SHOWA SOKKI
Meeting the needs for "safety and comfort"

Combined Simple and Precision Diagnostic Amplifier for PLC

MODEL-9403

A sensor amplifier designed to connect with built-in accelerometers for vibration measurement and continuous monitoring.

- Capable of versatile vibration measurement through switching measurement modes (acceleration, velocity, displacement).
- Selectable from three ranges (LOW/MID/HIGH).
- Capable of providing both AC output (alternating current waveform) and DC output (direct current voltage)

Combined Simple and Precision Diagnostic Amplifier for PLC

MODEL-9403

A Programmable Logic Controller (PLC) receives various input signals and controls programmed outputs accordingly. With high reliability and flexibility, it contributes to factory automation and efficiency.

MODEL-9403 is a sensor amplifier designed to connect with built-in accelerometers for vibration measurement and continuous monitoring.

Developed to support both simple and precision diagnostics, it measures vibrations in acceleration, velocity, and displacement modes for various applications and environments. It also provides high-precision vibration waveform data to PLC in real-time.

System Image

It amplifies signals from the vibration sensor attached to the measurement target with high precision and outputs them to the PLC.

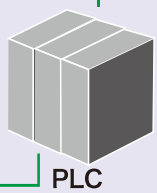
[ACOUT]
Based on the signals received by the PLC, it monitors vibration level changes and conducts specific phenomenon monitoring using FFT (frequency analysis).

[DCOUT]
Based on the signals received by the PLC, it monitors vibration levels with minimal sampling.

Machining equipment etc

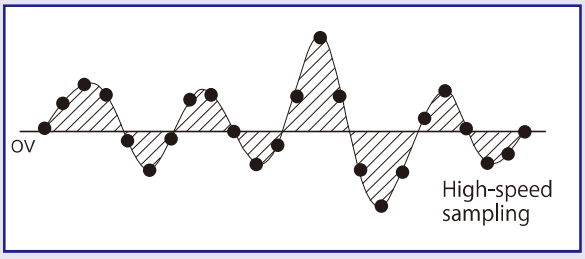
Vibration sensor

MODEL-9403

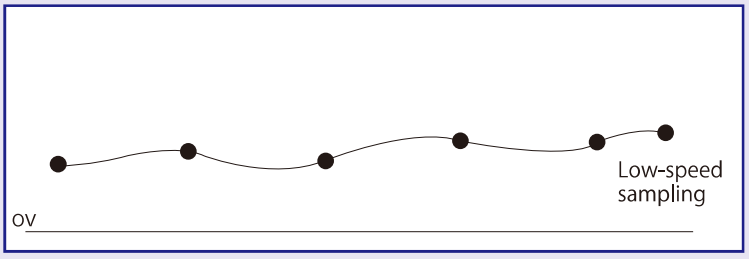


PLC
Programmable Logic Controller
(High-speed sampling unit)

AC OUTPUT



DC OUTPUT



Measurement Cases and Process

●Main Measurement Cases:

- Machining and Machine Tools, Machining Centers:
  (Detection of chipping or breakage on spindle blades, etc.)
- Reducers and Gearboxes:
  (Detection of tooth breakage or cracks in gears, etc.)
- Motors and Bearings:
  (Monitoring of abnormal vibrations due to bearing damage or lubrication failure, etc.)
- Press Machines,:
  (Detection of mold cracks or fractures, etc.)

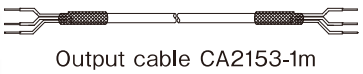
Basic Configuration (Vertical Axis Sensor)

This is the most versatile sensing system capable of monitoring vibrations in various production equipment.
The sensor is vertically oriented and has IP64-rated water resistance.

