Chapter 5

Using the Sound Level Meter Nor-116

The *Norsonic* sound level meter Nor-116 consists of three main parts; the microphone cartridge, the microphone preamplifier and the instrument body.

You may have to assemble the instrument the first time you use it.

Take utmost care when mounting the microphone cartridge onto the preamplifier. The cartridge is a very delicate device. Always keep the preamplifier disconnected from the instrument body when screwing the cartridge onto the preamplifier. Screw only fingertight.

If you screw the cartridge onto the preamplifier while the 116 is powered, the voltage present at the preamplifier terminals will catch you by surprise. The voltage is not hazardous by any means, but its presence may cause you to drop the cartridge. The cartridge may not withstand a fall onto the floor.

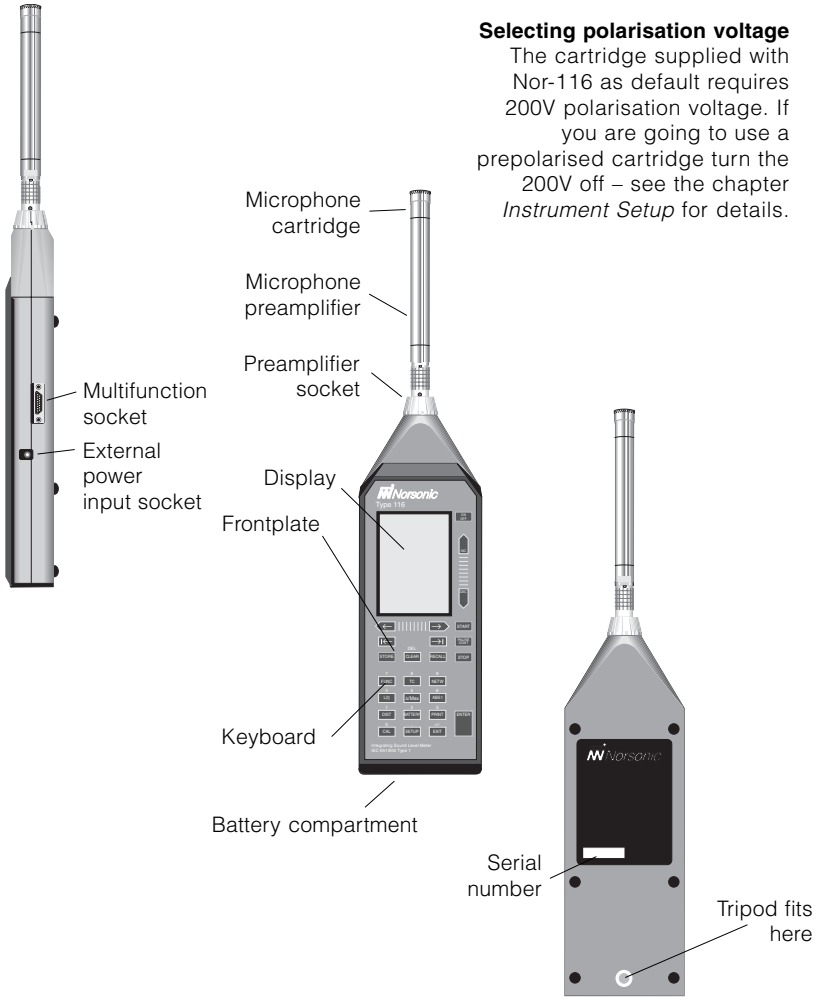
Timeout

If the Nor-116 is left unoperated for ten minutes it will shut itself off. This will not take place if the instrument is running (measuring) or paused.

When time-out is activated, any data not stored will be stored in today's directory as if they were stored there by you, i.e. the data will be located in the file with the highest file number.

Timeout applies only when the instrument is running on internal batteries

The main parts of the Nor-116…

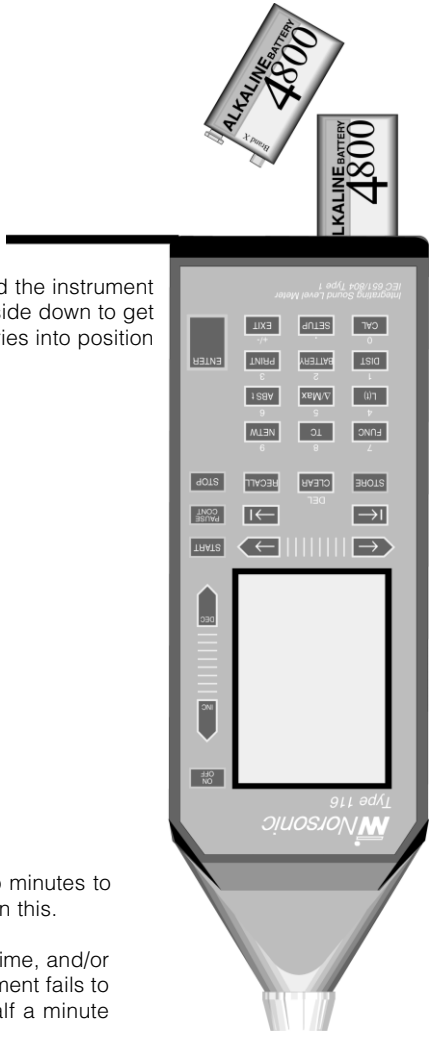


Selecting polarisation voltage
The cartridge supplied with Nor-116 as default requires 200V polarisation voltage. If you are going to use a prepolarised cartridge turn the 200V off – see the chapter *Instrument Setup* for details.

Replacing the batteries…

Slide the battery compartment lid to the right to open it…

…and hold the instrument exactly upside down to get new batteries into position



Note: When replacing batteries, fresh batteries must be inserted within two minutes to preserve the contents of the internal memory. See overleaf for more on this.

Note: If you for any reason leave the unit without batteries for a prolonged time, and/or you install NiCd rechargeable batteries, it may happen that the instrument fails to respond to attempts to switching it ON. If so, wait approximately half a minute before you try again.

A Few Words on Batteries

The Nor-116 comes with two 6LR61 nine volt batteries. Battery lifetime is typically 8–12 hours (depends on measurement mode and brand of batteries). If you switch to lithium batteries the life time will increase to 15–20 hours. The use of alkaline or lithium batteries is strongly recommended to avoid leakage.

The very first time batteries are inserted the display will show the text "Memory error" indicating that the memory contents have been corrupted. Press ENTER to continue. This will clear the entire memory.

If fresh batteries are not inserted within two minutes after the old batteries were taken out the memory will become corrupted, indicated by the text "Memory error" in the display. If so, follow the above procedure. Memory contents will be lost entirely.

Rechargeable batteries may also be used, but with reduced operating time. Connecting an external DC-source (11–25V) to the instrument will *not* charge rechargeable batteries, but power the instrument *in lieu* of the internal batteries.

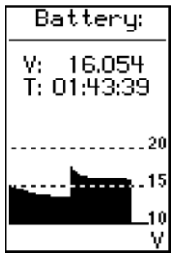
When the combined voltage of the two batteries drops below 10.5V, the instrument will shut itself off. However, they will still power the internal non-volatile memory, although the voltage is too low for normal operation.

The internal calendar/clock is powered by an integrated battery with approximately ten years of battery life-time.

Battery Voltage vs. Time

The Nor-116 offers a graphic presentation of the battery-versus-time history. Switch on the instrument and let it initalise (if applicable) and press BATTERY.

The display will now indicate the current combined voltage of the two batteries and the use-time elapsed since the batteries were replaced. The graph is updated every five minutes and each pixel corresponds to five minutes in the horizontal direction and 0.25V in the vertical direction.



When the Nor-116 is powered from internal batteries, the current battery voltage is displayed alongside with the time elapsed since the batteries were replaced

When the combined battery voltage drops below 13.5V, a battery low indicator appears in the display, and when it drops below 10.5V the instrument shuts itself down.

If the instrument is connected to an external DC-source, the battery voltage vs. time display will be shown without voltage and use-time information (empty graph). No battery low warning will be issued when the Nor-116 is connected to an external DC-source.

If left unattended and unoperated the Nor-116 will switch itself off after ten minutes. However, this does not apply if the instrument is measuring (including being paused during a measurement.

Battery Replacement

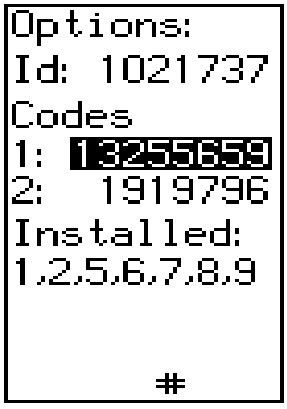
See also the previous page for details on how to replace batteries. Observe the polarity indicated on the instrument body, just above the battery compartment opening. Correct battery type is 6LR61. Alkaline or other non-leaking batteries are preferable.

Rechargeable batteries may be used, but the Nor-116 contains no charging circuit. Hence, rechargeable batteries must be recharged in a separate battery charger.

Any external DC-source (such as the Nor-334) used to power the Nor-116 should have a voltage in the range 11–25V. Polarity is GND at the centre pin.

If the Batteries Fail While Measuring

Should the batteries run so low during a measurement that further operation must be discontinued; the measurement will be halted and the data acquired so far will be stored in a directory called BATLOW. The Nor-116 will create this directory, if it didn't exist in beforehand. If you find more than one file in this directory, the file with the highest file number is the most recent file. Any other files present in the BATLOW directory come from previous battery power failures.



Available extensions for the Nor-116:

Ext. 1 Statistical calculations with 0.5 dB classwidth
Ext. 2 Level vs. time with 1/8, 1, 2, 3… seconds resolution
Ext. 3 TaktMax5 and IL_{EQ}
Ext. 4 Extended memory
Ext. 5 RS-232 serial interface
Ext. 6 Advanced L(t)
Ext. 7 Parallel detectors to measure with F, S and I simultaneously
Ext. 8 A-weighted sound power calculations
Ext. 9 German Beurteiligungspegel
Ext. 13 Adjustable Ln value

The setup of your Nor-116 will depend on the number of *extensions* it is equipped with.

Extensions are modules – made as hardware or in software, in the instrument or e.g. as PC software – available for your instrument. *Norsonic* extensions are always *optional* (and hence often referred to as *options*), in this way you do not have to pay for features you're not going to use anyway. Nevertheless, you may find that your tasks expand into new areas of acoustics as time goes by, therefore a typical *Norsonic* extension may be installed as a retrofit.

Unless you are absolutely certain about the extensions installed, we recommend that you spend some time to check which options are present in your unit. To produce a list of extensions installed press SETUP followed by **1** and then **9** – although 9 is not listed in the menu.

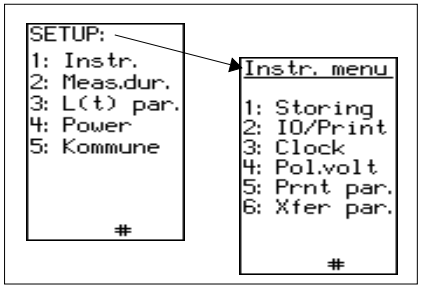
The menu that you now produced in the display contains an *ID code*, *two instrument codes* and finally the word INSTALLED. If no extensions (called *options* here) are listed below the word INSTALLED, your instrument is of the *basic* version.

Press ENTER to exit. The instrument will now restart (like when switched on).

Do not change the codes! If you change any of the codes, your installed extensions will cease to function.

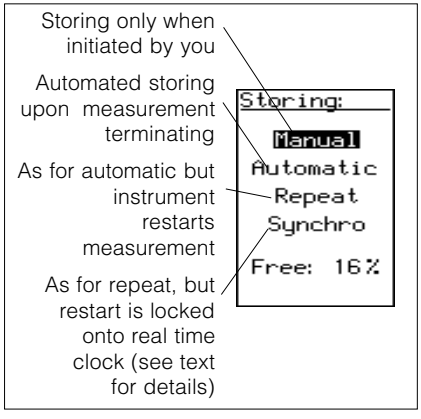
In order to configure your Nor-116 to your liking you should spend some time going through the Setup menus to see if anything needs to be changed.

To enter the Instrument Setup menu, press SETUP followed by 1.



Storage Mode

The Nor-116 offers four ways of storing acquired data after a measurement; viz. manual and three ways of automated storage. When set to *manual*, no storage takes place unless carried out by you.



In the *automatic* mode acquired data will be stored upon measurement termination, *regardless of the reason for termination* – i.e. irrespective of whether termination took place because the duration expired or because you pressed STOP.

Navigating in the menus

Use the ⟵ ⟶ to navigate between parameters in the menu and INC and DEC to alter a parameter

When set to *repeat*, the instrument will store the acquired data and then restart immediately and make another measurement using the same measurement setup and duration. This applies to measurements terminated by themselves only. If you force the measurement to terminate (by pressing STOP), it will not restart. Note that some time will be spent on storing the acquired data. Therefore a slight shift (in the magnitude of a few seconds or less) in the restart moment will be observed.

Assume you've set up the instrument to produce hourly reports and that you have started the instrument exactly on the hour. After some hours the start time will have shifted a few seconds. This can be avoided by forcing the instrument to terminate the measurement just before the measurement period expires to allow the data to be stored so that a new measurement can be started on time.

This is called *synchro* mode. When set to synchro mode the first measurement period is truncated, if needed, to make the periods fit the hour of the clock.

Example: Assume you set up the instrument to measure in 10 minutes periods and that you press start at 09:27:40. The first period will be truncated by the instrument and have a duration of almost 2 minutes and 20 seconds giving a little time for storing the acquired data. The amount of time needed depends on the amount of data to be stored , i.e. the combination of the number of functions and the number of periods. It can be as short as a fraction of a second.

The next measurements will then start at 09:30:00, 09:40:00, 09:50:00 etc. If you set the instrument to measure in five minutes periods it will lock on 09:30:00, 09:35:00 etc.

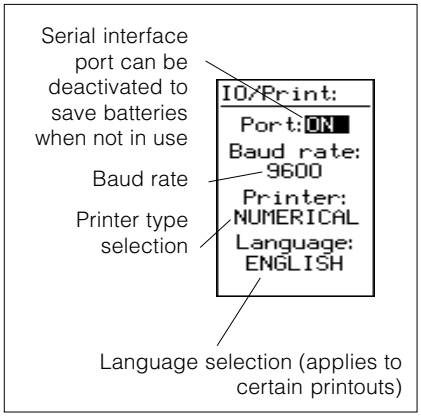
A typical application of this feature is to generate hourly reports.

IO/Print

In this menu you control the transfer rate and printer type.

We do recommend that you turn off (deactivate) the serial interface port whenever it's not in use to save batteries.

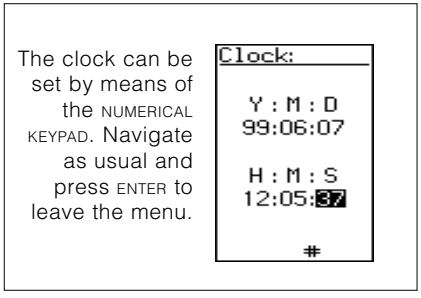
The *baud rate* determines the transmission speed and must be set to the same value in the PC or printer as in the Nor-116.



Select between 150, 300, 600, 1200, 2400, 4800 and 9600 baud.

