a m c VIBRO 2024

AVS 1003LF /
AVS 1001HF
APPLICATION EXAMPLES

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2024

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1. Introduction

The **AVS 1003LF** and **AVS 1001HF** digital sensors, manufactured by AMC VIBRO, can be used in several configurations. The most important ways to use them are:

a. machine protection: vibration signal parameters calculated by the sensors are read from them. In this configuration, a PLC controller or an industrial computer with an RS-485 interface and the MODBUS protocol can be used for reading. This solution allows for a very simple and quick addition of fault detection and dynamic protection functions to the control system

b. in combination with AVM 4000 Condition Monitoring System, which reads raw vibration data and determines advanced vibration signal parameters. This is a cost effective alternative to classic CMS systems

c. reading of raw vibration data via a dedicated user application (for laboratory and testing applications)

These are described in this document.

2. Reading vibration parameters via PLC/SCADA

Sensors can be used in machine protection systems. The vibration signal parameters calculated by the sensors are read from them. In this configuration, a PLC controller or an industrial computer with an RS-485 interface and the MODBUS protocol can be used for reading. The data is read at a speed of 115kbps. bus with multiple AVS sensors can be connected to one RS-485 port. This can result in significant savings on cabling.

This solution allows for a very simple and quick addition of fault detection and dynamic protection functions to the control system.
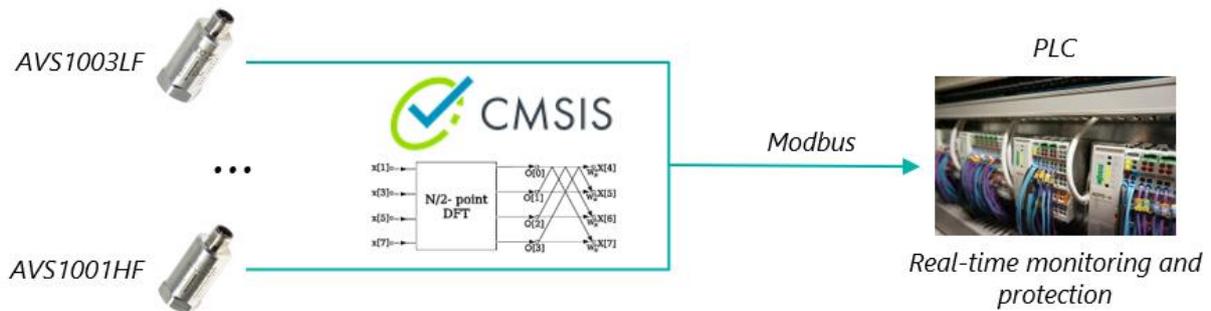
Configuration features:

Full system digitization

Immediate data availability in PLC/SCADA controllers

Envelope signal tracking

Easy expansion

ᑌᗰᑕ VIBRO

🔍 Extra wideband and narrowband narrowband analysis

〰️ Ultra-fast DSP library

Modbus register maps that should be used to read the data send by the sensor are provided below.

Register numbers for the AVS 1003LF sensor:

Name	Type	Address (dec)	Offset (hex)	Offset dec	Length (hex)	Length (dec)
Temperature	float32	31-32	0x3A	58	0x04	4
X Peak-to-Peak	float32	33-34	0x3E	62	0x04	4
X Acceleration Root Mean Square	float32	35-36	0x42	66	0x04	4
X Velocity Root Mean Square	float32	37-38	0x46	70	0x04	4
Y Peak-to-Peak	float32	39-40	0x4A	74	0x04	4
Y Acceleration Root Mean Square	float32	41-42	0x4E	78	0x04	4
Y Velocity Root Mean Square	float32	43-44	0x52	82	0x04	4
Z Peak-to-Peak	float32	45-46	0x56	86	0x04	4
Z Acceleration Root Mean Square	float32	47-48	0x5A	90	0x04	4
Z Velocity Root Mean Square	float32	49-50	0x5E	94	0x04	4

Register numbers for the AVS 1001HF sensor:

Name	Type	Address (dec)	Offset (hex)	Offset dec	Length (hex)	Length (dec)
Temperature	float32	31-32	0x3A	58	0x04	4
Peak-to-Peak	float32	33-34	0x3E	62	0x04	4
Acceleration Root Mean Square	float32	35-36	0x42	66	0x04	4
Velocity Root Mean Square	float32	37-38	0x46	70	0x04	4
Envelope Zero Peak	float32	39-40	0x4A	74	0x04	4

Envelope Root Mean Square	float32	41-42	0x4E	78	0x04	4

3. Digital CMS AVM 4000

In this configuration, the sensors cooperate with the AVM 4000 Condition Monitoring System. This system reads raw vibration data and determines advanced vibration signal parameters. AVM 4000 is an advanced monitoring system that can be precisely adjusted to the parameters of the monitored machine. It can determine hundreds of broad- and narrowband parameters from the raw vibration signal from many sensors. The system can automatically set alarm threshold values and then notify the user if they are exceeded.

The use of digital sensors is a cost-effective alternative to classic CMS systems.
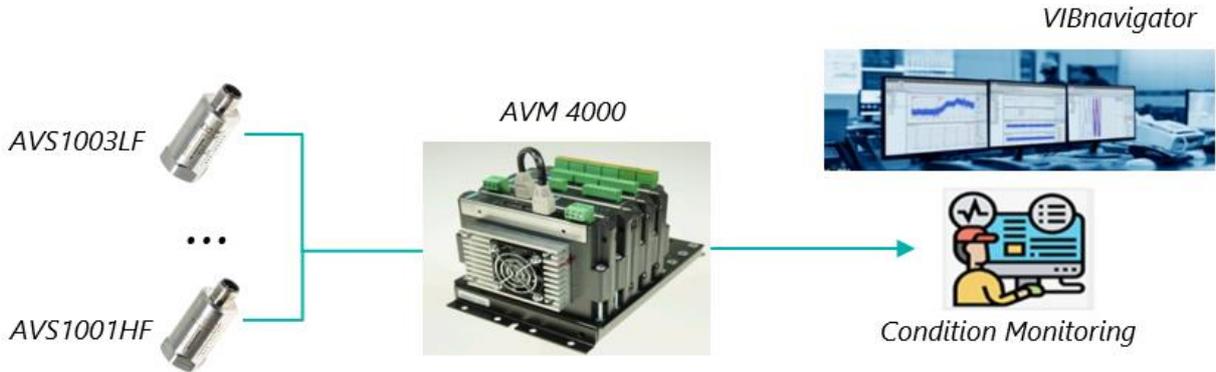
Configuration features:

