

# Instruction Manuals of Signal Converter (Detailed Edition) MODEL: VM-5011A

Manufacturer: **IMV CORPORATION** 

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# **INDEX**

Introduction	3
Safety Precautions	3
1. Overview	5
2. Features	5
3. System Composition	6
3-1. System Block Diagram	6
3-2. Equipment Configuration	6
4. Installation Method	7
4-1. Installation of the accelerometer	7
4-2. Laying of the Accelerometer Cable	8
4-3. Installation of the Converter	8
5. Wiring Method	8
6. Power on the Converter	. 2
7. Change of Measurement Range and DC Output	. 2
8. How to connect with the VP-8021A	. 4
	_
9. Handling precautions	. ၁
9. Handling precautions	
	5
10. Warranty	L 5
10. Warranty	1 5 1 6
10. Warranty	5 6 6
10. Warranty	5 6 6 7
10. Warranty	5 6 7 7
10. Warranty	5 6 7 7 8
10. Warranty	5 6 7 8 2 3
10. Warranty	5 6 7 7 8 2 3
10. Warranty	5 6 7 8 2 3 2 3 2 4
10. Warranty	5 6 7 8 2 3 2 3 2 4



#### Introduction

Thank you for purchasing Signal Converter "VM-5011 Series".

Read this instruction manuals carefully to ensure the best performance and longest product life of the device. In addition, pay attention to the cautions described below to use the product safety.

#### Caution

- (1) Signal converter (hereinafter referred to as "converter") is a device that diagnoses various vibration for industrial equipment such as electric motors and pumps, and consumer equipment. Do not use it for any other purpose.
- (2) When wiring the converter and piezoelectric acceleration sensor (hereinafter referred to as "accelerometer"), make sure that power supply source is "off" before performing the work.
- (3) Ground the system separately from the power equipment, and make sure to use the terminal block or binding post.
- (4) Signal line from the accelerometer and output signal line from the converter should not be bundled with the power line or the signal line that generates noise but should be laid in a separate system.

## Safety Precautions

It describes the items that you should follow in order to prevent harm to customers and other people and damage to property, and to use this product safely. Please be sure to read this instruction manuals and attached documents before use, and fully understand the contents for use.

After reading this manual, be sure to place it in a location so that you can always refer to it.

#### Expressions of Safety Instructions

Indication	Meaning of Indication
/ Warning	Indicates the contents that may cause a dangerous situation of death
Z:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	or serious injury if mishandled.
/!\Caution	Indicates the contents that may cause serious injury or property
Z:\Caution	damage if mishandled.
	Describes cases where there is no risk of injury to the operator, but it
Note	is expected to cause damage or failure to this product or other
	equipment or devices.

<sup>\* &</sup>quot;Serious injuries" are those with residual aftereffects such as blindness, injury, burns, electric shock, fractures, poisoning etc., and those requiring hospitalization or long-term hospital visits for treatment.

In addition to the danger level classification, this document also uses the following notation:

Memo: "Memo" describes supplementary explanations that could not be explained in the text and information that is useful to know.

<sup>\* &</sup>quot;Minor injuries" are those that do not require hospitalization or long-term hospital visits for treatment (other than the "serious injuries" above).



#### ♦ For Safe Use

# **Marning**

- (1) Do not use this product as a life-threatening alarm device.
- (2) When installing this product or peripheral devices in a high place, be sure to use a workbench such as a stepladder.
- (3) Do not use in abnormal conditions such as smoke, strange odor, or noise. Also, do not disassemble or modify this product regardless of whether it is normal or abnormal. It may cause electric shock, fire, or malfunction.
- (4) When installing near a moving part of the machine, make sure that the machine is stopped before installing it. Do not perform any installation work while the machine is in operation.

# 

- (1) Be sure to wear a helmet when working at heights.
- (2) When installing this product or peripheral devices in a high place, fix them firmly. If this product or peripheral devices fall, an accident may occur.
- (3) When the product is energized, do not touch the terminal block etc. carelessly.

## **Note**

- (1) When connecting the accelerometer to the converter, check the method that matches the specifications of the device to be connected. Improper connection may cause the product or connected devices to malfunction or be damaged.
- (2) Use this product in the environment described in this manual. If you use it in an environment not described in this manual, unexpected problems may occur. In addition, if the main unit is damaged or peripheral devices are damaged due to the above reasons, the warranty will be void.
- (3) Do not attach this product to the interference point or operating point of the object to be measured. The object to be measured may damage.

#### Memo

- (1) This product is a precision device. Please handle with care.
- (2) When performing automatic measurement operation using this product, it may not be possible to record measurement data as expected if the settings are not correct. Please check in the actual environment whether the measurement data can be obtained as expected, and after confirming that there are no problems, start operation at full scale.



## 1. Overview

The purpose of this product is to constantly monitor vibrations for safety confirmation during operation of various rotating devices such as electric motors and pumps, detection of abnormal operations, detection of deterioration phenomena, and early maintenance.

Vibration of the electric motor, pump, etc. is detected by the accelerometer, vibration signal is converted by the converter as envelope acceleration (hereinafter referred to as "E acceleration") and velocity. Those vibration level output as DC current of 4-20mA or DC voltage of 0-10V.

In addition, the vibration signal output AC voltage of 0-1V rms and can be used for analysis of vibration waveforms.

