

## Seismometer Catalogue

Seismometer is an equipment to provide an emergency shutdown or make an official announcement when earthquake occurs to prevent secondary disasters such as fire or explosion. There are various type and functions, so it is important to select the proper seismometers.

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\*The specifications and design are subject to change without notice.

**IMV CORPORATION** 





Future ntegrity

IMV treats our customers, suppliers and investors with the highest integrity, dealing with all our partners in an open and honest manner.

IMV works hard to earn and keep your trust.

IMV works with our customers and investors to secure their future, developing the products, skills and resources that will bring success. IMV appreciates this and work fast to meet our partners' future needs.

Reliability

Our customers use IMV's products to ensure reliability and performance. We build this reliability into all our products and services. IMV will be there when you need us.

Strength

Technology

1

IMV's financial strength means we will be a long-term partner for our customers and are able to invest in the research for new products. IMV has the strength in finances, products and people to serve our customers on a global basis. We have the strength to be the world's number 1 vibration test and measurement company.

IMV invests substantially in research to understand our customers' needs and the products to meet those needs. IMV has been the first to market many new products and technologies and we will continue to lead the market through technology and innovation for the benefit of our customers and investors.

## Secure the future

With our vision "Secure the Future", IMV continues to contribute to safety, comfort, and ecology in society. Since our establishment in 1957, we have been involving in various fields of technologies. In dealing vibration measurement, we have strengthen our product development and total service to our partners and society. We will be a company to "Secure the Future" with our reliable technology.





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#### Selection Guide for Seismic Monitoring System

System	Seismic monitoring system with display	Seismic monitoring system with display	Long period vibration monitoring system P13
Purpose Model	TM-0013-SW	SW-54 & SW-52	HM-0013
Provide contact outputs and control operation of plant or equipment etc. on occurence of earthquake.	0	0	O *Optional device is needed
Provide evacuation guidance *Announcement machine is needed (Optional item)	0	0	_
Display of earthquake information by indicator	0	0	O *Optional device is needed
Function check of seismic isolation building	_	_	O *Optional device is needed
Health monitoring for structure	_	_	0

#### **Control of Emergency Shutdown Valve**

When earthquake occurs, not all actions can be taken for emergency control.







Application examples



Petrochemical industry plant







Service tank



Sluice



Place where people assemble





Houses



Dam

Installation example



Water treatment and storage facilities



Factory evacuation





Petrochemical complexes



In hotel or shopping center

# Seismic Monitoring System with display TM-0013-SW

#### Can be connected with up to 3 seismometers

TM-0013-SW is an equipment to display and record the outputs of the seismometers (standard type, explosion / dust proof type). It is a high precision seismometer employing the servo accelerometers that can detect micro earthquakes.

#### Features

- Touch panel for intuitive operation
- Can be connected with up to earthquake monitoring 3 systems
- Output [AND / OR / 2 out of 3] after logic operation is obtainable

#### Function

#### **Display function**

Full color and large panel enables speedy observation.



#### One touch connector

One touch connector enables easy connections.



#### Time history display

Up to 100 time histories can be saved.

			A11	-	Details	Dete Bisto
-	Meditor	frigpr	tim	mt. Scale	Tector	
E	1	2016/07/07	55143183	¥.	218.9	54
2	8	1016101/01	-	1	297.8	54
0	5	2016/07/07	55:41:83	1	211.5	54
	1	2816/07/07	55:42:82		128.6	27
	2	2816/07/07	15:42:82	8	127.5	27
ŝ	5	2016/07/07	15:42:02	8	128.4	22

#### Earthquake information mail

E-mail to be delivered automaticaly when the earthquake occurs. Can get earthquake information even in a remote area.



#### Memory card

Earthquake information can be outputted through memory card.



#### Seismic sensor selection

The standard model of the seismic sensor is SW-52ST (equivalent to IP67). The explosion-proof model is SW-52EX.



#### System composition



#### **Specifications**

Item	
Number of connectable seismometer	Maximum 3
Screen display	7 inch (800 x 480 dot), Color LCD touch panel with TFT Earthquake monitor: current date and time, earthquake occurrence Recording data: log, earthquake history Setting : time, main body, seismometer system, print Maintenance: waveform data acquisition, test, memory card
Alarm contact output	Photo-MOS relay, contact rating: 60 V- 2.5 A (for both AC/DC, pea Earthquake alarm: up to 7-steps, 1a contact (On alarm occurrence: close) Reset methods
Interface (dedicated connector)	Seismometer connection, alarm output, analog output, digital input
Interface (others)	RJ-45 (LAN), USB2.0 (TypeA), SD memory card slot, power suppl
Clock	Accuracy: 20 ppm (daily error of 2 seconds) or better/Seismometer
Mounting method	Wall hanging, panel/rack mount (storing cabinet)
Operating temperature range	0 - 40°C
Operating humidity range	20 - 85% RH (non-condensing)
Power supply	DC24 V ±10%, less than 1.2 A (connected with 3 seismomters) of
Mass	Display unit: Approx. 2 kg/Including cabinet: Approx. 8 kg