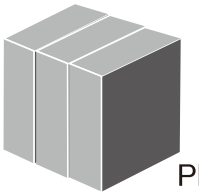
MODEL-2470

Sensor cable CA2953-5m

Combined Simple and Precision Diagnostic Amplifier for PLC
MODEL-9403



Output cable CA2153-1m



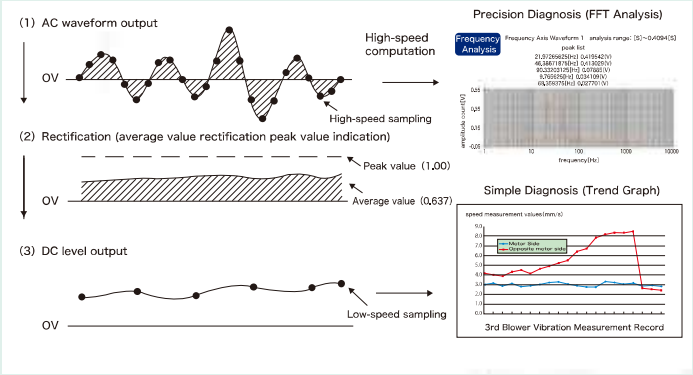
PLC

■ System Configuration

Item	Model	Quantity
Vibration sensor	MODEL-2470	1
Sensor cable	CA2953-5m	1
Combined Simple and Precision Diagnostic Amplifier for PLC	MODEL-9403	1
Output cable	CA2153-1m	1

Sampling Method:

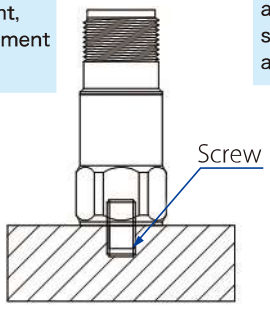
Confirm the rotation speed (frequency) of the measurement target and set the sampling value.
The right diagram shows the relationship between the waveform and sampling.
For precision diagnostics, sample the AC output at high speed; for simple diagnostics, sample the DC output at low speed.



Sensor Mounting Method

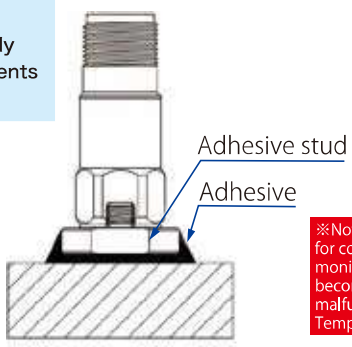
Tightening with screws

With a high resonance point, stablemeasurements are possible.



Adhesive stud

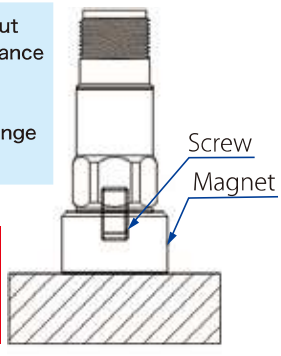
With proper adhesion, relatively stable measurements are possible.



※Not recommended for continuous monitoring as it may become detached and cause malfunctions. Temporary use is allowed.

Magnet

Easy to install, but with a low resonance point; careful attention to the measurement range is required.



Precision Diagnosis (AC Output)

Precision diagnosis aims to identify specific phenomena through real-time vibration changes and FFT (Frequency Analysis). After detecting abnormalities such as increased vibration values through simple diagnosis, precision diagnosis is performed based on the vibration waveform.

Vibration recording and analysis

Vibro Recorder

Real-time waveform monitoring and recording

By combining the Vibro Recorder and Vibro View, it is possible to record and analyze vibration waveforms, and perform FFT processing.

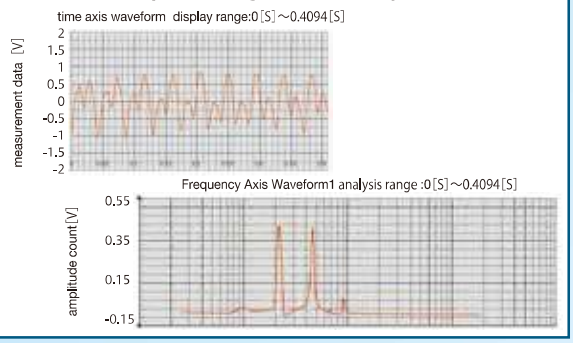
Vibro View

Connecting to a PC for waveform monitoring and real-time FFT processing.

