# amc VIBRO

**AVM GATEWAY**

**AVS 4000R**
amc VIBRO

**AVS 2000R**
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# AMC VIBRATION SENSOR

AVS 2000R

USER MANUAL

2018

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AMC VIBRO

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# 1. Introduction

In order to ensure quick and proper installation and commissioning of the system described in this manual, user absolutely must read and comply with the recommendations contained therein.

## 1.1. Copyright

This manual including drawings contained in it are protected by copyright law. Copying, distributing and changing in whole or in part requires AMC VIBRO Sp. z o.o. written permission.

Due to the continuous development of AVS 2000R devices, AMC VIBRO Sp. z o.o. reserves the right to modify this manual.

## 1.2. Configuration and handling

Installation, commissioning and operation should be entrusted to a person skilled in matters of electronics, industrial automation and measuring technology or specially trained for this purpose. The manufacturer is not liable for any damage to the AVS equipment as a result of improper use, non-use instructions described in this manual or maintenance and operation by unauthorized persons.

## 1.3. Symbols

**NOTE!**

**Information marked with this sign are of particular importance to the safety of the system.**

## 1.4. Important recommendations

System components are not resistant to aggressive cleaning agents, aerosols, alcohols and solvents. If necessary, dust can be removed with a dry brush, and larger dirt with a damp cloth.

# 2. AV SENSOR family

## 2.1. Description

The AV SENSOR is a wireless sensor system specially designed for measuring vibrations in industrial conditions. The entire system is configured and monitored by AVM GATEWAY device. Through the protocols implemented on the GATEWAY it is possible to connect the system with existing infrastructure. The AVS 2000R module is used to measure temperature and vibration in two axes. Moreover, it process parameters and calculate estimates.
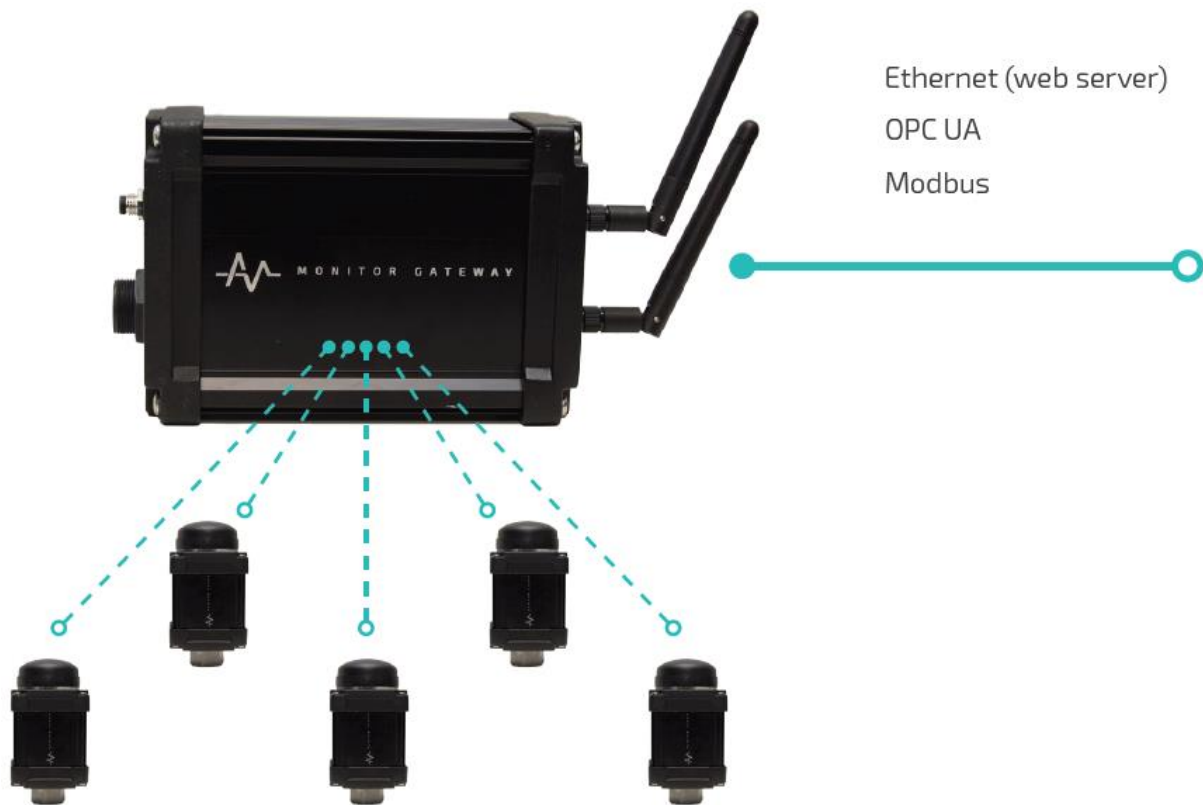
*Figure 1. The AV SENSOR System architecture*

AVM GATEWAY is responsible for coordinating the wireless network created by the AVS modules. The main task of AVM GATEWAY is to manage the sensor network and collect the data from the devices. GATEWAY has an OPC UA and Modbus communication protocol for integration with supervisory system. The module has implemented website where the user can configure the system, view and download gathered data.

When the above devices work together they form the AV SENSOR system. The wireless technology spares the hassle of wire routing to the machine, the costs of laying cable routes and unforeseen repairs.

The main advantages of the system are simple and quick assembly / disassembly and scalability. The AV SENSOR wireless diagnostic system provides the user with early detection of a malfunction, thereby avoiding unpredictable stops and losses.

## 2.2. The devices

- » **AVS 2000R** – Vibration sensor
- » **AVM GATEWAY** – GATEWAY module

# 3. Operation of AVS 2000R device



*Figure 2. AVS 2000R*

## 3.1. Method of operation

The AVS 2000R is a wireless dual-channel fully configurable unit for continuous monitoring and machine diagnostics. The module allows you to send information about the status of the machines via the radio network to the system where they are processed further. The AV SENSOR modules work in 868 MHz ISM band. Measurement data are collected periodically according to the configured interval. During the transmission with the GATEWAY the Vibration sensor LED blinks approximately once per second. In case of communication measurement problems data is stored in the internal memory of the device and transmitted at the time of re-connection so the continuity of measurement is maintained. The device can report alert states and adapt their own operating mode to them. The module performs warning or alarm function for each of the channel by setting thresholds for each measured estimate. This way the module can provide the security function.

## 3.2. Technical specification

*Table 1. Technical parameters of the AVS 2000R*

| Parameter | Description |
|---|---|
| Axes | 2 |
| Sensing element | Piezo-ceramic crystal |
| Measurement range | ±20 g peak |
| Frequency response | 0.4 - 10000 Hz for x and y axis (3 dB response) |
| Transverse sensitivity | 0.05 |
| Temperature measurement range | -20°C to 80°C |
| Sampling frequency | 40 kHz |
| Sampling resolution | 16 bit |
| Number of points - time waveform | 4000 samples |
| Maximal recording duration | 100 ms with 5 minutes interval |
| Acquisition modes | Periodic, warning-based, alarm-based |
| Vibration limit/ Shock limit | 5000 g peak |
| Hazardous environment | non |
| Operating temperature | -40°C to 85°C |
| Network standard | Star / mesh topology |
| Radio standard | ISM 868 MHz (Europe) / 915 MHz (USA) |
| Wireless range | Up to 150 meters in a typical industrial conditions |
| Battery | 7.2 V, 2 x AA-cell lithium-thionyl chloride (Li-SOCl$_2$) |
| Battery lifetime | Up to 6 years<br>5800 measurements with network synchronization<br>8096 measurements without network synchronization |
| Dimensions | 65 x 140 x 65 mm |
| Weight | 500 g |
| IP rating | IP67 |
| Built-in analysis | Measured value is vibration acceleration. Calculated estimates:<br><br>RMS & 0-Peak vibration acceleration [m/s$^2$]<br>acceleration kurtosis [-]<br>acceleration envelope RMS and Peak-Peak [m/s$^2$]<br>RMS & 0-Peak vibration velocity [mm/s]<br>ISO RMS velocity [mm/s]<br>Analysis in 8 defined bands (BEC) acceleration or velocity |

| Parameter | Description |
|---|---|
| Data buffer | Flash memory 8096 measurement packets |
| Calibration | Acceleration – sensor signal, temperature, battery level |

## 3.3. Calculated estimates

The method of measuring the vibration acceleration signal is based on collecting samples by a 16-bit ADC converter with a sampling rate of 40 kSps. In order to achieve the best performance of AVS 2000R the acceleration signal, temperature and battery level are calibrated in the production stage. The vibration measurement range is up to ± 20 g. The calculated estimates are:

- » acceleration 0-Peak and RMS
- » velocity 0-Peak and RMS
- » acceleration Kurtosis
- » envelope of acceleration Peak-Peak and RMS
- » velocity 0-Peak and RMS and RMS according to ISO 10816
- » RMS value of acceleration or velocity in eight defined bands (BEC)

For permanent storage of data the device has a flash memory and it can store the results of up to 8096 measurement cycles in it.

## 3.4. Work modes

Basically, we can distinguish two modes: active and inactive - storage mode. In storage mode, the device is turned off. The active mode can be divided into:

- » normal operation mode
- » operating mode in the warning state
- » operation mode in the alarm state

To set the device in the storage mode, you can hold the magnet in the same place as in the figure 3 for about 5 seconds until the LED light starts to blink quickly. Then just put the magnet away. Then LED light will stop blinking and the device will be in storage mode. The second way to change active state is unchecking the *active* field on the configuring website (figure 4). To exit the storage mode, an operator must hold the magnet for a second in the same place as before (figure 3) until the LED lights up.

*Figure 3. Wake up the Vibration sensor*

In active mode you can choose the interval in which the sensor will wake up. For example, with a selected interval of 2 hours, the Vibration sensor will wake up every day at 0 a.m., 2 a.m., 4 a.m. and so on. This applies to field *General Configuration* area in *Configuration* website tab.



*Figure 4. Active state and wake-up intervals*

Only when the alarm or warning threshold is detected number of times specified by the *repeat* parameter such data is noted and reported. This is made to avoid triggering accidental alerts. Similarly, in order to remove the alarm / warning status, the value of a source of the alert must not exceed the threshold for the number of times specified in the *repeat* field. This applies to field *Acquisition parameters* area in *Configuration* website tab. For example, an alarm will be reported at the *Repeat* parameter equal to 2 during the third threshold violation (1 occurrence + 2 repetitions).

# 4. Operation of AVM GATEWAY

*Figure 5. AVM GATEWAY*

## 4.1. Method of operation

AVM GATEWAY is the coordinator of wireless sensor network. It is used for configuration or downloading measurements and reports from all sensors. It also stores all data in non-volatile memory and presents them to users. It has connectivity via Ethernet, Modbus and OPC protocol. The alarms and warnings are reported through the GATEWAY device.

## 4.2. Technical specification

*Table 2. Technical parameters of the AVM GATEWAY*

| Parameter | Description |
|---|---|
| Power supply | 24 VDC (range 12-36 VDC 24 W) |
| Size | 106 x 187 x 56 mm |
| Weight | 735 g |
| IP rating | IP67 |
| Temperature range | -20°C to +80 °C |
| Ethernet channel | M8 4-pin connector<br>RJ45 for 10/100 Base-T Ethernet |
| IT and networks | TCP/IP (HTTP, OPC UA, Modbus) |
| Maximal number of transmitters | Up to 32x AVS 2000R SENSOR |
| Radio | ISM 868 MHz (Europe) / 915 MHz (USA) |
| SENSOR network configuration | GATEWAY Website |

# 5. Mechanical installation

This section presents the dimensions and method of mechanical installation of the AVS 2000R and the AVM GATEWAY modules.

## 5.1. AVS 2000R housing

1. Choose a mounting position on the machine housing.

    a. Choose what type of mount you should use. Refer to the machine warranty information to verify which housing is suitable → drilling a mounting hole or using an adhesive mounting pad.

    b. Provide enough space to install the sensor.

    c. Define a place for optimal radio frequency connectivity.

2. Prepare the mounting position.

    a. Prepare a clean surface. Use a steel brush to remove dirt or paint / corrosion protection lareys from the mounting surface.

    b. Prepare the mounting site.

3. Set the axis of the sensor as intended to the axis of the acceleration being monitored.

4. The maximal dimensions of the AVS 2000R module are 65 x 137 x 65 mm. The housing has a M8 screw 30 mm long, which is used to screw the sensor to the target object. The screw should be screwed to a depth of 9 mm and then tightened to the hole with two attached nuts.

