













WP4086 functionality (mk2 platform)

WP4086 mk2 toolbar


Whenever the WP4086 controller operated on the mk2 software (**WP4086 mk2**) is selected in the tree view, list view or on the Globe the **WP4086 mk2** toolbar will become visible at the top of the **SiteSelector** toolbar. The **WP4086 mk2** toolbar contains buttons for quick access to the **WP4086 mk2** commands. By clicking any of the buttons you activates a window enabling you to use certain sub-set of the **WP4086 mk2** functionality. Clicking the icons offered by the toolbar invokes opening of the following windows:

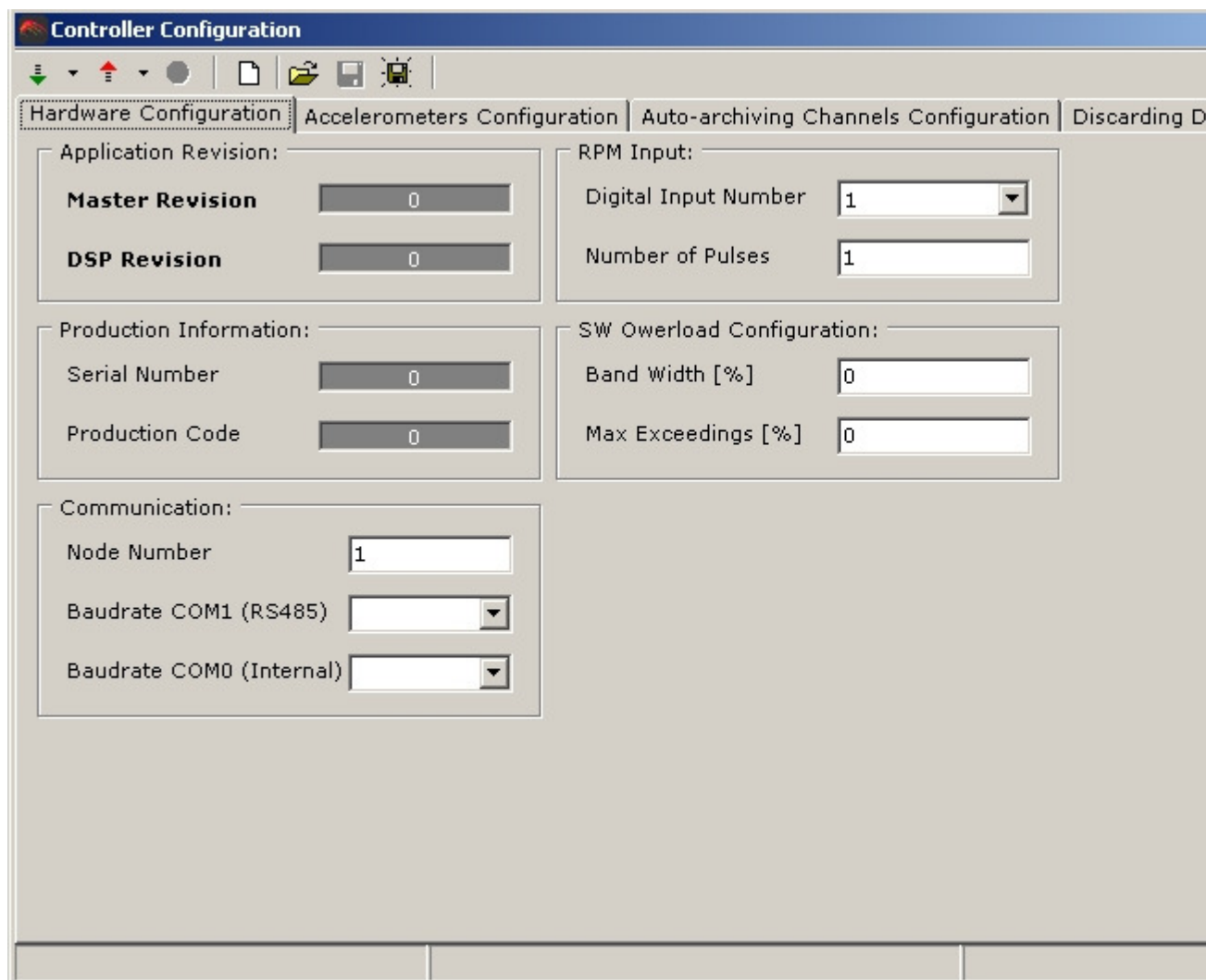
-  - **Controller Configuration.**
-  - **Hardware Calibration.**
-  - **DSP Status.**
-  - **Send Live Data.**
-  - **Accelerometer type setup.**
-  - **Production Information.**
-  - **Vibration Data Explorer.**
-  - **Measurement Search.**
-  - **Gain Estimation.**
-  - **Flash Memory Usage Statistics.**






Controller configuration





First, you have to set the hardware characteristics of the controller and the accelerometers. To do that, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data Panels** and eventually

choose **Controller Configuration** option. Alternatively, click  button from the **WP4086 mk2** toolbar. The following window will appear:



It contains four tabbed pages called **Hardware Configuration**, **Accelerometer Configuration**, **Auto-archiving Channels Configuration** and **Discarding Data-samples Configuration**. The toolbar common for all four pages consists of the following icons:

-  - Downloads current configuration from the controller. It is also possible to invoke the drop-down menu by clicking black triangle next to the icon. The menu offers you the possibility to download the entire configuration or the configuration of specific page. By default, on clicking the icon from the toolbar the configuration of currently active page is downloaded.
-  - Uploads current configuration to the controller. The drop-down menu called by clicking black triangle next to the icon allows you to upload either entire configuration or the configuration of specific page.
-  - Creates new configuration.