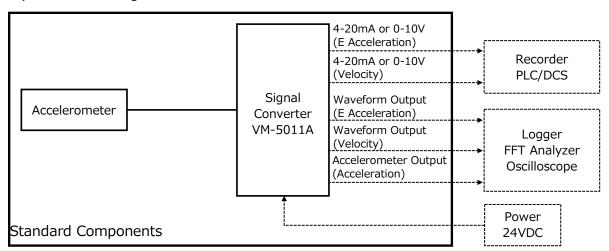
#### 2. Features

- (1) Simultaneous monitoring of E acceleration and velocity levels.
- (2) Several accelerometers are available for connection to the converter.
- (3) The converter is compact and can be mounted on a DIN rail.



# 3. System Composition

# 3-1. System Block Diagram



# 3-2. Equipment Configuration

## Main Components

Name	Model	Qty	Remarks
Signal Converter (Converter)	ter VM-5011A		
Accelerometer	VP-1001000206 (VP-100)		Cable Direct Leading
* Select one of the models at the time of purchase	VP-1001000106 (VP-100R)	1	Cable Direct Leading (Waterproof Type)
	VP-1001005406	1	Cable with Connector (Not included in price)
	VP-8021A		Cable with Connector (Standard Accessory)

#### Memo

- (1) The above quantity is for one set.
- (2) Refer to the options below for the cable of VP-1001005406.
- (3) Standard cable length of above accelerometers is 5m.
- (4) Detailed specifications of above accelerometers see section 11-4.

# Option (Not in included in price)

名 称 型 式		数量	備考	
Cable of VP-1001005406 MS-AC010-5			Straight Connector	
Length: 5m MS-AC011-5			Right Angle Connector	
Magnet for mounting MH-205R			for Flat Surface	
Accelerometer MH-206R			for Curved Surface	



#### 4. Installation Method

#### 4-1. Installation of the accelerometer

The accelerometer detects vibration on the bottom. Therefore, it is an important condition for detecting vibration that the bottom surface is in close contact with the vibrating part.

Ideally, the surface of the equipment on which the accelerometer will be installed should be as flat as possible, and the contact surface should be coated with silicone grease or oil (Fig. 4-1).

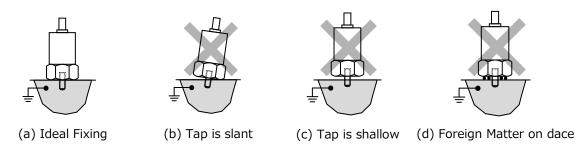


Fig.4-1 Installation of the Accelerometer

# **⚠** Caution

Be sure to check the following items before installing the accelerometer.

- (1) Is the instrument to be measured grounded
  - If the accelerometer mounting surface (measurement target instrument) is not properly grounded, it may become charged and may fail.
- (2) Is the accelerometer mounting surface cleanly finished

  Remove completely such as dirt, dust, and paint. Also, make sure that the tapped holes are upright with no foreign matter on the threads.

# Processing of the accelerometer mounting surface

The degree of close contact between the accelerometer and mounting surface directly affects the characteristics of the accelerometer.

Especially, since the accelerometer measures up to high frequencies, make mounting surface flat and tap M6 female screw perpendicular to mounting surface (Fig. 4-2).

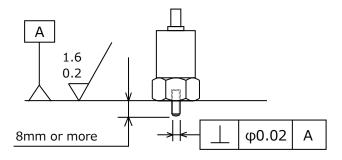


Fig.4-2 Processing of the accelerometer mounting surface



## 4-2. Laying of the Accelerometer Cable

- (1) The accelerometer cable fix away from the device to be measured and at the location closest to it, and then fix the cable appropriately so that there is no slack.
- (2) When relaying the accelerometer cable, use the junction box, and use the twisted pair shielded cable that takes the installation environment into consideration. Also, keep the wiring as short as possible.

# Memo

- (1) If the accelerometer cable is parallel to power line such as the inverter, noise from the power line may affect the measurement. Install the accelerometer cable as far away from the power line as possible.
- (2) To protect the accelerometer cable from vibration, use a flexible conduit up to it installation location.
- (3) When relaying the accelerometer cable using the junction box, install it in an environment with as little noise as possible (in a place where noise countermeasures have been taken).

#### 4-3. Installation of the Converter

The converter is mounted using 35mm DIN rail (Fig.4-3).

- (1) Hook the upper side of the converter body on DIN rail.
- (2) While pulling down stopper on the lower side of the converter, hook it on the DIN rail.