                                    AMC VIBRATION SENSOR / ©AMC VIBRO Sp. z o.o.
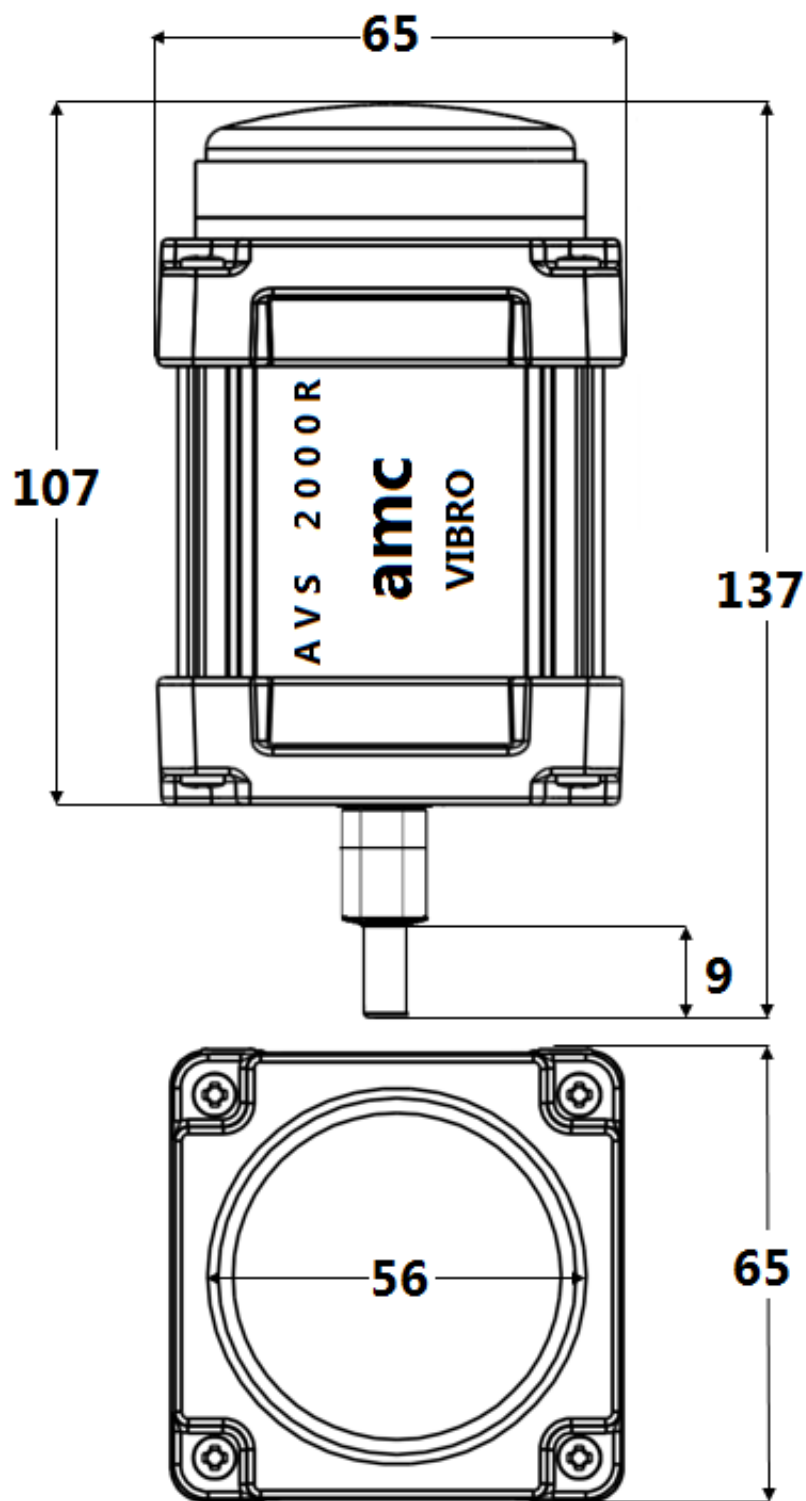
*Figure 6. AVS 2000R dimensions in millimeters*

*Table 3. AVS 2000 housing*

| Parameter | Value |
| --- | --- |
| Case material | Aluminum + stainless steel M8 screw |
| Width | 65 mm |
| Height | 137 mm |
| Length | 65 mm |

## 5.2. AVM GATEWAY housing

The maximal dimensions of the AVM GATEWAY module are 106 x 187 x 56 mm. The GATEWAY housing does not have mounting holes or screws.
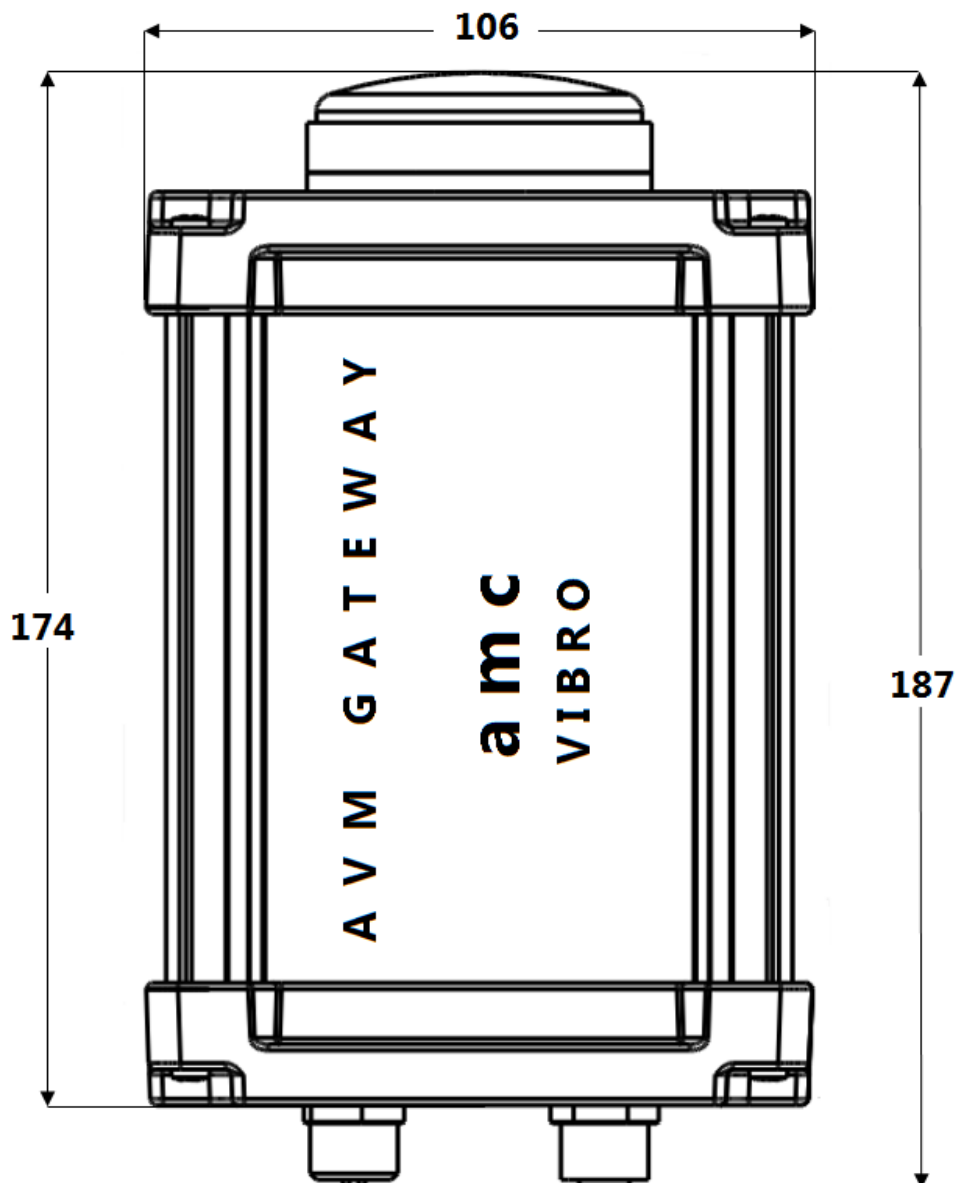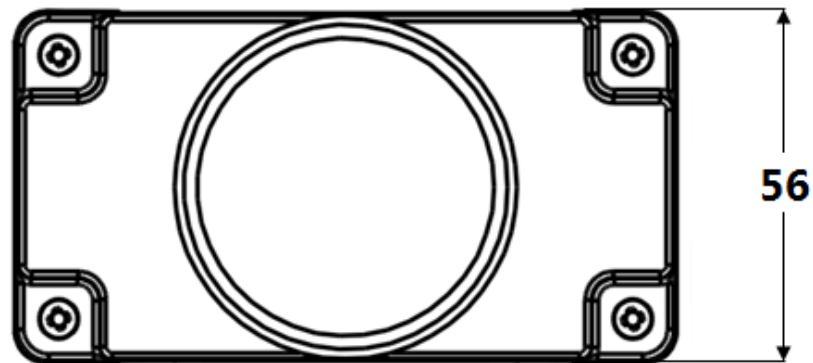
*Figure 7. AVM GATEWAY dimensions in millimeters*

*Table 4. AVM GATEWAY housing*

| Parameter | Value |
|---|---|
| Case material | Aluminum |
| Width | 106 mm |
| Height | 187 mm |
| Length | 56 mm |

# 6. Sensors network configuring

Configuration of sensors and network is made via website that is implemented in the GATEWAY. Settings can be done in the *Configuration* tab on the website. The changes must be confirmed with the *Save Changes* button. The changes are approved separately for GATEWAY and for Vibration sensor. The changes on the GATEWAY are updated immediately after they are saved. Changes  made for Vibration sensors are updated during next connection. The re-configuration status is visible in the detail view of Vibration sensors in the *Status* tab.

## 6.1. Connection parameters

**NOTE!**

In order to enter the GATEWAY website it is necessary to set the network card IP address of computer / tablet in accordance with the Ethernet network settings present on the GATEWAY. By default this is the IP address 192.168.0.10. The recommended web browser is Google Chrome.

*Table 5. Connection parameters*

| Parameter | Value |
|---|---|
| Default IP | 192.168.0.10 |
| Modbus TCP Port (fixed) | 502 |
| OPC Port (fixed) | 11664 |
| Default user name and password | admin |

GATEWAY settings that can be configured are in table 6. The area for entering these settings is presented in the figure 8.

*Table 6. GATEWAY settings*

| Number | Parameter to set |
|---|---|
| 1. | User name and password |
| 2. | GATEWAY name |
| 3. | IP address |
| 4. | Modbus activation |
| 5. | OPC activation |



*Figure 8. Administrator panel*

## 6.2. AVS 2000R set-up

Vibration sensor settings that can be configured are present in table 7. The area for entering these settings is presented in the figures 9 and 10.

*Table 7. AV SENSOR settings*

| Number | Parameter to set | Comment |
|---|---|---|
| 1. | Name of the saved configuration | The configuration can be saved on the AVM GATEWAY with the name and location you wish |
| 2. | Sensor name | You can give any name to your AVS 2000R |
| 3. | Channel X & Y name | The X and Y channels may have other names |
| 4. | Wakeup interval | During normal operation the AVS 2000R wake up every time specified by this parameter |
| 5. | State activation | If you uncheck this box and send configuration the AVS 2000R will go into the inactive-storage mode |
| 6. | Wakeup interval for Warning & Alarms for Channel X & Y | During operation when warnings or alarms occurred the AVS 2000R wake up every time specified by this parameter |
| 7. | Repeat for Warning & Alarms for Channel X & Y | In order to some event reported it must be repeated this number of times |
| 8. | Warning & Alarm thresholds for all estimates | The level of an estimate to report the warning or alarm |
| 9. | Bands name & type (acceleration / velocity) for 8 bands | You can name all bands and choose their type - that is whether the acceleration or velocity will be calculated in these bands |
| 10. | Frequency range of bands | It is possible to select the frequency ranges for 8 bands per channel |

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## Sensor Info

**Vibration Sensor**
00_11_7D_00_00_30_89_55 [ ID : 1 ]

**1**

### General Configuration

**2**

Name: Vibration Sensor    **Channel X:** Channel 1    **3**   **Channel Y:** Channel 2

**4** **Wakeup interval:** 5 min   **5** ☑ **Active**

### Acquisition parameters

| | | CH X | | CH Y | |
| --- | --- | --- | --- | --- | --- |
| | | Warning | Alarm | Warning | Alarm |
| **Wakeup interval** | **6** | 5 min | 5 min | 5 min | 5 min |
| **Repeat** | **7** | 2 | 2 | 2 | 2 | [-] |