-  - Stops current operation.
-  - Loads configuration from the previously saved file.
-  - Saves current configuration into a file.
-  - Saves current configuration into another file.

In order to help you keep track of the changes made to the current configuration, the star sign appears before the name of the page on appropriate tab whenever any configuration property was changed.

Hardware Configuration

This page consists of the following boxes:

- **Application Revision** and **Production Information**. The fields in these boxes are filled in automatically when you download configuration from the controller.
- **Communication**. The fields in this box are also filled in automatically after downloading configuration from the controller, however they can be entered manually as well.
- **RPM Input**. In this box you have to specify tachometer settings and properties. In the **Digital Input Number** field enter the number of the input channel in the controller for streaming data from the tachometer. This number can be 1 or 2. In the **Number of pulses** field enter the number of sensors mounted along speed shaft perimeter.
- **SW Overload Configuration**. Certain memory space is reserved for digital representation of the input signals. Therefore, only values in limited range can be handled. In order to handle the overloading of this space properly, the settings can be made to generate warnings or alarms in the case of overloading. Namely, in the field **Max Exceedings** you specify the number (in percents of the total number of measured values) of exceedings of the value defined as $(100 - \text{bandwidth})\%$ of the maximum value the memory buffer can handle, where bandwidth is the value specified in the field **Band Width**. When conditions defined by Max Exceedings and Band Width values are satisfied an overload message is generated.

Accelerometers Configuration

This page contains information on the accelerometers settings. There are eight accelerometers available, which are divided into three groups. This division into groups is stipulated by the WP4086 hardware limitation on the possibility to control the anti-aliasing filters on the input channel. The WP4086 has only three lines for controlling anti-aliasing filters. Therefore, one line is used for controlling several filters at a time.



When you download configuration from the controller, the fields **Type**, **Max. Freq.** and **Sensitivity** are automatically filled in, using accelerometer characteristics defined in [Accelerometer Type Setup](#) window. The field **Sensitivity**, however, can also be edited manually. Drop-down menu of the **Type** combo-box contains a list of previously defined [accelerometer types](#).

In the field **Location** you can specify physical place on the unit where accelerometer is mounted while in the field **Measurement direction** you can specify the direction of the measurements which could be radial or axial.




If the system works properly the values of the gains of both amplifiers are adjusted automatically to assure maximum usage of the space of output (with respect to hardware) buffer thus keeping in mind further digital processing of the signal. Therefore, normally the box in the **Gain adjustment mode** field should be unchecked. However, if automatic adjustment mode is known to work improperly due to some reasons, you have to check the box. The **Manual mode** button next to it becomes active. Click the button and in the appeared window specify the gains.

Auto-archiving Channels Configuration

When this page is active the toolbar provides three additional functionalities presented by the following icons:

-  - Creates new archiver channel.
-  - Edits current channel properties. Editing can also be invoked by double click on the highlighted item.

-  - Deletes the channel.

At the **Auto-archiving Channels Configuration** page it is possible to define the settings making the controller store the data if certain specified conditions are met. It is possible to set 40 different conditions which means there are 40 channels reserved for archiving data. Each condition is a combination of the values of the wind speed, the number of rotor revolutions per minute and the power produced. To download from the controller the currently configured channels click  icon. The channel is active when the led in the leftmost column is bright green. You can make the channel active/inactive by a mouse click. To create new auto-archiving channel click  icon. To edit already configured channel click  icon. In both cases **Auto-archiving channel setup** window will appear where you can define archiving conditions. The window can also be invoked by double mouse click of the line correspondent to certain channel. Specify archiving conditions and click **OK**. Note that you can make current channel active/inactive by either the mouse click of the led in **Controller Configuration** window or marking/unmarking **Active channel** box in the **Auto-archiving channel setup** window.


Discarding Data-samples Configuration

When this page is active the toolbar provides additional functionality compared to common toolbar tools:



- Edits current configuration.

When configuring auto-archiving channels you specify conditions to be met in terms of such parameters as the wind speed, the rotor rotational speed and the power produced each falling into defined range. However, in some cases, for example, if any of these parameters changes too frequently the archived data are not valuable because they are not useful for analysis. In order to reserve controller's memory, if the values of either the wind speed or the rotor rotational speed or the power produced can be classified as undesired the data should not be archived. You can define these undesired conditions (for certain frequency range) in the **Discarding Data-samples Configuration**


page. Simply double click the line corresponding to certain frequency range (or click  button from the toolbar). In the merged window specify conditions in terms of mean crossing (MC) and average deviation (AVD) parameters.



Hardware Calibration

The principal role of the hardware block of the vibration analysis system is to filter required frequencies out of a signal from the accelerometer and amplify the signal to the level needed for analysis. Except mentioned amplification, which is an intrinsic part of any signal processing system and will be properly accounted for in further analysis, the hardware block should bring no changes to the signal. Unfortunately, these changes can still take place, for example due to sudden changes of outside temperature or humidity. To overcome this, the hardware block should be calibrated. For this purpose, a generator sends test signal to the hardware block and expected output value is obtained by appropriate choice of an calibration factor.

