4. METER MODE

The **METER MODE** provides the user with the standard (and not standard) functions of the Integrating Sound Level Meter and Vibration Meter. The instrument meets requirements of the standards **IEC 651**, **IEC 804**, **ISO 8041** and **ISO 5349** for Type 1 instruments. It ensures the measurement performing according to the regulations of measurement standards (e.g. **ISO 2631** and **ISO 5349** for the vibrations). The RMS measurement of the voltage signals is also possible in this mode.

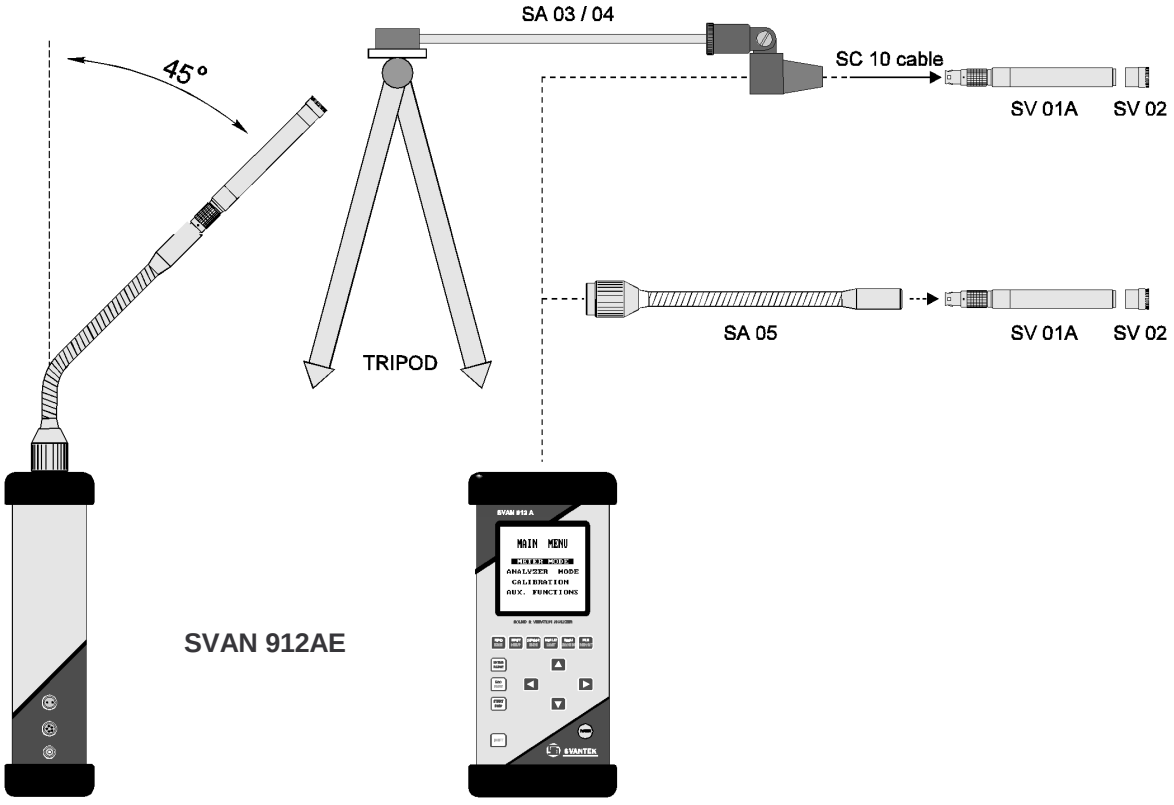
4.1. Sound measurement

The **METER MODE** provides the user with the standard (and not standard) functions of the standard Type 1 Sound Level Meter (according to **IEC 651**) and Type 1 Integrating Sound Level Meter (according to **IEC 804**).

For the sound measurement the system configuration should be as follows:

- Sound & vibration analyser SVAN 912AE;
- ½" microphone preamplifier SV 01A (or other, e.g. B&K 2669);
- ½" measurement microphone SV 02/C4 (or other, e.g. G.R.A.S. AN 40);
- Optionally SV 30, SV 03A acoustic calibrator or any other compatible.

The advised way of the microphone preamplifier mounting to the SVAN 912AE analyser is shown below.

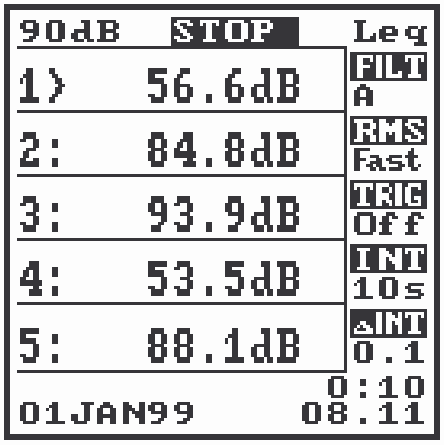


Notice: It is worth to underline that taking into account the cubic shape of the analyser the proposed mounting of the microphone preamplifier (it is using "goose neck" SA 05 or holder / extender SA 03 / 04 mounted on the tripod) is necessary to obtain the directional characteristics of the instrument conforming to the international standards IEC 651 and IEC 804 for Type 1 sound level meters.

In the **METER MODE** of the instrument the sound pressure level can be measured in **five parallel** "**profiles**". The following functions are available for the measurement of sound:"

- **Spl** – sound pressure measurement according to the **IEC 651** standard,
- **Leq** – level equivalent measurement according to the **IEC 804** standard,
- **Ssa** – sound statistical analysis (histograms).

The **RMS** detector type and weighting filter can be defined independently for each profile. It means that the profiles can be recognised as five classical sound level meters working independently. The "main results" of five profiles are presented concurrently after selecting in the window **DISPLAY** the proper option: **DISPLAY:5-Prof.**

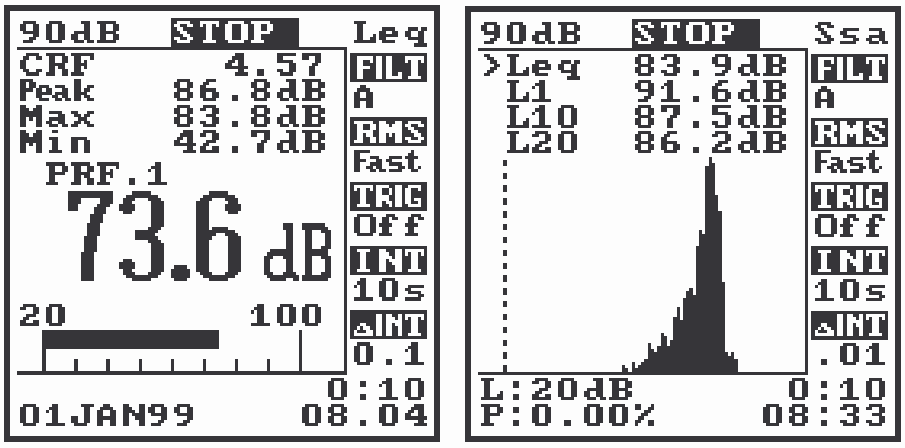


The display of the instrument in the METER MODE - "five profiles display mode"

For each profile **RMS** and / or **PEAK** values can be stored in the Buffer, with the time "step" defined by the **ΔINTEGR.**, according to the setting of the **PLOT** sub-window (cf. window **DISPLAY** for details).

Notice: *When the absolute sound pressure level value is important, the calibration of the measurement channel has to be done (the calibration factor must include the sensitivity of the used condenser microphone).* ***The calibration procedure*** *is described in the Chapter 6. When the calibration factor is taken into account, the text* ***CAL.*** *is displayed under the main measurement result.*

In "**one profile display mode**" (entered by **DISPLAY:1-Prof.**) the main result of the measurement (for the selected profile) is presented in the centre of the display area (the other profiles are measured concurrently but the results are not displayed). Several additional data are displayed above and below the main result. In the case when in the **DISPLAY** window the functions **Plot** or **Ssa** are selected, the measurement result has a graphical form.



The display of the instrument in the METER MODE - "one profile display mode"

The **OVERLOAD** and **UNDERRANGE** warnings can appear during the measurements.

Notice: *The **OVERLOAD** warning appears when the **Peak** value of the measured signal exceeds 13.2 dB the nominal value of the current range.*

Notice: *In the case when the measurement result is corrected by the calibration factor (**CALIBR.:On**) the **OVERLOAD** warning appears when the input signal exceeds the different level then mentioned above (e.g. if the scale factor is equal to +10 dB and the measurement range is equal to 110 dB the **OVERLOAD** warning will appear if the measured value surpasses ca 130.2 dB – for the sinusoidal signal).*

Notice: *The **UNDERRANGE** warning appears when the **RMS** value of the input signal is less then 60 dB in the relation to the nominal value of the current (active) range (it means ca 70 dB less then maximal level measured in the current range – for the sinusoidal signal).*

In "**five profiles display mode**" the **OVERLOAD** and **UNDERRANGE** warnings are displayed before the measurement results as an arrow Ø (if overload) or ⇓ (if under range) - respectively.

In "**one profile display mode**" the **OVERLOAD** and **UNDERRANGE** warnings are displayed above the measurement results. The profiles number (**PRF.1**, ..., **PRF.5**) is displayed in the same line.

Notice: *In the case when the calibration is switched on (**CALIBR.:On**) the measurement range includes the calibration factor (and is different then **RANGE** selected in the **INPUT** window).*

In "**one profile display mode**" the following values are displayed above the main result:

- **CRF** – Crest Factor defined as the ratio between the **Peak** and the **RMS** values in the measured time interval;
- **Peak** – the value measured in the time interval (the integration time of the **Peak** detector is equal ca 20 μs for 22.6 kHz band);
- **Max** – the maximal value of the measured signal on the **RMS** detector output in the time interval;
- **Min** – the minimal value of the measured signal on the **RMS** detector output in the time interval.

Notice: *The **CRF**, **Peak**, **Max** and **Min** values are cleared before the start of the new measurement unless the **Spl** function is selected.*

Additionally, in "**one profile display mode**" the following data are displayed on the screen:

- the current measurement **RANGE** – the line at the screen's top;
- the current state of the measurement: **RUN**, **Pause** or **STOP** – the line at the top;
- the current function: **Leq**, **Ssa**, **Spl**, ... – the line at the top;
- current date and time – the line at the bottom;
- time of the measurement – above the current time;
- the selected measurement parameters - in the column at the right side of the screen:
  - the type of the filter (**FILT**);
  - the type of the detector (**RMS**);
  - the kind of the trigger (**TRIG**);
  - the total integration time(**INT**);
  - the elementary integration step (**ΔINT**).

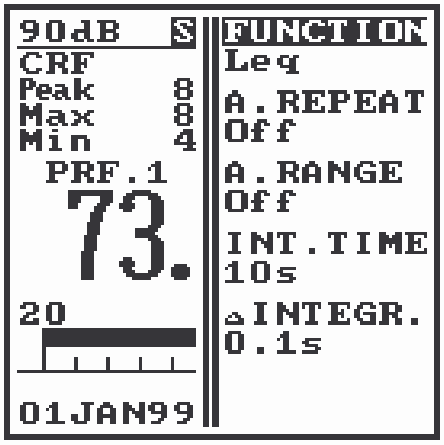
Notice: *In "**one profile display mode**" the selection of the profiles can be done using the **<▲>**, **<▼>** push-buttons.*

In the **METER MODE** for the sound measurements six control windows are available. These windows are displayed on the right side of the screen and are opened after pressing the corresponding push-buttons: **FUNC**, **INPUT**, **DISPLAY**, **CURSOR**, **FILE** and **SETUP**. The **<ZOOM>** push-button **is not active** in this mode.

Inside each window the selection of the required functions or parameters is available using the **< ◀ >**, **< ▶ >** push-buttons only when the proper sub-window or field is displayed inversely.

*The **FUNC** window*

This window contains the following sub-windows: **FUNCTION**, **A.REPEAT**, **A.RANGE**, **INT.TIME** and **ΔINTEGR.**.



