go2DECODE

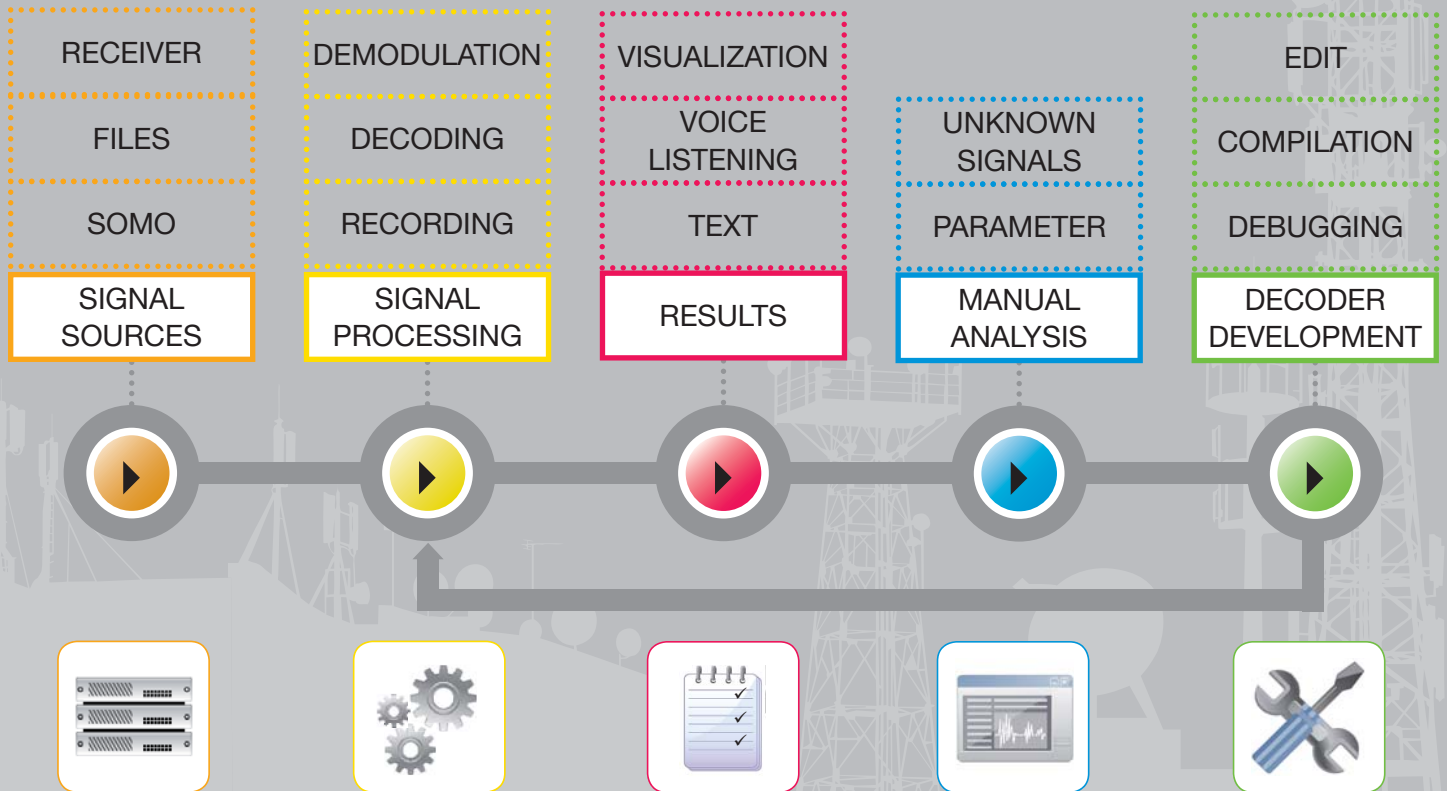## Analysis Recognition Demodulation Decoding

go2DECODE is the standalone software for signal recognition, demodulation, decoding, voice detection, signal recording and technical signal analysis.

