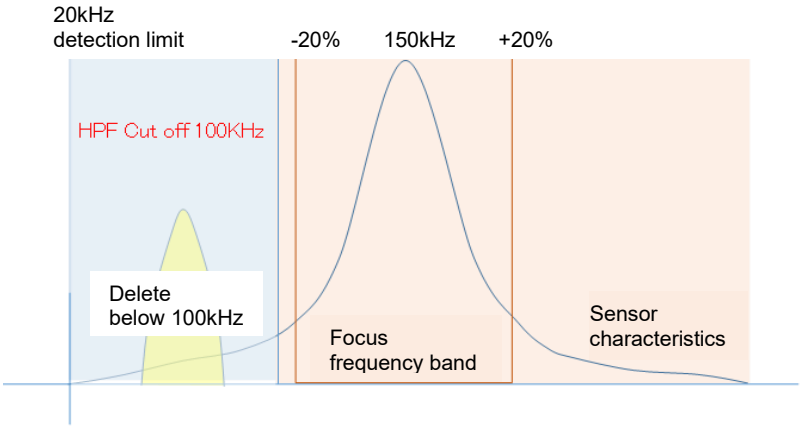
## 6-5. Frequency filter function

Frequency components (vibration, ultrasonic waves, etc.) that are unnecessary for AE measurement can be deleted.

HPF: 20, 30, 50, 80, 100, 150, 200, 240 [kHz] (-12 dB/oct)
LPF: 80, 100, 180, 200, 360, 400, 600, 1000 [kHz] (-12 dB/oct)

■ Image of HPF

HPF: High Pass Filter
LPF: Low Pass Filter




Set according to the sensor type.

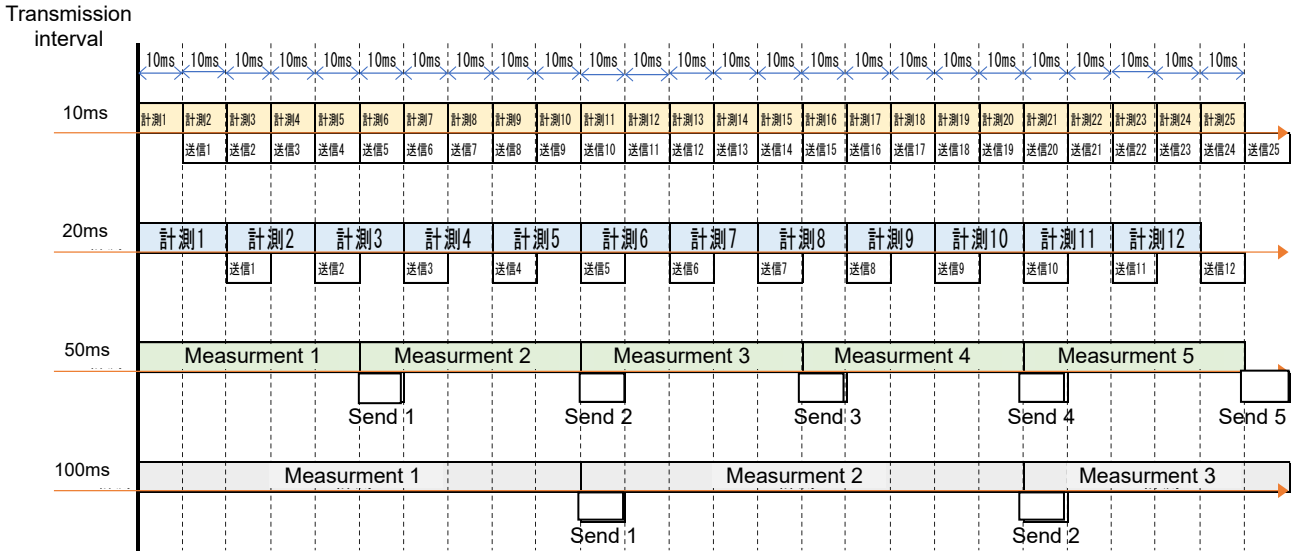
| | | | |
|---|---|---|---|
| FAEN-60(W)I | HPF : 30 | LPF : 100 | : for copper/aluminum |
| FAEN-S150(W)I | HPF : 100 | LPF : 200 | : for iron/stainless |
| FAEN-S300(W)I | HPF : 200 | LPF : 400 | : for ceramic |

## 6-6. Edge process time selection function

The edge process time (transmission interval) can be changed depending on the processing capability of the sequencer or the load factor of the software.

1, 10, 20, 50, 100, 500, 1000, 2000, 5000, 10000, 15000, 20000 [ms] are selectable.

[Image of transmission interval]




## 6-7. Apportioned function

If you set a long " Transmission interval ", the energy value may become large.
At this time, set the " Apportioned Value " and calculate and output the energy value.

Energy Value = Energy ÷ Factor of 10 of the apportioned value

Example: Energy value when the energy is 80,162,573,654 with apportioned value

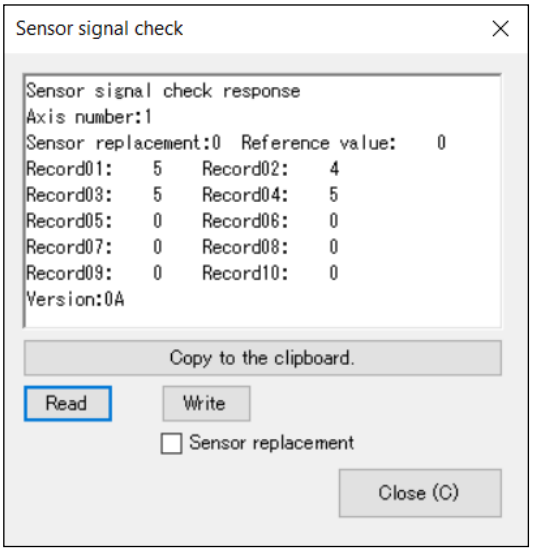
| Apportioned value | Energy value |
|---|---|
| 0 | 80,162,573,654 |
| 1 | 8,016,257,365 |
| 2 | 801,625,737 |
| 3 | 80,162,574 |
| 4 | 8,016,257 |
| 5 | 801,626 |
| 6 | 80,162 |
| 7 | 8,016 |
| 8 | 802 |
| 9 | 80 |

## 6-8. Sensor signal check function

The user can confirm the reliability of the AE sensor output.

- The initial AE sensor signal is memorized as a "reference value" in the amplifier.
- If "sensor signal check" is executed, the AE sensor signal is measured and saved in history 1.
  In addition, the reference value and AE sensor signal value at 10 measurements in the past are returned.

[Sensor signal check execution example]




* Record01 shows the latest data.

### Tips

- When an abnormality occurs in the sensor characteristics that affects the results of AE measurement, the sensor signal changes by more than two times.
- Monitor reliability visually or by connecting to a host controller.