The *printer* can be set to either Numerical, DeskJet, ThinkJet or Diconix.

The *language* setting is there to define the language used in certain printouts aimed at measurements made in accordance with certain German standards. It will not appear elsewhere. Select between English and German.



Clock

The Nor-116 comes with a real time clock which is the technical name for the clock showing the date and time of day.

To set the clock key in the correct figures and press ENTER. Navigate as usual.

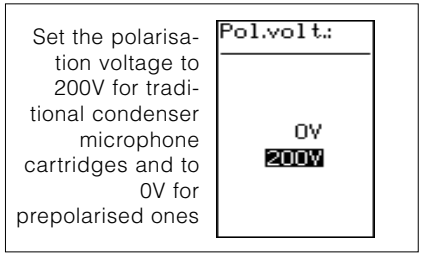
Polarisation Voltage

As default the Nor-116 comes with a standard condenser microphone cartridge requiring 200V polarisation voltage. However, electret or prepolarised microphones may also be used with this instrument.

Most prepolarised cartridges will not be harmed by being exposed to 200V polarisation voltage. This may or may not apply to specific electret microphone cartridges. Check this out before mounting the cartridge on the instrument. Norsonic is not liable for damages (neither direct damages nor consequential damages) occurring as a result of incorrect application of polarisation voltage to a microphone cartridge.

If the sensitivity of the microphone seems to be very low (all sound levels are on the lower side than they should be, you should check the status of the polarisation voltage. If set to 0V, traditional condenser microphones will appear to have very low sensitivity and if set to 200V, prepolarised cartridges will exhibit the same (provided they can take it). Allow for some time to settle before checking the sensitivity again.

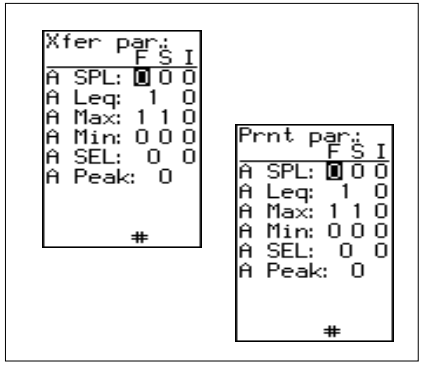
If the polarisation voltage is correct, but the sensitivity low, check the sensitivity setting in the *calibration* menu.



Print and Xfer Parameters

In the L(t) par. menu you may specify which functions you would like to measure. From there you can also indicate that these functions shall al be printed or transferred to a remote computer.

However, maybe you want to measure a multitude of functions, but print just a few and transfer just some of these functions. This is when to use these menus. They work exactly like the L(t) par. menu.



Calibrating the Nor-116

Calibration of the 116 should preferably take place before a measurement session is commenced, or whenever required by applicable standards.

You calibrate the Nor-116 by means of menus and keypushes – there is no potentiometer to turn when calibrating the 116.

For calibration, a sound calibrator – such as the *Norsonic* sound calibrator Nor-1251 (available separately) – is essential.

To calibrate the Nor-116:

1 Switch on the instrument by pushing ON/OFF and let it initialise (count down)
2 Mount the calibrator onto the microphone and switch on the calibrator
3 Select a suitable full scale deflection by pushing INC or DEC until the bargraph deflection falls in the upper half of its range
4 Press CAL to enter the calibration menu
5 Read the sound pressure level

   If the sound pressure level does not correspond to the output level of the calibrator, you should use INC and DEC to adjust the sensitivity until the correct level is indicated by the Nor-116.

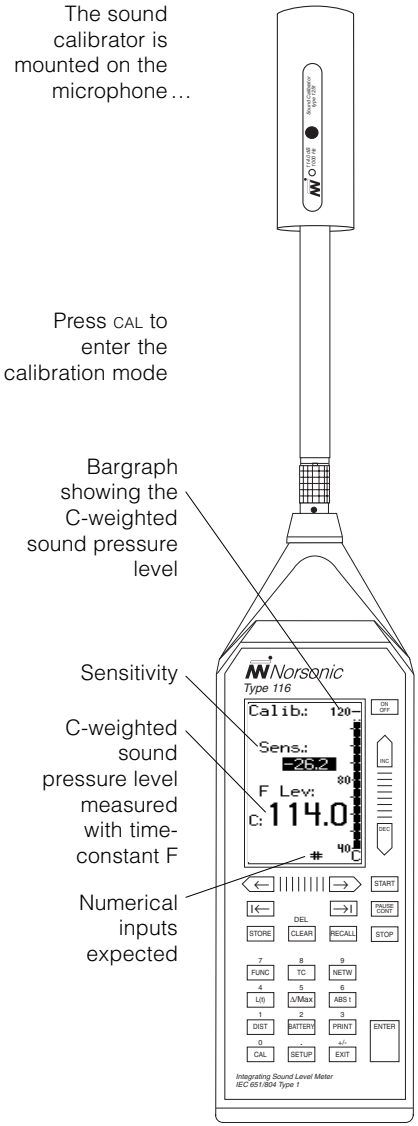
6 Once the setting is correct, push ENTER to return to normal display mode.

The microphone cartridge normally supplied with the Nor-116 is of the free-field type, i.e. it has been designed to compensate for its own influence on the sound field. To neutralise this when inserting the cartridge in a closed coupler like the sound calibrator the Nor-116 level must be adjusted to a value 0.2dB lower than the calibrator output level.

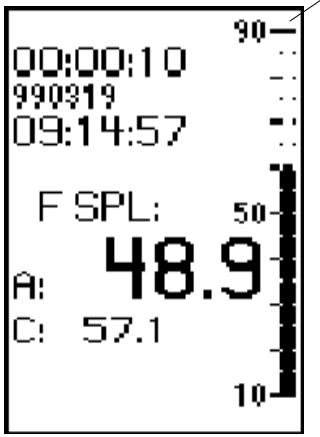
Example: The output level of the sound calibrator Nor-1251 is 114 dB. The Nor-116 should then be adjusted to 113.8dB. Similarly when used with other brands of precision calibrators; if the output level is 94dB, adjust the Nor-116 to 93.8 dB and so on.

If you know the microphone cartridge sensitivity, you may key this in by means of the NUMERICAL KEYPAD. However, doing so will never replace calibration with a sound calibrator, as the sensitivity adjustment procedure will neither detect microphone, preamplifier nor extension cable malfunction.

Note: Sometimes you may enter the calibration menu unintentionally. Do not press EXIT to leave the menu! Use ENTER instead! The EXIT key will be interpreted as a numerical input (±) and will alter the sensitivity value. You may then end up with a sensitivity value of 0dB re.1V/Pa. Measured levels will be wrong and the full scale setting will refuse to be set to 120dB. Re-enter the menu, key in –26.0dB as sensitivity and recalibrate the unit.



The display for this task…



Impossible to set 120dB as full scale?

The full scale deflection range available depends on the microphone cartridge sensitivity setting in the calibration menu. Check if you got that right – see the note at the bottom of the left page of this page spread.

Note: The input gain (full scale deflection) is a destructive parameter in the sense that any alteration will cause a loss of data already acquired but not yet stored. However, the Nor-116 will prompt you to confirm your intentions if you attempt to change the gain setting without storing the acquired data first. The same applies to other settings crucial to measurements. In this way inconsistency is avoided between the current measurement setup and the one used with the measurement.

Whenever you are making sound measurements you must set the instrument so that overload will not occur, yet in such a way that you do not miss significant parts of the measured data due to underscore.

To set this properly you expose the instrument to the sound field in which you are going to measure, whilst watching the bargraph.

Ideally the meter deflection should fall somewhere in the upper half of the measurement range, but below the upper end of the scale which is called the *full scale deflection*.

In cases of impulsive noise it may be hard to set the full scale deflection so that the meter deflection falls in the upper half of the range without occasionally overloading the instrument.

Always try to avoid overload. This is because overloaded measurements are unreliable – you can never tell how high the level really was, only that it was higher than the instrument could accommodate.

Measurements contaminated by overload are identified by a small arrow pointing upwards containing the letters OL.

What you really do when you sett the *full scale deflection* is to adjust the gain of the input amplifier of the Nor-116. Hence this operation is sometimes referred to as *gain setting*.

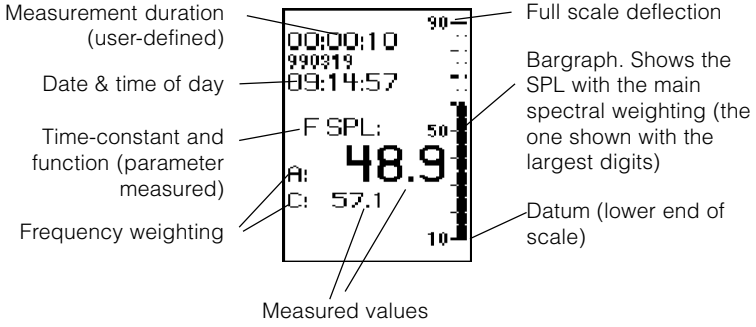
Assuming your instrument is in the *normal display mode*, press SETUP to gain access to the setup menu. Inside this menu press 2 to gain access to the Meas.dur. (Measurement duration) menu.

Use the NUMERICAL KEYPAD to key in the required measurement duration in *hours, minutes* and *seconds*. Minimum duration is *one second* and maximum is *one hundred hours less one second*. Use the CURSOR keys to move between the parameter-fields used to set the hours, minutes and seconds.

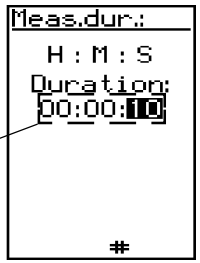
If the required setting doesn't differ very much from the current duration setting, it may be more convenient to use the INC and DEC buttons to increase/decrease the current setting than the NUMERICAL KEYPAD.

If you have keyed in numerical values terminate the key-in sequence by pressing ENTER. Whenever pressing ENTER is required, the instrument displays an "E" at the bottom of the display.

The normal display mode and the setup menu for a basic version instrument...



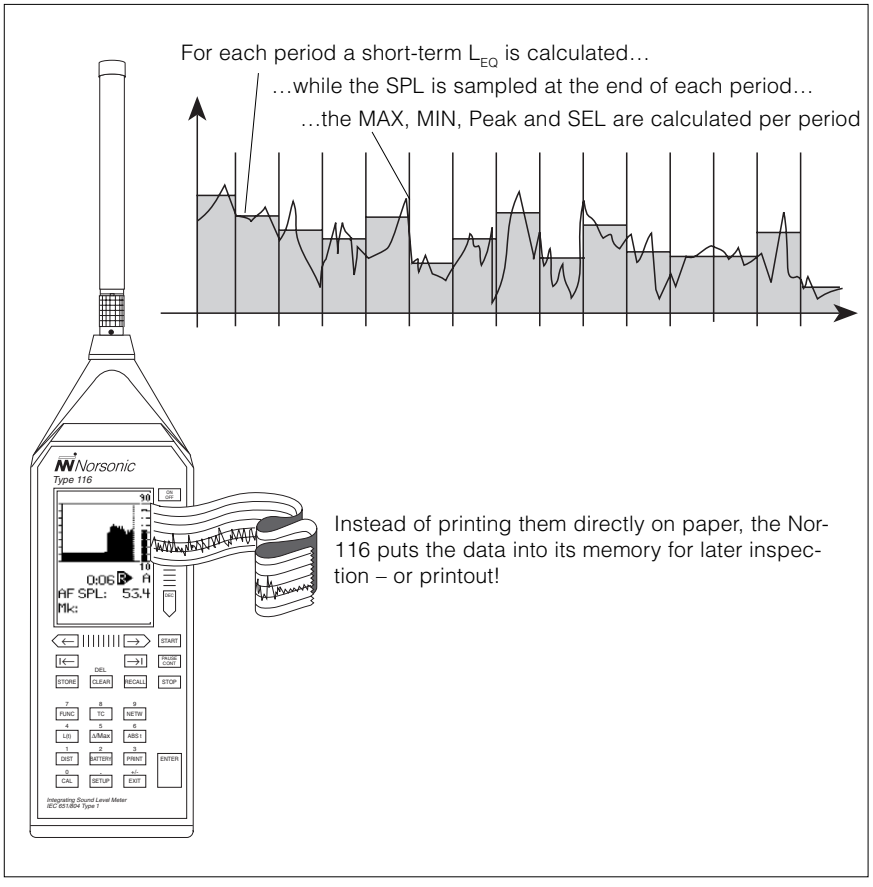
The Measurement Duration menu is accessed by pushing the *SETUP* key followed by *2*...



Set the duration in hours, minutes and seconds

Note: If your instrument is *not* of the basic version – skip this part and proceed with the part *Setting up an Extended Version Instrument* instead.

Note: Setting up the clock giving the time of day; correction for daylight saving time and other general instrument parameters is done in the instrument setup menu, described in the chapter *The Instrument Setup Menu*.



Note: The electronic level recorder concept uses memory even if you do not store the acquired data! There is only one memory in the Nor-116 and this is used both to store data and to make L(t) measurements. Until you store an L(t) measurement the data are marked "may be erased". Once you decide to keep the data (by storing them) the remark is removed and the data are stored in the memory. This sharing of the memory explains why the number of periods available is closely connected with the amount of free memory available. Remember that logging two parameters as L(t) occupies twice the amount of memory as logging just one parameter.

Still remember the old days when you recorded the level versus time on a paper roll using a level recorder?

Now you can do this electronically with your Nor-116 provided that it is equipped with the *L(t) extension*.

The Nor-116 will then divide the measurement into periods of equal length defined by the time resolution and log the time profile of $L_{EQ,A}$, $L_{MAX,A}$ and $L_{PEAK,C}$.

Units equipped with the *advanced L(t) extension* can log the time profile of any of the parameters available.

There are differences in when a parameter actually is measured – see the graph to the left.

Now, which resolution should you use?

Before making up your mind about this you should consider your needs for information.

For example, which parameter(s) are you going to log as L(t)? For how long time will you be measuring?

The Nor-116 will log global values during an L(t) measurement as well. The L_{EQ} of the entire measurement will always be measured alongside with the percentiles (if applicable to your unit) and the parameter(s) you set up to be logged as L(t).

If your instrument is an extended version instrument, equipped with at least *Extension 2,* the *Level vs. Time mode,* the Meas.dur. menu contains both parameter-fields for setting the *total duration* and for setting the *time-domain resolution*. Your Nor-116 will then act as an electronic level recorder.

Press SETUP followed by **2** to gain access to the setup menu.

Use the NUMERICAL KEYPAD to key in the required measurement duration in *hours, minutes* and *seconds*. Minimum duration is *one second* and maximum is *one hundred hours less one second*. Use DEL to correct erroneous inputs and ENTER to terminate.

If the required setting differs little from the current, it may be more convenient to use the INC and DEC buttons to increase/decrease the current setting.

Use the CURSOR keys to move between the parameter-fields used to set the hours, minutes and seconds.

Then define the resolution required. Maximum (finest) resolution is *1/128 seconds* and minimum is equal to the selected total duration. To access this field, use the CURSOR keys.

For resolutions better than one second, the resolution is presented as n/128 s fractions (hence the resolution must be a multiple of 1/128 s), but with the number of milliseconds indicated just below the key-in field. Units with the basic L(t) mode only are confined to 1/8 second as the only choice below one second.

