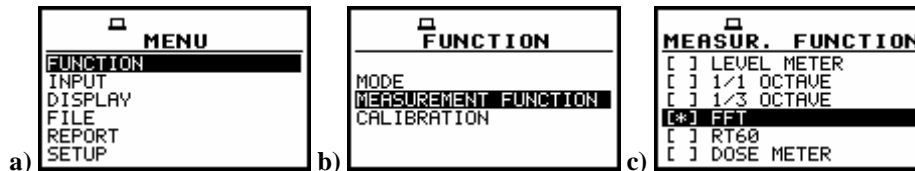


11 FFT ANALYSER

In order to select the **FFT** analysis mode the user has to enter the **FUNCTION** list by pressing the **<MENU>** push-button, selecting by means of the **<▲>**, **<▼>** (or **<<<>**, **<>>>**) the **FUNCTION** text and pressing the **<ENTER>** one. Then, the user has to open the **MEASUREMENT FUNCTION** window and press the **<ENTER>**. The **FFT** mode is selected by placing the special character in the line with the **FFT** text using the **<▲>**, **<▼>** (or **<<<>**, **<>>>**) push-buttons. After placing the character in the line with the **FFT** text the user has to press the **<ENTER>** push-button, which closes the **MEASUREMENT FUNCTION** window and confirms the selection. After pressing the **<ESC>** push-button the window is also closed but **any changes are ignored**.



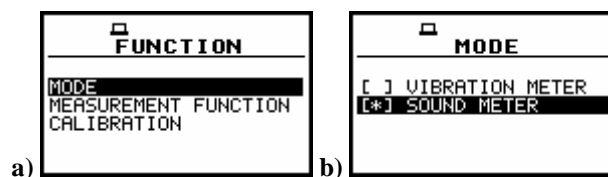
Main list with **FUNCTION** text selected (a), **FUNCTION** list opened with **MEASUREMENT FUNCTION** text selected (b), **FFT** analysis mode selected in **MEASUREMENT FUNCTION** window (c)



Notice: *It is not possible to change the mode during the execution of the measurements. It is possible to open different lists and windows but the positions in these lists are not displayed inversely and so - not accessible. The "Loudspeaker" icon indicates that the instrument is in the measurement process. In order to change the mode the measurement must be finished!*

11.1 FFT analyser of acoustic signal

In order to select the sound mode the user has to enter the **FUNCTION** window by pressing the **<MENU>** push-button, selecting by means of the **<▲>**, **<▼>** (or **<<<>**, **<>>>**) the **FUNCTION** text and pressing the **<ENTER>** one. Next, the user has to open the **MODE** window (to select the **MODE** text using the **<▲>**, **<▼>** or **<<<>**, **<>>>** push-buttons and press the **<ENTER>** one, when this text is displayed inversely).



FUNCTION list with **MODE** text selected (a); **SOUND METER** mode selected (c)

In the **MODE** window, the user can select the type of input signal, which has to be measured or analysed by the instrument. In the case of acoustic signals, the **SOUND METER** option should be selected by placing the special character in the line with the **SOUND METER** text. The position of the character can be changed using the **<▲>**, **<▼>** (or **<<<>**, **<>>>**) push-buttons. After placing the character in the line with the **SOUND METER** text the user has to press the **<ENTER>** push-button, which closes the **MODE** window. The **MODE** window is closed ignoring any changes made in it, after pressing any time the **<ESC>** push-button.

The instrument's operation as the **FFT** analyser is similar to the **SLM** mode. The narrow-band analysis (**FFT**) is performed in parallel to the level meter mode, in the real time with the **Z**, **A** or **C** weighting filter (**DC** input option is also possible). The spectrum is linearly averaged with the **HANNING**, **RECTANGLE**, **FLAT TOP** or **KAISER-BESSEL** time window. Additionally, the **TOTAL RMS** value for the full frequency range is displayed.



Notice: The **TOTAL RMS** result is measured with the weighting filter selected in the **FFT** window, which can be different than the **SLM** profiles settings. The **spectra are always linearly averaged**. Thus, the **TOTAL** value from the **FFT** analysis is usually different from those obtained for the **SLM** profiles (if the **RMS INTEGRATION** (path: MENU / SETUP / RMS INTEGRATION) was set as **EXPONENTIAL**).

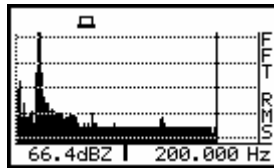
As the **FFT** analyser, the instrument operates in two input ranges: **LOW (RMS (A)** from **25.0 dB** to **125.9 dB**; **PEAK** from **59.0 dB** to **128.9 dB**) and **HIGH (RMS(A)** from **36.0 dB** to **142.9 dB**; **PEAK** from **72.0 dB** to **145.9 dB**), which can be selected in the **MEASUREMENT RANGE** window (path: MENU / INPUT / MEASUREMENT RANGE). In order to change the mode of the measurement results presentation (path: MENU / DISPLAY / DISPLAY MODES) the user has to press the **<▲>** or **<▼>** push-buttons. The following modes are available: **One profile**, **SPECTRUM**, **3 PROFILES**, **STATISTICS**, **LOGGER** and **FILE**.

One Profile, **3 PROFILES** and **LOGGER** display modes are identical as for the **SLM**. The **SPECTRUM** mode displays the narrow-band (**FFT**) analysis results (so-called spectrum) together with the **TOTAL RMS** value measured with the **Z** weighting filter.



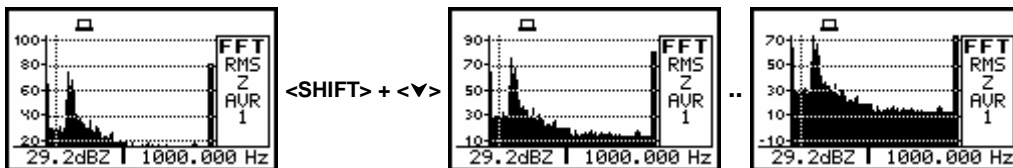
Notice: The user can select the number of the currently active modes of the measurement results presentation switching on (**[√]**) or off (**[]**) the given mode in MENU / DISPLAY / DISPLAY MODES window. Only one profile mode **cannot be switched off** (cf. the description of the **DISPLAY** list for the details).

