

User Manual

go2SIGNALS SOMO

PROCITEC GmbH





Imprint

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Contents

1	General	1
1.1	Overview	1
1.2	Abstract	2
2	Control of SOMO	5
2.1	Menu bar	5
2.1.1	File Menu	5
2.1.2	Menu Generator	7
2.1.3	Menu Playback	8
2.1.4	Menu Extras	8
2.1.5	Help Menu	9
2.2	Toolbar	9
2.2.1	Functions	9
2.2.2	Record Audio File	10
2.2.3	Signal Types	11
2.2.4	Channel Simulation	12
2.3	Spectrum/Sonagram Display	13
2.4	Generator List	15
2.5	Property Sheet	16
2.5.1	Parameters Tab	16
2.5.2	Code Tab	19
2.5.3	Text Tab	20
2.5.4	Extras Tab	21
2.5.5	Channel Tab	22
2.5.6	Edit Parameters of the Spectrum/Sonagram display	23
2.6	Shortcuts	29
3	Appendix	31
3.1	Support and Document-ID	31
3.2	Contact	31
4	List of Figures	32
5	List of Tables	33
6	Index	34

1 General

1.1 Overview

SOMO is an abbreviation for *Software Modulation Signal Generator*. SOMO is a signal generator capable of generating a great variety of signals of different modulation types with specific parameters for each signal.

The output can be realized via external interfaces, or can be used for test purposes by feeding it back into go2DECODE.

Below is a short overview of the features of SOMO followed by a comprehensive description, which explains all functions in detail.

Features of SOMO

- Creation of various modulation schemes
- Variable modulation parameters
- Variable encoding modems
- Text input editor
- Generating short-time emissions (bursts)
- Multi-channel systems (with a maximum number of 100 channels)
- Frequency range up to 192 kHz
- HF Channel Simulation (multipath fading and noise)
- Variable pulse forming
- Spectrum/sonagram display
- Various text encodes with a scrambler which can be parameterized
- Unlimited combination of all preset signals (signal scenario)
- Option to save output as audio (WAV) or complex baseband-signal (WAV, 1Q12 or 1Q16)

SOMO Elements

SOMO provides a great variety of parameter options and functions. The current present description begins with the menu bar where existing functions can be accessed.

Next is a description of the toolbar, a more convenient option due to its quick access features. The toolbar provides frequently used standard functions such as loading or saving.

The Spectrum/Sonogram Display shows graphics of the generated signals in the time range or the spectrum range.

The Generator List is required for display and selection of the generators, the Property sheet is required for configuration.

1.2 Abstract

Start of SOMO

To start SOMO select **<Programs><go2SIGNALS>** in the Windows® program group of the start menu and then in the subfolder of the current release the entry SOMO. SOMO can either be started directly from within go2DECODE via the **<Extras>** menu or from the **<Start menu>** of the desktop.

Operation of SOMO

On program start, the screen will show the user interface displayed in Figure 1. If the option **<Load default.som automatically>** in the File Menu is checked, the generator file "default.som" will be loaded automatically. In Figure 1 the file "default.som" contains two signals. The selected Morse signal has a center frequency of 12,500 Hz.

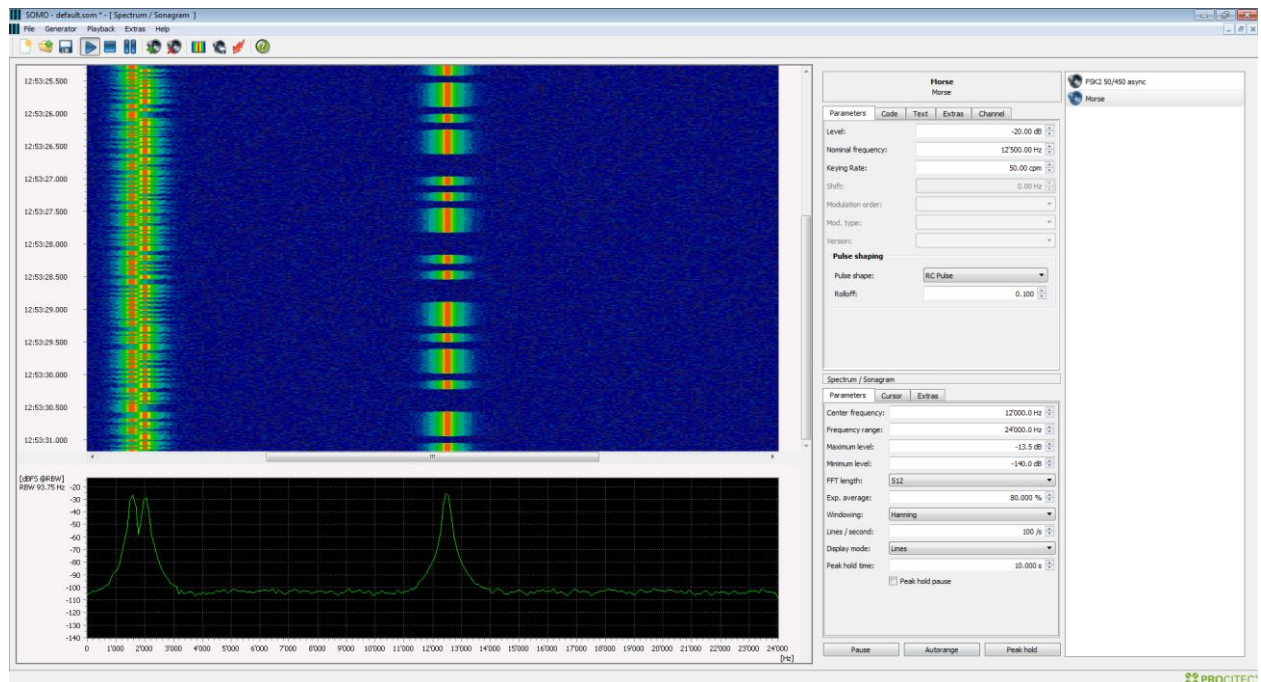






Figure 1: Signal Generation using SOMO

Click the icon  on the Toolbar to start playback. Otherwise, load a generator file using the menu **<File><Load generator file...>** or create a new generator file via the menu command **<File><New generator file>**.

To do so, select the desired signal type, e.g. Morse, in the **<Generator>** menu. This signal icon will appear in the *Generator List*. On pressing the Start icon on the toolbar () , the spectrum/sonogram display will show graphics of the generated spectrum in the time range and the frequency range. Generate and play back one or several signals either individually or in combination.

To activate or deactivate the generator, double click the speaker icon  or icon  respectively.

Highlighted (selected) generators in this list can be edited via the property sheet at the top (Figure 1). The spectrum/sonagram parameters can be edited in the display property sheet at the bottom.

SOMO will generate up to 100 signals of different modulation types with specific parameters for each signal. All activated signals are calculated and transmitted, or stopped and paused, using the icons on the Toolbar or the Menu bar.

Once your generator file is complete, save the file via the menu command **<File><Save Generator File...>**. The **<Save As>** dialogue box is displayed.

User Interface SOMO

The output can be realized via external interfaces, or can be used for test purposes by feeding it back into in go2DECODE.

2 Control of SOMO

2.1 Menu bar

SOMO provides a great variety of parameterizing options and functions. The present description starts with the Menu Bar where all existing functions are accessed. The menu bar is display in Figure 2.

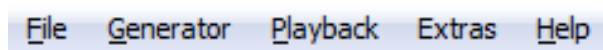


Figure 2: Menu bar

2.1.1 File Menu

When selecting **<File>**, the list in Figure 3 will be displayed.