### Level configuration

| | | CH X | | CH Y | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | Warning Threshold | Alarm Threshold | Warning Threshold | Alarm Threshold | |
| | **8** | | | | | |
| **accZP** | | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² ] |
| **accRMS** | | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² ] |

*Figure 9. Sensor configuration part 1*

## Sensor Info

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **8** | Band5 | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² RMS ] | |
| | Band6 | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² RMS ] | |
| | Band7 | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² RMS ] | |
| | Band8 | 0,8 | 1,2 | 0,8 | 1,2 | [ m/s² RMS ] | |

## Narrowband analyses parameters

| | CH X | | | | | | CH Y | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **From** | **To** | | **Name** | **Type** | | **From** | **To** | | **Name** | **Type** | |
| **Band1** | 0 | 100 | [Hz] | CH1 Band 1 **9** | Acceleration ▾ | **10** 0 | 100 | [Hz] | CH2 Band 1 | Acceleration ▾ | |
| **Band2** | 100 | 200 | [Hz] | CH1 Band 2 | Acceleration ▾ | 100 | 200 | [Hz] | CH2 Band 2 | Acceleration ▾ | |
| **Band3** | 200 | 400 | [Hz] | CH1 Band 3 | Acceleration ▾ | 200 | 400 | [Hz] | CH2 Band 3 | Acceleration ▾ | |
| **Band4** | 400 | 600 | [Hz] | CH1 Band 4 | Acceleration ▾ | 400 | 600 | [Hz] | CH2 Band 4 | Acceleration ▾ | |
| **Band5** | 600 | 1000 | [Hz] | CH1 Band 5 | Acceleration ▾ | 600 | 1000 | [Hz] | CH2 Band 5 | Acceleration ▾ | |
| **Band6** | 1000 | 2500 | [Hz] | CH1 Band 6 | Acceleration ▾ | 1000 | 2500 | [Hz] | CH2 Band 6 | Acceleration ▾ | |
| **Band7** | 2500 | 5000 | [Hz] | CH1 Band 7 | Acceleration ▾ | 2500 | 5000 | [Hz] | CH2 Band 7 | Acceleration ▾ | |
| **Band8** | 5000 | 10000 | [Hz] | CH1 Band 8 | Acceleration ▾ | 5000 | 10000 | [Hz] | CH2 Band 8 | Acceleration ▾ | |

**SAVE CHANGES**

*Figure 10. Sensor configuration part 2*

There are other ways to make configuration changes. The first one is to choose the *Multiple* configuration- it will work for many sensors at once. Just select the method from the drop-down list and select the sensors to which you want to send the new configuration. You can also enter a *Default* configuration to any new sensor in the network.

**Vibration Sensor**
00_11_7D_00_00_30_89_55 [ ID : 1 ]

**Multiple**

**Default**

| Name: | Vibration Sensor | Channel X: | Channel 1 | Channel Y: | Channel 2 |
|---|---|---|---|---|---|
| | | Wakeup interval: | 5 min | ✔ Active | |
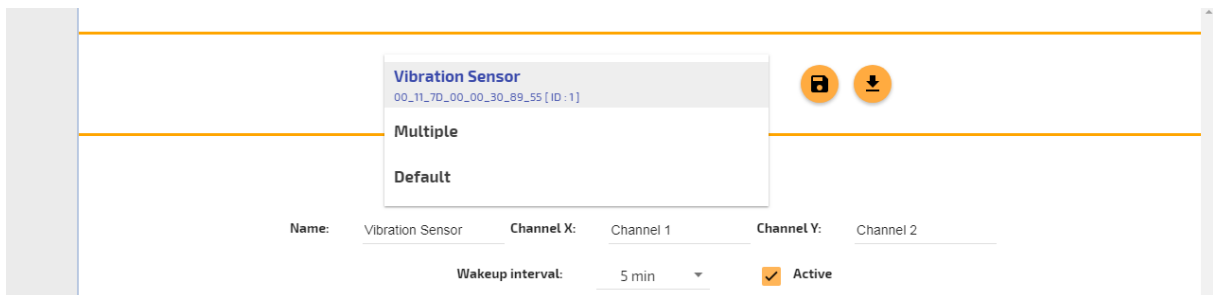
*Figure 11. Multiple and default configuration*

Another way to make changes is to use the Shortcut bar on the left side and drag the previously saved configurations. This can be used for example to drag a configuration of Vibration sensor ID 1 to the ID 2 module.



*Figure 12. Quick configuration*

You can also save the configuration of the currently selected sensor:

Select this button to save the configuration on a hard disk of your device.

Select this button to save the configuration on the GATEWAY in the folder of your choice.

AMC VIBRATION SENSOR / ©AMC VIBRO Sp. z o.o.

# 7. Data storage and presentation

## 7.1. General information

When it comes to presenting the layout of the network the first tab which appears immediately after entering the website is the most important one. After e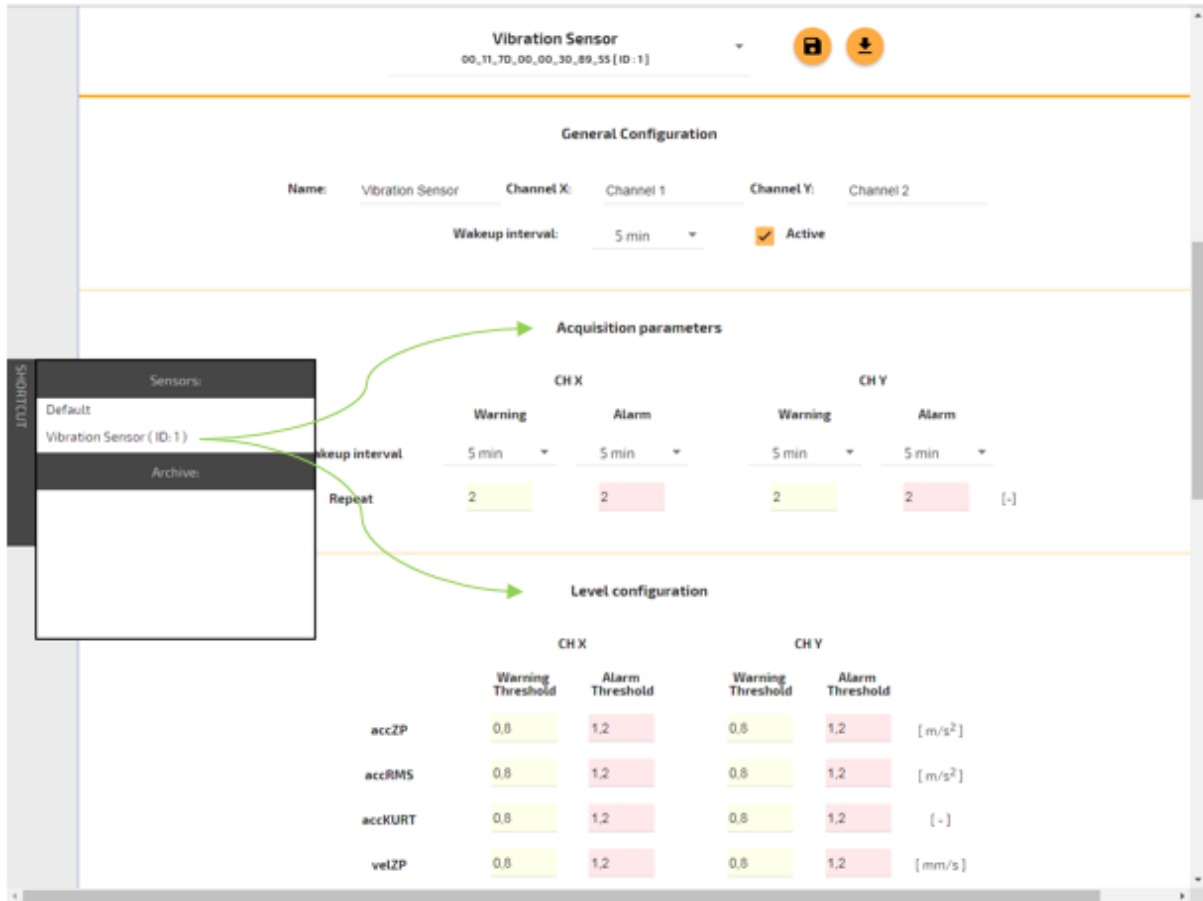ntering the website you go to the *Status* tab (on the banner at the top) and to the *Overview* field (in the bar on the left). You find there a graphical representation of the state of sensors, their name, MAC address and battery status. All modules present in the network assigned to the GATEWAY are visible in the *Overview* field. To remove them from the network click on the *X* mark in the upper right corner of the rectangle representing the AVS device or on the left side in the screen.
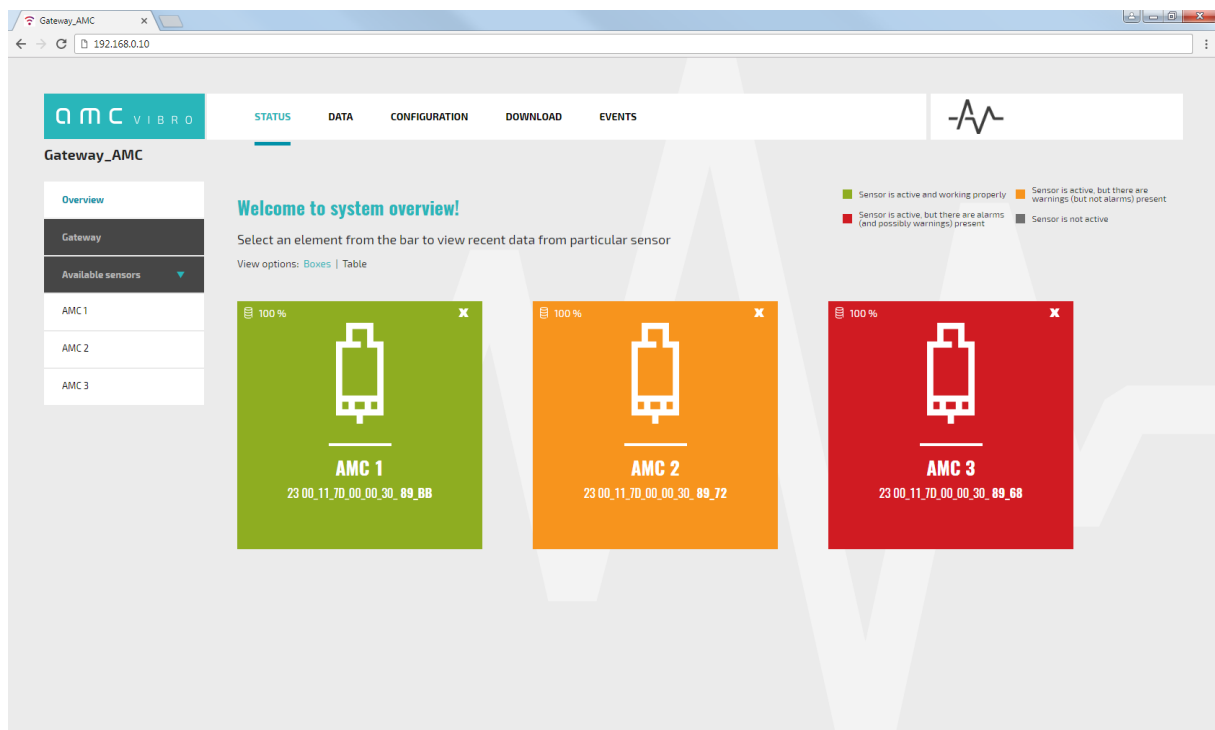


*Figure 13. Front page of GATEWAY – Boxes view*

## 7.2. Status

The condition of the sensors is explained in the legend in the upper right corner. Meaning of colors:

- » green - none of the estimates exceeds the set thresholds
- » yellow - there is at least one warning
- » red - there is at least one alarm
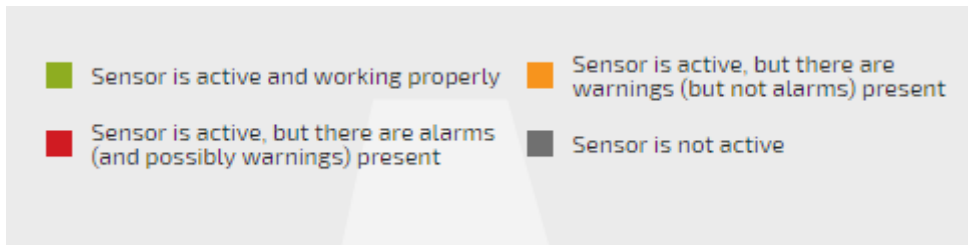
*Figure 14. Legend - the meaning of graphic markings*