The read-out of the interested spectrum value can be done by means of the cursor controlled by the **<◀>**, **<▶>** push-buttons. On the right side of the bottom of the display the selected frequency (or the **TOTAL**) is given, the numerical value and the units (**dB A**, **dB C** or **dB Z**) are on the left side of the bottom of the display.



Spectrum of narrow-band (FFT) analysis

In the **SPECTRUM** mode it is possible to shift the horizontal axis in relation to the vertical one of the presented results using the **<SHIFT>** and **<▲>** or **<SHIFT>** and **<▼>** push-buttons. After each pressing of these buttons the presented picture moves 10 dB down or up - respectively.



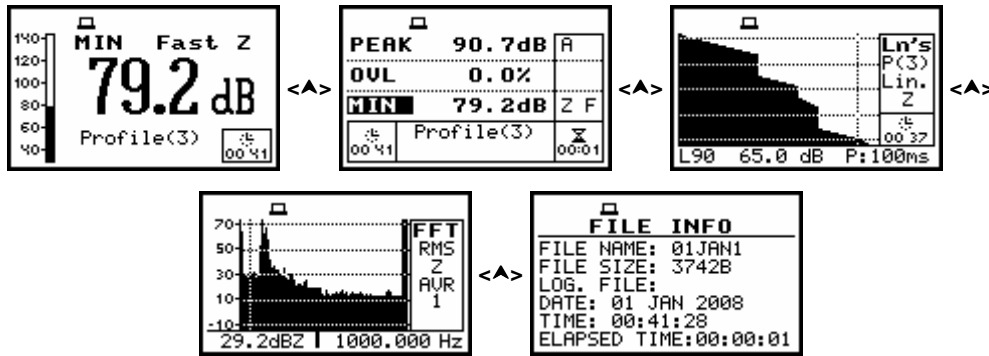
FFT analysis with the shifted horizontal axis in relation to vertical one

In the **SPECTRUM** mode it is also possible to change the view by pressing **<ALT>** + **<▲>** or **<ALT>** + **<▼>** push-buttons.

In the **LOGGER** presentation mode the results are presented which are logged from the profiles (in the case when the **LOGGER** is switched on and one or more of the **LOGGER** results are selected to be recorded in the **PROFILE x** windows) with the step set for all profiles in the **LOGGER STEP**. The active profile is changed after pressing the **<▲>** or **<▼>** push-buttons. The position of the cursor can be changed after pressing the **<◀>**, **<▶>** push-buttons. It is also possible to shift the horizontal axis in relation to the vertical one of the presented results using the **<SHIFT>** and **<▲>** or **<SHIFT>** and **<▼>** push-buttons (similarly as it has to be done in the **SPECTRUM** mode).

In the **STATISTICS** mode it is possible to select the **LN** value using the <<>, <>> push-buttons. The active profile, RMS integration and indicator of the weighting filter are displayed on the right side of the display. The **LN** corresponding to the current position of the cursor, its value and the unit are displayed on the left side of the bottom of the display. When the **STATISTICS** mode of result's presentation is entered (the <▲>, <▼> push-buttons are used for this purpose) in order to change the active profile <SHIFT> and <▲> or <SHIFT> and <▼> push-buttons should be pressed.

In **FILE INFO** mode it is possible to view information about the file the results are saved in: name of the file (**FILE NAME**), size of the file (**FILE SIZE**), in the case the data were logged - name of the logger file (**LOG. FILE**), date and time of saving measurement results (**DATE, TIME**) and period during which the main results saved in the file were measured (**ELAPSED TIME**).



Displays in FFT analysis

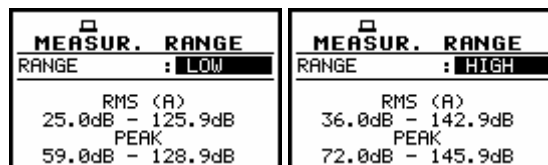


Notice: The narrow-band frequency analysis (FFT) is performed in the real time with the sampling frequency equal to 48 kHz, using so-called "overlapping" technique which scale depends on the selected band of analysis. Because of the small size of the unit's display only 100 values of the FFT spectrum are presented simultaneously on the display. The resolution of the presented spectrum can be increased by two after each pressing of the <SHIFT>+<<> push-button and decreased by two after pressing the <SHIFT>+<>> push-button. The resolution of the presentation can be increased in such way 16 times (up to 4 consecutive pressing of the <SHIFT>+<<> push-button).

11.1.1 Selection of the measurement range in the FFT analysis of acoustic signal - MEASUREMENT RANGE

The selection of the input range is possible after entering the **MEASUREMENT RANGE** window (path: MENU / INPUT / MEASUREMENT RANGE) by means of the <▲>, <▼> (or <<>, <>>) push-buttons and pressing the <ENTER> one. In **FFT** analysis the user can select (by means of the <<>, <>> and <ENTER> push-buttons) the input ranges specified in Appendix C.

The return to the **INPUT** list is made after pressing the <ESC> push-button (ignoring the changes) or <ENTER> push-button (confirming the selection).



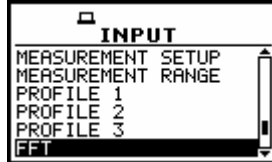
MEASUREMENT RANGE window in the FFT analysis, RANGE selection



Notice: If an **OVERLOAD** occurs it is signalled by the "Bell" icon (cf. Chapter 3 for details).

