3-Axis Vibration Meter VM-54

Habitability on Ships  Whole-Body Vibration  Hand-Arm Vibration

System for human related vibration measurements
All-round instrument

3-Axis Vibration Meter
VM-54

Optional program card line-up
VX-54WS/VX-54WB1/VX-54WH/VX-54FT
3-Axis Vibration Meter VM-54

Marine Vibration Card

**VX-54WS**

**Vibration measurement system for evaluating comfort in passenger and merchant ships**

ISO 6954:2000 provides the framework for measuring and recording vibrations that occur in the crew and passenger accommodation sections of ships, to evaluate suitability and comfort.

The present measurement system for marine vibrations consists of the Accelerometer (tri-axial) PV-83CW (for floor positioning), the 3-Axis Vibration Meter VM-54, and the Marine Vibration Card VX-54WS. The system allows measurement and evaluation compliant to the relevant standards.

---

**ISO 6954:2000**

Mechanical vibrations - Guidelines for the measurement, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships

- Accelerometer PV-83CW (tri-axial) (for floor positioning) is supplied as standard accessory of VX-54WS.
- Accelerometer PV-57A (for wall positioning) available as optional accessory.
- Storing of measurement data on CompactFlash™ memory card.
- Tri-axial analogue AC outputs for connection to frequency analyzer, data recorder, or other waveform recording device.
- Excel macro for creating reports is supplied accessory.
- Soft protection case with shoulder strap is supplied accessory for VX-54WS. This facilitates measurement in the marine environment and protects the unit from water and oil.
Specifications

Applicable standards: ISO 6954: 2000
Input: Accelerometer (tri-axial) PV-83CW, or Accelerometer PV-57A (option)
Measurement range: 1 to 80 Hz (Up to 1 kHz with flat characteristics, when using PV-57A)
Frequency weighting: Wm (ISO 2631-2: 2003), bandwidth limiting
Measurement modes: Acceleration, velocity
Measurement range:

[With PV-83CW]
- Acceleration (mm/s²): 30, 100, 300, 1000, 3000, 10,000
- Velocity (mm/s): 0.3, 1, 3, 10, 30, 100, 300

[With PV-57A]
- Acceleration (m/s²): 0.3, 1, 3, 10, 30, 100, 300, 1000
- Velocity (mm/s): 10, 30, 100, 300, 1000, 3000

Processing functions: RMS, max (MTVV), min
Measurement time settings: 10 sec, 1 min, 2 min, 10 min

Display: LCD x 2 (main and sub)
Data store function: Manual store
(up to 400,000 data can be stored on VX-54WS [128 MB CF Card])
Recording media: Compact Flash memory card
Interface: For dedicated printer only
(Output connectors: Connectors for 3 axis signals (AC))
Ambient conditions: -10 to +50 °C, max. 90 % RH
Power supply: Four IEC R14 (size “C”) batteries,
16 hours continuous operation with alkaline batteries
Dimensions and weight: Approx. 56 (H) x 200 (W) x 175 (D) mm;
approx. 1 kg (including batteries)
Supplied accessories: Accelerometer (tri-axial) PV-83CW
Connection Cable EC-54 (1.5 m)
Soft protection case

Excel macro

Frequency weighting curve Wm

Display screen examples

Unit inserted in soft protection case

System Configuration

Accelerometer Input

<table>
<thead>
<tr>
<th>Accelerometer</th>
<th>Carl Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV-57A (for wall positioning)</td>
<td>VP-51K</td>
</tr>
<tr>
<td>PV-83CW (for floor positioning)</td>
<td></td>
</tr>
</tbody>
</table>

Magnet Attachment

| VP-53S |

3-Axis Vibration Meter

| VM-54 |

Marine Vibration Card

| VX-54WS |

FFT Analysis Card

| VX-54FT |

Data Recorder

| DA-21 |

AC Adapter

| NC-98E |

Program card

Extension Cable

| EC-04Series |

Connection Cable

| EC-54 (1.5 m: between PV-83CW & VM-54) |

System Configuration =Option for VM-54

OP =Supplied for VX-54WS

SP =Supplied for VX-54FT

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54

OP =Option for VM-54
Vibrations arising in vehicles are transmitted to the human body via the feet, posterior, and via the back when leaning against a backrest. Methods for evaluating the effect of such vibrations are specified in the ISO 2631 series, which are concerned with vibration perception, comfort levels, and health damage. The standards aim at quantifying periodic as well as irregular and transient whole-body vibrations. Special frequency weighting characteristics are given for various vibration transmission routes and for the three axes.

The whole-body vibration measurement system consists of the Seat Measurement Accelerometer PV-62 (tri-axial), 3-Axis Vibration Meter VM-54, and Whole Body Vibration Card VX-54WB1. The system allows measurement and evaluation compliant to the relevant standards.