The display of the instrument in the METER MODE - the FUNC window, the Leq function

FUNCTION sub-window

This sub-window enables one to select the following measurement functions:

Spl sound pressure level according to the **IEC 651**,
Leq level equivalent according to the **IEC 804**,
Ssa sound statistical analysis (histogram),

***Notice:** Each change in the **FUNCTION** sub-window interrupts the current measurement and stops the instrument. The new measurement can be done after pressing the **<START>** push-button.*

***Notice:** All settings in the **FUNC** window **are common for all profiles**.*

The Spl function

The **Spl** function - gives an equivalent of the standard **Sound Level Meter** according to the **IEC 651 Standard** (meeting the requirements for the **Type "1"** instrument). The value of the functions is calculated from the formula:

$$\mathbf{Spl} = \max_{1 \le \mathbf{n} \le 200} \{20 \log(\mathbf{p_n} / \mathbf{p_0})\},$$

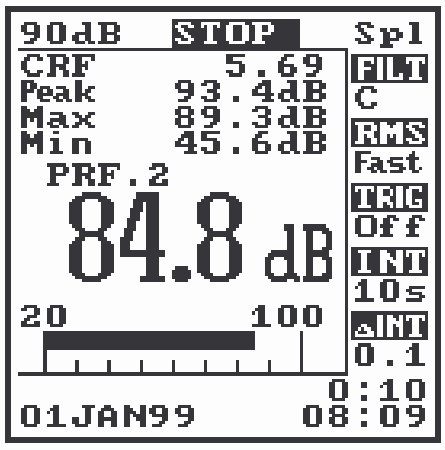
where:

n = 1, ..., 200;

$\mathbf{p_n}$ - the RMS value of the measured sound pressure for 5 ms time interval;

$\mathbf{p_0}$ - the value to which the measurement is related, equal to 20 μPa.

Sound Level Meter is available after setting **FUNCTION:Spl**.



The display of the instrument in the METER MODE - the Spl function "one profile display mode"

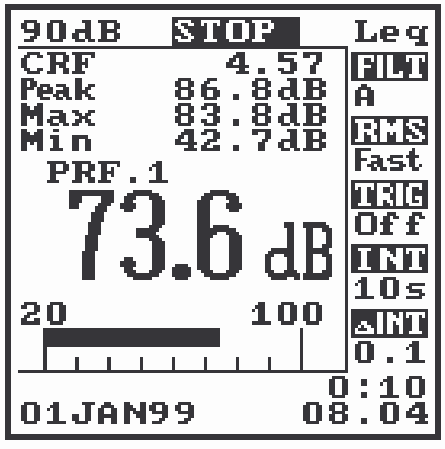
Notice: *The "main" RMS result is updated* ***once per second****. The displayed value is the* ***maximum*** *measured result* ***during the last second****. The* ***CRF****,* ***Peak****,* ***Max*** *and* ***Min*** *values are cleared with each* ***<START>*** *of the measurement.*

The **Auto Repeat** function should be used (**A. REPEAT:On**) in order to obtain the "continues" sound level measurement.

Notice: *For the active* ***Auto Repeat*** *function the* ***Max*** *and* ***Min*** *values are determined for the whole measurement time (from* ***<START>*** *to* ***<STOP>****).*

Notice: *The contents of the Buffer is cleared after beginning of the new measurement.*

The Leq function



The display of the instrument in the METER MODE - the Leq function

The **Leq** function - operates as the standard **Integrating Sound Level Meter** and conforms to the **IEC 804 Standard** (meeting the requirements for the **Type "1"** instrument). The value of the function is calculated according to the formula:

$$\mathbf{Leq} = 10\log\frac{1}{\mathbf{T}}\int_0^{\mathbf{T}}(\mathbf{p}(\mathbf{t})/\mathbf{p}_0)^2\mathbf{dt}$$

where:
T- total measurement time, equal to the value set in **INT.TIME**;
$\mathbf{p}(\mathbf{t})$ - the value of the measured sound pressure;
$\mathbf{p}_0$ - the value to which the measurement is related, equal to 20 μPa.

Integrating Sound Level Meter is available after setting the **FUNCTION:Leq**.

Notice: *Together with the **Leq** the **Ssa** and **Spl** functions and **SEL**, **Lex8**, **Ltm3** and **Ltm5** results are also calculated concurrently. The user can read out any of these values by the appropriate setting of the **DISPLAY** window. The **Spl** value displayed during the **Leq** integration is the last second result calculated by means of the **Spl** function. Additionally, ten statistical values are displayed (cf. the description of the **Ssa** function).*

Notice: *If an **OVERLOAD** appears during the **Leq** integration, it is "latched" and displayed until the end of the measurement. If the measured signal does not exceed the permissible values the **OVL.** prompt will be cleared by the next measurement **<START>**.*

The integration time (**INT.TIME**) for the **Leq** function can be set (cf. the description of the **INT.TIME** sub-window in the **FUNCTION** window):
- from **1 s** to **59 s** (with **1 s** step),
- from **1 m** (min) to **59 m** (with **1 m** step) and
- from **1 h** to **16 h** (with **1 h** step).

During the **Leq** measurement the current integration time is also displayed (for the **INT.TIME > 1s**).

Notice: *During the **Leq** measurement the RMS results are updated once per second disregarding the elementary integration time (**ΔINTEGR.**) The displayed values are the **instantaneous integration results** calculated **during the current time** (from the measurement **<START>**), so the interrupted measurement gives also correct **Leq** result. The **CRF**, **Peak**, **Max** and **Min** values are cleared with each **<START>** of the measurement.*

The **Leq** function may also be **temporary interrupted**. There are two ways for the "**PAUSE**" insertion into the measurement:
- by means of the **<START/STOP>** push-button. **It will terminate the current measurement!**
- by means of the **<ENTER/PAUSE>** push-button. It will insert an arbitrary long **PAUSE**. The measurement can be continued after pressing the **<START/STOP>** push-button.

Notice: *When the **Leq** function is in the **PAUSE** state, the last **10 seconds** of the integration can be deleted. It can be achieved by pressing the **<ENTER/PAUSE>** push-button up to ten times (each pressing of the **<ENTER/PAUSE>** push-button will delete the last **1 s** of the integration). Removing the last integration period **will not** change the **CRF**, **Peak**, **Max** and **Min** values, but can clear the **OVERLOAD** indicator (this option is dedicated for the release of the "unwanted" overloads from the **Leq** measurement).*

The **Auto Repeat** function can also be used (**A.REPEAT:On**) with the **Leq** function for the "continues" sound measurement.

Notice: *The usage of the* ***Auto Repeat*** *(****A.REPEAT:On****) for the* ***Leq*** *measurement causes* ***very important modification*** *of that function.* ***Read carefully the text below!***

The default state of the **A.REPEAT** function for the **Leq** measurement is **Off** (**A.REPEAT:Off**). The change of this setting to **On** (**A.REPEAT:On**) will cause the following operations:

- the new measurement will start automatically when the programmed integration time (**INT.TIME**) is reached. The **CRF**, **Peak**, **Max** and **Min** values **will be lost!**
- subsequently measured **Leq** (or / and **Peak** values) will be automatically stored in the PLOT buffer! So, (**A.REPEAT:On**) option can be successfully used e.g. for the 24 hours sound level monitoring in 1 minute periods.

The SEL result

The **SEL** result (Sound Exposure Level) is essentially the subset of the **Leq** function. It's value is equal to the **Leq result referred to the one second integration time** (so, for the **INT.TIME=1 s**, **SEL** is always equal to **Leq**). The result is calculated from the formula:

$$\mathbf{SEL} = 10\log\frac{1}{\mathbf{t}_0}\int_0^{\mathbf{T}}\left(\mathbf{p}(\mathbf{t})/\mathbf{p}_0\right)^2\mathbf{dt}$$

where:

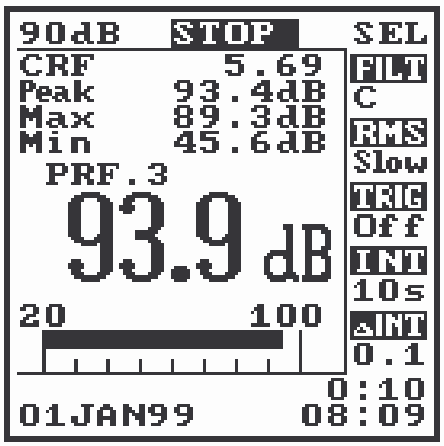
T - total measurement time, equal to the value set in **INT.TIME**;

$\mathbf{t}_0$ - time to which the measurement is related, equal to 1 s;

$\mathbf{p}(\mathbf{t})$ - the value of the measured sound pressure;

$\mathbf{p}_0$ - the value to which the measurement is related, equal to 20 μPa.

The **SEL** result can be also expressed in the linear energy units **Pa^{2}s** (the exception "**five profiles display mode**").



The display of the instrument in the METER MODE - the Leq function, the SEL result

The Lex8 result

The **Lex8** result (Sound Exposure Level referred to 8 hours) is essentially the subset of the **Leq** function. It's value is equal to the **Leq result referred to the eight hours integration time**. The result is calculated from the formula:

$$\mathbf{Lex}8 = 10\log\frac{1}{\mathbf{t}_0}\int_0^{\mathbf{T}}(\mathbf{p}(\mathbf{t})/\mathbf{p}_0)^2\mathbf{dt}$$

where:

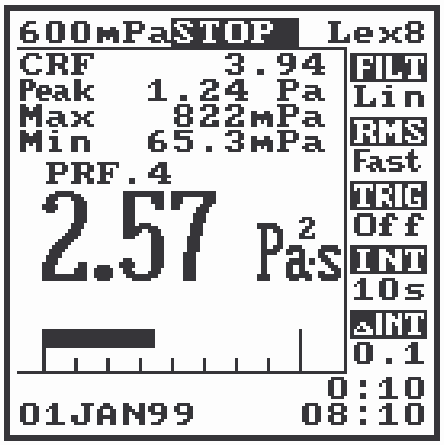
T - total measurement time, equal to the value set in **INT.TIME**;

$\mathbf{t}_0$ - time to which the measurement is related, equal to 8 h (28 800 s);

$\mathbf{p}(\mathbf{t})$ - the value of the measured sound pressure;

$\mathbf{p}_0$ - the value to which the measurement is related, equal to 20 μPa.

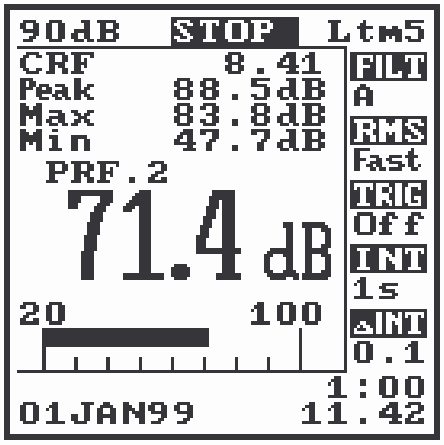
The **Lex8** result can be also displayed in the linear energy units **Pa²s** (the exception "**five profiles display mode**").



The display of the instrument in the METER MODE - the Leq function / Lex8 result

The Ltm3 and Ltm5 results

The **Ltm3** and **Ltm5** results (Takt-Maximal Levels) are calculated according to the German standard TA Larm.



The display of the instrument in the METER MODE - the Leq function / Ltm5 result

The Ssa function

The **Ssa** (**Sound statistical analysis**) function gives the statistical distribution of the sound levels (so called the "histogram"). The histogram is divided into **88 classes**, each **1 dB** wide. The statistical distribution function is calculated for the measurement results obtained for the elementary integration time (**ΔINTEGR.**).

