5. ANALYZER MODE

This mode enables the user to observe and to measure the input signal in the frequency domain (cf. § 5.1 for the narrow band and § 5.2 for the 1/1 & 1/3 octave band analysis) and in the time domain (cf. § 5.3).

The screen of the instrument contains in this mode the following parts:

- the field dedicated for the graphic presentation of the measured signal in both domains;
- the field dedicated for the alphanumerical description.

The upper character line (just above the graphic part of the screen) contains the data about:

- the current measurement range (e.g. **110 dB**),

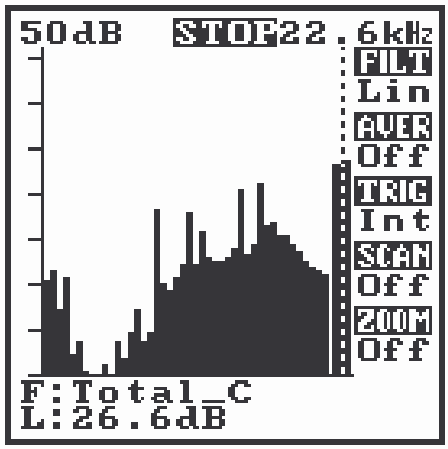
> ***Notice**: The possible overpass of this range (the **overload**) is signalled by the inversely displayed field.*

- the current state of the execution of the measurement:

  STOP - the measurement is stopped,
  RunS - the single measurement is performed,
  RunC - the continuous measurements are made,
  TRIG - the unit waits for the triggering signal (the **TRIG** function is on),
  ZOOM - the "zoom" is on (the measurement with the digital "heterodyning" of the frequency);

- the current measurement band (e.g. **11.3 kHz**) - from 0 Hz to the boundary value in the basic analysis and from **CENTR.FREQ-BAND/2** to **CENTR.FREQ+BAND/2** when the "zoom" is on (**ZOOM:On**), cf. the **ZOOM** window.

> ***Notice**: The text **TRIG** appears during the **waiting period** for the triggering impulse.*



The view of the display in the ANALYZER MODE - 1/3 octave function

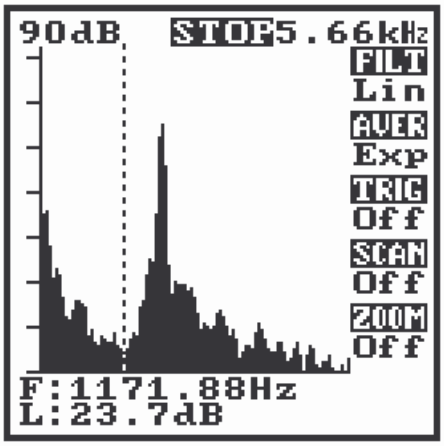
The 2 lowest bottom character lines (under the graphic part of the display) contain the data about:

- the value of the frequency (**F:**) pointed by the cursor,
- the value of the time (**T:**) for the sample of the measured signal pointed by the cursor,
- the value of the amplitude of the spectrum line (**L:**) or the value of the amplitude of the measured signal (**L:**) pointed by the cursor,
- the current value of the averaging time or recording time for the ”Spectra in Buffer”.

In the right part of the screen there are data about the chosen parameters, which have the crucial importance for the instrument operation:

- the selected weighting filter:
  - the **FILT** field - **Lin**, **A**, **C** or **HP** (cf. the description of the **FILTER** sub-window in the **INPUT** window);
- the selected averaging mode:
  - the **AVER** field - **Lin**, **Exp**, **HM**, **FL**, **FHM** or **Off** (cf. the description of the **AVERAG.** sub-window in the **FUNCTION** window);
  - the right-bottom field gives the current number of the averaged FFT spectrum or the current averaging time (for 1/1 and 1/3 octave analysis);
- the current activity and kind of the triggering function:
  - the **TRIG** field - **Int**, **Ext** or **Off** (which denotes the measurement without the triggering - **Free Run**; cf. the description of the **TRIGGER** sub-window in the **INPUT** window);
- the activity of the **SCANNING** function:
  - the **SCAN** field - **On** or **Off** (cf. the description of the **SCANNING** sub-window in the **DISPLAY** window);
- the activity of the zoom function in the narrow band analysis (**FFT**), cf. the **ZOOM** window.

The instrument's control in the **ANALYZER MODE** is similar to that described in the **METER MODE**. The analyser state is controlled by the parameters set in the following windows: **FUNCTION**, **INPUT**, **CURSOR**, **DISPLAY**, **ZOOM**, **REPORT**, **SETUP** and **FILE**.



The view of the display in the ANALYZER MODE - the Spectrum function

The selection of the main functions of the signal analysis can be performed in the **FUNCTION** sub-window of the **FUNCTION** window. The following options are available in this sub-window:

Time - the measurement of the signal in the time domain,

Spectrum - the frequency analysis of the measured signal by means of the FFT algorithm,

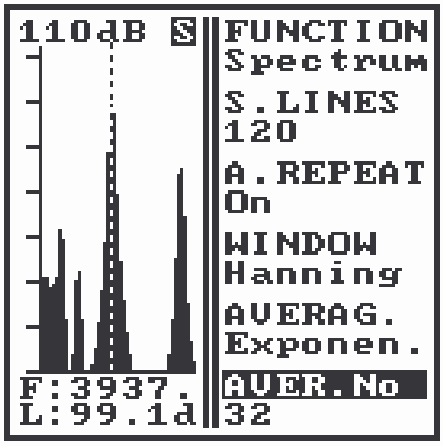
1/1 Oct. - the frequency analysis of the measured signal by means of the digital filters in 1/1 octave band (the filters are defined in base two system),

1/3 Oct. - the frequency analysis of the measured signal by means of the digital filters in 1/3 octave band (the filters are defined in base two system).

The proper function is selected using the **<◂>** and **<▸>** push-buttons after the activation of the desired sub-window.

5.1 Narrow band frequency analysis (FFT)

The narrow band frequency analysis (**FFT**) of the measured signal can be performed selecting in the **FUNCTION** window the **Spectrum** function. The analysis can be made for the signals up to 45.3 kHz.



The view of the display in the ANALYZER MODE - the FUNCTION window

*The **FUNCTION** window*

In the **FUNCTION** window for the **FFT** analysis the **S.LINES**, **A.REPEAT**, **WINDOW**, **AVERAG.** and **AVER.No** sub-windows can be selected and properly set.

S.LINES (Spectrum Lines) sub-window

This sub-window enables the user to select the number of spectrum lines of the **FFT** procedure from the following values: **120**, **240**, **480**, **960** or **1920**.

A.REPEAT (Auto Repeat) sub-window

This sub-window describes the way of the registration of the measurement results (recording):

- **On** - auto repeat of the measurement cycle (the continuous work),
- **Off** - the registration of the single measurement.

WINDOW sub-window

This sub-window defines the type of the smoothing function used for the FFT analysis. The following windows are available: **Hanning**, **Rectangle**, **Flat Top**, **Kaiser-Bessel** or **User**. The way of the introduction of the **User** window (defined by the user) is explained in the section concerning the usage of the RS 232 interface (cf. the description of the **#5** function in App. A).

AVERAG. sub-window

In this sub-window the type of the averaging of the measurement signal can be selected from: **Fast HM.**, **Fast Lin.**, **Off**, **Linear**, **Exponen.** or **Hold Max**.

- **Fast HM.** means the Fast Registration (without displaying the current values during the averaging process) of the Maximal Values,
- **Fast Lin.** means the Fast Linear Averaging (without displaying the current values during the averaging process),
- **Off** means that the Averaging is off,
- **Linear** means the Linear Averaging (with displaying the current averaged values during the data collection),
- **Exponen.** means the Exponential Averaging,

- **Hold Max** means the Registration of the Maximal Values (with displaying the current averaged values during the data collection).

Notice: *In the field of the instrument's status presentation the types of the averaging are denoted in the following way:* ***Lin*** *– for the linear averaging,* ***Exp*** *– for the exponential averaging,* ***HM*** *– for the registration of the maximal values,* ***FL*** *– for the fast linear averaging,* ***FHM*** *– for the fast registration of the maximal values.*

During the **linear averaging** (**Linear**) the average value of the consecutive spectra is calculated due to the formula:

$$\mathbf{Y_n} = \{(\mathbf{n}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{n}$$

where:
$Y_0 = 0$;
Y_n - the consecutive averaged spectrum;
X_n - the consecutive instantaneous power spectrum calculated by the FFT algorithm;
$n = 1, 2, ..., N$;
N - conforms to the value set in the **AVER.No** sub-window.

This formula describes the recursive way of the mean value calculation and enables one the observation of the averaged process. In the **Fast Linear Averaging** (**FL**) the consecutive $\mathbf{Y_n}$ results of the calculations **are not displayed**. The final result appears on the screen **after the collection** of the desired number (**N**) of the measurements. This was done in order to expand "the real time" band of the FFT analysis (100 % of the measured signal is transformed into the frequency domain and averaged).

In the Fast Linear Averaging mode (**FL**) the real time band analysis is equal to **12.8 kHz** (in the normal mode (**Lin**) - **1.6 kHz**).

Notice: *In order to give faster linear averaging, the* ***overlap processing*** *is used in the lower frequency ranges (the calculation of the spectrum on the base of the proper number of samples stored lately in the buffer). The overlap is* ***maximum 50 %****, thus the records are statistically independent.*

Notice: *The averaged spectra are* ***stored*** *in the* ***SCAN. BUFFER*** *(****till the buffer is filled-up****). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the* ***SCANNING*** *function (see below).*

The exponential averaging (**Exponen.**) means that the averaged value of the consecutive spectra is calculated due to the formula:

$$\mathbf{Y_n} = \{(\mathbf{N}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{N}$$

where:
$Y_1 = X_1$;
$N \geq 2$;
Y_n - the consecutive averaged spectrum;
X_n - the consecutive instantaneous power spectrum calculated by the FFT algorithm;
$n = 2, 3, ...,$
N - conforms to the value set in the **AVER.No** sub-window

This formula describes the recursive way of the weighted mean value calculation (with the weight equal to N) and enables one the observation of the averaged process. For $N \rightarrow \infty$ the exponential averaging is the analogy of the classic integration circuit in which time constant is equal to N/2.

Notice: *In order to give faster exponential averaging, the* ***overlap processing*** *is used in the lower frequency ranges. The overlap is* ***maximum 50 %****, thus the records are statistically independent.*

Notice: *The averaged spectra are* ***stored*** *in the* ***SCAN. BUFFER*** *All last instantaneous spectra are stored (****in the "circular" way - the last spectra are stored if the buffer is too short****). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the* ***SCANNING*** *function (see below).*

The registration of the maximal values (**Hold Max**) enables the user to store the greatest values of the spectrum lines which occurred during the given period of the averaging. The **fast registration of the maximal values** mode is similar to one described above, but only the final spectrum is displayed (after the collection of all data).

Notice: *In order to give faster* ***Hold Max*** *averaging, the* ***overlap processing*** *is used in the lower frequency ranges. The overlap is* ***maximum 50 %****, thus the records are statistically independent.*

Notice: *The averaged spectra are* ***stored*** *in the* ***SCAN. BUFFER*** *(****till the buffer is filled-up or the averaging is stopped****). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the* ***SCANNING*** *function (see below).*

The measurement is automatically stopped when any kind of averaging is chosen and the **STOP** text is displayed. It means that the **<START / STOP>** push-button has to be pressed in order to start the measurements with the averaging. In the case of the linear averaging and the registration of the maximal values the process is stopped after the gathering of the desired number of measurements. In the case of the exponential averaging the measurements are performed continuously and can be stopped by pressing the **<START / STOP>** push-button.

AVER.No sub-window

This sub-window defines the desired number of the averaging (for linear or HM) or the "weight" (for exponential). The value in the sub-window can be selected from **2** to **2048**.

Notice*: In the case of the exponential averaging the number given in this window denotes the weight with which the consecutive measured spectrum is averaged.*

*The **INPUT** window*

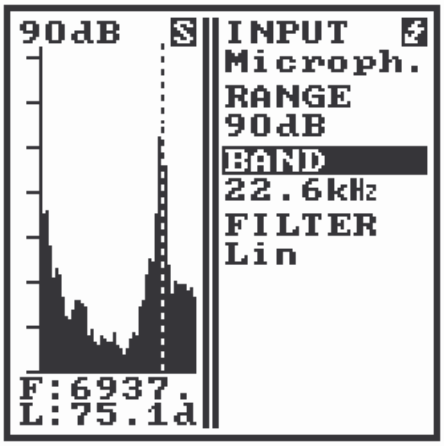
This window enables the user to select the source of the signal (the **INPUT** sub-window, the range of the signal (the **RANGE** sub-window), its band (the **BAND** sub-window) and the weighting filter (the **FILTER** sub-window).

