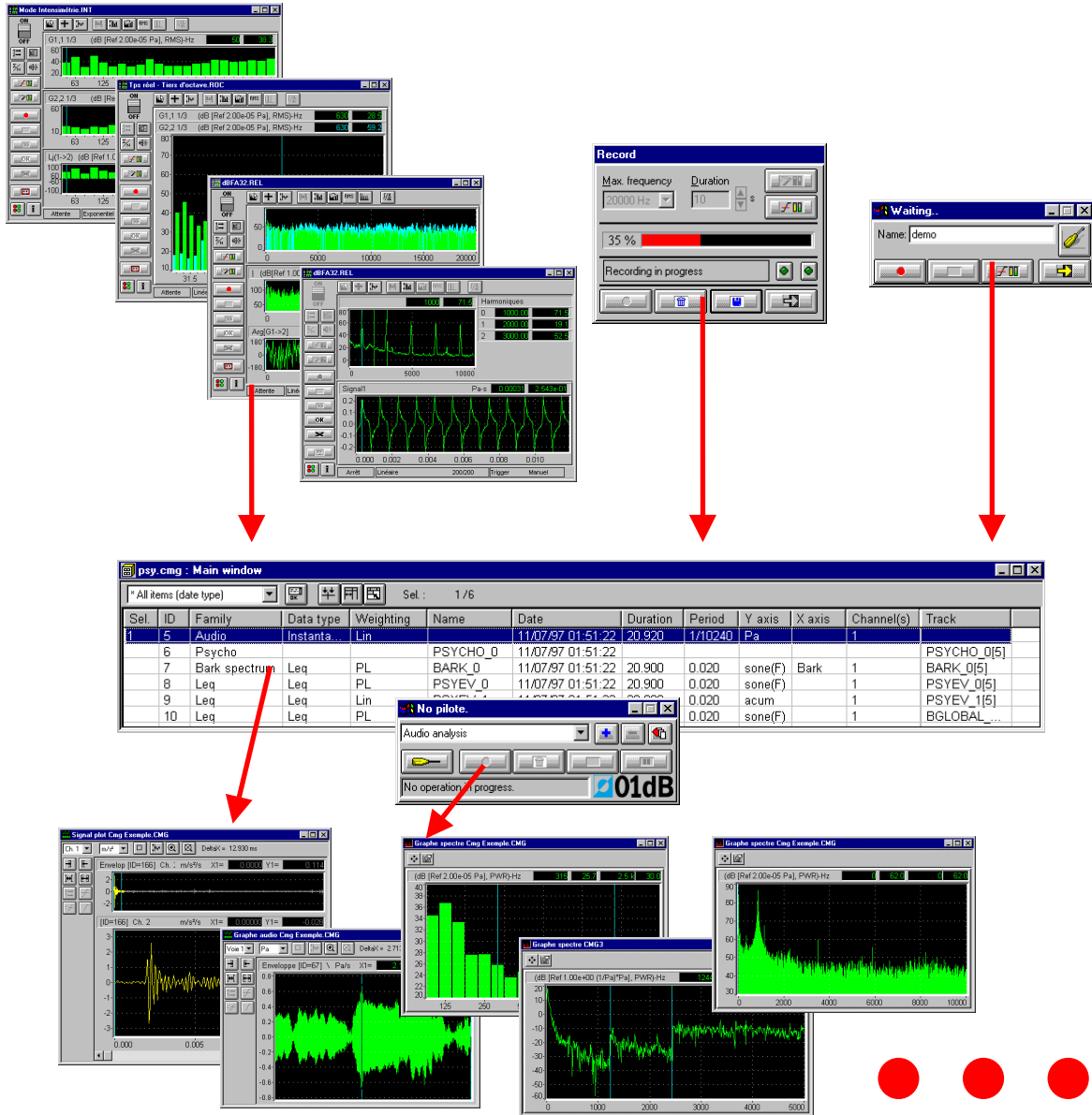


dBFA32 software suite

Frequency Analysis and much more...



USER MANUAL



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dBFA32 v. 4.4

Frequency analysis software suite and much more...


User manual


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TABLE OF CONTENTS ¹

1. DESCRIPTION OF A 01DB-STELL PC-BASED MEASUREMENT CHAIN	11
1.1. INTRODUCTION	11
1.2. GENERAL DESCRIPTION	12
1.3. INDUSTRIAL APPLICATIONS	13
2. ACQUISITION & ANALYSIS WITH DBFA32.....	15
2.1. OVERVIEW OF THE SOFTWARE PACKAGE: PRINCIPLE OF OPERATION	15
2.2. MEASURING WITH DBFA32.....	16
2.2.1. <i>Common steps</i>	16
2.2.2. <i>Signal recording (Audio and/or tachometric)</i>	17
2.2.3. <i>MLS acquisition mode</i>	18
2.2.4. <i>Real-time acquisition modes</i>	19
2.3. DATA PROCESSING WITH DBFA32.....	20
2.3.1. <i>Requests (data sorting)</i>	21
2.3.2. <i>Off-line processing analyses</i>	22
2.3.3. <i>Batch processing</i>	24
2.4. WHAT'S NEW IN DBFA32?.....	25
2.4.1. <i>Versions 4.400</i>	25
2.4.2. <i>Versions 4.300</i>	27
3. MEASUREMENT HARDWARE CONFIGURATION	29
4. MEASUREMENT CHAIN CALIBRATION.....	31
5. SIGNAL ACQUISITION (AUDIO AND TACHOMETRIC)	33
5.1. RECORDING COMMAND	33
5.2. GAIN AND THRESHOLD COMMAND	35
5.3. RECORD CONFIGURATION COMMAND	36
5.4. REAL-TIME DISPLAY OF A ROTATION SPEED.....	36
5.5. TACHOMETRIC MEASUREMENTS	37
5.5.1. <i>Generalities</i>	37
5.5.2. <i>Tachometric measurements in dBFA32</i>	37
5.5.2.1. Transducer definition.....	37
5.5.2.2. Transducer connection / Acquisition box	38
5.5.2.3. Hardware configuration in dBFA32	38
5.5.2.4. Activation of the tachometric channel	39
5.5.2.5. Tachometric threshold trigger definition (optional).....	39
5.5.2.6. Start the tachometric recording	40
5.5.2.7. Results	40
5.5.2.8. Exploitation example	41
6. MLS ACQUISITION MODE	43
6.1. INTRODUCTION	43
6.2. ACQUISITION SET-UP AND PARAMETERS.....	43
6.2.1. <i>Connection of the measurement chain elements</i>	43
6.2.2. <i>Acquisition parameters</i>	44
6.3. RUN AN ACQUISITION	46
7. REAL-TIME ACQUISITION (NARROW-BAND ANALYSIS).....	47
7.1. MEASUREMENT WINDOW OVERVIEW	48
7.2. MEASUREMENT SET-UP	49
7.2.1. <i>Cross-functions</i>	49
7.2.2. <i>Acquisition parameters</i>	49

¹ **Important Notice:** Because this software package is modular in structure, some of the functions described in this manual may not be available in your copy of the software. To upgrade your version with optional modules, contact your 01dB-Stell agent.

7.2.3.	<i>Averaging parameters</i>	51
7.2.4.	<i>Internal signal generator (option)</i>	51
7.2.5.	<i>Threshold, gain and autorange settings</i>	52
7.2.6.	<i>Signal acquisition (option)</i>	53
7.3.	DISPLAY CONFIGURATION	54
7.3.1.	<i>Curves to display</i>	54
7.3.2.	<i>Display dynamic configuration</i>	56
7.3.3.	<i>Overall levels</i>	56
7.3.4.	<i>Spectral units</i>	56
7.3.5.	<i>Harmonic cursors</i>	57
7.3.6.	<i>Integration / Derivation of spectra to be displayed</i>	57
7.4.	MEASUREMENT PROCESS	58
8.	REAL-TIME ACQUISITION (OCTAVES & THIRD OCTAVES ANALYSIS).....	59
8.1.	MEASUREMENT WINDOW OVERVIEW	60
8.2.	MEASUREMENT SET-UP	61
8.2.1.	<i>Acquisition parameters</i>	61
8.2.2.	<i>Averaging parameters</i>	62
8.2.3.	<i>Internal signal generator (option)</i>	62
8.2.4.	<i>Threshold, gain and autorange settings</i>	63
8.2.5.	<i>Signal acquisition (option)</i>	64
8.3.	DISPLAY CONFIGURATION	65
8.3.1.	<i>Curves to display</i>	65
8.3.2.	<i>Display dynamic configuration</i>	67
8.3.3.	<i>Overall levels</i>	67
8.3.4.	<i>Spectral units</i>	67
8.4.	MEASUREMENT PROCESS	68
9.	REAL-TIME ACQUISITION (INTENSITY MODE).....	69
9.1.	MEASUREMENT WINDOW OVERVIEW	70
9.2.	MEASUREMENT SET-UP	71
9.2.1.	<i>Cross-functions</i>	71
9.2.2.	<i>Acquisition parameters</i>	71
9.2.3.	<i>Averaging parameters</i>	74
9.2.4.	<i>Internal signal generator (option)</i>	74
9.2.5.	<i>Threshold, gain and autorange settings</i>	75
9.2.6.	<i>Signal acquisition (option)</i>	76
9.3.	DISPLAY CONFIGURATION	77
9.3.1.	<i>Curves to display</i>	77
9.3.2.	<i>Display dynamic configuration</i>	79
9.3.3.	<i>Overall levels</i>	79
9.3.4.	<i>Spectral units</i>	79
9.3.5.	<i>Harmonic cursors</i>	80
9.3.6.	<i>Integration / Derivation of spectra to be displayed</i>	80
9.4.	MEASUREMENT PROCESS	81
10.	TRANSIENT ANALYSIS.....	83
10.1.	REAL-TIME ANALYSIS.....	84
10.1.1.	<i>Description of the measurement window</i>	84
10.1.2.	<i>Measurement set-up</i>	86
10.1.2.1.	<i>Threshold and gain settings and autorange</i>	86
10.1.2.2.	<i>Measurement set-up</i>	87
10.1.3.	<i>Display and windowing set-up</i>	88
10.1.3.1.	<i>Curves to display</i>	88
10.1.3.2.	<i>Layout set-up</i>	89
10.1.3.3.	<i>Automatic adjusting of the display dynamic range</i>	89
10.1.3.4.	<i>Signal windowing</i>	90
10.1.3.5.	<i>Editing windowing parameters</i>	90
10.1.4.	<i>Real-time transient analysis process</i>	92
10.2.	POST-PROCESSING ANALYSIS.....	94
10.2.1.	<i>Description of the analysis window</i>	94

10.2.2.	<i>Analysis set-up</i>	95
10.2.2.1.	Batch window (elements to process)	95
10.2.2.2.	Analysis set-up	96
10.2.3.	<i>Display and windowing set-up</i>	97
10.2.3.1.	Curves to display	97
10.2.3.2.	Layout set-up	98
10.2.3.3.	Automatic adjusting of the display dynamic range	98
10.2.3.4.	Signal windowing	99
10.2.3.5.	Editing windowing parameters	99
10.2.4.	<i>Description of a post-processing transient analysis</i>	101
11.	ORDER EXTRACTION	103
11.1.	REAL-TIME ANALYSIS	104
11.1.1.	<i>Description of the measurement window</i>	104
11.1.2.	<i>Measurement set-up</i>	106
11.1.2.1.	Threshold and gain settings and autorange	106
11.1.2.2.	Measurement set-up	107
11.1.3.	<i>Display set-up</i>	109
11.1.3.1.	Measurement window	109
11.1.3.2.	Display set-up	109
11.1.4.	<i>Description of the measurement</i>	110
11.2.	POST-PROCESSING ANALYSIS	112
11.2.1.	<i>Description of the analysis window</i>	112
11.2.2.	<i>Analysis set-up</i>	113
11.2.2.1.	Batch window (elements to process)	113
11.2.2.2.	Analysis set-up	114
11.2.3.	<i>Display set-up</i>	116
11.2.3.1.	Display set-up	116
11.2.4.	<i>Description of a post-processing order extraction</i>	117
12.	SHOCK ANALYSIS	119
12.1.	REAL-TIME ANALYSIS	120
12.1.1.	<i>Presentation of the measurement window</i>	120
12.1.2.	<i>Measurement set-up</i>	122
12.1.2.1.	Threshold, gain and autorange settings	122
12.1.2.2.	Measurement settings	124
12.1.2.3.	Layout settings	125
12.1.2.4.	Signal windowing	125
12.1.3.	<i>Real-time shock analysis</i>	128
12.1.3.1.	Procedure	128
12.1.3.2.	Flow chart	129
13.	MANAGEMENT OF MEASUREMENT SESSION DATAFILES (CMG)	131
13.1.	CMG DATAFILE MANAGEMENT	131
13.1.1.	<i>New CMG datafile</i>	131
13.1.2.	<i>Open a CMG datafile</i>	132
13.1.3.	<i>Close a CMG datafile</i>	132
13.1.4.	<i>Save a CMG datafile</i>	132
13.1.5.	<i>Delete one or several CMG datafile(s)</i>	132
13.2.	MEASUREMENT SESSION WINDOW OVERVIEW	133
13.2.1.	<i>Toolbars</i>	133
13.2.2.	<i>Measurement session information window</i>	134
13.2.3.	<i>Measurement session comments</i>	134
13.2.4.	<i>Playback of signal recordings</i>	134
13.2.5.	<i>Delete data items</i>	134
13.2.6.	<i>Modify data items (editing)</i>	134
13.2.6.1.	Editing of items: date and time	135
13.2.6.2.	Editing of items: location and comments	135
13.2.6.3.	Editing of items: level conversion	135
13.2.6.4.	Editing of items: study zone	135
13.2.6.5.	Autospectrum type (building acoustics)	136
13.2.6.6.	Information	136
13.3.	PLOT DATA ITEMS (GRAPHICS)	136

13.3.1.	<i>Signal view</i>	138
13.3.2.	<i>Broad band spectra and/or multispectra, Bark bands, histograms and echogram</i>	140
13.3.2.1.	Display parameters of the graphical view.....	141
13.3.2.2.	Data parameters for the graphical view	142
13.3.3.	<i>Narrow band spectra and/or multispectra, transfer functions and coherence</i>	144
13.3.3.1.	Display parameters of the graphical view.....	145
13.3.3.2.	Data parameters for the graphical view	145
13.3.3.3.	Using harmonic, sideband and maximum cursors	148
13.3.4.	<i>Sonagram view</i>	152
13.3.4.1.	Data calculation parameters for display.....	152
13.3.5.	<i>Nichols / Nyquist views</i>	153
13.3.5.1.	Data calculation parameters for display.....	154
13.3.6.	<i>Lissajous view</i>	155
13.4.	LISTINGS OF DATA ITEMS (TABLES)	156
13.4.1.1.	Data parameters for the table of results	157
13.5.	DESCRIPTION AND SELECTION OF COLUMNS IN A MEASUREMENT SESSION WINDOW	158
13.6.	EDITING AND RUNNING REQUESTS (DATA SORTING)	159
13.6.1.	<i>Overview of requests' editing</i>	159
13.6.2.	<i>Add or modify a request (local or global)</i>	160
13.6.2.1.	Overview.....	160
13.6.2.2.	Definition principle	161
13.6.2.3.	List of the values available to define a request	162
13.6.3.	<i>Running a request</i>	164
13.7.	RESULT EXPLOITATION AND CUSTOMISATION	165
13.7.1.	<i>Printing results</i>	165
13.7.2.	<i>Exporting data to a word processing or spreadsheet software</i>	165
13.7.3.	<i>Principle and configuration of the Copy command</i>	167
13.7.4.	<i>Exporting data in 01dB-Stell WAV format or in MP3 format</i>	167
13.7.5.	<i>Exporting data in ASCII format (*.TXT text file)</i>	168
13.7.6.	<i>Exporting data in UFF format (Universal File Format)</i>	168
13.7.7.	<i>Customisation of dBFA32</i>	168
13.7.8.	<i>Measurement session general options</i>	169
14.	OFF-LINE PROCESSING	171
14.1.	INTRODUCTION	171
14.2.	CALCULATION SERVER OVERVIEW	172
14.3.	OVERVIEW AND CONFIGURATION OF ANALYSIS SCRIPTS	174
14.4.	USING SHORTCUTS TO RUN SCRIPTS.....	175
14.4.1.	<i>Assigning shortcuts</i>	175
14.4.2.	<i>Using shortcuts</i>	175
14.4.3.	<i>Quick editing of a script associated with a shortcut</i>	176
14.5.	LIST OF DEFAULT ANALYSIS SCRIPTS AND ASSOCIATED OPERATORS (PROCESSING FUNCTIONS)	177
14.6.	OVERVIEW AND CONFIGURATION OF OPERATORS (PROCESSING FUNCTIONS)	180
14.6.1.	<i>Spectral analysis</i>	181
14.6.1.1.	Theory	181
	Time-Frequency analysis.....	182
14.6.1.2.	Narrow-band spectrum Operator [FB].....	184
14.6.1.3.	Narrow-band Cross spectrum Operator [FBG12].....	185
14.6.1.4.	Broad-band spectrum Operator [FC]	186
14.6.1.5.	Pseudo Wigner-Ville transform operator.....	187
14.6.1.6.	Morlet wavelet transform operator	187
14.6.1.7.	Autoregressive modelling operator.....	188
14.6.1.8.	Capon transform operator	189
14.6.2.	<i>Operations on Signal data</i>	190
14.6.2.1.	Low-pass filtering Operator [LOW].....	190
14.6.2.2.	High-pass filtering Operator [HIGH]	191
14.6.2.3.	Band-pass Operator [PASS].....	192
14.6.2.4.	Cut-band filtering Operator [CUT].....	193
14.6.2.5.	Notch filtering Operator [NOTCH].....	194
14.6.2.6.	Frequency A-weighting Operator [WEIA]	194
14.6.2.7.	Frequency B-weighting Operator [WEIB].....	194
14.6.2.8.	Frequency C-weighting Operator [WEIC].....	195
14.6.2.9.	Windowing Operator [WIN]	195

Re-sampling operator [SAMPL].....	197
14.6.2.11. Gain optimisation [GAIN]	197
14.6.2.12. Undersampling Operator [DECIM].....	197
14.6.2.13. Denoising operator [DENOIS].....	198
14.6.2.14. Convolution operator	198
14.6.2.15. Envelope operator	199
14.6.2.16. Operator for Tachometric – Speed Profile conversion [RPMTACH]	200
14.6.2.17. Integration / Derivation operator [DIN]	201
14.6.2.18. Statistics operator [STAT]	202
14.6.2.19. Sliding statistics operator [STATGLIS].....	202
14.6.3. <i>Operations on spectra</i>	203
14.6.3.1. Theory	203
14.6.3.2. Frequency recomposition Operator [RECOMPF]	204
14.6.3.3. Time recomposition Operator [RECOMPT]	205
14.6.3.4. Integration / Derivation Operator [FBID].....	206
14.6.3.5. Overall Loudness history Operator [BGLOBAL]	207
14.6.4. <i>Frequency response functions</i>	208
14.6.4.1. Theory	208
14.6.4.2. Cross spectrum G21 Operator [FBG21].....	211
14.6.4.3. Frequency response function H1 Operator [FBH1].....	211
14.6.4.4. Inverse frequency response function 1/H1 Operator [FBIH1].....	211
14.6.4.5. Frequency response cross function H2 Operator [FBH2].....	212
14.6.4.6. Inverse frequency response cross function 1/H2 Operator [FBIH2].....	212
14.6.4.7. Coherence Operator [FBCOH].....	212
14.6.5. <i>Arithmetic operations</i>	213
14.6.5.1. Addition Operator [PLUS]	213
14.6.5.2. Subtraction Operator [MOINS].....	214
14.6.5.3. Averaging Operator [MOY].....	215
14.6.6. <i>Time history of an overall quantity</i>	216
14.6.6.1. Overall level Operator [LEQ].....	217
14.6.6.2. Overall level time history [GLOBAL]	218
14.6.6.3. Overall Loudness level time history Operator [BGLOBAL].....	218
14.6.7. <i>Psychoacoustics</i>	219
14.6.7.1. Bark bands	220
14.6.7.2. Stationary criteria.....	220
14.6.7.3. Psychoacoustic criteria Operator [PSYCHO].....	222
14.6.7.4. Specific Loudness Operator [BARK].....	223
14.6.7.5. Time history of psychoacoustic criteria [PSYEV]	224
14.6.8. <i>Exporting time signals</i>	225
14.6.8.1. Export to MATLAB format Operator [MATLAB].....	225
14.6.8.2. Export to 01dB-Stell WAV format Operator [WAV01DB]	226
14.6.8.3. Export to MP3 format operator [MP3].....	227
14.6.9. <i>Operations on overall levels</i>	228
14.6.9.1. Histogram Operator [HISTO]	228
14.6.9.2. Percentile Operator [Pxx].....	229
14.6.10. <i>Room Acoustics</i>	230
14.6.10.1. Echogram Operator [ECHOG].....	230
14.6.11. <i>MATLAB connection operator [MATCO]</i>	231
14.6.11.1. Use of Communication matlab operator	231
14.6.11.2. Type “SIGNAL”	234
14.6.11.3. Type “GLOBAL”.....	234
14.6.11.4. Type “BROAD BAND SPECTRUM”	235
14.6.11.5. Type “BARK BAND SPECTRUM”	235
14.6.11.6. Type “NARROW BAND SPECTRUM”	236
14.6.11.7. Type “COMPLEX NARROW BAND SPECTRUM”	236
14.6.11.8. Import Matlab results in dBFA32	237
14.6.11.9. Notes.....	237
14.6.12. <i>Tachometry</i>	238
14.6.12.1. Order extraction operator [EXO_0]	238
14.6.12.2. Order/Phase Extraction [OAF_0].....	239
14.6.12.3. Order filtering operator	240
14.6.12.4. Cycle defect operator	240
15. BATCH PROCESSING.....	241
15.1. OVERVIEW	241
15.2. SUMMARY.....	241

15.3.	COMPLETE PROCEDURE	242
16.	REMOTE CONTROLS AND DBFA32	245
16.1.	DEFINITION OF A GENERIC REMOTE CONTROL OBJECT	246
16.1.1.	<i>Selection of a generic remote control</i>	247
16.1.2.	<i>Configuration of a generic remote control</i>	247
16.1.3.	<i>Assignment of input functions</i>	248
16.1.4.	<i>Assignment of output functions</i>	249
16.1.5.	<i>Operating process</i>	250
16.2.	DESCRIPTION OF DBCD32.INI	251
16.3.	COMMUNICATION INTERFACE	252
16.3.1.	<i>For a RS232 9-pin serial port (male connector on the PC)</i>	252
16.3.2.	<i>For SYMPHONIE digital inputs / outputs (female MiniDyn connector)</i>	252
16.4.	REMOTE CONTROL EXAMPLES	253
16.4.1.	<i>Specific remote control of measurement process with a 50AI sound intensity probe</i>	253
16.4.1.1.	Choice and configuration of the remote control object	254
16.4.1.2.	Connection and operating process	254
16.4.2.	<i>2-button, 2-LED remote control for real-time acquisition</i>	255
16.4.2.1.	Choice and configuration of the remote control object	256
16.4.2.2.	Assignments of input and output contacts	256
16.4.2.3.	Connection and operating process	257
16.4.3.	<i>1-button, 2-LED remote control to manually start signal recordings</i>	258
16.4.3.1.	Choice and configuration of the remote control object	259
16.4.3.2.	Assignments of input and output contacts	259
16.4.3.3.	Connection and operating process	260
17.	TROUBLESHOOTING	261
18.	DATAFILE MANAGEMENT IN DBFA32	263
18.1.	IMPORT DATAFILES FROM 16-BIT SOFTWARE	263
18.2.	EXPORTING SIGNAL RECORDS IN WAV FORMAT	264
18.3.	FREQUENCY WEIGHTINGS	264
18.4.	SPECTRAL UNITS / DISPLAY TYPES	265
18.5.	STRUCTURE OF MEASUREMENT SESSION DATA FILES (*.CMG)	266
18.6.	SUMMARY: FILES USED BY DBFA32	268
19.	APPENDICES	271
19.1.	CONVERSION UNITS AND REFERENCES MANAGEMENT (FROM A PHYSICAL UNIT TO A DB LEVEL)	271
19.2.	EDITING OF THE SOFTWARE LICENCE NUMBER	272
19.3.	GENERATING SIGNALS WITH DBGENE32	273
19.3.1.	<i>Presentation of DBGENE32</i>	273
19.3.2.	<i>Generating white noise</i>	274
19.3.3.	<i>Generating pink noise</i>	274
19.3.4.	<i>Generating sine noise</i>	274
19.3.5.	<i>Generating frequency modulation</i>	275
19.3.6.	<i>Generating a *.WAV file</i>	275

1. DESCRIPTION OF A 01dB-STELL PC-BASED MEASUREMENT CHAIN

You have purchased a 01dB-Stell PC-based system to perform sound and vibration analysis. The 01dB-Stell concept is to combine sound and vibration instrumentation with the computational and management facilities of a PC.

For first time users of a PC-based measurement chain, the following chapter describes the concept with respect to environmental noise measurements.



For more general information on the concept of a PC-based measurement system, see the "getting started user manual" delivered with your system.

1.1. Introduction

In recent years, there has been much written and said about the use of personal computers in acoustics and vibrations, both for measurement and results processing. The advances in PCs have been nothing short of phenomenal, driven by the fast moving requirements of information technology in the office environment, and these benefits are starting to filter into our world of acoustics, in the form of more flexible measurement tools.

The pure technologists amongst us would doubtless plunge headlong into building an instrument on a PC, which in principle is not a difficult job, but the resulting system must offer clear benefits to the user before it can be accepted as a true alternative to more dedicated instrumentation.

This is where one of the traditional divides has emerged between instruments and PCs. The stand-alone instrument has always been used to provide the measurements, and the computer has been used simply as a storage device for archiving and displaying results, with simple post-processing functions. The interface between the two has either been in the form of a simple RS-232 serial communication, or via manual entry of results from a paper printout. This latter in particular has been responsible for many errors, with the tedium of copying numbers into a spreadsheet, for example, from a long roll of silver paper!

It is only relatively recently that computers have moved into the measurement arena, supported by the massive increase in available processing power. However, to build a sensible instrument using a PC, we need to consider which processes are better handled by stand-alone hardware, and what can be transferred to the PC environment.

The use of personal computers for acoustical measurement and data processing has been a topic of much discussion, even controversy over recent years. The phenomenal growth in PC technology now offers the benefits of computational speed and flexibility that are being employed in many areas of research and engineering applications.

Traditionally the function of acoustical measurement has belonged to the stand-alone instrument while the computer has carried out the tasks of data storage, display and basic processing. The interface between the two has been either an RS-232 serial communication or manual entry via a keyboard. Human error, excessive time and long rolls of silver paper are just some of the disadvantages of this system.

An attractive solution for the pure technologist is to build a PC-based instrument, though the benefits over the stand-alone instrument should be apparent. Alternatively, the design of an optimum PC-based measurement system will depend on the management of data handling between the dedicated hardware and the PC environment. The possibility of flexible and creative solutions that offer a very high degree of accuracy over a wide range of applications have been sought and developed over the last fifteen years by the team at 01dB-Stell.

1.2. General description

01dB-Stell has developed a modular PC-based measurement chain, similar to that used by traditional stand-alone measurement systems. This generic approach also applies to sound level meters, tape recorders or multi-channel analysers.

First, the **transducer** transforms a physical phenomenon into an electrical input signal. Secondly **the signal-conditioning** block transforms and/or amplifies the input signal for treatment in an acquisition unit. Conditioners require power supply.

The conditioned signal is then fed to a **digital signal acquisition unit**, with some dedicated DSP function performing the actual measurements.

Control of the instrument and output of the results is required. Control is via key commands on a control panel. Results such as a spectrum or time history graphs may also be stored, for example as raw audio data, similar to a DAT recording or as a spectrum memory or set of Ln measurements. Results are then available at the convenience of the user for post-processing operations, such as building acoustics calculations.

Finally, the instrument may have an interface to a computer for further analysis and reporting.

The **personal computer** may be used as a host to a stand-alone instrument. Duplication of function, however, quickly becomes apparent. A PC may handle many internal functions of the dedicated instrument more efficiently. Benefits of the PC include access to greater storage capacity, input/output devices, higher resolution with a Windows™ style graphical interface and general integration with the computer based design environment. The computer may also take responsibility for system control. Note that some existing analysers actually feature an internal x86 PC processor as the system controller!

As graphics, user interface, storage and post-processing are all handled by the PC platform, and the type of measurement performed is defined simply by the application software running on the computer, which sends calls to the hardware resources as necessary.

Application software packages run under Microsoft Windows. These define the nature of the instrument such as environmental noise analyser, a building acoustics analyser, a signal/frequency analyser, etc. To change the instrument, the user simply calls up different software 'modules'.

The **Level of Accuracy** achieved by a Sound Level Meter is determined by its grade, and is regulated by the legal requirements of the Standards IEC651, IEC804, IEC1043 and their national equivalents. Minimum requirements are given in respect of dynamic range, linearity, frequency response and indications.

What is a PC based measuring system? It is a system comprising hardware resources, software modules and a host computer, which must meet the current Standard specifications for its class. The requirements currently reflect the use of dedicated instruments, but until they are revised, the new instruments must still comply.

01dB-Stell is dedicated to the design and development of portable PC based measurement systems that offer a very high degree of accuracy and are intuitive to use in all aspects. Our systems are type 1 approved in several countries. This accuracy rating applies to the use of generic computing hardware, that in practice enables any brand of computer to be used that meets current minimum standards.

1.3. Industrial applications

To perform sound and vibration measurements with a 01dB-Stell PC-based measurement chain, this is the list of the hardware elements required. This list is non-exhaustive and may vary from application to application.

Transducer unit (dual channel measurements in option)

- Type I or Type 2 condenser microphone (pre-polarised, externally polarised)
- Associated preamplifier. It should supply the polarisation voltage for the condenser microphone if required.
- An accelerometer with integrated circuitry for vibration measurements
- A sound intensity probe (with remote control) for sound intensity and sound power measurements.

Accessories

- Windshield to protect the microphone (or an all weather windshield or an outdoors microphone unit).
- Extension cable for connection to the acquisition unit.
- Tripod.
- Measurement case.
- Vibration calibrator
- Type 1 or Type 2 acoustical calibrator to perform calibrated measurements.

Measuring instrument

- Notebook, industrial or desktop computer, that meets the minimum requirements specified by 01dB-Stell, with a Windows 95 or 98 operating system.
- Acquisition unit connected to the Notebook (e.g. SYMPHONIE box).
- dBFA32 acquisition and processing software with optional modules.



The photograph illustrates a field vibration measurement on a rotating shaft in an industrial area with a 01dB-Stell measurement chain.



All these elements can be purchased from 01dB-Stell. Contact your sales' representative for more information.



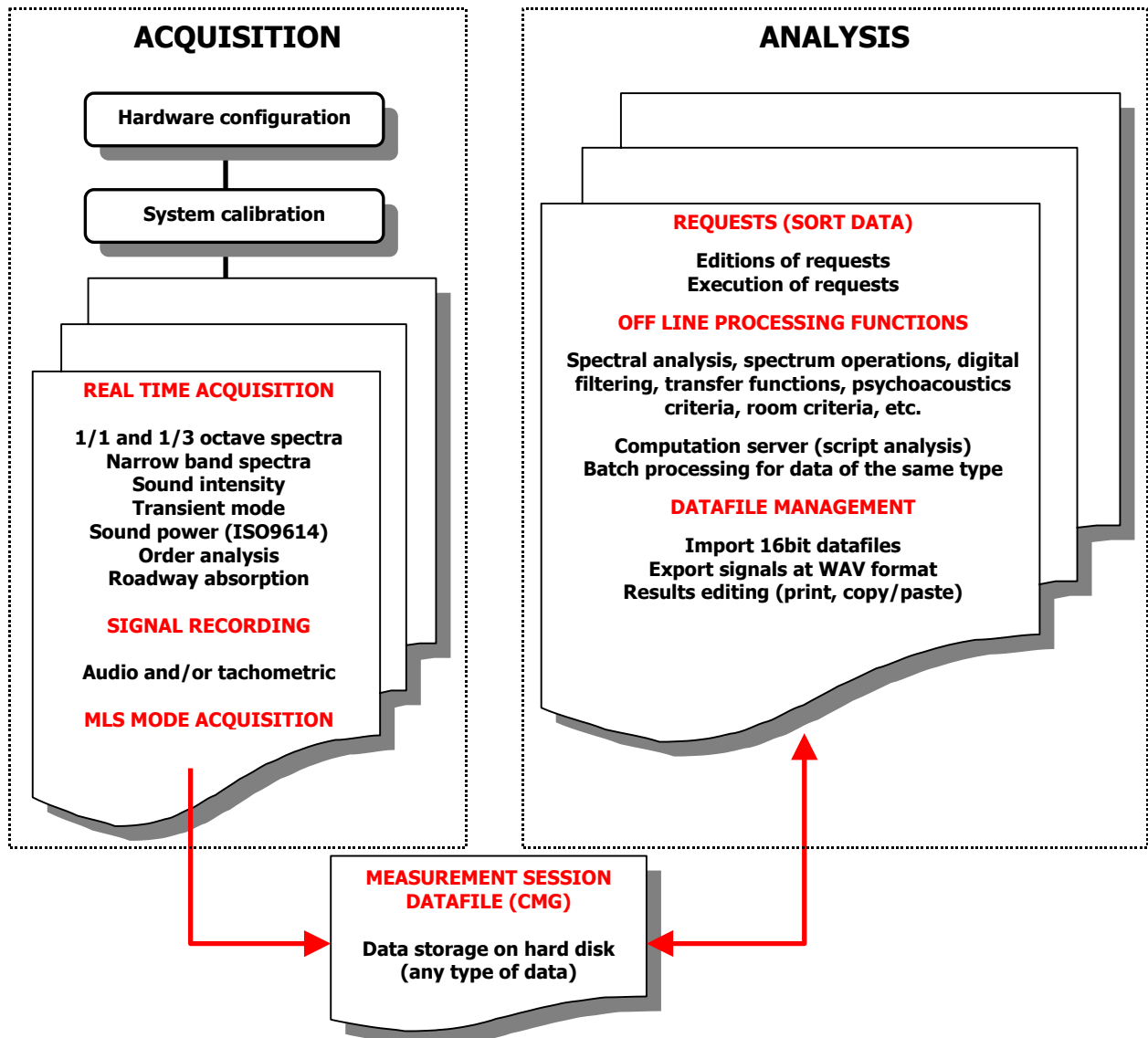
A complete description of how these different elements interconnected is given in the getting started manual delivered with your system.

2. ACQUISITION & ANALYSIS WITH DBFA32

2.1. Overview of the software package: principle of operation

dBFA32 allows the user to perform data acquisition and analysis at the same time. There is a sequence of steps that the user should follow. This will lead not only to successful measurement but also to rapid familiarity with the software.

The flow diagram below describes the overall structure of **dBFA32** software package:



All noise and vibration data acquired, as well as any analysis result, are saved in a database called a measurement session datafile (with a *.CMG extension).

The procedures for each type of measurement, as well as each data processing operation, are described in the following paragraphs. The stages common to each type of measurement are also described.

Each procedure is then described in details in the different chapters of this manual.

2.2. Measuring with dBFA32

Regardless of the type of measurement, the following stages are compulsory to carry out an acquisition with **dBFA32**.

2.2.1. Common steps

These steps have to be taken before each measurement. There are common to all the types of measurement.

Stage 1: Set up of the measurement chain

Connection of the hardware elements, definition of their characteristics in the database utility **dBCONFIG32**, set up of the signal conditioning options of both the transducer and the hardware peripheral.

 *Refer to the installation manual delivered with your system for more details*

Stage 2: Selection of acquisition hardware: one or more transducer / calibrator pair

Choose **Acquisition / Hardware Configuration**. Select the acquisition platform (and associated signal conditioning options), the correct transducer and calibrator pairs, etc. Refer to **chapter 1**.

Stage 3: Calibration

Carry out the calibration of the measurement chain before each measurement (Command **Acquisition / Calibration**). Refer to **chapter 4**.

Stage 4: Choice of the type of measurement

Open a new measurement set-up (Command **Acquisition / New measurement set-up**) or open an existing one (Command **Acquisition / Open measurement set-up**) to perform a real-time acquisition.


The user may choose to perform the following types of real-time acquisition:


- Narrow band spectra (*.REL) – Real Time Mode file. See **Chapter 7**.
- 1/1 or 1/3 octave band spectra (*.ROC) – Octave Real Time Mode file. See **Chapter 8**.
- Sound intensity (*.INT) – Intensimetry Mode file. See **Chapter 9**.
- Transient (*.ATR) – Transient Mode file. See **Chapter 10**.
- Order extraction (*.AOE) – Order Extraction Mode file. See **Chapter 11**.
- Road absorption (*.ARO) – Road Absorption Mode file.
- Sound power (ISO9614) - **File / New / ISO9614 campaign** command.

Measurement configuration contains all the parameters associated with a measurement.

To carry out measurements directly on audio recordings, go into the menu **Acquisition / Record**. The command **Acquisition / Record configuration** allows the user to define parameters relative to the acquisition process. Refer to **chapter 5**.

To carry out measurement using the MLS technique, use the command **Acquisition / MLS acquisition mode**. Refer to **chapter 6**.

 *For audio data acquisition and MLS data acquisition, the command **Acquisition / Gain and threshold** to define the gain level of each active measurement channel as well as threshold triggering conditions to start a measurement.*

 *Sound power determination according to ISO9614 is dealt with in a specific application note available on request.*

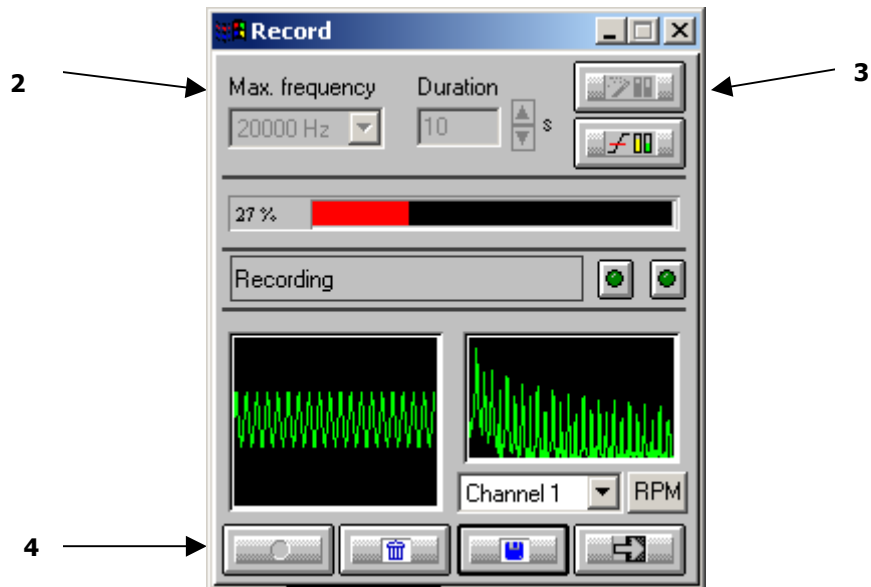
2.2.2. Signal recording (Audio and/or tachometric)

This command (**Acquisition / record**) useful to record audio signals for later frequency analysis. It can be used as a DAT recorder.

The tachometric signal can be recorded in parallel. Consult Paragraph 5.5.2 to know the procedure.

□ Stage 1: Define the acquisition process

In the **Acquisition** menu, select the command **Record configuration** and select the rearming mode: Manual or Automatic (when a threshold trigger is used). Then, use the command **Acquisition / Record**.



□ Stage 2: Acquisition parameters

Define the acquisition frequency range as well as the maximum duration of an audio record.

□ Stage 3: Gain and Threshold settings / Autorange

Select the gain settings command, manual or automatic (autorange).

These commands are used to adjust the dynamic range required for the measurement in order to eliminate surcharge and under loads during recording.

Autorange is used when the sound levels to measure do not vary greatly over the acquisition duration.

Threshold levels are used to automatically trigger a measurement when a threshold sound level is passed (a direction is specified).

□ Stage 4: Recording Audio files

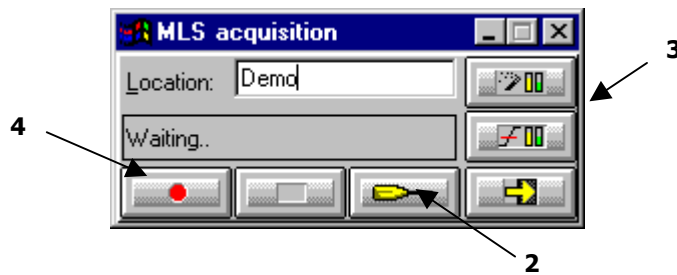
Start the acquisition when the set-up operations have been carried out. Audio data is saved to the computer hard disk in a measurement session datafile (*.CMG).

2.2.3. MLS acquisition mode

Use the command **Acquisition / MLS* acquisition mode** to start a measurement using the MLS technique. The impulse response of a linear system (constant impulse response whatever the level) can be measured. For room acoustics applications, the user can calculate transfer functions or an echogram from this impulse response and thereafter compute room acoustics criteria.

Stage 1: Connection of the measurement system to an amplified loudspeaker to generate the MLS sequence

Connect an amplified loudspeaker to the analogue output of the acquisition unit. The MLS sequence will be generated at the beginning of the acquisition process.



Stage 2: Definition of MLS acquisition parameters

Define the parameters relative to the MLS sequence to generate and the acquisition such as the sequence order, the number of averages, and the acquisition frequency range.

Stage 3: Gain settings

Select the gain setting command (automatic or manual).

These commands are used to adjust the dynamic range required for the measurement in order to eliminate surcharge and under loads during recording.

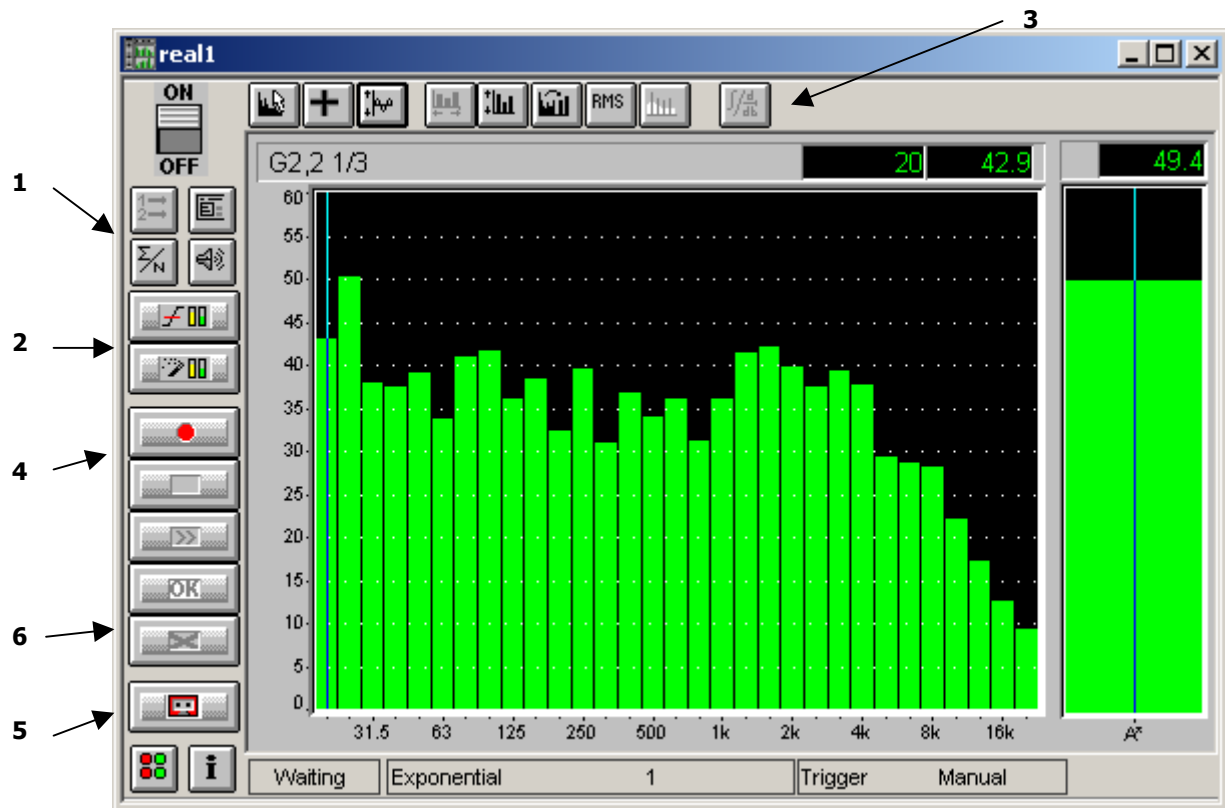
Stage 4: Impulse response recordings

Start the acquisition when the set-up operations have been carried out. Impulse responses are saved to the computer hard disk in a measurement session datafile (*.CMG).

* MLS : Maximum Length Sequence

2.2.4. Real-time acquisition modes

Whatever the type of real-time acquisition used (excluding noise power determination according to ISO9614), the measurement principle is as follows:



Stage 1: Measurement parameter settings

By starting a new measurement, definition of the configuration parameters is required (commands of the menu **Config**). These include for example acquisition parameters, averaging parameters, calculation of cross-functions (between active channels), etc.

As an option, It is possible to define the use of an internal generator by the command **Config / Generator**. The required signal (sinus, white noise, pink noise, and loop) is then played through the analogue output of the acquisition unit.

Another optional module allows the user to perform audio recording in the real-time acquisition mode. The command **Config / Signal** is used to define the signal acquisition parameters.

Stage 2: Setting the dynamic range

In the **Config** menu, select the **Thresholds and Gain** command or alternatively use the associated icon. The gain settings are used to set the dynamic range for the measurement in order to eliminate over or under charge during acquisition.

The Autorange facility is used when the sound level during the measurement is fairly constant. To initiate the autorange use the **Actions / Autorange** command or the function key **F8**.

Threshold levels are used to automatically trigger a measurement when a sound level (the threshold) is passed (a direction is specified).

□ **Stage 3: Setting up the display parameters**

Definition of the display parameters from the **Display** menu (for optimisation of the scale, display of overall levels and / or harmonic cursors, etc.). The colours of the graphs may be edited using **Preferences / Colours**.

Automatically adjust the display dynamic range by using the command **Actions / Autoscale**, the corresponding icon or the function key **F9**.

□ **Stage 4: Starting the measurement**

Start an acquisition using the command **Actions / Start**, the corresponding icon or the function key **F3**.

□ **Stage 5 (option): Signal recording**

Use the command **Actions / Audio**, the corresponding icon or the function key **F12** to start signal acquisition during a real-time acquisition.

□ **Stage 6: Valid, repeat, cancel the measurement**

At the end of each acquisition, the user may choose to valid the measurement result, repeat the current measurement or continue the current measurement using the commands of the **Actions** menu, the corresponding icons of the measurement window or the function keys.

On validation of the measurement results, the data is stored on the computer hard disk in a measurement session file (*.CMG).

2.3. Data processing with dBFA32

Data processing in **dBFA32** can now be performed in a global manner thanks to the implementation of analysis scripts. Each processing operation is available as an **operator**, which assembled in series or in parallel composes an analysis **script**. The scripts available in the application software are regrouped in a **calculation server**, with a user interface to configure and run an off-line analysis.

Using off-line **batch** processing, it is also possible to process a set of data items according to a given analysis script.

We present in the following paragraphs the procedures allowing the user:

- To generally manage measurement session datafiles (open, save, close, print, copy/paste, etc.)
- To sort measurement data items in a measurement session datafile

- To configure processing functions in an analysis script
- To execute an analysis script with the calculation server

- To import 16-bit datafiles (for users of 01dB-Stell PC-based systems with 16-bit version software packages)
- To export audio/signal events at the Microsoft WAV format

- To edit a measurement / test report.

The first action for data analysis is to open an existing measurement session (command **File / Open**) that contains the measurement data items to analyse.

2.3.1. Requests (data sorting)

Measurement session datafiles have a structure similar to databases. As any measurement result is stored into these datafiles, a set of requests functions allow the user to sort the data according to various parameters. One can display, for example, data items of the same family only (signals, narrow band spectra, octaves and third octave spectra, etc.) in the measurement session view.



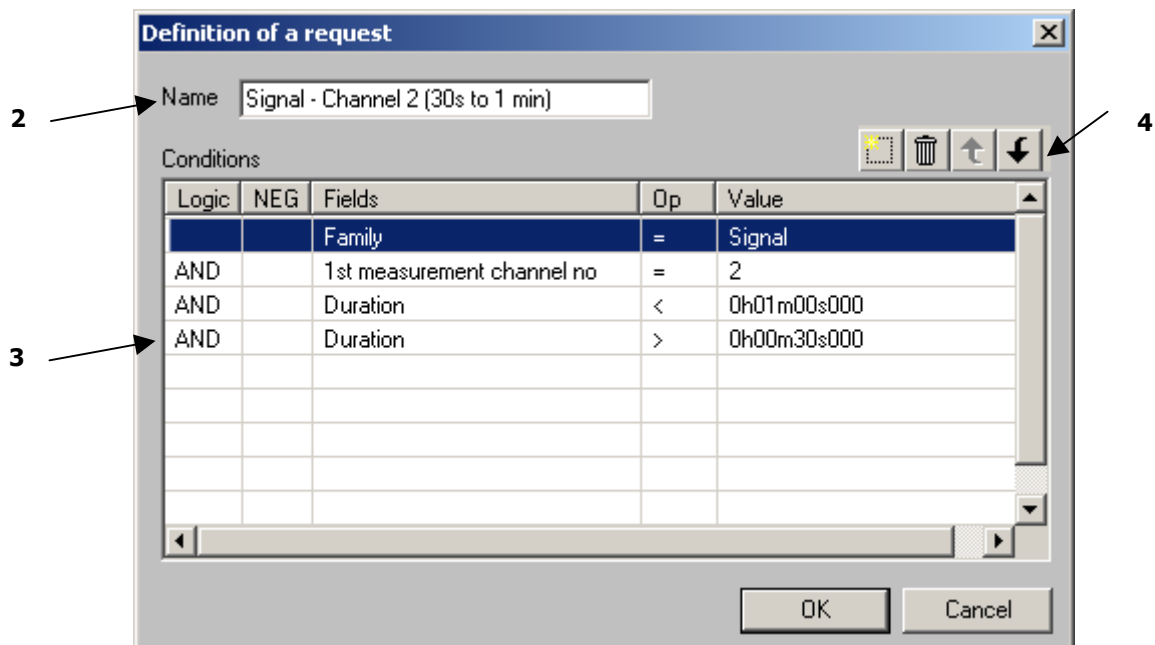
See **chapter 13.6** for more details.

□ Stage 1: Editing of requests

Use the command **Datafile / Edition of requests** to open the dialog box that allows the user to define, edit or remove requests.

dBFA32 manages two types of requests: **local requests**, which apply only to the active measurement session, and **global requests**, which apply to any measurement session.

The procedure to define a request is the same in both cases. Follow the instructions below to **add** a new request or **edit** the current request:



□ Stage 2: Request editing

Give a name to the current request.

□ Stage 3: Define the logical conditions of the request

Define all the required conditions of the request. Start by the **Fields** field: select a given type of information, then its value. If more than condition is defined, select the Boolean operator (AND/OR) that will define the interactions in-between the request conditions.

□ Stage 4: Management of the request conditions

Define the order of the conditions, remove a condition, add a condition, etc.

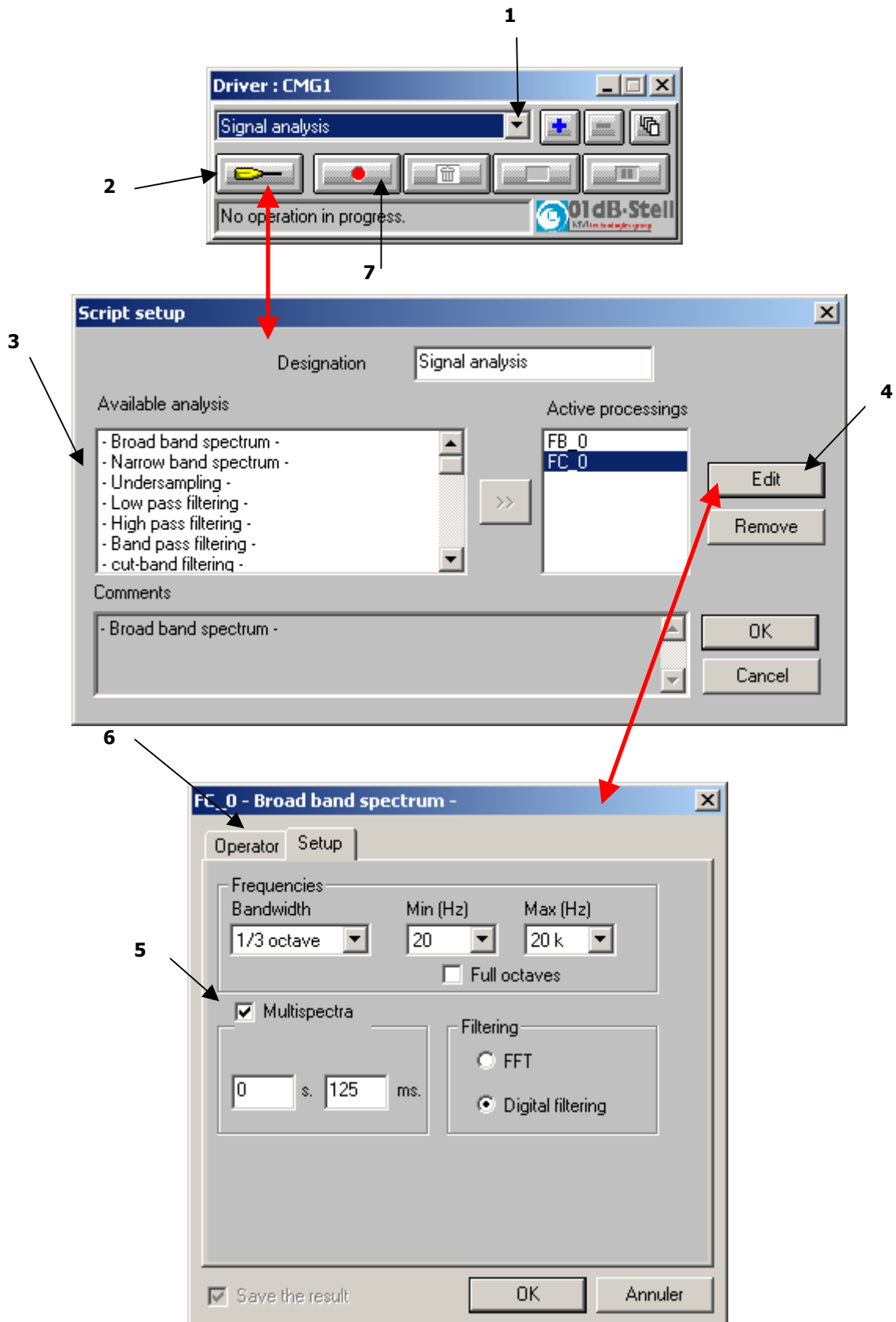
□ Stage 5: Run the request

Use the command **Datafile / Current request** or select the request in the scrolling list of the measurement session toolbar to execute it.

In the above example, after execution of this request, the following data items only will be listed in the measurement session window: audio events acquired on channel 2 of duration ranging from 30 seconds to 1 minute. Signals will then be sorted according to their duration by clicking on the title of the field called "Duration" in the measurement campaign.

2.3.2. Off-line processing analyses

Use the corresponding icon or the command **General / Calculation** server to initiate the calculation server that allows the user to configure and execute an analysis script. The following sketch illustrates the off-line analysis process:



Stage 1: Select an analysis script / script management

Select with the mouse in the measurement session window all the data items to (example: audio records). Then select in the list of the calculation server dialog box a pre-defined analysis script (e.g.: audio analysis), or a user-defined script (that can be created with the corresponding icons).

Stage 2: Edition of the analysis script

Click with the mouse on the corresponding icon to display the script configuration dialog box.

Stage 3: Select the required processing functions

Select in the list of **available processing** functions the different types of analyses required and then pass them into the list of **active processing** functions.

Stage 4: Edit the required processing functions

In the list of **active processing** functions, select the function (or operator) to configure and click on the **Edit** button. Repeat stage 5 and 6 for each active processing function.

Stage 5: Configure the processing function

In the **Configuration** tab, define the analysis parameters.

Stage 6: Additional configuration

In the **Operator** tab, input a user-defined name for the processing function.

Stage 7: Execute the analysis script

Once all set-up operations have been carried out, validate all the dialog boxes and click on the corresponding icon to execute the analysis script.

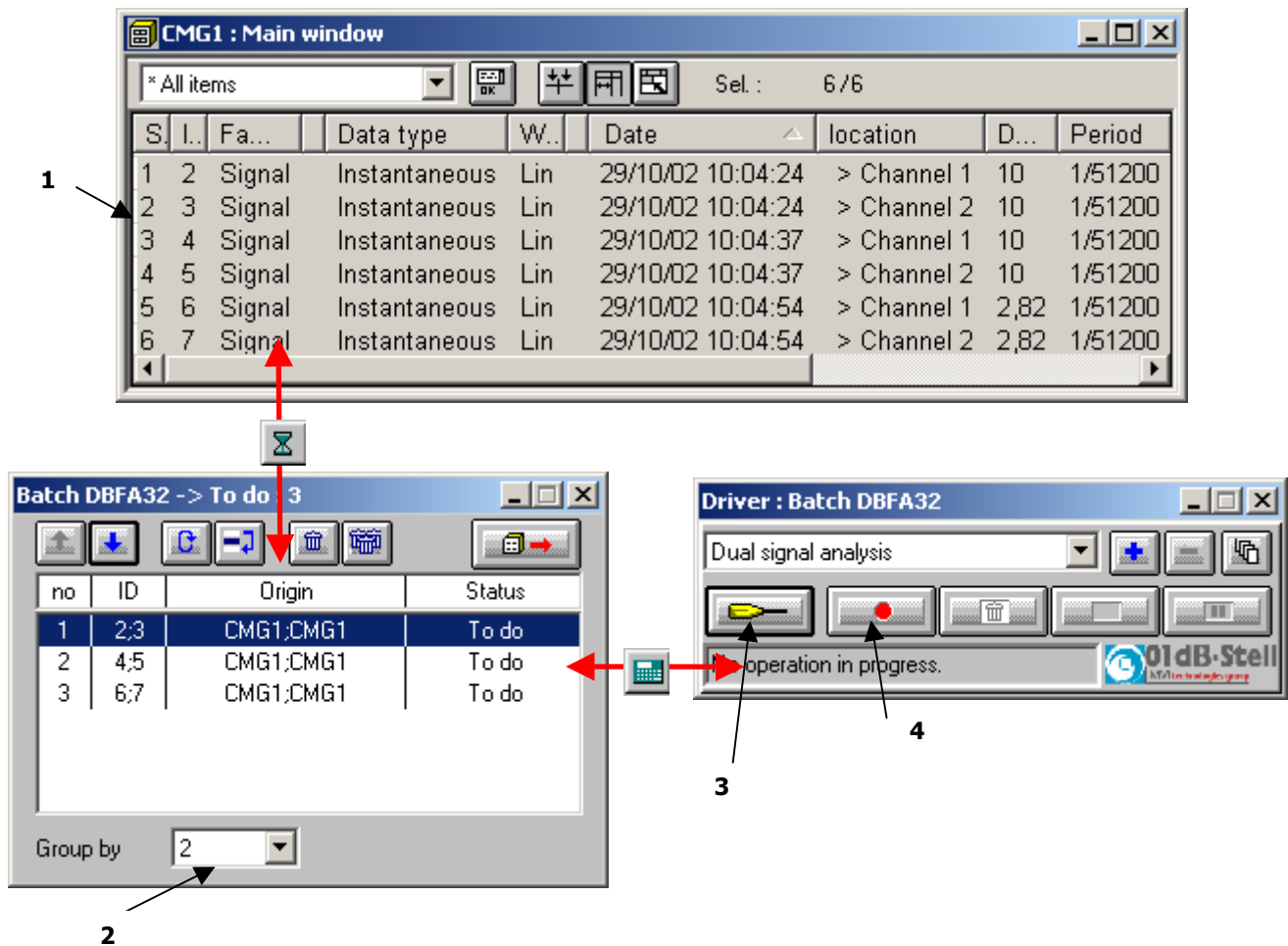
The various processing functions are then executed sequentially for the selected data items in the measurement session window.

The analysis results are then stored themselves in the active measurement session datafile.



*Refer to **chapter 14** for more details on the off-line processing process*

2.3.3. Batch processing



□ Stage 1: Selection of data items

Select with the mouse in the measurement session window all the data items for which a batch analysis will be performed then click on the corresponding icon or use the command **Datafile / Batches** to open the batch processing dialog box

□ Stage 2: Group data items

In the batch dialog box, group data items for the analysis. By default, each item is processed on its own, one after another (Groups of 1 in between X items). However, it is possible to group several data items together in order to perform arithmetic operations (addition, subtraction, averaging) or to calculate a cross-spectrum.


□ Stage 3: Configuration of the batch processing operations

Click on the corresponding icon to display the analysis script configuration dialog box. Refer to **paragraph 2.3.2** for more details on how to configure an analysis script.

⚠ Be careful, the title bar of the calculation server must feature "PILOTE: BATCH FOR..." in order to configure and run an analysis script in the batch mode. If this text is not displayed, click again on the batch dialog box.

□ Stage 4: Execution of the batch processing

Once the set-up operations have been carried out, validate all the dialog boxes and click on the corresponding icon to start the batch analysis. The different processing operations of the analysis script are executed for the data items grouped and locked in the batch dialog box. The analysis results are then stored in the active measurement session datafile.

 Refer to **chapter 15** for more details on the batch analysis process.

2.4. What's new in dBFA32?

In addition to the 32bit operating, compatible with the Windows XP / 2000 / NT / ME / 98 environments of the new 01dB-Stell software, **dBFA32** also includes many functions that did not exist in previous versions.

2.4.1. Versions 4.400

■ Organising campaigns

In order to facilitate the organisation of measurement campaigns, a "drag and drop" tool is now included in dBFA32. You can now move elements from a campaign to another just by dragging them as in Windows Explorer.

■ Editing measurement campaigns

To simplify the processing of measurement campaign, location, comments and date of the elements can now be entered directly by clicking on the area to edit – if the element is selected – without using the Campaign / Modify menu.

■ Printing (see Section 13.7.1)

A series of graphs can now be printed in one click. You just need to select the elements to be printed in the measurement campaign and then select **File / Print selection**. Graphs will be printed using default printing parameters.

■ Exporting spectra and overall levels (see Section 19.1)

The export unit (either physical unit or dB) can now be selected when exporting or cutting/pasting spectra and overall levels. To do so, use the dialog box for unit definition (**Preferences / Unit's management** menu).

■ Order extraction operator with phase calculation (see Section 14.6.12.2)

From a Signal element and a "Tacho" element (resulting from the recording of a tachometric signal on a dynamic channel), the Order/Phase Extraction operator performs an order extraction yielding:

- A multispectrum *versus* speed containing phase information,
- An overall level per order extracted *versus* speed,
- An element containing information on the phase per extracted order.

■ Integration and derivation operator for signals (see Section 14.6.2.17)

This operator is used to integrate and derive signals 1 to 3 times in post-processing.

■ Signal statistics operator (see Sections 14.6.2.18 and 14.6.2.19)

A complete module for statistics calculation on signals has been included into **dBFA32**. It consists of two operators, one yielding overall indices, the other used for sliding statistics. Average, maximum, minimum, standard deviation and Kurtosis are among the many calculated indices.

■ Loudness and Sharpness calculation operator (see Section 14.6.3.5)

From a Bark band multispectrum, this operator generates the time history for the Loudness and the Sharpness. For a Bark band spectrum,, the result is expressed as an overall levels.

■ Operator for calculating Statistical Indices (see Section 14.6.9.2)

The Percentile operator is used to calculate statistical indices corresponding to the level reached or exceeded during x % of the time, over the time history of an overall level. The index can be calculated either over the whole duration of the time history, or over a window size to be defined.

- **Envelope calculation operator** (see **Section 14.6.2.15**)

The Envelope operator is used to calculate either the signal envelope or the analytical signal phase, or its Hilbert transform.

This processing is used to study modulation phenomena, as it detects the modulating frequency, which is often lost in a spectrum of higher energy lines.

In vibration analysis, it is recommended for the diagnosis of bearing defects at an early stage, as well as for the study of mechanical (meshing) or electric (asynchronous motor) modulation phenomena.

- **Shock Analysis mode**

There is now a new acquisition mode in **dBFA32**: the Shock Analysis Mode. As for the Transient mode, it is used to acquire and analyse impulse signals, usually resulting from excitation with an impact hammer. The number of real-time measurement channels is unlimited.

In addition, this acquisition mode allows to store information on the linking when characterising complex systems, and to move on to the next measurements very easily.

- **Order Extraction mode (Real Time and Post-Processing)** - (see **Sections 11.1.22** and **11.2.2.2**)

In the real-time and post-processing order extraction mode, it is now possible to calculate the overall level (Lin or weighted) in a set frequency band, depending on the speed.

- **Real-time tachometer** (see **Section 5.4**)


A tachometric signal recorded on a dynamic channel can be converted into a speed profile in real time and viewed as a meter. This real-time conversion is only available for the Recording mode.

The physical unit of the signal is not necessarily the Volt.

- **Cursors**

Harmonic, sideband and maximum cursors that were only available for average spectra have now been incorporated to multispectra.

Sideband cursors: when searching for sidebands, the value table indicates the dE value between two bands.

When displaying several graphics windows, cursors can be synchronised on several open views provided dates are identical. For instance, when displaying a signal and a multispectrum, if you move the cursor on the signal display, the multispectrum will be displaced at the same time. This function is activated from the Campaign / Time synchronisation menu or by clicking on the  button in the **dBFA32** toolbar.

- **Signal generation using dBGENE32** (see **Section 19.3**)

The new software dBGENE32 is used to generate different types of signals via the sound card of the computer or of the acquisition platform. An amplified loudspeaker or even a shaker can thus be controlled.

dBGENE32 can generate signals of the following type:

- White noise
- Pink noise
- Sine
- Frequency modulation
- Reading of *.WAV files

The possibility to generate a signal on the acquisition platform is only available with Symphonie and Harmonie, and under Windows 98 and Windows Me.

■ **FFT and ESD spectra** (see **Section 13.3.3.2**)

A new spectral unit is included for the representation of FFT spectra: ESD (Energy Spectral Density). DSE is expressed in (Unit² × second / Hz) and represents the power spectral density multiplied by time:

$$\text{ESD} = \text{PSD} \times \text{Observation time}$$



It is the image of the energy contained in a transient signal, which, by definition, is bordered by zero amplitudes.

This type of signal then contains a finite quantity of energy. It cannot be characterised in terms of power, which would depend on the length of the recording.

DES is used for broad band noise measurements or background noise measurements. Indeed, in a power or amplitude spectrum, the noise level each channel depends on the channel width and hence on the spectrum resolution (thus, the background noise level of the spectrum varies according to the selected resolution. Similarly, any effective power or amplitude calculation in a broad band will depend on the resolution).

■ **Graphics windows**

There are two new buttons in the toolbar for viewing spectra and multispectra:

-  is used to show/hide the two cursors on the graph
-  is used to show the overall level between cursors (the second cursor is automatically activated)

For multispectra generated by an order extraction, order cursors can be activated in the sonagram view including corresponding cross sections.

Representation of the phase in the polar view of a complex function may be done in an unwinding fashion so as to clarify the representation when the phase oscillate between 180 and – 180.

Narrow band spectra can be displayed using either a linear or a logarithmic scale for the frequency.

2.4.2. Versions 4.300

■ **Tachometric Conversion operator**

A speed profile can be obtained from the tachometric acquisition carried out with **MELODIE**, **HARMONIE** or **SYMPHONIE** on a dynamic channel. The operator operates in post processing and regardless of the physical unit of the recorded tachometric signal.

■ **Integration/Derivation operator**

This operator is used to integrate or derive 1 to 3 times autospectra, FRF (transfer functions) and cross spectra in post processing mode.

■ **Graphics windows**

Several signals or spectra can now be displayed in the same graphics window.

Time signals cannot be superimposed, however they can be stacked in the same display window, if they have the same time length and the same sampling (starting and ending dates may differ).

Spectra and multispectra with the same resolution and frequency range can be stacked or superimposed (superimposition is possible only if they have the same physical unit).

Spectra and multispectra with different resolution, range and type (FFT, 1/3 octave) can only be stacked. Stacked multispectra have a common scroll bar.

▪ **Cursors**

Cursor synchronisation is possible in graphics windows of time signals, spectra, multispectra, Amplitude/Phase curves, Bode diagrams and sonagrams.

In post processing, harmonic and sideband cursors can be displayed with associated value tables. Values can be interpolated by clicking on an icon of the value table.

Activating the two cursors in a graphics window will give access to the display of DeltaX and DeltaY values.

Automatic detection of the N maximum values with an associated table listing corresponding interpolated amplitudes and frequencies. Parameter setting to indicate the number of peaks to be found and the emergence criterion (X dB with respect to the number of neighbouring lines).

Automatic detection of maximum values with an associated table listing the interpolated amplitude and the corresponding frequency. Parameter setting to indicate the emergence criterion (X dB with respect to the number of neighbouring lines).

Possibility to display the overall level between two user-defined frequencies and between two cursors (limit frequencies included in the calculation).

▪ **New graphic representation**

Display of Lissajous from two signals with the same duration and sampling.

Display of Nyquist/Nichols for complex functions (cross spectra and FRF).

▪ **Acquisition**

Keyboard shortcuts in the signal recording box.

Possibility to set units separately (ADC, dB, physical units) for each channel when setting thresholds and gains.

▪ **Measurement with MELODIE**

Transient analysis on two channels is now available, as well as intensimetry on two channels.

Real-time 1/1 and 1/3 octave measurement, on 10 channels at 20 kHz can be performed using a Pentium III 600 processor (minimum).

▪ **Importation and exportation**

Possibility to import and export in UFF58 file format.

▪ **Corrections**

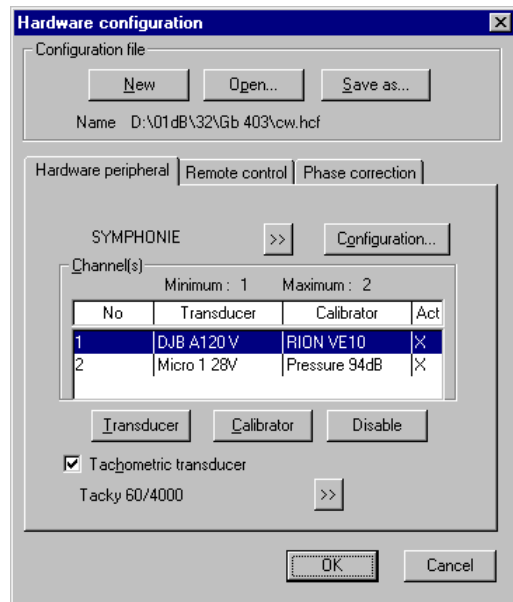
Inversion « Hz – Level » in the display of narrow and broad band spectra.

The sonagram spectrum is now corrected when displayed in full screen mode.

The term "Audio" is replaced with "Signal".

3. MEASUREMENT HARDWARE CONFIGURATION

Hardware specification and settings are required before any measurement. The **Hardware configuration** option is found under the **Acquisition** menu of **dBFA32** main window. This dialog box (see below) features various tabs: **Hardware Peripheral** is used to define which hardware elements are used to perform an acquisition (hardware peripheral, transducers, calibrators, active channels), **Remote control** is used to define and configure a remote control object (this tab is displayed only if the file DBCD32.INI is present in the 01dB-Stell program files directory), **Phase correction** is used to select a sound intensity probe calibration data file (file extension *.AU) and Robot tab is used to configure the use of a rotating arm for example.



From the **hardware peripheral** tab, define:

- The type of hardware platform
- The active measurement channels
- For each channel, a couple transducer / calibrator of same type
- The signal conditioning options of the selected hardware peripheral (**Configuration** key)

The hardware configuration defined here will be recalled automatically next time the program is used.

The acquisition platforms, transducers and calibrators are selected from hardware elements' databases defined under the hardware configuration programme **dBCONFIG32**.

Selection, use and configuration of remote controls are dealt with in **chapter 16**.

■ Hardware

The hardware board configuration sets up the computer so that it will be able to record data generated by the specified board. It sets the number of possible active channels. The Configuration key gives access to signal conditioning options, built-in the hardware unit.

■ Active channels

Among the possible channel(s) available on the acquisition unit, define which channels will be active for both acquisition and calibration.

■ Transducer

The transducer configuration loads the transfer function of the selected transducer and allows the conversion of measured data into an input voltage and the reverse process after data analysis to display the results. A transducer must be prescribed to each active channel.

■ Calibrator

The calibrator configuration allows the user to perform the calibration routine, which adjusts the transfer function of the transducer in order to perform calibrated measurements. A calibrator must be declared for each active channel (except for measurement channels with a voltage-type transducer).

To enable direct power supply of a transducer from a HARMONIE or SYMPHONIE unit or a JAZZ acquisition card, define the same option(s) for the transducer(s) and for the hardware platform (Configuration command) in the dBCONFIG tool.

■ Tachometric transducer

By ticking this box, it is possible to select the transducer to be used to perform tachometric signal recording in **dBFA32**. Refer to **chapter 5.5.2** for more detailed information.

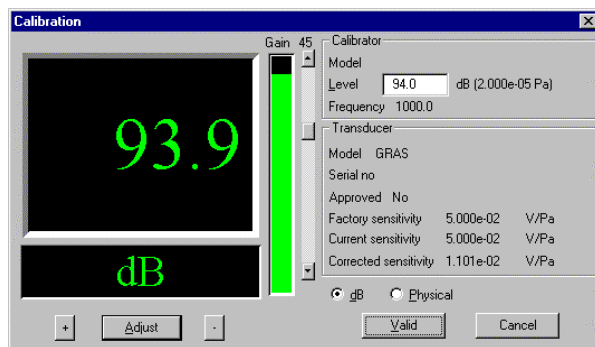
For more information concerning hardware configuration, refer to the getting started manual delivered with your measurement system.

4. MEASUREMENT CHAIN CALIBRATION

Calibration is recommended before every measurement. Calibration guarantees the reliability of the results.

Calibration affects the sensitivity of the selected transducer by adjusting it as a function of measured and expected values (defined by the frequency and level characteristics of the calibrator). The calibrators and transducers are defined by using dBCONFIG32 and they are selected using the **Hardware configuration** command in the **Acquisition** menu.

The current calibration is done using Leq over a 125-millisecond period. It measures the Leq value of the input signal and converts it into the unit set in the transducer's characteristics. By adjusting the level to the expected level, it changes the sensitivity of the transducer. By validating it, the adjusted value will now become the default value for the next time the program is used.



Access **Calibration** via the **Set-up** menu.

The input gain and transducer sensitivity may be calibrated from the control panel. Values may be modified using the "+", "-", and "Adjust" buttons.

Calibration levels can be expressed either in **dB** or in **physical** units.

On validation, the system is ready to carry out calibrated measurements.

Before calibration:

- Verify that the calibration signal remains constant for a sufficiently long period.
- Verify that the gain view meter is correctly positioned (no underload, no overload).
- It is preferable to place the calibrator on foam to reduce the effect of vibrations.

After calibration:

- If, for the same transducer / calibrator pair, the sensitivity after calibration differs greatly from the original sensitivity, damage to the microphone may have occurred.
- If the measured values are not correct but the calibration value is OK, it could mean that the sensitivity of the microphone is correct only at 1 000 Hz. Check the microphone membrane.

A microphone is very fragile equipment. A fall of 10 cm may damage the microphone membrane. As general rule, if the measured value in dB varies by +/- 1.5 dB from the value that would be measured with the microphone according to the original sensitivity (see calibration data sheet), consider your microphone as faulty.

Example: For a microphone that as a factory sensitivity of 50 mV / Pa and a calibrator that delivers 94 dB at 1000 Hz.

The microphone is able to perform correct measurements if:

- The measured calibration level lies between 92.5 dB and 95.5 dB.
- The current microphone sensitivity lies between (around) 40 mV/Pa and 60 mV/Pa (multiply or divide the original value by a factor of 1.1885)

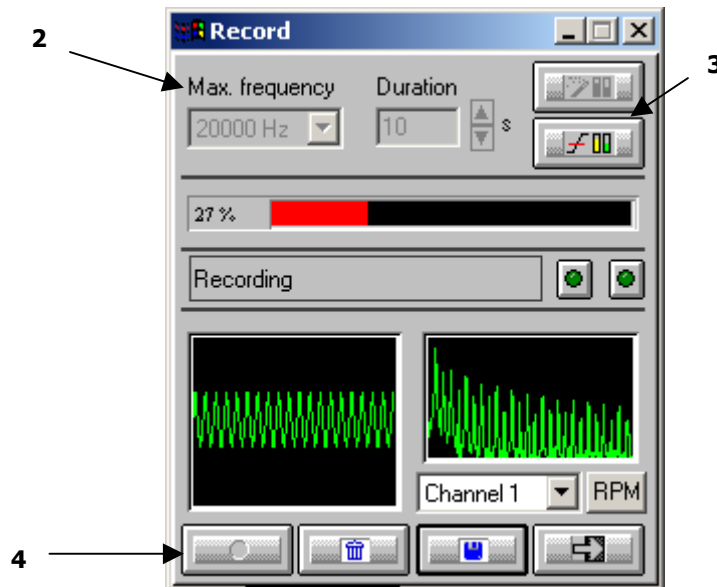
For greater or lower microphone sensitivities, consider the microphone as faulty. Return it to your 01dB-Stell agent

5. SIGNAL ACQUISITION (AUDIO AND TACHOMETRIC)







This command is accessible from the menu **Acquisition / Record**. The user can record audio signals then perform any type of off-line processing operation. This command can be used as a digital tape recorder (DAT). The tachometric signal can be recorded simultaneously. Refer to **Section 5.5** to know the procedure.

5.1. Recording command

The **Record** dialogue box allows the user to define the recording parameters and to carry out an acquisition.



With the following buttons the user can configure and control recordings:

	Start an automatic gain setting (autorange)		Stop the acquisition without saving signal file
	Show gain view meter and set the gains and threshold parameters		Stop recording and save signal file before the end of measurement duration
	Start recording		Exit the signal recording mode

After configuration (see **Chapter 3**) and calibration (see **Chapter 4**) of the measurement chain, the user can follow this procedure to record signals:

Stage 1: Definition of the acquisition mode (see Section 5.3)

Select the **Acquisition / Record configuration** menu and the rearming mode: manual or automatic (recording sequence, works only when using a threshold trigger). Then choose the **Acquisition / Record** command.

Stage 2: Setting up the measurement parameters

Define the following parameters:

■ The acquisition frequency range

Choose the frequency range for the acquisition. This range defines the sampling frequency of the signal file. The relation between the sampling frequency and the pass band is defined by the Shannon theorem.