## 6-9. micro SD storage function (Freddo Plus only)

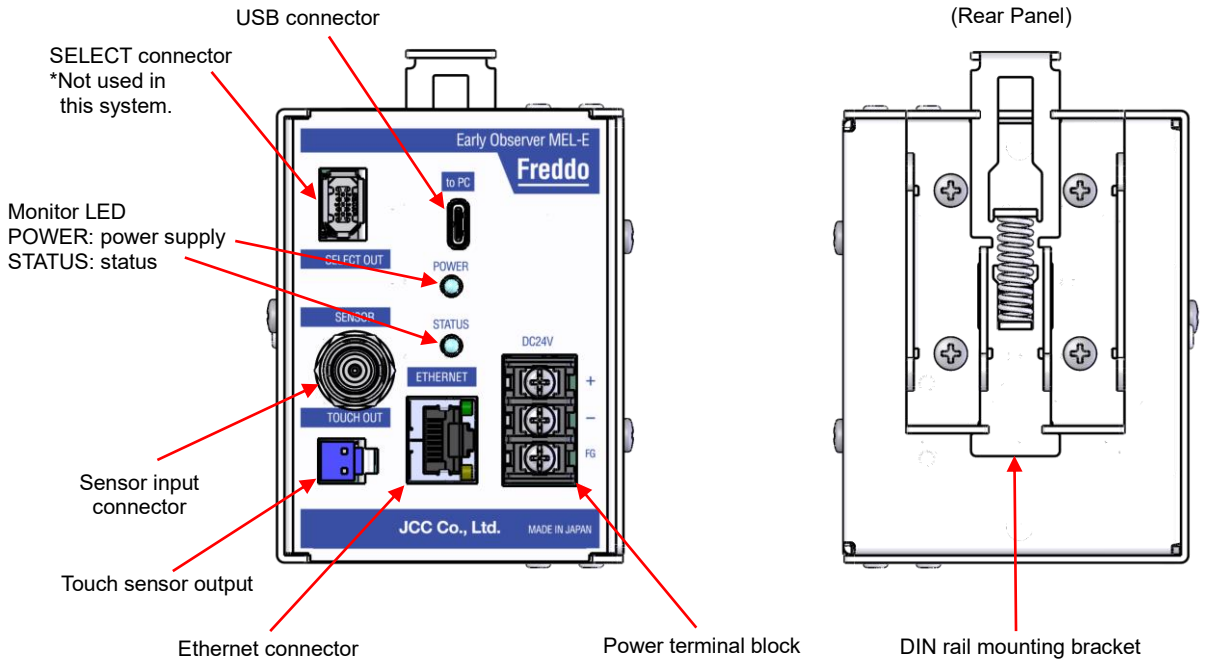
When measuring with the controller alone, AE measurement data can be saved to a microSD card.

- Recommended for microSDHC card (4 to 32 GB) with UHS-I U3 or V30 or higher.
- AE measurement data is saved in "CSV file" format.
- When the edge processing time is 10 ms, the log data size is 500 kB/min.
  32GB micro SD card can store approximately 60,800 minutes (about 42 days) of data.
- When performing continuous AE measurement, data is saved to a new file every 12,000 rows ( 2 minutes at an edge processing time of 10 ms).

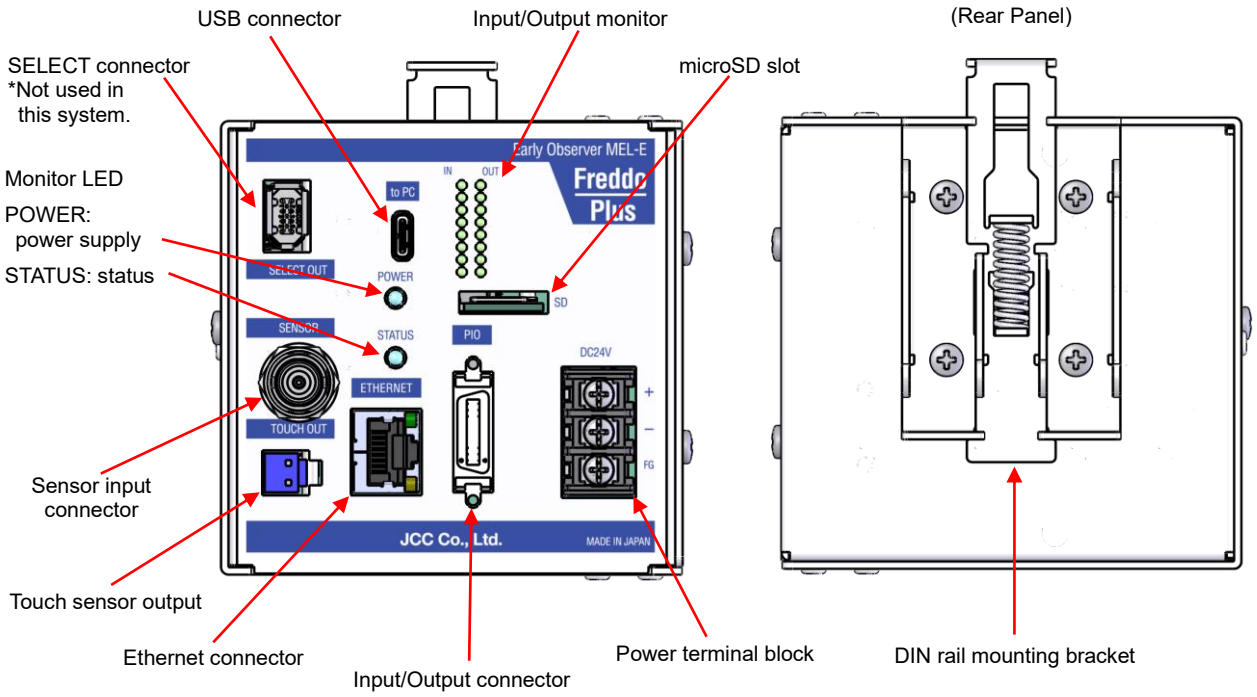
Note: Do not insert or remove microSD card while the power is on.

# 7. Name of each part

## ●Early Observer MEL-E Freddo




## ●Early Observer MEL-E Freddo Plus



(1) Power terminal block (M3)

+, - : Supplies 24 DCV.

FG : class-D grounding (ground resistance of 100 Ω or less).

(2) Sensor input connector

Connects the AE sensor.

(3) LAN connector

Connects the Ethernet interface unit of the PC.

Orange LED (top) :100Base-EX conection(lit), 10Base-TX connection(off)

Yellow LED(bottom) :Link(lit), No link(off), Activity(blinking)

(4) USB connector (USB Type-C)

By connecting Pegasus to a PC with a USB cable and using dedicated software, Pegasus settings and standalone logging can be recorded and displayed in graphs.

(5) Touch sensor output

Detects contact between the workpiece and tool and outputs a signal.

(6) Monitor LED

POWER: Lights up when the power is supplied

When turning on the power (lights up in green) -> at startup (lights up in orange) -> startup complete (lights up in green)

STATUS: Displays the status of the device

| | |
|---|---|
| During standby | : off |
| During measurement | : lighting in green |
| Breaking / short circuit of sensor cable | : flashing in red (about 2sec. intervals) |
| Voltage drop of internal power supply is detected | : lighting in red |

(7) Micro SD slot

Insert a microSD card (UHS-I U3 or V30 or higher) for recording AE measurement data.

Note: Do not insert or remove microSD card while the power is on.

(8) Input/Output connector

Connect Input/Output signals

Input : AE measurement, Logging, Type1 to 3, Threshold alarm reset.

Output : AE measurement, Logging, Type answerback 1 to 3, Threshold alarm 1 and 2, Device normally working.

(9) Input/Output monitor

Displays the on/off status of input/output signals.