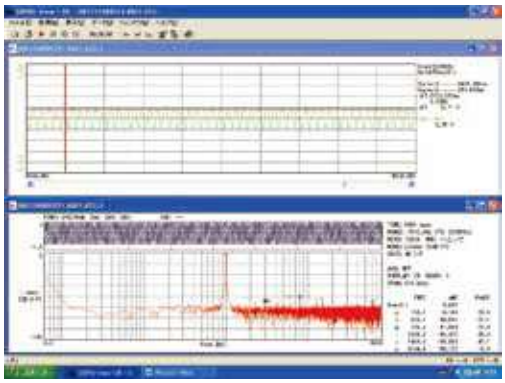
Envelope

As an option, connecting the MODEL-9402 allows for envelope processing to diagnose abnormalities such as damage to the bearings on the rotating shaft.

Waveform processing and FFT analysis on a PC



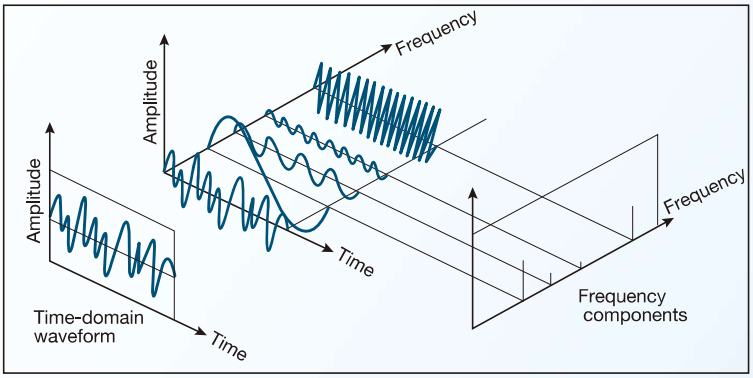
PC screen image



「FFT Analysis」

FFT is a method that converts raw vibration waveforms into the frequency domain to observe frequency components. Actual raw vibration waveforms appear as a combination of multiple waveforms. This is represented in a graph with frequency on the horizontal axis and vibration values on the vertical axis, allowing you to see the distribution of vibration values across frequency bands.

For example, in the high-frequency range, rolling bearing damage or gear damage can be detected as abnormalities. In the low-frequency range, rotational body imbalance can appear as an abnormality.



※To conduct precision diagnosis, an FFT computation unit is required on the PLC side.

Simple diagnosis (DC output)

The purpose of the simple diagnosis is to compare the regularly measured vibration levels with the reference values in order to detect equipment degradation or abnormalities at an early stage.

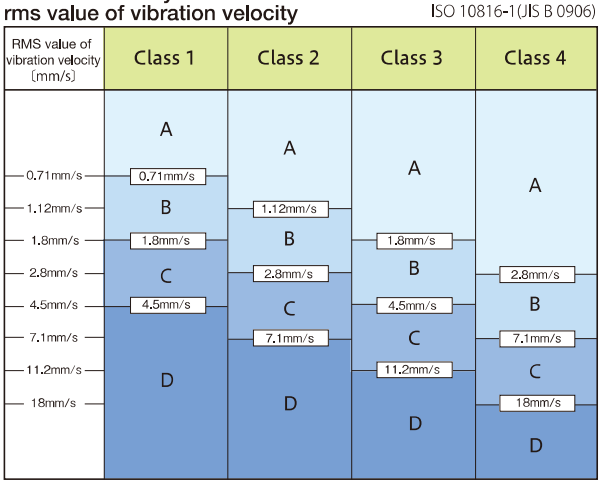
There are three types of reference criteria: "absolute value evaluation," "trend monitoring," and "comparative analysis of similar types."