To get from hours, minutes and seconds to fractions of seconds you may either use the DEC key or just key in the digits **00**.

To get from fractions of seconds to hours, minutes and seconds, key in **128**/128 seconds or use the INC key.

Units equipped with the *standard L(t) extension* can log the time profile of $L_{EQ,A}$, $L_{MAX,A}$ and $L_{PEAK,C}$ while for the *advanced L(t) extension*, you may set up time profile logging of several functions simultaneously.

Press SETUP followed by **3** to produce the L(t) functions setup menu.

This menu has two pages; one for each spectral weighting (A- and C-weighting). Use the NETW key to go between the pages. Use INC & DEC to activate/deactivate functions.

If your instrument is equipped with ext. 7 (parallel time constants), your options are expanded further to include logging of a function with different time constants (e.g. Max with both F, S and I time constants logged simultaneously).

Once you have set up the functions to be logged (remember to check out both spectral weightings), press ENTER to exit the setup menu.

The instrument will now ask if the function setup shall be copied to the print and transfer setups, respectively.

Often, but not always you would like to print all the functions logged as L(t). For long measurements involving many functions and a fine time resolution, you may want to print or transfer (to a PC) only some of the logged parameters. Separate setup menus are therefore available for setup of the functions to be printed and the functions to be transferred, respectively.

As a short-cut, you may transfer your new function logging setup to these two setup menus (print and transfer) by checking YES before pressing ENTER when asked.

If you want to retain the old setup of the print and transfer menus, just check NO before pressing ENTER.

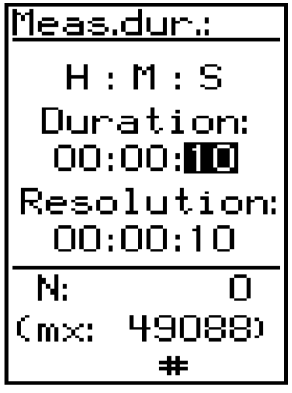
The Takt Maximal Function

The Takt Maximal Extension opens up for measurements of Takt Maximal 5 and IL_{EQ} (impulse weighted L_{EQ}). Be sure to set the measurement duration to a multiple of five seconds. Otherwise one period will be truncated and no Takt Maximal will be calculated for this truncated period.

Note: The n/128 second resolution applies to units with the advanced L(t) mode (ext. 6) only. Units without the advanced L(t) mode, but with the basic L(t) mode, have 1/8 second as the only choice when it comes to resolutions better than 1 second. To obtain a resolution of 1/8 second for these units, set the time resolution to 00:00:00 or use the DEC key.

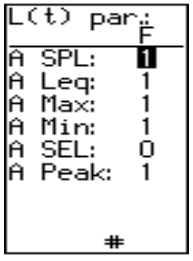
The menu for this task…

Press SETUP followed by 2 to produce this menu

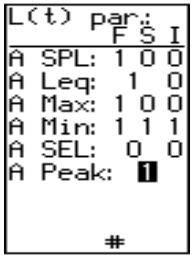


The parameter-field just below the horizontal line indicates the number of periods your chosen resolution will imply. The number in brackets at the bottom is the maximum number of periods that the memory can accommodate, given the present amount of free (unused) memory.

The advanced L(t) parameter menu



The advanced L(t) parameter menu for units with parallel time constants



If you want your parameter setup to also apply to your print setup and transfer setup menus, select yes.

Tip: If you don't want to spend precious memory on L(t) logging of a certain measurement set resolution to a value larger than the duration.

Provided that you have set up the instrument properly, you are now ready to start making measurements. Hold the instrument at arm's length or mount it on a tripod. This will help avoid both reflections from your body and blocking of sound from some directions.

Press START to begin the measurement. The instrument will now switch to display the relative time, i.e. the time elapsed since the measurement was started. Press ABS t to switch back to absolute time if required.

If left unoperated, the instrument will go on measuring until the preset duration expires. You may, however interrupt an ongoing measurement at any instant by pressing the STOP or the PAUSE/CONT key. This is a handy feature whenever events occur which you do not want to include in your measurements. Once everything is back to normal, a second press on PAUSE/CONT will resume the measurement.

Note that once you resume measuring, the latest ten seconds of data acquired just before you pressed PAUSE/CONT (to halt) will be deleted and the measurement will go on until the total measurement time equals the preset duration. If you press STOP before PAUSE/CONT no 10 seconds backerasure will take place.

If you let the measurement terminate by itself and then push the PAUSE/CONT button, the measurement will be prolonged until the total measurement time equals twice the initial setting. If you repeat this the total measurement time will end up equalling three times the initial setting etc.

In this case, there will be no deletion of acquired data upon resuming.

The Nor-116 measures several parameters simultaneously – viz. SPL, L_{EQ}, Max, Min, SEL and Peak + TaktMax5 and IL_{EQ} (TMax extension). Each of these functions can be displayed one by one by pressing the FUNC key successively. Alternatively, all the parameters may be displayed simultaneously in a table. Press TBL to display this table.

These data all relate to the entire measurement as such – not just parts of it – and they are therefore referred to as global parameters.

The ΔMAX function, on the other hand, permits switching between the global maximum and local maxima occurring after you reset the local maximum buffer (which is where the instrument stores this information). This function works during the measurement only and not after it.

The first time you press ΔMAX the displayed function will switch to Max, unless you had set it to display Max in beforehand (by means of the FUNC key).

The next time you press ΔMAX key, the Nor-116 will display a local maximum function. The local maximum indication will start the very moment you press ΔMAX the second time.

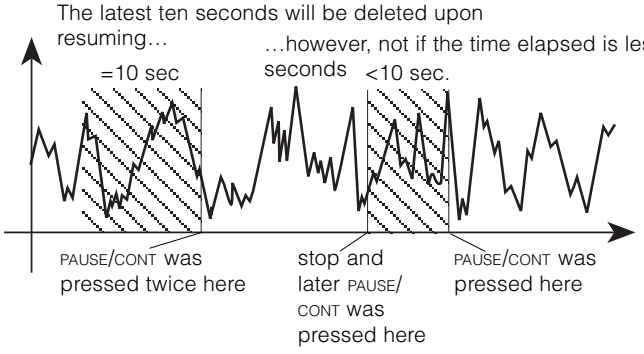
If you now press the ΔMAX key a third time the instrument will switch back to global maximum, showing the highest level occurring since the measurement started.

A fourth press on the ΔMAX key causes the Nor-116 again to switch to the local maximum function. The local maximum indication will now start the very moment you press ΔMAX the fourth time.

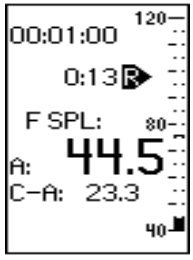
Note: It may happen that you introduce another pause less than ten seconds after the measurement resumed from a previous pause, or simply less than ten seconds after the measurement was started. If so, only the time back to where you resumed (or started) will be deleted. Once you resume a measurement you accept data already acquired (with the exception of those 10 seconds which are deleted).

Note: For L(t) measurements, the pause function deletion of ten seconds will not erase any part of the time profile graph. However, all the global parameters are affected in the same way as for non L(t) measurements. In the time profile the periods acquired during the pausing will be marked P.

The effect of pausing an ongoing measurement…



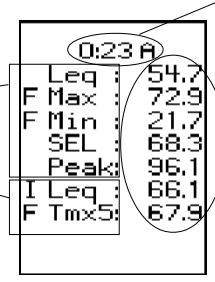
An ongoing measurement is denoted by an R in the display



The tabulation of data acquired appears when you press TBL while measuring – or after…

Applied time constants and parameters

Available only with TaktMax Extension

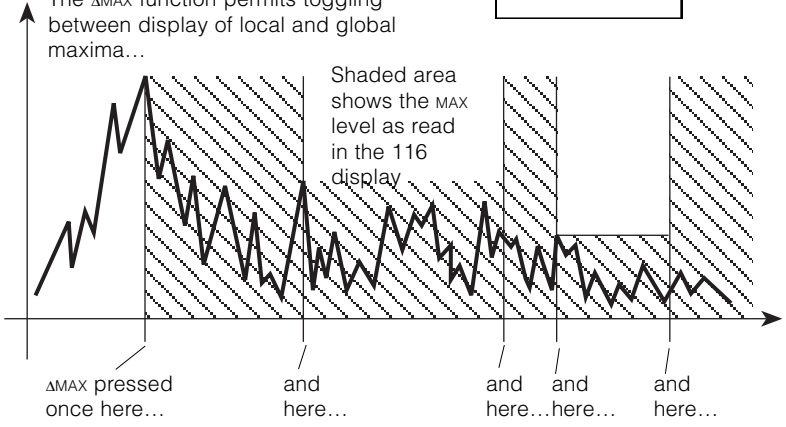


Measurement duration (so far) & weighting applied. Use the NETW key to display the data using the other spectral weighting

Results

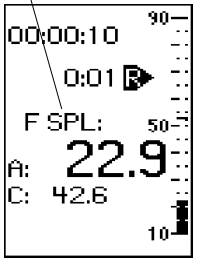
The Nor-116 measures a multitude of parameters simultaneously. To display another parameter, press FUNC while measuring (or after). The above Fig. shows the sequence in which the parameters will appear as you press the FUNC key.

The ΔMAX function permits toggling between display of local and global maxima…



Assuming the max function was not displayed in beforehand

Press the FUNC key successively, to display these parameters one by one in the normal display mode (here SPL)



If your unit is equipped with the LEVEL VS. TIME EXTENSION, you may also measure one or more parameters as functions of time.

To utilise the L(t) features, you must define a time resolution different (i.e. better or finer) from the total measurement duration.

The measurement is started by pressing the START button. To display the time profile, press the L(t) key during the measurement.

During the measurement, you may switch between graphical and numerical display by means of the L(t) key.

Should you need to pause the measurement, do this the usual way by pressing the PAUSE/CONT key. However, in L(t) mode, the Nor-116 will still collect data, but these data will be marked as acquired while paused!

In the graphical display mode, data acquired while paused will appear underlined.

This feature has three advantages – data acquired while paused do not take part in the calculations of any of the global parameters; it enables you to see what is going on during the pause and, if the data later are transferred to a PC, any part of the paused data may be"unpaused" and calculated on ad libitum.

There is a catch though – data acquired while the unit is paused will occupy their share of the memory. This means that even if you haven't set up the instrument to spend all free memory available on a time profile measurement, the memory may still run full if the pause is long enough.

So, what will happen then? When the 116 states the amount of free memory available, space has already been allocated for the global parameters of your measurement. Should it happen that the memory runs full during an L(t) measurement, the time profile acquisition will cease, the profile acquired so far will be retained and the measurement will continue as if it were just another global level measurement (which would be the case if the resolution exceeds the duration or when no time resolution option is available).

The Marker Feature

A special feature available during time profile measurements (applicable to units with advanced L(t) mode only) allows you to tag (mark) special events or incidents as they happen. These tags can later be used as identification. When you later move the graph cursor along the time profile graph (see below for details on this), markers will appear whenever the graph cursor is positioned at a period to which a marker was assigned. In addition the same period will appear underlined in the graph.

Altogether you have five + two different markers at your disposal. The five are user-controllable (more about them below) while the two are to indicate data acquired while the instrument is paused and to indicate the moment when an interrupted measurement is resumed. Profile data acquired during pause will be denoted P (all of these periods will be denoted P) and if you halt the measurement by pushing STOP and later press PAUSE/CONT to resume, the first period after resuming will be denoted S to make it easy to spot any discontinuities in the profile. The same annotation will appear in the printouts and after transfer to a PC.

The five user-controlled marker functions let you assign a digit – i.e. 0, 1, 2, 3 or 4 – to a period. The feature of having five markers gives you the option to discriminate between different events.

Of these five markers, the type 0 marker is in a class of its own. The type 0 marker is a marker you set to on for a number of periods. The digit 0 will then be assigned to all periods until you switch it off. To activate the type 0 marker press INC and to deactivate it press DEC. This type of marker is sometimes referred to as a *toggle marker.*

The four other markers are assigned to a period by pressing CAL to insert marker type 1, SETUP to insert marker type 2, EXIT to insert marker type 3 and finally ENTER to insert marker type 4. This type of marker is sometimes referred to as a *single marker.*

Note that the markers type 1–4 will be assigned to one period at the time – unlike the type 0, they cannot be set to on and then later to off.

The Nor-116 accepts only one marker assigned to each period. The maximum number of markers in a measurement cannot exceed one hundred. Observe that the number of pauses during the measurement will be drawn from the number of markers available – e.g. if ten pauses are made during a measurement, there will be room for only ninety markers in that measurement. The length of each pause has no effect on the number of markers employed.

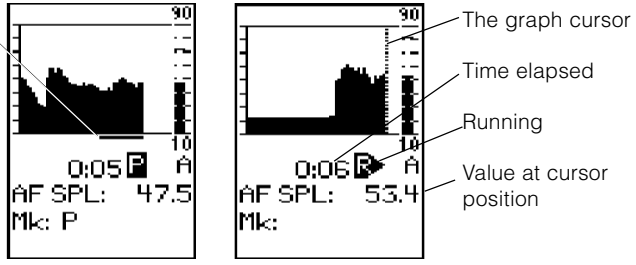
Post–measurement Features

Once the time profile measurement has terminated, you may move the graph cursor about the graph to inspect the acquired data. Use the CURSOR keys for this. To make the cursor move fast through the graph, keep the key depressed. To jump along the graph the |← and →| cursor keys may also be used. The first time you press the |← (→|) cursor key the graph cursor jumps to the extreme left (right) of the screen. The next you press the same key, the cursor will jump one screenwidth. Its current position is indicated as shown in the Fig. to the left.

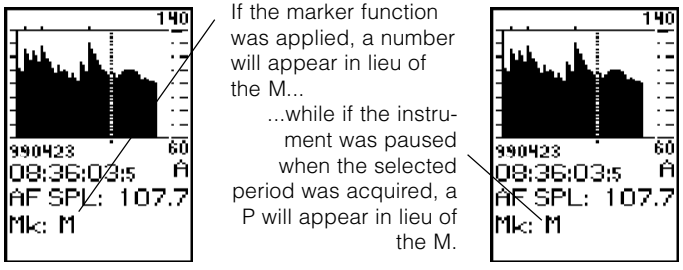
The global values are accessible in the same way as explained in a few pages back – either by use of the L(T) and FUNC or by use of the TBL key.

When measuring the level versus time, the display may be set to display the L(t) graphically...

When the unit is paused, the data acquisition does not halt, instead the data are marked as paused data. This is indicated in the L(t) display by underlining paused data.



The Mk field is used to supply additional information on the subperiod at which the graph cursor is located...



If the instrument was halted (by use of STOP), a push on PAUSE/CONT will produce an S in the first period after the measurement is resumed.

Note: The marker hierarchy of the Nor-116 is such that "S" has the highest priority, then comes "P" and finally "M" ($M \in \{0,1,2,3,4\}$). This means that if you first mark a subperiod and then press the PAUSE key to temporarily halt the measurement, up to ten seconds of periods (actual number of periods will depend on the resolution used) prior to pausing will also be set as paused. Your marked subperiod may then become one of these paused periods. As a consequence of the this hierarchy the "M" value will then be replaced by a "P".