- Full system digitization
- Automatic fault diagnostics
- Low cost high-frequency diagnostics (gearbox, REB)
- Easy expansion of digital sensors
- False alarms reduction
- Advanced diagnostic algorithms
- Wideband and narrowband analysis
- Envelope analysis

3.1 Vibro module configuration

In this case, the user will have to use two applications:

    a. **AV SENSOR Manager**, an application dedicated to managing AVS sensors
    b. **VIBnavigator**, used to configure the AVM 4000 system and view and analyze data

    1. Connect the sensor to the computer using the AVS USB CON adapter

<p align="center">PC → USB/USB C cable → AVS USB CON adapter → sensor</p>

    2. Run the AV SENSOR Manager software
    3. In the 'Device' tab, in the upper left corner of the application window, in the 'List of Serial Ports' section, select the appropriate port:

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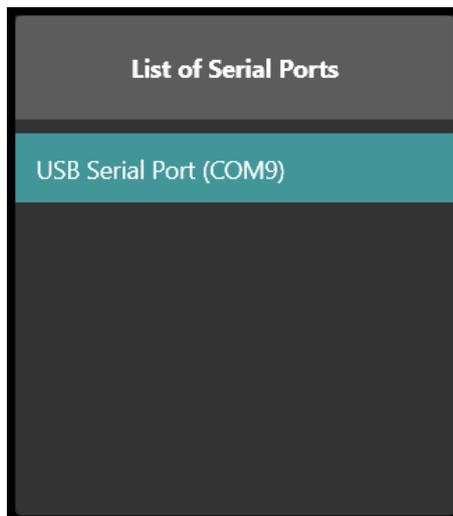
4. Click the 'Refresh' button in the 'List of Devices' section header, located in the lower left corner of the application window, and select the appropriate sensor (after it is detected by the software):
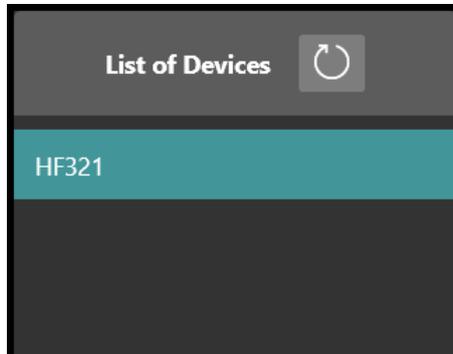
This will display the current sensor parameters in the main application window:
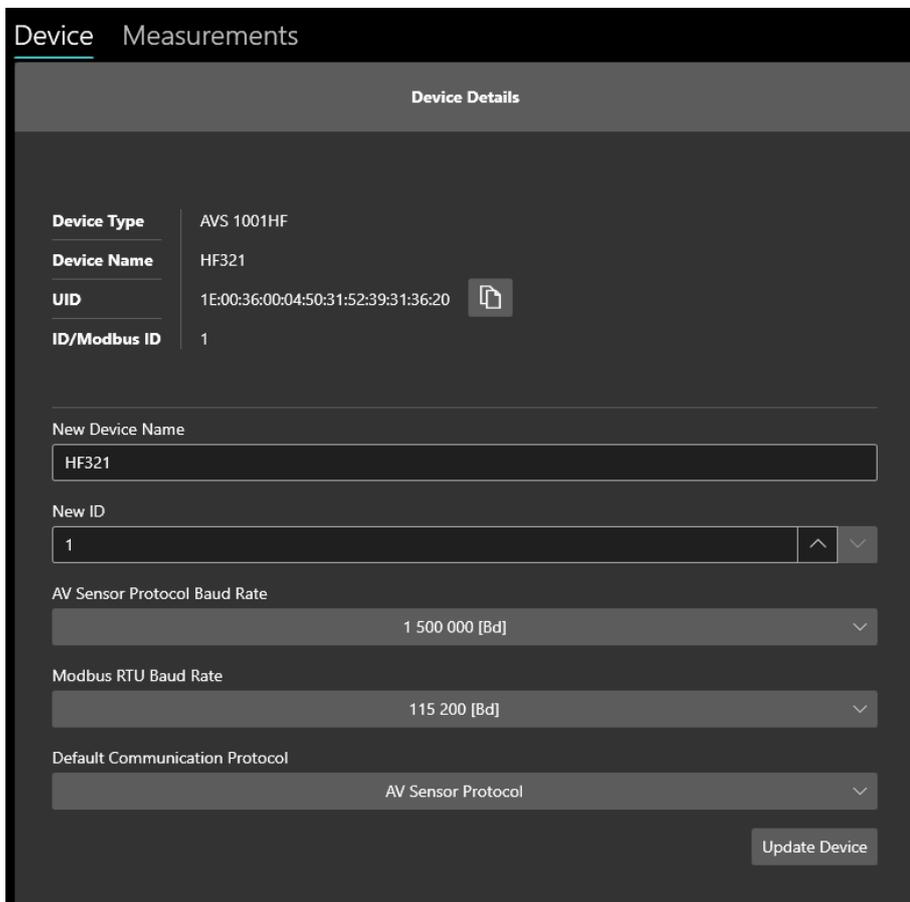
5. Default Communication Protocol' should be set to 'AV SENSOR Protocol'
6. Copy the sensor UID (using the button located on its right side)
7. Connect the sensor to the AVM 4000 system
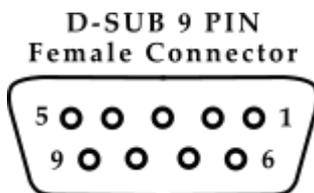
RS-485 Connector Pin number		Sensor cable Colours
3	RS485+	Brown
4	RS485-	Blue
5	GND	Black
-	+12 V	White