The list of available frequency ranges depends on the hardware platform.

Harmonie:	20 000 Hz, 10 000 Hz, 5 000 Hz, 2 500 Hz, 1 250 Hz, 625 Hz, 300 Hz, 150 Hz, 80 Hz, 40 Hz
Symphonie:	20 000 Hz, 10 000 Hz, 5 000 Hz, 2 500 Hz, 1 250 Hz, 625 Hz, 300 Hz, 150 Hz, 80 Hz, 40 Hz
Jazz:	20 000 Hz, 10 000 Hz, 5 000 Hz, 1 000 Hz, 500 Hz, 100 Hz, 50 Hz

■ The maximum record duration

Define the duration for audio recording. Use the up/down arrows to increase/reduce the duration of signal recording or input directly the recording duration via keyboard.

The maximum recording duration depends on the available hard disk space and the chosen pass band.

□ Stage 3: Threshold and gain settings / Autorange (see paragraph 5.2)

Select the icon of manual or automatic gain setting (autorange).

These commands are useful to set up the measurement dynamic range, in order to avoid overloads and underloads during recording. The autorange is useful, if the sound level does not vary greatly over the recording duration.

The thresholds allow to start a measurement automatically, if a sound level passes under (or over) the defined threshold.

The user can check with the overload indicators, if a threshold is exceeded (the lamp on the left-hand side becomes yellow, if a threshold is exceeded) or if an overload has occurred (the lamp on the right hand side becomes red in case of overload).

□ Stage 4: Signal recording

Start recording after configuring the parameters. The recordings are saved on the hard disk of the computer in a measurement session file (*.CMG). Use the following commands:



Start recording according to the defined parameters (by using a trigger condition, the acquisition starts only if this one is fulfilled).



Stop recording without saving the audio event.





Stop recording and save signal file before the end of measurement duration.



Exit the signal-recording mode

An indicator of the dialogue box reflects the recording status:

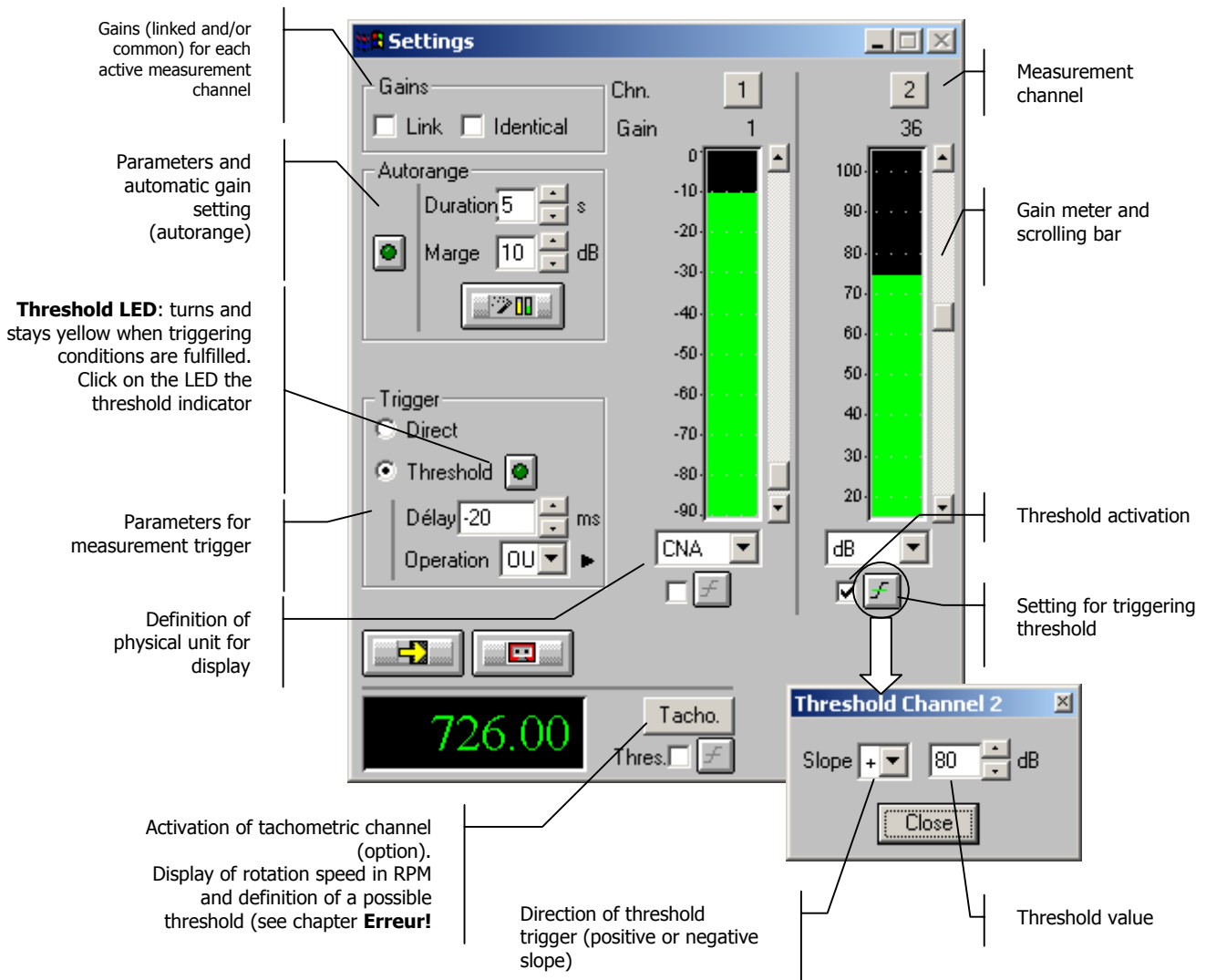
 Ready The programme waits for acquisition start command.

 Waiting for threshold... The recording is activated, but the trigger condition has to be fulfilled for signal recording.

 Recording in progress A recording is in progress.

5.2. Gain and Threshold command


This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange  Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level. The gain view meters may display the input levels according to three different units:

- **dB:** Display the view meters in physical decibel. This is a relative level in dB(dB(Lin)) calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC:** Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit:** Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².



The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).

Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

5.3. Record configuration command

This command allows defining the rearming type after recording a signal.



- **Manual**

The successive recordings are started manually by the user.

- **Automatic**

The successive recordings are started automatically (no user operation is needed).

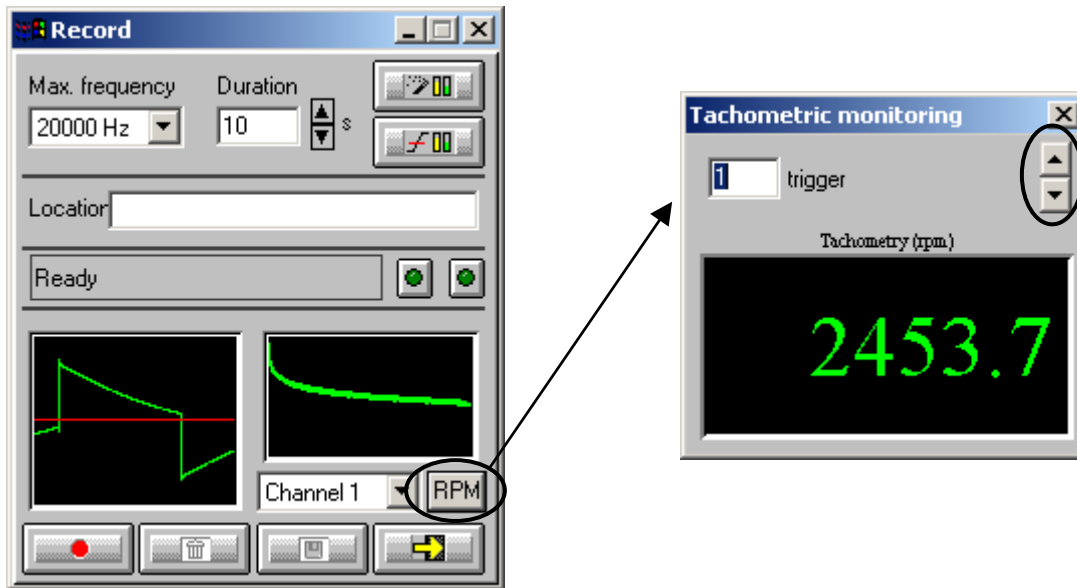
This option is only available in threshold triggering mode. Each time the threshold condition is fulfilled, a recording will be performed.

At the end of each recording, **dBFA32** stores the new item in a measurement session datafile.

5.4. Real-time display of a rotation speed

In the case of a tachometric transducer connected to one of the dynamic channels of the measurement system, the instantaneous rotation speed can be displayed as a meter.

To do so, click on the  button on the Recording dialog box.



Once the meter is displayed, enter the number of impulse and adjust the triggering threshold using the arrows (this threshold is displayed as a red line on the signal view).

 This meter can be activated regardless of the signal physical unit.

5.5. Tachometric measurements

5.5.1. Generalities

Measuring the tachometric signal is used to defined the status of a rotating machine by giving its rotation speed versus time.

These tachometric measurements carried out simultaneously with the signal acquisition on one or several channels allow for the sound and vibration characterisation of a machine according to its rotation speed. One of the main interests is to carry out signal recording operations when rotation speed conditions are fulfilled. Thus, signal storage will be performed only over time periods of interest.

In case of an acquisition with **SYMPHONIE**, **dBFA32** allows for the use of the dynamic input Mini DYN (PS/2) on the acquisition unit to perform these measurements.

dBFA32 uses then parallel measurement functions to acquire up to 3 signals simultaneously with **SYMPHONIE** and up to 5 signals with **HARMONIE** (sound or vibration signals from the 2 or 4 LEMO input plus the signal from the digital input).

5.5.2. Tachometric measurements in dBFA32

5.5.2.1. Transducer definition

In order to use the tachometric option in **dBFA32**, the user has to define at least one tachometric transducer in the hardware database using **DBCFIG32**

The **maximal rotating speed** of the used transducer defines a measurement range of the tachometric signal which precision is better than 0.02 % of the full-scale value.

The precision is no longer assured outside of these limits of 0.02 %.

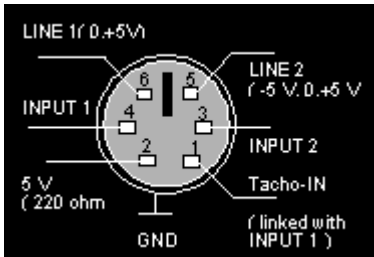
Example: For a transducer with a maximal rotation of 5000 rpm the measurement will be specified at 1 turn for the rotating speed between 0 and 5000 rpm.

 Refer to the online help of **dBCONFIG32** for more information.

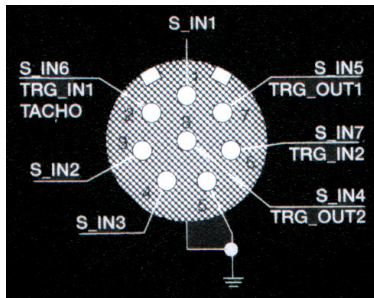
5.5.2.2. Transducer connection / Acquisition box

Connect the output cable of the tachometric transducer (optical cell, magnetic transducer) to the tachometric input of the acquisition box.

The transducer signal has to be of type TTL 0-5 V.

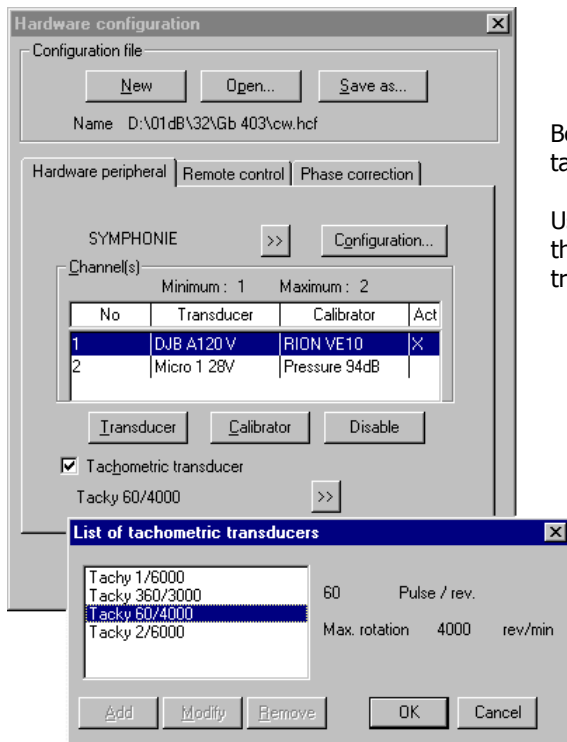


For **SYMPHONIE**, the digital input/output (Mini DIN PS/2 format) and wiring Symphonie shown opposite are used.



For **HARMONIE**, the input/output port (Lemo 8 format) with the wiring shown opposite us used.

5.5.2.3. Hardware configuration in dBFA32



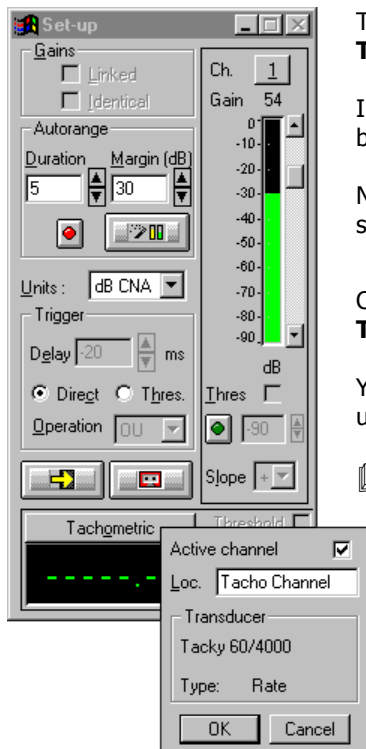
Before launching the measurement session, first select the tachometric transducer used for the acquisition.

Use the **Acquisition / Hardware configuration** command, then select a transducer among the list of tachometric transducers (see opposite).

Transducer options (number of impulse per round and maximum rotation speed) are displayed when a transducer is selected.

See chapter 3 for more information on **dBFA32** hardware configuration.

5.5.2.4. Activation of the tachometric channel



To activate the tachometric measurement channel use the option **Acquisition - Threshold and Gains** to display the dialogue box mentioned below.

In addition to the set-up options of "classical" gains and thresholds, the dialogue box displays a tachometric frame at the bottom of the window.

No tachometric transducer has been defined in the Hardware configuration, if the set-up window does not appear.

Click on the button **Tachometric** to display the channel options. **Then tick the channel activation box.**

You can also define the measurement location for this channel and display the used transducer name.

Refer to **paragraph 5.2** for more information about Gain and threshold box.

The inner window frame now displays the rotating speed in rpm.



5.5.2.5. Tachometric threshold trigger definition (optional)

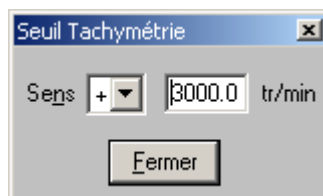
It may be interesting to start a signal recording when a predefined tachometric condition is fulfilled.



To do so, **tick the "Threshold" box** in the trigger section of the set-up window. *All settings made here are valid for tachometric **and** for audio records (according to the activation of each of these channels).*



Then tick the **threshold box** in the "Tachometric" section, enter the **threshold value** in rpm, then the sign of the **trigger slope** (+ or -) by clicking on the **f** button.



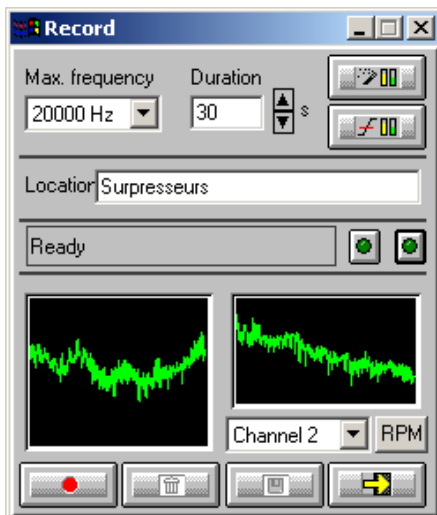
The tachometric threshold is active.

Several trigger thresholds are needed in certain cases (example: if activating the signal recording when a machine exceeds 3000 rpm or emits more than 90 dB).


The AND/OR operator determining the start of record operates as mentioned in the following table:


Operator functioning AND/OR according to the defined thresholds	
Threshold defined on...	Operator action field
...the tachometric channel only	No use
...an dynamic channel only	No use
...several dynamic channels	See paragraph 5.2
...one audio channel + tachometric channel	The operator starts the measurement on an audio AND / OR tachometric condition.
...several audio channels + tachometric channel	OR: The operator starts the measurement when one of the defined conditions is fulfilled (audio or tachometric independently). AND: The operator starts the measurement when all defined conditions are fulfilled (on audio as well as on tachometric).

5.5.2.6. Start the tachometric recording



The tachometric channel and trigger thresholds are now active.

Use the  button to open the **signal recording** window shown opposite.

Use the  button to start storing (like for a mere signal recording).

On the opposite you see a recording of **rotation speed versus time**, in addition to signal recordings, according to the active channels.

The recording of the tachometric signal record is always carried out alongside with at least on signal recording.

 Refer to **Section 5.1** for more information on the Signal Recording window.

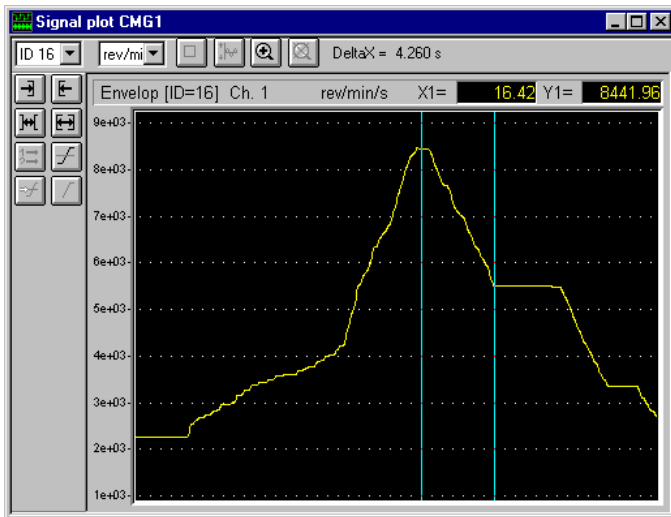
The bandwidth selection is taken into account for tachometric measurements.
 The bandwidth is only active for performed signal recordings.
 In fact, **tachometric measurements always give a rotation speed value every 20 ms.**

5.5.2.7. Results

At the end of the recording time, the tachometric measurement with one ore several parallel signal recordings will be transferred to a measurement session file.

Family	Date	1st channel location	Duration	Period	Y axis	Ch...
Audio	14/10/99 11:33:37	Gearing > Channel 1	30.000	1/25600	Pa	1
Counter	14/10/99 11:33:37	Gearing > Channel Tachometric	30.000	1/50	rew/min	1

The Counter line corresponds to the tachometric measurement, i.e., to the rotation speed values every 20 ms during the measurement duration.

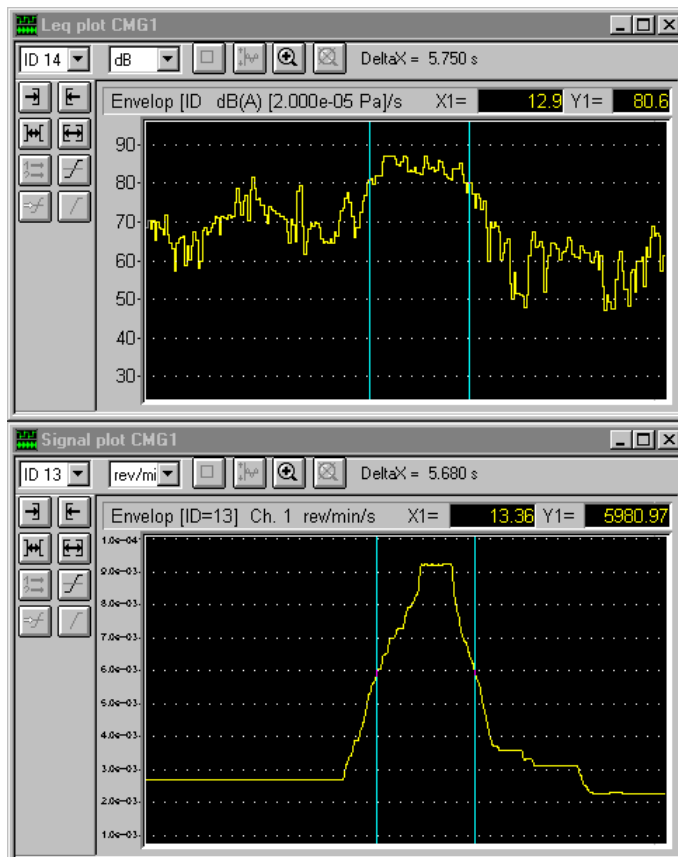


Display this history graph by double clicking on the Counter line (or using the **Datafile / Plot** command).

History of rotation speed (in rpm) versus time.

5.5.2.8. Exploitation example

Once the recording of tachometric signal is completed, this signal can be compared in screen with the recorded signal.



In the opposite example, an "Overall level" was first performed on the Signal item. Then the history of the overall levels displayed in dB(A) along with the history of the tachometric signal.

One can notice that the zone where the machine has been most noisy (level > 70 dB) corresponds to the fast rotation zone of the machine (between cursors).

6. MLS ACQUISITION MODE

6.1. Introduction

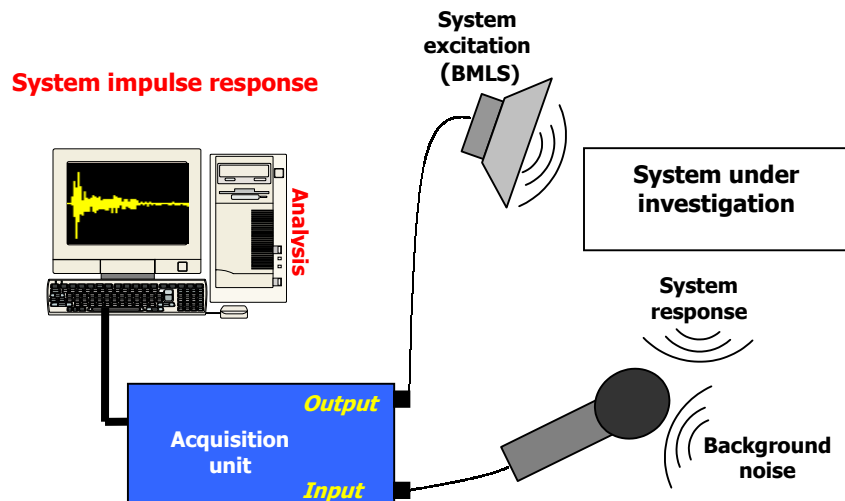
The acquisition in **MLS mode (Maximum Length Sequence)** is used for measurements of the impulse response of a given 'system'.

It is based on the emission of a Binary Maximum Length Sequence (**BMLS**). This sequence is a binary pseudo-random sequence of period $2^L - 1$ where L is the sequence order, defined in the parameters of the MLS acquisition dialogue box.

The system is excited by the BMLS. We measure the response of this system with a microphone, and we obtain by input/output inter-correlation the impulse response of the system.

The use of BMLS as emission signal allows the use of fast calculation methods, in order to evaluate the signal inter-correlation (Hadamard transform). The MLS module allows the user also to average several emissions/receptions, in order to obtain results with the best signal to noise ratio.

The MLS is therefore an efficient measurement technique in noisy environments that works without a powerful noise source and that allows to obtain results more accurate than traditional methods.



The MLS method is above all used for calculation of transfer functions for industrial applications and to obtain echograms in room acoustics.

6.2. Acquisition set-up and parameters

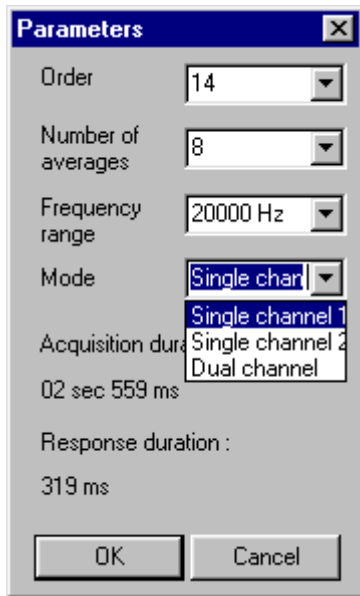
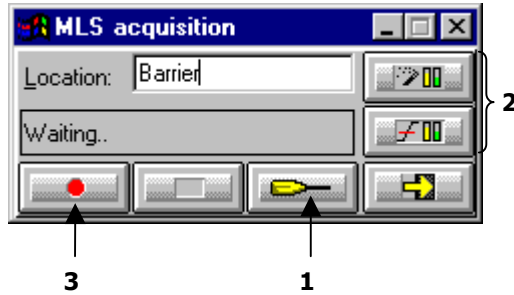
Several stages are necessary to carry out an acquisition in MLS mode. In the following, we describe these different stages:


6.2.1. Connection of the measurement chain elements

As shown in the diagram shown above, the user has to connect one (or several) microphone(s) to input channel(s) of the hardware platform for impulse response measurements and to connect an amplified loudspeaker to the output of the hardware platform, in order to generate the BMLS.

6.2.2. Acquisition parameters

After hardware configuration (see **Chapter 3**), use the command **Acquisition / MLS acquisition mode**. The following dialogue box appears on the screen.



① Click at first on the icon  to define the acquisition parameters in MLS mode, in order to obtain the best impulse response of the system. The dialogue box opposite appears on the screen.

The following parameters have to be defined:

- **Order**
Define the order of the emitted MLS. The higher this sequence order, the better noise removal in the response and the longer the response duration.
- **Number of averages (1 to 2048)**
The sequence (BMLS) is generated as many times as required. The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases.

 *Note: The dynamic increases by 3 dB when doubling the number of averages.*

▪ **Frequency range**

Choose the frequency range for the acquisition. With **SYMPHONIE** and **HARMONIE**, the available bandwidths are: 20 000 Hz, 10 000 Hz, 5 000 Hz, 2 500 Hz, 1 250 Hz, 625 Hz, 300 Hz, 150 Hz, 80 Hz, 40 Hz.

The selected bandwidth (BP) determines the sampling frequency (Fs) to use according to the Shannon theorem:
Fs = BP x 2.56 (for Symphonie).


▪ **Mode**

Choose here the acquisition mode: single channel 1, single channel 2 or dual-channel.

The response duration is equal to: **d = (2^L - 1) / Fs**.

With L : sequence order (selected previously) and Fs: Sampling frequency (depends on the pass band)

The acquisition duration is equal to: **(response duration d) * (number of averages)**.

 *The response duration (that depends on the order on the pass band) should be carefully chosen. It should be adapted to the geometry of the room.*

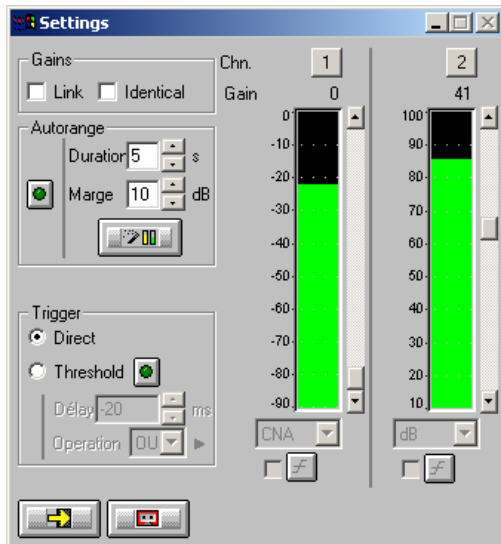
2 After set-up of the acquisition parameters in MLS mode, you must determine the measurement dynamic range, in order to avoid overloads or underloads during acquisition.



: **Manual setting** (see dialogue box below).



: **Automatic setting** - Direct access to Autorange command.



■ **Gains**

When the option **Linked** is active, the gains of all active measurement channels are modified: The gain setting of one active channel leads to identical modifications on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

■ **Autorange**



Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) under the maximum measured value.

- **Units: Definition of the display unit for the input level.** The gain view meters may display the input levels according to three different units:
 - **dB:** Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
 - **ADC:** Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
 - **Unit:** Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².



*The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).*

■ **Channels**

The gain setting scrolling bars allow the user to adjust the gains of active measurement channels manually. Click on the arrows, in order to increase or decrease the gain in steps of 1 dB. Click in between the arrows and the cursor and increase or decrease the gains in 10 dB steps.



Threshold triggering is disabled, because the acquisition in MLS mode does not use automatic threshold trigger like signal recordings for example.

6.3. Run an acquisition

After set-up of all acquisition parameters, define a **name** (or equivalent) of the recording. This will be used later in the field "Location" of the measurement session.

Use the following icons to carry out an acquisition in MLS mode:



Start recording of the impulse response with defined parameters.



Stop the active recording without validation, and restore the acquisition dialogue box in MLS mode.



Close the dialogue box of the acquisition in MLS mode and saves the current acquisition parameters as default values for the next acquisition in this module.

During acquisition, a recording progress indicator appears displaying the status of the measurement. An acquisition example is given below:



An overload can occur, if a strong parasite noise comes up during recording or if the input gain is too high. If an overload has been detected, the current recording stops and the result is not saved.

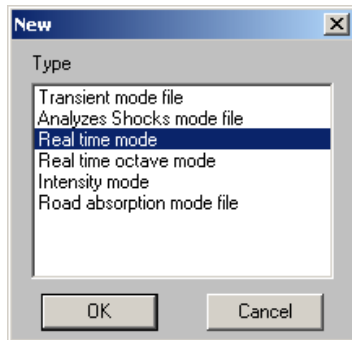
The impulse response will be saved on the hard disk at the end of acquisition. It builds up a new item of a measurement session (*.CMG) and **dbFA32** should know in which measurement session it will place the new item. If several measurement sessions are opened, a dialogue box is shown to select the session in which the item will be saved.

7. REAL-TIME ACQUISITION (NARROW-BAND ANALYSIS)

dBFA32 can be used to perform real-time acquisition of narrow band spectra using FFT analysis (from 101 lines to 801 lines) with different FFT windows (Rectangular, Hanning, Hamming, Flat Top, etc.) as well as a zoom factor.

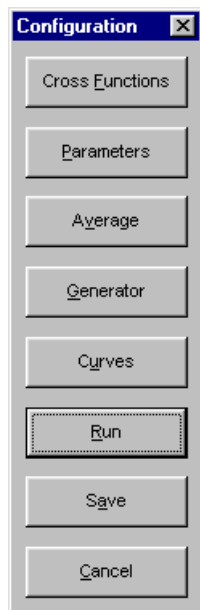
When performing dual-channel measurements, cross-spectra, transfer functions and coherence can be computed in real-time. The data can be displayed either in polar form (modulus and phase) or complex form (real and imaginary parts).

An internal signal generator can be used as an option to generate a white noise, a pink noise, a sinus or a loop signal through an amplified loudspeaker. Signal recording can also be performed in the real-time acquisition mode.



Use the command **Acquisition / New measurement set-up** to start a new measurement. The dialogue box shown opposite appears on screen.

Select **Real time mode** for measurements of spectra in narrow bands, then click on **OK**.



The dialogue box shown opposite appears on-screen after creation a new real time measurement mode. The user can define the main acquisition parameters before starting the measurement itself.

Following steps may be done:

- Activate calculation of **cross functions** between active channels (if possible).
- Define the acquisition **parameters**: frequency range, resolution, quantities to store, etc.
- Define the **averaging** parameters: type of averaging, averaging duration.
- Activate or disable the internal noise **generator** (white, pink, sinus, loop) (option).
- Define the **curves** to be displayed in the measurement window.
- **Run** the measurement. The real time measurement window appears on-screen.
- **Save** the measurement configuration. All the parameters of the measurements are saved in a configuration file with the extension *.REL for narrow band analysis.

The user may use this configuration again for other measurement sessions with the same parameters (command **Acquisition / Open a measurement set-up**).

The real time measurement window appears after setting up all parameters. Each function is now accessible from the measurement window toolbars.

7.1. Measurement window overview

An example of a real time narrow band measurement window is given below:

Display parameter toolbar: curves to display, overall levels, spectral units, harmonic cursors, etc.

Command toolbar: acquisition parameters, averaging parameters, gains, threshold, start, stop measuring, etc.

Display acquired data with cursor values and references.

Status bar: state and information about the acquisition process

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

- | | | | |
|--|--|--|--|
| | Enable/disable cross function computation | | Stop the acquisition |
| | Define acquisition parameters | | Continue the acquisition |
| | Define averaging mode and attributes | | Validate current results |
| | Internal signal generator (option) | | Cancel current results and start again |
| | Define gain and threshold parameters | | Start audio record (option) |
| | Perform an automatic gain adjustment (autorange) | | Show/hide overload bar |
| | Start acquisition | | Show/hide information table |


The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

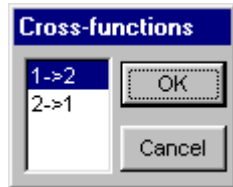
- | | | | |
|--|---|--|--|
| | Select curves to display | | Select overall levels to display |
| | Select curve layout type | | Select spectral units display |
| | Perform a Y-axis autoscale for all curves | | Harmonic cursor parameters |
| | Define Y-axis parameters | | Integration / Differentiation of displayed spectra |

7.2. Measurement set-up

All the functions described below are accessible from the command toolbar of the measurement window.


7.2.1. Cross-functions

Use the command  **Config / Cross function** to define the acquisition of cross spectra and transfer functions between active measurement channels. The following dialogue box appears.




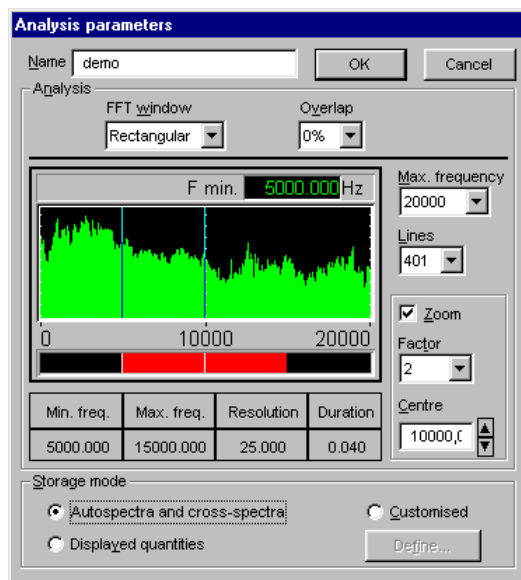
This dialogue box allows the user to activate (or not) the calculation of cross functions during acquisition and gives access to the transfer functions (H1, H2, 1/H1, 1/H2 and coherence).

For example, the options **1->2** and **2->1** activate respectively the cross function calculation from channel 1 to channel 2 and from channel 2 to channel 1.

 *The access to the different transfer functions is not possible if cross functions are not activated.*

7.2.2. Acquisition parameters

Use the command  **Config / Parameters** to define general acquisition parameters. The dialogue box shown below appears on the screen. The following parameters may be defined:



- **Name**
Input a measurement identifier. This field is compulsory. This identifier appears in the field "Location" of the measurement session.
- **FFT Window**
Choose the FFT window for the analysis. The following windows are available: **Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.**
- **Overlap**
Choose the overlap factor for the analysis amongst the following quantities: **0, 25%, 50% and 75%.** These factors depend on the hardware platform possibilities and the chosen bandwidth.
- **Max. frequency:** Select the maximum frequency of the analysis.
The pass band defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies. This list depends on the used hardware platform.

20000	300
10000	250
5000	200
2500	150
2000	125
1250	100
1000	80
800	64
625	50
500	40
400	32
	25

The command **Actions - Signal recording** allows the user to perform signal recording in real-time, simultaneously to the FFT analysis (see **paragraph 7.4**).

The pass bands are however less numerous than for the real-time analysis.

Therefore, when a signal recording is acquired in this analysis mode, the pass band that is used is adjusted to the closest maximum frequency available.

For example, if an acquisition is performed with a bandwidth of 1000 Hz, the maximum frequency of the signal recording will be 1250 Hz (closest frequency range).

If the user wishes to process signal records and spectra (from the real-time mode) with the same **frequency resolution**, it is required to select bandwidths that are available for both modes. The common maximum frequency ranges are highlighted in the table show opposite.

▪ Lines

Select the number of lines for the FFT analysis amongst the values displayed in the list. This list depends on the used hardware platform. The higher the number of lines the higher the frequency resolution.

▪ FFT zoom

This group allows the user to define the parameters of a FFT zoom. The zoom allows the user to reduce the frequency range of analysis around a centre frequency and thereby increase the frequency resolution.

Select **Zoom**, in order to activate the FFT zoom option. Then choose the **centre frequency** and the **zoom factor**.

The curve on the left-hand side informs the user about the chosen parameters. The red information bar (lower part) indicates the analysis frequency range while the spectrum the chosen frequency resolution.

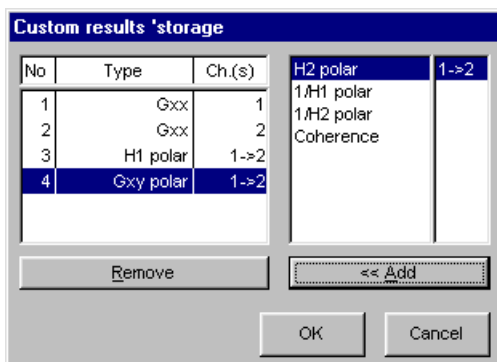
To modify the centre frequency or the minimum frequency (when the Zoom option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the zoom factor and the centre frequency in the right part of the dialogue box.

▪ Storage modes

Choose **Autospectra and cross-spectra** in order to save (after starting the measurement) the auto spectra and if required the cross spectra. This storage mode allows to later recompute quantities such as transfer functions.

Choose **Displayed quantities** in order to save (after starting the measurement) only the spectra that are displayed in the real time measurement window.

Choose **Customise**, in order to carry out a custom data storage. The programme stores the curves accessible for the current operating mode. To define the quantities to store, click on the **Define** button. The dialogue box **custom results' storage** appears on-screen.



The list on the right indicates the different spectra types and its channel references that may be stored.

The list on the left indicates the different spectra types that will be stored after validation of the measurement results.

The transfer functions are only accessible if cross function computation is activated.

Reminder

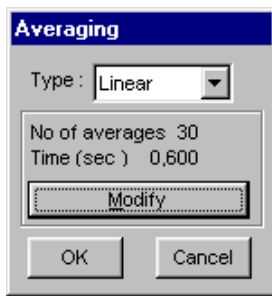
Gxx : Autospectra


Gxy : Cross spectra

H1, H2, 1/H1, 1/H2 and coherence : transfer functions and coherence.

To activate data storage of a given spectrum, select its type and the reference channels. Then use the command **Add**, in order to add the spectra to the storage list (left hand side). The user can also carry out this action by double clicking on its representation in the right hand side list.

7.2.3. Averaging parameters



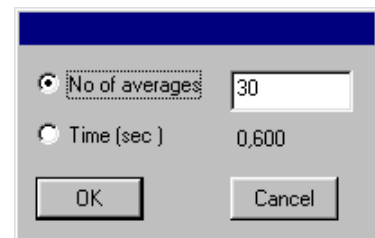
Use the  **Config / Average** command to define the averaging parameters of the measurement. The dialogue box shown opposite appears on screen.

This dialogue box allows the user to modify the type of averaging and the number of averages or the measurement duration.


There are 3 main types of averaging:

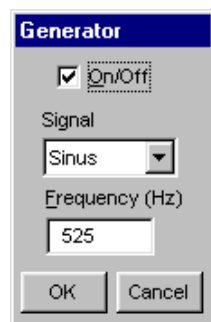
- **Linear:** This averaging mode gives the same weighting to all samples, which means a linear average on N samples that stops as far as the Nth sample is reached.
- **Exponential:** This averaging mode gives the highest weighting to the last reached sample and reduce progressively the influence of the previous samples. An exponential average does not stop.
- **Maximum:** This averaging mode keeps, on an analysis of N samples, the spectrum that present the highest power spectral density (PSD).

In this dialogue box, the user can **modify** the number of average to take into account and the averaging duration. These two parameters are linked by the general acquisition parameters (number of lines, bandwidth).



7.2.4. Internal signal generator (option)

Use the  **Config / Generator** command to define and activate the internal signal generator. The following dialogue box appears on screen.





Using **dBFA32** with the **SYMPHONIE** or **HARMONIE** hardware platforms, a **white noise, pink noise, a sinus** signal (whose **frequency** we define) can be generated.


Choose the option **Loop** to loop the input signal on the output of the hardware platform.

The generator is active when the box **On/Off** is activated.

Then connect an amplified loudspeaker to the output of the acquisition unit.

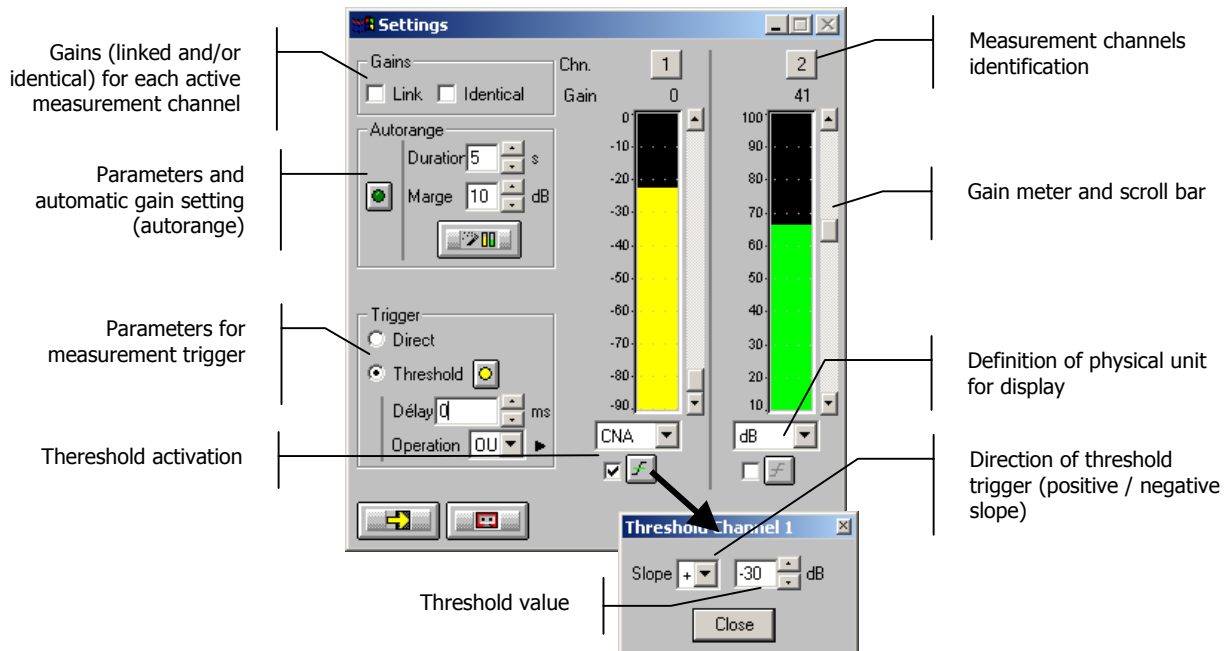
With **SYMPHONIE**, the signal output level can be set by clicking on the  icon, in Windows taskbar. Select the acquisition platform and click on **Properties** to set the output level of **SYMPHONIE (Attenuation setting (dB))** field).

If using the older generation of the **SYMPHONIE** or **HARMONIE** driver, the signal output level can be set with the  **Symphonie : 00066** driver icon in Windows 98 or ME taskbar. Click on this icon with the right button of the mouse to display the contextual menu. Select the **Configuration** field and set the output level of **SYMPHONIE** and **HARMONIE (Output level)** field).

 *For more information on the acquisition system (for instance, output wiring, setting of output volume), please refer to the system installation manual.*

7.2.5. Threshold, gain and autorange settings

This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange

Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level.

The gain view meters may display the input levels according to three different units:

- **dB:** Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC:** Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit:** Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².



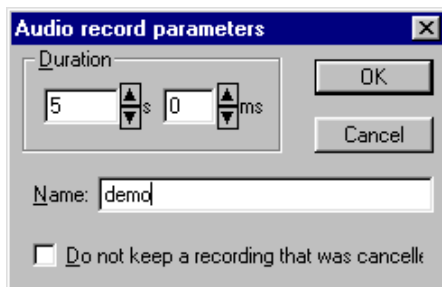
*The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).*

Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

7.2.6. Signal acquisition (option)

Use the command **Config / Signal** to define the signal recording parameters. The following dialogue box appears on screen.




- Record **duration** in seconds and milliseconds
- **Name** (or equivalent) that identifies the signal item in the measurement session (field "Location")
- Keep or not a signal in case of a cancelled recording.

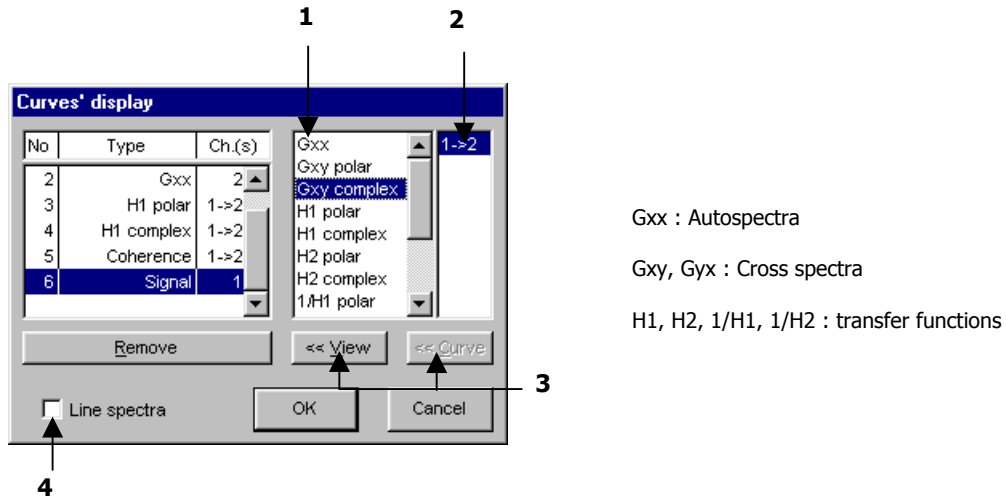
Additional acquisition parameters such as the pass band, the input gains and the active channel are identical to the parameters used for real-time measurements (See **paragraph 7.2.2**).

7.3. Display configuration

All these functions are accessible from the horizontal toolbar of the measurement window.

7.3.1. Curves to display

Use the command  **Display / Curves** to define the data to display in the measurement window. The following dialogue box appears on screen.



1 Choose the quantities to be displayed from the list of available quantities. For the real time mode in narrow bands, the user may display the following quantities:

Cross function deactivated	Cross function activated
Autospectra Gxx for each channel (G1,1 ; G2,2)	Autospectra Gxx for each channel (G1,1 ; G2,2)
Signal for each channel	Cross spectrum Gxy and inverse cross spectrum Gyx (G1,2 ; G2,1)
	Transfer function H1
	inverse transfer function 1/H1
	Cross transfer function H2
	Inverse cross transfer function 1/H2
	coherence

The transfer function and the cross spectra may be represented in **polar** form (modulus and phase) or **complex** (real part and imaginary part).

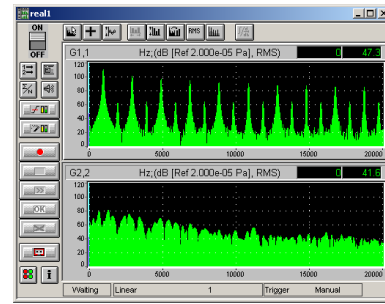
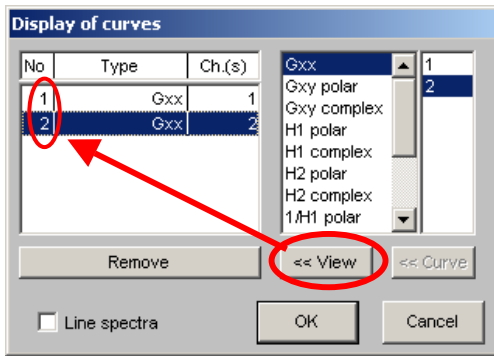
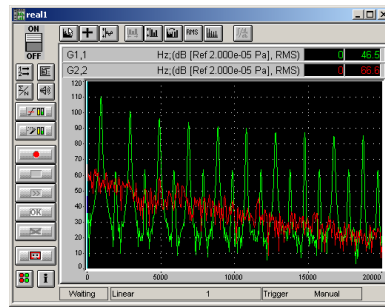
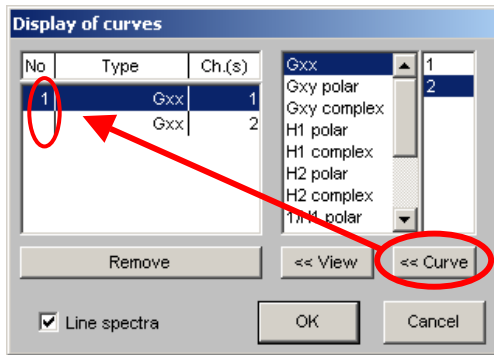
2 The right column of the dialogue box allows the user to combine the previous chosen quantities with the selected measurement channel(s).

For example, if working with two channels, this column allows to choose the autospectrum display of the required channels, the raw signal or the way of a cross function.

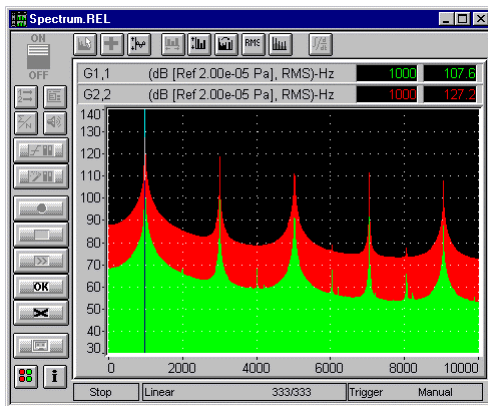
3 The curves, which will appear on the display are the curves displayed in the left column of the dialogue box.

Use the button **View**, in order to add a new spectrum line to the list. To superimpose a spectrum in an existing line, use the button **Curve**.

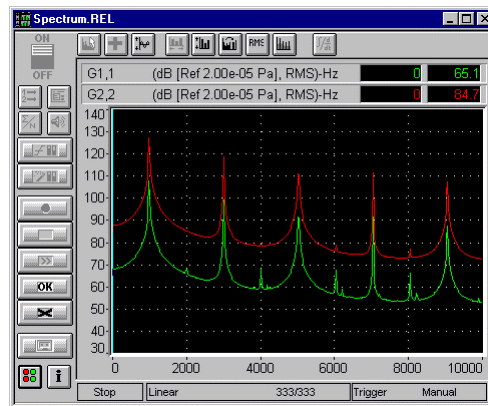
The programme enables the user to display as much lines as wanted in the real time measurement window and offers the possibility to superimpose several curves on the same view (when the curve types are compatible, i.e., of the same physical unit). An example is given below:



④ If **Line spectra** is marked, the bar spectrum is replaced by a line spectrum. An example of a spectrum with the same signal in the two modes is given below:




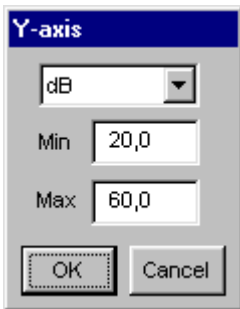
Bar-type spectra



Line-type spectra

7.3.2. Display dynamic configuration


Use the command  **Display / Y-axis** to select the display dynamic manually. The following dialogue box appears on screen.




This dialogue box allows the user to modify the unit of the Y-axis as well as the **minimum** and **maximum** values of the used scale.

There are two possible display units:


- **dB**: the dynamic is displayed in decibels according to the SI reference and depends on the transducer type of each channel.
- **Lin**: the dynamic is displayed in physical units according to the transducer type.

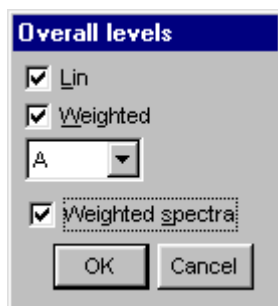
 *The defined parameters are only applied to the active curve after validation of the dialogue box.*

The command  **Actions / Autoscale (F9)** allows the user to adjust the display dynamic of all existing curves according to the measured levels.

'Autoscale' adjusts automatically the scales of the Y-axis of all curves, in order to enable a correct visualisation of all curves.

7.3.3. Overall levels

Use the command  **Display / Overall levels** to display up to two overall levels on the right hand side of the active display in the measurement window. The following dialogue box appears on screen



The display of overall levels is only possible for autospectra and authorises the display of:


- The overall Lin level (unweighted),
- An additional weighted overall level (A,B, C, etc.)

The option **weighted spectra** activates spectrum display using the selected frequency weighting. The spectra will be weighted in this case.

 *Refer to **paragraph 18.3** for a complete list of frequency weightings available in **dBFA32**.*

7.3.4. Spectral units




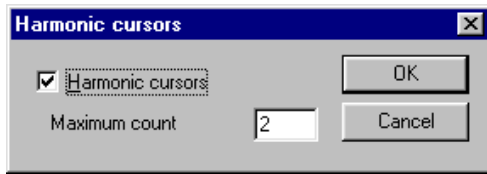
Use the command  **Display / Spectral unit** to modify the spectral unit of the spectrum of the active window. The dialogue box shown opposite appears on screen.

You can choose amongst the following spectral units: **ASD, PSD, RMS, and PWR.**

 *Refer to **paragraph 18.4** for a complete list of spectral units available in **dBFA32**.*

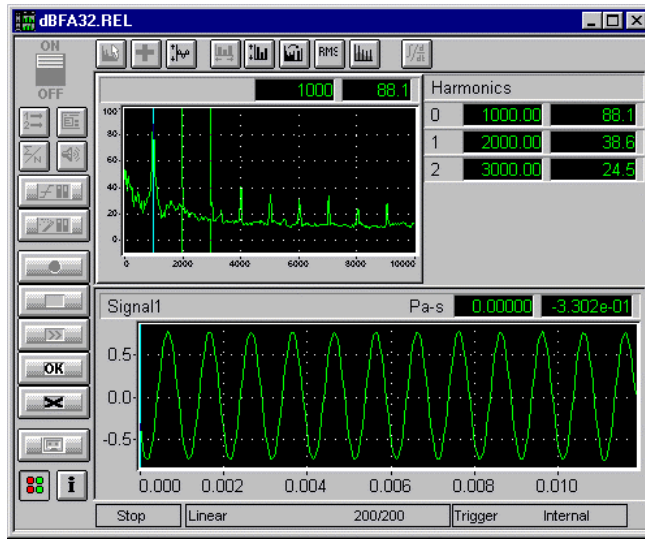
7.3.5. Harmonic cursors

Use the command  **Display / Cursors** to display the harmonic cursors on the graphical view of a narrow band spectra. The following dialogue box appears on screen.




Define the **maximum count** of harmonic cursors that you would like to see on the graph.

The main measurement window then looks as follows:



The display of the levels corresponding to the different markers appears on the right hand side of the spectrum.

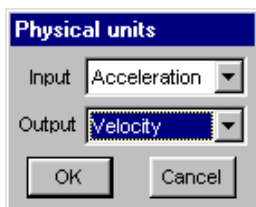
7.3.6. Integration / Derivation of spectra to be displayed

Use the command  **Display / Integration / Derivation** to carry out a simple or double integration / derivation of an active narrow band spectrum in the main window of the real time mode. The following dialogue box appears on the screen. There are two cases:



▪ **Derivation / Integration of an autospectrum.**

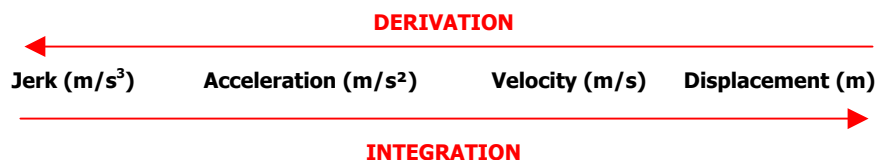
According to the physical unit of the measured spectra, the spectra is displayed, integrated or derived.



▪ **Derivation / Integration of a transfer function.**

The user may visualise the chosen transfer function by integration / derivation of the input and/or output spectrum, according to the physical unit of the input and output function (an autospectrum or a cross spectrum for each case).

The possible selections for each type are summarised below:



7.4. Measurement process

After measurement configuration, the user can control the measurement process with the following icons:



Start an acquisition. (F3)

The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.



Stop an acquisition (F4)



Continue a stopped measurement (F5)

This function continues averaging the previous results with measured values.



Accept current results (F7)

The measurement results are saved in a measurement session datafile.



Do not accept current results and restart the measurement (F6)



Start a signal recording (F12)

Start a signal recording directly from the real time measurement window. The audio record will be carried out according to the user-defined duration, the other parameters (gains, frequency range, etc.) are identical to the current real time analysis parameters.

Spectrum measurement is deactivated during signal recording. A recording progress indicator appears in the status bar of the real time window giving a percentage of the total recording progress.



Show/hide the overload bar.

The overload dialogue box appears on screen when this command is activated. This dialogue box enables detection an overload at any time.



There are two indicators for each channel, one for the instantaneous overload, another one for memorisation of the overload. The button **Reset** allows resetting the indicators.

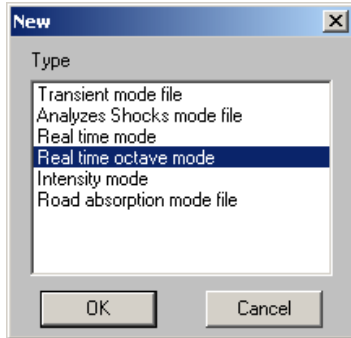
The instantaneous overload indicator becomes red as soon as an overload occurs on a given channel and becomes green again when it is terminated.

The indicator, which memorises the overload, becomes red as soon as an overload occurs and stays red until the button **Reset** is pressed.

8. REAL-TIME ACQUISITION (OCTAVES & THIRD OCTAVES ANALYSIS)

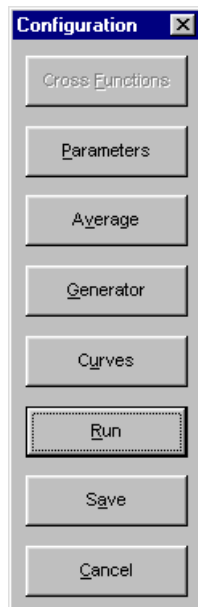
dBFA32 can be used to perform real-time acquisition of octave and third octave band spectra by digital filtering (Class 0 specifications according to IEC1260) on one or several measurement channels.

An internal signal generator can be used as an option to generate a white noise, a pink noise, a sinus or a loop signal through an amplified loudspeaker. Signal recording can also be performed in the real-time acquisition mode.



Use the command **Acquisition / New measurement set-up** to start a new measurement. The dialogue box shown opposite appears on screen.

Select **Real time octave mode** for measurements of spectra in broad bands, then click on **OK**.



The dialogue box shown opposite appears on-screen after creation a new real time measurement mode. The user can define the main acquisition parameters before starting the measurement itself.

Following steps may be done:

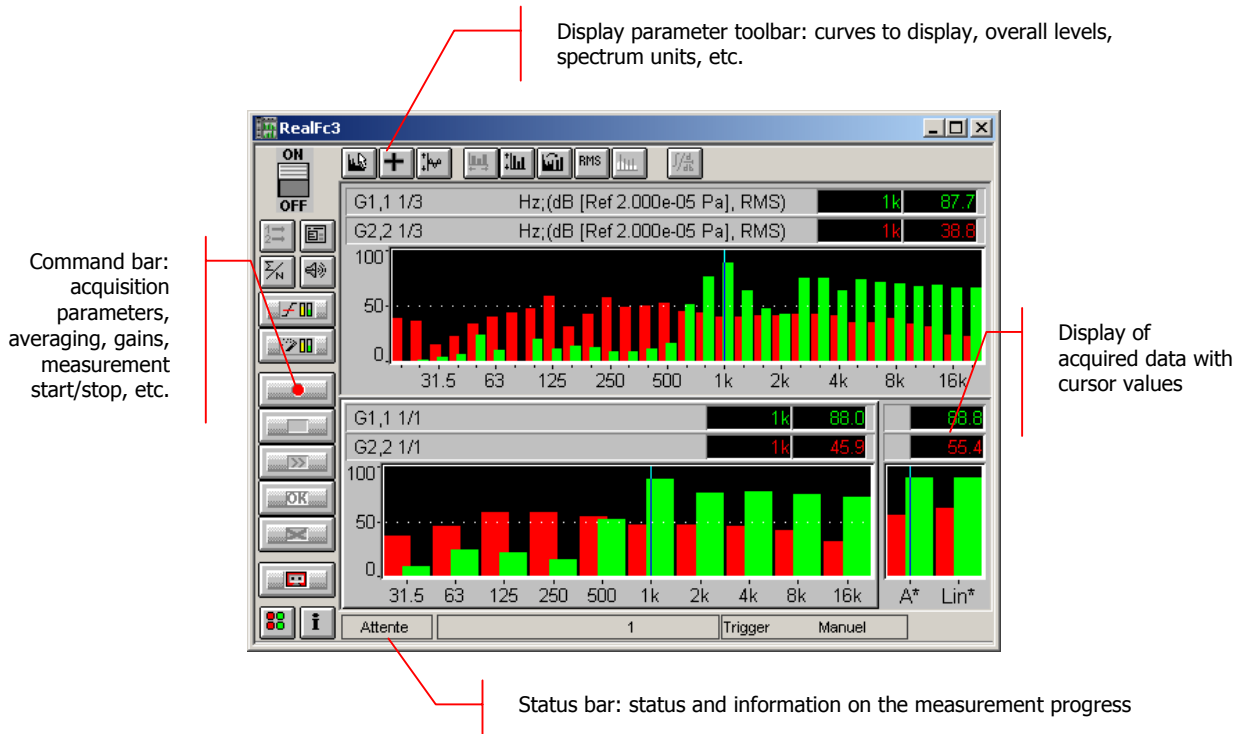
- Define the acquisition **parameters**: frequency range, resolution, quantities to store, etc.
- Define the **averaging** parameters: type of averaging, averaging duration.
- Activate or disable the internal noise **generator** (white, pink, sinus, loop) (option).
- Define the **curves** to be displayed in the measurement window.
- **Run** the measurement. The real time measurement window appears on-screen.
- **Save** the measurement configuration. All the parameters of the measurements are saved in a configuration file with the extension *.ROC for octave and third octave band analysis.

The user may use this configuration again for other measurement sessions with the same parameters (command **Acquisition / Open a measurement set-up**).

The real-time measurement window appears after setting up all parameters. Each function is now accessible from the measurement window toolbars.

8.1. Measurement window overview

An example of a real-time octave and third octave band measurement window is given below:



The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

- | | | | |
|--|---|--|--|
| | Enable/disable cross function computation (inactive in this mode) | | Stop the acquisition |
| | Define acquisition parameters | | Continue the acquisition |
| | Define averaging mode and attributes | | Validate current results |
| | Internal signal generator (option) | | Cancel current results and start again |
| | Define gain and threshold parameters | | Start audio record (option) |
| | Perform an automatic gain adjustment (autorange) | | Show/hide overload bar |
| | Start acquisition | | Show/hide information table |


The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

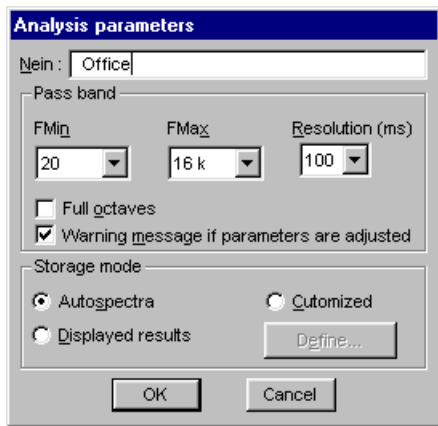
- | | | | |
|--|---|--|--|
| | Select curves to display | | Select overall levels to display |
| | Select curve layout type | | Select spectral units display |
| | Perform a Y-axis autoscale for all curves | | Harmonic cursor parameters (inactive in this mode) |
| | Define Y-axis parameters | | Integration / Differentiation of displayed spectra (inactive in this mode) |

8.2. Measurement set-up

All the functions described below are accessible from the command toolbar of the measurement window.

8.2.1. Acquisition parameters

Use the command  **Config / Parameters** to define general acquisition parameters. The dialogue box shown below appears on the screen. The following parameters may be defined:



- **Name**

Input a measurement identifier. This identifier appears in the field "Location" of the measurement session.

- **Fmin and Fmax (Hz)**

Define the lower and upper frequency limits of the analysis pass band. These values are the centre frequencies of third octave bands.

- **Resolution (ms)**

Select the time resolution of the analysis (acquisition time base) from the discrete values in the list.

If the option **Full octaves** is activated, the pass band is reduced to contain only the "full" octaves: The minimum frequency is replaced by the minimum value of the upper octave band. The maximum frequency is replaced by the maximum value of the lower octave band.

When the option **Warning message if parameters are adjusted** is validated, a dialogue box appears during validation of the current dialogue box, to display the adjusted parameters when needed.

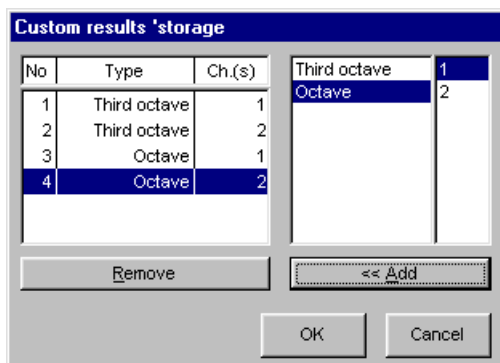
When this option is inactive, the programme adjusts automatically the parameter values in relation to the possibilities of the current acquisition unit.

- **Storage modes**

Choose **Autospectra** in order to save (after starting the measurement) the auto spectra. Octave band and third octave band spectra for each active measurement channel are stored in a measurement session datafile.

Choose **Displayed quantities** in order to save (after starting the measurement) only the spectra that are displayed in the real time measurement window.

Choose **Customise**, in order to carry out a custom data storage. The programme stores the curves accessible for the current operating mode. To define the quantities to store, click on the **Define** button. The dialogue box **custom results' storage** appears on-screen.

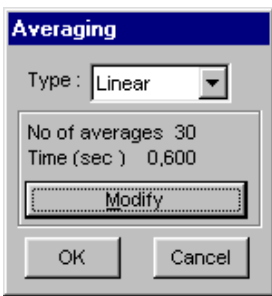



The list on the right indicates the different spectra types and its channel references that may be stored.

The list on the left indicates the different spectra types that will be stored after validation of the measurement results.

To activate data storage of a given spectrum, select its type and the reference channels. Then use the command **Add**, in order to add the spectra to the storage list (left hand side). The user can also carry out this action by double clicking on its representation in the right hand side list.

8.2.2. Averaging parameters



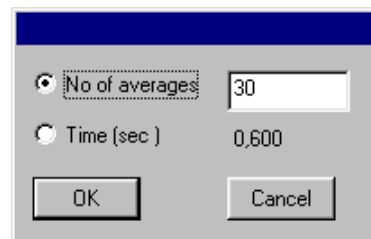
Use the command  **Config / Average** to define the averaging parameters of the measurement. The dialogue box shown opposite appears on screen.

This dialogue box allows the user to modify the type of averaging and the number of averages or the measurement duration.


There are 3 main types of averaging:

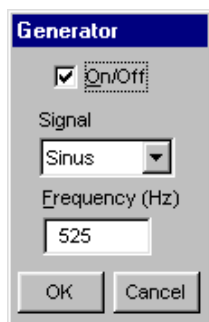
- **Linear:** This averaging mode gives the same weighting to all samples, which means a linear average on N samples that stops as far as the Nth sample is reached.
- **Exponential:** This averaging mode gives the highest weighting to the last reached sample and reduce progressively the influence of the previous samples. An exponential average does not stop.
- **Maximum:** This averaging mode keeps, on an analysis of N samples, the spectrum that present the highest power spectral density (PSD).

In this dialogue box, the user can **modify** the number of average to take into account and the averaging duration. These two parameters are linked by the general acquisition parameters (number of lines, pass band).



8.2.3. Internal signal generator (option)

Use the  **Config / Generator** command in order to define and activate the internal signal generator. The following dialogue box appears on screen.





Using **dBFA32** with the **SYMPHONIE** or **HARMONIE** hardware platforms, a **white noise, pink noise, a sinus** signal (whose **frequency** we define) can be generated.


Choose the option **Loop** to loop the input signal on the output of the hardware platform.

The generator is active when the box **On/Off** is activated.

Then connect an amplified loudspeaker to the output of the acquisition unit.

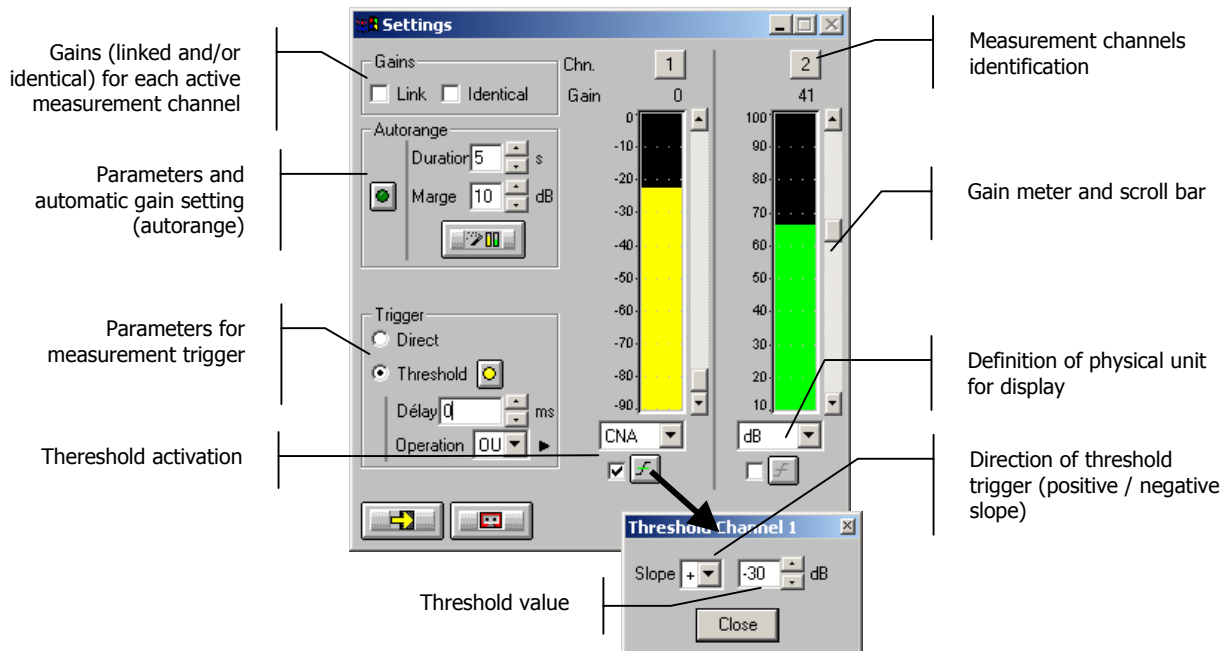
With **SYMPHONIE**, the signal output level can be set by clicking on the  icon, in Windows taskbar. Select the acquisition platform and click on Properties to set the output level of **SYMPHONIE (Attenuation setting (dB))** field).

If using the older generation of the **SYMPHONIE** or **HARMONIE** driver, the signal output level can be set with the  **Symphonie : 00066** driver icon in Windows 98 or ME taskbar. Click on this icon with the right button of the mouse to display the contextual menu. Select the **Configuration** field and set the output level of **SYMPHONIE** and **HARMONIE (Output level)** field).

 For more information on the acquisition system (for instance, output wiring, setting of output volume), please refer to the system installation manual.

8.2.4. Threshold, gain and autorange settings


This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.


The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange  Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level. The gain view meters may display the input levels according to three different units:

- **dB:** Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC:** Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit:** Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².

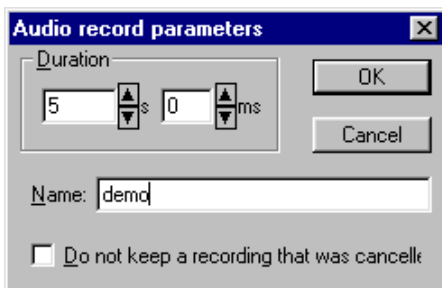
 *The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).*

Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

8.2.5. Signal acquisition (option)

Use the command **Config / Signal** to define the signal recordings parameters. The following dialogue box appears on screen.




- Record **duration** in seconds and milliseconds
- **Name** (or equivalent) that identifies the signal item in the measurement session ("Location" field)
- Keep or not a signal in case of a cancelled recording.

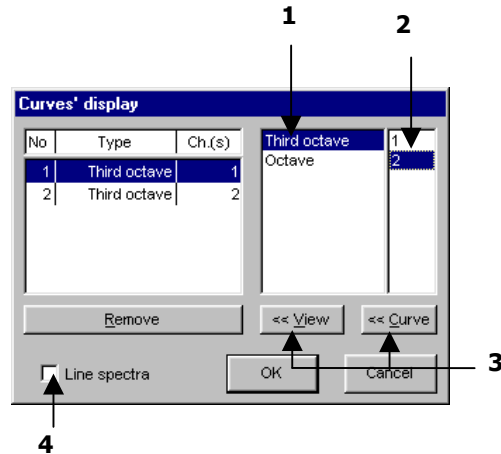
Additional acquisition parameters such as the pass band, the input gains and the active channel are identical to the parameters used for real-time measurements (See **paragraph 8.2.1**).

8.3. Display configuration

All these functions are accessible from the horizontal toolbar of the measurement window.

8.3.1. Curves to display

Use the  **Display / Curves** command to define the data to display in the measurement window. The following dialogue box appears on screen.



❶ Choose the quantities to be displayed from the list of available quantities. For the real time mode in octave and third octave bands, the user may display the following quantities:

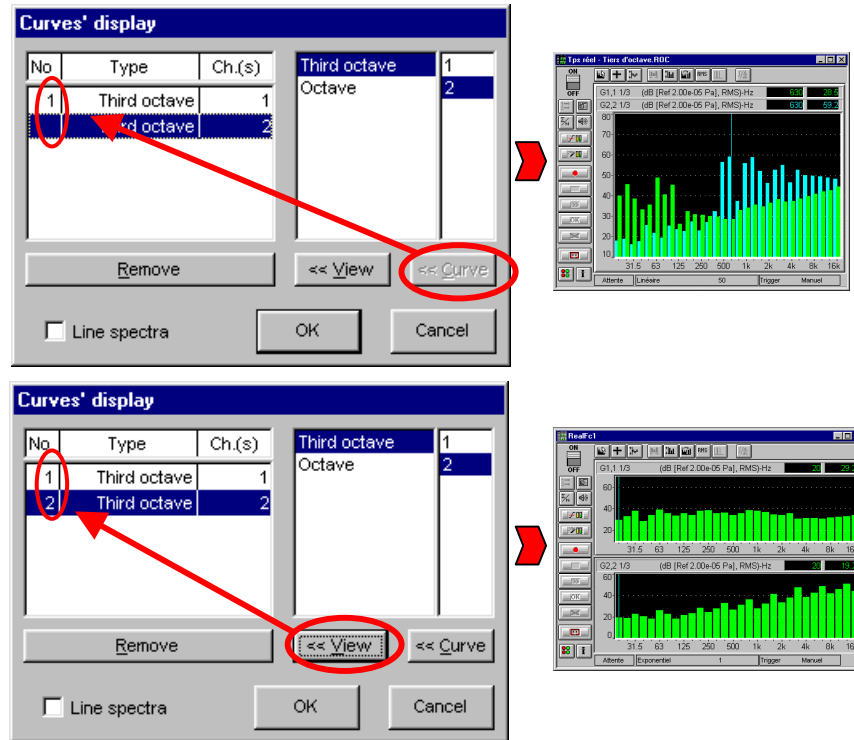
Cross function deactivated
Autospectra in octaves and third octaves for each measurement channel (G1,1 ; G2,2)

❷ The right column of the dialogue box allows the user to combine the previous chosen quantities with the selected measurement channel(s).

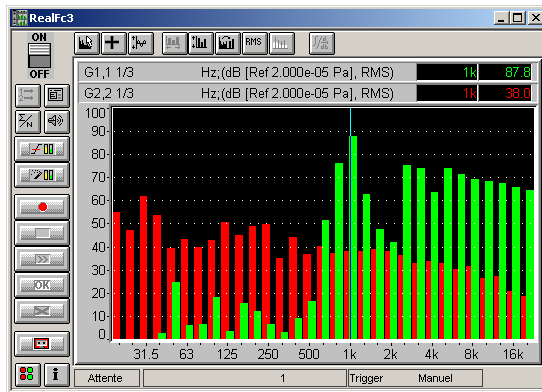
❸ The curves, which will appear on the display are the curves displayed in the left column of the dialogue box.

Use the button **View**, in order to add a new spectrum line to the list. To superimpose a spectrum in an existing line, use the button **Curve**.

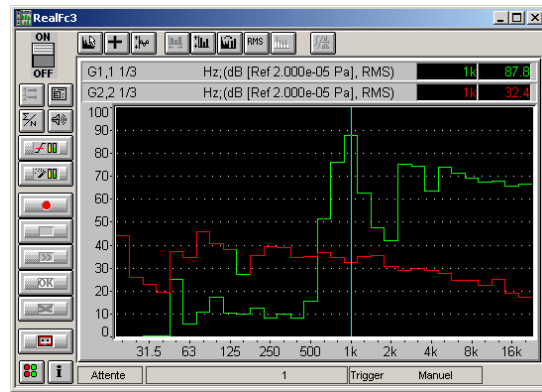
The programme enables the user to display as much lines as wanted in the real time measurement window and offers the possibility to superimpose several curves on the same view (when the curve types are compatible). An example is given below:



4 If **Line spectra** is marked, the bar spectrum is replaced by a line spectrum. An example of a spectrum with the same signal in the two modes is given below:




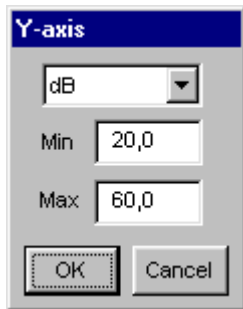
Bar-type spectra



Line-type spectra

8.3.2. Display dynamic configuration


Use the  **Display / Y-axis** command to select the display dynamic manually. The following dialogue box appears on screen.




This dialogue box allows the user to modify the unit of the Y-axis as well as the **minimum** and **maximum** values of the used scale.

There are two possible display units:


- **dB**: the dynamic is displayed in decibels according to the SI reference and depends on the transducer type of each channel.
- **Lin**: the dynamic is displayed in physical units according to the transducer type.