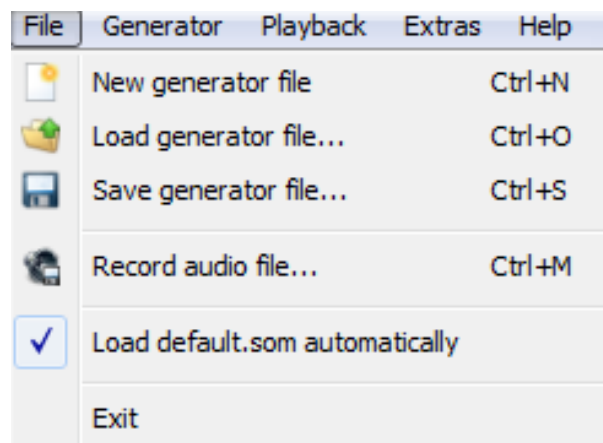


Figure 3: Menu File

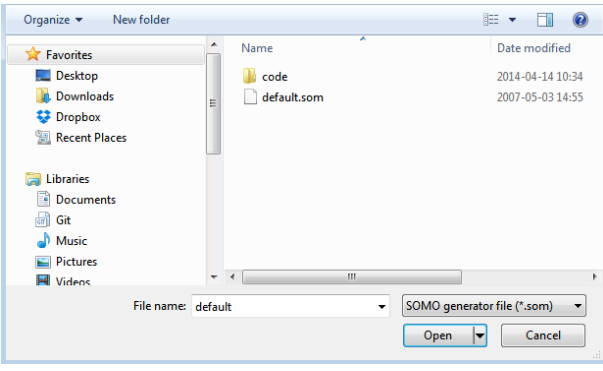
Menu Item	Function	Description
File	New generator file	Create a new, blank generator list. In general, the file type of the generator files is ".som". New generators are added to the list by selecting a signal type on the Menu Generator.
	Load generator file...	<p>Load existing lists by means of this function. When activated, the box in Figure 4 will be displayed:</p>  <p style="text-align: center;"><i>Figure 4: Load generator file</i></p> <p>It serves to select the directory and the generator list "*.som" file to be loaded.</p>
	Save generator file...	Save the created generator list. A directory and a file name are suggested, either of which can be changed or edited, respectively.
	Record audio file...	Record and save generated signals as "*.wav" files. See chapter Record Audio File...
	Load default.som automatically	This menu item defines whether a preset generator file is to be loaded automatically when SOMO is started or not. If the file "default.som" does not exist, it can be created and edited by the user and must be saved in the same file folder as "somo.exe". If this checkbox is deactivated, the last generator file loaded will be opened automatically. In this case, the directory is irrelevant.
	Exit	Exit the program

Table 1: File Menu Functions

2.1.2 Menu Generator

If **<Generator>** is selected, the list in Figure 5 will be displayed.

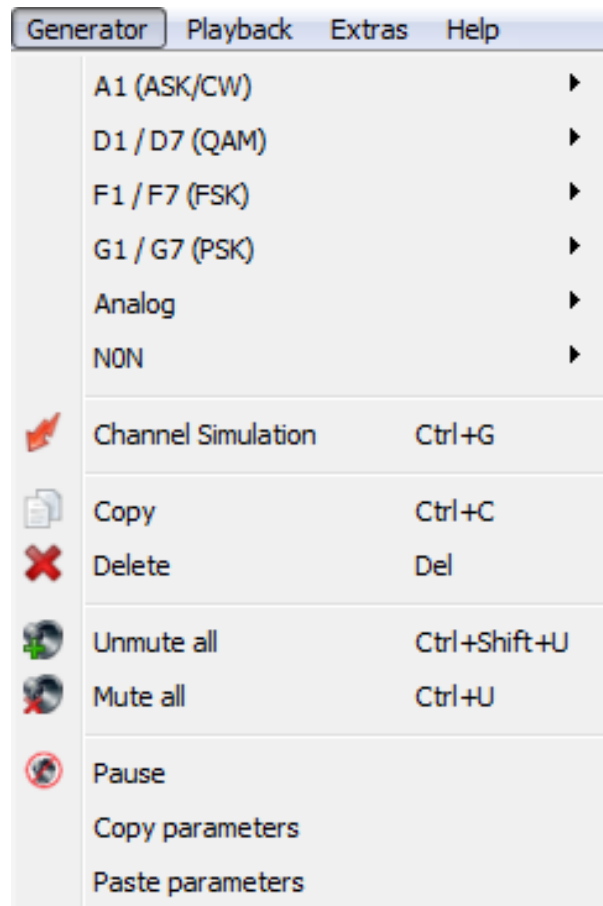


Figure 5: Menu Generator

Menu Item	Function	Description
Generator	A1 D1/D7 F1/F7 G1/G7 Analog NON	Allows for selection of a signal type for which to generate a signal, e.g. A1 ► Morse will generate a Morse signal. For all possible types of signals, see Table 8 in section Toolbar.
	Channel Simulation	Opens a dialog that allows to add white noise to the signals and to simulate a multipath propagation channel. See Channel Tab in Property Sheet.
	Copy	Copy the selected generator.
	Delete	Remove the selected generator from the list.
	Unmute all	Unmute (activate) all generators.
	Mute all	Mute (pause) all generators.
	Pause/Activate	This toggle switch serves to pause or activate the selected generator.
	Copy parameters	Copy the parameters of the selected generator.
	Paste parameters	Paste the previously copied parameters into the selected generator.

Table 2: Generator Menu Functions

2.1.3 Menu Playback

Figure 6 shows the menu which will be shown, when selecting **<Playback>**.

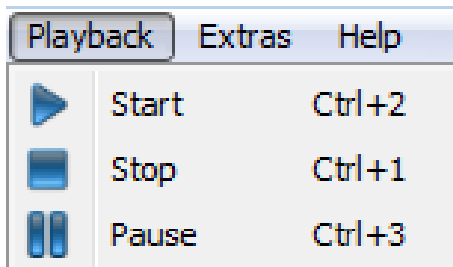


Figure 6: Menu Playback

Menu Item	Function	Description
Playback	Start	Play all activated signals from the generator list
	Stop	Stop playback
	Pause	Halt or restart playback

Table 3: Playback Menu Functions

2.1.4 Menu Extras

Selecting **<Extras>** open the menu displayed in Figure 7.

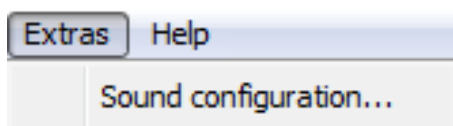


Figure 7: Menu Extras

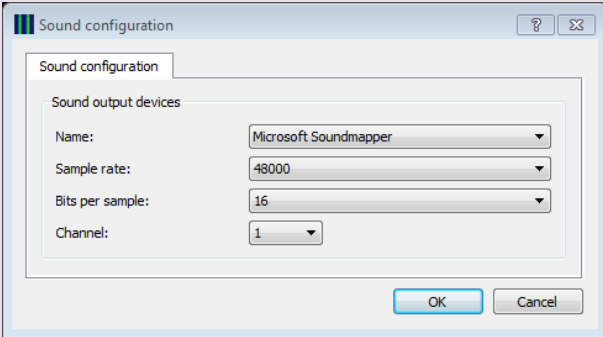
Menu Item	Function	Description
Extras	Sound Configuration...	<p>If your system features various sound cards (e.g. with different numbers of channels), use this item to select and configure the existing sound output devices. In the dialog box displayed, select the desired sound device, enter the values for sample rate and bits per sample, and edit the number of channels.</p> 

Figure 8: Menu extras sound configuration

Table 4: Extras Menu Functions

2.1.5 Help Menu

When selecting **<Help>**, the menu in Figure 9 will be shown.

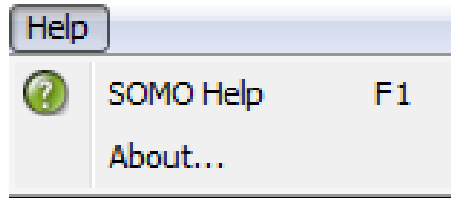


Figure 9: Menu Help

Menu Item	Function	Description
Help	SOMO Help	Open online Instruction Manual
	About...	Display information about SOMO

Table 5: Help Menu Functions












2.2 Toolbar



Figure 10: Toolbar

2.2.1 Functions



The toolbar displayed in Figure 10 features the following functions:

Icon	Function
	New generator file
	Load generator file...
	Save generator file...
	Start
	Stop
	Pause
	Unmute all
	Mute all
	Sonagram and spectrum display
	Record audio file...
	Channel Simulation

Icon	Function
	Online help

Table 6: Icons

The functions are identical with the functions of the menu items described in the paragraph Menu bar.

The toolbar can be moved as desired by clicking the toolbar handle ; the mouse pointer will then assume the shape . Keep the mouse button pressed to move the bar.

2.2.2 Record Audio File...

On selection of the menu item **<Record audio file...>** the dialog box in Figure 11 will be displayed.

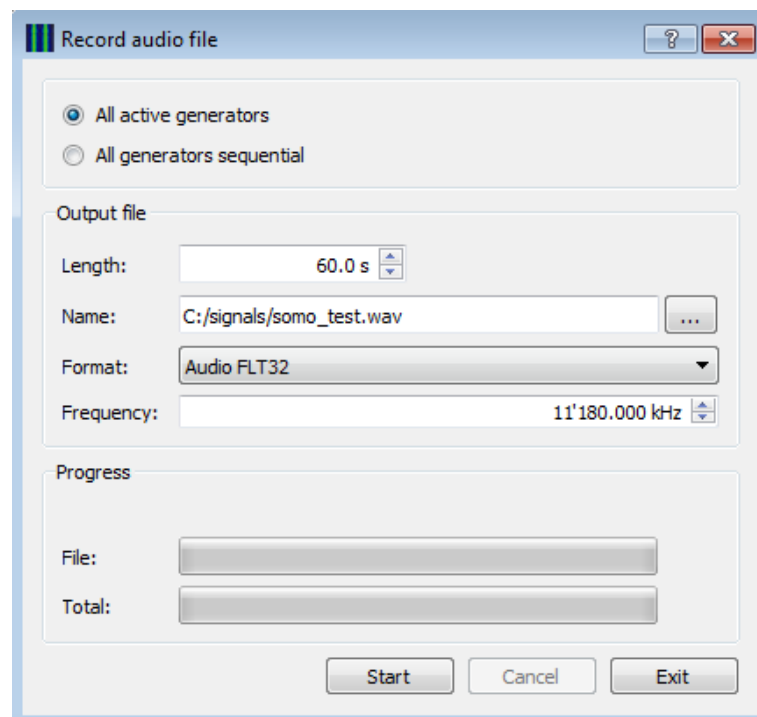


Figure 11: Record Audio File Dialog

Use this dialog to generate signals and save them in an audio file "*.wav". The spin box **<Length>** serves to enter the length of the signal to be recorded (minimum length 1.0 s, maximum length 1200 s). Only activated generators will be saved. If **<All generators sequential>** is enabled then the generators will not run parallel but a single file will be created for every generator.