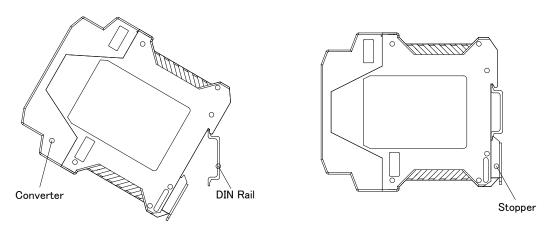


Fig.4-3 Installation of the Converter

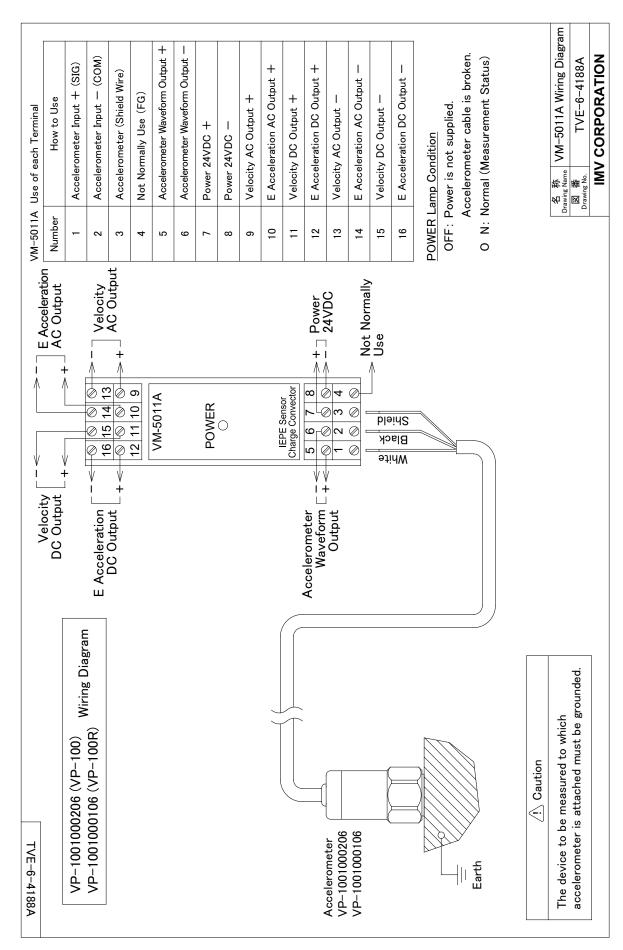
#### Memo

Install the converter in a clean place with as little noise as possible and little vibration or temperature change.

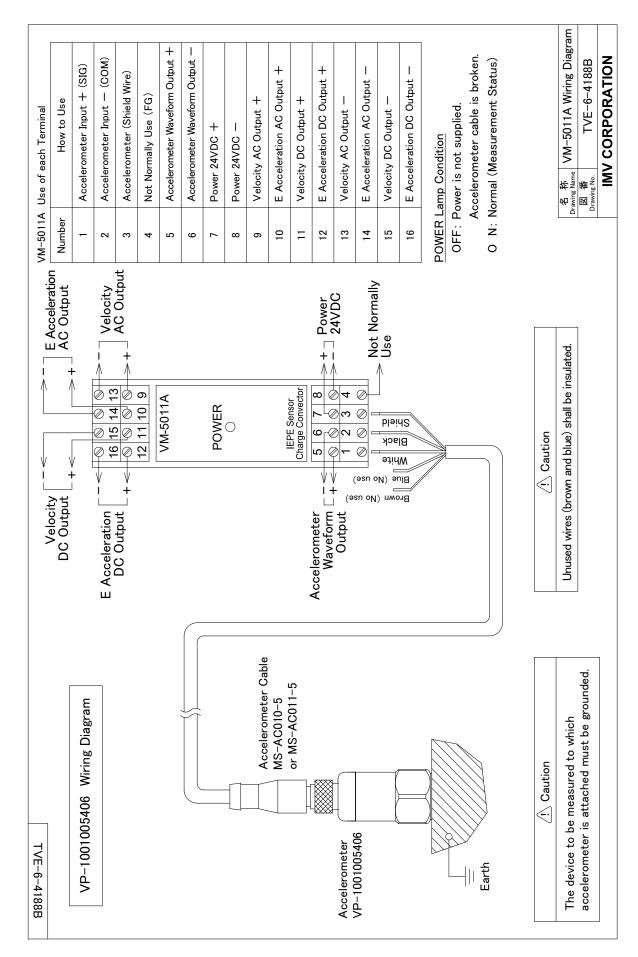
## 5. Wiring Method

Connect power supply, the accelerometer and various subsequent instruments according to the wiring diagram shown on from p9 to p11.

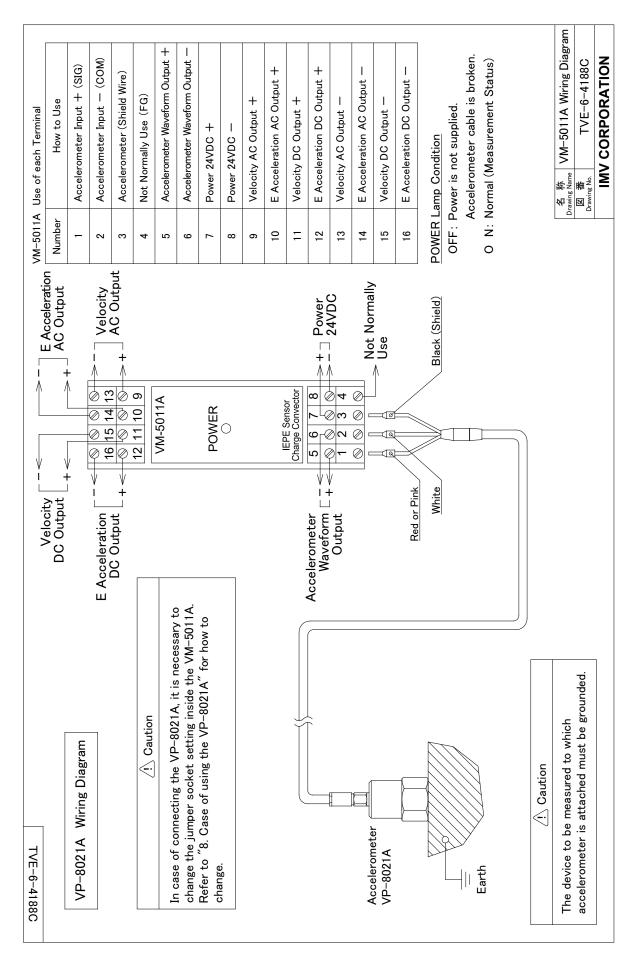














#### 6. Power on the Converter

After connecting according to section 5, turn on the power and the "POWER" lamp on the front of it will light up (Fig.6-1).