"absolute value evaluation,"

This is a method of using the judgment criteria values defined by ISO and JIS for determining acceptance or rejection. Absolute value management" in ISO 10816-1(JIS B 0906) specifies the evaluation reference values for vibration levels based on vibration velocity, categorized by the size of the machinery.

Vibration severity
rms value of vibration velocity

ISO 10816-1(JIS B 0906)



Machine group

Class 1	Engines and machines integrated as part of the overall componentsmachines (general-purpose electric machines with a power rating of 15 kW or less)
Class 2	Medium-sized machinery (such as electric motors ranging from 15 kW to 75 kW) without special foundations, and engines or machines (up to 300 kW) installed on solid foundations.
Class 3	Large prime movers or large rotating machines installed on rigid foundations.
Class 4	Large prime movers or large rotating machines set on foundations with relatively soft rigidity (such as turbo-generator sets and gas turbines exceeding 10 kW in output).

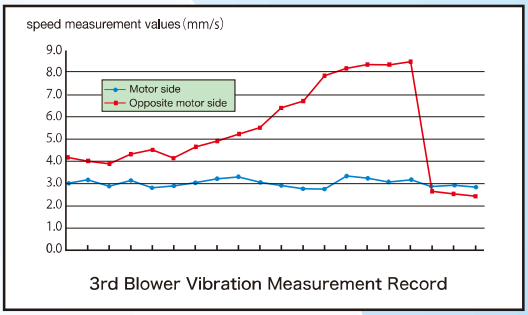
Evaluation zone

ZoneA	The zone that includes the vibration values of newly installed machines. (Excelent)
ZoneB	The zone where long-term operation is possible without any restrictions. (Good)
ZoneC	The zone where long-term continuous operation is not expected.(Fair)
ZoneD	The zone severe enough to cause damage.(Poor)

"trend monitoring,"

This is a method of regularly measuring the same part and determining acceptance or rejection based on how many times it has increased compared to the normal value (baseline). Generally, a value that is 2 to 3 times the normal value (baseline) is used as a cautionary guideline, and maintenance such as bearing replacement is considered.

The graph on the right shows the recorded vibration of a blower measured regularly. Abnormalities were observed on the non-motor side, which led to an overhaul, after which the system returned to normal.



3rd Blower Vibration Measurement Record

"comparative analysis of similar types."

This is a method of comparing similar machines to identify those with higher vibration values (indicating

How to Determine Measurement Modes

If there are no defined reference values, measurement using velocity (VEL) is recommended. If there are reference values for acceleration (ACC) or displacement (DISP) data, management using the relative value judgment method is recommended.

- Acceleration (ACC): High Frequency (Above 1 kHz) Used for measuring vibrations of relatively high frequency, such as those from bearings and gearboxes. It is ideal for detecting vibrations caused by impacts, such as bearing degradation, scratches, or chipping.
- Velocity (VEL): Mid Frequency (10 Hz – 1 kHz) Suitable for condition monitoring of rotating machinery. This is a widely used measurement unit, and it is specified by ISO as a general indicator for machine vibration evaluation.
- Displacement (DISP): Low Frequency (10 – several hundred Hz) Represents the amplitude of vibration and is ideal for measuring unbalanced vibrations, such as those found in fans and blowers.