The page **Hardware Calibration** offers the tools to perform calibration. To open it, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data Panels** and eventually choose **Hardware**

Calibration option. Alternatively, click  button from the **WP4086 mk2** toolbar. The following window will appear:

HW SW	Acc.	value	frequency band	preamp. gain	postamp. gain	total gain	total scale
Group 1	01	1,9759 G	10000 Hz	1	1	1,00	5,00 G
	02	0 G	10000 Hz	1	1	1,00	5,00 G
Group 2	03	0 G	10000 Hz	1	1	1,00	5,00 G
	04	0 G	10000 Hz	1	5	5,00	1,00 G
Group 3	05	0 G	10000 Hz	1	8	8,00	0,63 G
	06	0 G	10000 Hz	1	1	1,00	5,00 G
	07	0 G	10000 Hz	1	1	1,00	5,00 G
	08	0 G	10000 Hz	1	1	1,00	5,00 G

Refresh SetCor

00000905

You can perform hardware calibration for each of eight accelerometers. For certain accelerometer, select frequency band and set to 1 the pre- and the post- amplification gains. Then send test signal from the generator to the input of hardware and check the value in the column **value** - it should exactly correspond to the value determined by accelerometer's sensitivity. For example, if the sensitivity is 0,5V/G and test signal is a sinusoid with the amplitude of 1V, then the value in **value** field should equal 2,0G (i.e., signal's amplitude divided by sensitivity). If it is not, adjust **HW calibration factor** properly in order to obtain the value of 2,0G. To apply new calibration factor value click **SetFactors** button (it becomes active whenever calibration factor is changed). To apply any changes made to either frequency band or amplifiers gains click **SetConditions** button.

Here you can change the frequency band or the gains just for calibration purposes. If you like to return to actual accelerometers settings click **Refresh** button. The frequency band and the gains values specified at **Accelerometer Configuration** page of [Controller Configuration](#) window will be displayed.

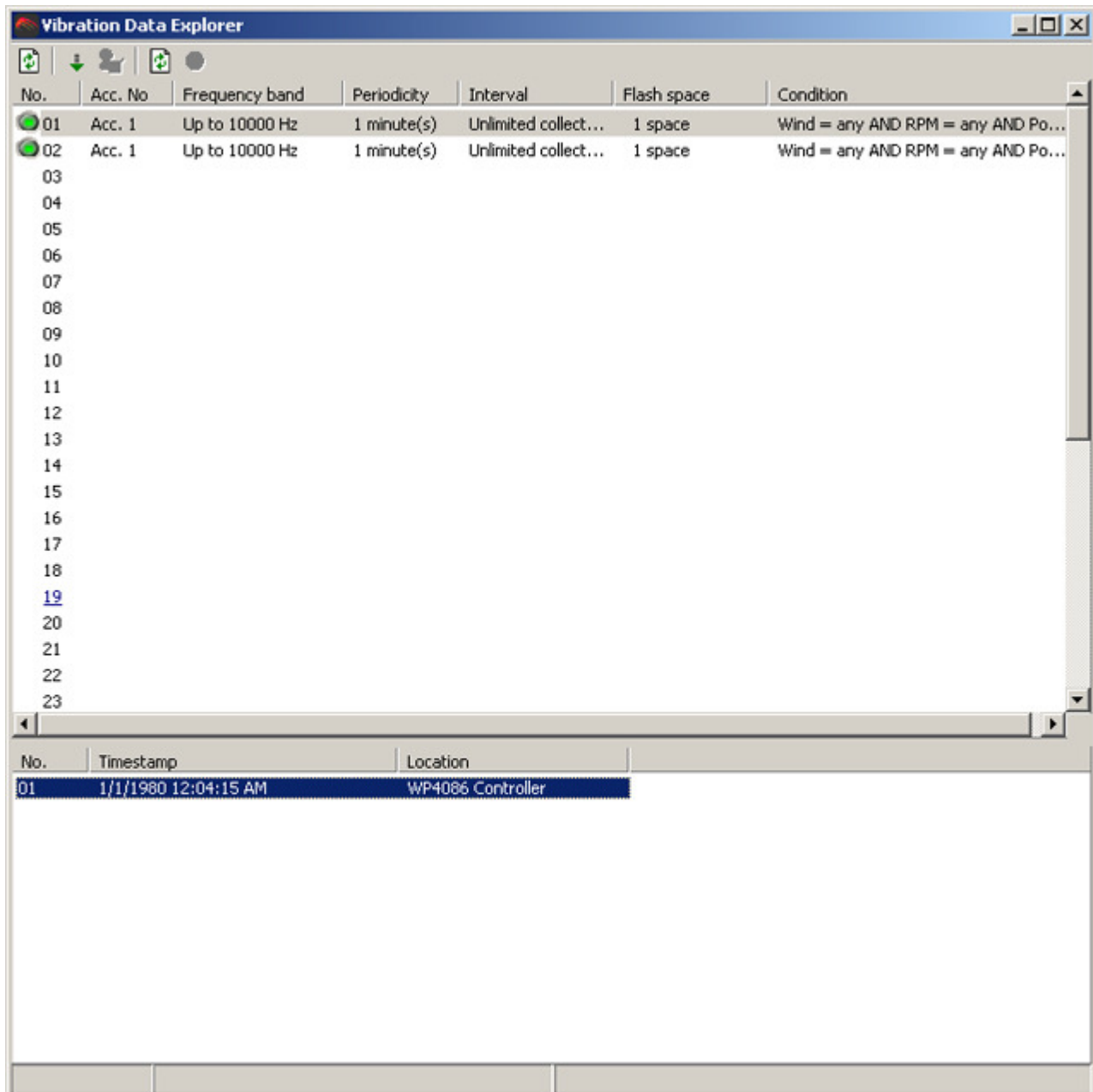
Two leftmost columns of **Hardware Calibration** window contain the leds indicating overload status. If there is no overload the led is bright green. In the case of an overload the led periodically becomes red. When hardware (**HW**) overload led is blinking red it means that the value of actual vibration signal is too high for the accelerometer to

handle it. If we set wrong values of the gains the system warns you about that by software overload (**SW**) led blinking red.