**ISO 2631-1 : 1997**
Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1 : General requirements

**ISO 2631-2 : 2003**
Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2 : Vibration in buildings (1 Hz to 80 Hz)

**ISO 8041 : 2005**
Human response to vibration — Measuring instrumentation

- Measurement result data can be stored on CF card.
- 3-axis output signal for connection to frequency analyzer, data recorder, or other waveform recording device.
Specifications


Input:
- Seat Measurement Accelerometer (tri-axial) PV-62
- Accelerometer (tri-axial) PV-83CW

Measurement:
- 0.5 to 80 Hz frequency range
- Frequency weighting: Wk, Wd, Wb, Wc, Wj, Wm, Wg, bandwidth limiting
- Measurement mode: Acceleration, Velocity (in case of Wm)

Measurement range:
- Acceleration (m/s^2): 0.3, 1, 3, 10, 30, 100, 300, 1000
- Acceleration (m/s^2): 0.03, 0.1, 0.3, 1, 3, 10
- Velocity (mm/s): 1, 3, 10, 30, 100, 300

Processing functions: RMS, MTVV, VDV, Synthesized Value, PEAK, Crest Factor

Measurement time settings:
- 1 to 30 sec in 1-sec units
- 1 min, 10 min, 30 min, 1 hour, 4 hours, 8 hours, 12 hours (max. 12 hours)

Display:
- LCD x 2 (main and sub)

Data store function:
- Auto store1, Auto store2, Manual store

Recording media:
- CompactFlash memory card

Output connectors:
- Connectors for 3-axis signals (AC)

Ambient conditions for use:
- -10 to +50°C, max. 90 % RH

Power supply:
- Four IEC R14 (size “C”) batteries, 16 hours continuous operation with alkaline batteries

Dimensions and weight:
- Approx. 56 (H) x 200 (W) x 175 (D) mm; approx. 1 kg (including batteries)
Vibrations arising in hand-held tools are transmitted to the hands, arms and shoulders of the operator. Methods for evaluating such vibrations are covered by ISO 5349-1 and ISO 5349-2. These standards not only specify frequency weighting characteristics and evaluation factors, they also contain detailed information about how to mount accelerometers. The hand-arm vibration measurement system consists of the Accelerometer PV-97C (tri-axial), 3-Axis Vibration Meter VM-54, and Hand-Arm Vibration Card VX-54WH. The system allows measurement and evaluation compliant to the relevant standards.

Accelerometer (tri-axial)
PV-97C

Option

3-Axis Vibration Meter VM-54

ISO 5349-1: 2001
Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements

ISO 5349-2: 2001
Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace

- Measurement result data can be stored on CF card.
- 3-axis output signal for connection to frequency analyzer, data recorder, or other waveform recording device.
**Display screen examples**

- **Graphic screen**
- **Numeric screen**
- **FFT screen (using VX-54FT)**

**System Configuration**

- **Accelerometer Input**
  - PV-97C (tri-axial)
  - PV-90B (single axis)
  - PV-91C (single axis: amplifier incorporated)

- **3-ch Preamplifier**
  - VP-80

- **Extension Cable**
  - EC-04 Series

- **3-Axis**

- **Data Recorder**
  - DA-21

- **Frequency Analyzer**

- **Program card**
  - NC-98E

- **Hand-Arm Vibration Card**
  - VX-54WH

- **FFT Analysis Card**
  - VX-54FT

**Specifications**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Piezoelectric Accelerometer PV-97C (tri-axial) or equivalent</td>
</tr>
<tr>
<td>Measurement</td>
<td>8 to 1 000 Hz</td>
</tr>
<tr>
<td>Frequency range</td>
<td>Wh</td>
</tr>
<tr>
<td>Frequency weighting</td>
<td>Acceleration</td>
</tr>
<tr>
<td>Measurement range</td>
<td>[With PV-97C]: Acceleration (m/s²): 30, 100, 300, 1000, 3000, 10 000 (VP-80 charge amplifier gain set to x 0.1)</td>
</tr>
<tr>
<td>Processing functions</td>
<td>RMS, MTVV, VDV, Synthesized Value, PEAK, Crest Factor</td>
</tr>
</tbody>
</table>

**Measurement time settings**

- 1 to 30 sec in 1-sec units
- 1 min, 10 min, 30 min, 1 hour, 4 hours, 8 hours, 12 hours (max. 12 hours)

**Display**

- LCD x 2 (main and sub)
- Auto store, Manual store

**Recording media**

- CompactFlash memory card

**Interface**

- For dedicated printer only
  (allows measurement data printout on dedicated printer)

**Output connectors**

- Connectors for 3-axis signals (AC)

**Ambient conditions**

- -10 to +50 °C, max. 90 % RH

**Power supply**

- Four IEC R14 (size “C”) batteries
  - 16 hours continuous operation with alkaline batteries

**Dimensions and weight**

- Approx. 56 (H) x 200 (W) x 175 (D) mm
  - approx. 1 kg (including batteries)

**Running R.M.S acceleration value**

\[
a_{\mathrm{r}}(t_0) = \left( \int_{t_0}^{t_0 + T} a_\omega(t) \, dt \right)^{1/2}
\]