8. Connect the AVM 4000 system to the power supply
9. Change the IP of the Ethernet connection on your computer so that it is in the same subnet as the AVM 4000 system (the default subnet of the AVM 4000 system is 50):
    a. Go to 'Network & Internet Settings' on your computer
    b. Next go to Ethernet settings
    c. Select 'Change card options'
    d. Select the corresponding Ethernet connection
    e. Go to its Properties
    f. Select 'Internet Protocol Version 4 (TCP/IPv4)'
    g. Check the 'Use the following IP address' option and enter the appropriate values for 'IP Address' (the first three numbers matching the IP address of the AVM 4000 system) and 'Subnet Mask' ('255.255.255.0'):
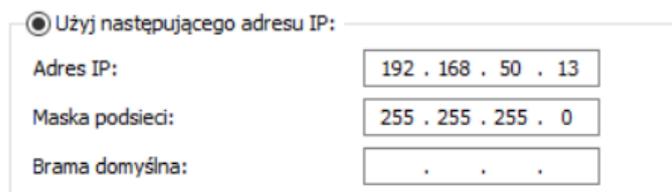
    h. Confirm with 'OK' in this and the next window and close the Ethernet connection settings
10. Launch the VIBnavigator software
11. In the 'My devices' tab, press the 'Scan' button:
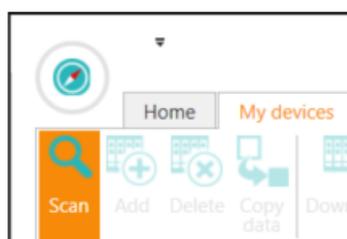
12. In the 'My devices' list on the left side of the application window, the searched device will appear (marked in turquoise):

13. Double-click on the name of the found device, this will open the system configuration in the main window of the application

14. Go to the 'Drivers' > 'ADI driver' node, switch the tab to the 'Device configurations editor' and add the slave node using the 'Add' button located in the top menu of the program. Click on the newly added node and click the 'Add' button again:
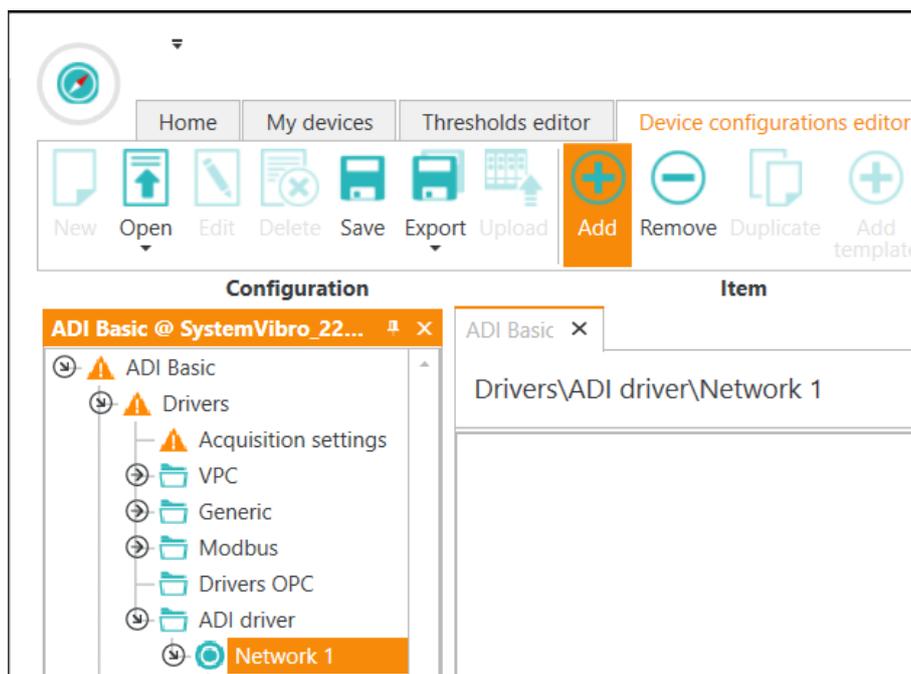
15. This will cause the new channel to appear in the main application window

16. Enter the parameters for the newly added channel:

  a. the channel must be active to view data from it

  b. you can choose any name for the channel, preferably indicative of its purpose

c. the appropriate type (LF/HF) must be indicated

d. enter the MAC address copied from the AV Sensor Manager in step 5.

e. the length of the raw signal should be 1 (1 second)

17. Click on the node 'Drivers' > 'ADI driver' > 'Network 1'and, in the 'Attributes' window, located in the lower right corner of the program, enter the parameters:

a. 'Communication port': '/dev/ttyS1' or '/dev/ttyS0' depending on the port used
S1 – for RJ45 port
S0 – for D-Sub DE-9 port

b. 'Bus speed': '1500000' (it is also possible to set the value 115200 or 500000, but the value 1500000 is the default and the best value)
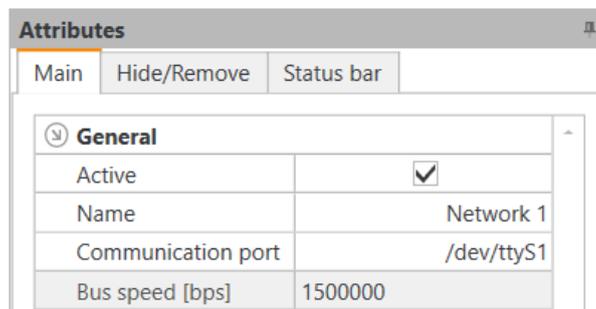
18. Go to the 'Machines' > 'Machine 1' > 'Channels' node, click on the 'Vibro channels' branch, and then the 'Add' button located in the top menu of the application. This will add the channel to the configuration:
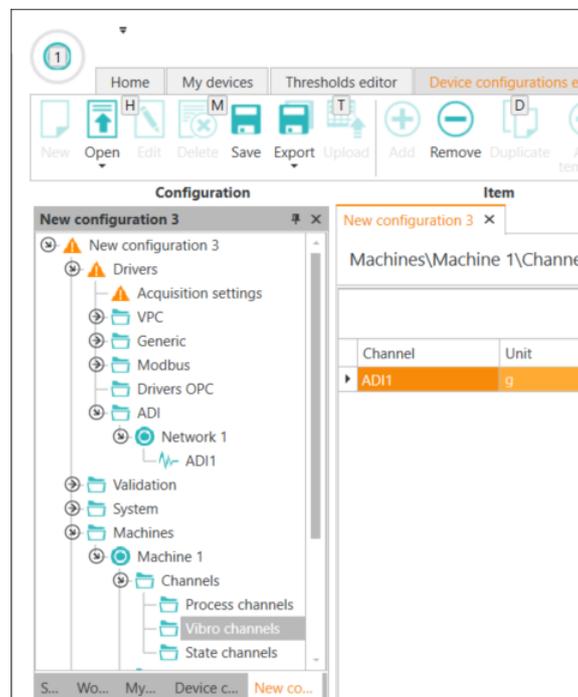
19. Go to 'Machines' > 'Machine 1' > 'Analyses' > 'User broadband analyzes' > 'ADI1' and click the 'Add' button as many times until all broadband analyses to be determined appear in the main application window

All available analyzes are shown in the figure below:

The 'Fragments' value should be set to 1 in each position.