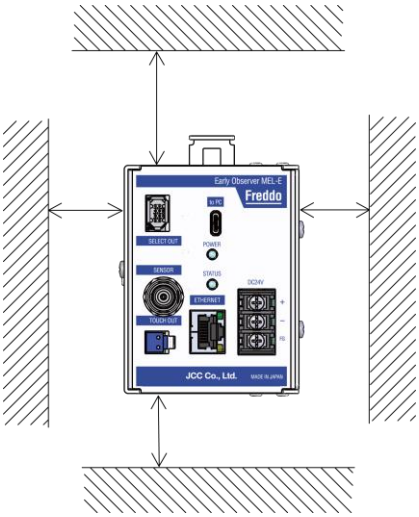
# 8. Attachment method and precautions

## 8-1. How to attach AE amplifier and precautions

### (1) Installation location

Avoid installation at the following places.

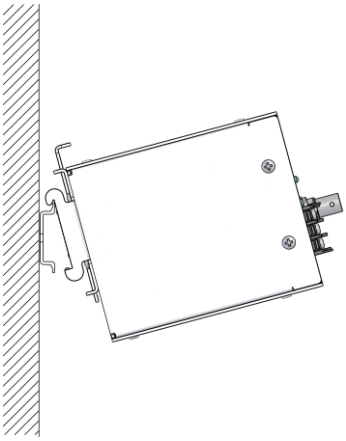
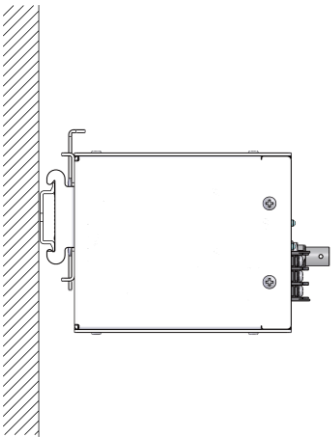
1) Place exposed to direct sunlight
2) Place where the ambient temperature exceeds the range -10 to +55 °C
3) Place where the ambient humidity exceeds the range 20 to 80 %RH
4) Place where there is a risk of dew condensation or a place where the humidity is high, and the temperature sharply changes
5) Dusty place
6) Place where there is much salt content or iron content
7) Place where there is combustible gas / corrosive gas
8) Place where there is a droplet of water, oil, chemicals, etc.
9) Place with vibration or impact




### (2) Cautions on attachment

1) Attach the device in the control panel.
2) Install the device separately from a high-voltage line and power line as much as possible to prevent the effect of noise.
3) Attach the AE amplifier to the 35 mm DIN rail.
4) Attach the AE amplifier vertically.
5) Ensure free space around the AE amplifier.
6) Do not place anything on the AE amplifier.

### (3) Attachment and detachment of converter

| Attachment | Detachment |
|---|---|
| Hitch the hook on the top of the AE amplifier to the DIN rail, and push it to fix while pushing the metal lever.  | While pressing the metal lever, pull the bottom of AE amplifier toward you to remove it.  |

## 8-2. How to attach AE sensor and precautions

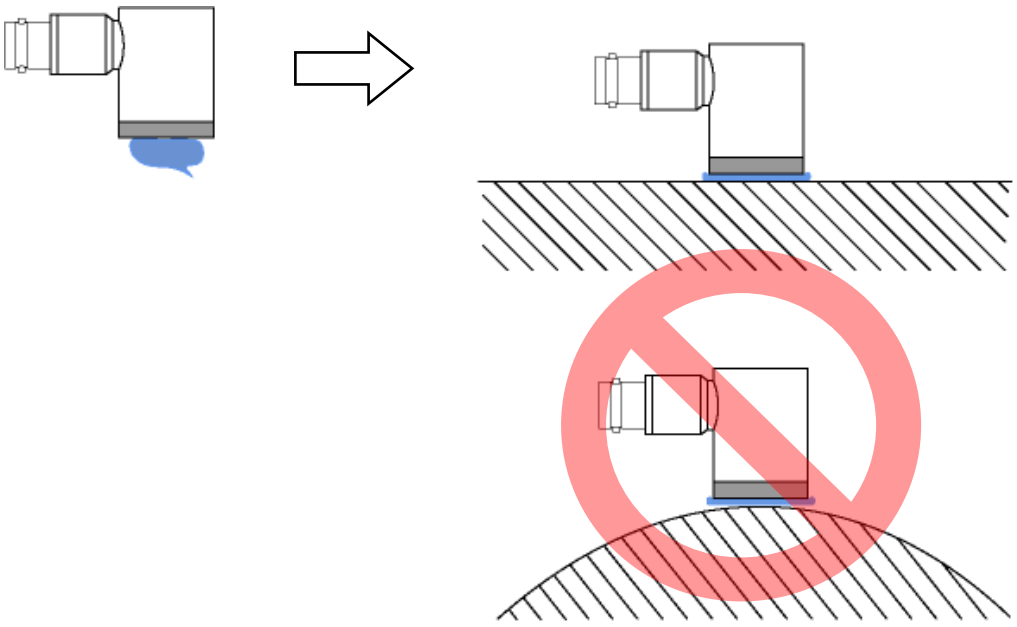
(1) Place to attach the AE sensor

Avoid installation at the following places.

1) Place where the ambient temperature exceeds the range -20 to +80 °C.
   If the ambient temperature exceeds the range shown above, control the temperature range using a stethoscopic rod or other tools.
2) Place where there is a droplet of water, oil, chemicals, etc.
   At a place where there is a droplet, use a waterproof AE sensor.

(2) Cautions on the attachment of the AE sensor

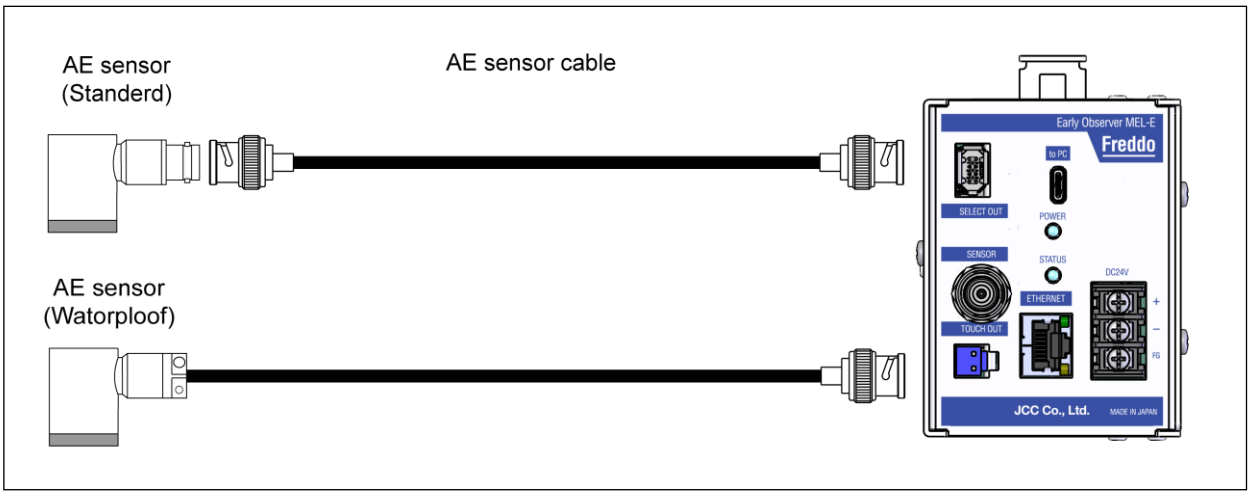
1) Attach the AE sensor on a flat surface as much as possible.
2) Before attaching the AE sensor, apply grease of vaseline on the contact surface of the AE sensor sufficiently not to generate a gap between the contact surface of the AE sensor and the measurement surface.
   ● Recommended grease: Shin-Etsu Chemical Co., Ltd. HIVAC-G



3) Fix the AE sensor using the dedicated sensor bracket.
4) When attaching the AE sensor to a non-magnetic material such as aluminum or stainless, fix the AE sensor with a tape or directly apply the adhesive agent such as "hot melt" on the contact surface of the AE sensor to fix it.
5) Install the AE sensor separately from a high-voltage line and power line as much as possible to prevent the effect of noise.