The directory and the file name are defined in the box **<Output file>**. When the dialog opens, the previous output file name is displayed. Change this name to prevent this file from being overwritten. The progress of the recording process is displayed.

Audio-signals can be stored in a variety of formats, basic audio as well as complex baseband data. The data-format can be defined with the combo box **<Format>** in the box *Output file*. This is shown in Figure 12. It is also possible to define the format in **<Files of type>** within the selection dialogue.

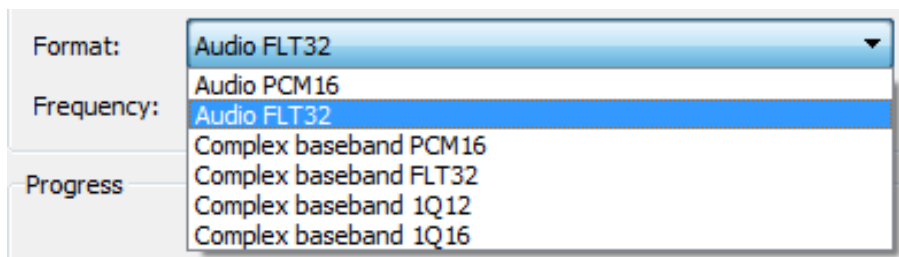


Figure 12: Audio Data-Format Selection

Data Format	Description
Audio PCM16 (*.wav)	The generated signal is stored without modification – as inphase wave file in 16 Bit Integer format.
Audio FLT32 (*.wav)	The generated signal is stored without modification – as inphase wave file in 32 Bit Float format.
Complex baseband PCM16 (*.wav)	The signal is converted to complex baseband and will be saved in 16 Bit integer format. The saved file is "stereo" with I/Q values in Left/Right channel. All go2DECODE applications will automatically recognize this format as complex baseband.
Complex baseband FLT32 (*.wav)	The signal is converted to complex baseband and will be saved in 32 Bit float format. The saved file is "stereo" with I/Q values in Left/Right channel. All go2DECODE applications will automatically recognize this format as complex baseband.
Complex baseband 1Q12 (*.q12)	The converted baseband signal is stored as 12 bit fixed-point number in little-endian Q1.10 format per sample without any file header. One I/Q pair occupies 24 bit – 3 bytes. With merely 12 bit the dynamic range is limited. The user has to set the modulator levels carefully to avoid over- and underflow in the saved file.
Complex baseband 1Q16 (*.q16)	The converted baseband signal is stored as 16 bit fixed-point number in little-endian Q1.14 format per sample without any header. One I/Q pair occupies 32 Bit – 4 bytes.

Table 7: Audio Recording Data Formats

When converting to complex baseband, the frequency 12.5 kHz of the generated signal is mixed to zero Hz and filtered. After conversion 86% of the Nyquist bandwidth is usable.

You can use the field **<Frequency>** to define the (virtual) sender frequency for the file. When e.g. you load the file into DANA or the SonagramViewer this value will then be shown instead of 0 Hz.

Use the **<Start>** button to start the recording, the **<Cancel>** button to abort the recording, and the **<Exit>** button to close the dialog window.

2.2.3 Signal Types

The following signal types can be generated:

Signal Type	Modulation
A1 (ASK/CW)	ASKn Morse
D1 / D7 (QAM)	QAMn ASKnPSKm

Signal Type	Modulation
F1 / F7 (FSK)	NCPFSKn CPFSKn (G)MSK F6/F7B TFM 3 TFM 5 DTFM
G1 / G7 (PSK)	PSKn A/B OQPSK
Analog	A3E A3E SC J3E LSB J3E USB F3E
NON	Sine Rectangle Sawtooth Triangle File

Table 8: Signal Types

2.2.4 Channel Simulation

Use this function to simulate a propagation channel. When **<Channel Simulation>** is selected, the dialog in Figure 13 will be opened.

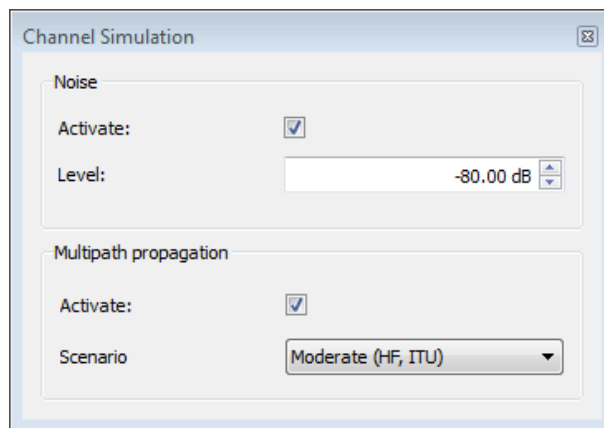


Figure 13: Channel Simulation Tab

Noise: To superimpose the signals with white noise check **<Activate>**. The noise setting defined in this dialog is available regardless of the generators. The **<Level>** can be set within a range from -100.00 to 0.00 dB. The energy value stated applies to the energy of the total noise signal in the band and is not identical with the SNR of the signal.

Multipath propagation: The multipath propagation simulator supports the Watterson and the enhanced ITS (Institute for Telecommunication Sciences) model. To active the simulator for all generators, check **<Activate>**. With the parameter **<Scenario>** there is the possibility to specify a certain scenario to control the intensity of the disturbance. The settings specified in this dialog override the individual settings of each generator. You find more information about the channel simulator in Channel Tab in section Property Sheet.