Key facts

- Fully automatic processing of HF/VHF/UHF communication signals

- Knowledge based recognition approach, using the analysts know-how

- Wide range of universal demodulators and standard decoders

- Automatic processing of adaptive transmission methods

- Voice detection and demodulation

- Determination and continuous tracking of signal characteristics

- IF/AF-recordings

- Displays for monitoring and manual analysis of unknown signals

- Definition and customization of decoders with Decoder Description Language

- Signal acquisition from digital or analogous receivers via LAN /USB or audio

WORKFLOW

SIGNAL SOURCES	SIGNAL PROCESSING	RESULTS	MANUAL ANALYSIS	DECODER DEVELOPMENT
RECEIVER	DEMODULATION	VISUALIZATION		EDIT
FILES	DECODING	VOICE LISTENING	UNKNOWN SIGNALS	COMPILATION
SOMO	RECORDING	TEXT	PARAMETER	DEBUGGING

go2DECODE

Single channel decoder for automatic demodulation and production, technical signal analysis and decoder development

- Automatic signal processing of radio data and voice signals, decoding, recording

- More than 250 modes for demodulating and decoding

- Signal decoding from digital or analogous receivers via streaming, audio, files or internal signal buffer

- Manual identifcation and analysis of unknown signals

- Creation and modification of decoders with Decoder Description Language (DDL)

- Integrated receiver control

- Easy integration through TCP/IP-based data interchange via LAN

Your vision is our incentive

go2DECODE is more than a single decoder software to analyse and monitor communication signals. The idea behind is to allow the user to adapt and automate their monitoring tasks, improving results and staying up to date with the signal scenario and current requirements.

With go2DECODE you analyse signals, adapt demodulator parameters, develop new decoders, set up new protocols and automate your monitoring tasks.
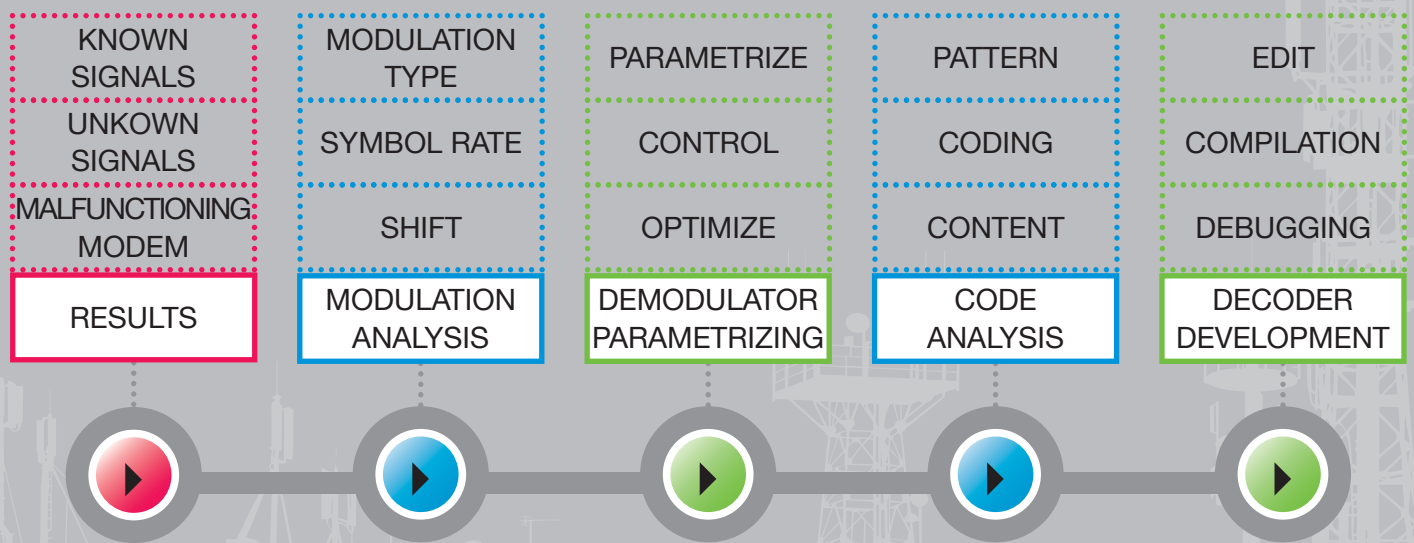
This way the analysts' knowledge and experience gets incorporated into all monitoring solutions based on go2SIGNALS products for future automatic processing.