# 9. Wiring and connection

## 9-1. Wiring of AE sensor




* When relaying the AE sensor cable, the metallic part of the BNC connector should not contact the equipment. For the relay of the AE sensor cable, the use of a "waterproof relay connector set" is recommended.

Waterproof relay connector set: EO-CONCT-BNC-W

**[Cautions on relaying AE sensor cable]**

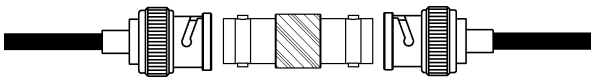
If the metallic part of the BNC connector contacts the equipment, the metallic parts may contact each other to generate AE waves.

For the relay of the AE sensor cable, the use of a "waterproof relay connector set" is recommended.

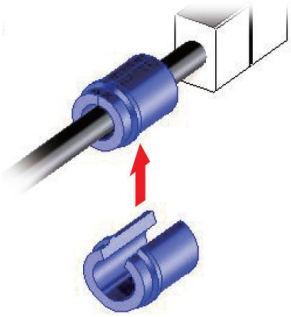
## 9-2. Relay and extension of AE sensor cable

■ Work procedure of waterproof relay connector set　　Model: EO-CONCT-BNC-W

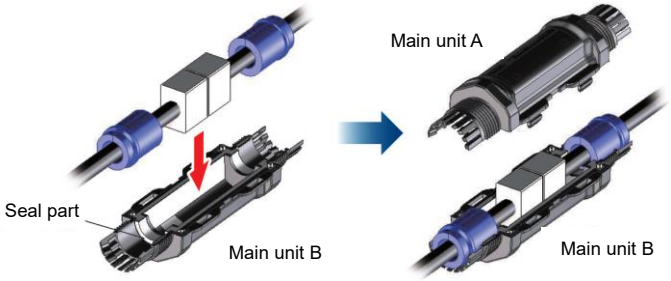
1) Connect the BNC connectors with a relay connector of "waterproof relay connector set".

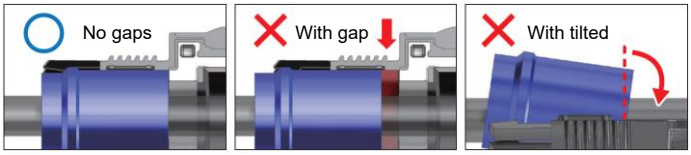


2) Open up the slit part of the rubber bush and cover the cable.



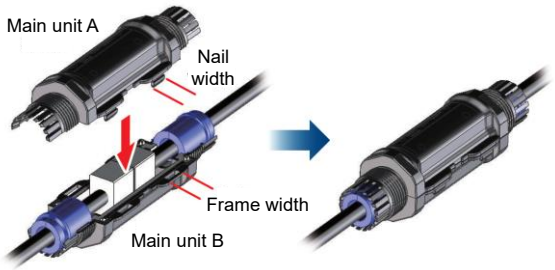
3) Embed the relay part and rubber bush into the main unit B. At this time, the edge surface of the rubber bush should contact the seal part (white) of main unit B without a gap, and it should not be tilted inward.



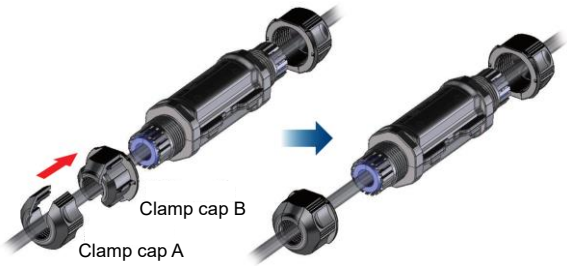

**[Caution]**
If the rubber bush is tilted inward, it interferes with the seal part of main unit A and it cannot be locked, so the watertightness gets damaged.

4) Check the orientation with nail width at the lock part of main unit A and frame width at the lock part of main unit B and embed the main unit A.




**[Caution]**
Embed the main unit A not to get the edge surface of rubber bush caught in the seal part (white) of main unit A.
Check the nail at the lock part is caught in the frame.

5) Assemble tightening caps A and B along the cable.




6) Tighten the tightening cap to fix the cable.



## 9-3. Input/output signal connections

This section explains the connection of the “input/output connectors” for Freddo Plus.

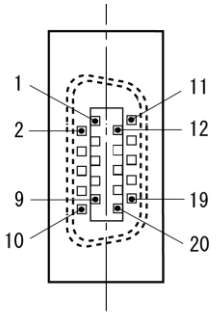
■Signal Name and Content

| In/ Out | Pin No. | Wire color | Signal Name | | Content |
|---|---|---|---|---|---|
| In | 1 | Orange Black1 | IN COM | Input common | Input signal common |
| | 2 | Gray Black1 | AE ST | AE measurement | ON = AE measurement start<br>OFF = AE measurement stop |
| | 3 | White Black1 | LOG ST | Logging | ON = loggng start, OFF = loggng stop |
| | 4 | Yellow Black1 | SEL1 | Type1 | Select the tool type<br>(threshold value, setting value) using binary bits.<br>1=000/2=100/3=010/4=110<br>/5=001/6=101/7=011/8=111 |
| | 5 | Pink Black1 | SEL2 | Type2 | |
| | 6 | Orange Black2 | SEL3 | Type3 | |
| | 7 | Gray Black2 | - | - | Do not connect anything. |
| | 8 | White Black2 | - | - | Do not connect anything. |
| | 9 | Yellow Black2 | RST | Threshold alarm reset | Turn on to disable the threshold alarm. |
| | 10 | Pink Black2 | - | - | Do not connect anything. |
| Out | 11 | Orange Red1 | OUT COM | Output common | Output signal common |
| | 12 | Gray Red1 | AE ST A | AE measurement answerback | ON = AE measurement start<br>OFF = AE measurement stop |
| | 13 | White Red1 | LOG ST A | Logging answerback | ON = loggng start, OFF = loggng stop |
| | 14 | Yellow Red1 | SEL1 A | Type1 answerback | Outputs the selected tool type as a binary bit.<br>1=000/2=100/3=010/4=110<br>/5=001/6=101/7=011/8=111 |
| | 15 | Pink Red1 | SEL2 A | Type2 answerback | |
| | 16 | Orange Red2 | SEL3 A | Type3 answerback | |
| | 17 | Gray Red2 | TH ALM1 | Threshold alarm 1 | The AE measurement value turns ON when it exceeds ‘Threshold 1’. |
| | 18 | White Red2 | TH ALM2 | Threshold alarm 2 | The AE measurement value turns ON when it exceeds ‘Threshold 2’. |
| | 19 | Yellow Red2 | RDY | Device normal | Should an abnormality occur in the AE system, it will switch to OFF. |
| | 20 | Pink Red2 | - | - | Do not connect anything. |

- During AE measurement, tool type input of SEL1/SEL2/SEL3 is not accepted.
- When the AE measurement input signal is off, logging also stops.
- The wire color is that of the EO-PPIO-C-3m.