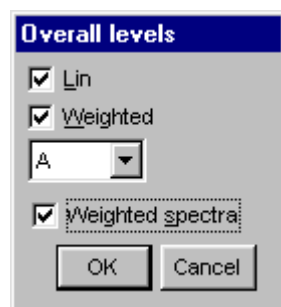
 *The defined parameters are only applied to the active curve after validation of the dialogue box.*

The command  **Actions / Autoscale (F9)** allows the user to adjust the display dynamic of all existing curves according to the measured levels.

'Autoscale' adjusts automatically the scales of the Y-axis of all curves, in order to enable a correct visualisation of all curves.

8.3.3. Overall levels

Use the command  **Display / Overall levels** to display up to two overall levels on the right hand side of the active display in the measurement window. The following dialogue box appears on screen



The display of overall levels is only possible for autospectra and authorises the display of:


- The overall Lin level (unweighted),
- An additional weighted overall level (A,B, C, etc.)

The option **weighted spectra** activates spectrum display using the selected frequency weighting. The spectra will be weighted in this case.

 *Refer to **Paragraph 18.3** for a complete list of frequency weightings available in **dBFA32**.*

8.3.4. Spectral units



Use the command  **Display / Spectral unit** to modify the spectral unit of the spectrum of the active window. The dialogue box shown opposite appears on screen.

You can choose amongst the following spectral units: **ASD, PSD, RMS, and PWR.**

 *Refer to **Paragraph 18.4** for a complete list of spectral units available in **dBFA32**.*

8.4. Measurement process

After measurement configuration, the user can control the measurement process with the following icons:



Start an acquisition. (F3)

The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.



Stop an acquisition (F4)



Continue a stopped measurement (F5)

This function continues averaging the previous results with measured values.



Accept current results (F7)

The measurement results are saved in a measurement session datafile.



Do not accept current results and restart the measurement (F6)



Start a signal recording (F12)

Start a signal recording directly from the real time measurement window. The audio record will be carried out according to the user-defined duration, the other parameters (gains, frequency range, etc.) are identical to the current real time analysis parameters.

Spectrum measurement is deactivated during signal recording. A recording progress indicator appears in the status bar of the real time window giving a percentage of the total recording progress.



Show/hide the overload bar.

The overload dialogue box appears on screen when this command is activated. This dialogue box enables detection an overload at any time.



There are two indicators for each channel, one for the instantaneous overload, another one for memorisation of the overload. The button **Reset** allows resetting the indicators.

The instantaneous overload indicator becomes red as soon as an overload occurs on a given channel and becomes green again when it is terminated.

The indicator, which memorises the overload, becomes red as soon as an overload occurs and stays red until the button **Reset** is pressed.

9. REAL-TIME ACQUISITION (INTENSITY MODE)

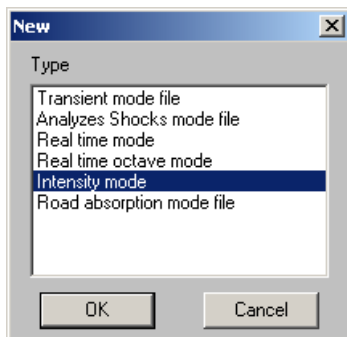
dBFA32 can be used to perform real-time acquisition of autospectra and cross-spectra in narrow bands (first and second FFT passes) as well as sound intensity and averaged sound pressure cross-spectra in octave or third octave bands by FFT analysis.

The characteristics of a sound intensity probe (microphone spacing, etc.) can be defined by the user to perform sound intensity measurements (acquisition of the active sound intensity level L_i , the reactive sound intensity level L_j and the free field sound intensity level SIL).

All the measured quantities can be displayed in narrow bands (for each FFT pass) or in octaves and third octave bands (recomposition from the FFT analyses).

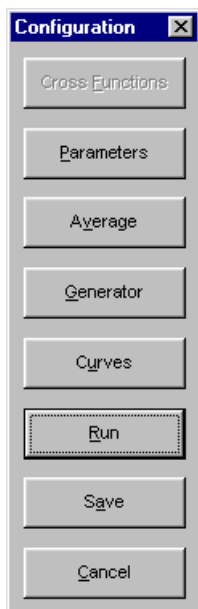
The cross-spectra in narrow bands can be displayed either in polar form (modulus and phase) or complex form (real and imaginary parts).

An internal signal generator can be used as an option to generate a white noise, a pink noise, a sinus or a loop signal through an amplified loudspeaker. Signal recording can also be performed in the real-time acquisition mode.



Use the command **Acquisition / New measurement set-up** to start a new measurement. The dialogue box shown opposite appears on screen.

Select **Real time mode** for measurements of autospectra, cross spectra, sound intensity and averaged sound pressure spectra in narrow bands (first and second FFT passes) and octaves and third octave bands, then click on **OK**.



The dialogue box shown opposite appears on-screen after creation a new real time measurement mode. The user can define the main acquisition parameters before starting the measurement itself

Following steps may be done:

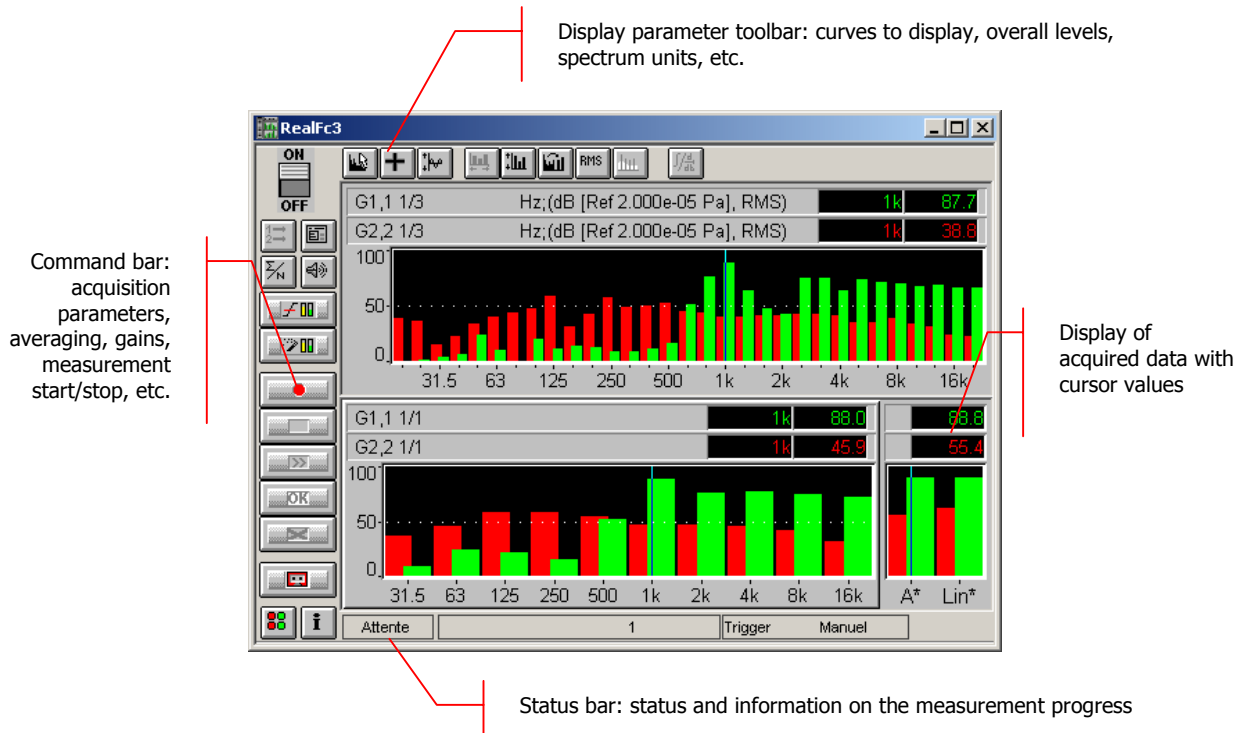
- Activate calculation of **cross functions** between active channels (if possible).
- Define the acquisition **parameters**: frequency range, resolution, quantities to store, etc.
- Define the **averaging** parameters: type of averaging, averaging duration.
- Activate or disable the internal noise **generator** (white, pink, sinus, loop) (option).
- Define the **curves** to be displayed in the measurement window.
- **Run** the measurement. The real time measurement window appears on-screen.
- **Save** the measurement configuration. All the parameters of the measurements are saved in a configuration file with the extension *.INT for this real-time acquisition mode.

The user may use this configuration again for other measurement sessions with the same parameters (command **Acquisition / Open a measurement set-up**).

The real time measurement window appears after setting up all parameters. Each function is now accessible from the measurement window toolbars.

9.1. Measurement window overview

An example of a real time intensity mode measurement window is given below:



The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

- | | | | |
|--|--|--|--|
| | Enable/disable cross function computation | | Stop the acquisition |
| | Define acquisition parameters | | Continue the acquisition |
| | Define averaging mode and attributes | | Validate current results |
| | Internal signal generator (option) | | Cancel current results and start again |
| | Define gain an threshold parameters | | Start audio record (option) |
| | Perform an automatic gain adjustment (autorange) | | Show/hide overload bar |
| | Start acquisition | | Show/hide information table |


The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

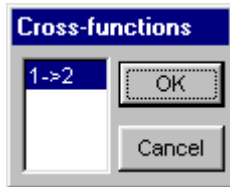
- | | | | |
|--|---|--|--|
| | Select curves to display | | Select overall levels to display |
| | Select curve layout type | | Select spectral units display |
| | Perform a Y-axis autoscale for all curves | | Harmonic cursor parameters |
| | Define Y-axis parameters | | Integration / Differentiation of displayed spectra |

9.2. Measurement set-up

All the functions described below are accessible from the command toolbar of the measurement window

9.2.1. Cross-functions

Use the command  **Config / Cross function** to define the acquisition of cross spectra and transfer functions between active measurement channels. The following dialogue box appears.




This dialogue box allows the user to activate (or not) the calculation of cross functions during acquisition and gives access to the transfer functions (coherence) as well as the computation of sound intensity and mean pressure level spectra.

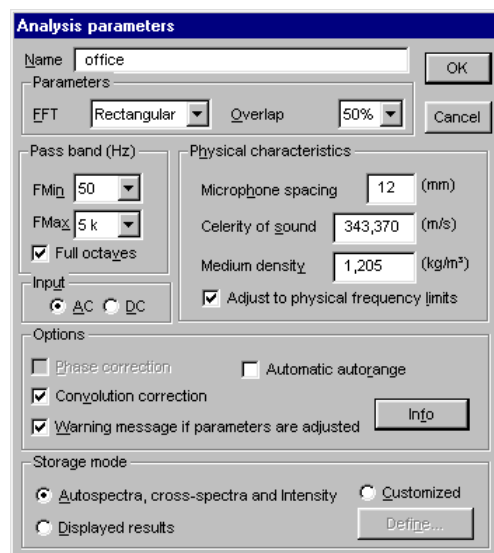
The option **1->2** activates the cross function calculation from channel 1 to channel 2.



When cross-function computation is not active, only autospectra in narrow bands (first and second FFT passes) and in octave and third octave bands can be measured.

9.2.2. Acquisition parameters

Use the command  **Config / Parameters** to define general acquisition parameters. The dialog box shown below appears on-screen. The following parameters may be defined :



■ Name

Input a measurement identifier. This identifier appears in the field "Location" of the measurement session.

■ FFT Window

Choose the FFT window for the analysis. The following windows are available: **Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top**.

■ Overlap

Choose the overlap factor for the analysis amongst the following quantities: **0, 25%, 50% and 75%**.

These factors depend on the hardware platform possibilities and the chosen bandwidth.

■ Pass band (Hz)

Define the upper and lower limits of the analysis pass band. These values are the third octave frequency bands. The pass band depends on the microphone spacing, of the selected minimum frequency and the activation or deactivation of the convolution correction.

If the option **Full octaves** is activated, the pass band is reduced to contain only the "full" octaves: The minimum frequency is replaced by the minimum value of the upper octave band. The maximum frequency is replaced by the maximum value of the lower octave band.

■ Input

The programme allows the user to choose between **AC** or **DC** input. With this option the continuous component of the signal can pass or not. By using the AC input a 0.5 Hz high pass filter is included in the signal chain.

When the option AC is chosen, it is necessary to use specific cables.

Physical quantities

The **microphone spacing** is only needed for the calculation of sound intensity level (Li, Lp, Lj, SIL) with a sound intensity probe. It has an influence to the measurable frequency range according to the table below.

The table below summarises these interactions for various microphone spacing. The value between brackets gives the high frequency limit when the convolution correction is activated.

Fmin (Hz)	→ 20	25 to 40	50 to 80	100 and +
Spacing (mm)				
50	12,5 – 1K (1,6K)	25 – 1K (1,6K)	50 – 1K (1,6K)	100 – 1K (1,6K)
25	25 – 2K (2K)	25 – 2K (3,15K)	50 – 2K (3,15K)	100 – 2K (3,15K)
12	50 – 2K (2K)	50 – 4K (4K)	50 – 4K (6,3K)	100 – 4K (6,3K)
6	100 – 2K (2K)	100 – 4K (4K)	100 – 8K (8K)	100 – 8K (12,5K)

The **physical limitation of the frequency range** is due, for high frequencies to the approximation of the pressure gradient and, for low frequencies to the microphone spacing (the larger the spacer, the lower the frequency band accessible).

With a 12 mm spacer (and the convolution correction activated), the software the frequency range required by the international standard (50 Hz - 6,3 kHz) but the user can advantageously perform its sound intensity measurements in two stages:

- A first series of measurements with a 12mm spacer for high frequency bands,
- Then a second series with a 25-mm spacer to cover low frequency bands.

The field **Celerity of sound** allows to define the sound velocity in the measurement conditions. This value has an influence on the intensity measurement.

The field **Medium density** allows to define the medium density in the measurement conditions. This value has an influence on the intensity measurement.

The option "**adjust to physical frequency limits**" automatically reduces the pass band to a limit pass band, in which the intensity may be calculated correctly.

After activation this option adjust the limits of the frequency ranges Fmin and Fmax so as they are included in the physical frequency limits.

With the button **Info**, the user may display the setting criteria of its physical frequency limits and the microphone space values as well as the residual pressure-index of the probe.

Options

The option **phase correction** allows the user to activate the phase correction during an intensity calculation. With the phase correction the user may correct the measured values in relation to the intrinsic phase shift of the probe (that is included in the phase correction file, defined in the hardware configuration - See **Chapter 3**).

The option **Convolution correction** allows the user to activate the convolution correction during an intensity calculation. With the convolution correction, the user may correct (within a limit of 3 dB) the high frequency error due to the approximation of the pressure gradient

When the option **Warning message if parameters are adjusted** is validated, a dialogue box appears, during validation of the current dialogue box, to display the adjusted parameters if needed. When this option is inactive, the programme adjusts automatically the parameter values in relation to the possibilities of the acquisition unit.

The option **Autorange** starts automatic gain setting at the start of each measurement.

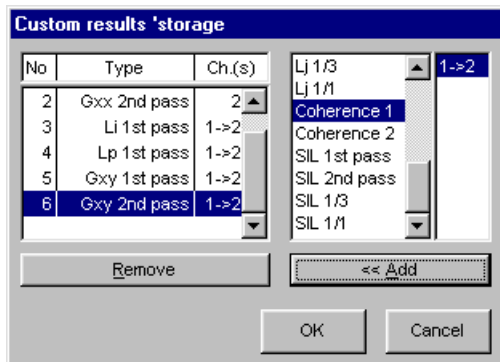
■ **Storage modes**

Choose **Autospectra, cross spectra and intensity** in order to save (after starting the measurement), the auto spectra and if necessary the cross spectra as well as the intensity spectra (active and reactive intensity) and the mean pressure level spectra.

The octave band, third octave band and narrow band (first and second pass FFT) spectra for each quantity are stored in the measurement session datafile.

Choose **Displayed quantities** in order to save (after starting the measurement) only the spectra that are displayed in the real time measurement window.

Choose **Customise**, in order to carry out a personalised storage. The programme stores the curves accessible for the current operating mode. To define the quantities to be stored, click on the button **Define**, the dialogue box custom results' storage appears.



The list on the right indicates the different spectra types and its channel references that may be stored.

The list on the left indicates the different spectra types that will be stored after validation of the measurement results.

The cross spectra, intensity spectra and the mean pressure level spectra are only accessible if the cross function computation is activated.

Reminder

Gxx: Autospectra
Gxy: Cross spectra

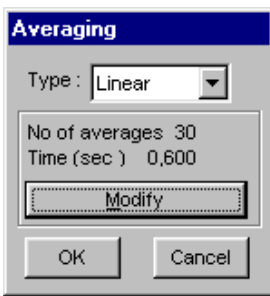
Li: Active intensity
Lj: Reactive intensity
SIL: Free field intensity
LP: Mean pressure levels


1st pass: first FFT pass (narrow bands)
2nd pass: second FFT pass (narrow bands)

1/1: octave bands
1/3: third octave bands

To activate data storage of a given spectrum, select its type and the reference channels. Then use the command **Add**, in order to add the spectra to the storage list (left hand side). The user can also carry out this action by double clicking on its representation in the right hand side list.

9.2.3. Averaging parameters



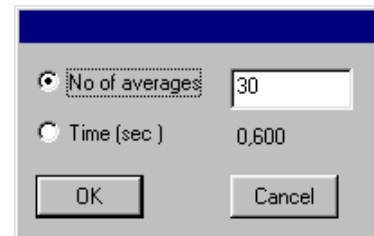
Use the command  **Config / Average** to define the averaging parameters of the measurement. The dialogue box shown opposite appears on screen.

This dialogue box allows the user to modify the type of averaging and the number of averages or the measurement duration.


There are 2 main types of averaging:

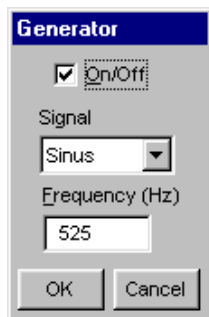
- **Linear:** This averaging mode gives the same weighting to all samples, which means a linear average on N samples that stops as far as the Nth sample is reached.
- **Exponential:** This averaging mode gives the highest weighting to the last reached sample and reduce progressively the influence of the previous samples. An exponential average does not stop.

In this dialogue box, the user can **modify** the number of averages to take into account and the averaging duration. These two parameters are linked by the general acquisition parameters (number of lines, pass band).



9.2.4. Internal signal generator (option)

Use the command  **Config / Generator** in order to define and activate the internal signal generator. The following dialogue box appears on screen.




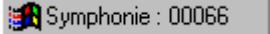
Using **dBFA32** with the **SYMPHONIE** or **HARMONIE** hardware platforms, a **white noise, pink noise, a sinus** signal (whose **frequency** we define) can be generated.


Choose the option **Loop** to loop the input signal on the output of the hardware platform.

The generator is active when the box **On/Off** is activated.

Then connect an amplified loudspeaker to the output of the acquisition unit.

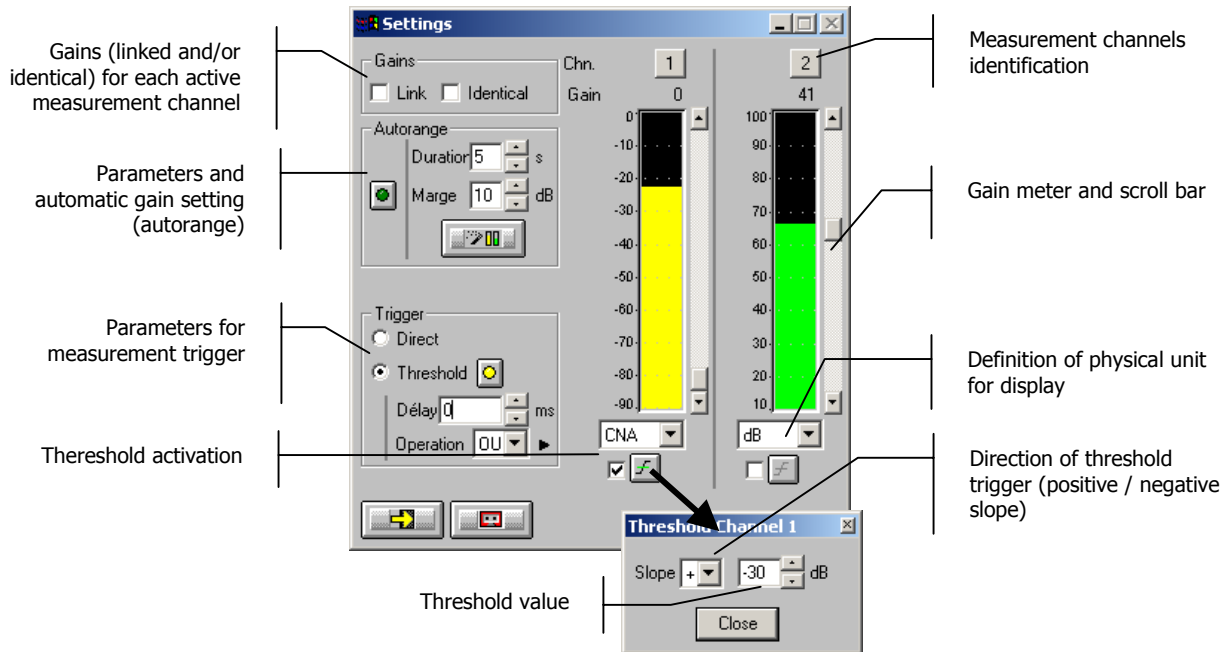
With **SYMPHONIE**, the signal output level can be set by clicking on the  icon, in Windows taskbar. Select the acquisition platform and click on Properties to set the output level of **SYMPHONIE** (**Attenuation setting (dB)** field).

If using the older generation of the **SYMPHONIE** or **HARMONIE** driver, the signal output level can be set with the  driver icon in Windows 98 or ME taskbar. Click on this icon with the right button of the mouse to display the contextual menu. Select the **Configuration** field and set the output level of **SYMPHONIE** and **HARMONIE** (**Output level** field).

 For more information on the acquisition system (for instance, output wiring, setting of output volume), please refer to the system installation manual.

9.2.5. Threshold, gain and autorange settings

This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.


The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level. The gain view meters may display the input levels according to three different units:

- **dB**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2 .

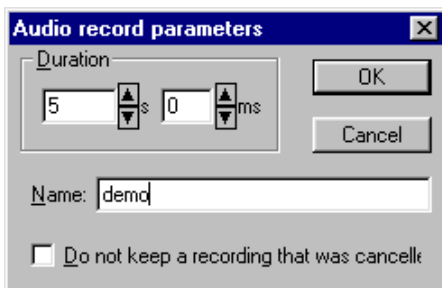
 The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management** (see **Section 19.1**).

Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

9.2.6. Signal acquisition (option)

Use the command **Config / Signal** to define the signal recordings parameters. The following dialogue box appears on screen.




- Record **duration** in seconds and milliseconds
- **Name** (or equivalent) that identifies the signal item in the measurement session ("Location" field)
- Keep or not a signal in case of a cancelled recording.

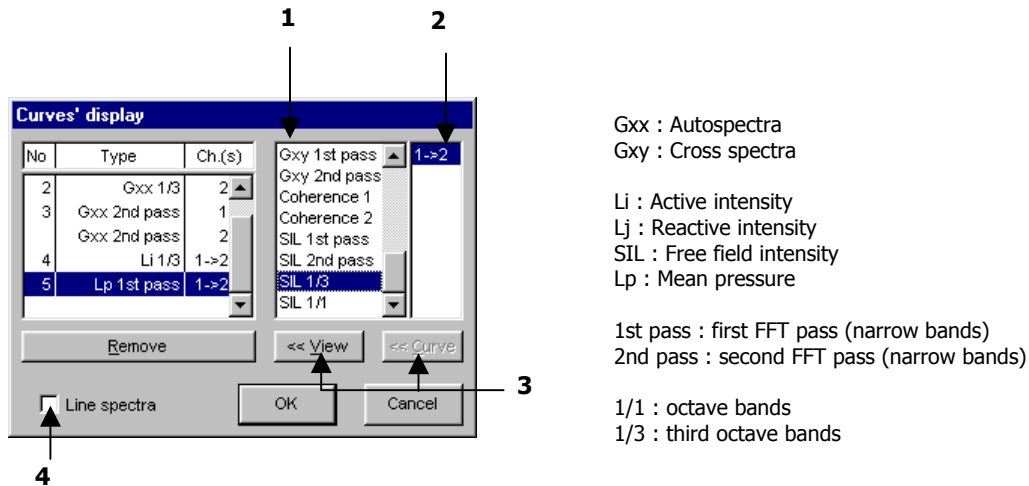
Additional acquisition parameters such as the pass band, the input gains and the active channel are identical to the parameters used for real-time measurements (See **paragraph 9.2.2**).

9.3. Display configuration

All these functions are accessible from the horizontal toolbar of the measurement window.

9.3.1. Curves to display

Use the command  **Display / Curves** to define the data to display in the measurement window. The following dialogue box appears on screen.



1 Choose the quantities to be displayed in the list of available quantities. For the real time intensity mode, the user may display the following data:

Cross function deactivated	Cross function activated
Autospectra for each measurement channel Gxx pass 1, Gxx pass 2, Gxx 1/3, Gxx 1/1	Li pass 1, Li pass 2, Li 1/3, Li 1/1 Lj pass 1, Lj pass 2, Lj 1/3, Lj 1/1 Cross spectra Gxy pass 1, Gxy pass 2, coherence 1, coherence 2 SIL pass 1, SIL pass 2, SIL 1/3, SIL 1/1 Lp pass 1, Lp pass 2, Lp 1/3, Lp 1/1

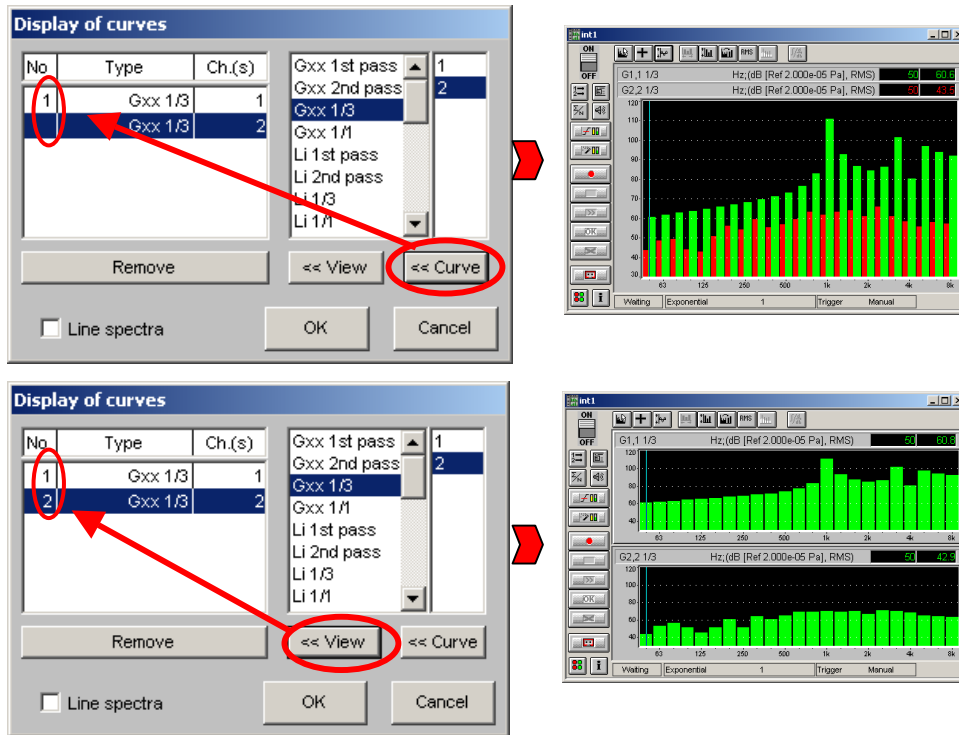
2 The right column of the dialogue box allows to combine the previous chosen quantities with the selected measurement channel(s).

Example: If working with two channels, this column allows to choose the autospectrum display of the wanted channels.

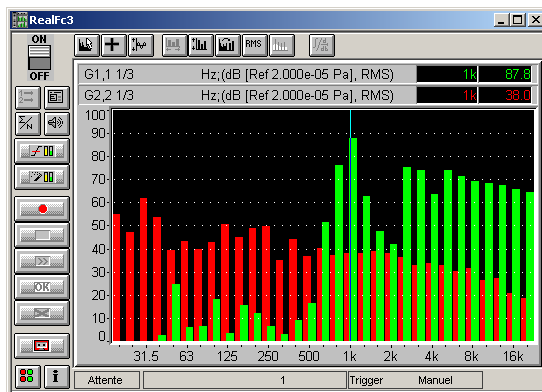
3 The curves, which will appear on the display are the curves displayed in the left column of the dialogue box.

Use the button **View**, in order to add a new spectrum line to the list. To superimpose a spectrum in an existing line, use the button **Curve**.

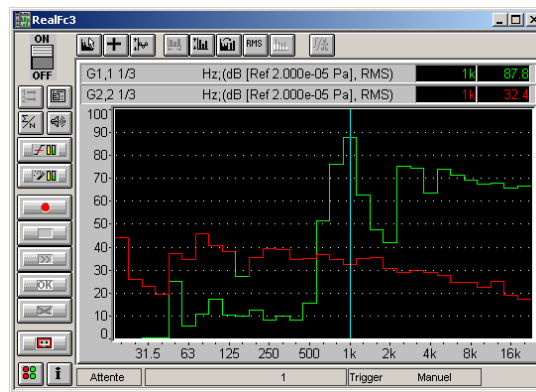
The programme enables the user to display as much lines as wanted in the real time measurement window and offers the possibility to superimpose several curves on the same view (when the curve types are compatible). An example is given below:



④ If **Line spectra** is marked, the bar spectrum is replaced by a line spectrum. An example of a spectrum with the same signal in the two modes is given below:




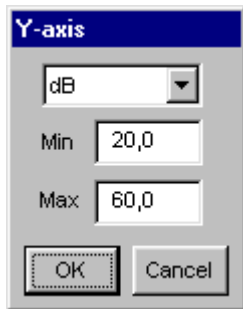
Bar-type spectra



Line-type spectra

9.3.2. Display dynamic configuration


Use the command  **Display / Y-axis** to select the display dynamic manually. The following dialogue box appears on screen.




This dialogue box allows the user to modify the unit of the Y-axis as well as the **minimum** and **maximum** values of the used scale.

There are two possible display units:


- **dB**: the dynamic is displayed in decibels according to the IS reference and depends on the transducer type of each channel.
- **Lin**: the dynamic is displayed in physical units according to the transducer type.

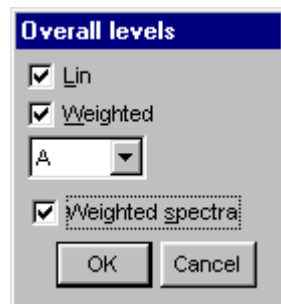
 *The defined parameters are only applied to the active curve after validation of the dialogue box.*

The command  **Actions / Autoscale (F9)** allows the user to adjust the display dynamic of all existing curves according to the measured levels.

'Autoscale' adjusts automatically the scales of the Y-axis of all curves, in order to enable a correct visualisation of all curves.

9.3.3. Overall levels

Use the command  **Display / Overall levels** to display up to two overall levels on the right hand side of the active display in the measurement window. The following dialogue box appears on screen



The display of overall levels is only possible for autospectra and authorises the display of:


- The overall Lin level (unweighted),
- An additional weighted overall level (A, B, C, etc.)

The option **weighted spectra** activates spectrum display using the selected frequency weighting. The spectra will be weighted in this case.

 *Refer to **paragraph 18.3** for a complete list of frequency weightings available in **dBFA32**.*

9.3.4. Spectral units




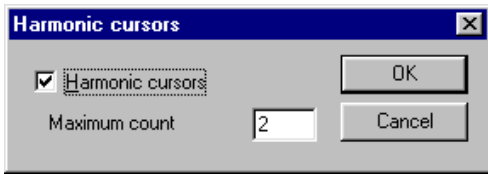
Use the command  **Display / Spectral unit** to modify the spectral unit of the spectrum of the active window. The dialogue box shown opposite appears on screen.

You can choose amongst the following spectral units: **ASD, PSD, RMS, and PWR**.

 *Refer to **paragraph 18.4** for a complete list of spectral units available in **dBFA32**.*

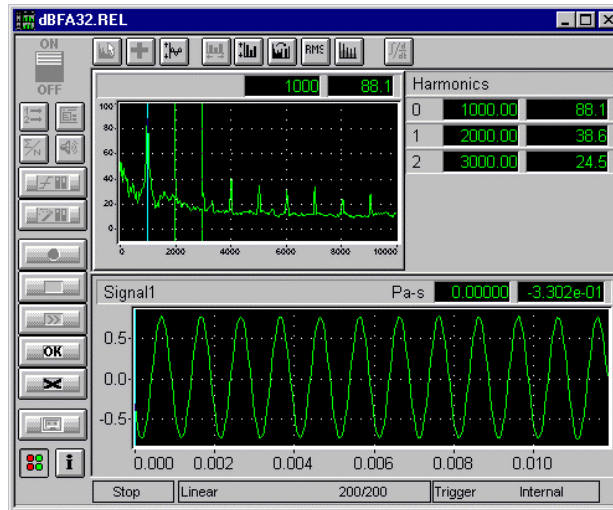
9.3.5. Harmonic cursors

Use the command  **Display / Cursors** to display the harmonic cursors on the graphical view of a narrow band spectra. The following dialogue box appears on screen.




Define the **maximum count** of harmonic cursors that you would like to see on the graph.

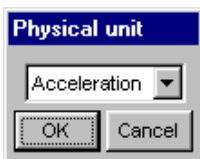
The main measurement window then looks as follows:



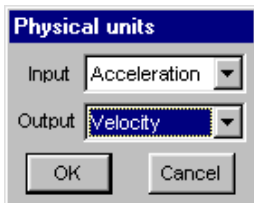
The display of the levels corresponding to the different markers appears on the right hand side of the spectrum.

9.3.6. Integration / Derivation of spectra to be displayed

Use the command  **Display / Integration / Derivation** to carry out a simple or double integration / derivation of an active narrow band spectrum in the main window of the real time mode. The following dialogue box appears on the screen. There are two cases:

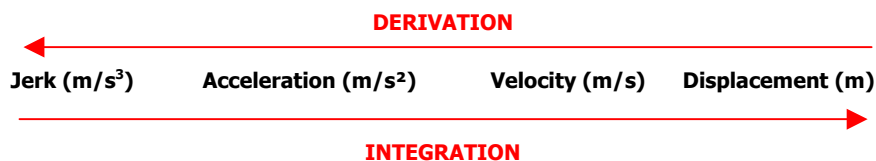


- **Derivation / Integration of an autospectrum.**
According to the physical unit of the measured spectra, the spectra is displayed, integrated or derived.



- **Derivation / Integration of a transfer function.**
The user may visualise the chosen transfer function by integration / derivation of the input and/or output spectrum, according to the physical unit of the input and output function (an autospectrum or a cross spectrum for each case).

The possible selections for each type are summarised below:



9.4. Measurement process

After measurement configuration the user can control the measurement process with the following icons:



Start an acquisition (F3)

The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.



Stop an acquisition (F4)



Continue a stopped measurement (F5)

This function continues averaging the previous results with measured values.



Valid current results (F7)

The measurement results are saved in a measurement session datafile.



Do not accept current results and restart the measurement (F6)



Start a signal recording (F12)

Start a signal recording directly from the real time measurement window. The audio record will be carried out according to the user-defined duration, the other parameters (gains, frequency range, etc.) are identical to the current real time analysis parameters.

Spectrum measurement is deactivated during signal recording. A recording progress indicator appears in the status bar of the real time window giving a percentage of the total recording progress.



Show/hide the overload bar.

The overload dialogue box appears on screen when this command is activated. This dialogue box enables detection an overload at any time.



There are two indicators for each channel, one for the instantaneous overload, another one for memorisation of the overload. The button **Reset** allows to reset the indicators.

The instantaneous overload indicator becomes red as soon as an overload occurs on a given channel and becomes green again when it is terminated.

The indicator, which memorises the overload, becomes red as soon as an overload occurs and stays red until the button **Reset** is pressed.

10. TRANSIENT ANALYSIS

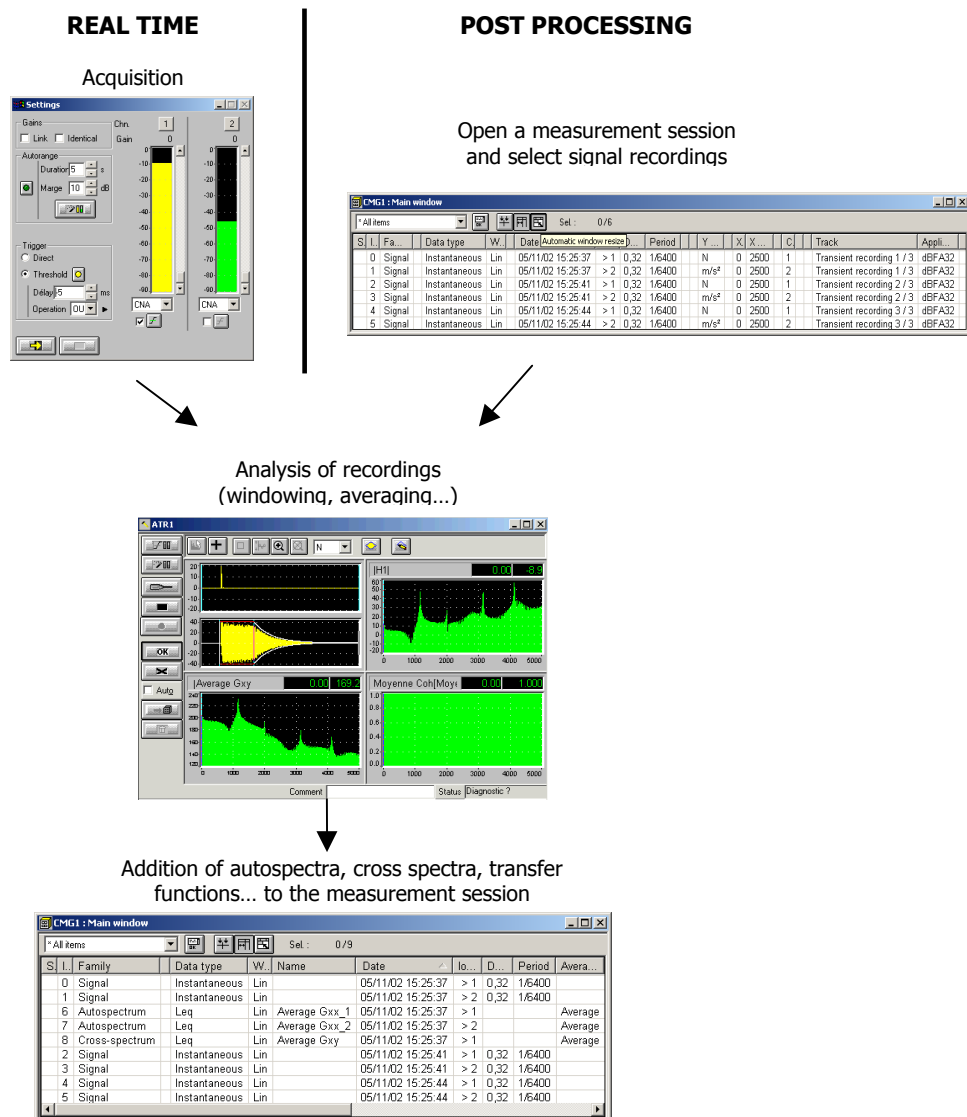
The principle of transient analysis is based on the **averaging of several measurements** performed on a same point.

Usually the excitation is carried out using an impact hammer connected to a channel of the acquisition platform. An accelerometer connected to another channel is used to receive the transmitted signal.

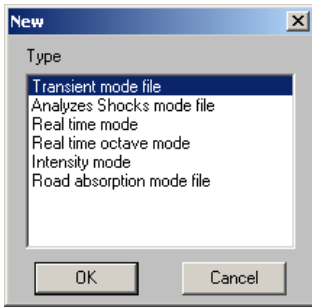
For each impact on a measurement point, an FFT analysis is performed and a recording of the signal can be stored.

Transient analysis can be performed either in **post-processing** mode (*.BTR files) on existing signal recordings, or in **real time** (*.ATR files).

The scheme below summarises the operating principle of transient analysis in **dBFA32**.



10.1. Real-time analysis



Use the command **Acquisition / New measurement set-up** to start a new measurement. The dialogue box shown opposite appears on screen.

Select **Transient Mode file** and click on **OK**.

When a real-time transient analysis document is active, the **File / Save** and **File / Save as** commands can be used at any time to store the measurement set-up on the hard disk. The document set-up is stored in a file with a *.ATR extension.

The *.ATR file includes all measurement and display parameters. It is then possible to load a real-time transient analysis document and to have the exact same set-up as during the recording (use **Acquisition / Open a measurement set-up**).

10.1.1. Description of the measurement window










The real-time transient analysis module of dBFA32 allows to display in a same window the **time history** of the signal, as well as one or several **spectra** calculated according to user-selected analysis parameters.

Action toolbar:
Acquisition, storage, analysis parameters and commands for measurement control









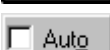
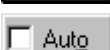


Display toolbar:
Signal display and windowing parameters

Status bar: used to enter a comment, view the status of the analysis process and the number of elements remaining to be acquired - processed.

The **Display toolbar** of the transient analysis window is used to perform the following operations:

-  Select graphs to display
-  View layout
-  Activate / Deactivate zoom autoscale
-  Perform an autoscale on a part of the signal view (zoom)
-  Activate the partial signal view (zoom) **
-  Deactivate the partial signal view (zoom) **
***: Zoom functions are inactive in Windowing Editing mode.*
-  Select display unit
-  (inactive) Apply windowing parameters to signal view
-  (active) Switch to windowing editing mode

The **Action toolbar** of the transient analysis window is used to perform the following operations:

-  Launch threshold and gain setting.
Required prior to any measurement.
-  Launch automatic gain setting (autorange).
-  Set processing parameters (acquisition + calculation).
-  Stop processing (acquisition + calculation).
-  Launch processing (acquisition + calculation).
-  **OK** Validate current result.
-  **X** Reject current result.
-  **Auto** Automatic validation of current result.
-   Transfer results to measurement session file.
-   Reset processing and discard current results.

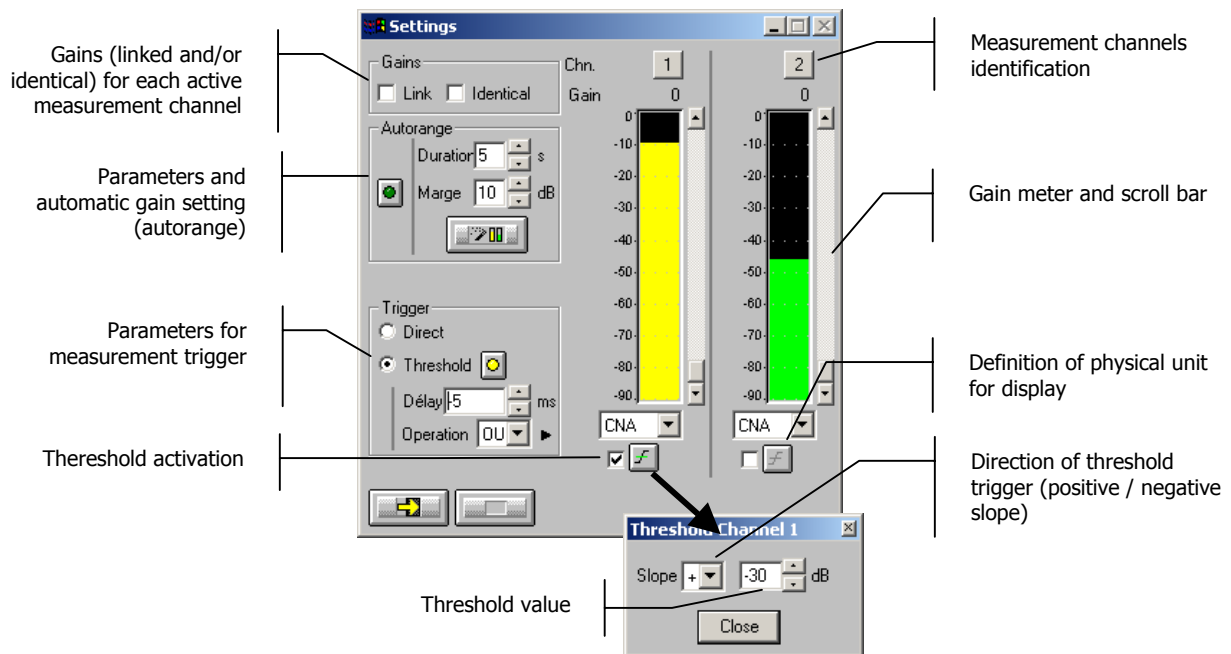
Refer to Section 10.1.4 for detailed information on the different stages in the analysis.

10.1.2. Measurement set-up

All these functions are accessible from the (vertical) action toolbar in the measurement window.

10.1.2.1. Threshold and gain settings and autorange

Gain and threshold parameters are defined in this dialog box, which is used by the program in many different ways. Thus, all functions are modular, that is all available parameters and actions can be activated or deactivated depending on the module using this function.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange

Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level. The gain view meters may display the input levels according to three different units:

- **dB**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.

- **Unit:** Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2 .



The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management** (see **paragraph 19.1**).



Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

10.1.2.2. Measurement set-up



Use the **Actions / Processing / Parameters (F5)** command to define the transient measurement parameters.

Recording

Bandwidth: enter the bandwidth to use for the signal recordings (that may be stored – see storage). If the “Linked to the analysis” option is checked, this value is automatically aligned on the value of the analysis bandwidth.

Number of impacts: defines the number of impacts that will be averaged (impact hammer or shotgun, for instance).

Measurement mode (Threshold or MLS):

- **Threshold mode:** the threshold value is defined in the gain and threshold setting dialog box. The total time length of the measurement can be entered only if the “Linked to the analysis” is unchecked.

- **MLS mode:** in addition to setting the threshold mode, switching to the MLS mode allows for the input of the number of averages. The total duration displayed at the bottom takes this value into account.

Analysis

Enter the bandwidth and the number of lines.

Remark:

The bandwidth and the number of lines selected for the analysis should comply with the performed signal recordings.

- Let D be the **duration** of the recording (s)
- BP the **bandwidth** of the recording (Hz)
- N the **number of points** in the recording
- BPa the analysis **bandwidth**

$$N = D * BP * 2.56$$

The **maximum number of line (L)** for the analysis is then:

$$L - 1 = (N / 2.56) * (BPa/BP)$$


Storage

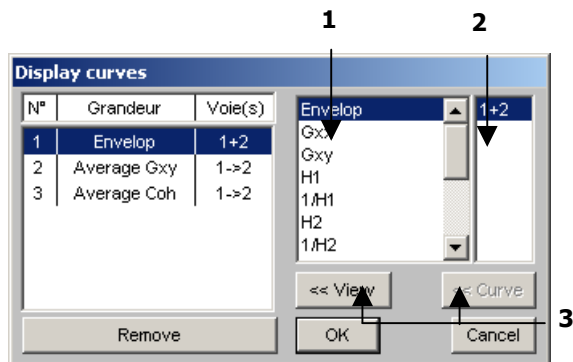
Save the signal recordings: check this option to transfer the acquired recordings to the measurement session at the end of the analysis process.

10.1.3. Display and windowing set-up

All these functions can be accessed from the (vertical) display toolbar in the measurement window.

10.1.3.1. Curves to display

Use the  **Plot / Curves** command to define data to display in the measurement window. The dialog box below is displayed:



Gxx: Autospectra
 Gxy: Cross spectrum
 H1,H2,1/H1,1/H2...: transfer functions

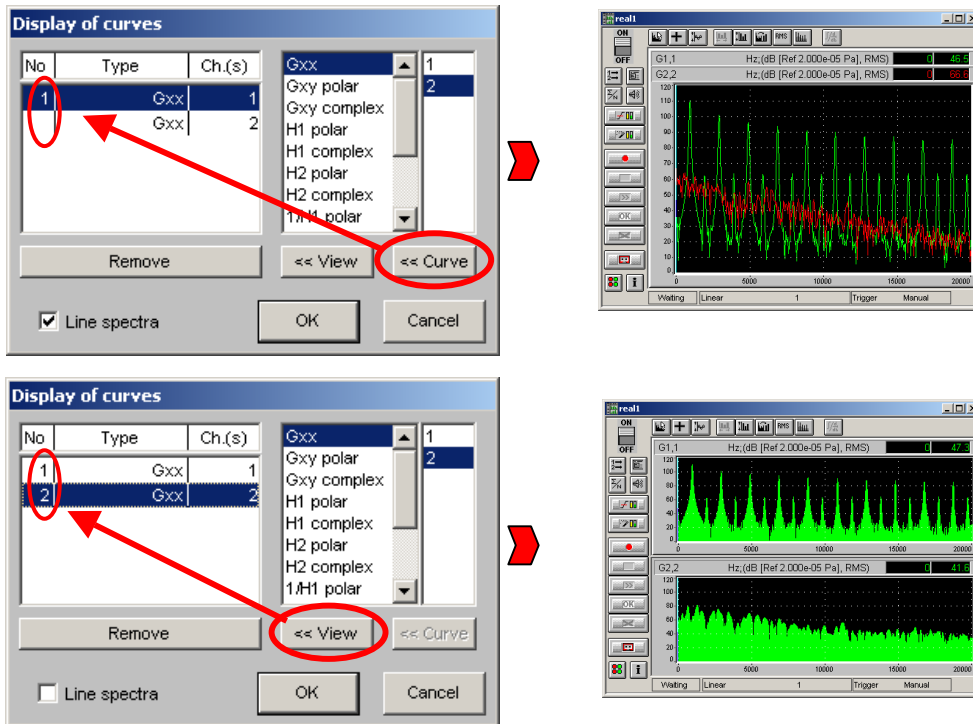
- 1 Select the **magnitudes to display** among the magnitude list.
- 2 The right column in the dialog box is used to relate the selected magnitude to the appropriate measurement channels(s).

For instance, when working with two measurement channels, this column is used to select the channel when displaying an autospectrum.

- 3 Curves displayed on screen will be those displayed in the left part of the box.

To add a new spectrum plot to the list, use the **View** button. To superimpose a spectrum to an existing plot, use the **Curve** button.

The program allows to display as many plots as you want in the real-time measurement window, as well as to superimpose several curves in the same view (when all curve types are compatible). An example thereof is shown below:

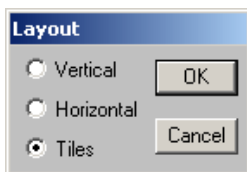


Display functions of the measurement window allow for the display of as many views as the system resources will allow. Moreover, for each curve, it is possible to superimpose up to 6 spectra of compatible type (same magnitude and channel with the same type of transducer).

If too many curves are selected for display, a message is displayed indicating that the system resources are too low for this operation.

10.1.3.2. Layout set-up

Use the **Plot / Layout** command to control the layout of the graphs inside the real-time window.



This dialog box is used to control the layout of the graphs within the real-time window. Horizontal, vertical or tile display can be selected.


10.1.3.3. Automatic adjusting of the display dynamic range

Use the **Plot / Autoscale (F9)** command to adjust the display dynamic range for all existing curves according to existing levels.

The autoscale operation automatically adjusts Y scales of all curves in order to obtain a correct display of all curves.

Use the **Plot / Automatic autoscale** to perform this setting in a systematic way.

10.1.3.4. Signal windowing

Use the  **Actions / Windowing** to apply the user-defined **weighting window** to the time history plot and to the calculated spectra.



When the function is **not active**, the time signal is displayed without taking the windowing parameters into account.



When the function is **active**, the time signal is updated with the selected windowing parameters.

When activating this function, calculated spectra are also updated, but if the windowing parameters are modified, spectra need to be updated using the windowing editing mode.

To modify the windowing parameters, use the editing function described hereafter.

10.1.3.5. Editing windowing parameters

dBFA32 transient analysis module is used to apply user-defined weighting windows to the acquired signal using a simple and powerful graphic interface.

It is possible to append segments of windows from different types, the duration of which can be set by the user.

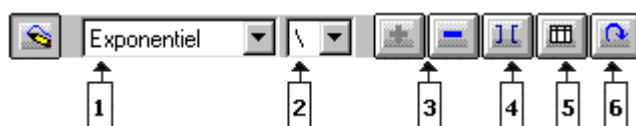
Procedure for windowing creation

Go to the windowing "Editing" mode

The transient analysis mode in **dBFA32** isolates specific phenomena on the spectral response by controlling very precisely the weightings applied to the signal.

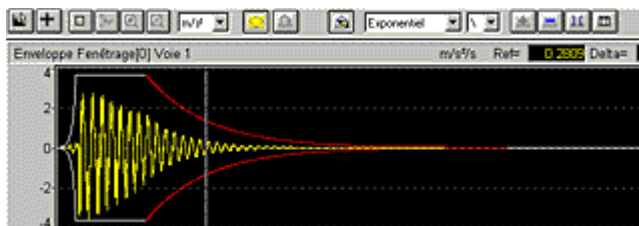
The editing bar is accessed by clicking on  in the display toolbar of the transient measurement window (or use the **Windowing / Editing mode** command).

The toolbar shown below is then display above the signal representation:



In editing mode, use the active cursor to select the window segments in the signal display. You can then modify the selected (red) segments.

In the example below, the exponential segment (negative slope) is selected (red). Its type and duration can now be modified as explained hereafter.

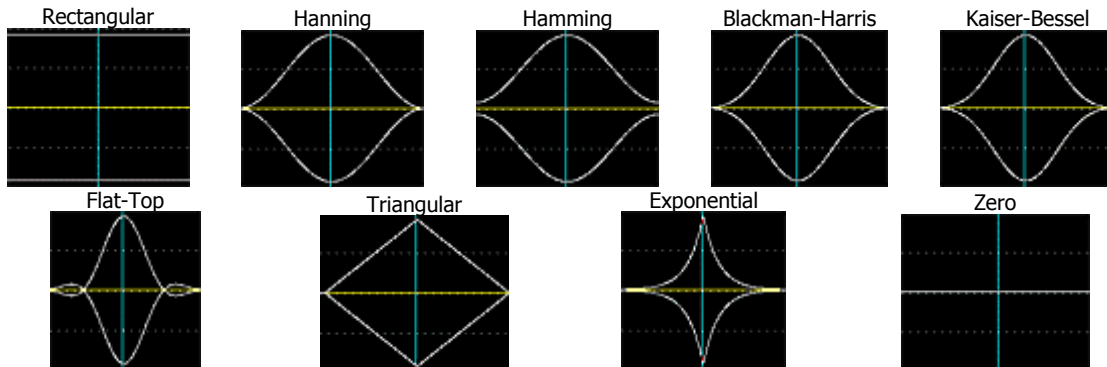


 The windowing creating / editing graphic interface always operates by creating segments **from left to right**.

1 Select the window type

Use the pop-up menu  or the **Window / Edit segment / Type** command.

Select the type of window to insert using the pop-up menu. The following window types are available:



2 Select the type

Use the pop-up menu  or **Window / Edit segment / Direction** to select if only the **positive slope (/)**, the **negative slope (\)** or the complete window (**/**) will be included into the inserted segment.

Remark: In the above views both the positive slope and the negative slope are inserted.

3 Add / Delete a window



or **Window / Add (or delete) a segment**

Once the type of window and the slope are selected, position the cursor to define the **right limit of the section**. The **left limit** is always the end of the previous section (or the beginning of the signal is no section has been defined yet).




Add a segment: it is displayed in white on the signal view.





Delete a segment: it must first be selected with the cursor (it is displayed in red).

If there were existing segment left of the deleted segment, they will be moved to the left.

4 Go to the "Adjusting segment limits" mode


Use  **Window - Adjust segment** to redefine the width of all segments defined graphically.

- **Select** the segment to resize with the cursor.
- Click on  (or go to **Window / Adjust segment**): you now have **two cursors** at the right and left limits of the segments.
- **Move** these cursors to redefine the segment width.
- Click on  to **quit** the adjusting mode.

Repeat this operation to resize other segments of the signal.

5 List of segments used


N°	Start (ms)	Duration (ms)	Cumul (ms)	Type
1	0.00	9.38	9.38	Zeros \
2	9.38	10.00	19.38	Hanning /
3	19.38	183.91	203.28	Rectangular /
4	203.28	116.56	319.84	Exponential \

Use  **Window / List** to view the following parameters for each segment:

- **Beginning** (ms): position of the segment left limit
- **Duration** (ms) of segment
- **Cumulative** (ms): cumulative length of the segment and of all segments at its left
- **Type**: Type of window and sign of the slope

6 Update the calculation

Use  or **Window / Update** to **redo the spectrum calculation** and take into account the modified windowing.

If you are not in Editing mode, use the signal update function () to update the spectrum calculation.

To view the action of the windowing on the signal, use the **Signal windowing** function (see Section 10.1.3.4).

10.1.4. Real-time transient analysis process

10.1.4.1.1. Procedure

- 1 Definition of the hardware configuration corresponding to transient analysis (see Chapter 3).
- 2 Calibration of the measurement chain (see Chapter 4).
- 3 Creation of a new transient measurement set-up:

Acquisition / New measurement set-up / Transient mode.

- 4 Automatic () or manual () **gain setting** and definition of a trigger **threshold** on at least one measurement channel (see Section 10.1.2.1).

 **Definition of a threshold prior to acquisition is compulsory.**

- 5 Setting of **processing parameters**  (F5)

Acquisition, analysis and storage parameters(see Section 10.1.2.2).

- 6 Setting of **display and windowing parameters** and possible recalculation of the signal and of the spectrum according to the windowing parameters (see Chapter 10.1.3).

7 Processing of recordings



Launch processing according to defined parameters (F3).



Abort processing (F4).

Diagnosis



Validate current result (F7). This function carries on the averaging of the results yet to come with the previous results.



It can be automated by checking the "Auto" box (Actions / Diagnosis / Automatic).



Reject current result (F6).

Decision

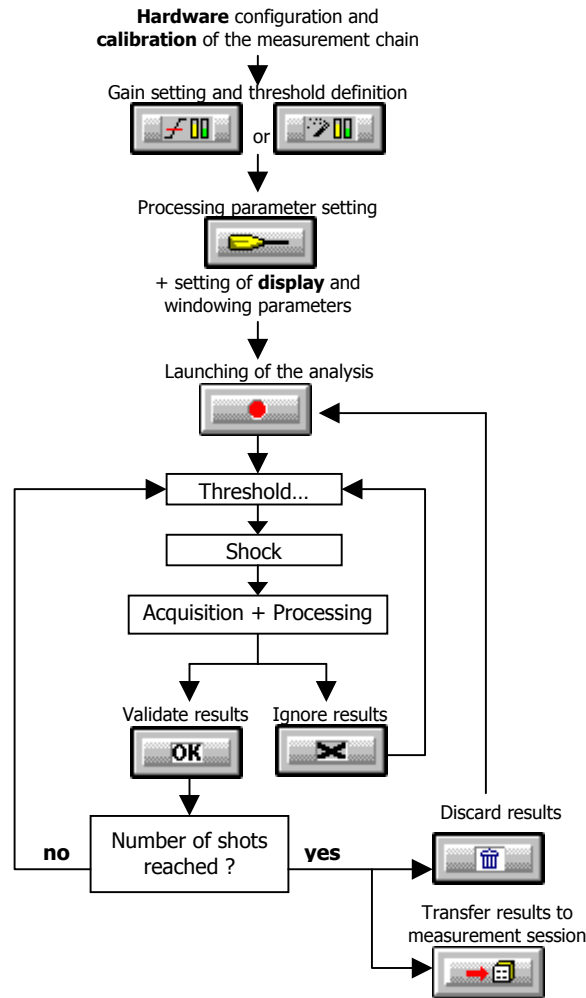


Transfer result into measurement session file (F12)
Measurement results are stored in a measurement session (campaign).



Reset processing and discard current results (F11)

10.1.4.1.2. Flow chart






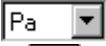





10.2. Post-processing analysis

To create a new post-processing transient analysis set-up, use the **Analysis / New analysis set-up** command. To save measurement and display parameters into a *.BTR file, use the **File / Save as** command. You can thus load an analysis and be in the exact same configuration as during the recording (**Analysis / Open analysis configuration**).











10.2.1. Description of the analysis window

The transient analysis module in **dBFA32** displays in a single window the **time history** of the signal and one or several **spectral views** calculated using the user-defined analysis parameters.

The **Display toolbar** in the transient analysis window gives access to the following functions:

	Select curves to display		Deactivate partial signal view (zoom) ** <i>**: zoom functions are not active in Editing mode</i>
	Layout		Select display unit
	Activate / Deactivate the zoom automatic autoscale		Apply windowing parameters to signal display
	Perform an autoscale in the partial signal view (zoom).		Go to Window Editing mode
	Activate partial signal view (zoom) **		

The **Action toolbar** in the transient analysis window gives access to the following functions:

	Transfer Signal items selected in the measurement session to the batch (elements to process).		Validate current result.
	View / Edit current batch (elements to process).		Ignore current result.
	Set processing parameters.		Automatic validation of current result.
	Stop processing.		Transfer results to measurement session.
	Start processing.		Reset processing and discard current results.

Refer to Section 10.2.4 for more information on the analysis process.

10.2.2. Analysis set-up

All these functions can be accessed from the (vertical) Action tool bar in the measurement window.

10.2.2.1. Batch window (elements to process)

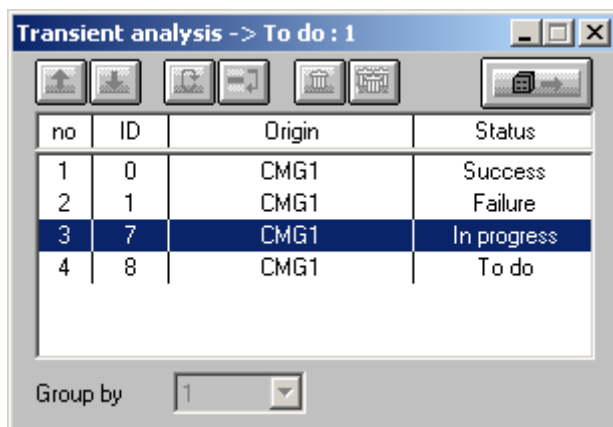


or **Actions / Batch** (F8) to manage the list of Signal items to process with the transient analysis module in **dBFA32**.

The number of items still to process is displayed in the title bar.



Use this icon to import signal items into the transient analysis module without using the batch window. It is recommended to use the batch window shown below to view the progress the of the analysis process.



The **status** of the processing is displayed for each item, along with its **origin** (target session) and its **identification** number (ID) in the session.



Transfer selected elements to an open session.



Sort the analysis order for the signal recordings.



Reset the batch.

The status of the elements changes to **"To do"**. This function can be used to relaunch an analysis using a different windowing on a set of existing recordings.



Deactivate the processing for the selected element (the status is **"Idle"**).



Delete the selected element from the batch.



Delete all elements from the batch.

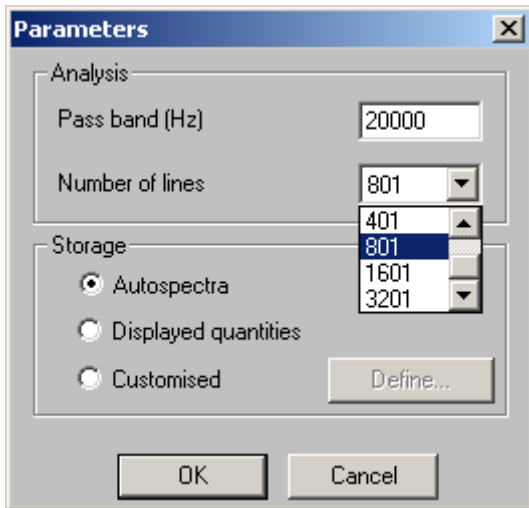
"Group by" (1 or 2): Process elements one after the others or by groups of 2 elements (two-channel recordings).

If the number of elements to process is odd and that they are processed by groups of two, then the last element becomes inactive in the batch (it will not be processed).

10.2.2.2. Analysis set-up



or **Actions / Analysis / Parameters** (F5) to define transient analysis parameters.



The following parameters can be defined:

- Bandwidth
- Number of lines
- Type of storage

Upon closing this box, the new analysis parameters will be applied.

Remark:

The bandwidth and the number of lines selected for the analysis must comply with the signal recordings already performed.

Let D be the **duration** of the recording
 BP the **bandwidth** of the recording (Hz)
 N the **number of points** in the recording
 BPa the analysis **bandwidth**

$$N = D * BP * 2.56$$

The **maximum number of lines L** for the analysis is then:

$$L - 1 = (N / 2.56) * (BPa/BP)$$

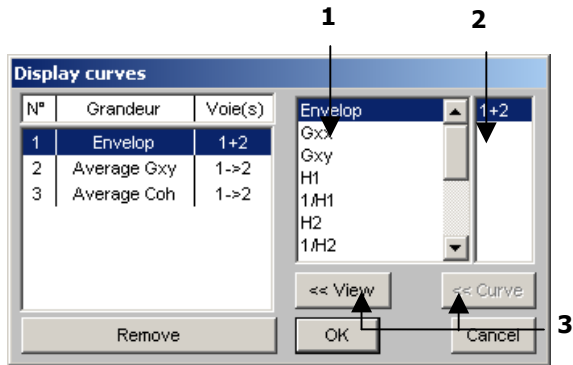
10.2.3. Display and windowing set-up

All these functions can be accessed from the (horizontal) Display toolbar in the measurement window.

10.2.3.1. Curves to display



or **Plot / Curves** to define the data to display in the measurement window. The dialog box below is displayed on screen.



Gxx: Autospectra
Gxy: Cross spectrum

H1,H2,1/H1,1/H2...: transfer functions

Envelope: Signal view

❶ Select the **magnitudes to display** among the magnitude list.

❷ The right column in the dialog box is used to relate the selected magnitude to the appropriate measurement channels(s).

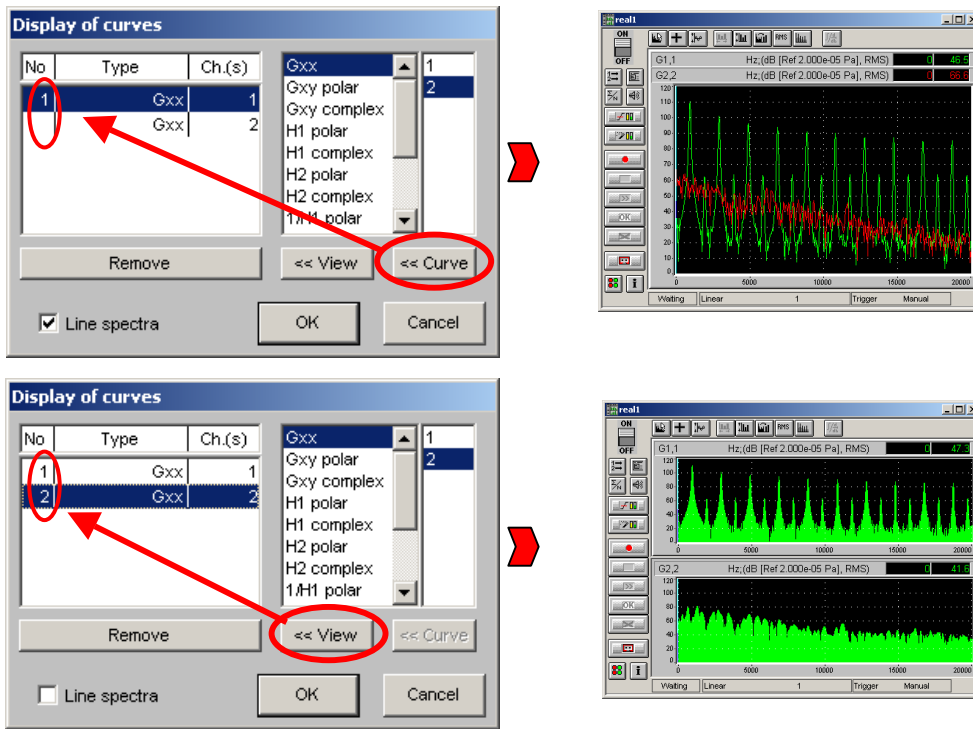
For instance, when working with two measurement channels, this column is used to select the channel when displaying an autospectrum.

❸ Curves displayed on screen will be those displayed in the left part of the box.

To add a new spectrum plot to the list, use the **View** button. To superimpose a spectrum to an existing plot, use the **Curve** button.

The program allows to display as many plots as you want in the real-time measurement window, as well as to superimpose several curves in the same view (when all curve types are compatible).


An example thereof is shown hereafter:



Display functions of the measurement window allow for the display of as many views as the system resources will allow. Moreover, for each curve, it is possible to superimpose up to 6 spectra of compatible type (same magnitude and channel with the same type of transducer).

If too many curves are selected for display, a message is displayed indicating that the system resources are too low for this operation.


10.2.3.2. Layout set-up

Use the  **Plot / Layout** command to control the layout of the graphs inside the real-time window.



This dialog box is used to control the layout of the graphs within the real-time window. Horizontal, vertical or tile display can be selected.


10.2.3.3. Automatic adjusting of the display dynamic range


Use the  **Plot / Autoscale (F9)** command to adjust the display dynamic range for all existing curves according to existing levels.


The autoscale operation automatically adjusts Y scales of all curves in order to obtain a correct display of all curves.

Use the  **Plot / Automatic autoscale** to perform this setting in a systematic way.

10.2.3.4. Signal windowing

Use the  **Actions / Windowing** to apply the user-defined **weighting window** to the time history plot and to the calculated spectra.

 When the function is **not active**, the time signal is displayed without taking the windowing parameters into account.

 When the function is **active**, the time signal is updated with the selected windowing parameters.

When activating this function, calculated spectra are also updated, but if the windowing parameters are modified, spectra need to be updated using the windowing editing mode.

To modify the windowing parameters, use the editing function described hereafter.

10.2.3.5. Editing windowing parameters

dBFA32 transient analysis module is used to apply to the acquired signal user-defined weighting windows using a simple and powerful graphic interface.

It is possible to append segments of windows from different types, the duration of which can be set by the user.

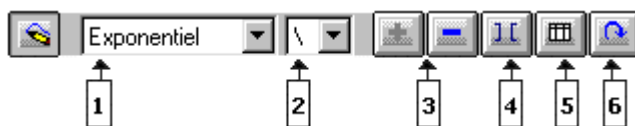
Procedure for windowing creation

Go to the windowing "Editing" mode

The transient analysis mode in **dBFA32** isolates specific phenomena on the spectral response by controlling very precisely the weightings applied to the signal.

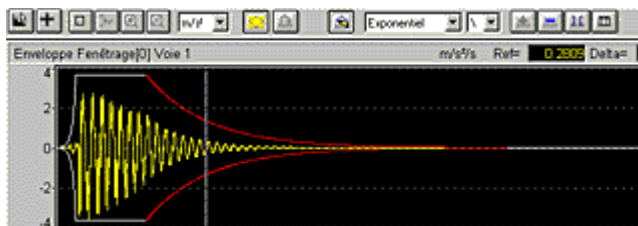
The editing bar is accessed by clicking on  in the display toolbar of the transient measurement window (or use the **Windowing / Editing mode** command).

The toolbar shown below is then display above the signal representation:



In editing mode, use the active cursor to select the window segments in the signal display. You can then modify the selected (red) segments.

In the example below, the exponential segment (negative slope) is selected (red). Its type and duration can now be modified as explained hereafter.

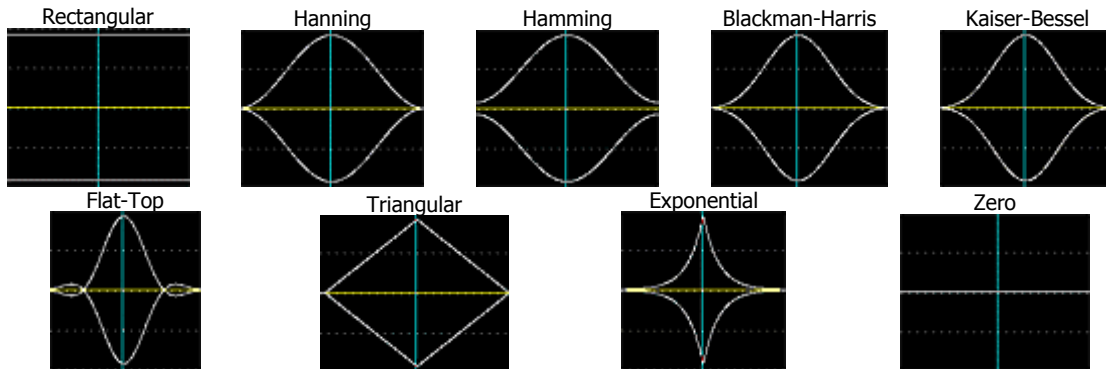


 The windowing creating / editing graphic interface always operates by creating segments **from left to right**.


1 Select the window type

Use the pop-up menu  or the **Window / Edit segment / Type** command.

Select the type of window to insert using the pop-up menu. The following window types are available:



2 Select the type

Use the pop-up menu  or **Window / Edit segment / Direction** to select if only the **positive** slope (/), the **negative** slope (\) or the complete window (/ \) will be included into the inserted segment.


Remark: In the above views both the positive slope and the negative slope are inserted.

3 Add / Delete a window


  or **Window / Add (or delete) a segment**



Once the type of window and the slope are selected, position the cursor to define the **right limit of the section**. The **left limit** is always the end of the previous section (or the beginning of the signal is no section has been defined yet).

 **Add** a segment: it is displayed in white on the signal view.

 **Delete** a segment: it must first be selected with the cursor (it is displayed in red).
If there were existing segment left of the deleted segment, they will be moved to the left.

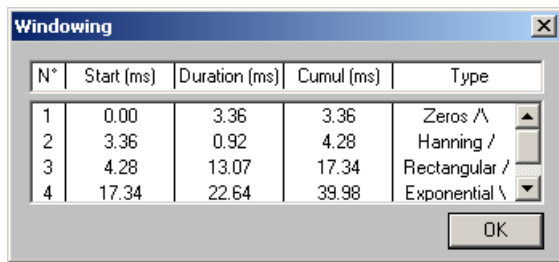
4 Go to the "Adjusting segment limits" mode

Use  **Window - Adjust segment** to redefine the width of all segments defined graphically.


- **Select** the segment to resize with the cursor.
- Click on  (or go to **Window / Adjust segment**): you now have **two cursors** at the right and left limits of the segments.
- **Move** these cursors to redefine the segment width.
- Click on  to **quit** the adjusting mode.

Repeat this operation to resize other segments of the signal.

5 List of segments used




N°	Start (ms)	Duration (ms)	Cumul (ms)	Type
1	0.00	3.36	3.36	Zeros /\
2	3.36	0.92	4.28	Hanning /
3	4.28	13.07	17.34	Rectangular /
4	17.34	22.64	39.98	Exponential \

Use  **Window / List** to view the following parameters for each segment:

- **Duration** (ms): position of the segment left limit
- **Duration** (ms) of segment
- **Cumulative** (ms): cumulative length of the segment and of all segments at its left
- **Type**: Type of window and sign of the slope

6 Update the calculation

Use  or **Window / Update** to **redo the spectrum calculation** and take into account the modified windowing.

If you are not in Editing mode, use the signal update function () to update the spectrum calculation.

To view the action of the windowing on the signal, use the **Signal windowing** function (see Section 10.1.3.4).

10.2.4. Description of a post-processing transient analysis

10.2.4.1.1. Procedure

1 **Open** one or several measurement sessions and **select** Signal items (elements) to analyse.

2 Open the post-processing transient analysis window using **Analysis / New analysis set-up**.

3  Retrieve selected Signal elements from active session.
and/or



Use **batch** window to:

- view elements to process
- group Signal items by two in case of a two-channel recording
- import other Signal items from an open session
- deactivate the analysis on one of the item...

See Section 10.2.2.1.

4 Set **processing parameters**  (F5)

Analysis and storage parameters (see Section 10.2.2.2).

5 Set **display and windowing parameters** and recalculate signal and spectrum according to windowing parameters (see Section **Erreur! Source du renvoi introuvable.**).

6 Process recordings



Launch processing according to defined parameters (F3).



Abort processing (F4).

Diagnosis



Validate current result (F7). This function carries on the averaging of the results yet to come with the previous results.



It can be automated by checking the "Auto" box (Actions / Diagnosis / Automatic).



Reject current result (F6).

Decision

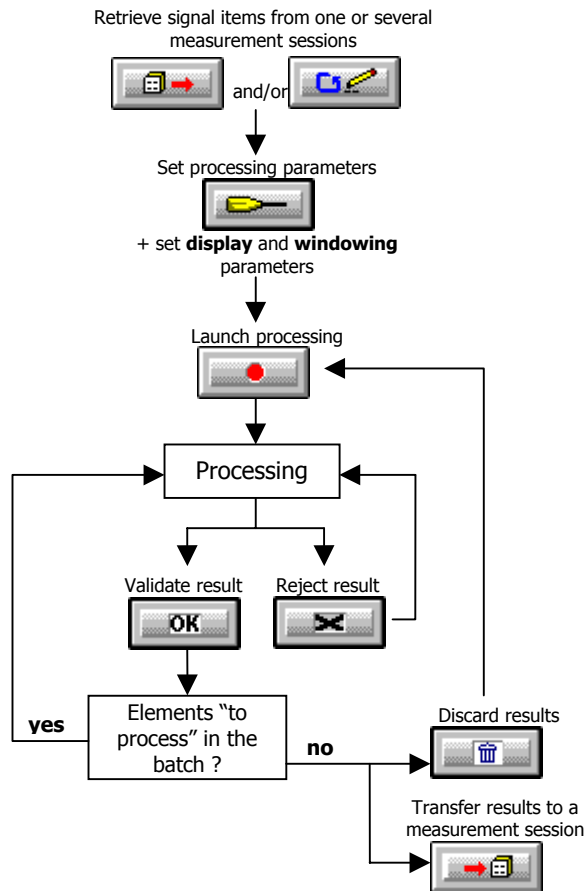


Transfer result into measurement session file (F12)
Measurement results are stored in a measurement session (campaign).



Reset processing and discard current results (F11)

10.2.4.1.2. Flow chart



11. ORDER EXTRACTION

Order analysis is based on the frequency analysis of a system's sound or vibration emission, which is related to its rotation speed and the harmonics of the rotating parts (orders).

This measurement method mainly applies to **rotating machinery** with fixed or variable speed. One can thus observe effects generated by rotating elements and their amplifications due to structural resonances.

During an order analysis, one or several sound or vibration measurement channel and one tachometric signal are recorded simultaneously.