#### Memo

- (1) The converter takes about 30 seconds from power-on to stability.
- (2) If "POWER" lamp is off even though power is being supplied, the accelerometer cable may not be connected properly, or the accelerometer cable may be broken. In such a case, turn off power supply to the converter once, check that the accelerometer cable is connected correctly, and then turn on power again.

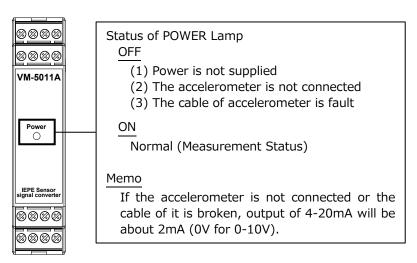


Fig.6-1 POWER Lamp Indication

# 7. Change of Measurement Range and DC Output

The converter can change measurement range and DC output. Follow the procedure below.

## Setting Method

- (1) Turn off power supply to the converter and disconnect all wiring connected to it.
- (2) Remove the converter from the DIN rail.
- (3) Push lock hooks on the top and bottom of the converter with a flat-blade screwdriver. Release the lock, then hold upper housing and pull it out from base housing (see Fig.7-1).

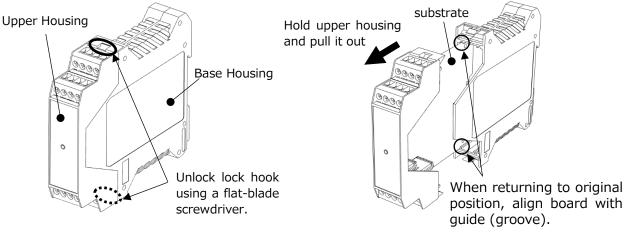
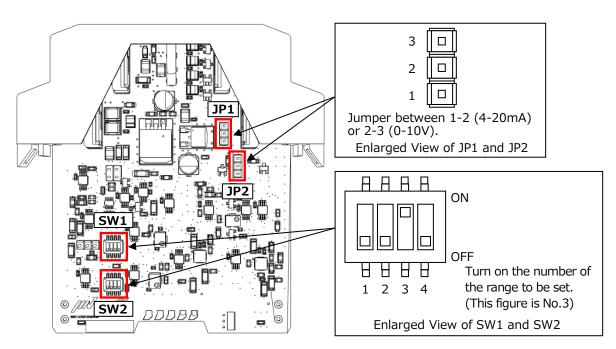


Fig.7-1 Pulling out upper housing



(4) Change measurement range and DC output according to Fig.7-2 below.



"JP" and "SW" Setting Item		Setting	Factory Default	
JP1	E acceleration	1-2	4-20mADC	<b>✓</b>
JPI	DC Output	2-3	0-10VDC	
JP2	Velocity	1-2	4-20mADC	<b>✓</b>
JP2	DC Output	2-3	0-10VDC	
		1	$0\sim10$ m/s $^2$ E rms	
SW1	E acceleration	2	$0\sim$ 25m/s <sup>2</sup> E rms	
(*)	Measuring Range	3	$0\sim50$ m/s $^2$ E rms	<b>✓</b>
		4	$0\sim100$ m/s $^2$ E rms	
		1	10mm/s rms	
SW2	Velocity	2	25mm/s rms	
(*)	Measuring Range	3	50mm/s rms	<b>V</b>
		4	100mm/s rms	

## (\*) Do not turn on more than one switch.

Fig.7-2 Setting of Measurement Range and DC Output

# **Note**

- (1) Do not change the jumper or the adjust variable resistance other than the above. Correct measurement may not be possible.
- (2) The converter is a precision device. Please handle with care.
- (3) Please do not forget to record and manage the settings.
- (5) After completing the settings, insert upper housing into base housing, check that lock hook is locked, attach it to the DIN rail, and reconnection each cable.



## 8. How to connect with the VP-8021A

The converter also supports connection with our MEMS high-frequency vibration sensor VP-8021A.

The setting of factory default connecting accelerometer is the VP-100. When connecting the VP-8021A to the converter, it is necessary to change jumper JP4 settings on circuit board (see Fig.A-1).

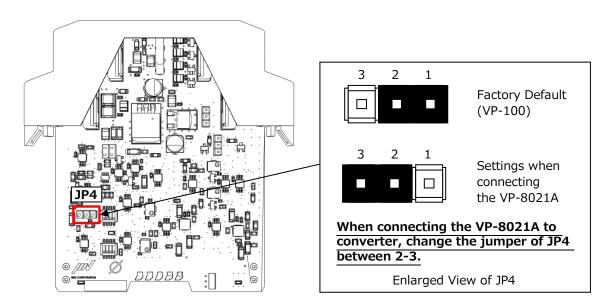


Fig.A-1 Jumper change when connecting the VP-8021A

Refer to "5. Wiring method" for how to connect the VP-8021A to the converter.

#### Memo

- (1) Refer to "7. Change of Measurement Range and DC Output" for how to pull out the board.
- (2) For more information on the VP-8021A, please check our website.