You can choose an overview: *Boxes* (figure 13) or *Table* (figure 15). In the table view you will additionally see the amount of free memory and the number of reported errors in the form: number of reported errors from channel 1 / number of reported errors from channel 2. Similar information will be seen after hovering the cursor over the rectangle representing the sensor.
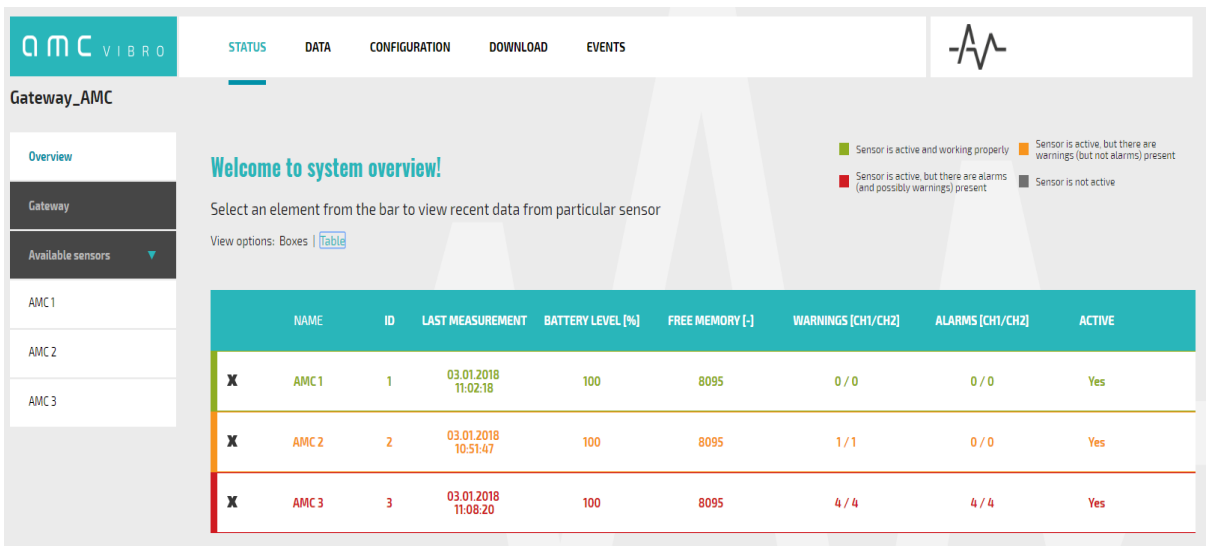


*Figure 15. Front page of GATEWAY – Table view*
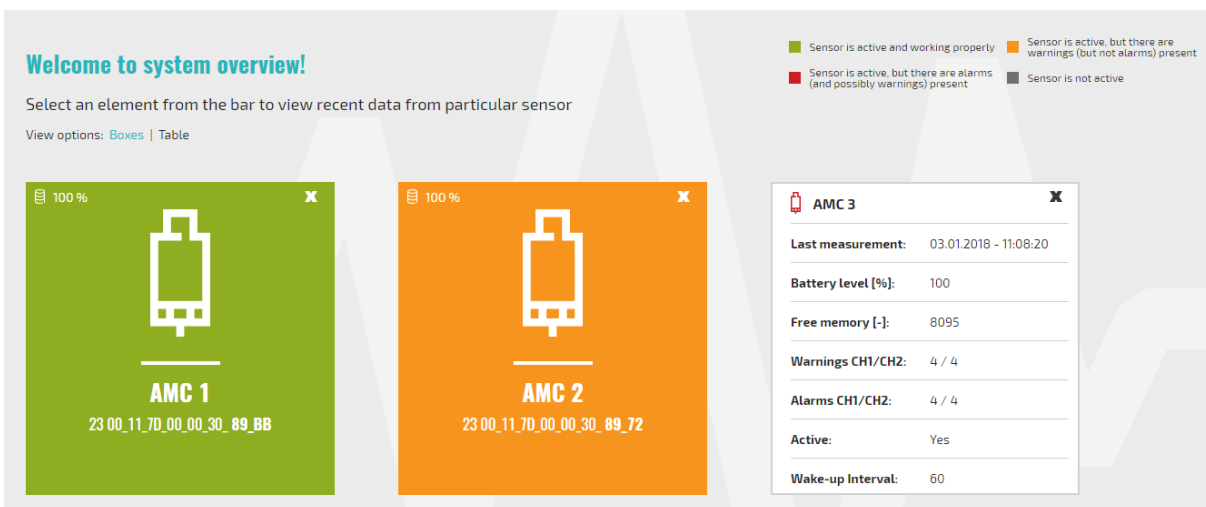


*Figure 16. Detailed view of the sensor*

In the *Status* tab on the *GATEWAY* field (in the bar on the left) there are information about the GATEWAY device. There you can also read and set the time on the GATEWAY device. You have to remember that the GATEWAY time is sent to the Vibration sensors and they save this date and this is operation time for them.
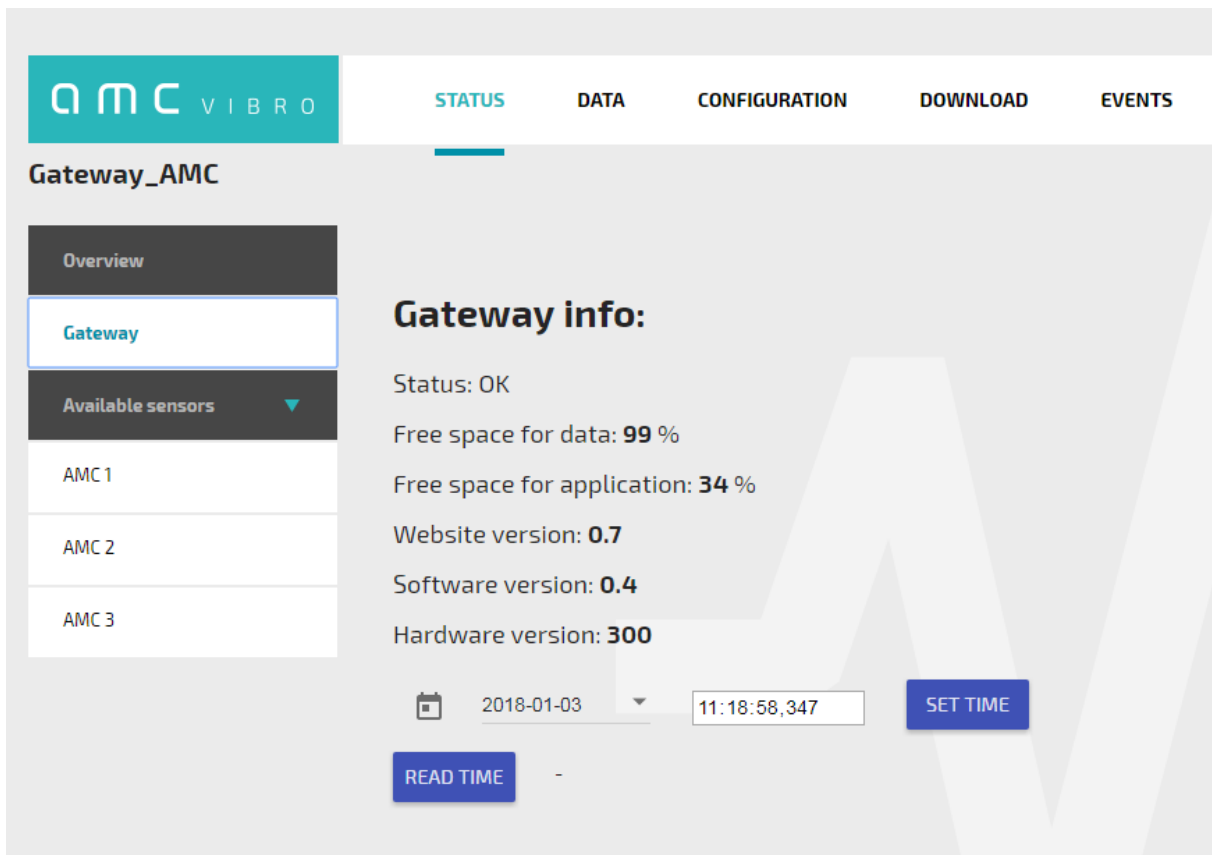


*Figure 17. The AVM GATEWAY information*

In the detailed view of any sensor (choice in the bar on the left side) you can see its detailed status. These are the elements described in table 8. Also in this case for the user's convenience the level of the estimate is color-coded in the same manner as before- described in figure 14.

Figure 18. Detailed information from AVS 2000R. Part I



Figure 19. Detailed information from AVS 2000R. Part II

*Table 8. Status of the AVS 2000R*

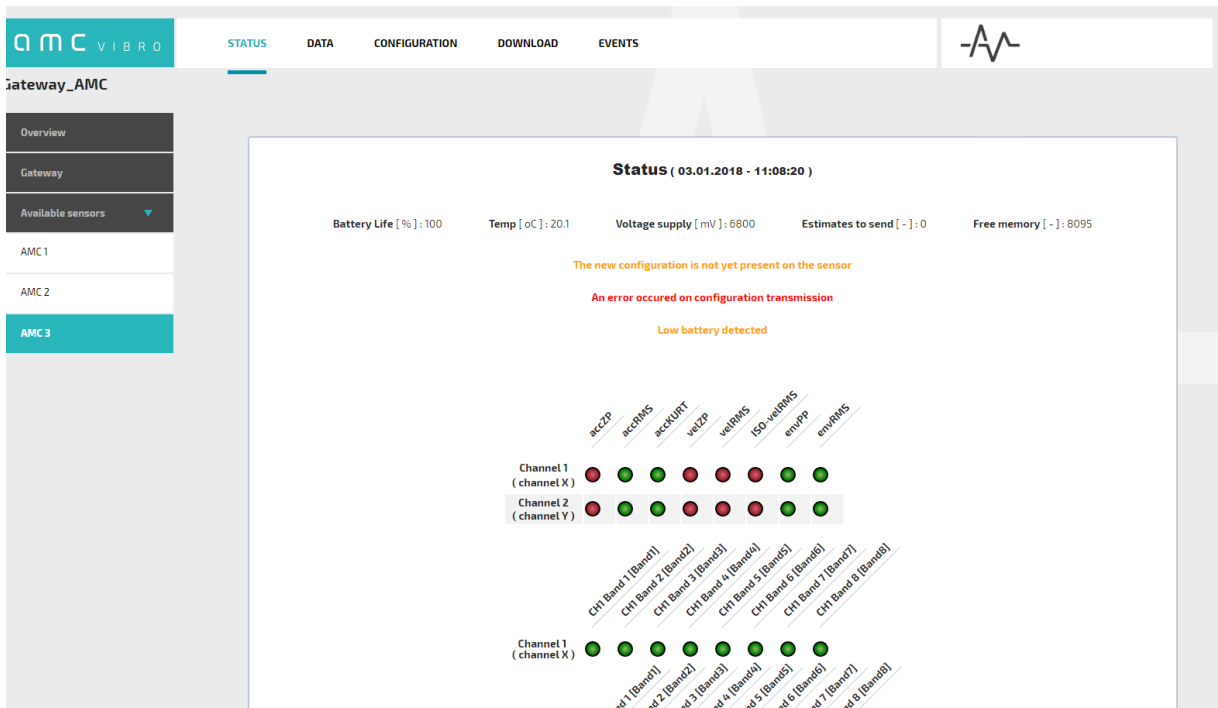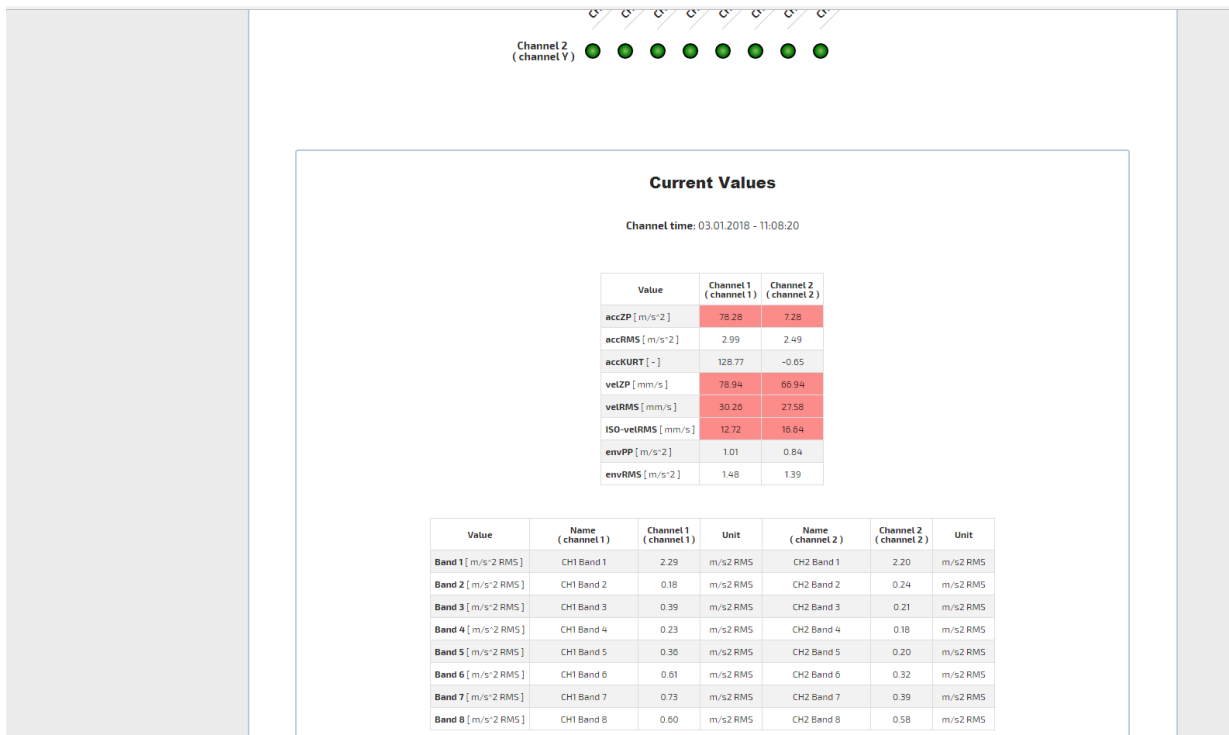| Parameter | Information |
|---|---|
| **Date of the status** | This is the date when the sensor device collected the measurements and judged its status, which is now visible on the site |
| **Battery Life** | The battery level which is expressed as percentage |
| **Temperature** | Temperature in Celsius degrees |
| **Voltage supply** | Battery voltage given in millivolts |
| **Estimates to send** | The number of statuses – packets of estimates that are waiting for sending to the GATEWAY |
| **Free memory** | Free place in the flash memory for the statuses - packets of estimates. It is equal: <br><br> 8095 - Estimates to send |
| **New configuration status** | If the newly sent configuration from AVM GATEWAY is not yet saved by AVS 2000R, the following message appears: *The new configuration is not yet present on the sensor* |
| **Status of configuration transmission** | If there is an error when sending the configuration, a message is displayed: *An error occurred on configuration transmission* |
| **Battery alert** | If the battery has run out, an message *Low battery detected* will appear and then the System administrator is obliged to report this event to AMC VIBRO to exchange the battery. |
| **Values of estimates** | The measured estimates are: <br><br> » 0-Peak & RMS  vibration acceleration [m/s2] <br> » acceleration kurtosis [-] <br> » 0-Peak & RMS vibration velocity [mm/s] <br> » ISO RMS velocity [mm/s] <br> » acceleration envelope RMS and Peak-Peak [m/s2] <br> » acceleration or velocity in 8 defined bands (BEC) |