Where:
- \( a_\omega(t) \): Instantaneous value of vibration acceleration to which frequency weighting was applied
- \( T \): Continuous measurement time (s)
- \( t_0 \): Observation time point (instantaneous time)

**Maximum Transient Vibration Value (MTVV)**

\[
MTVV = \max [a_{\mathrm{r}}(t_0)]
\]

**Vibration Dose Value (VDV)**

\[
VDV = \int_{0}^{T} a_\omega(t) \, dt
\]

Where:
- \( a_\omega(t) \): Instantaneous value of translational or rotary vibration acceleration to which frequency weighting was applied
- \( T \): Continuous measurement time (s)

**Frequency-weighting curve Wh for hand-transmitted vibration Weighting factor**

**Coordinate systems for the hand**

- a) Handgrip position
- b) Flat palm position

**Instantaneous value of vibration acceleration to which frequency weighting was applied**

**Moving average integral time (s)**

**Time (integral variable)**

**Observation time point (instantaneous time)**
3-Axis Vibration Meter VM-54

The 3-Axis Vibration Meter VM-54 can be used with PV-83CW and other various accelerometers.

**Inputs:**
- 3-channel input (using 3-Channel Input adapter VP-80)
- Measurement frequency range: 0.5 to 5 000 Hz
- Measurement mode: Acceleration rms value, Instantaneous value and maximum hold
- Measurement range: With piezoelectric accelerometer
  - 0.03, 0.1, 0.3, 1, 3, 10, 30, 100
  - 0.3, 1, 3, 10, 30, 100, 300, 1 000

**Display functions:**
- Main display:
  - Shows instantaneous value in specified channel (rms with 1 second integration time)
  - Shows FFT analysis result in specified channel and overall value simultaneously

**Frequency weighting characteristics:**
- Dependent on respective program card

**Processing frames:**
- Max. 999 (selectable in 1-frame steps)
- Max. 50 files

**Recall function:**
- For dedicated printer only (hard copy of sub display content can be produced on dedicated printer)

**Outputs:**
- AC output according to selected frequency weighting characteristics (O.A.)

**Battery life:**
- 16 hours continuous operation (using PV-83CW, at room temperature, with alkaline batteries)

**Ambient conditions:**
- -10 to +50 °C, max. 90 % RH

**Dimensions and weight:**
- 56 (H) x 200 (W) x 175 (D) mm; approx. 1 kg (including batteries)

**FFT Analysis card VX-54FT**

The VX-54FT functions as a memory card and allows storing FFT analysis result data in CSV format. The supplied Excel macro makes it easy to generate a graph display from the stored data.

**Display items:**
1. FFT processed spectrum display
2. Effective value (O.A.) calculated from time domain
3. O.A. value\(^*\) calculated from frequency domain (FFT result)

**Display functions:**
- Dependent on respective program card

**Frequency range settings:**
- 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz

**Window types:**
- Hanning, Rectangular

**Processing lines:**
- 400

**Processing:**
- Instantaneous value, RMS method, maximum value

**Display VM-54:**
- Main display:
  - Shows instantaneous value in specified channel
- Sub display:
  - Shows FFT analysis result in specified channel and overall value simultaneously

**Frequency weighting characteristics:**
- Dependent on respective program card

**Processing frames:**
- Max. 999 (selectable in 1-frame steps)
- Max. 50 files

**Recall function:**
- For dedicated printer only (hard copy of sub display content can be produced on dedicated printer)

**Outputs:**
- AC output according to selected frequency weighting characteristics (O.A.)

**Battery life (using VX-54FT):**
- 16 hours continuous operation (using PV-83CW, at room temperature, with alkaline batteries)

**Ambient conditions:**
- -10 to +50 °C, max. 90 % RH

**Dimensions and weight:**
- 56 (H) x 200 (W) x 175 (D) mm; approx. 1 kg (including batteries)

---

**Options**

<table>
<thead>
<tr>
<th>Product name</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFT Analysis Card</td>
<td>VX-54FT</td>
</tr>
<tr>
<td>3-ch Preamp</td>
<td>VP-80</td>
</tr>
<tr>
<td>Accelerometer (tri-axial)(^*)</td>
<td>VP-83CW</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>VP-57A</td>
</tr>
<tr>
<td>Carl Cable (for PV-57A)</td>
<td>VP-51K</td>
</tr>
</tbody>
</table>

---

**Specifications subject to change without notice.**

---

**Distributed by:**

RION Co., Ltd.
3-20-41, Higashimotomachi, Kokubunji, Tokyo 185-8533, Japan
Tel: +81-42-359-7888   Fax: +81-42-359-7442

---

This product is environment-friendly. It does not include toxic chemicals on our policy.

This leaflet is printed with environmentally friendly UV ink.

---

ISO 14001 RION CO., LTD.
ISO 9001 RION CO., LTD.

RION CO., LTD.
https://rion-sv.com/