2.3 Spectrum/Sonagram Display

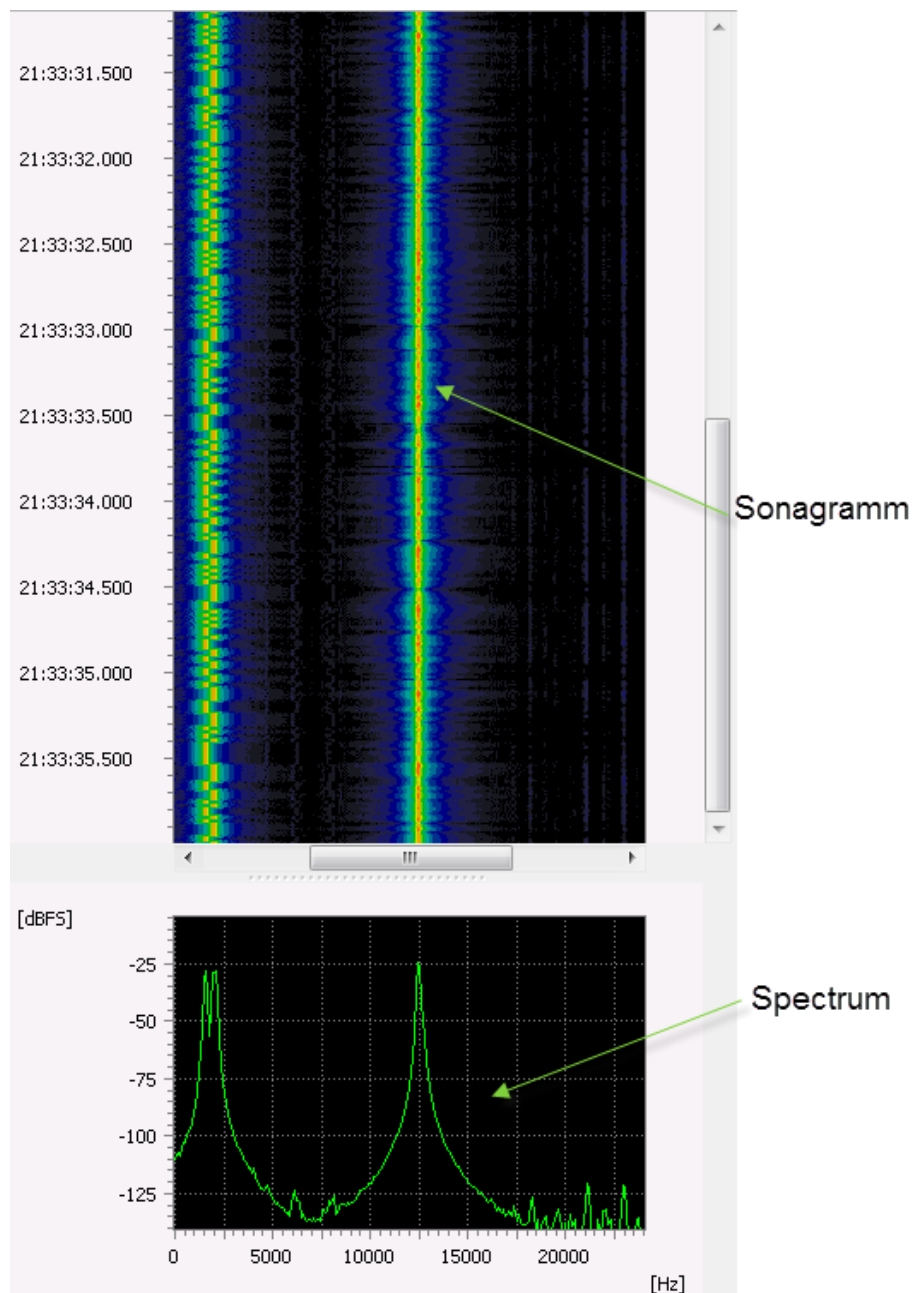


Figure 14: Spectrum/Sonagram Display

The spectrum/sonagram display is activated via the Menu bar or the Toolbar and serves to display and verify the signals calculated by the generators. It is displayed in Figure 14. The display consists of two sections: The upper section displays the sonagram while the lower one depicts the spectrum of the signal. The displays are freely resizable using a splitter.

New data will not be depicted in the display until the output has been activated (mode **<Start>** and generator activated). Parameter modifications will have an immediate effect on the signal.

The current UTC time in hours, minutes, seconds and milliseconds is displayed to the left of the sonagram. The spectrum is indicated in dBFS above the frequency axis (in Hz). The dis-

play features a popup menu (right click) for convenient cursor and zoom operations, displayed in Figure 15 and Table 9.

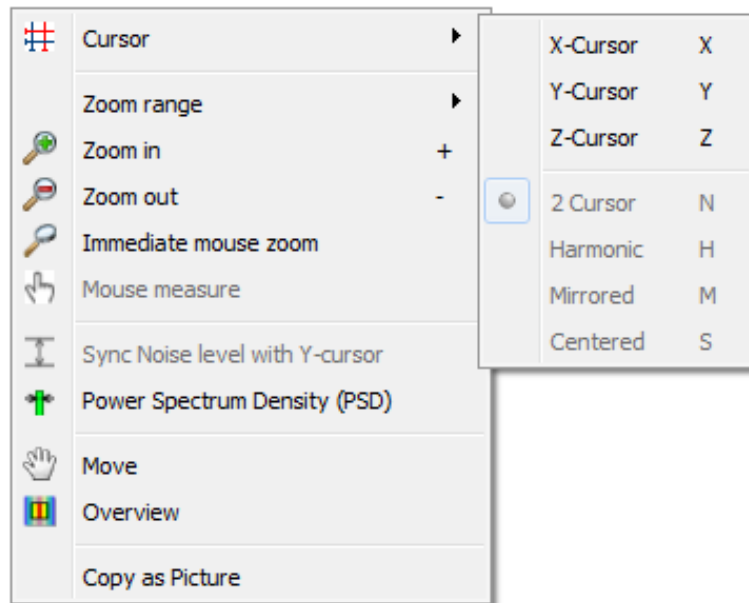


Figure 15: Spectrum/Sonagram Popup Menu

Parameter	Function														
Cursor	Activate and deactivate X-, Y-, Z- and Harmonic cursors <div data-bbox="751 1144 1134 1547" style="border: 1px solid gray; padding: 5px; margin: 10px auto; width: fit-content;"> <table border="1"> <tr><td>X-Cursor</td><td>X</td></tr> <tr><td>Y-Cursor</td><td>Y</td></tr> <tr><td>Z-Cursor</td><td>Z</td></tr> <tr><td><input checked="" type="checkbox"/> 2 Cursor mode</td><td>N</td></tr> <tr><td>Harmonic</td><td>H</td></tr> <tr><td>Mirrored</td><td>M</td></tr> <tr><td>Centred</td><td>S</td></tr> </table> </div> <div data-bbox="790 1563 1093 1594" style="text-align: center; font-size: small;"> Figure 16: Cursor selection </div>	X-Cursor	X	Y-Cursor	Y	Z-Cursor	Z	<input checked="" type="checkbox"/> 2 Cursor mode	N	Harmonic	H	Mirrored	M	Centred	S
X-Cursor	X														
Y-Cursor	Y														
Z-Cursor	Z														
<input checked="" type="checkbox"/> 2 Cursor mode	N														
Harmonic	H														
Mirrored	M														
Centred	S														
Zoom Factors	Max. frequency range. Zoom to maximum frequency range Max. time range. Zoom to maximum time range (show entire buffer without scrollbar) Max. frequency and time range. <div data-bbox="751 1749 1134 1899" style="border: 1px solid gray; padding: 5px; margin: 10px auto; width: fit-content;"> <table border="1"> <tr><td>Max. frequency range</td><td>F</td></tr> <tr><td>Max. time range</td><td>T</td></tr> <tr><td>Max. frequency and time range</td><td></td></tr> </table> </div> <div data-bbox="758 1915 1125 1946" style="text-align: center; font-size: small;"> Figure 17: Maximize zoom range </div>	Max. frequency range	F	Max. time range	T	Max. frequency and time range									
Max. frequency range	F														
Max. time range	T														
Max. frequency and time range															
Zoom in	Enlarged view of the section delimited by the cursors. Repeat this process until the spectrum area displayed is satisfactory.														

Parameter	Function
Zoom out	Reduced view of the section delimited by the cursors. Repeat this process until the spectrum area displayed is satisfactory.
Immediate Zoom	Zoom in by clicking the mouse at the desired position (zoom out using the <Ctrl> key)
Mouse measure	Delivers X-, Y- and Z-values at the current mouse position in the sonagram in the X-, Y- and Z-Cursor 1 boxes and displays them. If there is no valid Y-value the Y-Cursor 1 is set to the smallest allowed value. This feature is only available if the sonagram is paused.
Sync Noise level with Y-cursor	The Y-cursors are displayed at the currently estimated values for power and noise (red: power, green: noise). Modification of the X-cursors leads to a recalculation of the measured values and the Y-cursors also get updated. In case the Y-cursor get modified manually, e.g. for adjusting the noise floor, then the labels in the upper right corner are marked with a star to show that these are not the automatically determined values. It can only be selected when the sonagram is paused.
Power Spectrum Density (PSD)	Switches between power spectrum and power spectrum density (PSD).
Move	The mouse pointer changes into a hand. Drag the displayed section in the desired direction by moving the mouse while keeping the left mouse button pressed.
Overview	Opens a sonagram with an overview of the complete signal located in the buffer. In addition you see a rectangular mark around the section in the actual sonagram display.



Table 9: Spectrum/Sonagram Popup Menu Parameters


2.4 Generator List

The generator list, displayed in Figure 18, shows all generators selected. The generator list provides the option to activate and deactivate the generators and to edit the generator names.



Figure 18: Generator List

To deactivate the generator, i.e. switching it to mute, double click the speaker icon . To reactivate, double click the disabled speaker icon .

All activated generators are created during playback (Start ). All generators can be activated or deactivated as desired during playback.

To change the name of a generator, select the generator in question. The name can be edited as desired by another click on the name, or by pressing the function key <F2>.

Selected generators are deleted via the menu <Generator><Delete> or using the shortcut , or its parameters can be set in the property sheet.

Additionally, the generator list features two popup menus with commands from the Menu bar. Right-click the generator opens the left menu in Figure 19.

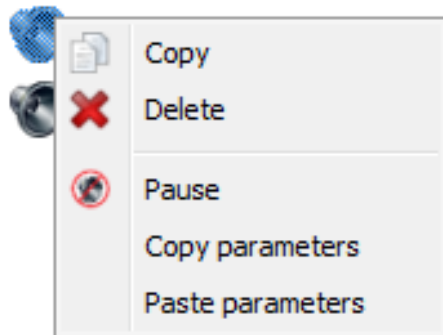


Figure 19: Popup Menu Generator / Generator list

Right-click within the generator list pane opens the menu shown in Figure 20 below.