The following input/output connectors are included.
Connector: 3M 10120-3000PE (soldered type, 20 pins)
Cover: 3M 10320-52F0-009

*Connectors with cables are available as an option.
Model: EO-PPIO-C-3m (AWG28 20-core, 3m length)

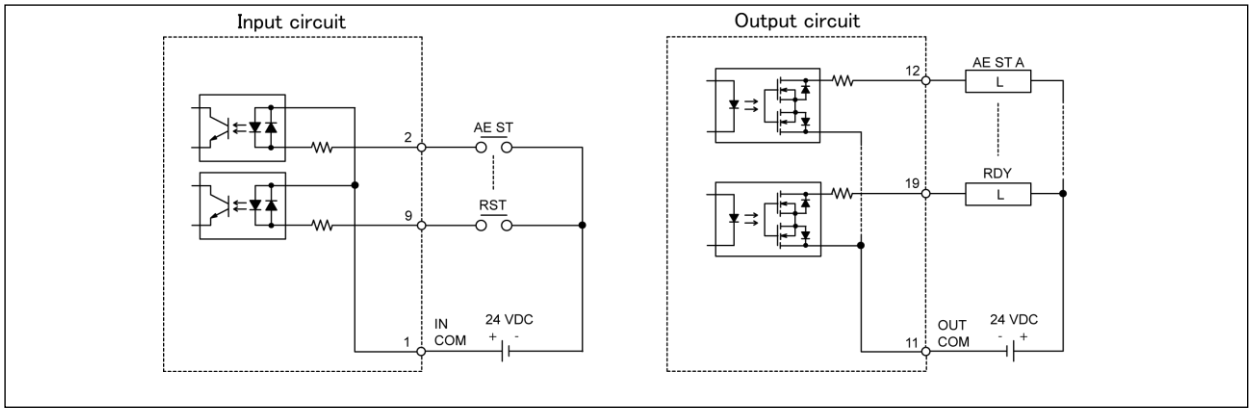


View from the soldering side

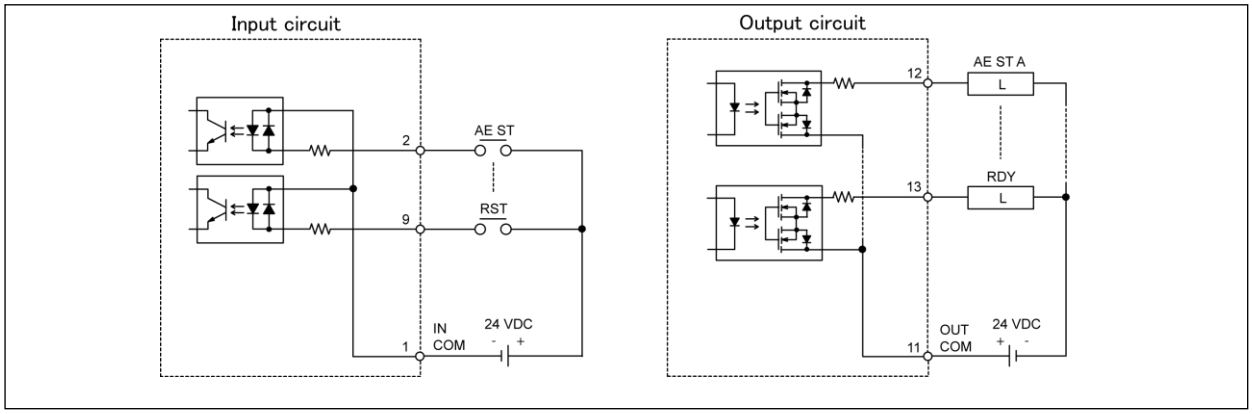
■Input/Output Circuit

Input and output signals can be connected either as a sink or source.
Connection examples are shown below.

[1] Sink Connection




[2] Source Connection



## 9-4. Touch sensor output connection

This section explains the connection for the touch sensor output.

Detects the touch-out of the cutting tool (the moment of contact with the material) by receiving AE waves and outputs within 2 ms.

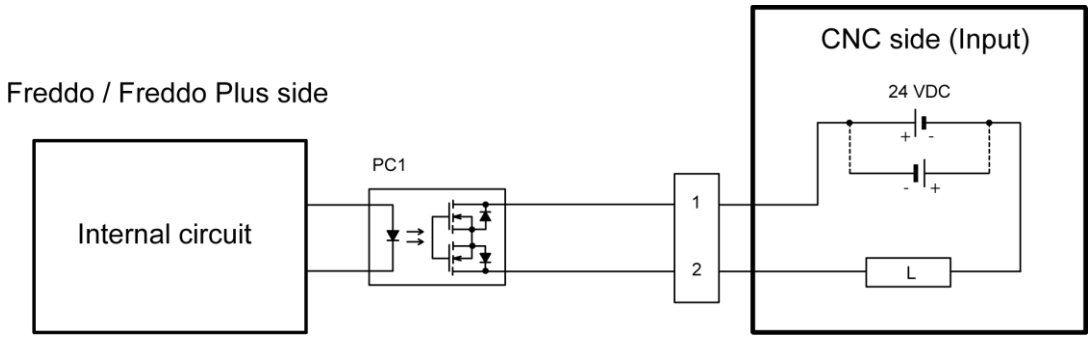
The output is a contact output (non-polar).
The contact specifications are shown below.

- Applied voltage: DC 60V or less
- ON current: 30mA or less

Use the following connectors for connection:
[Connector for connection side]

- VHR-2N (J.S.T. Mfg. Co., Ltd.)
- SVH-21T-P1.1 or SVH-41T-P1.1 (J.S.T. Mfg. Co., Ltd.)

*Connectors with cables are available as an option.
Model: EO-TOUCH-C-3m (AWG22 White/black twisted cable, 3m long)



# 10. AE measurement

## 10-1. AE measurement by sequencer

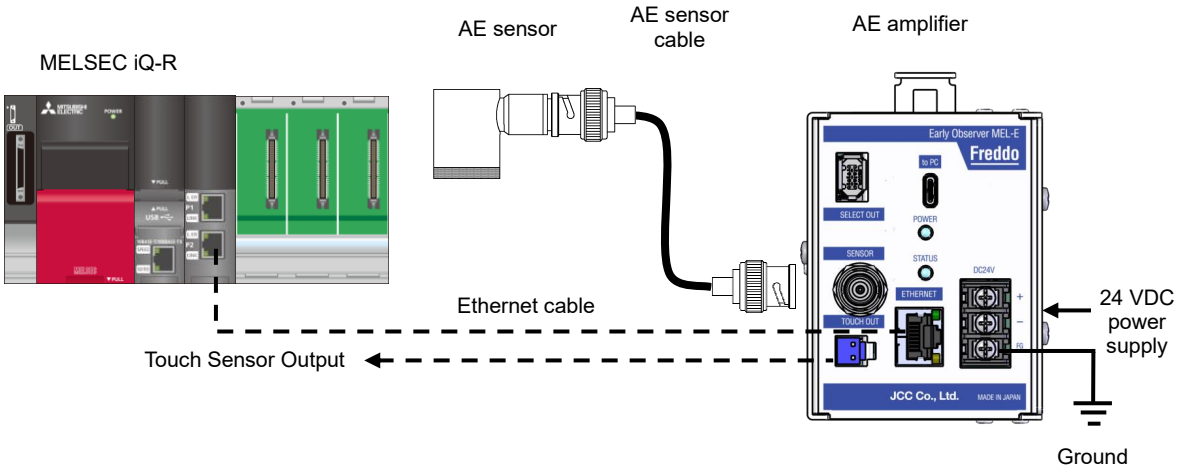
For the AE measurement from the sequencer (PLC), connect MEL-E Freddo and Ethernet unit of the sequencer with a LAN cable.