***Notice: The Ssa function can be treated as the extension of the Leg function**, because during the **Ssa** measurement the values of the **Leq**, **SEL**, **Lex8**, **Spl**, **Ltm3** and **Ltm5** are also calculated. The user can read out the calculated values changing the settings in the **DISPLAY** window. The **Spl** value displayed during the measurement is the result of the calculation of the **Spl** function during the last one second.*

***Notice: The Ssa function is only available for the Profile1**.*

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

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

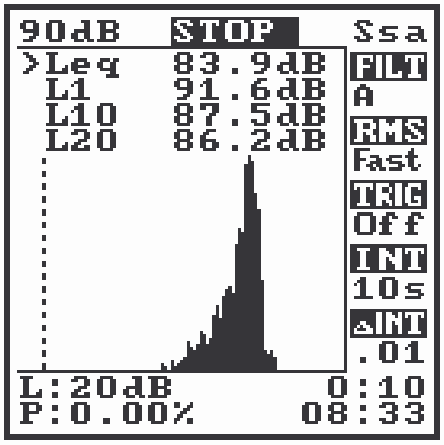
Additionally, another ten statistical values and the **Leq** value are displayed:

- **Leq:** gives the "expected value" of the histogram (it is calculated for the "dB" values);
- **LX1:** gives the class value for which the cumulative distribution function of the histogram is equal to X1 (in %);
- **LX2:** gives the class value for which the cumulative distribution function of the histogram is equal to X2 (in %);
- **LX3:** gives the class value for which the cumulative distribution function of the histogram is equal to X3 (in %);

.....

- **LX10:** gives the class value for which the cumulative distribution function of the histogram is equal to X10 (in %).

***Notice:** The X1, X2 and X3 values can be controlled by means of the **<▲>**, **<▼>** and **<◄>**, **<►>** push-buttons with the **<SHIFT>**.*



The display of the instrument in the METER MODE - the Ssa function

Notice: *All measurement results from the **Ssa** function can be stored as files in instrument's internal memory using the commands **Save**, **SaveNext** or **AutoSave** (cf. the **FILE** window). There is only one fundamental difference between the **Ssa** and **Leq** function in the case of storing in the files the histograms (calculated for the first profile). In the case of the **Leq** function the histogram is stored (the **Save** command) only when it is currently displayed on the screen (**DISPLAY:Stat**.) and is never saved in the **AutoSave** mode. For the **Ssa** function the histogram is saved in all options of the **Save** function. The reason for such difference is **the size of the file in the case when it contains the histogram**.*

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

This sub-window enables (**On**) or disables (**Off**) the user to perform the automatic repetition of the measurement cycle. The default setting of **A. REPEAT** is **On** for the **Spl** function and **Off** for all others.

Notice: *The setting of the **A.REPEAT** influences the storing of the measurement results in the meter's mode buffer (cf. the description of the **Leq** function).*

A.RANGE (**Auto Range**) sub-window

This sub-window enables (**On**) and disables (**Off**) one to perform the automatic gain control. The range is increased **20 dB** when **OVERLOAD** is detected and decreased (**20 dB** if possible) when the input signal drops more then **40 dB** below the full scale value.

INT.TIME (**Integration Time**) sub-window

This sub-window enables one to select the total integration time from the string: **1 m** (min), **5 m** (min), **15 m** (min), **1 h**, **8 h**, **16 h** (the direction to the left) or **1 s**, **2 s**, ..., **59 s**, **1 m** (min), **2 m** (min), ...**59 m** (min), **1 h**, **2 h**,..., **16 h** (the direction to the right).

Calculation of the total RMS values is done according to the formula given below:

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

where:

$\mathbf{Y_0} = 0$;

$\mathbf{Y_n}$ - subsequent averaged results in time interval equal to **ΔINT**;

$\mathbf{X_n}$ - subsequent result of linear averaging (for **ΔINT** period) of the samples taken from the output of the selected RMS detector every 5 ms (see below);

$\mathbf{n}$ = 1, 2, ..., N;

$\mathbf{N}$ - corresponds to the total integration time **INT.TIME** (N = INT.TIME[s] / ΔINT[s]).

It is worth to notice that the presented above formula gives **the true averaged result** for any moment during the total (**INT.TIME**) measurement time.

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

This sub-window enables the user to select the "elementary" integration time from the values: **0.01 s**, **0.02 s**, **0.05 s**, **0.1 s**, **0.2 s**, **0.5 s** or **1 s**.

Calculation of the **RMS** values for the **ΔINT** period is done according to the formula given below:

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

where:

$\mathbf{X_0} = 0$;

$\mathbf{X_k}$ - subsequent averaged results;

$\mathbf{R_k}$ - the result taken every 5 ms from the output of the selected RMS detector (**Linear**, **Impulse**, **Fast** or **Slow**);

$\mathbf{k}$ = 1, ..., K;

$\mathbf{K}$ - corresponds to the time value equal to **ΔINT** (K = **ΔINT**[s] / 5 ms).

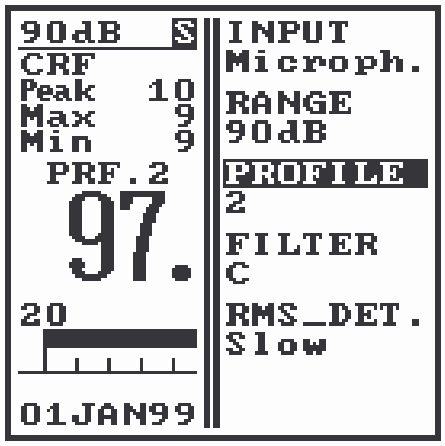
Notice: *The **RMS** values for the **ΔINT** elementary integration time are used for the calculations of:*
- the main result,
*- the **Min** and **Max** results (for the **Linear** detector),*
- the statistical analysis
*and are registered in the Meter Buffer (the **DISPLAY:PLOT** function) in the case when **A.REPEAT:Off** or the **SpI** is the currently selected function.*

*The **INPUT** window*

This window contains five following control sub-windows: **INPUT**, **RANGE**, **PROFILE**, **FILTER** and **RMS_DET.**.

INPUT sub-window

This sub-window enables one to select the measurement input. For the sound measurements the condenser microphone input (**Microph.**) must be selected. In this case the connection of the external SV 01A preamplifier or equivalent to the instrument is also required.



The display of the instrument in the METER MODE - the INPUT window / Leq function

RANGE sub-window

This sub-window enables one the selection of the measurement input range (the input gain or attenuation).

Notice: The setting in the RANGE sub-window is common for all "profiles".

There are four measurement ranges (in 20 dB steps) available: **70 dB**, **90 dB**, **110 dB** and **130 dB** (**dB** related to **20 μPa**; calibrated for the **50 mV/Pa** microphone).

PROFILE sub-window

This sub-window enables one to select the active profile for which the weighting filters (the sub-window **FILTER**) and the **RMS** detector (the sub-window **RMS_DET.**) should be set. It is possible to select: the first (**Profile1**), the second (**Profile2**), the third (**Profile3**), the fourth (**Profile4**) or the fifth (**Profile5**) measurement profile.

FILTER sub-window

This sub-window enables one to select the weighting filter for each of the sound measurement profiles.

Lin **5 Hz** to **23.67 kHz** (-3 dB),
A according to **IEC 651** Type 0,
C according to **IEC 651** Type 0,
G for the infra sounds measurements, according to **ISO / DIS 7196.2**.

Notice: Weighting filter can be set independently for each "profile".

Notice: *Each change of the* ***RANGE*** *or* ***FILTER*** *setting causes the <****STOP****> of the measurement (if* ***REPEAT:Off****). This is also valid for the* ***AUTO RANGE*** *function (****A.RANGE:On****). Thus the usage of the* ***AUTO RANGE is not recommended*** *for the measurement with the integration time longer then* ***1 s****.*

RMS_DET. (**RMS detector**) sub-window
This sub-window enables one to select the **RMS detector type**: **Linear** (**Lin**), **Impulse** (**Imp**), **Fast** or **Slow**.

The Linear detector - calculates the exact (the linear averaging) **RMS** value of the "elementary results" in time periods equal to 5 ms. The output of the detector is subsequently linearly averaged in **ΔINT** periods (**0.01 s**, **0.02 s**, **0.05 s**, **0.1 s**, **0.2 s**, **0.5 s** or **1 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** standard. 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** standard. 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** standard. The output of this detector is subsequently averaged linearly with the **ΔINT** integration step.

Notice: The RMS detector can be set independently for each "profile".

The **Impulse**, **Fast** and **Slow** detectors are realised numerically using so-called "exponential" averaging. **The result of this procedure conforms to the result given by the analogue RMS converter working with the proper integration time constant**.

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

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

where:
$\mathbf{R_0} = 0$;
$\mathbf{R_i}$ - subsequent averaged results;
$\mathbf{L_i}$ - subsequent result of linear averaging of the input samples taken every 5 ms;
$\mathbf{i}$ = 1, 2, 3, ... ;
N - corresponds to the current integration time constant (**Impulse**, **Fast** or **Slow**).

Notice: *For the* ***Impulse*** *detector time constants for averaging and for falling are defined independently (cf.* ***IEC 651*** *standard).*

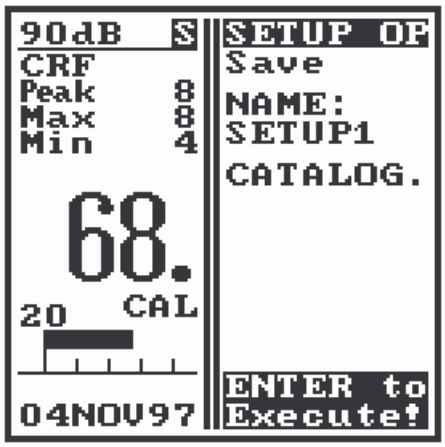
*The **SETUP** window*

This window contains the following control sub-windows: **SETUP OP**, **NAME** and **CATALOG.**.

SETUP OP sub-window

This sub-window enables the user the storage (**Save**), recovery (**Load**) and deletion (**Erase**) of the instrument's control configuration file ("SETUP File"). This file contains the following items:
- the measurement input,
- the microphone's polarisation,
- the measurement range,
- the display range,
- the weighting filter,
- the auto range setting,
- the measurement function,
- the auto repeat setting,
- the averaging mode,
- the integration time,
- the elementary integration time,
- the displayed function,
- the display's scale,
- the calibration setting.

***Notice:** After switching on the instrument and after **entering METER MODE** the **recently used SETUP File** is automatically loaded. The **SETUP File** loading can be disabled by means of the **SETUP MODE** function (cf. **AUX. FUNCTIONS / SETUP MODE**).*



The display of the instrument in the METER MODE - the SETUP window

NAME sub-window

This sub-window enables the user to define the SETUP File name. The introduction of this name can be done in two ways:
- a decrease or an increase of the given file name number (the **<◀ >** and **< ▶>** push-buttons),
- the entering new (up to eight characters) name after the opening of the next sub-window (**EDIT**) (cf. the **FILE** window).

CATALOG (**Catalogue**) sub-window

This sub-window enables one to check the contents of the SETUP Files catalogue.

Notice: *The selection of the file from the SETUP Files Catalogue can be done by means of the* **<▲>**, **<▼>** *and* <***ENTER***> push-buttons.

*The **DISPLAY** window*

This window contains the following control sub-windows: **DISPLAY** and **SCALE**.

DISPLAY sub-window

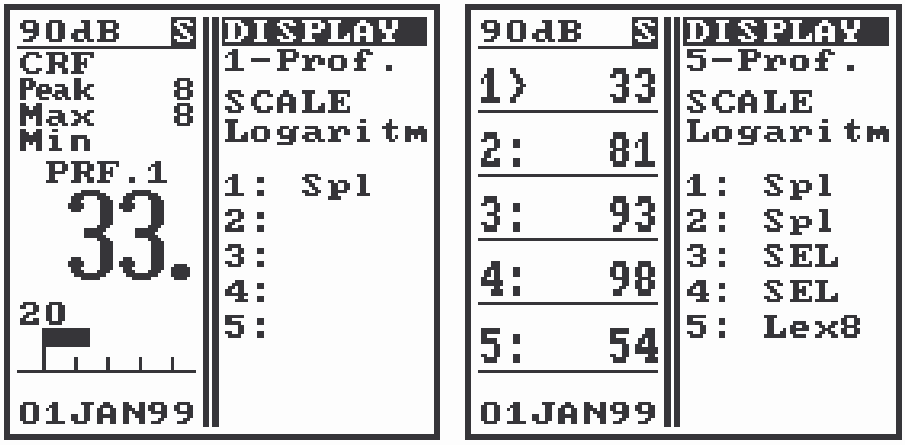
This sub-window enables one to set the current display mode as follows: **1-Prof.**, **5-Prof.**, **Stat.** or **Plot**. The setting of the parameter in this window is important for the **Save** operation (see below).