INPUT sub-window

This sub-window enables the user to choose the source of the measured signal (the choice of the measurement input). The following parameters can be programmed in the **INPUT** sub-window for the **FFT** analysis:

- **Reference** the internal source of the binary pseudo-random signal,
- **Microph.** the microphone input (the signal from the external condenser microphone preamplifier, e.g. from the SV 01A),
- **Direct** the direct, voltage input,
- **Charge** the input of the charge piezoelectric transducer,
- **Acceler.** the input from the IEPE vibration transducer typed (with the built-in charge preamplifier),
- **SV06** the input from four channel module for vibration measurements – cf. App. E,
- **SV08** the input from four channel module for sound and vibration measurements – cf. App. E.

The proper input is chosen by the use of the **<◄>**, **<►>** push-buttons after the activation of the sub-window.



The view of the display in the ANALYZER MODE - the INPUT window

RANGE sub-window

This sub-window enables the user to select the measurement input range (the input gain or attenuation). There are four measurement ranges (in 20 dB steps), which are defined as below:

- for sound measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **20 μPa**) calibrated for the microphone with the sensitivity of **50 mV / Pa**;
- for voltage measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **1 μV**);
- for vibration acceleration measurement: **316 mms^{-2}**, **3.16 ms^{-2}**, **31.6 ms^{-2}** or **316 ms^{-2}** (in **dB** respectively: **110 dB**, **130 dB**, **150 dB** or **170 dB**; the value in **dB** related to **1 μms^{-2}**) calibrated for the accelerometer with the sensitivity of **10 mV / ms^{-2}** or **10 pC / ms^{-2}**. For the non-metric units see Chap. 7.

BAND sub-window

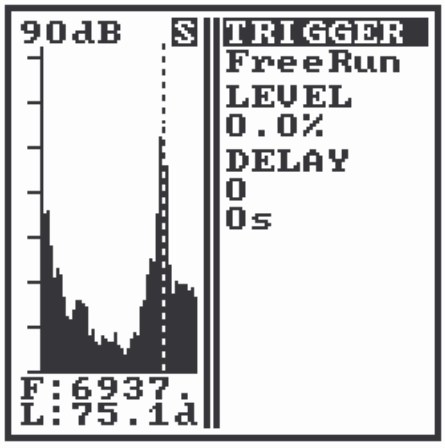
This sub-window enables the user to choose the band in which the measurement is done. There are 16 frequency bands from **45.3 kHz** to **1.38 Hz** in the binary sequence. In some particular cases the changes of the band in this window are limited. The bands **22.6 kHz** and **45.3 kHz** are not available when the **ZOOM** function is **On**.

FILTER sub-window

This sub-window enables the user to choose one of the weighting filters: **Lin**, **A**, **C** or **HP**.

*The **TRIGGER** window*

This window enables the user to start the measurement when the signal reach the desired level.



The view of the display in the ANALYZER MODE - the TRIGGER window

***Notice**: The **TRIGGER** window is a **sub-window** for the **INPUT** window. To open it, the **<INPUT>** push button must be pressed twice.*

In the **TRIGGER** window the following sub-windows are available: **TRIGGER**, **LEVEL** and **DELAY**.

TRIGGER sub-window
This sub-window enables one to select the trigger source;

- **Free Run** the measurement with the trigger off,
- **Int."+"** the triggering occurs when the rising slope of the measured signal overpasses the desired level,
- **Int."-"** the triggering occurs when the falling slope of the measured signal overpasses the desired level,
- **External** the triggering with the external impulse (the rising slope of the signal).

LEVEL sub-window
This sub-window enables one to set the triggering level from **-99.9 %** to **+99.9 %** of the full scale value with the **0.1 %** step (it is possible to increase the step with the **<SHIFT>** push-button).

DELAY sub-window
This sub-window enables one to set data analysis delay from the occurring trigger. This delay can be programmed in the range of **-4095** to **4096** samples (it is possible to increase the step with the **<SHIFT>** push-button). The corresponding delay time is also displayed on the screen.

***Notice**: The trigger function **is not active for the ZOOM** operation.*

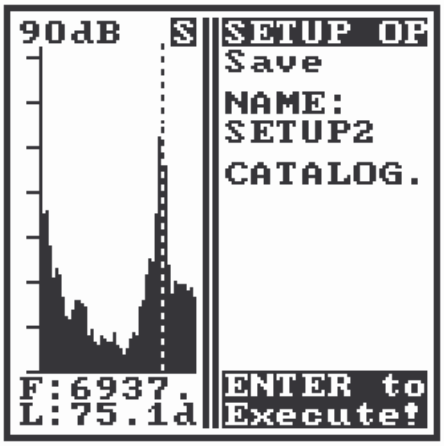
*The **SETUP** window*

In the **SETUP** window the following sub-windows are available: **SETUP OP**, **NAME** and **CATALOG**.

SETUP OP sub-window
This sub-window enables the user to store (**Save**), recover (**Load**) and delete (**Erase**) the instrument's control configuration file (so-called "Setup File"). This file contains the following parameters:
- the measurement input,
- the polarisation of the microphone,
- the measurement range,
- the measurement band,

- the type of triggering,
- the level of the trigger,
- the display range,
- the weighting filter,
- the measurement function,
- the recording mode,
- the number of the lines in the spectrum,
- the FFT window,
- the averaging mode,
- the averaging time,
- the averaging number,
- the cursor mode,
- the displayed range,
- the display scale,
- the spectrum plot type,
- the zoom mode,
- the zoom band,
- the zoom state,
- the settings of the calibration (the type and the coefficient).

Notice: *After powering the instrument and the* ***ANALYZER MODE entering*** *the default or the* ***last used user's Setup File*** *is automatically loaded. The user's Setup File loading can be disabled by means of the* ***SETUP MODE*** *function (see the* ***AUXILIARY FUNCTIONS / SETUP MODE****).*



The view of the display of the instrument in ANALYZER MODE - the SETUP window

NAME sub-window

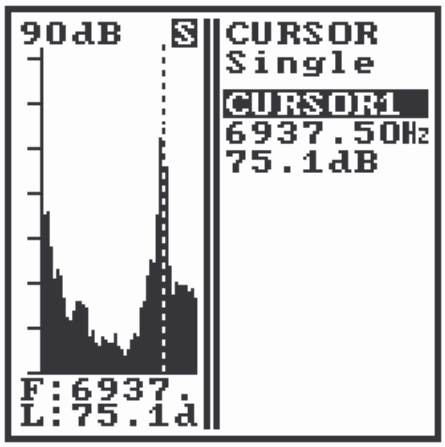
This sub-window enables one to enter the Setup File name. This name can be set in two ways:
- incrementing or decrementing the given file name number (the **<◄>**, **<►>** push-buttons),
- entering new, up to 8-character name, after opening next sub-window (**EDIT**) - cf. the description of the **FILE** window.

CATALOG. (Catalogue) sub-window

This sub-window enables one to check the contents of the Setup Files catalogue (cf. the description of the **FILE** window).

Notice: *The selection of the file from the Setup Files Catalogue can be done by means of the* ***<▲>****,* ***<▼>*** *and <****ENTER****> push-buttons (cf. the description of the* ***FILE*** *window).*

*The **CURSOR** window*



The view of the display in the ANALYZER MODE - the CURSOR:Single window

This window enables the user to make the cursor active in the field of the graphic presentation of the measurement results. In order to move the cursors the **<◄>**, **<►>** push-buttons should be pressed. The following sub-windows can be programmed in the **CURSOR** window for the **FFT** analysis: **CURSOR**, **CURSOR1**, **CURSOR2** and **HARM.NUM.**.

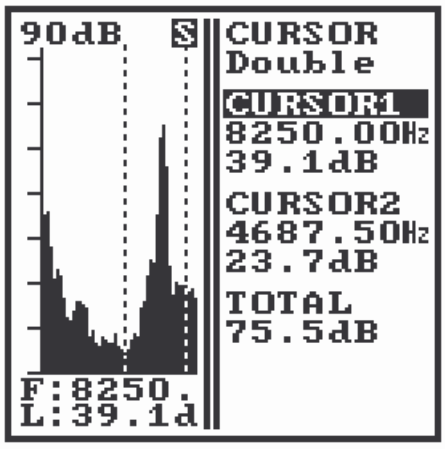
CURSOR sub-window

This sub-window enables the user to choose one from three available types of the cursors:

- **Single**,
- **Double**,
- **Harmonic**.

The Single Cursor is the standard way to read out the value of the spectrum lines.

The Double Cursor enables one to estimate the total value of the lines in the selected (using both cursors) part of the spectrum (in the linear and logarithmic scale). This value is displayed in the **TOTAL** field.



The view of the display in the ANALYZER MODE - the CURSOR:Double window

CURSOR1 sub-window

This sub-window is used to move the cursor in the field of graphic presentation of the measurement results. In order to move cursor the **<◄>**, **<►>** push-buttons should be pressed (the increase of the movement speed is possible with the **<SHIFT>** push-button). The control of the cursor is available when the sub-window is active. The read out of the amplitude and the frequency of the chosen line is also possible in this sub-window.

CURSOR2 sub-window
This sub-window acts as described above but for the second cursor (in the double cursor mode).

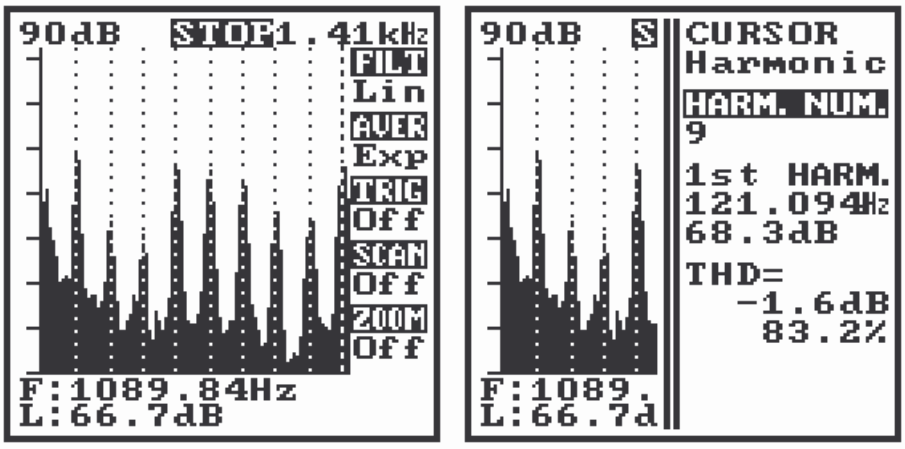
TOTAL field
This field displays the sum value of the spectrum lines (in the linear or logarithmic scale) placed between the both cursors (in the double cursor mode).

Notice: *The selection of the* ***CURSOR1*** *or* ***CURSOR2*** *can also be done* ***without the opening*** *of the* ***CURSOR window****. Pressing the <****SHIFT****> / <****CURSOR****> push-buttons causes the* ***exchange*** *(****<EXCH.>****) of the current active cursor (1 or 2).*

The Harmonic Cursor enables one to identify the harmonic components in the analysed spectrum. The frequency of the fundamental component is calculated in this window with the extended resolution as 1/N fraction of the N^{th} harmonic. Additionally, the estimation of the **TOTAL HARMONIC DISTORTION** (**THD**) value is possible.

$$\mathbf{THD} = \sqrt{\frac{V_2^2 + V_3^2 + \cdots + V_N^2}{V_1^2 + V_2^2 + V_3^2 + \cdots + V_N^2}}$$

where:
V_s - total RMS value of the measured signal,
V_2,..., V_n - RMS values of the harmonic components.



The view of the display in the ANALYZER MODE - the CURSOR:Harmonic window

To set the harmonic cursor position the following steps are required:

1. Select the **Harmonic** in the **CURSOR** sub-window. The **CURSOR1** position will be than interpreted as Fundamental (1^{st}) Harmonic component, as long as 2^{nd} harmonic value is within spectrum band. In the other case 1^{st} harmonic is set in the middle of the spectrum band.
2. Select the number of the harmonic components to be placed on the spectrum in the **HARM.NUM.** sub-window. If the subsequent **HARM.NUM**. value results in harmonic component frequency out of the spectrum band than setting of the such value is blocked.
3. Tuning of the harmonic components positions is done by moving the last (n^{th}) component. That cursor is drawn as standard Single Cursor, whereas other cursors have the different dotted shape.

Notice: *The selection of the* ***ZOOM*** *function or switching off the* ***Spectrum*** *function will result in the* ***"automatic"*** *entering of the* ***Double Cursor mode****.*

*The **DISPLAY** window*

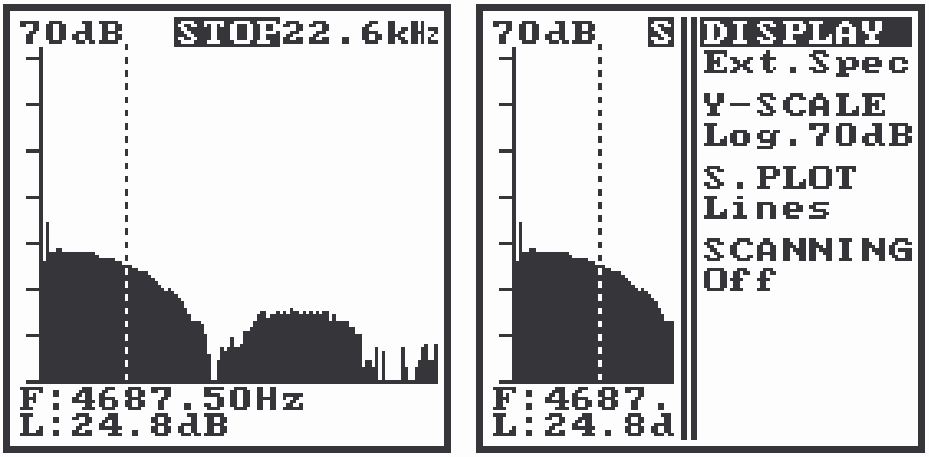
This window enables the user to change the parameters of the graphic presentation of the measurement results.