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## 7.3. Data

Viewing all measurement data is possible in the *Data* tab. Measurements are visible in the table and you can also put them on the chart by pressing the name of the column with the estimate to be drawn. First you need to decide which sensor data you choose to view. Each sensor is uniquely identified by the MAC address. The sensor can assume different names over its lifetime. Then data from periods when the sensor had different names can be viewed in the *Data Archive* tab. There you should choose the name assigned to the sensor at given time and the file with the date of saving measurements which you want to analyze.

In the *Current Values* tab you can view the current data - assigned to the sensor with the current name.



*Figure 20. Data tab – Data Archive*
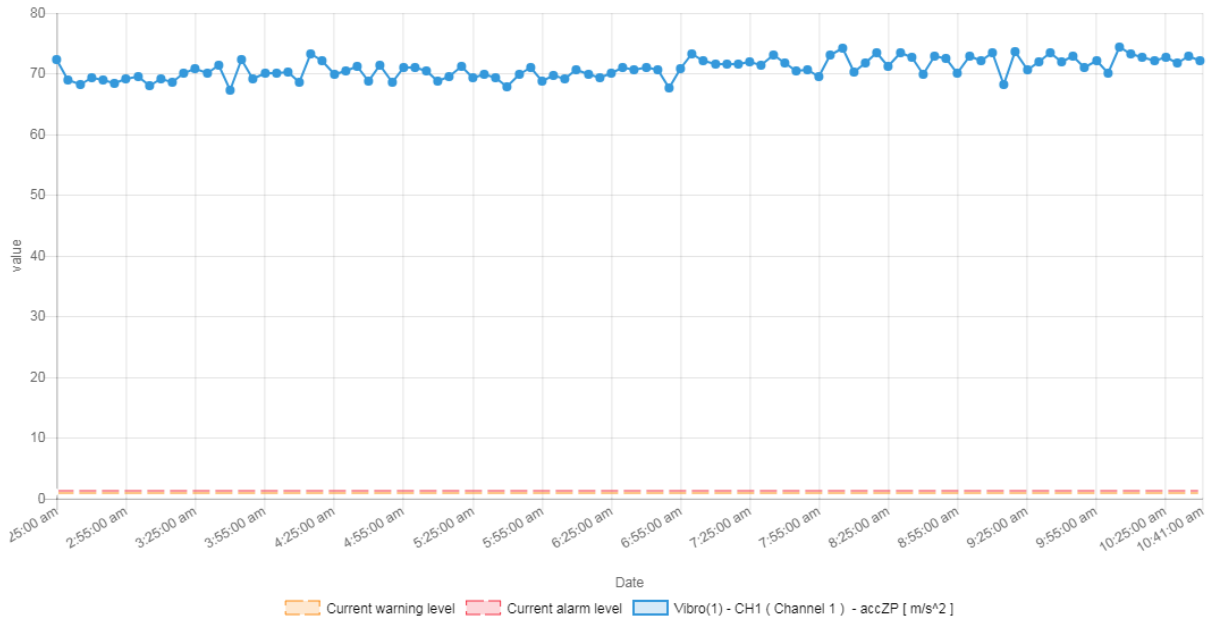
AMC VIBRATION SENSOR / ©AMC VIBRO Sp. z o.o.

*Figure 21. Data plot*



*Figure 22. Data tab – Current Values*

When selecting *Current Values*, you have the following display options to choose:

- » *Available sources* - measurements from channel X or Y or diagnostic data
- » *Keep plots on source change* - if you want to keep already drawn charts from one of the above sources in the chart field when you want to draw new graphs from another source along with them- check this option
- » *Set Number* - the number of last measurements to be displayed
- » *Custom Dataset* - advanced graph drawing options in which you can choose to draw any estimate from any sensors at once and clean all graphs at once with *clear plot* button
- » *From Date* - allows you to draw a chart from the selected date
- » Title of column - to draw a graph, click on the selected column title

Selected curves and chart legend are visible  in the area of the graph.

## 7.4. Download

The Measurements are stored in CSV format and can be downloaded via the website in the *Download* tab. Both the tab and the content of the sample file are presented in the figures below. After clicking the *Download* button the file archive is downloaded. It is a directory called *vibrosensor_MAC_address* along with directories inside with the names that this sensor had. In the folder with the name of the sensor there are files in the CSV format which have the date of saving the measurements as a title. If you want to narrow down the period from which you will download files, you have to check the *From* or *To* fields and select the chosen date. Otherwise, all files assigned to the sensor name will be downloaded.



*Figure 23. Download tab*

AMC VIBRATION SENSOR / ©AMC VIBRO Sp. z o.o.

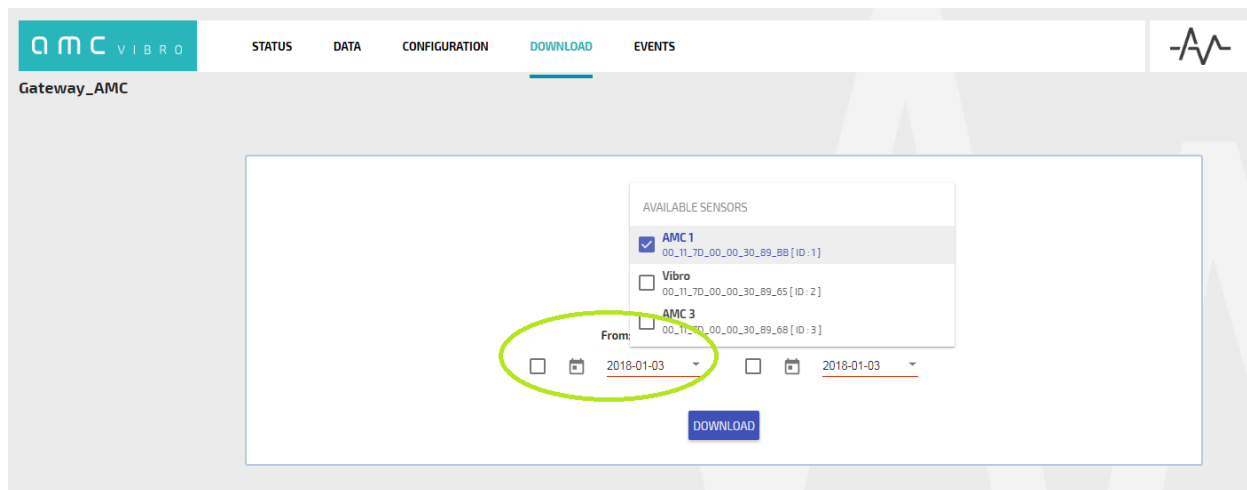| | A | B |
|---|---|---|
| 1 | Name sensor | AMC 1 |
| 2 | MAC | 00:11:7D:00:00:30:5F:9A |
| 3 | Sensor ID | 1 |
| 4 | Ch1 Name | Channel 1 |
| 5 | Ch2 Name | Channel 2 |

| Date[yyyy-mm-dd] | Time[hh:mm:ss] | Status | Battery Life | Temp[C] | Voltage supply[mv] | Sensor Status | RF Status | Left Estimates | Free memory | CH 1 | Warning | Alarm | accZP [m/s^2] | accRM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017-07-31 | 06:48:59 | 0 | 70 | 39.8 | 6181 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.046402 | |
| 2017-07-31 | 07:49:16 | 0 | 70 | 39.9 | 6161 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.051529 | |
| 2017-07-31 | 08:49:16 | 0 | 70 | 40 | 6223 | 1 | 0 | 1 | 8094 | | 0 | 0 | 0.045761 | |
| 2017-07-31 | 09:49:16 | 0 | 70 | 40.1 | 6192 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.503693 | |
| 2017-07-31 | 10:49:16 | 0 | 70 | 40 | 6212 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.858719 | |
| 2017-07-31 | 11:19:16 | 0 | 70 | 40 | 6216 | 1 | 0 | 0 | 8095 | | 1001 | 1000 | 0.548676 | |
| 2017-07-31 | 11:49:16 | 0 | 70 | 40 | 6223 | 1 | 0 | 0 | 8095 | | 1001 | 1000 | 0.466797 | |
| 2017-07-31 | 12:19:16 | 0 | 70 | 40 | 6226 | 1 | 0 | 0 | 8095 | | 1001 | 1000 | 0.449722 | |
| 2017-07-31 | 12:49:16 | 0 | 70 | 40 | 6229 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.40625 | |
| 2017-07-31 | 13:19:16 | 0 | 70 | 40 | 6233 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.429733 | |
| 2017-07-31 | 13:49:16 | 0 | 70 | 40 | 6236 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.609589 | |
| 2017-07-31 | 14:19:16 | 0 | 70 | 40 | 6247 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.431137 | |
| 2017-07-31 | 14:49:16 | 0 | 70 | 39.9 | 6243 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.575363 | |
| 2017-07-31 | 15:19:16 | 0 | 70 | 39.9 | 6247 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.596954 | |
| 2017-07-31 | 15:49:16 | 0 | 70 | 39.9 | 6247 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.476181 | |
| 2017-07-31 | 16:19:16 | 0 | 69 | 41 | 6250 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.514664 | |
| 2017-07-31 | 16:49:16 | 0 | 69 | 41 | 6253 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.433563 | |
| 2017-07-31 | 17:19:16 | 0 | 69 | 41 | 6257 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.638748 | |
| 2017-07-31 | 17:49:16 | 0 | 69 | 41 | 6253 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.534866 | |
| 2017-07-31 | 18:19:16 | 0 | 69 | 41 | 6253 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.42334 | |
| 2017-07-31 | 18:49:16 | 0 | 69 | 41 | 6233 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.411926 | |
| 2017-07-31 | 19:19:16 | 0 | 69 | 41 | 6212 | 1 | 0 | 0 | 8095 | | 0 | 0 | 0.528152 | |
| 2017-07-31 | 19:49:16 | 0 | 69 | 42 | 6202 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.42363 | |
| 2017-07-31 | 20:19:16 | 0 | 69 | 42.1 | 6181 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.509369 | |
| 2017-07-31 | 20:49:16 | 0 | 69 | 42.2 | 6192 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.551651 | |
| 2017-07-31 | 21:19:16 | 0 | 69 | 42.3 | 6175 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.700623 | |
| 2017-07-31 | 21:49:16 | 0 | 69 | 42.4 | 6178 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.641891 | |
| 2017-07-31 | 22:19:16 | 0 | 69 | 42.5 | 6195 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.502487 | |
| 2017-07-31 | 22:49:16 | 0 | 69 | 42.6 | 6205 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.676468 | |
| 2017-07-31 | 23:19:16 | 0 | 69 | 42.7 | 6178 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.554535 | |
| 2017-07-31 | 23:49:16 | 0 | 69 | 42.7 | 6178 | 1 | 0 | 0 | 8095 | | 1000 | 0 | 0.363251 | |