Main Features of the MODEL-9403

● A device for real-time measurement and continuous

●Power Input (DC 24V)

●Measurement modes for Acceleration / Velocity / Displacement

●LOW/MID/HIGH Range Settings

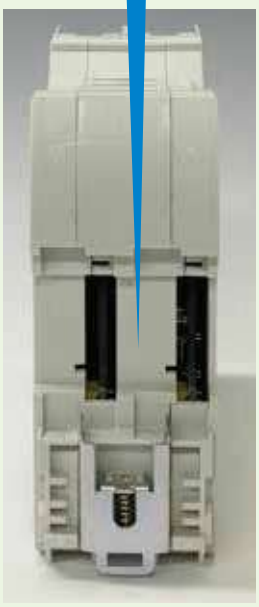
The input signals from the vibration sensor are amplified.
You can choose from three options: ×1, ×10, and ×100.
This allows for a wide range of detection, from minimal vibrations to large, shock-like vibrations.

●ACOUT (AC waveform) Supports DCOUT (DC waveform) output.

AC waveforms are required for advanced analysis using PLC, while DC waveforms are suitable for monitoring and can be handled with low sampling rates.

●DIN Rail Compatible

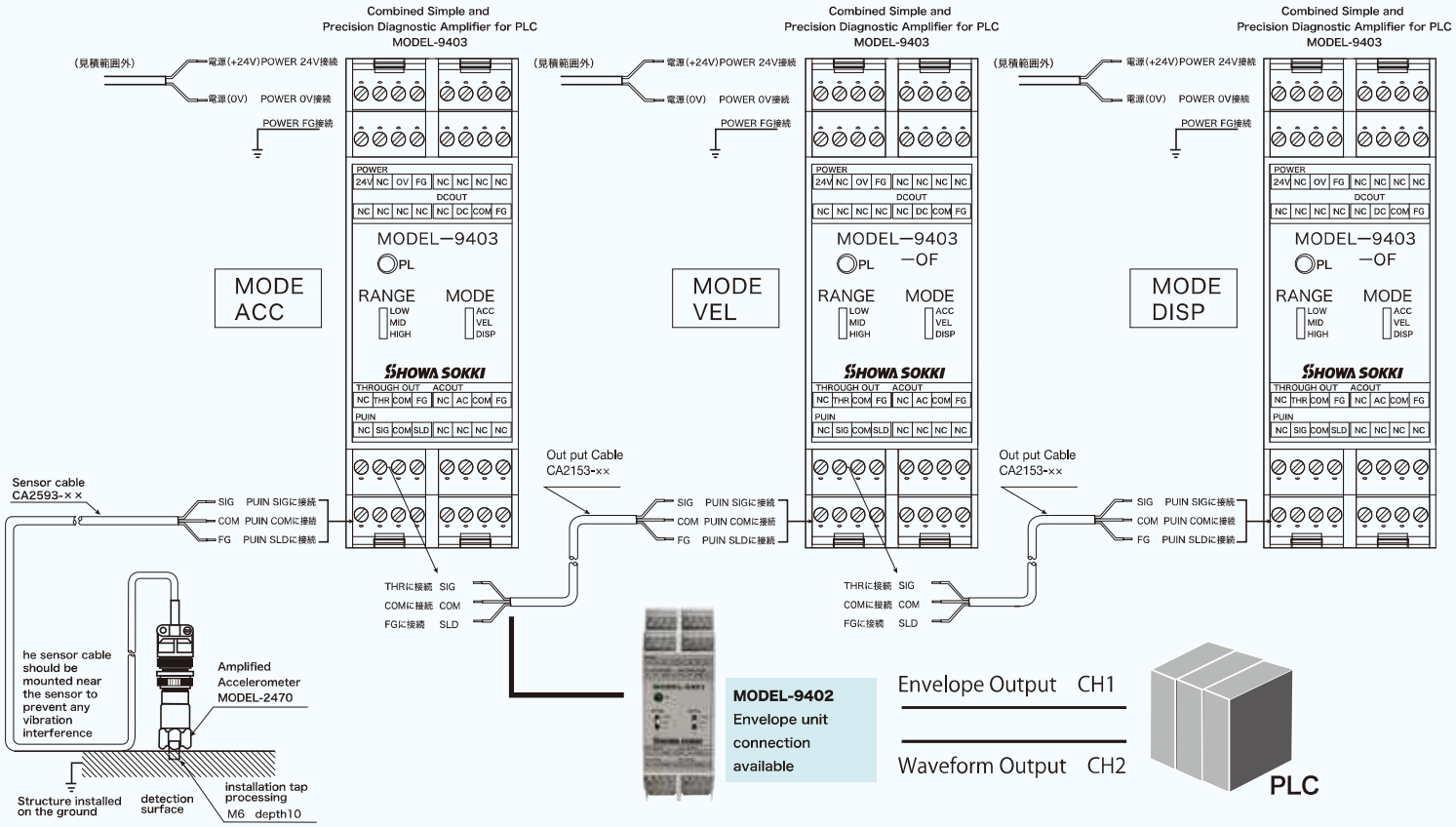
The rear is compatible with DIN rail mounting, allowing for compact installation inside panels.