***Notice**: The shift of the obtained plot (the change of the scale of the screen) from **-70 dB** to **+70 dB** related to the input range (**INPUT / RANGE**) with the **10 dB** steps can be achieved by pressing the **<▲>**, **<▼>** push-buttons when the **DISPLAY window is closed**.*

The following sub-windows can be programmed in the **DISPLAY** window for the **FFT** analysis: **DISPLAY**, **Y-SCALE**, **S.PLOT** and **SCANNING**.

DISPLAY sub-window

This sub-window enables the user to select the number of the FFT lines presented on the screen. Setting **DISPLAY:Spectrum** results in 96 FFT lines presentation. Setting **DISPLAY:Ext.Spec.** (Extended Spectrum) will present 120 FFT lines on the screen.



The view of the display in the ANALYZER MODE - window DISPLAY:Ext.Spec

***Notice**: The first displayed spectrum line can be the value of 0 Hz line calculated from the FFT algorithm or calculated in the time domain the RMS value for the time period for which the spectrum was taken. The meaning of this line is defined in **AUX.FUNCTIONS / TOTAL LINE:On** (the RMS value) or **Off** (*

Y_SCALE (the scale of the vertical axis "Y") sub-window

This sub-window enables the user to choose the scale on the vertical axis of the spectrum. The following possibilities are for the FFT spectrum presentations:

Log35dB the spectrum is drawn with the dynamics of 35 dB,

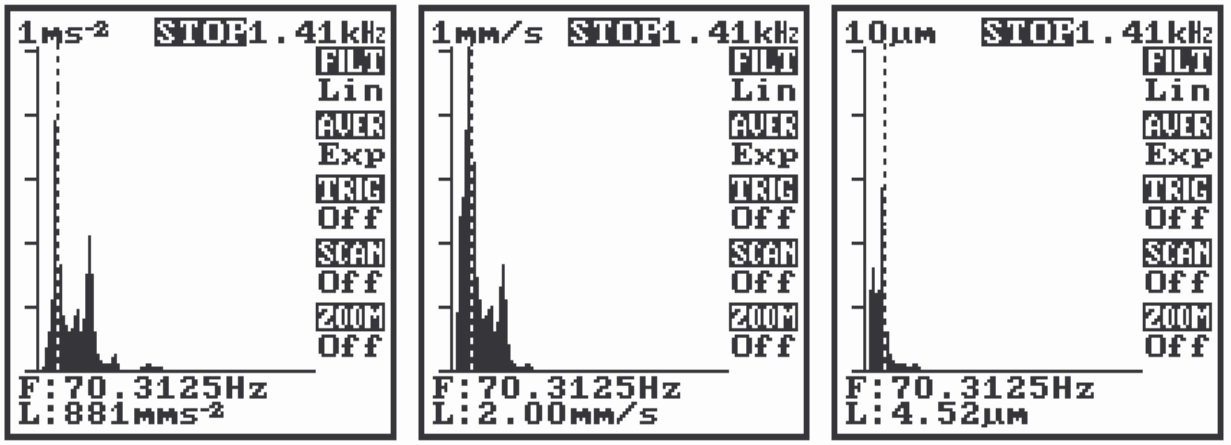
Log70dB the spectrum is drawn with the dynamics of 70 dB,

Lin the spectrum is drawn in the linear scale,

Velocity the spectrum of the speed of the vibration is drawn (it means the spectrum of the acceleration multiplied by the coefficient $\mathbf{1/\omega}$),

Displac. the spectrum of the displacement of the vibration is drawn (it means the spectrum of the acceleration multiplied by the coefficient $\mathbf{1/\omega^2}$).

***Notice**: If the dynamics of the measured signal overpasses the dynamics of the instrument's screen (e.g. with the dynamics of 35 dB) the observation of the whole spectrum can be achieved shifting the maximum value of the figure on the basic window level (cf. above). For the linear scale it conforms to the **multiplication** of the figure by the coefficients (**3.16**, **10**, **31.6** e.t.a.).*



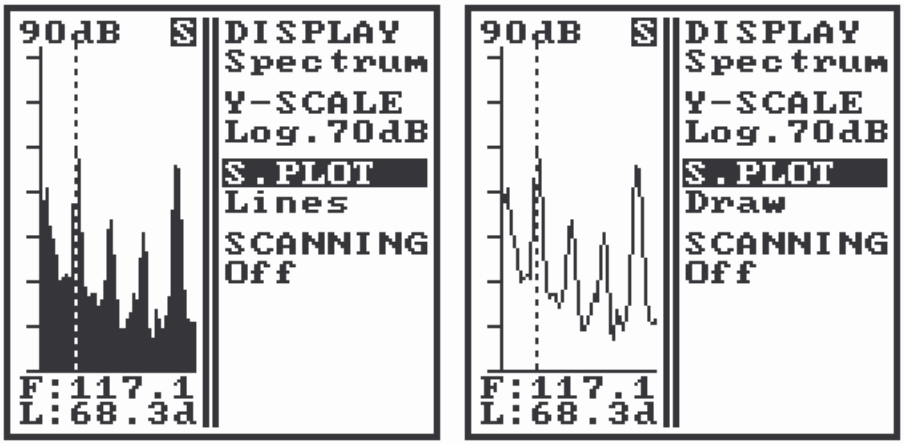
The view of the display in the ANALYZER MODE - the linear scale for Vibration spectrum

The Linear Display scale is a default for the acceleration spectra, for the velocity spectra and for the displacement spectra.

S.PLOT (The Spectrum "Plot Type") sub-window

This sub-window enables the user to choose the type of the FFT spectrum drawing:

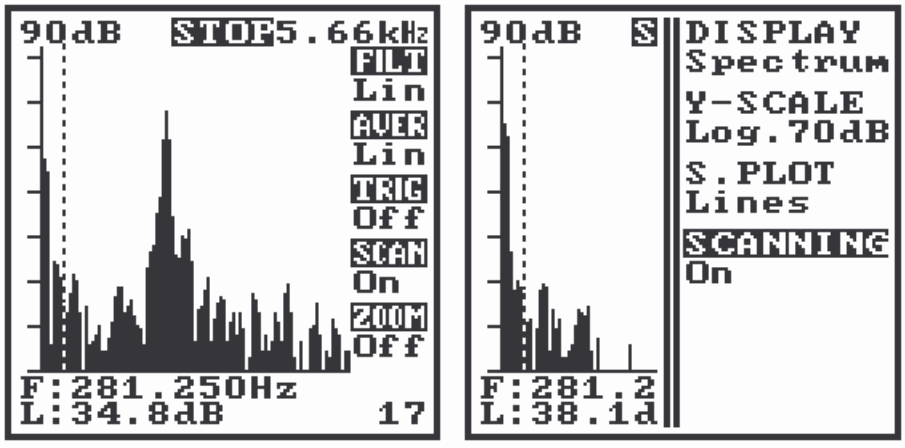
- standard **lines** or
- special **draw** (this type of plotting is available only for the **Spectrum** and **Time** functions).



The view of the display in the ANALYZER MODE - the DISPLAY / S.PLOT:Draw and Lines sub-windows

SCANNING sub-window

This sub-window enables the user to display the **FFT spectra** stored in the **SCAN.BUFFER** (c.f. the description of the **AVERAGING** sub-window).



The view of the display in the ANALYZER MODE - SCANNING:On and the 17th spectrum from the SCAN.BUFFER

***Notice**: The **SCANNING** can be set to **On** after the end of the averaging process (**STOP** mode) in which the registration of the consecutive spectra in the buffer was performed. The selection of the spectrum from the **SCAN.BUFFER** can be achieved pressing the **<SHIFT> / <▲>** or **<SHIFT> / <▼>** push-buttons when the control windows are closed.*

*The **ZOOM** window*

This window enables one to perform the frequency analysis with the digital frequency conversion up to the band of **11.3 kHz**. The maximum attainable resolution in the frequency domain is in this case equal to:

$$\Delta \mathbf{f} \cong 1{,}38[\mathbf{Hz}]/120 \cong 0{,}0114[\mathbf{Hz}]$$

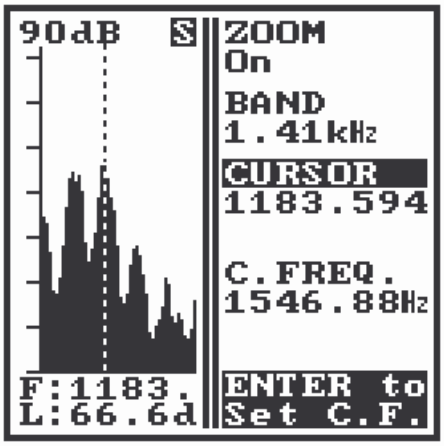
***Notice:** In the zoom mode the number of spectrum lines is always equal to 120. The **ZOOM** window can not be pulled down (activated) in the other case.*

The following sub-windows can be programmed after pulling down (entering) the window: **ZOOM**, **BAND** and **CURSOR**.

ZOOM sub-window

This sub-window enables one to switch on (**On**) or off (**Off**) the zoom function in the **ZOOM** window (the **<◄>**, **<►>** push-buttons when the window is active).

***Notice**: The zoom function **can not be activated** for the analysis in the bands of **22.6 kHz** and **45.3 kHz**.*



The view of the display in the ANALYZER MODE - the ZOOM window

BAND sub-window

This sub-window enables the user to change the band of the zoom analysis. It is possible to choose any band from **5.66 kHz** to **1.38 Hz**. The zoom band is set to the half of the basic band (e.g. the band which was active just before the switching on the zoom function) or to the value which was previously chosen by the user.

CURSOR sub-window

This sub-window is used to make the cursor active in the field of the graphic presentation of the measurement results. In order to move the cursors the **<◄>**, **<►>** push-buttons should be pressed (the step of the movement is increased pressing the **<SHIFT>** push-button).

C.FREQ field

The Centre Frequency points the centre value of the zoom frequency. In this way the centre of the band for the frequency conversion is determined. This value is programmed after the cursor setting in the desired place and pressing the **<ENTER>** push-button. The frequency displayed in the **CURSOR** sub-window is taken as the **C.FREQ** value.

*The **REPORTS** window*

This window is not active for the FFT analysis (**Spectrum function**).

*The **FILE** window*

This window enables the user to perform the operations on the data files coming from the **FFT** analysis. In particular it is possible to store the instantaneous or averaged spectrum.

The following sub-windows can be programmed in the **FILE** window: **FILE OP.**, **FILENAME** and **CATALOG.**

FILE OP. sub-window

This sub-window enables the user to choose the type of the file operation which has to be done. It has the following list of the options: **Save**, **SaveNext**, **Save_Buf**, **Load** and **Erase**, which are executed after pressing the **<ENTER>** push-button.

Save option

It enables one to store the currently displayed spectrum (an **exception: the spectra from SCAN.BUFFER when SCANNING is On**) in the internal memory of the instrument. The stored files have their own names given in the **FILENAME** sub-window (see below).

SaveNext option

It enables one to store the currently displayed spectrum. The stored file has automatically incremented **FILENAME** (as long as total number of the FILENAME characters will not exceed 8).

Save_Buf option

It enables one to store the series of the analysed spectra, recorded in the **SCAN.BUFFER**, in the instrument's internal memory The stored files have their own names given in the **FILENAME** sub-window (see below).

Load option

It enables the user to display on the screen the stored spectrum.

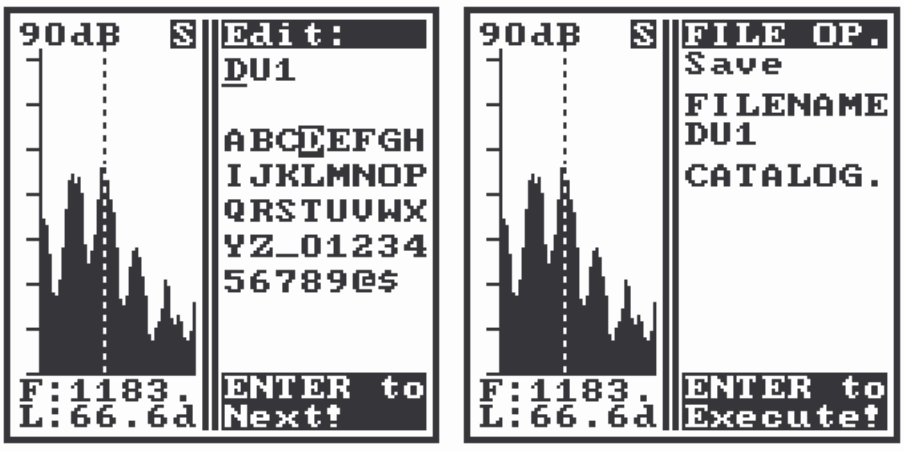
***Notice**: Together with the spectrum all its parameters and settings are restored (it means those which where saved during the execution of the **Save** option).*

Erase option

It enables one to delete a file from the memory. The user has to enter the **AUXILIARY FUNCTIONS MODE** in order to erase all files from the memory.