#### Outward dimensions





	Earthquake alarm output 7 relay [a] relay outputs FAULT alarm output	Earthquake alarm : Logical judgment for each level of the upper limit of 7-steps (For one seismometer / AND / OR / 2 out of 3) EAUIT Alarm : Device failure or power down
	4-20 mA output (6 Ch)	→ 2 Ch output × 3 seismic monitoring systems
K	Digital output (non-voltage contact)	External alarm reset
	Memory card	Earthquake history, log data, earthquake waveform data
	LAN (Ethernet)	E-mail notification Time calibration (NTP server) Earthquake information output (TCP socket communication)
	USB	USB Earthquake Type B data printer
Power supply terminal (M4 x 3P)		AC adaptor
	Power supply terminal (M4 × 3P)	Earthquake alarm output 7 relay [a] relay outputs FAULT alarm output 4-20 mA output (6 Ch) Digital output (non-voltage contact ) Memory card LAN (Ethernet) USB

Specification e date and time, maximum value (intensity scale, acceleration, SI value), alarm output condition ak value) hod: external input, internal timer (Seismometer setting), touch panel switch/FAULT alarm: 1a contact (At alarm occurrence: open) oly jack r time management: synchronized with main unit time at calibration r AC adaptor (AC100 - 240 V)



## Seismic monitoring system with display

A popular seismometer with display

SW-54 uses high resolution servo accelerometer which can detect micro earthquakes.

#### Features

- Easy to look touch panel display
- Equipped with memory function
- Alarm setting possible
- Space saving by wall-mounted



#### Function

#### Indication function

Importance level of information is shown by back color. It can be recognized even by remote watching. On earthquake ocurrence, "ocurrence time", "peak acceleration", "seismic intensity scale (measured seismic intensity)" are displayed.



#### Easy to operate

Touch panel is adopted. Easy operation makes speedy confirmation in an emergency.



#### Power supply

Select from AC 100 V or DC 24 V (Option)

#### Memory function

Up to 50 time histories can be saved. \*Option software is needed to export waveform data.

1	17/06/09 11:29:23 5+	ESC
2	17/06/09 11:29:23 5+	
3	17/06/09 11:29:23 4	UEL
4	17/06/09 11:25:51 1	NEXT

Time history screen image

#### Alarm setting

3-step alarm output by acceleration is possible. Alarm level is possible to be set.



Alarm setting screen image

#### Compact size Compact size makes easy

installation. It can be stored in a rack.



#### **Block Diagram**



#### Specifications

Processing Unit (SW-54)

Item	Specification		
Display element	STN monochrome LCD with touch switch / back light color : green / orange / red		
Display contents	Earthquake monitor display Earthquake generation display Earthquake generation time, maximum acceleration, seismic intensity scale, alarm operation Alarm hold display Avobe + reset button (whole reset of alarm / buzzer)		
	Setting display Trigger, alarm, date & time Maintenance display Pickup test, earthquake history		
Alarm and buzzer	Upper limit 3-step (ALM1-3), individual setting, buzzer for point, Alarm setting value : 0.1 to 999.9 (gal / seismic intensity scale / Kine) Settin interal: 0.1 step.0 is alarm operation OFF (seismic intensity sale alm is set byinstrumental seismic intensity value)		
Extra alarm	Alarm step  Upper limit 7-step (ALIM-10), individual setting (acceleration / seismic intensity scale / S valuelany setting is possible)    Alarm setting value  0.1 - 999.9 (gal/seismic intensity scale / Kine) setting interval 0.1 step, 0.0 is alarm operation OFF (seismic intensity scale alarm is set by instrumental seismic intensity value)		
	Alarm contact 1a contact [photo MOS relay] independent COM 2-point (ALM1-5, ALM 6-10, each 1-point) Contact rating 200 V – 0.65 A (AC / DC, peak value)		
Alarm and buzzer reset method	a. Automatic reset by an internal timer 1 – 9999 sec. (setting interval 1 sec., 0 is automatic reset OFF) b. External reset terminals (all steps reset by non-voltage [a] contact) c. Reset button on the touch panel (effective on alarm display)		
FAULT alarm	(Power failure or system abnormal) 1a / 1b contact switching type Contact rating : 2 A 30 VDC (maximum allowable voltage / current : 220 VDC / 2A)		
Serial output	For maintenance (conforms to RS232C) : MC1 (switch over) For external display (conforms to RS422) : MC2 For printer (conforms to RS232C) : MC2		
Back up unit	Backup time > 10 min. (ready time), charging time < 48 hours (no function at the operation by optional power 24 VDC )		
Mounting method	Wall hanging		
Operational temperature range	0 to + 50 °C		
Operational humidity range	10 to 85 %RH (non-condensing)		
Power supply	DC24 V ±10 %, less than 70 W		
Mass	Approx. 3 kg		