●Supports THROUGH OUT (Cascade Connection)

Has an AC waveform output from the acceleration sensor (primarily used for vibration analysis, etc.). It allows simultaneous measurement of each mode and is suitable for advanced analysis.

Note: It is necessary to configure with the model (9403-01) that has the sensor power supply disabled for certain sensors (see diagram below).



List of vibration sensors

We offer a variety of sensors to suit different applications and specifications.

						
Model number	Model-2470	Model-2479	Model-2475	Model-2476	Model-2481	Model-2450EX
Features	Universal, vertical type	Universal, horizontal type	High frequency compatible	High temperature resistant up to 150℃	Waterproof	For explosion-proof use※1
Sensitivity (per 10 m/s²)	10mV	10mV	10mV	10mV	10mV	5mV
Frequency range (Hz) (±3dB)	0.4～14,000	1～12,000	3～25,000	0.5～14,000	0.5～13,000	2～8,000
Maximum acceleration (m/s²)	800	800	600	800	800	720
Operating temperature (℃)	-50～+120	-50～+120	-50～+120	-50～+150	-50～+120	-20～+60
External dimensions(mm)	Hex17×46	24.9×30.5×19.1	20×19×15	Hex17×46	Hex22×33	Hex21×40
Weight(g)	62	85	35	62	90	76
Cable connector type	MIL-C-5015	MIL-C-5015	direct 4.9-meter cab	MIL-C-5015	direct 4.9-meter cab	R04
Mounting method	M6 adapter screw※2	M6 bolt	M4 Captive Screw	M6 adapter screw※2	M6 adapter screw※2	M6 screw
Insulation/Non-insulated	Insulation	Insulation	Insulation	Insulation	Insulation	Insulation

			
Model number	Model-2430	Model-2460A	Model-2463
Features	Compact and lightweight	3-axis compact	3-axis compact
Sensitivity (per 10 m/s²)	10mV	10mV	10mV
Frequency range (Hz) (±3dB)	5～10,000	1～8,000	0.5～10,000
Maximum acceleration (m/s²)	220	400	450
Operating temperature (℃)	-50～+110	-30～+110	-50～+80
External dimensions(mm)	Hex14×18.5	14.2×14.2×14.2	10×10×10
Weight(g)	10	11.1	4.4
Cable connector type	10-32UNF	DR-4S-4	CZ664
Mounting method	M6 screw	M5 screw	M3 screw
Insulation/Non-insulated	Non-insulated	Non-insulated	Non-insulated

※1：Additionally, a dedicated safety holder (barrier) and other accessories are required. Intrinsically safe explosion-proof. Due to the sensitivity of 5mV, the full scale (F.S) is approximately halved.

