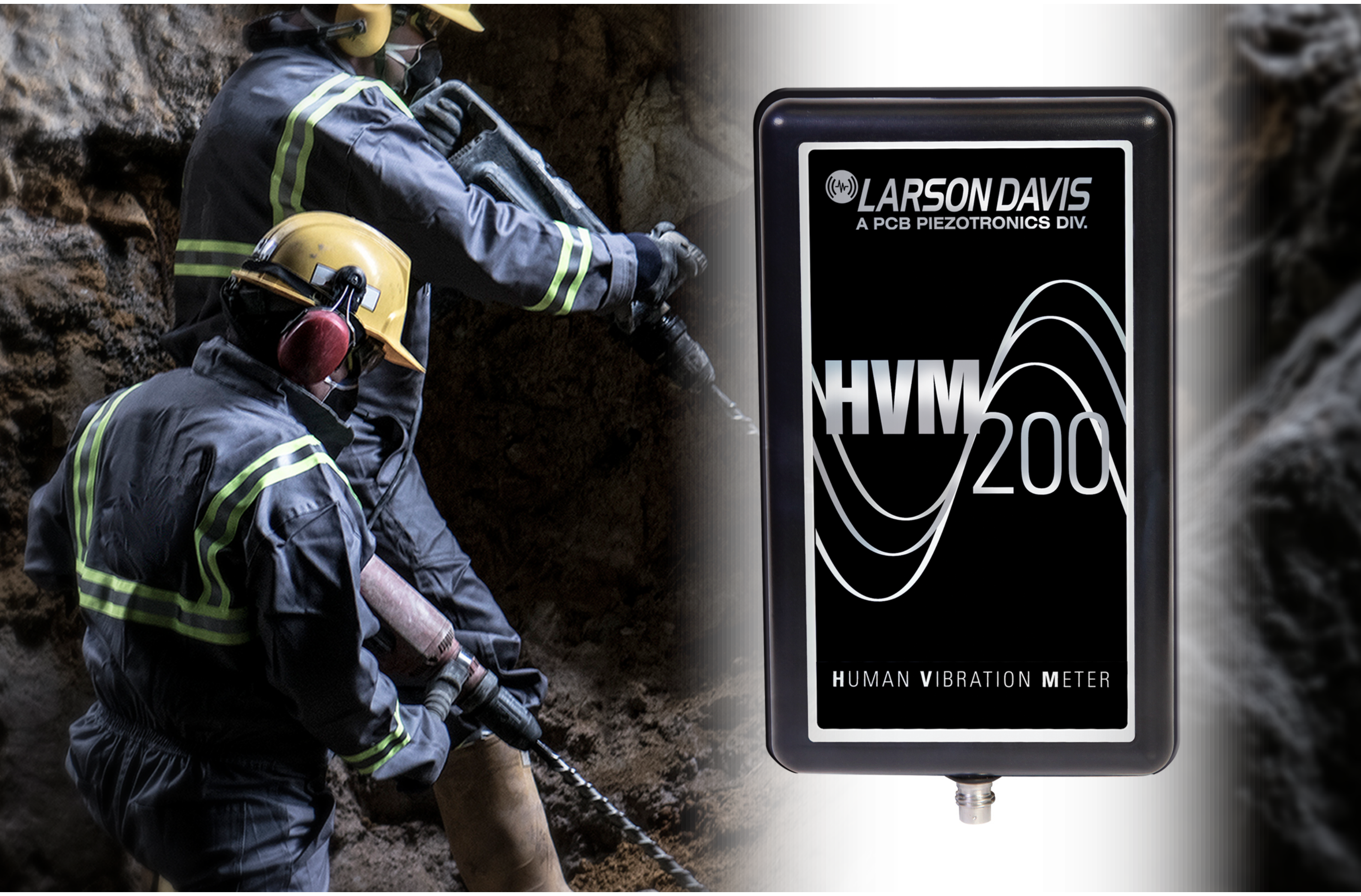
Model HVM200
Human Vibration Meter
Manual



LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Larson Davis

HVM200
Reference Manual

IHVM200.01 Rev C

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Warranty

For warranty information, refer to our *Terms and Conditions of Sale* on our website at www.larsondavis.com/TermsConditions.aspx.

HVM200 Purchase Information

Record the serial number and date of purchase below.
Serial Number:________________________ Date of Purchase:_____________________

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1681 West 820 North
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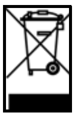


Contact Larson Davis

Website: www.larsondavis.com
Worldwide Corporate Headquarters
Larson Davis - a PCB Piezotronics division
Toll-free (in the US):888-258-3222
Phone:716-926-8243
USA fax:716-926-8215
E-mail: sales@larsondavis.com

Table of Contents

Module 1 Introduction

1.1 Overview

This module describes the features and options available on the HVM200.

1.2 Features

The Larson Davis HVM200 Human Vibration Meter is designed for use in assessing vibration as perceived by human beings.

The HVM200 provides the following features for vibration measurement:

- Whole body, hand-arm, and general vibration applications
- Wireless mobile interface
- Compact design for easy wear and convenient placement
- Mobile application for configuring, measuring, and viewing vibration data on multiple meters
- Connection and control of multiple meters through WiFi access
- Support for optional 1/1 and 1/3 Octave Band Analysis
- Data analysis and visualization using optional G4 LD Utility software

1.3 Standard Contents

The HVM200 package includes the following contents:

TRY THIS Record the meter serial number and date of purchase in a safe place where it can be retrieved, in case you require customer support.

- HVM200 Human Vibration Meter and certificate
- BAT018 Rechargeable Lithium Battery
- PSA035 Power Supply and Adapters
- CBL218 USB Type A to micro-B USB Cable
- CBL217-01 Accelerometer Cable (1/4-28 4-pin connection)
- G4 LD Utility Software CD

- Removable 8 GB SD Memory (in meter)
- Optional license document for HVM support in G4 LD Utility if purchased

1.3.1 Optional Kits

The following HVM200 models provide kits with the following contents:

- HVM200-HA-41F: Standard contents with CCS047 Hard Shell Case, CCS048-L Hand/Arm Vibration Arm Band, SEN041F accelerometer, ADP081A Hand Adapter, and SWW-G4-HVM software license
- HVM200-WB: Standard contents with CCS047 Hard Shell Case, SEN027 Whole Body Vibration Seat Adapter, and SWW-G4-HVM software license
- HVM200-ALL-41F: Standard Contents with CCS047 Hard Shell Case, CCS048-L Hand/Arm Vibration Arm Band, SEN041F accelerometer, ADP081A Hand Adapter, and SWW-G4-HVM software license

1.3.2 Optional Accessories

Optional CCS047 Hard Shell Case

SWW-G4-HVM

License to enable HVM100 and HVM200 support in G4 LD Utility

HVM200-OB3

1/1 and 1/3 Octave Band Analysis firmware

HVM200-RAW

Record sampled raw data files

SWW-G4-SDK

G4 software development kit

CCS047

Hard Shell Case for transport and protection of HVM200 and accessories

CCS048-L (large) and CCS048-S (small)

Arm Band for wearing the HVM200

SEN026

Accelerometer for ADP063 palm adapter.

SEN040F & SEN041F

Accelerometers for Hand-Arm vibration measurement

SEN020

Accelerometer for Hand-Arm and general vibration measurements

LEARN MORE For more information on HVM200 accessories, including sensors, see “Adaptor Resonance & Frequency Response” on page B-1

SEN027

Seat Adapter, accelerometer, and adapter for whole-body vibration measurements

ADP063, ADP080A, ADP081A, and ADP082A

Adapters for accelerometer placement

CBL217-05, CBL216, and CBL217-01

Cables for connection between accelerometers and HVM200 meter

394C06

Hand-held Shaker for vibrational measurement verification

Module 2 Getting Started

2.1 Overview

This module provides instructions for setting up and configuring HVM200 meters for use with the HVM200 Control app and G4 LD Utility.

2.2 Powering the HVM200

Before using your HVM200, charge the battery completely by following these steps:

Step 1 Slide and remove the back battery cover from the HVM200 meter.

FIGURE 2-1 Remove Battery Cover

Step 2 Insert the supplied battery into the HVM200 by sliding the battery contacts against the meter power contacts first and then lowering the other end of the battery into the tray.

TAKE NOTE Make sure the battery contacts are fully seated against the power contacts in the meter and that the battery lies flat in the tray.

FIGURE 2-2 Insert Battery

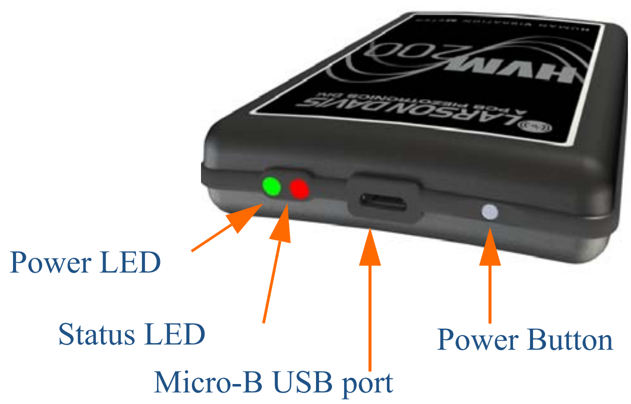
Step 3 Slide the back battery cover onto the HVM200.

TAKE NOTE The Power LED displays a yellow color while charging.

TAKE NOTE Avoid leaving the battery drained for extended periods of time in order to maximize overall battery life.

Step 4 Connect one end of the supplied USB cable to the HVM200 Micro-B USB port and the other end to the PSA035 charger.

FIGURE 2-3 HVM200 Communication



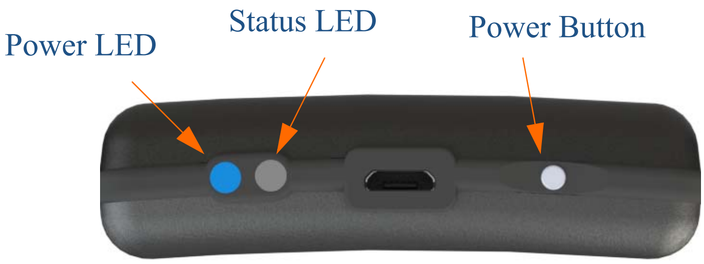
LEARN MORE Refer to the back label of your HVM200 for a description of each LED indication, or see see "LED Indications" on page A-4.

Step 5 In order to get an accurate battery reading, the HVM200 must be fully charged prior to use. When fully charged, the Power LED displays a solid green color. Charging time may take from 3 to 6 hours.

2.3 Power Button Operation

The HVM200 has one button. This power button operates all functions needed for full operation.

FIGURE 2-4 HVM200 Power Button



Turn Meter On

Press power button until the Power LED shows blue.

Start Measurement

Press power button once and the Status LED will show green. It may flash to indicate run pending. When the green light stops flashing and periodically winks, this means the meter is working and collecting data.

LEARN MORE For further help with the LED indicators, refer to the label on the back of the meter, or see “LED Indications” on page A-4.

Stop Measurement

Press power button once and the Status LED will show red to indicate that the measurement has stopped.

Turn Meter Off

Press and hold power button just until the Power LED shows blue, then let go. Wait until both LEDs go dark, this indicates that the meter is now off.

2.4 Downloading the HVM200 Control App

Use your mobile device to find and download the HVM200 Control app from Google Play or the Apple App Store®. To find the app, search for “HVM200”.

Table 2.1 Mobile Requirements

	Apple	Android
Space	2.5MB	2.8M
OS Version	7.0 or later	4.0 and up

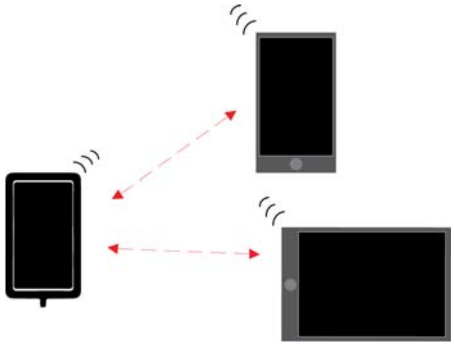
2.5 Connecting the HVM200 to a Mobile Device

With the HVM200 Control app, you can make a direct WiFi connection to the HVM200 from your mobile device.

2.5.1 Mobile Device Connection Options

One HVM200 to multiple mobile devices.

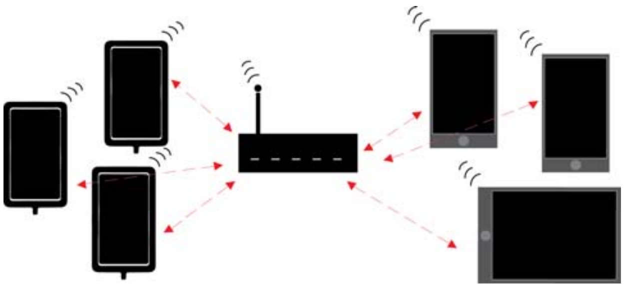
FIGURE 2-5 Mobile Connection



Use HVM200 Access Point to connect meter to one or more mobile devices.

Multiple HVM200 to multiple mobile devices

FIGURE 2-6 Mobile Connections



If a router is within range, connect the HVM200 to the same WiFi network as mobile device(s).

2.5.2 Connecting to a Mobile Device via Access Point

With the HVM200 Control app, you can make a direct WiFi connection to the HVM200 from your mobile device:

TRY THIS If there is no network showing, make sure the HVM200 is turned on.

Step 1 Open the WiFi settings on your mobile device.

TAKE NOTE Depending on your mobile device, you may need to perform this step each time you want to connect to the HVM200.

Step 2 Connect to the HVM200 WiFi network displaying the serial number of your meter.

Step 3 Launch the HVM200 Control app to begin controlling the meter on your mobile device.

FIGURE 2-7 HVM200 Access Point

Step 4 Connect the HVM200 by selecting the meter with the serial number displayed for your meter.

2.5.3 Connecting HVM200 to WiFi Network

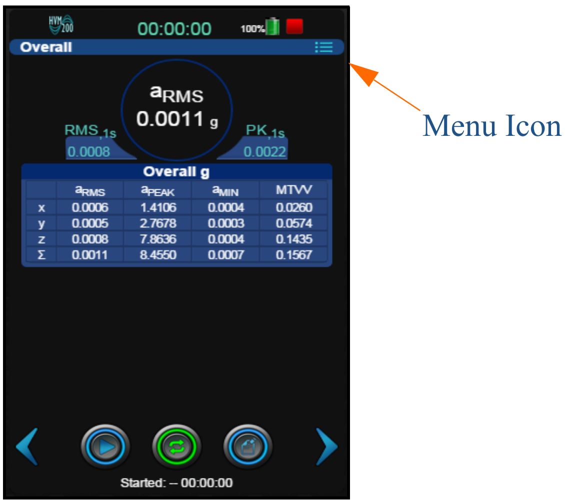
The HVM Control App will be able to connect to the HVM200 as long as the mobile device is connected to the same wireless local network as the HVM200.

To establish a WiFi connection over a network with the HVM200 meter, follow these steps:

Step 1 Launch the HVM200 Control app or the G4 Live Stream view. Select your meter. Click the menu icon.

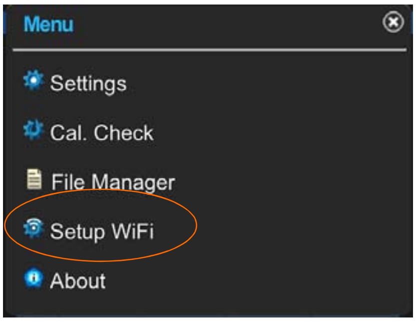
TAKE NOTE It is best to make the initial connection to a WiFi network while also connected to a PC via USB, if possible.

FIGURE 2-8 HVM200 App



Step 2 On the HVM200 Menu, select **Setup WiFi**.

FIGURE 2-9 WiFi Setup

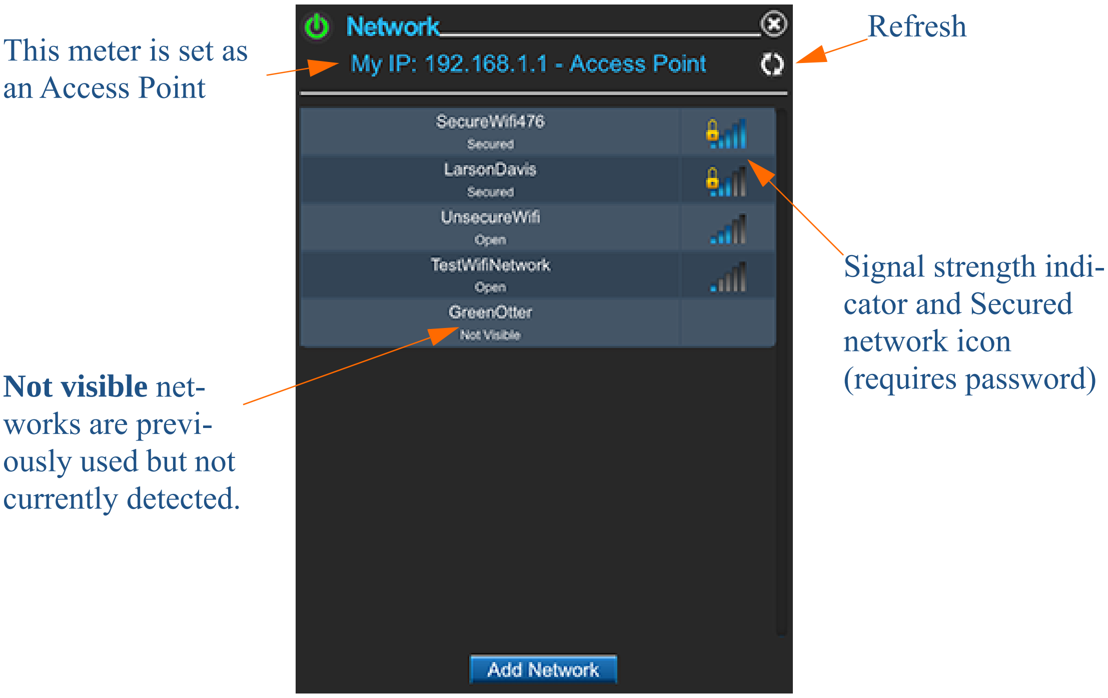


LEARN MORE Networks are listed in the order of greatest signal strength.

TAKE NOTE If you have already entered a password and saved a network, the HVM200 automatically connects to the network with the greatest signal strength.

Step 3 Select an available network. If no network appears on the list, click the refresh button. To connect to a hidden network, click **Add Network** and provide network name.

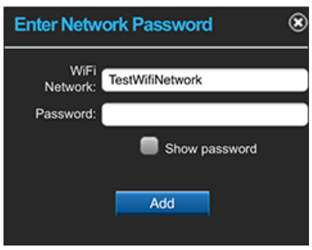
FIGURE 2-10 Network Settings.



TAKE NOTE The HVM200 supports WPA and WPA2 WiFi security. Larson Davis recommends using secure WiFi networks.

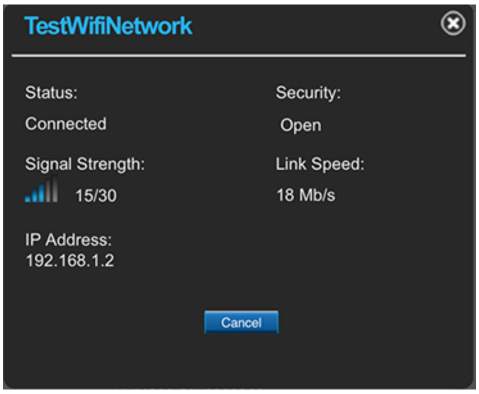
Step 4 Enter the network password, if required, and click **Add**

FIGURE 2-11 Enter Network Password



Step 5 Verify your network connection details by clicking the newly added network from the list.

FIGURE 2-12 Network Connection Details



Step 6 In the connect screen of the HVM Control App, if the HVM200 and your mobile device are both on the same local network, you will see it in the list. Select it to connect.

2.6 Connecting HVM200 to G4 LD Utility

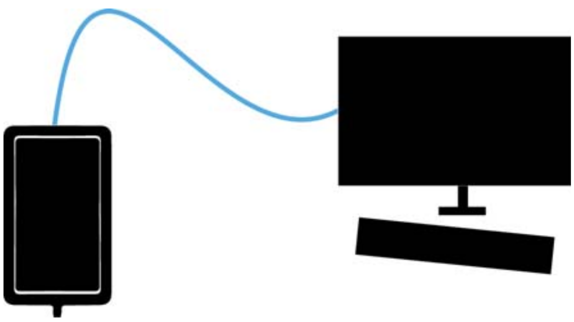
TAKE NOTE G4 LD Utility for HVM software requires a license.

G4 LD Utility for HVM software provides features for setup, measurement, data download, and data viewing.

2.6.1 G4 LD Utility Connection Options

HVM200 to PC via USB Cable

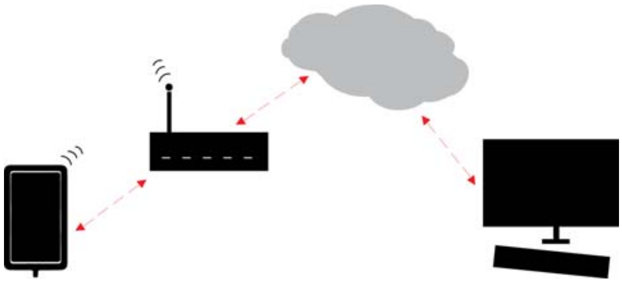
FIGURE 2-13 USB Cable Connection



Using a Micro B USB cable, you can directly connect your PC to meter and operate it using G4 LD Utility.

HVM200 to PC via TCP/IP

FIGURE 2-14 TCP/IP Connection



With the meter connected to a WiFi network that has Internet access, a PC can access the meter as long as it is currently connected to the Internet and you have the IP address to enter into G4 LD Utility, in addition port forwarding will need to be set up on the gateway or router.

2.6.2 Connecting the HVM200 meter to G4 LD Utility via USB

LEARN MORE For more information on working with G4 LD Utility, refer to the G4 LD Utility Software Manual.

Step 1 Connect the HVM200 to a PC with the provided USB to micro-B USB cable. (CBL218).

Step 2 Launch G4 and click **Connect**.

Step 3 Connect via USB.

Step 4 Click the **Live View** button. The **Live View** presents the same interface as the HVM200 App for working with measurements.

2.6.3 Connecting the HVM200 meter to G4 LD Utility via IP Address

LEARN MORE For more information on working with G4, refer to the G4 LD Utility Software Manual.

Step 1 Using previous instructions, connect meter to a WiFi network with Internet access.

Step 2 Launch G4 and click **Connect**.

Step 3 Connect via TCP/IP. Click the **Add Meter** button.

Step 4 Place your cursor in fields and enter the IP address.

Step 5 Once IP address is entered, the **Connect** button will turn blue, select it.

TAKE NOTE IP address is the only required field to add a meter, unless a password has been created.

Step 6 Click the **Live View** button. The **Live View** presents the same interface as the HVM200 App for working with measurements.