#### Outward dimensions



#### Measurement unit (SW-52)

Item	Specification		
Detecting method	Omni-directional non-directivity detection by vector product acceleration		
Built-in pickup	Force-balance servo type accelerometer		
Frequency range	0.3 to 10 Hz ±10%		
Acceleration	0 to 5000 gal (3-component vector product)		
range	NS / EW direction : ± 3000 gal, UD direction : + 2000 to - 4000 gal		
Low pass filter	30 Hz (-3 dB), 4th butterworth		
A / D converter	16 bit, 100 Hz sampling		
Display	7-segment LED, 4-digit display (xxx.x or xxxx)		
Alarm	Alarm step Upper limit 3-step (ALM1-3) individual setting		
	Alarm setting Level 0.1–999.9 gal * <sup>1</sup> setting interval 0.1 step, 0.0 is alarm operation OFF		
	Alarm contact 1a contact (photo MOS relay, COM common)		
	Contact rating 200 V - 0.65 A (AC / DC peak value)		
	Relay Made by Panasonic PD1a type (AQY277A)		
Alarm reset	a. Automatic reset by an internal timer 1-9999 sec. (setting interval : 1 sec., 0 is automatic reset OFF)		
method	b. External reset terminals (all steps reset by no-voltage a contact)		
DC output	DC4 – 20 mA, load resistance < 300 $\Omega$		
0	Full scale : 10 to 3000 gal (setting interval : 1 gal)		
Serial I/F	Communication with SW-54 (conforms to RS422)		
Clock	Accuracy < 70 ppm (daily error of 6 seconds)		
0. 6. 11. 1	lime calibration ±30 sec. correction (external input of no-voltage a contact)		
Operational temperature range	0 to + 50°C		
Operational humidity range	10 to 100%RH (non-condensing)		
Power supply	DC24 V ± 10% less than 10 W *2		
Structure	Waterproof (equivalent to IP67)		
Material	Aluminum die-casting		
Mass	Approx. 1.5 kg		
Mounting method	Installation on the ground (fixed by anchor)		
I / O cable	Waterproof connector		
	One-touch lock connector (made by Nanaboshi Electric)		
	INRW-2421PF11 (connector diameter : approx. 34.1 mm)		
	FKEV-SB 0.3sg×10 pair (outer diameter ; approx. 10.5 mm)		
	· · · · · · · · · · · · · · · · · · ·		
Built -in acce	lerometer (VP-5511B / 3)		

Conversion method	Force-balance servo type accelerometer
Detection method	Horizontal 2-direction, vertical 1-direction
Sensitivity	0.204 V/(m/s <sup>2</sup> ) ± 5 %
Frequency range	DC to 100 Hz ± 10 % DC to 30 Hz ± 3 %
Natural frequency	> 300 Hz
Max. measuring acceleration	NS / EW direction : ± 29.4 m/s <sup>2</sup> / UD direction : - 39.2 to + 19.6 m/s <sup>2</sup>
Linearity	0.3 % full scale

\*1 Initial setting values are 80, 250, 400 gal \*2 When connected with SW-74(74SI), power is supplied from SW-74 (74SI)

#### Seismometer options

## External display ED74 Applicable model SW-74/SW-74SI Indicates acceleration amplitude, seismic intensity scale and alarm occurence time. 0....

Specifications		
Display element	STN monochrome	
Display content	Earthquake monitoring display : current time (back display : green / letter : black) Earthquake occurrence display : occurrence time, maximum acceleration, seismic intensity (back screen : orange / letter : black)	
Display size	92.8 (W) x 37.1(H) mm	
Back light	LED (3 colors : green, red, orange)	
Power supply	DC24 V	

#### Printer RP-E11-W3FJ1-U

Applicable model TM-0013-SW



#### Print acceleration, earthquake scale and time etc. from the seismometer.

Specifications

Printing method	Thermal line dot
Printing contents	Date and time of occurrence, date and time of maximum value, date and time of end, maximum acceleration per each conponents
Power supply	Dedicated AC adaptor 24 V ± 5 %
Size	129 (W) × 129 (D) × 129 (H) mm
Mass	Approx. 1300 g

## Multiple control unit (2 out of 3) CU-5 Applicable model SW-54/SW-52 ...

This device makes reliability of the relay contact output of the alarm signal to control or stop activation higher. An alarm signal is output when 2 units out of 3 generate alarm signals.

#### Specifications

Alarm output	Up to 5 step 2 out of 3 alarm relay contact outputs
	(each 3 contact)
Alarm reset	Automatic recoery 2 or less outputs out of 3
Alarm display	Indication : individual display for each 5 steps
	Reset method : manual by pressing reset button
Power supply	AC 100 V 50 / 60 Hz 100 VA or less
Size	480 (W) × 300 (D) ×149 (H) mm
Mass	16kg

#### Seismometer detector protection housing sw-72-PC-SUS Applicable model SW-52



Outward dimensions

#### Seismometer options (software)



By connecting between the earthquake monitoring equiment and PC with dedicated cable, each settings, earthquake information data (date / time / maximum gal value / seismic intensity) or waveform data can be acquired.



#### Seismometer options (servo type accelerometer)

A motion is sensed by a displacement detector, a current is fed to the coil to get back the pendulum mass to the original position. This current will be proportional to the acceleration, that is converted to an output voltage. The servo type accelerometer is for the earthquake monitoring or measurements of micro tremor on the civil engineering structures because of its higher sensitivity and stability or more accurate phase responses in the lower frequency range than those of other vibration transducers.