11.1.2 Selection of the FFT analysis parameters for acoustic signal - FFT

The **FFT** window appears on the **INPUT** list in the **FFT** mode. The **FFT** window contains the positions, which determine the way the spectra are averaged (**AVERAGING**), the weighting filter (**FILTER**), the band of the analysis (**BAND**), the kind of time-window used in the analysis (**WINDOW**), the number of lines (**LINES**) and **LOGGER** for recording **FFT** spectra in logger files. In order to open the **FFT** window the user has to select on the **INPUT** list the **FFT** text using the **<▲>**, **<▼>** push-buttons and press the **<ENTER>** one. The return to the **INPUT** window is made after pressing the **<ESC>** push-button (ignoring the changes) or after pressing the **<ENTER>** push-button (confirming the selection).



INPUT window with FFT text selected

11.1.2.1 Selection of the spectra averaging in the FFT analysis of acoustic signal - AVERAGING

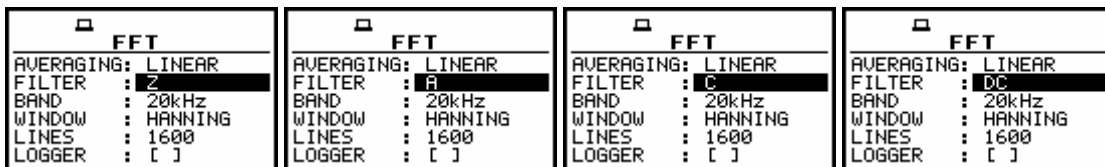
The **AVERAGING** enables the user to select the way in which the spectra in the **FFT** analysis are averaged: linearly or exponentially. Up to the internal software version named as 6.06 only **LINEAR** is available in the case of sound signal (this position cannot be accessed and changed).

11.1.2.2 Selection of the weighting filter in the FFT analysis of acoustic signal - FILTER

The following weighting filters are available in the narrow band **FFT** analysis:

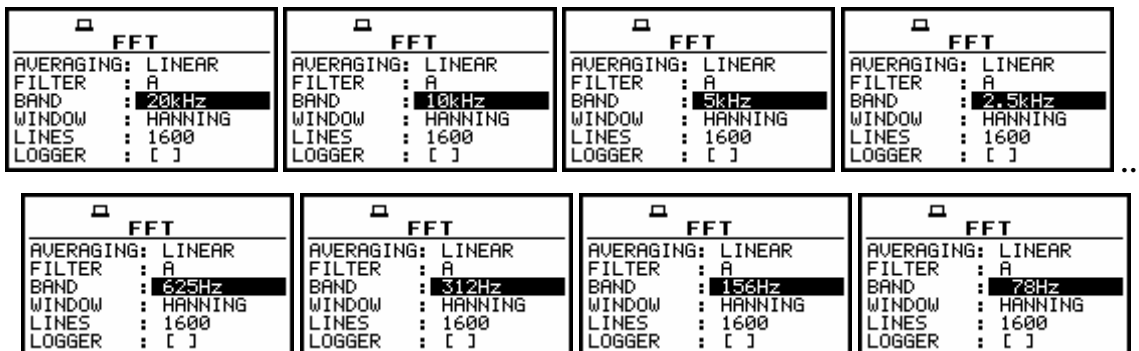
- **A** type 1 according to the IEC 651 and IEC 61672-1 standards
- **C** type 1 according to the IEC 651 and IEC 61672-1 standards
- **Z** type 1 according to the IEC 61672-1 standard
- **DC** DC input

The characteristics of these filters are given in Appendix D. The selection of the required filter is made with the **<◀>**, **<▶>** push-buttons. After pressing the **<ENTER>** push-button the user can confirm the selection and close the window. The return to the **INPUT** window is made also after pressing the **<ESC>** push-button but in this case the selection is ignored.



FFT window, the selection of the weighting filter

11.1.2.3 Selection of the analysis band of acoustic signal - BAND



FFT window, the selection of the band in which the analysis is to be performed

The **BAND** enables the user to select the band in which the narrow-band analysis of the signal has to be performed. The user can choose: **20.0 kHz**, **10.0 kHz**, **5.0 kHz**, **2.5 kHz**, **1.25 kHz**, **625 Hz**, **312 Hz**, **156 Hz** and **78 Hz**. The selection of the required value is made by pressing the <<>, <>> push-buttons and the <ENTER> one in order to confirm the selection and to close the **FFT** window. If, instead of the <ENTER> push-button the <ESC> one is pushed, the selection is ignored and the **FFT** window is closed.

11.1.2.4 Selection of time window in the FFT analysis of acoustic signal - WINDOW

The **WINDOW** enables the user to select the coefficients of time window, which are used in the **FFT** analysis. Available time windows of the **FFT** analysis are as follows: **HANNING**, **RECTANGLE**, **FLAT TOP**, **KAISER-BESSEL**.

The selection of the window is made by means of the <<>, <>> push-buttons. The confirmation of the change made in the line requires pressing the <ENTER> push-button, which simultaneously closes the window. The **FFT** window is closed ignoring any changes made in there, after pressing any time the <ESC> push-button.

FFT	FFT	FFT	FFT
AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : RECTANGLE LINES : 1600 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : FLAT TOP LINES : 1600 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : KAISER-BES LINES : 1600 LOGGER : []

FFT window, TIME-WINDOW selection

11.1.2.5 Selecting the number of the lines of FFT analysis - LINES

The **LINES** enables the user to select the number of lines of the **FFT** analysis. There are three values available: **1600**, **800** and **400**. The selection of the value is made by means of the <<>, <>> push-buttons. The confirmation of the change made in the position requires pressing the <ENTER> push-button, which simultaneously closes the window. The **FFT** window is closed ignoring any changes made in there, after pressing any time the <ESC> push-button.

FFT	FFT	FFT
AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 800 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 400 LOGGER : []

FFT window, LINES selection

11.1.2.6 Enabling the FFT spectra time-history logging - LOGGER

The **LOGGER** enables to record spectra of the **FFT** analysis in the logger file. The activation of the logger is possible only if **LOGGER** functionality has been activated in the **MEASUREMENT SETUP** window (*path: MENU / INPUT / MEASUREMENT SETUP / LOGGER ON*). In order to switch on the logger of the **FFT** analysis the user has to press the <>> push-button and the <ENTER> one. If, instead of the <ENTER> push-button the <ESC> one is pushed, the selection is ignored and the **FFT** window is closed.