Vibration Data Explorer

At the **Auto-archiving Channels Configuration** page of the [Controller Configuration](#) window you define the wind speed, the rotor rotational speed and the power produced conditions to be satisfied for the signals archiving to launch. The **Vibration Data Explorer** window allows you to view these archived signals, both stored in a controller's memory and in Gateway database. To access this window, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data Panels** and finally choose **Vibration Data Explorer** option. Alternatively, click button from the **WP4086 mk2** toolbar. The window will appear:




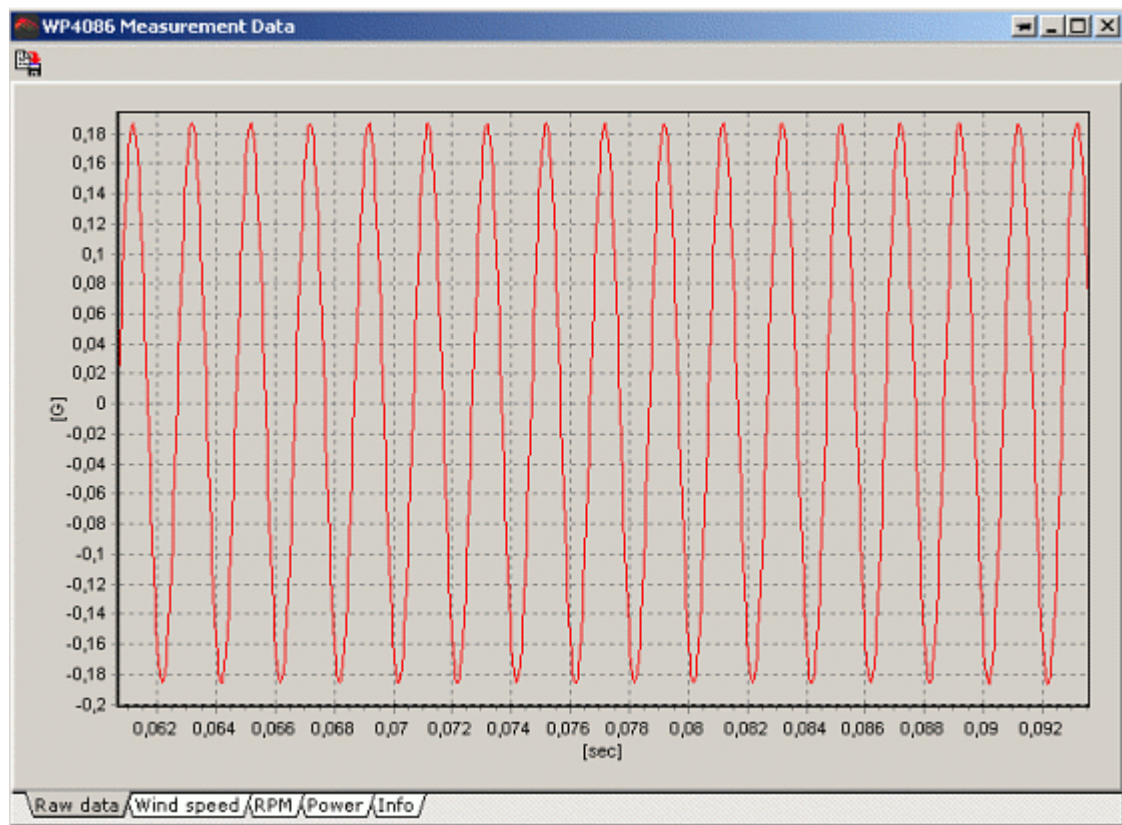
The toolbar consists of five icons offering the following functionalities:

- - (leftmost icon) Refreshes data on auto-archivers settings
- - Downloads the signal associated with selected timestamp

-  - Shows the signal stored in database
-  - Refreshes timestamps of selected auto-archiever
-  - Stops current operation



The upper part of the window contains the list of auto-archievers with their settings and archiving conditions. Click the line correspondent to certain auto-archiever. The list of timestamps of archiving for selected auto-archiever will be displayed in the lower part of the window. The maximum number of timestamps is determined by the number of flash spaces reserved for the auto-archiever. To view the signal associated with certain timestamp double click

appropriate line in the lower part of the window. Alternatively, first click the line and then click  button from the toolbar. The **WP4086 Measurement data** window will appear.



It allows you to view in graphical format the raw signal as well as changes of the wind speed, the RPM and the power clicking appropriate tab at the bottom of the window. Additionally, you can view the values of all important parameters (accelerometers settings, mechanical characteristics of wind turbine operation, etc.) at the moment of archiving clicking **Info** tab. It is also possible to save measurement data clicking the icon on the toolbar.