Machines\Machine 1\Analyses\User broadband analyses\ADI1

Drag a column header here to group by that column

Active	Name	Algorithm	Fragments
✓	VRMS	VRMS	1
✓	0-P	0-P	1
✓	P-P	P-P	1
✓	Coeff-0-P	Coeff-0-P	1
✓	Avg	Avg	1
✓	RMS	RMS	1
✓	Crest	Crest	1
✓	Kurtosis	Kurtosis	1

After adding all the options, you can select the options that you are not interested in and then remove them using the 'Remove' button located in the top menu of the application:

If you have only one channel added to the 'User broadband analyzes' node or if we want to add the same broadband analyzes for all the channels there, you can click on this node and indicate the analyzes we are interested in using the tiles in the top menu of the application:

20. Navigate to 'Machines' > 'Machine 1' > 'Analyses' > 'User narrowband analyzes' > 'ADI1' and click 'Add' button

21. This will add a new, 'empty' narrowband analysis:

Analysis				Phase marker		Bands		Velocity HP Filter		Displacement HP Filter	
Active	Name	Physical value	Result	Speed channel	Envelope	Denomination	Bands	Active	Cutoff freque...	Active	Cutoff freque...
✓	Analysis 1	Acceleration	RMS		☐	Frequency	❗				

The 'Speed channel' field should always be left empty because we do not have a speed channel.

The 'Denomination' field should always be set to 'Frequency'.

In 'Bands' all ranges should be given in Hertz (Hz).

If we select a single value in the 'Bands' field instead of a range, the program defaults to a range of 3% of the given value. For example, for the value of 100 Hz, the range from 98.5 Hz to 101.5 Hz is taken.

After defining its parameters, further narrowband analyzes can be added to the configuration.

22. It is also possible to define alarm thresholds for both broadband and narrowband analyses. To do this, go to 'Machines' > 'Machine 1' > 'Limits' > 'User broadband limits' or 'User narrowband limits' ('User narrowband limits'), depending on the analysis for which the alarm threshold is to be defined and click the 'Add' button located in the top menu of the program

23. This will cause a new limit to appear in the main application window:

Active	State	Channel	Operator	Warning value	Alarm value	Hysteresis	Counter	Warning out channel	Alarm out channel
☑	[Unknown]	ADI1.VRMS	>	0	0	0	1		

After defining its parameters, further alarm thresholds can be added to the configuration

The 'Warning out channel' and 'Alarm out channel' fields concern advanced configuration and should remain empty by default.

24. After defining all device configuration parameters, click the 'Save' button located in the top menu of the program, in the 'Device configurations editor' tab, and then the 'Upload' button:
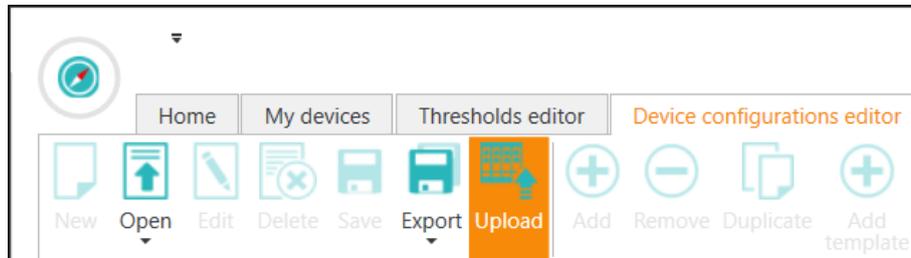
25. This will open the 'Upload configuration' window. Using the checkbox, select the appropriate AVM 4000 system and press the 'Upload' button, this will upload the configuration to the device:
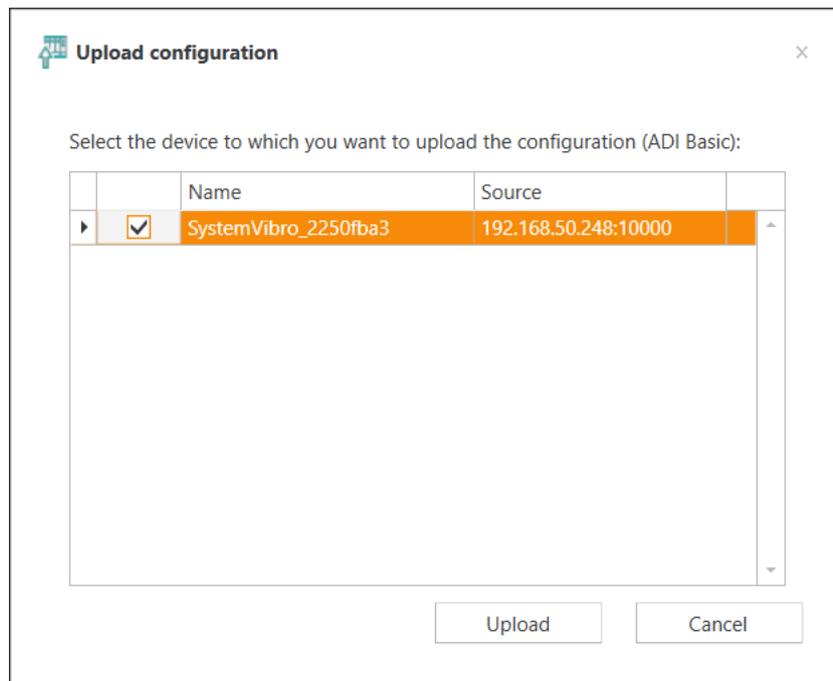
3.2 Modbus configuration

With the AVS 1003LF/1001HF sensors and VIBnavigator software, you can not only record and view raw vibration data but also analyze it. Additionally, the AVM 4000 system allows you to collect trends from the sensor via the Modbus RTU protocol. It is worth noting that you can receive either raw data or Modbus data from one sensor.