SINGLE WORKPLACE AND SYSTEM SOLUTIONS

Although go2DECODE is optimized for standalone applications, it is able to interact with other radio monitoring solutions based on go2MONITOR. Open interfaces allow for an easy TCP/IP based communication. The field of application ranges from a single go2DECODE connected via the audio interface with a manual adjustable receiver to a system solution, comprising receiver controls, job interfaces, communication with other radio monitoring systems and a central database.

KNOWN SIGNALS	MODULATION TYPE	PARAMETRIZE	PATTERN	EDIT
UNKOWN SIGNALS	SYMBOL RATE	CONTROL	CODING	COMPILATION
MALFUNCTIONING MODEM	SHIFT	OPTIMIZE	CONTENT	DEBUGGING
RESULTS	MODULATION ANALYSIS	DEMODULATOR PARAMETRIZING	CODE ANALYSIS	DECODER DEVELOPMENT

Use Cases

Manual and automatic signal monitoring

go2DECODE is used to observe a single fre-quency. Its signal detection and production is a multi-level process. The integrated Automatic Production Channel (APC) buffers the incoming signal continuously. Buffering allows lossless processing: detection, recognition and decoding without losing the first bit of an emission.

If a signal is detected, the APC checks for the known modem types in its modem list. Signal parameters (e.g. center frequency and baud rate) are determined and displayed. Decoded text will be displayed as plain text or as a formatted XML-stream.

Manual analysis of unknown signals

New and unknown signals can be stored, ma-nually or automatically. These records are used for signal analysis, measuring modulation and coding parameters. A comprehensive set of build in analysis tools with special modulation and coding analyzing features supports the operator, from the beginner up to the expert.

Some examples of its possibilities:

- Spectrogram and spectrum displays for FFT analysis and baud rate measurement
- Autocorrelation display to find out signal repetitions
- Constellation display for phase modulation analysis
- Analysis display to measure amplitude, frequency and phase behavior
- Hell display for coding analysis
- Extensive set of cursor functions to measure harmonics

Adaptation of demodulator and decoder library

go2DECODE differs to other analysis tools, enabling the operator to parametrize its set of universal demodulators. The analysis functions can not only be used to analyse the input signals, they can also be used to monitor the internal processing of the demodulator.

The operator is able to set up a demodulator on a new signal, parametrize the demodulator and control and optimize the demodulation process. The bits can be stored and transfered for extended stream analysis to other analysis tools (see go2ANALYSE) or used as input data for the internal decoder.

With the advanced Decoder Description Language, (DDL) new decoders can be created or existing ones can be modified. Therefore we deliver go2DECODE inclusive the DDL source code for many of our decoders. Just use them as a template or adapt them to your needs with the integrated DDL editor. An additional decoder debugger tool is part of the go2DECODE Professsional version.

Information about the demodulator settings and the decoders can be stored as a modem description file extending the protocol library.