If your instrument is equipped with the *Statistics Extension* (push SETUP followed by **1** and then **9** – although 9 is not listed in the menu – to see this. If equipped the list will tell that "1" is installed. The "1" means *extension 1– statistics*), eight percentiles will be calculated from the acquired measurement results. Note that the percentiles are fixed and that they are global values – they are not related to, nor depending on any L(t) measurements. This *extension* does not require the presence of other *extensions*.

The eight fixed percentiles are $L_{0.1}$, L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99}.

You may, however, have your Nor-116 equipped with one user-adjustable percentile and seven fixed – see Fig. for details.

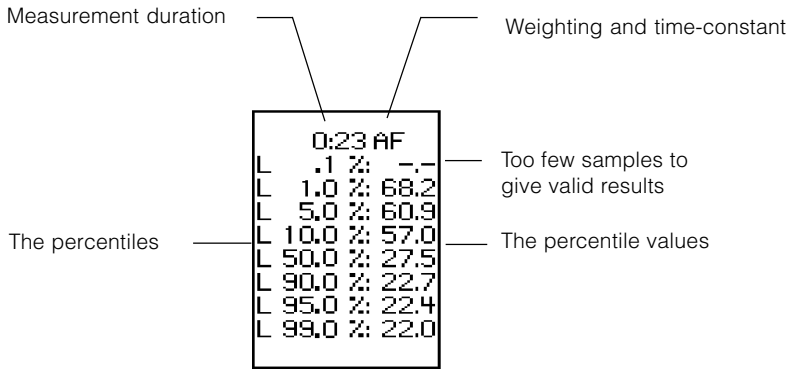
Note that since the percentiles are made from sorting samples according to level, there must be enough samples present to calculate the percentiles – to calculate the L_1, at least one hundred samples must have been received, and similarly to calculate the $L_{0.1}$, at least one thousand samples must have been received. Until such conditions have been fulfilled, the corresponding percentile values will be replaced by a "–.–" in the display.

The Nor-116 acquires 16 samples per second for statistics – i.e. a measurement duration of at least 63 seconds will be needed to get valid data for the $L_{0.1}$.

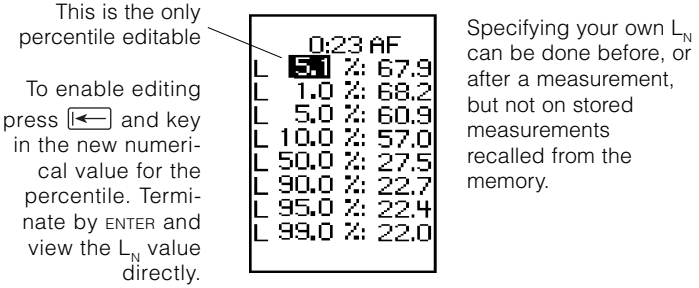
Once the STATISTICS EXTENSION is installed, you need to do nothing to activate it. It will do its work – every time!

To display the percentiles, push TBL until the percentiles table appears. The percentiles table is *not* accessible during a measurement – the instrument will then behave as if the extension wasn't installed.

To produce the percentiles table, push the TBL key until it appears...



If your instrument is equipped with extension 13 – one user-adjustable percentile…



Note: This table is not accessible during a measurement!

The *sound power calculation extension* enables you to make a complete sound power measurement, resulting in an L_{W_A} value (the A-weighted sound power level) of any test object in accordance with ISO 3746 and related Standards. This means that when equipped with a Nor-116 you may test the L_{W_A} of new products for the European CE labelling in the production area (*in-situ*), rather than in a laboratory (*in-vitro*).

Making Measurements

Before you start to make sound power measurements we recommend that you familiarise yourself with how to make regular sound level measurements.

Once the test object is properly placed, you start the setup procedure by selecting measurement duration as described in making a level measurement.

Then press SETUP followed by 4. The instrument will now enter the *measurement control display.*

The Nor-116 allows 1–40 microphone positions to be measured. The initial measurement control display shows 8 positions, but this may be extended to further pages covering the positions 9–40 by pressing the ⇥ key ("next page").

At the bottom of the screen, the averaged sound pressure level based on the measured microphone positions, is displayed. Each microphone position is selected by moving the field cursor using the ⇐ or ⇒ keys to the selected position, and then pressing the START key. The screen will show the normal measurement display during a measurement, and return to the control screen and display the measured L_{EQ_A} value for the measured positions at the end of each measurement

Background Noise

A background noise measurement is required to have the 116 calculate the background noise correction K_1 for you. On pressing the FUNC key, the *background noise measurement control display* is displayed. This test follows the exactly the same procedures as the sound power measurements.

However, the background noise level will in most situations vary little from one microphone position to another, it will therefore normally be enough to measure the background noise level for one typical microphone position.

Use the FUNC key to toggle between the *measurement control display* and the *background noise measurement control display.*

Measurement Surface

The Sound Power calculation requires the operator to select the correct measurement surface. This is done by pushing the SETUP key again, and choosing the corresponding selection in the sound power setup menu. The selected surface is indicated by H for Hemispherical and P for Parallelepiped with an additional w or c for test objects placed against a wall or in a corner. The selected surface is also indicated by a simple diagram.

Depending on the selected surface, the measurement radius or distance from the reference box as well as the size of the reference box (i.e. the minimum square box that fits around the test object) must be keyed in. The calculated area S of the total measurement surface will then be displayed.

Finally, the *acoustic environment correction* K_2 must be chosen and keyed in.

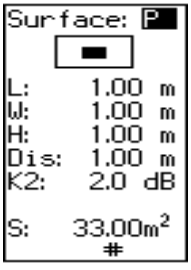
Sound Power Results

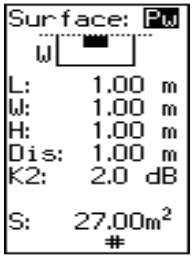
Based on the averaged sound pressure level of all the microphone positions, the measured background noise level and the selections and corrections made in the sound power setup menu, the Nor-116 displays the final L_{W_A} result by pressing the TBL key.

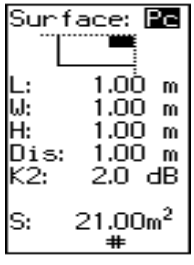
In addition to the overall results, the impulsive noise values, the L_{PEAK_C} level and the noise directivity of the test object for all microphone positions are found by sequential pushes of the TBL key.

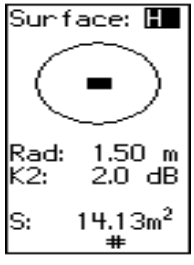
The results may also be copied to a printer. The report includes necessary spaces for all the required measurement information to be written directly on the report by the user. On a second page, the individual results for each of the microphone positions are printed.

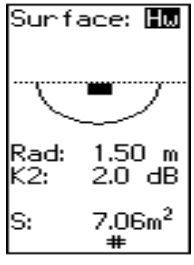
The measurement surface can be either a hemisphere or a parallelepiped. In addition you may choose between different locations of your test object, i.e. on the floor, up against a hard reflecting wall or in a corner…

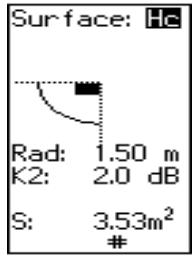






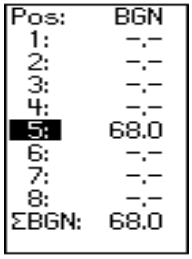






The background noise measurement display…

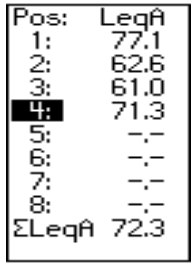
Although the 116 lets you measure the background noise level in up to 40 positions, the background noise level will in most situations vary so little from one microphone position to another that it is, for most cases, sufficient to measure the background noise level for one typical microphone position



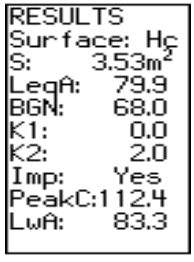
Use ⇥ (next) and ⇤ (previous) to go between pages

The measurement control display….

Although only 8 microphone positions are shown, there are further "pages" so that a total of 40 microphone positions can be covered. Use the ⇥ key



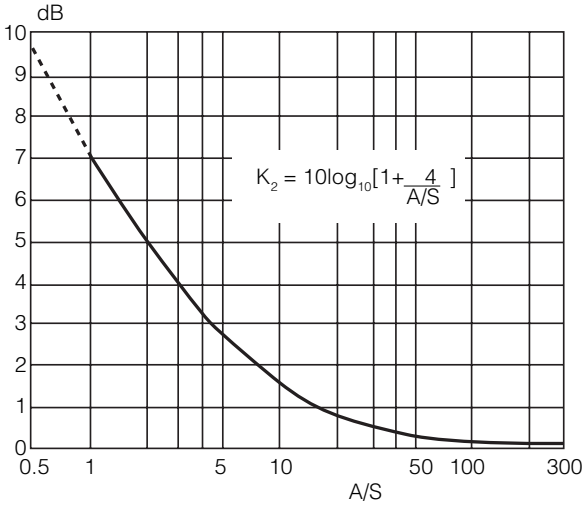
After a successful set of measurements has been made, the results are presented like this upon pressing the **TBL** key



The results can also be printed out. Turn to Printouts for a sample

The environmental correction factor K_2 accounts for the influence of undesired sound reflections from room boundaries and/or reflecting objects near the source under test. The magnitude of this environmental correction factor depends principally on the ratio of the sound absorption area A of the test room to the area S of the measurement surface. The magnitude does not depend strongly on the location of the source in the test room.

When measuring in accordance with the ISO 3746, the environmental correction factor K_2 is obtained from this graph by entering the abscissa with the appropriate value of A/S

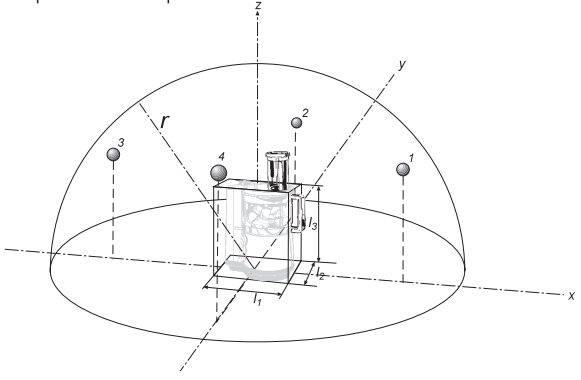


α	**Description of Room**
0.05	Nearly empty room, smooth hard walls made concrete, brick, plaster or tile
0.1	Partly empty room, room with smooth walls
0.15	Room with furniture, rectangular machinery or industrial room
0.2	Irregularly shaped room with furniture, irregularly shaped machinery or industrial room
0.25	Room with upholstered furniture, machinery or industrial room with small amount of acoustical material
0.35	Room with acoustical material om both ceilings and walls
0.5	Room with large amounts of acoustical material on ceiling and wall

Calculating the A: The value of the mean acoustic absorption coefficient α is estimated by using the above table. The value of A is then given, in m^2 by $A = \alpha \times S_V$ in which S_V is the total area of the surface of the test room (walls, ceiling and floor) in m^2

Calculating the S:

Hemispheres: $S = 2pr^2$



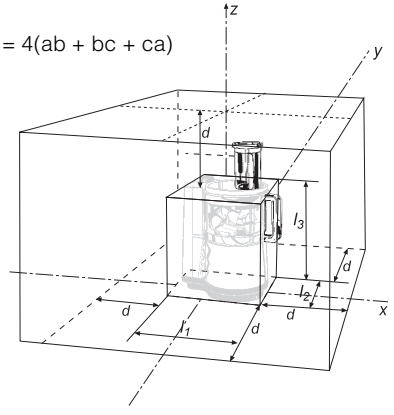
Parallelepiped: $S = 4(ab + bc + ca)$

$a = \frac{l_1}{2} + d$

$b = \frac{l_2}{2} + d$

$c = \frac{l_3}{2} + d$

l_1, l_2, l_3 are the dimensions of the rectangular reference parallelepiped



Making Printouts

Once you have made your measurements, you may want to make hardcopies for your reports etc.

The Nor-116 can output acquired data numerically to most alphanumerical printers equipped with an RS-232 serial interface. A very important thing here is the baud rate, which reflects the transmission speed over the RS-232 interface. The Nor-116 can be set to a variety of baud rates – for details see *Instrument Setup*.

If you want to run printouts on a parallel port printer, a serial to parallel adaptor is available. Contact your local representative for details on this.

Any baud rate will do, but the printer and the Nor-116 must, of course, be set to the same baud rate to make things work properly.

Once set up, just press PRINT to generate a printout. The look of the printouts will depend on the kind of measurement you have made [ordinary or L(t)]. Examples of printouts are shown on this and the following page.

For more information turn to the chapters *The Instrument Setup Menus* and *Setting up an Extended Version Instrument*.

Printout example when L(t) display was selected before PRINT was pressed...

```
Start Date : 99:05:10   Time  : 13:42:39
End   Date : 99:05:10   Time  : 13:44:23
Duration   :     1:21   Pause :     0:23
Full Scale : 120 dB     Sens. :  -26.0dB
Time Const.: S          Period: 00:00:01

Rel.Time  CS Min:
    0:01   53.3    53.2    53.0    53.7    53.7
    0:06   53.7    53.3    53.2    52.7    52.7
    0:11   53.3    53.5    53.6    53.5    53.6 P
    0:16   53.5 P  53.1 P  53.1 P  53.1 P  53.3 P
    0:21   53.6 P  54.2 P  54.7 P  59.0 P  56.2 P
    0:26   54.4 P  53.7 P  54.4 P  53.8 P  53.4
    0:31   53.4    53.4    53.4    53.2    53.1
    0:36   53.1 1  53.6    53.5    53.2    53.0
    0:41   86.7    82.3    78.6    74.3    70.0
    0:46   66.5    62.6 4  59.1    57.8   105.4
    0:51  101.0    96.7    92.3    88.0    83.6
    0:56   79.3    75.0    70.6    66.3    62.3
    1:01   52.9 S  52.7    52.4    52.2    52.1
    1:06   51.9    51.7    51.5    52.3    52.7 2
    1:11   52.1    52.1    52.0    51.9    51.9
    1:16   61.5   102.0    97.7 3  93.3    89.0
    1:21   84.7    80.3    76.0    71.6    67.3
    1:26   63.2    59.5    56.3    54.0    52.0 S
    1:31   52.8    52.9    52.5    52.8    52.0
    1:36   51.7
```

The above example shows that markers appear in the printout next to the period they have been assigned to.

The contents of the leftmost columnmay be set to appear as absolute time if you press the **abs** key to set the display to show absolute time before printing.