FILENAME sub-window

This sub-window enables one to set the file name for the **Save**, **Load** and **Erase** options. The maximum number of characters in the FILENAME is eight. This sub-window has two control levels:



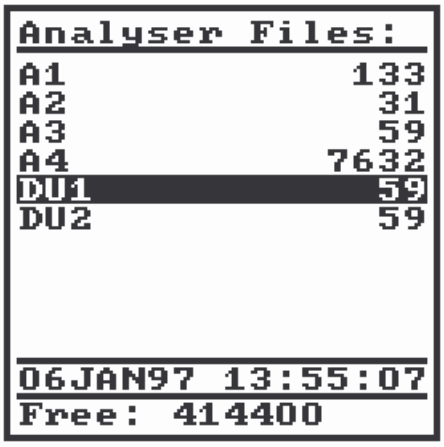
The view of the display in the ANALYZER MODE - the Edit and FILE OP sub-windows

- on the first level the file name number can be incremented or decremented (by means of the **<◀>**, **<▶>** push-buttons), e.g.: RESULT1, RESULT2, RESULT3 e.t.a.
- on the second level, available after the **EDIT** sub-window opening (the **<ENTER>** push-button with the **FILENAME** window active), eight character file name can be defined. The entering of the desired name is possible by the character selection (the **<ENTER>** and **<◀>**, **<▶>**, **<▲>**, **<▼>** push-buttons) from the list printed on the screen.

CATALOG.(Catalogue) sub-window

This sub-window enables one to overview the list of the stored files and to estimate the size of the free, unoccupied, internal memory. The catalogue is available after pressing the **<ENTER>** push-button. The return from the catalogue occurs after pressing the **<ESC>** one.

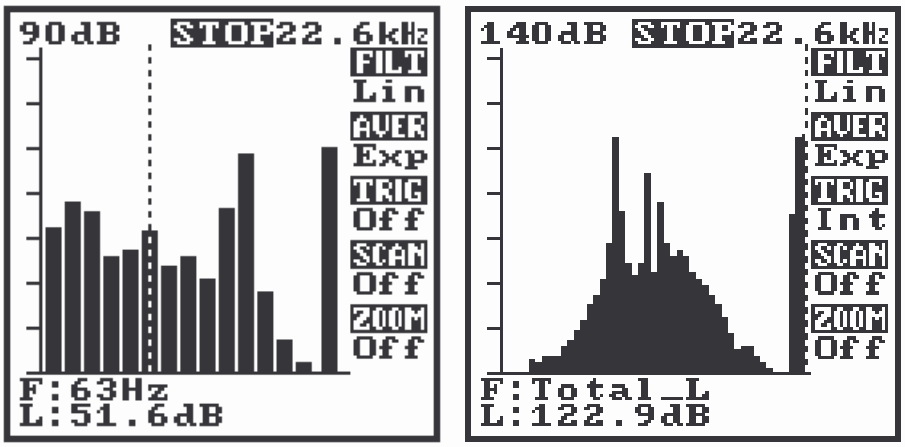
***Notice**: The selection of the file from the CATALOGUE (for the **Save**, **Load** or **Erase** option) can be achieved by choosing the proper file name (displayed "inversely") and pressing the **<ENTER>** push-button.*



The view of the display in the ANALYZER MODE - the CATALOG. Sub-window

5.2 Frequency analysis in 1/1 & 1/3 octave bands

The instrument is able to perform frequency analysis in 1/1 & 1/3 octave bands after setting **FUNCTION: 1/1 Oct.** or **1/3 Oct.** in the **FUNCTION** window. 1/1 octave analysis is made in the frequency bands from 2 Hz to 16 kHz plus the total RMS value for the selected weighting filter. 1/3 octave analysis is done in frequency bands from 1 Hz to 20 kHz plus the total RMS value for the selected weighting filter.



The view of the instrument's display in the ANALYZER MODE – 1/1 Octave function and 1/3 Octave function

For the **Microphone** and **Direct** inputs three total RMS values for the **A**, **C** and **Lin** weighting filters (so called respectively – **Total_A**, **Total_C** and **Total_L**) are calculated and displayed additionally.

For the **Microphone** and **Direct** inputs, for each 1/3 octave spectrum, three total RMS values for the **Impulse**, **Fast** and **Slow** time constant detectors (so called respectively – $\mathbf{RMS_{Impulse}}$, $\mathbf{RMS_{Fast}}$ and $\mathbf{RMS_{Slow}}$) are calculated but not displayed. These values are stored in the buffer containing spectra and in the files.

*The **FUNCTION** window*

The following sub-windows are available and can be programmed in this window: **FUNCTION**, **RMS_DET**, **A.REPEAT**, **ΔINTEGR.**, **AVERAG.** and **AV.TIME**.

RMS_DET. (**RMS detector**) sub-window
This sub-window enables the user to select the **RMS detector type**: **Linear** (**Lin**), **Impulse** (**Imp**), **Fast** or **Slow**. Selected RMS detector is placed on the output of each 1/1 or 1/3 octave filter. The output of each detector is averaged according to the settings of the **AVERAG.** and **ΔINTEGR.** control windows (see below).

The Linear detector calculates the exact RMS value of so-called "elementary results" with **ΔINT** (integration time) equal to **1/128 s**.

The Impulse detector - gives the result, which is an equivalent to the analogue RMS detector operation with the integration time constant "**Impulse**" according to the IEC 651. The output of this detector is subsequently averaged linearly with the **ΔINT** integration step.

The Fast detector - gives the result, which is an equivalent to the analogue RMS detector operation with the integration time constant "**Fast**" according to the IEC 651. The output of this detector is subsequently averaged linearly with the **ΔINT** integration step.

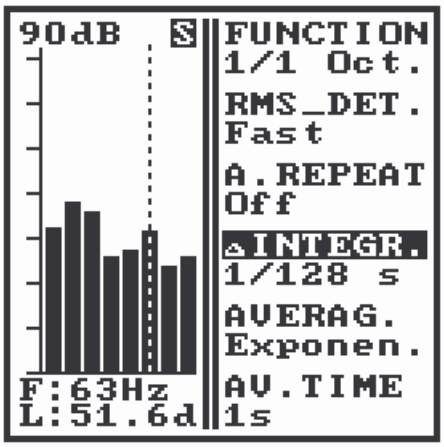
The Slow detector - gives the result, which is an equivalent to the analogue RMS detector operation with the integration time constant "**Slow**" according to the IEC 651. The output of this detector is subsequently averaged linearly with the **ΔINT** integration step.

Calculations of the given exponential detector type is done according to the formula:

$$\mathbf{R_i} = \{(\mathbf{N}-1)\mathbf{R_{i-1}} + \mathbf{L_i}\}/\mathbf{N}$$

where:
$R_1 = L_1$;
R_i - the subsequent averaged results;
L_i - the result of the linear averaging of the input data samples for every 1/128 second period;
i = 2, 3, ... ;
N - constant corresponding to the current integration time constant (**Impulse**, **Fast** or **Slow**).

The sequence of the linear averaging results for every 1/128 second period (the L_i values) constitutes the output of the linear detector.



The view of the display in the ANALYZER MODE - the FUNCTION window with 1/1 Octave analysis selected

A.REPEAT (Auto Repeat) sub-window

This sub-window describes the way of the registration of the measurement results (recording):

- **On** - auto repeat of the measurement cycle (the continuous work),
- **Off** - the registration of the single measurement.

Notice: *The setting of the **A.REPEAT** influences the recording of the spectra in buffer (called **AutoSpectra Buffer**):*
*- when **A.REPEAT is ON** the subsequent **spectra, averaged over the AV.TIME**, are stored in the buffer (the measurement procedure is repeated automatically);*
*- when **A.REPEAT is Off** the subsequent **spectra, averaged over the ΔINTEGR.**, are stored in the buffer (the measurement procedure is stopped after **AV.TIME**).*

ΔINTEGR. (**Elementary Integration Time**) sub-window

This sub-window enables the user to select the elementary integration time of the selected detector from the following values:
1/128 s, **1/64 s**, **1/32 s**, **1/16 s**, **1/8 s**, **1/4 s** or **1/2 s**.

The subsequent **$RMS_{\Delta INTEGR}$.** values are calculated from the formulae:

$$\mathbf{X_k} = \{(\mathbf{k}-1)\mathbf{X_{k-1}} + \mathbf{R_k}\}/\mathbf{k}$$

where:
$X_0 = 0$;
X_k - the subsequent averaged results;
R_k - the result taken from the selected RMS detector (**Linear**, **Impulse**, **Fast** or **Slow**) every 1/128 s;
k = 1, 2, 3, ..., K;
K - corresponds to the current value of **ΔINTEGR.**; $\mathbf{K} = \Delta\mathbf{INTEGR}/(1/128\mathbf{s})$.

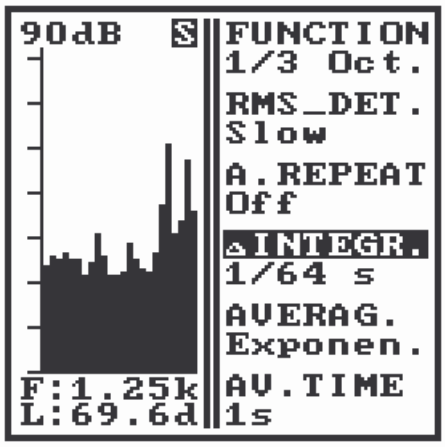
Notice: *Setting of the elementary integration time (**ΔINTEGR.**) is essential for:*
***- the statistical analysis**,*
***- the contents of the AutoSpectra Buffer** (when **A. REPEAT is Off**).*

AVERAG. sub-window

In this sub-window the type of the averaging of the measurement signal can be selected from: **Fast HM.**, **Fast Lin.**, **Off**, **Linear**, **Exponen.** or **Hold Max**.

- **Fast HM.** means the Fast Registration (without displaying the current values during the averaging process) of the Maximal Values,
- **Fast Lin.** means the Fast Linear Averaging (without displaying the current values during the averaging process),
- **Off** means that the Averaging is off,
- **Linear** means the Linear Averaging (with displaying the current averaged values during the data collection),
- **Exponen.** means the Exponential Averaging,
- **Hold Max** means the Registration of the Maximal Values (with displaying the current averaged values during the data collection).

Notice: *In the field of the instrument's status presentation the types of the averaging are denoted in the following way: **Lin** – for the linear averaging, **Exp** – for the exponential averaging, **HM** – for the registration of the maximal values, **FL** – for the fast linear averaging, **FHM** – for the fast registration of the maximal values.*



The view of the display in the ANALYZER MODE - the FUNCTION window with 1/3 Octave analysis selected

During the **linear averaging** (**Linear**) the average value of the consecutive 1/1 or 1/3 octave analysis results is calculated due to the formula:

$$\mathbf{Y_n} = \{(\mathbf{n}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{n}$$

where:
$Y_0 = 0$;
Y_n - the consecutive averaged 1/1 or 1/3 octave analysis results;
X_n - the consecutive values of $RMS_{\Delta INTEGR.}$;
n = 1, 2, ..., N;
N - conforms to the value set in the **AV.TIME**, **N=AV.TIME / ΔINTEGR.**

This formula describes the recursive way of the mean value calculation and enables one the observation of the averaged process. In the **Fast Linear Averaging** (**FL**) the consecutive $\mathbf{Y_n}$ results of the calculations **are not displayed**. The final result appears on the screen **after the collection** of the desired number (**N**) of the measurements.

Notice: *The averaged 1/1 or 1/3 octave analysis results are **stored** in the **SCAN. BUFFER** (**till the buffer is filled-up or the averaging is stopped**). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the **SCANNING** function (see below).*

The exponential averaging (**Exponen.**) means the calculation of the time weighted 1/1 or 1/3 octave analysis result, which is an equivalent to the analogue RMS detector operation with the time constant set in the **AV.TIME**. The exponential averaging is performed due to the formula:

for $n \le N$:

$$\mathbf{Y_n} = \{(\mathbf{n}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{n}$$

for $n > N$:

$$\mathbf{Y_n} = \{(\mathbf{N}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{N}$$

where:
$Y_0 = 0$;
Y_n - the consecutive averaged 1/1 or 1/3 octave analysis results;
X_n - the consecutive values of $RMS_{\Delta INTEGR.}$;
n = 1, 2, 3, ...;
N = AV.TIME / ΔINTEGR.

Notice: *The averaged **1/1** or **1/3 octave** analysis results are stored in the **SCAN. BUFFER** All last instantaneous results are stored (**in the "circular" way - the last results are stored if the buffer is too short**). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the **SCANNING** function (see below).*

The registration of the maximal values (**Hold Max**) enables the user to store the greatest values of 1/1 or 1/3 octave analysis results which occurred during the given period of the averaging. The **fast registration of the maximal values** mode is similar to one described above, but only the final result is displayed (after the collection of all data).