2.7 Connecting the Accelerometer

LEARN MORE Refer to the "Handheld Shaker for vibrational measurement verification" in this manual for information on selecting the proper accelerometer for the HVM200 meter.

To connect the accelerometer to your HVM200 meter, follow these steps:

Step 1 Insert the accelerometer cable into the 4-pin connector on the HVM200 and then rotate the nut on the cable until the connection is tight.

Step 2 Insert the other end of the accelerometer cable into the 4-pin connector on the accelerometer and tighten the cable nut.

Step 3 If the HVM200 is not already turned on, press the power button once, the Power LED will turn blue.

Step 4 Connect the HVM200 to G4 via USB.

LEARN MORE For more information on working with G4 tabs and settings, refer to the G4 LD Utility Software Manual.

Step 5 Click the **Setup Manager** tab in G4. Under the meter settings (displaying the meter serial number) click the **Sensor** tab.

TAKE NOTE If you are using an accelerometer with Transducer Electronic Data Sheet (TEDS) capabilities, the sensitivity values will already be displayed for the x, y, and z axes of the sensor.

FIGURE 2-15 Sensor Settings

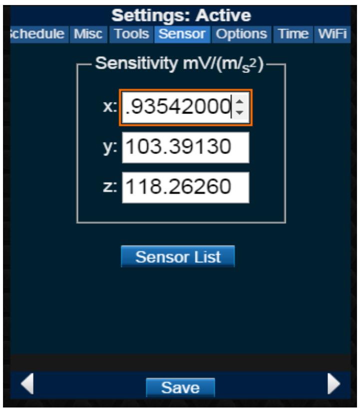
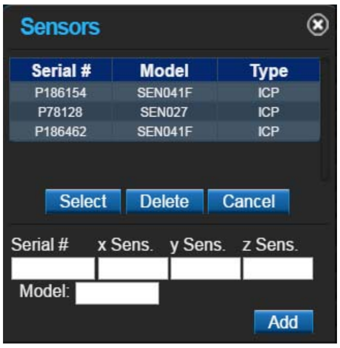


FIGURE 2-16 Sensor Tab

Step 6 Click **Sensor List**.

TAKE NOTE Sensor information, including model, serial number, and sensitivity specifications are usually listed on the calibration certificate that comes with an accelerometer.

FIGURE 2-17 Sensor List Identification and Sensitivity



Step 7 In the **Sensor List**, type the model, serial number of your accelerometer, and the sensitivity for the x, y, and z axes and then click **Add**.

Step 8 Select the accelerometer when it appears in the list and click **Select**. The sensitivity values will automatically appear on the Sensor tab. Click **Save**. Use the Sensor List to quickly access and select stored sensors for future measurements.

Module 3 Making Measurements

3.1 Overview

This module provides an example procedure for performing a vibration measurement with the HVM200 Control app and G4 LD Utility.

The following example demonstrates procedures for measuring vibration, including:

- Setting Up the Measurement
- Making the Measurement
- Downloading the Measurement Data

3.2 Setting Up the Measurement

To set up the measurement:

1. *Perform a calibration check.*
2. *Specify a setup file on your mobile device.*

The following sections describe these steps in more detail.

3.2.1 Perform a Calibration Check

TAKE NOTE A calibration check on an HVM200 requires a hand held shaker like the PCB Model 394C06.

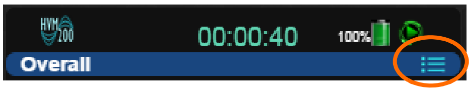
To perform a calibration check, follow these steps:

Step 1 If you have not indicated sensitivity values for the x, y, and z axes on the **Sensor** tab, refer to “Connecting the Accelerometer” to specify these settings.

Step 2 Launch G4 or HVM Control app on mobile device, connect to HVM200, and click **Live View**.

Step 3 Click the Menu icon.

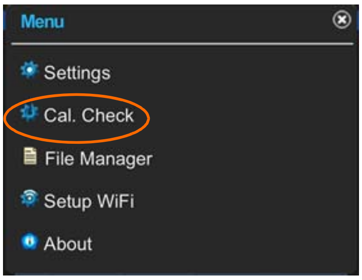
FIGURE 3-1 Menu Icon



TAKE NOTE A calibration can only be made if the meter is stopped and currently on **Live**. Performing a calibration will automatically put the meter in this state.

Step 4 Click **Cal. Check** on Menu.

FIGURE 3-2 Cal. Check Option



Step 5 Enter the **Reference** value for the shaker you will use to perform the calibration check and click **Set**. This value is usually provided in the shaker reference documentation.

Step 6 Attach the transducer on your shaker so that the axis you wish to check is oriented properly.

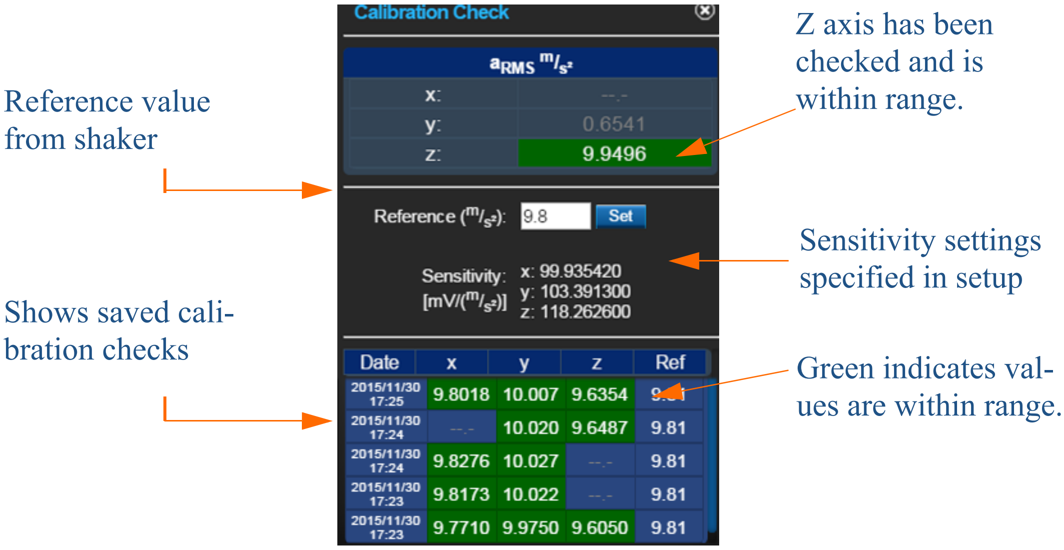
Step 7 Start the shaker and note the $\mathbf{a}_{rms}$ values for each axis, as follows:

TAKE NOTE The filter is automatically set to the Fb weighting during calibration check measurements and restored when finished.

- Values are gray when level has not been checked.
- Values are white when level is being checked.
- Values are red if the axis measurement is complete and the level varies from the reference value by more than ± 5%.
- Values are green if the axis measurement is complete and the level is within ± 5% of the reference value.

Step 8 Repeat the process for each axis on the accelerometer.

FIGURE 3-3 Calibration Check



LEARN MORE If you are using G4 LD Utility software (optional license required), the last two saved calibration checks are displayed in measurement spreadsheets. See the G4 LD Utility Software Manual for more information.

Step 9 To save the calibration check, close the **Calibration Check** dialog box. Saved calibration check information is displayed at the bottom of the dialog box when it is re-opened.

3.2.2 Selecting a Setup File Using Your Mobile Device

The HVM200 includes nine default setups in its **Settings** list. These default setups correspond to settings typically used for different methods of measurement.

You can also create new setup files on the **Settings** list. To create a new setup file, follow these steps:

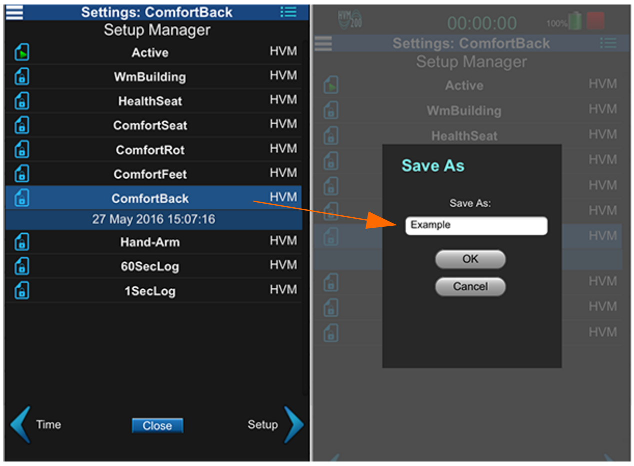
Name the Setup File

TRY THIS The easiest way to create a new setup file is to modify an existing default setup and save it with a different name.

Step 1 Tap the menu icon on the HVM200 app and then tap **Settings**.

Step 2 Press and hold your finger on a default Setup File in the **Settings** list. Select **Save As** and specify the setup name.

FIGURE 3-4 Name the Setup File



TAKE NOTE If you return to the **Setup Manager** tab from a settings tab, you are prompted to save settings. Click **Yes** to apply the changes to the setup.

Step 3 Find and click the setup file you just created by scrolling down the list. The list now displays a report icon next to your new setup file.

FIGURE 3-5 Select New Setup File

Set Operating Mode, Interval Time, and Weighting

TAKE NOTE The interval time values represent the span that data is collected, averaged, and stored before starting a new sample.

Step 4 Use the bottom right arrow to move to the **Setup** tab, specify any changes to your settings and select the **Store Raw Data** option if you have it installed and need it for your post-measurement analysis. The **Store Raw Data** option will greatly increase the amount of memory required to store the measurement. Click **Save**.

The supplied HVM200 memory card can store individual file sizes up to 2 GB and more than 6 hours of measurements with the **Store Raw Data** option enabled. When not enabled, the card can store approximately 8000 hours of measurements.

TAKE NOTE The **Wh** weighting is automatically specified for all axes with the Hand/Arm mode. For more information on operating mode options and weighting curves, “Specifications” on page A-1.

FIGURE 3-6 Operation Settings

This is the Setting Menu which will allow you to jump to any of the settings options at anytime.

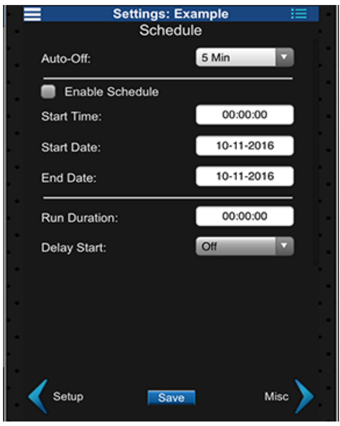
Set Measurement Schedule

TAKE NOTE When run duration is set to **00:00:00** the HVM200 will run until manually stopped. If the run duration is set to any other time, the HVM200 will automatically stop after acquiring data for the selected amount of time.

Step 5 If needed, schedule the HVM200 to take a measurement automatically by selecting the **Enable Schedule** option on the **Schedule** tab. Specify the **Start Time**, **Start Date**, **End Date**, and **Duration**. Specify a **Delay Start**, if needed.

TAKE NOTE If a manual measurement overlaps with the **Start Time** of a scheduled measurement, the scheduled measurement will not start until the manual measurement has stopped and any specified delay has passed.

FIGURE 3-7 Schedule Settings



TAKE NOTE **Auto-Off** is the amount of time the HVM200 will remain fully powered if it is not taking a measurement. If a measurement occurs, this time will reset.

Set OBA Time History, Decibel Reference, and Exposure Settings

Step 6 On the **Misc** tab, select **1/1 Octave** or **1/3 Octave** to include octave band analysis in your measurement data, if you have the options installed.

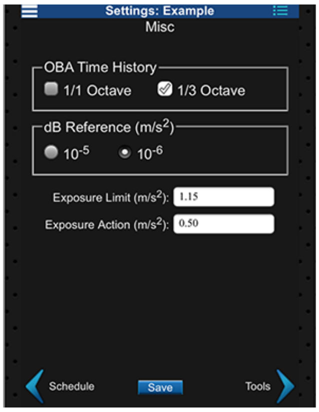
TAKE NOTE Single and double integration are not allowed when display units are set to dB.

Step 7 If you plan to choose dB reference units as the **Display Units** (**Tools** tab), select **10^{-5}** or **10^{-6}** as the **dB Reference** on this tab; otherwise this selection is ignored.

Step 8 Specify the **Exposure Limit** and **Exposure Action**.

TAKE NOTE The exposure settings show default values according to the EU Physical Agents Directive (2002/44/EC) but can be modified according to differing standards or needs.

FIGURE 3-8 Misc. Settings



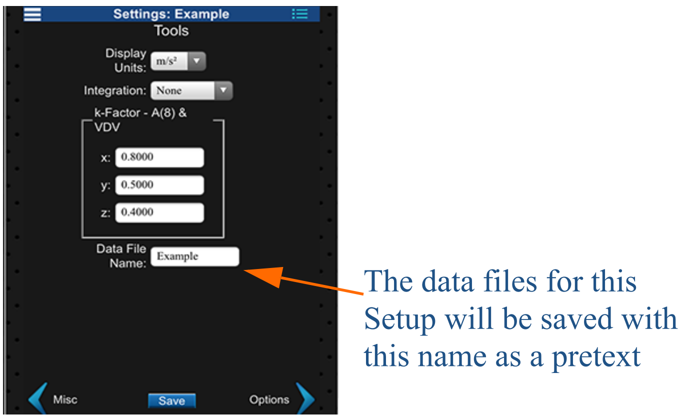
Choose Tools Settings

TAKE NOTE Single integration calculations convert acceleration values into velocity values; double integration converts acceleration values into displacement values.

TAKE NOTE For whole body measurements, the HVM200 multiplies the specified **k-Factor** by the instantaneous acceleration for each axis to produce the summation (Σ) value in the Overall view of the app. K-factors are ignored for general vibration and hand/arm measurements. See “Glossary of Terms” on page C-1.

Step 9 On the **Tools** tab, choose the **Display Units** and **Integration** method. Specify the **k-Factor** for each axis and type a **Data File Name**. Click **Save**.

FIGURE 3-9 Tools Settings



Verify Sensor Settings

If you are using an accelerometer with TEDS capability, the **Sensor** tab on the HVM200 settings (displaying serial number) are automatically specified. If your accelerometer does not have TEDS capability and you have not already specified the settings, refer to the section “Connecting the Accelerometer” on page 2-9.

Verify Installed Options

If you have purchased Octave Band Analysis or Raw Data options, click the **Options** tab and verify that they are displayed and selected in the list. You can deselect this feature temporarily if given measurement does not require the data.

3.3 Making the Measurement

To make the vibration measurement:

1. *Position the HVM200 meter and accelerometer.*
2. *Start the measurement.*
3. *Observe data.*
4. *Stop and annotate the measurement.*

The following sections describe these steps in more detail.

3.3.1 Position for Hand/Arm Vibration

For Hand/Arm vibration measurement, follow these steps:

Step 1 Attach the Larson Davis CCS048 Arm Band on the person being monitored. The end with the transparent cover should be the farthest from the hand.

Step 2 Insert the HVM200 into the arm band so that the accelerometer connector is nearest the hand.

Step 3 Connect the accelerometer to the HVM200.

TAKE NOTE Refer to see “Mechanical” on page B-1.

Step 4 Attach the accelerometer to an appropriate adapter and place it so that the vibration that is coupled to the hand can best be measured.

3.3.2 Position for Whole Body Vibration with Seat Adapter

For whole body vibration measurements using the Larson Davis SEN027 Seat Adapter, follow these steps:

TAKE NOTE The Seat Adapter is sold with the SEN027 accelerometer already housed within the adapter and with the cable already connected to the accelerometer.

Step 1 Place the seat adapter in the location where the person being monitored will sit.

Step 2 Connect CBL217-01 to the HVM200 on one end and the seat adapter cable on the other end.

Step 3 Set the HVM200 meter in a secure location, where it will not fall from its position.

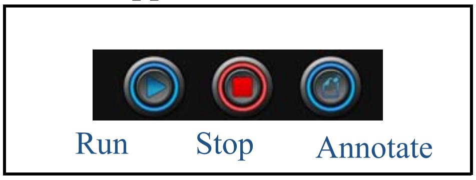
3.3.3 Start/Stop the Measurement

Start Measurement

TRY THIS You can also start the measurement manually by pushing the power button on the HVM200 for at least one second after it is stable (or after the Status LED is red), see “Power Button Operation” on page 2-3.

Click the **Run** button that appears on the HVM200 Control app or G4 LD Utility.

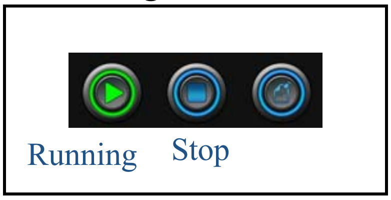
FIGURE 3-10 Meter is stopped



Stop Measurement

Click the **Stop** button.

FIGURE 3-11 Meter is running measurement



View Live Data

While meter is stopped and not taking a measurement, click the red **Stop** button. A green Live button will appear. To return to stop, press **Live** again.

FIGURE 3-12 Viewing Live Data & Meter is stopped

Observe Data

The HVM200 Control app provides the following data displays:

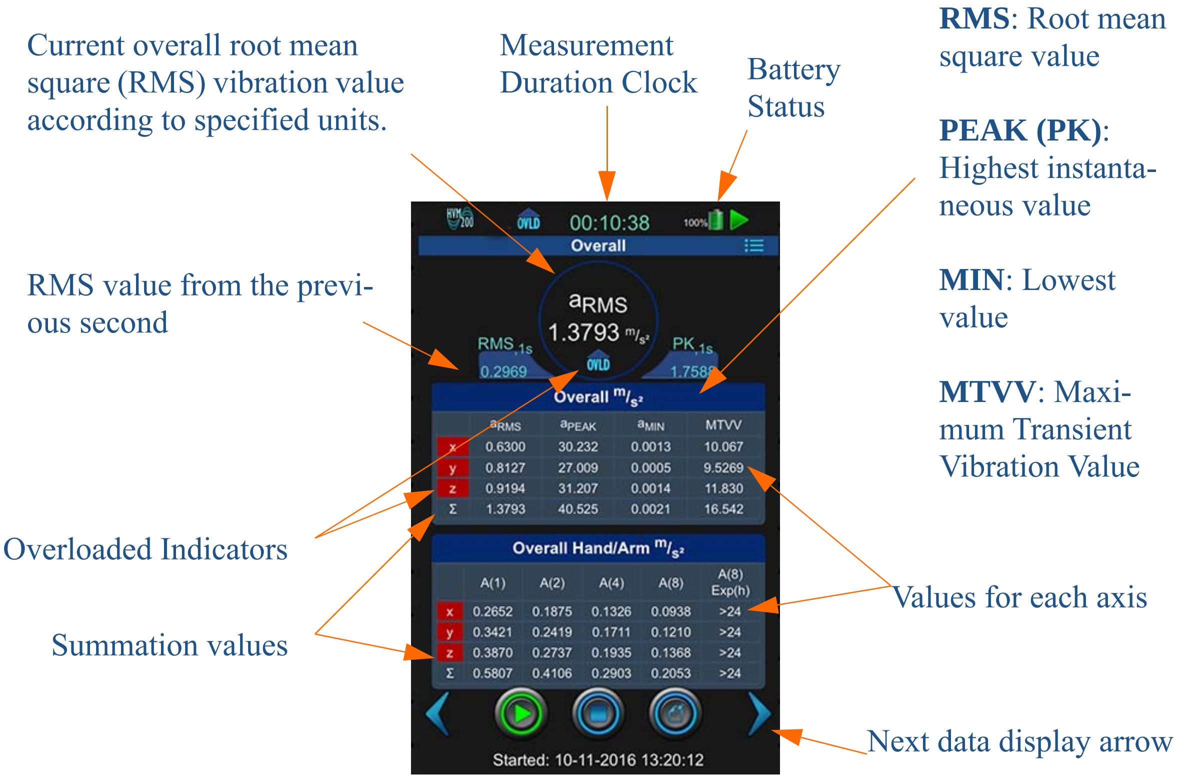
TRY THIS Alternatively, you can also schedule measurements automatically on the **Schedule** tab if you do not need to observe them.

- Overall
- Summation
- X-axis
- Y-axis
- Z-axis

To advance from one data display to the next, click the **Next Arrow**. To enlarge a data display, click the **Zoom** button.

The **Overall** display shows cumulative data for all three axes and their summation for the measurement.

FIGURE 3-13 Overall Data Display

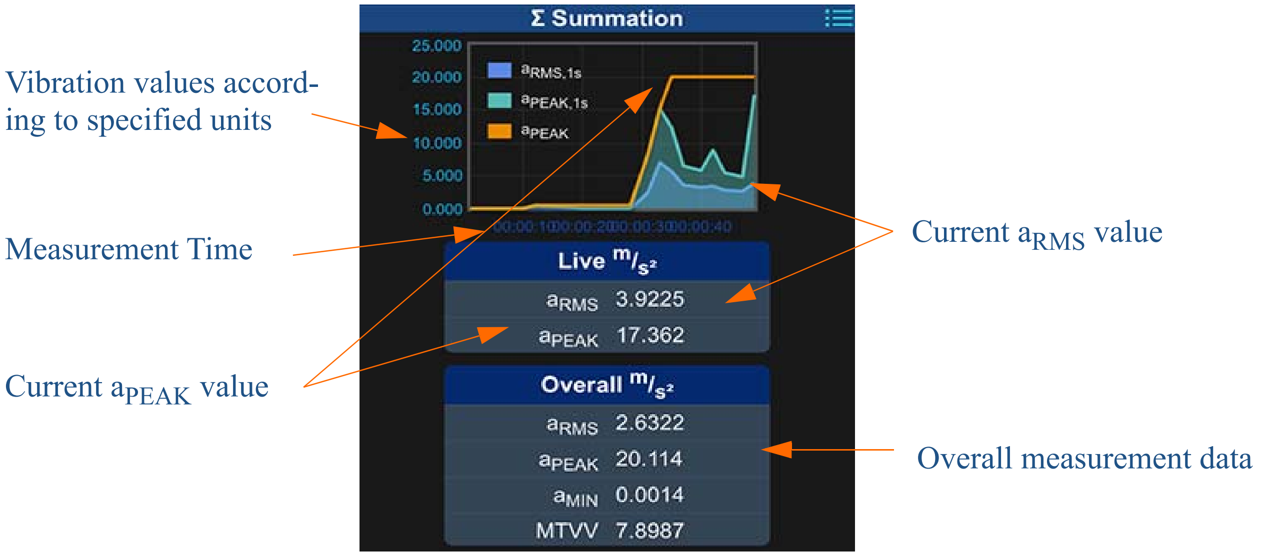


MIN and **MTVV** are the minimum and maximum whole body and hand/arm values of the vibration signal with a one second exponential time weighting. **MIN** and **MAX** are the minimum and maximum general vibration values.

Σ represents the summation of vibration values taken from the X, Y, and Z axes.

The **Summation** display provides a real-time graphical representation of the current summed values from all three axes.