Printout example when the normal display mode (or the numerical display) was selected before **PRINT** was pressed…

```
Start Date : 99:05:10   Time  : 10:00:20
End   Date : 99:05:10   Time  : 10:00:35
Duration   :     0:15   Pause :     0:00
Full Scale : 110 dB     Sens. :  -26.0dB
Time Const.: F

A  Leq :   71.5          C  Leq :   72.9
AF Max :   90.4          CF Max :   90.2
AF Min :   43.1          CF Min :   51.4
A  SEL :   83.3          C  SEL :   84.6
A  Peak:  113.5          C  Peak:  112.6
AI Leq :   84.5          CI Leq :   84.8
AF Tmx5:   85.7          CF Tmx5:   85.4
L .1   :    -.-          L 50   :   45.4
L  1   :   88.8          L 90   :   43.6
L  5   :   75.0          L 95   :   43.5
L 10   :   59.0          L 99   :   43.1
```

Example of printout from a sound power measurement…

```
                                                                  Norsonic AS

Sound Power Measurement According to ISO 3746/EN 23746

Page 1 of 2:  General Information and Overall Results

Sound source
Manufacturer: ........................  Type: ................  Ser.No: ..........
Dimensions: .......(l) .......(w) .......(h)        Year of manufacture: .......
Technical data: ..................................................................

Test conditions
Operating conditions: ............................................................
Location of sound source in test environment: ....................................
Multiple sources: ................................................................

Acoustic environment
Test environment: ................................................................
Wind speed: ..........................  Wind direction: ..........................
Acoustical qualification of the test environment: ..............................

Instrumentation manufacturers
Instrument: ...Norsonic AS.......  Type: ....116...  Ser.No: ...................
Preamplifier: .Norsonic AS.......  Type: ...1201...  Ser.No: ...................
Microphone: ...Norsonic AS.......  Type: ...1220...  Ser.No: ...................
Windscreen: ......................  Type: ..........  Characteristics: ..........
Calibrator: ......................  Type: ..........  Ser.No: ...................
Calibration method:...............................................................
Calibration date:.................  Place: ...................  Result: ..........

Acoustical data
Measurement surface: Parallelepiped on three reflecting planes
Reference box Length:         1.00 m
Reference box Width :         1.00 m
Reference box Height:         1.00 m
Measurement distance:         1.00 m
Measurement surface area:    21.00 m2

A-weighted sound power:   Lw =  73.7 dB(A)

Surface sound pressure:         60.5dB(A)
Background noise correction K1:  0.0 dB
Environmental correction K2:     8.5CdB   Qualification method: ................
Maximum C-weighted Peak:        99.1dB
Impulsive noise:                 Yes
```

Memory Handling – Storing and Retrieving

Data acquired during a measurement may be stored in the internal memory of the Nor-116 for future use.

The memory is of the *nonvolatile* type – i.e. stored data are retained even during power off. You may store and later retrieve acquired data as well as measurement setups in the memory.

The procedure for storing data and for storing setups are quite similar; whenever you store acquired data the corresponding setup is stored along with the data. Hence, if you set up the instrument and then store without making a measurement, you will have stored a measurement setup!

The memory is organised very much in the same way as the memory of a personal computer; viz. with directories and file names. The major difference is that neither directory names nor file names are freely selectable in the Nor-116. Instead, today's date is used as directory name and the files stored in the directory are numbered consecutively starting from file number 001. Files cannot be stored under a different directory, nor can they be moved to another directory. Files with sound power data have P as a suffix, while files with level data have L as a suffix and L(t) files have T as a suffix.

One exception to this is when you store setups, these are stored in a separate directory called SETUP. Note that all setups are stored in this directory – regardless of date of storing!

Manual or Automated Storing

To store acquired data, just press STORE *after* the measurement. To store a measurement setup, just press STORE *before* you make the measurement. This is the manual way of doing it. However, you may like to automate the process of storing acquired data – a feature very easy to implement with the Nor-116!

In the *Setup* menu (accessible with the SETUP key followed by **1**) there is a point called *Storing*.

Set the cursor to *Manual* to store data only when pressing STORE.

Set it to *Automatic* to have the Nor-116 store the acquired data as soon as the measurement terminates (irrespective of reason for termination – either because you pushed STOP or because the preset duration expired).

Set it to *Repeat* to combine the autostore with an autostart (i.e. the start of another measurement with the same setup and duration) or to *Synchro* which is like *Repeat* but with the Nor-116 locking onto its real time clock to ensure that the periods always are synchronised with the real time clock. A more detailed discussion on this can be found in *The Instrument Setup Menus.*

The settings in this menu will apply to all measurements until the setting is changed.

Retrieving Stored Information

To retrieve stored data or setups, use the RECALL key. Note that the setup cannot be exploited in future measurements. The RECALL function is a *viewing* function rather than a short-cut for setups. Instead a previously stored setup must be retrieved to achieve this.

Use the ⇤ and ⇥ keys to go between the directory column and the file column. To move up and down in any of the columns use the ⇐ & ⇒ keys.

Once you have found the file you want to retrieve, push ENTER to retrieve it. If you want to exit the menu without retrieving any file – push EXIT to return to normal display mode.

When Memory Gets Full

Although large, the memory of the Nor-116 may get full permitting no more data or setups to be stored in the memory.

In that case, old files should be removed from the memory. If you need a backup, or think that the data are of so great value to you that you do not want to delete them, you should either make hard-copies of them, or transfer them to a remote computer.

A separate PC-software program called Nor-Xfer (Transfer), available from *Norsonic*, makes transfer of data from the Nor-116 to a PC running Windows 95/98/NT very easy to do, even for people with little or no remote control experience.

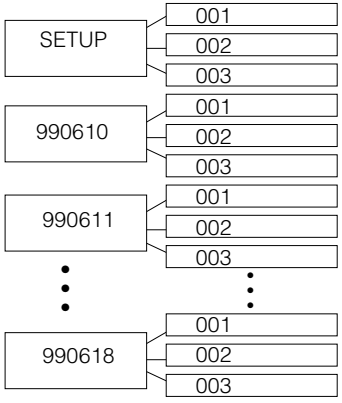
Data are stored in directories named after the date storing took place. Measurement setups are stored in a separate setup directory called SETUP...

All setups stored will be stored in the directory SETUP.

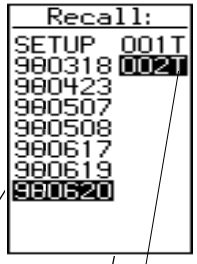
A directory will be created the moment you attempt to store something in the memory. The name of the directory will be today's date.

Neither files nor setups can be stored in other directories. Neither can they be moved to another directory.

For simplicity we have shown only three files per directory. The maximum number of files that may be stored in a single directory is 999.



The directory and the file columns...



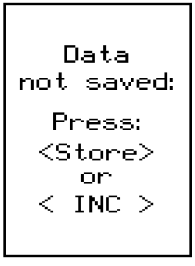
Directories

Files of the selected directory

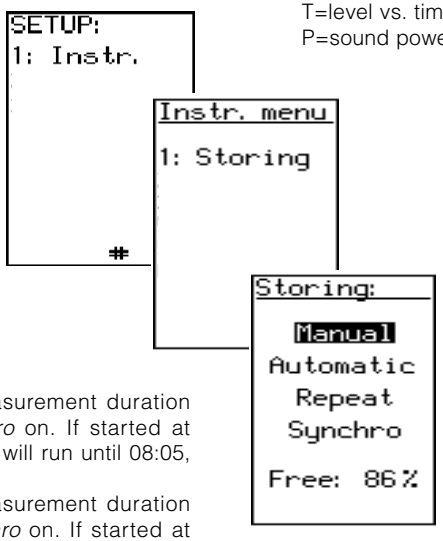
Suffix indicates file type
L=level
T=level vs. time
P=sound power

The Nor-116 strives at protecting the acquired data.
If you press any key that will lead to loss of data, you will be warned...

...You will be forced to confirm your intentions either by pressing the same key a second time or, if you pressed incorrectly, you should store the data first.



In the Instrument Setup menu, there is access to the storing mode of the 116...

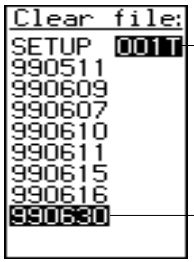


How Synchro works:
Example 1: Assume measurement duration set to 5 minutes, *Synchro* on. If started at 08:02 am, the first period will run until 08:05, the next until 08:10 etc.
Example 2: Assume measurement duration set to 22 minutes, *Synchro* on. If started at 08:02 am, the first period runs until 08:22, the next until 08:44 etc.
For noise-monitoring tasks *Synchro* is the preferred setting.

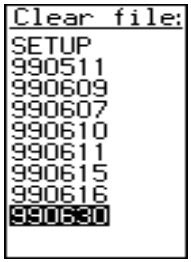
Memory Handling – Deleting Files and Directories

To delete a file:

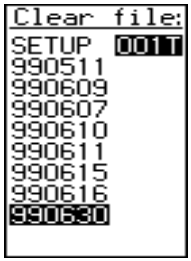
❶ Start by pressing the **CLEAR** key



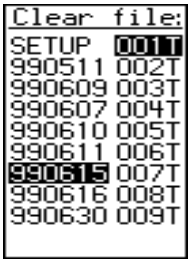
❷ Then use the ⇤ key to move to the directory column…



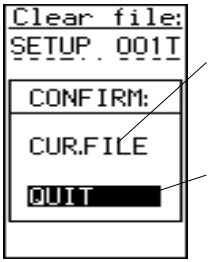
❸ Use the ⇦⇨ keys to move to the required directory



❹ Use ⇥ to move back to the files column and the ⇦⇨ to move to the required file and press **ENTER**.



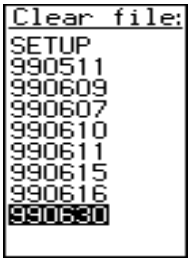
❺ You will now be prompted to confirm your intentions



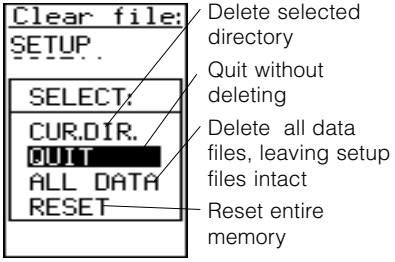
To delete a directory:

❶ Start by pressing the **CLEAR** key

❷ Then use the ⇤ key to move to the directory column…



❸ Press **ENTER** to produce the below prompt and select your option…



❹ Press **ENTER**.

Deleting setup files only:

To do this treat them as files or directories to be removed. There is no single command to remove setup files leaving data files intact.

Resetting the entire memory:

Follow the procedure for deleting a directory, but select RESET before pressing **ENTER**

The Nor-116 default settings

Battery time:	0
Calibration value:	–84dB (the instrument enters the calibration menu if value lost
Measurement time:	10s
Resolution:	10s
Time constant:	F
Storage selection:	SPL A
Network:	A
Storage mode:	Manual
FSD	120dB
Polarisation voltage:	200V
Serial interface:	Off
Baud rate:	9600

When the Nor-116 is powered for the first time, all instrument settings are set to default values. These settings are retained in the instrument by means of a small backup battery. However, should anything incorrect be revealed during the self-tests, inconsistent values are changed back to their default settings.

The Nor-116 has three sockets; a microphone socket, a mini D-sub socket and the external power input socket.

Note that GND is ground, i.e. all GND terminals represent the same ground. There is no such as digital and analogue ground in the Nor-116.

The input terminal (pin 4) on the microphone socket is AC-coupled with an input impedance of 161kΩ. Max input voltage is ±15V.

VGA/Video Adaptor Nor-244

A VGA/Video adaptor is available separately. This adaptor enables Nor-116 displays to be shown in real time on a VGA or RGB monitor.

The signals are taken from the mini D-sub connector. The adaptor has its own D-sub socket so that connecting the adaptor to the Nor-116 will not block the access to the other functions available at the instrument's mini D-sub socket.

The output sockets available on the Nor-244 are:

- A 25 pin D-sub female socket conveying RGB signals
- A standard 15 pin HDD VGA socket
- A mini D-sub extension socket providing the pin configuration of the Nor-116 mini D-sub output socket itself.
- BNC outlet: AC-out, A-weighted
- BNC outlet; AC-out, Flat
- RS-232 standard 9 pin socket, in parallel with the other RS-232's

The adaptor is shown on the righthand page of this page spread.

Compatibility and Restrictions

The 25 pin D-sub female of the Nor-244 adaptor containing the RGB signals has a pin configuration compatible with the Nor-830 and Nor-836 multifunction I/O socket. Hence a cable working with the Nor-830/836 will also work with this output.

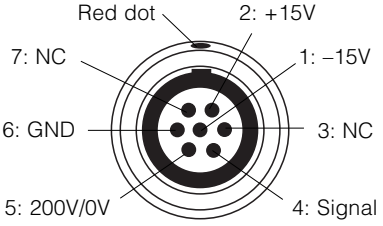
This implies that even the serial interface signals to control the Nor-116 from remote are available at this outlet.

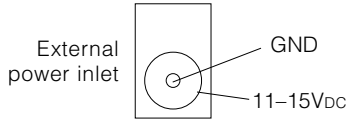
Observe that the pin configuration of the mini D-sub extension socket is identical to the corresponding outlet of the Nor-116 itself, with the exception of the video output. This prevents attempts to run more than one video adaptor from a single Nor-116. The video adaptor is powered from the Nor-116, connecting more than one adaptor will simply be too much for the sound level meter. Use the mains adaptor (Nor-334) rather than the internal batteries.

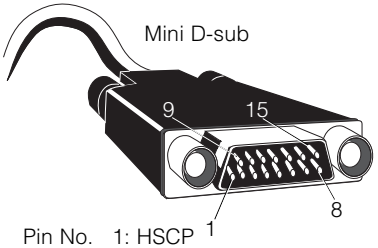
The RS-232 with the standard 9 pin socket has been added to permit the use of standard cables commercially available.

Note: To ensure proper operation, the Nor-116 should (must) be switched off while connecting/disconnecting the Nor-244 adaptor to/from the Nor-116.