To get Modbus data:

1. Connect the sensor to your computer using the AVS USB CON adapter

PC → USB/USB C cable → AVS USB CON adapter→ sensor

2. Launch the AV Sensor Manager software
3. In the 'Device' tab, in the upper left corner of the application window, in the 'List of Serial Ports' section, select the appropriate port:
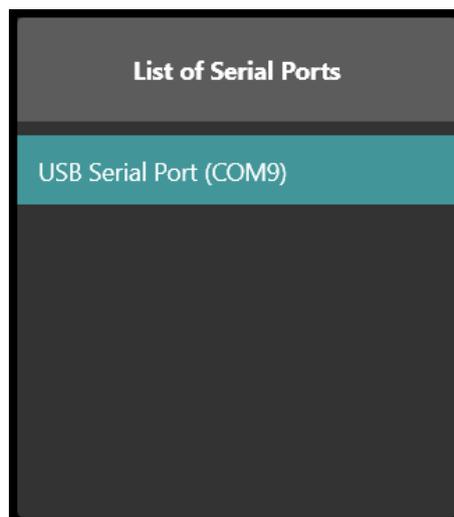
4. Click the 'Refresh' button located in the heading of the 'List of Devices' section, located in the lower left corner of the application window, and select the appropriate sensor (after it is detected by the software:
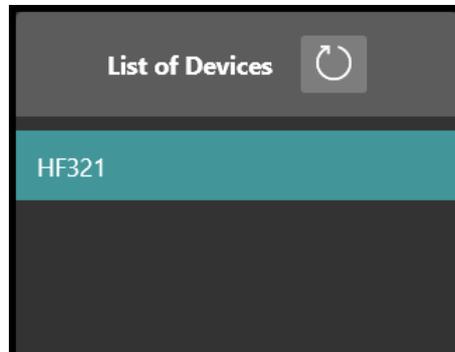
This will display the current sensor parameters in the main application window:
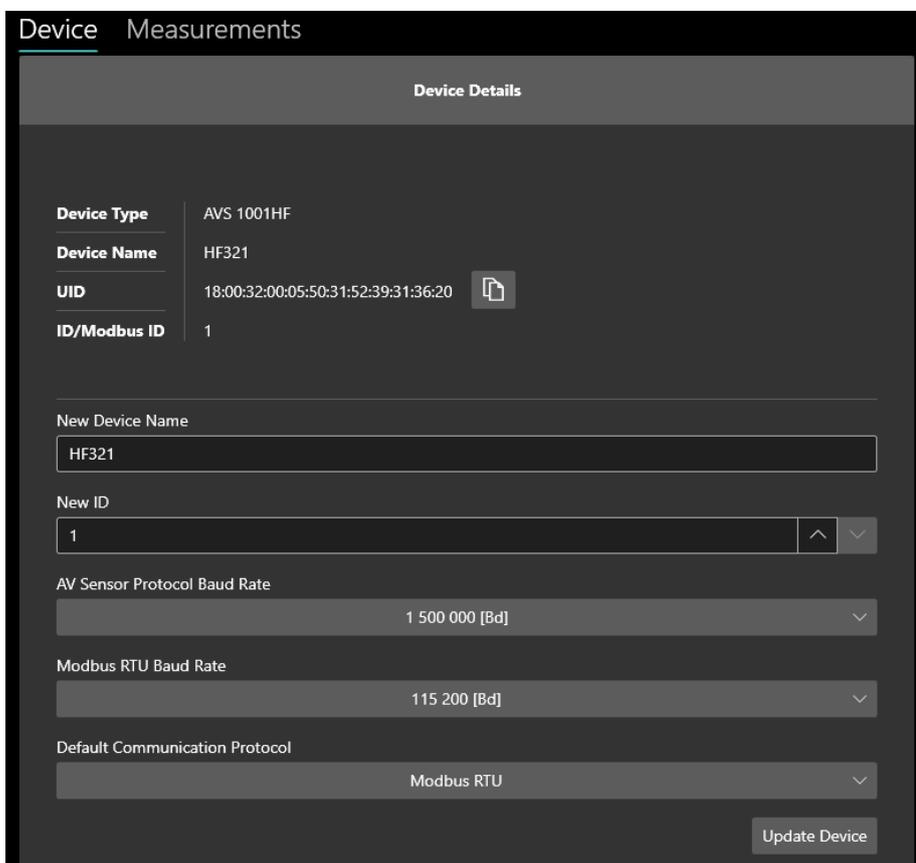
5. 'Default Communication Protocol' should be set to 'Modbus RTU'
6. Copy the 'ID/Modbus ID' value. The Modbus ID value can be changed in the "New ID" field and then saved via "Update Device"

7. Connect the sensor to the AVM 4000 system
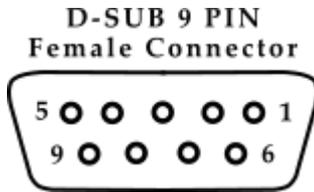
RS-485 Connector Pin number		Sensor cable Colours
3	RS485+	Brown
4	RS485-	Blue
5	GND	Black
-	+12 V	White

8. Connect the AVM400 system to the power supply
9. Change the IP of the Ethernet connection on your computer so that it is in the same subnet as the AVM 4000 system (the default subnet of the AVM 4000 system is 50):
   a. Go to 'Network & Internet Settings' on your computer
   b. Then to the Ethernet settings
   c. Select 'Change card options'
   d. Select the appropriate Ethernet connection
   e. Go to its Properties
   f. Select 'Internet Protocol Version 4 (TCP/IPv4)'
   g. Check the 'Use the following IP address' option and enter the appropriate values for 'IP Address' (the first three numbers matching the IP address of the AVM 4000 system) and 'Subnet Mask' ('255.255.255.0'):
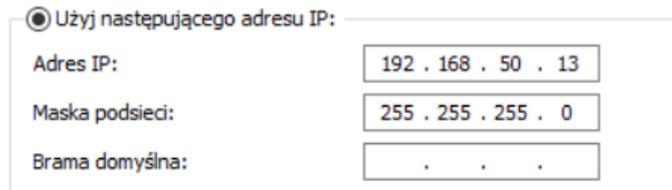
   h. Confirm with 'OK' in this and the next window and close the Ethernet connection settings
10. Launch the VIBnavigator software
11. In the 'My devices' tab, press the 'Scan' button:
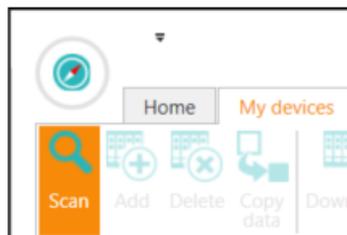
12. The searched device will appear in the 'My devices' list on the left side of the application window (marked in turquoise):