For the communication of AE measurement data, FB for communication is programmed for the sequencer.

* For how to program FB, refer to "Software Manual for Connecting MELSEC iQ-R".

■ Configuration of equipment

[ MEL-E Freddo ]




| Item | Specifications |
|---|---|
| Recommended Ethernet interface unit | Ethernet interface unit made by Mitsubishi Electric Corporation<br>MELSEC iQ-R : RJ71EN71, RnENCPU (Port1) |
| | Simultaneous measurement by connecting multiple units via HUB, etc. is not covered by the warranty. |

* For the LAN cable, a "shielded LAN cable" with a high shielding effect is recommended.
Both of straight and cross types of LAN cables are usable.

■ Procedure of AE measurement from sequencer

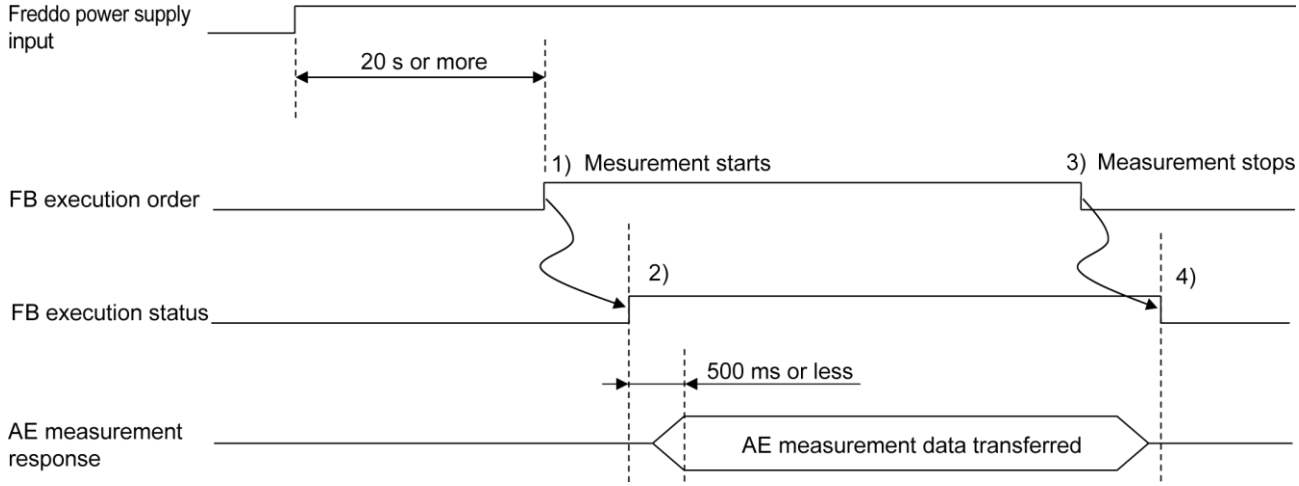
Carry out the AE measurement from the sequencer (PLC) in the following procedure.

* For how to program FB, refer to "Software Manual for Connecting MELSEC iQ-R".

Here is the procedure of AE measurement from the sequencer (PLC).

1) Turn on the "execution order" of AE measurement FB.
2) Receive the AE measurement data.
3) Turn off the "execution order" of AE measurement FB.
4) Check the "execution status" of AE measurement FB is off.

(The sequence of AE measurement is terminated)



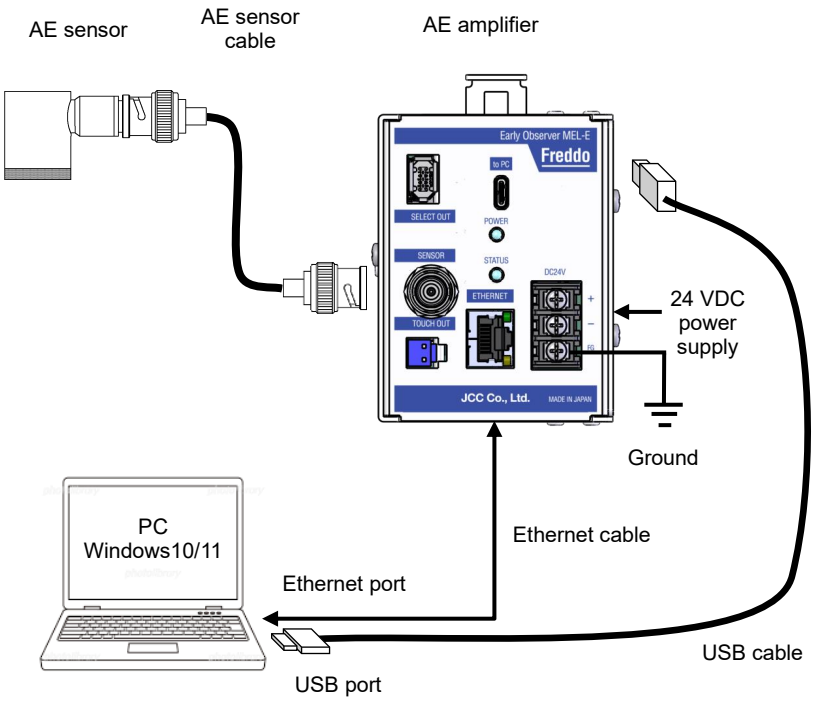

CAUTION

Execute the AE measurement after 20 seconds or later after turning on the power supply of MEL-E. (Activation of MEL-E is complete [POWER LED: lights up in green] after 20 seconds or later after turning on the power supply.)

## 10-2. AE measurement by PC

Connect Freddo to PC via "USB" or "Ethernet" cable and AE measurement can be executed by the dedicated software (AE SYSTEM SUPPORT TOOL for Pegasus_Freddo)
When the AE measurement transmission interval is 1 ms, perform measurements using an "Ethernet" connection.
The measurement data can be displayed as a graph on the PC display and saved in CSV format in the memory of PC.

■ Configuration of equipment




For how to operate the dedicated software (AE SYSTEM SUPPORT TOOL for Pegasus_Freddo), refer to the user's manual.

**[Cautions on AE measurement by PC]**

-If the AE measurement is performed by connecting the USB port of PC with a "USB cable", the Ethernet communication of MEL-E Freddo is interrupted.
-To restart the Ethernet communication with the MEL-E Freddo, turn off and on the power supply of MEL-E Freddo.
-AE measurement on a PC largely depends on the PC specifications.
Please use it for short-term measurements (approximately within 1 hour).

■ A USB driver is required to connect MEL-E Freddo to a PC via USB.

When connecting MEL-E Freddo via USB for the first time, connect MEL-E Freddo to your computer with a USB cable in an environment where you can perform Windows Update via the Internet.
The USB driver for the "Freddo/Freddo Plus" will be automatically installed.