*Figure 24. Data file*

Important notice- data format is made in a way to provide marking of warnings and alarms as well as self-diagnostic status. The method of marking is as follows:

» Warnings and Alarms – the value in the the warning and alarm field has a 16-bit binary format. Value of 1 indicates the presence of a warning or alarm and value of 0 means that they are not present. The LSB (in a file the first bit visible on the far right side) means the alarm of the first estimate, that is acceleration 0-Peak from channel X. The second bit from the left means that the source of occurrence is acceleration RMS from channel Y and so on

» Sensor Status – bit coding is as follows, counting out from LSB (that is from the right side). The value of 1 means the presence of the mentioned state:

1. Active mode
2. Temperature measurement failed
3. RTC chip error
4. Flash memory error
5. RAM memory error
6. Analog process failed
7. Not used
8. Reconfiguration not received yet
9. Reconfiguration error

» RF Status – bit coding is as follows, counting out from LSB (that is from the right side). The value of 1 means the presence of the mentioned state:

1. RF module error

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## 7.5. Events

As mentioned- the GATEWAY monitors all network devices and occurrences by them reported. It reacts to exceeding measured values above the thresholds of warnings and alarms. These occurrences are listed in the Events tab. You can choose a sensors to view alerts. There are the following options to choose:

- » *From Date* – allows you to choose a date since you will be viewing events. Otherwise all possible will be displayed
- » *Source* – the source of occurrence: All, Channel X or Channel Y
- » *State* – All - if all alerts are displayed - past and present or Current – if only still ongoing alerts are displayed
- » *Type* – Warnings or Alarms or All
- » *Estimate* – a kind of estimate which is the source of occurrence / alert

*Start date* parameter informs when the occurrence began and the *End date* parameter informs when the occurrence was stopped.
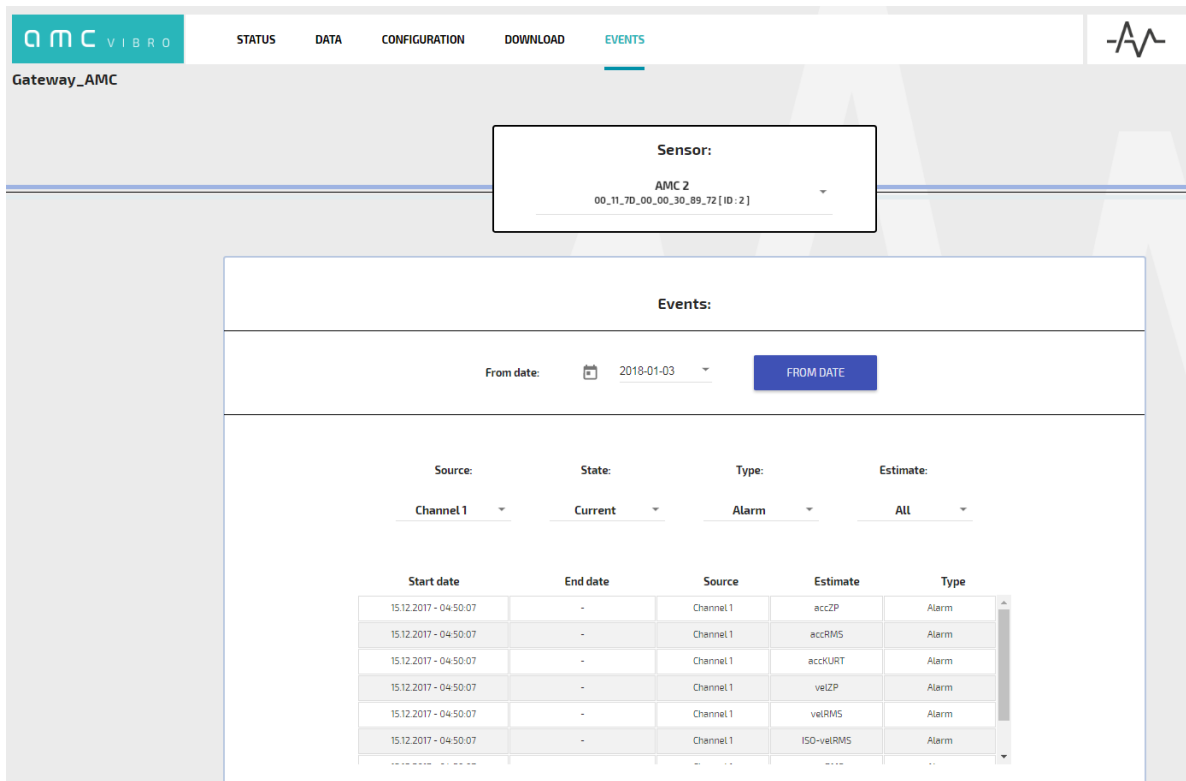


*Figure 25. Events tab*

## 7.6. Modbus and OPC protocols

Due to AVM GATEWAY functionality measurement data can be readed in various ways. For example they can be applications to Modbus client or OPC UA client.

By using the GATEWAY you can have access to all current data via Modbus TCP / IP - port 502, function 03 Read Holding Registers. Table 9 shows the Modbus registers of the AVS 2000R, ID number = 1.

The registers available for reading via the GATEWAY for subsequent IDs are shifted by a number equal to:

$$2025 + 58 * (ID \text{ of AVS } 2000R - 1)$$

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AMC VIBRO provides a spreadsheet for determining register addresses. System operator only needs to enter the ID number of AVS 2000R device. Then addresses of registers assigned to the sensor with the given ID are automatically displayed. The figure 26 shows example date read using the Modbus client.

*Table 9. Modbus registers*

| AVM 2000R ID 1 | | Register | Address | Type | Size [B] | Unit / Range |
|---|---|---|---|---|---|---|
| | **Status** | OPC Status | 2000 | uint16_t | 2 | boolean |
| | | Modbus Status | 2001 | uint16_t | 2 | boolean |
| | | WWW status | 2002 | uint16_t | 2 | boolean |
| **AVS 2000R** | **Time Stamp** | Day | 2025 | uint16_t | 2 | 1-31 |
| | | Month | 2026 | uint16_t | 2 | 1-12 |
| | | Year | 2027 | uint16_t | 2 | number |
| | | Hour | 2028 | uint16_t | 2 | 0-23 |
| | | Minute | 2029 | uint16_t | 2 | 0-59 |
| | | Second | 2030 | uint16_t | 2 | 0-59 |
| | **Status** | RF MAC | 2031 | 8 x uint16_t | 16 | ASCII |
| | | Id | 2039 | uint16_t | 2 | number |
| | | Battery Life | 2040 | uint16_t | 2 | % |
| | | Temperature | 2041 | int16_t | 2 | °C |
| | | Voltage supply | 2042 | uint16_t | 2 | mV |
| | | SENSOR Status | 2043 | uint16_t | 2 | binary |
| | | RF Status | 2044 | uint16_t | 2 | binary |
| | | Left Estimates | 2045 | uint16_t | 2 | binary |
| | | Free memory | 2046 | uint16_t | 2 | number |
| | **Estimates CH1** | Warning | 2047 | uint16_t | 2 | binary |
| | | Alarm | 2048 | uint16_t | 2 | binary |
| | | acceleration 0-Peak | 2049 | uint16_t | 2 | x0.001 m/s2 |
| | | acceleration RMS | 2050 | uint16_t | 2 | x0.001 m/s2 |
| | | acceleration Kurtosis | 2051 | uint16_t | 2 | number |
| | | velocity 0-Peak | 2052 | uint16_t | 2 | x0.001 m/s |
| | | velocity RMS | 2053 | uint16_t | 2 | x0.001 m/s |
| | | ISO-velocity RMS | 2054 | uint16_t | 2 | x0.001 m/s |
| | | envelope Peak-Peak | 2055 | uint16_t | 2 | x0.001 m/s2 |
| | | envelope RMS | 2056 | uint16_t | 2 | x0.001 m/s2 |
| | | Band[8] | 2057 | 8x uint16_t | 16 | x0.001 m/s2 or x0.001 m/2 |
| | **Estimates CH2** | Warning | 2065 | uint16_t | 2 | binary |
| | | Alarm | 2066 | uint16_t | 2 | binary |
| | | acceleration 0-Peak | 2067 | uint16_t | 2 | x0.001 m/s2 |

| AVM 2000R ID 1 | Register | Address | Type | Size [B] | Unit / Range |
|---|---|---|---|---|---|
| | acceleration RMS | 2068 | uint16_t | 2 | x0.001 m/s2 |
| | acceleration Kurtosis | 2069 | uint16_t | 2 | number |
| | velocity 0-Peak | 2070 | uint16_t | 2 | x0.001 m/s |
| | velocity RMS | 2071 | uint16_t | 2 | x0.001 m/s |
| | ISO-velocity RMS | 2072 | uint16_t | 2 | x0.001 m/s |
| | envelope Peak-Peak | 2073 | uint16_t | 2 | x0.001 m/s2 |
| | envelope RMS | 2074 | uint16_t | 2 | x0.001 m/s2 |
| | Band[8] | 2075 | 8x uint16_t | 16 | x0.001 m/s2 or x0.001 m/2 |
| | | | | | *acceleration or velocity |



*Figure 26. Date reading from the Vibration sensor ID 1*

Important notice- data format is made in a way to provide marking of warnings and alarms as well as self-diagnostic status. The method of marking is as follows:

- » Warnings and Alarms – the value in the warning and alarm field has a 16-bit binary format. A value of 1 indicates the presence of a warning or alarm and a value of 0 means that they are not present. The LSB (in a file the first bit visible on the far right side) means the alarm of the first estimate, that is acceleration 0-Peak from channel X. The second bit from the left means that the source of occurrence is acceleration RMS from channel Y and so on.
- » SENSOR Status – bit coding is as follows, counting out from LSB (that is from the right side). The value of 1 means the presence of the mentioned state:

1. Active mode
2. Temperature measurement failed
3. RTC chip error
4. Flash memory error
5. RAM memory error
6. Analog process failed
7. Not used
8. Reconfiguration not received yet
9. Reconfiguration error

» RF Status – bit coding is as follows, counting out from LSB (that is from the right side). The value of 1 means the presence of the mentioned state:

1. RF module error

Similarly, the namespace that lists the contents of fields for OPC communication is listed in the table 10. The port used is 11664. The identifier of each field is of the string type. It starts with the type of sensor followed by the id number followed by the group and field name (see table). Figure 27 shows the OPC field structure for the Vibration sensor.