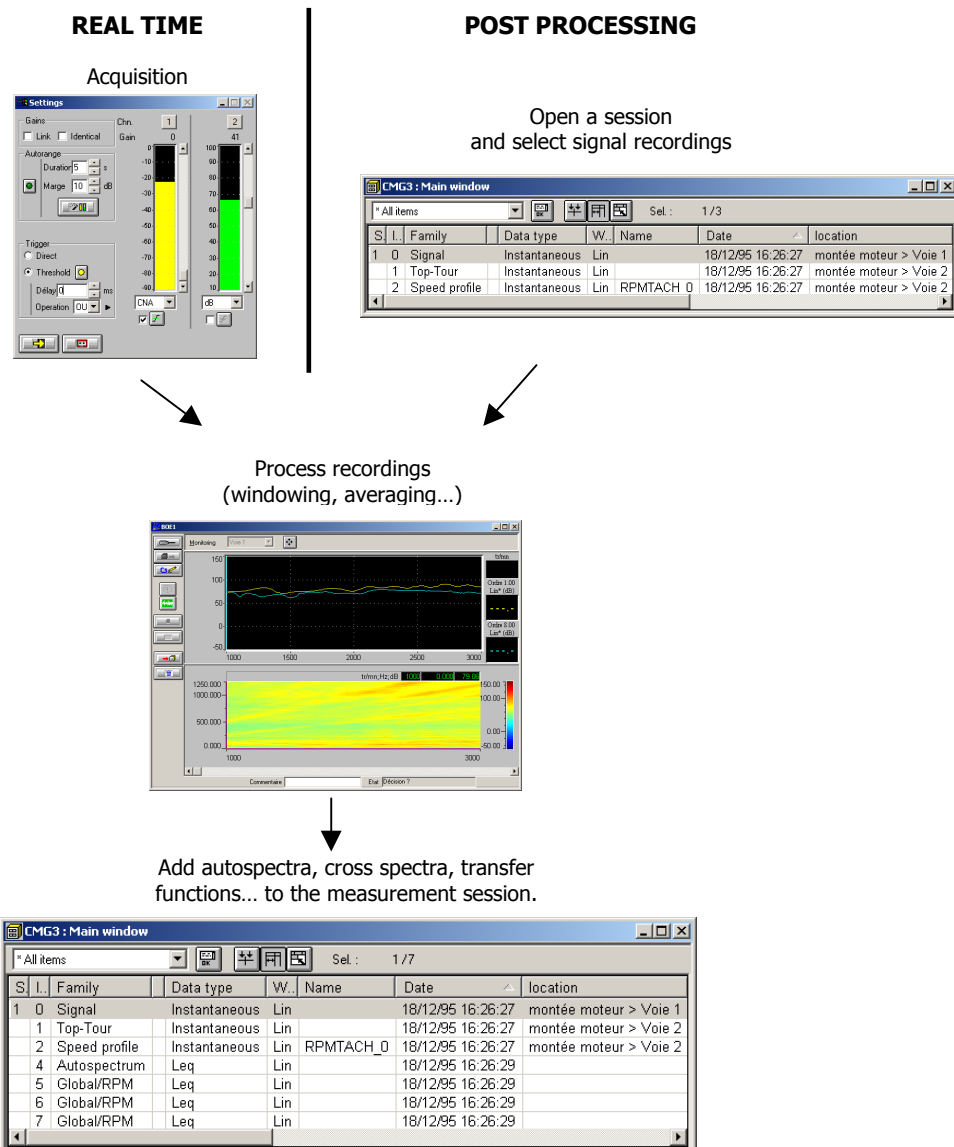
With **dBFA32**, order extraction can be carried out from a **FFT frequency analysis**:

- Either in **real time** (*.AOE files) from sound and vibration signals and from a tachometric signal (recorded on a tachometric channel),
- Or in **post-processing** mode (*.BOE files), on existing recordings (in this case, the tachometric signal can be acquired on a dynamic channel to be analysed more precisely).

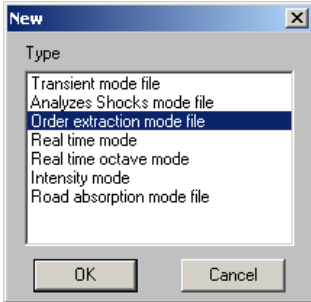


Caution! Do not mix up **order extraction** and **order tracking**.

During an order analysis with **order tracking**, the signal is sampled according to the system rotation speed, whereas an order analysis with **order extraction** is carried out from a FFT frequency analysis.



11.1. Real-time analysis



Select **Acquisition / New measurement set-up** to start a new measurement and display the dialog box shown opposite.

Select **Order Extraction File** and click on **OK**.

When an analysis document is active, the **File / Save** and **File / Save as** commands can be used at any time to store the measurement set-up on the hard disk. The document set-up is stored in a file with a *.AOE extension.

The *.AOE file includes all measurement and display parameters. It is then possible to load a real-time order extraction document and to have the exact same set-up as that of the recording (use **Acquisition / Open a measurement set-up**).

11.1.1. Description of the measurement window

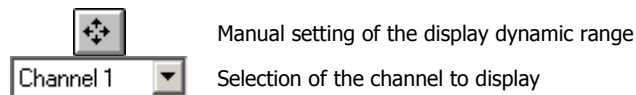
The real-time order extraction module of **dbFA32** allows to display - in the same window - the **history** of overall levels, of order, as well as a sonagram calculated according to user-selected analysis parameters.

Display toolbar:
Display parameters

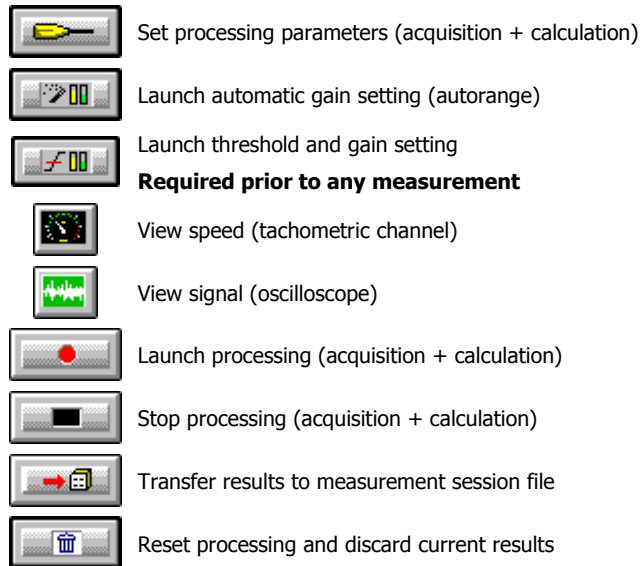
Action toolbar:
Acquisition, storage, analysis parameters and commands for measurement control

Status bar: used to enter a comment, view the status of the analysis process and the number of elements remaining to be acquired - processed.

The **Display toolbar** of the order extraction window gives access to the following functions:



The **Action toolbar** of the order extraction window gives access to the following functions:



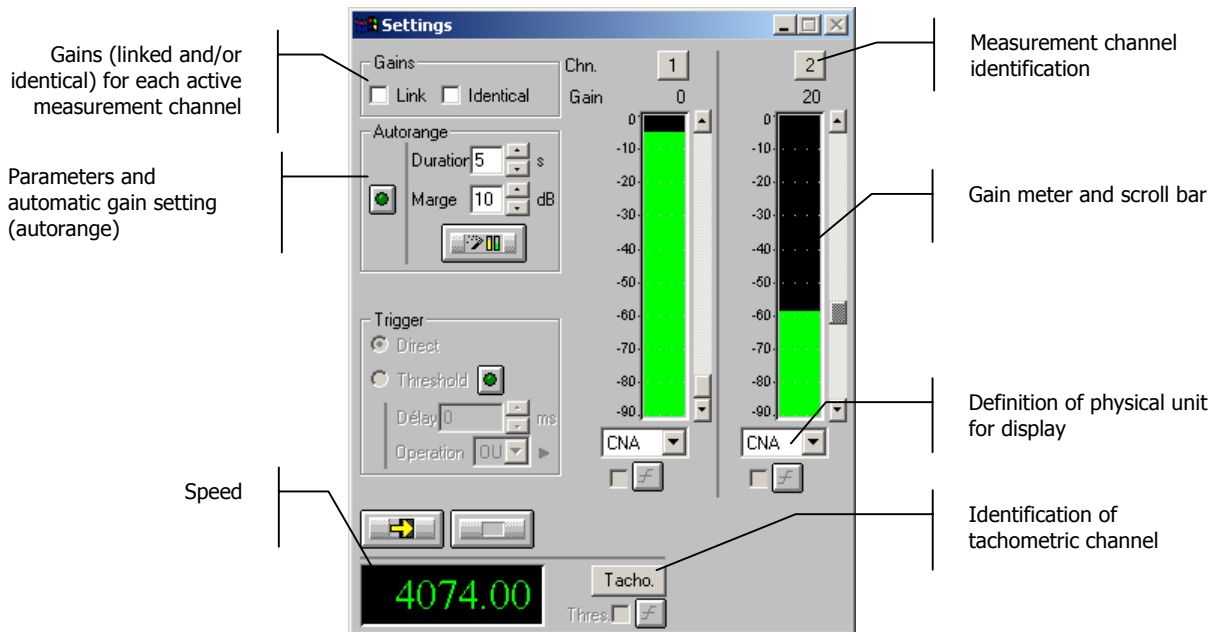
See Section 11.1.4 for a detailed description of the analysis process.

11.1.2. Measurement set-up

All these functions can be accessed from the (vertical) action toolbar in the measurement window.

11.1.2.1. Threshold and gain settings and autorange

Gain and threshold parameters are defined in this dialog box, which is used by the program in many different ways. Thus, all functions are modular, that is all available parameters and actions can be activated or deactivated depending on the module using this function.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.


The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjusts the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit for the input level. The gain view meters may display the input levels in three different units:

- **dB:** Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the 0 dB reference of the transducer type.
- **ADC:** Display the view meters in converter decibel. This is a relative level in dB. The 0 dB level is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit:** Display the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2 .

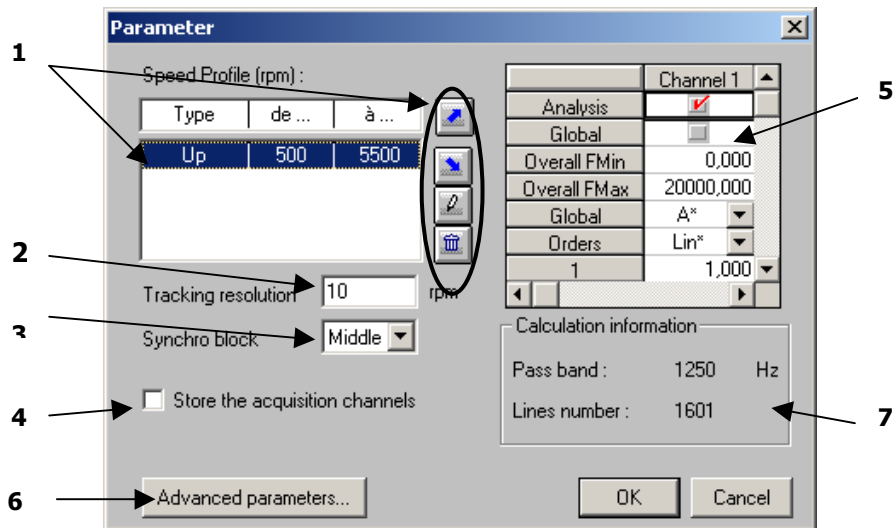
 *The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management** (see **paragraph 19.1**).*

11.1.2.2. Measurement set-up



or **Actions / Parameters** (F5) to define the measurement and analysis parameters for the order extraction.

This dialog box is used to set the parameters of the elements to analyse:



1 Definition of the parameters for the sequence of run-ups and/or coast-downs on a speed range to define **(Speed profile)**



add a run-up



add a coast-down



modify the run-up or coast-down value for the selected element



delete selected element

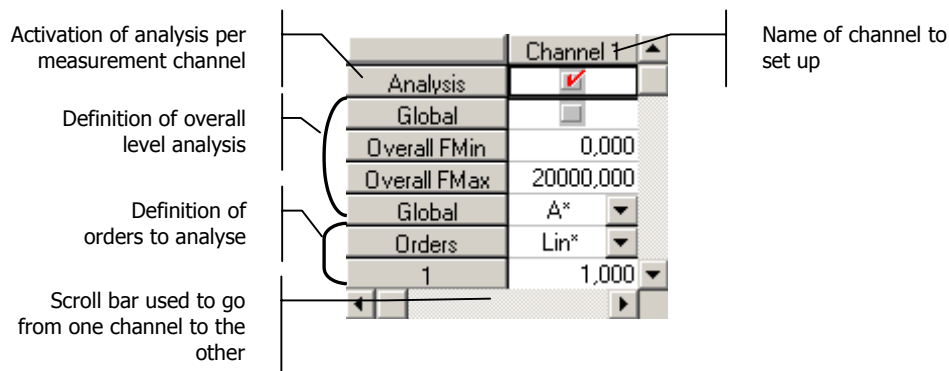
2 Use the **Tracking Resolution** to define the speed interval between two FFT spectrum calculations.

3 The **Block synchro** parameter is used to assign a FFT spectrum to a speed.

- Either the spectrum is assigned to the speed measured when the data storage (for spectrum calculation) started (**Start**),
- Or the spectrum is assigned to the speed measured when the said data storage ended (**End**),
- Or the spectrum is assigned to the average speed between the beginning and the end of data storage (**Middle**)

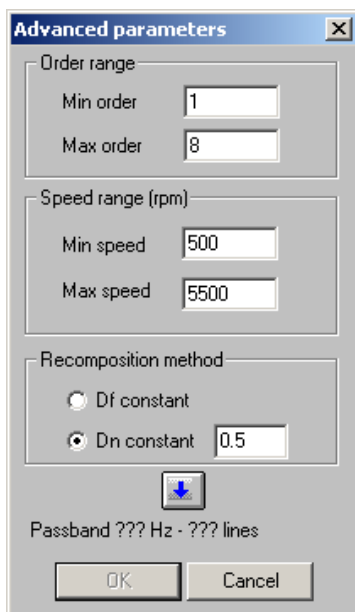
4 When the "**Store acquisition channels**" box is checked, signal recordings are stored in the measurement session at the end of the analysis process.

5 Definition of data to store in the measurement session. There is one column per channel.




- **Analysis:** Activation of analysis per measurement channel
- **Overall Fmin and overall Fmax:** Frequency limits for overall level calculation
- **Overall:** Activation of overall level analysis
- **Overall weight.:** Weighting applied to the overall level (if **Overall** is active)
- **Order weight.:** Weighting applied to the order calculation
- **1, 2, ..., 8:** Enter here the number of the order to extract from the analysis. Orders can be non-integer. 8 orders maximum can be extracted.


6 **Advanced parameters** are used to define measurement parameters (maximum frequency and number of lines) according to the study to carry out.



- **Order range:** Enter the limits for the study (minimum and maximum orders to extract).
- **Speed range:** Definition of the speed range for the whole study. It should include the speed profile (sequence of run-ups and/or coast-downs) defined previously (1).
- **Recomposition method:** Define which frequency band will be used for the energy calculation of orders.

With **Df constant**, the frequency band used to calculate the order will be a band of constant width Df.
 With **Dn constant**, the frequency band used to calculate the order energy will be a frequency band proportional to the speed, and increasing with the frequency (Df=Dn*Speed/60, with the speed in rpm).

When all parameters have been entered, click on  to launch the calculation of the bandwidth and of the required number of lines for the measurement, then validate.

 *Speed_{Max} (rpm) and Order_{Max} are used to calculate the bandwidth (BP). The number of lines N is calculated from the bandwidth and the most restricting Df (the smallest) according to the selected recomposition method, keeping in mind that at least 5 FFT lines are required by **dbFA32** in the extraction bandwidth.*

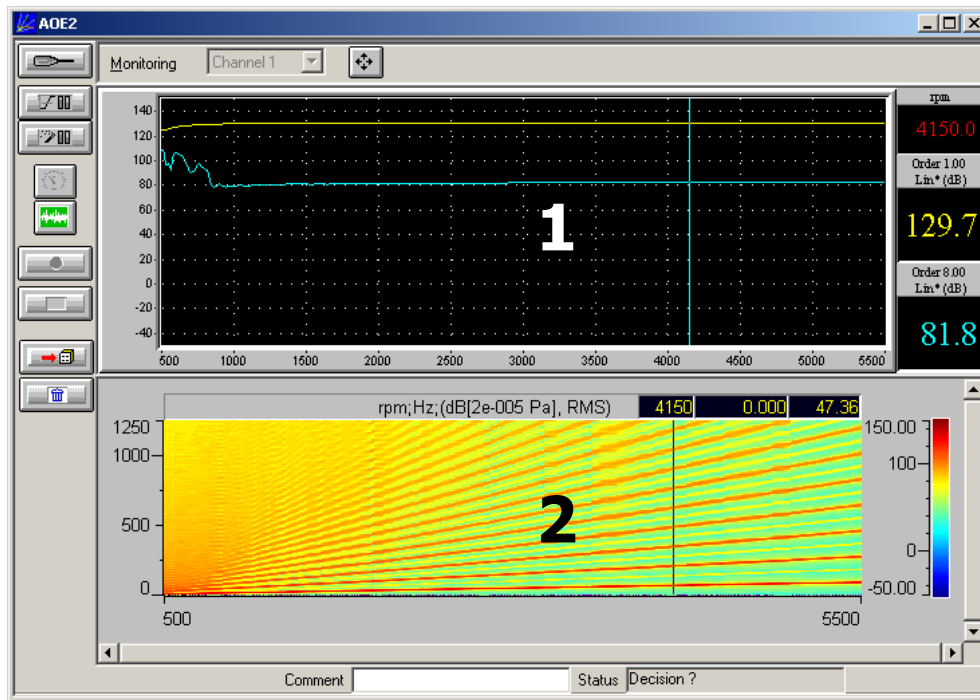
$$BP = \frac{Speed_{Max}}{60} \times Order_{Max} \qquad N = \frac{BP}{\left(\frac{Df}{5}\right)}$$

11.1.3. Display set-up

All these functions can be accessed from the (horizontal) display toolbar in the measurement window.

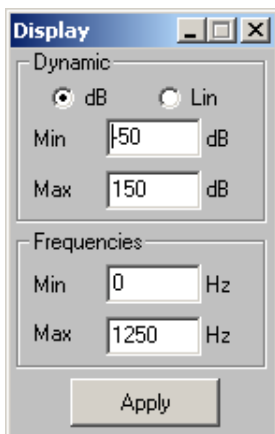
11.1.3.1. Measurement window

With the real-time order extraction module in **dBFA32**, the history of overall levels, orders **1** and a sonogram calculates according to analysis parameters selected by operator **2** can be displayed in the same window.




11.1.3.2. Display set-up

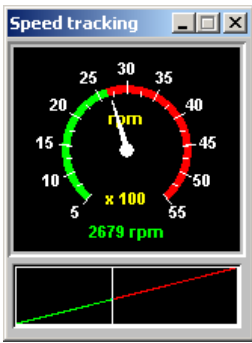
Select the measurement channel to display with .




Use  or **Plot / Parameters** to define the display dynamic range.

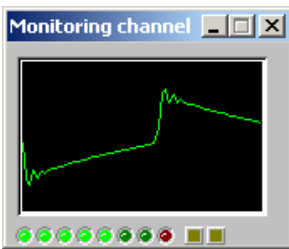
- **Dynamic:** set view **1**
- **Frequency:** set view **2**

It is also possible to display a meter showing the real-time speed using the  button,



Speed view

and to display the signal using .



Signal view

11.1.4. Description of the measurement

- ❶ Define hardware configuration adapted to the order extraction (see **Chapter 3**).
- ❷ Calibrate measurement chain (see **Chapter 4**).
- ❸ Create a new Order Extraction Mode measurement set-up.

Acquisition / New measurement set-up / Order Extraction Mode.

- ❹ Automatic () or manual () **gain** setting. Check tachometric signal:

1369.50

- ❺ **Processing parameter** setting  (F5)

Acquisition, analysis and storage parameters (See Section 11.1.2.2)

- ❻ Display setting (see Section 11.1.3.2)

 Speed meter

 Signal display

7 Launch measurements



Start measurement according to predefined parameters (F3)



Stop measurement (F4)



View speed variation within defined speed range

Decision



Transfer results to a measurement session (F7)



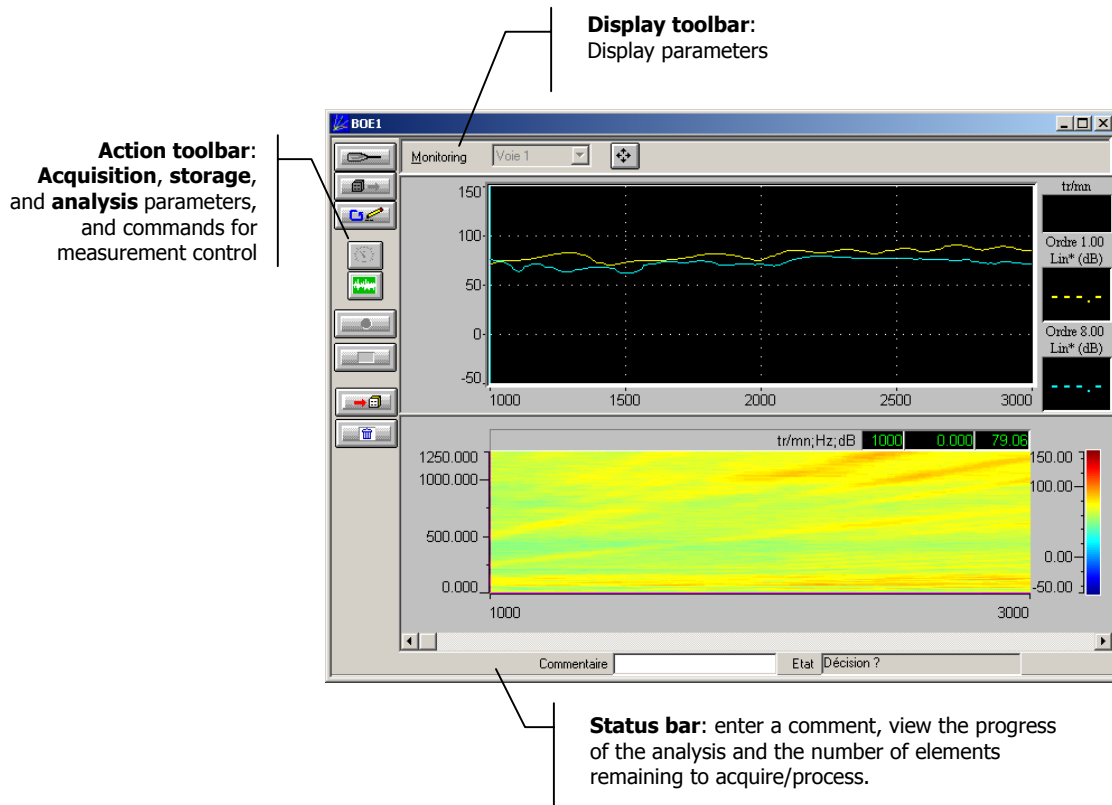
Discard current results

11.2. Post-processing analysis

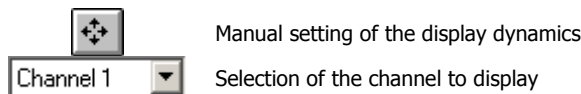
To create a new post-processing order extraction configuration, use the **Analysis / New analysis set-up** command. To save display and measurement parameters in a *.BOE file, use **File / Save as**. It is thus possible to load an analysis with the exact same configuration as that of the recording (**Analysis / Open analysis set-up**).

11.2.1. Description of the analysis window

In the post-processing order extraction module, it is possible to display in the same window the overall level and the order history, as well as a sonagram calculates according to the analysis parameters defined by the operator.



The following operations are available from the **Display toolbar** in the order extraction window:



The following operations are available from the **Action toolbar** in the order extraction window:

- | | | | |
|--|---|--|--|
| | Set processing parameters. | | Launch processing. |
| | Transfer selected elements from session to batch (elements to process). | | Stop processing. |
| | View / Edit current batch (elements to process). | | Transfer results to measurement session. |
| | View speed (tachometric channel). | | Discard current results. |
| | View signal (oscilloscope) | | |

Refer to Section 11.2.4 for a detailed description of the analysis process.

11.2.2. Analysis set-up

All these functions are available from the (vertical) action toolbar in the measurement window.

11.2.2.1. Batch window (elements to process)



Use **Actions / Edit** (F8) to manage the list of Signal and Speed profile items to process in the order extraction module of **dbFA32**. To be valid all items should be inserted in the batch in the following order:

- If grouping by two, put one Signal item, and then a Speed profile item
- If grouping by three, put two Signal items and then one Speed profile item
- ... Always put Signal items before Speed profile items.



To save time, select items in the active session, one by one, in the right order, by holding the "CTRL" key down, and insert all elements in the batch at the same time.

The number of items remaining to be processed is displayed in the title bar.



Use this icon to import Signal and Speed profile items in the order extraction module without using the batch window.

no	ID	Origin	Status
1	2;10	porelle.CMG;Order analys	Success
2	2;10	porelle.CMG;Order analys	Failure
3	2;10	porelle.CMG;Order analys	In progress
4	2;10	porelle.CMG;Order analys	To do

Group by: 2

The **status** of the processing is shown for each element, as well as its **origin** (target session) and its **identification** number (ID) in the session.



Transfer selected items from the session to the batch.



Sort signal recordings for analysis.



Reset the batch.

For all items in the batch, the status changes to "To process". This function can be used to restart an analysis using a different windowing on a set of existing recordings.



Deactivate the processing for the selected items (status = "**Inactive**").



Delete selected items from the batch.




Delete all items from the batch.

"Group by" (1 to 4): Process elements one after the other or by groups of two to four (multi-channel recordings).

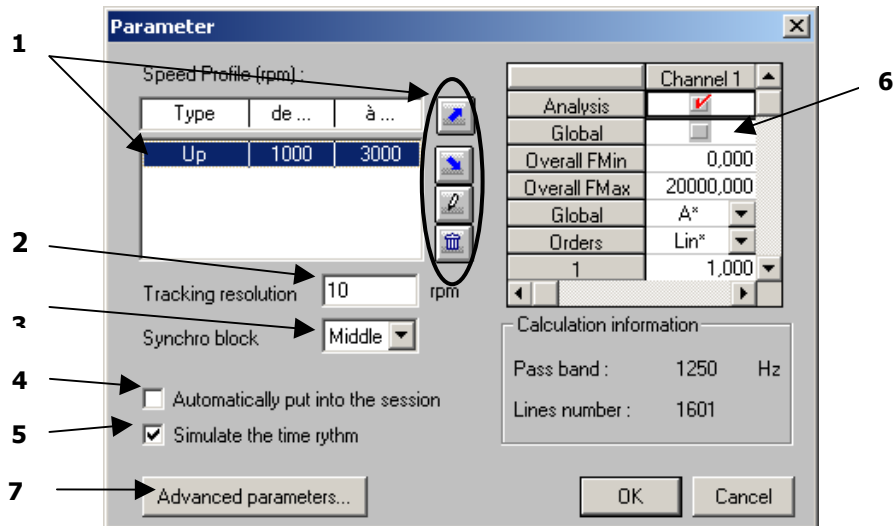
If there is an odd number of elements to process, and if they are grouped by two, the last element in the batch becomes inactive (it will not be processed).

11.2.2.2. Analysis set-up



Use  or **Actions / Parameters** (F5) to define the measurement and analysis parameters for the order extraction.

Parameters of the elements to analyse are set in the dialog box shown below:



1 Definition of the parameters for the sequence of run-ups and/or coast-downs on a speed range to define (**Speed profile**)



add a run-up



add a coast-down



modify the run-up or coast-down value for the selected item



delete selected item

2 Use the **Tracking Resolution** to define the speed interval between two FFT spectrum calculations.

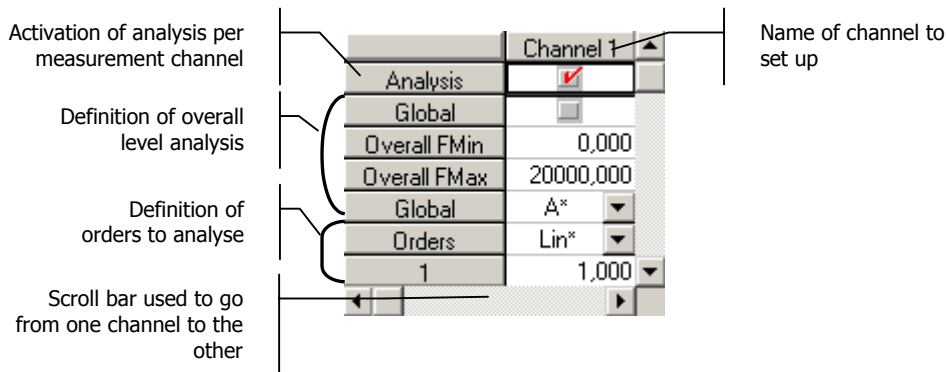
3 The **Block synchro** parameter is used to assign a FFT spectrum to a speed.

- Either the spectrum is assigned to the speed measured when the data storage (for spectrum calculation) started (**Start**),
- Or the spectrum is assigned to the speed measured when the said data storage ended (**End**),
- Or the spectrum is assigned to the average speed between the beginning and the end of data storage (**Middle**)

4 When the box "**Automatic transfer to session**" is checked, results are automatically transferred to the measurement session, and this to save time when running a series of analyses.

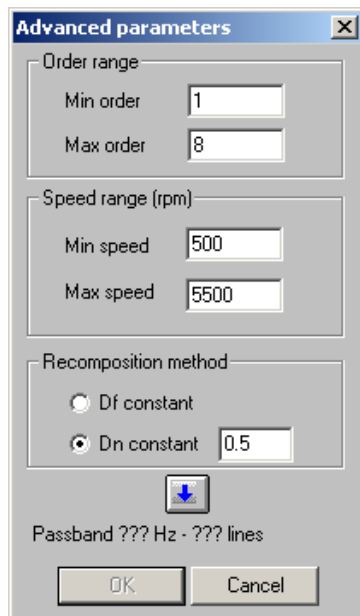
5 When the “**Simulate timing**” box is checked, the analysis time is the same as for a real-time measurement. If the box is not checked, the analyses takes up all the PC resources and can then go faster.

6 Definition of data to store in the measurement session. There is one column per channel.



- **Analysis:** Activation of analysis per measurement channel
- **Overall Fmin and overall Fmax:** Frequency limits for overall level calculation
- **Overall:** Activation of overall level analysis
- **Overall weight.:** Weighting applied to the overall level (if **Overall** is active)
- **Order weight.:** Weighting applied to the order calculation
- **1, 2, ..., 8:** Enter here the number of the order to extract from the analysis. Orders can be non-integer. 8 orders maximum can be extracted.


7 **Advanced parameters** are used to define measurement parameters (maximum frequency and number of lines) according to the study to carry out.



- **Order range:** Enter the limits for the study (minimum and maximum orders to extract).
- **Speed range:** Definition of the speed range for the whole study. It should include the speed profile (sequence of run-ups and/or coast-downs) defined previously (1).
- **Recomposition method:** Define which frequency band will be used for the energy calculation of orders.

With **Df constant**, the frequency band used to calculate the order will be a band of constant width Df.

With **Dn constant**, the frequency band used to calculate the order energy will be a frequency band proportional to the speed, and increasing with the frequency ($Df=Dn*Speed/60$, with the speed in rpm).

When all parameters have been entered, click on  to launch the calculation of the bandwidth and of the required number of lines for the measurement, then validate.

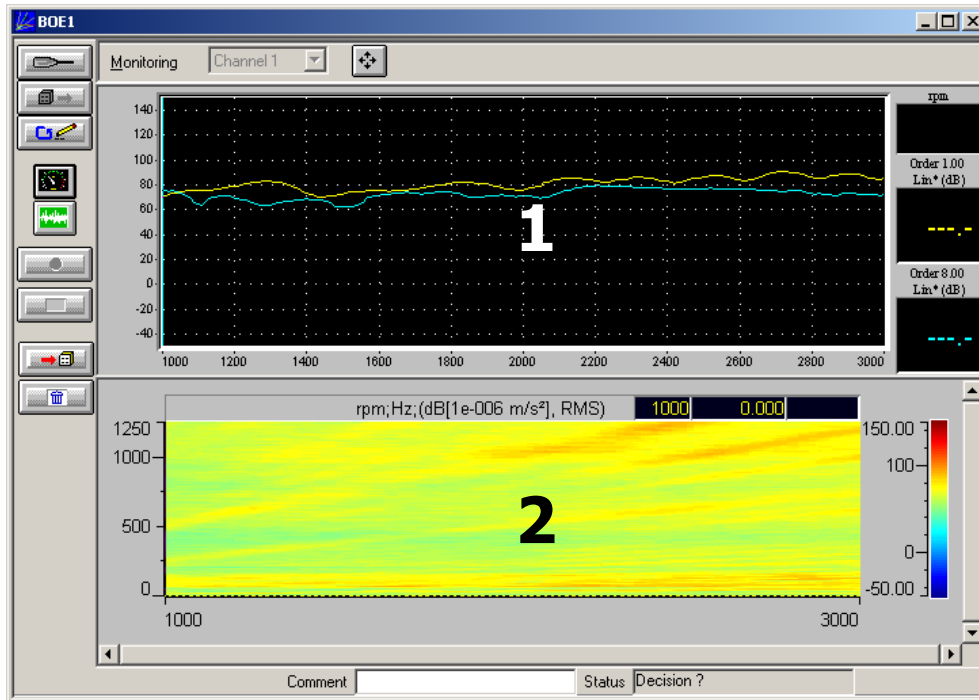


$Speed_{Max}$ (rpm) and $Order_{Max}$ are used to calculate the bandwidth (BP).
 The number of lines N is calculated from the bandwidth and the most restricting Df (the smallest) according to the selected recomposition method, keeping in mind that at least 5 FFT lines are required by **dbFA32** in the extraction bandwidth.

$$BP = \frac{Speed_{Max}}{60} \times Order_{Max} \qquad N = \frac{BP}{\left(\frac{Df}{5}\right)}$$

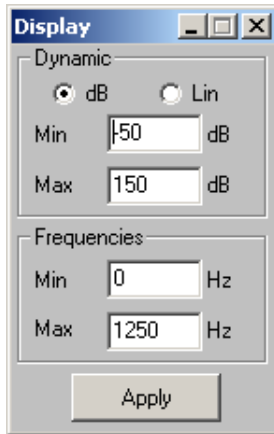
11.2.3. Display set-up


With the post-processing order extraction module in **dbFA32**, the history of overall levels, orders **1** and a sonogram calculated according to analysis parameters selected by operator **2** can be displayed in the same window.




11.2.3.1. Display set-up

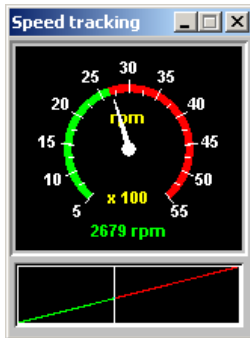
Use to select the channel to display.




Use  or **Plot / Parameters** to define the display dynamic range.

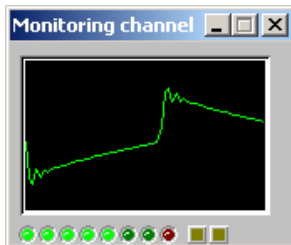
- **Dynamic:** set view ①
- **Frequency:** set view ②

It is also possible to display a meter showing the real-time speed using the  button,



Speed view

and to display the signal using .



Signal view

11.2.4. Description of a post-processing order extraction

① **Open** one or several measurement sessions and **select** Signal/Speed profile elements for analysis.

② Open the post-processing order extraction window using **Analysis / New analysis set-up**.

③ : Retrieve selected Signal and Speed profile elements from the active session, and/or

 use the **batch** window to:


- view elements to analyse
- group Signal and Speed Profile elements two by two (1 Signal + 1 Profile) or three by three (2 Signals + 1 profile – two-channel recording)
- import other Signal elements from an open session

- deactivate analysis for one of the elements

4 Set **processing parameters**  (F5)

Analysis and storage parameters (see Section 11.2.2.2)


5 Set display (see Section 11.2.3.1)



 Display speed meter

 View signal


6 **Processing** of recordings

 Start processing according to defined parameters (F3)

 Stop processing (F4)

 Display  of the speed variation within the defined range

Decision

 Transfer results in a measurement session (F7)

 Discard current results

12. SHOCK ANALYSIS

Shock analysis is based on the **averaging of several measurements** of transient signals, resulting usually from exciting a structure with an impact hammer.

At least two measurement channels are required: one channel for the excitation and one or several channels, usually coupled with accelerometers, to receive the structure response.

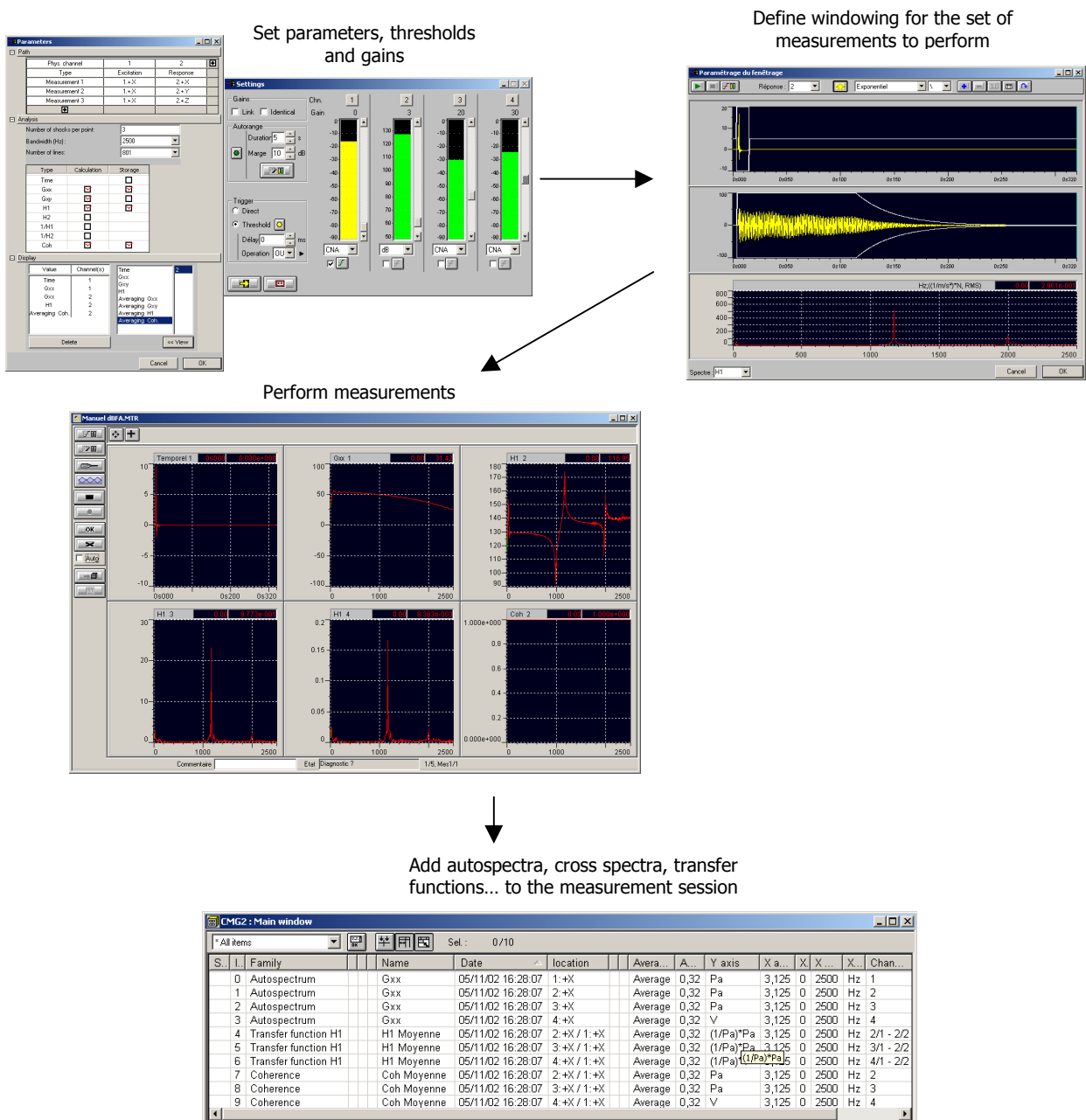
For each impact on a measurement point, a FFT analysis is performed and the recording of the signal can be stored.

Moreover, the position of the transducer on the system under study (X, Y or Z direction and reference number) or saved for each measurement point. Measurements can then be exported and processed easily using modal analysis software.

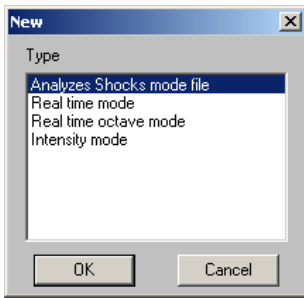
Shock analysis can be performed in **real time** (*.MTR files).

The scheme below summarises the operating mode of for the shock analysis performed by **dBFA32**.

REAL TIME



Real-time analysis



Use **Acquisition / New measurement set-up** to start a new measurement.

In the dialog box shown opposite, select **Shock analysis mode file** then click on **OK**.

When a real-time shock analysis document is active, the **File / Save** and **File / Save as** commands can be used at any time to store the measurement set-up on the hard disk. The document set-up is stored in a file with a *.MTR extension.

All measurement and display parameters are saved. It is then possible to recall a real-time shock analysis document and have the exact same set-up as for the recording (use **Acquisition / Open a measurement set-up**).

12.1.1. Presentation of the measurement window

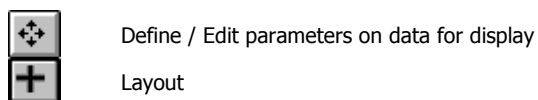
The real-time shock analysis module in **dbFA32** allows to display in the same window the signal **time history** for one or several channels and one or several **spectral views** calculated according to the user-defined analysis parameters.

Action toolbar:
Acquisition, storage, analysis parameters, commands for measurement control

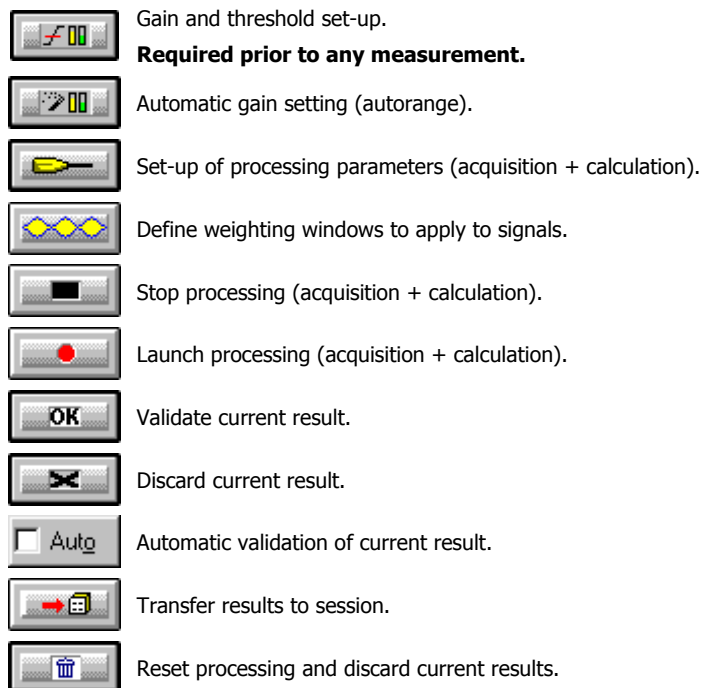
Display toolbar:
Curves to display, overall levels, spectral units, etc.

Status bar: progress of the analysis process and number of items remaining to be acquired/processed.

The **Display toolbar** in the shock analysis window is used to perform the following operations:



The **Action toolbar** in the shock analysis window is used to perform the following operations:



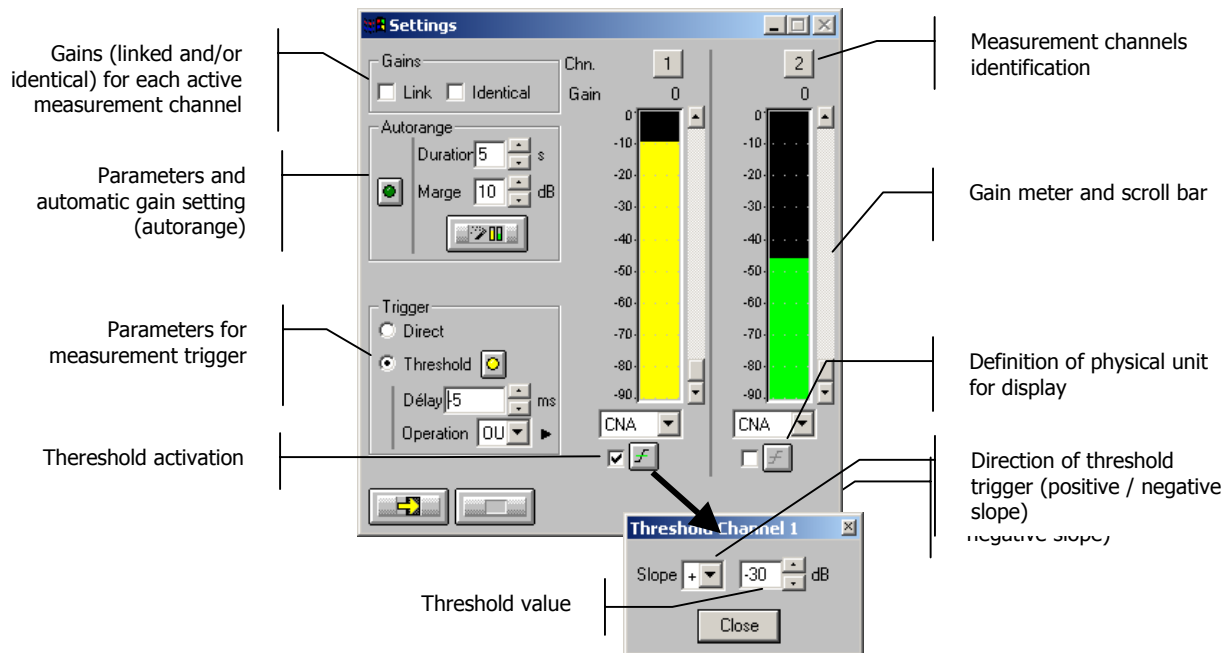
Refer to Section 12.1.3 for a detailed description of the analysis progress.

12.1.2. Measurement set-up

All functions are accessible from the actions (vertical) toolbar in the measurement window.

12.1.2.1. Threshold, gain and autorange settings

This dialog box is used to define gain and threshold parameters. The program uses this window in many different ways. As all operations are modular, all available parameters and actions can then be activated or deactivated depending on the module using them.



Gains

When the option **Linked** is active, the gains on all active measurement channels are modified: the gain setting of one active channel leads to identical modifications on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed on to all other active channels. This option is only available if the option **linked** has been chosen.

Autorange

Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration**, defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

Units: Definition of the display unit of the input level. The gain view meters may display the input levels according to three different units:

- **dB**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2 .



The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management** (see **paragraph 19.1**).



Trigger: Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.



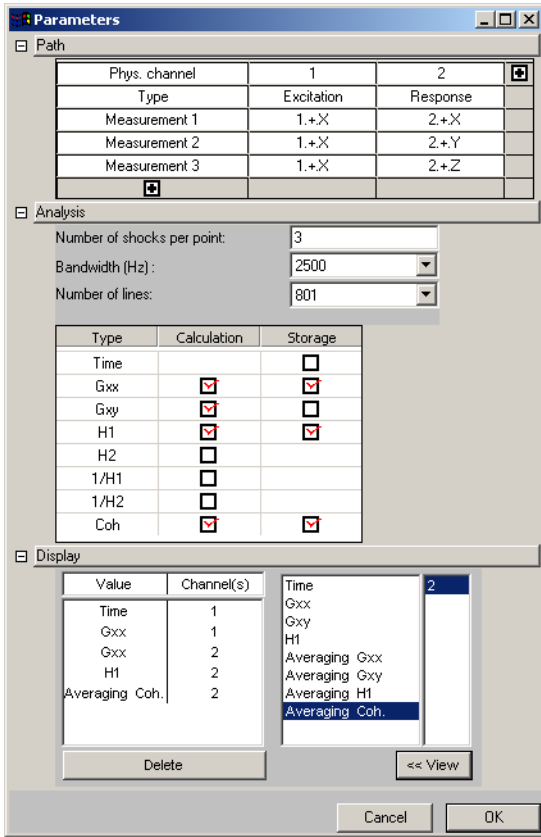
Defining a threshold is compulsory to start acquisition in the Shock Analysis mode.

- **Trigger delay (in ms):** For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation:** Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

12.1.2.2. Measurement settings



Use (or **Actions / Processing / Parameters** or F5) to define shock analysis parameters.



Path

Define the sequence for the set of measurements to perform on the system under study.

In the **Type** field, select the channel that will receive the system response.

For each **Measurement X** line, enter the reference no. for the transducer position, as well as its direction (X, Y, Z, -X, -Y and -Z).

to add a line.

Analysis

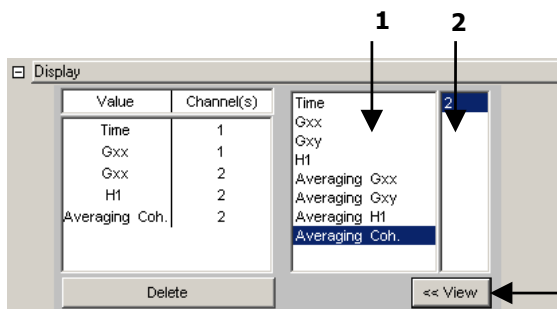
Number of shocks per point: Define the number of impacts to average.

Bandwidth (Hz): Select the analysis bandwidth. The bandwidth defines the maximum frequency of the analysis. A pop-up list displays available maximum frequencies. This list depends on the acquisition platform.

Number of lines: Select the number of lines for the FFT analysis among the values displayed in the list. This list depends on the acquisition hardware. The greater the number of lines, the higher the frequency resolution.

Selection table: Check the items to calculate and to store. Only calculated items are stored in the session or displayed in the real-time measurement window.

Viewing



Gxx: Autospectra
 Gxy: Cross spectra
 H1, H2, 1/H1, 1/H2...: transfer functions
 Coh: Coherence


1 Select the metrics to display among the list of available metrics

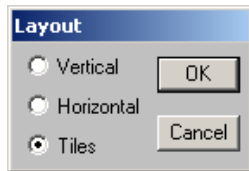
2 Use the right column to assign the selected metrics to the appropriate measurement channel(s).

For instance, if more than two measurement channels are used, this column will allow to select the channel for the display of an autospectrum or of the raw signal or the direction of the cross function for a cross spectrum or a transfer function.

③ Curves displayed on screen are those displayed in the left section of the dialog box. To add a new plot to the list, use the “View” button.

12.1.2.3. Layout settings

Use  (or **Plot / Layout**) to manage the layout in the real-time window.



This dialog box is used to control the layout of the different views inside the real-time window. Horizontal, vertical or mosaic displays are available.

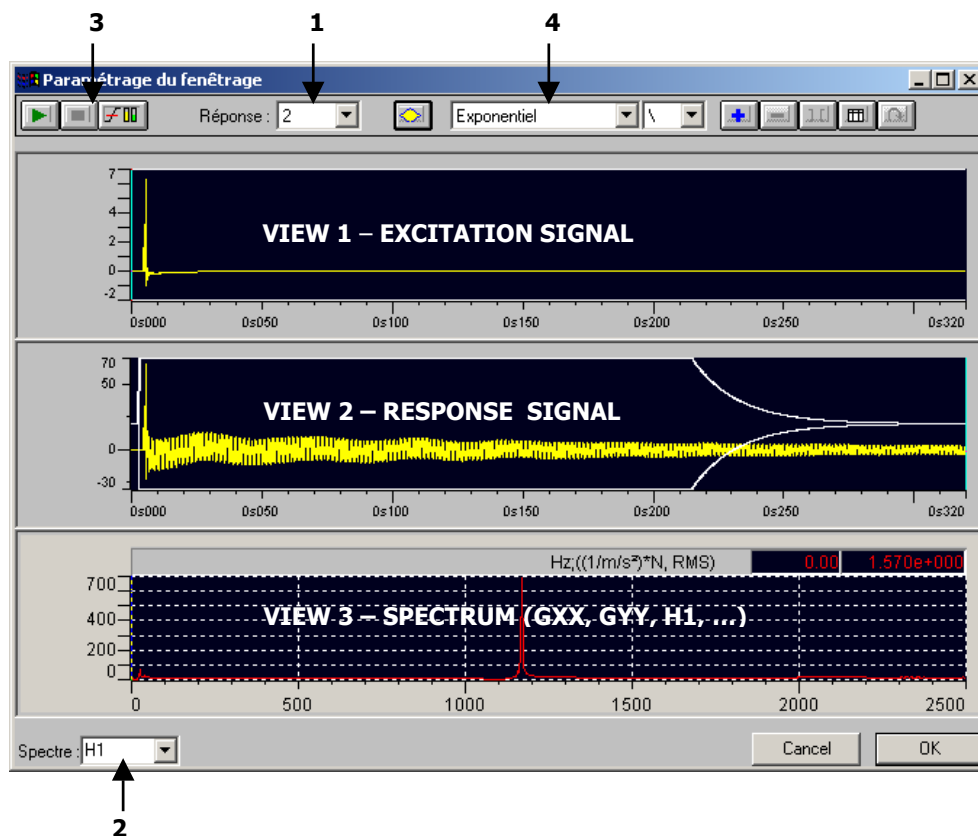
12.1.2.4. Signal windowing

In the shock analysis module of **dbFA32** user-defined weighting windows can be applied to acquired signals using a simple and powerful graphics interface.

It is possible to append segments from windows of different types and the duration of which can be set by the user.

Procedure for windowing creation

Use  to open the **Windowing set-up** window.



① Select the channel to view in **View 2** (response signal). **View 1** displays the excitation signal.

② Select the spectrum to display in **View 3**: either Gxx or Gyy or H1 or 1/H1 or H2 or 1/H2.

3 This toolbar is used to launch an acquisition in order to edit the windowing for the whole series of measurements.



Start measurement



Stop measurement



Threshold and **gain** settings for the different channels

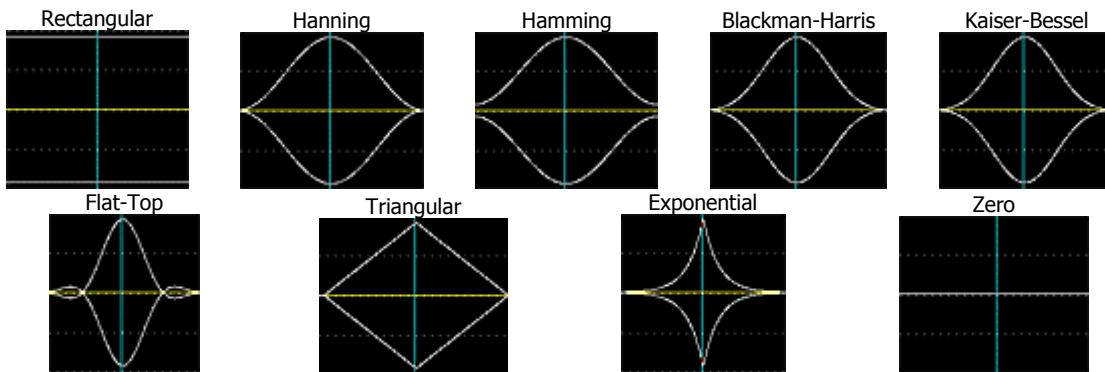
4 The toolbar shown below is used to define the weighting windows to apply to the signals. Weighting windows for excitation signal and for response signal may be edited separately. **The windowing defined for the response signal will be the same for all response channels.**




Window type

Pop-up menu:

Select the window type using the pop-up menu. The following window types are available:



Slope

Use the pop-up menu () to select if the positive slope (/), the negative slope (\) or the full window (^) will be part of the inserted segment.

Note: In the above representations both positive and negative slopes have been inserted.

Add / Delete a window



Once the window type and the slope are selected, move the cursor to define the **right limit** of the section. The **left limit** is always located at the end of the previous section (or at the beginning of the signal if no section has been defined yet).






Add a segment: it is displayed in white on the signal view.




Delete a segment: first select it (it is displayed in red on the view).
If there were segments to the right of the deleted segments, they will be displaced to the left.

“Adjusting segment limits”

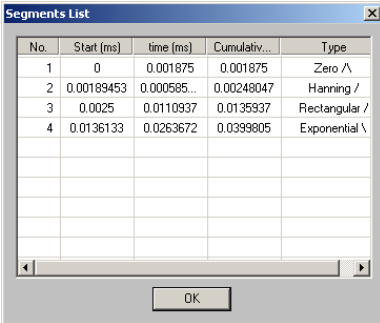
Use  to redefine the width of all segments defined graphically.

- **Select** the segment to resize with the cursor.
- Click on  (or **Windowing / Adjust segment**): **two cursors** are now displayed at the right and left limits of the segment.
- **Move** these cursors to redefine the width of the segment.
- Click on  to **quit** the adjusting mode.


Repeat this procedure for all other signal segments.

 The windowing creating/editing graphics interface always operates based on the creation of segment **from left to right**. The active cursor is used to select window segments on the signal view. Selected (red) segments can then be modified by the user.

List of segments used



No.	Start (ms)	time (ms)	Cumulativ...	Type
1	0	0.001875	0.001875	Zero ^
2	0.00189453	0.000585...	0.00248047	Hanning /
3	0.0025	0.0110937	0.0135937	Rectangular /
4	0.0136133	0.0263672	0.0399805	Exponential \

Use  to view the following parameters for each segment:

- **Beginning** (ms): position of the segment left limit
- **Duration** (ms) of segment
- **Cumulative** (ms): cumulative length of the segment and of all segments at its left
- **Type**: Type of window and sign of the slope

Update the calculation

Use  to **redo the spectrum calculation** and take into account the modified windowing.

To view the result of the windowing on the signal, use , which also updates the spectrum calculation.

12.1.3. Real-time shock analysis

12.1.3.1. Procedure

- ① Definition of the hardware configuration corresponding to shock analysis (see Chapter 3).
- ② Calibration of the measurement chain (see Chapter 4).
- ③ Creation of a new measurement set-up:

Acquisition / New measurement set-up / Shock analysis mode.

- ④ Automatic () or manual () **gain setting** and definition of a trigger **threshold** on at least one measurement channel (see Section 10.1.2.1).

- ☛ **Definition of a threshold prior to acquisition is compulsory.**


- ⑤ Setting of **processing and display parameters**  (F5)

Acquisition, analysis and storage parameters(see Sections 10.1.2.2 and 12.1.2.3).


- ⑥ Setting of **windowing parameters**  (see Chapter 12.1.2.4)


- ⑦ **Processing** of recordings


 Launch processing according to defined parameters (F3).

 Abort processing (F4).


Diagnosis


 Validate current result (F7). This function carries on the averaging of the results yet to come with the previous results.

 It can be automated by checking the "Auto" box (Actions / Diagnosis / Automatic).

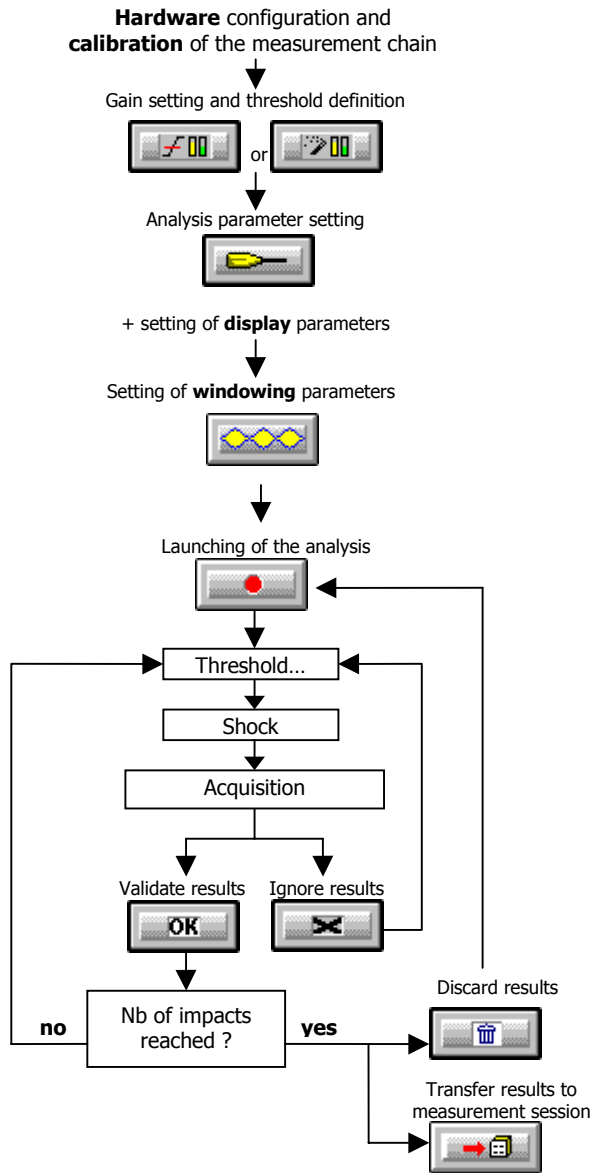
 Reject current result (F6).

Decision

 Transfer result into measurement session file (F12)
Measurement results are stored in a measurement session (campaign).

 Reset processing and discard current results (F11)

12.1.3.2. Flow chart



13. MANAGEMENT OF MEASUREMENT SESSION DATAFILES (CMG)

Any data acquired in **dBFA32** is stored in a **measurement session** datafile (*.CMG extension). From this datafile, the user can perform a given analysis (for example, calculation of a narrow band average spectrum from a signal recording).

From the measurement session window, it is possible to print tables of results and graphics, to copy and paste data items to a spreadsheet or word processor for further analysis and for editing a measurement report.

This chapter deals with the following aspects of data processing:

- **General operations on the measurement session datafiles**

Description of the measurement session window, comments, information window, delete data items, display graphics and table of results, export data into a spreadsheet or word processor, start an off-line analysis, start a batch analysis.

- **Requests (sort data items)**

Edition of requests, execution of requests.



*The different types of off-line processing functions, as well as the analysis process, are dealt with in **chapter 14**.*



*Batch analysis is dealt with in **chapter 15**.*



Be careful, if you have the ISO9614 module for sound power determination, the measurement session can be displayed as standard (see this chapter) or in a specific manner. Refer to the corresponding application note in the latter case.


13.1. CMG datafile management

A measurement session data file, with the CMG extension, may represent several megabytes of data and **dBFA32** may work simultaneously on several data files.




In order to facilitate session management, elements can be moved from one session to another by dragging them with the mouse like in Windows Explorer.

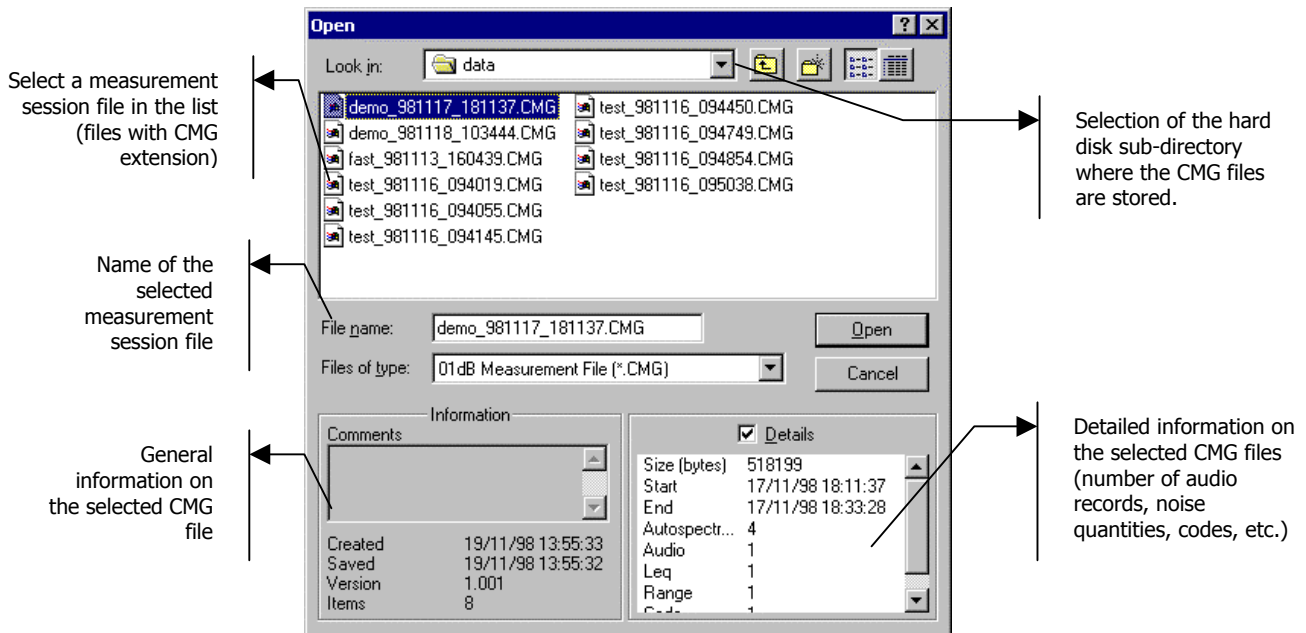
13.1.1. New CMG datafile

To create a new measurement session datafile (*.CMG) that is empty, click on the  icon or use the **File / New (CTRL+N)** command.

An empty measurement session is then displayed on screen.

13.1.2. Open a CMG datafile

To open a CMG measurement session file stored on the computer hard disk, click on the icon  or use the command **File / Open**. The following dialog box appears on screen.



The upper part of this dialog box allows the user to select a measurement session file CMG for processing in **dBFA32** by choosing the appropriate location on the hard disk.

The lower part of this dialog box is activated when a CMG file has been selected in the list. Various information on the datafile is given such as:

- The date and time the file has been first recorded and when it was last saved, the version and the number of items contained in the CMG file.
- By ticking the **details** box, the size in bytes of the datafile, the start and end dates of the measurements, the number of events (signal recordings, spectra, etc.), as well as general parameters (dynamic range, number of codes, etc.)

Once a file has been selected, click on the **Open** button to open the datafile and proceed with its analysis.

13.1.3. Close a CMG datafile

To close a measurement session file of CMG type, use the command **File / Close**. Closing down the window of the datafile will also result in closing the CMG datafile. All others windows (results' listings, plots, etc.) will be closed as well.

dBFA32 will also prompt the user to save this CMG datafile if any modifications have been made to it before closing.

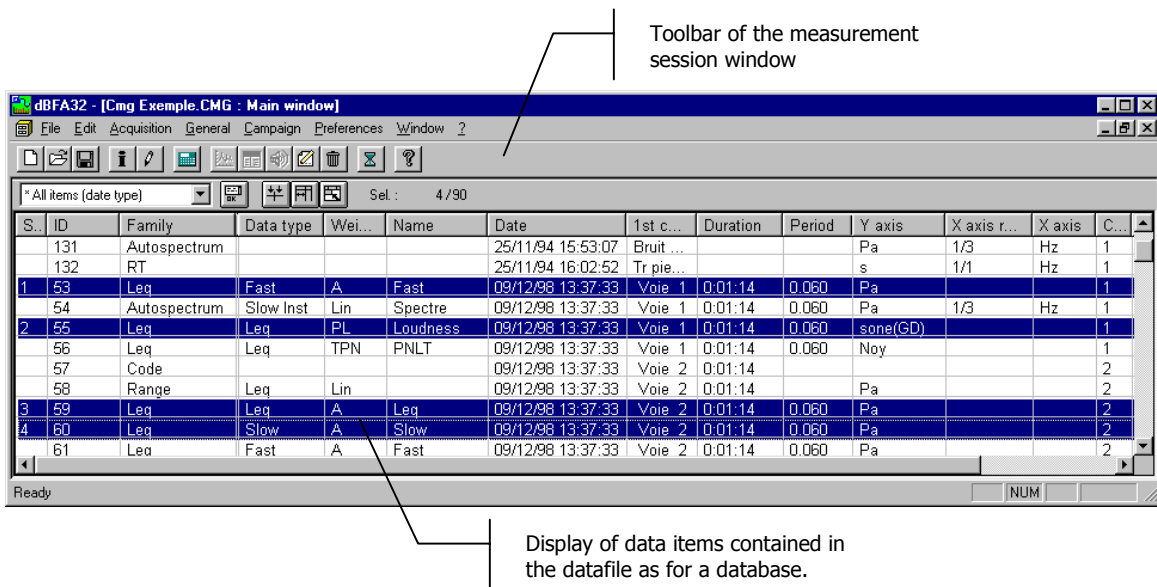
13.1.4. Save a CMG datafile

Use the command **File / Save (CTRL+S)** or **File / Save As** to save the measurement session on the computer hard disk

13.1.5. Delete one or several CMG datafile(s)

Use the command **File / Delete session(s)** to delete one or several measurement session datafiles, including temporary files. A dialog box is displayed on screen in order to select the datafiles to delete.

13.2. Measurement session window overview


















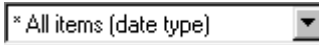




In the measurement session window, the data items are displayed as for a database. Each line corresponds to a given type of data (audio event, spectrum, etc.) and each column corresponds to a given type of information about this data item (name, weighting, frequency or time resolution, etc.)

The horizontal toolbar allows the user to perform general and data processing operations for the data items contained in the measurement session.

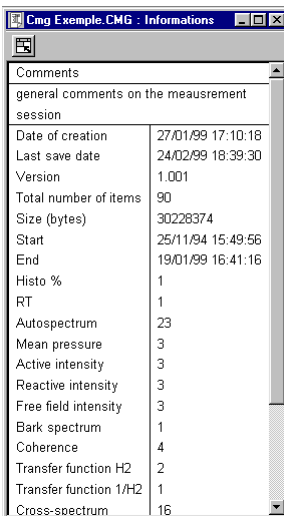
Select data items in the list and perform the desired operation.


13.2.1. Toolbars

The following operations are possible for the data items contained in a measurement session file. According to the type and number of items selected in the list, some operations may not be activated.

- | | | | |
|---|--|---|--|
|  | Create an empty measurement session file (CTRL + N) |  | Plot (graphics) the selected data items |
|  | Open an existing measurement session file (CTRL + O) |  | List (table) the selected data items |
|  | Save the active measurement session file (CTRL + S) |  | Playback the selected signal recordings |
|  | Display an information window about the measurement session |  | Modify a data item (date, level correction, etc.) |
|  | Edit the general comment of the measurement session |  | Delete the selected items |
|  | Launch the operation server (off-line analysis)
See chapter 14 |  | Start a batch processing analysis -
See chapter 15 |
|  | Display a window to create a test report |  | Open the index on the on-line help system |
|  | Display a multispectrum (sonagram) | | |
-
- | | | | |
|---|---|---|---|
|  | Sort data items according to the selected request |  | Automatically adjust the width of each column |
|  | Edit requests |  | Automatically adjust the size of the measurement session window |
|  | Select the window columns to display | | |

13.2.2. Measurement session information window



Use the command  **General / Session Information** to display the information window of the active measurement session.

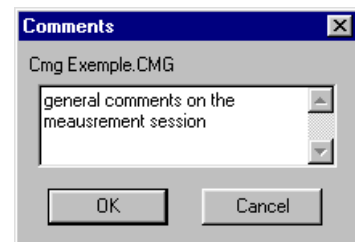
The following information is given in this window:

- Date of creation and last modification
- Number of data items contained in the datafile
- Datafile size
- Start and end date and time
- Number of data items of each family

This list is updated automatically each time a modification is made into the measurement session datafile.


13.2.3. Measurement session comments

Use the command  **General / Session comments** to input a general comment for the active measurement session datafile.

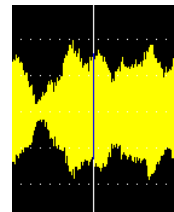


13.2.4. Playback of signal recordings




Select a recording in the list and use the command  **Datafile / Replay** to playback a recording through the sound system of the computer (signal output of **HARMONIE**, **SYMPHONIE**, **JAZZ** – Win98 and ME only - or integrated sound card). The dialog box shown aside is displayed on-screen during playback.


When a plot is displayed in dBFA32, a **vertical cursor** follows the progress of the playback on this plot.



13.2.5. Delete data items

Select the data items to remove in the list and use the command  **Edit / delete** or the **Delete** function key. After confirmation of the deletion, the data items are completely removed from the measurement session file.

13.2.6. Modify data items (editing)

Select one or several data items in the list and use the command  **Datafile / Modify** to edit general parameters of these items. The user may modify the following parameters for each item:

- The start date and time
- The location and comment defined during acquisition
- The study zone of the item

Furthermore, it is possible to apply a calibration correction (level in dB) for some given types of data items.

For Signal items, an Information tab is available.

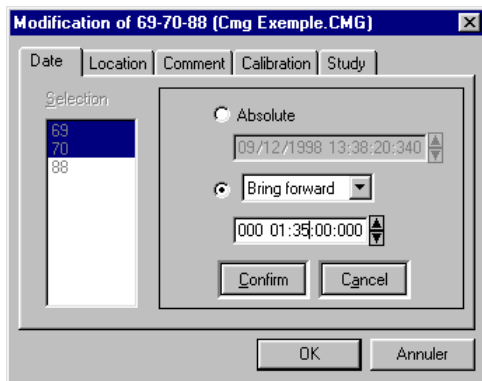
For autospectra resulting from building acoustics measurements, the measurement channel can be assigned a type.

Each item is identified in the measurement session by its **identifier (ID)**. This identifier is a number.



To simplify the processing of measurement sessions, location, comments and date of the elements of a session can be entered directly by clicking on the appropriate files when the element is selected.

13.2.6.1. Editing of items: date and time



In the **Date** tab, edit the date and time values, corresponding to acquisition start, for the selected data items.

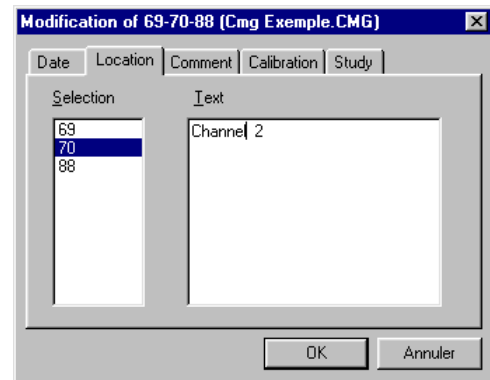
The modification can be performed in an **absolute** manner (direct editing of the date and time) or by bringing forward or putting back the original date by a user-defined duration (format: Day / hour / minutes / seconds / milliseconds).

The user has to **confirm** each date and time modification.

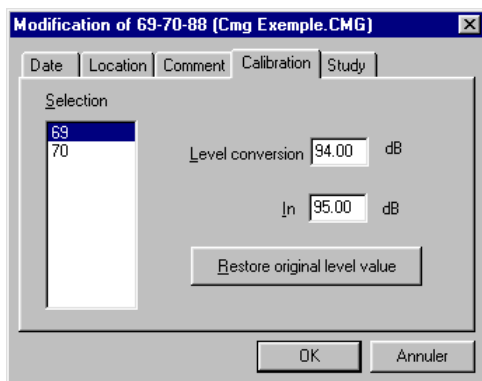
13.2.6.2. Editing of items: location and comments

In the **Location** tab, edit the comment relative to the location of the measurement channel.

In the **Comment** tab, edit the comment relative to, for example, the measurement conditions.



13.2.6.3. Editing of items: level conversion



In the **calibration** tab, define a calibration adjustment for the selected data items.

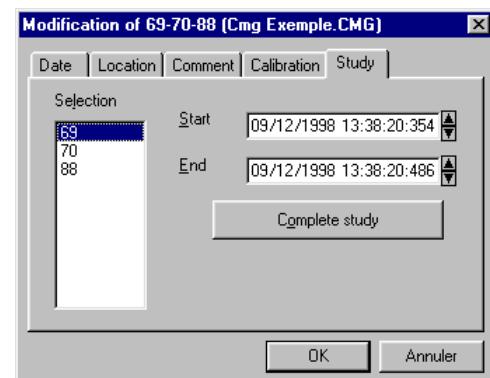
A calibration level conversion in decibels is applied globally with a resolution of 0.01 dB.

Click on the key **Restore original level value** to cancel the level correction.

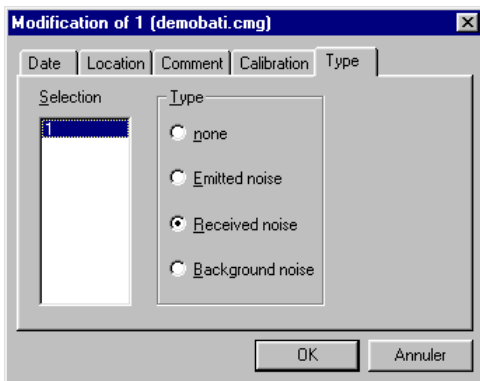
13.2.6.4. Editing of items: study zone

In the **study** tab, select the study zone for any subsequent analysis.

Click on the **Complete study** key to select the complete duration of the data item for an analysis.



13.2.6.5. Autospectrum type (building acoustics)



In the **Type** tab, select the type of a given autospectrum for building acoustics calculations.

Select **Emitted noise** for an emitted noise spectrum, **Received noise** for a received noise spectrum, **Background noise** for a background noise spectrum. Select none for any other type of spectrum.

13.2.6.6. Information

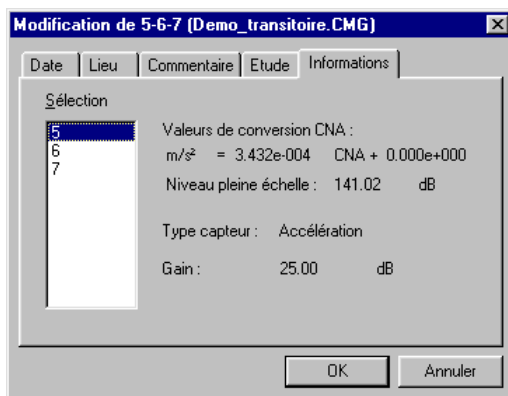
• ADC conversion value

Conversion value to go directly from the digital value of the acquisition card to the analogue value in Pa. This value depends on the transducer sensitivity and on the gain.

Example:

For the **SYMPHONIE** acquisition platform, the sampling is performed on 16 bits, i.e., on values ranging from -32768 to $+32768$.

For a value of 5000, the level in m/s^2 is $5000 \times ADC$, i.e., $5000 \times 3.432e-4 = 1.716 m/s^2$



▪ Full-scale level


Maximum value (in dB) that can be measured with the current ADC value.

For **SYMPHONIE**, this value is equal to:
 $20 \log [(32768 \times CNA) / P_0]$ in dB
 with the reference pressure $P_0 = 20 \mu Pa$

▪ Type of transducer used to acquire the signal

▪ Gain on the input signal

13.3. Plot data items (graphics)

Use the command  **Datafile / Plot**, after selection of one or several data items in the list, to display the data in a graphical manner, when possible. The data are displayed either in different windows, or in the same window, stacked or superimposed depending on the elements selected. Double click on a data item in the list to also display a graphical view.