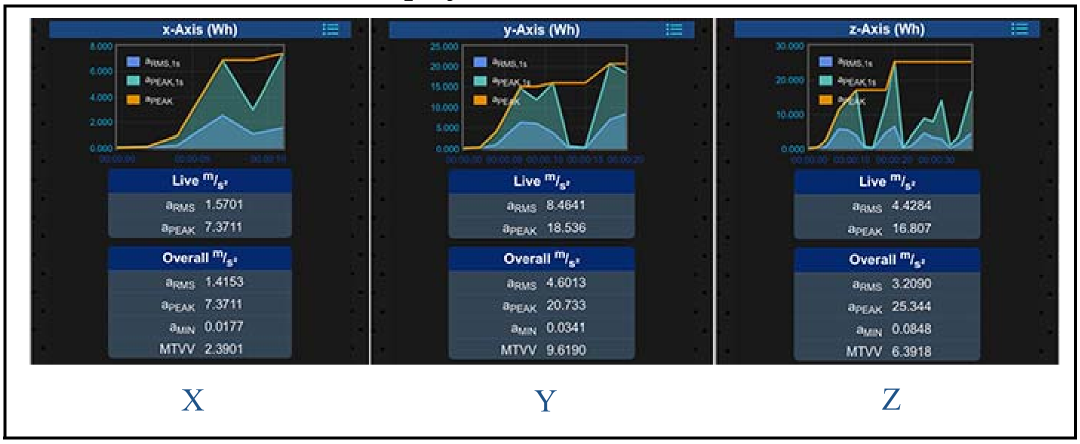
FIGURE 3-14 Summation Data Display



For more information on summation values, including Vibration Dose Value (VDV) and the daily vibration exposure value over eight hours A(8), see the "Glossary" on page C-1.

The Axes displays provide real-time graphical and tabular representations of current and overall values for each axis, similar to Figure 3-14.

FIGURE 3-15 X, Y, and Z Axes Data Displays



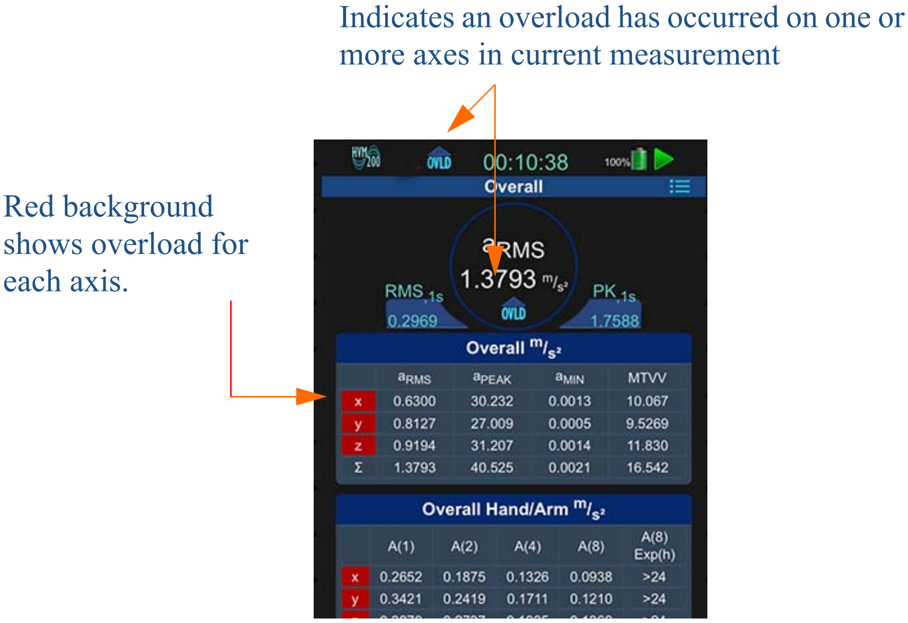
Overload and Under-range Indicators

Overload

LEARN MORE For information on overload indications on the Status LED, see “Operational Characteristics” on page A-4.

An overload occurs when the signal from the accelerometer exceeds the input range of the meter.

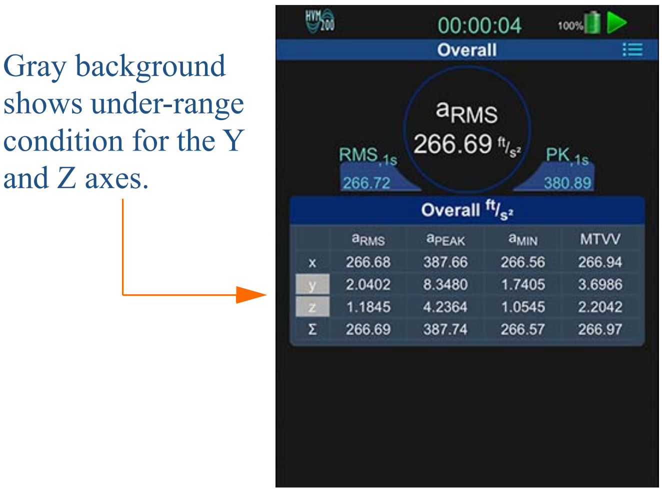
FIGURE 3-16 Overload Indicators



Under-range

An under-range occurs when the signal from the accelerometer is below the input range to the point it cannot be measured accurately.

FIGURE 3-17 Under-range Indicators



Annotate the Measurement

Click the Annotate button and type a note to include with the measurement (you do not need to stop the measurement to annotate).

FIGURE 3-18 Annotate Button

TAKE NOTE An annotation note may be made before the measurement is started and will be added as an overall measurement note; only one such note may be applied to the measurement, but it can be overwritten if needed.

FIGURE 3-19 Annotate Measurement

3.4 Downloading Data

Once you have clicked the **Stop** button and the measurement is completed, you can download and work with data by using any of the following methods:

TAKE NOTE Refer to the G4 LD Utility Manual for information on downloading and viewing data with G4.

LEARN MORE For tips on working with raw data, see see “Working with RAW Data Files” on page 3-12

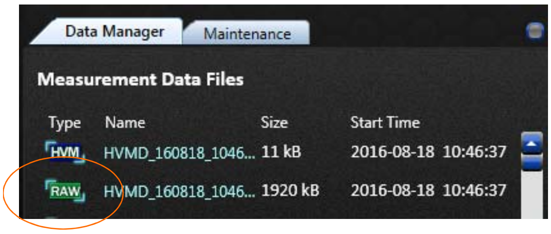
- Download and view **.hvm2** files in G4. The HVM functionality in G4 requires a license.
- Download raw data files. You also need to specify storing data with this option on the **Setup** tab during measurement setup. See "Selecting a Setup File Using Your Mobile Device" for more information.
- Use a third-party tool. Because **.hvm2** files are stored in JavaScript Object Notation (JSON) format, you can copy the data file from the removable SD memory card and work with it in any tool compatible with the format.

3.4.1 Working with RAW Data Files

RAW data files can be created with each measurement, if the Setup File has checked “Store Raw Data” on the Setup Tab, see “Figure 3-6 Operation Settings” on page 3-5.

While HVM200 is connected to G4, a RAW file can be downloaded from the Data Manager tab. The file will always be larger than an HVM file.

FIGURE 3-20 Raw Data File



The raw data file is a binary file that contains raw data samples in a float format for the x, y, and z axes after sensitivity has been applied. Each sample contains 12 bytes in the following format:

Byte	0	1	2	3	4	5	6	7	8	9	10	11
Definition	X Axis Sample				Y Axis Sample				Z Axis Sample			

The byte order within each float is little endian.

TAKE NOTE The resulting data will be in acceleration, which is the standard method of displaying the data, and will need to be integrated into velocity or displacement if needed.

In order to work with a RAW file, you will need MATLAB, GNU Octave, or similar program. The following script can be used to parse the data. The file name will need to be adjusted to match the file name of your RAW file. After parsed, "Weighting Filters for Raw Data" to adjust weighting filters for hand arm or whole body vibration purposes.

```
%% Example Matlab / GNU Octave code for parsing HVM200 raw data format
close all; clear all; clc;
%% Number of Samples to read
Sample_Rate = 7161.45833;% Hz (Hard wired sample rate)
Sample_Time = 10; %second
num_samples_to_read = Sample_Rate*Sample_Time;

%% Open file, Read, Close
%% filename = 'HVM_SERIAL_NUMBER_BASENAME_DATESTAMP.00.raw';
filename = 'HVM_0000056_HVMD_151216_180801.00.raw';
rawsavename = 'HVM_0000056';
filteredsavename = 'HVMFilt_0000056';
FID = fopen(filename,'r');
A = fread(FID,[num_samples_to_read*3],'float');
fclose(FID);

%% Build Axis data
axis_counter = 1;
x_axis = zeros(1,floor(num_samples_to_read));
y_axis = zeros(1,floor(num_samples_to_read));
z_axis = zeros(1,floor(num_samples_to_read));
x_axis = A(1:3:end);
y_axis = A(2:3:end);
z_axis = A(3:3:end);
%% Remove DC bias from data (optional)
x_axis = x_axis - mean(x_axis);
y_axis = y_axis - mean(y_axis);
z_axis = z_axis - mean(z_axis);
```

```
%% Plot
figure(1);
plot(x_axis,'-b');
hold on;
plot(y_axis, '-r');
plot(z_axis, '-k');
hold off;
legend('x','y','z');
title('HVM200 Data');

save(rawsavename,'x_axis','y_axis','z_axis','Sample_Rate','Sample_Time')
;

%% Further processing through ISO 8041 Wk filter
x_axis_filt = isofilwk(x_axis, Sample_Rate);
y_axis_filt = isofilwk(y_axis, Sample_Rate);
z_axis_filt = isofilwk(z_axis, Sample_Rate);
figure(2);
plot(x_axis_filt,'-b');
hold on;
plot(y_axis_filt, '-r');
plot(z_axis_filt, '-k');
hold off;
title('HVM200 Data with Wk filter');
legend('x','y','z');

save(filteredsavename,'x_axis_filt','y_axis_filt','z_axis_filt','Sample_
Rate','Sample_Time');
```

Weighting Filters for Raw Data

The "isofilwk()" function comes from sample code taken from the ISO 8041 standard, and can be modified for other weighting filters using the desired parameters from Table 3-1 'Parameters and transfer functions of the frequency weightings (source: ISO 8041)'.

Use the following script and table to adjust RAW data file for hand arm or whole body vibrations.

```
isofilwk() Sample Code (ISO 8041 standard)
function y = isofilwk(x, fs)

% ISOFILWK
% Filter ISO 8041 Wk
%       y = isofilwk(x,fs)
```

```
%       y output signal, acceleration
%       x input signal, acceleration
%       fs sampling frequency Hz
%       bilinear transformation algorithm is used
f1 = 0.4;
f2 = 100;
f3 = 12.5;
f4 = 12.5;
Q4 = 0.63;
f5 = 2.37;
Q5 = 0.91;
f6 = 3.35;
Q6 = 0.91;

% Note that in the function “butter” the variables Ql and Q2 are
% effectively set to equal to l/sqrt(2), therefore they don't need
% to be explicitly set here.

w3 = 2*pi*f3;
w4 = 2*pi*f4;
w5 = 2*pi*f5;
w6 = 2*pi*f6;

nyq = fs/2; % Nyquist frequency

% determine parameters for band limiting high pass and low pass
[b1,a1] = butter (2,f1/nyq, 'high' ); % High pass
[b2,a2] = butter (2,f2/nyq); % Low pass

% determine parameters for a-v transition
B3 = [1/w3 1];
A3 = [1/w4/w4 1/Q4/w4 1];
[b3,a3] = bilinear (B3, A3, fs);

% determine parameters for upward step
B4 = [1/w5/w5 1/Q5/w5 1]*w5*w5/w6/w6;
A4 = [1/w6/w6 1/Q6/w6 1];
[b4,a4] = bilinear (B4, A4, fs);

% Apply filter to input signal vector x (output to signal vector y)
y = filter (b2, a2, x); % Apply low-pass band limiting
y = filter (b1, a1, y); % Apply high-pass band limiting
y = filter (b3, a3, y); % Apply a-v transition
```

```
y = filter (b4, a4, y); % Apply upward step

end
```

Weighting	Band-limiting				a-v-transition			Upward step				Gain
	f_1 Hz	Q_1	f_2 Hz	Q_2	f_3 Hz	f_4 Hz	Q_4	f_5 Hz	Q_5	f_6 Hz	Q_6	K
W_b	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	16	16	0,55	2,5	0,9	4	0,95	1,024
W_c	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	8	8	0,63	∞	1	∞	1	1
W_d	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	2	2	0,63	∞	1	∞	1	1
W_e	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	1	1	0,63	∞	1	∞	1	1
W_f	0,08	$1/\sqrt{2}$	0,63	$1/\sqrt{2}$	∞	0,25	0,86	0,0625	0,80	0,10	0,80	1
W_h	$10^{8/10}$	$1/\sqrt{2}$	$10^{31/10}$	$1/\sqrt{2}$	$100/(2\pi)$	$100/(2\pi)$	0,64	∞	1	∞	1	1
W_j	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	∞	∞	1	3,75	0,91	5,32	0,91	1
W_k	0,4	$1/\sqrt{2}$	100	$1/\sqrt{2}$	12,5	12,5	0,63	2,37	0,91	3,35	0,91	1
W_m	$10^{-0,1}$	$1/\sqrt{2}$	100	$1/\sqrt{2}$	$1/(0,028 \times 2\pi)$	$1/(0,028 \times 2\pi)$	0,5	∞	1	∞	1	1

NOTE 1 For weighting *W*b, Table A.1 of ISO 2631-4:2001 rounds the value of parameter Q_1 to 2 decimal places. The parameter specified here is the exact value.

NOTE 2 For weighting *W*h, Table A.1 of ISO 5349-1:2001 rounds the values of parameters f_1, f_2, f_3 and f_4 to 5 significant figures and parameter Q_1 to 2 decimal places. The parameters specified here are the exact values.

Table 3.1 Parameters and transfer functions of the frequency weightings (source: ISO 8041)

Module 4 Changing Features

4.1 Overview

This module provides instructions for setting and disabling features, and upgrading the HVM200.

4.2 Setting/Syncing Meter Time and Date

The HVM200 has a time feature that allows the meter's internal clock to be either manually set or synced with your PC or mobile device.

4.2.1 Setting/Syncing Time via G4 LD Utility

Step 1 Ensure the meter is powered on.

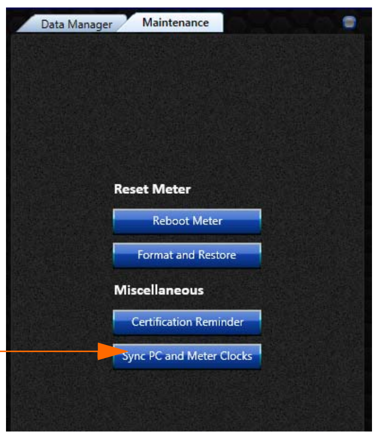
Step 2 Launch G4 LD Utility and connect meter either through USB cable or IP address.

TAKE NOTE If you don't see the Time tab, you may be in a different setting than Active. Only in the Active setting can you set or sync the time.

Step 3 Navigate **Meter Manager** ➝ **Maintenance**.

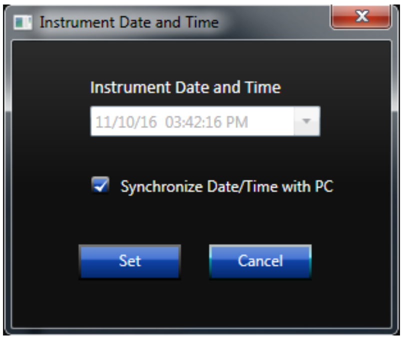
FIGURE 4-1 Maintenance Tab

Select Sync PC and Meter Clocks



Step 4 Select **Set** to use the PC clock as the new time for the meter. If you uncheck this option, you can set the date and time manually.

FIGURE 4-2 Date and Time



4.2.2 Setting/Syncing Time via HVM200 Control app

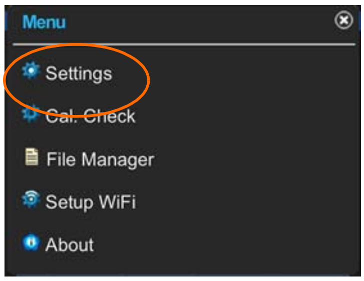
Step 1 Make sure the meter is powered on.

LEARN MORE For more information on connecting the HVM200 to mobile app, see “Connecting the HVM200 to a Mobile Device” on page 2-4

Step 2 Launch app and connect the HVM200 meter to your device using an Access Point or WiFi network.

Step 3 Navigate **Menu** ⇢ **Settings**.

FIGURE 4-3 HVM200 Menu



TAKE NOTE If you don’t see the Time tab, you may be in a different setting than Active. Only in the Active setting can you set or sync the time.

Step 4 In the new HVM screen, select the upper left **Menu** icon, then choose **Time**.

FIGURE 4-4 HVM200 Time Tab

Step 5 There are two options:

- Set Time: Tap the inside of the time and data fields, edit by hand what time you want the meter to be, then select Set Time.
- Sync Time: Select this button to sync the time on your meter with the time on your mobile device.

4.3 Turning Off/On WiFi Signal

4.3.1 Turn Off WiFi Signal

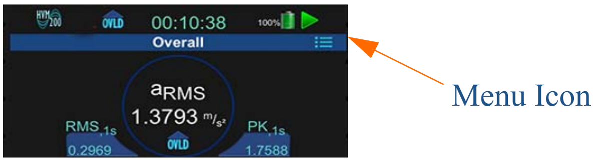
To disable WiFi signal completely from the HVM200 meter, follow these steps:

CAUTION You will only be able to turn the WiFi signal back on from G4 LD Utility with meter connected via USB.

Step 1 Launch the HVM200 Control app or the G4 LD Utility Live Stream view.

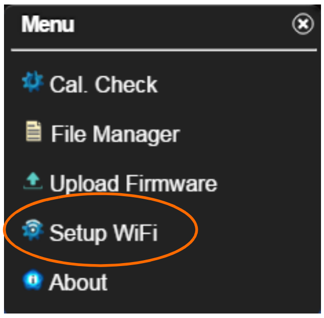
Step 2 Click the menu icon.

FIGURE 4-5 HVM200 App



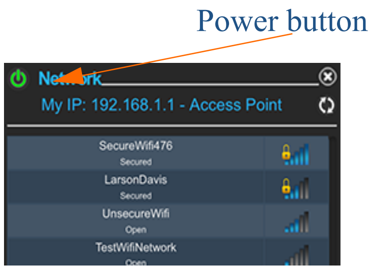
Step 3 On the HVM200 Menu, select **Setup WiFi**.

FIGURE 4-6 **WiFi Setup**



Step 4 Click on the power button.

FIGURE 4-7 **Network Settings**



Step 5 An Alert will appear. Select Confirm. WiFi is now disabled.

4.3.2 Turn Back On WiFi Signal

To turn the WiFi signal back on from the HVM200 meter, follow these steps:

Step 1 Connect HVM200 via USB cable to PC, launch G4 LD Utility and connect meter, see “Connecting HVM200 to G4 LD Utility” on page 2-8.

Step 2 From the Setup WiFi screen, click the red power symbol in the upper left side

FIGURE 4-8 **Network Settings**

Step 3 An Alert will appear, click Confirm.

Step 4 A reboot is required to turn the WiFi back on, so you can select the Reboot button or manually turn off the meter

FIGURE 4-9 **Reboot Button**

Step 5 A dialogue box will appear. Select **Confirm**.

Step 6 A second alert will appear. Wait 30 seconds.

Step 7 The meter will lose connection to G4 LD Utility.

Step 8 Reestablish connection.

4.4 Upgrade Firmware and Options

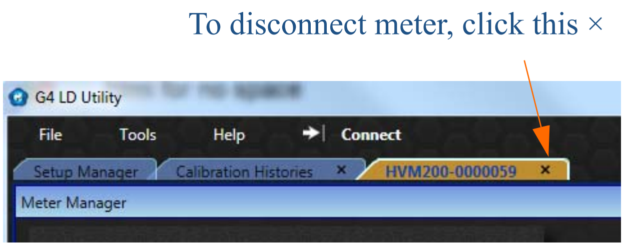
To upgrade firmware and install optional firmware, follow these steps:

Step 1 Make sure the meter is powered on.

Step 2 Launch G4 LD Utility and connect the HVM200 meter to your PC. see "Connecting HVM200 to G4 LD Utility" on page 2-7

Step 3 If you meter is connected to G4 LD Utility, disconnect by clicking on the × on the tab of your meter.

FIGURE 4-10 **Disconnect Meter**

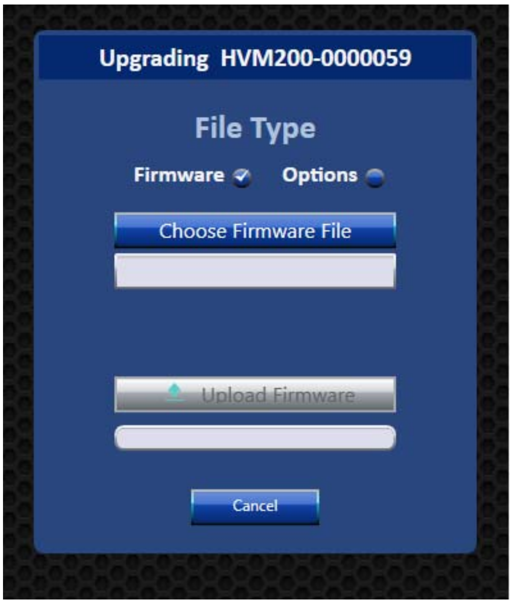


Step 4 From G4, navigate **File** ⇢ **Upgrade Firmware or Options**.

Step 5 Choose meter, then select **Connect.**

Step 6 In this dialogue box you can check Firmware or Options, then press button for **Choose Firmware File** (or **Choose Options File** if you checked "Options".

FIGURE 4-11 **Upgrade Firmware**



Step 7 Open selected file.

Step 8 Press button for **Upload Firmware** (or Upload Options). A success message will appear, close out window.

Appendix A Specifications

Specifications are subject to change without notice.

A.1 General Characteristics

- Measurement modes: Hand-arm, Whole-body, Vibration
- Metrics by mode:

Vibration	RMS, Peak, Min, Max (x, y, z & Σ)
Hand-arm	RMS, Peak, Min, MTVV, A(8) (x, y, z & Σ)
Whole-body	RMS, Peak, Min, MTVV, A(8) Act, A(8) Exp, EP VDV (x, y, z & Σ)

- Measurement units: m/s^2, cm/s^2, ft/s^2, in/s^2, g, dB

A.1.1 Time History (Logging)

- Store interval (user-selected): 1, 2, 5, 10, 20, 30 s; 1, 2, 5, 20, 30 min; 1 hr
- Stored values: RMS and Peak for x, y, and z axes and for Σ.

A.1.2 Run Modes

- Manual: Run/stop with app or meter button
- Timed: Start at time specified in setup
- Delayed: Start after delay specified in setup of 5, 10, 20, 30, or 60 seconds

A.1.3 Clock/Calendar

- 24 hour clock format: hh:mm:ss
- Run-time resolution: 1 second
- 5 minute (typical) clock retention during battery change

Time of Day Drift

Worst case: 6.91 seconds per day (-10 °C to + 50 °C).