1-Prof. – "**one profile display mode**"

In **"one profile display mode"** the user can set up, for one selected profile, any of the available measurement results **Spl**, **Leq**, **SEL**, **Lex8, Ltm3** and **Ltm5**.

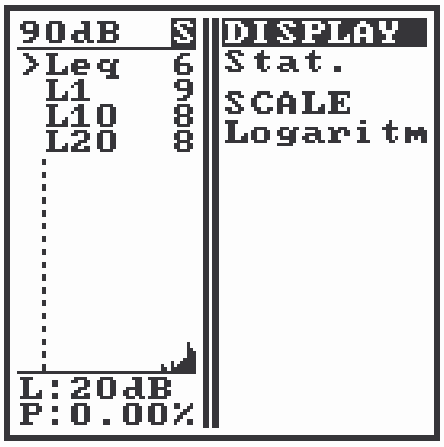
5-Prof. – "**five profiles display mode**"

In "**five profiles display mode**" the user can select one from all available measurement results **Spl**, **Leq**, **SEL**, **Lex8**, **Ltm3** and **Ltm5** to be displayed in a profile. The displayed value is set independently in each profile.



The display in the METER MODE - the DISPLAY window – "one profile" and "five profiles display mode"

Stat. – statistical analysis mode



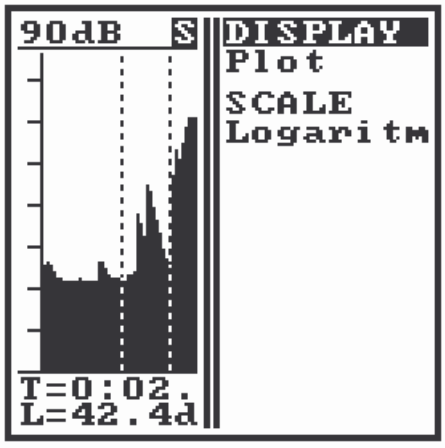
The display of the instrument in the METER MODE - the DISPLAY window –statistics (Stat.)

Notice: Ssa function is available only for "Profile1"!

PLOT display mode

The observation and recording of the sound level changes during the **Spl** or **Leq** measurement can be performed by means of the **PLOT** function. All results, measured with the **elementary integration time** (**ΔINTEGR.**) or **INT.TIME**, are stored in the buffer and can be displayed as a function of time (time history) when the **DISPLAY** window is set to **PLOT**. The buffer "length" is sufficient to store approx. **32000 results**.

Notice: *The buffer is cleared with each <**START**> of the measurement.*



The display of the instrument in the METER MODE - the DISPLAY window –PLOT

*The **PLOT** window*

The contents of the buffer can be defined by means of the **PLOT** sub-windows. This sub-window can be opened after **pressing the <DISPLAY> push button twice**.

For each profile **RMS** and / or **PEAK** values can be stored in the Buffer, with the time ”step” defined by the **ΔINTEGR.**, according to the setting in the **PLOT** sub-window. So, **up to ten** independent buffers can be created.

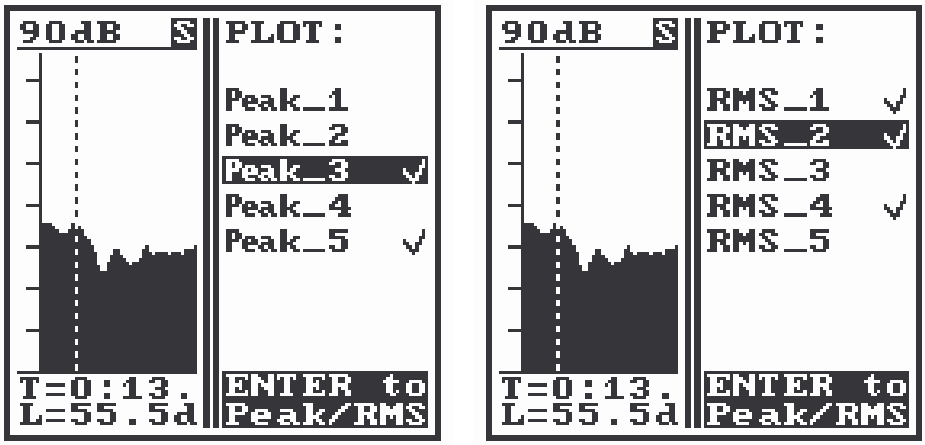
Notice: Each buffer’s length is equal to 32000 divided by the number of created buffers!

The contents of each **PLOT buffer** can be:

- displayed as a function of time when the **DISPLAY** window is set to **PLOT**. The **<▶>** and **<◀>** push-buttons enable one to read out the stored value and time of the measurement (with **<SHIFT>** and **<▶>**, **<◀>** the step of the movement can be increased).
- **saved** in a standard way as a file (when **DISPLAY:PLOT** is active).

Notice: All created buffers are saved in one file!

Notice: *The buffers contents can be controlled by means of the **<▲>**, **<▼>**, **<◀>** and **<▶>** push-buttons.*



The display of the instrument in the METER MODE - the PLOT sub-windows

SCALE sub-window

This sub-window enables the user to change the scale in which the measurement result is given. Two types of the scale are available:

- **Linear** the linear scale,
- **Logarithm** the logarithmic scale.

The logarithmic scale is the default for the sound measurement.

Notice: *The results given in the linear scale are calculated as the* ***[log]$^{-1}$ function with the 0.1 dB step****.*

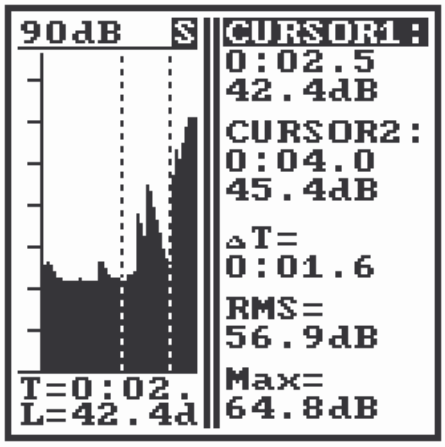
Notice: *The* ***Plot*** *function for the* ***SCALE:Linear*** *setting is still presented in the logarithmic scale, only the Y axis is scaled with the linear units.*

*The **CURSOR** window*

The window contains the following control sub-windows or field: **CURSOR1**, **CURSOR2**, **ΔT=**, **RMS=** and **MAX=**.

CURSOR1 and **CURSOR2** sub-windows

These sub-windows are active **when the window DISPLAY is set to PLOT** and enables one to evaluate the time relations between events registered in buffer and the calculation of the **RMS** value for the arbitrary selected part of it, as well to determine the **MAX** value.



The display of the instrument in the METER MODE - the CURSOR window

*The **FILE** window*

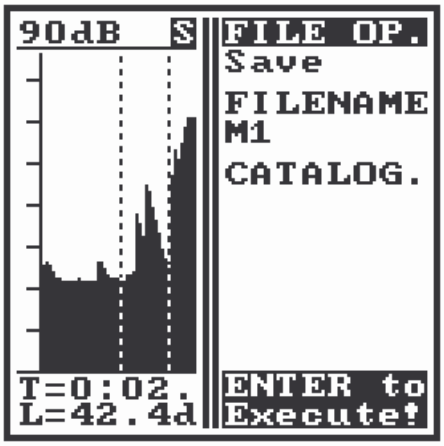
The window contains the following control sub-windows: **FILE_OP**, **FILENAME** and **CATALOG.**.

FILE_OP (**File Operation**) sub-window

This sub-window enables one to select the file operation. The window has following list of the options (commands, file operations): **AutoSave**, **SaveNext**, **Save**, **Load** and **Erase**.

AutoSave option

This command enables the user to store the measurement result in the internal memory of the instrument in the automatic way. The first file name has to be set in advance by means of the **FILENAME** window (see below) and this name will be automatically incremented after each save operation. Storing measurement results will take place after every "detection" of the **STOP** mode. Additionally, when setting **A.REPEAT:On** results of all measurement cycles will also be saved. **This function is not active for the FUNCTION:Spl with A.REPEAT:On and for PLOT files** (see below **Save** function).



The display of the instrument in the METER MODE - the FILE window

***Notice:** The measurement process will be interrupted (forced **STOP** state) when the automatically generated file name **already exists or file cannot be created**.*

SaveNext option

This command enables the user to store the measurement result in the internal memory of the instrument. The file name has to be set in advance by means of the **FILENAME** window (see below) and this name is automatically incremented **before** subsequent save operation.

Save option

This command enables the user to store the measurement result in the internal memory of the instrument. The file name has to be set in advance by means of the **FILENAME** window (see below).

***Notice:** The contents of the file stored by the **Save** command is strongly depended on the combination of the parameters setting in the **FUNCTION** and **DISPLAY** windows. Four different types of data files can result from it:*

1. *The file contains only the basic **RMS** results and ten selected **LN** values;*
2. *The file contains the basic **RMS** results, ten selected **LN** values and the whole statistics (**histogram**), when **FUNCTION:Ssa** or **DISPLAY:Stat.** are displayed;*
3. *The file contains the basic **RMS** results, ten selected **LN** values and the results from the **PLOT** buffer, when **DISPLAY:PLOT** is displayed;*
4. *The file contains the basic **RMS** results, ten selected **LN** values, the whole statistics (**histogram**) and the results from the **PLOT** buffer, when **FUNCTION:Ssa** & **DISPLAY:PLOT** are displayed.*

Load option

This command enables the user to read-out the measurement result stored in the internal memory of the instrument (by the **Save** command). The file name has to be set in advance by means of the **FILENAME** window (see below),

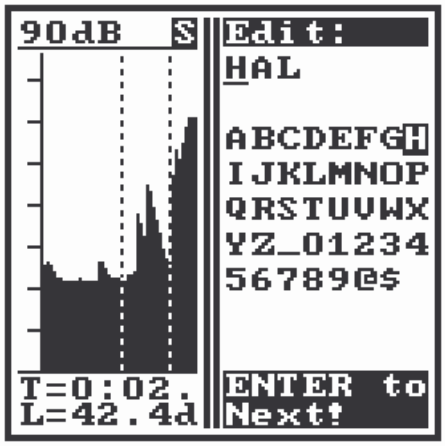
Erase option

This command enables one to delete the selected file. The file name has to be set in advance by means of the **FILENAME** window (see below).

FILENAME sub-window

This sub-window enables the user to set the file name for the **Save, Load** and **Erase** operations. The window has two control levels:

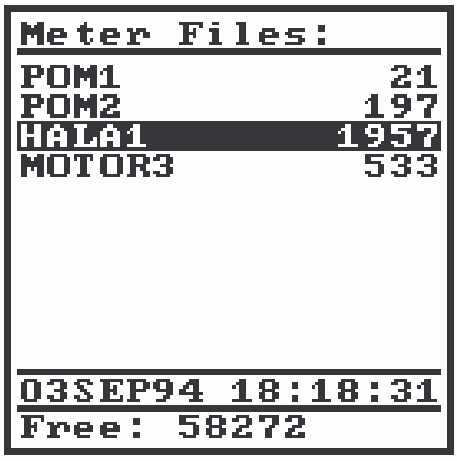
- on the "first level" the file name number may be incremented or decreased (by means of the **<◄>** and **<►>** push-buttons), e.g.: Result1, Result2, Result3 e.t.a.
- on the "second level", available after opening the **EDIT** sub-window (the **<ENTER>** push-button with the active **FILENAME** window), up to eight character file name can be defined. The entering of the desired name is possible by the selection of the characters (the **<ENTER>** and **<▲>**, **<▼>**, **<◄>**, **<►>** push-buttons) from the list printed on the screen.



The display of the instrument in the METER MODE - the FILENAME window

CATALOG (**Catalogue**) sub-window

This sub-window enables one to present the contents of the internal memory of the instrument. Only the files stored in the given instrument mode (e.g. the **METER MODE**) are listed there.