Each opening of the **WP4086 Measurement Data** window is accompanied by automatic writing into Gateway's database the data associated with selected timestamp. In the **Vibration Data Explorer** window it is reflected by appropriate record in the **Location** column. If the signal has not been viewed, the **Location** column would contain

WP4086 controller record. To view the signal stored only in the controller's memory click  button whereas to view the signal stored in database click  button.



Measurement search

While [Vibration Data Explorer](#) allows you to view archived signals stored both in controller's memory and in Gateway database, the **Measurements search** offers you searching tools to look for and view the signals stored in Gateway database and satisfying various criteria, in particular, time of measurement and values of such principal parameters as wind speed, speed shaft revolutions per minute and produced power. To open **Measurements search** window, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data**

Panels and eventually choose **Measurement search** option (alternatively, click  button from the **WP4086 mk2** toolbar).

Measurement Search

Controller

Accelerometer: 1

Frequency band: ignore 10 Hz

Timestamp: above Date: 25-10-2005 Time: 00:00:00

RPM [rpm] Power[kw] Wind speed [m/s]

Mean: ignore

Peak to peak: ignore

Search1

Search criteria

Acc = 1 and Time stamp > 25-10-2005

Controller name	#	Time	Frequency band	RPM mean	Wind speed...
New Unit 1	1	26-10-2005 10:1...	10000	0	0
New Unit 1	1	26-10-2005 10:3...	10000	0	0

Select columns data

☒ RPM min ☐ RPM max ☐ Wind speed min ☒ Wind speed max ☐ Power min ☐ Power max

Search

Found 2 element(s)



The upper part of the window serves for defining search settings.

The **Controller** field asks you to enter in correspondent boxes a number of the accelerometer to perform search on as well frequency range and timestamp. Drop-down list of the **Frequency band** field offers two options: ignore and equals whereas that of **Timestamp** contains two additional options - above and below. Functionalities of these options are obvious.

The field below invites you to specify the values of speed shaft revolutions per minute (RPM), produced power in kW and wind speed in m/s. As the searching criteria you can define mean or peak to peak value of mentioned parameters. Appearance of additional boxes next to **Mean** and **Peak to peak** fields for entering **min** and **max** values is determined by the option selected from the drop-down list.

Having specified the search criteria click **Search** button. The **Search criteria** window displays a summary of the search settings specified above. Below this window the results of the search are presented. Normally, the search result window is arranged in columns defining controller's name, accelerometer number, timestamp, frequency band as well mean values of RPM, wind speed and power produced, however, minimum and maximum values of these parameters can be displayed by checking correspondent boxes in **Select columns data** window. Double click the line in the search result window to view the signal and associated information in the **WP4086 Measurement Data** window. (See [Vibration Data Explorer](#)).

The **Measurement search** toolbar offers the following tools:

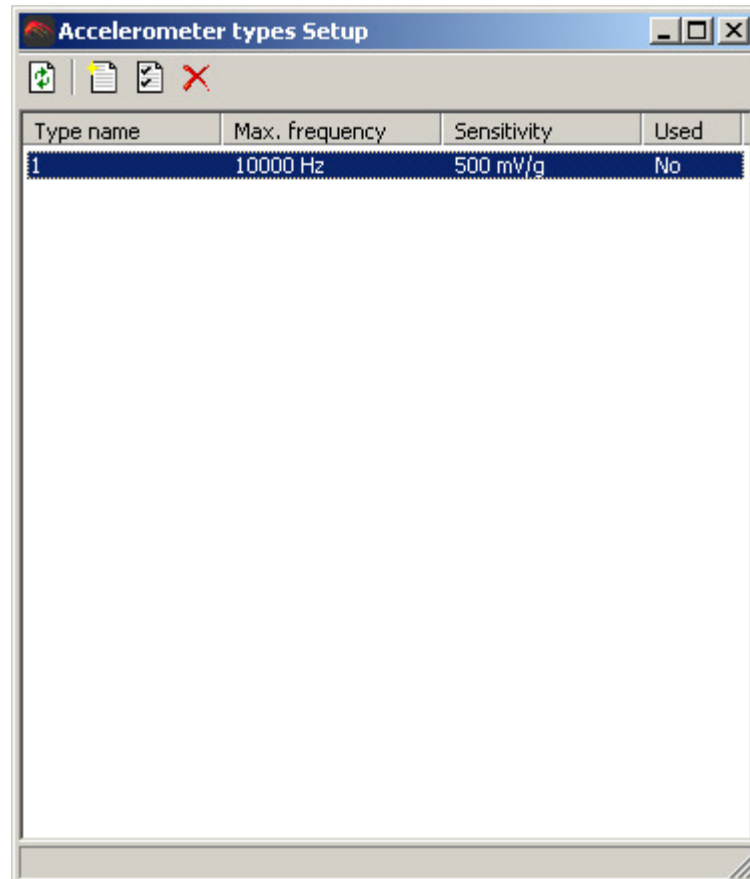
-  - It is possible to define several sets of search criteria. Click this button and define new search set. You can skip between different searches by clicking the **Search** tab with correspondent number.
-  - deletes current search tab.



Accelerometer type setup

To define characteristics of the accelerometer, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data Panels** and eventually choose **Accelerometer Type Setup** option.