URL: https://www.imv.co.jp



# 9. Handling precautions

# Caution

- (1) Avoid moving the accelerometer during vibration measurement. When moving, turn off power supply to the converter before moving.
- (2) Use a DC power supply for this product and use a stable power supply with little external noise (noise surge pulse).

## Note

When storing this product for a long period of time, avoid places exposed to direct sunlight, high humidity, and dusty places, and store it in a place within the operating temperature and humidity range.

#### Memo

When disposing of this product, dispose of it as industrial waste.

# 10. Warranty

This product is shipped after the strict inspection in our factory. But in case the system has the fault caused by the responsibility of IMV as the defect under production and material during warranty period, we will repair or replace free of charge. However, consumables such as lamps will be excluded.

In this case, it is limited to the warranty period. The warranty period of this product is one year from the date of delivery. However, even within the warranty period, repairs will be charged in the following cases.

- (1) Any damage and breakdown caused by natural disaster such as fire, earthquake, flood, lightning damage.
- (2) Any transporting, moving, or dropping which does not related us after finishing our delivery.
- (3) Any error operation, unusual power supply input, and the fault caused by disassembling/repairing/modifying by customer.



# 11. Specifications

# 11-1. Specifications of the Converter (VM-5011A)

Model		VM-5011A	
Input Range		$0\sim 500 \text{m/s}^2$	
Measuring Range of	E acceleration	10Hz to 1kHz	
Frequency		Band Pass Filter: 500Hz~10kHz (*2)	
	Velocity	10Hz to 1kHz (*2)	
		(ISO 2954:2012 Filter Characteristics compliant)	
Measuring Range (*1)	E acceleration	$\Box$ 10m/s <sup>2</sup> E rms	
		$\square$ 25m/s <sup>2</sup> E rms	
		■ 50m/s <sup>2</sup> E rms	
		$\square$ 100m/s <sup>2</sup> E rms	
	Velocity	☐ 10mm/s rms	
		☐ 25mm/s rms	
		■ 50mm/s rms	
		☐ 100mm/s rms	
Connect Accelerometer	(*1)	■ VP-100 (*3)	
		☐ VP-8021A	
DC Output (*1)	E acceleration	■ 4-20mA (Load 500Ω or lower)	
		$\square$ 0-10V (Load 100k $\Omega$ or higher)	
	Velocity	■ 4-20mA (Load 500Ω or lower)	
		$\square$ 0-10V (Load 100k $\Omega$ or higher)	
AC Output	E acceleration	0-1Vrms (Load 100kΩ or higher)	
	Velocity	0-1Vrms (Load 100k $\Omega$ or higher)	
Linearity	DC Output	within ±3%F.S	
	AC Output	within ±5%	
Accelerometer Waveform	n Output	Depends on Voltage Sensitivity of Accelerometer	
		Bias Voltage: 9VDC	
Operating Temperature		0 to 50℃、95%RH or less	
and Humidity Range		without freezing or condensation	
Suitable Cable of Termi	nal Block	0.2 to 2.5mm <sup>2</sup> (Single wire / Stranded wire)	
		(AWG12 to 24)	
Power Supply of the Co	nverter	24VDC±10%	
Power Supply of Accele	rometer	24VDC 3.5mA±20%	
Power Consumption		3W or less	
Case Material		Resin	
Outer Dimensions (Exclu	ding protrusions)	W22.6×H99×D113.6mm (See p.16)	
Weight		Approx. 150g	

<sup>\*1 &</sup>quot;■" is factory default settings.

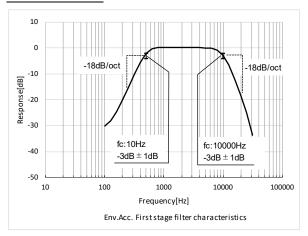
\*3

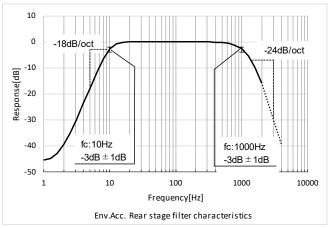
<sup>\*2</sup> Refer to "10-2. Standard Characteristic of the Converter".



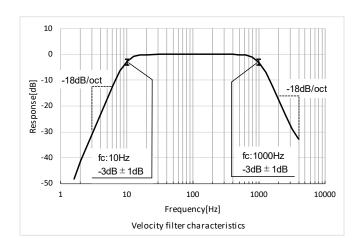
## 11-2. Standard Characteristic of the Converter

# E Acceleration

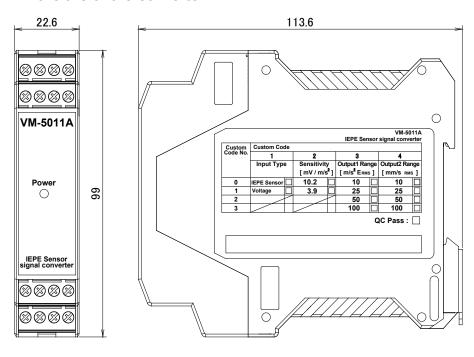




# Velocity



# 11-3. Outer Dimensions of the Converter



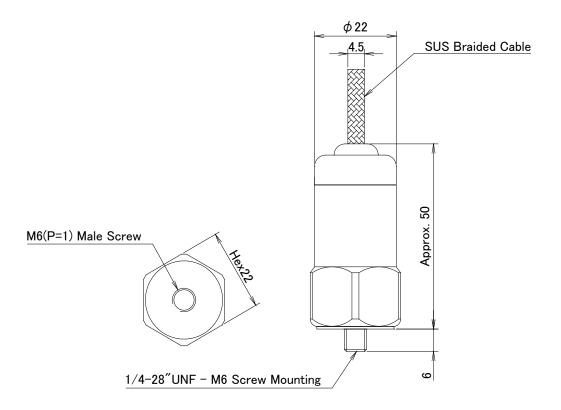
Unit [mm]