- Detectable down from DC
- Advanced linearity and high resolution
- High sensitivity and large output voltage
- Excellent phase response in low frequency range
- Stable operation because of armature flexure suspension free from friction or fatigue
- Static sensitivity calibration is possible using the gravity acceleration
- Long cable can be used because of the pretty low output impedance













#### requency range DC to 100 Hz latural frequency > 400 Hz inearity. ± 0.1% full scale 4.9 ×10<sup>-5</sup> m/s<sup>2</sup> or less solution DC±11 to 16 V ower supply erating temperature range -25 to +70°C Water-proof Water-proof packing Brass tube C2700T

5.5 kg



#### **VP-5232EX**



#### Fixed on the ground

#### Specifications

- opeenieddenie			
Sensitivity direction	HHV		
Maximum measurable acceleration	29.4 m/s <sup>2</sup>		
Sensitivity	0.204V/(m/s <sup>2</sup> ) ±5%		
Frequency range	DC to 100 Hz		
Natural frequency	> 250 Hz		
Linearity	±0.1% full scale		
Resolution	4.9 ×10 <sup>-5</sup> m/s <sup>2</sup> or less		
Power supply	DC±15V		
Operating temperature range	-10 to +60°C		
Structure	Flame-proof (Ex db IIB T4)		
Cable connection	Pressure-resistant packing		
Material	Aluminum		
Weight	5 kg		
Self test	Equipped		



#### MEMO



## Structure Health Monitoring System

Structure health monitoring system involves the observation of a structural system over time using periodically sampled dynamic response measurements from an array of sensors. It is used for obtaining condition information and evaluating soundness by nstalling acceleration pickup in the building or bridge.

Structure health mointoring system Smart display unit



### Long period **Vibration Mointoring System** HM-0013

#### 3 axis simultaneous measurement of earthquake waveform or low frequency vibration

Cost effective measuring unit for structure health monitoring. Usable for versatile application including fine earthquake measurement or tilt detection not limited to structure monitoring.

#### Features

- High precision long period vibration measurement capability
- High precision micro motion measurement capability
- Versatile monitoring functions





#### **Function**

#### High precision long period vibration measurement capability

Operation verification at low frequency 0.04 by AIST\* has proven that HM-0013 can detect the long-ground motion accurately. \*AIST: National Institute of Advanced Industrial Science and Technology.



#### High precision micro motion measurement capability

Because microtremor down of 0.1 gal is measurable, it is also used for evaluation of floor vibration in addition to earthquake monitoring.



#### Versatile monitoring functions

Data save memory for power failure Recording for seismic motion must survive even on blackout. To meet this requirement, HM-0013 carries the memory with no limitation on writing time number which won' t be lost in power failure.

#### Synchronization designated line

Synchronization in multi-point measurement is very important and HM-0013 is designed for those analysis is easily carried out. Complete synchronization is possible since the each unit secures designated line for synchronization. Synchronization for all measured data is secured with simultaneous AD conversion in each axis.

#### Host loss recovery function

After the condition is set and the measurement starts, even the connection to the host is shut down, single unit of HM-0013 continues the normal operation as long as the power is secured.

#### **RS485 Modbus communication**

In case of HM-0013 connected in series, being supplied power provided by the host, up to 4 pcs connection within total 80 m is possible. By using power junction box between connections, it can extend the cable length and increase the number of connecting units. Even if the specially prepared host is not available, you can establish your system as you like refering the data map provided by IMV.



#### Self-check function

Operation check from HM-0013 internal sensor to output function. For example, it checks if the unit is correctly operated from remote place once in a day.

#### Thin dedicated cable

Can be operated with external diameter 5 mm cable ( $\varphi$ 5). Easy installation with smaller restriction (connector  $\varphi$ 13)

#### **Case Study**

Comparing concrete structure as building or public facility and infra structure as bridge or tunnel to human body, measurements that are carried out like the human body health check are called as structure health monitoring. The health monitorings by vibration measurements are going to be promoted as one of various diagnosis methods. Their application to aging diagnosis of buildings or bridges is now beginning.



Joint study with Prof. Kawai from Osaka City University to conduct health monitoring of bridge. It is adopted as one of subjects of SIP (strategic innovation creation program) by Ministry of Land, Infrastructure, Transport and Tourism

By measuring vibration or tilt of a bridge pier, obtaining the condition of score at lower part of foundation work is demonstrated. \*Scouring can be defined as a process mode by that the particles of the soil or rock around the periphery of the abutment or pier of the bridge spanning over a water body, gets eroded. If it proceeded may cause overturning of bridge pier or dike break, so it needs to be monitored by an inspector when it is heavy rain.