Data items of the following types may be displayed graphically in **dBFA32**:

Signal editing view

- Signal recording (signal or tacho)
- Leq levels and sound pressure levels (Fast, Slow, Impulse) versus time
- Psychoacoustic criteria versus time
- Impulse response
- Speed profile (tachometry)

Broad band spectrum and/or multispectrum view

- Octave, third octave, 1/Nth octave band spectra
- Bark band spectra
- Active reactive and free-field intensity spectra
- Histograms and cumulated histograms
- Echograms

Narrow band spectrum and/or multispectrum view

- Narrow band autospectra and cross spectra
- Transfer functions
- Coherence
- Active reactive and free-field intensity spectra

Sonagram view

- Multispectra

Lissajous view


- Between two Signal items

Nichols/Nyquist view

- Transfer functions and cross spectra

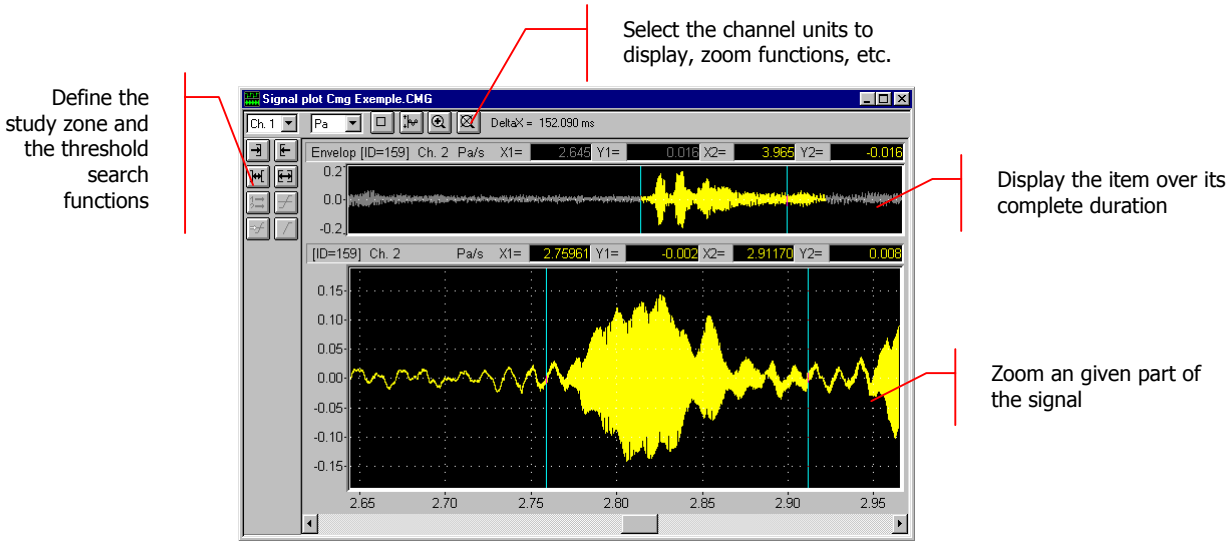
Let us now describe each view in the following paragraphs.




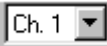











When several graphic windows are displayed, a synchronisation of the cursors on all open views is possible, provided dates are identical. For instance, if a signal is displayed, along with a multispectrum, and if the cursor is displaced on the signal view, then it will do the same on the multispectrum view. Use the Session / Time synchronisation menu or the  button in the toolbar to activate this function.

13.3.1. Signal view

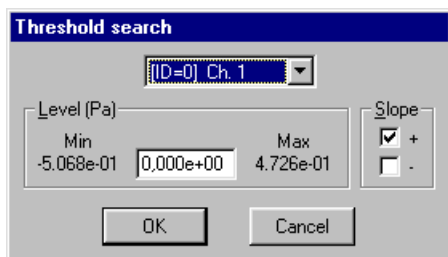
In this type of graphical view, any time history of a signal (in physical units), noise and vibration quantity (level in dB or in physical units) can be displayed. An example of signal view is given below:




Several Signal items can be displayed in the same signal-editing window if there were multiple selections in the measurement session. It is then possible to link the cursor displacement on all views by holding down the CTRL key while moving one cursor or by pressing the  key.



- | | | | |
|---|---|---|--|
|  Ch. 1 | Select the active channel for the view |  | Cursor synchronisation when several signals are displayed |
|  Pa | Select the display unit |  | Beginning of the study zone |
|  | Activate/ Deactivate automatic autoscale for the zoom |  | End of the study zone |
|  | Perform an autoscale in the signal zoom view |  | Define the study zone in between the cursors |
|  | Activate the zoom view |  | Define the study zone over the complete duration of the item |
|  | Deactivate the zoom view |  | Show/Hide a channel and activate/deactivate a channel for any subsequent study |

The vertical toolbar allows the user to define the study zone for the signal and to perform threshold search operations.



The threshold search command (command  **Study / Threshold / Search**) allows the user to define the level of the threshold (value given in physical unit) and a slope (positive or negative) to the threshold condition.

When the threshold condition has been fulfilled, the cursor is located at the threshold exceeding on the graphical view.

The command  allows the user to stop the threshold search and the command  allows the user to find the next threshold exceeding.

The horizontal toolbar allows the user to define display parameters of the graphical view. It is possible to use **zoom** functions to zoom a part of the signal and perform an **autoscale** for the zoom view.

The display units depend of the type of graphical view.

For **signals**, it is possible to select the following display units:

- **ADC:** Displays the dynamic in dB converter. It is a relative decibel level. The 0dB level is the full-scale value of the converters (i.e. a sample which has a numerical value of 2¹⁶ (32767) corresponds to the 0dB value). dBADC values are always negative between 0 and -90dB.
- **V:** Dynamic display in Volts.
- **Physical unit:** If the transducer is a microphone, the dynamic is displayed in Pascals (**Pa**), if the transducer is an accelerometer, the dynamic is displayed in Acceleration (**m/s²**).

For sound and vibration quantities of type autospectrum, cross-spectrum and transfer functions, it is possible to select the following display units:

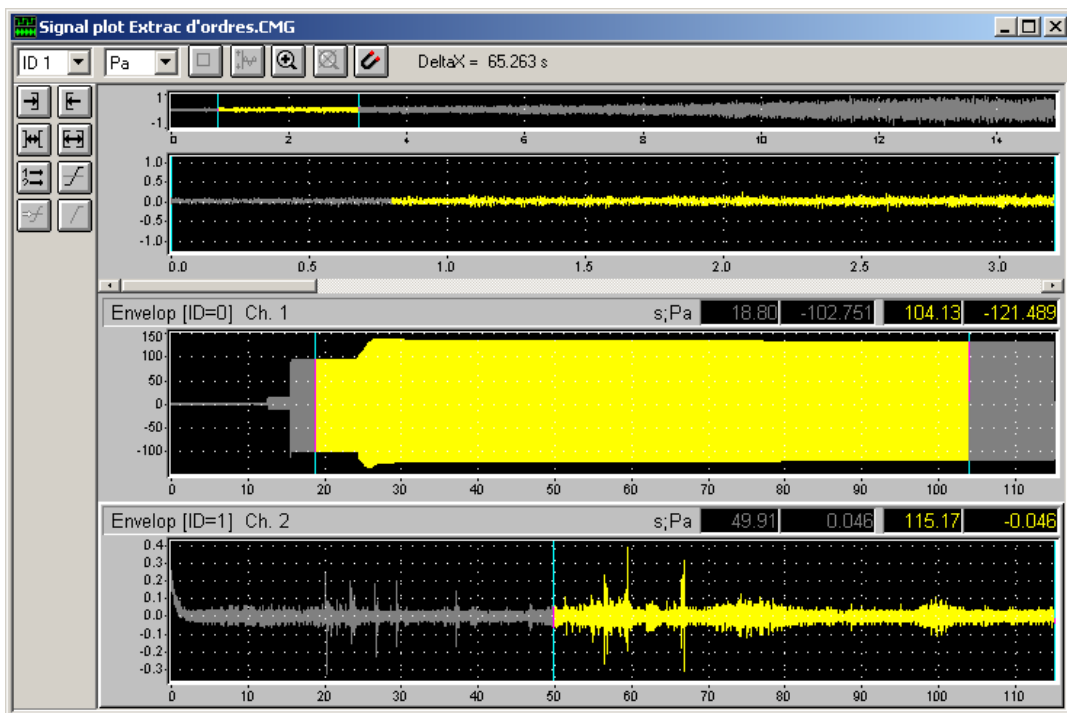
- **dB:** Level in decibels of the considered quantity (Leq, Slow, Fast, Impulse, etc...)
- **RMS (Root Mean Square):** Average quadrate value for all the instantaneous squared values expressed in physical units.
- **PWR (Power):** The power represents the average of a squared value. It is the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units



Refer to **paragraphs 18.3 and 18.4** for a detailed list of the frequency weightings and spectral units available in **dBFA32**.

The levels are calculated from international system units (SI). It is possible to modify the default values with the command **Preferences / Units' management**. See **paragraph 19.1**.

It is possible to display up to two signals on the same graphical view if the data items have the same characteristics (periods, duration).



13.3.2. Broad band spectra and/or multispectra, Bark bands, histograms and echogram

This type of view is used to graphically display spectra and/or multispectra in broad bands (octaves, third octaves, and 1/Nth octaves), in Bark bands (psychoacoustic), as well as echograms and histograms.

For multispectra (a spectrum calculated for each integration step, defined by the user), a scrolling bar at the bottom of the view is shown in order to view the spectral quantity at different time periods.

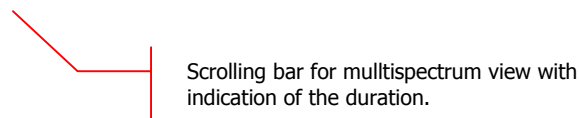
An example of this type of view is given below:



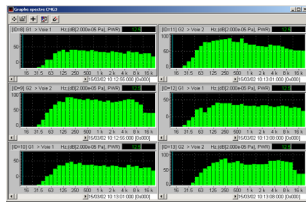
The toolbar of the graphical view allows the user to perform the following operations:

- | | | | |
|--|--|--|---|
| | Definition / Editing of data parameters for the graphical view | | Definition / Editing of display parameters for the graphical view |
| | Curve layout | | Go to stacked/superimposed mode if several curves with the same characteristics are displayed |
| | Activation / Deactivation of second cursor | | Activation / Deactivation of Lin overall level display between cursors |
| | Cursor synchronisation if several curves are displayed | | |

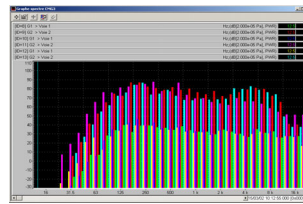
The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management**. See **paragraph 19.1**.



It is possible to display in a same window as many stacked curves as the system can handle, regardless of their characteristics. If the elements have the same units (Pa, m/s², ...), curves can be superimposed.



Stacked curves



Superimposed curves

13.3.2.1. Display parameters of the graphical view


Set-up the graphical display parameters using  (Plot / Plot set-up).

The plot is updated immediately when a modification is made. Each plot has its own settings' dialog box: a modification on one plot does not affect the settings of another plot.

The dialog box 'Display spectrum Cmg Exemple.CMG' contains the following settings and annotations:

- X axis:** Scale. Annotation: Display or not X-axis scale.
- Y axis:** Scale. Constant range. Min: 10.0, Max: 50.0. Annotation: Display or not the Y-axis scale and select the graph dynamic range (constant range or set up manually the minimum and maximum limits).
- Various:** Grid. Annotation: Display or not a millimetered grid on the plot.
- Cursor(s):** 1, 2. Show. Annotation: Show / Hide one or two cursors on the plot.
- Value:** Show. Annotation: Show / Hide cursors' values and select channels.
- Zoom:** In, Out. Annotation: Zoom in the plot for the time portion between cursors (IN) Zoom out the plot (OUT).

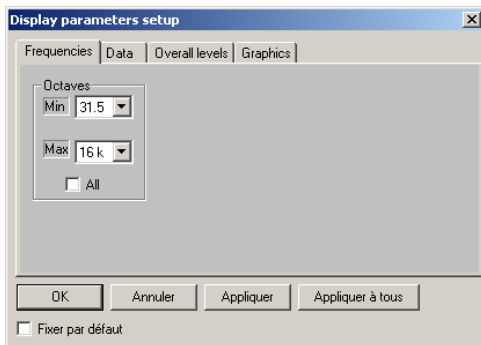
13.3.2.2. Data parameters for the graphical view

Define data parameters for the graphical view using  (**Plot / Parameters**). The dialog box shown below appears on screen.

The tabs allow the user to define the following parameters.

To set default parameters, just check the **Fixer par défaut** box and click on OK, Apply or Apply to all.

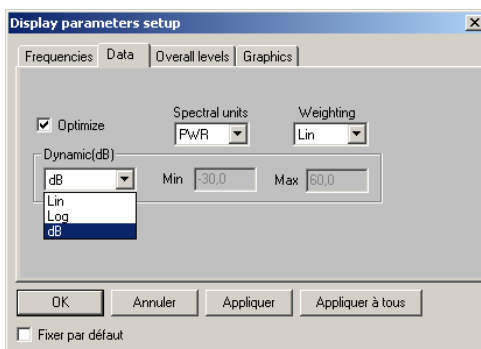
■ X axis (Frequency) tab



In this tab, select the minimum and maximum frequency bands for spectrum display in the graphical view.

If the **All** box is ticked, the spectrum is displayed over the complete frequency range of acquisition.


■ Data tab



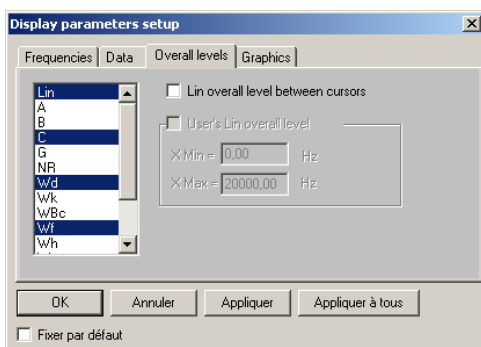
In this tab, select if the data should be displayed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

Then select the required spectral unit (**RMS** or **PWR** for broad band spectra and multispectra), as well as the frequency weighting to apply to the spectral data values.

If the **Optimise** box is not ticked, the user may then select the minimum and maximum values of the display dynamic range.


 Refer to **paragraphs 18.3 and 18.4** for a detailed list of the frequency weightings and spectral units available in **dBFA32**.

■ Overall levels tab (broad band spectra and multispectra)

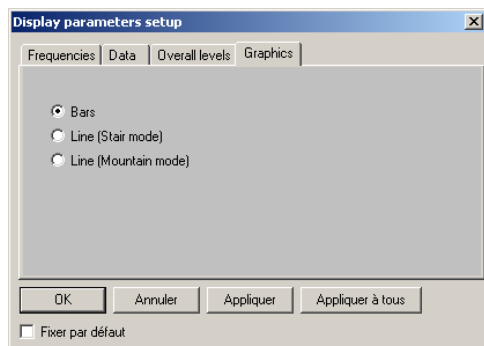


In this tab, and for broad-band spectra and multispectra only, select the overall levels to compute according to a given frequency weighting, displayed in a list.

Overall levels are then displayed on the right handside of the spectrum view.

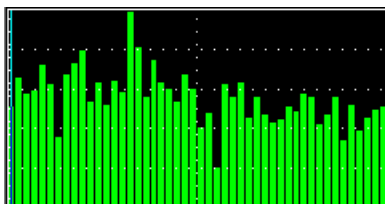
 Refer to **paragraphs 18.3** for a detailed list of the frequency weightings available in **dBFA32**.

■ Graphics tab

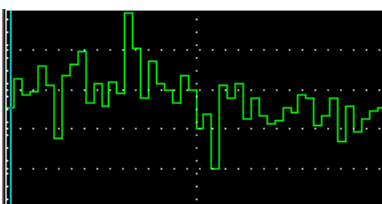


In this tab, select the type of graphics that will be displayed: line mode or bar mode.

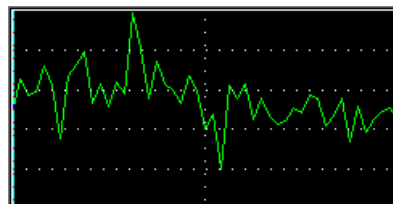
Examples of the different types of graphical representation are given below:



Bar mode



Line mode (stairs)



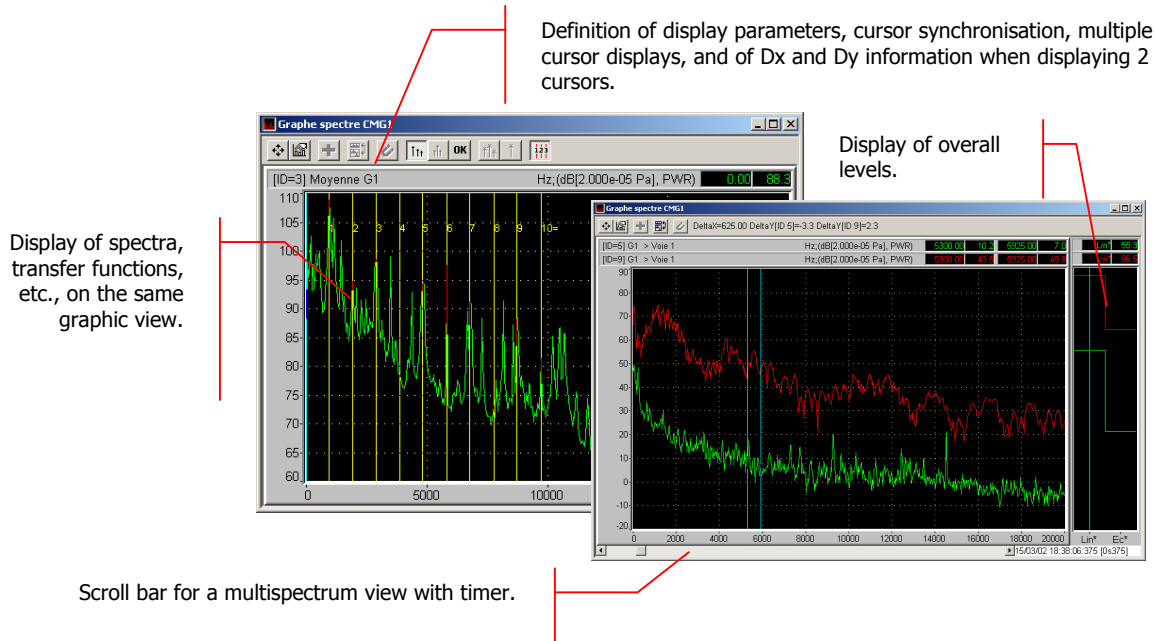
Line mode (mountain)

13.3.3. Narrow band spectra and/or multispectra, transfer functions and coherence

This type of view is used to graphically display autospectra and cross-spectra in narrow bands, with multispectrum capability, as well as transfer functions and coherence.

For multispectra (a spectrum calculated for each integration step, defined by the user), a scrolling bar at the bottom of the view is shown in order to view the spectral quantity at different time periods. Calculation of harmonic cursors and maxima is not possible on a multispectrum.

An example of this type of view is given below:




The toolbar of the graphical view allows the user to perform the following operations:

- | | | | |
|--|--|--|---|
| | Definition / Editing of data parameters for the graphical view | | Definition / Editing of display parameters for the graphical view |
| | Curve layout | | Go to stacked/superimposed mode if several curves with the same characteristics are displayed |
| | Activation / Deactivation of second cursor | | Activation / Deactivation of Lin overall level display between cursors |
| | Cursor synchronisation if several curves are displayed | | Display harmonic cursors (autospectrum only) |
| | Display sideband cursors (autospectrum only) | | Launch interpolation calculation on harmonic and sideband cursor table |
| | Display maximum x values (autospectrum only) | | Display maximum (autospectrum only) |
| | Display identification labels for multiple cursors (autospectrum only) | | |

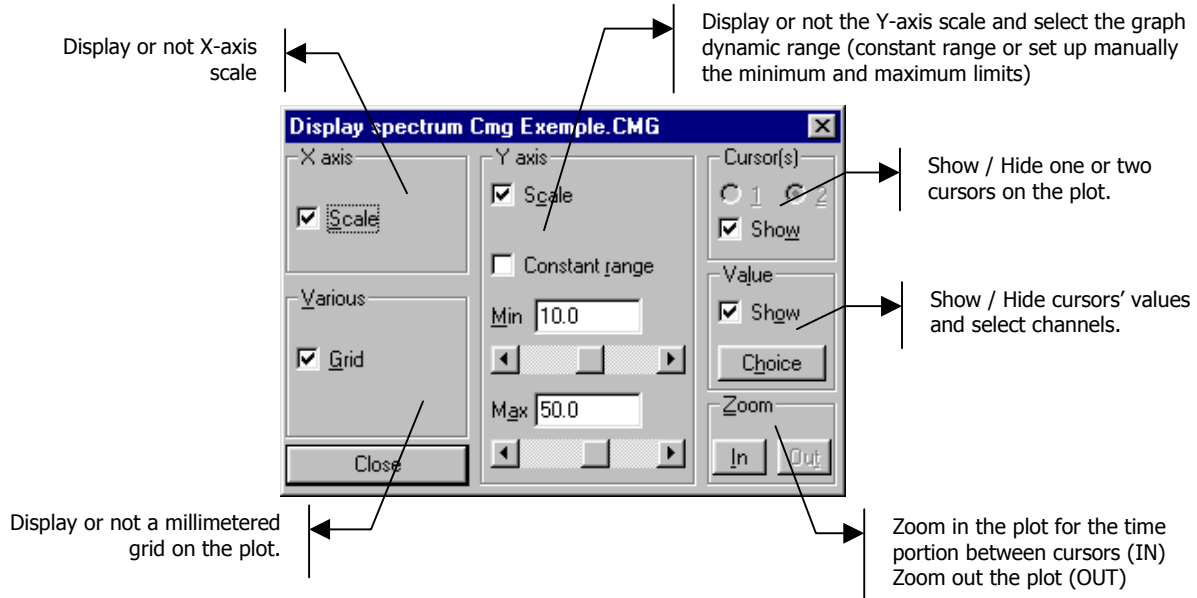
The levels are calculated from international system units (IS). It is possible to modify the default values using the command **Preferences / Units' management**. See **paragraph 19.1**.

It is possible to display in a same window as many stacked curves as the system can handle, regardless of their characteristics. As long as the elements have the same units (Pa, m/s², ...), curves can be superimposed.


13.3.3.1. Display parameters of the graphical view

Set up the graphical display parameters with the command  (**Plot / Plot set-up**).

The plot is updated immediately when a modification is made. Each plot has its own settings' dialog box: a modification on one plot does not affect the settings of another plot.



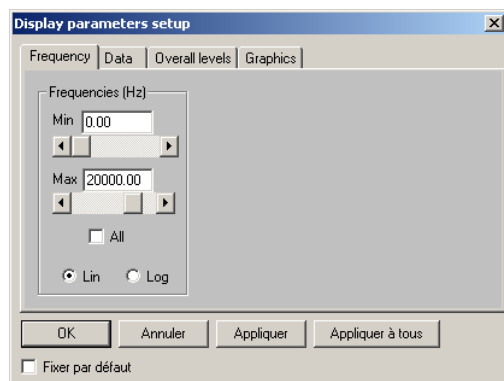
13.3.3.2. Data parameters for the graphical view

Define data parameters for the graphical view by the command  (**Plot / Parameters**). The following dialog box appears on-screen.

To set default parameters, just check the Fixer par défaut box and click on OK, Apply or Apply to all.

The tabs allows the user to define the following parameters:

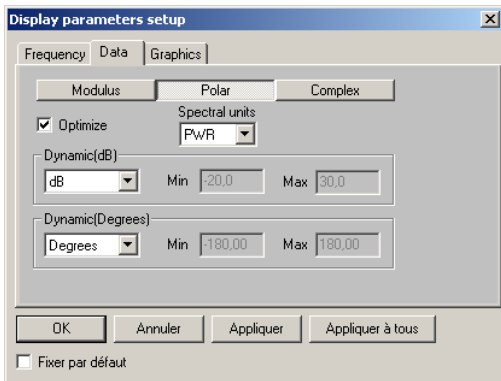
- **X axis (Frequency) tab**



In this tab, select the minimum and maximum frequency bands for spectrum display in the graphical view

If the **All** box is ticked, the spectrum is displayed over the complete frequency range of acquisition.

■ **Data tab**



In this tab, select if the data should be displayed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

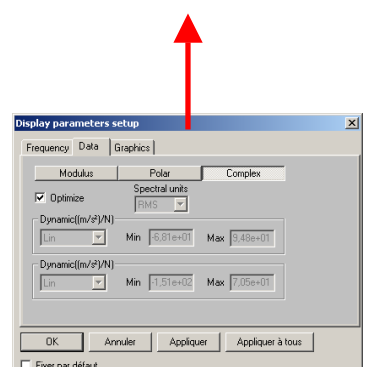
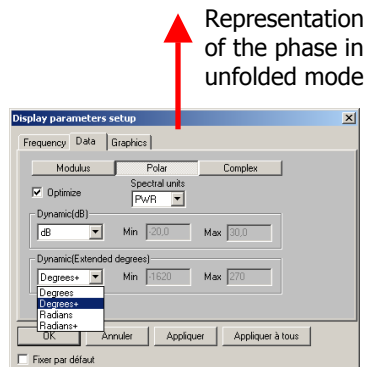
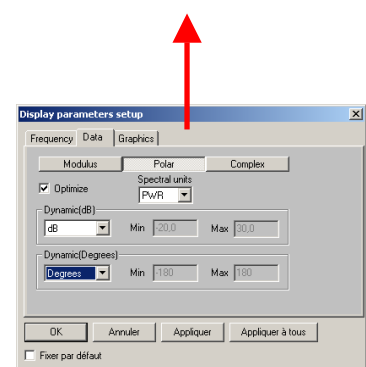
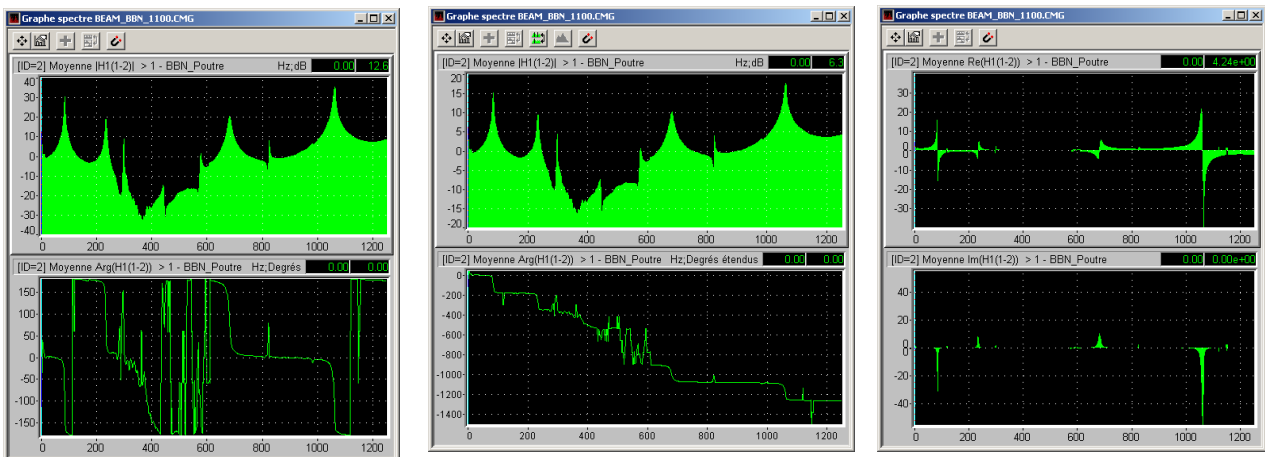
Then select the required spectral unit (**RMS, PWR, PSD and ASD** for narrow band spectra and multispectra) as well as frequency weighting to apply to the spectral data values.

If the **Optimize** box is not ticked, the user may then select the minimum and maximum values of the display dynamic range.

For cross-spectra and transfer functions, the user may display the data values in different manners: just the **modulus** (absolute value of the considered quantity), in **polar** form (modulus and phase) or in **complex** form (real and imaginary parts).

When displaying spectra in polar form, the phase can be represented as unfolded to have a clearer representation when the phase oscillates between +180 and -180°. To do so, select a dynamic range in **Degree+** or **Radian+**.

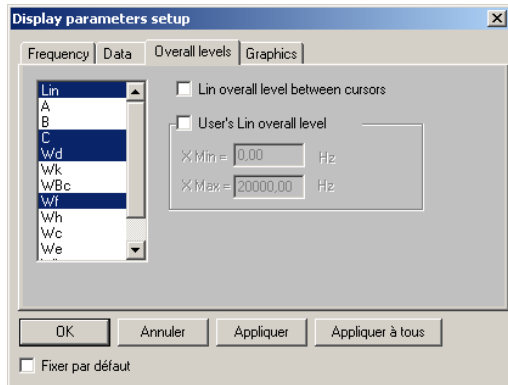
Different examples of these types of views are given below:



Representation of the phase in unfolded mode

Refer to **paragraphs 18.3 and 18.4** for a detailed list of the frequency weightings and spectral units available in **dBFA32**.

■ Overall levels tab



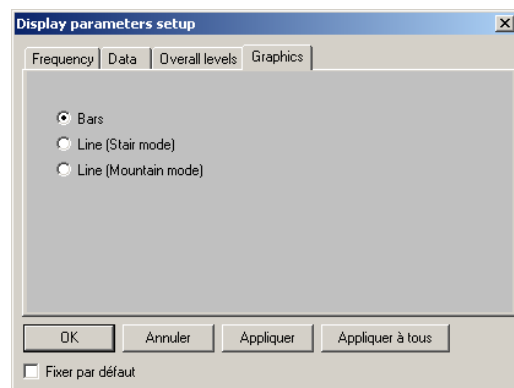
In this tab, select the overall levels to compute according to a given frequency weighting, displayed in a list.

It is possible to calculate and display a level between two fixed frequencies by checking the "User overall level" box and specifying a frequency range (labelled "U" on the curve).

If two cursors are activated, it is possible to calculate a "Lin overall level between cursors" (labelled "Ec" on the curve). To activate the second cursor, see Section 13.3.3.1.

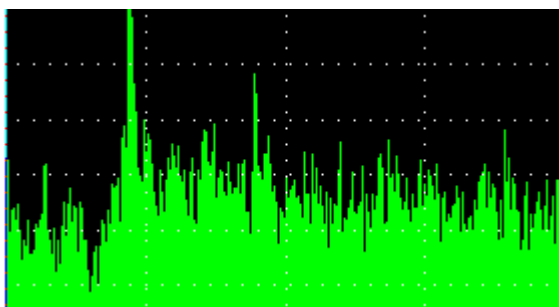
 Refer to **paragraphs 18.3** for a detailed list of the frequency weightings available in **dBFA32**.

■ Graphics tab



In this tab, select the type of graphics that will be displayed: line mode or bar mode.

Examples of the different types of graphical representation are given below:



Bar mode



Line mode (stair and mountains)

13.3.3.3. Using harmonic, sideband and maximum cursors

Maximum cursors

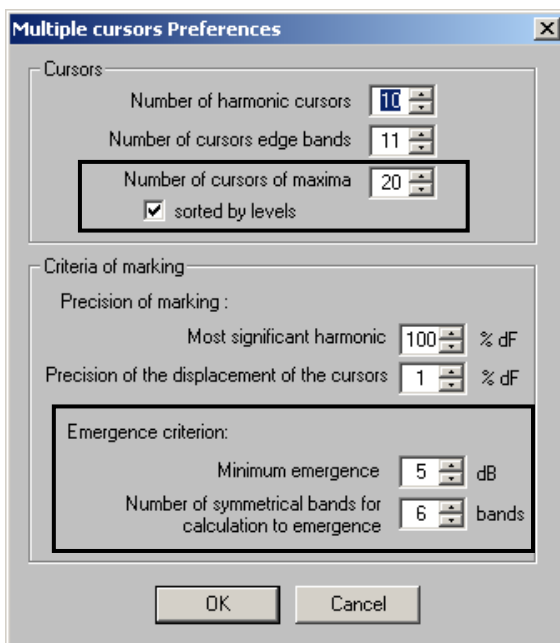
Principle and operating mode

The aim of this operation is to detect lines resulting from the FFT calculations that stand out most, and then to get closer to the true value (Frequency + Level) of the physical phenomenon, using an interpolation calculation depending on the FFT weighting window and on the peak shape (since the exact value is never located exactly on a FFT calculation line).

Search parameters set-up

Use **Preferences / Multiple Cursors** to set parameters for maximum search. The dialog box below is then displayed:

Parameters pertaining to maximum cursors are circled.



■ Cursors

Enter the number of cursors to search for and display.

For maximum cursors they may be sorted by level if the box "Sort by level" is checked. If this box is not checked, maxima will be sorted by increasing frequency.

■ Emergence criterion



Set criteria for maximum detection.

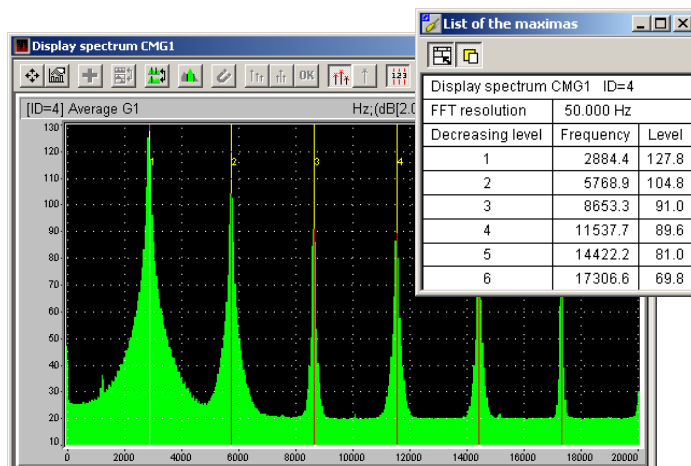
Enter the minimum emergence with respect to the level of the two symmetrical neighbouring lines located X/2 lines on the left and X/2 lines on the right for a peak to be considered as a maximum, X being the "Number of symmetrical neighbouring lines...".

Example: If the "Number of symmetrical neighbouring lines" is set to 6 and the emergence to 5 dB, for a peak to be a maximum, its level must be greater by (or equal to) 5 dB than the two values located 3 lines before and 3 lines after.


These parameters are defined for all measurement sessions and do not need to be reset. They must however be adapted to the different types of spectrum encountered.

Launching maximum search and calculation of interpolated values

Open the plot of the spectrum to analyse, and launch the search for the maximum using the  button, or use  to launch the search for a defined number of maxima (number defined in the Preferences menu).



If peaks meet the search criteria defined in the preferences, cursors will label the detected maxima on the plot and a table listing the results for the interpolation calculations will be displayed.

Use  in the table to have it always in the foreground.

❑ Harmonic and sideband cursors

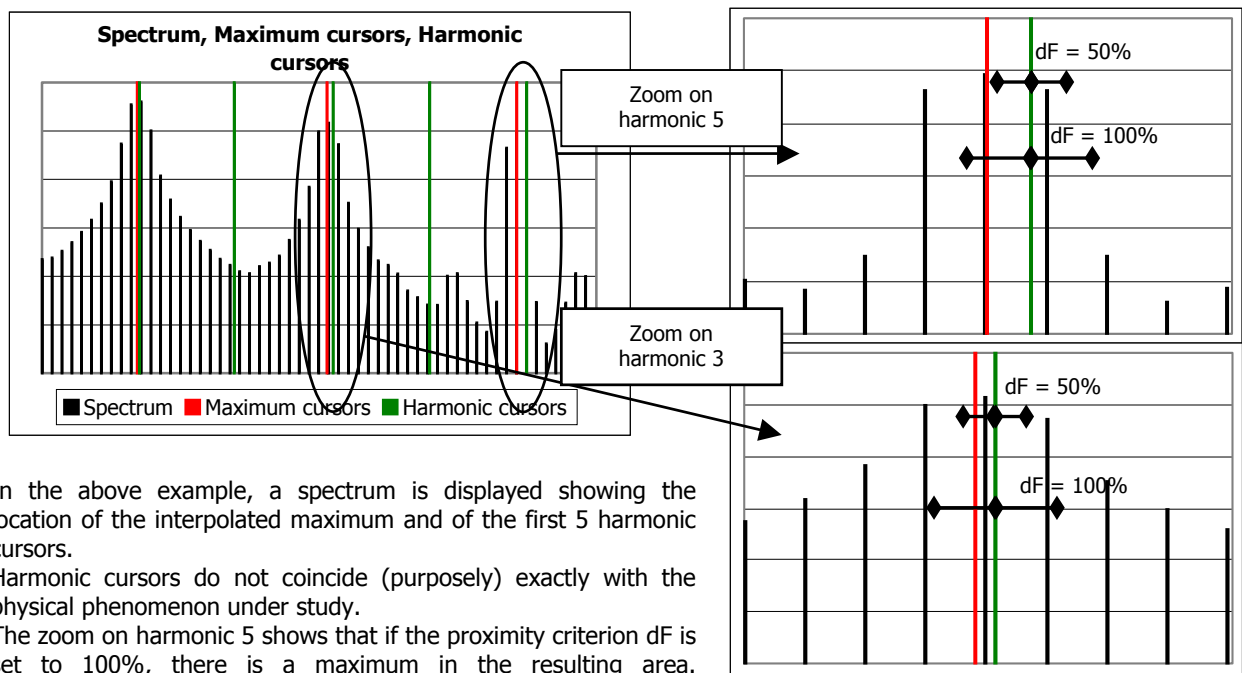
Principle and operating mode

In the case of harmonic cursors, the purpose is to find the fundamental frequency and the harmonics of a phenomenon, and then to get closer to the exact value of the said phenomenon using an interpolation calculation – depending on the FFT weighting window and on the peak shape (since the exact value is never located exactly on a FFT calculation line in the case of periodic phenomena). In the case of sideband cursors, the aim is to find the exact value of the main (carrier) frequency of a phenomenon, modulated in amplitude and/or in frequency by another phenomenon (side bands).

The following steps are required for the detection and the calculation of harmonics:

- ❶ **Spot the fundamental frequency** on the spectrum
- ❷ **Visually adjust** harmonic cursors with a displacement **step** in **percent** of the spectrum FFT **resolution**. Indeed, if the displacement of the fundamental frequency is carried out by steps of one (100%), then for the displacement of 1 FFT line, harmonic 10 moves by 10 FFT lines.
- ❸ For each cursor displacement, dBFA32 searches for a **significant harmonic**. The **significant harmonic** is that highest in frequency and closest to a maximum (see emergence criteria) within the limit set by the user in percent of the FFT resolution. This harmonic will be used as a reference for the **interpolation calculation**.

Precision on the detection of the significant harmonic and on the proximity criterion:



In the above example, a spectrum is displayed showing the location of the interpolated maximum and of the first 5 harmonic cursors.

Harmonic cursors do not coincide (purposely) exactly with the physical phenomenon under study.

The zoom on harmonic 5 shows that if the proximity criterion dF is set to 100%, there is a maximum in the resulting area. Harmonic 5 is the highest in frequency and thus it is the significant harmonic.

On the contrary, if dF is set to 50%, then the closest maximum to harmonic 5 does not belong to the defined area anymore.

Zoom on harmonic 3 shows then that if dF is set to 50%, there is a maximum located in the defined area. Harmonic 3 will then be the significant harmonic since it is the highest frequency meeting the proximity criterion.

- ❹ If there is a **significant harmonic** then the **interpolation** calculation can be launched.

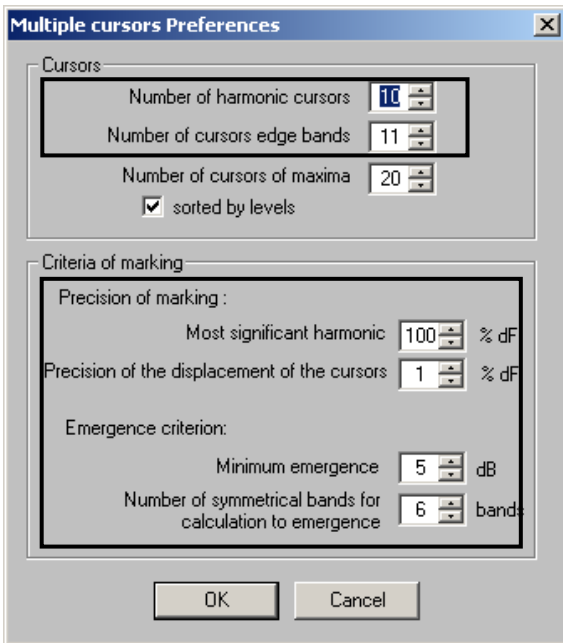
The frequency and the level of the significant harmonic are interpolated, then for each harmonic the level is interpolated from the cursor position. The frequency is calculated according to the significant harmonic using the rule of 3 (for the frequency calculation there can actually be an interaction between the window effect and the position of the significant harmonic).

5 If no harmonic meets the emergence and proximity criteria, one can “force” a harmonic by double clicking on the cursor of the chosen harmonic. The interpolation calculation can then be launched based on the selected harmonic.

Search parameters set-up

Use **Preferences / Multiple Cursors** to set parameters for harmonic search. The dialog box below is then displayed.

Parameters pertaining to harmonic and sideband cursors are circled.



■ **Cursors**

Enter the number of cursors to calculate and display. The number of sideband cursors is always odd given that we are searching for frequencies (side bands) around a centre frequency (carrier).

■ **Marking criteria**

The “**Most significant harmonic**” parameter is used to set the tolerance between the position of the most significant harmonic and a maximum.

The “**Precision for cursor displacement**” parameter is used to define the displacement step for the cursor placed on the fundamental frequency.

The “**Emergence criteria**” parameters are used to set parameters for the detection of maxima.

Enter the minimum emergence with respect to the level of the two symmetrical neighbouring lines located at X/2 lines on the left and X/2 lines on the right, X being the “Number of symmetrical neighbouring lines...”.

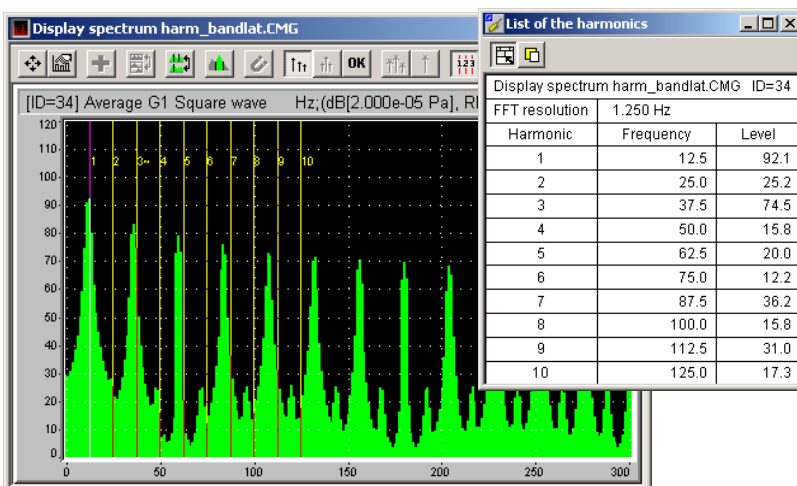
These parameters are defined for all measurement sessions and do not need to be reset. They should however be adapted to the different types of spectra encountered.

Launching harmonic search and calculation of interpolated values

Open the plot of the spectrum to analyse and follow the steps described hereafter:


1 Place the cursor on the fundamental frequency.


2 Press to display harmonic cursors and a table of values corresponding to the FFT lines.



Use to have the table always displayed in the foreground.

3 Click on the graphics window to make it active and move the harmonic cursors using the CTRL and arrow keys so that they correspond **visually** to the harmonics. If a significant harmonic is found, it will be labelled with a “=” sign if it is exactly on the FFT line or with a “~” sign otherwise.

4 Click on  to launch the interpolation calculation and obtain calculated values that are closer to the physical phenomenon.

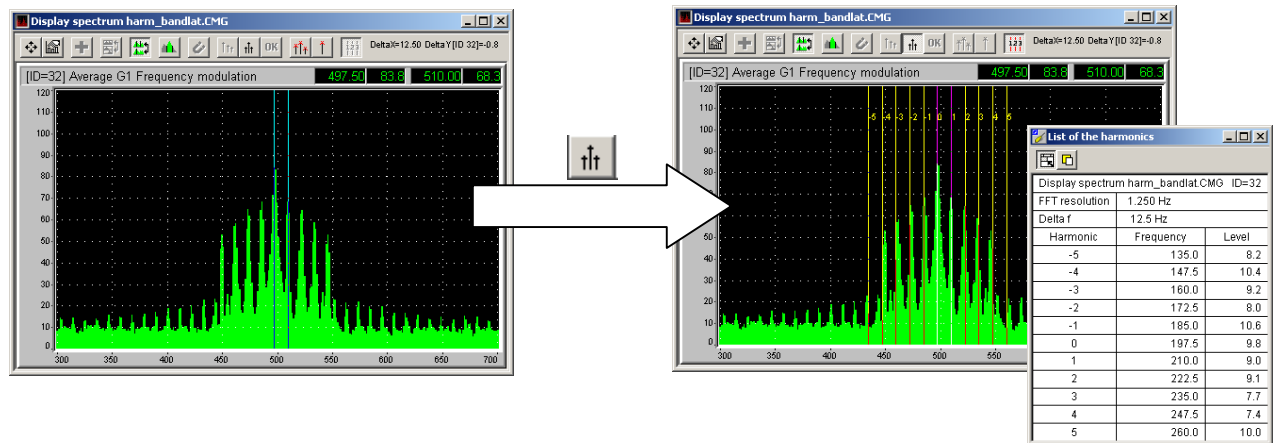
If the  button is disabled, it means that no line corresponds to the emergence and tolerance criteria. It is then necessary to better adjust the search parameters.

It is also possible to impose a significant harmonic by double clicking on the cursor of the corresponding harmonic. In this case, an “X” will be displayed next to the harmonic.

Sideband cursor

For sideband cursors, the principle and the stages are the same, but a second cursor needs to be activated (see Section 13.3.3.1).

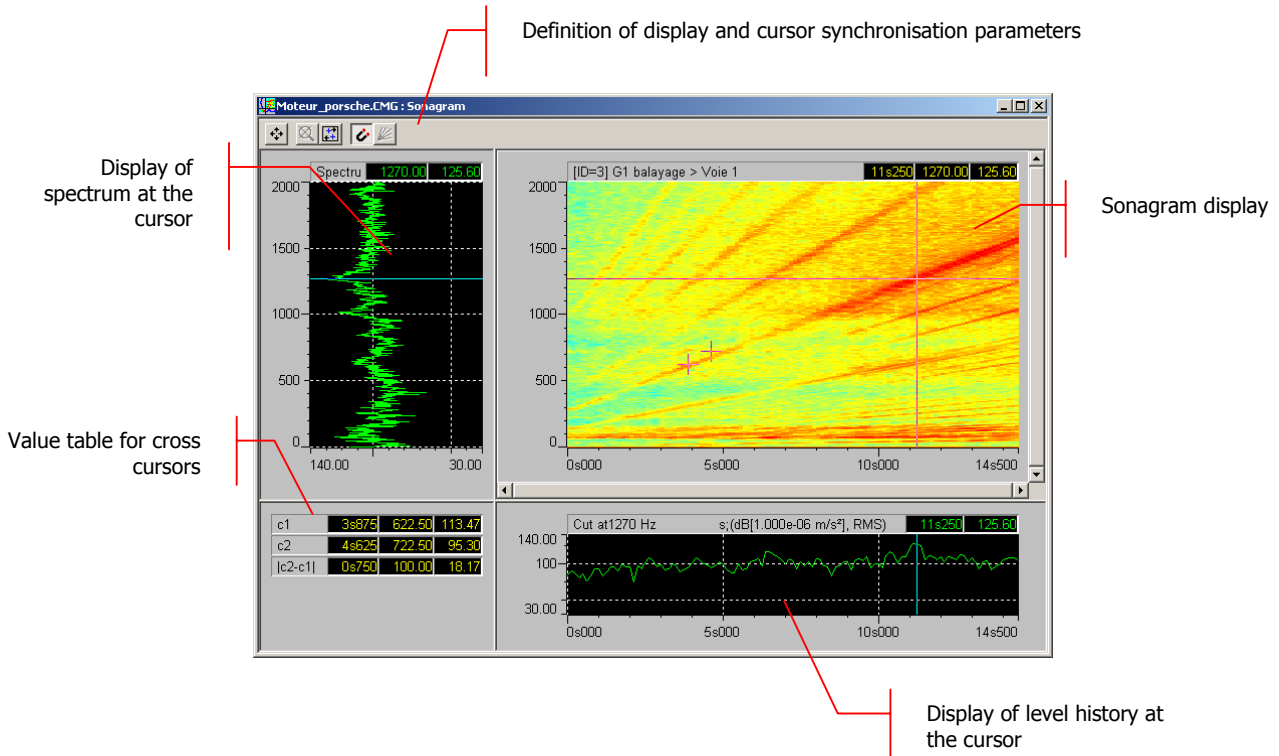
Place a cursor on the fundamental frequency and then the second cursor on the next greater side band (right of the fundamental frequency).








13.3.4. Sonagram view

This type of view displays all narrow-band autospectra, with timing or other mode (depending on the speed...). To view the sonagram, first select the item and then use the **Session / Sonagram** menu.

An example of a sonagram view is shown below:



The toolbar of the graphic view gives access to the following operations:

-  Define / Edit data parameters for display
-  Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse
-  Place cross cursors in sonagram corners (bottom left and top right)
-  Cursor synchronisation between the three views (spectrum, time history and sonagram)
-  Activate or deactivate order cursor

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 19.1**.

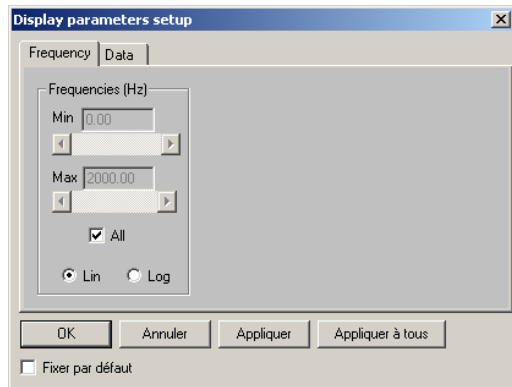
13.3.4.1. Data calculation parameters for display

Use  or **Plot / Parameters** to set calculation parameters. A dialog box including several tabs is displayed on screen.

These tabs are used to define the parameters described hereafter.

To set the default parameters, check the **Fixer par défaut** box and click on OK, Apply or Apply to all.

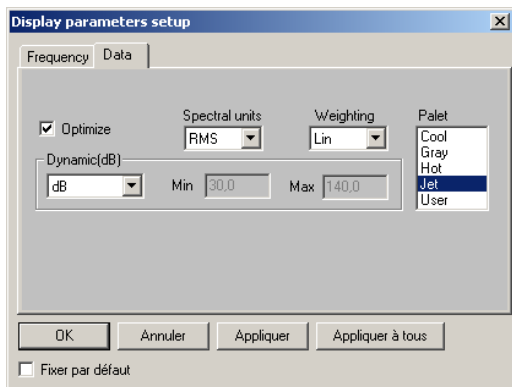
■ “Frequencies” tab



Select the minimum and maximum frequency bands to be displayed on the graphic view.

Check the **All** box to view data over the acquisition frequency range.

■ “Data” tab




Select physical units (**Dynamic: Lin or Log**) or decibels (**dB**) for data display.

Select the spectral unit (**RMS** or **PWR** for broad band spectra and multispectra), as well as the weighting to apply to all spectral data.

Select the weighting to apply to the spectrum (Lin, A, B,...), and the colour palette to use on the sonagram view.

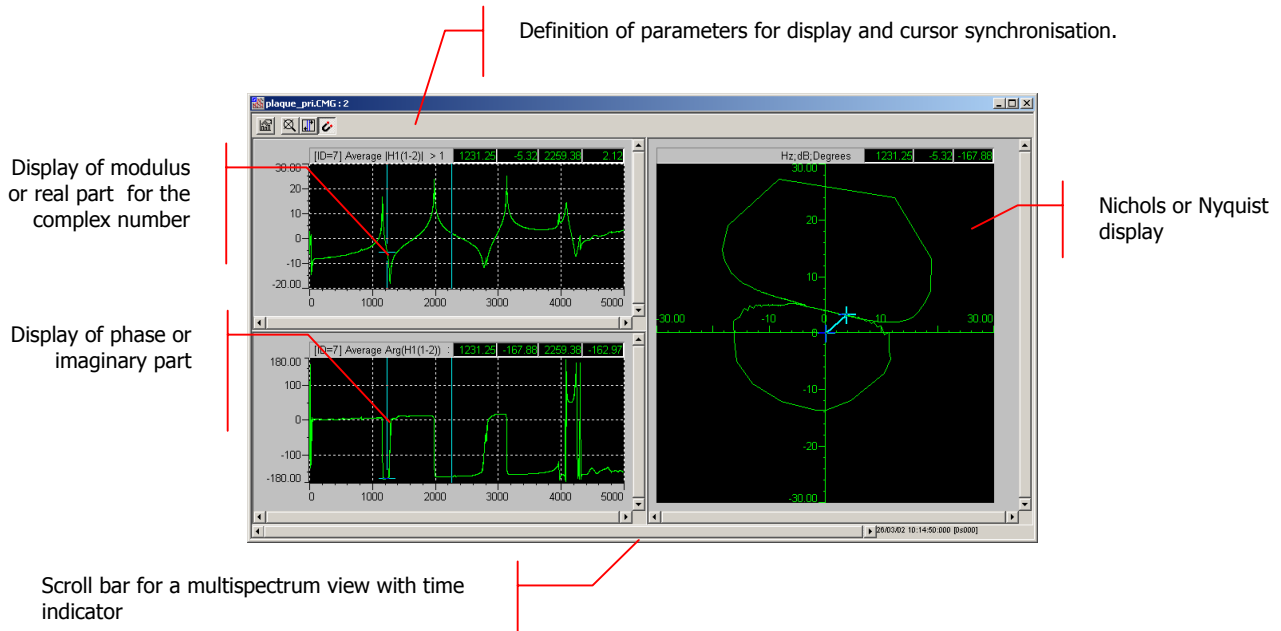
If the **Optimise** box is not checked, then minimum and maximum values of the display dynamic range can be set here.

 Refer to Sections 18.3 and 18.4 for a detailed list of frequency weightings and types of spectral units available in **dBFA32**.

13.3.5. Nichols / Nyquist views

This type of view is used to display all narrow band transfer functions and cross spectra with or without timing. To view the Nichols or the Nyquist diagram, select the item and go to **Sessions / Nichols/Nyquist**.

The figure below shows an example of Nichols / Nyquist view:



The toolbar in the graphic window gives access to the following operations:



Define / Edit data parameters for display



Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse



Place cross cursors in corners



Cursor synchronisation for the selection of a specific working area

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 19.1**.

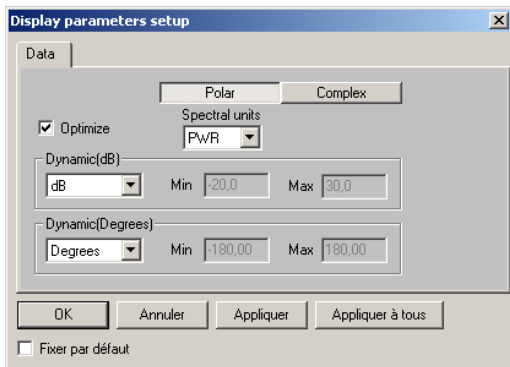
13.3.5.1. Data calculation parameters for display

Use  or **Plot / Parameters** to set calculation parameters. A dialog box including several tabs is displayed on screen.

These tabs are used to define the parameters described hereafter.

To set the default parameters, check the **Fixer par défaut** box and click on OK, Apply or Apply to all.

■ "Data" tab





Select the appropriate representation; the polar view corresponds to the Nichols representation, and the complex view to the Nyquist representation.

Select physical units (**Dynamic: Lin or Log**) or decibels (**dB**) for data display.

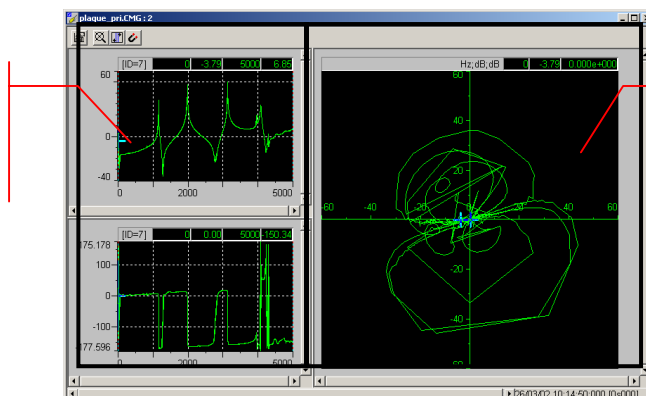
Select the spectral unit (**RMS or PWR** for broad-band spectra and multispectra), as well as the weighting to apply to all spectral data.

If the **Optimise** box is not checked, then minimum and maximum values of the display dynamic range can be set here.

 Refer to Sections 18.3 and 18.4 for a detailed list of frequency weightings and types of spectral units available in **dBFA32**.

 In this view, the parameters for the modulus/phase or real/imaginary complex views are dissociated from the Nichols or Nyquist views. It is then possible that both the Modulus/phase view and the Nyquist view are displayed at the same time. To avoid this, click on the "Apply to all" button so that the transition from Nichols to Nyquist is applied to both views. Otherwise, remember to apply the same parameters on both views.

Modulus + phase view or real + imaginary complex view

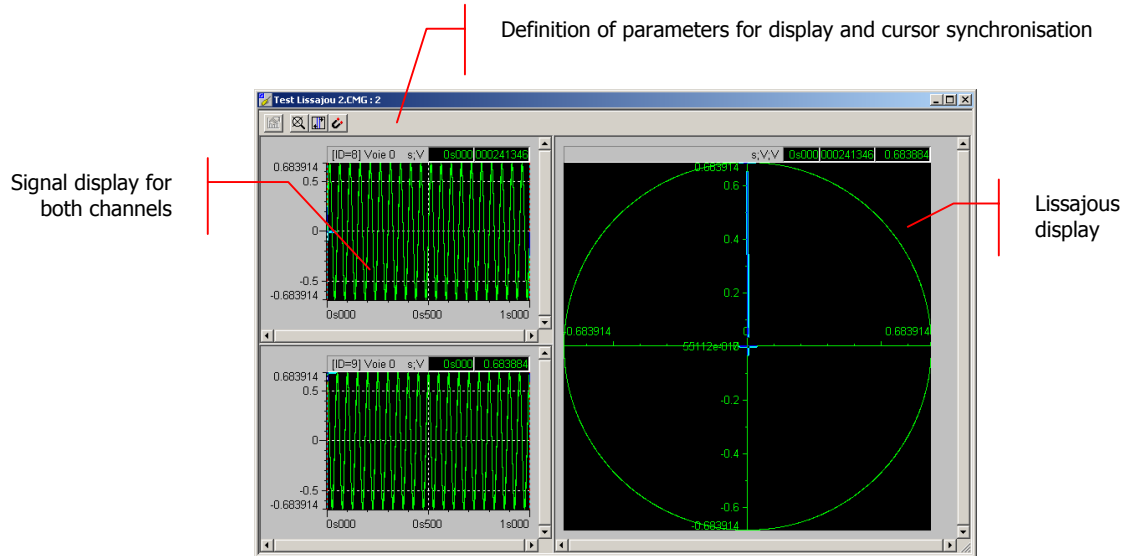


Nichols or Nyquist view

13.3.6. Lissajous view

This type of view displays the Lissajous representation between two signals. To view the Lissajous representation, select two Signal items and go to **Sessions / Lissajous**.

An example is shown below:



The toolbar in the graphic window is used to perform the following operations:



Define / Edit data parameters for display



Cancel zoom – Zoom function is accessible by pressing on the Shift key and selecting the area with the mouse




Place cross cursors in corners



Cursor synchronisation for the selection of a specific working area

Levels (in dB) are calculated with respect to the international system reference values. Reference values can be modified, as well as the physical units, using the **Preferences / Units' management** menu. See **Section 19.1**.

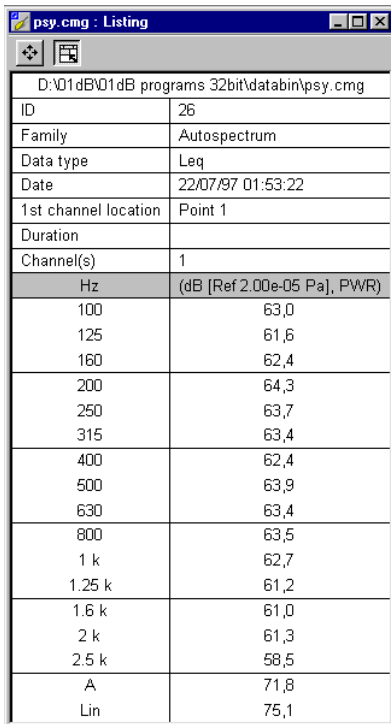
13.4. Listings of data items (tables)

Use the command  **Datafile / List**, after selection of one or more data items in the list, in order to display data items as a table of results. The user can also double click on the items of interest to display the table of results.

The following types of data items may be displayed as a table in the application **dBFA32**:

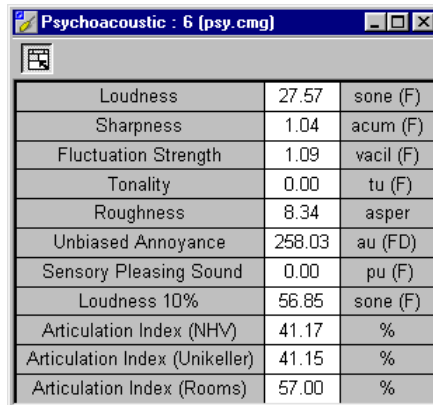
- Broad-band spectra
- Stationary psychoacoustic criteria

Examples of tables of results are given below:



D:\01dB\01dB programs 32bit\databin\psy.cmg	
ID	26
Family	Autospectrum
Data type	Leq
Date	22/07/97 01:53:22
1st channel location	Point 1
Duration	
Channel(s)	1
Hz	(dB [Ref 2.00e-05 Pa], PWR)
100	63,0
125	61,6
160	62,4
200	64,3
250	63,7
315	63,4
400	62,4
500	63,9
630	63,4
800	63,5
1 k	62,7
1.25 k	61,2
1.6 k	61,0
2 k	61,3
2.5 k	58,5
A	71,8
Lin	75,1

Table of results for broad band spectra



Loudness	27.57	sone (F)
Sharpness	1.04	acum (F)
Fluctuation Strength	1.09	vacil (F)
Tonality	0.00	tu (F)
Roughness	8.34	asper
Unbiased Annoyance	258.03	au (FD)
Sensory Pleasing Sound	0.00	pu (F)
Loudness 10%	56.86	sone (F)
Articulation Index (NHV)	41.17	%
Articulation Index (Unikeller)	41.15	%
Articulation Index (Rooms)	57.00	%

Table of results for psychoacoustic criteria

The toolbar of the table of results allows the user to perform the following operations:




Definition / Editing of data parameters for the table of results



Automatically adjust the window size to the table size

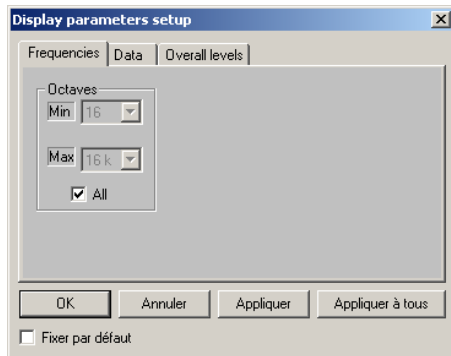
The levels are calculated from international system units (IS). It is possible to modify the default values with the command **Preferences / Units' management**. See **paragraph 19.1**.

13.4.1.1. Data parameters for the table of results

Define data parameters for the table of results using the  command (**Listing / Parameters**). The following dialog box appears on-screen. This command only applies to broad-band spectra. The tabs within this dialog box are used to define the following parameters:

To set the default parameters, check the **Fixer par défaut** box and click on OK, Apply or Apply to all.

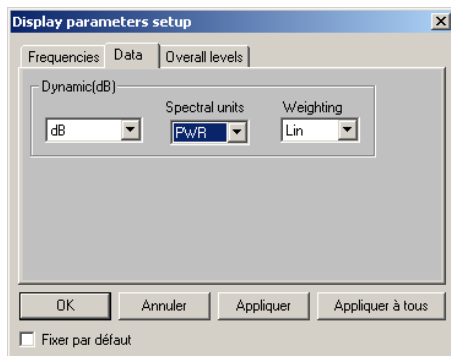
■ X axis (Frequencies) tab



In this tab, select the minimum and maximum frequency bands for spectrum data values in the table of results.

If the **All** box is ticked, the spectrum values are listed over the complete frequency range of acquisition.

■ Data tab



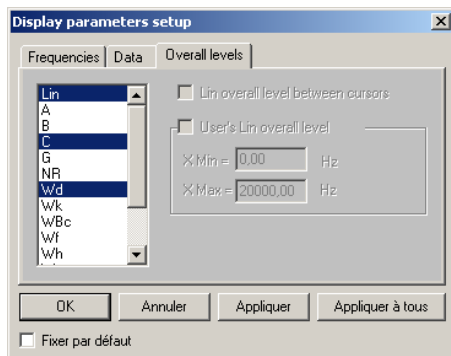
In this tab, select if the data should be listed in physical units (**Dynamic: Lin or Log**) or in decibels (**dB**).

Then select the required spectral unit (**RMS** or **PWR** for broad-band spectra), as well as frequency weighting to apply to the spectral data values.



Refer to **paragraphs 18.3 and 18.4** for a detailed list of the frequency weightings and spectral units available in **dBFA32**.

■ Overall levels tab




In this tab, select the overall levels to compute according to a given frequency weighting, displayed in a list.

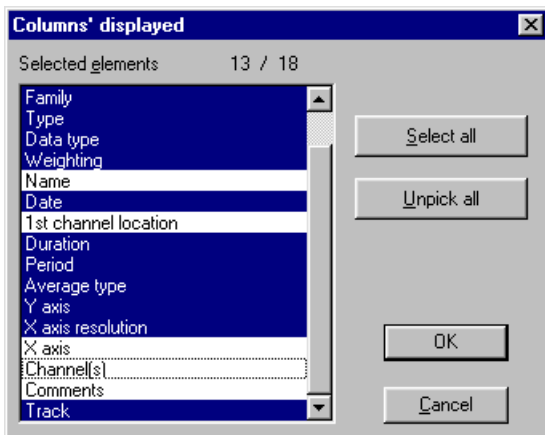
Overall levels are then displayed at the bottom of the table of results.



Refer to **paragraphs 18.3** for a detailed list of the frequency weightings available in **dBFA32**.

13.5. Description and selection of columns in a measurement session window

Use the command  **Datafile / Columns** to select the columns that will be displayed in the main window of a measurement session data file. The dialog box shown below appears on screen.



Select with the mouse the different column fields that will be displayed in the main window of a measurement session data file.

The key **Select all** allows the user to select all possible columns fields while the key **Unpick all** allows the user to clear all the column fields.

The table below gives the meaning of column available in a measurement session window:


Columns	Meaning
Selection (Sel.)	When selecting several data items in the measurement session window, a number is shown in this column that displays the selection order of the data items.
ID	Identifier of the data item. A number. This number is incremented (from 0) each time a data item is added to the measurement session.
Family	Set of data items of the same family: audio, autospectra, transfer functions, etc.
Type	Type of a given spectrum (emitted noise, received noise, etc. for building acoustics)
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis: A, B, C, Lin weightings, vibration weightings, etc.
Name	Name of the analysis that created this data item. It is the name of the operator for an off-line analysis and the name of the acquired quantity for a real-time measurement.
Date	Date and time of the data item, corresponding to the date of creation or modification
Location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.
Duration	Duration of the data item (hour / minutes / seconds)
Period	Base duration or integration time of data items that vary with time.
Average type	Type of averaging method used to compute the data item (average, min., max., statistical)
Average duration	Duration of the averaging for the element calculation
Y axis	Physical unit (or dB for the histograms) of the Y axis
X axis resolution	Resolution of the X axis (in seconds for time histories of data items, frequency resolution for spectrum data items)
X min	Minimum frequency value
X max	Maximum frequency value
X axis	Unit of the X axis (Hz, seconds, %, etc.)
Channel(s)	Number of the measurement channel on which the data item has been acquired
Information	Information on the element
Comments	Comments of the data item, from measurement set-up or item modification
Track	For off-line analysis, this field indicates how this data item was computed : ID of the original data item, name and type of operators used to compute the result)

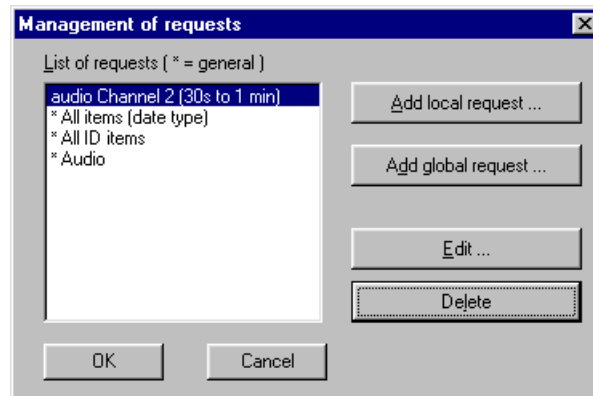
13.6. Editing and running requests (data sorting)

Measurement session datafiles have a structure similar to databases. As any measurement result is stored into these datafiles, a set of requests functions allow the user to sort the data according to various parameters.

One can display, for example, data items of the same family only (audio events, narrow-band spectra, octaves and third octave spectra, etc.) in the measurement session view.

13.6.1. Overview of requests' editing

Use the command  **Datafile Edition of requests** to open the dialog box that allows the user to define, edit or remove requests.



dBFA32 manages two types of requests: **local requests**, which apply only to the active measurement session, and **global requests**, which apply to any measurement session. Global requests are preceded by an asterisk (*).

The procedure to define a request is the same in both cases.

Click on "Add local request..." to add a new local request to the active measurement session and click on "Add global request..." to add a new global request for any measurement session that will be opened in the application software.

Click on **Edit** to modify an existing request selected in the list and click on **Remove** to remove an existing request from the list.

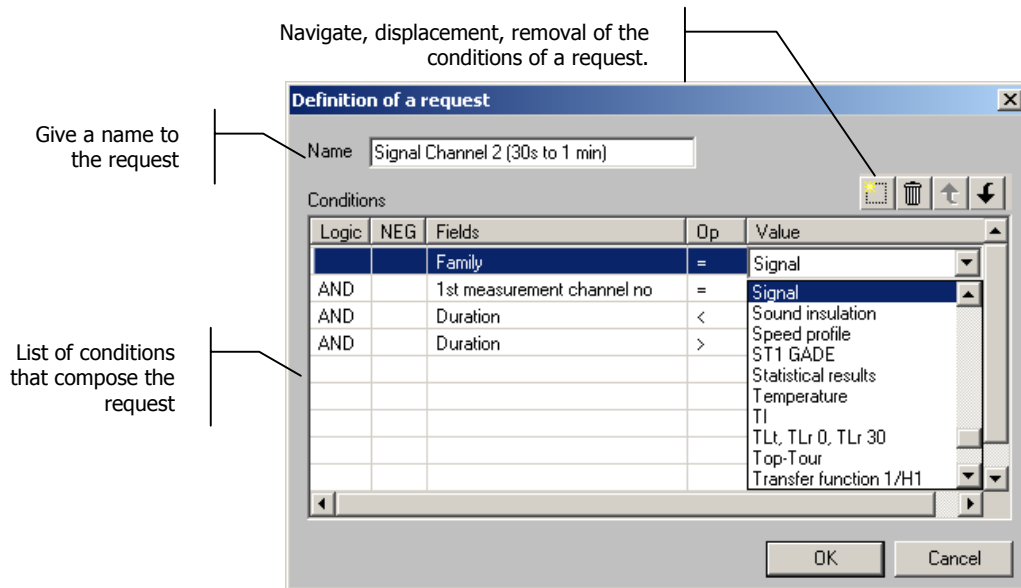
By default, only one type of general request is defined in **dBFA32**:

- *** All items**
Sort data items of a measurement session

13.6.2. Add or modify a request (local or global)

13.6.2.1. Overview

Access the dialog box shown below when creating a new request or editing an existing request.



After definition of the request name (that will appear in the list of requests), define one or several conditions that compose the request. The columns of the list of conditions of a request allows the user to define the following parameters:

- **Logic column**

Define a Boolean operator (**AND/OR**) when several conditions have been defined. The data items will be displayed when all the conditions of the request are verified (**operators AND**) or at least one condition is verified (**operators OR**).

- **NEG column (negative)**

If this case is activated, the data items that will be displayed are the items that do not correspond to the condition.

- **Fields column**

Select the quantity according to which the data items will be sorted. A list proposes all the fields that characterise data items (family, name, ID, duration, etc.)

- **Op column (operation)**

Equality, inequality of the quantity selected in the Fields column.

- **Value column**

Value that takes the quantity selected in the Fields column. The operation of the Op column forms the condition of the request.

Furthermore, a tool bar allows the user to perform the following operations:



Insert a condition in the list at the current mouse location



Remove the condition selected in the list



Move up the condition selected in the list (appears in video inverse)



Move down the condition selected (highlighted) in the list

The definition order of the conditions is important: indeed, the Boolean operator (logic column) of the last condition defined is applied to all the conditions that precede it.

For example, for a set of conditions to verify simultaneously (AND operator in between each condition), if the operator for the last condition is OR, then the request will display data items that match all the conditions associated by the AND operator, as well as the data items that match the last condition.

The example below illustrates the principle:

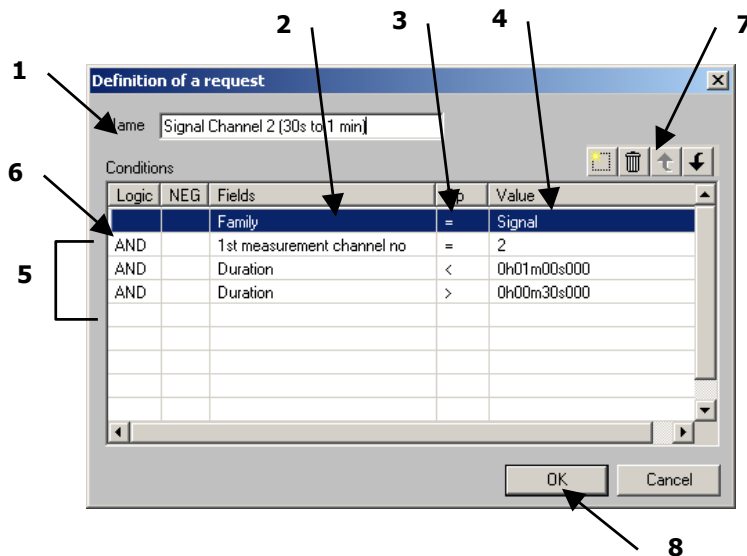
Logic	NEG	Fields	Op	Value	Logic	NEG	Fields	Op	Value
		Family	=	Signal			Family	=	Signal
AND		Duration	<	0h01m00s000	AND		Duration	<	0h01m00s000
AND		Duration	>	0h00m30s000	OR		Duration	>	0h00m30s000

Data items of the Signal family and of duration ranging from 30 seconds to 1 minute will be displayed.

Data items of the Signal family and of duration greater than 30 seconds will be displayed, as well as data items (whatever the family) of duration less than 1 minute.

13.6.2.2. Definition principle

Follow the instructions below to add a new request:



1. Give a **name** to the current request. This name will appear in the list of requests in the management dialog box.
2. On the first line of the conditions' list, click on the **Fields** column and select the desired quantity in the scrolling list.
3. On the same line, click on the **Op** column and select the equality value in the scrolling list.
4. On the same line, click on the **Value** column and select a value in a scrolling list or input it manually.
5. Repeat steps 2 to 4 for each condition to define.
6. Select the Boolean operators in the Logic column to define interactions in between the conditions.
7. Define the order of the request conditions, remove a condition if necessary.
8. Validate the request.

13.6.2.3. List of the values available to define a request

Here is a complete table of the different choices available when defining a request.