Alternatively, click  icon from the **WP4086 mk2** toolbar. The window will appear:




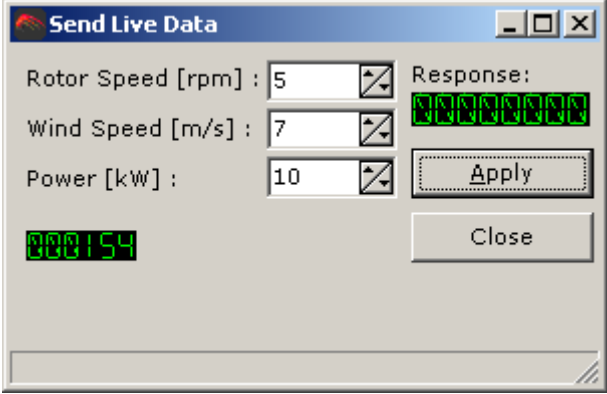
It contains a list of the previously defined accelerometers, each entry in the list consisting of accelerometer's **Type Name**, **Max. frequency**, **Sensitivity** and whether it is active or inactive (values **Yes/No** in the field **Used**). The toolbar of the window has icons allowing to *refresh* the list, *create* new accelerometer, *edit* current accelerometer as well as *delete* accelerometer. Each icon's functionality is displayed when mouse is placed on it. Whether you decide to *create* or *edit* accelerometer clicking correspondent icon (or double clicking appropriate line from the list), the same window will be opened inviting you to specify accelerometer's type, its maximum frequency and sensibility. Note that you are allowed to edit only those accelerometers which are not currently in use (it is a case when value of the field **Used** is **No**).



Sending test data

The **Send Live Data** form is designed for testing purposes. When the WP4086 controller is not connected to a unit controller you can send to the WP4086 power production data from the PC. The window is activated

when you press the  button on the WP4086 tool bar.



Send Live Data

Rotor Speed [rpm] : 5

Wind Speed [m/s] : 7

Power [kW] : 10

Response: 00000000

000154

Apply

Close

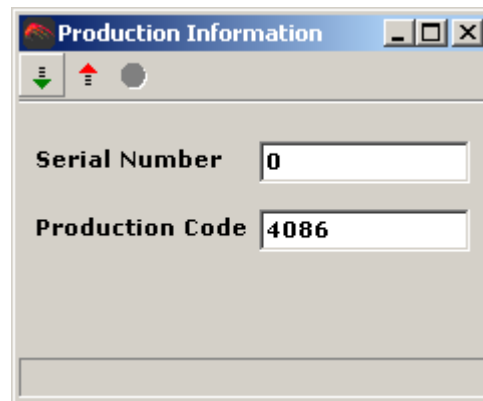
Enter the values and click **Apply** button.






Production information

Information about controller's production code and serial number is displayed in the **Production Information** window. To open it, from the **SiteSelector** toolbar select **Show** then **Retrieve Unit Data** then **WP4086 MK2 Data Panels** and eventually choose **Production Information** option. Alternatively,

click  icon from the **WP4086 mk2** toolbar.



You can download information from the controller using  button or upload it to the controller using  button. Also you can stop current operation by clicking  button.



DSP Status

The DSP status Panel is accessed by selecting the **Show** option of the main menu, then **Retrieve Unit**

Data, WP4086mk2 Data Panels and finally **DSP Status** or by clicking on the  icon on the tool bar.

This panel allows a user to see the status of the process. The **DSP Mode** field shows one of the three possible modes of the controller:

- Setup - when the controller's main parameters are being set up;
- Calibration - when the hardware is being adjusted;
- Standard - when the controller is in the process of normal operation.

The program requests data from the controller with a certain frequency. The counter in the top right hand side of the panel shows the number of such requests and every time a new request is made the number increases by one. If for some reason the program fails to connect to the controller or receive a new data the number will not increase and a message indicating an error code will appear in the bottom part of the panel.

Further down on the panel a list of accelerometers appears with four properties being either active or inactive. The properties are as follows:

- Attached - if active indicates that the accelerometer was configured. Does not indicate a physical presence of the accelerometer;
- Hardware overload - if active indicates that the signal was beyond the set limits because of some hardware inconsistency;
- Software overload - if active indicates that the signal was beyond the set limits because of the way it was processed;
- Fallen off - if active indicates that the accelerometer is not physically present.

The next two entries indicate the status of two flash memory devices of the controller with two possible options - green if the flash is functional and red if not.

When the controller is powered the previously set up parameters are being read from its memory and applied. If this process was successful the green indicator next to **DSP configuration parameters state** will appear. If not, the default parameters will be loaded in the controller and the red indicator will be shown.


Three streams of data - wind speed, rpm and power are continuously being fed into controller and a green indicator is lit next to **Live Data Source** entry. If for some reason the controller stops receiving these data the green indicator changes to red.