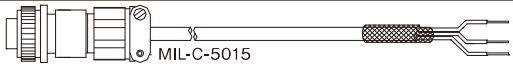
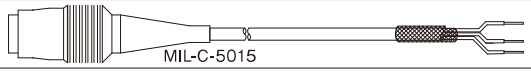
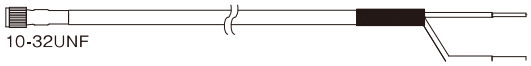
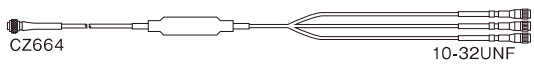
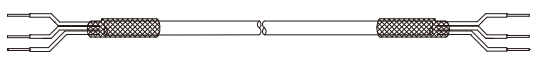
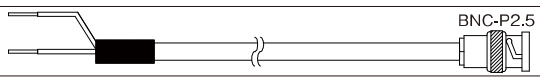
※2：The screw hole size on the bottom of the sensor is 1/4–28."

Accessory List

Model number	Product Name	Compatible Sensor Model
SF8	Adhesive Stud for 1/4-28	2470,2476,2481
SI-19	Insulated Adhesive Stud for M3	2463
SI-20	Insulated Adhesive Stud for M5	2460A
SI-21	Insulated Adhesive Stud for M6	2430
SF8M-9	Adhesive Pad for M6	2479,2450EX
SI-12	Insulated Stud for M3	2463
SI-17	Insulated Stud for M6	2430
MG-1	Temporary Mounting Magnet	2470,2476,2481 2479,2450EX,2430
MG-3B	Temporary Mounting Magnet (for Curved Surfaces)	2470,2476,2481 2479,2450EX,2430
BL-3(A)/MP-02	Three-Axis Block/Insulated Mounting Base	2470,2476,2481
NZB2-26R430	Safety Retainer	2450EX
C25A-JJ	Relay Connector	-
VERSIL406	Two-Part Epoxy Adhesive	-

List of connection cables

These are cables used for connecting various sensors and PLCs

Product name	Model number	Feature	Length specification	Specifications (connector type at both ends)
Universal sensor cable	CA2953-XXm	Waterproof performance of the sensor connection part (equivalent to IP64)	In 1-meter increments	
High waterproof sensor cable	CA2474-XXm	Waterproof performance of the sensor connection part (equivalent to IP68)	In 1-meter increments	
Compact sensor cable	CA1447-XXm	For MODEL-2430※1	In 1-meter increments	
3-axis sensor cable	LZD6423 (Only 3 meters)	For MODEL-2463※2	Fixed at 3 meters	
Output cable	CA2153-1m※3	Connect the amplifier and PLC	Fixed at 1 meters※3	
BNC output cable	CA1446-XXm	End with BNC connector output	Fixed at 1 meters	

(The 'XX' at the end of the model number specifies the length in meters)

※1：When connecting to the MODEL-2431, the intermediary connector C25A-JJ is required

※2：The end of the 3-axis sensor cable is extended using the small sensor cable CA1447 through the intermediary connector C25A-JJ.

※3：The cable length of the CA2153 is only 1 meter. If you require a longer length, please feel free to contact us.