Effects of Temperature and Humidity

- Operating temperature: 14°F to 122°F (-10 °C to 50 °C)
- The RMS level of the HVM200 varies up to ± 1% when exposed to temperatures of - 10 °C to 50 °C and relative humidity (RH) 20 to 90% (non-condensing).
- Tested at 159.4 Hz and 9.81 m/s^2.

A.1.4 Effects of Magnetic Fields

Complete instrument RMS level varies up to ± 1.4% when exposed to an 80 A/m, 60 Hz magnetic field (worst case orientation).The complete instrument is defined as the HVM200 meter, CBL217-01, and SEN041F.

A.1.5 Effects of Mechanical Vibrations

Complete instrument RMS level varies up to ± 0.4% when exposed to mechanical vibrations of 30 m/s^2 at 79.58 Hz (worst-case orientation).

A.1.6 Stabilization Time

- 60 seconds
- Measurements with integration settings require up to one minute additional stabilization time before initiating (the Power LED may display a solid green color during this additional stabilization time).

A.1.7 Data Storage

- Removable micro SD memory card up to 32 GB.
- 2 GB file size limit. Files are truncated at 2 GB. No limit to number of files or setups.
- Data and settings are stored in non-volatile memory
- Swapping limitation: Device must be off while replacing Micro SD card or battery.

A.1.8 Transducer Electronic Data Sheets (TEDS) Support

- Chips supported by HVM200: DS2430 and DS2431
- Versions supported: 0.9 (only DS2430 chip) and 1.0
- Templates supported: 0 (version 0.9), 25 (version 1.0)

A.2 Physical Characteristics

A.2.1 Dimensions/Weight

- Length: 4.6 inches (11.8 cm)
- Width: 2.6 inches (6.7 cm)
- Depth: 0.7 inches (1.8 cm)
- Weight: 4.6 ounces (130 grams) - including battery
- Ingress Protection Rating: IP42

A.2.2 Communication Interface

- USB 2.0 Hi-Speed
- WiFi 802.11 b/g/n with WPA and WPA2 security

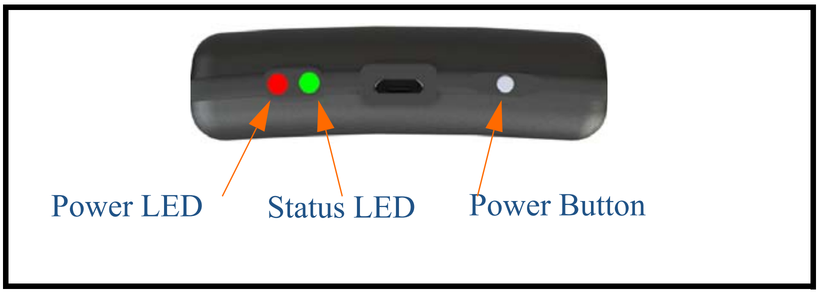
A.2.3 Connections

- Micro-B USB cable (Communication and power)
- 1/4-28 4-pin 3-channel sensor connector

A.3 Operational Characteristics

A.3.1 LED Indications

The following tables shows HVM200 LED indications, states, and additional information.



Power LED		
Indication	**State**	**Additional Information**
	**System Warning**	Click the Warning Icon on the G4 LD Utility Live View. The "About This Meter" information shows if there is a sensor/cable connection error, battery connection error, or SD memory card error. To avoid system errors, do not hot swap SD memory cards.  G4 Live View Warning Icon
 **(Blinking)**	**Battery Low**	Charge the HVM200 via USB from your computer or from the PSA035 power supply. If not charged, the HVM200 will shut down when the remaining battery life approaches the threshold for safe shut down. If the HVM200 shuts down mid-measurement, the file is truncated and G4 LD Utility may not be able to display summary information for the file.
	**Battery Charging**	Allow the battery to charge fully to maximize overall battery life.
	**Battery Charged**	N/A
	**Power On**	Power On is displayed both on start up and shut down. When turning on the HVM200, press the power button for about one second until the blue LED is displayed. When shutting down, press the power button until the blue LED is displayed and the Status LED is dark. Power On is also displayed when the HVM200 is running on battery power (not simultaneously charging through USB connection).

Status LED		
Indication	**State**	Additional Information
	Measurement Stopped	The HVM200 is not running a measurement.
	Measurement Running	The HVM200 is in the process of taking a measurement.
(Blinking)	**Measurement Run Pending**	The HVM200 is stabilizing for an impending measurement, which may last up to 60 seconds, or is awaiting a delayed start set from the scheduling tab.
	Overload	A signal from the accelerometer is currently exceeding the calibrated input range of the HVM200.
(Blinking)	**Overloaded**	An overload has occurred in this measurement.

Power Button Functions

Power Button Functions	
Action	**Press Power Button**
Turn on power	At least one second until Power LED is blue
Turn off power	Until Power LED is blue and Status LED is dark
Start or stop toggle for manual measurement	After turning on meter, less than three seconds
Shut down (if unresponsive)	At least 16 seconds

A.4 Electrical Characteristics

A.4.1 Power Consumption

- USB Power: 130 mA in station mode; 180 mA in access point mode
- Battery run time: 12 hours in station mode; 9 hours in access point mode

A.4.2 Power Supply

- User replaceable rechargeable lithium-ion battery
- Charge time: 3.5 hours with Larson Davis PSA035 power supply

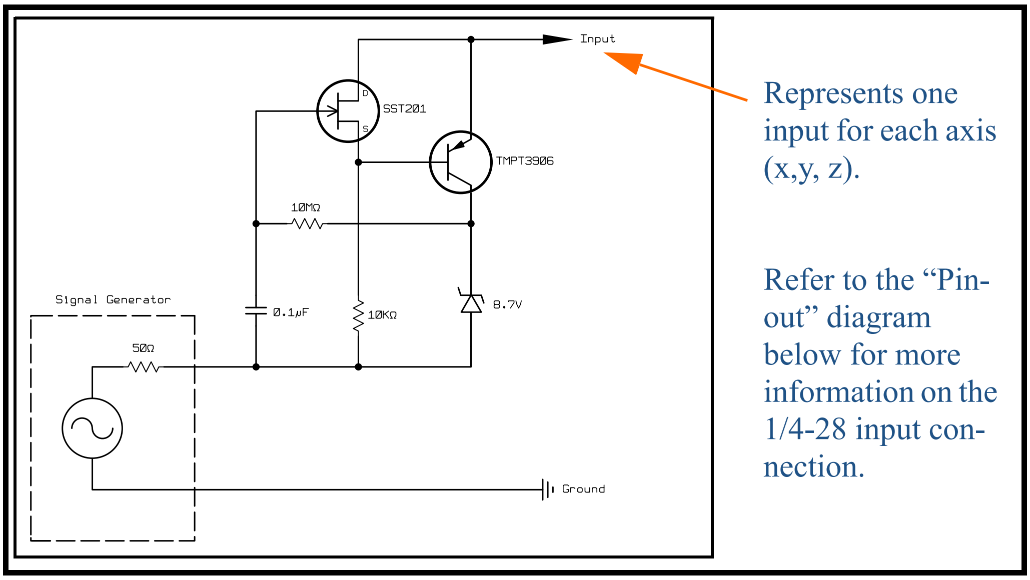
- External Power:

USB Type A to Micro-B USB cable, 3 ft (1 m)

Larson Davis Power Supply PSA035 (universal 100-240 VAC to 5 V USB power adapter)

A.4.3 Electrical Testing

During electrical testing, the following circuit was used:

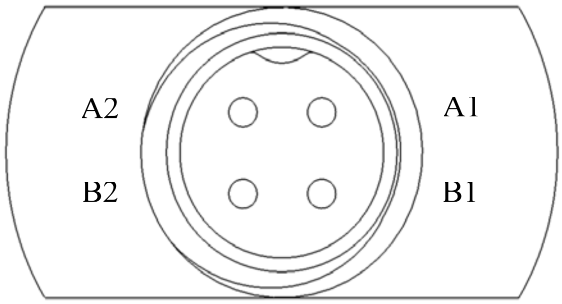


Circuit to Inject Electrical Signal into HVM200 ICP® Inputs

A.4.4 Input

- Input type: ICP, IEPE, or CCP
- Excitation current: 2 mA
- Input connector: 1/4-28 4-pin male (the input connection is also the transducer connection)
- Measurement input voltage range: 1.8 to 16 Vdc
- Measurement AC reference bias voltage: 9 Vdc
- Absolute voltage range (min to max): 0 to 28 V
- Bandwidth: 0.4 Hz to 3000 Hz
- Range: Single range
- Sample rate: 7161.45833 Hz

Pinout



Pin	Signal
A1	GND
A2	X Axis
B1	Y Axis
B2	Z Axis

A.5 Reference Values

The following values represent the primary frequencies and amplitudes at which weighting filters are specified and tested.

Operating Mode	Frequency Weighting	Reference Frequency	Reference Amplitude
Vibration	Fa (0.4 Hz to 100 Hz) Fb (0.4 Hz to 1250 Hz) Fc (6.3 Hz to 1250 Hz)	50 rad/s (7.958 Hz) 500 rad/s (79.58 Hz) 500 rad/s (79.58 Hz)	10 m/s^2 10 m/s^2 10 m/s^2
Hand Arm	Wh	500 rad/s (79.58 Hz)	10 m/s^2
Whole Body	Wm Wb Wc Wd We Wj Wk Wf (Severity)	100 rad/s (15.915 Hz) 2.5 rad/s (0.3979 Hz)	1.0 m/s^2 1.0 m/s^2 1.0 m/s^2 1.0 m/s^2 1.0 m/s^2 1.0 m/s^2 1.0 m/s^2 0.1m/s^2

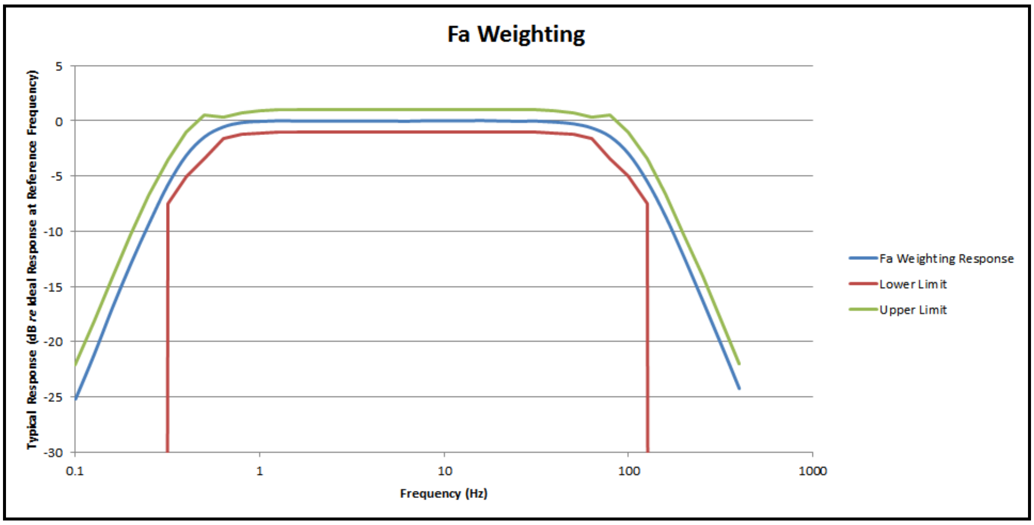
A.6 Measurement Ranges

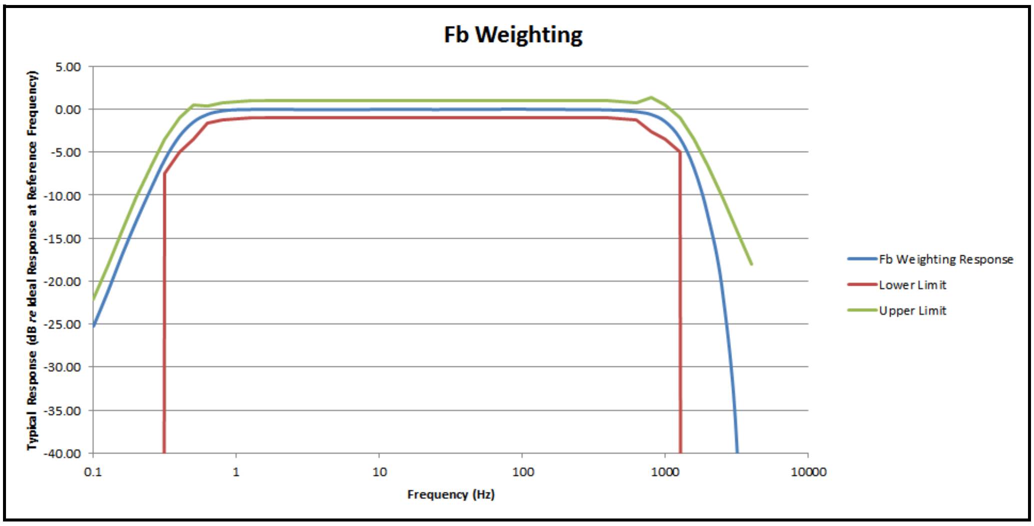
The following table shows the HVM200 dynamic and linearity ranges in root-mean square values. (Peak values are 1.414 times higher.)

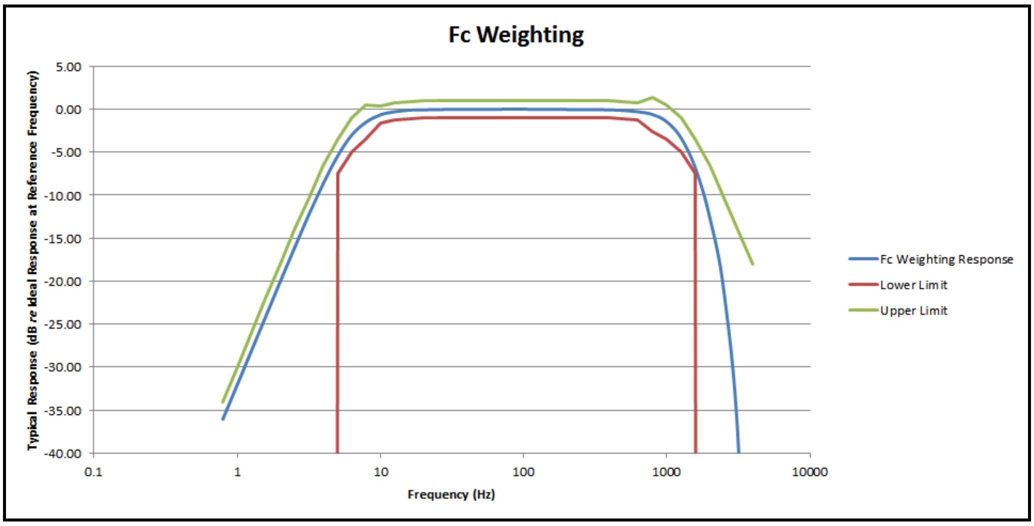
Frequency Weighting	Noise Floor (typical mV)	Lower Limit (Under-range mV)	Lower Limit Linearity Range (typical mV)	Lower Limit Linearity Range (maximum mV)	Upper Limit (Overload V)
Fa	0.028	0.204	0.092	0.178	5.01
Fb	0.046	0.232	0.133	0.176	5.01
Fc	0.041	0.205	0.116	0.152	5.01
Wb	0.016	0.167	0.073	0.137	5.01
Wc	0.021	0.184	0.089	0.150	5.01
Wd	0.014	0.181	0.072	0.175	5.01
We	0.012	0.193	0.073	0.161	5.01
Wf	0.009	0.185	0.100	0.147	5.01
Wh	0.014	0.087	0.042	0.090	5.01
Wj	0.023	0.167	0.077	0.151	5.01
Wk	0.018	0.144	0.073	0.121	5.01
Wm	0.017	0.103	0.060	0.077	5.01

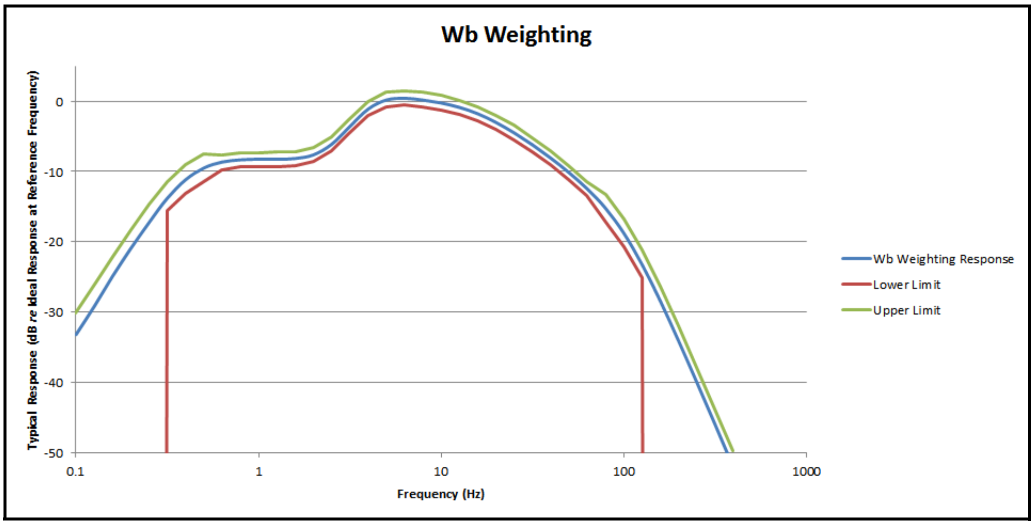
A.7 Frequency Weighting Curves

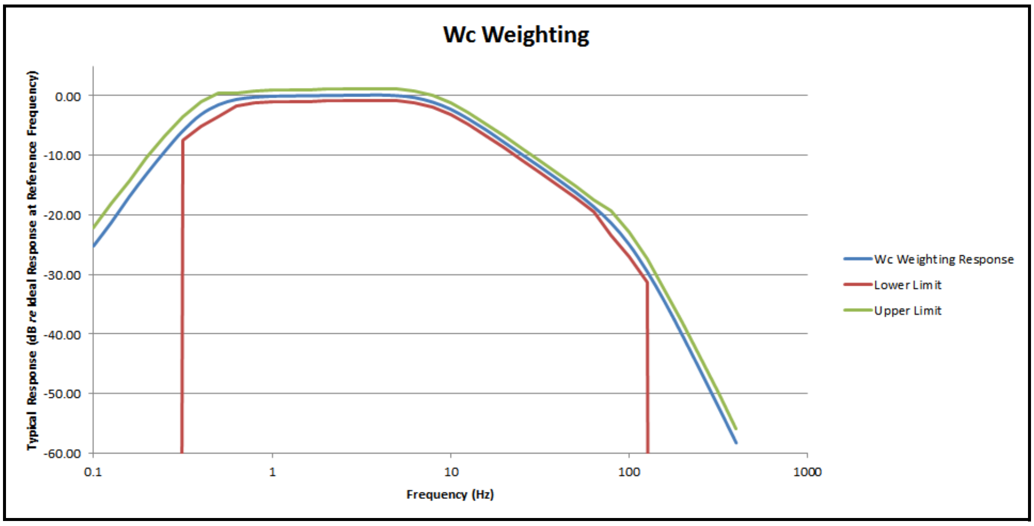
The following graphs show frequency weighting curves for the HVM200.

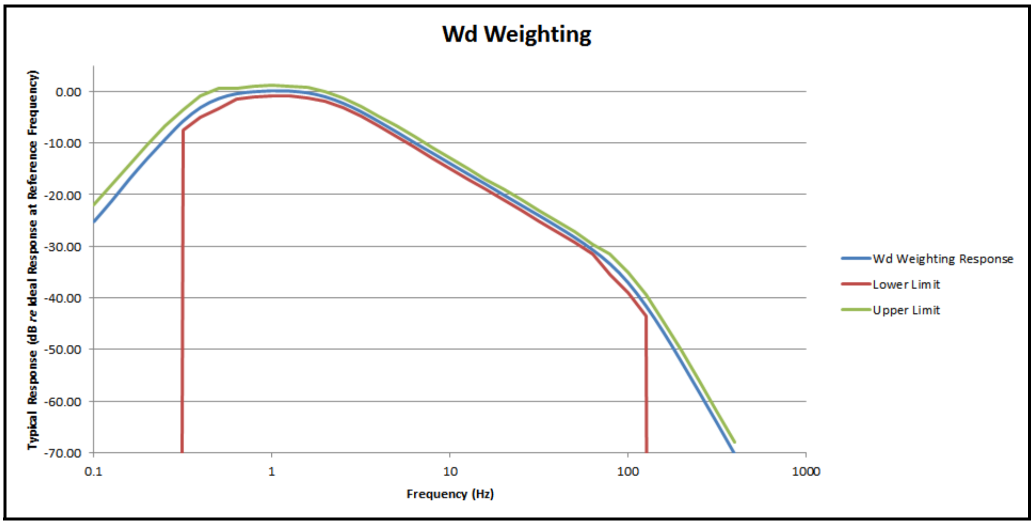

Fa Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
5
0
-5
-10
-15
-20
-25
-30
0.1
1
10
100
1000
Frequency (Hz)
Fa Weighting Response
Lower Limit
Upper Limit


Fb Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
-40.00
0.1
1
10
100
1000
10000
Frequency (Hz)
Fb Weighting Response
Lower Limit
Upper Limit

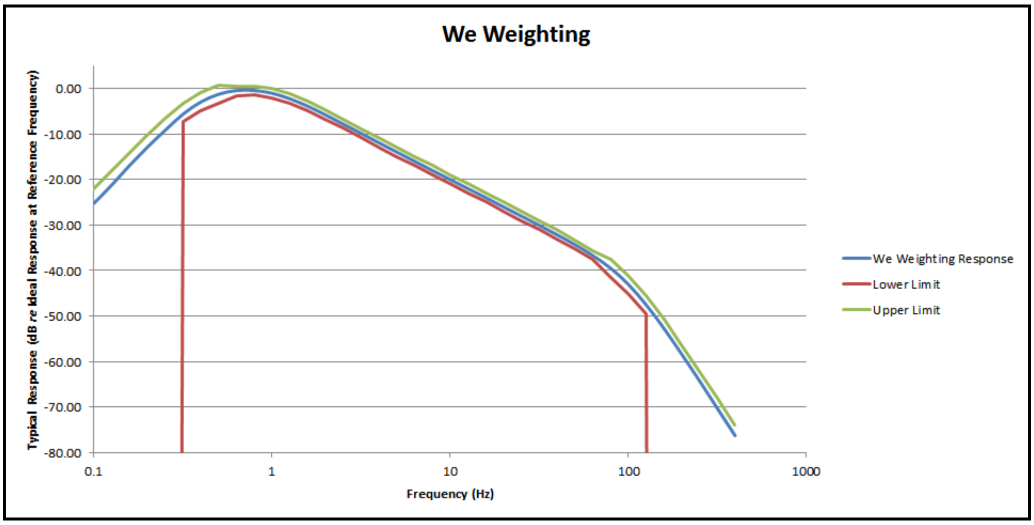

Fc Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
-40.00
0.1
1
10
100
1000
10000
Frequency (Hz)
Fc Weighting Response
Lower Limit
Upper Limit