Extending the list of modems for manual and automatic monitoring

Just include your own generated protocols in the modem list used for signal monitoring. Thus, new and previously unknown signals can be recognized and processed automatically.
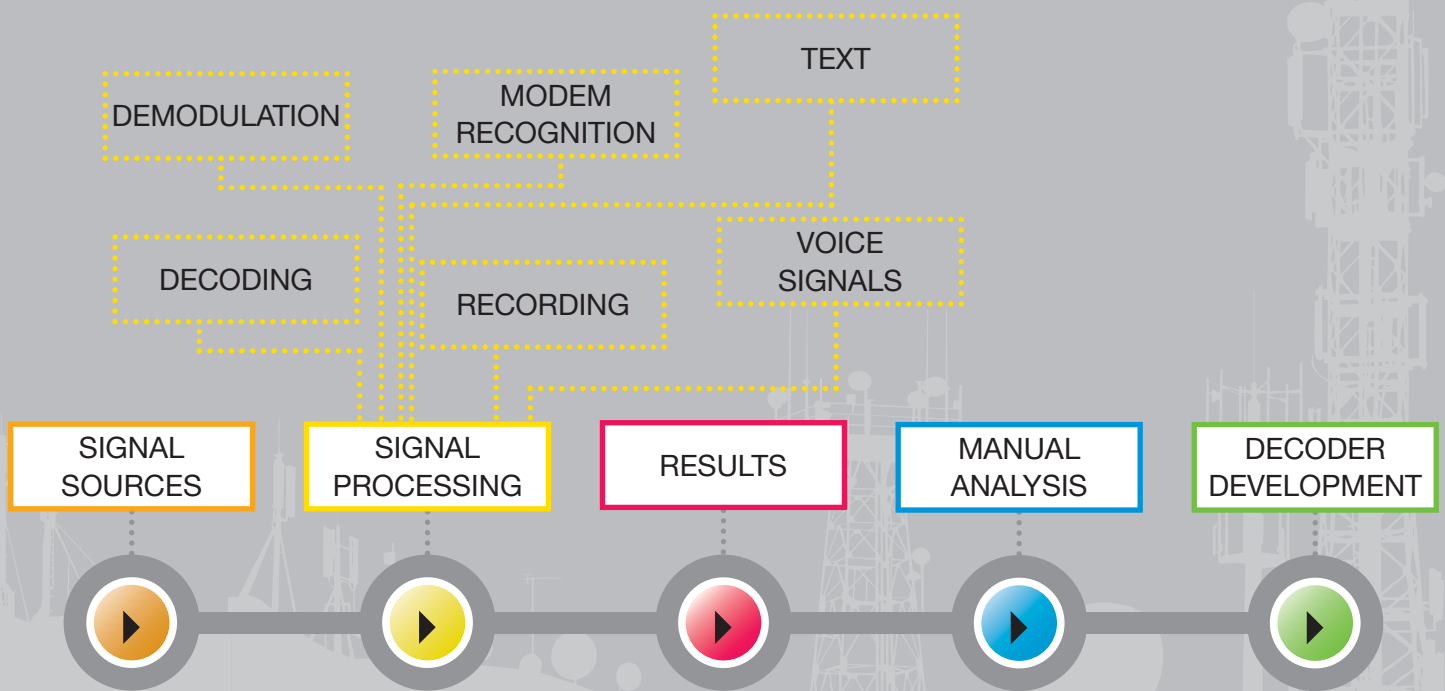
Modem description files can also be used in go2MONITOR.

In addition, go2DECODE is the perfect companion for go2MONITOR if signal analysis functions are required.

go2ANALYSE offers additional functions for low level code inspection.
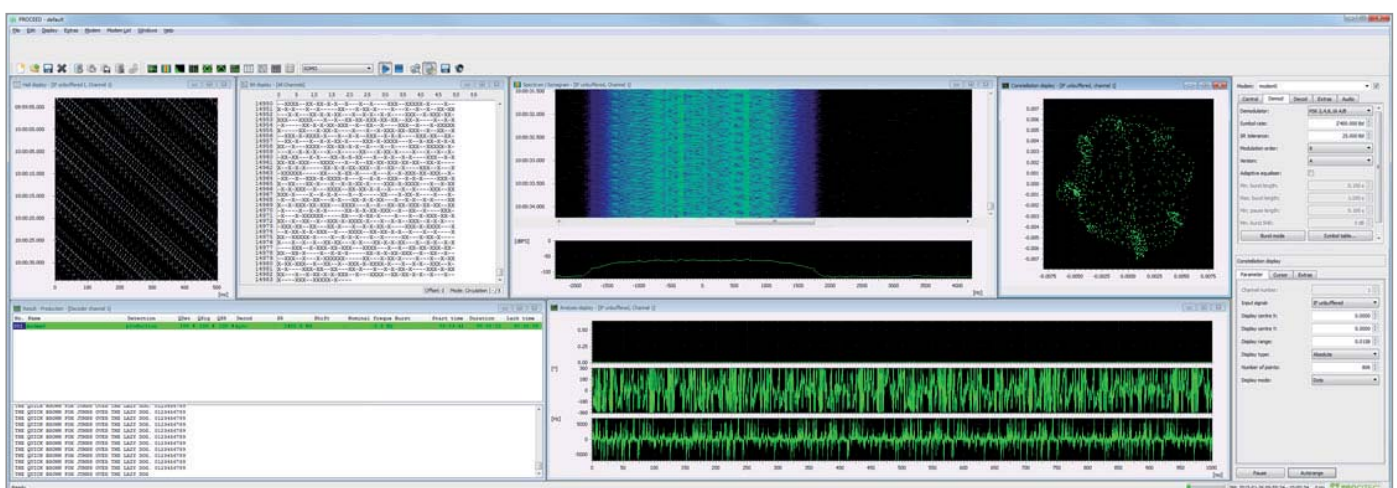
Main window of go2DECODE