Notice: *The averaged **1/1** or **1/3 octave** analysis results are **stored** in the **SCAN. BUFFER** (**till the buffer is filled-up or the averaging is stopped**). Afterwards, the buffer contents can be displayed on the instrument's screen by means of the **SCANNING** function (see below).*

The measurement is automatically stopped when any kind of averaging is chosen and the **STOP** text is displayed. It means that the **<START / STOP>** push-button has to be pressed in order to start the measurements with the averaging. In the case of the linear averaging and the registration of the maximal values the process is stopped after the gathering of the desired number of measurements. In the case of the exponential averaging the measurements are performed continuously and can be stopped by pressing the **<START / STOP>** push-button.

AV.TIME sub-window

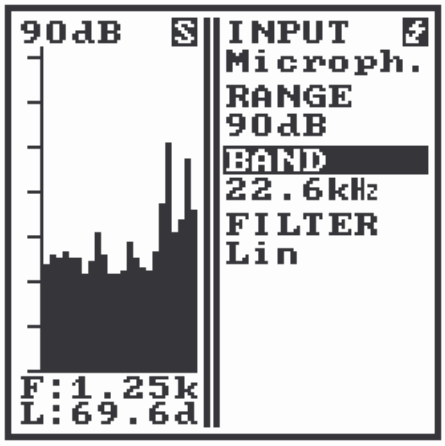
This sub-window enables the user to set time of the averaging. It is possible to select value from **1 s** to **60 min** (with **1 s** step).

*The **INPUT** window*

This window enables the user to select for **1/1** or **1/3 octave** analysis the source of the signal (the **INPUT** sub-window, the range of the signal (the **RANGE** sub-window), its band (the **BAND** sub-window) and the weighting filter (the **FILTER** sub-window).

INPUT sub-window

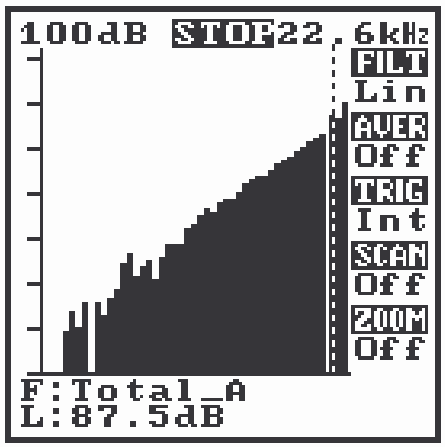
This sub-window enables the user to choose the source of the measured signal (the choice of the measurement input). The following sources are available:



The view of the display in the ANALYZER MODE - the INPUT window in 1/3 Octave analysis

- **Reference** the internal source of the binary pseudo-random signal,
- **Microph.** the microphone input (the signal from the external condenser microphone preamplifier, e.g. from the SV 01A),
- **Direct** the direct, voltage input,
- **Charge** the input of the charge piezoelectric transducer,
- **Acceler.** the input from the IEPE vibration transducer typed (with the built-in charge preamplifier),

The proper input is chosen by the use of the **<◄>**, **<►>** push-buttons after the activation of the sub-window.



The view of the display in the ANALYZER MODE - the Reference input selected in 1/3 Octave analysis

RANGE sub-window

This sub-window enables the user to select the measurement input range (the input gain or attenuation). There are four measurement ranges (in 20 dB steps), which are defined as below:

- for sound measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **20 μPa**) calibrated for the microphone with the sensitivity of **50 mV / Pa**;
- for voltage measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **1 μV**);

- for vibration acceleration measurement: **316 mms^{-2}**, **3.16 ms^{-2}**, **31.6 ms^{-2}** or **316 ms^{-2}** (in **dB** respectively: **110 dB**, **130 dB**, **150 dB** or **170 dB**; the value in **dB** related to **1 μms^{-2}**) calibrated for the accelerometer with the sensitivity of **10 mV / ms^{-2}** or **10 pC / ms^{-2}**. For the non-metric units see Chap. 7.

BAND sub-window

This sub-window shows the band **22.6 kHz** in which the measurements are performed in the case of **1/1** or **1/3 octave** analysis.

FILTER sub-window

This sub-window enables the user to choose one of the weighting filters: **Lin**, **A**, **C** or **HP**.

*The **TRIGGER** window*

This window is not active for 1/1 and 1/3 octave analysis.

*The **SETUP** window*

In the **SETUP** window the following sub-windows are available: **SETUP OP**, **NAME** and **CATALOG**.

SETUP OP sub-window

This sub-window enables the user to store (**Save**), recover (**Load**) and delete (**Erase**) the instrument's control configuration file (so-called "Setup File"). This file contains the following parameters:
- the measurement input,
- the polarisation of the microphone,
- the measurement range,
- the measurement band,
- the type of triggering,
- the level of the trigger,
- the display range,
- the weighting filter,
- the measurement function,
- the recording mode,
- the number of the lines in the spectrum,
- the FFT window,
- the averaging mode,
- the averaging time,
- the averaging number,
- the cursor mode,
- the displayed range,
- the display scale,
- the spectrum plot type,
- the zoom mode,
- the zoom band,
- the zoom state,
- the settings of the calibration (the type and the coefficient).

***Notice:** After powering the instrument and the **ANALYZER MODE entering** the default or the **last used user's Setup File** is automatically loaded. The user's Setup File loading can be disabled by means of the **SETUP MODE** function (see the **AUXILIARY FUNCTIONS / SETUP MODE**).*

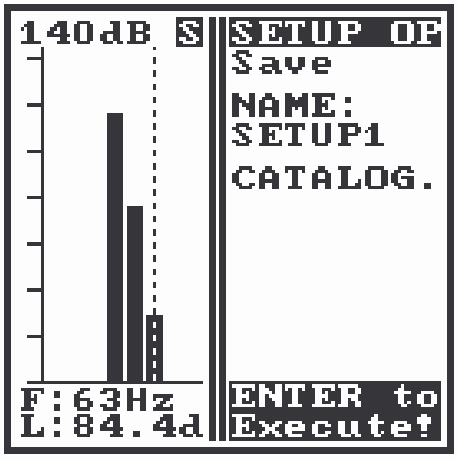
NAME sub-window

This sub-window enables one to enter the Setup File name. This name can be set in two ways:
- incrementing or decreasing the given file name number (the **< ◄ >**, **< ► >** push-buttons),
- entering new, up to 8-character name, after opening next sub-window (**EDIT**) - cf. the description of the **FILE** window.

CATALOG. (Catalogue) sub-window

This sub-window enables one to check the contents of the Setup Files catalogue (cf. the description of the **FILE** window).

Notice: *The selection of the file from the Setup Files Catalogue can be done by means of the* ***< ▲ >****,* ***< ▼ >*** *and <****ENTER****> push-buttons (cf. the description of the* ***FILE*** *window).*



The view of the display of the instrument in ANALYZER MODE - the SETUP window

*The **CURSOR** window*

This window enables the user to make the cursor active in the field of the graphic presentation of the measurement results. In order to move the cursors the **< ◄ >**, **< ► >** push-buttons should be pressed. The following sub-windows can be programmed in the **CURSOR** window for **1/1 or 1/3 octave** analysis: **CURSOR**, **CURSOR1** and **CURSOR2**.

CURSOR sub-window

This sub-window enables the user to choose one from two available types of the cursors:
- **Single**,
- **Double**.

The Single Cursor is the standard way to read out the results of **1/1** or **1/3 octave** analysis.

The Double Cursor enables one to estimate the total value of the lines in the selected (using both cursors) part of 1/1 or 1/3 octave analysis (in the linear and logarithmic scale). This value is displayed in the **TOTAL** field.

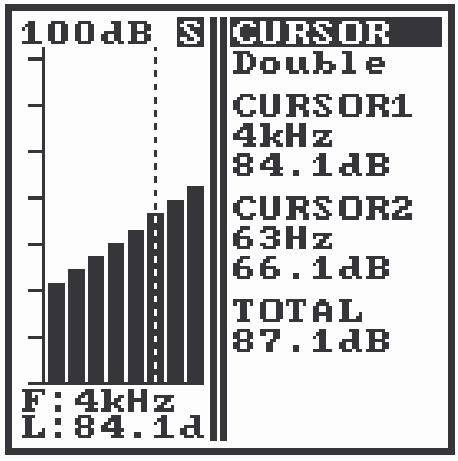
Notice*: The value in the* ***TOTAL*** *field is different then* ***Total line in 1/1 or 1/3 octave*** *analysis results. The Total line gives the* ***RMS*** *value of the input signal (for different weighting filters) calculated in the time domain (cf. the* ***METER MODE****)!*

CURSOR1 sub-window

This sub-window is used to move the cursor in the field of graphic presentation of the measurement results. In order to move cursor the **<◄>**, **<►>** push-buttons should be pressed (the increase of the movement speed is possible with the **<SHIFT>** push-button). The control of the cursor is available when the sub-window is active. The read out of the amplitude and the frequency of the chosen line is also possible in this sub-window.

CURSOR2 sub-window

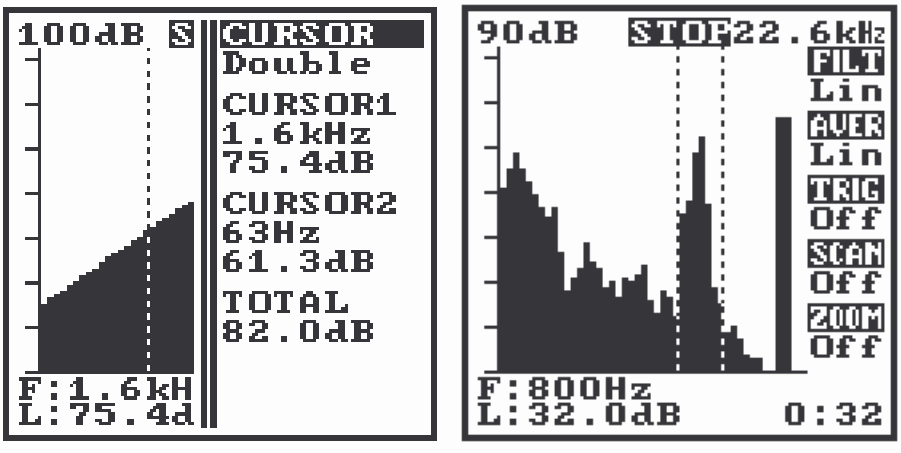
This sub-window acts as described above but for the second cursor (in the double cursor mode).



The view of the display in the ANALYZER MODE - the CURSOR window in 1/1 Octave analysis

TOTAL field

This field displays the sum value of 1/1 or 1/3 octave lines (in the linear or logarithmic scale) placed between the both cursors (in the double cursor mode).



The view of the display in the ANALYZER MODE - double cursor in 1/3 Octave analysis

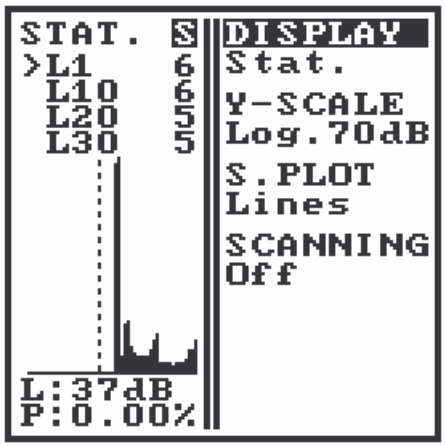
Notice: *The selection of the* ***CURSOR1*** *or* ***CURSOR2*** *can also be done* ***without the opening*** *of the* ***CURSOR window****. Pressing the <****SHIFT****> / <****CURSOR****> push-buttons causes the* ***exchange*** *(****<EXCH.>****) of the current active cursor (1 or 2).*

*The **DISPLAY** window*

This window enables the user to change the parameters of the graphic presentation of the measurement results. The following sub-windows can be programmed in the **DISPLAY** window for **1/1** or **1/3 octave** analysis: **DISPLAY**, **Y-SCALE**, **S.PLOT** and **SCANNING**.

DISPLAY sub-window

This sub-window enables the user to switch between **1/1** or **1/3 octave** analysis results and statistics for the selected spectrum band (or Total RMS with **A**, **C** and **Lin** weighting filter). The proper parameter is chosen using the **<◄ >**, **<► >** push-buttons, when the sub-window is active.

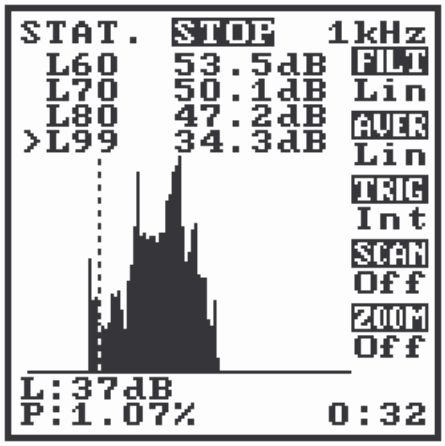


The view of the display in the ANALYZER MODE - the DISPLAY:Stat. window in 1/1 Octave analysis

The statistical analysis function gives the statistical distribution of the levels (so-called "histogram") for each **1/1** or **1/3 octave** band and Total RMS calculated with **A**, **C** and **Lin** weighting filters.