* If the USB driver cannot be installed, download the driver from the website shown below, and then install it. https://ftdichip.com/drivers/vcp-drivers/

*Installation of the USB driver is required only when connecting MEL-E Freddo via USB for the first time. Installation of the USB driver is not required from the second time onwards.

## 10-3. AE measurement by standalone controller

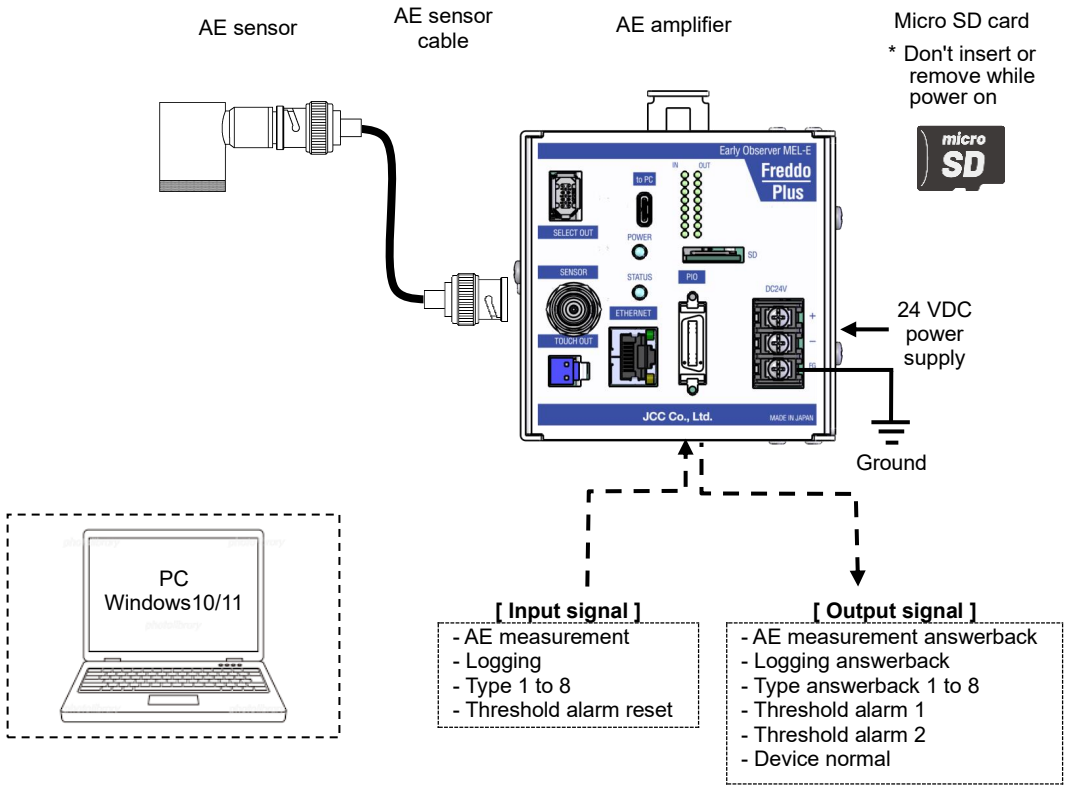
Freddo Plus can perform AE measurement using the controller alone.

Using the input and output signals of Freddo Plus, AE measurement is performed by the controller alone.

AE measurement data (logging data) can be saved to a microSD card in CSV format.
* Do not insert or remove microSD card while the power is on.

■ Configuration of equipment

[ MEL-E Freddo Plus ]




AE measurements are configured by connecting a PC and using the dedicated software “AE SYSTEM SUPPORT TOOL for Pegasus_Freddo”.
Refer to the user manual for operating instructions.

■Procedure of AE measurement from standalone controller

Carry out the AE measurement from the standalone controller in the following procedure.

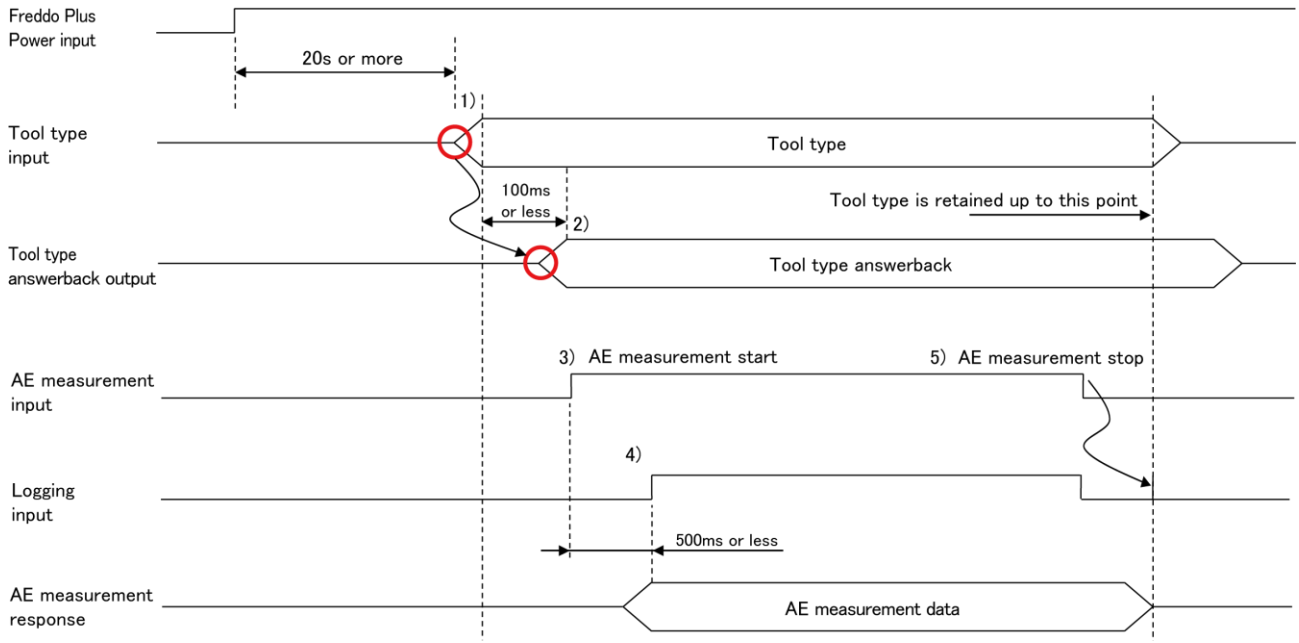
[ Procedure of AE measurement from standalone controller ]

1) Turn on the tool type number from the input signal.
2) Check the answerback of the input tool type.
3) Turn on "AE measurement" from the input signal.
4) Turn on "loggingt" from the input signal.

(AE measurement and logging execution)

5) Turn off "AE measurement" and "loggingt" of the input signal.

(AE measurement is terminated)




CAUTION

Execute the AE measurement after 20 seconds or later after turning on the power supply of MEL-E. (Activation of MEL-E is complete [POWER LED: lights up in green] after 20 seconds or later after turning on the power supply.)

- During AE measurement, tool type input of SEL1/SEL2/SEL3 is not accepted.
- When the AE measurement input signal is off, logging also stops.

■Logging data of AE measurement from standalone controller

Logging data can be saved to a microSD card in CSV format.

- Folder: Folders 1 to 8 are created for each tool type.