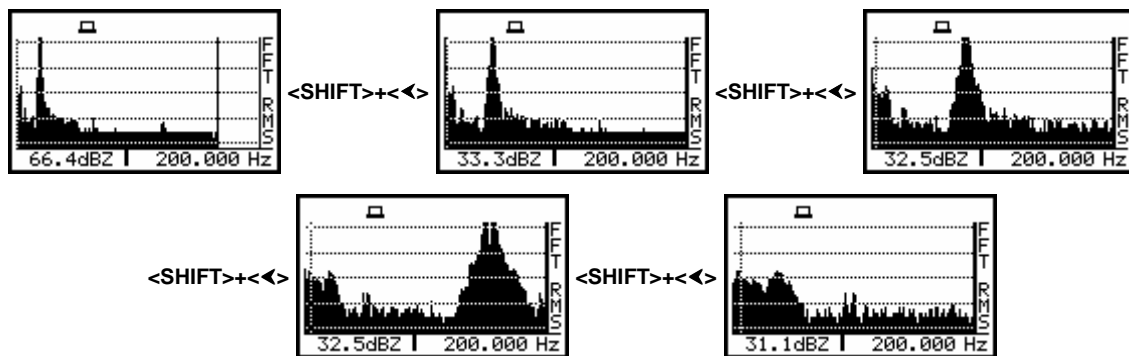
FFT	FFT
AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : []	AVERAGING: LINEAR FILTER : 2 BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : [✓]

FFT window, LOGGER activation

11.1.3 Narrow-band analysis of acoustic signal

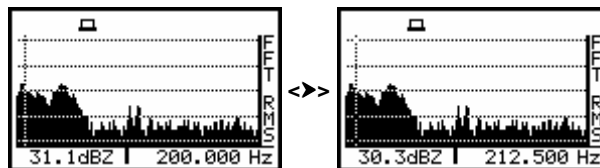
The narrow-band analysis of acoustic signal is performed in each band with 1600, 800 or 400 lines. This analysis is made in the real-time using the overlapping technique. In the case of 1600 lines selection, the spectrum is calculated on the base of 3840 samples of the measured input signal. The sampling frequency is equal to 48 kHz, so the highest available resolution for 20.0 kHz band is equal to $48000 / 3840 = 12.5$ Hz. It is possible to present on the instrument's display only 100 lines, which cover the whole band of analysis, so only each 16th, 8th or 4th line is presented. If the user wants to see on the display the spectrum for the highest band (with 1600 lines selected), the resolution (the difference in frequency between two neighbour lines on the display) is equal to $16 * 12.5$ Hz = 200 Hz. In this mode of presentation, the line with the highest value among 16 neighbour spectrum-lines saved in the buffer, is displayed.

After pressing the **<SHIFT>+<>** push-button the user can increase two times the resolution of the spectrum **presented on the display**. On the display still 100 lines are presented but they cover half of the performed analysis band. This effect is presented on the figures below. The cursor was placed in the left limit of the visible spectrum, so the corresponding frequency value is simultaneously equal to the resolution of the visible spectrum.



FFT analysis, the resolution increasing of the presented spectrum

The resolution of the presented spectrum after single pressing of the **<SHIFT> + <>** push-button, for 20.0 kHz band is equal to $200 / 2 = 100$ Hz. The line with the highest value among 8 neighbour lines, saved in the instrument's memory, is presented on the display in this case. After few possible, consecutive pressing of the **<SHIFT> + <>** push-button the highest available resolution of the performed calculation is presented on the instrument's display (for 20.0 KHz band it is equal to 12.5 Hz as it is on the last of the given above pictures). In this case on the display only a small part of the analysis band is presented. This part is equal to $100 * 12.5$ Hz = 1250 Hz. The user has to scroll the presentation to the left or to the right in order to see the other part of the spectrum.



FFT analysis, the presented spectrum with the highest resolution for 20.0 kHz band

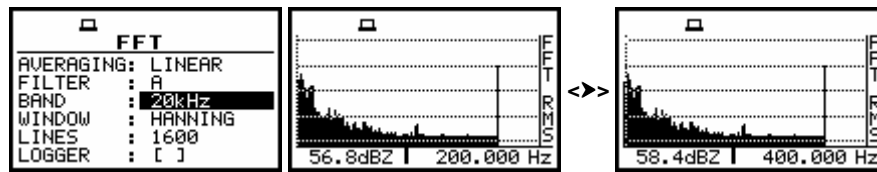
Pressing once the **<SHIFT> + <>** push-buttons the user can decrease two times the resolution of the spectrum presented on the instrument's display and increase two times the observed part of the analysis band. The user can repeat this operation up to the presentation on the display the whole band of the performed analysis.

The highest resolution of the analysis depends on the selected band and lines and for **1600** lines selected is equal to:

- 12.5 Hz for the band named as **20.0 kHz**
- 6.25 Hz for the band named as **10.0 kHz**
- 3.125 Hz for the band named as **5.0 kHz**

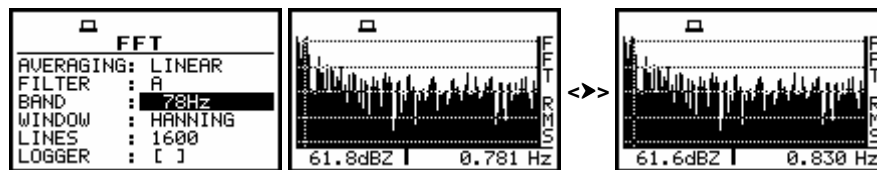
- 1.5625 Hz for the band named as **2.5 kHz**
- 0.78125 Hz for the band named as **1.25 kHz**
- 0.390625 Hz for the band named as **625 Hz**
- 0.1953125 Hz for the band named as **312 Hz**
- 0.09765625 Hz for the band named as **156 Hz**
- 0.048828125 Hz for the band named as **78 Hz**

It is worth to underline that the zoom function is not implemented in the instrument (the function that enables one to achieve the highest resolution in any of the performed analysis bands). Along with two times decreasing of the analysis band the resolution is doubled. The displays with the results of the narrow-band analysis in 20.0 kHz and 78.0 Hz are presented on the figures below. The selected analysis band is given on the left display. The next views present the limits and the resolution of the chosen band (the worst available resolution of the presentation is selected).