Fields column	Description (Fields column)	Op column	Value column
1/n octave	Frequency resolution of a broad band spectrum or multispectrum	< ; <= ; <> ; = ; > ; >=	n = 1, 3, 6, 12, 24, 48
Application	Name of the application software used to create the item	@, =	Manual input
Building calculation	Results generated from building calculations (airborne isolation, shock noise...)	= ; <>	Alpha p / Alpha w; Alpha s; D (French standard); D (ISO standard); Dn,w; Dn,T / Dn,T,W; DnT / DnAT pink, DnT / DnAT route; Unknown; Ln / Ln,w; L'n / L'n,w; LnT / LnAT; L'nT / L'nT,w; R / R,w; R' / R'w
Date	Date of creation of the item	< ; <= ; <> ; = ; > ; >=	Manual input (day/month/year hh:mm:ss). 01/02/1999 16:42:05
Duration	Duration of an item	< ; <= ; <> ; = ; > ; >=	Manual input (ddd/hh/mm/ss/ms) 30 seconds : 000j00h00m30s000
Family	Set of data items of the same family: signal, autospectra, transfer functions, etc.	= ; <>	attack decay sustain release, signal, autospectrum, clarity, code, coherence, comment, counter, room criteria, EDT, transfer functions (1/H1, H1, 1/H2, H2), histogram (% , Nb), cumulated histogram (% , Nb), Intensity (active, reactive, free field), cross-spectrum, sound insulation, Leq, measurement, mean pressure, psycho, RASTI, impulse response, sensitivity, Bark spectrum, scalar spectrum, STI, TI, TR
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)	= ; <>	Peak, Fast, Fast Inst., Fast Max, Fast Min, Impulse, Impuls Inst, Impuls Max, Impuls Min, instantaneous, Isel, Leq, Min, RC, RC Inst., RC Max, RC Min, SEL, Slow, Slow Inst, Slow Min, Slow Max, Tmax 3, Tmax 5
X axis quantity	Physical unit of the X axis	= ; <>	Bark, dB, Hz, Order, Scalar
Y1 axis quantity	Physical unit of the Y-axis.	= ; <>	Acceleration, counter, displacement, force, jerk, Noy, pressure, rate, rate (DC), second, scalar, sone (D, F, GD, GF), voltage, velocity, W/m ²
Y2 axis quantity	For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum		
ID	Identifier of the data item. A number. This number is incremented (from 0) each time a data item is added to the measurement session.	< ; <= ; <> ; = ; > ; >=	Manual input of a number
Information	Information on some calculation results (order analysis, ...)	@ ; =	Manual input
Location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.	@ ; =	Manual input of a location
Average type	Type of averaging method used to compute the data item	= ; <>	Max, Min, Average, Stat
1st meas. Channel no	Number of the measurement channel used to create the item.	< ; <= ; <> ; = ; > ; >=	1, 2, 3, 4
2nd meas. Channel no	For cross-spectra, the number of each channel used to calculate the cross spectrum is described		

Fields column	Description (Fields column)	Op column	Value column
Name	Name of the analysis that created this data item. It is the name of the operator for an off-line analysis and the name of the acquired quantity for a real-time measurement.	@ ; =	Manual input
Period	Base duration or integration time of data items that vary with time.	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000 seconds) 125 ms : 0.12500
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis: A, B, C, Lin weightings, vibration weightings, etc.	= ; <>	A, B, C, D, G, Lin, PL, Pla, PN, Pink A, Pink Lin, Road A, Road Lin, TPN, Wb, WBC, Wc, Wd, We, Wf, Wh, Wj, Wk
Resolution	Unit of x axis	< ; <= ; <> ; = ; > ; >=	Manual input
Building acoustics spectrum	Spectrum for the calculation of building acoustics criteria	= ; <>	Background noise, emitted noise, received noise
Statistics	Statistical index Ln	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) L99.8 : 99,8000
X axis unit	X axis unit for a quantity acquired with other software (not 01dB)	@ ; =	Manual input
Y1 axis unit	X axis unit for a quantity acquired with other software (not 01dB). For example, the temperature	@ ; =	Manual input
Y2 axis unit	For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum	@ ; =	Manual input
Version	Version of the file format	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) Version 1.01 : 1,01000


Legend:

<	Less than
<=	Less than or equal to
<>	Not equal to
=	Equal to
>	Greater than
>=	Greater than or equal to
@	Contains the character string

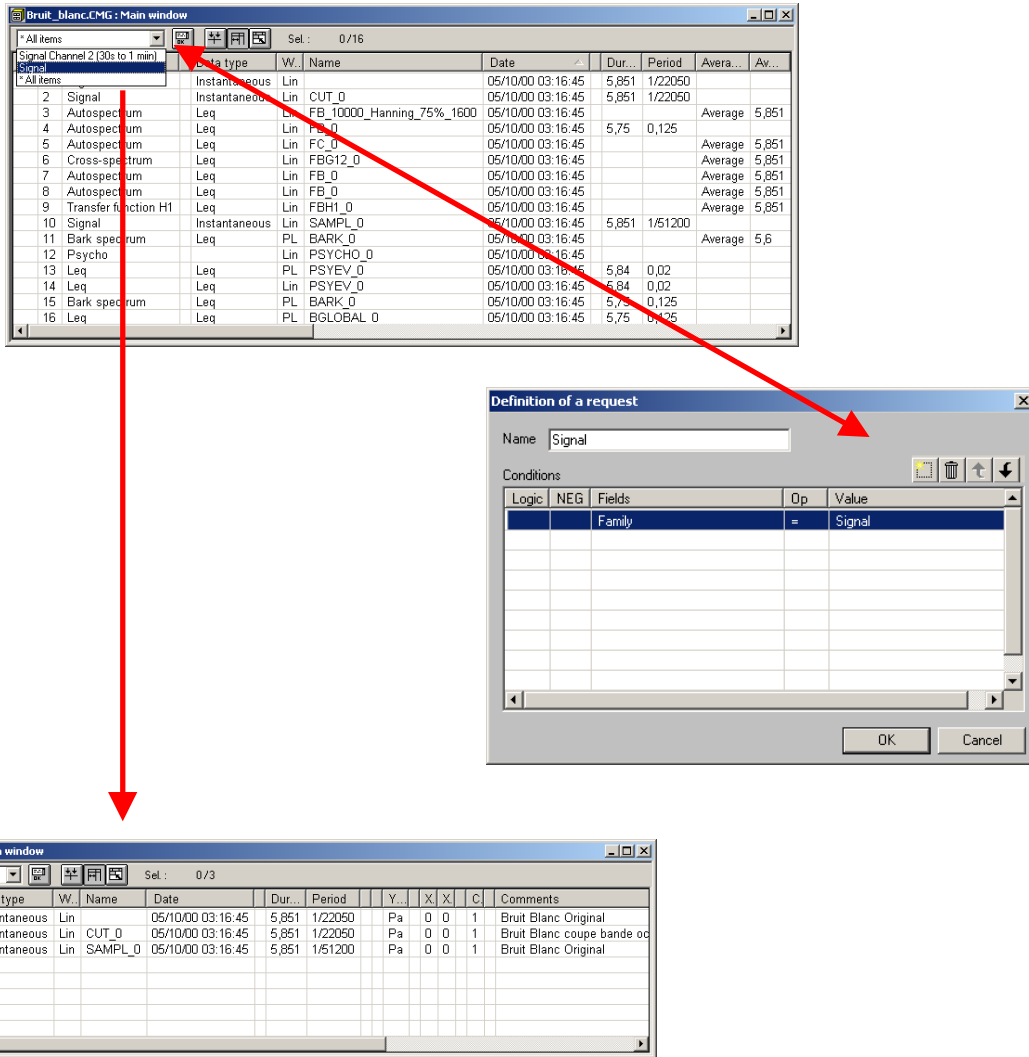


Refer to **paragraphs 18.3** for a detailed list of the frequency weightings available in **dBFA32**.

13.6.3. Running a request

Once all the requests have been defined, use the scrolling list  of the measurement session window or the **Datafile / Current request** command.

The selected request is then executed automatically. An example of execution of a request to display only items of the Signal family is given below:

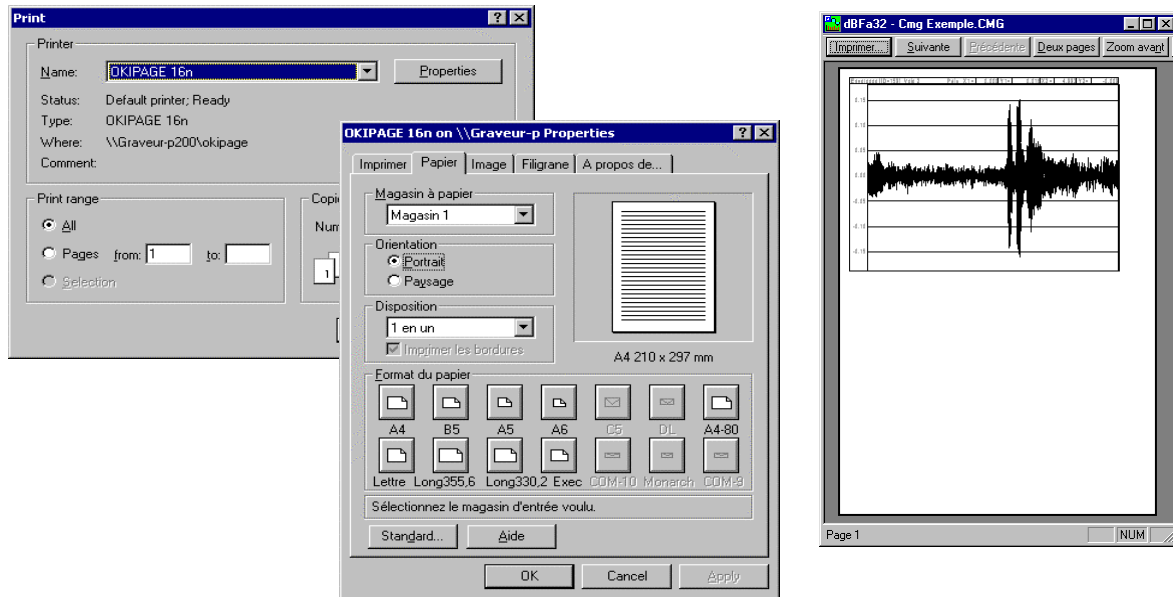


13.7. Result exploitation and customisation

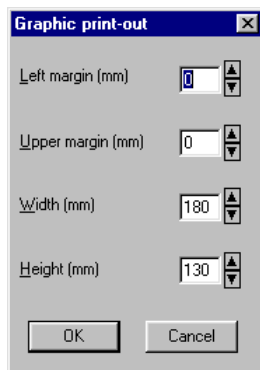
In **dBFA32**, it is possible to print directly a data plot and/or a result listing and to export the results as graphics or values in standard office spreadsheet and word processor software, for further processing and result presentation. The user can also customise the way the data is displayed in the software.

13.7.1. Printing results

Using the commands of the **File** menu, results can be directly printed by **dBFA32**, if a printer is connected to the computer, of course. Use the command **File / Print (CTRL + P)** to display the Print dialog box. Specify which pages should be printed, the number of copies, and the printer driver to use as well as other parameters (print quality, etc.).



Access directly to the printer configuration dialog box by the command **File / Print Setup** and to a preview of the document to print by the command **File / Print Preview**. The toolbar of the print preview window allows the user, for example, to zoom in the preview document.



When printing graphics, the user can set a few additional parameters by the **commands Preferences / Print options**.

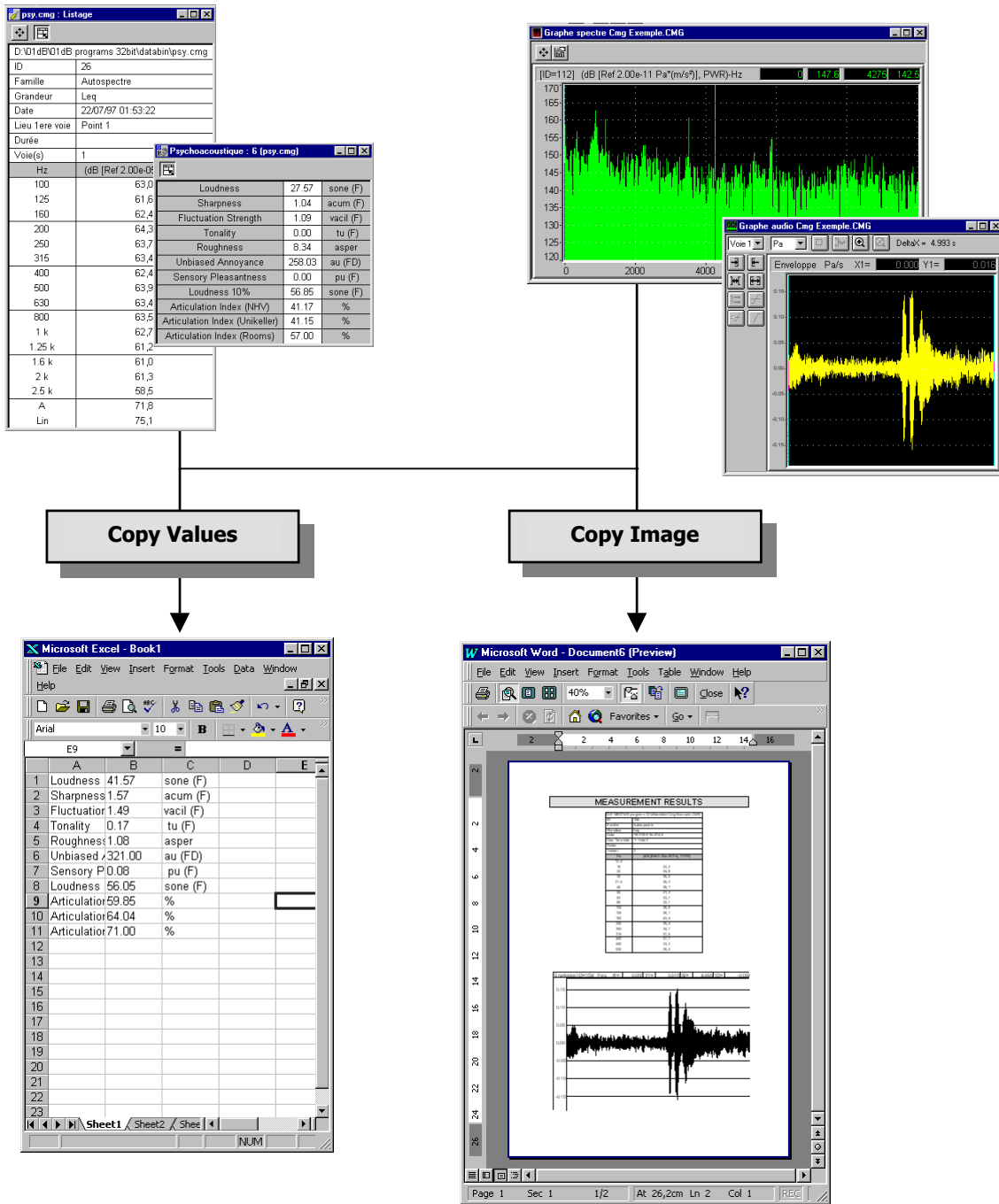
The user can set the margins of the graphic printout frame.



*To print a set of graphs, select the elements to print in the measurement session and go to **File / Print selection**. Graphs will be printed using the default printing parameters.*

13.7.2. Exporting data to a word processing or spreadsheet software

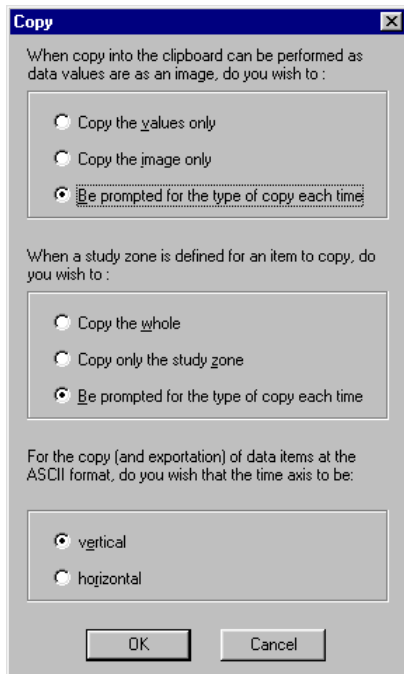
Results can be exported either as images (graphs and data tables) or as actual values, using **Edit / Copy (CTRL+C)**. Then paste (**Edit / Paste**) the data into a word or spreadsheet process.



13.7.3. Principle and configuration of the Copy command

The copy command may be configured to work in different ways in **dBFA32**. Use the command **Preferences / Copy options** to define how the copy command will work. The following dialog box appears on screen.

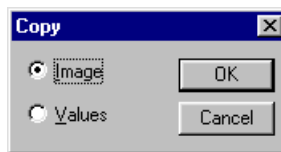
By default, for all graphical views, the command **Edit / Copy** can be used to copy the image of the graphical view. The data values cannot be copied.



- **Copy of tables of results**

In some cases, for a table of results mainly, it is possible to copy either an image of the table or the data values of the table at the ASCII format.

The default option **Be prompted for the type of copy each time** allows the user to display a dialog box for choosing to copy either the image or the values of the table of results.

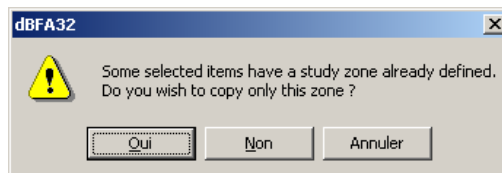


The option **Copy the values only** can be used to copy directly the data values. The option **Copy the image only** can be used to directly copy the image of the table.

- **Copy of an item when a study zone has been defined**

For items where a study zone can be defined (an audio signal for example), it is possible to copy the image of the view over the complete duration of the item (option **Copy the whole**) or to copy only the image of the view over the defined study zone (**Copy only the study zone**).

The default option **Be prompted for the type of copy each time** allows the user to display a message to either copy the image of the view over the complete duration or the study zone. The following message appears on screen:



 See **paragraph 13.2.6** for more details on defining a study zone.

- **Copy data items in ASCII format**

When copying directly data items from the measurement session window in ASCII format, an additional parameter is the way it will be pasted in a word or spreadsheet processor. It is also possible to export data in dB or in physical unit. Select this option using the **Preferences / Units' management** menu (see Section 19.1).

The data values can be displayed **vertically** (default value): data of X-axis and Y-axis are displayed in columns. Alternatively, they can be displayed **horizontally**: data of X-axis and Y-axis are displayed in lines.

13.7.4. Exporting data in 01dB-Stell WAV format or in MP3 format

Select a Signal item in a measurement session and go to **File / Export** to export data in **01dB-Stell WAV** format (Microsoft WAV format including additional information on the measurement) or in **MPEG layer III** (MP3) format.

To export a set of signal recordings, use the operators "Export in WAV format" (section 14.6.8.2) and "Export in MP3 format" (Section 14.6.8.3).

13.7.5. Exporting data in ASCII format (*.TXT text file)

The **File / Export** command is used to copy data from one or several items in a measurement session into a text file (*.txt) in ASCII format. These files can be opened with many applications: Windows NotePad, word processor, spreadsheet application, database. Any operation can then be performed to edit a measurement report or do calculations on the data. Each field in the ASCII file is separated from the other by a "tab" character, making it easier to import these files into a spreadsheet processor.

13.7.6. Exporting data in UFF format (Universal File Format)

Select one or several items in a measurement session, go to **File / Export** and select the "Universal File" (*.UFF) file type to export data in UFF format.

This file format is universal and recognised by many measurement systems.

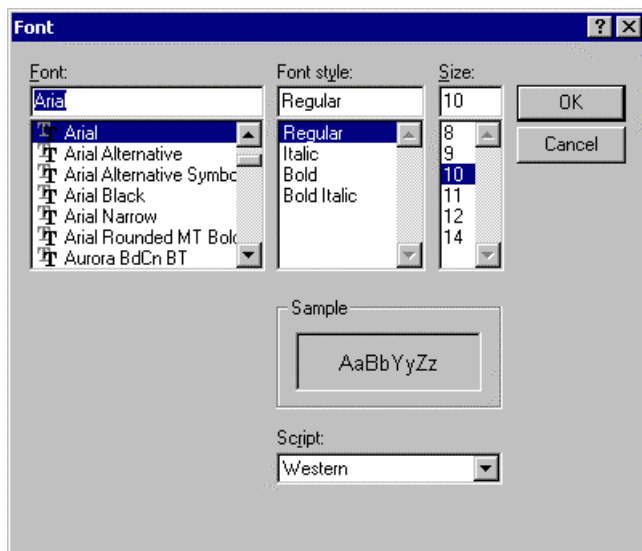
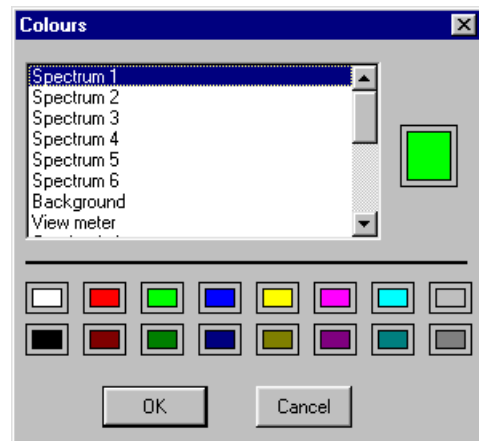
13.7.7. Customisation of dBFA32

The software allows the user to customise various parameters for displaying the data.

The commands **Preferences / Colours** allows the user to respectively set the colours of the different types of data displayed on screen.

Select in this list the type of data for which you want to modify the colour. The actual colour associated to this type of data is displayed next to the list. Then, select with the mouse the new colour in the bottom part of the dialog box.

Click on **OK** when all the modifications have been carried out.

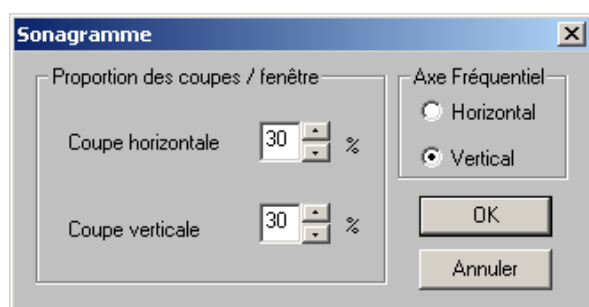


The command **Preferences / Font** allows the user to choose which computer font will be used to display text in **dBFA32**.

Select the font type, style (regular, Italic, Bold, etc.) and size in this dialog box.

Click on **OK** when all the modifications have been carried out.

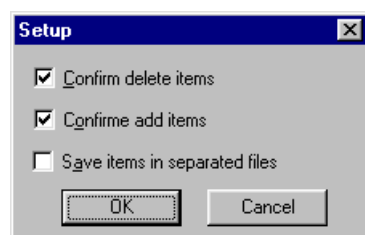
Customisation of the sonagram view



The **Preferences / Sonagram window** is used to customise the layout of the sonagram view.

“**Proportion of sections / window**” is used to set the dimensions of the different views (Sonagram, frequency cross section and time cross section), and “**Frequency axis**” to position the frequency axis vertically or horizontally.

13.7.8. Measurement session general options



Use the **Preferences / Measurement session** command to define general parameters about the management of measurement session datafiles.

The **Confirm delete items** option allows the user to display a dialog box to confirm or not any item removal operation in the active measurement session datafile.

The **Confirm add items** option allows the user to display a dialog box to confirm or not any item addition in the active measurement session datafile.

The **save items in separated files** option allows the user to save the different items of a measurement session files into binary files. The binary data of each item are stored in a BID (Binary Item Data) file and the references of this item are saved into the measurement session itself.

The **save automatically every X minutes** option is used to regularly save measurement sessions.

14. OFF-LINE PROCESSING

14.1. Introduction

Data processing in **dBFA32** can now be performed in a global manner thanks to the implementation of analysis scripts. Each processing operation is available as operators, which assembled in series or in parallel compose an analysis **script**. The scripts available in the application software are regrouped in a **calculation server**, with a user interface to configure and run an off-line analysis.

An **operator** can be represented as a black box, with a single or several inputs and an output. Each of them corresponding to data items stored in a measurement session datafile.



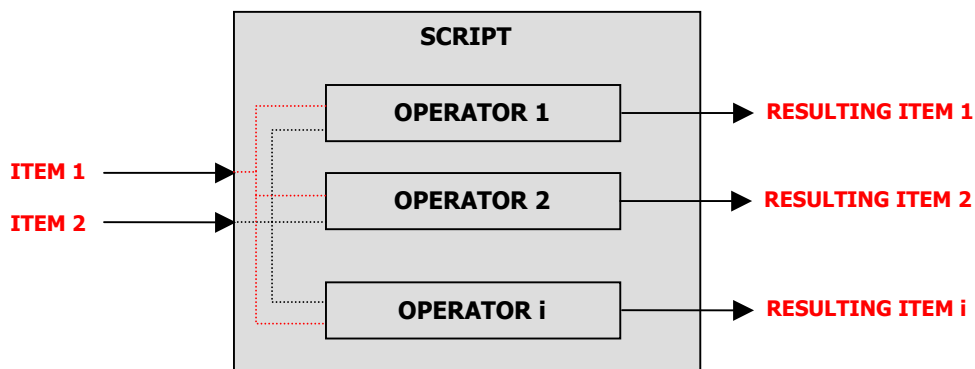
Each operator has its own configuration dialog box, allowing the user to define analysis parameters if required (e.g. Number of lines and frequency range for a narrow band FFT analysis). The name and a description of each operator, as well as notification of the computation progress, are also available.

A **script** regroups several operators, assembled in series or in parallel. One can therefore build up a complex analysis script from these simple "layers".

The script structure also help to check that the analysis is coherent (compatibility of the output items of one stage and the input items of another stage) and to activate each operator when all entities (inputs, analysis parameters) are available to run the processing function.




In the actual version, the operators cannot be assembled in series. A script therefore regroups operators in parallel, acting independently from one another, to process the same input data items.

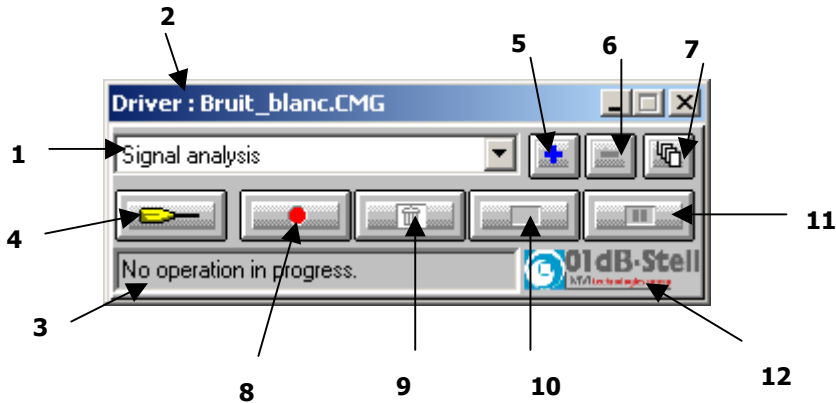


All the scripts available in 01dB-Stell application software are themselves regrouped into a **calculation server**, with a user interface to configure and run an off-line analysis.

dBFA32 proposes a set of pre-defined scripts, managed by the calculation server. It allows the user to activate, configure, stop, and suspend an off-line analysis.

14.2. Calculation server overview

When a measurement session datafile is opened, use the command  **General / calculation server** to launch the calculation server allowing the user to define and execute post-processing analyses. The following user-interface is displayed on-screen:



1. List of scripts: this list shows all analysis scripts that are compatible with the data items selected in the measurement session datafile. According to the status of the calculation server (analysis in progress, waiting, and pause) and the user actions (stop analysis, activate an analysis), these scripts are accessible for edition and configuration.

2. Pilot measurement session: the title of the window indicates which document (measurement session or a batch) is currently controlling the calculation. When selecting items in a measurement session (or in a batch), the calculation server gives only access to the analysis scripts that are compatible with the data items to analyse. The user may then select a script by selecting it in the list.

3. Status bar: this zone shows, when a script is being executed, the name of the active operator as well as the ID of the data item currently being analysed.

4. Configuration of a script: click on this key to display the script configuration dialog box (see **paragraph 14.3**).

5. Duplication: click on this key to duplicate a default script of the application software in order to rename it, to select different operators or to change analysis parameters.

For example, the application software may offer only one script for audio data analysis. If the user wishes to keep this script with the current settings, he (or she) can duplicate the script and define different analysis types and analysis parameters. The default and user-defined scripts are automatically saved for any subsequent analysis.

6. Cancellation: click on this key to delete a user-defined script (obtained after duplication) from the calculation server. Default scripts cannot be deleted.

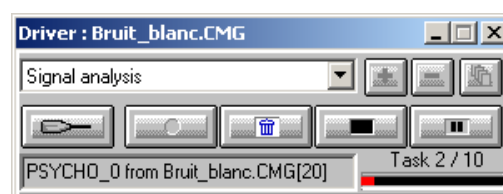
7. Access all scripts: click on this key to display and access all the analysis scripts contained in the calculation server, and not only the scripts compatible with the data items selected in the measurement session. In this mode, no analysis can be performed. Click again on the same key to unlock the calculation server and perform an analysis.

This mode is also used to assign operator scripts to shortcut buttons in the session toolbar. See the section on shortcuts for operator scripts.

8. Click on this key to **launch** the analysis process according to the selected script and for the selected data items.


9. Abort: the script currently being executed is stopped. The analysis is thereby aborted. No result is saved in the measurement session datafile.

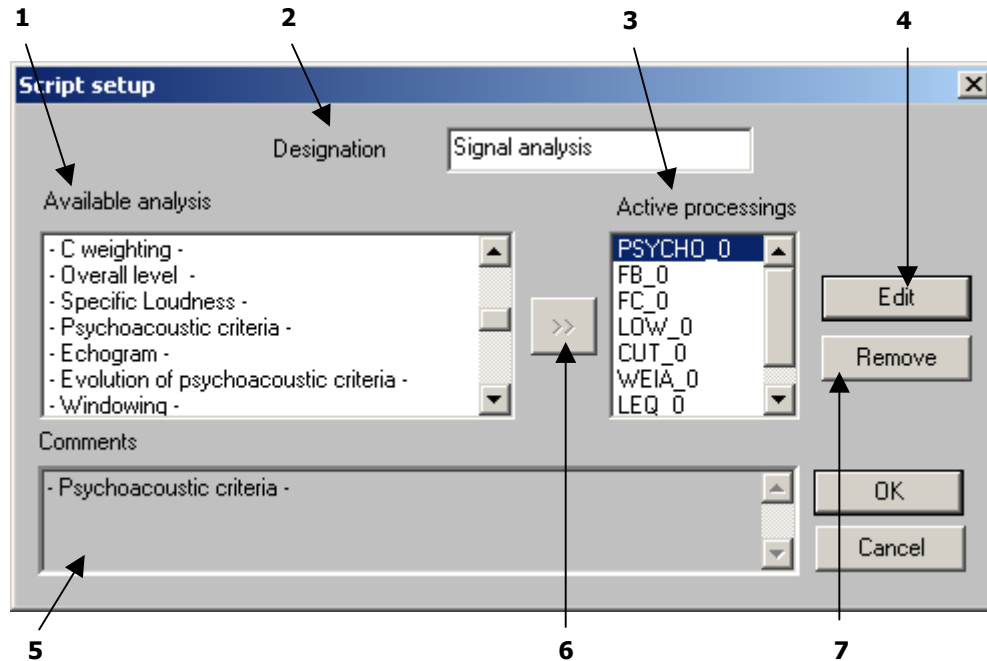
- 10. Interrupt:** click on this key to interrupt the analysis process. The partial results are saved into the active measurement session datafile.
- 11. Pause:** click on this key to temporarily stop the analysis process. The analysis will be carried out again when this key is pressed again.
- 12. Logo /Computation progress:** this part of the dialog box shows the current progress in the computation for the operator displayed in the status bar. According to the type of operator, this zone may take different aspects:
 - **Proportional bar:** it notifies the user of the computation progress with a scale ranging from 0 to 100 % (figure on the left hand side)
 - **Symbol bar:** it shows the computation progress of the current task, for operators made of several operations (figure on the right hand side). Because of the complexity of some calculations (such as computation of psychoacoustic criteria), the server cannot know in advance how much time is required to complete the calculation). The task currently being processed and an overall progress bar are therefore shown on screen.




14.3. Overview and configuration of analysis scripts



Click on the icon  to access to the script configuration dialog box shown below. This dialog box is used to select and configure each single operator of the script.



1. List of **available processings**: it shows all the types of processings compatible with the active script. The same operator can be used several times with different parameters to process the same items.
2. **Designation**: give a name to the script. A user-defined name can be specified.
3. Set of **active processings** currently part of the script. These operators will be activated to analyse independently the same set of items when running the script.
4. **Edit** the parameters of the selected operator (in the list of available processings). Each operator shows its own configuration dialog box.
5. Comments describing the operator selected in the available processings' list. If an operator from the active processings' list is selected, the comment field shows the type of the operator.
6. **Key**  that allows adding an operator into the active processings' list. Different operators of the same type may be added (the user may for example define a multispectrum analysis in third octave band with different time steps in the same script). A generic name for each operator is given by default.
7. The key **remove** allows the user to remove an operator from the list of the active processings.

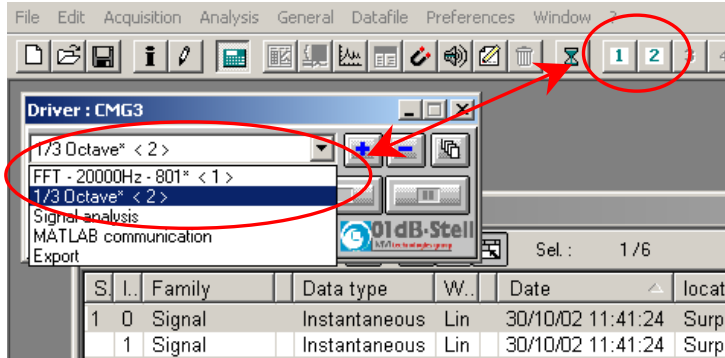
Once the list of active processings has been defined, edit each one of them to define the calculation parameters.

To do so, select the adequate operator in the list and press the **Edit** key.

14.4. Using shortcuts to run scripts





The **dBFA32** interface allows to launch operator scripts directly from the shortcut buttons in the session main toolbar.

Each of the six buttons can be assigned to a predefined script in the calculation server.



The calculation server will display the shortcut number next to the script name, as shown opposite.

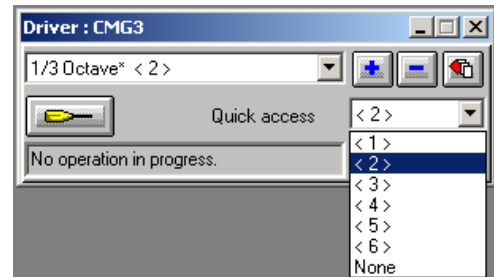
14.4.1. Assigning shortcuts

- 1 Use  or General / Calculation server
- 2 Use  to consult all scripts in the server, and not only those corresponding to the selection in the measurement session.
- 3 Select a calculation script in the pop-up list , and change the settings if need be using .
- 4 Select the shortcut number on the pop-up list on the right:

The corresponding shortcut button becomes active in the toolbar:




Note: To delete an existing shortcut, select a script in the list on the left, then select "None" in the quick access list.



14.4.2. Using shortcuts

Once shortcuts have been assigned, calculation scripts can be launched by clicking on the shortcut buttons in the session toolbar.


- 1 Select one or more items in the session (depending on the operations to perform). Shortcut buttons corresponding to operations compatible with the selected items are enabled.
- 2  Click on the shortcut button to launch the corresponding script.

Note: Shortcuts cannot be used in a batch analysis.

14.4.3. Quick editing of a script associated with a shortcut

A script associated with a shortcut button can be directly edited, without going into the calculation server.

To do so, click on the shortcut button for which you want to modify the script while holding down the "Shift" key.

SHIFT +  = EDITING

14.5. List of default analysis scripts and associated operators (processing functions)

The table shown below gives a complete description of the default scripts contained in the calculation server, with associated operators and types of data items it can be used with.

Script	Operator [Default name]	Description / Result	Active for
TACHOMETRY	Order extraction [EXO_0]	From a tachometric channel and a measurement channel, this operator performs the order extraction with a selection of the method (constant resolution in order or in frequency)	One Signal item and one Speed profile
	Order filtering [FIO_0]	This process uses an order tracking time filter from a tachometric channel. Filter characteristics (min/max order), as well as tracking timing, are user-selected.	
	Cycle defects [ACY_0]	This process characterises cycle defects with respect to a reference tachometric channel.	
SPECTRA OPERATIONS	Frequency recomposition [RECOMPF_0]	Recomposition of a broad band or narrow band multispectrum into a multispectrum of different frequency bandwidth, including Loudness/bark.	Autospectrum, Intensity (active, reactive, free field)
	Time recomposition [RECOMPT_0]	Recombination a broad band or narrow band multispectrum on a different time basis Calculation of minimum / maximum / averaged spectrum, Extraction of an instantaneous spectrum for which the overall level meets user-defined criteria.	
	Overall level time history [GLOBAL_0]	Time history of the overall level of a multispectrum, with frequency weighting.	
	Cepstrum [CEPS_0]	This process calculates the cepstrum from a narrow band average spectrum.	
TRANSFER FUNCTIONS	Cross spectrum G21 [FBG21_0]	This processing produces, from a cross-spectrum, the cross-spectrum defined as its associated complex.	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Ch.1 - Ch. 2
	Transfer function [FBH1_0]	This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the transfer function defined by $G_{xy} / G_{xx} $.	
	Inverse transfer function [FBIH1_0]	This processing produces, from the autospectrum Gxx of the input signal and the cross spectrum Gxy between the input and the output, the transfer function defined by $ G_{xx} / G_{xy}$.	
	Cross transfer function [FBH2_0]	This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the transfer function defined by $ G_{yy} / G_{yx}$.	
	Inverse cross transfer function [FBIH2_0]	This processing produces, from the autospectrum Gyy of the output signal and the cross spectrum Gxy between the input and the output, the transfer function defined by $G_{yx} / G_{yy} $.	
	Coherence [FBCOH_0]	This processing produces, from the autospectra Gxx and Gyy of the input and output signals and the cross spectrum Gxy between the input and the output, the coherence defined by $Co^2 = [G_{xy} ^2] / [G_{xx} \cdot G_{yy}]$.	
DERIVATION / INTEGRATION	Derivation / Integration [FBID_0]	Integration or derivation of an autospectrum or a cross spectrum (acceleration, velocity, displacement).	Autospectrum or cross-spectrum (acceleration, velocity, Displacement)

Script	Operator [Default name]	Description / Result	Active for
CONVOLUTION	Convolution [CVL_0]	This operator performs the convolution of a signal by an impulse response.	A Signal item and an Impulse Response
HISTOGRAM	Histogram [HISTO_0]	Histogram of a global quantity, with selection of the class bandwidth (in dB) and limits.	Leq*
DUAL AUDIO ANALYSIS	Cross-spectrum [FBG12_0]	Narrow band cross-spectrum with time history capability (narrow band multispectrum) and frequency zoom. The user specifies the FFT window, the overlap and the number of lines.	2 Signal items
AUDIO ANALYSIS	Broad band spectrum [FC_0]	Broad band spectrum, ranging from octaves to 1/48th octaves, with time history capability (broad band multispectrum). The user may either use digital filtering (Class 0 IEC1260) or FFT synthesis.	1 Signal item, or an Impulse Response
	Narrow band spectrum [FB_0]	Narrow band spectrum, with time history capability (narrow band multispectrum) and frequency zoom. The user specifies the FFT window, the overlap and the number of lines.	
	Undersampling [DECIM_0]	Undersampled time signal, fixed by the user. A low-pass filter (Butterworth order 20) ensures anti-aliasing, the undersampling ratio varies between 2 and 50.	
	Low pass filtering [LOW_0]	Low-pass filtered time signal (Butterworth, even order from 2 to 30).	
	High pass filtering [HIGH_0]	High-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Band pass filtering [PASS_0]	Band-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Cut-band filtering [CUT_0]	Band-cut filtered time signal (Butterworth, even order from 2 to 30).	
	Notch filtering [NOTCH_0]	Notch filtered time signal. The user defines the filter selectivity (S factor). The frequency range at -3 dB is then of $f_e / (PI * S)$ for an order 2. By increasing the order number, Attenuation is emphasised at the expense of Selectivity.	
	A weighting [WEIA_0]	A-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent.	
	B weighting [WEIB_0]	B-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent.	
	C weighting [WEIC_0]	C-weighted time signal. The filter used fulfils Type 0 requirements of standard IEC651 and equivalent.	
	Overall level [LEQ_0]	Short Leqs time history of the time signal. Frequency (Lin, A, B, C) and time (Leq, Peak, Fast, etc.) weightings can be applied.	
	Specific Loudness [BARK_0]	Bark band specific Loudness, with time history capability (specific Loudness multispectrum), a time step ≤ 50 ms is required for later psychoacoustic criteria computation. The result is expressed in sones, according to Zwicker B.	

* Leq family: Overall noise quantity integrated over time (Short Leq, Fast, Slow, Impulse, etc.)

Script	Operator [Default name]	Description / Result	Active for
AUDIO ANALYSIS	Psychoacoustic criteria [PSYCHO_0]	Stationary psychoacoustic criteria: Loudness, Loudness 10%, Fluctuation Strength, Sharpness, Tonality, Roughness, Unbiased Annoyance, Sensory Pleasing Sound, and Articulation Index.	1 Signal item, or an Impulse Response
	Echogram [ECHOG_0]	Octave or third octave echogram	
	Evolution of psychoacoustic criteria [PSYEV_0]	time history of a psychoacoustic quantity : Loudness (Zwicker B), Sharpness	
	Windowing [WIN_0]	User-defined time weighting window on a time signal, defined with segments of classical windows. (Hanning, Rectangular, Flat Top, etc.)	
	Gain optimisation [GAIN_0]	This processing amplifies time signal DAC data in order to optimise, for example, the replay level. The physical level remains unchanged.	
	Re-sampling [SAMPL_0]	This processing re-samples the audio signal to a frequency specified by the user.	
	Capon transform [CAPON_0]	This processing calculates the Capon time-frequency transform.	
	Denoising [DENOIS_0]	This processing performs denoising of a signal by decomposition/recomposition in wavelets.	
	Pseudo Wigner-Ville [WVI_0]	This processing performs smoothed pseudo Wigner-Ville transform of a signal	
	AR Model [AR_0]	This processing performs an autoregressive modelling on a fixed length sliding window.	
	Morlet [MOR_0]	This processing performs a Morlet wavelet decomposition.	
	Tachometric-Speed conversion [RPMTACH_0]	This processing yields the speed (in rpm) versus a tachometric signal acquired on an input channel.	
ARITHMETIC	Addition [PLUS_0]	Sums up all the selected quantities. The user may choose either to perform an arithmetic or an energetic sum. Do not apply to complex spectra	From 2 signals, autospectra, Leq Cross-spectra, Transfer functions, coherence (complex spectra)
	Subtraction [MOINS_0]	Subtracts all the selected quantities. The user may choose either to perform an arithmetic or an energetic subtraction. Do not apply to complex spectra	
	Averaging [MOY_0]	Average all the selected quantities. The user may choose either to perform an arithmetic or an energetic average.	
EXPORT	Export in MATLAB format [MATLAB_0]	This function exports the input quantity to the MATLAB format (.MAT file). This file can be directly processed into MATLAB with the "load" function.	1 or more signal items
	Export in 01dB-Stell WAV format [WAV01DB_0]	This processing exports the input quantity at the WAV 01dB-Stell format (*.WAV file, Windows compatible).	
	Export in MP3 format [MP301DB_0]	This processing exports the input data in MPEG Layer III (MP3) format. The exported signal must be sampled at 32 or 44.1 kHz	
OPERATIONS ON PARTIAL LOUDNESS	Overall Loudness level time history [BGLOBAL_0]	This analysis results in the overall Loudness level time history of a Loudness/Bark multispectrum.	Bark spectrum

14.6. Overview and configuration of operators (processing functions)

An operator is used to perform an analysis on a single or several data items. Each operator has its own name (that the user can modify), analysis parameters and computation progress information.

When an operator process a data item, this input quantity is locked in the active document. It cannot be deleted and the document that controls the calculation server cannot be closed. These items are unlocked when the calculation is ended or aborted.

The following paragraphs present each operator: definition, set-up parameters, compatibility, etc. The operators are presented as follows:

- **Spectral analysis**

Theory, narrow-band and broad-band spectra and multispectra, narrow-band cross-spectra, pseudo Wigner-Ville transform, decomposition in Morlet wavelets, Capon transform, autoregressive modelling on a sliding window.

- **Operations on Signal data**

Theory, low-pass, high-pass, band-cut, band-pass, notch filtering, undersampling, A, B and C frequency weightings, user-defined time windows, gain optimisation, re-sampling, denoising, tachometric conversion, convolution.

- **Operations on spectra**

Theory, frequency recomposition in broad bands and Loudness/Bark bands, time recomposition, integration/ derivation.

- **Transfer functions**

Theory, cross-spectra, transfer functions and coherence.

- **Arithmetic**

Theory, addition, subtraction and averaging.

- **Time history of an overall quantity**

Theory, Short Leq time history, Extraction of Leq level from a multispectrum, Extraction of a Loudness level from a multispectrum in bark bands.

- **Psychoacoustics**

Theory, stationary psychoacoustic criteria, spectra in bark bands, specific Loudness, time history of psychoacoustic criteria.

- **Audio data export**

Theory, export to MATLAB format, to WAV (01dB-Stell) format, and to MP3 format.

- **Operations on overall levels**

Theory, histograms.

- **Room acoustics**

Theory, echogram.

- **Tachometry**

Theory, order extraction, order filtering, cycle defects.

14.6.1. Spectral analysis

14.6.1.1. Theory

Two types of analysis allow the user to estimate the averaged or "instantaneous" frequency contents of a signal: **narrow-band analysis and broad-band analysis.**

- **Narrow-band analysis**, based on a classical periodogram (Welch-Wosa) or Gabor analysis, with selection of an overlap, a weighting window and a zoom factor. A time integration can be selected to generate a multispectrum. This analysis can be applied to a couple of input quantities, in order to calculate a cross-spectrum.

The Fourier transform of a signal called $x(t)$ (respectively $y(t)$) results in a complex autospectrum G_{xx} (respectively G_{yy}) given by:

$$G_{xx}(f) = \int_{-\infty}^{+\infty} x(t) \cdot e^{-j2\pi ft} dt$$

We often represent autospectra as a modulus only. We therefore call "autospectrum" the modulus of an autospectrum (complex quantity with a modulus and a phase).

Let us designate the real and imaginary parts of G_{xx} by G_{xxr} and G_{xxi} respectively. Then:

$$|G_{xx}|^2 = G_{xxr} \cdot G_{xxr} + G_{xxi} \cdot G_{xxi}$$

The result, expressed in dB, is equal to:

$$20 \cdot \log_{10}(|G_{xx}| / REF)$$

With $REF = 2e^{-5}$ for sound pressure levels.



If the selected physical unit is not the IS unit, and if a conversion factor C_x is calculated (e.g.: $C_x = 9.81$ for an acceleration level expressed in g), then the above expression becomes:

$$20 \cdot \log_{10}(|G_{xx}| \cdot C_x / REF)$$

The cross-spectrum between channel x and channel y can be computed from the autospectra G_{xx} and G_{yy} using the formula:

$$G_{xy} = G_{xx} \cdot G_{yy}^*$$

Where G_{yy}^* is the conjugated complex of G_{yy} (same real parts, opposed imaginary parts).
The modulus of the result, expressed in dB is given by:

$$20 \cdot \log_{10}(|G_{xy}| / [REF_X \cdot REF_Y])$$



If the selected physical unit is not the IS unit, and if a conversion factor C_x is calculated (e.g.: $C_x = 9.81$ for an acceleration level expressed in g), then the expression above becomes:

$$20 \cdot \log_{10}(|G_{xy}| \cdot C_x \cdot C_y / [REF_X \cdot REF_Y])$$

The phase of the result, expressed in radian, is equal to:

$$\text{atan}(G_{xyi} / G_{xyr}),$$

Where G_{xyr} et G_{xyi} respectively designate the real and imaginary part of G_{xy} .



By convention, the cross-spectrum between a 50 dB sinusoid and a 60 dB sinusoid of the same frequency gives a level of 55 dB.

- **Broad-band analysis**, from octave bands to 1/48th octave bands, with selection of the method (FFT narrow-band recombination for 5 lines minimum or Class 0 standardised digital filtering). A time integration can be selected to generate a multispectrum.

In both cases, the algorithm uses undersampling in order to optimise the ratio between the sampling frequency and the maximum frequency of analysis. Then, for each octave band below the highest one, the signal is undersampled by a factor 2 in order to keep this optimal ratio for each computation pass. We therefore obtain a fast, simple and reliable algorithm, allowing the analysis to reach low frequencies.

FFT synthesis:

This method is based on the computation of an autospectrum in narrow bands, in accordance to the previous definition. The narrow bands are then recombined (sum) as a function of the broad band limits (octaves and sub-division of octave bands) and the frequency band calculated.

However, FFT synthesis of a broad frequency band is allowed only if 5 narrow band lines are included in this range.

Advantages of the method

- Fast, Reliability of the FFT algorithm

Drawbacks of the method

- Low frequency limit:** During an FFT analysis, we obtain a spectrum with lines uniformly spread over the frequency axis, with a resolution of fs/N , where fs is the sampling frequency and N the size of the FFT used (number of samples). However, the lower the centre frequency of an octave band (or $1/n^{\text{th}}$ octave band), the smaller the bandwidth. We therefore have only a few narrow bands to recombine a broad band at low frequencies and we often go under the limit of 5 lines for a statistically correct synthesis. Another drawback of the method can thereby be identified: high frequency broad bands are the synthesis of a large number of narrow bands while it is not the case at lower frequencies.
- Time resolution compromise:** One can obtain a result for a given band only if the number of available points for computation (depending on the undersampling stage and the original time duration of the signal) is greater or equal to the FFT size required to synthesise this band. The number of points can be greater than the number of points required to obtain the time resolution required. The result cannot therefore be obtained for the time step, but for a greater one.

Digital filtering:

This method is based on a bench of digital filters (as many filters per octave band as there are octave sub-divisions) of the Butterworth family, of order 8. These filters consist of a chain of 4 elementary Butterworth cells of order 2.

Advantages of the method

- Accurate estimation of the result
- Time resolution very small. No limitation or time/frequency compromise.

Drawbacks of the method

- Digital filtering requires a delay to be performed, because of the delay of energy propagation induced by the physical characteristics of the filter (depending on its complexity and type). A delay therefore appears at low frequencies, because of the large number of filters used.

Time-Frequency analysis

Spectral analysis based on Fourier transform (FFT) and digital filtering ($1/n$ octave) provides a good description of stationary and pseudo-stationary signals.

Unfortunately, there are limits to these techniques when signals to analyse are not stationary.

In this case, the solution is to calculate instantaneous spectra for each time step of the signal. Tools to do so are called time-frequency analysis techniques. There are several methods, none of which is predominant. Their use depends on the target application and on the pros and cons of each one to display requested information.

Several methods can be used by **dBFA32**:

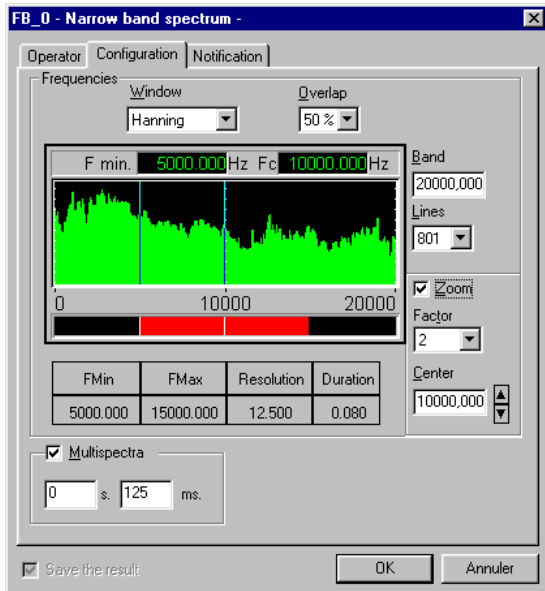
- Wigner-Ville transform (WVT)
- Wavelets transform (WT)
- Autoregressive modelling
- Capon transform

The increase in computer resources has allowed for the application of digital models of these transforms and thus obtain the time-frequency descriptions of these non stationary signals. However, even before the computer era, man, and especially the musician, has used time-frequency analysis techniques when writing music scores.

14.6.1.2. Narrow-band spectrum Operator [FB]

This analysis results in a narrow-band spectrum, with time history capability (narrow-band multispectrum) and frequency zoom. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **FFT Window:** Choose the FFT window for the analysis. The following windows are available: **Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.**

- **Overlap:** Choose the overlap factor for the analysis amongst the following quantities: **0, 25%, 50% and 75%.**

During a FFT analysis, the overlap factor represents the percentage of samples that are used simultaneously in two adjacent data blocks.

- **Max. frequency:** Select the maximum frequency of the analysis.

The pass band defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies.

- **Lines :** Select the number of lines for the FFT analysis amongst the values displayed in the list: **101, 201, 401, 801, 1601 or 3201.** The higher the number of lines the higher the frequency resolution.

- **FFT zoom**

This group allows the user to define the parameters of a FFT zoom. The zoom allows the user to reduce the frequency range of analysis around a centre frequency and thereby increase the frequency resolution. Select **Zoom**, in order to activate the FFT zoom option. Then choose the **centre frequency** and the **zoom factor**.

The curve on the left-hand side informs the user about the chosen parameters. The red information bar (lower part) indicates the analysis frequency range while the spectrum indicates the chosen frequency resolution.

To modify the centre frequency or the minimum frequency (when the Zoom option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the zoom factor and the centre frequency in the right part of the dialogue box.

- **Multispectra:** if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

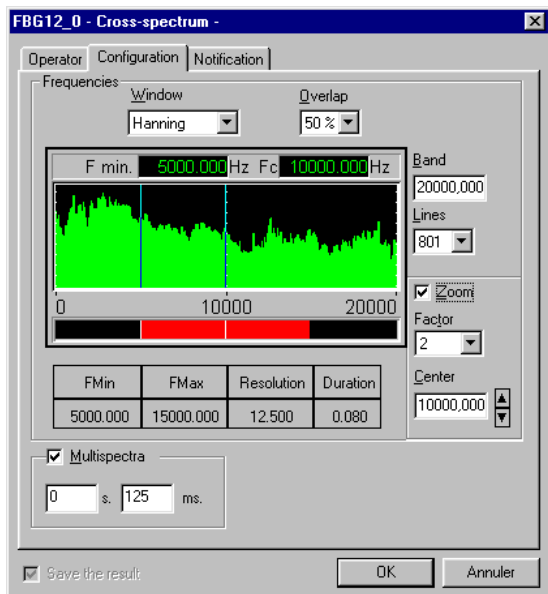
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	FB_0
Active for	Signal, Impulse Response families
Restrictions	Only apply for one item The length of a time block must smaller than that of the signal
Family of the result	Autospectrum

14.6.1.3. Narrow-band Cross spectrum Operator [FBG12]

This analysis results in a narrow-band cross-spectrum with time history capability (narrow-band multispectrum) and frequency zoom. The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **FFT Window:** Choose the FFT window for the analysis. The following windows are available: **Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.**

- **Overlap:** Choose the overlap factor for the analysis amongst the following quantities: **0, 25%, 50% and 75%.**

During a FFT analysis, the overlap factor represents the percentage of samples that are used simultaneously in two adjacent data blocks.

- **Max. frequency:** Select the maximum frequency of the analysis.

The pass band defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies.

- **Lines :** Select the number of lines for the FFT analysis amongst the values displayed in the list: **101, 201, 401, 801, 1601 or 3201.** The higher the number of lines the higher the frequency resolution.

▪ **FFT zoom**

This group allows the user to define the parameters of a FFT zoom. The zoom allows the user to reduce the frequency range of analysis around a centre frequency and thereby increase the frequency resolution. Select **Zoom**, in order to activate the FFT zoom option. Then choose the **centre frequency** and the **zoom factor**.

The curve on the left-hand side informs the user about the chosen parameters. The red information bar (lower part) indicates the analysis frequency range while the spectrum the chosen frequency resolution.

To modify the centre frequency or the minimum frequency (when the Zoom option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the zoom factor and the centre frequency in the right part of the dialogue box.

- **Multispectra:** if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

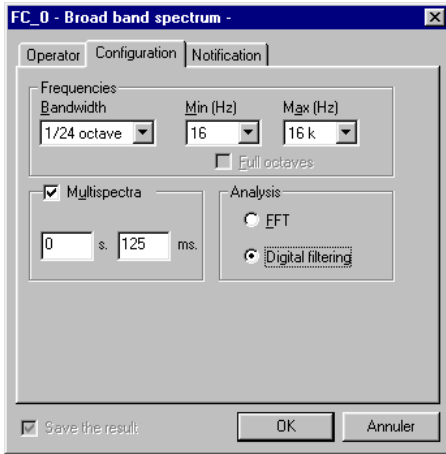
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Dual signal analysis
Default name	FBG12_0
Active for	2 items of the Signal family
Restrictions	Apply for 2 audio events with same sampling frequency The length of a time block must smaller than that of the signal
Family of the result	Cross-spectrum

14.6.1.4. Broad-band spectrum Operator [FC]

This analysis results in a broad-band spectrum, ranging from octaves to 1/48th octaves, with time history capability (broad-band multispectrum). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Bandwidth** to define the spectrum bandwidth for the analysis: 1/1, 1/3, 1/6, 1/12, 1/24 and 1/48th octave bands.
- **Min:** Minimum centre frequency of analysis in Hz
- **Max:** Maximum centre frequency of analysis in Hz
- **Full octaves:** If this option is activated, the software will set the minimum and maximum frequency limits so that only full octaves are calculated.
- **Analysis:** Select the method used to perform frequency analysis: FFT or digital filtering.

- **Multispectra:** if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

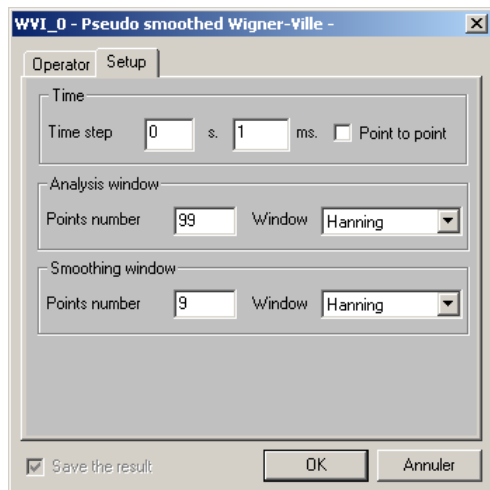
Default script	Signal analysis
Default name	FC_0
Active for	Signal, Impulse Response families
Restrictions	Only apply for one item The time resolution required for multispectrum must be less than the item duration FFT synthesis: the item must be long enough to obtain at least 5 lines per broad band
Family of the result	Autospectrum

14.6.1.5. Pseudo Wigner-Ville transform operator

Use this operator to obtain a multispectrum with a timing ranging up to the sample, and a good frequency resolution. The Time-Frequency ratio can reach $1/4\pi$.

The dialog box below is displayed on screen:

In the **Configuration** tab, the following analysis parameters may be defined:



- **Time step:** Define the timing for multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).

- **Analysis window:** Define the number of points in the time window under analysis (which corresponds to $2N-1$, an odd number) and then select the weighting window to apply to the calculation. The sample "seeing back" the spectrum instant is the centre sample.

- **Smoothing window:** Define the number of points in the time smoothing window (corresponds to $2M-1$, an odd number) then select the weighting window to apply to the smoothing.

The **Operator** tab provides a detailed description of this type of processing and offers the possibility to change its name. The **Notification** tab is used to define parameters relative to the structure of the notification of the calculation progress.

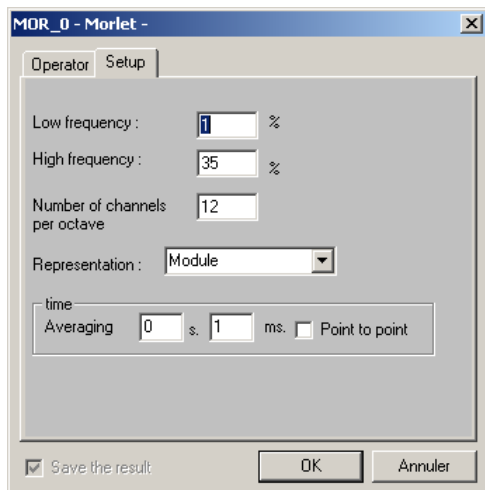
Default script	Signal analysis
Default name	WVI_0
Active for	Signal family
Restrictions	Applies for one item only
Result family	Autospectrum

14.6.1.6. Morlet wavelet transform operator

Use this operator to obtain a multispectrum with a timing down to the sample and a good frequency resolution. The Time-Frequency ratio can reach $1/4\pi$.

The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Upper / Lower frequency:** Define maximum and minimum frequencies to study, as a percentage of the sampling frequency. The upper frequency cannot exceed 35% to avoid aliasing effect.

- **Number of channels per octave:** Define the number of channels per octave, i.e., the bandwidth (in nth octave).

- **Representation:** Select the representation: Modulus, phase, real part or imaginary part.

- **Time:** Define the timing of multispectra, in milliseconds or sample by sample by checking the **Point by point** (depends on the sampling frequency).

The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name. The **Notification** tab is used to define parameters relative to the structure of the notification of the calculation progress.

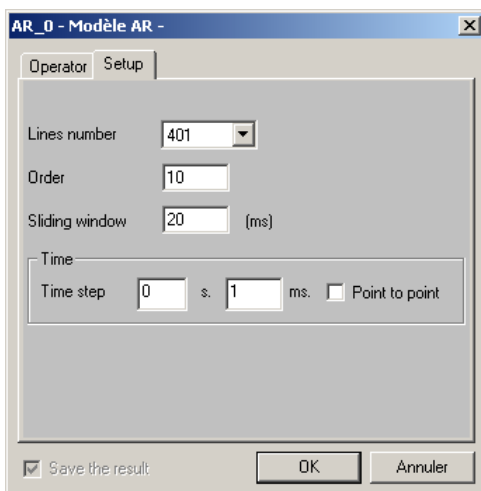
Default script	Signal analysis
Default name	MOR_0
Active for	Signal family
Restrictions	Applies for one item only
Result family	Autospectrum

14.6.1.7. Autoregressive modelling operator

Use this operator to obtain a multispectrum with a timing down to the sample and a good frequency resolution. The Time-Frequency ratio can reach $1/4\pi$.

The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Number of lines:** Enter the number of lines that will define the frequency resolution.

- **Order:** Define the filtering order (a high order can yield better results).

- **Sliding window:** Define the length of the time block to analyse.

- **Time:** Define the timing for the multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).

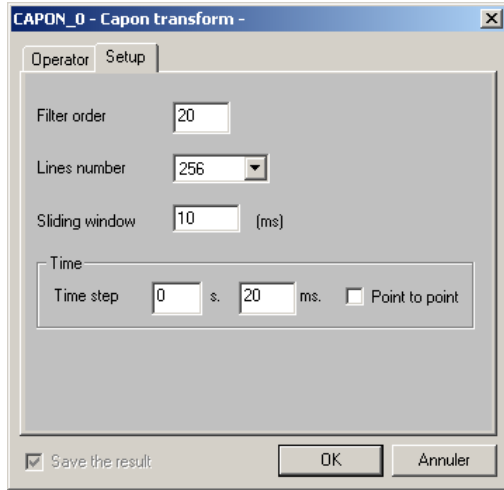
The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name. The **Notification** tab is used to define parameters relative to the structure of the notification of the calculation progress.

Default script	Signal analysis
Default name	AR_0
Active for	Signal family
Restrictions	Applies for one item only
Result family	Autospectrum

14.6.1.8. Capon transform operator

Use this operator to obtain a multispectrum with a timing going down to the sample and a good frequency resolution. The Time-Frequency ratio can reach $1/4\pi$. The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Filter order:** Define the filtering order (a high order can yield better results).
- **Number of lines:** : Enter the number of lines that will define the frequency resolution.
- **Sliding window:** Define the length of the time block to analyse.
- **Time:** Define the timing for the multispectra, in milliseconds or sample by sample by checking the **Point by point** option (depends on the sampling frequency).

The **Operator** tab provides a detailed description of this type of processing and offers the possibility to modify its name. The **Notification** tab is used to define parameters relative to the structure of the notification of the calculation progress.

Default script	Signal analysis
Default name	CAPON_0
Active for	Signal family
Restrictions	Applies for one item only
Result family	Autospectrum

14.6.2. Operations on Signal data

There are several types of operations that can be performed:

- **Selective digital filtering or frequency weightings**

The digital filters used by 01dB-Stell are recursive filters based on elementary Butterworth cells of order 2, ensuring a great stability over the frequency range.

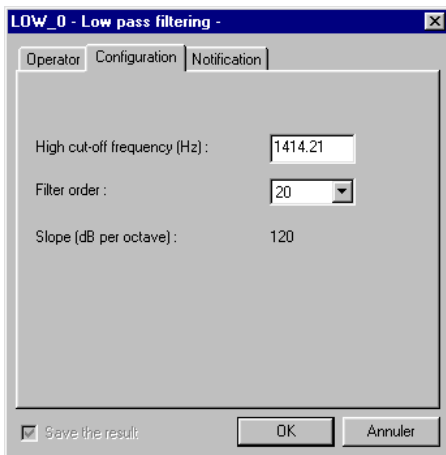
- **Time windowing by a pre-defined window**

- **Signal processing:** Resampling, undersampling, gain, denoising, convolution, envelope

- **Integration and derivation**

14.6.2.1. Low-pass filtering Operator [LOW]

This analysis results in a low-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **High cut-off frequency:** define the cut-off frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of high-frequency bands.

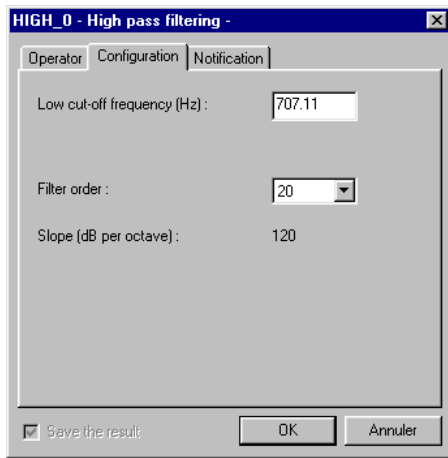
Low-pass filters remove components with a frequency higher than the specified cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	LOW_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.2. High-pass filtering Operator [HIGH]

This analysis results in a high-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Low cut-off frequency:** define the cut-off frequency in Hz.
- **Filter order:** select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low-frequency bands.

Low-pass filters remove components with a frequency lower than the specified cut-off frequency with an octave fall off rate (dB / octave) that depends on the filter order.

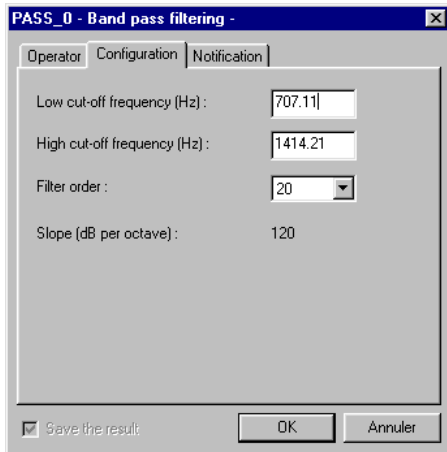
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	HIGH_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.3. Band-pass Operator [PASS]

This analysis results in a band-pass-filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Low cut-off frequency:** define the low cut-off frequency in Hz.
- **High cut-off frequency:** define the high cut-off frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high-frequency bands.

Band-pass filters remove components whose frequency is lower than the specified low cut-off frequency and greater than the high cut-off frequency with an octave fall off rate (dB / octave) depending on the filter order. It corresponds to a low-pass filter and a high-pass filter simultaneously.

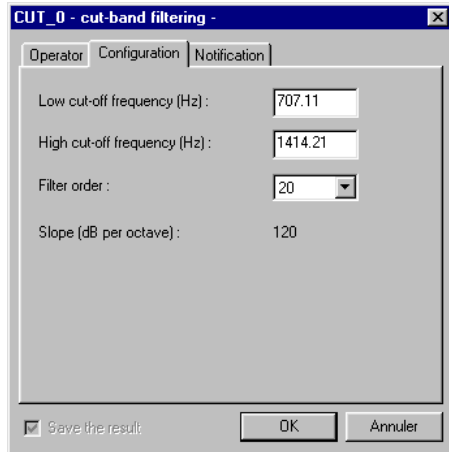
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	PASS_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.4. Cut-band filtering Operator [CUT]

This analysis results in a band-stop filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Low cut-off frequency:** define the low cut-off frequency in Hz.
- **High cut-off frequency:** define the high cut-off frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order define the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high frequency bands.

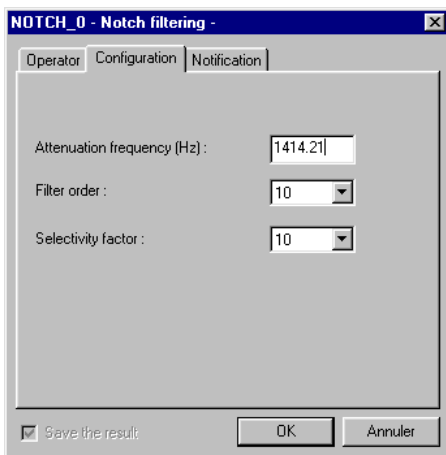
Cut-band filters remove components whose frequency lies in the range between the low cut-off frequency and the high cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	CUT_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.5. Notch filtering Operator [NOTCH]

This analysis results in a notch-filtered time signal. The following dialog box appears on-screen. In the **Configuration** tab, the following analysis parameters may be defined:



- **Attenuation frequency Fa:** define the rejection frequency in Hz.
- **Filter order.** Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.
- **Selectivity factor S.** Define the selectivity parameter: 10, 20, 40 or 80.

The user defines the filter selectivity (S factor). The frequency range at -3 dB is then of $f_s / (\pi * S)$ for an order 2. By increasing the order number, attenuation is emphasised at the expense of selectivity.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	NOTCH_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.6. Frequency A-weighting Operator [WEIA]

This analysis results in an A-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	WEIA_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.7. Frequency B-weighting Operator [WEIB]

This analysis results in an B-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	WEIB_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.8. Frequency C-weighting Operator [WEIC]

This analysis results in a C-weighted time signal. The filter used fulfils Type 0 requirements of IEC651 and equivalent standards.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	WEIC_0
Active for	Signal, Impulse Response families
Restrictions	Only applies for one item
Family of the result	Signal, Impulse Response families

14.6.2.9. Windowing Operator [WIN]

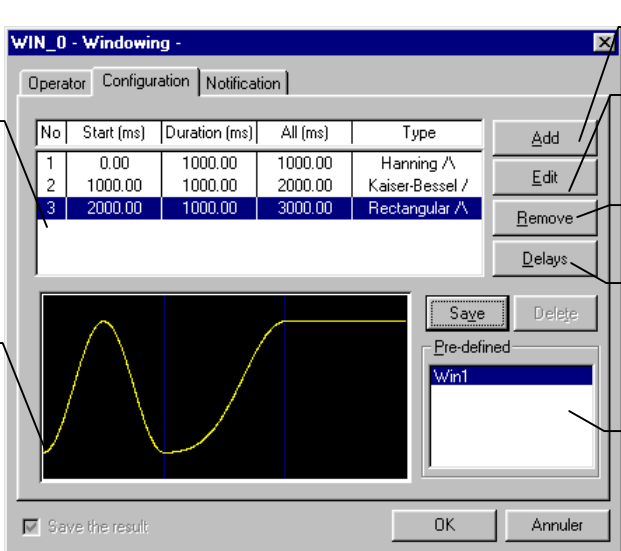
This processing allows the user to apply a user-defined time weighting window on a time signal, using segments of classical windows (Rectangular, Kaiser Bessel, Flat Top, etc.), zeros (signal set to 0) and holes.

The beginning of the window may be applied to the starting date and time of the signal study zone. Zeros, before and after the signal, of user-defined duration, may also be added in order to extract or select a portion of the signal.

Once the time window has been defined, the user may save it into a catalogue of pre-defined window (in the *.INI of the application software). This is an important feature when performing the same data processing operations.

 See **paragraph 13.3.1** for more information on how to define a study zone for a time signal.

The following dialog box appears on screen. In the **Configuration** tab, define the specific weighting window:



Liste of sections that compose the weighting window

Graphical display of the window being created.

Add a section

Edit the parameters of the section selected in the list

Remove the section selected in the list


Define pre and post delays before and after the window

List of user-defined windows that have been saved in the application software

The operating process to configure the operator is given below:

1. Define a study zone for the signal under investigation and write down the duration of each section for which specific weighting will be applied. **This operation is really important for later definition of the sections of the weighting window.**
2. Access the Windowing operator and define the adequate segments for the signal(s) under investigation. Click on the **Add** button to add a new section, on the **Edit** button to modify an existing section and click on the **Remove** button to delete an existing section of the window.
3. Click on the **Delays** button to define delays before and after the window, if necessary.

4. Click on the **Save** button to save the weighting window in the application software. This window can be recalled later, next time the user wishes to analyse data items with the same window.
5. Close the configuration dialog box and run the analysis script (see **paragraph 14.2**)

 *The beginning of the time window (excepted the pre-delay) will match the beginning of the signal study zone.*


■ **Add and Edit keys**

Click on the **Add** button to add a new section or on the **Edit** button to modify an existing section of the weighting window. The following dialog box appears on screen.

Select the section **duration** (in milliseconds) as well as the **type** of classical window to use: **Rectangular, Hanning, Hamming, Blackman-Harris, Kaiser-Bessel, FlatTop, Triangular, Exponential, Zeros and Holes.**

Then select if only the **rising slope (/)**, the **falling slope (\)** or the complete window (/\/) will be part of the section.

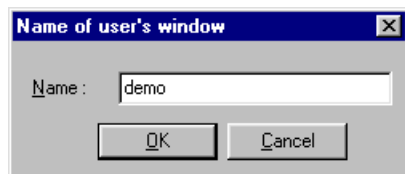
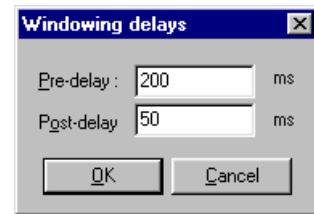
Once the section parameters have been defined, click on **OK**. The section is then displayed in the list and the graphical display of the weighting window is updated.

 *Use the **Hole** window to cut a section of a signal. Use the **Zeros** window to remove spikes from the signal.*

■ **Delay button**

Click on this key to define a delay (in milliseconds) before and after the weighting window. The following dialog box appears on screen.

Set these parameters to zero if no delay is required.



■ **Save button**

Once the window has been defined, click on this key to save it for later use. A dialog box is shown on screen in order to give a specific name to that window.

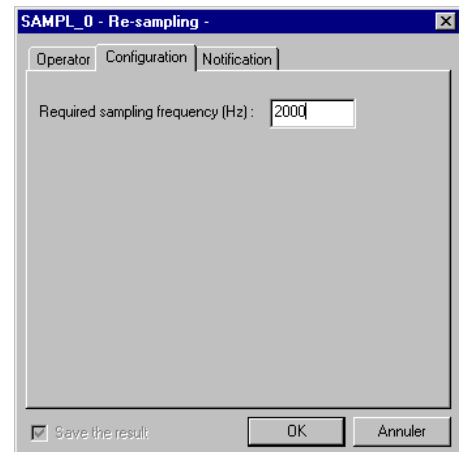
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	WIN_0
Active for	Signal, Impulse Response families
Restrictions	Applies for one item only
Family of the result	Signal, Impulse Response families

14.6.2.10. Re-sampling operator [SAMPL]

This processing re-samples the signal to a frequency specified by the user.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.



Default script	Signal analysis
Default name	SAMPL_0
Active for	Signal, Impulse Response families
Restrictions	Applies for one item only
Family of the result	Signal, Impulse Response families

14.6.2.11. Gain optimisation [GAIN]

This processing amplifies time signal DAC data in order to optimise, for example, the replay level. The physical level remains unchanged.

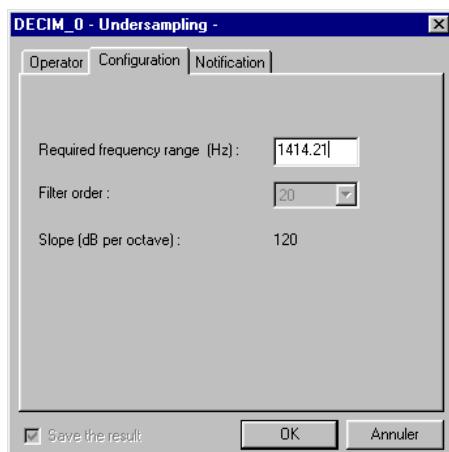
This optimisation can be **automatic** or **manual** according to a level defined by the user. *The manual optimisation is useful to compare signals.*

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	GAIN_0
Active for	Signal, Impulse Response families
Restrictions	Applies for one item only
Family of the result	Signal, Impulse Response families

14.6.2.12. Undersampling Operator [DECIM]

This analysis results in an undersampled time signal, fixed by the user. A low-pass filter (Butterworth order 20) ensures anti-aliasing, the undersampling ratio varies between 2 and 50. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Required frequency range:** define the maximum frequency of the audio event after undersampling.

It is recommended not to undersample audio files below 2000 Hz unless source recognition, by playing back the file, is unimportant.

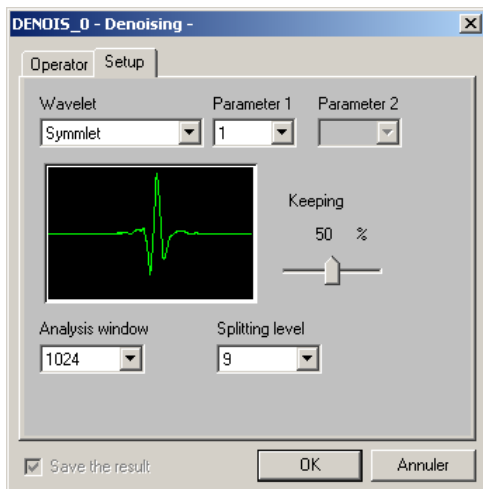
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	DECIM_0
Active for	Signal, Impulse Response families
Restrictions	Applies for one item only
Family of the result	Signal, Impulse Response families

14.6.2.13. Denoising operator [DENOIS]

This processing is used to clean the signal and improve the signal-to-noise ratio. The dialog box below is displayed on screen.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Wavelet and Parameters 1 and 2:** Select the wavelet family and its parameters. The wavelet shape is displayed in the view below and should be as close as possible to the signal shape.

- **Analysis window:** Block size, in number of points, on which each decomposition will be performed and on which denoising will be carried out over time.

- **Decomposition level:** The wavelet decomposition performs a multi-scale analysis by a two-fold undersampling at each decomposition step. By analogy with a filter bench, this means that with an analysis window of size 1024, two mirror low-pass and high-pass filters will be used to generate two daughter wavelets of 512 points and then the same procedure be carried out again on daughter wavelets (to the 9th level maximum).

- **Conservation:** Select the percentage for energy saving.

An energy thresholding is performed on the lowest level daughter wavelets, by selecting only a defined percentage of wavelet coefficient. The lower energy components corresponding to the noise are thus deleted. The original signal is then rebuilt by applying reverse filters and interpolating ; thus yielding a signal including only the higher energy components.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	DENOIS_0
Active for	Signal, Impulse response families
Restrictions	Apply to one item only
Results family	Signal, Impulse Response

14.6.2.14. Convolution operator

This processing performs signal convolution by an impulse response.

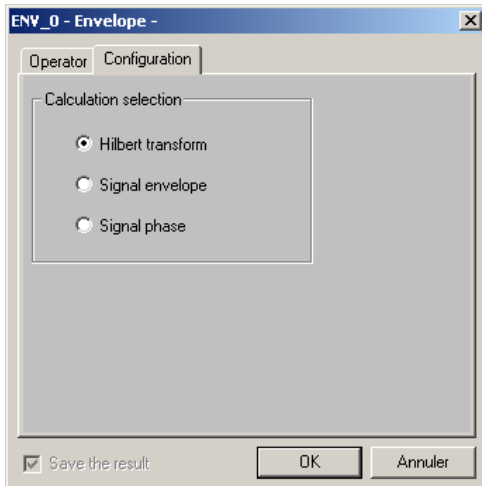
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Convolution
Default name	CVL_0
Active for	1 Signal item + 1 Impulse Response
Restrictions	Applies for signals with the same sampling frequency
Result family	Signal, Impulse Response

14.6.2.15. Envelope operator

This processing calculates either the signal envelope or the analytical signal phase, or its Hilbert transform.

In the **Configuration** tab, the following analysis parameters may be defined:



- **Hilbert transform:** The Hilbert transform of the spectrum signal $X(f)$ consists in building the spectrum signal $X'(f)$ with: $X'(f) = -j \cdot \text{sgn}(f) X(f)$

Performing a FFT on the original signal, then this operation and then a reverse FFT, yields a time signal, which is the Hilbert transform of the original signal.

The resulting signal is sometimes called a phase quadrature signal, as applying a Hilbert transform is equivalent to adding $\pi/2$ to the phase for positive frequencies and subtracting $\pi/2$ for negative frequencies.

Thus, the transform of $\cos(2\pi \times f_0 \times t)$ is $\sin(2\pi \times f_0 \times t)$.