The display of the instrument in the METER MODE - the CATALOG window

4.2. Vibration measurement

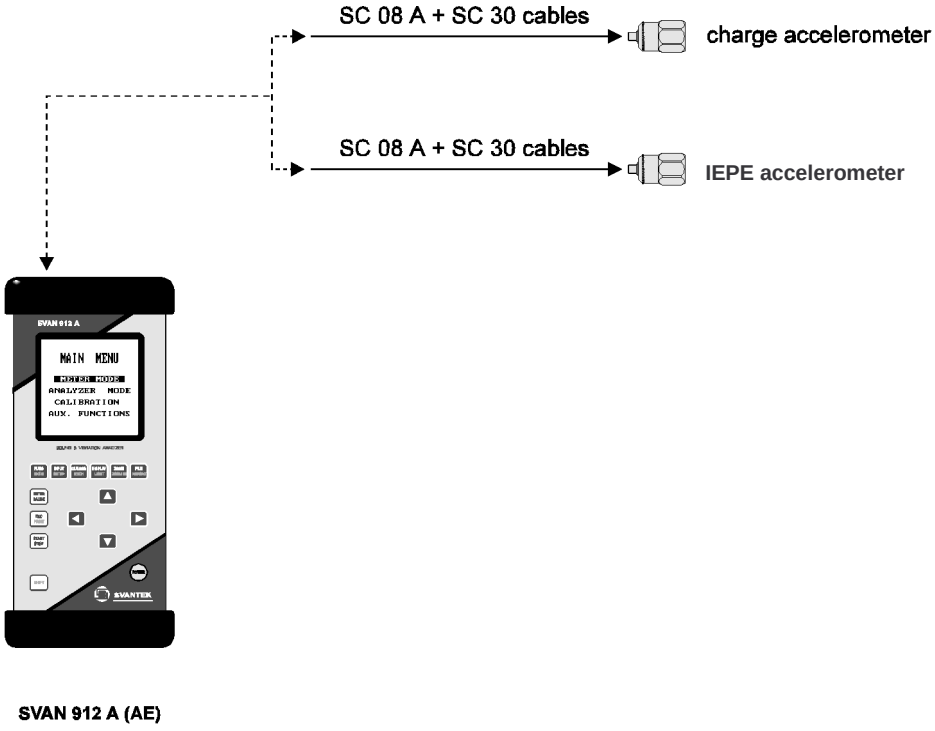
In the instrument's **METER MODE** vibration can be measured in five parallel so-called profiles. The measurement is performed by means of the **Val** function using different filters selected from the **FILTER** sub-window of the **INPUT** window. There are the following possibilities:

- the vibration acceleration is measured with the **HP**, **Lin**, **W-Bxy**, **W-Bz**, **W-Bc**, **H-A** and **KB** filter;
- the vibration velocity is measured with the **Vel1**, **Vel3**, **Vel10** and **MF-Vel** filter;
- the vibration displacement is measured with the **Dil1**, **Dil3** and **Dil10** filter.

The RMS detector and the filter can be defined independently for each profile. It means that these profiles can be treated as five standard vibration level meters working in parallel.

For the vibration measurement the system configuration should be as follows:

- Sound & vibration analyser SVAN 912AE,
- Charge piezoelectric transducer or
- ICP® type piezoelectric transducer,
- Optionally SV 10A calibrator or any other.



Configuration of the SVAN 912AE analyser for vibration measurement

The presentation of the measurement results is available in two modes selectable by the user in the **DISPLAY** window.

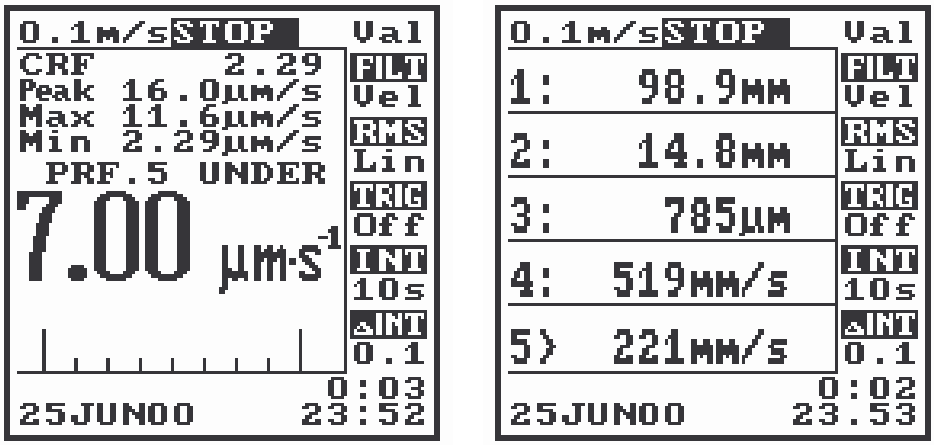
The main results from five profiles are visible on the screen after the selection in the **DISPLAY** window the option **5-Prof.** (**DISPLAY:1-Prof.**)

In "**one profile display mode**" (entered by **DISPLAY:1-Prof.**) the main result of the measurement (for the selected profile) is presented in the centre of the display area (the other profiles are measured concurrently but the results are not displayed). Several additional data are displayed above and below the main result.

In the case when in the **DISPLAY** window the **PLOT** option is selected, the result has a graphical form.

For each profile **RMS** and / or **PEAK** values can be stored in the Buffer, with the time "step" defined by the **ΔINTEGR.**, according to the setting of the **PLOT** sub-window (cf. the **DISPLAY** window for details).

Notice: The instrument always performs parallel measurement in five programmed profiles (the chosen detector and filter) despite the selected mode of result's presentation.



The display in the METER MODE - in "one profile" and in "five profiles display mode"

The following values are displayed in "**one profile display mode**" above the main result:

- **CRF** – Crest Factor defined as the ratio between the **Peak** and the **RMS** values in the measured time interval;
- **Peak** – the value measured in the time interval (the integration time of the **Peak** detector is equal ca 20 µs for 22.6 kHz band);
- **Max** – the maximal value of the measured signal on the **RMS** detector output in the time interval;
- **Min** – the minimal value of the measured signal on the **RMS** detector output in the time interval.

***Notice:** The **CRF**, **Peak**, **Max** and **Min** values are cleared before the start of the new measurement unless the **Spl** function is selected.*

Additionally, in "**one profile display mode**" the following data are displayed on the screen:

- the current measurement **RANGE** taking into account the calibration factor – the line at the screen's top;
- the current state of the measurement: **RUN**, **Pause** or **STOP** – the line at the top;
- the current function: **Val** – the line at the top;
- current date and time – the line at the bottom;
- time of the measurement – above the current time;
- the selected measurement parameters - in the column at the right side of the screen:
  - the type of the filter (**FILT**);
  - the type of the detector (**RMS**);
  - the kind of the trigger (**TRIG**);
  - the total integration time(**INT**);
  - the elementary integration step (**ΔINT**).

***Notice:** In "**one profile display mode**" the selection of the profiles can be done using the <▲>, <▼> push-buttons.*

In "**five profiles display mode**" five main RMS results are displayed conforming to the settings in the **FUNCTION** and **INPUT** window. The meaning of the remaining data presented on the screen is the same as in "**one profile display mode**".

The **OVERLOAD** and **UNDERRANGE** warnings can appear during the measurements.

In "**five profiles display mode**" the **OVERLOAD** and **UNDERRANGE** warnings are displayed before the measurement results as an arrow Ø (if overload) or ⇓ (if under range) - respectively.

In "**one profile display mode**" the **OVERLOAD** and **UNDERRANGE** warnings are displayed above the measurement results. The profiles number (**PRF.1**, ..., **PRF.5**) is displayed in the same line.

Notice: *The **OVERLOAD** warning appears when the **Peak** value of the measured signal exceeds 13.2 dB the nominal value of the current range.*

Notice: *In the case when the measurement result is corrected by the calibration factor (**CALIBR.:On**) the **OVERLOAD** warning appears when the input signal exceeds the different level then mentioned above (e.g. if the scale factor is equal to +10 dB and the measurement range is equal to 150 dB the **OVERLOAD** warning will appear if the measured value surpasses ca 170.2 dB – for the RMS of the sinusoidal signal).*

Notice: *The **UNDERRANGE** warning appears when the **RMS** value of the input signal is less then 60 dB in the relation to the nominal value of the current (active) range (it means ca 70 dB less then maximal level measured in the current range – for the sinusoidal signal).*

Notice: *When the absolute value of vibrations is important, the calibration of the measurement channel has to be done (the calibration factor must include the sensitivity of the transducer used in measurements). **The calibration procedure** is described in the Chapter 6. When the calibration factor is taken into account, the text **CAL.** is displayed under the main measurement result.*

Notice: *When the calibration is switched on (**CALIBR.:On**) the calibration factor is included in the measurement range and this range can be different from that one set in the **RANGE** sub-window of the **INPUT** window.*

In the **METER MODE** for the vibration measurements some control windows are available. These windows are displayed on the right side of the screen and are opened after pressing the corresponding push-buttons: **FUNC**, **INPUT**, **DISPLAY**, **CURSOR**, **FILE** and **SETUP**. The **<ZOOM>** push-button **is not active** in this mode.

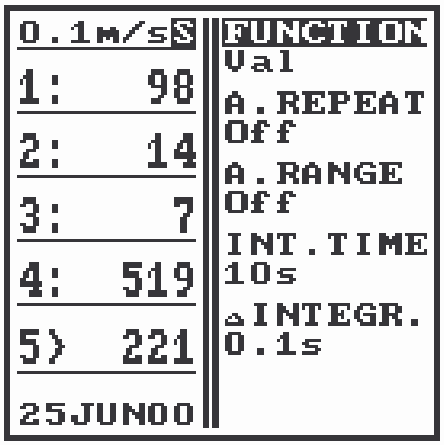
Inside each window the selection of the required functions or parameters is available using the **<◂ >**, **<▸ >** push-buttons only when the proper sub-window or field is displayed inversely.

*The **FUNC** window*

The window contains the sub-windows or fields after-mentioned: **FUNCTION**, **A.REPEAT**, **A.RANGE**, **INT.TIME** and **ΔINTEGR.**.

FUNCTION sub-window

This sub-window, in the case of the vibration measurements (**INPUT:Charge** or **INPUT:Acceler.**), is set to the **Val** function (**V**ibration **a**cceleration **l**evel). This function is the equivalent of the standard integrating vibration meter, Type 1 conforming to the **ISO 8041** standard. The measurement of the acceleration, velocity and displacement of the vibrations is possible by means of this function.



The display of the instrument in the METER MODE - the FUNC window

Notice: *The measured value is defined by the selection of the filter in the* ***FILTER*** *sub-window of the* ***INPUT*** *window. Due to the parallel measurements in five* ***profiles it is possible to measure simultaneously acceleration, velocity and displacement of the vibrations****.*

For the **vibration acceleration measurement** the following filters are available (cf. the description of the **FILTER** sub-window):

W-Bxy, **W-Bz**, **W-Bc**, **H-A**, **HP**, **Lin** and **KB**.

The characteristics of all mentioned above filters are given in App. D.

The measurement range for the transducer with the sensitivity of **10 mV/ms^{-2}** or **10 pC/ms^{-2}** is equal to from **0.001 ms^{-2}** to **1000 ms^{-2}**, (cf. the App. C).

For such transducer the acceleration can be measured in four ranges: **110 dB**, **130 dB**, **150 dB** and **170 dB** (in **dB** related to **1 μms^{-2}**, cf. the **RANGE** sub-window in the **INPUT** window).

It is possible to use non-metric units in the vibration accelerometer measurements. For these units see Chap. 7.

Notice: *The usage of the accelerometer with the sensitivity different from* ***10 mV/ms^{-2}*** *(or* ***10 pC/ms^{-2}****) will result in the change of the measurement range, see the Appendix C for details.*

Notice: *During the vibration measurements of the acceleration, velocity and displacement the current range is displayed in the upper left corner of the screen (including the value of the calibration factor if the calibration is switched on).*

If an **OVERLOAD** condition appears during the **Val** integration, it is "latched" and displayed until the end of the measurement (**OVL.** prompt will be cleared by the next measurement **<START>**).