Measurement scene Vibration monitoring at Yoshino river in Shikoku area



#### **Specifications**

#### HM-0013

Item	High precision mode	High frequency mode	Note
Measurement axis	3 axis ()		
Measurement range (full scale)	± 2000 Gal	±6000 Gal	Each axis
Frequency range	-100	) Hz	Sensor only 1000 Hz
Acceleration accuracy	± 0.5 % FS (± 0.1 % FS)	± 5.0 % FS (± 1.0 % FS)	Standard (special)
Sensor noise density (rms)	XY : 0.0001 g / √Hz level / Z : 0.0002 g / √Hz level	XY : 0.0003 g / √Hz level / Z : 0.0005 g / √Hz level	0.1 Hz–100 Hz Less than 0.00004 g / \Hz between 1 Hz to 100 Hz)
A / D resolution	24	ΔΣ type	
Power supply	DC 12 V		
Structure	IP		
Communication	RS485 (I	Convertible in option	
Time accuracy	5.0 p	Accurate with 13 seconds per month	
Operating temperature range	-10 to +		
Size	90 × 70 ×	Excluding connectors etc.	
Mass	Approx		
Function	Temperature	Near temperature of sensor module	
	Temperatu		
	Daisy chain	Sensor condition confirmation	
	Sensor s	elf check	

#### Outward dimensions



#### Obtaining condition of the scour of bridge pier (Japan MLIT, SIP project)

This study is conducted by "SIP infrastructure management and technology" Council for Science, Technology and Innovation.

## **Smart Display Unit**

TM-0013-HM

#### For a multi-point earthquake monitoring

By combining the long-period vibration monitoring unit and the smart display unit, it is possible to construct a multi-point earthquake monitoring and observation system.

#### Features

- Up to 4 HM-0013 can be connected
- **7** inch touch panel installed
- Record waveform by time reservation
- Supports email notification via Ethernet

# TM-0013-HM



## IMV SHM

#### **System Conposition**



#### **Example of installation**



#### **Specifications**

Item	Specifications		Item		Specifications
Clock	Accuracy: 20 p	pm (daily difference 2 seconds) or less	Connector shape	One-touch loc	k connector
	Time synchronization of the main clock is possible with NTP, GPS, etc.		The number of pins	16 pins	
Installation method	VESA standard 100 mm x 100 mm Installation hole		Contact specifications	The number of contacts	8(AQV252GA made by Panasonic)
	Wall Installatio	n bracket (optional)		Contact rating	60 V-2.5 A (AC/DC both use, peak value)
Ambient temperature	0 to 40 °C	(1)		Contact function	Linked to vibration detection of each HM-0013
Ambient humidity	20 to 45 %RH	(Non-condensing)		Contact operation	Open during standby/Closed when vibration is detected
Power supply	AC100-240 V	+10 %	Connector internal	Pin No.	Signal name
i owei supply	50 VA or less (	When 4 pcs of HM-0013 are connected)	pin placement	1/2	CH1-NO/CH1-C
Size	210(H) x 284 (V	() x 65(D) mm (excluding connectors etc.)		3/4	CH2-NO/CH2-C
Weight	210(11) X 204 (V	() x 05(D) mm (excluding connectors etc.)		5/6	CH3-NO/CH3-C
weight	Approx. 2 kg			7/8	CH4-NO/CH4-C
Display part				9/10	CH5-NO/CH5-C
· · · ·				11/12	CH6-NO/CH6-C
Item	Specifications			13/14	CH7-NO/CH7-C
Size	7.0-inch wide, 800 (H) x 480 (V) dots			15/16	CH8-NO/CH8-C
Display method TN 262, 144 color					
Drive system	TFT active mat	rix	LAN (Ethernet) Possible with a c	commercially availa	able cable with the following specifications
Back light	High-brightnes	s white LED (OFF time can be changed by setting)	Item	Specifications	
Touch panel method	Resistive film a	nalog tablet	Connector shape	RJ45 connector	
Interface			Standard	10BASE-T/100BASE-TX	
			Use	FTP client fund	ction: Automatic file transfer
HM-0013 Connection [HM] Syste	m Composition D	agram		NTP client fun	ction: Time synchronization of the main clock
Item	_	Specifications			
Connector shape	One-touch lock connector				
The number of pins	6 pins				
Bit rate setting	781250 bps/115200 bps [default]/57600 bps/38400 bps				
Connector internal	Pin No.	Signal name (HM-0013-M/E)			
pin placement	1/2	Power supply +/Power supply -			
	3/4	D-OUT/D-IN			
	5/6	RS-485+/RS-485-			

#### **Function**

#### Easy to operate with easy-to-read icons

By adopting a color touch panel and menu display, it is possible to easily display and set the system status and waveform data.



#### Record up to 5000 records \* Depending on memory card capacit

Up to 5000 recorded data\* can be recorded.

\*Depends on the capacity of the memory card.

The history can be checked in the list, and the waveform screen can be checked by clicking.

Ns.	Data and time	Vector[Call	1
1	00501032019609_No4_Auto		
2	05072017143401_Nol_Auto		
3	06072017145201.Nol_Auto		_
4	06072017151401_No1_Auto		
5	05072017152701_No1_Auto		
6	06072017153900_Ncl_Autu		
7	06072017153900_No2_Auto		
6	06072017153900_No3_Auto		
9	06072017153900_No4_Auto		
10	05072017161000_Nol_Auto		-

#### Warning flash screen that allows simultaneous confirmation of multiple points

When an earthquake occurs, the seismic intensity, maximum acceleration, and time of occurrence detected by each HM-0013 are displayed.