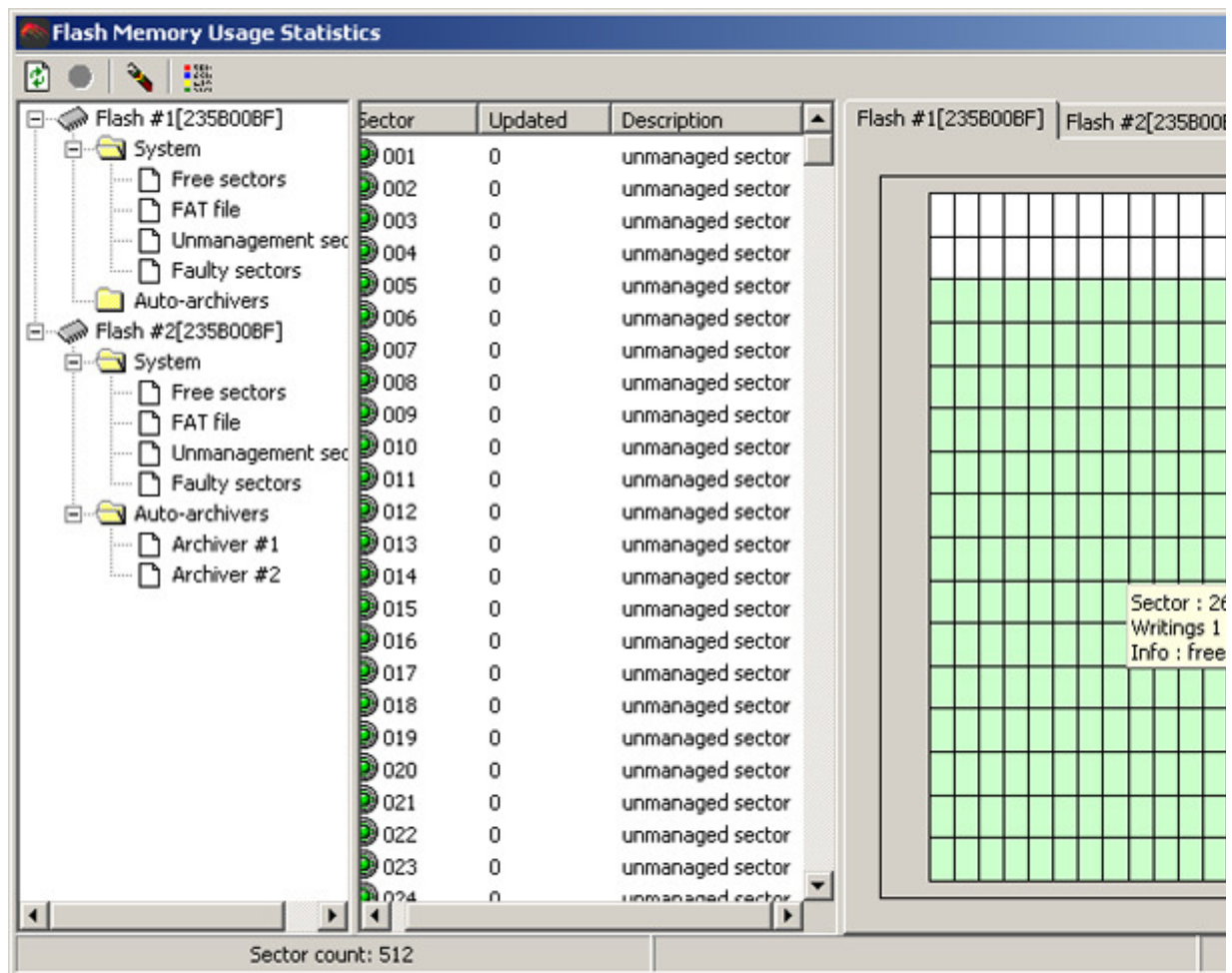
Another stream of data, coming from the **Tacho Generator** also represents rotational speed of the rotor but is more precise and updated more frequently than **Live Data Source**. The green and red indicators show whether the **Tacho Generator** is functional or not, respectively.



Flash Memory Usage Statistics

The WP4086 controller is equipped with two flash memory devices. The first flash is used for storing the WP4086 boot program, application program and configuration parameters. The second flash serves as a short-term storage for signal analysis results: Baseline FFTs and raw data signals produced by the Auto-archiving channel and logs produced by the Comparison channel. Because the WP4086 writes to the second flash quite often, it can stop working properly in comparatively short while unless certain remedy is involved. To ensure the optimal lifetime of the second flash the WP4086 controls it in a special way. In particular, the software prevents each sector in the flash from being updated more frequently than once in 30 minutes. Furthermore, the WP4086 program keeps track of the number of writings in each sector. This

information is available for the users. To view the flash usage statistics press the  button on the WP4086 tool bar. The following window will appear:



The **Flash memory usage statistics overview** window is composed of three views: the tree view, the list view and the flash memory map.

The **tree view** displays the distribution of the memory for different purposes. Each node in the tree represents some memory domain. The **System** node represents unused and internally used memory. The **Comparators** and **Trends** nodes represent memory domains allocated for comparison and trend channels correspondingly. Branches of the tree are the sub-domains of the parent domain.

The **list view** enumerates sectors used by the memory domain selected in the tree view. It arranges information about a sector in three columns:

- **Sector.** Shows sector number.





- **Updated.** Shows number of writings into the sector.
- **Description.** Describes the type of information stored in the sector.

The memory **map** represents each flash sector as a coloured rectangle. The colour of the sector depends on the number of writings into that sector. Besides, the more frequently a sector is used within the limits given below the more saturated its colour is. There are three colour zones:

- **Green.** If there were from 1 to 90000 writings.
- **Yellow.** If there were from 90001 to 99000 writings.
- **Red.** If there were from 99001 to 100000 writings.

Clicking certain item in the **tree view** causes appropriate adjustments in the **list view** and **map**, namely the **list view** displays numbers of the sectors allocated for this item and number of writings to them, while the **map** visualizes this information. Two tabs in the map window allow a user to switch between the first and second memory map.