FFT analysis of the acoustic signal, 20.0 kHz band, 200 Hz resolution

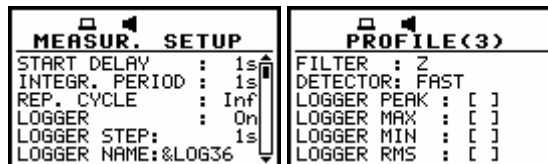
The highest available resolution is presented on the figure below. For 78.0 band, after pressing four times the **<SHIFT>+<<>** push-button (1600 lines selected), the difference between two consecutive spectrum lines is equal to 0.048828125 Hz.




FFT analysis, 78.0 kHz band, view of the completely available band with 0.048828125 Hz resolution



Notice: It is not possible to change the values of the parameters during the execution of the measurements. It is possible to open different lists and windows but the positions in these lists are not displayed inversely and so - not accessible. The “Loudspeaker” icon indicates that the instrument is in the measurement process. In order to change the range the measurement must be finished!



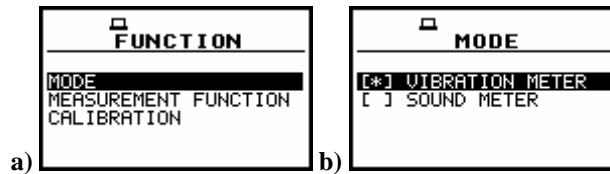
Displays with not accessible parameters of the INPUT list during measurements



Notice: All other settings of the instrument are common for the FFT analyser and the sound level meter mode.

11.2 FFT analyser of vibration signal

In order to select the instrument's vibration mode the user has to enter the **FUNCTION** window by pressing the **<MENU>** push-button, selecting by means of the **<▲>**, **<▼>** (or **<◀>**, **<▶>**) push-buttons the **FUNCTION** text and pressing the **<ENTER>**. Next, the user has to open the **MODE** window (to select the **MODE** text using the **<▲>**, **<▼>** or **<◀>**, **<▶>** push-buttons and press the **<ENTER>** one, when this text is displayed inversely).



FUNCTION window with MODE text selected (a) and VIBRATION METER mode selected (b)

In the **MODE** window, the user can select the kind of input signal, which has to be measured or analysed by the instrument. In the case of vibration signals, the **VIBRATION METER** option should be selected by placing the special character in the line with the **VIBRATION METER** text. The position of the character can be changed using the **<▲>**, **<▼>** (or **<◀>**, **<▶>**) push-buttons. After placing the character in the line with the **VIBRATION METER** text the user has to press the **<ENTER>** push-button, which closes the **MODE** window. The **MODE** window is closed ignoring any changes made in it, after pressing in any time the **<ESC>** push-button.

The instrument's operation as narrow-band analyser of vibration signal is similar to the **VLM** mode. In narrow-band (**FFT**) analysis, the spectrum is available in parallel to the **VLM** operation. The analysis is performed in the real time with the **Z** weighting filter displayed in the **FFT** window (*path: MENU / INPUT / FFT*). The spectrum is linearly averaged with the **HANNING**, **RECTANGLE**, **FLAT TOP** or **KAISER-BESSEL** time-window. Additionally, the **TOTAL RMS** value for the full frequency range is displayed. In order to inform the user about the working mode of the instrument, in **3 PROFILES** mode of result's presentation the **dotted line** are used for the indication that the instrument **does not work** in the **LM** mode. In the **LM** mode, the continuous lines are used.

PEAK 75.2dB \bar{A}		PEAK 74.4dB \bar{A}	
OVL 0.0%		OVL 0.0%	
TIME 00:00:01		TIME 00:00:01	
Profile(1)		Profile(1)	
00:02	00:01	00:00	00:01

3 PROFILES result's presentation mode with the dotted lines indicating that the instrument does not work in the LM mode and continuous lines in LM mode



Notice: The **TOTAL RMS** result is measured with the weighting filter selected in the **FFT** window, which can be different that the **VLM** profiles settings. The **spectra are always linearly averaged**. Thus, the **TOTAL** value from **FFT** analysis is usually different from those obtained for the **VLM** profiles.

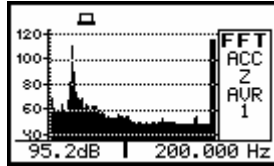
In order to change the mode of the measurement results presentation the user has to press the **<▲>** or **<▼>** push-buttons. The following modes are available:

One profile, 3 PROFILES, SPECTRUM and LOGGER.



Notice: The user can select the number of the currently active modes of the measurement results **presentation** switching on (**[√]**) or off (**[]**) the given mode (*path: MENU / DISPLAY / DISPLAY MODES*). Only one profile mode **cannot be switched off** (cf. proper chapter for details).