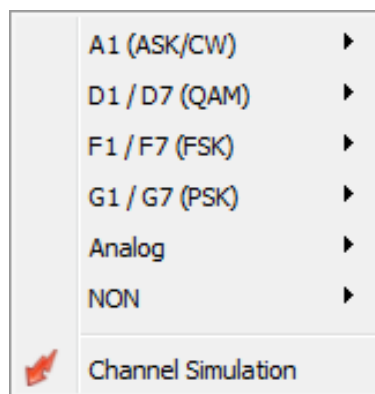


Figure 20: Popup Menu Generator / Generator list

2.5 Property Sheet

A very helpful feature to enter numerical values is the adjustability of every digit before and after the decimal point. Place the cursor after the digit to be changed and increase or reduce its value using the scroll wheel of your mouse, the up/down controls, or the arrow keys on the keyboard.

Note: The popup menu (right mouse button) in all spin boxes provides editor functions and display unit selection.

2.5.1 Parameters Tab

In the **<Parameters>** tab there is a difference between digital and analog generators. The parameters for digital generators are display in Figure 21 and the parameters for analog generators are displayed in Figure 22.

Digital Generators

Figure 21: Parameters Tab (digital generators)

The following parameters are available for selection. Their accessibility varies with the generator selected:

Parameter	Description and Input Options
<Level>	Output level of a signal in the range from -100 to 0 dB. 0 dB equals the maximum gain of the sound card. The total level of the output can be changed using the mixer (level setting of the operating system)
<Nominal frequency>	Center frequency of the signal. In case of a multichannel generator this represents the frequency of the first channel.
<Symbol Rate>	Symbol rate of the signal in the range from 0 – 19,200 Bd., or Keying rate in cpm (= characters per minute) with Morse signals
<Shift>	Only with FSK signals. Shift (distance between the minimum frequency and the maximum frequency) of the signal.
<Modulation order>	Modulation order of a symbol as a power of 2. Admissible values: 2, 4, 8, 16, 32, 64, 128, 256
<Mod. Type>	Different modulation variants of ASKnPSKm: ASK2PSK4 ASK2PSK8 ASK4PSK8 ASK4PSK16 ASK2PSK2
<Version>	PSK Version A or B. Only with PSKn signals
Pulse shaping	
<Pulse shape>	Pulse shape of the base band symbol: RC Pulse, RC Spectrum, RRC Spectrum, Gaussian Pulse, Chirp
<Rolloff>	Only available for pulse shapes <i>RC Pulse</i> , <i>RC Spectrum</i> and <i>RRC Spectrum</i> . The roll-off changes the spectrum of the signal. The roll-off value is between 0.000 and 1.000.
BT	Only available for pulse shape <i>Gaussian Pulse</i> . Product of bandwidth <i>B</i> and symbol duration <i>T</i> . The value is between 0.100 and 1.000.

Parameter	Description and Input Options
Shift	Only available for pulse shape <i>Chirp</i> . <i>Shift</i> describes the length of the chirp in frequency range. The end frequency of the chirp is <i>Nominal Frequency + Shift</i> . If the value of <i>Shift</i> is positive, the result is an up-chirp. If it is negative, the chirp becomes a down-chirp.
Windowing	Only available for pulse shape <i>Chirp</i> . With <i>Windowing</i> it is possible to multiply the chirp with one of these window functions: <i>None</i> , <i>Tukey</i> , <i>Hanning</i> or <i>Blackman</i> .
Tukey parameter	Only available for pulse shape <i>Chirp</i> and Window <i>Tukey</i> . This parameter describes the ratio of Hanning section length to the entire window length. The value is between 0.00 and 1.00. If the value is 0.00, the window becomes a rectangle. If the value is 1.00, it becomes a Hanning window.

Table 10: Digital Generator Parameters

Analog Generators

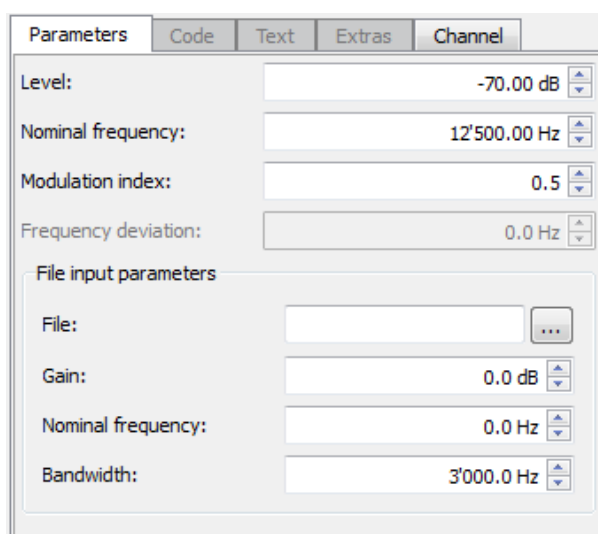


Figure 22: Parameters Tab (analog generators)

Parameter>	Description and Input Options
<Level	Output level of a signal in the range from -100 to 0 dB. 0 dB equals the maximum gain of the sound card. The total level of the output can be changed using the mixer (level setting of the operating system)
<Nominal frequency>	Centre frequency of the signal
<Modulation index>	Modulation index for AM modulation in the range of 0.1 through 2.0
<Frequency deviation>	Frequency deviation for FM modulation; range 1.0 up to value set in box Nominal Frequency

Parameter>	Description and Input Options
File input parameters	
<File>	Select file to be modulated or played back (WAV file)
<Gain>	Amplify the signal in the file selected in a range of 0 – 100 dB
<Nominal Frequency> / <Bandwidth>	These two parameters determine which frequency range of the selected file is to be used. After selecting the file, these parameters are first automatically set so that the entire frequency range of the file is selected. The "Nominal Frequency" parameter defines the lower frequency limit and the "Bandwidth" parameter the desired bandwidth. Both values are limited by the sampling rate of the input file. In case of a inphase input file the „Nominal Frequency“ can be set between 0 and half of the sampling rate of the selected file. With a complex input file, the "Nominal frequency" parameter is limited downwards to the negative half sampling rate.

Table 11: Analog Generator Parameters

2.5.2 Code Tab

The <Code> tab, shown in Figure 23, displays all encoding settings. Every generator has its own text generator and modulates its encoding individually.

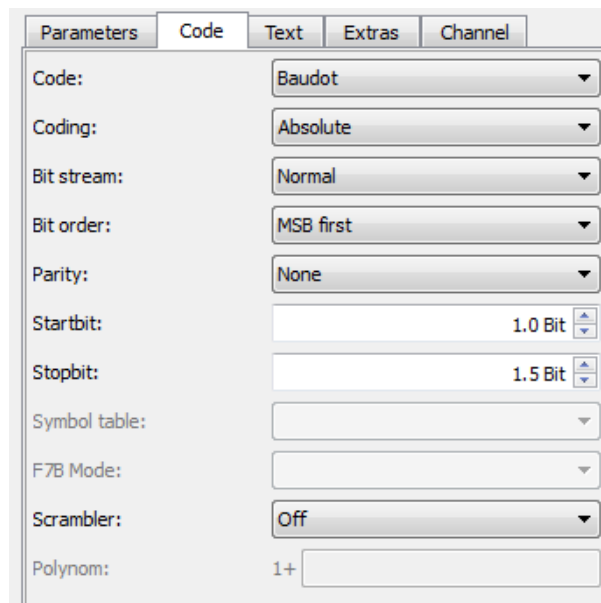


Figure 23: Code Tab

The following parameter setting options are available:

Parameter	Description and Input Options
<Code>	Choose between the following encoding types: Bit (input 01 or x-) ASCII 8 bit HC ARQ ASCII 7 bit Baudot ITA 2
<Coding>	Choose between absolute and differential encoding
<Bit stream>	Choose between inversion of the bit stream or no inversion
<Bit order>	Order of the data bits (not with code Bit): LSB first MSB first
<Parity>	Selection of parity test, inserting of a parity bit, if required (not with code Bit): None Even Odd
<Startbit>	Insert start bit(s) into the bit stream: 0.0 to 10.0 bits (not with code Bit)

Parameter	Description and Input Options
<Stopbit>	Insert stop bit(s) into the bit stream: 0.0 to 10.0 bits (not with code Bit)
<Symbol table>	Various symbol tables: V. 17 Trellis V. 22 V. 26 V. 27 V. 29 V. 32 V. 32 Trellis V. 32bis Trellis V. 33 Trellis Gray
<F7B Mode>	Mode of the two channels with F7B : Data/Data Data/Morse Morse/Data
<Scrambler>	Activation of scrambler: Off V. 27 511 Test loop V. 22 V. 17,29,32,33 Polynomial input
<Polynom>	If the scrambler is in Input mode, any desired polynomial with a maximum length of n=128 can be entered: $x^{-k1} + \dots + x^{-kn}$ The input of the exponents k_i , separated by the character "+", will also be sufficient: Example: $x^{-5}+x^{-8}$ also can be obtained by the input of "5+8"

Table 12: Code Tab Parameters

It depends on the generator type whether or not the parameters of the coding can be edited (for example with *Sine*).