The toolbar at the top of the window offers the buttons for quick access to the following commands:

-  - Refresh an overview.
-  - Cancel currently active operation.
-  - Reset flash usage statistics (set number of writings into each sector to 0). This command is available only for the user with the **Configurer** access rights.
-  - Switch on/off colour legend on the memory map.

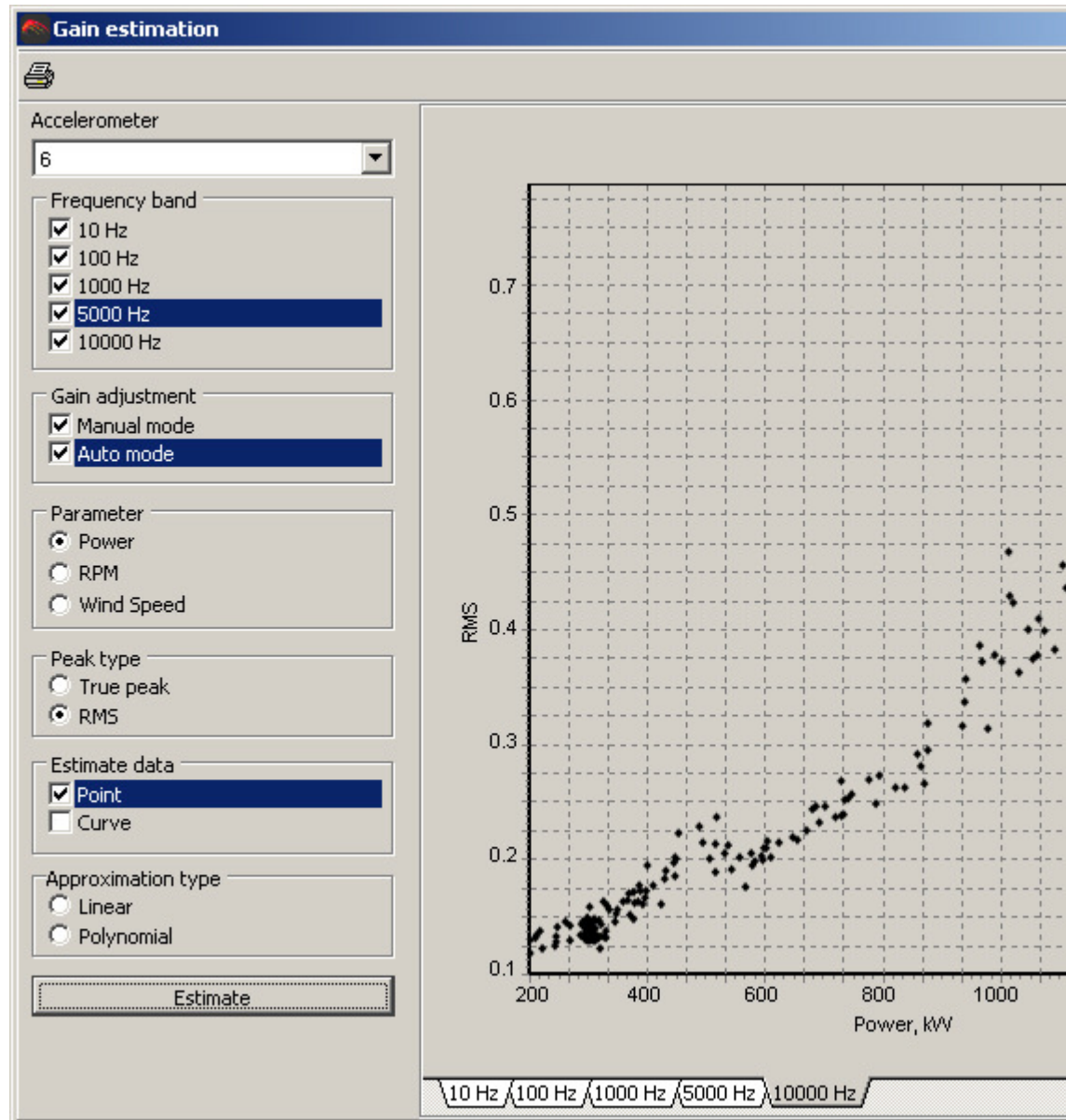


Gain Estimation

The Gain estimation panel is accessed by selecting the **Show** option of the main menu, then **Retrieve Unit Data, WP4086mk2 Data Panels** and finally **Gain estimation** or by clicking on the



icon on the tool bar.



This panel allows a user to estimate the calibration coefficients that should be applied to the signal. It bases its calculations on the results from the database, collected during certain period of time.

The left hand side of the panel represents different kinds of user definable parameters. In the right hand side of the panel the graphical representation is shown.

In the top left hand side a required **accelerometer** should be chosen from a drop-down menu. Then a user can choose a desired **frequency range**. It is possible to choose several frequency ranges by ticking appropriate checkboxes. To view a graph for a desired frequency range a required tab should be chosen in the bottom of the right hand side panel.

Next a **manual, automatic** or both modes could be selected by ticking required check boxes - it

allows to see signals the gains for which were entered manually or calculated automatically, or both types of signals respectively. Further down the parameters which are going to be graphically represented are chosen. It is possible to see the change of the **signal's peak** or its **root mean square** with the change of **power, wind speed** or **rpm**. The selected data will be represented as a set of **points** or a **graph**, or both. If the desired output is a curve then either a linear or polynomial approximation method could be selected.