Analytical signal:

- **Signal envelope and analytical signal phase:** The analytical signal of a time signal $x(t)$ is a complex signal, the real part of which is $x(t)$ and the imaginary part is the Hilbert transform of $x(t)$. The envelope $x(t)$ is obtained by taking into account the module of this signal.

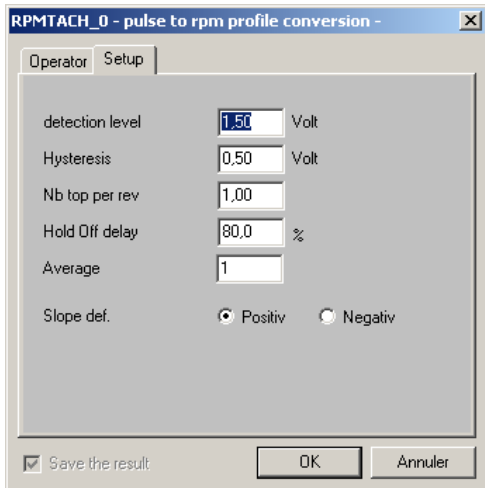
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Envelope
Default name	ENV_0
Active for	1 Signal item
Restrictions	Applies for 1 item only
Result family	Signal

14.6.2.16. Operator Pulse to RPM profile conversion [RPMTACH]

This operator is used to convert a tachometric signal acquired on a dynamic channel into a speed profile used for order analysis. The dialog box shown below is displayed on screen:

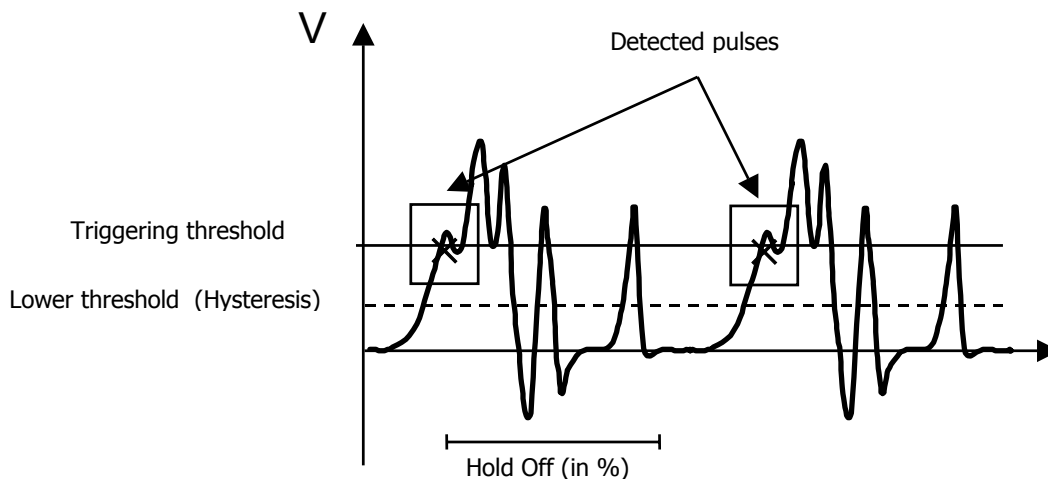
In the **Configuration** tab, the following analysis parameters may be defined:



- **Detection threshold:** Define the threshold value for pulse detection.
- **Lower threshold (Hysteresis):** Define the lower threshold before reactivating the trigger for the pulse detection (case when the tachometric signal is of poor quality).
- **Number of pulse per revolution:** Specify the number of pulse per revolution.
- **Hold Off delay:** Define the time period during which the trigger is deactivated, as a percent of the time between the two previous triggers (case when the tachometric signal is of poor quality).

- **Averaging:** Define the number of items to average before calculating the speed.
- **Slope definition:** Define the signal slope for pulse detection.

Example: poor-quality signal



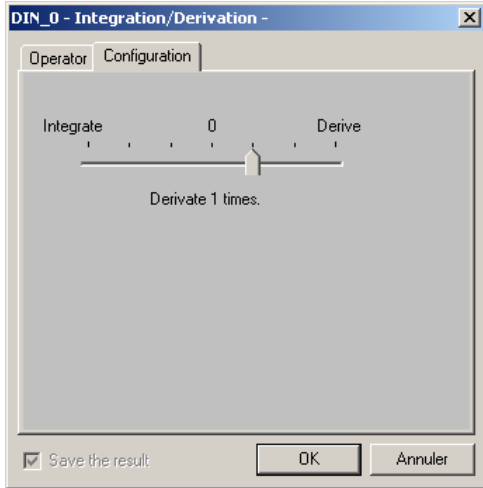
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	RPMTACH_0
Active for	1 Signal item
Restrictions	Applies for 1 item only
Result family	Speed profile

14.6.2.17. Integration / Derivation operator [DIN]

This processing allows for the integration or the derivation of an acceleration, speed or displacement signal. The dialog box shown below is displayed.

In the **Configuration** tab, the following analysis parameters may be defined:



■ **Integration / Derivation:** Use this field to integrate/derive signals.

Move the cursor to the left to integrate the signal once (first tick), twice (second tick) or three times (third tick).

Move the cursor to the right to derive the signal once (first tick), twice (second tick) or three times (third tick).

The table below summarises the different integration/derivation options depending on the type of signal.

Data type		Integration			Derivation		
		1	2	3	1	2	3
Signal	m/s ²	m/s	M	x	m/s ³	x	x
	m/s	m	X	x	m/s ²	m/s ³	x
	m	x	X	x	m/s	m/s ²	m/s ³

Nomenclature:

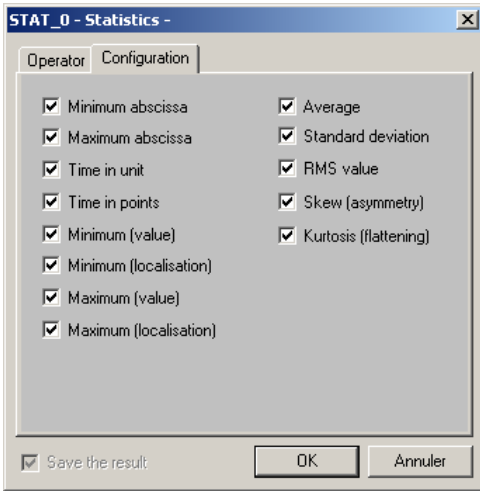
Jerk	m/s ³
Acceleration	m/s ²
Speed	m/s
Displacement	m

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	Integration / derivation
Default name	DIN_0
Active for	Acceleration, speed, displacement signals
Restrictions	Applies to one item only The number of derivations or integrations should be compatible with dimension units
Result family	Jerk, acceleration, speed or displacement signals

14.6.2.18. Statistics operator [STAT]

This function is used to calculate statistical indicators such as average, maximum, minimum, standard deviation and Kurtosis on a signal. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

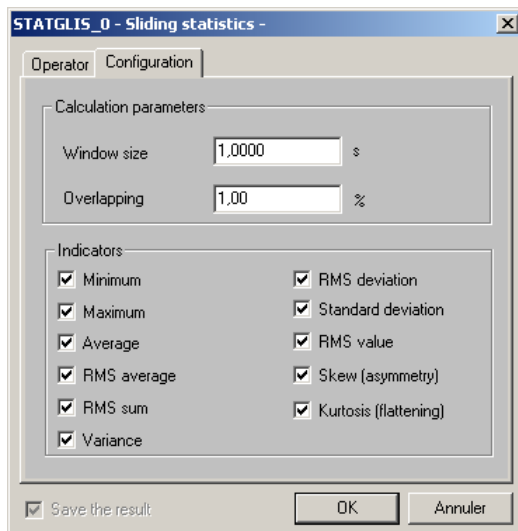
- Check the elements to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	Statistics
Default name	STAT_0
Active for	Signals
Restrictions	Applies to 1 item
Result family	Results table

14.6.2.19. Sliding statistics operator [STATGLIS]

This function is used to calculate statistical indicators such as average, maximum, minimum, standard deviation and Kurtosis on a signal with a sliding calculation window. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Window size:** Enter the duration of the indicator calculation window.
- **Overlap:** Enter the overlap factor for the calculation.
- **Indicators:** Check the elements to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator

Default script	Sliding statistics
Default name	STATGLISS_0
Active for	Signals
Restrictions	Applies to 1 item
Result family	Signal; 1 item per index

14.6.3. Operations on spectra

14.6.3.1. Theory

Various operations are possible on spectra:

- **Frequency recombination**

From spectra or multispectra, in narrow bands or in broad bands, it is possible to recombine spectra or multispectra with a lower frequency resolution.

The synthesis of a broad-band spectrum into another broad-band spectrum is classical. For example, the recombination of a third octave band spectrum into an octave spectrum is done by the energetic sum of the 3 third octave bands that would be part of an octave band.

For synthesis of a narrow-band spectrum into a broad-band spectrum, the energetic summation is allowed only if there is at least 5 narrow bands to sum, those lying in the frequency limits of the broad band.

- **Time recombination**

From multispectra in narrow bands or in broad bands, it is possible to perform various time operations:

- Recombination according to a greater time base
- Extraction of maximum, minimum and averaged spectra
- Extraction of an instantaneous spectrum, whose overall level satisfies a given criterion (minimum, maximum, weighted or not).

- **Integration/derivation**

Spectra in narrow bands (autospectra and cross-spectra), which physical unit that can be integrated or derived (jerk, acceleration, velocity, displacement), can be integrated or derived according to the following formula (Y is the result, X is the input):

Derivation n times:

$$Y(f) = (j.2.\pi.f)^n X(f)$$

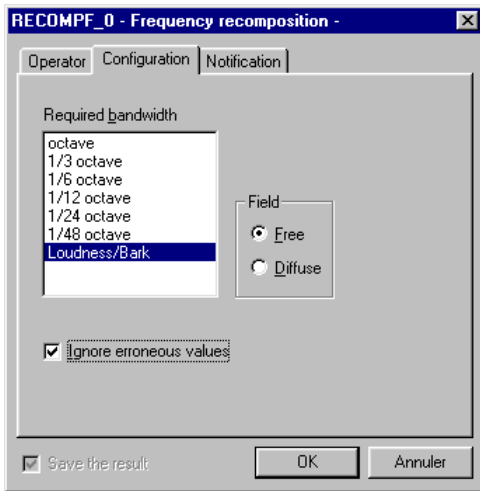
Integration n times:

$$Y(f) = \frac{1}{(j.2.\pi.f)^n} X(f)$$

A cross-spectrum that results from the computation of velocity and displacement spectra, for example, can therefore be integrated once for one quantity (velocity), and be derived twice for the other unit (displacement).

14.6.3.2. Frequency recomposition Operator [RECOMPF]

This analysis results in the recomposition of a broad band or narrow band multispectrum into a multispectrum of different frequency bandwidth. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Required bandwidth.** Select the octave sub-division of the spectrum to recompose.

For a frequency recomposition in Barks bands (with conversion to a Loudness level), give details on the type of sound field: **Free field** or **Diffuse field**.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

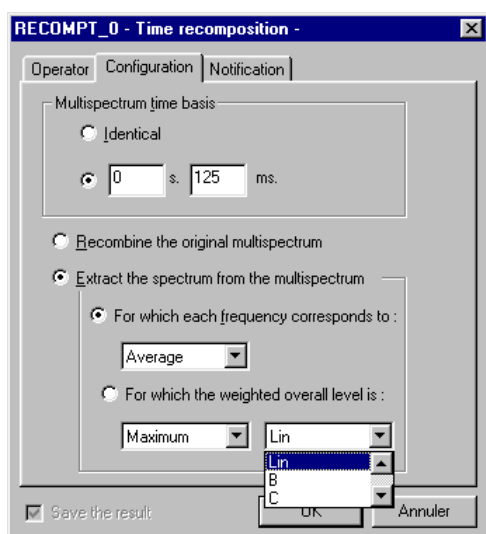
Default script	Spectra operations
Default name	RECOMPF_0
Active for	Autospectrum, Intensity (active, free field, reactive)
Restrictions	Apply for one item only Narrow bands to Bark bands: a minimum of 5 narrow band values is required to synthesis a specific Loudness Broad band to broad band: the required bandwidth must be greater than the original bandwidth (e.g.: 1/6 octave spectrum recombine into an octave spectrum)
Family of the result	Autospectrum, Intensity (active, free field, reactive)

14.6.3.3. Time recomposition Operator [RECOMPT]

This processing allows the user to recombine a broad-band or narrow-band multispectrum:

- either on a larger time basis (multiple of the initial time basis)
- or to calculate the minimum / maximum / average spectrum, from the multispectrum on the same different time basis or on a different one. The recomposition on a different time basis affects the minimum and the maximum extraction.
- Alternatively, to extract an instantaneous spectrum the overall level of which meets user-defined criteria, from the multispectrum and on a different time basis or not.

The following dialog box appears on-screen. In the **Configuration** tab, the following analysis parameters may be defined:



▪ Multispectrum time basis

Select the multispectrum time basis (identical or multiple of the original time basis) in order to recombine the multispectrum or extract a spectrum.

Two possibilities are then offered to the user:

▪ Recombine the original multispectrum

Select this option to recombine the original multispectrum according to a different time basis, multiple of the original time basis.

The result of the analysis is a narrow-band or broad-band multispectrum of greater time basis.

▪ Extract a spectrum from a multispectrum

Select this option to extract a spectrum from the multispectrum. The user may extract the following spectra:

- The **average, minimum or maximum** spectrum, for which each frequency correspond respectively to the average, minimum or maximum values of the multispectrum, from the multispectrum and on a previously defined time basis.
- The instantaneous spectrum for which the overall level is either the **maximum** or the **minimum, A, B, C or Lin** weighted level of the multispectrum, from the multispectrum and on a previously defined time basis.



The multispectrum time basis for the recombination must greater and a multiple of the original time basis.



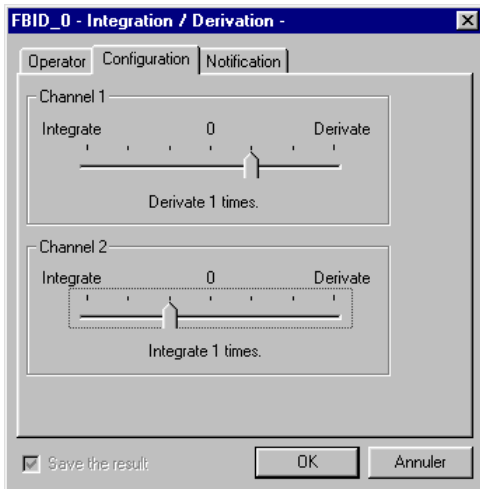
Extracting spectra can be done on a multispectrum with a different time basis as well. The time basis of the multispectrum will therefore greatly influence the result.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Spectra operations
Default name	RECOMPT_0
Active for	Autospectrum, Intensity (active, free field, reactive)
Restrictions	Apply for one item only Must be a multispectrum
Family of the result	Autospectrum, Intensity (active, free field, reactive)

14.6.3.4. Integration / Derivation Operator [FBID]

This processing integrates or derives an autospectrum or a cross spectrum (acceleration, velocity, and displacement). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Channel 1:** Use this field to integrate / derive autospectra and the first channel of cross-spectra.

Move the cursor to the left to integrate the spectrum once (first notch), twice (second notch) or three times (third notch).

Move the cursor to the left to derive the spectrum once (first notch), twice (second notch) or three times (third notch).

- **Channel 2:** Use this field to integrate / derive autospectra and the second channel of cross-spectra.

The table shown below lists the different possibilities of integration and derivation as a function of the physical unit of the data item:

Data items families		Channel 1						Channel 2						
		Integration			Derivation			Integration			Derivation			
		1	2	3	1	2	3	1	2	3	1	2	3	
Autospectra	m/s ²	m/s	m	x	m/s ³	x	x	x	x	x	x	x	x	x
	m/s	m	x	x	m/s ²	m/s ³	x	x	x	x	x	x	x	x
	m	x	x	x	m/s	m/s ²	m/s ³	x	x	x	x	x	x	x
Cross-spectra	m/s ²	m/s	m	x	m/s ³	x	x	m/s	m	x	m/s ³	x	x	x
	m/s	m	x	x	m/s ²	m/s ³	x	m	x	x	m/s ²	m/s ³	x	x
	m	x	x	x	m/s	m/s ²	m/s ³	x	x	x	m/s	m/s ²	m/s ³	x

Legend:

- Jerk m/s³
- Acceleration m/s²
- Velocity m/s
- Displacement m

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Integration / derivation
Default name	FBID_0
Active for	Acceleration, velocity and displacement autospectra and cross-spectra
Restrictions	Apply for one item only The total number of derivations and integration must be compatible with the physical units of the data items
Family of the result	Jerk, acceleration, velocity and displacement autospectra and cross-spectra

14.6.3.5. Overall Loudness history Operator [BGLOBAL]

This processing yields the time history of the Loudness or the Sharpness for a Bark band spectrum. For a single spectrum, the result is an overall level. The dialog box below is displayed:

In the **Configuration** tab, the following analysis parameters may be defined:



- Select the magnitude to calculate.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	History of overall loudness
Default name	BGLOBAL_0
Active for	Bark spectrum
Restrictions	Applies to one item only
Result family	Overall (either time history or data table)

14.6.4. Frequency response functions

14.6.4.1. Theory

These operators allow the user to compute various transfer functions and associated cross-spectrum from two autospectra (Channel 1 and Channel 2) and a cross-spectrum. Each quantity is defined below:

■ Cross spectrum G21 (Gyx)

The cross-spectrum Gyx of channels x and y is computed from the cross-spectrum Gxy by the formula:

$$\mathbf{Gyx = Gxy^* \text{ then } } G_{yx}(f) = 2 \cdot X(f) \cdot Y^*(f)$$

Where Gxy* is the associated complex of Gxy (same real part, opposed imaginary part).

The modulus of the result, expressed in dB, is equal to :

$$10 \cdot \log_{10} \left(\frac{G_{yx}(f)}{X_{ref} \cdot Y_{ref}} \right) = 10 \cdot \log_{10} \left(\frac{2 \cdot X(f) \cdot Y^*(f)}{X_{ref} \cdot Y_{ref}} \right)$$

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$10 \cdot \log_{10} \left(\frac{G_{yx}(f)}{X_{ref} \cdot Y_{ref}} \cdot Cx \cdot Cy \right)$$

The phase of the result, expressed in radians, is equal to:

The phase difference between spectra Yf) and X(f).

■ Frequency response function H1

If x is the input signal and y the output signal of the process, the transfer function H1 is defined as:

$$Y(f) = H(f) \cdot X(f)$$

The analyser calculates only autospectra and cross spectra. The first method is then to multiply the above equation on both sides by the conjugated Fourier transform of X(f), i.e., X*(f). From the Gxy cross spectrum and the Gxx cross spectrum, one obtains an expression called H1:

$$\mathbf{H_1 = Gxy / Gxx}$$

The modulus of the result, expressed in dB, is:

$$20 \log_{10} \left(\frac{|H_1| \cdot X_{ref}}{Y_{ref}} \right)$$

|H1| is the module of the frequency response function.

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$20 \log_{10} \left(\frac{|H_1| \cdot C_y \cdot X_{ref}}{C_x \cdot Y_{ref}} \right)$$

The phase of the result, expressed in radians, is equal to:

The phase of the Gxy cross spectrum

■ Inverse frequency response function 1/H1

If x is the input signal and y the output signal of the process, the inverse transfer function 1/H1 is defined from the cross-spectrum Gxy and the modulus of the autospectrum |Gxx|:

$$1/H1 = Gxx / Gxy.$$

The modulus of the result, expressed in dB, is equal to:

$$20 \log_{10} \left(\frac{|1/H_1| \cdot Y_{ref}}{X_{ref}} \right)$$

|H₁| is the modulus of the frequency response function.

The phase of the result, expressed in radians, is equal to:

The opposite of the Gxy cross spectrum phase

■ Frequency response function H2

If x is the input signal and y the output signal of the process, the frequency response cross function is defined based on the cross spectrum Gxy and the autospectrum Gyy. This is obtained by multiplying each side of the initial equation for the frequency response function H(f) by the conjugated Fourier transform of Y(f), i.e., Y*(f). It is called H₂:

$$H2 = Gyy / Gyx$$

The modulus of the result, expressed in dB, is equal to:

$$20 \log_{10} \left(\frac{|H_2| \cdot X_{ref}}{Y_{ref}} \right)$$

|H₁| is the modulus of the frequency response function.

If the selected physical unit is not the IS unit, and if a conversion factor Cx is calculated (e.g.: Cx=9.81 for an acceleration level expressed in g), then the expression above becomes:

$$20 \log_{10} \left(\frac{|H_2| \cdot C_y \cdot X_{ref}}{C_x \cdot Y_{ref}} \right)$$

The phase of the result, expressed in radians, is equal to:

The phase of cross spectrum Gxy or the opposite of the phase of cross spectrum Gyx

▪ Inverse cross transfer function 1/H₂

If x is the input signal and y the output signal of the process, the inverse cross transfer function $1/H_2$ is defined as the cross-spectrum G_{yx} and the autospectrum G_{yy} :

$$1/H_2 = G_{yx} / G_{yy}$$

The modulus of the result, expressed in dB, is equal to:

$$20 \log_{10} \left(\frac{|1/H_2| \cdot Y_{ref}}{X_{ref}} \right)$$

$|H_2|$ is the modulus of the frequency response function.

The phase of the result, expressed in radians, is equal to :

The opposite of the phase of cross spectrum G_{xy} or the phase of G_{yx}

▪ Coherence

If x is the input signal and y the output signal of the process, the coherence is defined based on the cross-spectrum G_{xy} and the autospectra G_{xx} and G_{yy} . If γ is the coherence, then:

$$\gamma^2 = |G_{xy}|^2 / [|G_{xx}| \cdot |G_{yy}|]$$

The coherence is a dimensionless number ranging from 0 to 1.

▪ Other method for determining the frequency response function: transmissibility calculation

By raising the initial expression of the frequency response function $H(f)$ to the power of two, a new expression is obtained:

$$|H_a|^2 = \frac{G_{yy}}{G_{xx}}. \text{ This expression does not contain any phase information.}$$

The modulus of the result, expressed in dB, is equal to:

$$10 \log_{10} \left(\frac{|H_a|^2 \cdot X_{ref}^2}{Y_{ref}^2} \right)$$

$|H_a|$ is the modulus of the frequency response function.



*This method for the determination of the frequency response function is not developed in **dBFA32**.*

14.6.4.2. Cross spectrum G21 Operator [FBG21]

This processing produces, from a cross-spectrum, the cross-spectrum defined as its associated complex.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBG21_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	None
Family of the result	Cross-spectrum

14.6.4.3. Frequency response function H1 Operator [FBH1]

This processing produces, from the autospectrum G_{xx} of the input signal and the cross spectrum G_{xy} between the input and the output, the frequency response function defined by $G_{xy} / |G_{xx}|$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBH1_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution
Family of the result	Frequency response function H1

14.6.4.4. Inverse frequency response function 1/H1 Operator [FBIH1]

This processing produces, from the autospectrum G_{xx} of the input signal and the cross spectrum G_{xy} between the input and the output, the transfer frequency response defined by $|G_{xx}| / G_{xy}$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBIH1_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution
Family of the result	Frequency response 1/H1

14.6.4.5. Frequency response cross function H2 Operator [FBH2]

This processing produces, from the autospectrum G_{yy} of the output signal and the cross spectrum G_{xy} between the input and the output, the transfer frequency response defined by $|G_{yy}| / G_{yx}$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBH2_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution
Family of the result	Frequency response function H2

14.6.4.6. Inverse frequency response cross function 1/H2 Operator [FBIH2]

This processing produces, from the autospectrum G_{yy} of the output signal and the cross spectrum G_{xy} between the input and the output, the frequency response function defined by $G_{yx} / |G_{yy}|$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBIH2_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution
Family of the result	Frequency response function 1/H2

14.6.4.7. Coherence Operator [FBCOH]

This processing produces, from the autospectra G_{xx} and G_{yy} of the input and output signals and the cross spectrum G_{xy} between the input and the output, the coherence defined by $Co^2 = [|G_{xy}|^2] / [|G_{xx}| \cdot |G_{yy}|]$.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Frequency response functions
Default name	FBCOH_0
Active for	Autospectrum Channel 1 + Autospectrum Channel 2 + Cross-spectrum Channel 1 - Channel 2
Restrictions	Check the compatibility of the physical units, the type of data, the weighting window, frequency and time resolution
Family of the result	Coherence

14.6.5. Arithmetic operations

These operators allow the user to add, subtract or average signal data, spectra and overall quantities.

 **For complex spectra (cross-spectrum, transfer function, coherence), only the averaging operator is available.**

These operations can be performed according to two types of arithmetic rules:

▪ Algebraic rule

For energy summation (spectra, overall quantities): **40 dB + 40 dB = 80 dB**

For amplitude summation (signal) : **40 dB + 40 dB = 80 dB**

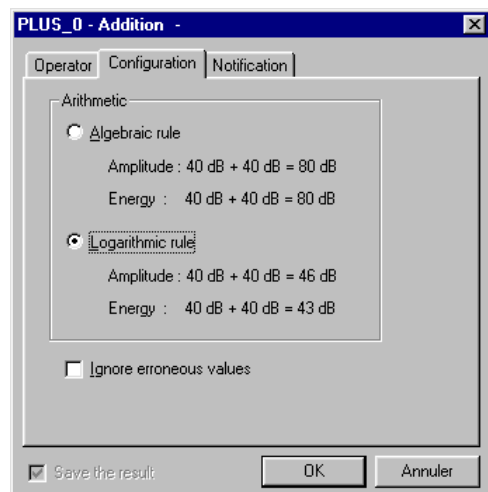
▪ Logarithmic rule

For energy summation (spectra, overall quantities): **40 dB + 40 dB = 43 dB**

For amplitude summation (signal): **40 dB + 40 dB = 46 dB**

14.6.5.1. Addition Operator [PLUS]

This processing sums up all the selected quantities. The user may choose either to perform an algebraic or logarithmic sum. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

▪ Algebraic rule

Select the algebraic rule for an algebraic summation of data items.

▪ Logarithmic rule

Select the logarithmic rule for an energetic summation of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

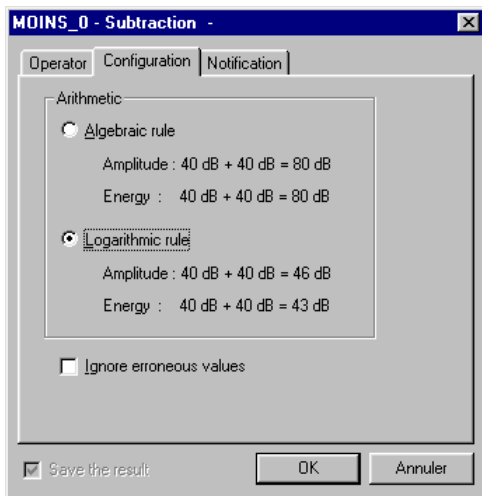
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Arithmetic
Default name	PLUS_0
Active for	At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.).
Restrictions	If signals: same physical units, sampling frequency and references. If Leq: same physical units, time basis, references, type of data. If autospectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.
Family of the result	Signal, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.)

 **Loudness levels cannot be added.**

14.6.5.2. Subtraction Operator [MOINS]

This processing subtracts all the selected quantities. The user may choose either to perform an algebraic or logarithmic subtraction. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Algebraic rule**

Select the algebraic rule for an algebraic subtraction of data items.

- **Logarithmic rule**

Select the logarithmic rule for an energetic subtraction of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

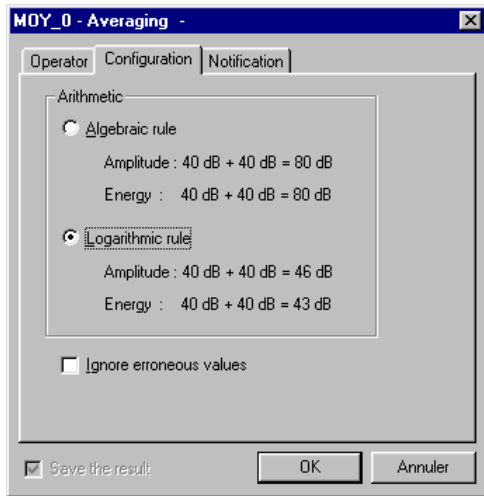
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Arithmetic
Default name	MOINS_0
Active for	At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.).
Restrictions	If signals: same physical units, sampling frequency and references. If Leq: same physical units, time basis, references, type of data. If autospectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.
Family of the result	Signal, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.)

 **Loudness levels cannot be subtracted.**

14.6.5.3. Averaging Operator [MOY]

This processing averages all the selected quantities. The user may choose either to perform an algebraic or logarithmic average. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Algebraic rule**

Select the algebraic rule for an algebraic average of data items.

- **Logarithmic rule**

Select the logarithmic rule for an energetic average of data items.

If the box **Ignore erroneous values** is ticked, frequency bands that present erroneous values are still computed. There are not computed (no value) if the box is not ticked.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Arithmetic
Default name	MOY_0
Active for	At least 2 signals, autospectra, Leq (Leq, Peak, Slow, Fast, etc.). Complex spectra: cross-spectra, transfer functions, coherence
Restrictions	If signals: same physical units, sampling frequency and references. If Leq: same physical units, time basis, references, type of data. If spectra: same physical units, references, band width or resolution (narrow bands), time basis, type of data.
Family of the result	Signals, autospectrum, Leq (Leq, Peak, Slow, Fast, etc.) Complex spectra: cross-spectra, transfer functions, coherence

 **Loudness levels cannot be averaged.**

14.6.6. Time history of an overall quantity

There are two ways to estimate the time history of an overall quantity:

- **From a time signal**

This operator allows the user to compute, from a Signal item, the Short Leq time history of time basis ranging from 5 milliseconds to 999 seconds. The overall level may be frequency weighted (A, Lin, B, and C) and / or time weighted according to:

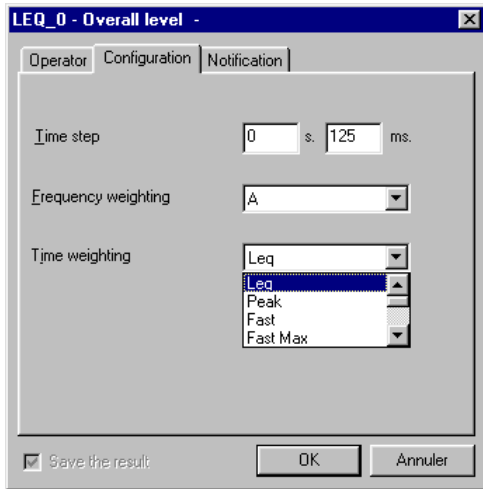
- Leq**: Classical short Leq time history
- Peak**: Time history of the maximum values of the signal over the item duration
- Fast**: Fast integration of the elementary short Leq
- Fast Min**: Time history of the minimum Fast values over the item duration
- Fast Max**: Time history of the maximum Fast values over the item duration
- Slow**: Slow integration of the elementary short Leq
- Slow Min**: Time history of the minimum Slow values over the item duration
- Slow Max**: Time history of the maximum Slow values over the item duration
- Impuls**: Impulse integration of the elementary short Leq
- Impuls Max**: Time history of the maximum Impulse values over the item duration

- **From a multispectrum**

These operators allow the user to perform a frequency recombination over a user-defined frequency range, with or without frequency weighting in order to calculate the time history of an overall level (frequency channel, overall level, Loudness, etc.). These processing functions apply to multispectra in narrow bands, broad bands and Bark bands.

14.6.6.1. Overall level Operator [LEQ]

This analysis results in a short Leq's time history of the time signal. Frequency (Lin, A, B, C) and time (Leq, Peak, Fast, etc.) weightings can be applied. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Time step**

This is the integration duration used to compute the overall level over the item duration. It varies from 1 ms to 999s

- **Frequency weighting**

Select the weighting to apply to the computed overall level: **A, B, C, and Lin**

- **Time weighting**

Select which time weighted overall level has to be computed: **Leq, Peak, Slow, Slow Max, Slow Min, Fast, Fast Max, Fast Min, Impulse, Impulse Max**

If, for example, a time step of 1 s is chosen for a 2 s long audio recording, only two values will be calculated (one value per second). The result will therefore be useless. It is recommended to specify as small a step as possible without increasing calculation time too much.

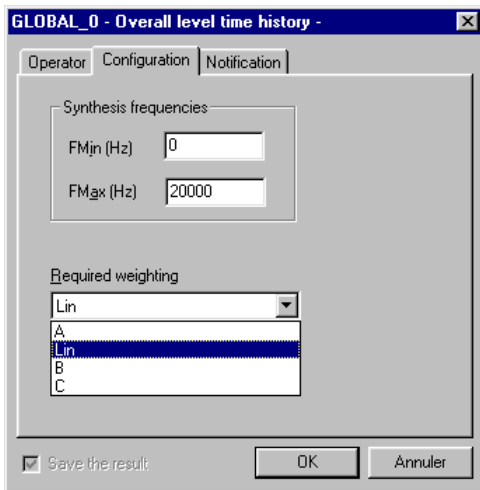
Excessive calculation time may cause problems if the computer has insufficient power. This should also be remembered with respect to the number of quantities and weightings involved in the calculation.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	LEQ_0
Active for	Signal, Impulse Response
Restrictions	Apply to one item only
Family of the result	Leq

14.6.6.2. Overall level time history [GLOBAL]

This analysis results in the time history of the overall level of a multispectrum, with frequency weighting. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

▪ **Synthesis frequencies**

Define the minimum and maximum frequency bands used to compute the overall level.

▪ **Required weighting**

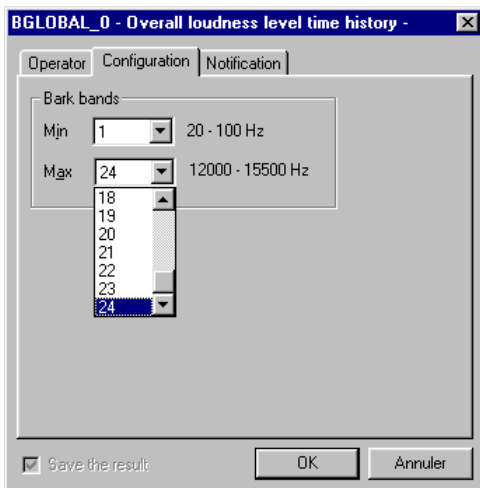
Select the weighting to apply to the computed overall level time history: **A, B, C, and Lin.**

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Spectra operations
Default name	GLOBAL_0
Active for	Autospectrum, intensity (active, reactive, free field)
Restrictions	Apply to one item of the type broad band or narrow band spectra only Narrow bands: require a common frequency range between the synthesis frequency range and the data item frequency range.
Family of the result	Leq

14.6.6.3. Overall Loudness level time history Operator [BGLOBAL]

This analysis results in the overall Loudness level time history of a Loudness/Bark multispectrum. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

▪ **Bark bands**

Gives minimum and maximum Bark bands used for computation of the overall Loudness level.

An indication of the frequency range covered by the analysis, for any given Bark band, is given.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Operations on specific Loudness
Default name	BGLOBAL_0
Active for	Bark spectrum (see paragraph 14.6.7.4)
Restrictions	Apply to one item only
Family of the result	Leq

14.6.7. Psychoacoustics

Various operators allows the user to compute psychoacoustic criteria:

▪ **Stationary criteria**

It is currently possible to measure the sound intensity of a noise event (in dB) and therefore quantify the nuisance level they may cause. Standard techniques however, are too simplistic to account for the subjective nature of human response to noise.

Psychoacoustics is a relatively new branch of psychophysics that addresses this problem. A number of parameters have been defined in order to take account of the subjective nature of human perception and judgement of sound quality:

- Loudness, Loudness 10%**
- Fluctuation Strength**
- Sharpness**
- Tonality**
- Roughness**
- Unbiased Annoyance** (a combination of Sharpness, Fluctuation Strength and Loudness 10%).
- Sensory Pleasing Sound** (depends on Roughness, Sharpness, Tonality and Loudness criteria).



These criteria are defined in "Psychoacoustics: Facts and Models" by Zwicker and Fastl, Springer-Verlag, Ed.

Furthermore, 3 types of **Articulation Indices** can be calculated:

- NHV (Noise, Vibration and Harshness)** for the car industry.
- Unikeller**, a variant of the Beranek method that does not have indices limited to the range 0~100%.
- Rooms** generally used for offices and public places.

▪ **Loudness spectrum in Bark bands**

Digital filtering (24 filters) based on Butterworth filters of order 8, and for which the frequency limits correspond to the Bark bands.

▪ **Time history of Loudness and Sharpness criteria**

From a Loudness spectrum in Bark bands (intermediate computation done by the operator), the Bark bands are recombined to form the required criterion.

Before the presentation of each operator, let us present theoretically each psychoacoustic quantity.

14.6.7.1. Bark bands

In the field of acoustics, a third octave spectrum would usually be represented by narrow bands. However, this does not take into account the resolution frequency of the human ear. It is possible to divide the audible spectrum into 24 critical or so called, "bark" bands. These have variable band widths in order to simulate human perception of sound more realistically. In addition, the 24-band format enables simplifications of the calculation process.

Values F_{MIN} , F_{MAX} and F_c of each Bark band are:

N°	FMIN	Fc	FMAX
1	20	50	100
2	100	150	200
3	200	250	300
4	300	350	400
5	400	450	510
6	510	570	630
7	630	700	770
8	770	840	920
9	920	1000	1080
10	1080	1170	1270
11	1270	1370	1480
12	1480	1600	1720
13	1720	1850	2000
14	2000	2150	2320
15	2320	2500	2700
16	2700	2900	3150
17	3150	3400	3700
18	3700	4000	4400
19	4400	4800	5300
20	5300	5800	6400
21	6400	7000	7700
22	7700	8500	9500
23	9500	10500	12000
24	12000	13500	15500

Conversion from Hertz to Barks is possible using the equation:

$$z \text{ in Bark and } f \text{ in kHz : } z = \left[13 \cdot \text{Arctg}(0,76 \cdot f) + 3,5 \cdot \text{Arctg}(0,133 \cdot f)^2 \right] \text{Bark}$$

14.6.7.2. Stationary criteria

Loudness

Loudness is a measure of sound energy and is expressed in *Sones*. It represents the intensity of the sound as perceived by the ear. As a reference, 1 sone is the level given by a pure sound of 1 kHz at 40 dB. This level increases by powers of two.

In this way, a relationship between the dB scale and sones may be established for 1 kHz. For the other frequencies, the sound level and frequency are altered to give the same feeling of Loudness. This method may appear user-dependent, however studies have shown considerable independence of this factor from the results.

The resulting Isosone graphs are made up of points corresponding to frequency levels that have equal Loudness obtained from pure sounds.

Fluctuation Strength

The fluctuation strength concerns the sound models for frequencies f_{mod} perceived to be less than 20 Hz. The unit of Fluctuation strength is the vacil.

Sharpness

The Sharpness of a sound describes the level of acuteness. It behaves in part as a barycentre weighting of the Bark band spectra. It is expressed in acum.

Tonality

It allows to quantify tonal components in a spectrum of a signal by comparison of the Loudness level due to these components and the overall Loudness.

Roughness

The Roughness criterion is used to identify the perturbing effect of mid-frequency modulation. It is expressed in Asper. It deals with sound level modulated in the range 20 Hz - 300 Hz.

Unbiased Annoyance UBA

All the previous parameters give an indication on the nature of the noise and its perception by human experience. However; it would be interesting to be able to obtain a general description. Zwicker proposed a new parameter called **Unbiased Annoyance**.

The Unbiased Annoyance is a measure of how unpleasant the noise is perceived to be and is a combination of the previous parameters (Sharpness, Fluctuation Strength, and Loudness 10%).

Sensory Pleasing Sound SPS

All the preceding parameters give an indication on the nature of the noise and its perception by human experience. However; it would be interesting to be able to obtain a general description. Zwicker proposed a new parameter called **Sensory Pleasing Sound**.

The Sensory Pleasing Sound is a measure of how pleasant the noise is perceived to be and is a combination of the previous parameters (Roughness, Sharpness, Tonality).

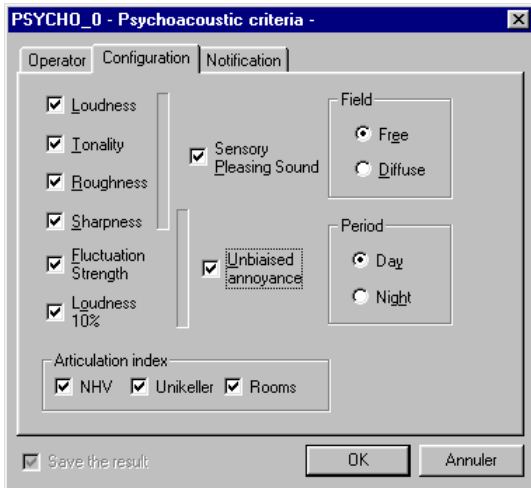
Articulation index: Rooms, Unikeller, NHV

The articulation index aims to quantify the perception of fluctuating phenomena present in the studied noise. This index is expressed as a % where a high value indicates good audibility. Three main algorithms are used to calculate these articulation indices:

- The **Rooms** algorithm is used particularly for sound measurements in offices, rooms and public places in general.
- The **Unikeller** algorithm is a variation on the classic method developed by Beranek though here the indices are not limited to a scale ranging from 0~100%.
- The **NHV** algorithm (Noise, Vibration and Harshness) has particular relevance to the car industry.

14.6.7.3. Psychoacoustic criteria Operator [PSYCHO]

This analysis may result in the following stationary psychoacoustic criteria : Loudness, Loudness 10%, Fluctuation Strength, Sharpness, Tonality, Roughness, Unbiased Annoyance, Sensory Pleasing Sound, Articulation index. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Tick the required boxes to calculate the corresponding psychoacoustic criteria.

Note that Sensory Pleasing Sound, Loudness, Tonality, Roughness and Sharpness criteria have to be computed as well.

The computation of the criteria Sensory Pleasing Sound also depends on the type of sound field (**free** or **diffuse**).

Note that the computation of the criteria Unbiased Annoyance, the Sharpness, Fluctuation Strength and Loudness 10% criteria have to be computed as well.

The computation of the criteria Unbiased Annoyance also depends on the time of the day (**day** or **night**).

The table shown aside is an example of results obtained after psychoacoustic analysis of an audio record.



Refer to the previous paragraphs for more details on each psychoacoustic criterion.

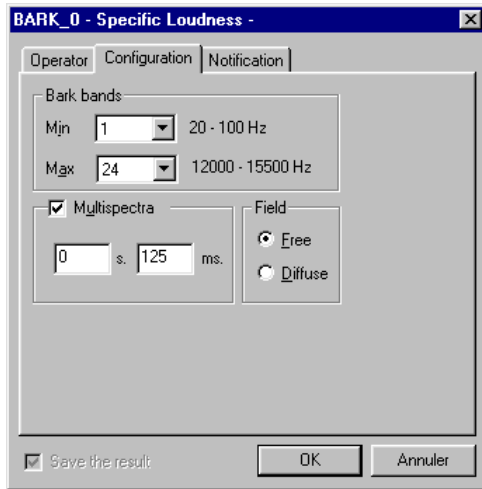
	27 (FD)	
Loudness	27.57	sone
Sharpness	1.04	acum
Fluctuation Strength	1.09	vacil
Tonality	0.00	tu
Roughness	8.34	asper
Unbiased Annoyance	258.03	au
Sensory Pleasing Sound	0.00	pu
Loudness 10%	56.85	sone
Articulation Index (NHV)	41.17	%
Articulation Index (Unikeller)	41.15	%
Articulation Index (Rooms)	57.00	%

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	PSYCHO_0
Active for	Signal, impulse response
Restrictions	Apply only for one item
Family of the result	Psycho

14.6.7.4. Specific Loudness Operator [BARK]

This analysis results in a Bark band specific Loudness, with time history capability (specific Loudness multispectrum), a time step ≤ 50 ms is required for later psychoacoustic criteria computation. The result is expressed in sones, according to Zwicker B. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Bark bands**

Gives the minimum and maximum Bark bands used for computation of the overall Loudness level.

An indication of the frequency range covered by the analysis, for any given Bark band, is given.

- **Multispectra**

If this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

- **Field**

Select the type of sound field (**free** or **diffuse**) to compute the specific Loudness level.

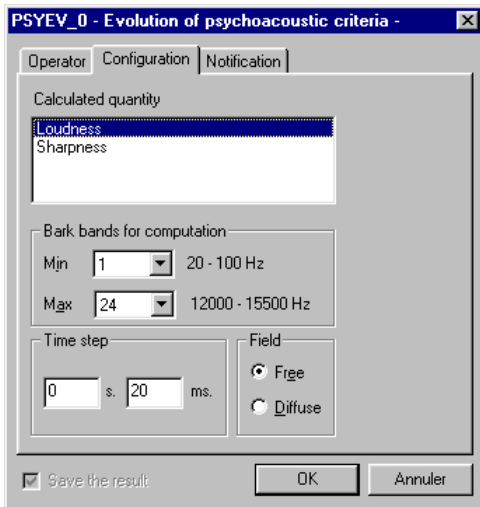
Note that this type of analysis is required in order to perform an analysis with the operator **Overall Loudness level time history**.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	BARK_0
Active for	Signal, impulse response
Restrictions	Apply only for one item
Family of the result	Bark spectrum

14.6.7.5. Time history of psychoacoustic criteria [PSYEV]

This analysis results in the time history of psychoacoustic quantities : Loudness (Zwicker B), Sharpness. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Calculated quantity**

Select the psychoacoustic criterion for which the time history will be calculated : **Loudness, Sharpness**.

- **Bark bands for computation**

Gives the minimum and maximum Bark bands used for computation of the psychoacoustic criteria.

An indication of the frequency range covered by the analysis, for any given Bark band, is given.

- **Time step**

Select the integration time to calculate the time history. This time step may vary from 1 ms to 999 seconds

- **Field**

Select the type of sound field (**free** or **diffuse**) to compute the psychoacoustic criterion.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

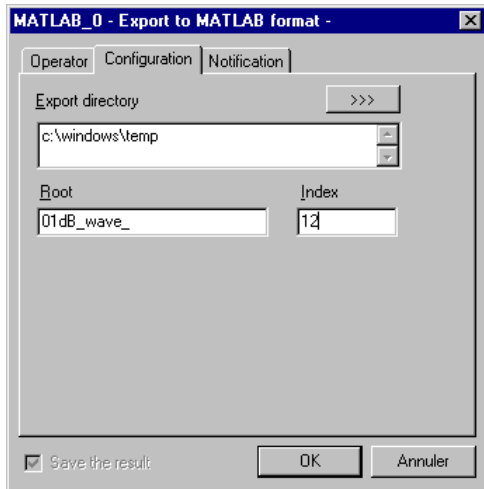
Default script	Signal analysis
Default name	PSYEV_0
Active for	Signal, impulse response
Restrictions	Apply only for one item
Family of the result	Leq

14.6.8. Exporting time signals

These operators are used to export audio events at the MATLAB format (*.MAT file, that can be directly processed into MATLAB with the "load" function) or the wave 01dB-Stell format (*.WAV files) compatible with Windows.

14.6.8.1. Export to MATLAB format Operator [MATLAB]

This function exports the input quantity to the MATLAB format (.MAT file). This file can be directly processed into MATLAB with the "load" function. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

▪ **Export directory**

Select a folder on the computer hard disk for storing the audio events that have been exported (MAT files).

The key **>>>** allows the user to browse the hard disk in order to find a specific folder.

▪ **Root / Index**

Select the root number for audio event exportation. The type of the exported audio records will be root_index_number.MAT.

In the example above, the first record will be name 01db_wave_12.MAT, then 01db_wave_13.MAT, etc.

⚠ **If a directory already contents exported records, select an index number higher than the maximum existing index in order to avoid overwriting records.**

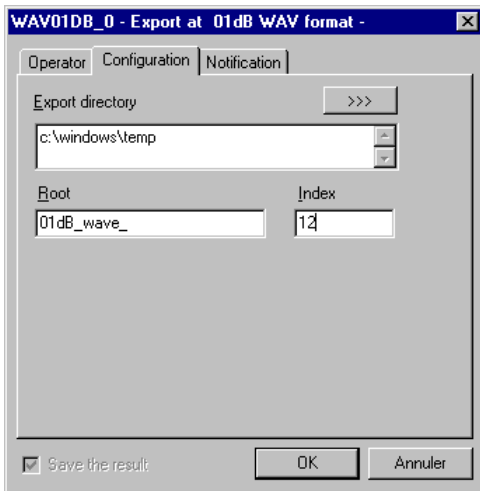
If using this operator in batch mode, the selection number of the item will be indicated in the file name.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Export
Default name	MATLAB_0
Active for	Signal families
Restrictions	none
Family of the result	x

14.6.8.2. Export to 01dB-Stell WAV format Operator [WAV01DB]

This processing exports the input quantity at the WAV 01dB-Stell format (*.WAV file, Windows compatible). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Export directory**

Select a folder on the computer hard disk for storing the audio events that have been exported (MAT files).

The key **>>>** allows the user to browse the hard disk in order to find a specific folder.

- **Root / Index**

Select the root number for audio event exportation.

The type of the exported audio records will be `root_index_number.WAV`.

In the example above, the first record will be name 01db_wave_12.WAV, then 01db_wave_13.WAV, etc.

💡 If a directory already contains exported records, select an index number higher than the maximal existing one in order to avoid overwriting records.

If using this operator in batch mode, the selection number of the item will be indicated in the file name.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Export
Default name	WAV01DB_0
Active for	Signal families
Restrictions	None
Family of the result	x

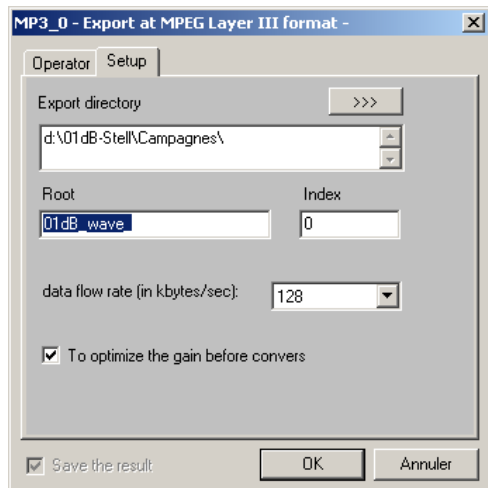
14.6.8.3. Export to MP3 format operator [MP3]

This operation is used to export signal items in MPEG Layer III (MP3) format, which allows for data compression with no loss of quality during playback.

The exported signal (selected in a measurement session) must be sampled at **32 kHz** or **41 kHz**.

To export a signal sampled with a different frequency, use the resampling operator (see Section 14.6.2.10) before to obtain compatible signals.

Use the dialog box below to perform the exportation.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Export directory**

Select a directory on the hard disk where to export data.


The **>>>** button is used to browse the hard disk and search for a specific directory.

- **Root / Index**

Select the root name from which each record will be exported.

Exported records will be named root_index_number.MP3.

In the above example, the first exported record is named Demo1.MP3, the second, Demo2.MP3, and so on.

 The index number is a way not to overwrite existing records previously exported in a directory.

In case of a multiple exportation (batch), the element selection number will be indicated in the filename.

- **Timing of the data flow**

Select the rate for the MP3 files in Kbytes/sec (by default: 128 Kbytes/sec).

The lower the rate, the smaller the created files (but possible quality loss).

The **Operator** tab provides a detailed description for the operating of this type of processing and can be used to modify its name.

The **Notification** tab is used to define parameters pertaining to the displayed information on calculation progress.

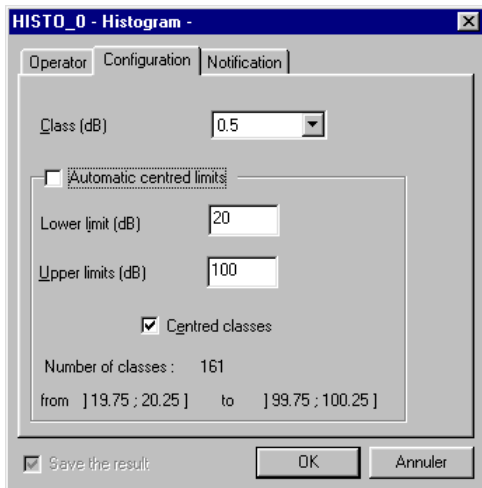
Default script	Exportation
Default name	MP3_0
Active for	Signal families
Restrictions	none
Result family	x

14.6.9. Operations on overall levels

From the time history of an overall quantity, it is possible to compute an histogram in dB, presenting the statistical distribution of the levels per class in %.

14.6.9.1. Histogram Operator [HISTO]

This processing produces a histogram of an overall quantity. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Class**
Select the class width (in dB) of the histogram to compute : 0.1dB, 0.5dB, 1dB, 5dB or 10dB.
- **Limits**
Select automatically or manually the lower and upper level limits (in dB) for the different classes of the histogram.

As a function of these limits and of the resolution of the histogram, the number of classes of the histogram is also given.

In manual mode (option **Automatic centred limits** not activated), it is possible to select or not the option Centred classes, for each class to be centred on an integer value of the dB levels.

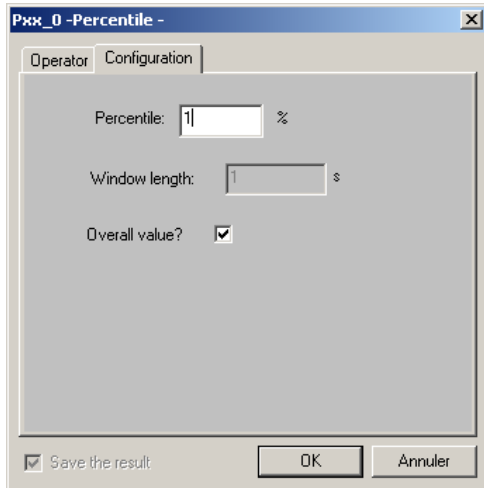
The lowest and highest classes are also given as an indication.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Histogram
Default name	HISTO_0
Active for	Leq (Leq, Peak, Fast, Slow, etc.)
Restrictions	Apply only for one item
Family of the result	Histo %

14.6.9.2. Percentile Operator [Pxx]

This processing is a statistical calculation over the time history of overall levels, allowing for the calculation of the level reached or exceeded during x % of the time, either over the whole time history, or over a window size to define. The dialog box shown below is displayed on screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Percentile:** Enter the statistical index to calculate.
- **Window size:** length of the calculation window, which is going to move point by point.
- **Overall value?:** Check this box to obtain an overall index over the whole time history.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Percentile
Default name	Pxx_0
Active for	History of an overall level
Restrictions	Apply to one item only
Results family	Overall level or history of an overall level

14.6.10. Room Acoustics

An operator is especially dedicated to room acoustics applications. From an impulse response acquired by MLS mode or by classical impulse technique, an echogram filtered in octave bands or third octave bands can be computed.

☛ **A specific operator used to compute commonly used room acoustics criteria (reverberation Time, Clarity, STI, etc.) is available in the dBBA132 software package.**

14.6.10.1. Echogram Operator [ECHOG]

This analysis results in an octave or third octave echogram. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Bandwidth** to define the spectrum bandwidth for the analysis: **octave, 1/3 octave bands.**
- **Min:** Minimum centre frequency of analysis in Hz.
- **Max:** Maximum centre frequency of analysis in Hz
- **Full octaves:** If this option is activated, the software will set the minimum and maximum frequency limits so that only full octaves are calculated.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	ECHOG_0
Active for	Signal, Impulse Response
Restrictions	Apply only to one item
Family of the result	Autospectrum

14.6.11. MATLAB connection operator [MATCO]

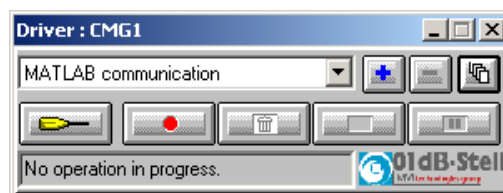
The MATLAB software holds today a leader position in scientific operating software thanks to its many tool boxes dedicated to very specialised domains like signal processing, image processing, neuronal network, automatism, etc.

A link in dBFA32 using the DCOM protocol allows the user to use MATLAB as ActiveX server (automation server). That enables sending data (items of a dBFA32 measurement session) in the MATLAB workspace to use the specific display and/or processing functions. After having transmitted the data to MATLAB, the user has also the possibility to restore these data in dBFA32 and to modify them as a new item.

14.6.11.1. Use of Communication matlab operator

A dedicated script integrates this operator. When selecting an item which is MATLAB operator compatible, the screen indicates the following dialogue box.

Note: the MATLAB communication script can group together several communication operators activated in parallel that works on the same inputs (batches).



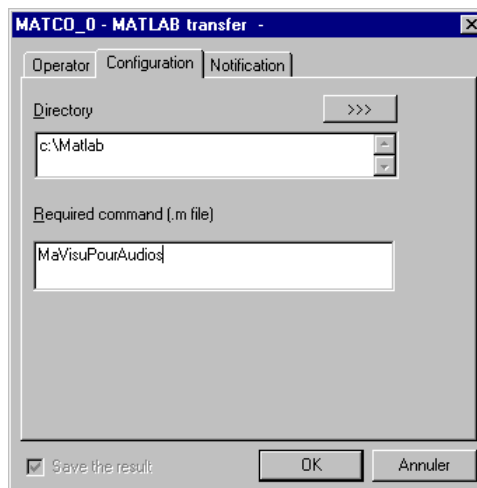
In the following are the types compatible at the moment:

- **Type "SIGNAL"**: Signals, impulse response, static measurements, tachometric, etc.
- **Type "GLOBAL"**: Short Leq, history of the psycho-acoustic parameters, etc.
- **Type "Narrow band spectrum"**: Narrow band, real and complex spectra.
- **Type "Broad band spectrum"**: Fractional octave spectrum (1/1 to 1/48 octave)
- **Type "Bark band spectrum"**: Sound intensity/bark spectra

The script edition proposes the following interface:

The command files in .m format are familiar for all MATLAB users. These are text files which integrate a function that can be called directly from the MATLAB command window.

The 01dB-Stell operator does the same: it proposes to the user to call a file function (normally the same name) with a list of fixed and pre-defined parameters that the MATLAB user has to respect.



The standard .m files are on the installation CD-ROM of 01dB-Stell programs:

- **audio.m** for "signal" type items
- **leq.m** for "global" type items
- **fb.m** for "narrow band spectrum" type items
- **fc.m** for "broad band spectrum" type items
- **bark.m** for "bark band spectrum" type items

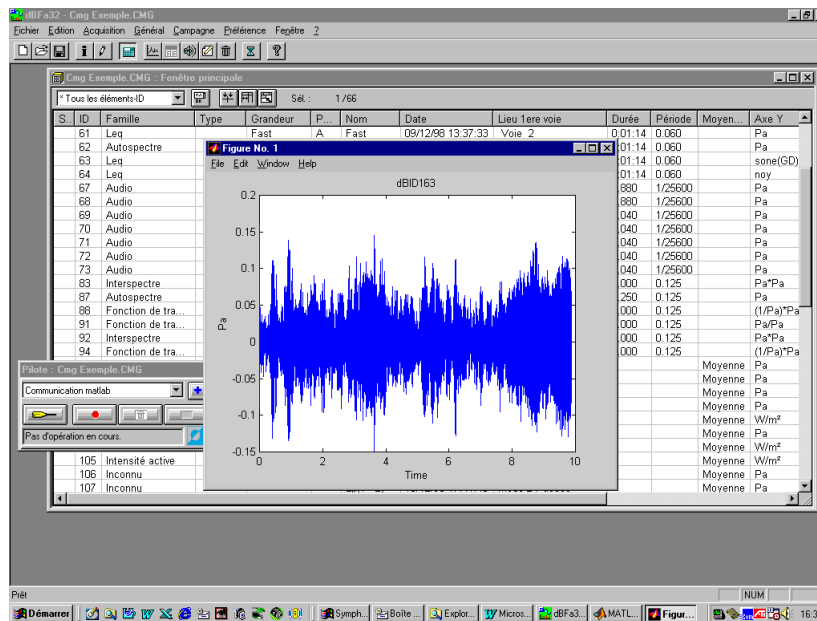
Copy the .m files in a directory on your hard disk, if using the MATLAB operator. Then enter the directory path in the "Working directory " field of the dialogue box below.

Let us consider the .m file below, for **example**:

```
function MaVisuPourAudios(ID,nom,fe,unite)

figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

With this file we display a "SIGNAL" type item of dBFA32.
 The activation of a script displays the MATLAB visualisation below in dBFA32, for example.



We consider the argument list passed to the function:

ID

Name of the variable that shows the item selected as script input in dBFA32 in the MATLAB space. This identifier is created as follows: dB+n° where the number is the ID of the item in the dBFA32 measurement session.

Nom

Descriptive (string) of the item including the name (comments). Used here as figure title.

fe

sampling frequency of the item.

unite

string table that identifies the unit in which the quantity is expressed.

After this display and after deleting the item in dBFA32, the variable remains valid in the MATLAB workspace. Only closing MATLAB or a clear command ('dBID6') will delete these data.

The MATLAB command window displays the list of available variables, if typing the command " who ".

```
" who
Your variables are:
dBID6
"
```

Then we can use this data as all MATLAB data.
As follows (maximal and averaged value), for example:

```
" max(dBID6)
ans =
0.1914
" mean(dBID6)
ans =
1.8266e-007
"
```

The file name .m is obviously free. Only the syntax is to respect (number of parameters and type).

All MATLAB errors are transferred to dBFA32 and indicated to the user, in case of a faulty syntax or an incorrect use of parameters

We change the MaVisuPourAudios file as follows, for example :

```
function MaVisuPourAudios(ID,nom,fe,unite,other)
figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

The result is then :



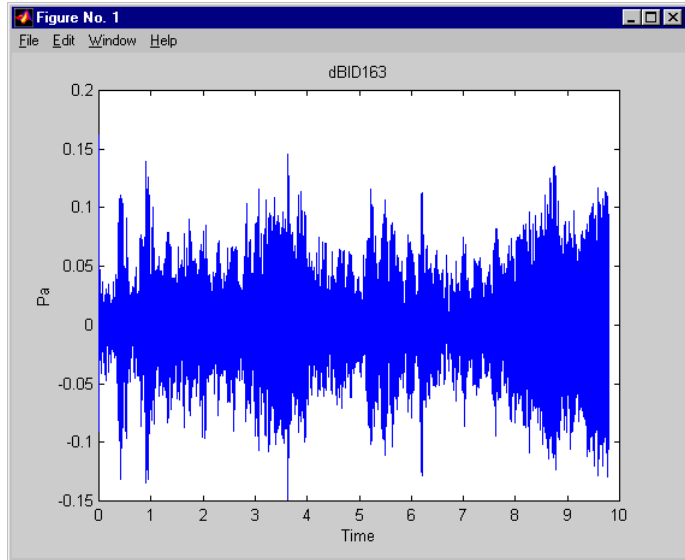
14.6.11.2. Type "SIGNAL"

Syntax
 function xxx(ID, nom, fe,unite)
 ID identifier of the variable: dBID+n°ID dBFA32
 nom name of the variable : ID(comment) (string)
 fe sampling frequency
 unite unit (string)

Example ("audio.m" file on CD-ROM):

```
function audio(ID,nom,fe,unite)
figure;
nb=size(ID);
t=1:1:nb(1);
vect_t=t/fe;
plot(vect_t,real(ID));
xlabel('Time');
ylabel(unite);
title(nom);
```

Result



14.6.11.3. Type "GLOBAL"

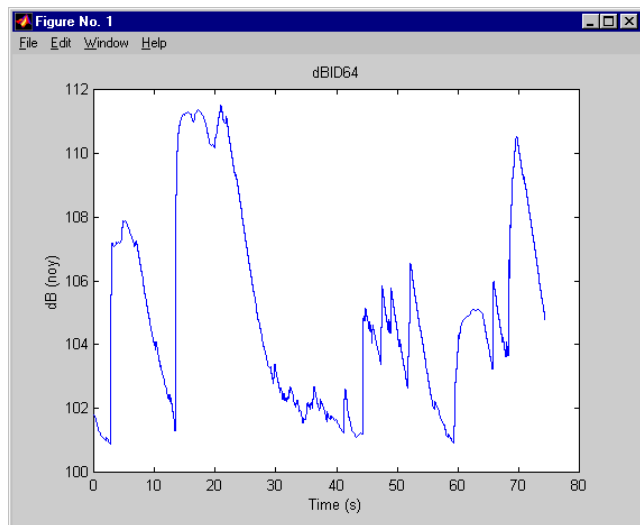
Syntax
 function xxx(ID, nom, periode,unite)
 ID identifier of the variable: dBID+n°ID dBFA32
 nom name of the variable : ID(comment) (string)
 periode period (time step)
 unite unit (string)

Note: ID is expressed in physical units and in energy

Example ("leq.m" file on CD-ROM):

```
function leq(ID,nom,periode,unite)
figure;
nb=size(ID);
t=1:1:(nb(1)+1);
ID(nb(1)+1)=ID(nb(1));
vect_t=(t-1)*periode;
stairs(vect_t,10*log10(ID/2e-5/2e-5));
xlabel('Time (s)');
yunit=sprintf('dB (%s)',unite);
ylabel(yunit);
title(nom);
```

Result



14.6.11.4. Type "BROAD BAND SPECTRUM"

Syntax

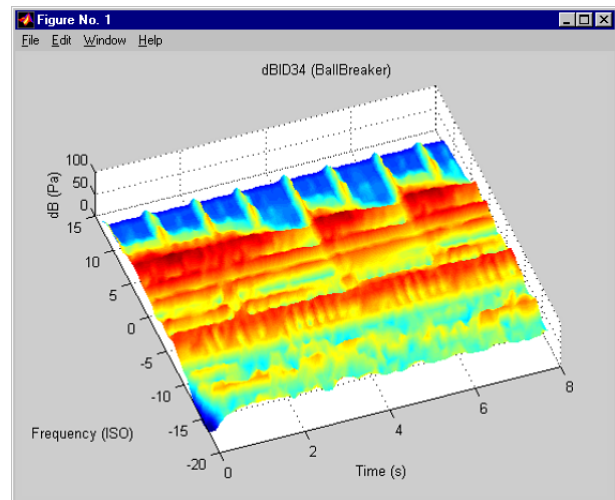
```
function xxx(ID, nom, fe, unite)
ID          identifier of the variable: dBID+n°ID dBFA32
nom         name of the variable : ID(comment) (string)
periode     period (time step)
imin       ISO index of the min band
partial     fractional octave (1,3,6,12,24,48)
unite      unit (string)
```

Note: ID is expressed in physical units and in energy

Example ("fc.m" file on CD-ROM):

```
function fc(ID,nom,periode,imin,partial,unite)
figure;
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
vect_t=(t-1)*periode;
vect_f=imin+(f-1);
surf(vect_t,vect_f,max(10*log10(ID/2e-5/2e-5),0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Frequency (ISO)');
aff=sprintf('dB (%s)',unite);
zlabel(aff);
view(0,90);
title(nom);
```

Result



14.6.11.5. Type "BARK BAND SPECTRUM"

Syntax

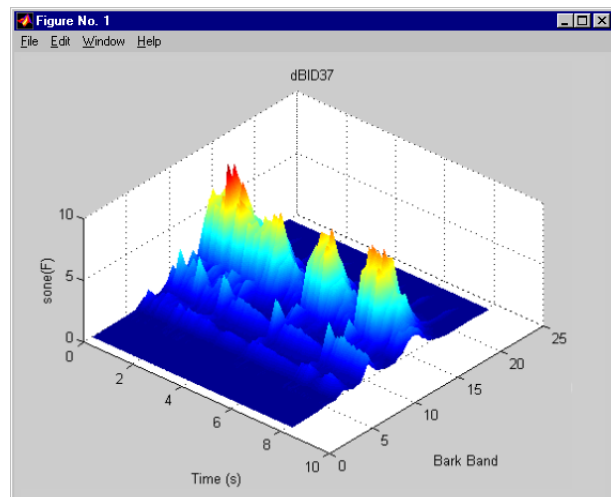
```
function xxx(ID, nom, fe, unite)
ID          identifier of the variable: dBID+n°ID dBFA32
nom         name of the variable : ID(comment) (string)
periode     period (time step)
imin       index of the min band (1 to 24)
unite      unit (string)
```

Note: ID is expressed in physical units and in energy

Example ("bark.m" file on CD-ROM):

```
function bark(ID,nom,periode,imin,unite)
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
f=(f-1)+imin;
vect_t=(t-1)*periode;
surf(vect_t,f,max(ID,0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Bark Band');
aff=sprintf('%s',unite);
zlabel(aff);
view(0,90);
title(nom);
```

Result



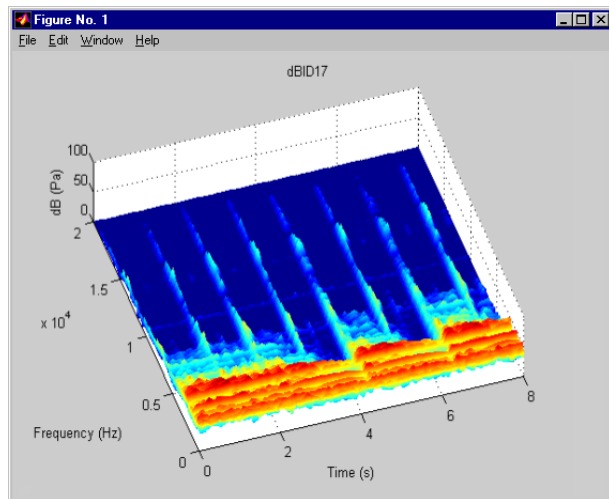
14.6.11.6. Type "NARROW BAND SPECTRUM"**Syntax**

```
function xxx(ID, nom, fe, unite)
ID          identifier of the variable: dBID+n°ID dBFA32
nom         name of the variable : ID(comment) (string)
periode    period (time step)
fmin       minimal spectrum frequency (Hz)
resolf     frequency resolution (Hz)
unite      unit (string)
```

Note: ID is expressed in physical units and in energy

Example ("fb.m" file on CD-ROM):

```
function fb(ID,nom,periode,fmin,resolf,unite)
figure;
nb=size(ID);
t=1:1:nb(2);
f=1:1:nb(1);
vect_t=(t-1)*periode;
vect_f=fmin+(f-1)*resolf;
surf(vect_t,vect_f,max(10*log10(ID/2e-5/2e-5),0));
shading interp;
rotate3d;
xlabel('Time (s)');
ylabel('Frequency (Hz)');
aff=sprintf('dB (%s)',unite);
zlabel(aff);
view(0,90);
title(nom);
```

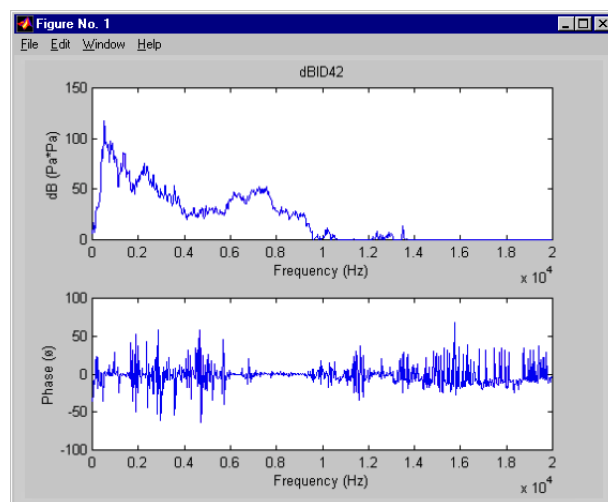
Result**14.6.11.7. Type "COMPLEX NARROW BAND SPECTRUM"****Syntax**

```
function xxx(ID, nom, fe, unite)
ID          identifier of the variable: dBID+n°ID dBFA32
nom         name of the variable : ID(comment) (string)
periode    period (time step)
fmin       minimal spectrum frequency (Hz)
resolf     frequency resolution (Hz)
unite      unit (string)
```

Note: ID is expressed in physical units and in amplitude (complex spectrum).

Example (with averaged spectrum: period=0) ("fbc.m" file on CD-ROM):

```
function fbc(ID,nom,periode,fmin,resolf,unite)
figure;
nb=size(ID);
f=1:1:nb(1);
vect_f=fmin+(f-1)*resolf;
subplot(2,1,1);
plot(vect_f,max(20*log10(abs(ID)/2e-5/2e-5),0));
xlabel('Frequency (Hz)');
aff=sprintf('dB (%s)',unite);
ylabel(aff);
title(nom);
subplot(2,1,2);
plot(vect_f,angle(ID)*180/3.1415);
xlabel('Frequency (Hz)');
ylabel('Phase (°)');
```

Result

14.6.11.8. Import Matlab results in dBFA32

The MATLAB communication operator is also used to import MATLAB data in dBFA32. Therefor it is enough to modify the audio file .m (called **reverse .m**) as follows:

```
function ret=reverse(ID,nom,fe,unite)
nb=size(ID);
global dBResult;
dBResult=ID(nb(1):-1:1);
ret=1;
```

Required modifications:

The function has now a return variable: ret.

The function defines in its code a global variable called dBResult (fixed name).

A test will be carried out on the return value of the function after the start of the MATLAB reverse function.

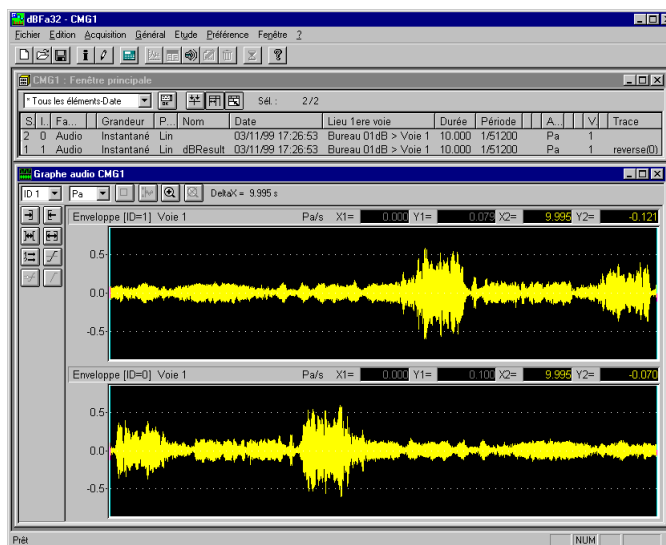
The MATLAB operator import automatically a variable called dBResult as an item in the measurement session.

CONSTRAINT:
dBResult has to have the same dimension as the ID input.

This one allows the user to dedicate treatments in MATLAB that are not proposed in dBFA32.

The Reverse function is used to get the mirror of a signal, for example.

The name of the new item is " dBResult " and it has the path of the operator.



14.6.11.9. Notes

Start MATLAB

The first script activates the application, if MATLAB is not already active. The following scripts will use the same proceedings.

You have to use the matlab.exe /Automation command in your Windows shortcut, if you want to start MATLAB before dBFA32 it starts.

Started in this way dBFA32 will use the MATLAB application already activated.

MATLAB recording as ActiveX server

Start the matlab.exe /RegServer command the first time.

Using batches

Thanks to the dBFA32 batches you can study systematically your signals with the MATLAB function .m. At the end of the batch you get you results in dBFA32 if needed.

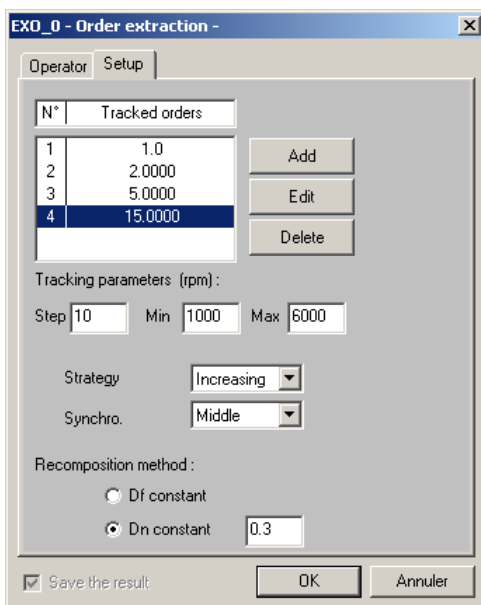
14.6.12. Tachometry

These operators are used to carry out various post-processing operations on signals coupled to speed profiles or to a dynamic acquisition channel of the tachometric signal:

- order extraction,
- order extraction with phase information,
- order filtering on a time signal,
- detection of cycle defects.

14.6.12.1. Order extraction operator [EXO_0]

This operator performs order extraction from a speed channel and a measurement channel (selection of the method: constant resolution in order or in frequency).



In the **Configuration** tab, the following analysis parameters may be defined:

- **Tracked orders:** Enter the orders to extract from the analysis. Orders may be non integers.
- **Tracking parameters:** Define the speed interval between two FFT spectra calculation. Enter the minimum and the maximum speed for the analysis.
- **Strategy:** Indicate whether it is a run up (Increasing) or a run down (Decreasing).
- **Block Synchro:** Indicate if the speed used to date the spectrum is that at the beginning, at the middle or at the end of the analysis time block.

- **Recomposition method:** Define which frequency band will be used for the energy calculation of orders.
Df constant: the frequency band used to calculate the order will be a band with a constant width of Df.
Dn constant: the frequency band used to calculate the order energy will be a frequency band proportional to the speed, increasing with the frequency ($Df = Dn \times \text{Speed}/60$, with Speed in rpm).

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

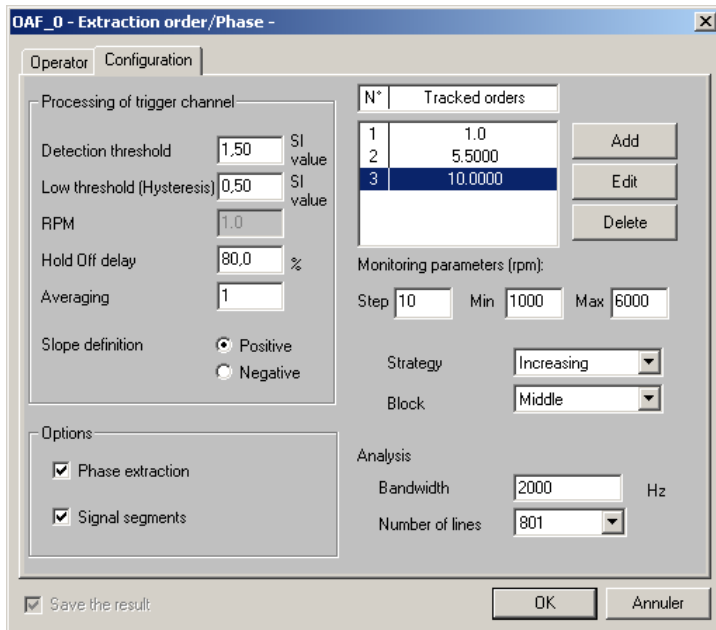
Default script	Signal analysis
Default name	EXO_0
Active for	Signal + Speed Profile families
Restrictions	Items must belong to the same measurement
Result family	Overall/RPM; Autospectrum

14.6.12.2. Order/Phase Extraction [OAF_0]

This operator performs an order extraction from a Signal item and a Tacho item (resulting from the recording of a tachometric transducer on a dynamic channel). This operation yields:

- A multispectrum versus speed containing phase information,
- An overall level per extracted order versus speed,
- An item containing information on the phase per extracted order.