MODEL- 9403 specifications Terminal arrangement

Input Specifications		
Input Terminal	Terminal Block (3.8mm Pitch)	
Sensor Power Supply	DC24V (Typ), 4mA	
Compatible Sensor	Built-in Preamp Type	
Measurement mode and measurement range		
Measurement mode	Measurement range (F.S.)	
Acceleration	LOW	0 to 2 [m/s^2] Peak
	MID	0 to 20 [m/s^2] Peak
	HIGH	0 to 200 [m/s^2] Peak
Velocity	LOW	0 to 2 [mm/s] RMS
	MID	0 to 20 [mm/s] RMS
	HIGH	0 to 200 [mm/s] RMS
Displacement	LOW	0 to 0.2 [mm] P-P
	MID	0 to 2 [mm] P-P
	HIGH	0 to 20 [mm] P-P
Measurement mode and frequency characteristics		
Measurement mode	Frequency characteristics	
Acceleration	5Hz to 5kHz (±1dB), 5Hz to 10kHz (±3dB)	
Velocity	10Hz to 1kHz(※1)	
Displacement	10Hz to 1kHz (±1dB)	
※1 The upper frequency limit should be within the range that does not exceed the maximum acceleration of the connected accelerometer.		
Output Specifications (AC OUT)		
Output Terminal	Terminal Block (3.8mm Pitch)	
Output signal	±2V/F.S	
Accuracy	±2% (at 23° C ±5° C, with F.S input in each mode, at 80Hz frequency)	
AC noise	Less than 10mVRMS	
Output impedance	Approximately 50Ω	
Load resistance	10kΩ or more	
Output specifications (DC OUT)		
Output Terminal	Terminal Block (3.8mm Pitch)	
Detection method	True RMS (Root Mean Square) conversion	
Output signal	+2V DC / Full Scale	
DC offset	Less than 10mV DC	
Accuracy	±5% (at 23° C ±5° C, with F.S input in each mode, at 80Hz frequency)	
Output impedance	Approximately 50Ω	
Load resistance	10kΩ or more	
General Specifications		
Power Supply	DC24V (typ) (Voltage Range: DC18 to 36V)	
Current consumption	Less than 100mA (Power supply voltage DC24V, at 23° C ±5° C, in LOW range, with F.S input, at 80Hz frequency)	
Temperature and Humidity Range	-10~+60℃、Less than 93%RH(No Condensation)	
Mass	Approximately 195g (excluding sensor and cables)	

※When connecting a 100.0mV sensor.

①	②	③	④	⑨	⑩	⑪	⑫
24V	NC	0V	FG	NC	NC	NC	NC
NC	NC	NC	NC	NC	DC	COM	FG
⑤	⑥	⑦	⑧	⑬	⑭	⑮	⑯

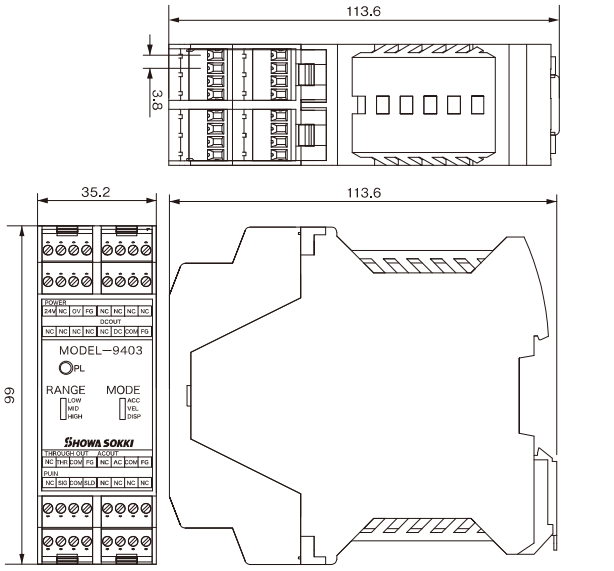
⑰	⑱	⑲	⑳	㉕	㉖	㉗	㉘
NC	THR	COM	FG	NC	AC	COM	FG
NC	SIG	COM	SLD	NC	NC	NC	NC
㉑	㉒	㉓	㉔	㉙	㉚	㉛	㉜

①～④ Connect the DC 24V power supply
⑤～⑧ Not used
⑨～⑫ Not used
⑬～⑯ Output a DC waveform of + 2VDC
⑰～⑳ THROUGH output
㉑～㉔ Connect the sensor
㉕～㉘ Output AC waveform ±2V
㉙～㉜ Not used

Product model

Product name	Model number	Remarks /Notes
Simplified Precision Diagnosis Dual-use Amplifier for PLC	MODEL-9403(-00) MODEL-9403-01	Standard Specifications -00 is usually omitted Power Supply Disconnection for Sensor
Envelope Output	MODEL-9402	Envelope Unit

MODEL-9403 Outline drawing



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