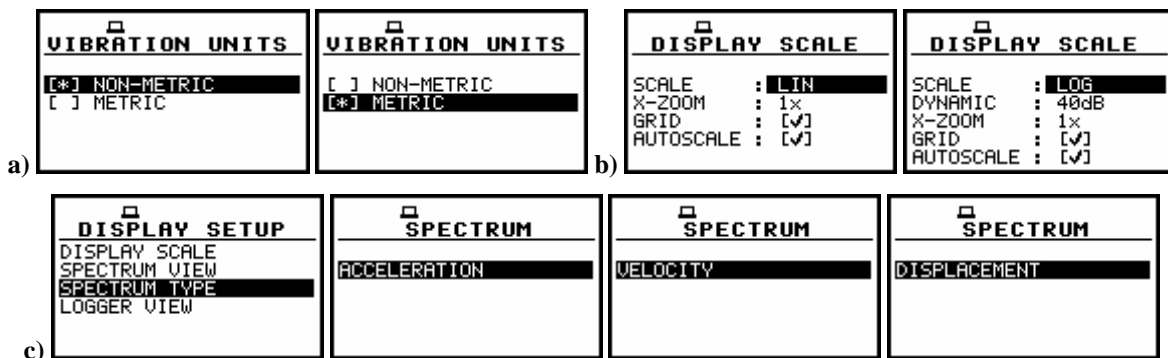
One Profile, 3 PROFILES and **LOGGER** display modes are identical as for the **VLM**. The **SPECTRUM** mode displays the narrow-band (**FFT**) analysis results (so-called spectrum) together with the **TOTAL** RMS value measured with the weighting filter displayed in the **FFT** window. The read-out of the interested spectrum value can be done by means of the cursor controlled by the **<<>**, **<>>** push-buttons. On the right side of the display the selected frequency (or the **TOTAL**) is given, the numerical value and the units.



Narrow-band (FFT) analysis in the SPECTRUM display mode

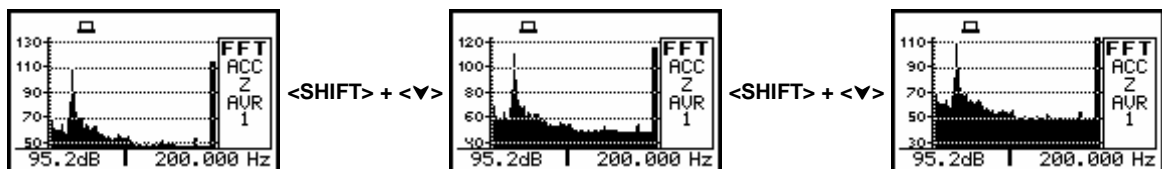


Note: The displayed units during the measurement or analysis of vibration signal depends on the different settings made in the **VIBRATION UNITS** (path: MENU / SETUP / VIBRATION UNITS / METRIC or NON-METRIC), the **SCALE** (path: MENU / DISPLAY / DISPLAY SCALE / SCALE / LINear or LOGarithmic) and the **SPECTRUM TYPE** (path: MENU / DISPLAY / DISPLAY SETUP / SPECTRUM TYPE / ACCELERATION, VELOCITY or DISPLACEMENT).



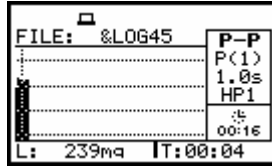
Displays with different settings influencing the units of vibration results

In the **SPECTRUM** mode it is possible to shift the horizontal axis in relation to the vertical one of the presented results using the **<SHIFT>** and **<▲>** or **<SHIFT>** and **<▼>** push-buttons. After each pressing of these buttons the presented picture moves 10 dB down or up - respectively.




Displays in the FFT analysis with the shifted horizontal axis in relation to vertical one

In the **LOGGER** mode the results are presented, which are saved in the logger from the profiles (in the case when the **LOGGER** is switched on and one or more **LOGGER** results are selected to be saved on the **PROFILE x** sub-lists) with the step set for all profiles in the **LOGGER STEP**. The active profile is changed after pressing the **<<>** or **<>>** push-buttons. The position of the cursor can be changed after pressing the **<<>**, **<>>** push-buttons. It is also possible to shift the horizontal axis in relation to the vertical one of the presented results using the **<SHIFT>** and **<▲>** or **<SHIFT>** and **<▼>** push-buttons (similarly as it has to be done in the **SPECTRUM** mode).

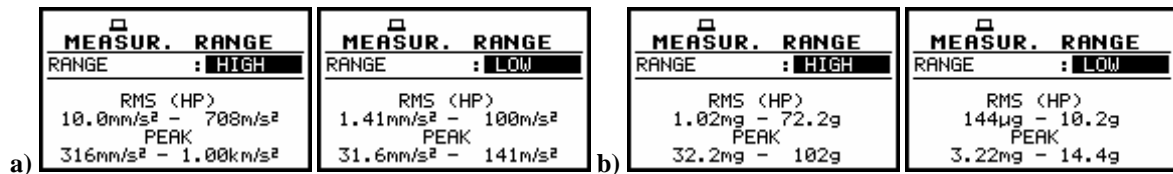


FFT analysis in LOGGER presentation, registered results from profile 1 expressed in NON-METRIC units

 **Notice:** The narrow-band frequency analysis (FFT) is performed in the real time with the sampling frequency equal to 48 kHz, using so-called “overlapping” technique which scale depends on the selected band of analysis. All 100 values of the FFT spectrum are presented simultaneously on the display however, the resolution of the presented spectrum can be changed. After each pressing of the <SHIFT> + <←> push-button the resolution is increased by two and after pressing the <SHIFT> + <→> push-button - decreased by two. The resolution can be increased in such way 16 times (up to 4 consecutive pressing of the <SHIFT> + <←> push-button).

11.2.1 Selection of the measurement range in the FFT analysis of vibration signal - MEASUREMENT RANGE

The selection of the input range is possible after entering the **RANGE** position (from the **INPUT** list by means of the <▲>, <▼> (or <←>, <→>) push-buttons and pressing the <ENTER> one. In FFT analyser the user can select (by means of the <←>, <→> and <ENTER> push-buttons) the input ranges specified in Appendix C. The return to the **INPUT** window is made after pressing the <ESC> push-button (ignoring the changes) or <ENTER> push-button (confirming the selection).