FUNCTIONS

DEMODULATION

MODEM RECOGNITION

TEXT

DECODING

RECORDING

VOICE SIGNALS

SIGNAL SOURCES	SIGNAL PROCESSING	RESULTS	MANUAL ANALYSIS	DECODER DEVELOPMENT

Functions: Signal processing

Automatic recognition and decoding

go2DECODE's signal detection and production is a multi-level process. The incoming signal is buffered continuously. Buffering allows lossless demodulation in respect of time. The signal is checked in the modem list taking into account: detection, recognition, demodulation and decoding.

The protocol type is automatically recognized and its content produced. Signal characteristics (e. g. center frequency and baud rate) are determined and displayed. Decoded text will be displayed as plain text or as a formatted XML-stream.

Processing of voice signals

A powerful voice detection module is integrated. The voice processing algorithms of go2DECODE are insensitive to wideband interferences caused by a thunderstorm.

The sensitivity level itself can be parameterised. In addition to the decision "voice yes or no" the module determines the values for nominal frequency, voice pitch and modulation type.

The voice transmission can be demodulated and stored in audio files for listening and further processing. All this is done in real-time and tailored to the typical COMINT signal scenario.

Recording

Beyond from the demodulation and decoding of radio signals, the recording of signals is an important task in daily work.
Recorderd signals are the basis for manual technical analyses of unknown signals and for archiving the signals of interest. go2DECODE enables to record both, IF as well as AF after demodulation.

The recordings are started and stopped either via automatic triggers or manually by the operator. The triggers supported by go2DECODE are configurable squelch, signal detection, modem recognition and voice detection.