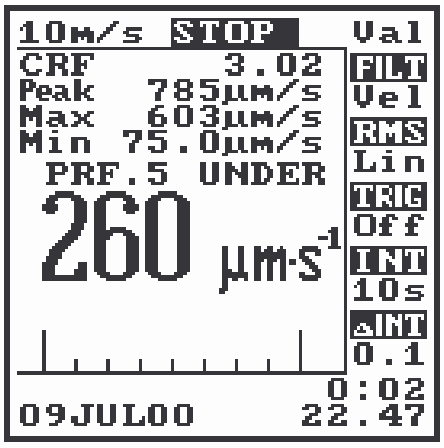
For the **vibration velocity measurement** the following filters are available (cf. the description of the **FILTER** sub-window):

Vel1, **Vel3**, **Vel10** and **MF-Vel**.

The characteristics of single integration filters (**Vel1**, **Vel3** and **Vel10**) and **MF-Vel** filter are given in App. D.

The measurement range for the transducer with the sensitivity of **10 mV/ms^{-2}** or **10 pC/ms^{-2}** is equal:

- for the **Vel1** filter from **100 μm/s** to **148 m/s** (for the frequency of **1 Hz**) and from **100 μm/s** to **0.5 m/s** (for the frequency of **330 Hz**) - cf. App. C.
- for the **Vel3** filter from **50 μm/s** to **48 m/s** (for the frequency of **3 Hz**) and from **50 μm/s** to **160 mm/s** (for the frequency of **1000 Hz**) - cf. App. C.
- for the **Vel10** filter from **20 μm/s** to **14.8 m/s** (for the frequency of **10 Hz**) and from **20 μm/s** to **50 mm/s** (for the frequency of **3000 Hz**) - cf. App. C.
- for the **MF-Vel** filter from **20 μm/s** to **14.8 m/s** (for the frequency of **10 Hz**) and from **20 μm/s** to **150 mm/s** (for the frequency of **1000 Hz**) - cf. App. C.



The display of the instrument in the METER MODE - the vibration velocity measurement

For mentioned above transducer the vibration velocity can be measured in nine ranges (depending on the selected **Vel** filter): **0.003 m/s**, **0.01 m/s**, **0.03 m/s**, **0.1 m/s**, **0.3 m/s**, **1 m/s**, **3 m/s**, **10 m/s** and **30 m/s** (or - respectively **130 dB**, **140 dB**, **150 dB**, **160 dB**, **170 dB**, **180 dB**, **190 dB**, **200 dB** and **210 dB** - the value in **dB** related to **1 nm/s**).

The detailed description of all available measurement ranges for the **Vel1**, **Vel3**, **Vel10** and **MF_Vel** filters depending on the selected input range (the measurement range for the vibration velocity) is given in App. C.

It is possible to use non-metric units in the vibration velocity measurements. For these units see Chap. 7.

If an **OVERLOAD** appears during the measurements, it is "latched" and displayed until the end of the measurement (the **OVL.** prompt will be cleared by the next measurement **<START>**).

Notice: *The **UNDERRANGE** warning during the measurements with the **Vel** filters is referred to the output of the integrating filter! It means that for the **high frequencies** of the measured signal this prompt can appear even in the case when the amplitude of the signal is equal to the full scale of the currant range. So, it is possible (depending on the input signal frequency) that alternatively with the **UNDERRANGE** the **OVERLOAD** warning will appear.*

Notice: *The usage of the accelerometer with the sensitivity different from **10 mV/ms^{-2}** (or **10 pC/ms^{-2}**), will result in the change of the measurement range, cf. the **Appendix C** for details.*

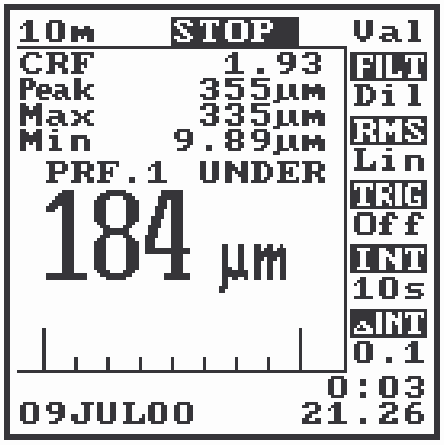
For **the vibration displacement measurement** the following filters are available (cf. the description of the **FILTER** sub-window):

Dil1, **Dil3** and **Dil10**.

The characteristics of double integration filters (**Dil1**, **Dil3** and **Dil10**) are given in App. D.

The measurement range for the transducer with the sensitivity of **10 mV/ms^{-2}** or **10 pC/ms^{-2}** is equal:

- for the **Dil1** filter from **20 μm** to **23 m** (for the frequency of **1 Hz**) and from **20 μm** to **80 m** (for the frequency of **18 Hz**) - cf. App. C.
- for the **Dil3** filter from **3 μm** to **2.5 m** (for the frequency of **3 Hz**) and from **3 μm** to **8 mm** (for the frequency of **57 Hz**) - cf. App. C.
- for the **Dil10** filter from **0.2 μm** to **2.3 m** (for the frequency of **10 Hz**) and from **0.2 μm** to **0.8 mm** (for the frequency of **181 Hz**) - cf. App. C.



The display of the instrument in the METER MODE - the vibration displacement measurement

For mentioned above transducer the vibration displacement can be measured in six ranges (depending on the selected **Dil** filter): **0.0001 m**, **0.001 m**, **0.01 m**, **0.1 m**, **1 m** and **10 m** (or - respectively **160 dB**, **180 dB**, **200 dB**, **220 dB**, **240 dB** and **260 dB** - the value in **dB** related to **1 pm**).

The detailed description of all available measurement ranges for the **Dil1**, **Dil3** and **Dil10** filters depending on the selected input range (the measurement range for the vibration displacement) is given in App. C.

It is possible to use non-metric units in the vibration displacement measurements. For these units see Chap. 7.

If an **OVERLOAD** appears during the measurements, it is "latched" and displayed until the end of the measurement (the **OVL.** prompt will be cleared by the next measurement **<START>**).

Notice: *The **UNDERRANGE** warning during the **Dil1** measurement is referred to the output of the integrating filter! It means that for the **high frequencies** of the measured signal this prompt can appear even in the case when the amplitude of the signal is equal to the full scale of the currant range. So, it is possible (depending on the input signal frequency) that alternatively with the **UNDERRANGE** the **OVERLOAD** warning will.*

Notice: *The usage of the accelerometer with the sensitivity different from **10 mV/ms^{-2}** (or **10 pC/ms^{-2}**), will result in the change of the measurement range, cf. the **Appendix C** for details.*

The **Val** function enables one to use four available **RMS** detectors (**Linear**, **Impulse**, **Fast** and **Slow**) and all integration time ”steps” (**ΔINT**).

Notice: *During the **Val** measurement the RMS results are updated once per second disregarding the elementary integration time. The displayed values are the **instantaneous integration results** calculated **during the whole time (from the measurement <START>)**, so the measurement interrupted at any moment gives the correct **Val** result. The **CRF**, **Peak**, **Max** and **Min** values are cleared with the each **<START>** of the measurement.*

During the **Val** measurement the current integration time is also displayed (for the **INT.TIME > 1 s**).

The **Val** function can also be **interrupted**. There are two ways for the "**PAUSE**" insertion into the measurement:

- by means of the **<START/STOP>** push-button. **It will terminate the current measurement!**
- by means of the **<ENTER/PAUSE>** push-button. It will insert an arbitrary long **PAUSE**. The measurement can be continued by pressing the **<START/STOP>** push-button.

Notice: *When the **Val** function is in the **PAUSE** state, the last **10 seconds** of the integration can be deleted. It can be achieved by pressing the **<ENTER/PAUSE>** push-button up to ten times (each pressing will delete last **1 s** of the integration). Removing of the last integration period **will not** change the **CRF**, **Peak**, **Max** and **Min** values, but can clear the **OVERLOAD** indication (this option is dedicated for the release of the "unwanted" overloads from the **Val** measurement).*

The **Auto Repeat** function can also be used (**A.REPEAT:On**) with the **Val** function for the "continues" acceleration measurement.

Notice: *The usage of the **Auto Repeat** (**A.REPEAT:On**) for the **Val** measurement causes the **very important modification** of that function. **Read carefully the text below!***

The default state of the **A.REPEAT** function for the **Val** measurement is **Off** (**A.REPEAT:Off**). The change of that setting to **On** (**A.REPEAT:On**) will cause the following operations:

- the new measurement will be started automatically after reaching the programmed integration time (**INT.TIME**). The **CRF**, **Peak**, **Max** and **Min** and values **will be lost!**
- all measured **Val** results will be automatically stored in the **PLOT** buffer! So, (**A.REPEAT:On**) option can be successfully used e.g. for the 24 hours vibration level monitoring in 1 minute periods.

All measurement results for the **Val** function can be stored as the files by means of the **Save** command (cf. the **FILE** window).

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

Notice: *The setting of the **A. REPEAT** influences the operation of storing the results in the Buffer.*

Notice: *The setting in the **A. REPEAT** sub-window is **common** for all profiles.*

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

A.RANGE (**Auto Range**) sub-window

This sub-window enables (**On**) and disables (**Off**) one the automatic gain control. The gain is decreased **20 dB** when **OVERLOAD** is detected and increased (**20 dB** if possible) when the input signal is lower more then **40 dB** below the full scale value.

Notice: *The setting in the **A. RANGE** sub-window is **common** for all profiles.*

INT.TIME (**Integration Time**) sub-window

This sub-window enables one the selection of the total integration time from the string: **1 m** (min), **5 m** (min), **15 m** (min), **1 h**, **8 h**, **16 h** (the direction to the left) or **1 s**, **2 s**, ..., **59 s**, **1 m** (min), **2 m** (min), ... **59 m** (min), **1 h**, **2 h**,..., **16 h** (the direction to the right).

Notice: *The setting in the **INT.TIME** sub-window is **common** for all profiles.*

Calculation of the total RMS values is done according to the formula given below:

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

where:

$\mathbf{Y_0}$ = 0;

$\mathbf{Y_n}$ - subsequent averaged results in time interval equal to **ΔINT**;

$\mathbf{X_n}$ - subsequent result of linear averaging (for **ΔINT** period) of the samples taken from the output of the selected RMS detector every 5 ms (see below);

n = 1, 2, ..., N;

N - corresponds to the total integration time **INT.TIME** (N = INT.TIME[s] / ΔINT[s]).

It is worth to notice that the presented above formula gives **the true averaged result** for any moment during the total (**INT.TIME**) measurement time.

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

This sub-window enables the user to select the "elementary" integration time from the values: **0.01 s**, **0.02 s**, **0.05 s**, **0.1 s**, **0.2 s**, **0.5 s** or **1 s**.

Notice: *The setting in the **ΔINTEGR.** sub-window is **common** for all profiles.*

Calculation of the **RMS** values for the **ΔINT** period is done according to the formula given below:

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

where:

$\mathbf{X_0}$ = 0;

$\mathbf{X_k}$ - subsequent averaged results;

$\mathbf{R_k}$ - the result taken every 5 ms from the output of the selected RMS detector (**Linear**, **Impulse**, **Fast** or **Slow**);

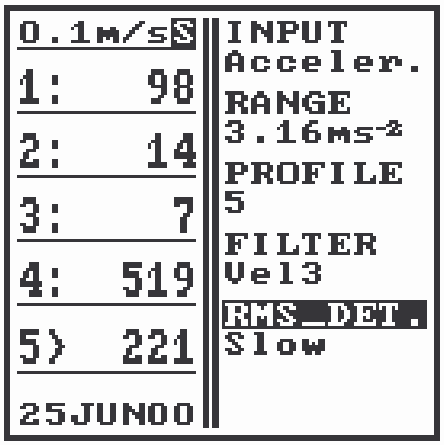
k = 1, ..., K;

K - corresponds to the time value equal to **ΔINT** (K = ΔINT[s] / 5 ms).

Notice: *The RMS values for **ΔINT** elementary integration time are used for the calculations:*
- of the main result,
*- of the **Min** and **Max** results (for the **Linear** detector)*
*and are registered in the Meter Buffer (the **DISPLAY:Plot** function) when **A.REPEAT:Off**.*

*The **INPUT** window*

The window contains the following control sub-windows: **INPUT**, **RANGE**, **PROFILE**, **RMS_DET.** and **LP_FILTER** (only for the **Charge** input).