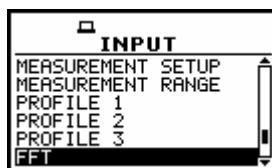


MEASUREMENT RANGE window in FFT analysis mode, METRIC units, linear scale (a), NON-METRIC units, linear scale (b)

11.2.2 Selection of the FFT analysis parameters for vibration signal - FFT

The **FFT** is a context element, which appears on the **INPUT** list in the **FFT** mode. The **FFT** window contains the positions, which determine the way the spectra are averaged (**AVERAGING**), the weighting filter (**FILTER**), the band of the analysis (**BAND**), the kind of time-window used in the analysis (**WINDOW**), number of lines (**LINES**) and **LOGGER** for recording **FFT** spectra in logger files.

In order to open the **FFT** window the user has to select on the **INPUT** list the **FFT** text using the <▲>, <▼> push-buttons and press the <ENTER> one. The return to the **INPUT** list is made after pressing the <ESC> push-button (ignoring the changes) or <ENTER> push-button (confirming the selection).



INPUT window with FFT text selected

11.2.2.1 Selection of the spectra averaging in the FFT analysis of vibration signal - AVERAGING

The **AVERAGING** influences the way in which the spectra in the **FFT** analysis are averaged. Up to the internal software version named as 6.06 only **LINEAR** is available (this position cannot be accessed and changed).

11.2.2.2 Selection of the weighting filter in the FFT analysis of vibration signal - FILTER

Only one, **Z** filter is available in the narrow-band analysis of the vibration signal. The characteristic of this filter is given in Appendix D. The **FILTER** position is not accessible in the **FFT** window.

11.2.2.3 Selection of the analysis band of vibration signal - BAND

The **BAND** enables the user to select the band in which the narrow-band analysis of the vibration signal has to be performed. The user has the following possibilities: **20.0 kHz**, **10.0 kHz**, **5.0 kHz**, **2.5 kHz**, **1.25 kHz**, **625 Hz**, **312 Hz**, **156 Hz** and **78 Hz**. The selection of the required value is made pressing the <<>, <>> push-buttons and the <ENTER> one in order to confirm the selection and to close the **FFT** window. If, instead of the <ENTER> push-button the <ESC> one is pushed, the selection is ignored and the **FFT** window is closed.

<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 10kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 5kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>
<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 2.5kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 1.25kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 625Hz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>
<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 312Hz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 156Hz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 78Hz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>

FFT window, the selection of the band in which the analysis is to be performed

11.2.2.4 Selection of time-window in the FFT analysis of vibration signal - WINDOW

The **WINDOW** enables the user to select the coefficients of time-window, which are used in the **FFT** analysis. Available time-windows of the **FFT** analysis are as follows: **HANNING**, **RECTANGLE**, **FLAT TOP**, **KAISER-BESSEL**.

The selection of the window is made by means of the <<>, <>> push-buttons. The confirmation of the change made in the line requires pressing the <ENTER> push-button, which simultaneously closes the window. The **FFT** window is closed ignoring any changes made in there, after pressing any time the <ESC> push-button.

<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 20kHz WINDOW : HANNING LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 20kHz WINDOW : RECTANGLE LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 20kHz WINDOW : FLAT TOP LINES : 1600 LOGGER : [] </pre>	<pre> FFT AVERAGING: LINEAR FILTER : Z BAND : 20kHz WINDOW : KAISER-BES LINES : 1600 LOGGER : [] </pre>
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FFT window, TIME-WINDOW selection

11.2.2.5 Selecting the number of the lines of FFT analysis - LINES

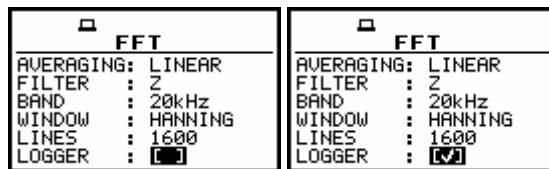
The **LINES** enables the user to select the number of lines of the **FFT** analysis. There are three values available: **1600**, **800** and **400**. The selection of the value is made by means of the **<<>**, **<>>** push-buttons. The confirmation of the change made in the position requires pressing the **<ENTER>** push-button, which simultaneously closes the window. The **FFT** window is closed ignoring any changes made in there, after pressing any time the **<ESC>** push-button.



FFT window, LINES selection

11.2.2.6 Enabling the FFT spectra time-history logging - LOGGER

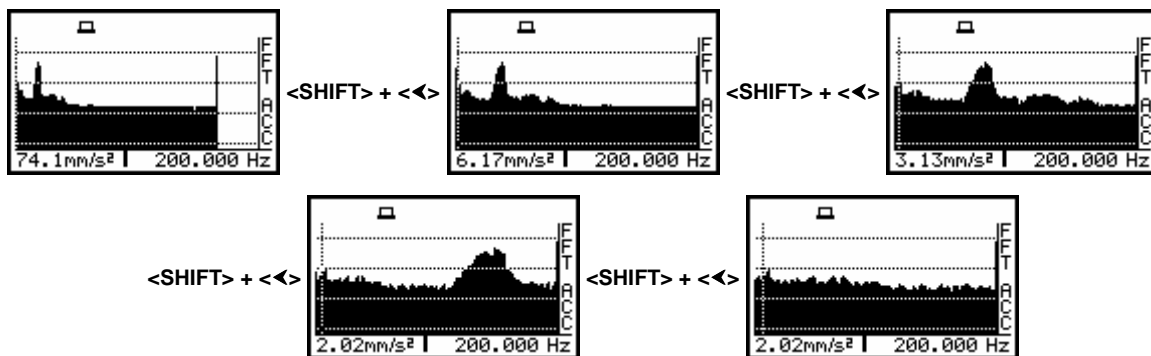
The **LOGGER** enables to record spectra of the **FFT** analysis in the logger file. The activation of the logger is possible only if **LOGGER** functionality has been activated in the **MEASUREMENT SETUP** (path: *MENU / INPUT / MEASUREMENT SETUP / LOGGER ON*). In order to switch on the logger of the **FFT** analysis the user has to press the **<>>** push-button and the **<ENTER>** one. If, instead of the **<ENTER>** push-button the **<ESC>** one is pushed, the selection is ignored and the **FFT** window is closed.



