



Manual

m+p VibSlideRule

Revision 3.3 - May 2021

A dark blue rectangular box containing the text 'm+p' in a large, white, bold, sans-serif font, and 'vib slide rule' in a smaller, white, bold, sans-serif font directly below it.

m+p
vib slide rule

m+p international
Mess- und Rechnertechnik GmbH

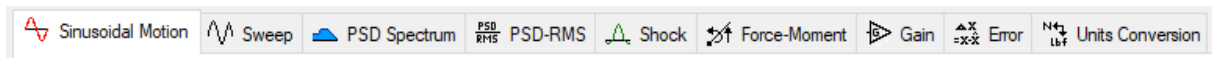
General

m+p VibSlideRule offers a wide range of tools for vibration testing and structural analysis:

 Sinusoidal Motion	- calculate displacement, velocity, acceleration and frequency - supports translational as well as rotational/angular motion
 Sweep	calculate sweep time and number of cycles for a sine sweep defined by start- and stop frequency, sweep type and sweep rate
 PSD Spectrum	- definition of arbitrary PSD-spectrum using linear interpolation between data-points - calculate corresponding RMS- and peak-values for displacement, velocity, acceleration - export PSD-spectrum for use in m+p international VibControl using linear-linear or linear-logarithmic axis scaling (e.g. according to IEC 61373 – random testing)
 PSD-RMS	calculate RMS-value for given bandwidth and constant PSD-spectrum
 Shock	- half-sine, saw tooth, rectangle and trapezoid pulse shapes - compute pulse width, peak acceleration and velocity change
 Force-Moment	compute moment, force and distance
 Gain	- compute input-output ratio (linear and dB) - supports amplitude and power input values
 Error	compute errors for true and actual measurements (% and dB)
 Units Conversion	- Convert values between different units - Force: $\text{N} \leftrightarrow \text{lbf}$ - Transducer Sensitivity: $\text{mV}/\text{'Unit'} \leftrightarrow \text{'Unit'}/\text{V}$ - Acceleration: $\text{m/s}^2 \leftrightarrow \text{g}$ - Velocity: $\text{m/s} \leftrightarrow \text{in/s}$ - Displacement: $\text{mm} \leftrightarrow \text{in}$

Handling

To select your required module click the associated tab in the tab control:



In each case, any variable can be set to compute the other variables' values.

Set a value

- Click, hold and move the **slider** representing that variable's value.
- Click the slider's **text box** and enter a value via the keyboard. Press Enter or leave the text box to set the value.



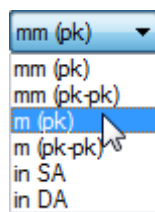
Fixing parameters

Each calculator type has a number of variables. In general, any parameter can be varied and will be used for calculating the other variables' values. Since in most cases two variables are required to do the calculations, the previously set value will also be kept constant.

To fix a particular value permanently check the **fix check box** on the right hand side of the slider. The value of the slider will be kept constant until you uncheck the fix check box or change the slider's value as described above.

Units

Use the slider's **units combo box** to choose the unit to be used for that slider.

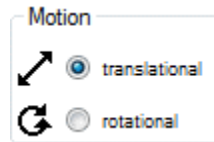


This will automatically convert the current value to the chosen unit and adapt the slider's limits. Be aware of the different kinds of scaling. While **peak** (pk) or **peak-peak** (pk-pk) are used with metric units **single amplitude** (SA) or **double amplitude** (DA) are available with imperial units.

Modules

Sinusoidal Motion

Sinusoidal motion allows calculates displacement, velocity, acceleration and frequency for harmonic motion. Select translational or rotational/angular motion via the radio buttons:



According to this either translational coordinates

$$f, \ddot{x}, \dot{x}, x$$

or angular coordinates

$$f, \ddot{\varphi}, \dot{\varphi}, \varphi$$

are used. The relation between acceleration, velocity and displacement is

$$\begin{aligned}\ddot{x} &= \omega \dot{x} = \omega^2 x \\ \ddot{\varphi} &= \omega \dot{\varphi} = \omega^2 \varphi\end{aligned}$$

with angular frequency

$$\omega = 2\pi f.$$

Sweep

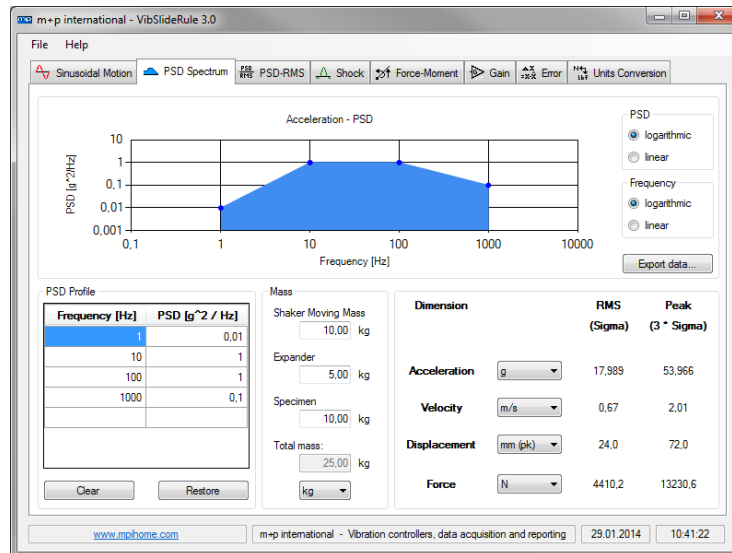
Based on the parameters

- Start frequency
- Stop Frequency
- Sweep type
- Sweep rate

the sweep time and the resulting number of cycles are calculated.