The display of the instrument in the METER MODE - the INPUT window

INPUT sub-window

This sub-window enables one the selection of the measuring input.

Reference the internal source of the reference signal (the pseudo random binary noise),
Microph. the input for the sound signals (the external preamplifier is required),
Direct the input for the voltage signals,
Charge the piezoelectric charge accelerometer input,
Acceler. the ICP® accelerometer type input.
SV06 the input for four channel module for vibration measurements,
SV08 the input for four channel module for vibration and sound measurements.

***Notice:** The setting in the **INPUT** sub-window is **common** for all profiles.*

The vibration measurements can be performed using **Charge**, **Acceler.**, **SV06** and **SV08** inputs.

RANGE sub-window

This sub-window enables one the selection of the measurement input range (the input gain or attenuation). For the vibration acceleration measurement there are four measurement ranges (in 20 dB steps) available, which are defined below:

316 mms^{-2}, **3.16 ms^{-2}**, **31.6 ms^{-2}** and **316 ms^{-2}** (for the transducer's sensitivity of **10 mV/ms^{-2}** or **10 pC/ms^{-2}**). It conforms to **110 dB**, **130 dB**, **150 dB** and **170 dB** in **dB** related to **1 μms^{-2}**.

***Notice:** The setting in the **RANGE** sub-window is **common** for all profiles.*

PROFILE sub-window

This sub-window enables one to select the active profile for which the weighting filters (the sub-window **FILTER**) and the **RMS** detector (the sub-window **RMS_DET.**) should be set. It is possible to select: the first (**Profile1**), the second (**Profile2**), the third (**Profile3**), the fourth (**Profile4**) or the fifth (**Profile5**) measurement profile.

***Notice:** The selection of the current profile is done by means of the **<◀>** and **<▶>** push-buttons together with **<SHIFT>**.*

FILTER sub-window

This sub-window enables one the selection of the weighting filter for the given measurement input.

Notice: *The setting in the **FILTER** sub-window is **independent** for each profile.*

For the vibration acceleration measurement:

W-Bxy	(**W**hole **B**ody **x**, **y**), conforming to **ISO 8041**, Type 1;
W-Bz	(**W**hole **B**ody **z**), conforming to **ISO 8041**, Type 1;
W-Bc	(**W**hole **B**ody **c**ombined), conforming to **ISO 8041**, Type 1;
H-A	(**H**and-**A**rm), conforming to **ISO 8041**, Type 1;
HP	high pass filter (cf. App. C);
Lin	high pass filter (cf. App. C);
KB	special filter for the application on the ships (**KB** = "**W-Bc**" + 28.9 dB).

For the vibration velocity measurement:

Vel1	filter of single integration (1 Hz – 330 Hz);
Vel3	filter of single integration (3 Hz – 1000 Hz);
Vel10	filter of single integration (10 Hz – 3000 Hz);
MF-Vel	special filter for machines (10 Hz – 1000 Hz) conforming to **ISO 10816**.

For the vibration displacement measurement:

Dil1	filter of double integration (1 Hz – 18 Hz);
Dil3	filter of double integration (3 Hz – 57 Hz);
Dil10	filter of double integration (10 Hz – 181 Hz).

Notice: *Each change of the **RANGE** or **FILTER** setting causes the <**STOP**> of the measurement (if **A.REPEAT:Off**) or the <**START**> of the next measurement (if **A.REPEAT:On**). The usage of the **AUTO RANGE is not recommended** for the measurement with the integration time longer then **1 s**.*

RMS_DET (**RMS detector**) sub-window

This sub-window enables one the selection of the **RMS detector type**: **Linear** (**Lin**), **Impulse** (**Imp**), **Fast** or **Slow**.

Notice: *The setting in the **FILTER** sub-window is **independent** for each profile.*

The Linear detector - calculates the exact RMS value of the "elementary results" in the time intervals equal to 5 ms. The output of this detector is subsequently averaged linearly with the **ΔINT** integration step.

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

The **Impulse**, **Fast** and **Slow** detectors are realised numerically using so-called "exponential" averaging. **The result of this procedure conforms to the result given by the analogue RMS converter working with the proper integration time constant**.

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

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

where:
$\mathbf{R_0}$ = 0;
$\mathbf{R_i}$ - the subsequent averaged results;
$\mathbf{L_i}$ - the result of the linear averaging of the input data samples for every 5 ms periods;
i = 1, 2, 3, ... ;
N - constant, corresponding to the current integration time constant (**Impulse**, **Fast** or **Slow**).

Notice: *For the **Impulse** integration time the time constant of averaging and time constant of falling are defined independently.*

LP_FILTER sub-window

This sub-window enables one to set additional 2 kHz low pass filter (cf. App. C). This sub-window is active only for the **Charge** input and is not available for the **Acceler.** one.

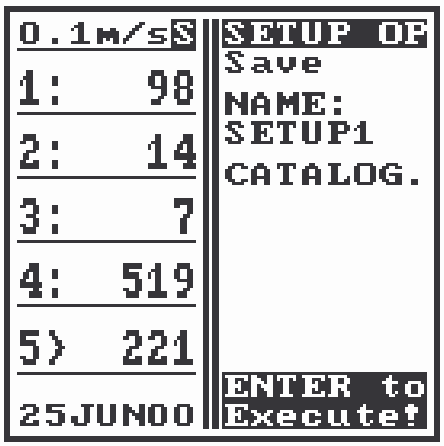
Notice: *The setting in the **LP_FILTER** sub-window is **common** for all profiles.*

*The **SETUP** window*

The window contains the following control sub-windows: **SETUP OP**, **NAME** and **CATALOG.**.

SETUP OP

This sub-window enables the user the storage (**Save**), recovery (**Load**) and deletion (**Erase**) of the instrument's control configuration file (so-called "SETUP File"). That file contains the following items:
- the measurement input,
- the measurement range,
- the display range,
- the weighting filter,
- the auto range setting,
- the measurement function,
- the auto repeat setting,
- the averaging mode,
- the integration time,
- the elementary integration time,
- the displayed function,
- the display's scale,
- the calibration setting.



The display of the instrument in the METER MODE - the SETUP window

Notice: *After switching on the instrument and after* ***entering METER MODE*** *the* ***last used user SETUP File*** *is automatically loaded. The user SETUP File loading can be disabled by means of the* ***SETUP MODE*** *function (cf.* ***AUX. FUNCTIONS/SETUP MODE****).*

NAME sub-window

This sub-window enables the user to define the SETUP File name. The introduction of this name can be done in two ways:

- a decrease or an increase of the given file name number (the **< ◂ >, < ▸ >** push-buttons),
- the entering new (up to eight characters) name after the next (**EDIT**) sub-window opening (cf. the **FILE** window).

CATALOG (**Catalogue**) sub-window

This sub-window enables one to check the contents of the SETUP Files catalogue.

Notice: *The selection of the file from the SETUP Files Catalogue can be done by means of the* **< ▴ >**, **< ▾ >** *and* <***ENTER***> push-buttons*.*

*The **DISPLAY** window*

The window contains the following control sub-windows: **DISPLAY** and **SCALE**.

DISPLAY sub-wimdow

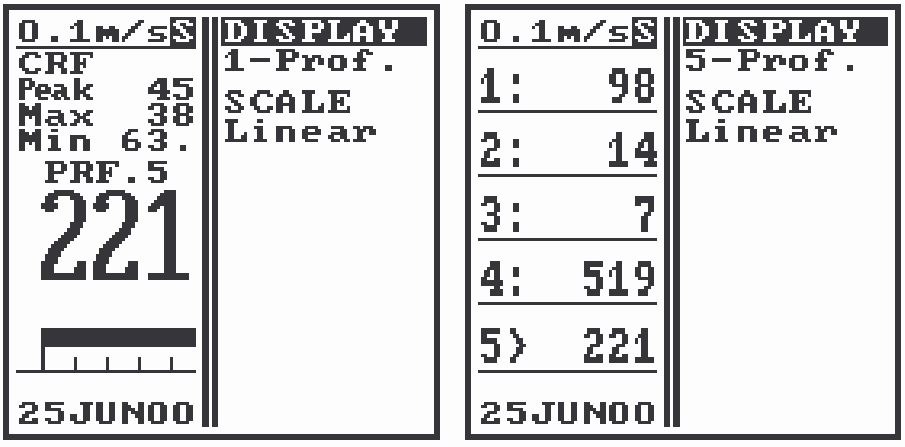
This sub-window enables one to select the way in which the measurement results should be displayed. There are the following possibilities: **1-Prof.**, **5-Prof.** or **Plot**. The setting of the parameter in this window is important for the **Save** operation (see below).

1-Prof. – "**one profile display mode**"

In "**one profile display mode**" the measurement result from one selected profile is presented on the whole screen. In vibration measurements there is only one function: **Val** but there exist quite a lot filters for the measurement of acceleration, velocity and displacement.

5-Prof. – "**five profiles display mode**"

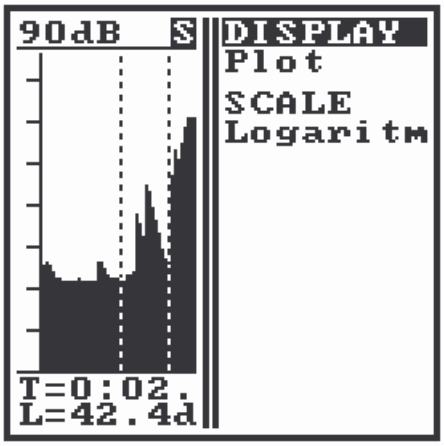
In "**five profiles display mode**" the measurement results from five profiles are presented simultaneously on the whole screen. In vibration measurements there is only one function: **Val** but there exist quite a lot filters for the measurement of acceleration, velocity and displacement. The selection of a filter can be done independently for each profile.



The display in the METER MODE - the DISPLAY window - "one profile" and "five profiles display mode"

Plot display mode

This mode enables one the observation and recording of the vibration level changes during the measurement. All results, measured with the **elementary integration time** (**ΔINTEGR.**) or **INT.TIME**, are stored in the buffer and can be displayed as a function of time (time history) when the **DISPLAY** window is set to **Plot**. The "length" of the buffer enables one to store approx. **32000 results**.



The display of the instrument in the METER MODE - the DISPLAY window

*The **PLOT** window*

The contents of the buffer can be defined by means of the **PLOT** window. This window can be opened after **pressing the <DISPLAY> push button twice**.

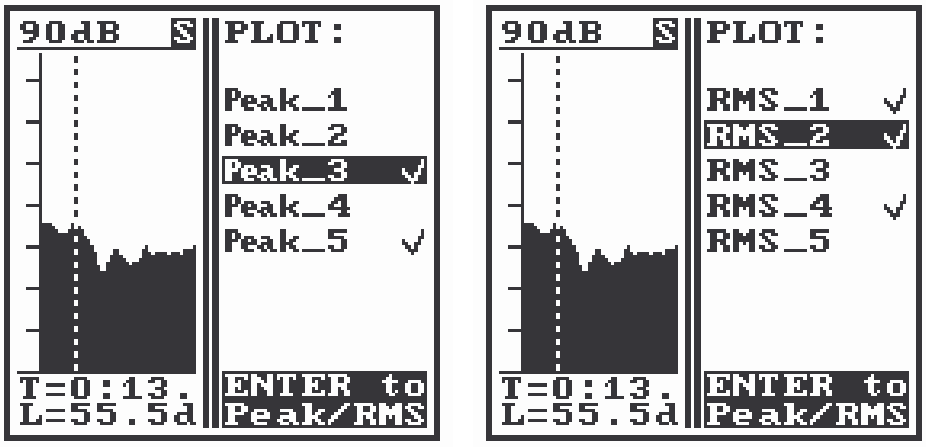
For each profile **RMS** and / or **PEAK** values can be stored in the Buffer, with the time ”step” defined by the **ΔINTEGR.**, according to the setting in the **PLOT** sub-window. So, **up to ten** independent buffers can be created.

Notice: Each buffer’s length is equal to 32000 divided by the number of created buffers!