FFT window, LOGGER activation

11.2.3 Narrow-band analysis of vibration signal

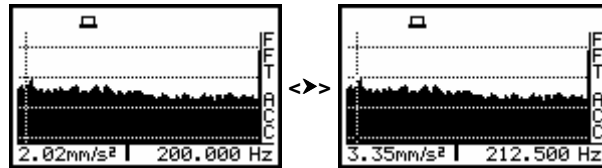
The narrow-band analysis of vibration signal is performed in each band with 1600, 800 or 400 lines. This analysis is made in the real-time using the overlapping technique. The spectrum, in the case of 1600 lines selection, is calculated on the base of 3840 samples of the measured input signal. The sampling frequency is equal to 48 kHz, so the highest available resolution for 20.0 kHz band is equal to $48000 / 3840 = 12.5$ Hz. It is possible to present on the instrument's display simultaneously only 100 lines with the whole band of analysis. Taking into account that 100 lines cover the highest band one can calculate that it is 16 times less than it is saved in the memory ($1600 / 100 = 16$). Therefore, if the user wants to see on the instrument's display the spectrum for the highest band, the resolution (the difference in frequency between two neighbour lines on the display) is equal to $16 * 12.5 = 200$ Hz. In this mode of presentation, the line with the highest value among 16 neighbour spectrum-lines saved in the instrument is displayed.



FFT analysis, the resolution increasing of the presented spectrum

After pressing the **<SHIFT>+<<>** push-button the user can increase two times the resolution of the spectrum **presented on the display**. On the display still 100 lines are presented but they cover half or less than half of the performed analysis band. This effect is presented on the figures below. The cursor was placed in the left limit of the display, so the corresponding frequency value is simultaneously equal to the resolution of the visible spectrum.

The resolution of the presented spectrum after single pressing of the **<SHIFT>+<<>** push-button, for 20.0 kHz band is equal to $200 / 2 = 100$ Hz. The line with the highest value among 8 neighbour lines saved in the instrument's memory is presented on the display in this case. After four consecutive pressing of the **<SHIFT>+<<>** push-button the highest resolution of the performed calculation is presented on the instrument's display (for 20.0 kHz band it is equal to 12.5 Hz as it is on the last of the given above pictures). In this case on the display only a small part of the analysis band is presented. This part is equal to $100 * 12.5$ Hz = 1250 Hz.



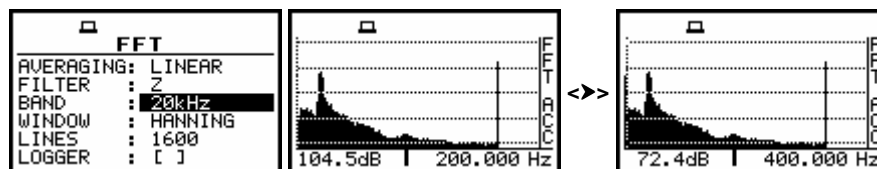
FFT analysis, the presented spectrum with the highest resolution (12.5 Hz), equal to the resolution of the performed calculations for 20.0 kHz band

Pressing once the **<SHIFT>+<>>** push-button the user can decrease two times the resolution of the spectrum presented on the instrument's display and increase two times the observed part of the analysis band. The user can repeat this operation up to the presentation on the display the whole band of the performed analysis.

The highest resolution of the analysis depends on the selected band and number of lines and, in the case of 1600 lines selection, is equal to:

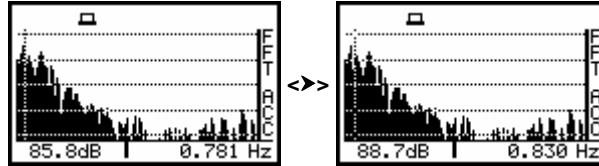
- 12.5 Hz for the band named as **20.0 kHz**
- 6.25 Hz for the band named as **10.0 kHz**
- 3.125 Hz for the band named as **5.0 kHz**
- 1.5625 Hz for the band named as **2.5 kHz**
- 0.78125 Hz for the band named as **1.25 kHz**
- 0.390625 Hz for the band named as **625 Hz**
- 0.1953125 Hz for the band named as **312 Hz**
- 0.09765625 Hz for the band named as **156 Hz**
- 0.048828125 Hz for the band named as **78 Hz**

It is worth to underline that the zoom function is not implemented in the instrument (the function that enables one to achieve the highest resolution in any of the performed analysis bands). Along with two times decreasing of the analysis band the resolution is doubled. The displays with the results of the narrow-band analysis in 20.0 kHz and 78.0 Hz bands are presented on the figures below. The selected analysis band is given on the left picture. The next views present the limits and the resolution of the chosen band (the worst available resolution of the presentation is selected).



Displays in the FFT analysis of the vibration signal, 20.0 kHz band, 200 Hz resolution

The highest available resolution is presented on the figure below. For **78.0 Hz** band, after pressing four times the **<SHIFT>+<<>** push-button, the difference between two consecutive spectrum lines is equal to 0.048828125 Hz.



FFT analysis of the vibration signal, 78.0 kHz band, the view of the completely available band with 1.4648438 Hz resolution and the view of the selected part of the 78.0 kHz band with 0.048828125 Hz resolution (LOGarithmic scale)



Notice: It is not possible to change the values of the parameters during the execution of the measurements. It is possible to open different lists and windows but the positions in these lists are not displayed inversely and so - not accessible. The “Loudspeaker” icon indicates that the instrument is in the measurement process.

FFT	MEASUR. RANGE
AVERAGING: LINEAR	RANGE : HIGH
FILTER : Z	RMS (HP)
BAND : 20kHz	10.0mm/s ² - 700m/s ²
WINDOW : HANNING	PEAK
LINES : 1600	316mm/s ² - 1.00km/s ²
LOGGER : []	

Displays with not accessible parameters of the INPUT window



Notice: All other settings of the instrument are common for the FFT analyser and the level meter mode.