Microphone socket pin-out
(external view)

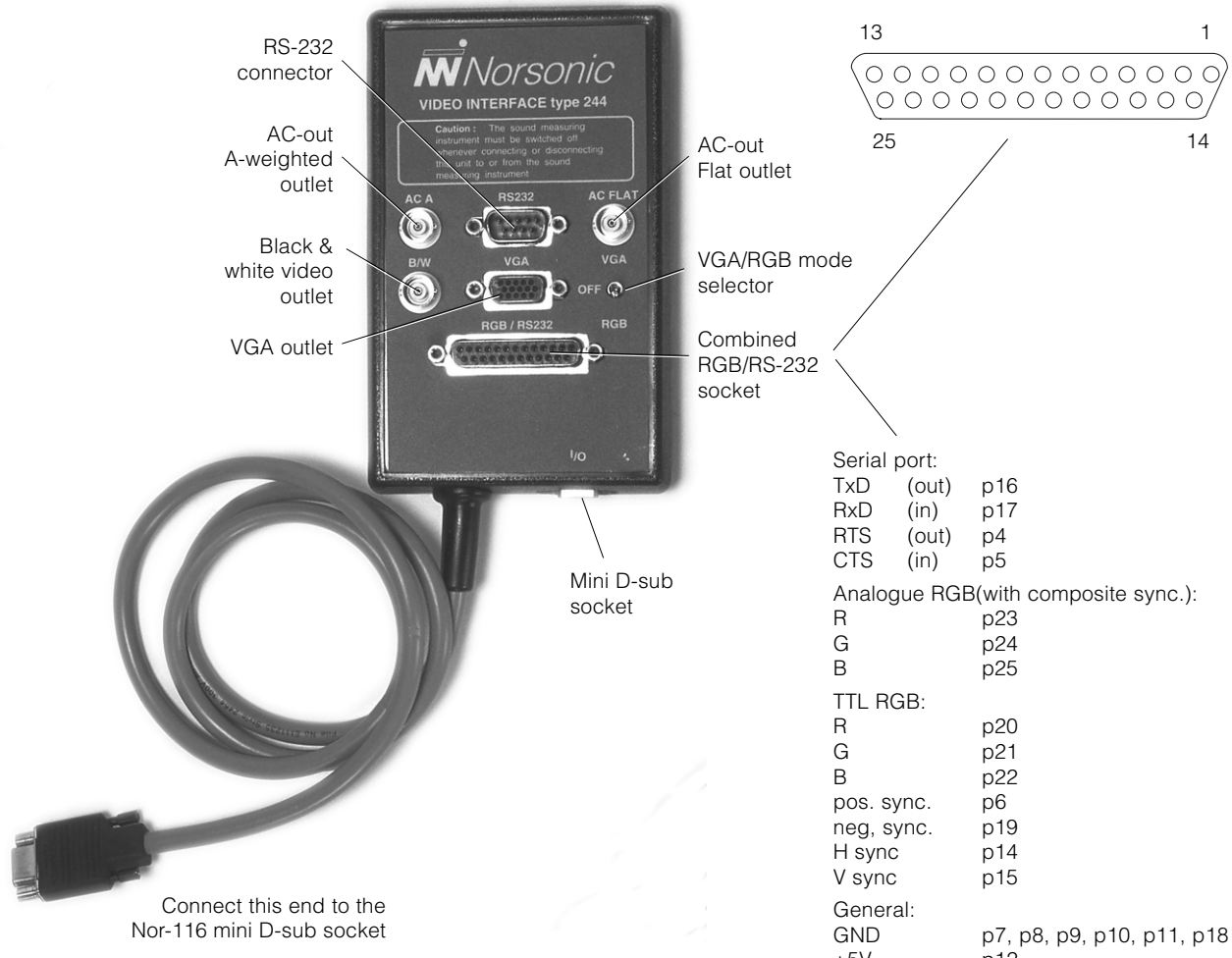






Pin No. 1: HSCP
Pin No. 2: ED
Pin No. 3: +5V
Pin No. 4: RTS
Pin No. 5: TD
Pin No. 6: +10V
Pin No. 7: GND
Pin No. 8: AC-out (flat)
Pin No. 9: CDATA
Pin No. 10: LP
Pin No. 11: GND
Pin No. 12: CTS
Pin No. 13: RD
Pin No. 14: GND
Pin No. 15: AC-out (A-weighted)

The video/VGA adaptor Nor-244 (available separately)



Serial port:

TxD	(out)	p16
RxD	(in)	p17
RTS	(out)	p4
CTS	(in)	p5

Analogue RGB(with composite sync.):

R	p23
G	p24
B	p25

TTL RGB:

R	p20
G	p21
B	p22
pos. sync.	p6
neg, sync.	p19
H sync	p14
V sync	p15

General:

GND	p7, p8, p9, p10, p11, p18
+5V	p12

Accuracy at Lower End of Scale—Using Other Input transducers

The lower limit is determined by the self-noise of the combination of input transducer and the Nor-116 input stages. For details on self-noise when the Nor-116 is used together with its standard microphone – see Specifications.

The standard microphone is a ½" type. If you switch to a 1" you will experience a lower self-noise limit of typically 12dB(A) SPL.

Generally, we recommend a signal/self-noise ratio of 7dB to keep the linearity errors (due to self-noise) less than 0.2dB.

If you choose to use the Nor-116 to analyse noise or vibration recorded on tape, we recommend that you remove the preamplifier and connect the tape recorder output directly to preamplifier socket – contact your local representative for details, if necessary. Note that signal is on pin #4 and GND on pin #6.

A suitable cable for this will be the Nor-1438 LEMO–BNC.

Nor-116 low noise correction table

Nor-116 shows [dB(A)]	Correct dB values for Nor1220 (½″)	MK102 (1″)	20pF equiv.
10.0			7.0
11.0			8.8
12.0			10.3
13.0			11.7
14.0		11.0	13.0
15.0		12.8	14.3
16.0		14.3	15.4
17.0		15.7	16.5
18.0		17.0	17.6
19.0	16.0	18.3	18.7
20.0	17.8	19.4	19.8
21.0	19.3	20.5	20.8
22.0	20.7	21.6	21.9
23.0	22.0	22.7	22.9
24.0	23.3	23.8	23.9
25.0	24.4	24.8	24.9
26.0	25.5	25.9	25.9
27.0	26.6	26.9	27.0
28.0	27.7	27.9	28.0
29.0	28.8	28.9	29.0
30.0	29.8	29.9	30.0

Calculating the Voltage Sensitivity

A charge amplifier has a low input impedance and a sensitivity proportional to the charge. The influence from the cable capacitance is then without significance, ie the accelerometer will maintain its sensitivity independently of the cable length.

If a voltage amplifier is used, the input impedance must be high enough not to disturb the frequency range of interest. The resistive part of the input impedance will set the lower frequency limit. The higher the impedance, the lower the low-frequency limit will be. The microphone preamplifier has a very high impedance (typically 20 GΩ) and will therefore be a good choice as voltage amplifier.

The input capacitance and the cable capacitance will form a voltage divider together with the capacitance of the accelerometer and the voltage sensitivity at the amplifier input will be given by:

$$S_v = S_q / [C_a + C_c + C_i]$$

in which S_v is the voltage sensitivity; S_q the accelerometer charge sensitivity; C_a the accelerometer capacitance; C_c the cable capacitance and C_i the voltage amplifier input capacitance (normally negligible).

The Nor-116 may be used for vibration measurements also. However, the scaling of the vibration level will be in dB, which easily may be converted to linear units by the user.

The most important vibration transducer today is without doubt the accelerometer, due to its widespread use. Accelerometers can be connected to the Nor-116 either directly or via a charge amplifier.

While sound level meters are calibrated in dB based on a microphone sensitivity of around 50mV/Pa, vibration measurements normally uses g or ms^{-2}.

The calibration value is in mV/Pa or dB re 1V, for example 50mV/Pa = –26.0dB re 1V. It is easy to convert from one to the other because 20 log(50/1000) = –26dB.

Accelerometers are very similar—ie the sensitivity is given in mV/g or mV/ms^{-2}. If the value had happened to be 50mV/g the sensitivity would have been as for the microphone, ie –26dB re 1V.

Similarly, if the level given is $10mV/ms^{-2}$ the sensitivity would be 20 log(10/1000) = –40 dB and this would be what to key in as sensitivity in the Nor-116.

Generally you find the sensitivity from: XdB = 20 log(s/1000) where s is in mV/g or mV/ms^{-2}. In this case, 0dB will correspond to 20mg or $20ms^{-2}$ as the reference for sound levels is 20µPa.

Some calibrators state the calibration level in Peak values and not RMS, so subtract 3dB. This correction is, however, valid for sinusoidal signals only.

All of the above is valid when the accelerometer is used with its standard length of cable only. If you use other lengths or types of cable, the resulting voltage sensitivity must be calculated – see the example below. Note that in the case of line-drive, or if you use a charge amplifier this does not apply, as the accelerometer output signal will then not be affected by the input impedance of the sound level meter.

Example:

Assume you have an accelerometer/cable configuration with the following data:

Charge sensitivity	S_q	$= 1.14pC/ms^{-2}$
Internal capacitance	C_a	$= 1020pF$
Specific cable capacitance	C_c	$= 100pF/m$
Cable length	l	$= 1.8m$

$$S_v = [1.14 \times 10^{-12}] / [(1020 \times 10^{-12}) + (1.8 \times 100 \times 10^{-12})]$$
$$S_v = 0.95mV/ms^{-2}$$

Specifications

Unless stated otherwise, all levels given in the specifications below refer to a microphone sensitivity of 50mV/Pa or –26dB re 1V/Pa corresponding to the Norsonic microphone cartridge Nor-1220, 1225 or 1230 normally delivered with the instrument.

OVERALL ACCURACY

The complete instrument including preamplifier Norsonic 1201 and microphone cartridge Nor-1220/1225 corresponds to the requirements in IEC 60651 type 1, IEC 60804 type 1. When the instrument is equipped with Norsonic microphone cartridge 1230 the instrument satisfies the requirement in ANSI S1.4A-1985 type 1 and ANSI S.43.1997 type 1 for integrating-averaging sound level meters.

REFERENCE DIRECTION OF INCIDENCE

Along the axis of symmetry for microphone/preamplifier (Nor-1220)

ANALOGUE INPUT

Connector: 7 pin LEMO fitting preamplifier Nor-1201

Preamplifier supply voltage: ±17V

Polarisation voltage: 0 or 200V (±1%). Selectable from menu

Max input voltage: ±10V$_{PEAK}$ (Abs. max ±15V)

Input impedance: 161kΩ, 120pF. AC-coupled

Noise (A- and C-weighted): < 3µV (10dB).

Measurement range with preamplifier Nor-1201, microphone Nor-1220 (½"):

A-weighted: 22–135dB, up to 140dB for peak

C-weighted: 24–135dB, up to 140dB for peak

Measurement range with preamplifier Nor-1201, microphone MK102 (1"):

A-weighted: 17–135dB, up to 140dB for peak

C-weighted: 19–135dB, up to 140dB for peak

The measured figures are at least 5dB above the noise floor. Higher levels may be measured by application of attenuator Nor-1260 or by use of a less sensitive microphone

Influence of extension cable: Up to 10m extension cable (Nor-1408) may be used between the preamplifier and instrument body without any correction. Longer cables may influence the measurement of high level/high frequency signals

ANALOGUE OUTPUT

Flat and A-weighted signal outputs (AC) are provided. Output impedance max. 100Ω, min. load impedance 2kΩ. Shortcircuiting the terminals will not affect measurement accuracy.
FSD corresponds to approx. 0.83V.

MEASUREMENT RANGES

For microphone sensitivity in the range –24.1 to –34.0dB re 1V/Pa the total measurement range for the instrument is divided in five ranges with 70dB overlap: 10–90dB; 20–100dB; 30–110dB; 40–120dB (Reference range); 50–130dB

Reference level: 94.0dB

Reference frequency: 1000Hz

The total measurement range corresponds to 3µV to 3V$_{RMS}$, up to ±10V peak, at the input terminal.

By selecting microphone sensitivity setting in 0.1dB steps in the range –84.0 to +15.9dB re 1 V/Pa, the total displayed range may be set in 10dB steps between –30 to +90dB and 60–180dB; peak up to 190dB

Accuracy of range settings: better than 0.2dB between any gain settings

OVERLOAD DETECTOR

Instantaneous and latched overload indication

LEVEL DETECTOR

Simultaneous detection of A- and C-weighted levels. Levels from 80dB below to 7dB above FSD are indicated. Resolution 0.1dB. Time constant F, S and/or I.

Displayed functions are instantaneous level, minimum level, maximum level, Equivalent continuous level and sound exposure level within the selected measurement period.
[TaktMax as Extension 3 (optional)]

Crest factor: Minimum 10 at FSD, increasing for lower levels

Linearity range: 80dB according to IEC 804, type 1 (5dB above, to 75dB below FSD)

Pulse range: 83dB according to IEC 804, type 1

PEAK DETECTOR

Simultaneous detection of A- and C-weighted peak levels

Dynamic range: 10dB above to 57dB below FSD

***A*ccuracy:** ±2 dB

INTEGRATION TIME

The measurement time is selectable in 1 second step from 1s to 99h 59m 59s. Integration settling time is less than 1s. Measurement periods down to 1/8s in level vs time mode [Extension 2 (optional)]

On activating the PAUSE function, the instrument will cancel acquired data recorded up to 10 seconds before the switch was operated

MARKER

If advanced level versus time mode is selected [Ext. 6 (optional)], up to 5 markers may be placed at different points along the time axis for identification purposes

GRAPHICAL DISPLAY

Graphical reflective LCD display, 64×128 pixels

Dimensions: (B×H): 43×61 [mm]

DATA MEMORY

Memory size: 512 kbyte nonvolatile memory powered by main instrument batteries, even if the voltage is too low for normal operation. Removed batteries must be replaced within 2 minutes to retain stored information. Storage of up to 1440 measurements and up to 245 000 values (depends on measurement configuration). Stored values may be recalled and displayed or transferred via the serial interface.

LEVEL DISTRIBUTION

[Extension 1 (Optional)]

Class width: 0.5dB

Range: 169 classes from 80dB below, to 3dB above FSD. The upper and lower classes has extended limits.

Calculation of percentage levels: 0.1, 1, 5, 10, 50, 90, 95 and 99% (Interpolated to 0.1dB resolution). Optional 1 percentile freely selectable

DISPLAYED FUNCTIONS

A- and C-weighted measured simultaneously. Time constant has to be selected, (optional: F, S and I measured simultaneously) other functions measured in parallel

FUNCTIONS MEASURED

A-weighted functions: SPL F(ast); SPL S(low); SPL I(mpulse); L_{eq}; SEL; SEL I, A-weighted; Max F; Max S; Max I; Min F; Min S; Min I; TaktMax5 (Optional); $L_{eq}I$ (Optional); Peak; Distribution (0.1, 1, 5, 10, 50, 90, 95, and 99 %-values) for A-weighted, F-level (Optional)

C-weighted functions: SPL F; SPL S; SPL I; L_{eq} ; SEL; $L_{eq,I}$; SEL I; Max F; Max S; Max I; Min F; Min S; Min I; TaktMax 5 (Optional); Peak.

The levels may represent a complete measurement record from the start to the end, or shorter time periods set by the selected time resolution. A number of subsequent periods form a level versus time record [Ext. 2 and Ext. 6 (Optional)].

DISPLAYED SETTINGS

Measurement related: Measurement duration; range & setup information; overload information

General: Battery voltage and battery low indication; run-time since battery change; calendar and time of day

CALENDAR/CLOCK

The instrument contains a real time clock running from internal batteries

Typical lifetime: > 10 years

Accuracy: ±2 min per month

I/O INTERFACE

RS232 digital interface for instrument control, data exchange and printout.

Baud rate: 150, 300, 600, 1200, 2400, 4800 or 9600 bit/sec.

Interface circuit may be switched on/off to save battery power

VIDEO OUTPUT

By application of video-adaptor type 244, a copy of the graphical display may be shown on an external RGB or VGA monitor

BATTERY

Battery type: 2 pcs LR61 (9 volt Alkaline)

Typical battery lifetime: 8–12 hours for Alkaline depending on measurement mode. Prolonged operation, typical 15–20 hours, for lithium (RS232 off). NiCd rechargeable batteries may be used (charged outside instrument) with reduced operation time. Use of serial- and video-interfaces will reduce battery life time.