Each time a logging, "logging data" and "summary data"are saved in CSV file format.
*If performing continuous AE measurements, a new logging data file is created every 12,000 row.

1) Logging Data File

File name: Tool type number-Measurement date-Measurement time-Serial number of the file.

Example: 1-20250425-114953_00001.csv

| Column | Item | Description |
|---|---|---|
| A | Time(h:mm:ss.000) | Time (h:mm:ss.000)<br>*To show milliseconds on Excel, set the display format to “h:mm:ss.000” in the user definition. |
| B | Amplitude(mV) | Maximum amplitude value |
| C | Energy | Energy value |
| D | RMS(mV) | Effective value |
| E | Counts | 0 V or number of intersection points of Amp. threshold value |
| F | Interval(ms) | Transmission interval |
| G | Wire | Sensor cable information (OK / NG) |
| H | Power | Power information (OK / NG) |
| I | Gain(dB) | Gain value |
| J | LPF(kHz) | LPF value |
| K | HPF(kHz) | HPF value |
| L | Threshold(%) | Amp. Threshold value |
| M | Apportion | Energy apportionment value |
| N | Out1 | Threshold alarm 1（0:OFF / 1:ON） |
| O | Out2 | Threshold alarm 1（0:OFF / 1:ON） |
| P | Version | Version information |

2) Summary File

File name: Tool type number-Measurement date-Measurement time_summary.

Example: 1-20250425-114953_summary.csv

| Row | Item | Description |
|---|---|---|
| 1 | Amplitude-Maximum(mV) | Maximum amplitude value |
| 2 | Amplitude-Average(mV) | Average amplitude value |
| 3 | Amplitude-Variation(mV) | Variation amplitude value (maximum - minimum) |
| 4 | Energy-Maxmum | Maximum energy value |
| 5 | Energy-Total | Sum energy value |
| 6 | RMS-Maximum(mV) | RMS Maximum |
| 7 | RMS-Total | Sum RMS value |
| 8 | Energy-Apportionment | Energy apportionment value |
| 9 | RMS-Apportionment | RMS apportionment value |
| 10 | LPF(kHz) | LPF value |
| 11 | HPF(kHz) | HPF value |

# 11. Inspection and Troubleshooting

## 11-1. Inspection

| Item | Descriptions | Judgment Criteria | Remarks |
|---|---|---|---|
| Power supply | When measured at the power terminal block, is the voltage fluctuation range within the standard? | Power supply voltage fluctuation standard 12.0 to 24.0 VDC | Tester |
| Ambient environment | Is the ambient temperature within the specified range? | Controller : -10 to +55℃ | Thermometer |
| | Is there any dust or other buildup? | No dust | Visual |
| Installation status | Is the AE sensor properly fixed? | No rattle | |
| | Is the lubricant between the AE sensor and the measured object in proper condition? | Appropriate | |
| | Is the sensor cable about to break? | No abnormalities in appearance | |
| | Is the sensor cable connector loose? | No looseness | |
| | Are the input/output connectors loose? | No looseness | |

## 11-2. Troubleshooting

This section explains the errors that occur with Freddo/Freddo Plus and how to troubleshoot them.

| Problem | | Possible remedies | Countermeasure |
|---|---|---|---|
| LED POWER | Orange lit | System is operating. | Wait for the system to start up (approx. 20 sec). |
| LED STATUS | Red lit | Controller power supply is out of range. | Keep the power supply within the standard range. |
| | | The controller power supply is malfunctioning. | Replace the controller. |
| | Red blinks (1 time) | The sensor connector is disconnected. | Secure the sensor connector. |
| | | The sensor connector is loose. | Secure the sensor connector. |
| | | The sensor cable is broken. | Replace the sensor cable. |
| | | The sensor cable is shorted. | Replace the sensor cable. |
| | | AE sensor is malfunctioning. | Replace AE sensor. |
| | | The sensor circuit in the controller is malfunctioning. | Replace the controller. |
| | Red blinks (2 times) | microSD card not installed. | microSD card not installed. |
| | | The microSD card is low on storage space. | Formatting the microSD card. |
| AE detection level is low (small). | | GAIN setting is low. | Increase the GAIN setting |
| | | There is a gap on the contact surface of AE sensor. | Apply grease to the contact surface of the AE sensor. |
| AE detection level is high (large). | | GAIN setting is high. | Decrease the GAIN setting |
| | | AE detection level is high (large). | - Move the AE sensor mounting position away.<br>- Insert a thin rubber sheet between the contact surfaces of the AE sensor. |
| Noise appears in AE measurement data | | AE waves other than the AE sensor focus frequency are present. | Modify the LPF and HPF settings. |
| | | The sensor connector is in contact with a metal object. | Wrap cushioning material around the sensor connector. |
| | | A noise source is present near the AE sensor or cable. | - Keep the AE sensor and cable away from noise sources.<br>- Attach clamp filters to both ends of the sensor cable. |
| AE measurement cannot be performed from the external input signal. | | Input signal wiring is incorrect. | Correct the wiring. |
| AE measurement with a 1 ms period cannot be performed from a PC. | | The PC and Freddo are connected via USB. | Connect the PC and Fredo via Ethernet (LAN). |

If the above measures do not improve the situation, contact JCC.

## 12. WARRANTY PERIOD AND SCOPE

**The products described in this document are not intended for applications (such as medical equipment, vehicles, aircraft/spacecraft, and nuclear equipment control) that require extremely high reliability. If the customer considers using the products for such applications, please consult JCC's sales representative in advance.**
**Although JCC endeavors to improve the quality and reliability of our products, electronic devices in general are not free from malfunctions or failure. When wishing to apply our products to customer's equipment or system, the customer is responsible for ensuring the thoroughly safe design of the equipment or the system so that malfunctions or failure of our products will not cause any loss of human life, injuries, or loss of property.**

The warranty period of the delivered product is one year from the date of delivery.
In the event of a breakdown of the product during the above-mentioned warranty period due to our fault, we will repair or replace the returned product free of charge.
However, the breakdown caused by any of the following is not covered by this warranty.

1. Use or handling in an inappropriate condition or environment
2. Other than the delivered product
3. Unauthorized modification or repair by other than JCC
4. Matters not due to our fault, such as Acts of God or natural disaster
5. Matters or phenomena that couldn't be predicted by the technologies and techniques that were available at the time of delivery of the product

The warranty referred to herein means the warranty on the delivered product alone and does not cover any damages incurred by the breakdown of the delivered product. The specifications, operating instructions, and other descriptions in this document are subject to change without prior notice for improvement and other purposes. The price of the delivered product does not include any fees for dispatching engineers and other servicing.
The following cases are separately charged.

1. Assistance in installation, adjustment, and trial operation
2. Maintenance inspection, adjustment, and repair
3. Technical assistance, etc.




* This product is a data logging system adopting the AE sensor as a key technology, which does not guarantee machine failure sign diagnosis result or quality control.

■ **Contact** JCC Corporation
https://www.j-isb.jp/

**<Kobe Office>** **Dainichi Kakogawa Building 3F, 2444, Kitazaike,
Kakogawa-cho, Kakogawa-shi, Hyogo-ken, 675-0031, Japan
TEL: +81-79-423-2550 / FAX: +81-79-423-2551**

**<Technical Center>** **4-1-2, Ueno-cho, Toyota-shi, Aichi-ken, 471-0015, Japan
TEL: +81-565-87-2205 / FAX: +81-565-87-2206**