The histogram is divided into **88 classes**, each of **1 dB** wide.

Notice: *The statistical distribution function is calculated for the measurement results obtained for the elementary integration time (**ΔINTEGR.** or **AV.TIME**).*



The view of the display in the ANALYZER MODE – Statistics in 1/1 Octave analysis

Read out of the histogram values can be achieved by means of the **<◄ >** and **<► >** push-buttons:

- **P:** gives the probability (in percentage) of the level in the selected class;
- **L:** gives the selected class value;

Additionally, ten another statistical values are displayed:

- **L_{X1}:** gives class value for which cumulative distribution function of the histogram is equal to X1 (in %).
- **L_{X2}:** gives class value for which cumulative distribution function of the histogram is equal to X2 (in %).

.....

- **L_{X10}:** gives class value for which cumulative distribution function of the histogram is equal to X10 (in %).

Notice: *The X1, X2 and X10 values can be controlled by means of the* **<▲>**, **<▼>** *and* **<SHIFT>** / **<◀>** *or* **<SHIFT>** / **<▶>** *push-buttons.*

Notice*: Switching between statistics can be done using <****SHIFT****> and* **<▲>**, **<▼>** *push-buttons (when the* ***DISPLAY window is closed****).*

Notice*: All* ***statistics*** *together with the* ***1/1*** *or* ***1/3 octave*** *analysis results, their parameters and settings are stored by the* ***Save*** *option* ***when DISPLAY:Stat.*** *is selected.*

Y_SCALE (the scale of the vertical axis "Y") sub-window

This sub-window enables the user to choose the scale on the vertical axis of **1/1** or **1/3 octave** analysis results presentation. The following possibilities are available:

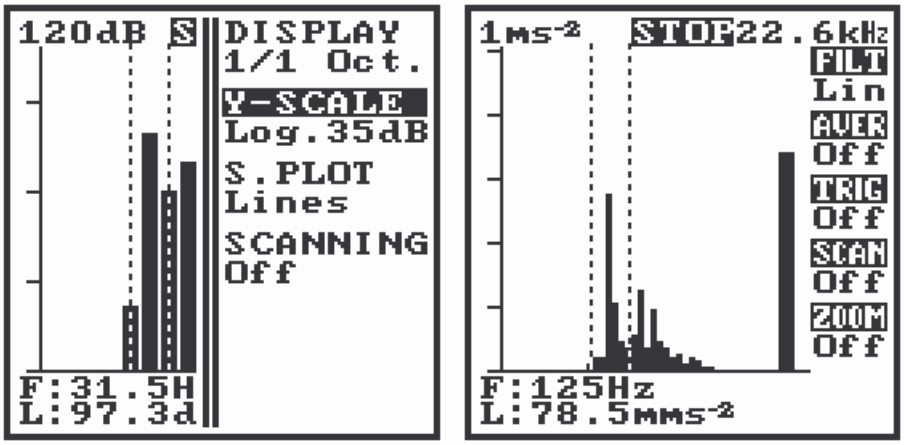
Log35dB 1/1 or 1/3 octave analysis results are drawn with the dynamics of 35 dB,

Log70dB 1/1 or 1/3 octave analysis results are drawn with the dynamics of 70 dB,

Lin 1/1 or 1/3 octave analysis results are drawn in the linear scale,

Velocity 1/1 or 1/3 octave analysis results of the speed of the vibration are drawn (it means the results of the acceleration are multiplied by the coefficient **1/ω** for the corresponding centre frequency),

Displac. 1/1 or 1/3 octave analysis results of the displacement of the vibration are drawn (it means the results of the acceleration are multiplied by the coefficient **$1/\omega^2$** for the corresponding centre frequency).

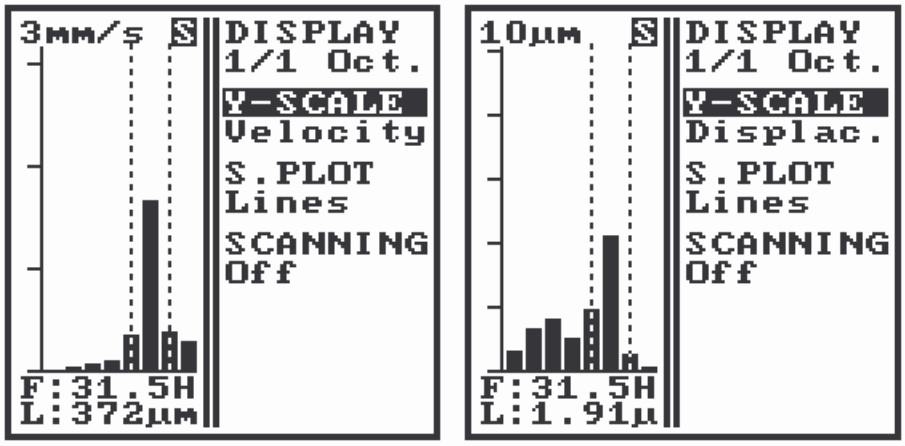


The view of the display in the ANALYZER MODE - the DISPLAY window in 1/1 octave analysis and the linear scale for the acceleration of vibration

Notice*: If the dynamics of the measured signal overpasses the dynamics of the instrument's screen (e.g. with the dynamics of 35 dB) the observation of the whole spectrum can be achieved shifting the maximum value of the figure on the basic window level (cf. above). For the linear scale it conforms to the* ***multiplication*** *of the figure by the coefficients (****3.16****,* ***10****,* ***31.6*** *e.t.a.).*

***Notice**: Shifting graphical presentation (plot) on the screen (in the range from –70 dB to +70 dB) can be achieved by pressing the **<▲>**, **<▼>** push-buttons when the **DISPLAY window is closed**.*

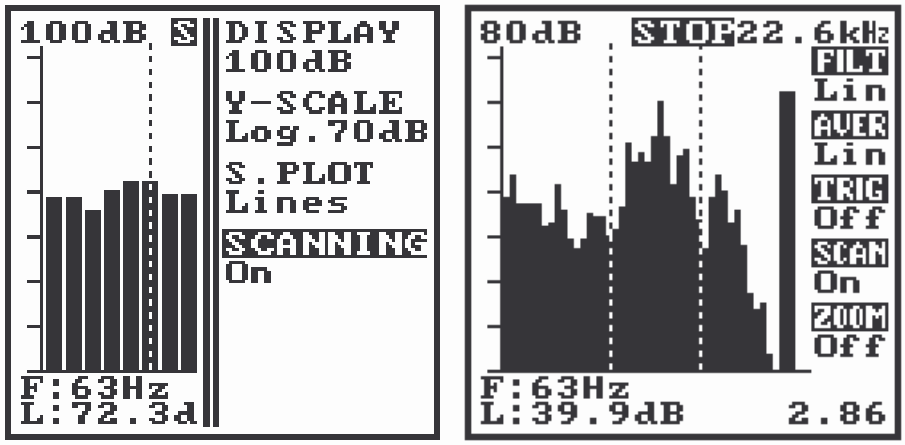
***Notice**: If the dynamics of the measured signal overpasses the dynamics of the instrument's screen (e.g. with the 35 dB dynamics) the observation of the whole spectrum can be achieved by shifting the maximum value of the figure on the basic window level (cf. above). For the linear scale it conforms to the **multiplication** of the figure by the coefficients (**3.16**, **10**, **31.6** e.t.a.).*



The view of the display in the ANALYZER MODE - the linear scale for velocity and displacement of vibration

S.PLOT (The Spectrum "Plot Type") sub-window
This sub-window is not active for 1/1 or 1/3 octave analysis (only one setting is available: **Lines**).

SCANNING sub-window
This sub-window enables the user to display 1/1 or 1/3 octave analysis results stored in the **SCAN.BUFFER** (c.f. the description of the **AVERAGING** sub-window).



The view of the display in the ANALYZER MODE - the DISPLAY window with the SCANNING:On selection and 1/3 octave analysis results stored in the buffer in time equal to 2.86 sec.

***Notice**: The **SCANNING** can be set to **On** after the end of the averaging process (**STOP** mode) in which the registration of the consecutive results in the buffer was performed. The selection of the results from the **SCAN.BUFFER** can be achieved pressing the **<SHIFT> / <▲>** or **<SHIFT> / <▼>** push-buttons when the control windows are closed.*

*The **ZOOM** window*

This window is not active for **1/1** or **1/3 octave** analysis

*The **REPORTS** window*

This window enables one to read out all results of **1/1** or **1/3 octave** analysis.

***Notice**: The scrolling of the report is possible by means of the **<▲>**, **<▼>** push-buttons.*

1/1 Oct. Report:	
2Hz	62.9dB
4Hz	62.2dB
8Hz	64.3dB
16Hz	63.4dB
31.5Hz	67.1dB
63Hz	77.8dB
125Hz	75.2dB
250Hz	73.7dB
500Hz	108.6dB
1kHz	140.5dB
2kHz	113.5dB
4kHz	92.9dB
8kHz	91.8dB

1/3 Oct. Report:	
2Hz	60.3dB
2.5Hz	64.4dB
3.15Hz	59.8dB
4Hz	58.9dB
5Hz	59.3dB
6.3Hz	61.5dB
8Hz	63.1dB
10Hz	63.4dB
12.5Hz	61.2dB
16Hz	59.8dB
20Hz	62.2dB
25Hz	65.1dB
31.5Hz	65.2dB

The view of the display in the ANALYZER MODE - 1/1 octave analysis report and 1/3 octave analysis report

*The **FILE** window*

This window enables the user to perform the operations on the data files coming from the **1/1 and 1/3 octave** analysis. In particular it is possible to store the instantaneous or averaged **1/1** and **1/3 octave** so-called spectrum. The following sub-windows can be programmed in the **FILE** window: **FILE OP.**, **FILENAME** and **CATALOG.**

FILE OP. sub-window

This sub-window enables the user to choose the type of the file operation which has to be done. It has the following list of the options: **Save**, **SaveNext**, **Save_Buf**, **Load** and **Erase**, which are executed after pressing the **<ENTER>** push-button.

Save option

It enables one to store the currently displayed the set of statistics (when selected **DISPLAY:Stat.**) or 1/1 and 1/3 octave spectrum (an **exception: the spectra from SCAN.BUFFER when SCANNING is On**) in the internal memory of the instrument. The stored files have their own names given in the **FILENAME** sub-window (see below).

SaveNext option

It enables one to store the currently displayed spectrum. The stored file has automatically incremented **FILENAME** (as long as total number of the FILENAME characters will not exceed 8).

Save_Buf option

It enables one to store the series of 1/1 or 1/3 octave analysis results, recorded in the **SCAN.BUFFER**, in the instrument's internal memory The stored files have their own names given in the **FILENAME** sub-window (see below).

Load option

It enables the user to display on the screen the stored 1/1 and 1/3 octave analysis results.

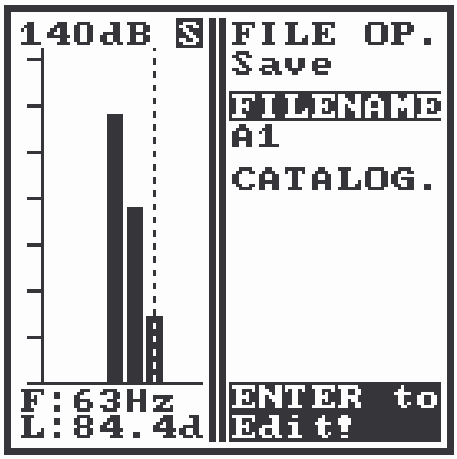
Erase option

It enables one to delete a file from the memory. The user has to enter the **AUXILIARY FUNCTIONS MODE** in order to erase all files from the memory.

***Notice**: Together with the results of 1/1 and 1/3 octave analysis all theirs parameters and settings are restored (it means those which where saved during the execution of the **Save** option).*

FILENAME sub-window

This sub-window enables one to set the file name for the **Save**, **Load** and **Erase** options. The maximum number of characters in the FILENAME is eight. This sub-window has two control levels:

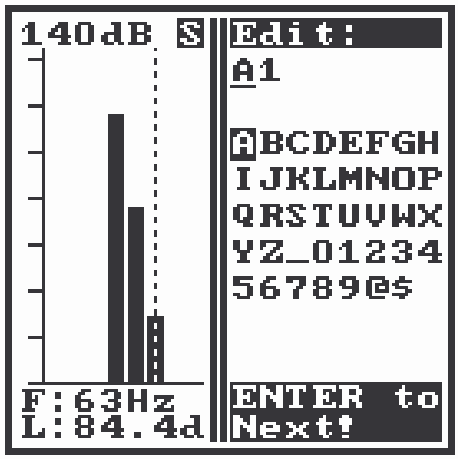


The view of the display in the ANALYZER MODE - the FILE_OP window

- on the first level the file name number can be incremented or decreased (by means of the **<◀>**, **<▶>** push-buttons), e.g.: RESULT1, RESULT2, RESULT3 e.t.a.
- on the second level, available after the **EDIT** sub-window opening (the **<ENTER>** push-button with the **FILENAME** window active), eight character file name can be defined. The entering of the desired name is possible by the character selection (the **<ENTER>** and **<◀>**, **<▶>**, **<▲>**, **<▼>** push-buttons) from the list printed on the screen.