2.5.3 Text Tab

This tab, shown in Figure 24, allows for the definition of a text to be sent via the signal, unless any of the generators *Sine*, *Rectangle*, *Triangle*, *Saw tooth* or an *analog generator* has been selected. If the code *Bit* has been chosen, the input should consist of "0" and "1", or of "x" and "-". Other characters will be ignored with this option.

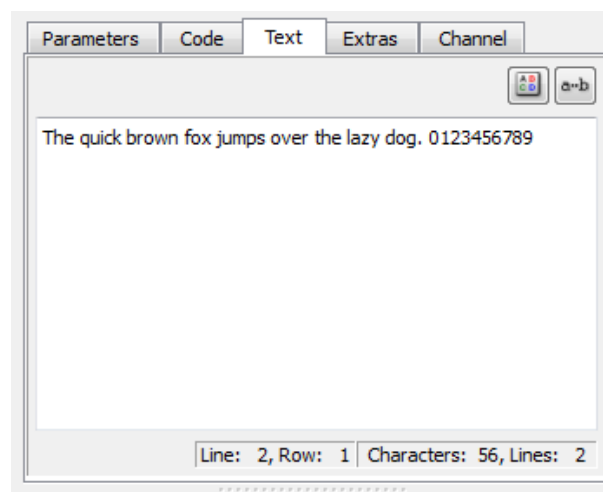



Figure 24: Text Tab

The <Text> tab resembles a text editor, i.e. various actions can be carried out using shortcuts. For example, the complete text can be highlighted using <Select All> in the popup menu and can then be deleted using the key .

To reinstall the default text, simply click the icon  and acknowledge the alert message by pressing <Yes>.

The toggle button  serves to show/hide all nonprinting characters in the text. The panes at the bottom indicate the current cursor position (line, row) and the size of the text with number of characters and lines.

2.5.4 Extras Tab

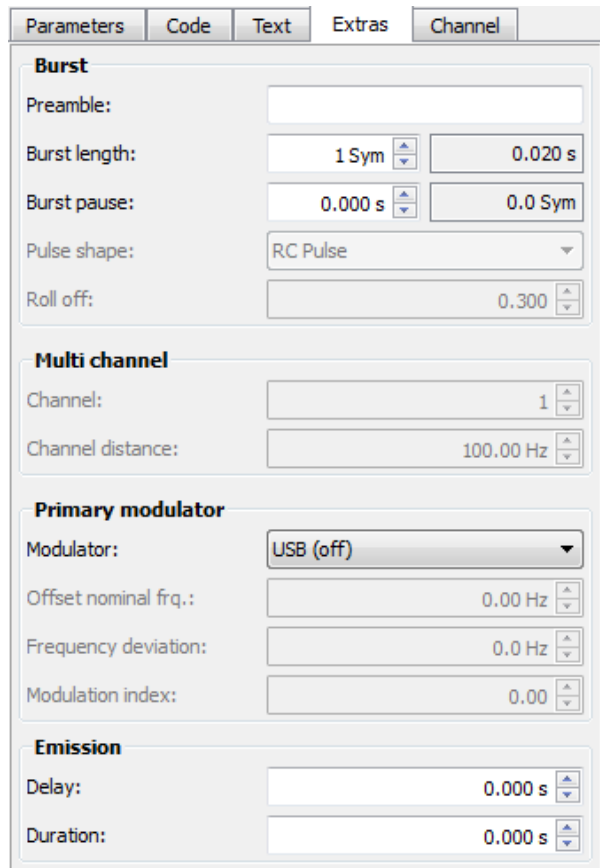


Figure 25: Extras Tab

The **<Extras>** tab is displayed in Figure 25 and allows the setting of several or all parameters, depending on the signal type:

Group Box	Parameter	Description
Burst	<Preamble>	Enter a Bit combination at the beginning of a burst Use the following format: 01001...
	<Burst length>	Definition of the length of a burst (in symbols): 1 to 100,000 sym. The adjacent pane shows the equivalent in seconds. With multi-channel modems, please bear in mind that the number of symbols entered to determine the burst length will refer to all channels, i.e. with a number of channels of 10 and a desired burst length of 3 symbols (in time), enter a burst length of $10 \times 3 = 30$.
	<Burst pause>	Definition of the pause time between two 2 bursts (0 means burst mode Off): 0.000 to 3600.000 sec. The adjacent pane shows the equivalent in symbols.
	<Pulse shape>	Pulse shape of the burst with CPFSK _n , (G)MPK, TFM signals: RC Pulse RC Spectrum RRC Spectrum
	<Roll off>	Roll-off for the pulse shape: 0.000 to 1.000
Multi-Channel	<Channel>	Number of channels: 1 to 100 (Maximum is limited by the totally available bandwidth)
	<Channel distance>	Distance between the individual channels in multi-channel mode.

Group Box	Parameter	Description
Primary Modulator	<Modulator>	Choose the modulator desired: USB (off), LSB, AM, or FM
	<Offset nominal freq.>	Frequency offset of the primarily modulated signal relative to the parameter in box Nominal Frequency
	<Frequency deviation>	Frequency deviation for FM modulation; range 1.0 up to value set in the box Nominal Frequency
	<Modulation index>	Modulation index for AM modulation in the range of 0.1 through 2.0
Emission	<Delay>	Signal starts only after the parametrized time
	<Duration>	Maximum duration of emission (0 = infinite)

Table 13: Extras Tab Parameters

Selection of parameters depends on generator type.

Note: Analog generators as well as generators of the types NON or Morse do not have any **<Extras>** parameters.

2.5.5 Channel Tab

The **<Channel>** tab is shown in Figure 26. This tab allows the simulation of a multipath propagation channel. The simulator supports the Watterson and the enhanced ITS (Institute for Telecommunication Sciences) model. Every generator has its own channel simulator with the settings set here. The individual generator settings are overridden with the setting of the global channel simulator from the toolbar, if it is activated there.

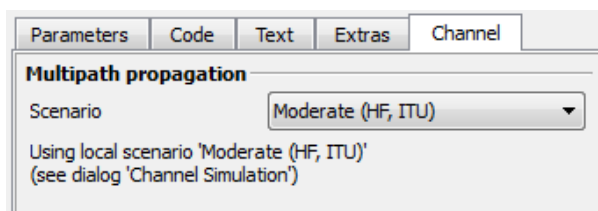


Figure 26: Channel Tab

Following table shows which scenarios are provided for the channel simulation. The scenarios marked with *ITU* are parameters settings, which are provided in the ITU Recommendation *ITU-R F.1487* and *ITU-R F.520.2*. When selecting these scenarios, the Watterson model is used. The Watterson model is valid for bandwidths up to 12 kHz. When selecting scenarios marked with *ITS*, the ITS Model is used. The ITS Model is valid for bandwidths up to 1 MHz. The ITS scenarios use the same settings as the Watterson scenarios, but with some additional parameters.

Scenario	Description
None	No channel simulation
Flat1 (HF, ITU)	Propagation paths: 1 Doppler spread: 0.2 Hz
Flat2 (HF, ITU)	Propagation paths: 1 Doppler spread: 1.0 Hz
Good (HF, ITU)	Propagation paths: 2 Relative delay: 0.5 ms Doppler spread: 0.1 Hz

Scenario	Description
Moderate (HF, ITU)	Propagation paths: 2 Relative delay: 1 ms Doppler spread: 0 Hz
Poor (HF, ITU)	Propagation paths: 2 Relative delay: 2 ms Doppler spread: 1 Hz
Flutter (HF, ITU)	Propagation paths: 2 Relative delay: 0.5 Hz Doppler spread: 10 Hz
Good (HF, ITS)	ITU Parameter + additional Parameters
Moderate (HF, ITS)	ITU Parameter + additional Parameters
Poor (HF, ITS)	ITU Parameter + additional Parameters
Flutter (HF, ITS)	ITU Parameter + additional Parameters

Table 14: Parameters Tab Channel

2.5.6 Edit Parameters of the Spectrum/Sonagram display

To edit the parameters of the spectrum/sonagram display, use the corresponding property sheet. The parameters are distributed on several tabs.

The parameters of the spectrum/sonagram are displayed by activating the **<Parameters>** tab which provides the settings displayed in Figure 27.