Wb Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0
-10
-20
-30
-40
-50
0.1
1
10
100
1000
Frequency (Hz)
Wb Weighting Response
Lower Limit
Upper Limit

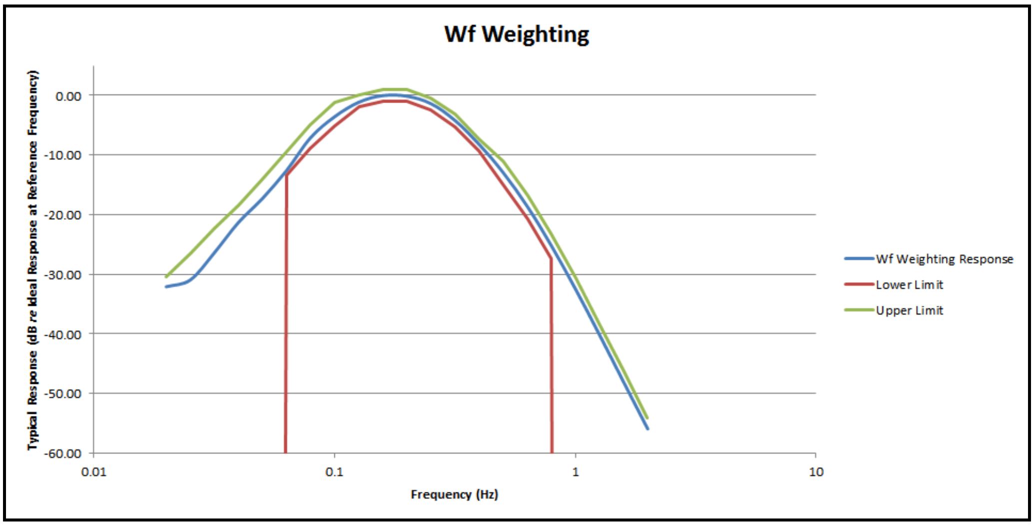

Wc Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
0.1
1
10
100
1000
Frequency (Hz)
Wc Weighting Response
Lower Limit
Upper Limit



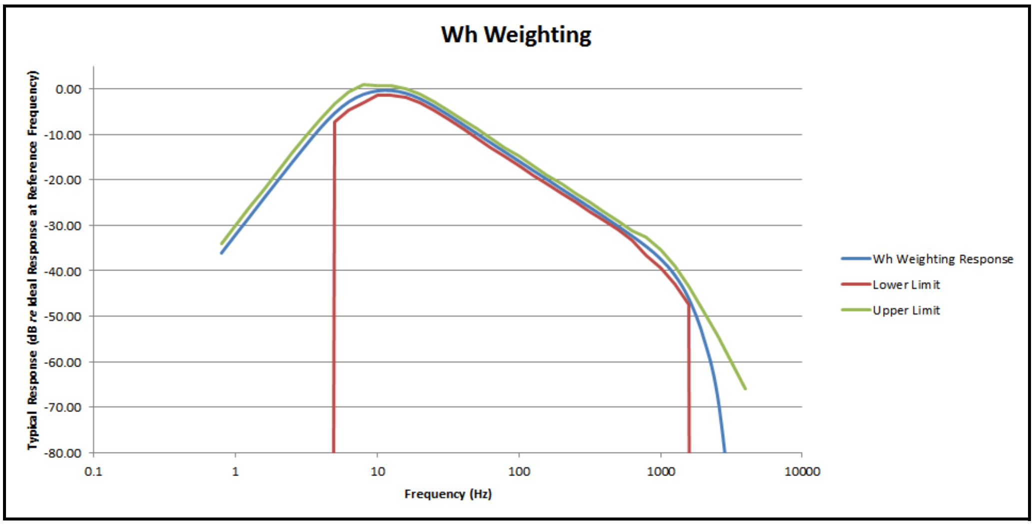
Wd Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
0.1
1
10
100
1000
Frequency (Hz)
Wd Weighting Response
Lower Limit
Upper Limit

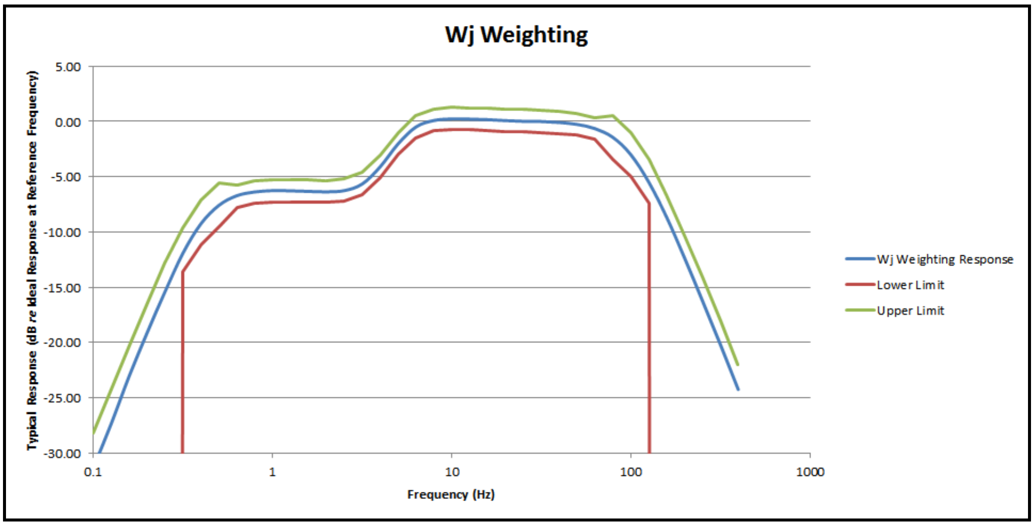


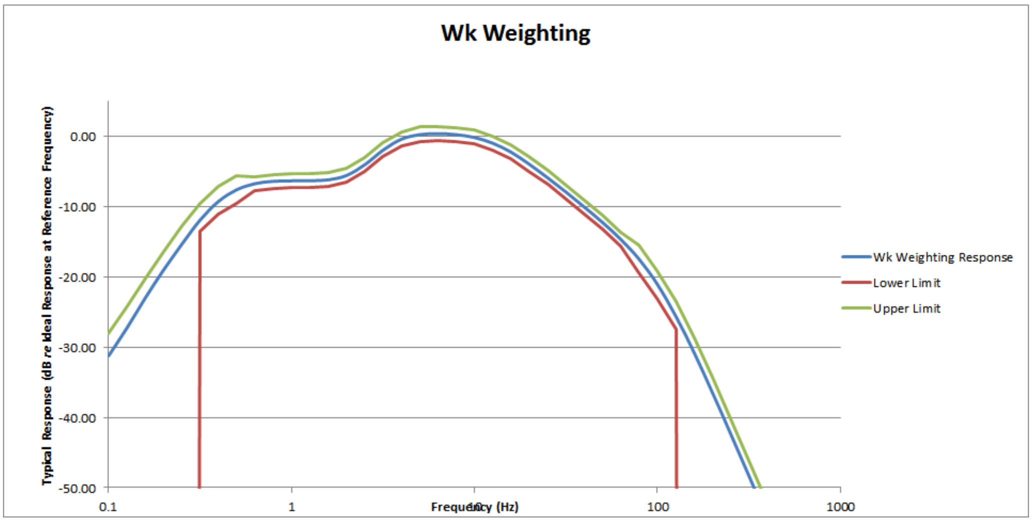
We Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
-80.00
0.1
1
10
100
1000
Frequency (Hz)
We Weighting Response
Lower Limit
Upper Limit

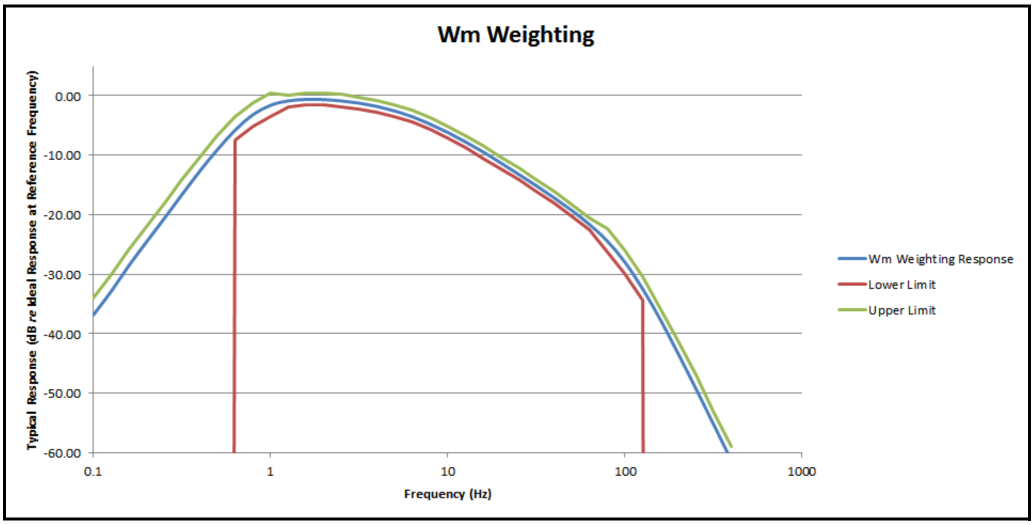


Wf Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
0.01
0.1
1
10
Frequency (Hz)
Wf Weighting Response
Lower Limit
Upper Limit


Wh Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
-80.00
0.1
1
10
100
1000
10000
Frequency (Hz)
Wh Weighting Response
Lower Limit
Upper Limit


Wj Weighting
Typical Response (dB re Ideal Response at Reference Frequency)
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
0.1
1
10
100
1000
Frequency (Hz)
Wj Weighting Response
Lower Limit
Upper Limit





A.8 Frequency Weighting Tables

The following tables show frequency weighting values for the HVM200.

Fa (Flat 0.4 Hz to 100 Hz)

Freq (Hz)	Fa Ideal (dB)	Fa Typical (dB)	Tolerance (dB)
0.1000	-24.10	-25.19	+2/-∞
0.1259	-20.12	-21.21	+2/ -∞
0.1585	-16.19	-16.92	+2/ -∞
0.1995	-12.34	-12.95	+2/ -∞
0.2512	-8.71	-9.26	+2/-2
0.3162	-5.51	-5.84	+2/-2
0.3981	-3.05	-3.15	+1/-1
0.5012	-1.48	-1.46	+1/-1
0.6310	-0.65	-0.57	+1/-1
0.7943	-0.27	-0.17	+1/-1
1.000	-0.11	0.06	+1/-1
1.259	-0.04	0.00	+1/-1
1.585	-0.02	-0.02	+1/-1
1.995	-0.01	-0.03	+1/-1
2.512	0.00	-0.03	+1/-1
3.162	0.00	-0.03	+1/-1
3.981	0.00	-0.02	+1/-1
5.012	0.00	-0.03	+1/-1
6.310	0.00	-0.04	+1/-1
7.943	0.00	0.00	0
10.00	0.00	-0.01	+1/-1
12.59	0.00	0.00	+1/-1
15.85	0.00	0.02	+1/-1
19.95	-0.01	-0.02	+1/-1
25.12	-0.02	-0.05	+1/-1
31.62	-0.04	-0.03	+1/-1
39.81	-0.11	-0.12	+1/-1
50.12	-0.27	-0.27	+1/-1
63.10	-0.64	-0.65	+1/-1
79.43	-1.46	-1.44	+1/-1
100.0	-3.01	-2.99	+1/-1
125.9	-5.46	-5.47	+2/-2
158.5	-8.64	-8.65	+2/-2
199.5	-12.27	-12.32	+2/ -∞

Freq (Hz)	Fa Ideal (dB)	Fa Typical (dB)	Tolerance (dB)
251.2	-16.11	-16.20	+2/ -∞
316.2	-20.04	-20.16	+2/ -∞
398.1	-24.02	-24.22	+2/ -∞

Fb (Flat 0.4 Hz to 1260 Hz) Frequency Weighting

Freq (Hz)	Fb Ideal (dB)	Fb Typical (dB)	Tolerance (dB)
0.1000	-24.10	-25.24	+2 / -∞
0.1259	-20.12	-21.23	+2 / -∞
0.1585	-16.19	-16.94	+2 / -∞
0.1995	-12.34	-12.99	+2 / -∞
0.2512	-8.71	-9.29	+2 / -2
0.3162	-5.51	-5.84	+1 / -1
0.3981	-3.05	-3.18	+1 / -1
0.5012	-1.48	-1.49	+1 / -1
0.6310	-0.65	-0.59	+1 / -1
0.7943	-0.27	-0.21	+1 / -1
1.000	-0.11	-0.08	+1 / -1
1.259	-0.04	-0.05	+1 / -1
1.585	-0.02	-0.04	+1 / -1
1.995	-0.01	-0.04	+1 / -1
2.512	0.00	-0.04	+1 / -1
3.162	0.00	-0.07	+1 / -1
3.981	0.00	-0.05	+1 / -1
5.012	0.00	-0.05	+1 / -1
6.310	0.00	-0.07	+1 / -1
7.943	0.00	-0.06	+1 / -1
10.00	0.00	-0.03	+1 / -1
12.59	0.00	-0.03	+1 / -1
15.85	0.00	-0.01	+1 / -1
19.95	0.00	-0.03	+1 / -1
25.12	0.00	-0.05	+1 / -1
31.62	0.00	-0.02	+1 / -1
39.81	0.00	-0.02	+1 / -1
50.12	0.00	-0.03	+1 / -1
63.10	0.00	-0.03	+1 / -1
79.43	0.00	0.00	0
100.0	0.00	-0.01	+1 / -1

Freq (Hz)	Fb Ideal (dB)	Fb Typical (dB)	Tolerance (dB)
125.9	0.00	-0.04	+1 / -1
158.5	0.00	-0.02	+1 / -1
199.5	0.00	-0.05	+1 / -1
251.2	-0.01	-0.06	+1 / -1
316.2	-0.02	-0.05	+1 / -1
398.1	-0.04	-0.10	+1 / -1
501.2	-0.11	-0.15	+1 / -1
631.0	-0.27	-0.31	+1 / -1
794.3	-0.64	-0.63	+1 / -1
1000	-1.46	-1.47	+2 / -2
1259	-3.01	-3.35	+2 / -2
1585	-5.46	-6.86	+2 / -2
1995	-8.64	-12.55	+2 / -2
2512	-12.27	-21.30	+2 / -∞
3162	-16.11	-39.09	+2 / -∞
3981	-20.04	-85.43	+2 / -∞

Fc (Flat 6.3 Hz to 1260 Hz), Wh, and Wf Frequency Weighting.

Freq (Hz)	Fc Ideal (dB)	Fc Typ (dB)	Wh Ideal (dB)	Wh Typ (dB)	Tolerance (dB)	Wf Ideal (dB)	Wf Typ (dB)	Tolerance (dB)
0.7943	0.7943	-36.06	-36.00	-36.10	+2 / -∞	-32.37	-32.08	+2 / -∞
1.000	1.000	-32.08	-31.99	-32.08	+2 / -∞	-28.40	-30.95	+2 / -∞
1.259	1.259	-28.08	-27.99	-28.09	+2 / -∞	-24.41	-26.39	+2 / -∞
1.585	1.585	-24.08	-23.99	-24.07	+2 / -∞	-20.34	-21.30	+2 / -∞
1.995	1.995	-20.09	-20.01	-20.08	+2 / -∞	-16.06	-17.28	+2 / -∞
2.512	2.512	-16.16	-16.05	-16.12	+2 / -∞	-11.45	-12.58	+2 / -2
3.162	3.162	-12.31	-12.18	-12.26	+2 / -∞	-6.86	-7.07	+2 / -2
3.981	3.981	-8.70	-8.51	-8.56	+2 / -2	-3.16	-3.56	+2 / -2
5.012	5.012	-5.50	-5.27	-5.32	+2 / -2	-0.92	-1.13	+4 / -1
6.310	6.310	-3.02	-2.77	-2.83	+2 / -2	0.04	-0.02	+1 / -1
7.943	7.943	-1.52	-1.18	-1.25	+2 / -2	-0.06	-0.12	+1 / -1
10.00	10.00	-0.67	-0.43	-0.46	+1 / -1	-1.41	-1.39	+1 / -1
12.59	12.59	-0.31	-0.38	-0.39	+1 / -1	-4.22	-4.21	+1 / -1
15.85	15.85	-0.12	-0.96	-0.99	+1 / -1	-8.22	-8.22	+1 / -1
19.95	19.95	-0.08	-2.14	-2.17	+1 / -1	-13.05	-12.96	+2 / -2
25.12	25.12	-0.06	-3.78	-3.83	+1 / -1	-18.73	-18.63	+2 / -2
31.62	31.62	-0.02	-5.69	-5.71	+1 / -1	-25.30	-25.22	+2 / -2
39.81	39.81	-0.03	-7.72	-7.75	+1 / -1	-32.57	-32.49	+2 / -∞
50.12	50.12	-0.03	-9.78	-9.80	+1 / -1	-40.26	-40.20	+2 / -∞
63.10	63.10	-0.03	-11.83	-11.86	+1 / -1	-48.14	-48.11	+2 / -∞
79.43	79.43	0.00	-13.88	-13.88	0	-56.11	-55.96	+2 /-∞
100.0	100.0	-0.01	-15.91	-15.92	+1 / -1			
125.9	125.9	-0.04	-17.93	-17.97	+1 / -1			
158.5		-0.02		-19.97	+1 / -1			
199.5	0.00	-0.05	-19.94	-22.01	+1 / -1			
251.2	0.00	-0.06	-21.95	-24.04	+1 / -1			
316.2	-0.01	-0.05	-23.96	-26.06	+1 / -1			
398.1	-0.02	-0.10	-25.98	-28.13	+1 / -1			
501.2	-0.04	-0.15	-28.00	-30.21	+1 / -1			
631.0	-0.11	-0.31	-30.07	-32.40	+1 / -1			

Freq (Hz)	Fc Ideal (dB)	Fc Typ (dB)	Wh Ideal (dB)	Wh Typ (dB)	Tolerance (dB)	Wf Ideal (dB)	Wf Typ (dB)	Tolerance (dB)
794.3	-0.27	-0.63	-32.23	-34.70	+1 / -1			
1000	-0.64	-1.47	-34.60	-37.41	+2 / -2			
1259	-1.46	-3.35	-37.42	-40.97	+2 / -2			
1585	-3.01	-6.86	-40.97	-46.21	+2 / -2			
1995	-5.46	-12.55	-45.42	-54.40	+2 / -2			
2512	-8.64	-21.30	-50.60	-67.23	+2 / -∞			
3162	-12.27	-39.09	-56.23	-92.87	+2 / -∞			
3981	-16.11	-86.14	-62.07	-101.37	+2 / -∞			

Wm, Wc, and Wd Frequency Weightings

Freq (Hz)	Wm Ideal (dB)	WmTyp (dB)	Wc Ideal (dB)	Wc Typ (dB)	Wd Ideal (dB)	Wd Typ (dB)	Tolerance (dB)
0.100	-32.04	-36.81	-24.10	-25.20	-24.09	-25.23	+2 / -∞
0.1259	-28.20	-32.86	-20.12	-21.23	-20.12	-21.21	+2 / -∞
0.1585	-23.98	-28.53	-16.19	-16.93	-16.18	-16.96	+2 / -∞
0.1995	-20.23	-24.53	-12.34	-13.00	-12.32	-13.00	+2 / -∞
0.2512	-16.71	-20.60	-8.71	-9.30	-8.68	-9.28	+2 / -2
0.3162	-13.51	-16.58	-5.51	-5.88	-5.47	-5.78	+2 / -2
0.3981	-10.98	-12.67	-3.05	-3.17	-2.98	-3.10	+1 / -1
0.5012	-9.53	-9.04	-1.47	-1.50	-1.37	-1.40	+1 / -1
0.6310	-8.71	-5.76	-0.64	-0.60	-0.50	-0.45	+1 / -1
0.7943	-8.38	-3.18	-0.25	-0.23	-0.08	-0.06	+1 / -1
1.00	-8.29	-1.59	-0.08	-0.06	+0.10	0.12	+1 / -1
1.259	-8.27	-0.85	+0.00	-0.01	+0.06	0.06	+1 / -1
1.585	-8.07	-0.61	+0.06	0.02	-0.26	-0.28	+1 / -1
1.995	-7.60	-0.64	+0.10	0.05	-1.00	-1.06	+1 / -1
2.512	-6.13	-0.86	+0.15	0.09	-2.23	-2.30	+1 / -1
3.162	-3.58	-1.24	+0.19	0.12	-3.88	-3.93	+1 / -1
3.981	-1.02	-1.78	+0.21	0.14	-5.78	-5.84	+1 / -1
5.012	0.21	-2.55	+0.11	0.04	-7.78	-7.85	+1 / -1
6.310	0.46	-3.52	-0.23	-0.31	-9.83	-9.92	+1 / -1
7.943	0.21	-4.76	-0.97	-1.06	-11.87	-11.91	0
10.0	-0.23	-6.16	-2.20	-2.25	-13.91	-13.95	+1 / -1
12.59	-0.85	-7.75	-3.84	-3.88		-15.98	+1 / -1
15.85	-1.83	-9.44	-5.74	-5.74		-17.95	+1 / -1
19.95	-3.00	-11.30	-7.75	-7.81		-20.02	+1 / -1
25.12	-4.44	-13.19	-9.80	-9.85	-15.93	-22.04	+1 / -1
31.62	-6.16	-15.12	-11.87	-11.91	-17.95	-24.05	+1 / -1
39.81	-8.11	-17.14	-13.97	-14.00	-19.97	-26.12	+1 / -1
50.12	-10.09	-19.26	-16.15	-16.20	-21.98	-28.28	+1 / -1
63.10	-12.43	-21.62	-18.55	-18.59	-24.01	-30.67	+1 / -1
79.43	-15.34	-24.40	-21.37	-21.39	-26.08	-33.45	+1 / -1

Freq (Hz)	**Wm Ideal (dB)**	**WmTyp (dB)**	**Wc Ideal (dB)**	**Wc Typ (dB)**	**Wd Ideal (dB)**	**Wd Typ (dB)**	**Tolerance (dB)**
100.0	-18.72	-27.95	-24.94	-24.96	-28.24	-37.02	+1 / -1
125.9	-23.00	-32.43	-29.39	-29.45	-30.62	-41.50	+2 / -2
158.5	-28.56	-37.60	-34.57	-34.63	-33.43	-46.68	+2 / -2
199.5	-34.03	-43.28	-40.20	-40.32	-36.99	-52.36	+2 / -∞
251.2	-39.69	-49.17	-46.04	-46.21	-41.43	-58.25	+2 / -∞
316.2	-45.65	-55.16	-51.98	-52.19	-46.62	-64.23	+2 / -∞
398.1	-51.84	-61.23	-57.95	-58.29	-52.24	-70.30	+2 / -∞