Node1 Address 1 Trigger data and time 07/05/2017 11:50:67 Seismic intensity VI Pain acceleration 179:0129 Gat	Node2  Address  2    Trigger date and time  07/05/2017  11.50-47    Seismic intensity
Node3  Address  3    Trigger data and time  07/05/2017  11:50:47    Seismic intensity  III  IIII    Peak accessation  11:9579  Gat	Node4 Address 4 Trigger date and time 07/05/2017 11:50:47 Seismic intensity IV Peel accession 17:5057 Cal

#### Status monitoring with reserved measurement

Up to 4 waveform recordings can be reserved depending on the settings, and the condition of the building can be monitored on a regular basis.

Read Sering) <%	Data and Temp		1		17	: 48	: 00
Hassurement	Daily-ON			Record	ng duration	10	seconds
Record Strong? -City	Date and Terre	01 /	01 /	2015	10	: 30	1 00
Self-degross	Daly-OFF	1		Record	ng duration		seconds
Record Setting2 (01)	Dela and Table		1	n -		): [_	
Self-degross	Daily- ON	1		Record	ng duration		seconds
Record Second 475	Data and Terra	01 /	01 /	2015	10	: 26	1 00
Self-dagrook	Daty- OFF			Record	ng duration		seconds
					Time setting	1	Return



Contact output [Relay output] System configuration diagram

#### MEMO



## **Related Products**

IMV provides total service with various related products to support vibration measurements and evaluation.

Seismometer calibration system	≫ P19
Narranty and maintenance	>>> P20
Technical guide	>>> P21
Other product and service information	>>> P23
End of sales products	>>> P24



## Seismometer calibration system

PET-0A & PET-03H

#### For easy on site inspection of the seismometer

This is the system to generate earthquake motion by combination of ultra small electro dynamic horizontal vibration table (PET+03H) and power amplifier with built in oscillator (PET-0A).

+	
Features	
i Gatalos	

- Small and compact slip table
- Operatable by external signal input



#### **Specifications**

#### Slip table (PET-03H)

Item	Specification	
Excitation force	29.4 N	
Maximum acceleration	10 m/s <sup>2</sup>	
Maximum displacement	10 mmp-p	
Frequency range	0 to 150 Hz	
Maximum payload	15 kg	
Size	300 (W) × 300 (D) × 60 (H) mm	
Mass	20 kg	

#### Power amplifier with oscillator (PET-0A)

Item	Specification
quency range	2 to 20000 Hz
ication	5 digit LED indication
ver supply	AC 100 V ±10% 50/60 Hz
ver consumption	100 VA (for rated output)
oling	Air cooling
e	260 (W) × 280 (D) × 150 (H) mm
88	9 kg

#### Warranty and Maintenance

#### Warranty

All IMV products are shipped after passing the strict quality control inspection, but if you find any failure, please inform us the details.

#### Warranty period

The warranty period is one or two years. (It depends on the product. Please contact us for further information.)

#### Warranty coverage

(1) If failure happens in the above mentioned period due to the fault of IMV, repair will be made free of charge. However, the following cases are excepted.

- 1. Damage caused during transportation / transfer at customer's side or by their handling mistake.
- 2. Damage caused by natural disaster such as fire, earthquake, flood and lightning or abnormal voltage.
- 3. Damage caused by use with another product.
- 4. Damage caused by disassembling, repair or remodel by others who is not our personnel.

(2) Limit of coverage is the extent described in (1). Any secondary damages (failure of other equipments, opportunity loss, lost profit etc.) caused by failure of IMV products at the customers are exempted from the coverage.

#### Field inspection

#### Details

·Function inspection for each section by input of equivalent electronic signal ·Sensitivity calibration and performance check ·Replacement and maintenance of consumable goods ·Submission of report and test results \*An official quotation will be provided if repair or replacement of consumable goods are needed.

#### Required days

In two weeks after a request

#### Inspection at our factry

#### Details

·Inspection, unit calibration, operation check, total calibration by excitation \*An official quotation will be provided if repair or replacement of consumable goods are needed.

#### Required days

10 days after receipt at our factory \*Required days may be varied as the case.

#### Maintenance and inspection examples

Period	Inspection contents	Replacement parts
On delivery	Operation check	
1 to 3 years	Periodic inspection	ink ribbon , battery
3 to 6 years	Periodic inspection	
6 to 10 years	Overhaul	power supply, relay, capacitor, LCD
10 to 14 years	Periodic inspection	printer
14 to 16 years	Overhaul	power supply, relay, pickup, LCD

Replacement parts may be varied according to the model \*Update is recommended from 16 years on

Contact / Delivery address

#### **IMV CORPORATION MES Engineering Service**

870 hizure, midoriku, sagamihara, Kanagawa, 252-0185, Japan TEL: +81-42-687-2431 FAX: +81-42-687-2430

#### **Technical Guide**

#### 1 Terminology

#### 1. Seismic intensity scale

The scale determined by Japan Meteorological Agency :

It was revised after Hanshin Awaji Earthquake to be divided into ten stages shown in the following table.