*Table 10. OPC fields*

| Device type | Field name | ID |
|---|---|---|
| Vibration SENSOR | TimeStamp | vs{x}.TimeStamp |
| | Configuration – Active | vs{x}.conf.active |
| | Configruration – Wakeup interval | vs{x}.conf.wakeup |
| | Diagnostic – Batery life | vs{x}.diag.battLife |
| | Diagnostic – Free memory | vs{x}.diag.freeMem |
| | Diagnostic – Id | vs{x}.diag.id |
| | Diagnostic – MAC | vs{x}.diag.mac |
| | Diagnostic – RF Status | vs{x}.diag.rfStatus |
| | Diagnostic – Status | vs{x}.diag.status |
| | Diagnostic – Temperature | vs{x}.diag.temp |
| | Diagnostic – Voltage supply | vs{x}.diag.voltSupply |
| | Estimate Ch{n} - Band | vs{x}.est.ch{n}.band |
| | Estimate Ch{n} – ISOvelRMS | vs{x}.est.ch{n}.ISOvelRMS |
| | Estimate Ch{n} – accKURT | vs{x}.est.ch{n}.accKURT |
| | Estimate Ch{n} – accRMS | vs{x}.est.ch{n}.accRMS |
| | Estimate Ch{n} – accZP | vs{x}.est.ch{n}.accZP |
| | Estimate Ch{n} – envPP | vs{x}.est.ch{n}.envPP |
| | Estimate Ch{n} – envRMS | vs{x}.est.ch{n}.envRMS |
| | Estimate Ch{n} – velRMS | vs{x}.est.ch{n}.velRMS |
| | Estimate Ch{n} – velZP | vs{x}.est.ch{n}.velZP |
| | Event Ch{n} – Alarm | vs{x}.event.ch{n}.alarm |
| | Event Ch{n} – Warning | vs{x}.event.ch{n}.warning |
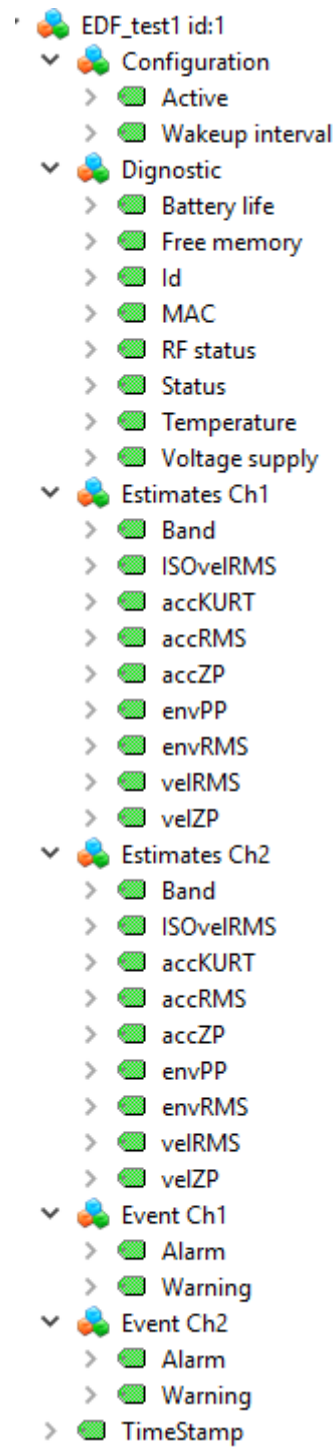
*Figure 27. The OPC structure for the Vibration sensor*

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# 8. Quick start

In order to start the new AVS SYSTEM follow the instructions below.

## 8.1. Mechanical part

1. Install the AV SENSOR System from AMC VIBRO on your object as described in chapter 4.

## 8.2. AVM GATEWAY part

2. Connect the AVM GATEWAY to the power supply as shown in figure 28. After connecting the module to the power supply it will automatically start. After two minutes it will be ready to work and the website will respond.



*Figure 28. AVM GATEWAY description of connectors*

3. Connect the AVM GATEWAY to the your computer using an Ethernet network cable. Do it as shown in the picture 29.

AMC VIBRATION SENSOR / ©AMC VIBRO Sp. z o.o.
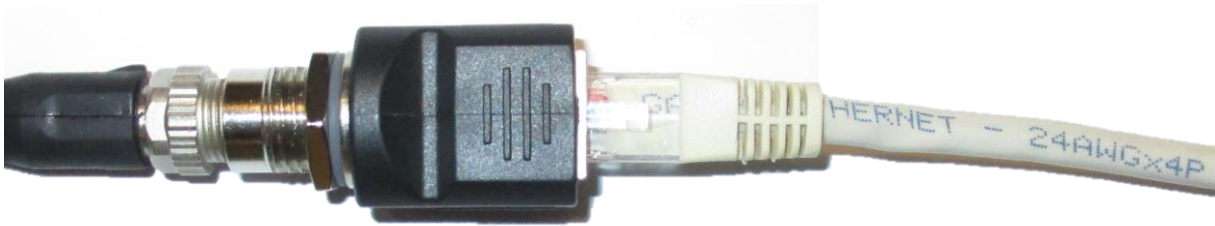
*Figure 29. Patch cord insert*

**NOTE!**

4. Now set the network adapter of your device for example a laptop or PC computer from which you will connect to the AVM GATEWAY. For the first use set your computer IP address to 192.168.0.2 and the subnet mask 255.255.255.0. You do not need to fill other fields. The illustrations below show how to do it in the Windows 7 operating system.

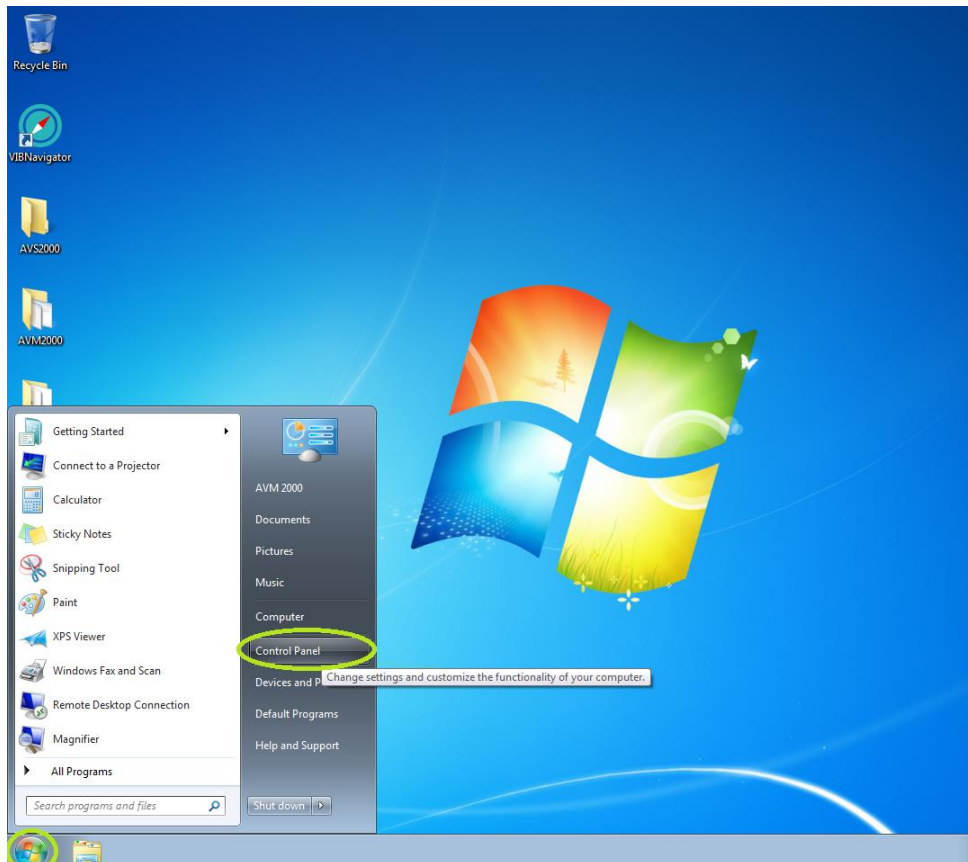» Left-click on the *Start* button and open *Control Panel*



*Figure 30. OS Control Panel*

![AMC VIBRO logo]

» Left-click on *View network status and tasks* option
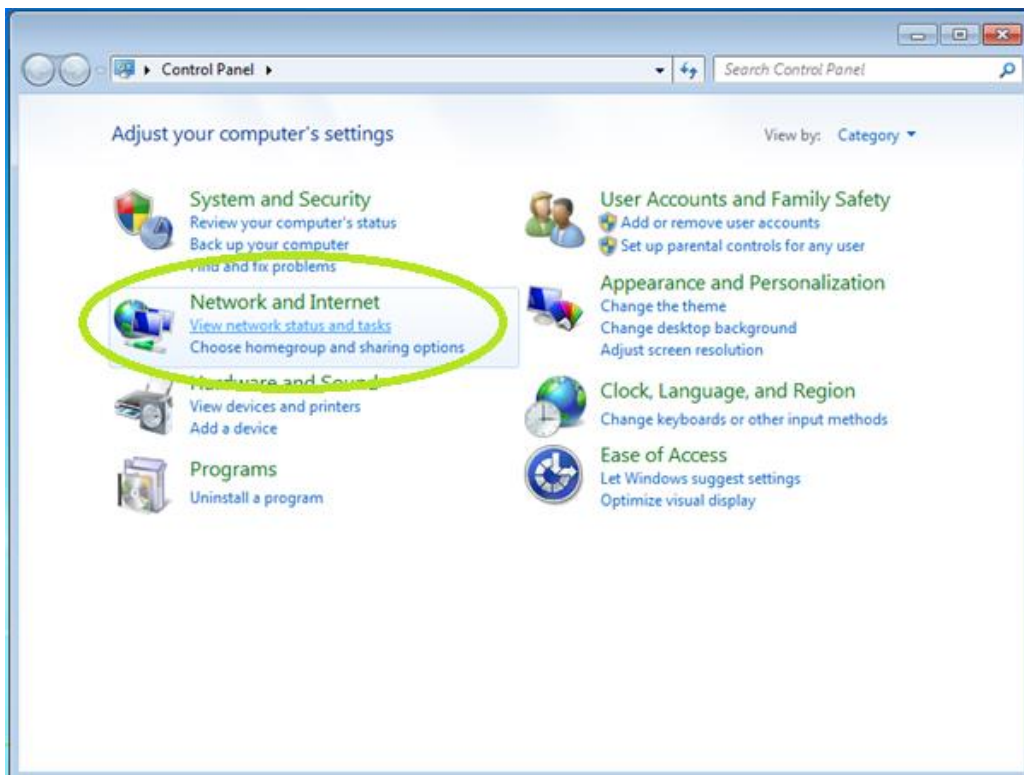
» Left-click on *Change adapter settings* option

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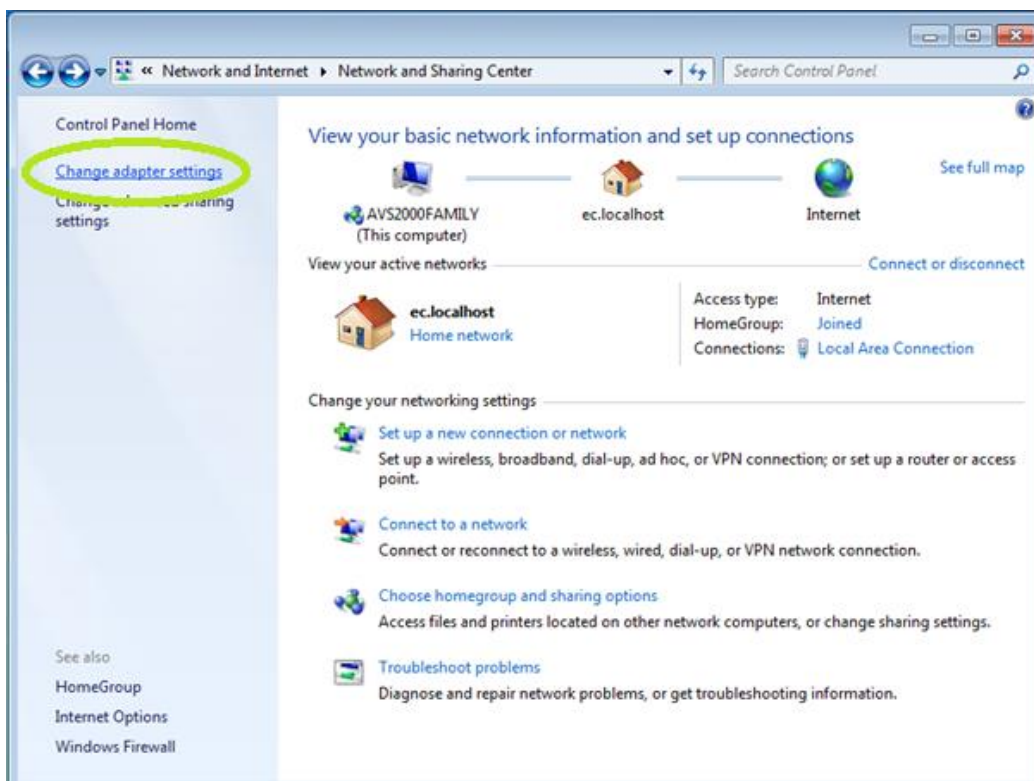
» Right-click on your network adapter and open its *Properties*