We, Wj, and Wk Frequency Weighting

Freq (Hz)	We Ideal (dB)	We Typ (dB)	Wj Ideal (dB)	Wj Typ (dB)	Wk Ideal (dB)	Wk Typ (dB)	Tolerance dB
0.100	-24.08	-25.22	-30.18	-31.27	-30.11	-31.20	+2 / -∞
0.1259	-20.09	-21.22	-26.20	-27.28	-26.14	-27.24	+2 / -∞
0.1585	-16.14	-16.91	-22.27	-22.99	-22.21	-22.98	+2 / -∞
0.1995	-12.27	-12.92	-18.42	-19.08	-18.37	-19.00	+2 / -∞
0.2512	-8.60	-9.20	-14.79	-15.37	-14.74	-15.32	+2 / -2
0.3162	-5.36	-5.66	-11.60	-11.89	-11.55	-11.88	+2 / -2
0.3981	-2.86	-2.99	-9.15	-9.25	-9.11	-9.24	+1 / -1
0.5012	-1.27	-1.28	-7.58	-7.59	-7.56	-7.57	+1 / -1
0.6310	-0.55	-0.48	-6.77	-6.72	-6.77	-6.71	+1 / -1
0.7943	-0.52	-0.47	-6.42	-6.38	-6.44	-6.37	+1 / -1
1.00	-1.11	-1.08	-6.30	-6.26	-6.33	-6.30	+1 / -1
1.259	-2.29	-2.29	-6.28	-6.28	-6.29	-6.28	+1 / -1
1.585	-3.91	-3.92	-6.32	-6.33	-6.13	-6.16	+1 / -1
1.995	-5.80	-5.82	-6.34	-6.37	-5.50	-5.54	+1 / -1
2.512	-7.81	-7.85	-6.22	-6.26	-3.97	-4.01	+1 / -1
3.162	-9.85	-9.87	-5.60	-5.66	-1.86	-1.93	+1 / -1
3.981	-11.89	-11.95	-4.08	-4.11	-0.31	-0.38	+1 / -1
5.012	-13.93	-13.98	-1.99	-2.04	+0.33	0.28	+1 / -1
6.310	-15.95	-16.00	-0.47	-0.51	+0.46	0.42	+1 / -1
7.943	-17.97	-18.04	+0.14	0.08	+0.32	0.28	0
10.0	-19.98	-20.02	+0.26	0.23	-0.10	-0.14	+1 / -1
12.59	-19.98	-22.01	+0.26	0.21	-0.10	-0.95	+1 / -1
15.85	-21.99	-23.99	+0.22	0.16	-0.93	-2.22	+1 / -1
19.95	-23.99	-26.05	+0.16	0.07	-2.22	-3.95	+1 / -1
25.12	-26.00	-28.06	+0.10	0.01	-3.91	-5.88	+1 / -1
31.62	-28.01	-30.06	+0.06	-0.01	-5.84	-7.90	+1 / -1
39.81	-30.04	-32.14	+0.00	-0.10	-7.89	-10.04	+1 / -1
50.12	-32.11	-34.30	-0.08	-0.27	-10.01	-12.24	+1 / -1
63.10	-34.26	-36.68	-0.25	-0.65	-12.21	-14.66	+1 / -1
79.43	-36.64	-39.47	-0.63	-1.44	-14.62	-17.48	+1 / -1

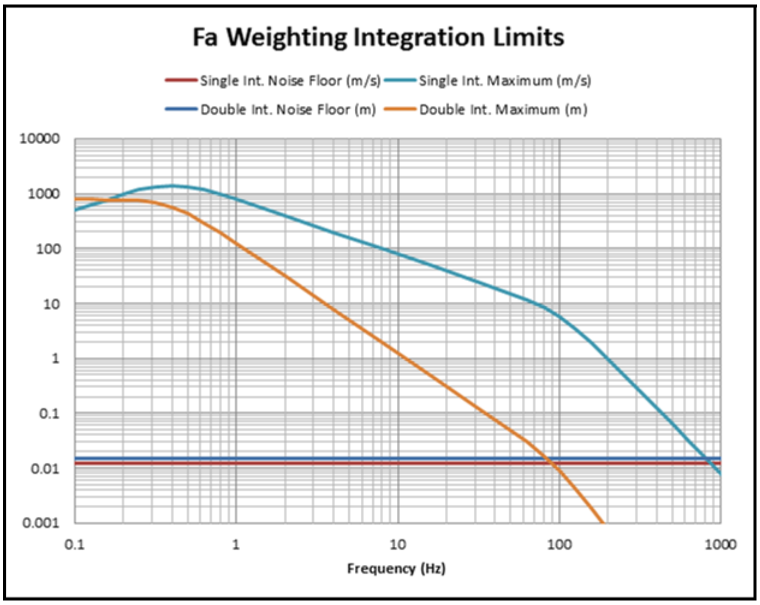
Freq (Hz)	We Ideal (dB)	We Typ (dB)	Wj Ideal (dB)	Wj Typ (dB)	Wk Ideal (dB)	Wk Typ (dB)	Tolerance dB
100.0	-39.46	-43.03	-1.45	-3.01	-17.47	-21.05	+1 / -1
125.9	-43.01	-47.51	-3.01	-5.49	-21.04	-25.55	+2 / -2
158.5	-47.46	-52.69	-5.45	-8.66	-25.50	-30.73	+2 / -2
199.5	-52.64	-58.37	-8.64	-12.34	-30.69	-36.42	+2 / -∞
251.2	-58.27	-64.21	-12.26	-16.22	-36.32	-42.32	+2 / -∞
316.2	-64.11	-70.24	-16.11	-20.18	-42.16	-48.30	+2 / -∞
398.1	-70.04	-76.29	-20.04	-24.25	-48.10	-54.40	+2 / -∞

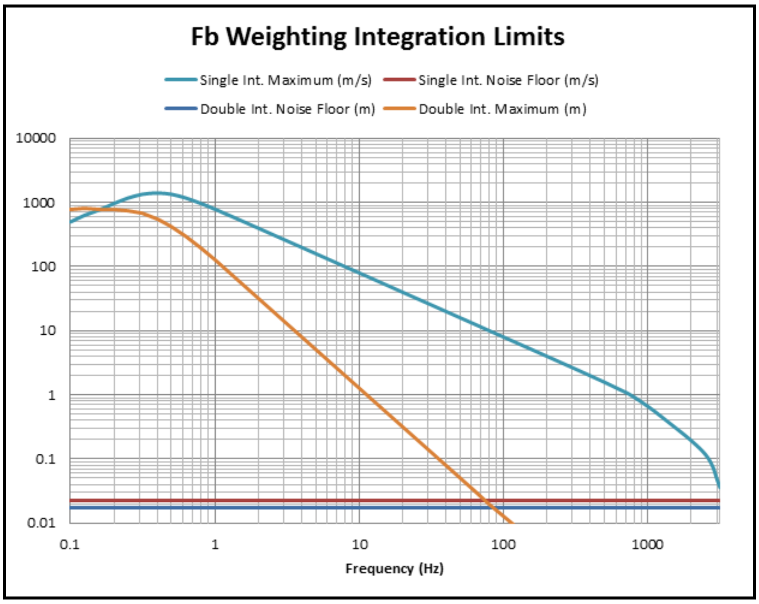
A.9 Integration Weighting Limits

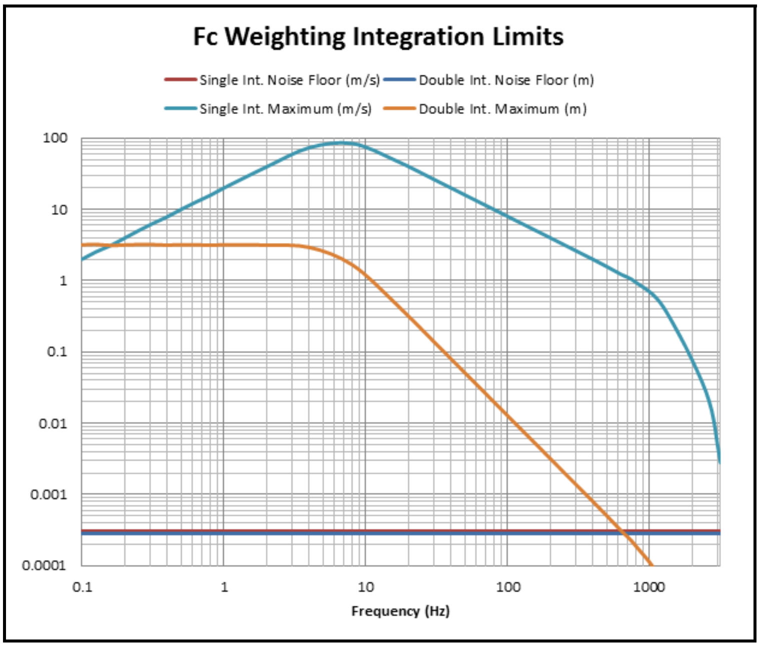
All data presented is with a reference sensitivity of 1 mV/m/s^2. The amplitude values on the tables and figures scale according to the ratio of selected sensor sensitivity values to 1 mV/m/s^2.

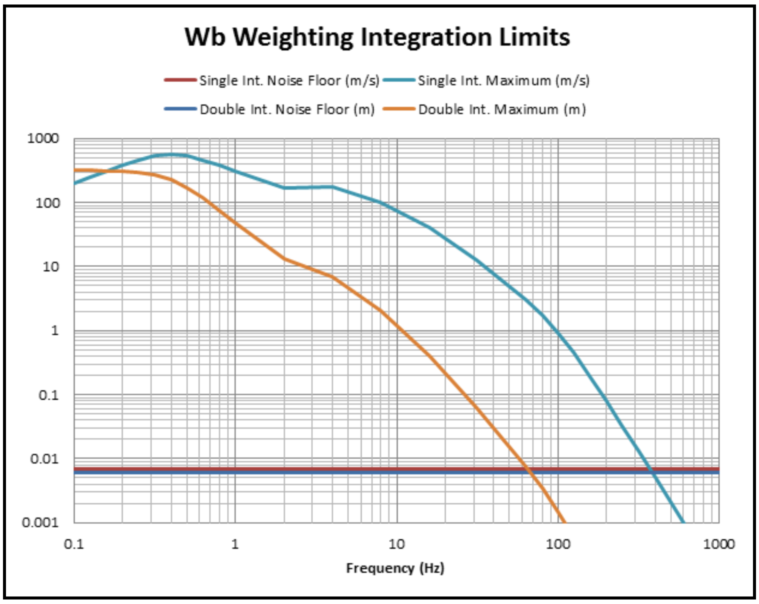
	Single Integration		Double Integration	
Weighting	**Noise Floor (m/s)**	**Max (m/s)**	**Noise Floor (m)**	**Max (m)**
Fa	0.0121	1403.690	0.0150	801.367
Fb	0.0220	1403.690	0.0173	801.367
Fc	0.0003	84.283	0.0003	3.235
Wb	0.0068	563.341	0.0060	317.432
Wc	0.0163	1403.690	0.0143	801.367
Wd	0.0155	1415.048	0.0111	801.367
We	0.0108	1434.733	0.0102	804.139
Wf	0.0802	5740.123	0.1707	8823.712
Wh	0.0003	87.044	0.0002	3.235
Wj	0.0080	695.458	0.0077	397.953
Wk	0.0083	698.669	0.0067	400.711
Wm	0.0049	698.620	0.0034	204.094

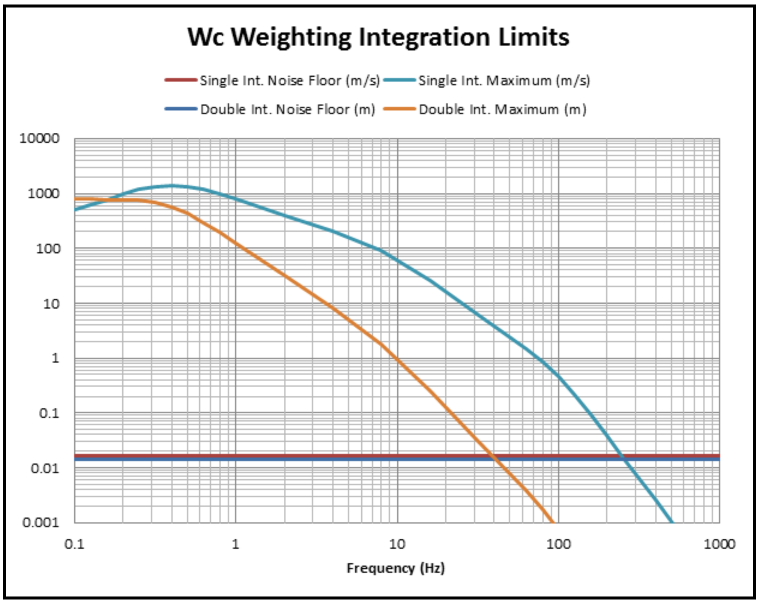
For the following charts, the valid measurement range for each weighting is shown between the noise floor and the maximum.

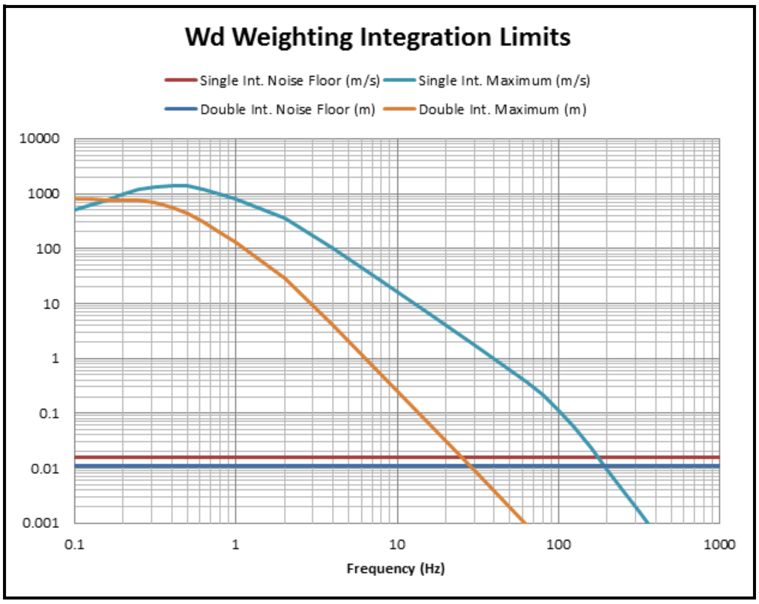

Fa Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)

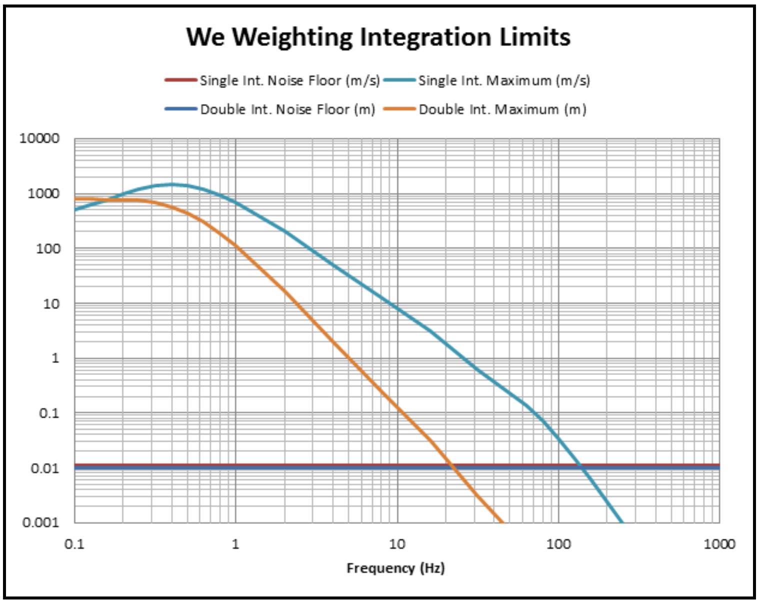

Fb Weighting Integration Limits
Single Int. Maximum (m/s)
Single Int. Noise Floor (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.1
1
10
100
1000
Frequency (Hz)

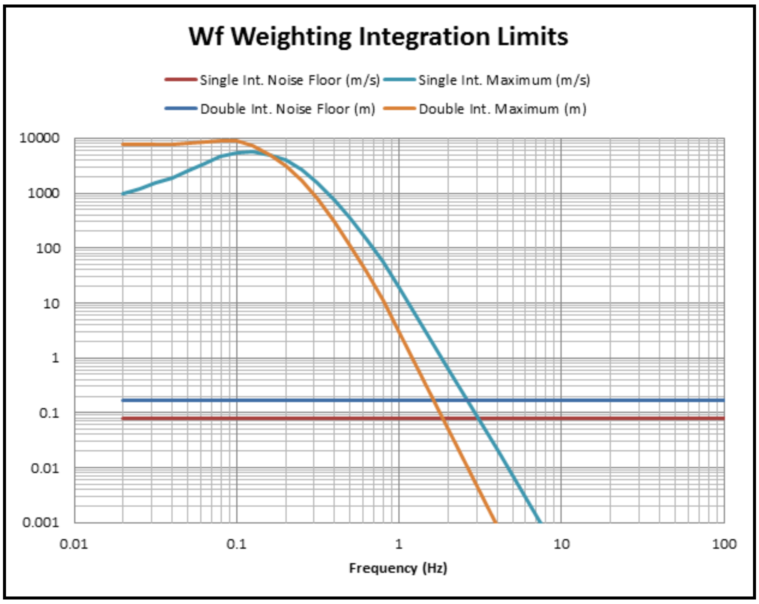

Fc Weighting Integration Limits
Single Int. Noise Floor (m/s)
Double Int. Noise Floor (m)
Single Int. Maximum (m/s)
Double Int. Maximum (m)
100
10
1
0.1
0.01
0.001
0.0001
0.1
1
10
100
1000
Frequency (Hz)

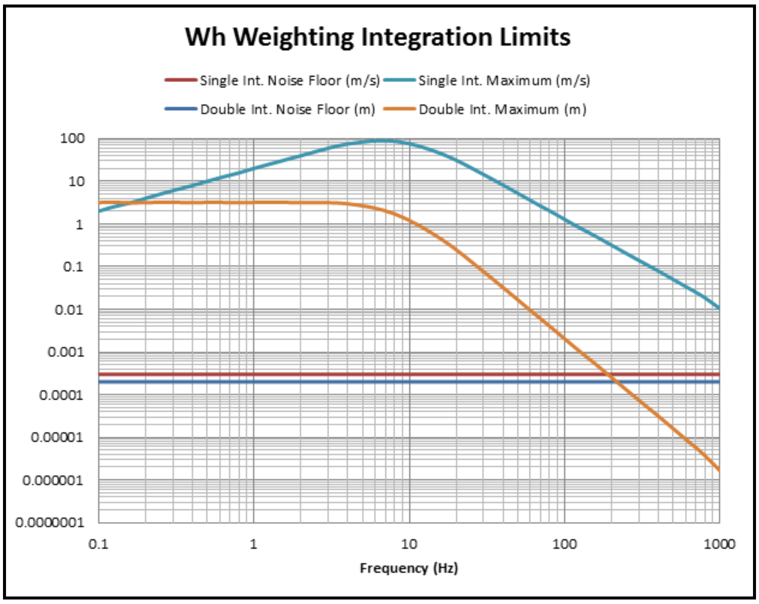

Wb Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)

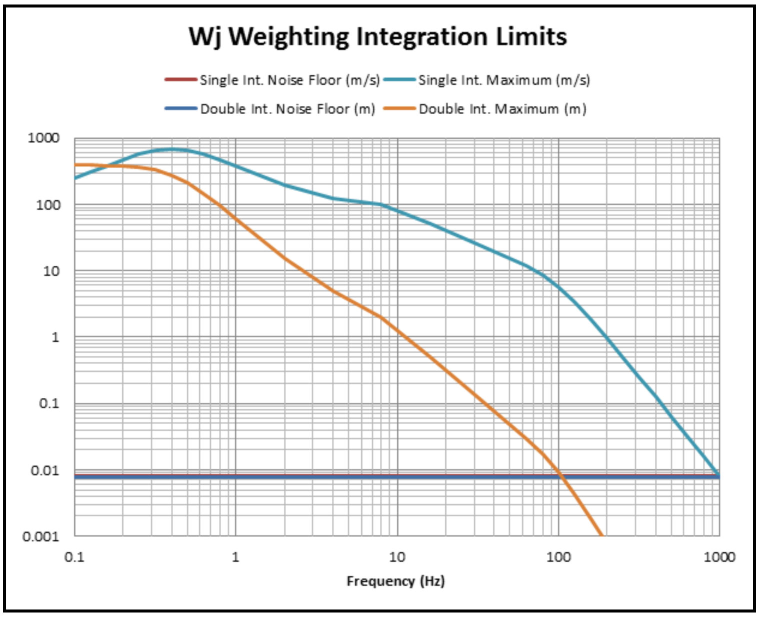

Wc Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)

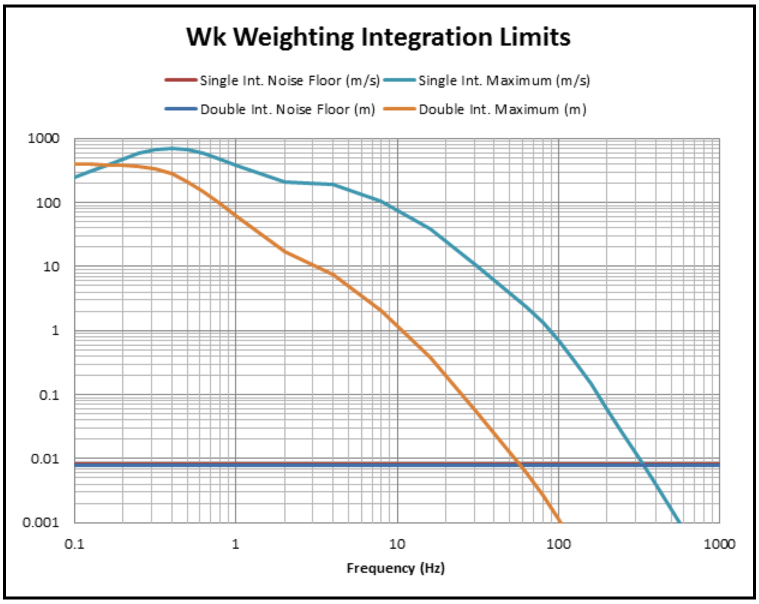

Wd Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)

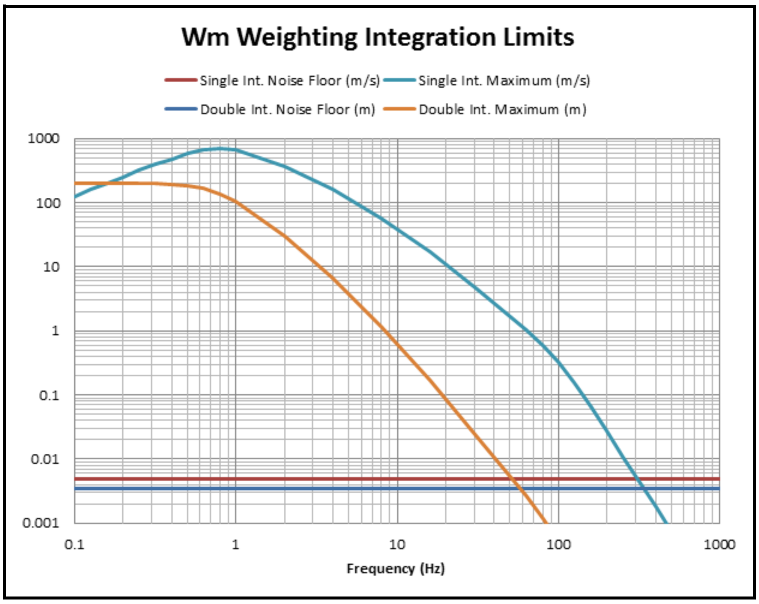

We Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)


Wf Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
10000
1000
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100
Frequency (Hz)


Wh Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
100
10
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
0.0000001
0.1
1
10
100
1000
Frequency (Hz)


Wj Weighting Integration Limits
Single Int. Noise Floor (m/s)
Single Int. Maximum (m/s)
Double Int. Noise Floor (m)
Double Int. Maximum (m)
1000
100
10
1
0.1
0.01
0.001
0.1
1
10
100
1000
Frequency (Hz)





A.10 1/1 & 1/3 Octave Band Filters

Octave Band Analysis (OBA) is an optional feature for the HVM200.