Seismic intensity scal of JMA	Measured seismic intensity	Effects on human	Effects on life line
0	under 0.5	No feeling	
1	0.5 to under 1.5	Some people indoor feel tremor.	
2	1.5 to under 2.5	Most people indoor feel motion. Some people wake up.	
3	2.5 to under 3.5	Most people indoor feel motion. Some people feel fear.	
4	3.5 to under 4.5	Most people feel terrible fear and look to their own safety. Most people wake up.	
5 weak	4.5 to under 5.0	Many people look to their own safety. Some people feel difficulty on their action.	Safety devices will be activated. Gas supply will be shut down in some area. The water pipes may be damaged. Water supply may be cut off.
5 strong	5.0 to under 5.5	Many people feel big fear and feel difficulty on their action.	Damages may happen on gas pipes or main water pipes to residential area.
6 weak	5.5 to under 6.0	Standing is difficult	Damages happen on gas pipes or main water pipes to residential area.
6 strong	6.0 to under 6.5	People can't stand and have to crawl to move.	Damages may happen on gas pipes or main water pipes.
7	Over 6.5	People can't act by own intention.	Utilities such as power, gas ,water supply stop in wide area.

#### Calculation of seismic intensity

Seismic intensity scale which is announced as earthquake information is of converted from the measured seismic intensity that is the numerical value representing the severity of the earthquake at the observation point. The seismic intensity is calculated by digital processing in the seismometer as follows. Digital processing as the Fourier transform, filtering and inverse Fourier transform are applied, on each acceleration component in 3 axis (horizontal 2 elements, up-down element) and filtered so that each has a frequency characteristics as shown below. Vector composition is made out of the 3 elements filtered as mentioned above. Then," a" which fulfils that the summation of the time lengths, in which the absolute amplitude of the vector composed waveform exceeds the value" a" is just 0.3 sec, is figured out. Using this" a", I= 2 log a + 0.94 is calculated to get the seismic intensity I (real number). The seismic Intensity (detailed number) is obtained by counting the third decimal fractions over 5 of I as 1 of its second decimal disregarding the rest. The seismic intensity publically used is obtained by cutting off the fraction of the second decimal fractions. The relationship between the seismic intensity and its scale is shown in the table.

ıt	Seismic intensity(I)	Seismic intensity scale
d	I < 0.5	0
r	$0.5 \le I < 1.5$	1
	$1.5 \leq I < 2.5$	2
t	$2.5 \le I < 3.5$	3
d	3.5 ≦ I < 4.5	4
d	$4.5 \le I < 5.0$	5 (weak)
с	$5.0 \leq I < 5.5$	5 (strong)
1	$5.5 \leq I \leq 6.0$	6 (weak)
	$6.0 \le I < 6.5$	6 (strong)
	6.5 ≦ I	7



#### Calcuration of measured seismic intensity



It is usual to take the maximum acceleration (peak amplitude in Gal) to trigger the control signal for the seismometer used as an alarm signal generator. Use of the maximum acceleration has a merit that the alarm signal can be generated instantly without delay.

Conventional seismic intensity scale	Acceleration (Gal)	
not sensible	Under 0.8	
1	0.8 to 2.5	
2	2.5 to 8	
3	8 to 25	
4	25 to 80	
5	80 to 250	
6	250 to 400	
7	Over 400	

#### 2.Gal

Gal (1 Gal = 1 cm/s<sup>2</sup>) is an unit of acceleration which has been widely used in the field of earthquake study. It has been allowed to use for "gravitational acceleration" "earthquake" without the limitation of "grace period" by the New Measurement Act which adopts international unit system with such limit of use.

#### 3.SI value

While it is hardly distinguishable from the International unit system (SI), the "SI" value frequently used at chemical plants or gas related industries is used for the "Spectrum Intensity". It has been known that it is highly correlated to structural damages by earthquakes. To figure out this SI, a structure is considered to an assembly of the 1 DOF damped free vibration systems arrayed on the time axis with a certain interval of the natural period. The velocity response is calculated applying the earthquake motion to each such 1 DOF system. SI value which shows the strength of the earthquake against the structure is obtained by summing the peak value of each velocity response and multiplying a coefficient.

800.0

#### What is SI value?

It is a velocity response spectrum to express the effects of the earthquakes given to the structure. When a structure has high rigidity, its major natural period locates in the band of 0.1 to 2.5 sec. It is possible to get one of standards to express the destructive power of the earthquake by the spectral integration (area calculation) throughout such time band. This value is called as the Spectrum

SI (h) = 
$$\frac{1}{2.4} \int_{0.1}^{2.5} \text{Sv}(h,T) \cdot dT$$

Sv (h,T) =Velocity response spectrum (maximum velocity response of 1 degree of freedom system with T sec. natural period) h : Damping constant

#### Internal composition of the seismometers

25 sets of 1 DOM damped free vibration systems (0.1 sec. step is of the time band 0.1 to 2.5 sec. for 3 directions) are in a simulated seismometer. The output signal from the servo type accelerometer or broad motion sensor is applied to figure out the velocity response spectrum (Sv) in real time, then the S I is calculated to be displayed at every one second. When the calculated S I exceeds the pre-set value, alarm signal is output.

#### 2 Notes for instruction

#### Cable length

It has almost no limitation for the length of the cable because the frequency dealt is low. The longest cable actually used was 1,500 m. The long cable is requested to be used with the instrumentation cable tray and be located apart the power cables avoiding picking up noises.