# 11-4. Specifications of Accelerometer

# (1) VP-1001000206 (VP-100) (Cable Direct Leading Type)

Detecting Method	Compression Type
Resonance Frequency	22kHz or more
Frequency Range	2Hz to 10kHz ±1dB
Voltage Sensitivity	$10.2 \text{mV/(m/s}^2) \pm 10\%$
Max Measurement Acceleration	784m/s <sup>2</sup>
Drive Current	0.5 to 8mA (18 to 30VDC)
Operating Temperature	-55 to +140℃
Protection Class	IP65
Weight	Approx. 106g (without Cable)
Case Material	SUS303
Mounting Method	M6 Screw
Cable Sheath Material	SUS Braided Cable
Cable Length	5m (Standard Length)
Outer Dimensions	See below Figure

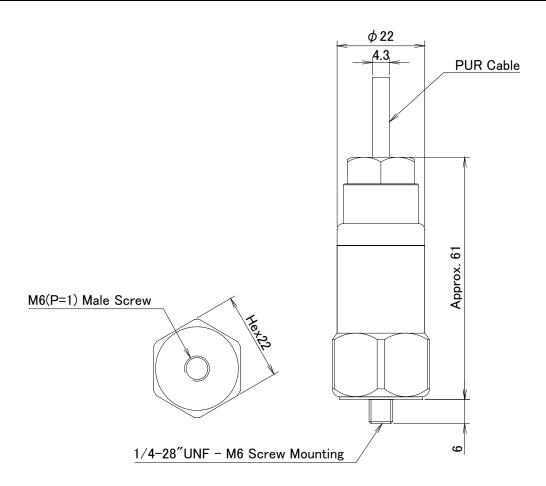


Outer Dimensions of the VP-1001000206 (Unit: mm)



# (2) VP-1001000106 (VP-100R) (Waterproof Type with Oil-resistant Cable)

Detecting Method	Compression Type
Resonance Frequency	22kHz or more
Frequency Range	2Hz to 10kHz ±1dB
Voltage Sensitivity	$10.2 \text{mV/(m/s}^2) \pm 10\%$
Max Measurement Acceleration	784m/s <sup>2</sup>
Drive Current	0.5 to 8mA (18 to 30VDC)
Operating Temperature	-55 to +140℃
Protection Class	IP65
Weight	Approx. 125g (without Cable)
Case Material	SUS303
Mounting Method	M6 Screw
Cable Sheath Material	PUR
Cable Length	5m (Standard Length)
Outer Dimensions	See below Figure

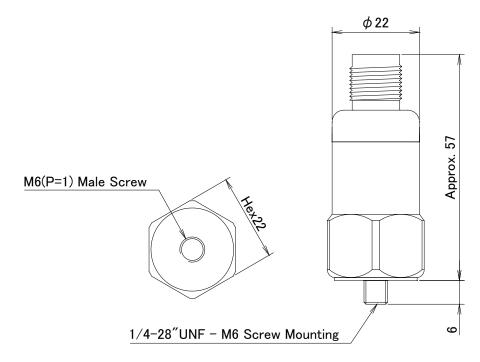


Outer Dimensions of the VP-1001000106 (Unit: mm)



# (3) VP-1001005406 (Connector Type)

Detecting Method	Compression Type
Resonance Frequency	22kHz or more
Frequency Range	2Hz to 10kHz ±1dB
Voltage Sensitivity	$10.2 \text{mV/(m/s}^2) \pm 10\%$
Max Measurement Acceleration	784m/s <sup>2</sup>
Drive Current	0.5 to 8mA (18 to 30VDC)
Operating Temperature	-55 to +140℃
Protection Class	IP67
Weight	Approx. 125g (without Cable)
Case Material	SUS303
Mounting Method	M6 Screw
Cable Connecting Method	M12 Connector
Outer Dimensions	See below Figure



Outer Dimensions of the VP-1001005406 (Unit: mm)

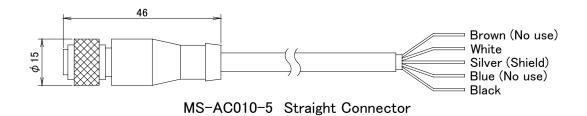


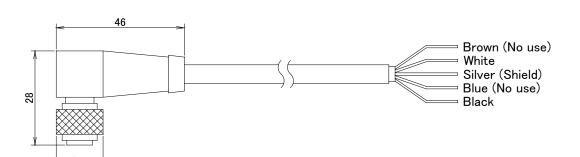
# Out view of the Cable of VP-1001005406 (Connector Type)