13. Double-click on the name of the found device, this will open the system configuration in the main application window

14. Go to the 'Drivers' > 'Modbus' > 'Master RTU' node, go to the 'Device configurations editor' tab and add a new device using the 'Add' button located at the top program menu, then click on the newly added node and in the "Attributes" window located in the lower right corner of the program, enter the parameters:

    a. 'Communication port': '/dev/ttyS1' or '/dev/ttyS0' depending on the port used

        S1 – for RJ45 port

        S0 – for D-Sub DE-9 port

Note: The ADI driver and the Modbus driver cannot be configured at the same time on the same port. If we have previously configured the ADI driver, use the second port or remove the ADI driver configuration.

    b. 'Bus speed': '115200'
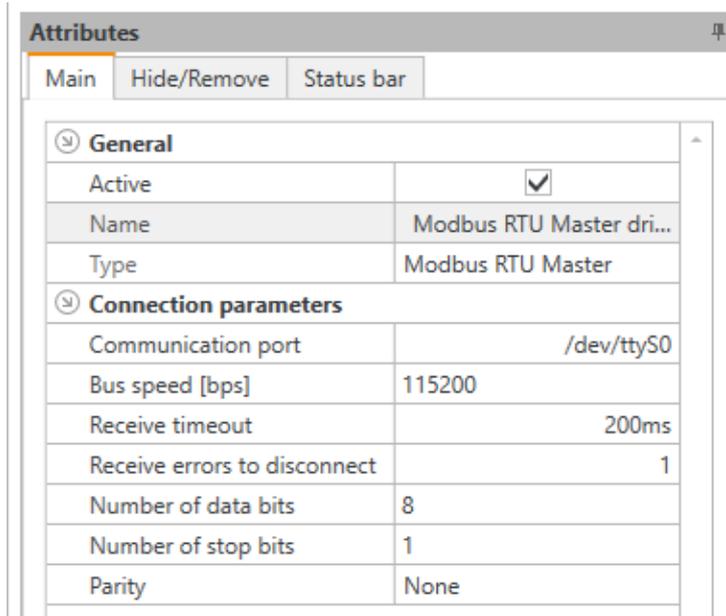
15. Click again on the newly added node and click the 'Add' button to add the register (it will appear in the main application window):
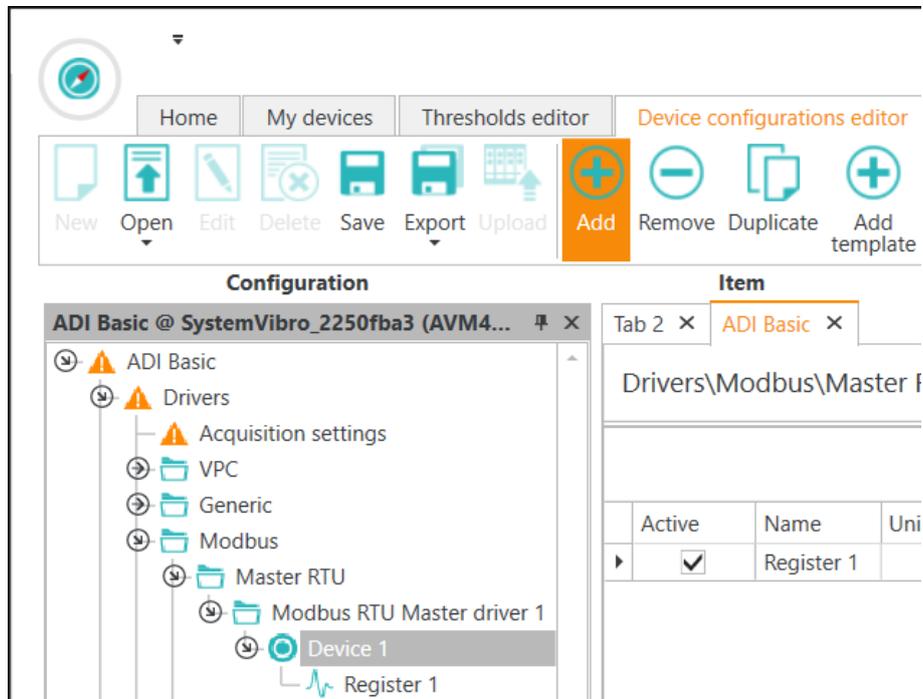
16. Click on the newly added node and in the "Attributes" window located in the lower right corner of the program, enter the parameters:
   a. 'Number' – enter the 'ID/Modbus ID' value copied from the AV Sensor Manager program
   b. Modbus registers merging' – set the value to '20'
17. Enter the parameters for the newly added channel:

Active	Name	Unit	Register	Bit number	Data type	Minimum	Maximum	Gain	Offset	Refresh	Expiration
✓	Register 1		100	0	uint16	0	65535	1	0	1000	5000

   a. the registry must be active to view data from it
   b. you can give it any name, preferably consistent with its intended purpose
   c. the unit depends on the analysis being defined
   d. the register number depends on the analysis being defined
   e. The register table is presented at the beginning of the document.
   f. 'bit number' – always 0
   g. data type ('data type') – float32
   h. the minimum value depends on the expected scope of the analysis, probably 0
   i. The maximum value depends on the expected scope of the analysis
   j. 'gain' – always 1
   k. 'offset' – always 0
   l. refresh interval ('refresh') [ms] – recommended value: 1000
   m. expiration time ('expiration') [ms] - time during which the last received value will be maintained, if the sensor query fails, after this period, if data is still not received, the user will receive empty values