A.10.1 OBA Compliance

- IEC 61260-1:2014 Class 1
- ANSI S1.11-2014 Part 1, Class 1

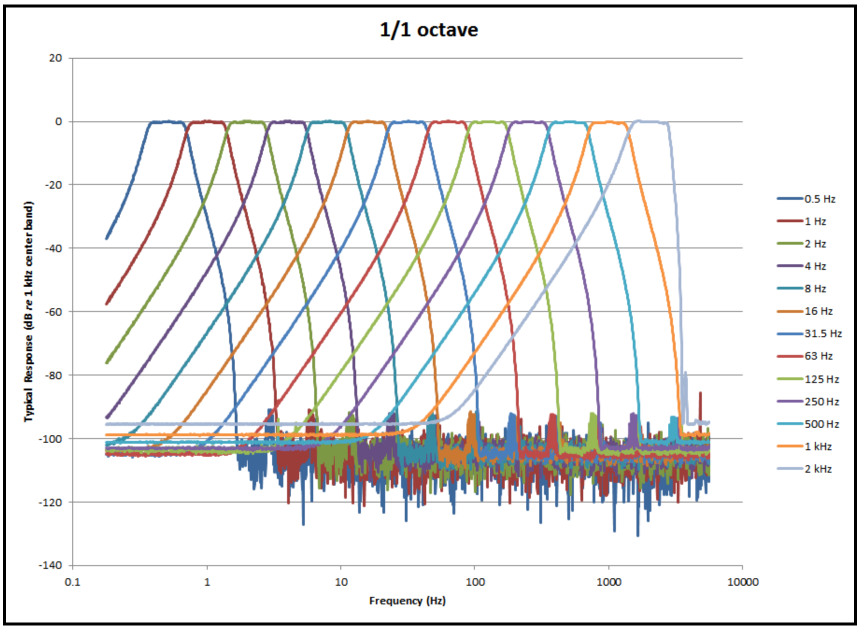
A.10.2 OBA General Specifications

- 1/1 Octave Filters: 0.5 Hz to 2000 Hz
- 1/3 Octave Filters: 0.4 Hz to 2500 Hz
- Weighting: Unweighted
- Measured Values: RMS and Peak OBA Filter Responses

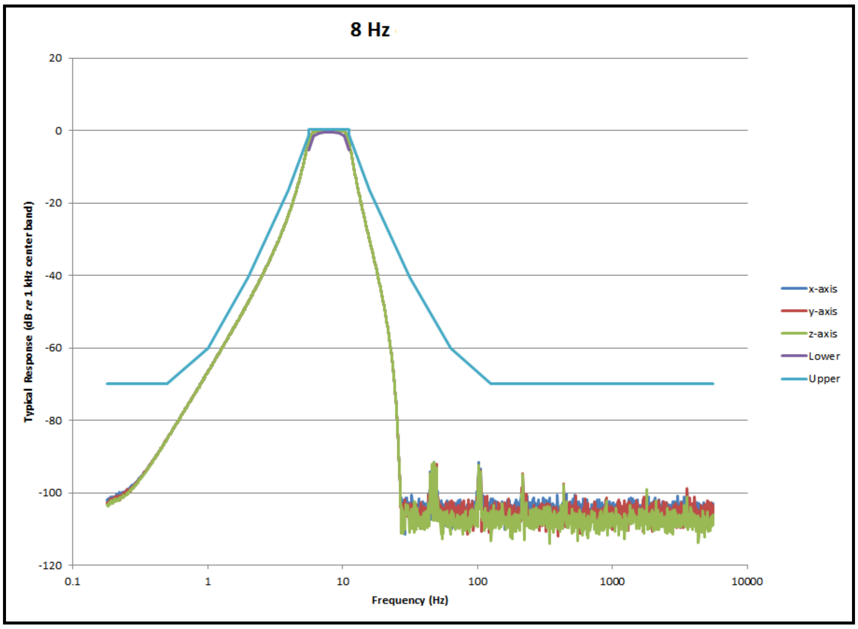
A.10.3 1/1 OBA Filter Responses

1/1 Octave Measurement Range			
Frequency (Hz)	**Noise Floor (mV)**	**Lower Limit Linearity (mV)**	**Overload (V)**
0.5	0.0076	0.079	5.01
1	0.0101	0.126	5.01
2	0.0088	0.089	5.01
4	0.0095	0.112	5.01
8	0.0100	0.089	5.01
16	0.0097	0.112	5.01
31.5	0.0103	0.071	5.01
63	0.0114	0.100	5.01
125	0.0140	0.071	5.01
250	0.0157	0.056	5.01
500	0.0190	0.056	5.01
1000	0.0245	0.079	5.01
2000	0.0343	0.100	5.01

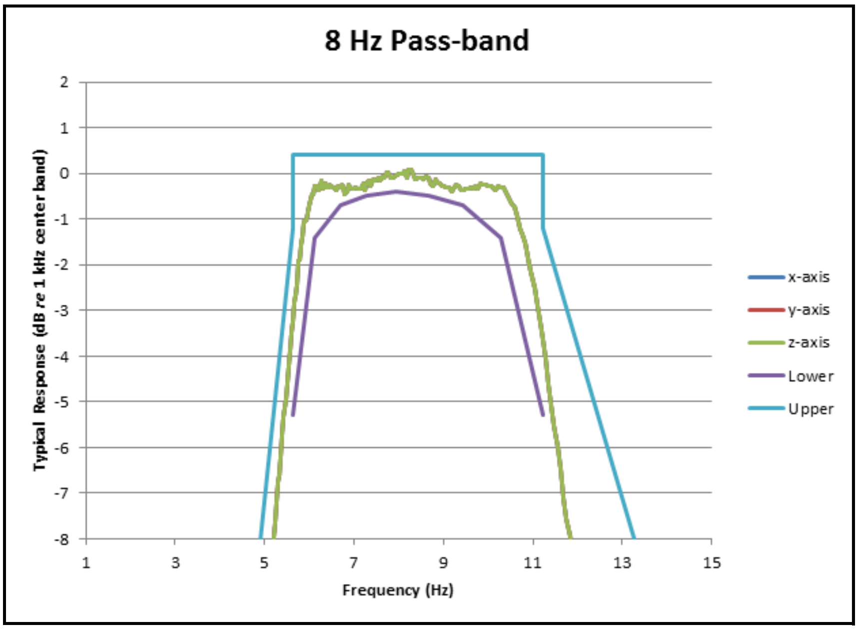
1/1 Octave Filter Response Summary Graph



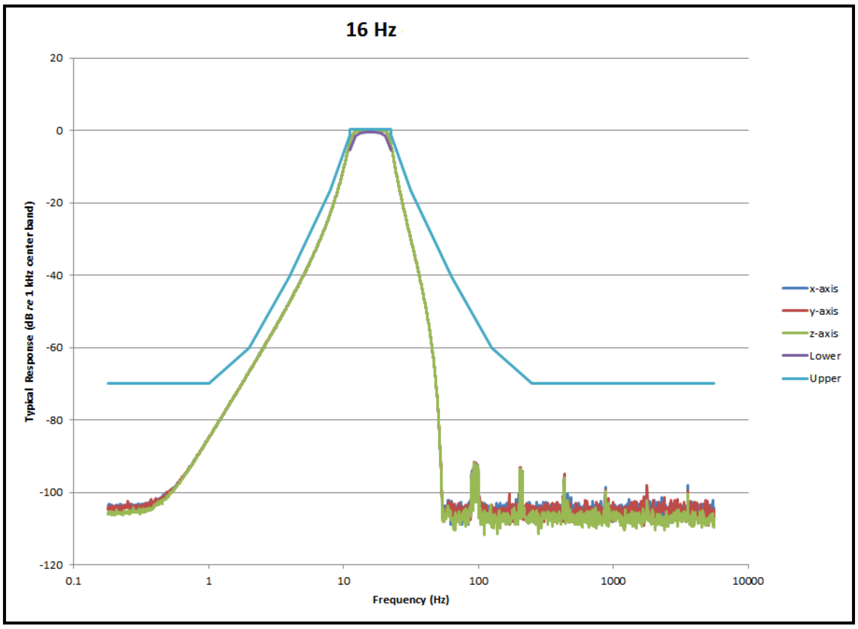
1/1 OBA 8.0 Hz Filter Response



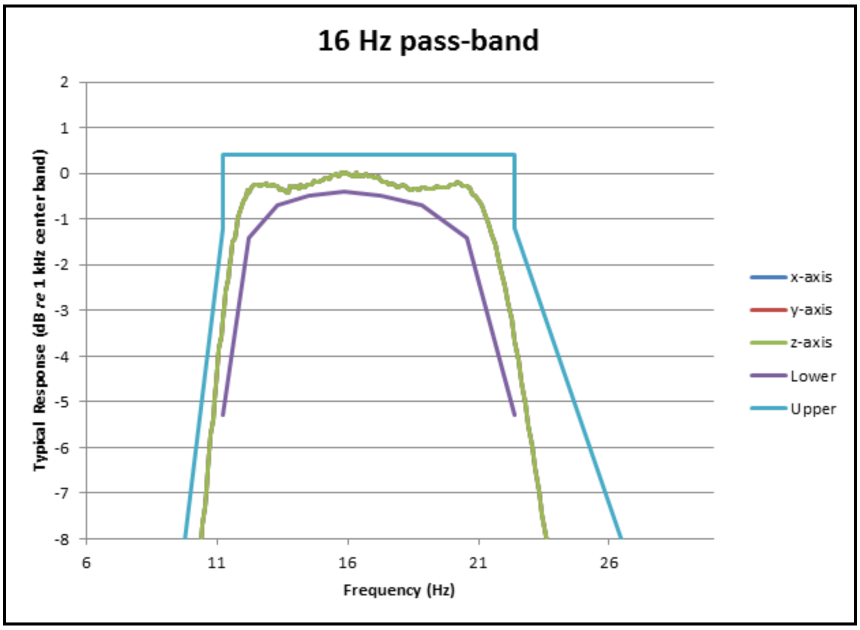
1/1 OBA 8.0 Hz Filter Response: Pass-band



1/1 OBA 16.0 Hz Filter Response



1/1 OBA 16.0 Hz Filter Response: Pass-band

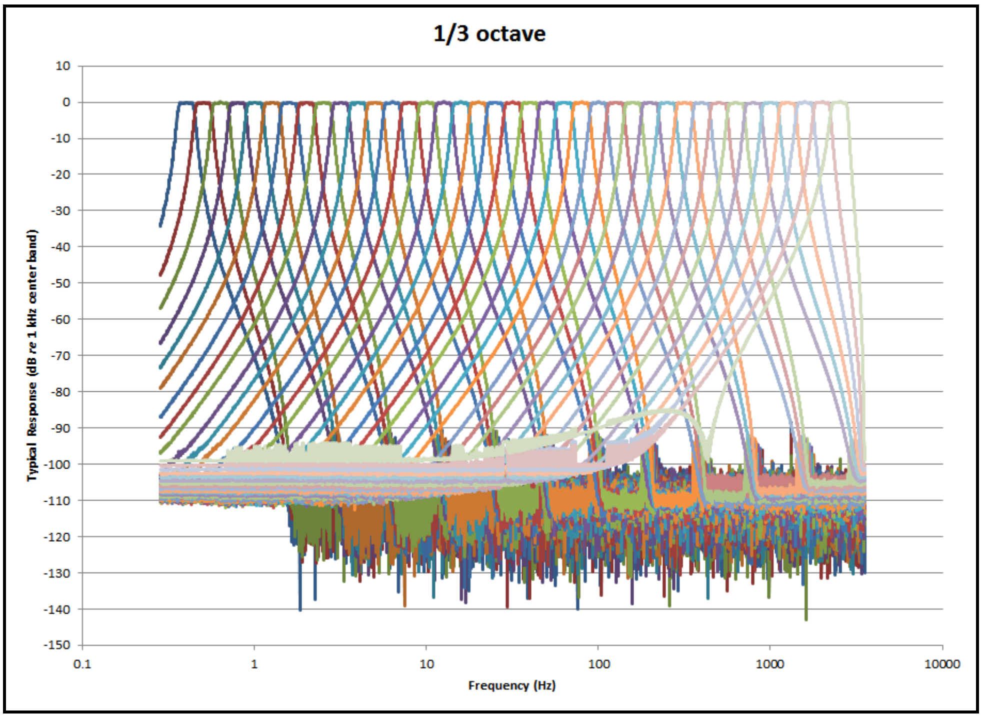


1/3 OBA Filter Responses

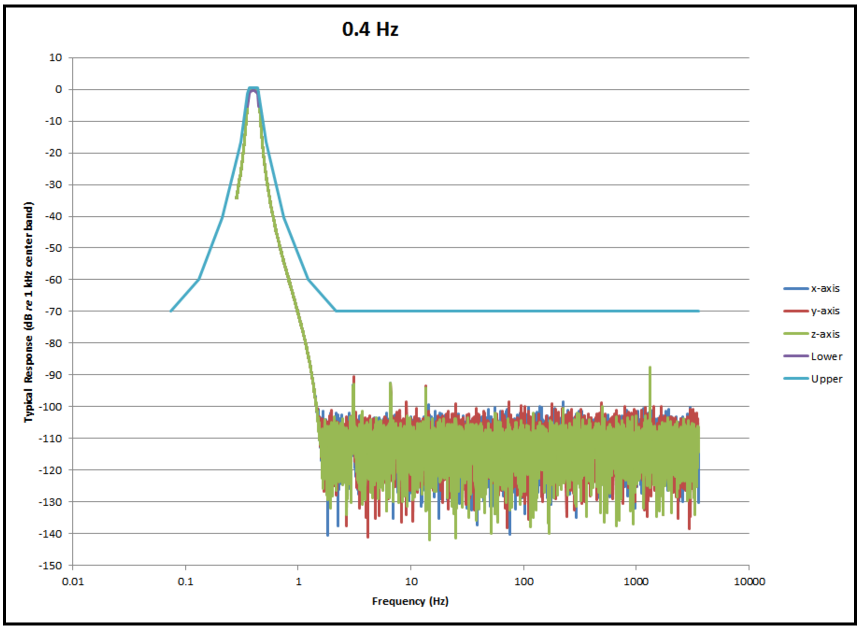
1/3 Octave Filter Measurement Range			
Frequency (Hz)	**Noise Floor (mV)**	**Lower Limit Linearity (mV)**	**Overload (V)**
0.4	0.0064	0.071	5.01
0.5	0.0055	0.063	5.01
0.63	0.0057	0.112	5.01
0.8	0.0053	0.089	5.01
1	0.0052	0.126	5.01
1.25	0.0054	0.178	5.01
1.6	0.0050	0.079	5.01
2	0.0055	0.158	5.01
2.5	0.0055	0.178	5.01
3.15	0.0053	0.282	5.01
4	0.0050	0.141	5.01
5	0.0053	0.112	5.01
6.3	0.0054	0.200	5.01
8	0.0053	0.089	5.01
10	0.0053	0.089	5.01
12.5	0.0054	0.056	5.01
16	0.0053	0.056	5.01
20	0.0054	0.089	5.01
25	0.0055	0.071	5.01
31.5	0.0056	0.063	5.01
40	0.0057	0.089	5.01
50	0.0059	0.056	5.01
63	0.0062	0.056	5.01

1/3 Octave Filter Measurement Range			
80	0.0064	0.056	5.01
100	0.0069	0.056	5.01
125	0.0075	0.056	5.01
160	0.0074	0.063	5.01
200	0.0079	0.056	5.01
250	0.0084	0.056	5.01
315	0.0091	0.056	5.01
400	0.0098	0.079	5.01
500	0.0105	0.056	5.01
630	0.0115	0.079	5.01
800	0.0126	0.056	5.01
1000	0.0139	0.056	5.01
1250	0.0153	0.063	5.01
1600	0.0171	0.056	5.01
2000	0.0191	0.056	5.01
2500	0.0219	0.063	5.01

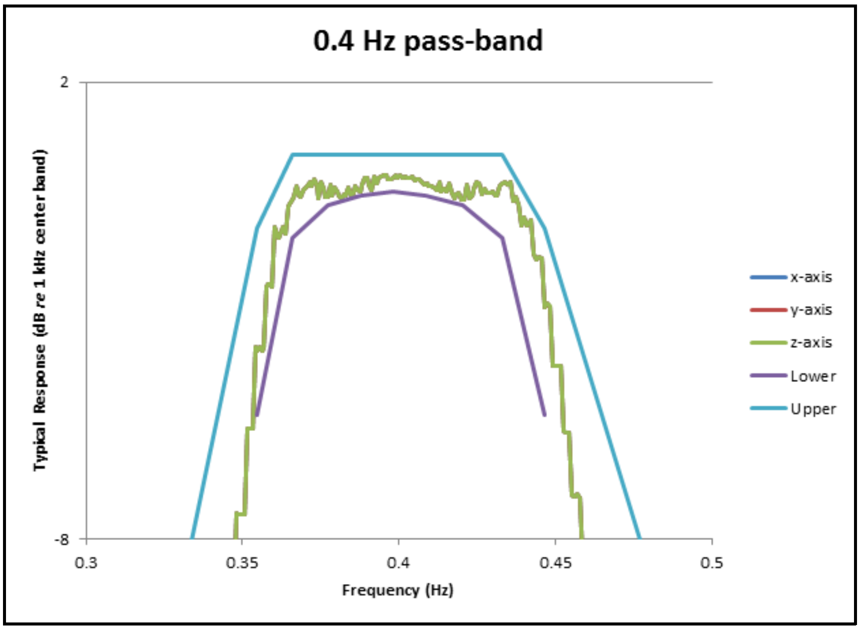
1/3 Octave Filter Summary Graph



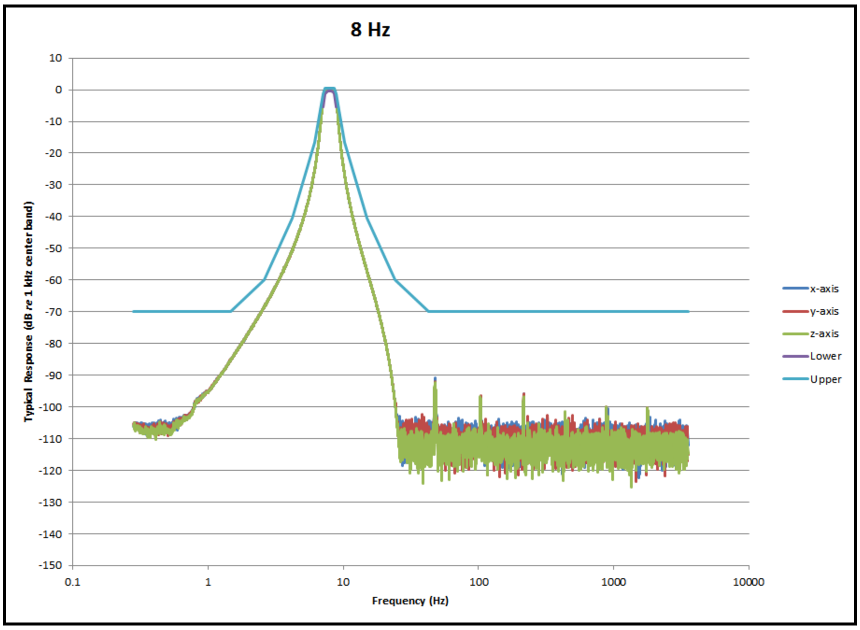
1/3 OBA 0.4 Hz Filter Response



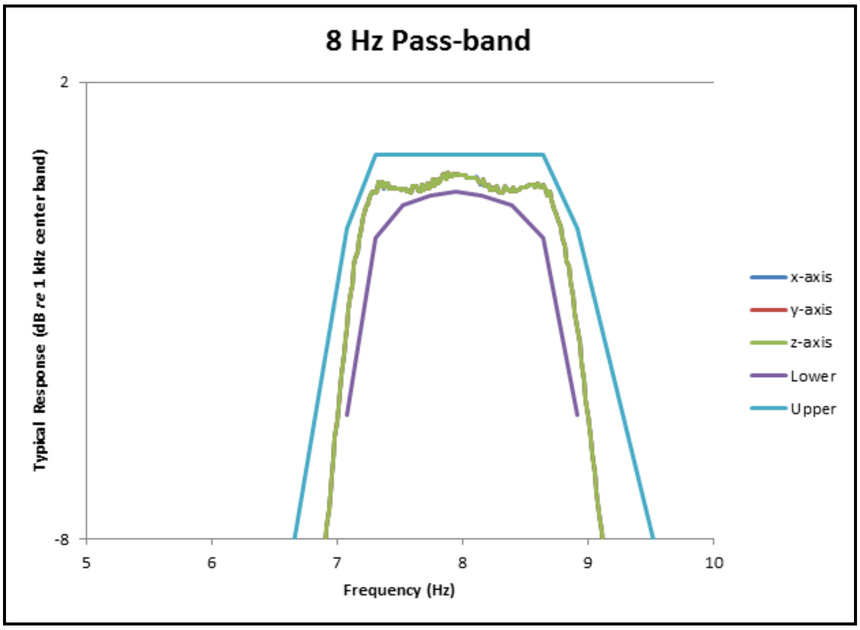
1/3 OBA 0.4 Hz Filter Response: Pass-band