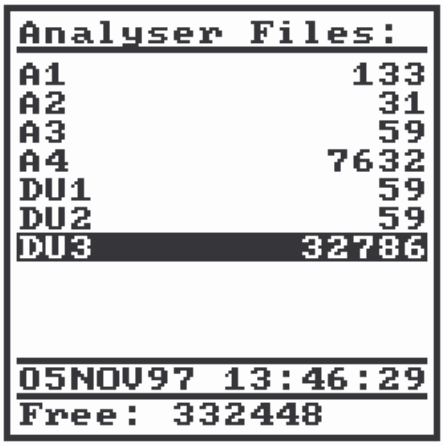
CATALOG.(Catalogue) sub-window

This sub-window enables one to overview the list of the stored files and to estimate the size of the free, unoccupied, internal memory. The catalogue is available after pressing the **<ENTER>** push-button. The return from the catalogue occurs after pressing the **<ESC>** one.



The view of the display in the ANALYZER MODE - the FILE_OP/FILENAME window

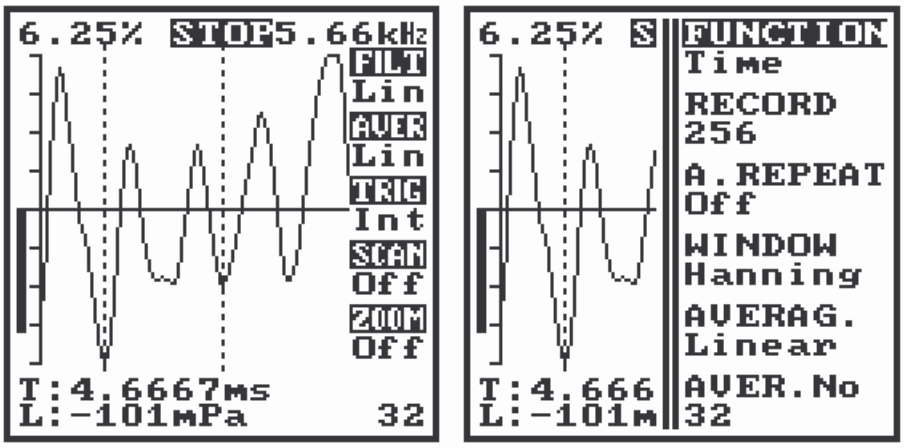
***Notice**: The selection of the file from the CATALOGUE (for the **Save**, **Load** or **Erase** option) can be achieved by choosing the proper file name (displayed "inversely") and pressing the **<ENTER>** push-button.*



The view of the display in the ANALYZER MODE - the FILE_OP/CATALOG. window

5.3 Time wave forms analysis

The instrument can perform time wave form analysis of the measured signal after setting **FUNCTION: Time** - in the **FUNCTION** window.



The view of the display in the ANALYZER MODE - the FUNCTION window with Time analysis

*The **FUNCTION** window*

In the **FUNCTION** window for time wave form analysis the **RECORD**, **A.REPEAT**, **WINDOW**, **AVERAG.** and **AVER.No** sub-windows can be selected and properly set.

RECORD sub-window

In this sub-window the number of signal's samples collected in the buffer in each measurement cycle can be determined. The user can select from the values: **256**, **512**, **1024**, **2048** or **4096**.

A. REPEAT (**Auto Repeat**) sub-window

This sub-window enables (**On**) or disables (**Off**) the automatic repetition of the measurement cycle.

WINDOW sub-window

This sub-window is not active for the time signal analysis.

AVERAG. sub-window

In this sub-window the type of the averaging of the measurement signal can be selected from: **Fast HM.**, **Fast Lin.**, **Off**, **Linear**, **Exponen.** or **Hold Max**.

- **Fast HM.** means the Fast Registration (without displaying the current values during the averaging process) of the Maximal Values,
- **Fast Lin.** means the Fast Linear Averaging (without displaying the current values during the averaging process),
- **Off** means that the Averaging is off,
- **Linear** means the Linear Averaging (with displaying the current averaged values during the data collection),
- **Exponen.** means the Exponential Averaging,
- **Hold Max** means the Registration of the Maximal Values (with displaying the current averaged values during the data collection).

Notice: *In the field of the instrument's status presentation the types of the averaging are denoted in the following way: **Lin** – for the linear averaging, **Exp** – for the exponential averaging, **HM** – for the registration of the maximal values, **FL** – for the fast linear averaging, **FHM** – for the fast registration of the maximal values.*

During the **linear averaging** (**Linear**) the average value of the consecutive input signal record is calculated due to the formula:

$$\mathbf{Y_n} = \{(\mathbf{n}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{n}$$

where:
$Y_0 = 0$;
Y_n - the consecutive averaged signal record;
X_n - the consecutive instantaneous measured signal record;
n = 1, 2, ..., N;
N - conforms to the value set in the **AVER.No** sub-window.

This formula describes the recursive way of the mean value calculation and enables one the observation of the averaged process. In the **Fast Linear Averaging** (**FL**) the consecutive $\mathbf{Y_n}$ results of the calculations **are not displayed**. The final result appears on the screen **after the collection** of the desired number (**N**) of the measurements. This was done in order to expand the real time band of the analysis. In the **Fast Linear Averaging** mode this real time band is equal to 22.6 kHz.

The exponential averaging (**Exponen.**) means that the averaged value of the consecutive input signal record is calculated due to the formula:

$$\mathbf{Y_n} = \{(\mathbf{N}-1)\mathbf{Y_{n-1}} + \mathbf{X_n}\}/\mathbf{N}$$

where:
$Y_1 = X_1$;
$N \geq 2$;
Y_n - the consecutive averaged signal record;
X_n - the consecutive instantaneous input signal record;
n = 2, 3, ...,
N - conforms to the value set in the **AVER.No** sub-window

This formula describes the recursive way of the weighted mean value calculation (with the weight equal to N) and enables one the observation of the averaged process. For $N \rightarrow \infty$ the exponential averaging is the analogy of the classic integration circuit in which time constant is equal to N/2.

The registration of the maximal values (**Hold Max**) enables the user to store the greatest values of the input signal records which occurred during the given period of the averaging. The **fast registration of the maximal values** mode is similar to one described above, but only the final signal record is displayed (after the collection of all data). In the **Fast Hold Max** mode the real time band is equal to 22.6 kHz.

The measurement is automatically stopped when any kind of averaging is chosen and the **STOP** text is displayed. It means that the **<START / STOP>** push-button has to be pressed in order to start the measurements with the averaging. In the case of the linear averaging and the registration of the maximal values the process is stopped after the gathering of the desired number of measurements. In the case of the exponential averaging the measurements are performed continuously and can be stopped by pressing the **<START / STOP>** push-button.

***Notice**: The time averaged input signal can further be analysed by means of the **Spectrum** function (the **FFT** spectrum can be obtained with all available "smoothing" functions, see the **WINDOW** sub-window).*

AVER.No sub-widow

In this sub-window the user can select the desired number of the averaged time records from the values: **2**,..., **2048**.

***Notice**: In the case of the exponential averaging the number given in this sub-window denotes the weight with which the consecutive measured signal records are averaged - for N>2.*

*The **INPUT** window*

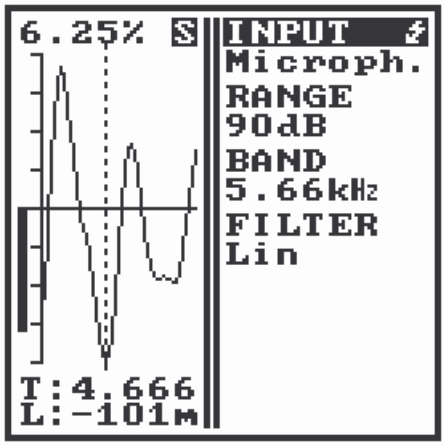
This window enables the user to select the source of the signal (the **INPUT** sub-window, the range of the signal (the **RANGE** sub-window), its band (the **BAND** sub-window) and the weighting filter (the **FILTER** sub-window).

INPUT sub-window

This sub-window enables the user to choose the source of the measured signal (the choice of the measurement input). The following parameters can be programmed in the **INPUT** sub-window for the **Time** analysis:

- **Reference** the internal source of the binary pseudo-random signal,
- **Microph.** the microphone input (the signal from the external condenser microphone preamplifier, e.g. from the SV 01A),
- **Direct** the direct, voltage input,
- **Charge** the input of the charge piezoelectric transducer,
- **Acceler.** the input from the IEPE vibration transducer typed (with the built-in charge preamplifier),
- **SV06** the input from four channel module for vibration measurements – cf. App. E,
- **SV08** the input from four channel module for sound and vibration measurements – cf. App. E.

The proper input is chosen by the use of the **<◀ >**, **< ▶>** push-buttons after the activation of the sub-window.



The view of the display in the ANALYZER MODE - the INPUT window

RANGE sub-window

This sub-window enables the user to select the measurement input range (the input gain or attenuation). There are four measurement ranges (in 20 dB steps), which are defined as below:

- for sound measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **20 μPa**) calibrated for the microphone with the sensitivity of **50 mV / Pa**;
- for voltage measurement: **70 dB**, **90 dB**, **110 dB** or **130 dB** (the value in **dB** related to **1 μV**);
- for vibration acceleration measurement: **316 mms^{-2}**, **3.16 ms^{-2}**, **31.6 ms^{-2}** or **316 ms^{-2}** (in **dB** respectively: **110 dB**, **130 dB**, **150 dB** or **170 dB**; the value in **dB** related to **1 μms^{-2}**) calibrated for the accelerometer with the sensitivity of **10 mV / ms^{-2}** or **10 pC / ms^{-2}**. For the non-metric units see Chap. 7.

BAND sub-window

This sub-window enables the user to choose the frequency band in which the measurement is done (from **45.3 kHz** to **1.38 Hz** in the binary sequence).

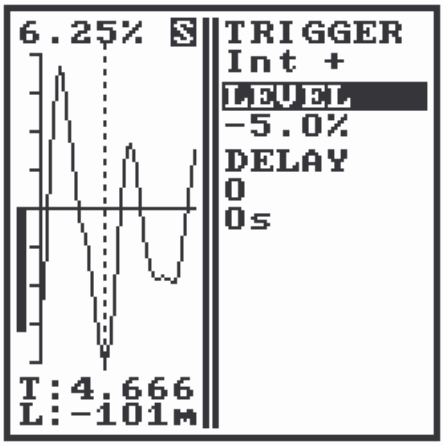
FILTER sub-window

This sub-window enables the user to choose one of the weighting filters: **Lin**, **A**, **C** or **HP**.

*The **TRIGGER** window*

This window enables the user to start the measurement when the signal reach the desired level.

***Notice**: The **TRIGGER** window is a **sub-window** for the **INPUT** window. To open it, the **<INPUT>** push button must be pressed twice.*



The view of the display in the ANALYZER MODE - the TRIGGER window

In the **TRIGGER** window the following sub-windows are available: **TRIGGER**, **LEVEL** and **DELAY**.

TRIGGER sub-window

This sub-window enables one to select the trigger source;

- **Free Run** the measurement with the trigger off,
- **Int."+"** the triggering occurs when the rising slope of the measured signal overpasses the desired level,
- **Int."-"** the triggering occurs when the falling slope of the measured signal overpasses the desired level,
- **External** the triggering with the external impulse (the rising slope of the signal).

LEVEL sub-window

This sub-window enables one to set the triggering level from **-99.9 %** to **+99.9 %** of the full scale value with the **0.1 %** step (it is possible to increase the step with the **<SHIFT>** push-button).

DELAY sub-window

This sub-window enables one to set data analysis delay from the occurring trigger. This delay can be programmed in the range of **-4095** to **4096** samples (it is possible to increase the step with the **<SHIFT>** push-button). The corresponding delay time is also displayed on the screen.

***Notice**: The trigger function **is not active for the ZOOM** operation.*

*The **SETUP** window*

In the **SETUP** window the following sub-windows are available: **SETUP OP**, **NAME** and **CATALOG**.

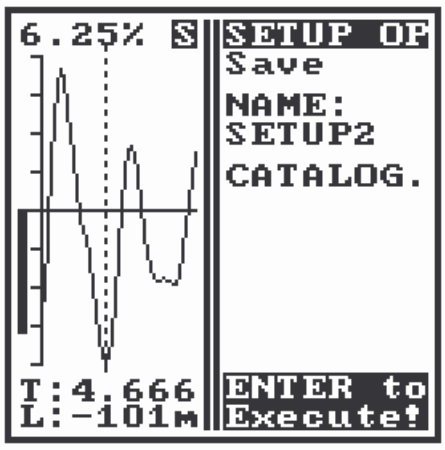
SETUP OP sub-window

This sub-window enables the user to store (**Save**), recover (**Load**) and delete (**Erase**) the instrument's control configuration file (so-called "Setup File"). This file contains the following parameters:
- the measurement input,
- the polarisation of the microphone,
- the measurement range,
- the measurement band,
- the type of triggering,
- the level of the trigger,
- the display range,
- the weighting filter,
- the measurement function,
- the recording mode,
- the number of the lines in the spectrum,
- the FFT window,
- the averaging mode,
- the averaging time,
- the averaging number,
- the cursor mode,
- the displayed range,
- the display scale,
- the spectrum plot type,
- the zoom mode,
- the zoom band,
- the zoom state,
- the settings of the calibration (the type and the coefficient).