go2DECODE also allows to record the demodulated bit stream to a txt-file or a special go2DECODE format (including meta data like the quality of each bit).
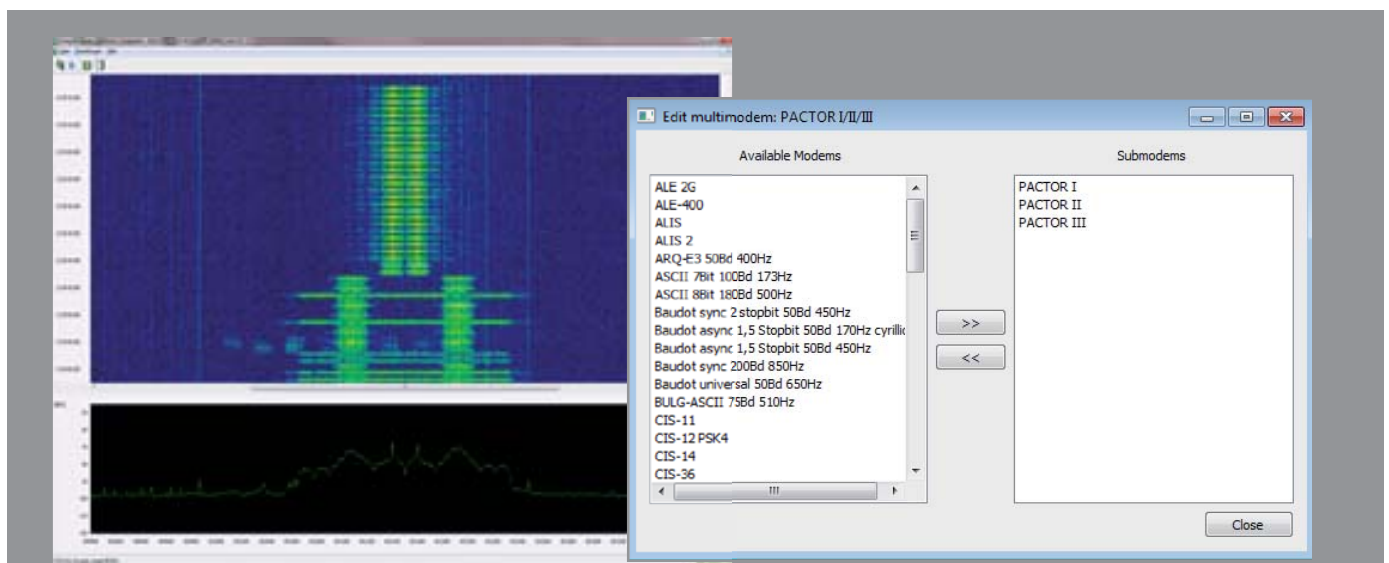
HANDLING OF ADAPTIVE PROTOCOLS

The multimodem feature describes and combines multiple modes used within modern protocols to one multimodem. Thereby adaptive radio signals using different modes can be produced as one signal without loss. The user can define own multimodems or edit existing multimodems in a comfortable way.

FUNCTIONS

MODULATION

PHASE

SYMBOL RATE

PATTERNS

FREQUENCY

AMPLITUDE

SHIFT

| SIGNAL SOURCES | SIGNAL PROCESSING | RESULTS | MANUAL ANALYSIS | DECODER DEVELOPMENT |
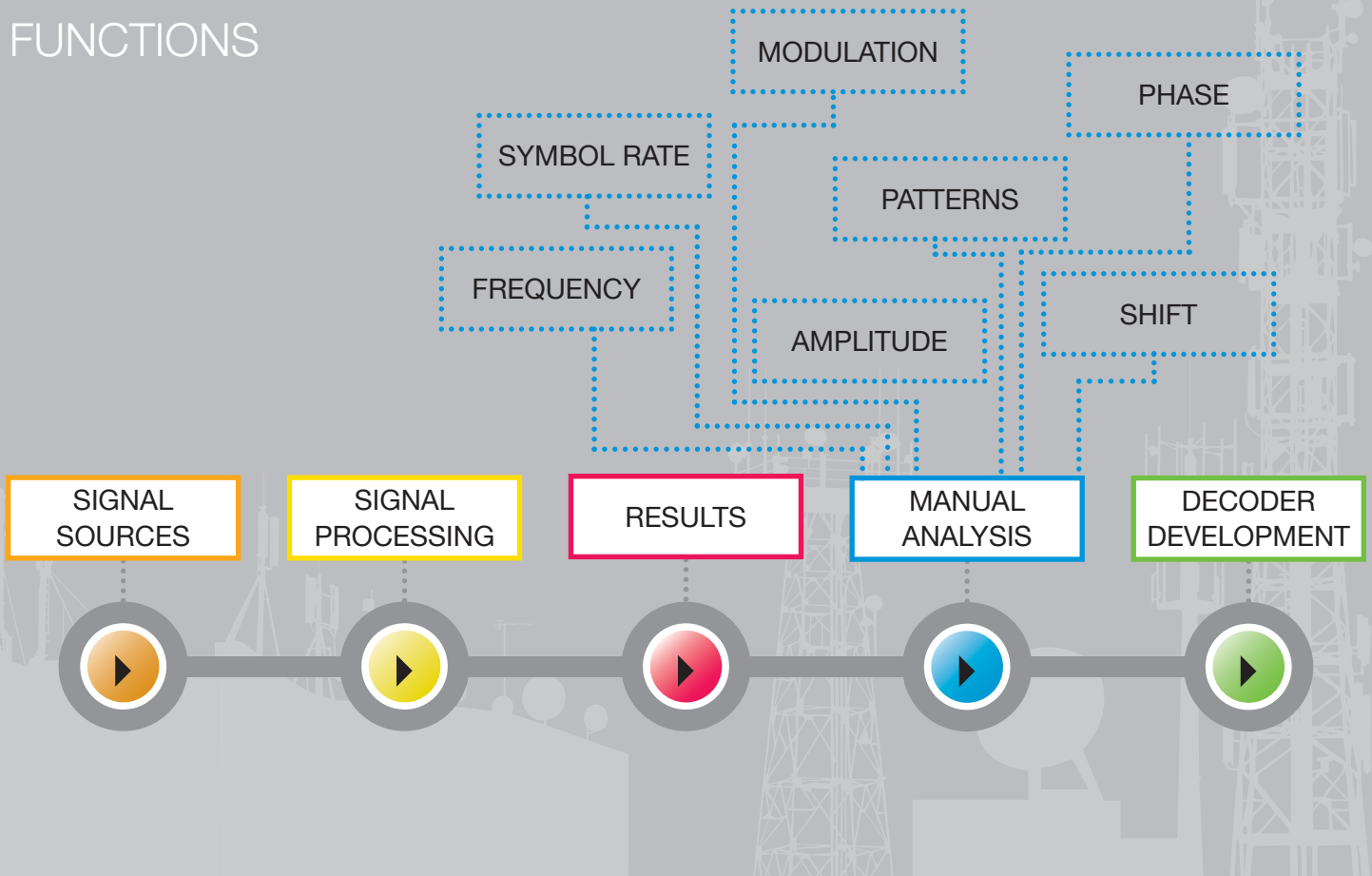
Functions: Signal analysis