Cable Sheath Material: PUR

Finished Outer Diameter: Approx. 5.9mm

Cable Length: 5m



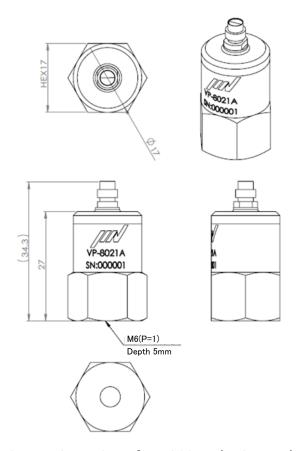


MS-AC011-5 Right Angle Connector



# (2) VP-8021A (including Cable with a Connector)

Detecting Method	Capacitance (MEMS) Type
Resonance Frequency	17kHz or more
Frequency Range	10Hz to 8kHz ±3dB
Voltage Sensitivity	$3.9 \text{mV/(m/s}^2) \pm 5\%$
Max Measurement Acceleration	490m/s <sup>2</sup>
Drive Current	3.5mA (Typ.) 24VDC (Max.)
Operating Temperature	-30 to +120℃
Weight	Approx. 15g
Case Material	A5052 (Alumite treatment)
Mounting Method	M6 Screw
Cable Sheath Material	ETFE
Cable Length	5m (Standard Length)
Outer Dimensions	See below Figure



Outer Dimension of VP-8021A (Unit: mm)



# 12. Maintenance and Troubleshooting

#### 12-1. Maintenance

Check the following items when performing maintenance and inspection.

- (1) Maintenance of the Converter
  - (a) Is the screw at the connector terminal where cable is connected loose?
  - (b) Is the connected cable damaged?
  - (c) Is the power supply as specified (whether POWER lamp is on)?
  - (d) Is there any abnormal heat generation while the power is on?
- (2) Maintenance of the Accelerometer
  - (a) Is accelerometer installed loosely (is it securely installed)?
  - (b) Is accelerometer or the cable of accelerometer damaged?
  - (c) Is there a problem with the grounding of measurement target device to which sensor is attached?

## 12-2. Troubleshooting

If you feel any malfunction or abnormality, please check the following before requesting repair or replacement. If the problem persists even after checking the following, please contact the purchasing agent or us.

Status	Cause	Treatment	
POWER lamp does not	Power is not being supplied.	Please supply power.	
light.	Cable connection is not made, or	Make sure to connect them securely.	
	cable connection is incorrect.		
	The supply power supply voltage is	Check the power supply	
	out of the specification range.	specifications.	
	Accelerometer does not connect.	Please connect it.	
	Accelerometer cable is disconnection.	Replace the cable of it.	
Output of 4-20mADC does	Accelerometer cable is unconnected	Connect the cable correctly.	
not change from 2mA.	or disconnected.		
Vibration measurements	Accelerometer is installed in the	Reinstall in the correct detecting	
are very small (large).	wrong detection direction.	direction.	
	Vibration is small (large).	_	
①Vibration measurements	Accelerometer is not securely fixed.	Please fix it securely.	
are very unstable.	There is a poor contact in cable	Please connect it securely.	
②Suddenly, vibration	connection part of the converter.		
measurement became	Accelerometer is broken.	If you own an accelerometer of the same	
extremely large (small).		specifications, check if the phenomenon	
		is reproduced or if the phenomenon is	
		switched by replacing the accelerometer.	
	The converter is out of order.	If you own a converter of the same	
		specifications, check if the phenomenon	
		is reproduced or if the phenomenon is	
		switched by replacing the converter.	
	Vibration is unstable or large (small).	_	



# 13. About Envelope Acceleration (E acceleration)

If the inner ring of a rolling bearing is scratched, vibration with an impact (several kHz or more) will occur each time the rolling element passes through the scratch (Fig.13-1).

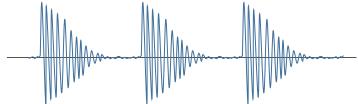


Fig.13-1 Example of impact waveform when bearing is abnormal

By processing the impact waveform by absolute value and passing it through a low-pass filter, the envelope curve corresponding to the thick line in Fig.13-2 is obtained. By frequency analysis of the obtained envelope, the repetition period (frequency) of impact can be obtained.

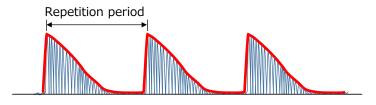


Fig.13-2 Envelope processing

In addition, the waveform with impact also includes the primary rotation component and low-frequency vibration component, and these components become noise in the envelope processing, so they are removed in advance using a bandpass filter.

This product uses a bandpass filter of 500Hz to 10kHz before envelope processing, removes primary rotation components and low frequency components, performs envelope processing, and outputs the enveloped waveform as "E acceleration AC output". (See Figure 13-3).

Since the impact repetition frequency differs depending on which part of the bearing is damaged, precise diagnosis is possible by frequency analysis using the E-acceleration AC output.

In addition, the waveform after envelope processing is converted to 4-20mA or 0-10V and output as a vibration level, so early detection of bearing abnormalities can be expected by managing the vibration level.

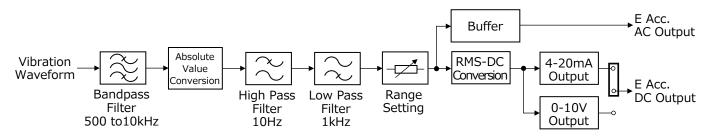


Fig.13-3 Block Diagram of E acceleration



Appendix.1 When the place where accelerometer is attached is not grounded Normally, the location where accelerometer is installed (the device to be measured) must be grounded.

If for some reason it cannot be grounded, ground it via the converter as shown in Fig.A-1.