18. After defining all device configuration parameters, click the 'Save' button located in the top menu of the program, in the 'Device configurations editor' tab, and then the 'Upload' button. : :
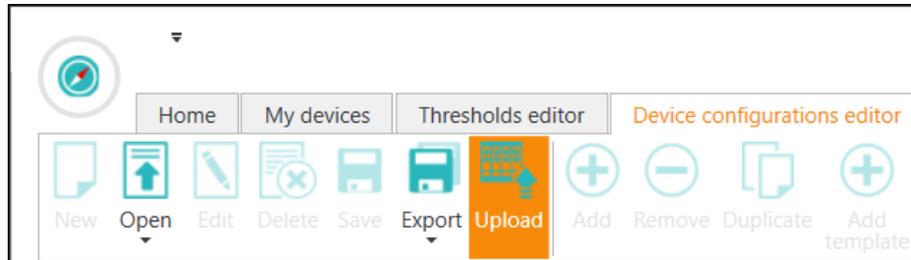
19. This will open a new 'Upload configuration' window, in which, using the checkbox, select the appropriate AVM 4000 system and then press the 'Upload' button, as a result of which the configuration will be uploaded to the device :
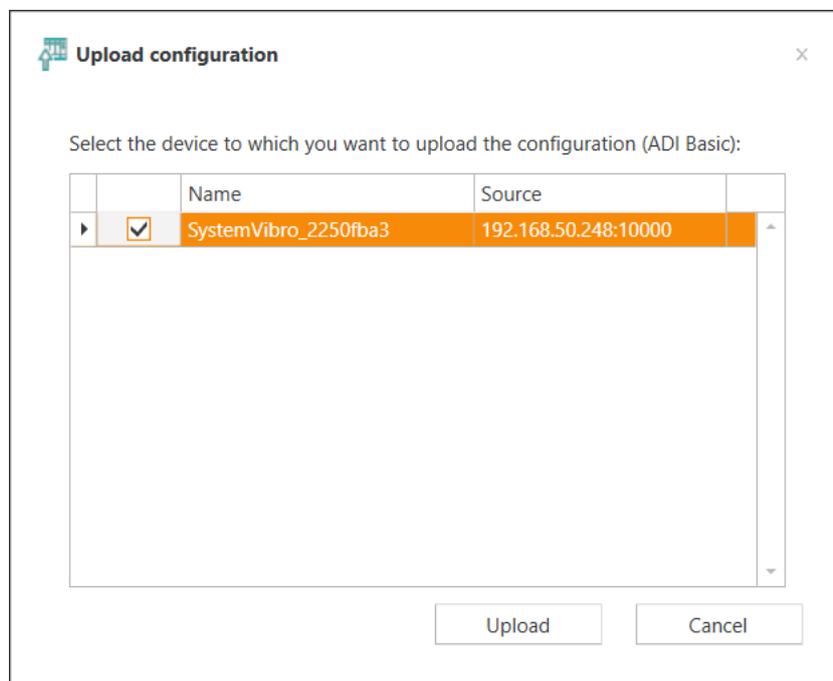
3.3 Data preview

To view data recorded by the AVM 4000 system:

1. Create a new folder on your computer where the recorded data will be saved
2. Go to the 'System' tab, located in the lower left corner of the VIBnavigator application window:

3. Click on the 'Connect to source' icon in the upper left corner of the 'System' section and select 'AVM 4000 file database':
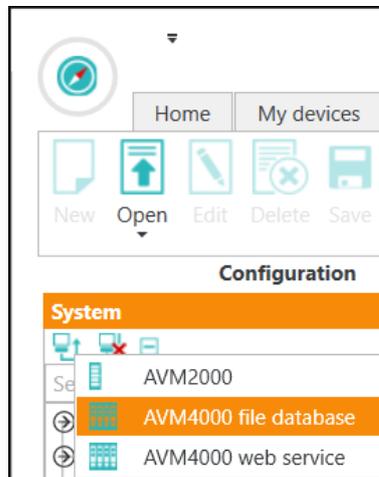
   4.
5. This will bring up a new 'Connect to AVM 4000 data source' window.
6. Enter the parameters 'Name', under which the AVM 4000 device will be visible in VIBnavigator, and 'Path', which is the address of the folder created in step 1, and press the 'Connect' button:

7. This will cause the system to appear in the 'System' tab tree, on the left side of the application window:
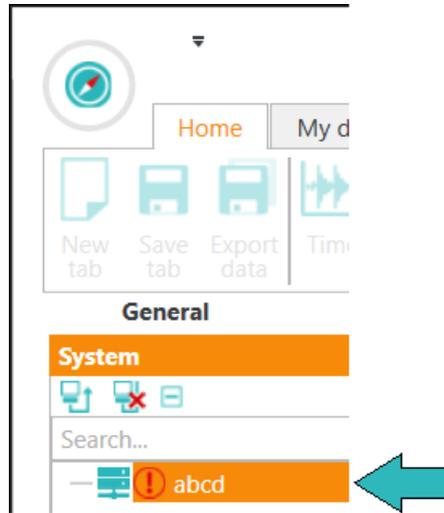
8. Click on the system name and go to the 'Attributes' window, located in the lower right corner of the program