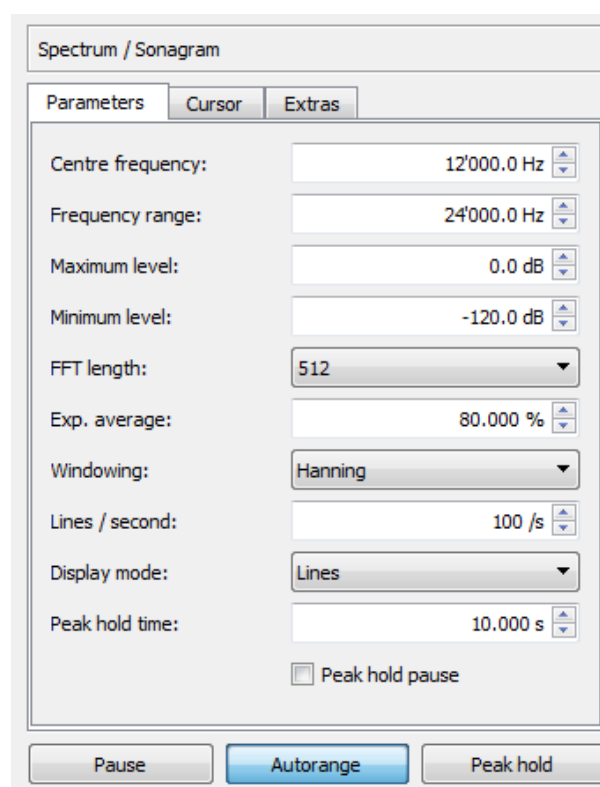
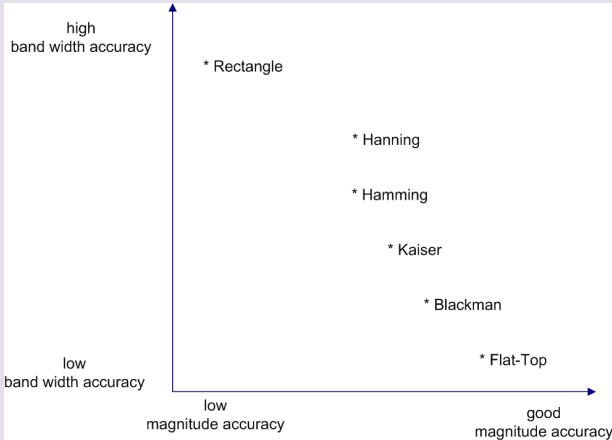


Figure 27: Parameters Tab

Parameter	Function
<Centre frequency>	Set the frequency section to view in combination with the frequency range. The center frequency is the center of the section.
<Frequency range>	Set the frequency section to view in combination with the center frequency. The frequency range is the range within the section. This setting allows for manual entry of a zoom level. Also, see the parameters <Zoom in > and <Zoom out> in Table 16 and Figure 29.
<Maximum level>	Define the level range in the spectrum display. The maximum level is the upper end of the section.
<Minimum level>	Define the level range in the spectrum display. The minimum level is the lower end of the section.
<FFT length>	Number of values of frequency in which the signal will be displayed. Increase the FFT length to obtain a higher resolution of the displayed frequency range.
<Exp. Average>	The spectrum is displayed as an average of several spectrums. Changing the spectrum will result in a total view of the spectrum. 0%: No average - 80%: Low average 80% - 99%: High average 100%: No updating of the spectrum
<Windowing>	<p>The FFT algorithm serves to calculate the spectrum. This algorithm, however, shows inaccuracies in the amplitude (attenuation) as well as in the bandwidth (expansion) of a signal due to the finite signal probe. These inaccuracies can be reduced by means of windowing as shown in Figure 28:</p>  <p style="text-align: center;"><i>Figure 28: Windowing</i></p>
<Lines / second>	This is the number of spectrums that can be calculated and displayed within one second. The parameter defines the time resolution for the sonagram, i.e. also the scroll speed.
<Display mode>	In mode Line, the spectrum is displayed as a closed curve. In mode Beam, the single values are displayed as bars.
<Peak hold time>	When the time adjusted has elapsed, the peak hold (i.e. red curve in the spectrum) will be reset by setting on the current spectrum. 0 means no reset.
<Peak hold pause>	When the time adjusted in <i>Peak Hold Time</i> has elapsed, <Pause> is selected and the display is frozen. To re-activate the current display, <Pause> has to be selected again.
<Pause>	In <Pause>, the display is frozen (not the signal processing). Editing the parameters is possible for a more detailed analysis of the current signal range.
<Autorange>	Automatic setting of the displayed range in order to view the total amplitude and frequency range. <Autorange> analyzes approx. 12 spectral lines. The display is adapted on every change of the range. On pressing <Autorange> again, the process will be deactivated (toggle).

Parameter	Function
<Peak hold>	When activating <Peak hold>, the maximum energies in the spectrum will be recorded and displayed as a red curve.

Table 15: Parameters Tab Parameters

Cursor Functions of Displays

The cursor parameters are displayed by activating the <Cursor> tab. It is shown in Figure 29. This tab enables to insert cursors into the display which serve to select or clarify specific sections of the display, or measure the signal data. The individual cursor positions are displayed and can be edited.

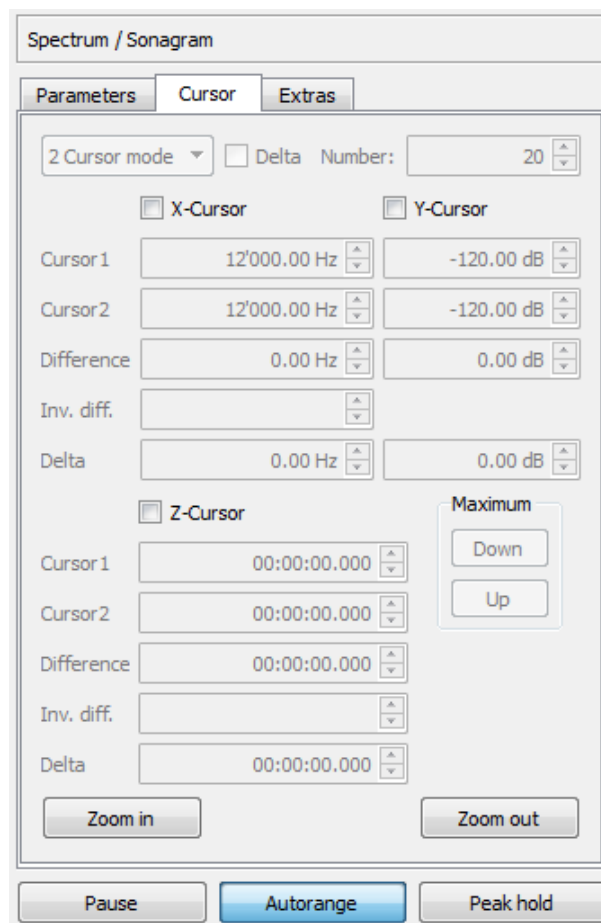


Figure 29: Cursor Tab

Parameter	Function
Drop-down Menu Cursor mode	<p>2 Cursor mode 2 independent, moveable cursors will be displayed in the window.</p> <p>Harmonic Several cursors are activated at equidistant intervals. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor. The Harmonic function can only be applied in combination with X-cursors, Y-cursors or Z-cursors. It serves to measure repeating intervals.</p> <p>Mirrored Several cursors are activated at equidistant intervals. Cursor 1 will be on one side and in the middle of the even-numbered equidistant cursor and the odd-numbered equidistant cursor is located on the other side. If you move one cursor (except cursor 1) all other cursors besides cursor 1 will move symmetrically.</p> <p>Centred Several cursors are activated at equidistant intervals. In contrast to <Mirrored>, all cursors (except cursor 1) and the cursor which is in the opposite of the first mirrored cursor are moving.</p>
<Delta>	The positions of Cursor1 and Cursor2 stay the same during changes of the cursor mode or the number of cursors, if this checkbox is not activated, otherwise the positions of the 2 outermost cursors are tried to keep fixed. This allows a convenient way to have multiple cursors at equidistant intervals in a specific area without the need to adapt the cursors. To cancel the additional cursors, select "2 Cursor mode".
<Number>	Use this spin box to determine the number of cursors to be displayed in Harmonic mode.
<X-Cursor>	The cursors are activated/deactivated in X-direction. They are used to measure values of time.
<Y-Cursor>	The cursors are activated/deactivated in Y-direction and are used to measure the values on the Y-axis (which varies from display to display, i.e. phase, frequency, etc.).
<Cursor 1>	Coordinates of the first X-, Y- and Z-cursor each
<Cursor 2>	Coordinates of the second X-, Y- and Z-cursor each
<Difference>	Difference between Cursor1 and Cursor2
<Inv. Diff.>	Inverted difference is a function for direct readout of symbol rate (determination of which is a major purpose of the Z-cursors) according to the formula $1 / [\text{value in box Difference}]$
<Delta>	Gap between the minimum and maximum cursor. In "2 Cursor" mode it is the same as Difference, in all other cases it is Difference times Number-1.
<Z-Cursor>	The cursors are activated in Z-direction. They are used to measure values of time.
<Cursor 1>	Coordinates of the first X and Y Cursor each
<Cursor 2>	Coordinates of the second X and Y Cursor each
<Difference>	Difference between Cursor1 and Cursor2
<Inv. Diff.>	Inverted difference is a function for direct readout of symbol rate (determination of which is a major purpose of the Z-cursors) according to the formula $1 / [\text{value in box Difference}]$
<Delta>	Gap between the minimum and maximum cursor. In "2 Cursor" mode it is the same as Difference, in all other cases it is Difference times Number-1.
<Down>	Sets X-Cursor1, Y-Cursor1 to the next visible maximum on the spectrum line against X-direction, if cursors are activated.
<Up>	Sets X-Cursor1, Y-Cursor1 to the next visible maximum on the spectrum line in X-direction, if cursors are activated.
<Zoom in>	<p>With enabled cursors, the button <Zoom in> serves to graphically zoom into the area delimited by the cursors. With disabled cursors, the zoom enlarges the area by factor 1/2 each time it is activated (X-direction only).</p> <p>Additionally, the user may draw a rectangle in the display window and zoom into this section graphically by means of the button <Zoom in>. If the display window has activated cursors, the zoom via rectangle will take priority. After zooming, the rectangle shown as a white dotted line will disappear. Otherwise, simply click any position in the display window to delete the rectangle.</p>
<Zoom out>	Each time the button <Zoom out> is activated, the display area is enlarged by factor 2. With disabled cursors, the zoom is exclusively made in X-direction.