Battery voltage and operating-time since change of battery is indicated

Socket for external DC supply: 11–25V

WARM-UP TIME

The warm-up time for the main instrument without preamplifier/microphone is very short and the instrument obtain the final accuracy as soon as the self-test is done. Used with Nor-1201/1220/1225/1230

microphone system this time is prolonged due to the charging of the microphone with the polarisation voltage. Normal sensitivity is reached within one minute. If unit is to calibrated a two-minute waiting time is recommended after power-on. Warm-up time is reduced if electret microphones with permanent polarisation are used in lieu of the standard microphone supplied with the Nor-116

TEMPERATURE & HUMIDITY RANGE

Operating: –10 to +50°C

Storing: –20 to +60°C (without batteries)

Humidity: 10 to 90% RH, provided no condensation

EFFECT OF VIBRATION

If the instrument is used under vibrational conditions, it is recommended to use extension cable between the preamplifier and the instrument body. The vibration will mainly affect the microphone which is most sensitive if the vibration is applied perpendicular to the diaphragm. Typical values are 55–65dB for acceleration values of 1ms^{-2} perpendicular to the diaphragm

EFFECT OF MAGNETIC FIELDS

The effect of a magnetic field of 80A/m, 50/60Hz in the most sensitive direction of the instrument corresponds to approx. N/A dB

OVERALL WEIGHT AND DIMENSIONS

Approx. 610g incl batteries.

D: 28 mm; W: 74 mm; H: 234 mm excl., 365 incl. microphone/preamplifier

Glossary of Terms

A-weighting. By putting different emphasis to different parts of the audible frequency range, measured sound can be brought to correlate very well with subjective loudness. Since the electrical network used to accomplish this puts different weight to different parts of the audible frequency range, it is often referred to as a (spectral)weighting network, and the graph its frequency response describes is often referred to as the A-weighting curve. The A-weighting curve represents one approximation to the human hearing. Others exist as well, but the A -weighting curve is the one that correlates the best among the approximations not containing level dependent attenuation and amplification. The A-weighting curve is characterised by attenuating both the low and the high end of the spectrum, emphasizing the region around 1 kHz where the ear's sensitivity is at its peak.

C-weighting. Another weighting curve designed to make objective measurements correlate with the human hearing-see also A-weighting. After years with use only as a substitute for linear (the term linear is not unambiguously defined in standards) and with peak measurements, it has become increasingly popular also with less sophisticated sound instrumentation, mainly because it more or less follows the A-curve for high frequencies and is almost flat for frequencies below 1 kHz. The difference between the C- and the A-weighted value will then give condensed information on the spectral contents of the measured sound. Example: If the C – A value is >0, the sound level is dominated by low-frequency (below 1 kHz) sound.

Equivalent Continuous A-weighted Sound Pressure Level, $L_{Aeq,T}$ .The constant level expressed in dB(A) which, lasting for as long as a given A-weighted noise event, i.e. for a period of time T, has the same amount of acoustic energy as a given A-weighted noise event. The general definition of the equivalent continuous sound pressure level is:

$$Leq = 10 \log \frac{1}{T} \int_0^T \frac{p^2(t)}{p_0^2} dt$$

in which T is the measurement period, p(t) is the actual sound pressure signal and p_0 is the reference sound pressure (20 µPa). If the sound pressure in the above equation has been exposed to an A-weighting network, we obtain the $L_{Aeq,T}$

Extensions. Norsonic instruments are of modular design. In this way the user does not have to pay for features never used. However, the modules may be installed as retrofit any time allowing functional expansion of the instrument. Since this functional expansion extends the application range of the instrument, it is referred to as an Extension to the instrument. Most Extensions are designed to work inside the instrument, but even a PC program designed to work together with the instrument may sometimes be regarded as an Extension. Since an Extension is not a part of the basic instrument, it is referred to as an option in our price lists.

F(ast). One of the three internationally standardised time-constants. When a sound level meter is exposed to a sudden change in level (from level X to level Y and then assuming that the level remains at level Y) the time-constant is the time it takes to for the meter to reach 63% of the distance between the two levels. Time-constant F equals 125 milliseconds.

Frequency Weighting. See A-weighting and C-weighting.

Full Scale Deflection (FSD). The maximum permissive input level not causing overload in the instrument taking the signal's crest factor into account (crest factor is an indicator of the "spikiness" of the signal). The FSD is set by means of adjusting the input amplifier gain.

Global. Regarding the Nor-116, the term global means applying to the entire measurement, e.g. the global maximum SPL, means the highest SPL value recorded in that measurement. See also Local.

ILeq. The I(mpulse)-weighted continuous equivalent level is defined as:

$$ILeq = 10 \log \frac{1}{T} \int_{t_1}^{t_1+T} 10^{L_i(t)/10} dt$$

in which the L_i is the I-weighted sound pressure level.

I(mpulse). A time-weighting with 35 ms time-constant, followed by peak detection and a 1.5 s time-constant for the decay of the signal. See also F or S. Defined by IEC 60651.

Input Amplifier Gain. The input amplifier gain defines the maximum permissive input signal level. Must be set so that no overload occurs to produce correct level readings See also Full Scale Deflection.

Leq. See The Equivalent Continuous A-weighted Sound Pressure Level, $L_{Aeq,T}$

L_N. See Percentiles.

Local. In the Nor-116 measurement context the local maximum (or minimum) SPL need not be the highest (lowest) recorded in a given measurement. Instead it may be the highest (lowest) in a fraction of the total measurement period. We therefore refer to it as a local maximum (minimum) as opposed to global maximum (minimum) which expresses the highest (lowest) SPL recorded at all in a given measurement.

Marker. A way of tagging noise events as they occur. Assigning a code to one or more of the subperiods of a level vs. time measurements opens up for later identification of the source(s).

Maximum. The highest sound pressure level (SPL) recorded. Can be either a global or a local maximum, cf. the ΔMax Key in Reference. The Max function of the Nor-116 gives you the global SPL maximum of a measurement, detected with a selected time-constant. Should not be confused with peak.

Minimum. The lowest sound pressure level (SPL) recorded in a measurement.

Normal Display Mode. The display as it looks after you have switched on the unit and initialisation is successful.

Options. See Extensions.

Overload. When the input signal becomes too high the instrument will fail to treat it correctly and the levels read out may be incorrect. To avoid this the input amplifier gain must be adjusted.

Peak. The peak sound pressure is the maximum absolute value of instantaneous sound pressure within a specified time interval. Measured in pascal (Pa).

Peak Level. As for peak, but expressed in dB re. 20 µPa.

Percentile. The term percentile is used to express the amount of the measuring time a certain level was exceeded. Example: If the L_5 = 85 dB, this means that the sound pressure level exceeded 85 dB for 5% of the measurement time. L_{99} is close to the background noise level (since this level was exceeded for 99% of the time) and $L_{0.1}$ is close to the maximum level (since it was exceeded only 0.1% of the time).

Result Mode. Once a measurement has terminated, and the Nor-116 has been subject to no further manipulation than inspection of the acquired data, it is said to be in result mode.

Running. When the Nor-116 is measuring, including being temporarily halted (by pausing), it is said to be in running mode.

SEL. See Sound Exposure Level.

S(low). One of the three internationally standardised time-constants. When a sound level meter is exposed to a sudden change in level (from level X to level Y and then assuming that the level remains at level Y) the time-constant is the time it takes to for the meter to reach 63% of the distance between the two levels. The above ignores that the microphone may influence on the response time because of insufficient high-frequency response. Time-constant S equals 1000 milliseconds.

Sound Exposure Level (SEL). Equal to the Leq of an event, but normalised to 1 sec, i.e. the level of a one second event containing the same energy as the actual event.

Sound Pressure. Total instantaneous pressure at a point in presence of sound waves less the static pressure at the point. Unit, pascal (Pa).

Sound Pressure Level (SPL). As for sound pressure, but expressed in dB re. 20 µPa.

Static Pressure. Pressure that exists at a point in the absence of a sound wave. Unit, pascal (Pa).

Statistics. In some applications, such as community noise measurements and airport noise monitoring, the statistical distribution of the sound level is used to describe the noise emission profile of the measured object. Calculated data are sometimes presented as distribution (density) or cumulative distribution, but for short also often as percentiles.

Takt Maximal. A way of assessing the Leq based on consecutive measurement of SPL maximum within a few seconds periods. The Nor-116 uses five seconds periods and is therefore said to measure the Takt Maximal 5. Briefly, the SPL maximum is measured inside five seconds intervals and an Leq based on these maximum values is then calculated. Used mainly in Germany.

Weighting Network. See A-weighting and C-weighting.

Remote Control Commands, Index, Warranty

Remote Control Commands Listed Alphabetically

A
AT x Absolute time on/off

B
BP x Transfer sound power raw data values
BT Battery time transfer
BV Battery voltage transfer
BW x Bandwidth/network setup

C
CD x Clear directory command
CF xxxx Clear file command
CO CONTINUE command
CS xx.x Sensitivity setup

D
DM x DMax activate
DR x Directory info. transfer
D$"xxxxxx" Directory name setup

E
EC xx.x Set env. corr. factor

F
FE xxxx File exist command
FM Free memory transfer
FS I/O status transfer
F$ Directory name transfer

G
GA x Gain setup

H
H x Measurement time – Hours setup
HR xx.x Set hemisphere radius

I
ID Instrument ID code transfer
IR Instrument software RESET command
IS Instrument start-up status transfer
IT Return instrument identification string

K
K x Keyboard simulation

L
LL Disable local keyboard command
LO Enable local keyboard command
LW Transfer of power Lw

M
M x Measurement time – Minutes setup
MC Meas. clear ð READY mode
MD xx.x Set meas. dist. (par.epiped)
MF Meas. finished status transfer
MS Meas. status transfer

O
OP x Calibration tone control ON/OFF

P
PA PAUSE command
PO x,y Numerical print parameters setup
PS Percentile table transfer
PT x Percentile table value transfer

R
RF xxxx Recall file command
RH xx.x Set ref. box height
RL xx.x Set ref. box length
RS x Set ref. surface type
RT yymmddhhmmss Set real time clock
RW xx.x Set ref. box width

S
S x Measurement time – Seconds setup
SF Save file command
SM x Storage mode select
SO Software options transfer
SP STOP command
ST START command
SU x† Instrument setup transfer
SW Software version transfer

T
TA x† SPLmin transfer
TB x† SPLmax transfer
TC x Time constant setup
TD Real-time clock time transfer
TE x† SEL transfer
TF x† DMax transfer (Running only)
TL x LEQ transfer
TM x† Tmax5 transfer
TO Overload status transfer
TP Peak transfer
TS x† SPL transfer
TT Elapsed measurement time transfer

U
UB y,z Time buffer block data transfer
UG Current period-number transfer
UH x Long period time— Hours setup
UM x Long period time— Minutes setup
UN xxx Short period time— Milliseconds setup
UO x,y,z Time buffer data transfer
UP Selected # of periods transfer
UQ # free periods transfer
UR x,y Recorded parameters setup (00,x à ALL)
US xx Long period time— Seconds setup
UT x,y Block transfer parameters setup (00,x à ALL)

V
VS x Polarisation voltage select

† *These variables apply to extended version instruments only. For basic version instruments no variable should be specified for these commands.*

Instruction	Code	Parameter	Comments
Select gain	GA x	x = 0 –10dB gain x = 1 +10dB gain x = 2 +10dB gain x = 3 +20dB gain x = 4 +30dB gain	FSD = 130 dB @ 50 mV/Pa FSD = 120 dB @ 50 mV/Pa FSD = 110 dB @ 50 mV/Pa FSD = 100 dB @ 50 mV/Pa FSD = 90 dB @ 50 mV/Pa
Select sense	CS x	$-84.0 \leq x \leq 15.9$	Sensitivity in dB re. 1 V
Calibration tone control	OP x	x = 0 OFF x = 1 ON	Note: Requires a hardware update

Instruction	*Code*	*Parameter*	*Comments*
Start a measurement	ST	*None*	
Stop a measurement	SP	*None*	
Continue a measurement	CO	*None*	
Pause a measurement	PA	*None*	
DMax handling	DM x	0 = display normal Max value 1 = clear and display ΔMax value	
Select/deselect absolute time	ATx	0 = Relative time 1 = Absolute time	
Polarisation voltage on/off	VS x	0 = Polarisation voltage off—0V 1 = Polarisation voltage on—200V	
Measurement clear → READY mode	MC	*None*	

Instruction	*Code*	*Parameter*	Comments
Select network	BW x	x = 0: A network & C x = 1: C network & A x = 2: A network & C - A	Used to select network for transfer commands too.
Select time constant	TC x	x = 1: F x = 2: S x = 3: I	

Instruction	*Code*	*Parameter*	*Comments*
Select directory name	D$"xxxxxx"	"SETUP" or "YYMMDD"	Directory name . Use this command before RF x, CD x and DR x to select I/O directory name.
Transfer directory name	F$	None	Transfer format: xxxxxx<CR><LF>
Save file	SF	*None*	
Recall file*	RF x	1 ≤ x ≤ 999	
Clear file*	CF x	1≤ x ≤ 999	
Clear selected directory*	CD x	x = 0, 1 or *None*	0 or *None*: Clear selected directory 1: Clear all directories except SETUP
Transfer dir. information*	DR x	x = 0: Info on current file x = 1: Info on current directory x = 2: Info on curr. dir. & all files x = 3: Info on all directories x = 4: Info on all dir. & all files	*Transfer format, directory information:* xxxxxx nnnn<CR><LF> *Transfer format, meas. result file information:* - nnnn D MYY:MM_1:DD HH:MM_2:SS<CR><LF> xxxxxx = dir. name, nnnn = file number 'D' is either S (Setup), D (Level Data) or T (Time Data). 'M' is either L (Level mode), P (Sound Power Mode) or K («Kommune» Mode) A completed transfer is followed by <EOF><CR><LF> in which <EOF> is End of File (CTRL Z, ASCII char. No. 26 or Hex 1A)
Test the existence of a file number in 116*	FE x	1 ≤ x ≤ 999	Transfer format: S<CR><LF> Returned status:'@' = File number is not used. 's' = File number in use
Return free memory space	FM	*None*	Transfer format: xxxxxx<CR><LF>
Select storage mode	SM x	x = 0: Manual, x = 1: Auto x = 2: Repeat, x = 3: Syncro	

*) Use D$ to select directory name

Instruction	*Code*	*Parameter*	*Comments*
Lock keyboard	LL	*None*	
Active keyboard	LO	*None*	
Keyboard simulation	K x	1 ≤ x ≤ 38	1: INC 2: —>| 3: —> 4: <— 5: DEC 6: RECALL 7: CLEAR 8: |<— 9: START 10: NETW 11: TC 12: STORE 13: FUNC 14: PAUSE 15: ABS 16: DMAX 17: LT 18: STOP 19: PRINT 20: BATT 21: TBL 22: ENTER 23: EXIT 24: SETUP 25: CAL 26: 0 27: 1 28: 2 29: 3 30: 4 31: 5 32: 6 33: 7 34: 8 35: 9 36: . 37: ± 38: DEL
Instrument software RESET	IR	*None*	