9. Enter the parameters 'Address', the IP address of the AVM 4000 system and 'Port', where the value '10000' should be entered:
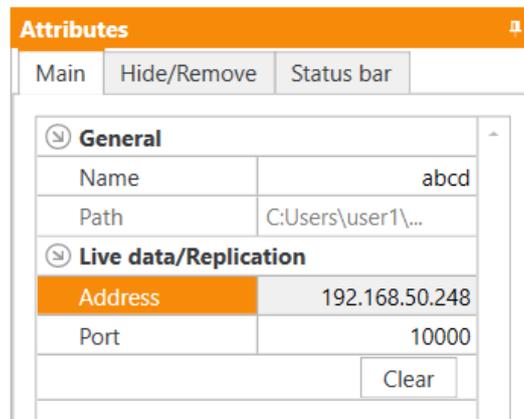
10. Return to the 'System' window, right-click on the system name and select 'Synchronize database':
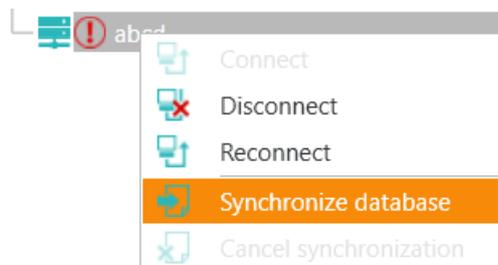
11. This will download the data stored on your device to your computer. It will also allow you to preview them in the VIBnavigator software:
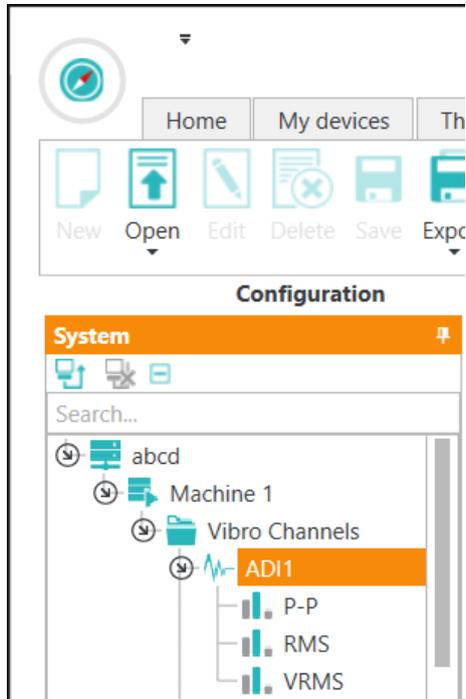
4. Digital vibration data

In this configuration, the sensors are used to read raw vibration data via a dedicated user application. Raw vibration signals are downloaded, so the user has the greatest freedom to tailor the analyzes to their needs. This is useful for laboratory applications and testing.
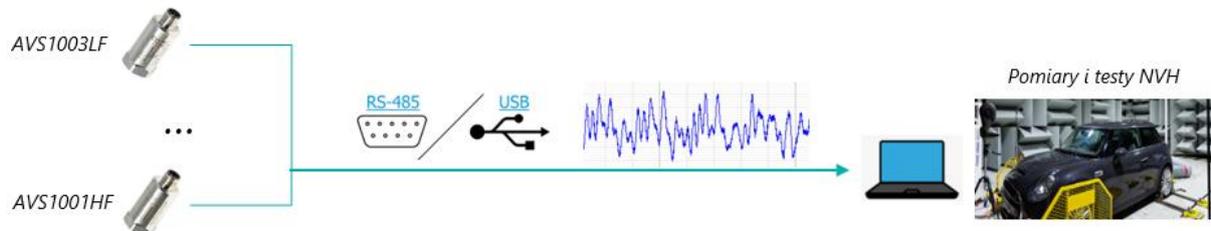
Cechy konfiguracji:

Direct digital data access

Easy expansion of digital sensors

Automatically switchable industrial or PC interface

Reliable data transmission up to 1km

Adjustable signal bandwidth

Automatic sensors mapping

![AMC VIBRO logo]

Dedicated software, **AV SENSOR Manager**, can be used to operate sensors in the described configuration. This process is described below, step by step:

1. Follow steps 1. – 4. from subsection 3.1
2. This will display the current sensor parameters in the main application window:
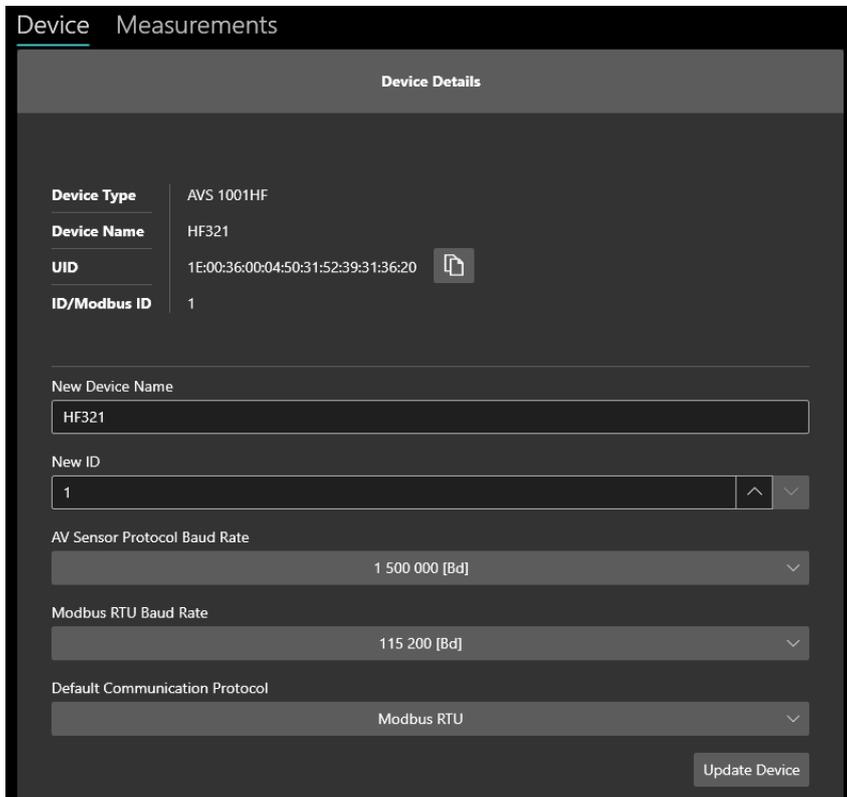
From here the user can change:

    a. sensor name ('New Device Name')
    b. sensor ID number ('New ID')
    c. 'Modbus RTU Baud Rate'
    d. 'Default Communication Protocol' – the sensor can operate either in the mode in which the user receives raw vibration data as an output ('AV Sensor Protocol') or in the 'Modbus RTU' mode

    The change of parameters must be confirmed by pressing the 'Update Device' button.

Parameters:

    a. 'Device Type'
    b. 'UID'

are read-only fields.

ΠΜΓ V I B R O

1. In the next step, the user can go to the 'Measurements' tab and view:
   a. the raw vibration signal, along with its spectrum
   b. values that are sent by the sensor using the Modbus RTU protocol

   To view:
   a. a raw vibration signal and its spectrum, press the 'Start reading' slider located in the 'AV SENSOR Protocol' section. When you are done, you can click the slider again.
   b. Modbus RTU values, press the 'Start reading' slider located in the 'Modbus RTU' section. When you are done, you can click the slider again.
   Data can also be saved to a file.