PSD-Spectrum

The results section presents the RMS and peak-values of acceleration, velocity and displacement of the defined PSD-spectrum.



The RMS value results from integration of the PSD-spectrum over frequency

$$\ddot{x}_{\text{RMS}} = \int_{f_{\min}}^{f_{\max}} \text{PSD}(f) \, df$$

and the peak value is directly related to the RMS value

$$\ddot{x}_{\text{Peak}} = 3\ddot{x}_{\text{RMS}}.$$

By setting the mass values in the mass section the required shaker force is calculated

$$F_{\text{RMS}} = m_{\text{total}} \ddot{x}_{\text{RMS}}.$$

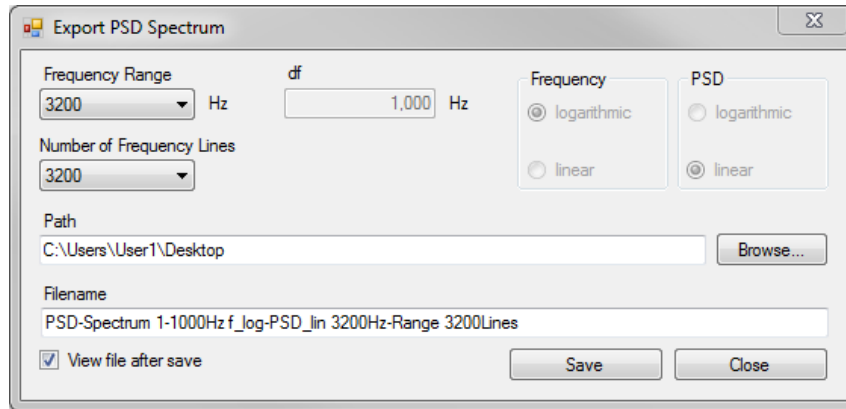
Define arbitrary PSD-Spectrum by adding values to the profile table. Interim values may be appended to the table as the lines will be sorted automatically. Use the clear button to delete all data points or the context menu to delete rows. The chart will be updated to show the current spectrum each time the spectrum table is edited. Change the axes' scaling using the radio buttons on the right.

Note: Between the data points of the PSD-Spectrum linear interpolation using the current axes' scaling (linear/logarithmic) is used. Thus, RMS and peak results will change when changing the scaling.

To use linear PSD-Spectrum over linear frequency (e.g. according to IEC 61373 – random testing) the defined spectrum can be exported to a text file for use in **m+p international VibEditor**:

- Define the PSD-spectrum in the spectrum table
- Set the scaling (linear/logarithmic) for frequency axis and PSD axis as required
- Press **Export** button
- Resume with **OK**

- In the export window select **frequency range** and **number of frequency lines** to be used in **m+p international VibControl**
- Choose path and filename to store the text file
- Press **Save**.
- If **view file after save** is checked the text file will be shown.



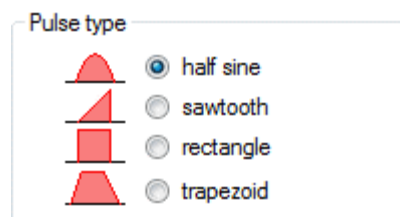
PSD-RMS

RMS-value and constant PSD-spectrum for a given bandwidth are related by

$$\ddot{x}_{\text{RMS}} = (f_{\text{max}} - f_{\text{min}}) \text{PSD}$$

Shock

Four pulse types are available and can be selected via the radio buttons



Each pulse is defined by its pulse width (duration) and its peak acceleration (maximum value). Trapezoid pulses additionally require the leading and trailing edge duration.

The change in velocity results from integration of acceleration over the pulse duration:

$$\Delta \dot{x} = \int_{t_{\text{start}}}^{t_{\text{stop}}} \ddot{x}(t) dt$$

Force-Moment

Using the simple relationship

$$M = Fs$$

the moment of force can be calculated from a force and the distance.

Gain

The linear input-output gain is just the quotient of output to input amplitude

$$G_{\text{lin}} = \frac{A_{\text{output}}}{A_{\text{input}}}$$

The dB-Gain using amplitude inputs is defined as

$$G_{\text{dB,Amp}} = 20 \log_{10}(G_{\text{lin}})$$

while for power signals the dB-Gain is defined as

$$G_{\text{dB,Pow}} = 10 \log_{10}(G_{\text{lin}})$$

Error

The error between a true value $\hat{x}$ and a defective value x expressed in percent is

$$e_P = \frac{x - \hat{x}}{\hat{x}} \cdot 100\%$$

and in dB

$$e_{\text{dB}} = 20 \log_{10} \left(\frac{x - \hat{x}}{\hat{x}} \right)$$

Units Conversion

The most common measures are available and can be converted between different units.

Force

Newton - N	Pound-force - lbf
1	0,225

Edit one of the text boxes and press enter to confirm. The second text box will be updated immediately. A red number indicates the value has not been updated yet.

Contact



m+p international - Mess- und Rechnertechnik GmbH

Thurnithstraße 2
30519 Hannover

www.mpihome.com

Phone: (+49) 511 – 85 603 0
Fax: (+49) 511 – 85 603 10
E-mail: sales.de@mpihome.com