#### Installation of detectors

Pickups of seismometer are servo type accelerometers or IMV's newly developed broad motion sensors. In principle, they can detect earthquakes regardless of direction. Instllations on the surface of the vertical pillars, even on the ceilings in upside down. Contact us for instllation of the earthquake observation system which will be used to record the earthquake waveforms along the exactly designated direction. Horizontality, prependicularity or measurement axis direction are not very important just for measurements of vector composed acceleration or calculation of seismic intensity, if the recorded waveforms themselves are not needed to be calibrated along the absolute orientation.Installation in EPS at the building will allow easy maintenance and cable arrangements. Cable tray should be of the type of instrumentation. Use of the protection covers is recommended at same time.

#### **3** Function

#### Alarm output (SW-54 / SW-52

The alarm relay contact outputs are exported to make emergent control of machinery on occurrence of earthquakes to prevent the secondary disasters.

#### Earthquake waveform data (SW-54 / SW-52 )

When earthquake is detected, acceleration waveform in each measurement channel is saved as digital data. It can be retrieved in the CSV format with the optional maintenance software. Waveform display software which display and print out CSV format waveform data for SW-74 is available as option.

#### Time correction (SW-54 / SW-52 )

Time correction of the Seismometer is carried out by the non-voltage "a" contact input. The time correction unit which exports non-voltage "a" contact output receiving NHK-FM and GPS signals is prepared as one of the optional units.

#### **Technical Guide**





#### Power failure backup (SW-54 / SW-52)

A power failure backup is equipped as standard for every model which is supplied AC100 V power. The models of 24 V do not have the built-in power backup function expecting power supplied from the sauces equipped such functions. Power backup time is10 min or 1hr depending on the model. Specifications which have the detailed description should be referred. Recommended battery replacement period is every 3 years.

#### Earthquake detection method -prevention of incorrect action- (all models)

Seismic vibration which may cause damage to buildings may continue more than one second and finish in several tens of second. Meanwhile, shock wave generated by something hitting into an accelerometer is quite different, finishing at longest about 0.5 second. Electrical noise such as thunder lighting or a fluorescent light is short-period impulse characteristic, so is expected to finish in milliseconds. This function can recognize the difference of characteristics and protect it from an incorrect operation by setting the time lug in seismic detection.

#### Other product and service information

#### Vibration test systems

Vibration test systems reproduce vibrating environments onto products. It enables evaluation of the product durability and the reliability. As part of our focus, IMV produces 6 degree of freedom (6DOF) vibration test systems which reproduce real vibrating environments as ecologically friendly intelligent systems. IMV has the largest share in vibration test systems in the world market.





degree of freedom vibration test sv



#### Test laboratory

Since Japan's first establishment of vibration/shock test laboratory in Tokyo in 1998, we have been developing test laboratory businesses as Osaka test laboratory in 2005, Nagoya test laboratory in 2007 and the first overseas test laboratory in Thailand in 2012. Corresponding to development of the hybrid car, we opened the Advanced Technology Centre for Environmental Testing which is specialized in the battery testing and test for the large specimens in Uenohara, Yamanashi in 2015.



Environmental reliability evaluation system

IMV has released 1 ch/1 power supply/1 measurement circuit Migration Testers (of MIG series) first in the test equipment industry and others.

Advanced Technology Centre



MIG-87

MIG-8600B



Experienced IMV engineers will support to solve the problems of vibration and noise in any industrial field.





ion design and work fo manufacturing facilities

#### Head office/Sales Office

#### Osaka



Please contact the head office for product details. Tel +81 6 6471 3155

#### Nagoya





Sagamihara



#### End of sales products and alternative systems

End of sales				Alternative systems	
	Model	Product name	Maintenance period	Model	Product name
1	SW-101	Seismic Monitoring System	End	SW-74	Seismic Monitoring System
2	SW-165	Seismo Switch	End	SW-72	Seismic Monitoring System
3	SW-201	Seismo Switch	End	SW-72	Seismic Monitoring System
4	SW-70	Digital Strong Motion Seismograph	End	-	-
5	SW-8002/n	Seismic Monitoring System	End	-	-
6	SW-81	Seismic Monitoring System	End	SW-011-SYS	Evaluation System for Seismic Isolation
7	SW-90 E series	Seismic Monitoring System	End	SW-74	Seismic Monitoring System
8	SW-90K3	Seismic Monitoring System	End	SW-74	Seismic Monitoring System
9	SW-94	Seismic Monitoring System	End	SW-74	Seismic Monitoring System
10	SW-94IC	Evaluation System for Seismic Isolation	End	SW-011-SYS	Evaluation System for Seismic Isolation
11	SW-94SI	Seismic Monitoring System	End	SW-74SI	Seismic Monitoring System
12	VP-5112	Servo type Accelerometer -Standard-	End	_	-
13	VP-5112 HH/HHV	Servo type Accelerometer -General type-	End	VP-5113 HH/HHV	Servo type Accelerometer -Drop-proof-
14	VP-5122	Servo type Accelerometer -High Sensitivity-	End	-	-

\*Refer to IMV website for the old systems which is not listed above. https://www.imv.co.jp/e/products/end/list\_01.php