Parameter	Function
<Pause>	In Pause, the display is stopped (not the signal processing). Modification of the parameters is possible for a more detailed analysis of the current signal range.
<Autorange>	Automatic setting of the displayed range to view the total amplitude, frequency and phase range. This mode analyzes approx. 12 vectors. The display is adapted on every change of the range. On pressing <Autorange> again, this process will be deactivated (toggle).
<Peak hold>	By activating <Peak hold> , the maximum energies in the spectrum are recorded and displayed as a red curve.

Table 16: Cursor Tab Parameters

Tab Extras

The **<Extras>** tab features additional options with regard to the display type and is displayed in Figure 30.

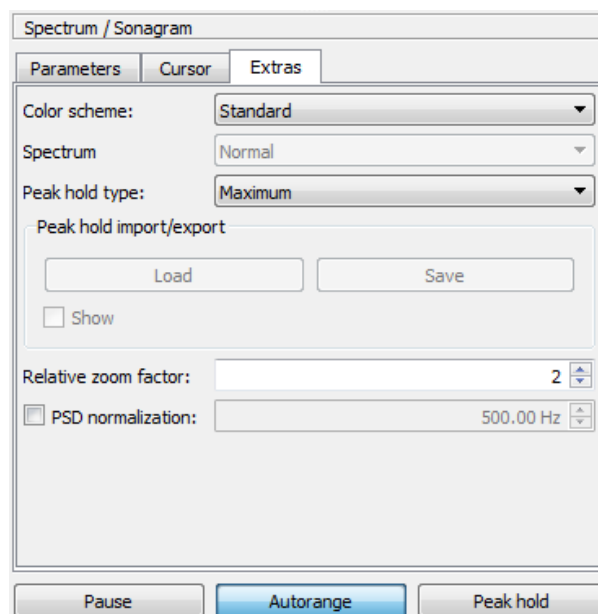


Figure 30: Extras Tab

The list box **<Color scheme>** serves to select the color schemes for the displays:

Color Scheme	Foreground Color	Background Color
Default	light	black
Inverse	dark	white
Monochrome	shades of grey	white

Table 17: Display Color Schemes

Further, the **<Extras>** tab has a drop-down menu *Spectrum*, which is inactive unless the Z-cursors are enabled. Specify whether you wish to display

- the spectrum usually averaged exponentially (*Normal*)
- the spectrum exactly at the position of Cursor1 (*At Cursor 1*)
- the spectrum averaged between the two cursors (*Average value Cur. 1/2*)

The group box *Peak-Hold import/export* permits to save and load peak hold curves for accurate comparison. The two functions are inactive unless the buttons **<Pause>** and **<Peak hold>** are selected.

The curves are stored in “*.csv” format (*Comma Separated Value*), which is editable in Microsoft® Excel or a suitable editor such as e.g. Microsoft® WordPad. When loading a saved curve, it is inserted in the spectrum display as a yellow line. The checkbox **<Show>** is not active unless a curve has been loaded.

Please make sure to display the inserted curve using the original FFT length or an adjacent FFT length.

In the **<Relative Zoom Factor>** group box, enter the desired relative zoom factor for zooming out and its inverse for zooming in. By default, this spin box is preset to 2.

Switching between power spectrum and power density spectrum (PSD, Power Spectral Density) is done with the **<PSD normalization>** check box.

2.6 Shortcuts

Function	Shortcut
Start online help	<F1>
Rename	<F2>
Show /hide parameters	<F5>
Stop	<Ctrl> + <1>
Start	<Ctrl> + <2>
Pause	<Ctrl> + <3>
Select all	<Ctrl> + <A>
Copy	<Ctrl> + <C>
Delete selected generator	
Jamming	<Ctrl> + <J>
Load generator file	<Ctrl> + <L>
New generator file	<Ctrl> + <N>
Save generator file	<Ctrl> + <S>
Paste	<Ctrl> + <V>
Record audio file	<Ctrl> + <W>
Cut	<Ctrl> + <X>
Undo	<Ctrl> + <Z>
Unmute all	<Ctrl> + <Shift> + <U>
Mute all	<Ctrl> + <U>
Channel Simulation	<Ctrl> + <G>

Table 18: Shortcuts

3 Appendix

3.1 Support and Document-ID

Requests and suggestions?

Any requests and suggestions about our products will be highly appreciated. We would be glad to receive your information.

Further questions? We are pleased to support you!

If you still have any questions, don't hesitate to ask your friendly and helpful Support.

For a rapid assistance please have the following required information on hand:

- Document-ID GODSOE19010020181120
- Product name and und version
- License
- Dongle No.
- Use case
- Operating system
- Language of the operating system
- Other applications running
- Screenshot

3.2 Contact

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4 List of Figures

Figure 1: Signal Generation using SOMO	2
Figure 2: Menu bar.....	5
Figure 3: Menu File.....	5
Figure 4: Load generator file.....	6
Figure 5: Menu Generator	7
Figure 6: Menu Playback	8
Figure 7: Menu Extras.....	8
Figure 8: Menu extras sound configuration	8
Figure 9: Menu Help	9
Figure 10: Toolbar.....	9
Figure 11: Record Audio File Dialog	10
Figure 12: Audio Data-Format Selection	11
Figure 13: Channel Simulation Tab	12
Figure 14: Spectrum/Sonagram Display	13
Figure 15: Spectrum/Sonagram Popup Menu	14
Figure 16: Cursor selection.....	14
Figure 17: Maximize zoom range.....	14
Figure 18: Generator List	15
Figure 19: Popup Menu Generator / Generator list.....	16
Figure 20: Popup Menu Generator / Generator list.....	16
Figure 21: Parameters Tab (digital generators)	17
Figure 22: Parameters Tab (analog generators)	18
Figure 23: Code Tab	19
Figure 24: Text Tab	20
Figure 25: Extras Tab	21
Figure 26: Channel Tab.....	22
Figure 27: Parameters Tab	23
Figure 28: Windowing	24
Figure 29: Cursor Tab	25
Figure 30: Extras Tab	27

5 List of Tables

Table 1: File Menu Functions.....	6
Table 2: Generator Menu Functions	7
Table 3: Playback Menu Functions	8
Table 4: Extras Menu Functions	8
Table 5: Help Menu Functions	9
Table 6: Icons.....	10
Table 7: Audio Recording Data Formats	11
Table 8: Signal Types	12
Table 9: Spectrum/Sonagram Popup Menu Parameters	15
Table 10: Digital Generator Parameters	18
Table 11: Analog Generator Parameters	19
Table 12: Code Tab Parameters	20
Table 13: Extras Tab Parameters	22
Table 14: Parameters Tab Channel	23
Table 15: Parameters Tab Parameters	25
Table 16: Cursor Tab Parameters	27
Table 17: Display Color Schemes	27
Table 18: Shortcuts.....	29

6 Index

Abstract	2	Menu bar	5
Appendix	31	Menu Extras	8
Channel Simulation	12	Menu Generator	7
Channel Tab	22	Menu Playback	8
Code Tab	19	Overview	1
Contact	31	Parameters Tab	16
Control of SOMO	5	Property Sheet	16
Edit Parameters of the		Record Audio File...	10
Spectrum/Sonagram display	23	Shortcuts	29
Extras Tab	21	Signal Types	11
File Menu	5	Spectrum/Sonagram Display	13
Functions	9	Support and Document-ID	31
General	1	Text Tab	20
Generator List	15	Toolbar	9
Help Menu	9		