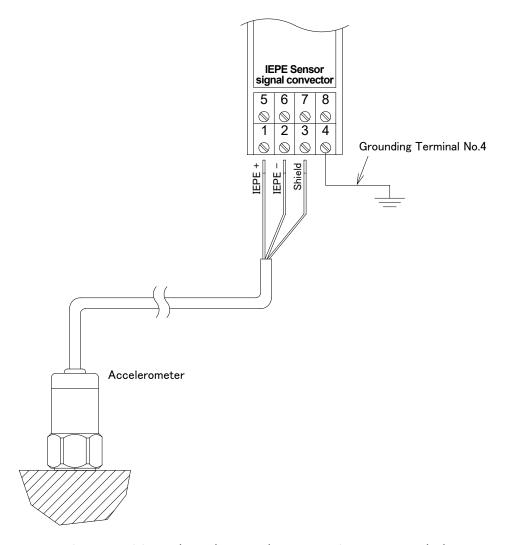


Fig.A-1 Wiring when the Accelerometer is not grounded

#### Memo

If the location where accelerometer is installed (device to be measured) is grounded, do not make the above wiring.

By grounding at two points, a loop is formed through the ground wire, which adversely affects the minute signal flowing through the accelerometer signal line, which may prevent correct vibration measurement.



# Appendix.2 About voltage input connection specifications

The current for driving IEPE sensor (accelerometer) is output from accelerometer input terminal of the converter. It can be set to ON (IEPE sensor connection) or OFF (voltage input connection) of the drive current supply with jumper JP3 (see Fig.A-2).

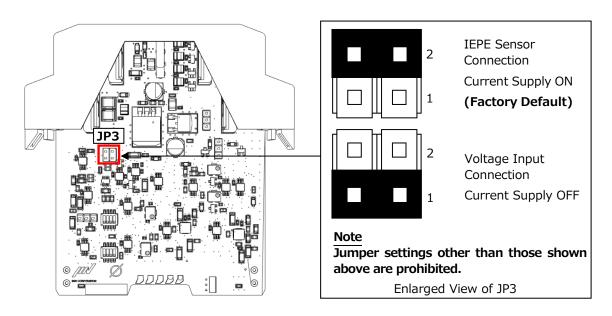


Fig.A-2 Drive Current Supply Setting

## Memo

- (1) Refer to "7. Change of Measurement Range and DC Output" for how to pull out the board.
- (2) In the case of voltage input connection, POWER lamp lights up after power is supplied regardless of the cable connection status to the accelerometer input terminal.



# © Example of using voltage input connection

Use accelerometer waveform output of another type of the converter (VM-5011B etc.) and connect it to the accelerometer input terminal of voltage input specification the converter (VM-5011A).

This makes it possible to measure E acceleration ( $m/s^2E$  rms) and velocity (mm/s rms) at the same time (see Fig.A-3).

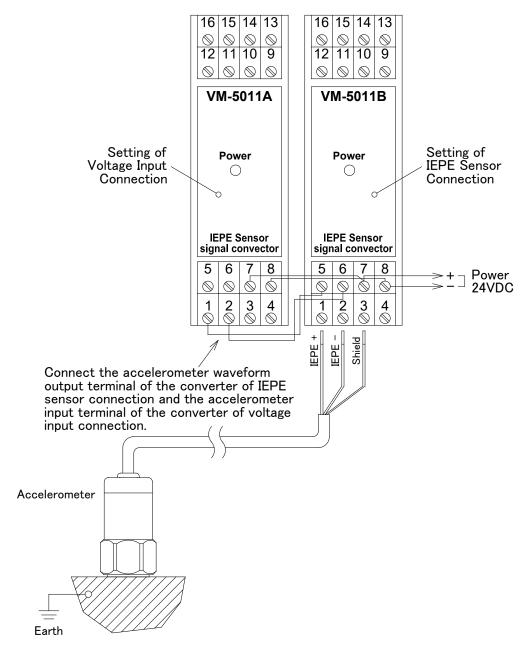


Fig.A-3 Connection example of voltage input specification the converter

# Caution

Before performing the wiring work, turn off the power supply to the converter.



# Appendix.3 About Magnet (Accelerometer mounting options)

A magnet for attaching the VP-100 and the VP-8021A to the measurement point is available as an option (see Table.A-1 and Fig.A-4).

Table.A-1 Accelerometer Mounting Magnet

Model	Model Mounting Material		Adsorption	Outer
	Surface	Material	Force	Dimensions
MH-205R	Flat Surface	Steel	Approx. 160N	See Fig.A-6
MH-206R	Curved Surface	SUS	Approx. 150N	See Fig.A-6

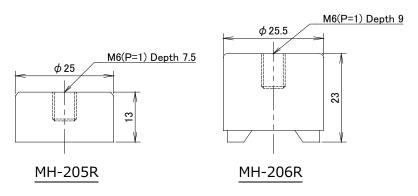


Fig.A-4 Outer Dimensions of Magnet (Unit: mm)

# **↑** Cautions

The adsorption force of magnet is very strong, even if it is installed to the accelerometer mounting surface from a very short distance, a large impact will be applied to it.

Accelerometer may break down due to a large impact, so once you touch the end of magnet to the mounting point, keep your hands on it and install it quietly.

## **Note**

The adsorption force of magnets decreases due to deterioration over time.

Accelerometer may detect a large impact or vibration that occurs when it falls off the mounting surface due to a decrease in adsorption force.