In the **Configuration** tab, the following analysis parameters may be defined:



Management of the trigger input channel

- **Detection threshold:** Define the threshold value for impulse detection.
- **Lower threshold (Hysteresis):** Define the lower threshold that the signal must pass to reactivate the trigger for impulse detection (case of a poor-quality tachometric signal).
- **Number of impulse / revolution:** Indicate the number of impulse per revolution.
- **Hold Off delay:** Definition of a time period during which the trigger is deactivated, as a percent of the time between the two previous triggerings (case of a poor-quality tachometric signal).

- **Averaging:** Define the number of elements to average before speed calculation.
- **Slope definition:** Define the signal slope for impulse detection.

Tracked orders: Use this table to add, delete or modify orders to extract. Orders may be non integers.

Tracking parameters (rpm): Define the speed interval between two FFT spectra calculation. Enter the minimum and maximum speed for analysis.

- **Strategy:** Indicate whether it is a run up (**Increasing**) or a run down (**Decreasing**).
- **Block Synchro:** Indicate if the speed used to date the spectrum is that at the beginning, at the middle or at the end of the analysis time block.

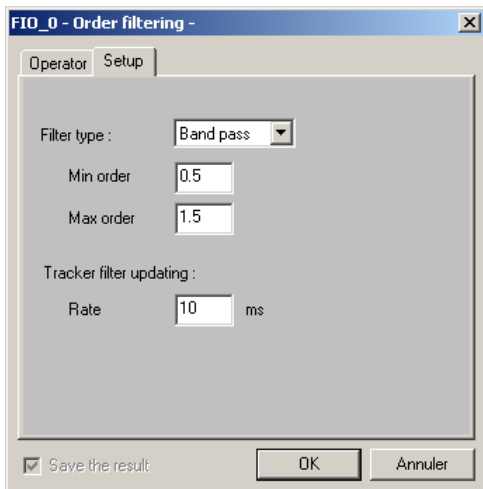
Analysis: Enter the bandwidth (in Hz), as well as the number of lines for the calculation.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Phase/order extraction
Default name	OAF_0
Active for	Signal family + Trigger family
Restrictions	Items should belong to the same measurement
Result family	Complex spectrum; Overall/RPM; Measurement/RPM; Signal

14.6.12.3. Order filtering operator

This operator uses an order tracking time filter from a speed channel. Filter characteristics (min/max order), as well as tracking timing, are user-defined.



In the **Configuration** tab, the following analysis parameters may be defined:

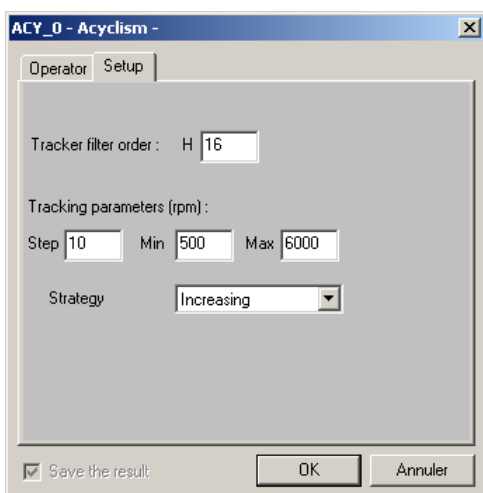
- **Filter type:** Define the type of filtering to perform (low pass, high pass, band cut, notch).
- **Min/max order:** Define the frequency ranges used by the filter.
- **Tracking filter update:** Define the time interval for tracking filters.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	FIO_0
Active for	Signal + Speed profile families
Restrictions	Items should belong to the same measurement
Result family	Signal

14.6.12.4. Cycle defect operator

This operator is used to characterise cycle defects with respect to a reference tachometric channel and to calculate statistical magnitudes on amplitudes versus speed.



In the **Configuration** tab, the following analysis parameters may be defined:

- **Tracking filter order:** Enter the order of the low-pass tracking filter.
- **Tracking parameters:** Enter the speed range to analyse, as well as the analysis step in rpm.
- **Strategy:** Indicate whether it is a run up (**Increasing**) or a run down (**Decreasing**).

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	FIO_0
Active for	Signal + Speed profile families
Restrictions	Items should belong to the same measurement
Result family	Signal

15. BATCH PROCESSING

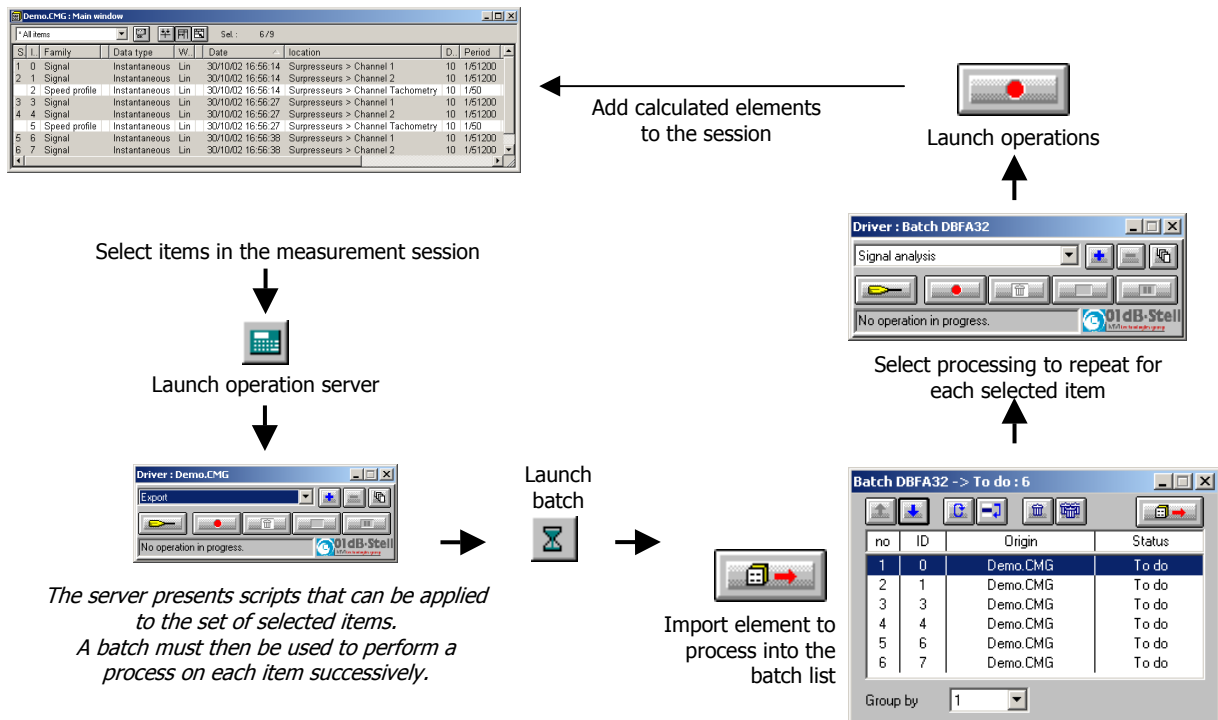
15.1. Overview

This chapter deals with the new capability of 01dB-Stell software packages to launch a batch processing for a set of data items.

For example, if the user wishes to apply the same analysis script for a set of signal items contained in a measurement session file, it is possible to define a set of input quantities and to apply the script automatically input by input.

15.2. Summary

The procedure for using batch scripts is summarised in the scheme below.



Complete procedure


- **Select items** to process in the measurement session.



- (or **Main Menu / Operation server**) to open the server and display the window below.



The server displays the scripts that can be applied to the set of selected items. No set-up is required here for the time being since we will perform a processing **on each item successively**. A batch processing will then be used.

-  (or **Session Menu / Batches**) to launch the batch processing window shown opposite.



- Import selected items to the measurement session.

- The following function are available:



Sort the items for analysis.



Reset the batch. The status of all signal items switches to "To process".



Deactivate processing for selected item (status becomes "inactive").



Delete selected item from the batch.



Delete all items from the batch.

no	ID	Origin	Status
1	0	Demo.CMG	Success
2	1	Demo.CMG	Success
3	3	Demo.CMG	Success
4	4	Demo.CMG	Failure
5	6	Demo.CMG	To do
6	7	Demo.CMG	To do

Group by: 1

"Group by" : Grouping items is useful when performing a batch analysis with a script calculating a cross spectrum (i.e., requiring 2 Signal items for input), a transfer function (group of 3 relevant items) or an averaging, etc.

If the number of items to process is not a multiple of the group size, the last items becomes inactive in the batch (it will not be processed).

- The script server lists **all available scripts** to process batch items.



The title bar should read: **Driver: dBFA32 batch**.
 Select the processing to perform on each group in the batch.

Refer to **Chapter 14.2** for more information on the operation server.



- Launch processing

- The operation window is as follows:



The progress of the processing on each item is displayed, along with its origin (target session) and its identification number in the session.

The number of items remaining to process is listed in the title bar.

The batch may be interrupted at any time by acting on script server.

Interrupting () and aborting () have the same consequence: the batch processing is definitively stopped.

- Calculated items are automatically added to the session.

Working on several sessions

A batch may contain items originating from several sessions, in which case a source session must be selected when importing item into the batch ("Source session" window). This selection is repeated for each importation using



At the end of the processing, a "Target session" window is displayed in order to select the session to which all items will be exported.

The batch being a way to automate a processing, selecting a target session will not disturb the current calculations. All calculated items in a batch will be exported to a single session.

16. REMOTE CONTROLS AND DBFA32

It is possible to use remote control objects with 01dB-Stell PC-based measurement systems to control the measurement process (start data logging, run measurements from the sound intensity probe handle, etc.) or to enable a specific event when a user-defined condition is fulfilled (wait for measurement, notify an overload, etc.).

The interface between a physical remote control and the measurement system is performed either by the RS232 serial interface of the computer or the digital inputs / outputs of the acquisition unit. In the measurement software module, at the hardware configuration stage, a remote control object can be defined.

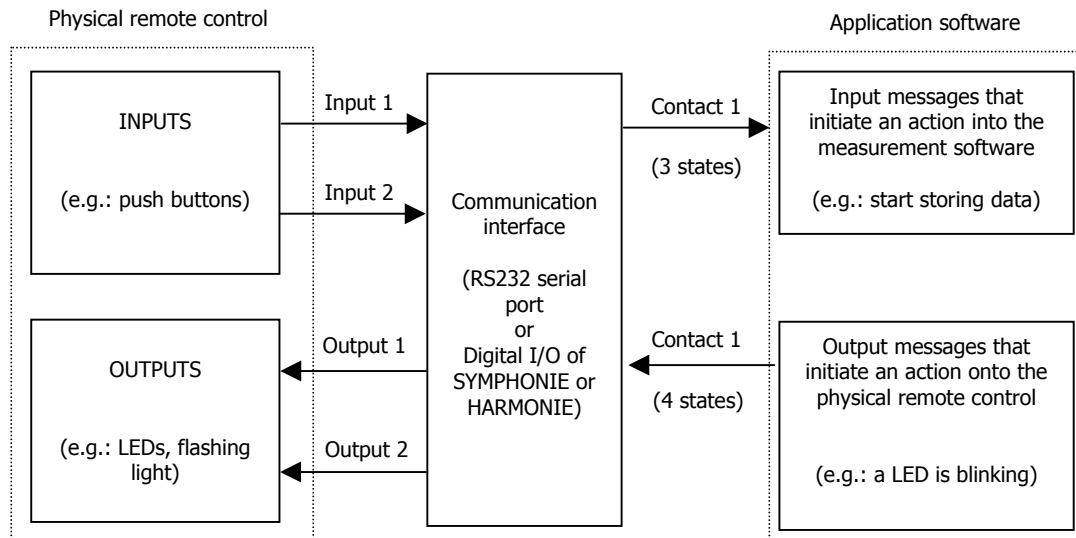
We describe in this chapter the generic remote controls of **dBFA32** (definition, configuration and operating mode).

Then, we present various applications for **dBFA32** remote controls:

- Remotely control the acquisition process for sound intensity and sound power (ISO9614) measurement with the keys of the probe handle.
- Remotely control the acquisition process with a generic device attached to the acquisition peripheral.
- Triggering signal recordings from a simple one button physical remote control.

The electrical drawings of the physical remote controls and the communication interfaces (RS232 port, **SYMPHONIE** or **HARMONIE** digital inputs / outputs) are also given.

16.1. Definition of a generic remote control object



A generic remote control object for 01dB-Stell programs is made of 2 physical inputs and 2 physical outputs. It features **16 input functions** and **16 output functions**, each one of them having a START and a STOP state.

It means that **32 input messages** can be received by an application software by mean of the remote control object (to remotely control the measurement for example) and **32 output messages** can be sent by the application software to a physical remote control (to trigger a light alarm for example).

Messages are assigned to each **contact** (corresponding to an input or an output of a physical remote control) in order to perform a specific operation.

The input contacts (generally connected to push buttons of a physical remote control) can present 3 different states : click, double click and long push of a button. An input message is assigned to each state.

The output contacts (generally connected to flashing lights or LEDs) can present 4 different states: active, inactive, blinking and flash. A contact state is assigned to an output message.

In fact, each contact corresponds to a specific pin of the communication interface (RS232 connector of a microcomputer, MiniDyn connector of the **SYMPHONIE** or **HARMONIE** acquisition unit).

When an input contact is activated, a voltage is generated on this pin. This voltage is then interpreted by the remote control object and the application software execute the appropriate input message.

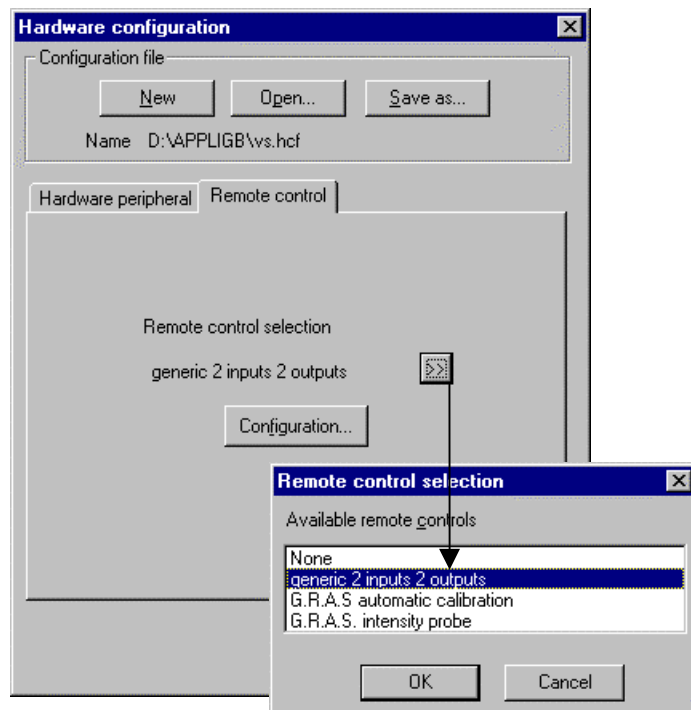
When an output message is sent by the application software to the remote control object, the output contact is activated and, depending on its state, a voltage is generated on the pin of the communication interface. This voltage signal is then interpreted by the physical remote control.

Remote control objects are defined in the file DBCD32.INI. If you do not have this file in the 01dB-Stell program folder, contact 01dB-Stell technical support to obtain a copy of it. A complete description of this file is given in this manual.

Follow the procedure below to define a generic remote control object :

1. Selection of the remote control
2. Configuration of the remote control
3. Assignment of the input functions
4. Assignment of the output functions
5. Configuration of event triggering parameters in the application software (if required)
6. Use of the remote control

16.1.1. Selection of a generic remote control



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Stell programs directory). The dialog box shown aside is displayed on screen.

Click on the >> key, and select the remote control type **generic 2 inputs 2 outputs** and click on OK.

The specific remote control **G.R.A.S automatic calibration** and **G.R.A.S intensity probe** are predefined object to respectively activate the electrostatic actuator of the GRAS outdoor microphone units (41AM and 41CM) automatically from the application software **dBTRIG32** and to drive sound intensity and sound power measurements from the 50AI intensity probe handle in **dBFA32**.

After the selection of the remote control, configure its parameters.

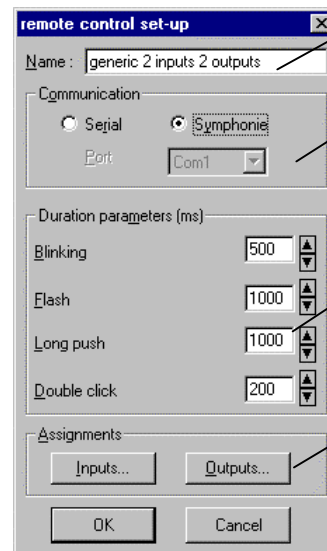
16.1.2. Configuration of a generic remote control

After the selection of the remote control, click on the **Configuration** key to configure the remote control object parameters. The following dialog box appears on-screen:

Define in this dialog box the **name** of the remote control and the **communication** interface to use (either a **Serial** port or the **SYMPHONIE** or **HARMONIE** digital inputs / outputs).

The **duration parameters** refer to the states of the input and output contacts of the remote control.

In the example shown aside, and for input contacts, the state **Long push** corresponds to a continuous essential push of 1000 ms minimum; the state **Double click** corresponds to two successive key push of time interval less than 200 ms.



Remote control name

Select the communication interface (RS232 or SYMPHONIE/HARMONIE digital inputs / outputs)

Define the duration parameters for the input and outputs contacts

Define the message associated to the input and output contacts

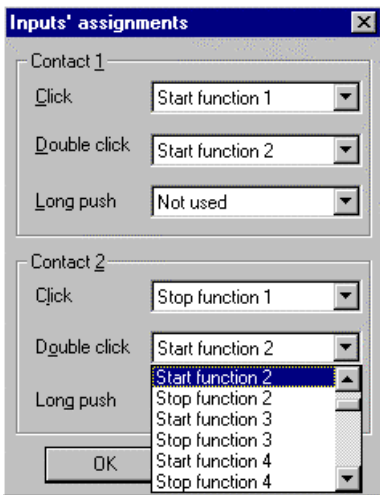
For output contacts, the state **Blinking** generates a voltage on a pin of the connector of the communication interface every 500 ms and the state **Flash** generates a voltage on this pin for 1000 ms only one time.

The configuration of the input and output functions can be accessed by the keys **Inputs** and **Outputs**.

16.1.3. Assignment of input functions

After configuration of the general parameters of the remote control, define which input function will be assigned to each input contact. Access the dialog box shown below by the **Inputs** key.

Select for each state of an input contact a function in the list of input functions. The input contacts present three different states:



- **Click: Simple push of a key.** The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) while the key is pushed.

- **Double click: Two successive pushes of a key.** The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) twice over a user-defined time interval.

- **Long push: Continuous push of a key.** The voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) twice over a user-defined period.

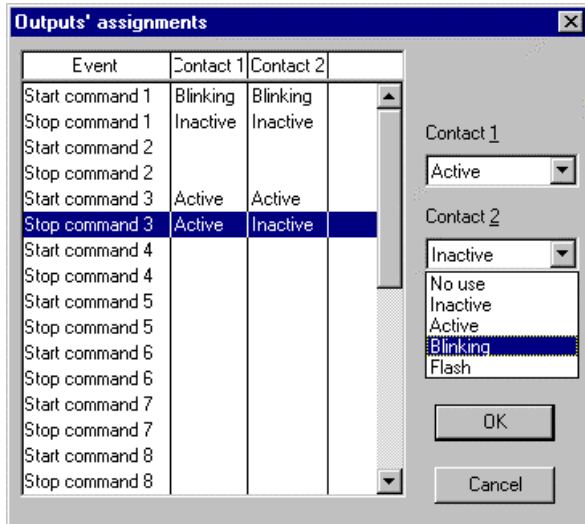
When one of these states occurs, an input message will be interpreted by the application software. The table below shows a list of the actions that will be interpreted by **dBFA32** for each input function:

FUNCTION , STATE	ACTION
MEASUREMENT - STORAGE	
Start function 1	Start or accept a measurement (data logging)
Stop function 1	Stop or reject a measurement (data logging)

16.1.4. Assignment of output functions

After configuration of the general parameters of the remote control and the input contact assignments, define the assignment of the output contacts that the application software will send to the physical remote control when a user-defined condition has been fulfilled (for example, activation of a LED when a measurement result has to be validated). Access this dialog box by the **Outputs** key.

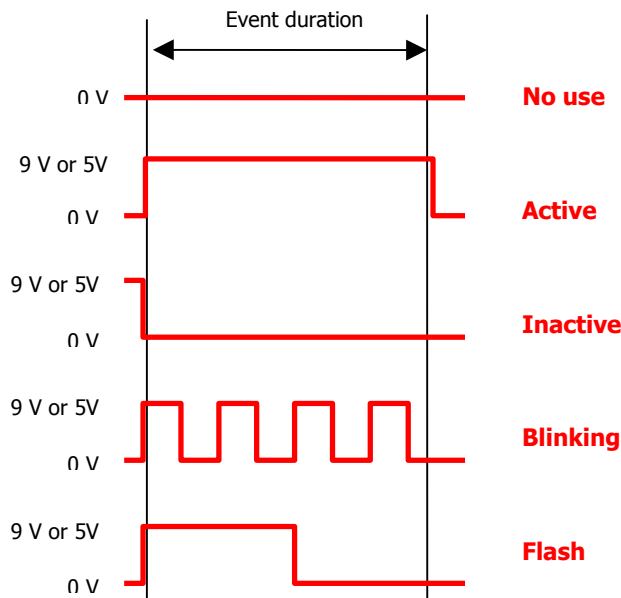
For adequate output functions (or events), define the state of each output contact. Output contacts present four different states:



- **No use.**
- **Active.** While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from the current state to 9V (RS232) or 5V (SYMPHONIE/HARMONIE).
- **Inactive.** While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from the current state to 0V.
- **Blinking.** While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) at a user-defined rate.

- **Flash.** While an event is activated, the voltage on the appropriate pin of the connector of the communication interface passes from 0V to 9V (RS232) or 5V (SYMPHONIE/HARMONIE) for a user-defined period.

The drawing below illustrates the different states of the output contacts:



For **dBFA32**, the table below gives the list of actions for each output contact:

FUNCTION , STATE	ACTION
MEASUREMENT - STORAGE	
Start command 1	Notify the remote control that the application software waits to start an acquisition
Stop command 1	Notify the remote control that an acquisition is in progress
Start command 2	Notify the remote control that the application software waits to accept / reject the measurement result
Stop command 3	Notify the remote control that an overload occurred during acquisition
CALIBRATION	
Start command 5	Notify the remote control that calibration is in progress
Stop command 5	Notify the remote control that calibration is finished

No specific software configuration is required in **dBFA32**.

16.1.5. Operating process

Once a remote control object has been completely configured and (if required) once triggering parameters have been defined in the application software, the operator may use the remote control. The operating process is very simple.

Simply connect the physical remote control to the communication interface that was selected. When the triggering conditions are fulfilled, or when the user clicks on a button, the physical remote control or the software executes the actions defined.



Consult the examples for more information on the use of the remote controls.

If you wish to develop a physical remote control for specific needs, do not hesitate to contact your 01dB-Stell representative to discuss your application.



Consult the connection diagrams of the communication interface as well.

16.2. Description of dBCD32.INI

The dBCD32.INI file contains information relative to the definition of remote control objects used in 01dB-Stell measurement software programs. The syntax in the file is as follow:

[Com Device]
Count=4

It is the **number of remote control objects** defined in the file. They are numbered in this example from 0 to 3 - therefore a total of 4 objects. This number is incremented each type a new remote control object is defined.

[CDEV 0]
Type=1

This is the **type of remote control**. Type = 1 define a generic 2 inputs 2 outputs remote control.

Name= generic 2 inputs 2 outputs
Comm=-1
Clign=500
Flash=1000
Appui=1000
DbIClk=200

These parameters are defined in the **configuration of the remote control** (name, communication port, and duration parameters). See paragraph 16.1.2

Fct Clk0=0
Fct DbIClk0=0
Fct Appui0=0
Fct Clk1=0
Fct DbIClk1=0
Fct Appui1=0

These parameters are defined in the **configuration of the input contacts, associated to an input message** (See paragraph 16.1.3). The number corresponds to one of the 32 input messages. It varies between 0 (not used) and 32 (stop function 16).

Out1_9=2
Out2_9=2
Out1_10=1
Out2_10=1
Out1_15=2
Out2_15=1
Out1_16=1
Out2_16=1
Out1_17=2
Out2_17=1
Out1_18=1
Out2_18=1

These parameters are defined in the **configuration of the output contacts** (See paragraph 16.1.4). A state of an output contact is associated with this output messages. The number corresponds to one of the 32 output messages. It varies between 0 (not used) and 32 (stop command 16).

[CDEV 1]
Type=7
Name= G.R.A.S automatic calibration
Comm=-1

This specific remote control is used to activate an electrostatic actuator of GRAS outdoors-permanent microphone units 41AM/CM in **dBTRIG32**.

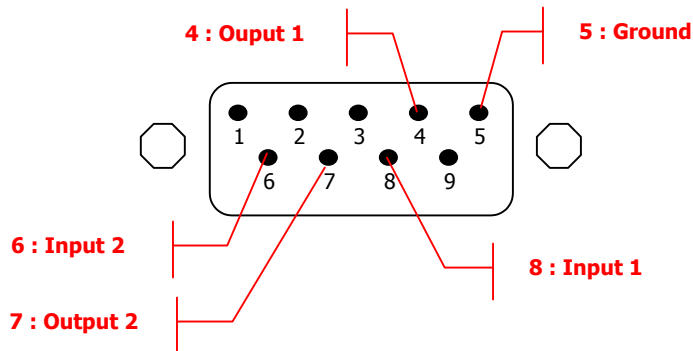
[CDEV 2]
Type=2
Name= G.R.A.S. sound intensity probe
Comm=-1
Clign=500
Flash=200
Appui=1000

This specific remote control is used to control measurements of sound intensity and sound power in **dBFA32** from the handle of a GRAS sound intensity probe 50AI.

16.3. Communication interface

Find in this paragraph the electrical drawings that indicate which pins correspond to input and output contacts of a generic remote control.

16.3.1. For a RS232 9-pin serial port (male connector on the PC)

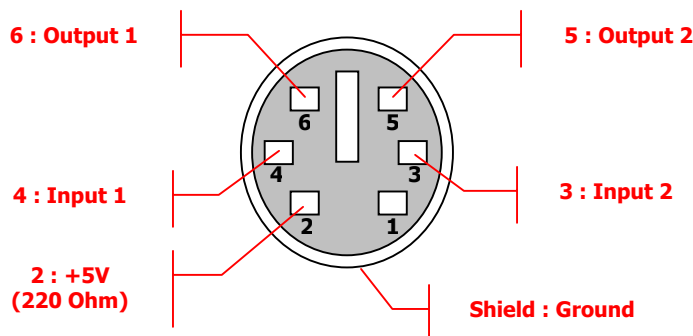


Input contact n°1	Pin 8
Input contact n° 2	Pin 6
Output contact n°1	Pin 4
Output contact n°2	Pin 7
Ground	Pin 5

The generated output signal from a RS232 serial port varies from -9V or -12V (lower state) to +9V or +12V (higher state) for a current of 5mA.

In most cases, an input remote control requires a 9V-power supply for the push key. This voltage is not supplied by the RS232 interface. A solution is to generate an output signal on the RS232 interface (output contact always activated) and to power supply the push key with it, or to use a capacitance network or a battery.

16.3.2. For SYMPHONIE digital inputs / outputs (female MiniDyn connector)



Input contact n°1	Pin 4
Input contact n° 2	Pin 3
Output contact n°1	Pin 6
Output contact n°2	Pin 5
Ground e	Body
Signal (+5V / 20mA)	Pin 2

The generated output signal from the MiniDyn connector varies from 0V (lower state) to +5V (higher state) for a current 20 mA.

Pin 2 of the MiniDyn connector always supply +5V / 20 mA in order to power supply various elements of the physical remote controls connected to it.

16.4. Remote control examples

In this paragraph, we give several examples to define, configure and use a remote control object in the application software **dBFA32**. All the electrical drawings of the physical remote controls evoked are also given.

- Specific remote control for sound intensity and sound power (according to ISO9614) measurement, with a GRAS 50AI sound intensity probe
- 1 button, 2 LEDs remote control to manually start signal acquisition
- 2 buttons, 2 LEDs remote control for real-time acquisition

16.4.1. Specific remote control of measurement process with a 50AI sound intensity probe



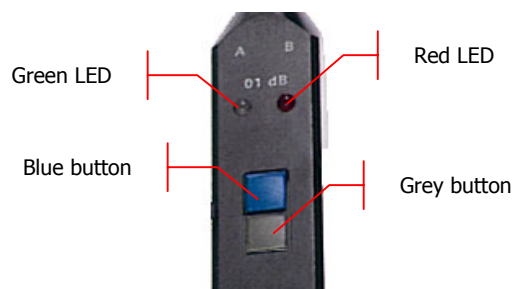
If you are using a sound intensity probe type **GRAS 50AI** with a remote control, the measurement process is simplified because the operator does not need to use the keyboard or the mouse to start, stop, validate a measurement.

The remote control is very useful if the source under test is located at a certain height or in a location difficult to access.

The photograph shown aside features the sound intensity probe **50AI** with the connection box for the Symphonie acquisition platform.

The handle of the sound intensity probe features two remote control buttons that can be used to pilot the acquisition process and two LEDs to inform the user on the measurement progress:

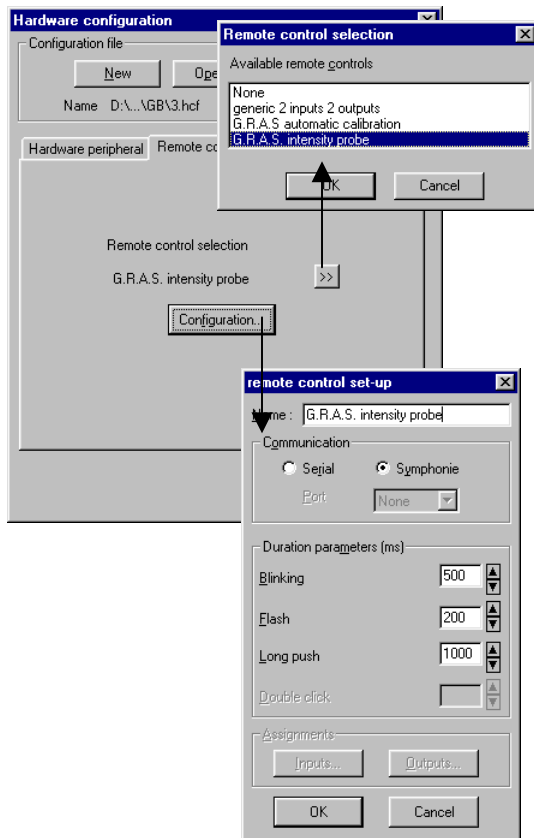
- The upper button (blue) is a 'positive' button: it is used to start and validate a measurement result.
- The lower button (grey) is a 'negative' button: it is used to prematurely stop an acquisition or to repeat the current measurement.
- The left LED (green) and the right LED (red) are used to indicate the different states of the sound intensimeter (waiting for measurement start, acquisition ended, overload)



To configure this remote control, perform the following operations:

- Choice and configuration of the remote control object
- Assignments of input and output contacts
- Connection and operating process

16.4.1.1. Choice and configuration of the remote control object



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Stell programs directory).

Click on the >> key, and select the remote control **G.R.A.S. sound intensity probe** and click on **OK**.

After the selection of the remote control, click on the **Configuration** key and select the communication port **Symphonie**. The physical remote control (built-in the probe handle) will be connected to the digital inputs / outputs of the acquisition unit with the interface box.

Define the duration parameters **Blinking** and **Flash**, corresponding to the two output states, and **Long push**, corresponding to one of the two input contacts according to your specific needs.

The functions' assignments of the inputs and the outputs of this remote control cannot be modified. Refer to the example described in **paragraph 16.4.2** for a detailed description of these functions to remotely control the measurement process during real-time acquisition in **dBFA32**.

16.4.1.2. Connection and operating process

Once the remote control is configured, switch on the measurement system and connect the probe to the acquisition unit with the interface box (channel 1, channel 2 and digital inputs / outputs). Start a real-time acquisition in the intensity mode or ISO9614 mode.

Then proceed as follows:

- ❶ Place the sound intensity probe at the first measurement location. When the **Green LED blinks**, it means that the system is waiting to start an acquisition.
- ❷ Press the **Blue button**. The acquisition starts. At the end of the acquisition, the **two LEDs blink**. It means that the system waits for a decision:
 - **Validation** of the measurement by the **blue button**
 - **Repetition** of the measurement by the **grey button**
- ❸ Whatever the choice, the system waits for another measurement start action: for the same measurement point if the last acquisition has been eliminated, for the next measurement point if it has been validated.

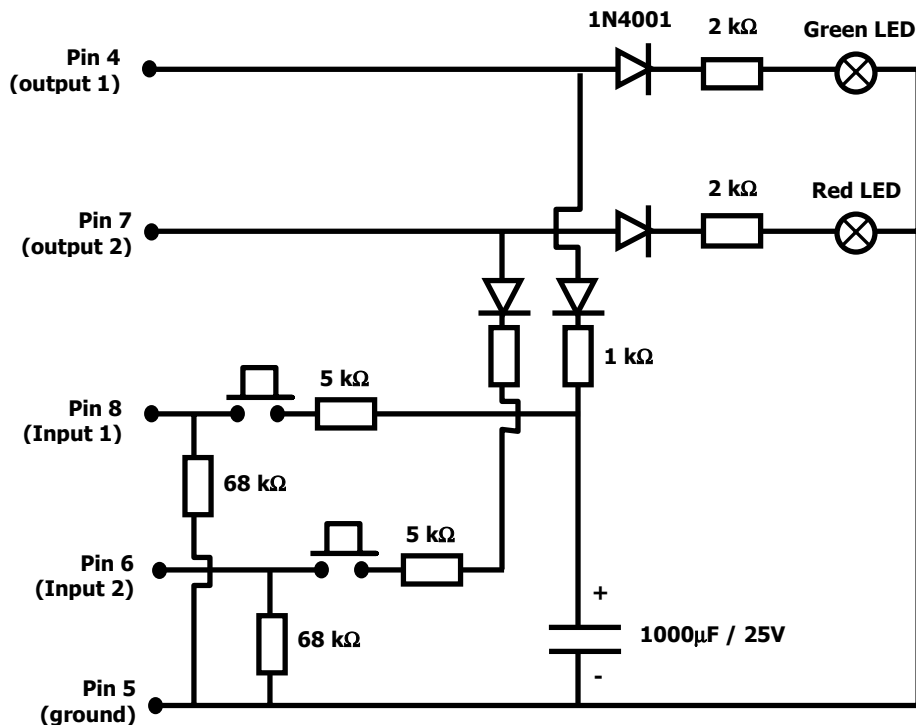
The **Red LED** indicates a possible overload during acquisition.

- ❹ Perform the measurement again for each point.

16.4.2. 2-button, 2-LED remote control for real-time acquisition

Let us consider a real-time narrow frequency analysis of machinery noise on a factory floor. The user wishes to remotely control the measurement process at a distance : the measurement system stands 5 meter away from the machine and the operator stands next to the machine controls to modify its operating process (e.g.: increasing rpm speed).

To address this application, we can use a 2-button, 2-LED remote control connected to the RS232 serial port of the computer. The electrical diagram of such a remote control is as follows:



The green LED blinks when the system is ready to carry out an acquisition. The user clicks once on the first push key (input 1) to start measuring, and the green LED is then switched on continuously.

Click on the second push key (input 2) to stop the acquisition before the end of the averaging time.

Once the measurement is finished, the green and red LEDs are blinking. The user can click on the first push key to accept the result or on the second push key to reject the result.

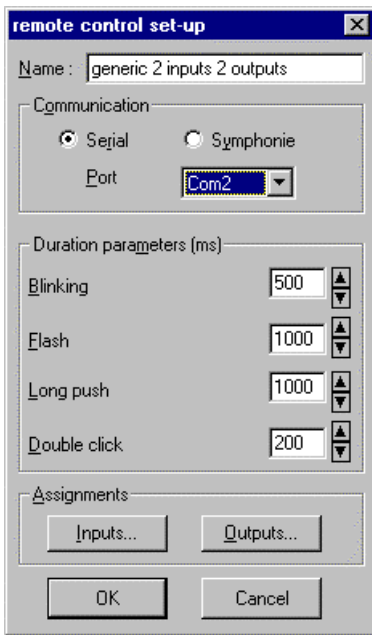
Whatever the choice, the system waits for another measurement start action: for the same measurement point if the last acquisition has been eliminated, for the next measurement point if it has been validated.

The **Red LED** indicates an overload during acquisition if it is lit continuously.

To configure this remote control, perform the following operations:

- Choice and configuration of the remote control object
- Assignments of input and output contacts
- Connection and operating process

16.4.2.1. Choice and configuration of the remote control object



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Stell programs directory).

Click on the >> key, and select the remote control type **generic 2 inputs 2 outputs** and click on **OK**. Click on the **Configuration** key to configure the remote control object parameters. The dialog box shown aside appears on-screen.

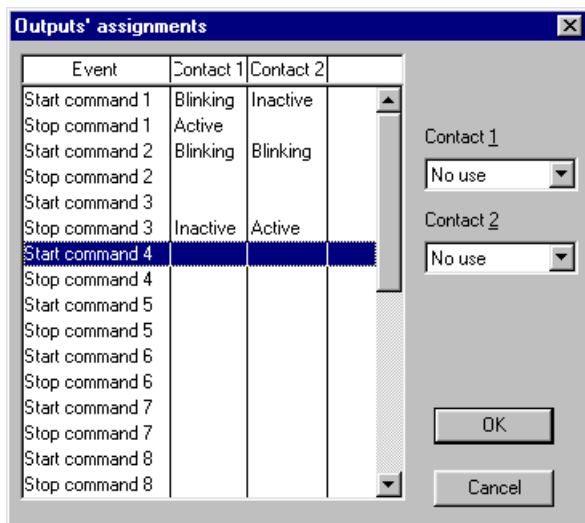
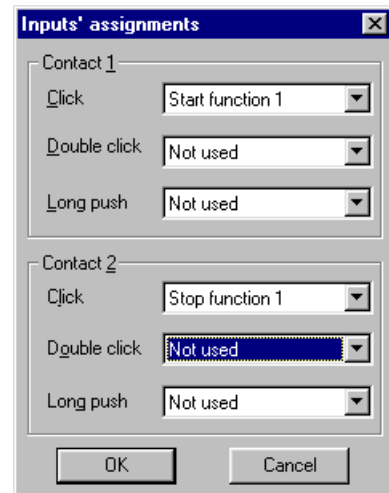
Select the communication interface to use (a **serial** one) and the communication **port**. In this example, the physical remote control will be connected on the COM2 serial port of the computer.

Define the duration parameters **Blinking** and **Flash**, corresponding to the two output states, and **Long push** and **double click**, corresponding to two input contacts.

16.4.2.2. Assignments of input and output contacts

Click now on the **Inputs** key of the remote control set-up dialog box.

In our example, we start an acquisition (**Start function 1**) for a simple click of the first key of the remote control (contact 1) and we stop the acquisition (**Stop function 1**) for a simple click of the second key of the remote control (contact 2).



Click now on the **Outputs** key of the remote control set-up dialog box.

The green LED (on contact 1) blinks (**blinking**) when the application software waits to start an acquisition (**Start command 1**). The green LED is switched on continuously (**active**) while an acquisition is in progress (**Stop command 1**).

The red LED (on contact 2) and the green LED blink (**blinking**) when the application software awaits a decision to validate or repeat the measurement.

The red LED stays continuously lit (**active**) when an overload occurred (**Stop command 3**).

16.4.2.3. Connection and operating process

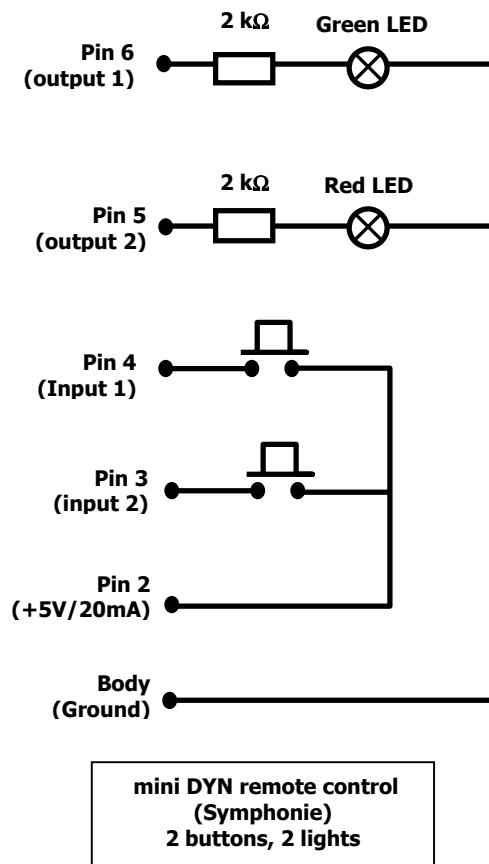
Once the remote control is configured, switch on the measurement system (connect the transducers, hardware configuration, calibration , etc.), connect the remote control to the COM2 RS232 interface and start a real-time acquisition mode (real-time mode, real-time octave mode, intensity mode). Proceed as follows:

- ❶ Place the transducer at the first measurement location. When the **Green LED blinks**, it means that the system waits to start an acquisition.
- ❷ Press once the **first button**. The acquisition starts. At the end of the acquisition, the **two LEDs blink**. It means that the system waits for a decision:
 - **Validation** of the measurement by the **first button**
 - **Repetition** of the measurement by the **second button**
- ❸ Whatever the choice, the system waits for another measurement start action: for the same measurement point if the last acquisition has been eliminated, for the next measurement point if it has been validated.

The **Red LED** indicates a possible overload during acquisition.

- ❹ Perform the measurement again as required.

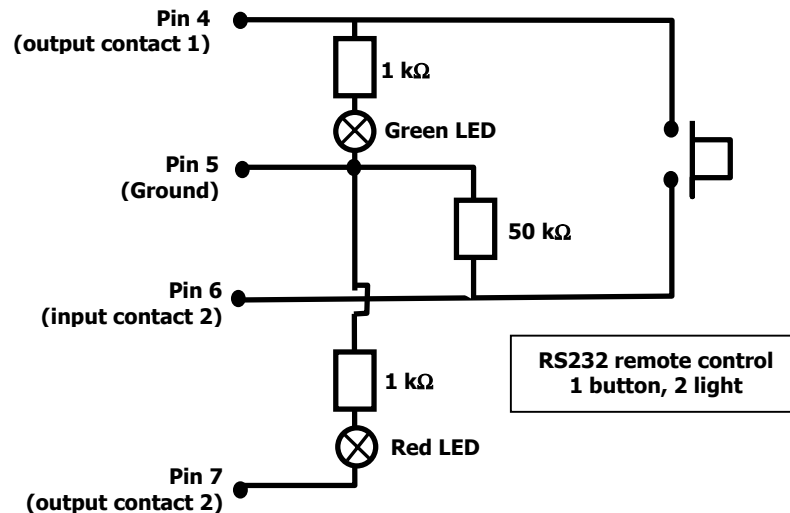
 Note that if we used a SYMPHONIE remote control instead, the electrical drawing of a Symphonie remote control is much simpler:



16.4.3. 1-button, 2-LED remote control to manually start signal recordings

The aim of this application is to start a signal recording by a simple key push of a physical remote control connected to a serial port of the computer.


The electrical drawing of this remote control (one button, two lights) uses a RS232 interface:



When the user clicks once on the push key, a signal recording is started. When he (or she) double clicks on the push keys, the audio record is stopped.

The green LED will be lit when a measurement is in progress. It will blink when the recording is ended.

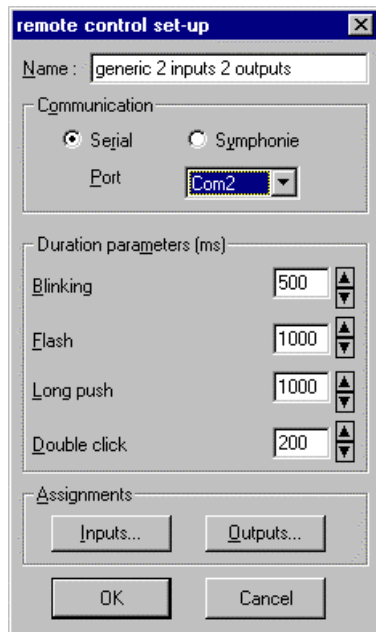
The red LED will lit continuously when an overload occurred.

 *This remote control requires a 9V-power supply for the push key. This voltage is not supplied by the RS232 interface. A solution is to generate an output signal on the RS232 interface (output contact always activated)*

To configure this remote control, perform the following operations:

- Choice and configuration of the remote control object
- Assignments of input and output contacts
- Connection and operating process

16.4.3.1. Choice and configuration of the remote control object



At the hardware configuration stage, select the **remote control** tab (shown only if the DBCD32.INI file is present in the 01dB-Stell programs directory).

Click on the >> key, and select the remote control type **generic 2 inputs 2 outputs** and click on **OK**. Click on the **Configuration** key to configure the remote control object parameters. The dialog box shown aside appears on-screen.

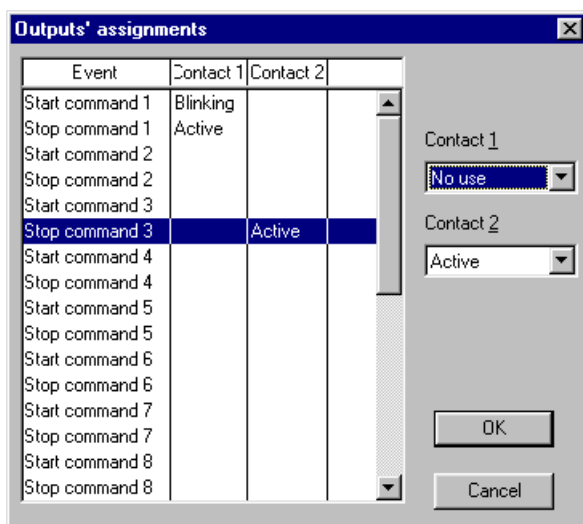
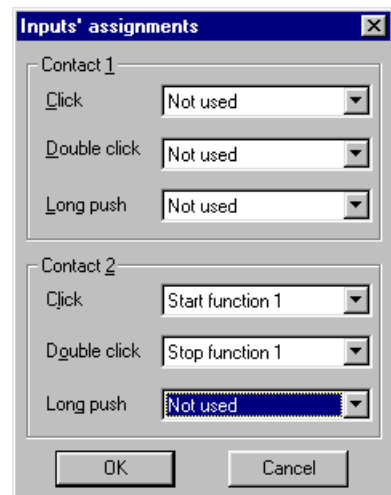
Select the communication interface to use (a **serial** one) and the communication **port**. In this example, the physical remote control will be connected on the COM2 serial port of the computer.

Define the duration parameters **Blinking** and **Flash**, corresponding to the two output states, and **Long push** and **double click**, corresponding to two input contacts.

16.4.3.2. Assignments of input and output contacts

Click now on the **Inputs** key of the remote control set-up dialog box.

In our example, we have to start an audio record (**Start function 1**) when clicking on the push key of the remote control and to stop audio recording (**Stop function 1**) when double clicking on the push key.



Click now on the **Outputs** key of the remote control set-up dialog box.

The green LED (on contact 1) blinks (**blinking**) while data logging has not started (**Start command 1**). It will stay lit all the time (**active**) during the measurement (**stop command 1**).

The red LED (on contact 2) stays continuously lit (**active**) when an overload occurred (**Stop command 3**). The overload indication is given only at the end of signal acquisition.


16.4.3.3. Connection and operating process

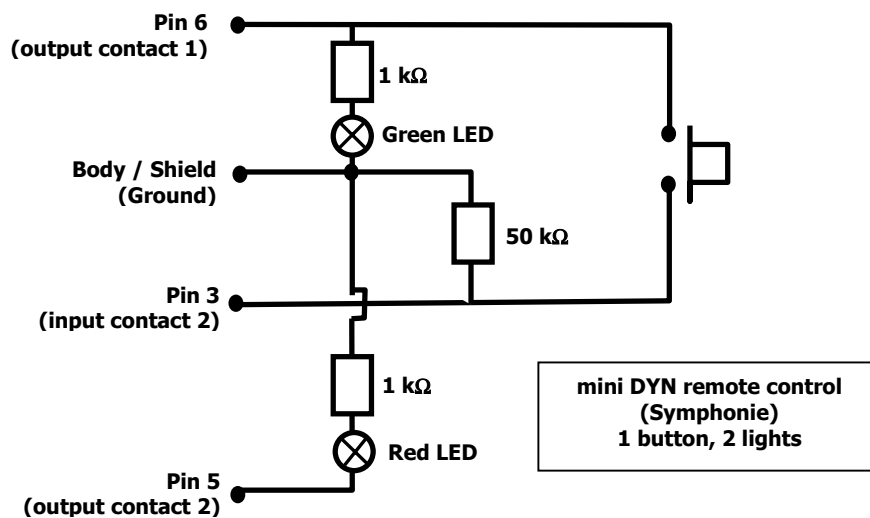
Once the remote control is configured, switch on the measurement system (connect the microphone, set-up the measurement, etc.) and connect the remote control to the COM2 RS232 interface.

The green LED will blink. Start signal acquisition using the keyboard. The green LED will be continuously switched on.

Click once on the push key to start a signal recording. The green LED will be continuously switched on. Double click on the push key to stop audio recording. The green LED will be blink and the measurement is stopped.

Once a measurement is carried out thoroughly, the signal recording is stored into a measurement session. If an overload occurred, the red LED will be continuously switched on.

 Note that if we used a SYMPHONIE remote control instead, the electrical drawing of a Symphonie remote control is much simpler:



17. TROUBLESHOOTING

Below are a few common problems and solutions encountered with **dBFA32**. For other problems, please consult the troubleshooting section of the getting started manual that was delivered with your system before calling technical support.

🔦 **Nothing happens when launching a measurement session in dBFA32.**

- Check that the hardware platform has been correctly installed and configured on the computer and in the **dBCONFIG32** software utility.
- Check in the hardware configuration dialogue box that a transducer / calibrator couple has been declared and enabled.

🔦 **The measured levels are identical whatever the noise level.**

- Check that the transducer and extension cable are correctly connected to the acquisition platform and that the transducer is plugged to the active measurement channel.
- Check that, for SYMPHONIE and the JAZZ acquisition card, the correct signal conditioning options (Click on **configure** in the hardware configuration dialogue box) are activated if using a 200V polarised microphone.

🔦 **The measured level seems incorrect**

Before anything else, perform calibration as explained in chapter 4. If the problem is not solved, proceed as follow.

Check your microphone. Microphones are fragile equipment that can be damaged by a (small) fall or water. First, check its sensitivity. You may also check the appearance of its membrane. To do so, unscrew the protection grid. If the surface is uneven or scratched, the microphone is damaged.

Check the calibrator. Over the years, the signal amplitude of the calibrator may vary. It will therefore induce a systematic error in all measurements. Send the calibrator back every two years to the manufacturer to test it.

Check the extension cable. Directly plug the microphone to the acquisition unit (if possible) and compare the measured values. If a large difference is observed, the cable may present a problem. Send it back to the manufacturer.

Check the hardware signal conditioning options (SYMPHONIE and JAZZ). Please, refer to the getting started manual that was delivered with your system for details.

Check transducers' and calibrators' definitions in dBCONFIG32. A simple test is to define a new transducer and calibrator in dBCONFIG32 using the factory characteristics. Then perform a calibration of the system. Compare the sensitivities of the old and new transducers in dBCONFIG32. If they are greatly different, it may come from the definitions in dBCONFIG32. In this case, remove the old transducer and calibrators from the databases. **Do not forget that a great difference of sensitivity could also mean that the microphone is damaged.**

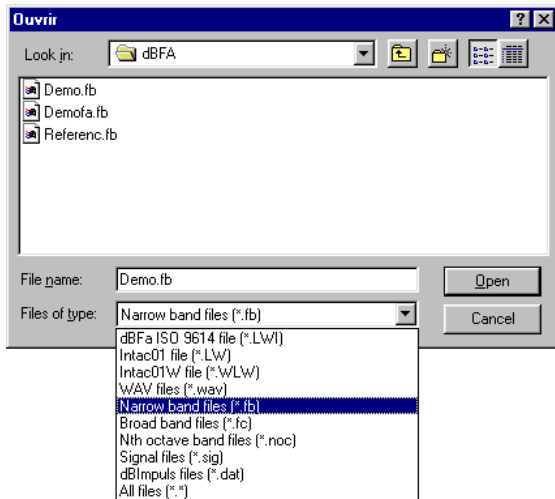
🔦 **No values are displayed.**

- Check that the colours of the curves are not the same as the colour of the background.
- Check that the analyser has been switched on.

18. DATAFILE MANAGEMENT IN DBFA32

18.1. Import datafiles from 16-bit software

For users that evolved from a 01dB-Stell measurement system in a DOS version or Windows 16bit version to the 32bit software versions, it is possible to import data files to the new format. Use the command **File / Import** from the adequate software package.



In **dBFA32**, the dialog box shown aside appears on screen.

Select the adequate folder on the computer hard disk where the files to import are located then click on the **Open** key.

The data is converted to the new datafile format. A new measurement session is created to store the data, or the data is stored into a measurement session already opened.

The table shown below gives a list of old datafiles that can be imported in **dBFA32**:

File / Function	Origin
Files *.SIG Signal recordings (audios)	dBARIA
Files *.DAT Impulse responses	dBIMPULS
Files *.WAV Signal recordings (audios) in Windows format	dBFA, dBTRIG, dBBATI
Files *.FB Narrow band spectra catalogue	dBFA
Files *.FC Broad band spectra catalogue	dBFA, dBBATI
Files *.NOC Broad band spectra catalogue (1/Nth octaves)	dBFA, dBAUDIO
Files *.LWI Sound power measurements according to ISO9614	DBFA
Files *.LW and *.WLW Sound power measurements according to ISO9614	INTAC
Files *.LOG Files in SONY © PC Scan II format	PC Scan II software
Files *.MP3 Files in MPEG Layer III format	Any program handling MP3 format
Files *.HDR Files in TEAC format	TEAC
Files*.DAC Files in nSoft format	Nsoft
Files *.UFF Files in Universal File format	Any program handling UFF format

18.2. Exporting signal records in WAV format

Use the command **File / Export** to export signal data stored in a measurement session to a WAV datafile in 01dB-Stell format (Microsoft WAV file format with additional header information about the acquisition). Select the signal item in the measurement session list and give a name to the WAV datafile that will be created.

Refer to **chapter 14**, and more particularly to **paragraph 14.6.8.2** for more information about an operator that can export a set of signal items in the WAV format.

18.3. Frequency weightings

First, here is the list of all the frequency weightings available to calculate overall levels:

- **A weighting:** Sensitivity of the human ear at low levels
- **Lin weighting:** No weighting (linear)
- **B weighting:** Sensitivity of the human ear at medium levels
- **C weighting:** Sensitivity of the human ear at high levels
- **G weighting:** Infrasound weighting
- **Pink Lin weighting:** Global Lin with respect to pink noise
- **Road Lin weighting:** Global Lin with respect to road traffic noise
- **Pink A weighting:** Global A with respect to pink noise
- **road A weighting:** Global A with respect to road traffic noise
- **PL weighting:** Correspond to a Loudness acquisition channel displayed in dB equivalent
- **PN weighting:** Correspond to a Perceived noise level (PNL) acquisition channel displayed in dB equivalent
- **TPN weighting:** Correspond to a Perceived noise level Tone corrected (PNLT) acquisition channel displayed in dB equivalent

The following vibration frequency weightings can be selected:

ISO2631 part 1

- **Principal weightings W_d** (horizontal vibrations) **and W_k** (vertical vibrations) to evaluate the adverse effects of vibrations on human beings relative to health, comfort and perception issues.
- **Additional weighting W_c** (seat back vibration measurement), **W_e** (rotation vibration measurement) and **W_j** (vibration measurement under head of recumbent person) related to comfort issues, in specific cases.
- **Principal weighting W_f** to evaluate the adverse effects of vibrations on human beings relative to motion sickness
- **Principal weighting W_b** to evaluate the adverse effects of vibrations on human beings relative to comfort issues in given environments (vehicles on rails, for example)

ISO8041 (and ISO2631 part 2)

- **Principal weighting W_{Bc}** (all directions combined) to evaluate the adverse effects of continuous and shock-induced (1Hz to 80Hz) vibrations in buildings.

ISO8041 (and ISO5349)

- **Hand-arm weighting W_h** (all directions) to evaluate hand-transmitted vibrations.

18.4. Spectral units / display types

For **signals**, it is possible to select the following display units:

- **ADC:** Displays the dynamic in dB converter. It is a relative decibel level. The 0dB level is the full scale value of the converters (i.e., a sample which has a numerical value of 2¹⁶ (32767) corresponds to the 0dB value). dBADC values are always negative between 0 and -90dB.
- **V:** Dynamic display in Volts.
- **Physical unit:** If the transducer is a microphone, the dynamic is displayed in Pascals (**Pa**), If the transducer is an accelerometer, the dynamic is displayed in Acceleration (**m/s²**).

For sound and vibration quantities of type autospectrum, cross-spectrum and transfer functions, it is possible to select the following display units:

- **dB:** Level in decibels of the considered quantity (Leq, Slow, Fast, Impulse, etc.)
- **RMS (Root Mean Square):** Average quadrature value for all the instantaneous squared values expressed in physical units.
- **PWR (Power):** The power represents the average of a squared value. It is the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units
- **PSD (Power Spectral Density):** This unit is used to determine the power in a frequency band for a random signal. It is expressed squared units by Hertz.
- **ASD (Amplitude Spectral Density):** This unit represents the square root of the power spectrum density. It is the unit used to find the amplitude in a frequency band for a random signal. It is expressed in square rooted units per Hertz.
- **ESD:** Unit representing the power spectral density multiplied by time and expressed Unit² x second / Hz.

18.5. Structure of measurement session data files (*.CMG)

Because of the increasing needs for data logging of a great variety of noise and vibration quantities in environmental and industrial applications (multi-channels, long term monitoring, wide range of units, transducers, measured static and dynamic quantities, etc.), **01dB-Stell developed a new data file format well adapted to store, display and process measurement results.**

All the previous datafile formats have therefore been dropped and a unique file format that can address all our applications (and much more) has been developed. Based on a database structure, it rationalises the edition, the display, the processing and the various "Office" operations that can be performed on measurement results in 01dB-Stell PC-based measurement chains.

This chapter describes the new structure of the datafiles, as well as all the resulting processing operations.

☐ Measurement session

The first requirement in the definition of this format was to identify a structure of the "container" type, intuitive enough for being used by a non-experienced operator, and flexible enough to store all type of noise, vibration and other quantities measured by 01dB-Stell systems. We therefore decided to call this type of file "measurement session".

Any 01dB-Stell application software module will therefore store, handle and display MEASUREMENT SESSIONS: Genuine containers of a set of measurements performed for environmental, industrial and building acoustics applications.

A measurement session is therefore defined by its name (generic root name), a comment (to fully describe the context of a measurement).

But what do we find in a measurement session file and how do we handle the data?

Going down one level in the structure, we reach the heart of the data file structure that is the elementary entity used to store a given type of data. **This generic entity is called an ITEM. Its structure is identical for all quantities stored in a measurement session.**

Physical data storage of the items is not shown to the user. Depending on the requirements of the application software used, the measurement sessions, which reference in its header all these item boxes, will contain the complete set of measured quantities in a single file or in individual files (one by item). In both cases, later computing operations (file copies, architecture on the computer hard disk, etc.) will be easier to integrate and to perform.

☐ Item

Let us now describe this structure : the item is a stand-alone quantity that must be able to contain any type of data sets (description, metrological and reference information, actual measurement values) in order to address the present and future measurement applications.

A non-exhaustive list of items currently stored as items is given below.

The following quantities, measured by 01dB-Stell systems, can be stored as items of a measurement session data file:

- Signal recordings
- Impulse responses acquired by MLS technique
- Time histories of overall quantities: Overall levels (frequency and time weighted), civil aviation criteria (PNL,PNLT), psychoacoustic criteria (Loudness, Sharpness, etc.), spectral time history
- Autospectra and cross spectra, in real or complex narrow bands, time averaged or not, computed in real time or off-line
- Broad band spectra (from octave to 1/48th octave resolution), computed in real time or off-line
- Bark band spectra (specific Loudness)
- Transfer functions (cross-spectra, coherence, etc.)
- Noise source codes
- Measurement chain information (dynamic range selection, overload, etc.)
- Comments
- Table of results (psychoacoustics)
- Histograms
- Echograms
- Room acoustic criteria
- etc.

The container therefore has a database structure well adapted to handle batch processing, for example.

18.6. Summary: Files used by dBFA32

01dB-Stell software use or create different type of files:

- **Program files**
- **Parameter files**
- **Data files**

■ **Program files**

These files are an integral part of the measurement system. They combine libraries of functions (***.DLL files**) that are common to several programmes, executable files (***.EXE files**) for each specific software modules and driver files (***.DRV files**) specific to each acquisition platform. The drivers establish a communication protocol between the computer, the software module and the acquisition unit.

The programme files also contain the software **help files (*.CHM)**

By default, they are located in **C:\ PROGRAM FILES\01DB\PROGRAMS**. The drivers of the acquisition cards are located under **C:\WINDOWS\SYSTEM**.

■ **Parameter files**

These are initialisation and configuration files containing the measurement parameters, the list of characteristics of the different measurement chain elements and the measurement chain configurations of different applications, for example. These files are also located in the same directory as the programmes but are not delivered with the installation CDROM.

When the acquisition software is first used, a file is created to save the essential parameters. If this file is destroyed, it will be necessary to configure the software and hardware again.

See the sketch below.

■ **Data files**

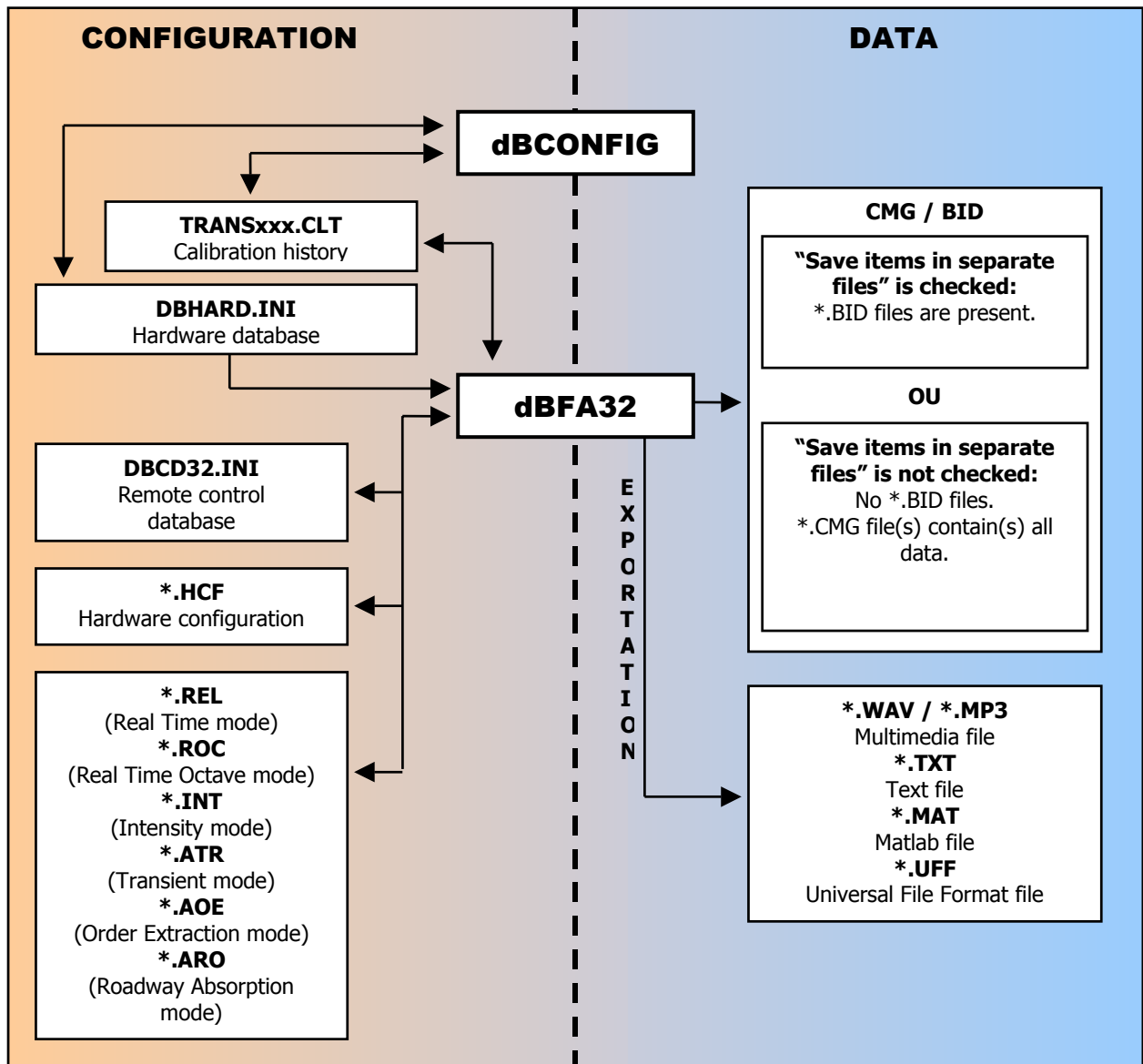
These files contain the measurement results. They can be located anywhere on the computer hard disk. A directory **C:\ MY DOCUMENTS \ 01DB MEASUREMENT SESSIONS** is created by default.

For users that have evolved from a 01dB-Stell measurement system running with 16-bit applications to a system running with 01db-Stell 32-bit applications, the format of data files has evolved. The files can be imported with the command **File / Import** in the measurement software.

To avoid deleting everything by mistake we advise not to put the measurement files under the same path directory as the programme files.

See the sketch below.

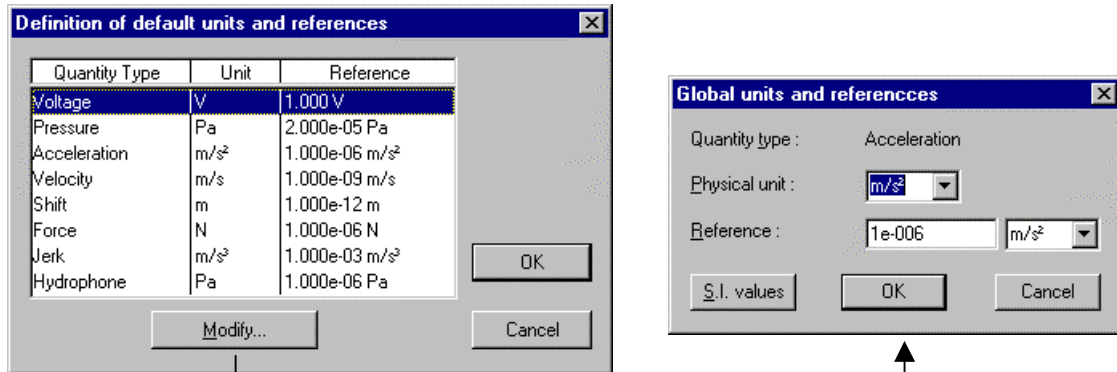
Configuration and Data files used by dBFA32 (see below for further information).



For further information see **dBCONFIG32** on-line help and chapters 3 (Hardware configuration) and 13.7.8 (Selection of storage type) in this manual.

19. APPENDICES

19.1. Conversion units and references management (from a physical unit to a dB level)



Use the command **Units' management** under the **Preferences** menu. The following dialog box appears on-screen:

dBFA32 allows to define default units and references used for each type of metrics. Also it is possible to define export and "copy/paste" units for spectra and overall levels, either physical units or dB.

Click on **modify** to edit the **physical unit** and/or the **reference** value of the selected quantity in the list, as well as the **export** unit. Click on **IS values** to select the values of the International system as standard.

⚠ This function cannot be accessed when a measurement is running. Close the measurement window to edit the references values and the units.

Let us consider an example of conversion.

For pressure type transducers, the reference value of the SI system is $2 \cdot 10^{-5}$ Pa. The sound pressure level is given by the formula :

$$L_p = 10 * \log (p^2/p_0^2) \text{ where } p_0 \text{ is the reference value}$$

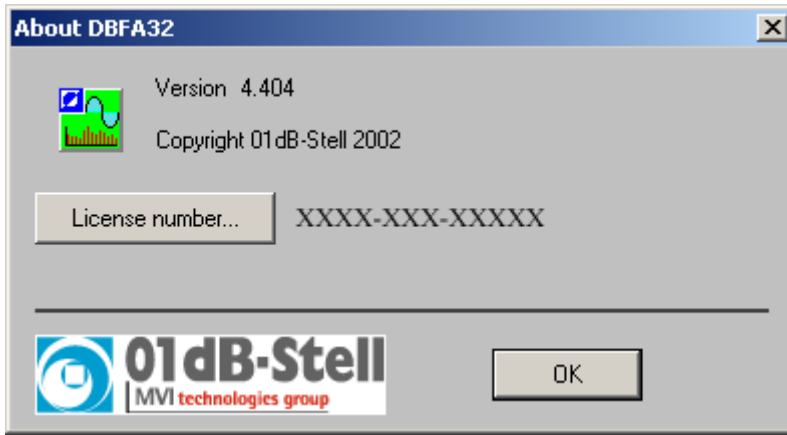
Therefore, for an acoustic pressure level of $2 \cdot 10^{-2}$ Pa, **dBFA32** will use a reference of $p_0=2 \cdot 10^{-5}$ Pa, to calculate a sound pressure level of 60 dB (that is $10 \cdot \log[2(10^{-2})^2/2(10^{-5})^2]$).

If one define a reference level of $p_0=2 \cdot 10^{-6}$ Pa, the sound pressure level displayed in **dBFA32** will be equal to 80 dB.

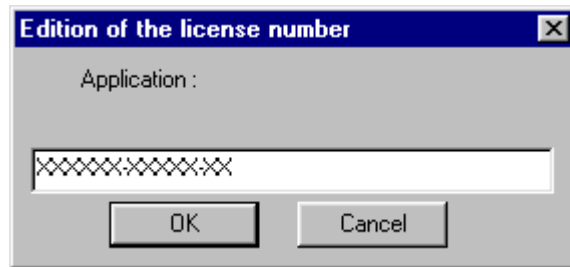
Likewise, it will be possible to edit these parameters for each type of transducer, depending on the application.

19.2. Editing of the software licence number

Use this command (menu ? / **About dBFA32**) to obtain general information on the software version, copyright and licence number.



If the licence number of the software module has to be modified, click on the key Licence number. The following dialog box appears on screen:



Enter the new licence number, provided by 01dB-Stell technical support.

Start again the application software in order to account for this modification.

19.3. Generating signals with dBGENE32

The **dBGENE32** software is used to generate different types of signals via the computer sound card or the acquisition platform. An amplified loudspeaker or even a shaker can thus be controlled.

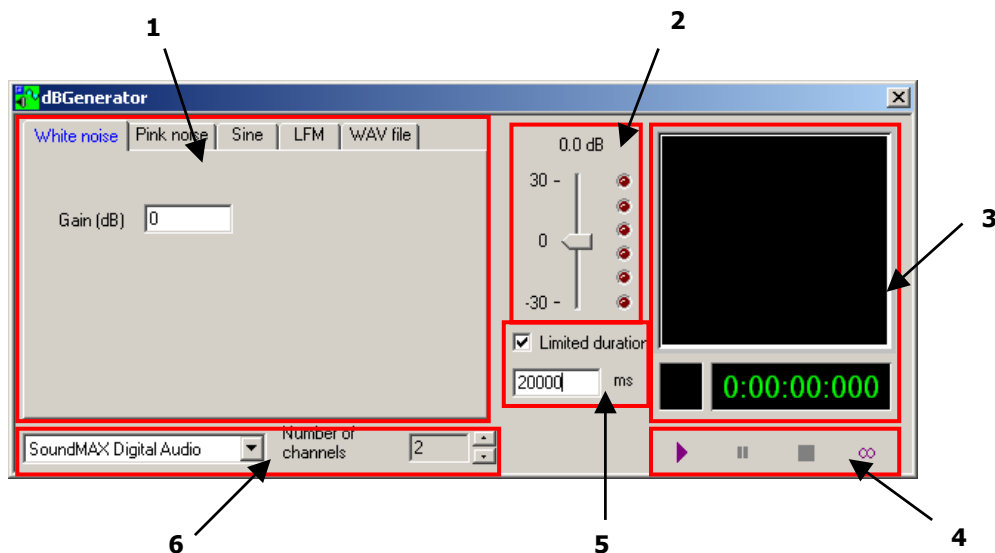
The following signals can be generated by dBGENE32:

- White noise
- Pink noise
- Sine
- Frequency modulation
- Playback of *.WAV files

Generating a signal on the acquisition platform is only possible with **SYMPHONIE** or **HARMONIE**, with Windows 98 and Windows Me.

19.3.1. Presentation of dBGENE32

The figure below shows the overall interface of dBGENE32, from which all generator functions are available:







❶ Select and define parameters for the signal to generate.

❷ Set the general output level. This control is active during emission so that the general volume can be adjusted at any time. The 0 dB value corresponds to the maximum amplitude that can be generated by a sound card without saturation (according to the model).

❸ Real-time display of the shape of the generated signal, of the time elapsed and of the generator status.

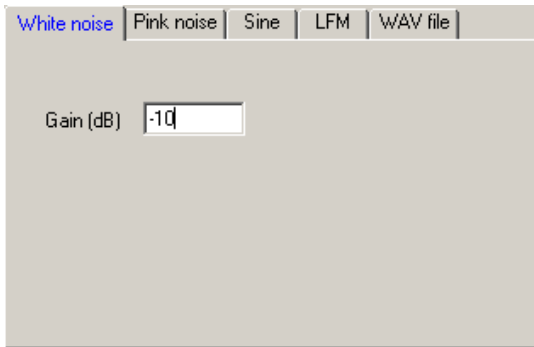
❹ Generator control bar:

-  launch emission for a limited time or not (according to ❸),
-  pause before a possibly resuming emission,
-  stop emission,
-  launch emission for an infinite time, regardless of the parameters.


- 5 Define a time limit for the emission. Check the **Limited time** box and enter a time in **ms**.
- 6 Select the output peripheral device (PC sound card or acquisition platform) and the number of channels to use.

19.3.2. Generating white noise

To generate a white noise, click on the **White noise** tab:

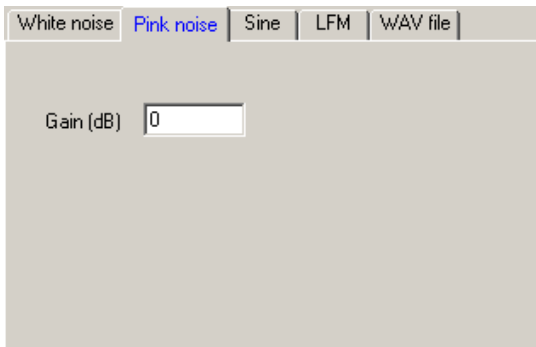


- The **gain** is the only parameter that can be set for the generation of white noise. A gain of 0 dB corresponds to the maximum amplitude that can be generated by a sound card without saturation (depending on the model).

Once signal parameters are set, use  to launch the emission.

19.3.3. Generating pink noise

Click on the **Pink noise** tab to generate pink noise:

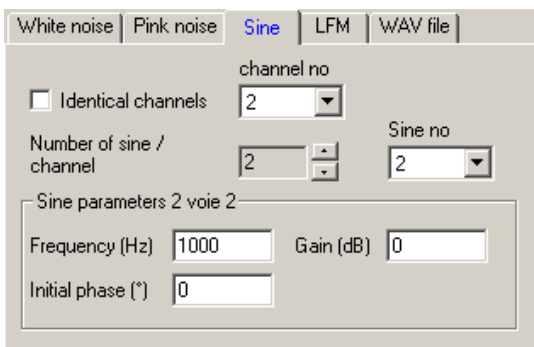


- The **gain** is the only parameter that can be set for the generation of white noise. A gain of 0 dB corresponds to the maximum amplitude that can be generated by a sound card without saturation (depending on the model).


Once signal parameters are set, use  to launch the emission.

19.3.4. Generating sine noise

Click on **Sine** to generate a Sine. Several different frequencies can be generated simultaneously on the same channel and each channel can be set up separately.

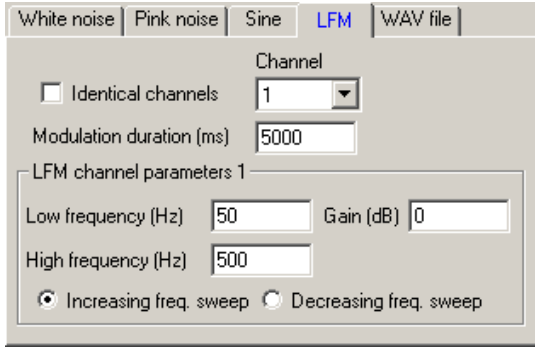


- **Identical channels / Channel No.:** If at least 2 channels are used, different signals can be generated on each channel. Select the channel to configure, if you wish to configure each channel independently.
- **Number of sine / channel:** Indicate the number of sine to generate on each channel.
- **Sine no.:** To configure each frequency, select the no. of the sine to configure.
- **Parameter of sine X on channel X:** Enter the frequency, the initial phase and the gain or the selected sine.


Once signal parameters are set, use  to launch the emission.

19.3.5. Generating frequency modulation

Click on the **MLF** tab to generate a frequency modulation. A different frequency modulation can be generated on each channel.

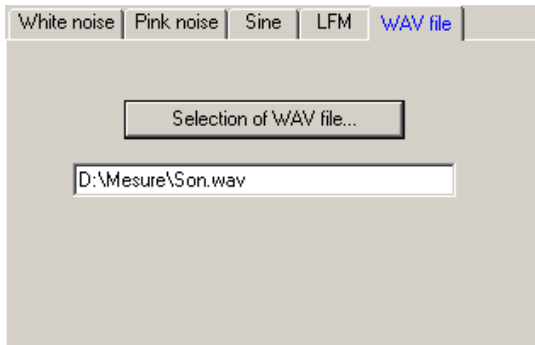


- **Identical channels / Channel No.:** If at least 2 channels are used, different signals can be generated on each channel. Select the channel to configure, if you wish to configure each channel independently.
- **Modulation time:** Enter the sweep time in **ms**.
- **MLF parameters:** Enter the lower and the upper frequency, as well as the gain and the sweeping direction for the modulation.


Once signal parameters are set, use  to launch the emission.

19.3.6. Generating a *.WAV file

To generate a signal resulting from a *.WAV file, click on the **WAV file** tab.



- Click on **WAV file selection...** and open the file.

Once signal parameters are set, use  to launch the emission.