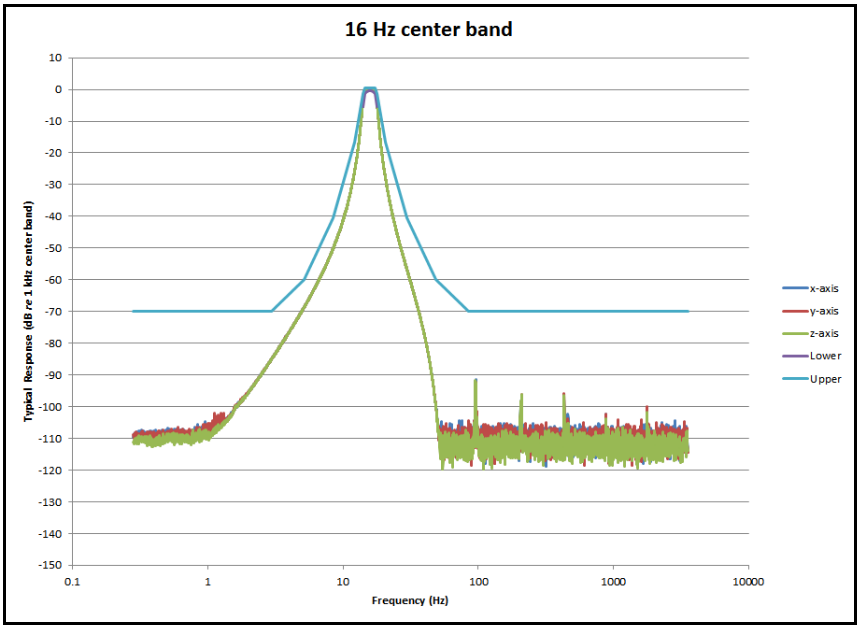
1/3 OBA 8.0 Hz Filter Response



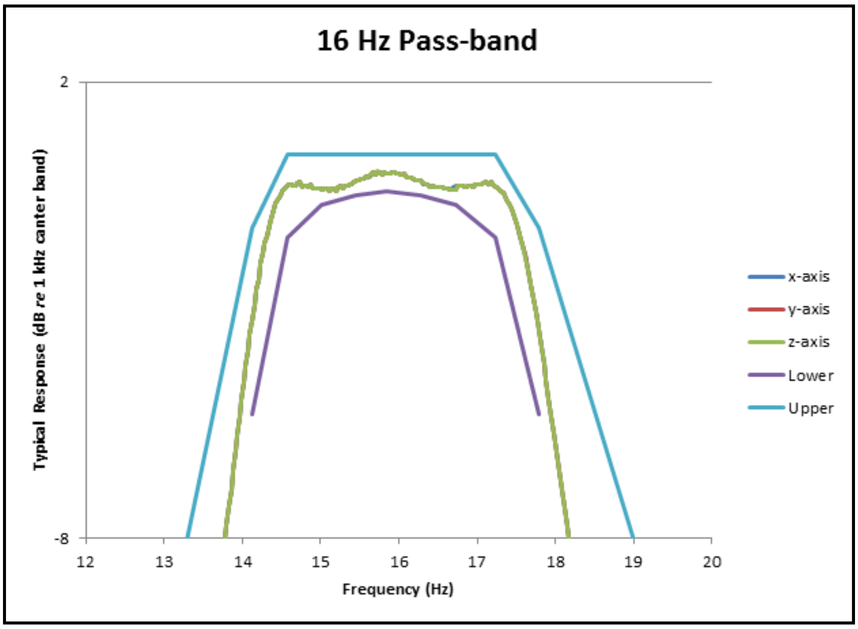
1/3 OBA 8.0 Hz Filter Response: Pass-band



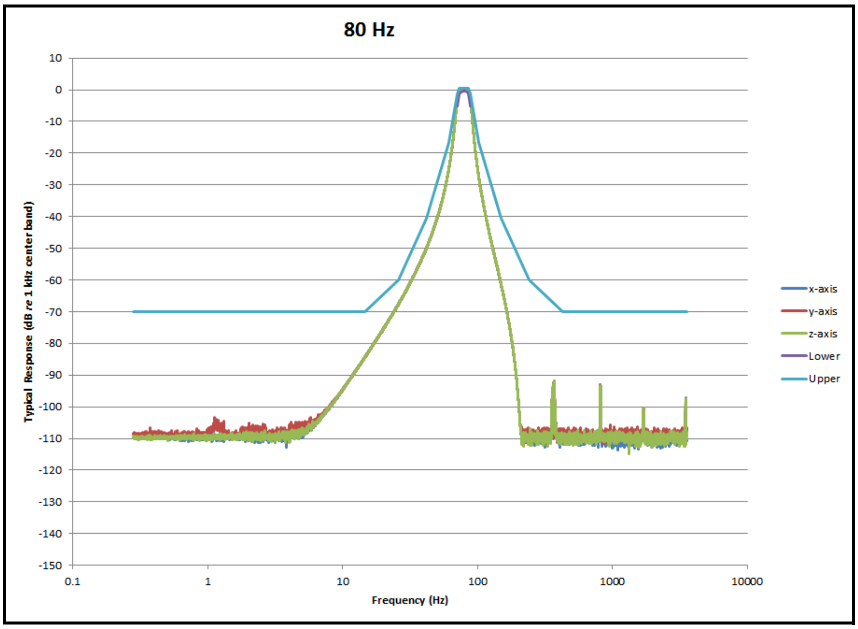
1/3 OBA 16.0 Hz Center Band Filter Response



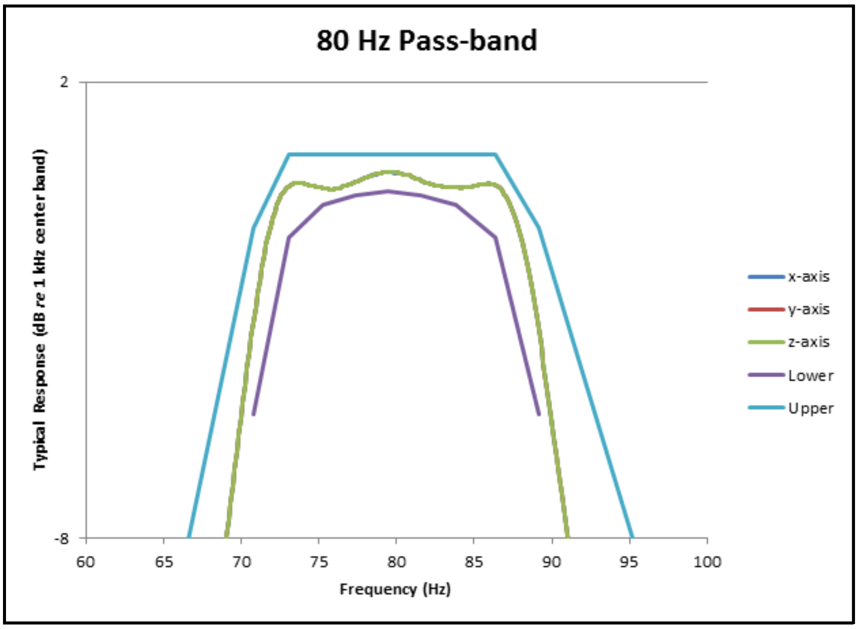
1/3 OBA 16.0 Hz Filter Response: Pass-band



1/3 OBA 80.0 Hz Filter Response



1/3 OBA 80.0 Hz Passband Filter Response



A.11 Standards Met

Type Precision

The Larson Davis HVM200 Human Vibration Meter is a Type 1 instrument designed for use in assessing vibration as perceived by human beings. The instrument meets the requirements of ISO 8041:2005(E).

Additionally, because the HVM200 meets the current ISO 8041:2005 standard, it is also compatible with the standards listed below. These standards define methods for the measurement of whole-body and hand-arm vibration.

- ISO 2631-1:1997 Mechanical vibration and shock -- Evaluation of human exposure to whole-body vibration -- Part 1: General requirements
- ISO 2631-5:2004 Evaluation of human exposure to whole-body vibration -- Part 5: Method for evaluation of vibration containing multiple shocks
- ISO 2631-2:2003 Evaluation of human exposure to whole-body vibration -- Part 2: Continuous and shock-induced vibrations in buildings (1 to 80 Hz)
- ISO 2631-4:2001 Mechanical vibration and shock -- Evaluation of human exposure to whole-body vibration -- Part 4: Guidelines for the evaluation of the effects of vibration and rotational motion on passenger and crew comfort in fixed-guide-way transport systems
- 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
- EN 1032:2003 Mechanical vibration -- Testing of mobile machinery in order to determine the vibration emission value
- ANSI S2.70 Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand

AppendixB Adaptor Resonance & Frequency Response

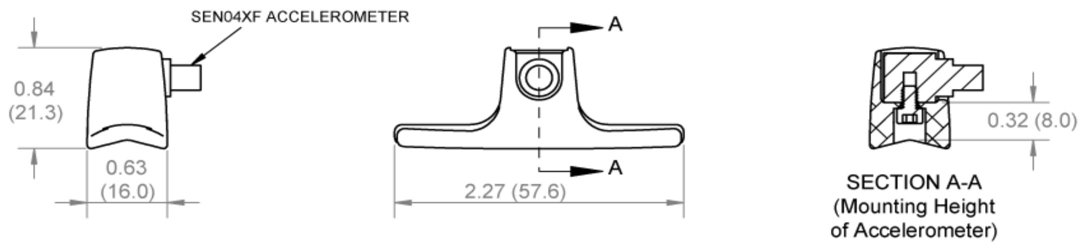
Experimental measurements indicate no resonances within the Wh frequency range for the adaptors ADP080A, ADP081A and ADP082A.

B.1 Mechanical

Specification	Unit	ADP080 A	ADP081 A	ADP082 A
Total Mass of Vibration Sensor & Mounting System (including sensor, adapter, & mounting screw)	ounces (grams)	0.67 (19)	0.74 (21)	0.35 (10)
Mounting Height of Vibration Sensor (distance between sensor and mounting surface)	inches (mm)	0.32 (8.0)	0.18 (4.6)	0.32 (8.1)
Adapter dimensions	inches (mm)	Shown Below	Shown Below	Shown Below

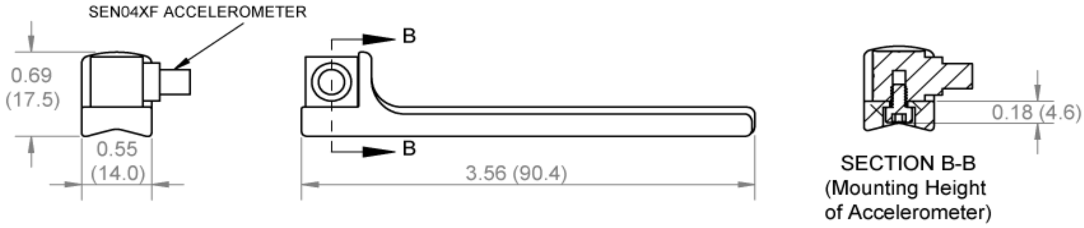
B.1.1 ADP080A

FIGURE B-1 (Hand Adapter with SEN04XF Accelerometer)



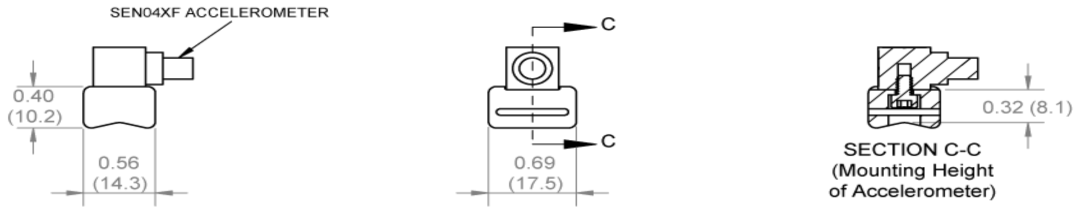
B.1.2 ADP081A

FIGURE B-2 (Handle Adapter with SEN04XF Accelerometer)



B.1.3 ADP082A

FIGURE B-3 (Clamp Adapter with SEN04XF Accelerometer)



B.1.4 Measurements

Frequency Response

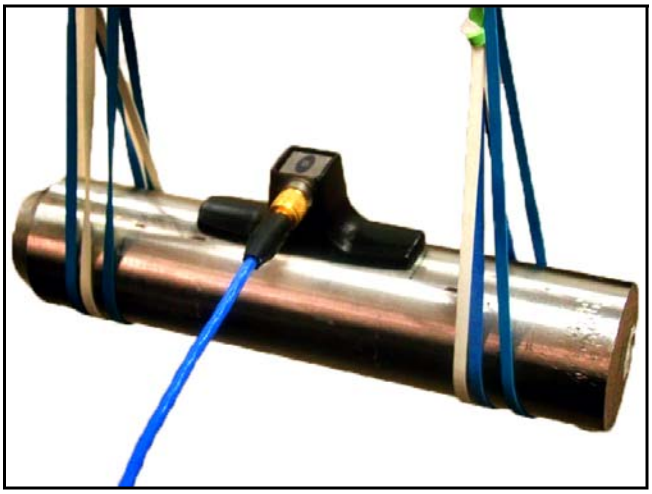
The frequency response measurements were performed by suspending the test object and exciting it with a modal hammer. The responses were measured in x, y and z directions using a triaxial accelerometer connected to the test object using the specified adapter. A graphic is included to illustrate the test configuration.

Triaxial Accelerometer

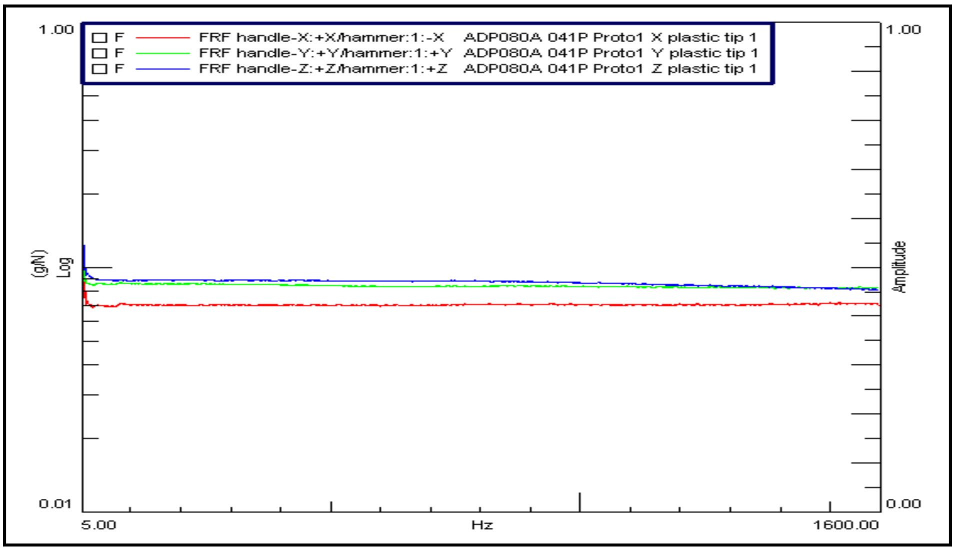
The triaxial accelerometer used for these tests was a Larson Davis Model SEN041F having a sensitivity of 10 mV/g.

B.1.5 ADP080A + SEN041

FIGURE B-4 ADP080A + SEN041

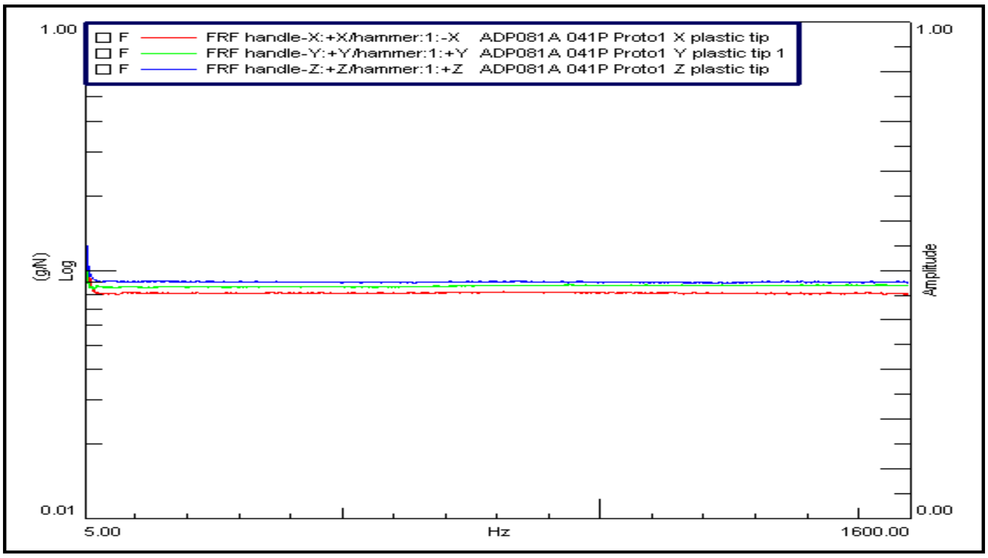


Frequency Response Function X, Y and Z



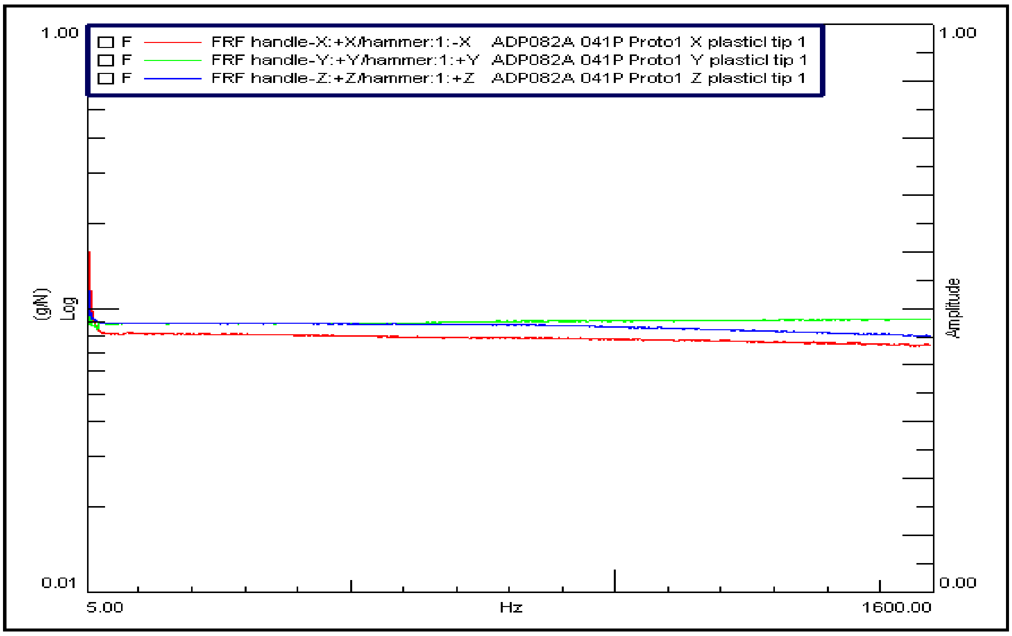
B.1.6 ADP081A + SEN041

Frequency Response Function X, Y and Z



B.1.7 ADP082A + SEN041

Frequency Response Function X, Y and Z



Appendix C Glossary of Terms

The following table contains definitions and calculations for terminology used in the HVM200 manual.

Term	Equation Description
RMS Acceleration	$Aeq = \sqrt{\frac{1}{T}\int_0^T a_w^2(t)dt}$ T= Integration time in seconds. $a_w(t)$ = instantaneous acceleration. t = Time, in seconds. The Aeq integration time is from Run to Reset; the display is updated once per second.
RMS Acceleration in Decibels	$eq = 20Log\sqrt{\frac{1}{T}\int_0^T \frac{a_w^2(t)}{a_o^2}(dt)} \quad dB$ a_o = reference acceleration, 10^{-6} m/s^2 or 10^{-5} m/s^2 (user selectable)
Allowed Exposure Time	$\left[\left(a_L m/s^2\right)/(Aeq)\right]^2 \times 8hours$ a_L is user selectable. A8Exp: a_L typically = 5 A8Act: a_L typically = 2.5

Term	Equation Description
Energy Equivalent RMS Acceleration	The HVM200 measures the following quantities: $$A(8) = \sqrt{\frac{1}{8Hours}\int_0^T a_w^2(t)dt}$$ $$A(4) = \sqrt{\frac{1}{4Hours}\int_0^T a_w^2(t)dt}$$ $$A(2) = \sqrt{\frac{1}{2Hours}\int_0^T a_w^2(t)dt}$$ $$A(1) = \sqrt{\frac{1}{1Hours}\int_0^T a_w^2(t)dt}$$
Exposure Points (P_E)	$$P_E = \left(\frac{ka_w}{a_{\exp}}\right)^2 \frac{T}{8\ \ hours} 100$$ a_w = the vibration magnitude in m/s^2. T= the exposure time in hours. k = the multiplying sum factor for the individual axis. a_{exp} = the exposure action value. The summation measurement exposure points will be the maximum of the three axes exposure points.
Running RMS Acceleration LINEAR	$$Arms = \sqrt{\frac{1}{\tau}\int_{t_0-\tau}^{t_0} a_w^2(t)dt}$$ τ = Integration time, in seconds. t_o = Observation time The linear Arms integration time is controlled by the Averaging time setting; a new linear Arms value is calculated and displayed at the end of each integration period.

Term	Equation Description
Running RMS Acceleration EXPONENTIAL	$$Arms = \sqrt{\frac{1}{\tau}\int_{-\infty}^{t_0} a_w^2(t)\exp\left(\frac{t-t_0}{\tau}\right)dt}$$ τ = Time constant of the measurement. An averaging time of SLOW is equivalent to a time constant of 1 second.
Vibration Dose Value	$$VDV = \left(\int_0^T a_w^4(t)dt\right)^{\frac{1}{4}}$$ The *VDV* integration time is from Run to Reset; the display is updated once per second. The *VDV* is not calculated for units of dB org. For whole body vibration mode: $VDV_{sum} = max(VDV_x + VDV_y + VDV_z)$
Maximum Transient Vibration Value	Amax = maximum reading of all Arms readings from Run to Reset. The display is updated at the end of each Averaging time period.
Minimum Transient Vibration Value	Amin = minimum reading of all Arms readings from Run to Reset. The display is updated at the end of each Averaging time period.
Long Term Maximum Peak	Amp = peak level of the instantaneous weighted acceleration, $a_W(t)$; measured over the entire measurement period, from Run to Reset. The displayed Amp value is updated once per second.
Short Term Maximum Peak	Peak = peak level of the instantaneous weighted acceleration, $a_W(t)$; measured during one Averaging time period. The peak measurement period is controlled by the Averaging time setting; a new Peak value is calculated and displayed at the end of each Averaging time period.

Term	Equation Description
Summed Instantaneous Acceleration	$a_{w\Sigma}(t)$ = instantaneous, summed acceleration $a_{wx}(t)$, $a_{wy}(t)$, $a_{wz}(t)$ = X, Y, and Z axis instantaneous acceleration K_x, K_y, K_z = X, Y, and Z axis Sum Factors The HVM200 uses the formula above to calculate the instantaneous, summed acceleration, $a_{w\Sigma}(t)$. This value is then used to calculate a sum quantity for the A_{rms},A_{min}, A_{max}, A_{mp}, A_{eq}, Peak, VDV, and PE. K factors affect only sum value and not individual axis data.

Appendix D Regulatory Compliance Statement

FCC

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by manufacturer could void the user's authority to operate the equipment.

IMPORTANT! Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Industry Canada

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

IMPORTANT! Tous les changements ou modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actioner cet équipment.

47 CFR 15.505- FCC

Class B

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/ TV technician for help.

Class A- FCC

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.