***Notice:** After powering the instrument and the **ANALYZER MODE entering** the default or the **last used user's Setup File** is automatically loaded. The user's Setup File loading can be disabled by means of the **SETUP MODE** function (see the **AUXILIARY FUNCTIONS / SETUP MODE**).*

NAME sub-window

This sub-window enables one to enter the Setup File name. This name can be set in two ways:
- incrementing or decreasing the given file name number (the **<◄>**, **<►>** push-buttons),
- entering new, up to 8-character name, after opening next sub-window (**EDIT**) - cf. the description of the **FILE** window.



The view of the display in the ANALYZER MODE -the SETUP window

CATALOG. (Catalogue) sub-window

This sub-window enables one to check the contents of the Setup Files catalogue (cf. the description of the **FILE** window).

Notice: *The selection of the file from the Setup Files Catalogue can be done by means of the* **<▲>**, **<▼>** *and <**ENTER**> push-buttons (cf. the description of the **FILE** window).*

*The **CURSOR** window*

This window enables the user to make the cursor active in the field of the graphic presentation of the measurement results. In order to move the cursors the **<◀>**, **<▶>** push-buttons should be pressed. The following sub-windows can be programmed in the **CURSOR** window for the **Time** analysis: **CURSOR**, **CURSOR1** and **CURSOR2**.

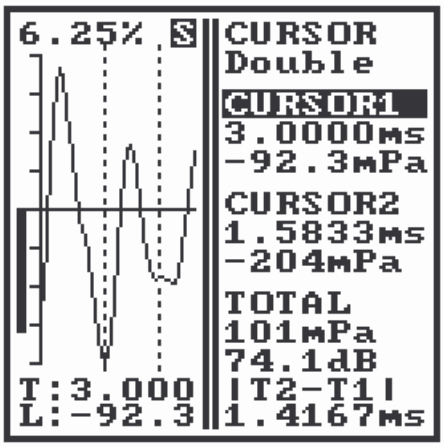
CURSOR sub-window

This sub-window enables the user to choose one from two available types of the cursors:

- **Single**,
- **Double**.

The Single Cursor is the standard way to read out the value of the registered signal.

The Double Cursor enables the user to estimate the time interval between the chosen samples (displayed in the **|T2 - T1|** field) as well as corresponding RMS value (displayed in the **TOTAL** field).



The view of the display in the ANALYZER MODE - the CURSOR window in the Time analysis; Double Cursor mode

CURSOR1 sub-window

This sub-window is used to move the cursor in the field of graphic presentation of the measurement results. In order to move cursor the **<◀>**, **<▶>** push-buttons should be pressed (the increase of the movement speed is possible with the **<SHIFT>** push-button). The control of the cursor is available when the sub-window is active. The read out of the amplitude and the time of the chosen result is also possible in this sub-window.

CURSOR2 sub-window

This sub-window acts as described above but for the second cursor (in the double cursor mode).

Notice: *The selection of the **CURSOR1** or **CURSOR2** can also be done **without the opening** of the **CURSOR window**. Pressing the <**SHIFT**> / <**CURSOR**> push-buttons causes the **exchange** (**<EXCH.>**) of the current active cursor (1 or 2).*

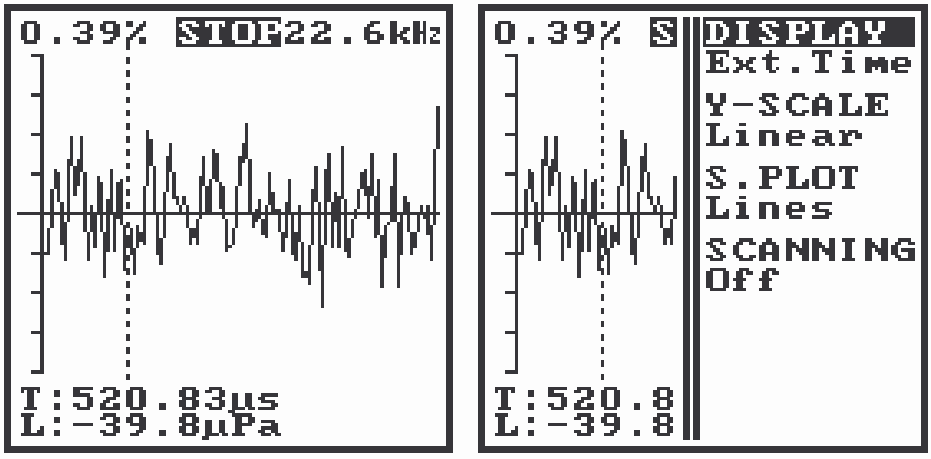
*The **DISPLAY** window*

This window enables the user to change the parameters of the graphic presentation of the measurement results. It contains four sub-windows (**DISPLAY**, **Y-SCALE**, **S.PLOT** and **SCANNING**) but only the **DISPLAY** sub-window is active for the **Time** analysis. The other sub-windows are set by the default parameters as follows:

- **Y_SCALE: Linear**
- **S.PLOT**(SpectrumPlot)**: Lines**
- **SCANNING: Off**

DISPLAY sub-window

This sub-window enables the user to select the number of the time signal points to be presented on the screen. Setting **DISPLAY: Time** results in 96 lines presentation. **DISPLAY: Ext. Time.** (Extended Time) gives 120 time points on screen.



The view of the display in the ANALYZER MODE - the DISPLAY window with the EXT.Time selected

Notice*: The user can choose the scale on the vertical axis of the picture in the time domain analysis. The proper value is chosen using the <▲>, <▼> push-buttons, when the **DISPLAY** window **is closed**. These scales conform to the nominal changes of the input signals in the given range, multiplied by the following coefficients:*

100% *- 1:1 in the relation to the full scale value,*
25% *- 4:1 in the relation to the full scale value,*
6.25% *- 16:1 in the relation to the full scale value,*
1.56% *- 64:1 in the relation to the full scale value,*
0.39% *- 256:1 in the relation to the full scale value,*
0.1% *- 1024:1 in the relation to the full scale value.*

Notice*: It is not possible to shift the figure up or down for the time domain analysis.*

*The **ZOOM** window*

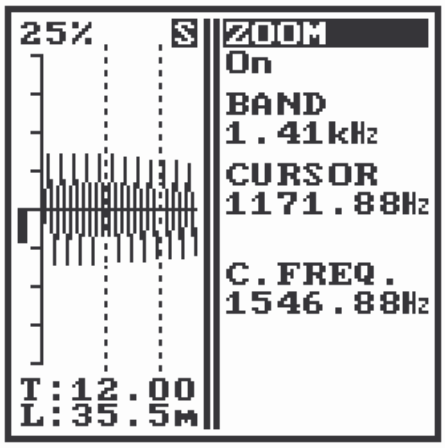
This window enables one to perform the signal analysis with the digital frequency heterodyning up to **11.3 kHz band**. This window contains three sub-windows (**ZOOM**, **BAND** and **CURSOR**) and one field (**C.FREQ**).

***Notice:** In the zoom mode only the **real part** of the heterodyned signal is displayed. The **ZOOM** window can **only** be pulled down (opened) when the **RECORD** sub-window is set to **256**.*

ZOOM sub-window

This sub-window enables one to switch on (**On**) or off (**Off**) the zoom function using the **< ◂ >** or **< ▸ >** push-button (when the sub-window is active).

***Notice**: The zoom function can not be activated for the analysis in **22.6 kHz** and **45.3 kHz** bands.*



The view of the display in the ANALYZER MODE -the ZOOM window

BAND sub-window

This sub-window enables the user to change the band of the zoom analysis. It is possible to choose any band from **5.66 kHz** to **1.38 Hz**. The zoom band is set to the half of the basic band (e.g. the band which was active just before the switching on the zoom function) or to the value which was previously chosen by the user.

CURSOR sub-window

This sub-window is not active for the Time analysis.

C.FREQ field

This field can be set only in the Spectrum function.

*The **REPORTS** window*

This window is not active for the Time analysis.

*The **FILE** window*

This window enables the user to perform the operations on the data files coming from the time wave form analysis. In particular it is possible to store the instantaneous or averaged time signal. The following sub-windows can be programmed in the **FILE** window: **FILE OP.**, **FILENAME** and **CATALOG.**

FILE OP. sub-window

This sub-window enables the user to choose the type of the file operation which has to be done. It has the following list of the options: **Save**, **SaveNext**, **Save_Buf**, **Load** and **Erase**, which are executed after pressing the **<ENTER>** push-button.

Save option

It enables one to store the currently displayed time history in the internal memory of the instrument. The stored files have their own names given in the **FILENAME** sub-window (see below).

SaveNext option

It enables one to store the currently displayed time signal. The stored file has automatically incremented **FILENAME** (as long as total number of the FILENAME characters will not exceed 8).

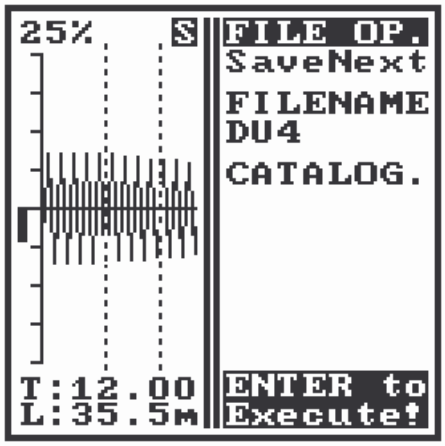
Save_Buf option

It enables one to store the series of the measured signal, recorded in the **SCAN.BUFFER**, in the instrument's internal memory The stored files have their own names given in the **FILENAME** sub-window (see below).

Load option

It enables the user to display on the screen the stored time signal.

***Notice**: Together with the time signal all its parameters and settings are restored (it means those which where saved during the execution of the **Save** option).*



The view of the display in the ANALYZER MODE - the FILE_OP window in Time analysis

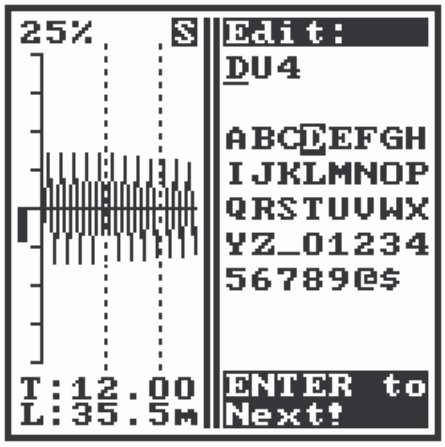
Erase option

It enables one to delete a file from the memory. The user has to enter the **AUXILIARY FUNCTIONS MODE** in order to erase all files from the memory.

FILENAME sub-window

This sub-window enables one to set the file name for the **Save**, **Load** and **Erase** options. The maximum number of characters in the FILENAME is eight. This sub-window has two control levels:

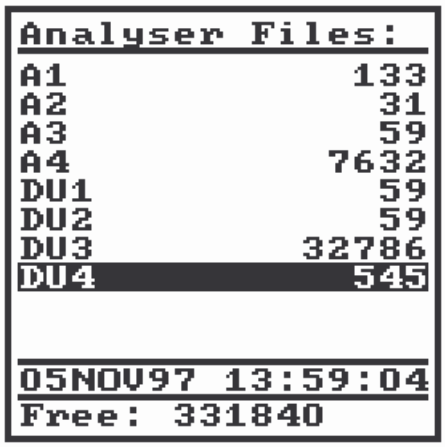
- on the first level the file name number can be incremented or decreased (by means of the **<◄>**, **<►>** push-buttons), e.g.: RESULT1, RESULT2, RESULT3 e.t.a.
- on the second level, available after the **EDIT** sub-window opening (the **<ENTER>** push-button with the **FILENAME** window active), eight character file name can be defined. The entering of the desired name is possible by the character selection (the **<ENTER>** and **<◄>**, **<►>**, **<▲>**, **<▼>** push-buttons) from the list printed on the screen.



The view of the display in the ANALYZER MODE - the FILE_OP/FILENAME sub-window

CATALOG.(Catalogue) sub-window

This sub-window enables one to overview the list of the stored files and to estimate the size of the free, unoccupied, internal memory. The catalogue is available after pressing the **<ENTER>** push-button. The return from the catalogue occurs after pressing the **<ESC>** one.



The view of the display in the ANALYZER MODE - the FILE_OP/CATALOG. sub-window

***Notice**: The selection of the file from the CATALOGUE (for the **Save**, **Load** or **Erase** operation) can be achieved by choosing the proper file name (displayed "inversely") and pressing the **<ENTER>** push-button.*