» Double-click on *Internet Protocol Version 4 (TCP/IPv4)* field
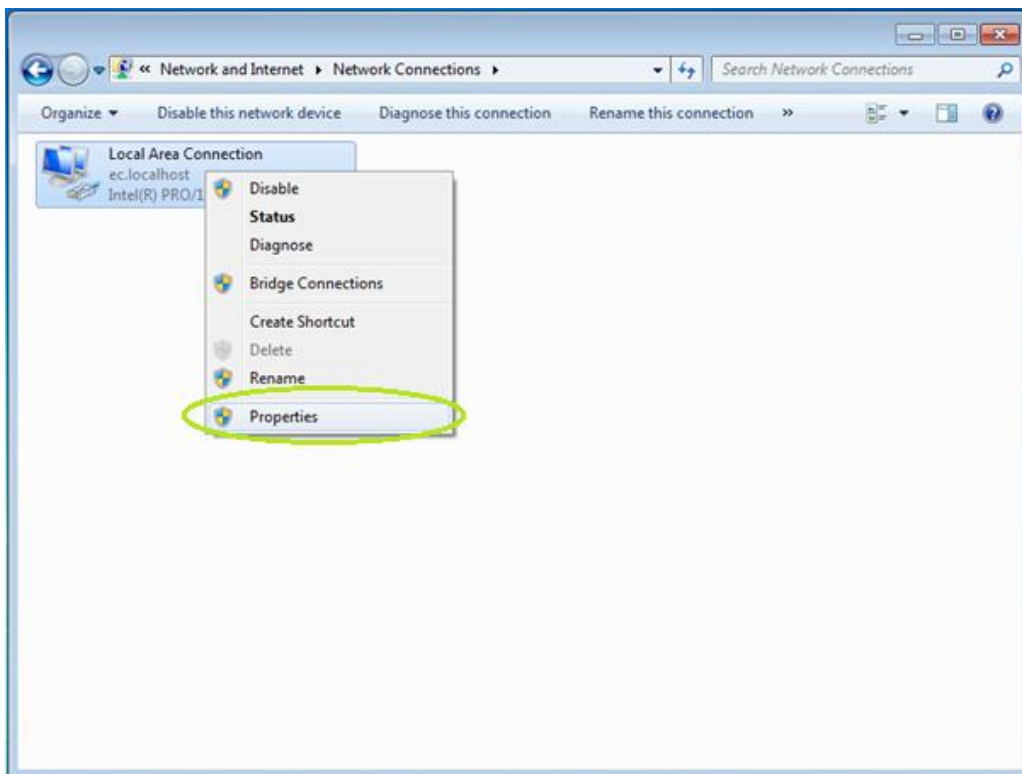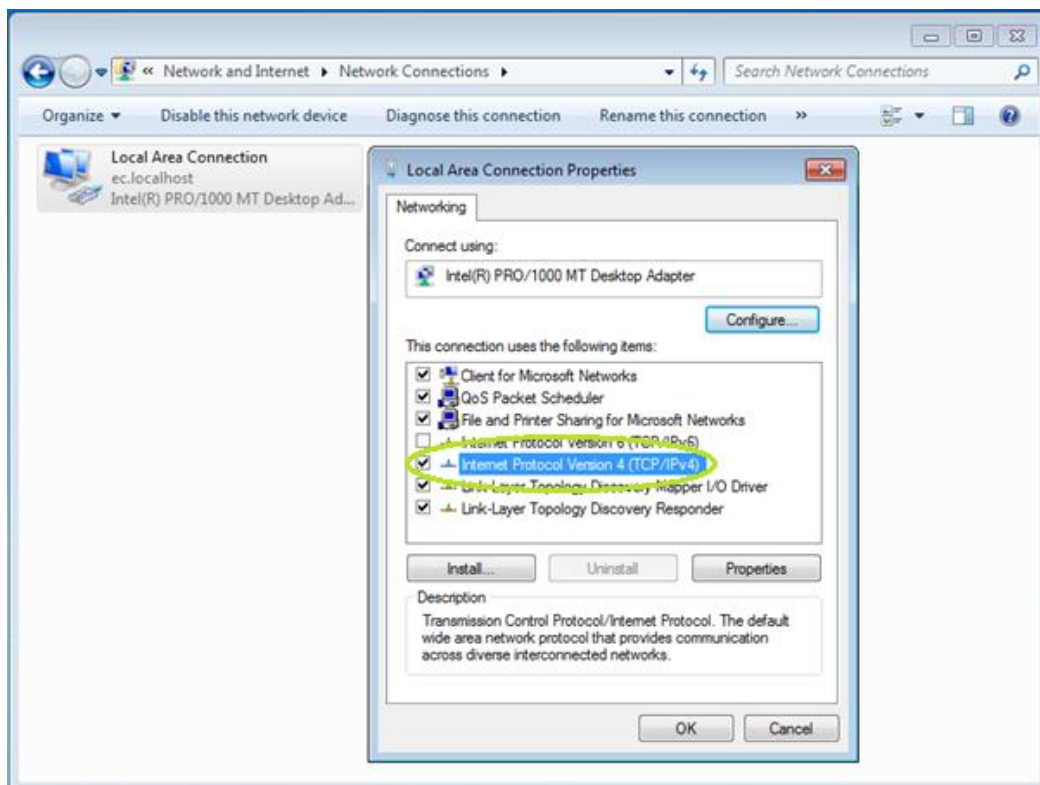
> » Select the *Use the following IP address* option and type *IP address:* 192.168.0.2 and *Subnet mask:* 255.255.255.0. Then confirm your changes by clicking *OK* in the open windows (*Internet Protocol Version 4 (TCP / IPv4) Properties* and *Your Network Adapter Properties*)
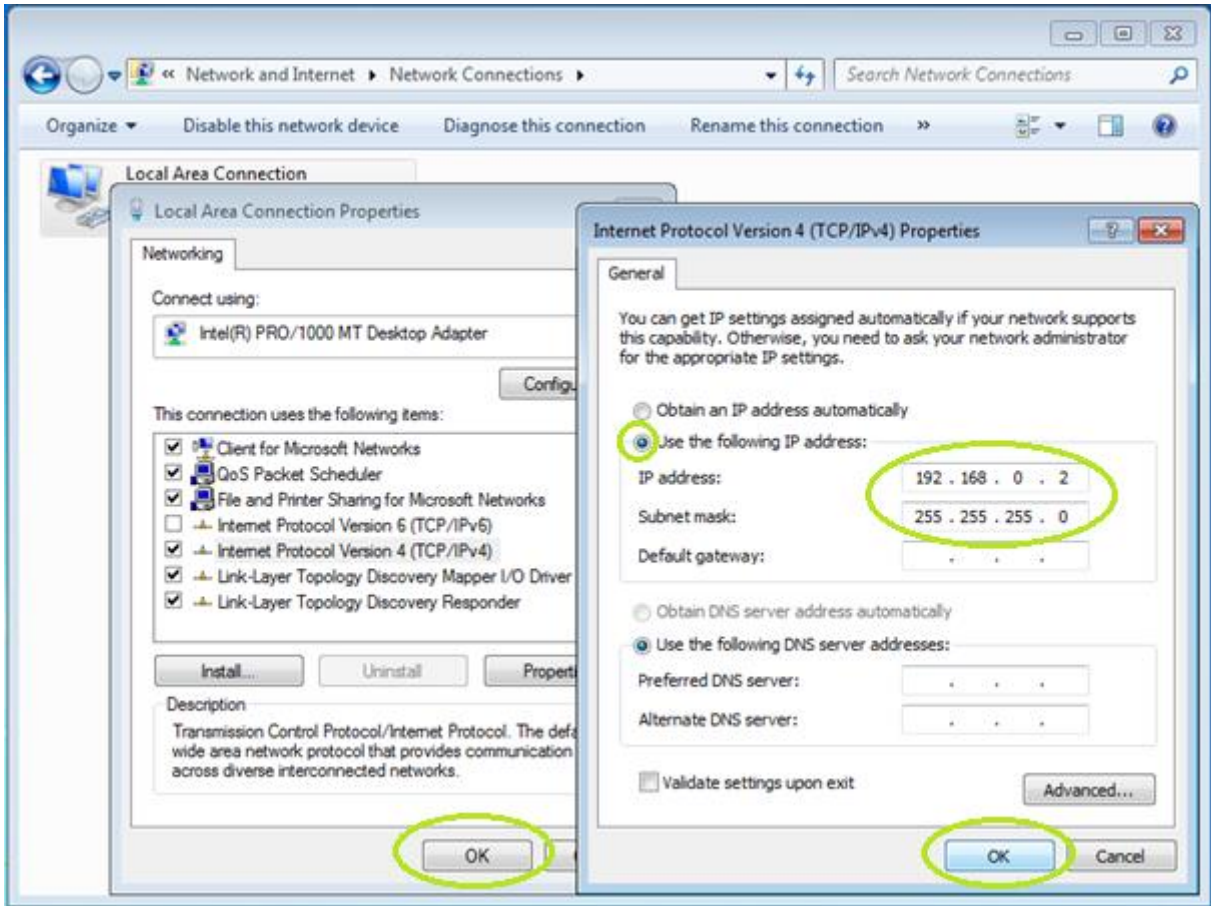


*Figure 35. Computer IP address*

5. After this steps you should be able to browse the website on the AVM GATEWAY. You will also be able to set the AVM GATEWAY module to the IP address of your wish.

## 8.3. AVS 2000R part

6. Now you should wake up all of the AVS devices by applying a neodymium magnet to a device until LED blinks. After waking up the sensors will take measurements and register in the radio network map. They will be visible on the website (*Status* tab, *Overview* field). They will work according to the default configuration. The default and target settings for each sensor can be modified by user via the website in the *Configuration* tab. After receiving the target configuration the sensor will automatically wake up according to the settings.

*Figure 36. Wake up the Vibration sensor*

7. All modules present in the network assigned to the GATEWAY are visible in the *Overview* field. To set the device in the storage mode, you can hold the magnet in the same place as in the figure 36 for about 5 seconds until the LED light starts to blink quickly. Then just put the magnet away. Then LED light will stop blinking and the device will be in storage mode. To exit the storage mode, an operator must hold the magnet for a second in the same place as before (figure 36) until the LED lights up.
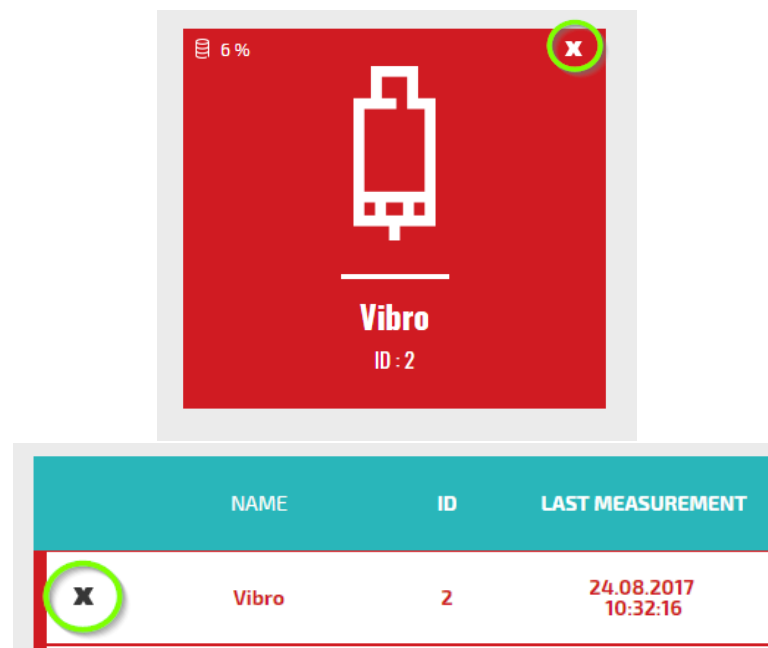


*Figure 37. Removal of the AVS 2000R from the network*

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8. To enter any other network configuration follow the instructions in chapter 5. To view the data follow the instructions in chapter 6.

# 9. Battery safety and recycle

The AVS 2000R wireless sensor uses 3.6V lithium AA batteries. Lithium batteries are volatile. When handling and storing lithium metal batteries, follow below precautions:

» Store and handle lithium metal batteries in the way to avoid contact with other lithium batteries.
» Don't place lithium metal batteries on hot, metal surfaces.
» If you store an inactive Vibration sensor- remember to remove the battery.

The lithium batteries will typically last up to six years.

## 9.1. Hazardous Materials

AVS 2000R system does not use any hazardous materials outlined by RoHS. These regulations confirm that lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ether, or other battery related materials are limited to no more than trace amounts.



## 9.2. Recycling Facilities

When decommissioning out of use devices, minimize the impact of the waste created. Refer to local waste removal administration for current information on proper material collection and recycling.