Instruction	*Code*	*Parameter*	*Comments*
Short period time – n/128s.	UN x	x = 16 1 ≤ x ≤ 127[1]	125 ms selected (16/128 = 0.125) n/128s selected[1]
Recorded values on/off.	UR x,y	1 ≤ x ≤ 12 y = 0 Selected parameter OFF[1] y = 1 Selected parameter ON[1]	x-settings for advanced L(t) extension: 01: A SPL 02: A Leq 03: A Max 04: A Min 05: A SEL 06: A Peak 07: C SPL 08: C Leq 09: C Max 10: C Min 11: C SEL 12: C Peak
		1 ≤ x ≤ 28[2] y = 0 Selected parameter OFF[1] y = 1 Selected parameter ON[1]	x-settings for advanced L(t) extension including multiple time constant extension: 01: A F SPL 02: A S SPL 03: A I SPL 04: A Leq 05: A I Leq 06: A F Max 07: A S Max 08: A I Max 09: A F Min 10: A S Min 11: A I Min 12: A SEL 13: A I SEL 14: A Peak 15: C F SPL 16: C S SPL 17: C I SPL 18: C Leq 19: C I Leq 20: C F Max 21: C S Max 22: C I Max 23: C F Min 24: C S Min 25: C I Min 26: C SEL 27: C I Sel 28: C Peak If advanced L(t) mode and PTC extension[2] both are present all the above settings are simultaneously selectable. Else, only one is selectable at the time (the others are reset).
Parameter setup for numerical printing	PO x,y	1 ≤ x ≤ 12 1 ≤ x ≤ 28[2] y = 0 Selected parameter OFF[1] y = 1 Selected parameter ON[1]	The parameter number—see UR above. The state of the parameter—see UR above.
Block transfer values On/Off	UT x,y	As for PO command	As for PO command

[1.] Advanced L(t) extension only [2.] Parallel Time Constant extension only

Instruction	Code	Parameter	Comments
Block transfer of periods	UB y,z	0 ≤ y ≤ 99999 0 ≤ z ≤ 99999	The No. of the first period. The No. of periods. Transfer format: Sxxx.x…Sxxx.x<CR><LF> repeated z times No. of parameters per period is set via the UT command Status returned: E = data valid M = data with overload U = no data calculated/measured A = no data available
Transfer calculated No. of periods	UP		Transfer format: xxxxxx<CR><LF>
Transfer No. of free periods available in memory	UQ		Max. No. of periods that may be allocated outside of current buffer Transfer format: xxxxxx<CR><LF>
Transfer of current period-number	UG		Transfer format: xxxxxx<CR><LF>
Transfer of periods	UO x,y,z	1 ≤ x ≤ 12 1 ≤ x ≤ 28[1] 0 ≤ y ≤ 99999 0 ≤ z ≤ 99999	Recorded value No. See UR command on the previous page. The No. of the first period to be transferred. The total No. of periods to transfer. Transfer format: Sxxx.x<CR><LF> repeated z times Status returned, see UB command above.

[1] Advanced L(t) extension only

Measurement Duration I/O Commands

Instruction	*Code*	*Parameter*	*Comments*
Measurement time—Hours	H x	**0 ≤ x ≤ 99**	Hours
Measurement time—Minutes	M x	**0 ≤ x ≤ 59**	Minutes
Measurement time—Seconds	S x	**0 ≤ x ≤ 59**	Seconds
Long period time—Hours	UH x	**0 ≤ x ≤ 99**	Hours
Long Period Time—Minutes	UM x	**0 ≤ x ≤ 59**	Minutes
Long period time—Seconds	US x	**0 ≤ x ≤ 59**	Seconds

Note! Short period time (n/128 seconds) is set by UN command—see L(t) Setup I/O commands

Real Time Clock I/O Commands

Instruction	Code	Parameter			Comments
Set RTC	RT yymm$_1$ddhhmm$_2$ss	00 01 01 00 00 00	≤ yy ≤ mm$_1$ ≤ dd ≤ hh ≤ mm$_2$ ≤ ss	≤ 99 ≤ 12 ≤ 31 ≤ 23 ≤ 59 ≤ 59	year, month, day, hour, minute and second
Transfer real time clock	TD	*None*			Transfer format: yymmddhhmmss<CR><LF>

Instruction	*Code*	*Parameter*	Comments
Transfer elapsed meas.time	TT	*None*	Transfer format: hhmmss<CR><LF>
Transfer battery voltage	BV	*None*	Transfer format: xx.xx<CR><LF>
Transfer battery time	BT	*None*	Transfer format: hhmmss<CR><LF>
Instrument startup status	IS	*None*	Transfer format: S<CR><LF> Status characters: T = Test running M = Memory test failed L = Level test failed C = Startup calibration test failed @ = All tests OK
Software version readout	SW	*None*	Transfer format: XXXXXX<CR><LF>
Instrument ID code	ID	*None*	Transfer format: XXXXXX<CR><LF>
Instrument identification string	IT	*None*	NOR116<CR><LF>

Instruction	*Code*	*Parameter*	*Comments*
Transfer instrument setup	SU (x)	x = 0 (or none): Format 1 x = 1: Format 2 x = 2: Power mode setup/status	Format 1: *Byte No. Description* 0 Time constant ('F', 'S', 'I') 1 Main network ('A' or 'C') 2 Full scale defl. (xxx dB) 5 Polarisation voltage On ('P') or Off (' ') 6 Sensitivity (xxx.x dB) 11 Measurement time setting 17 Storage type ('M'anual, 'A'uto, 'R'epeat, 'S'yncro) 18 Storage directory name 24 Storage file number 28–35 Empty ('spaces') String terminates here unless ext. 2 present 40 Period time type ('L' ≥ 1 sec., 'S' < 1 second) 41 Period time ('hhmmss' or xxx/128 s) 46 logged parameter(s) in sample mode Each parameter is two bytes and right justified. See also UR xx command. Format 2: *Byte No. Description* 0–11 Measurement start time (YYMMDDHHMMSS) 12–23 Measurement end time (YYMMDDHHMMSS)

Instruction	Code	Parameter	Comments
Transfer instrument setup *cont.*	SU (x)	x = 0 (or none): Format 1 x = 1: Format 2 x = 2: Power mode setup/status	Power mode setup: *Byte No.* *Description* 0 Surface type: 0 = Hemisphere (floor) 1 = Hemisphere (wall) 2 = Hemisphere (corner) 3 = Parallelepiped (floor) 4 = Parallelepiped (wall) 5 = Parallelepiped (corner) 1 Surface length† 6 Surface width† 11 Surface height† 16 Measurement distance or hemisphere radius 21 Surface area 28 Background corr. factor 33 Environmental corr. factor 38 Impulsive power flag ('1' = impulsive, '0' = not impulsive)
Software extensions (options) installed	SO	*None*	Transfer format: xx,xx,xx,…<CR><LF>

†If empty, the measurement surface is considered to be hemispherical

Instruction	*Code*	*Parameter*	*Comments*
Transfer of SPL	TS x†	x = 0: Current x = 1: F x = 2: S x = 3: I	Transfer format: Sxxx.x<CR><LF> S = E (data valid), M (data with overload), U (no data). Use BW x command to select between A- and C-weighted values.
Transfer of SPLmin	TA x†	As for TS command	See TS above
Transfer of SPLmax	TB x†	As for TS command	See TS above
Transfer of LEQ	TL x	x = 1: LEQ x = 2: LEQI	See TS above
Transfer of Tmax5	TM x†	x = 1: TaktMax 5 F x = 2: TaktMax 5 I	See TS above
Transfer of Peak	TP		See TS above
Transfer of SEL	TE x†	x = 1: SEL x = 2: ISEL	See TS above
Transfer of Delta Max	TF x†	As for TS command	As TS above, but only when RUNNING
Transfer overload status	TO		Transfer format: S<CR><LF> Status returned: E (No overload), O (Overload active now), L (Latched overload, but no overload now)

†Applies to units equipped with ext. 7 (parallel time constants) only.

Instruction	*Code*	*Parameter*	*Comments*
Set reference surface type	RS x	x = 0: Hemisphere (floor) x = 1: Hemisphere (wall) x = 2: Hemisphere (corner) x = 3: Parallelepiped (floor) x = 4: Parallelepiped (wall) x = 5: Parallelepiped (corner)	
Set reference box length	RL x	0.00 ≤ x ≤ 56.00	[metres]
Set reference box width	RW x	0.00 ≤ x ≤ 32.00	[metres]
Set reference box height	RH x	0.00 ≤ x ≤ 40.00	[metres]
Set measurement distance	MD x	0.00 ≤ x ≤ 20.00	Parallelepiped [metres]
Set hemisphere radius	HR x	0.00 ≤ x ≤ 10.00	[metres]
Set environmental correction factor	EC x	0.00 ≤ x ≤ 10.00	Correction factor [dB]
Transfer of Lw (sound power level)	LW	*None*	Transfer format: Sxxx.x<CR><LF> Status returned: E = data valid M = data with overload U = no data calculated/measured C = Environmental corr. too high B = backgr. noise level too high

Instruction	*Code*	*Parameter*	*Comments*
Transfer sound power raw data	BP x	x = 0: LeqA x = 1: BGN x = 2: PeakC x = 3: DI x = 4: LeqAI x = 5: Impulsiveness	Transfer format: Sxxx.x<CR><LF> repeated 40 times S = E (data valid), M (data with overload), U (no data).

Statistical Distribution I/O Commands

Instruction	*Code*	*Parameter*	*Comments*
Transfer percentiles available	PS	*None*	Transfer format: p1p2p3p4p5p6p7p8<CR><LF>
Percentile table readout (Ln values)	PT x	x = 1: 0.1% x = 2: 1% x = 3: 5% x = 4: 10% x = 5: 50% x = 6: 90% x = 7: 95% x = 8: 99%	Transfer format: Sxxx.x<CR><LF> S = E (data valid), R (data with overrange), U (no data calculated)

Instruction	*Code*	*Parameter*	*Comments*
Fetch status	FS	None	Transfer format: SSSS<CR><LF> Status characters: See table next page.
Measurement finished status	MF	None	Transfer format: S<CR><LF> Status returned: F -> Finished @ -> Not finished Note! Status is cleared after reading.
Measurement status	MS	None	Transfer format: S<CR><LF> Status returned: R - Running P - Pause @ - Not running

Note! 1st to 4th byte gives error codes for the 4 latest occurred errors.

DECimal	ASCII	Corresponding meaning
64	@	OK - no error
90	Z	Command unknown
91	[	Option (ext.) not present
92	\	I/O locked
93	]	No marker table for given file
95	_	No graphical data
96	'	Graphical scaling error
97	a	Device error
100	d	No digit read
101	e	Number is illegal
102	f	Text-string too long
103	g	Illegal command (in this mode)
104	h	No data valid
105	i	Number out of range
106	j	
107	k	
108	l	
109	m	
110	n	Error in text format
111	o	
112	p	Memory full
113	q	No file found error
114	r	
115	s	File number already in use
116	t	
117	u	
118	v	
119	w	
120	x	Illegal in RUNNING
121	y	
122	z	
123	{	Memory operation OK
124	|	
125	}	

If You Are Having a Problem with Your Equipment

If you are having a problem with your Norsonic equipment, first check out that all the basic requirements to the entire instrumentation are fullfilled for the task you want to accomplish.

Verify that the required optional instrument extensions are present and operating. In case the Norsonic product is a software program, verify that your computer has the minimum hardware necessary for this product and that it runs on an operating system platform sufficiently powerful for the task.

In cases where the Norsonic equipment is used together with equipment from other manufacturers, verify that this equipment works properly. You should also verify that the use of these products together with Norsonic products causes no harm to either products.

Observe that any damage to Norsonic products caused by the use of Norsonic equipment together with equipment from other manufacturers, is considered to originate from improper handling of the Norsonic equipment and thus not covered by our warranty.

If you are uncertain about the configuration of instrument extensions (options) etc. concerning your Norsonic hardware, you should consult the user-documentation accompanying your Norsonic products.

For the equipment manufactured by others than Norsonic, and for your computer, you should check the user-documentation included with these products.

The user-documentation should provide the answers to the majority of your questions.

If your questions are not answered in the user-documentation, contact the dealer(s) where you purchased your instrumentation/hardware.

If you feel confident that your problem is due to your Norsonic equipment, you are welcome to contact Norsonic or your local Norsonic representative.

Kindly state the product type number and serial number (when applicable) in all correspondence and have it available whenever you call for support.

If you make any claim for repair, update or replacement do not send goods to the factory without written consent from Norsonic AS giving shipping instructions, cf. our Terms of Warranty.

Declaration of Conformity

We, Norsonic AS, Gunnersbråtan 2, Tranby, Norway, declare under our sole responsibility that the product:

Sound Level Meter type Nor-116

FROM SERIAL NUMBER 20241

to which this declaration relates, is in conformity with the following standards or other normative documents:

Performance complying with:	IEC 60651 type 1 IEC 60804 type 1 DIN 45 657 ANSI S1.4A-1985 type 1 ANSI S1.43-1997 type 1
Safety:	EN61010-1:1993 for portable equipment and pollution category 2.
EMC:	EN 50081-1 EN 50082-1

following the provisions of the LVD- and EMC-Directive.

This product has been manufactured in compliance with the provisions of the relevant internal Norsonic production standards. All our products are tested individually before they leave the factory. Calibrated equipment—traceable to national and international standards—has been used to carry out these tests.

This Declaration of Conformity does not affect our warranty obligations.

Tranby, October 1995

Dagfinn Jahr
Quality Manager

The declaration of conformity is given according to EN 45014 and ISO/IEC Guide 22.

Norsonic AS, PO. Box 24, N-3421 Lierskogen, Norway

Warranty

The normal warranty period provided for our products is 12 months after the time of delivery unless stated other on the warranty certificate included in the shipment.

Norsonic AS gives no warranty for products or parts included in the shipment not manufactured by the seller, other than granted to the seller by the original manufacturer.

The warranty does not include damage due to improper handling, overload, force majeure or normal wear and tear. The warranty is not granted if the buyers make modifications or repairs without our written consent.

Norsonic AS can choose either to repair or to replace parts having defects due to material and/or workmanship, provided these defects cause unsatisfactory operation or appearance.

Defective goods should be returned to our factory or one of our distributors as decided by the seller. However, no goods shall be returned to our factory without a foregoing written consent from Norsonic AS giving shipping instructions.

Return shipments are to be paid and insured by the buyer unless otherwise agreed.

If a defect has to be repaired at the user's premises, the buyer will be charged travelling and residential expenses.

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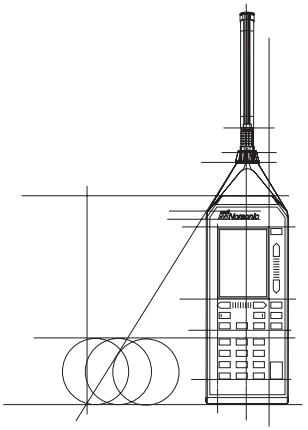

The Sound Level Meter Nor-116

Your approach to the Nor-116 documentation depends on what you want to do and how much you already know. However experienced you may be, we do recommend that you spend a few minutes on reading through this little manual. It may prove useful.

Book Level

- ✓ **Beginning**
- ✓ **Some experience**
- ✓ **Intermediate**
- ✓ **Advanced**

- ✓ **Tutorial**
- ✓ **How-to**
- Reference

Norsonic

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http://www.norsonic.com

Norsonic AS supplies a complete range of instrumentation for acoustics – from sound calibrators, microphones & preamplifers; via small hand-held sound level meters to advanced, yet portable, real time analysers, but also spectrum shapers, building acoustics analysers and complete community, industry and airport noise monitoring systems. Contact your local representative or the factory for information on our complete range of instrumentation.