The contents of each **PLOT buffer** can be:

- displayed as a function of time when the **DISPLAY** window is set to **PLOT**. The **< ▸ >** and **< ◂ >** push-buttons enable one to read out the stored value and time of the measurement (with the **<SHIFT>** and **< ▸ >**, **< ◂ >** push-buttons the step of the movement can be increased).
- saved in a standard way as a file (when **DISPLAY:PLOT** is active).

Notice: All created buffers are saved in one file!



The display of the instrument in the METER MODE - the PLOT sub-windows

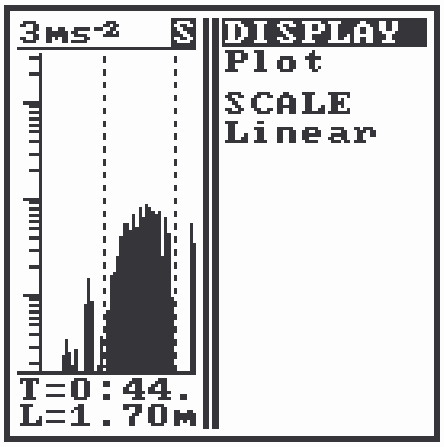
Notice: *The buffers contents can be controlled by means of the <▲>, <▼>, <◀> and <▶> push-buttons.*

SCALE sub-window

This sub-window enables the user to change the scale in which the measurement result is given. Two types of the scale are available:

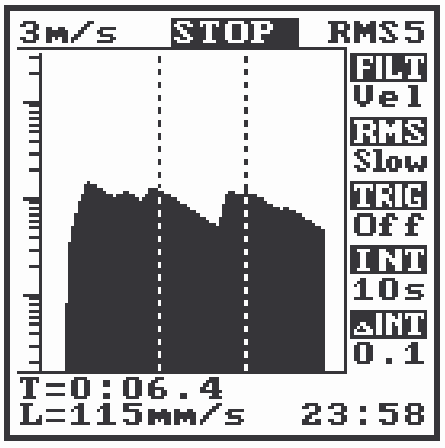
Linear the linear scale,
Logarithm the logarithmic scale.

The linear scale is the default for the vibration (acceleration, velocity and displacement) measurement.



The display of the instrument in the METER MODE - the DISPLAY window

Notice: *The results given in the linear scale are calculated as the* ***[log]$^{-1}$ function with the 0.1 dB step****.*



The display of the instrument in the METER MODE - the PLOT function for the SCALE: Linear

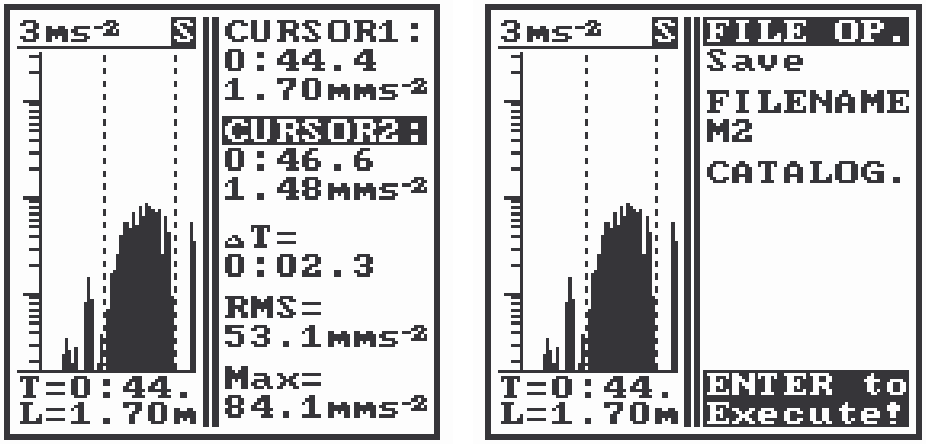
Notice: *The drawing in the* ***Plot*** *mode for the* ***SCALE:Linear*** *setting is still presented in the logarithmic scale, only the Y axis is scaled with the linear units (cf. the above figure) .*

*The **CURSOR** window*

The window contains the following control sub-windows or field: **CURSOR1**, **CURSOR2**, **ΔT=**, **RMS=** and **MAX=**.

CURSOR1 and **CURSOR2** sub-windows

When the DISPLAY window is set to PLOT the **CURSOR1** and **CURSOR2** sub-windows are active and enables one the evaluation of the time relations between events registered in the buffer and the calculation of the **RMS** value for the arbitrary selected part of it and the **MAX** value determination.



The display of the instrument in the METER MODE - the CURSOR window and the FILE window

*The **FILE** window*

The window contains the following control sub-windows: **FILE OP.**, **FILENAME** and **CATALOG.**.

FILE OP. (**File Operation**) sub-window

This sub-window enables one the selection of the file operation. The window has the following list of the options (commands, file operations): **AutoSave**, **SaveNext**, **Save**, **Load** and **Erase**.

AutoSave option

This command enables the user to store the measurement result in the internal memory of the instrument in the automatic way. The first file name has to be set in advance by means of the **FILENAME** window (see below) and will be automatically incremented after each save operation. Storing measurement results will take place after every "detection" of the **STOP** mode. Additionally, when setting **A.REPEAT:On**, results of all measurement cycles will also be saved. The **METER MODE** Buffer is not saved in the **AutoSave** command!

***Notice: The measurement process will be interrupted** (forced **STOP** state) when the automatically generated file name **already exists or file cannot be created**.*

SaveNext option

This command enables the user to store the measurement result in the internal memory of the instrument. The file name has to be set in advance by means of the **FILENAME** window (see below) and is automatically incremented before subsequent save operation.

Save option

This command enables the user to store the measurement result in the internal memory of the instrument. The file name has to be set in advance by means of the **FILENAME** window (see below).

Notice: *The contents of the file stored by the **Save** command is strongly depended on the combination of the parameters setting in the **FUNCTION** and **DISPLAY** windows. Two different types of the data files can result from it:*

1. *The file contains only the basic **RMS** results;*
2. *The file contains the basic **RMS** results and the contents of the **PLOT** buffer, when **DISPLAY:PLOT** is displayed.*

*More details about the file structure are given in the **Appendix B**.*

Load option

This command enables the user to read-out the measurement result stored in the internal memory of the instrument (by the **Save** operation). The file name has to be set in advance by means of the **FILENAME** window (see below).

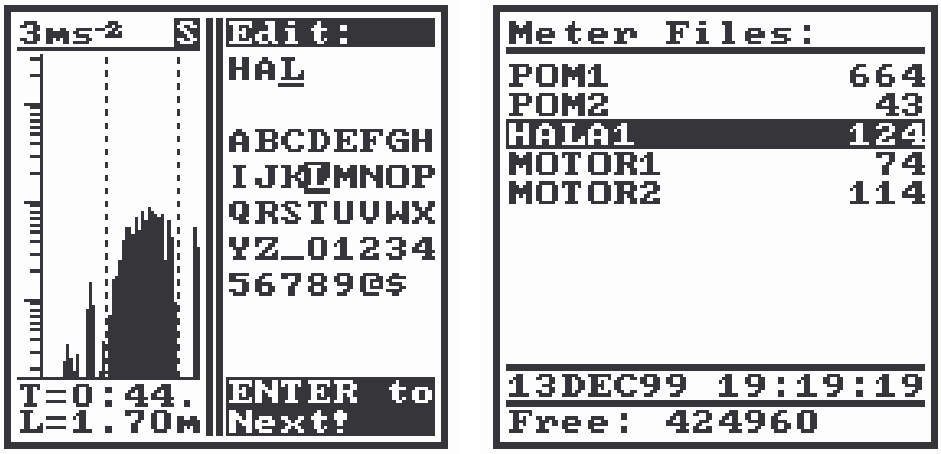
Erase option

This command enables one to delete the selected file. The file name has to be set in advance by means of the **FILENAME** window (see below).

FILENAME sub-window

This sub-window enables the user to set the file name for the **Save, Load** and **Erase** operations. The window has two control levels:

- on the "first level" the file name number may be incremented or decremented (by means of the **<▲>** and **<▼>** push-buttons), e.g.: Result1, Result2, Result3 e.t.a.
- on the "second level", available after opening the **EDIT** sub-window (the **<ENTER>** push-button with the active **FILENAME** window), up to eight character file name can be defined. The entering of the desired name is possible by the selection of the characters (the **<ENTER>** and **<▲>**, **<▼>**, **<◀>**, **<▶>** push-buttons) from the list printed on the screen.



The display of the unit in the METER MODE - the FILENAME window and the CATALOGUE window

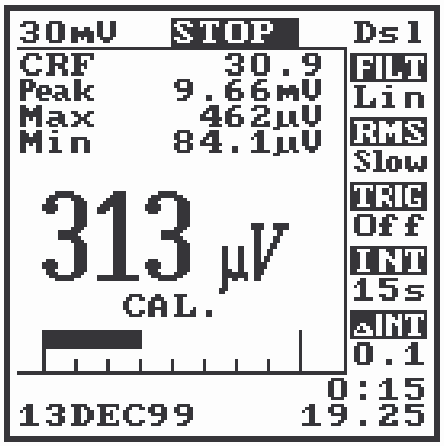
CATALOG (**Catalogue**) sub-window

This sub-window enables one the presentation of the contents of the internal memory of the instrument. Only the files stored in the given instrument mode (e.g. the **METER MODE**) are listed there.

4.3. Voltage measurement

In the **METER MODE** of the instrument the voltage can be measured directly by means of the **Dsl** and **Dsa** functions selected in the **FUNCTION** window. In this case the direct input should be chosen (**INPUT:Direct**).

The **Dsl** (**Direct signal level**) and **Dsa** (**Direct statistical analysis**) functions operate in the same way as **Leq** and **Ssa** (in "**one profile display mode**").



The display of the instrument in the METER MODE - the Dsl function with parameters

There are only three differences:

- The voltage can be measured in four ranges: **70 dB**, **90 dB**, **110 dB** and **130 dB** (in **dB** related to **1 µV**; cf. the **RANGE** sub**-**window). The measurement range is equal **12 dB - 140 dB**, cf. the **Appendix C.**
- All weighting filters can be selected with the **Dsl** function: **Lin**, **A**, **C**, **HP**, **G**, **W-Bxy**, **W-Bz**, **W-Bc**, **H-A**. See the **FILTER** sub-window of the **INPUT** window.
- The additional calibration of the voltage measurements **can only be done** by means of the "input attenuation" factor (**INP_ATT in the CALIBRATION MODE**).

4.4. Internal reference voltage measurement

The internal reference voltage measurement is used for testing the accuracy of the instrument's analogue input. In order to perform this measurement the user has to select the following settings:

*The **INPUT** window:*

INPUT - sub window

Reference the internal reference (binary pseudo-random) signal

(**RMS value = 90 dB**)

FILTER - sub window

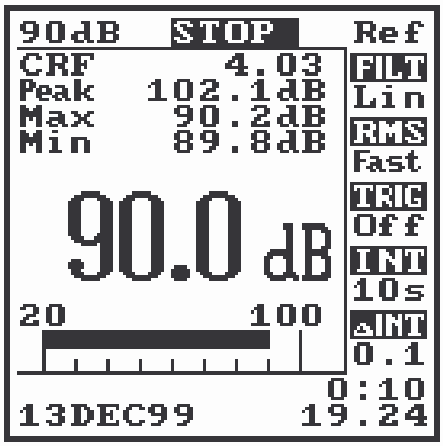
Lin

*The **FUNC** window:*

FUNCTION - sub window

Ref the measurement of the internal reference (the binary pseudo-random) signal the RMS value;

After pressing the **<START>** push button the main result 90 dB (± 0.1 dB) should be obtained. Please contact service in other case.



The display of the instrument in the METER MODE – internal reference voltage measurement

Notice: The internal reference mode is recommended for the temporary testing of the instrument's analogue input..

Notice: *The **Ref** function is also available in five profiles with the **Lin**, **A**, **C**, **HP**, **G**, **W-Bxy**, **W-Bz**, **W-Bc** and **H-A** filters but it is not recommended to use this option (five profiles with different filters) in order estimate the proper operation of the instrument.*