Manual signal analysis

Precise measurements can be achieved with the displays provided by go2DECODE. With spectrum / spectrogram, spectrum, autocorrelation display, constellation display, time domain / eye-pattern display all the important tools needed to determine the signal characteristics are available.

The analysis display allows for the simultaneous interpretation of magnitude, frequency and phase of a signal to get an impression of the utilized modulation.

The Hell display and the bit display show information about the used coding. In each display double, cross-hair or harmonic cursors are offered. This powerful functions can provide an in-depht analysis which is often required to setup new demodulators and decoders which may be applied for automatic decoding.

Signal generator

go2DECODE contains a software based solution to generate modulated signals.

It's the perfect tool for operator training; simulation of signal scenarios, comparison of signals when analysing unknown signals, and testing of hardware and software.

It generates a wide range of modulation types. Modulator parameters like frequency, symbol rate, pulse shape or burst length can be changed to situation-specific values. It is possible to modify the coding scheme and to edit the text or bit pattern used.

Moreover, it serves to generate complex signal scenarios with many different signals in parallel and channel simulation which can be stored and reloaded.
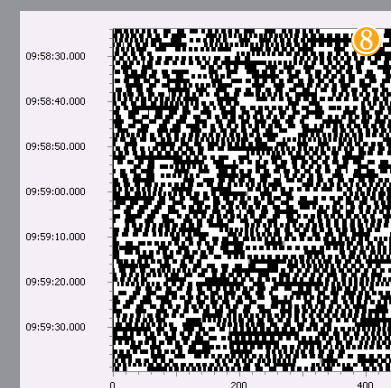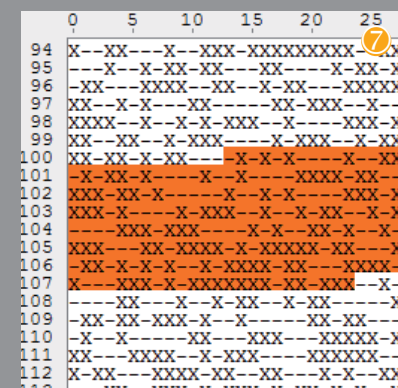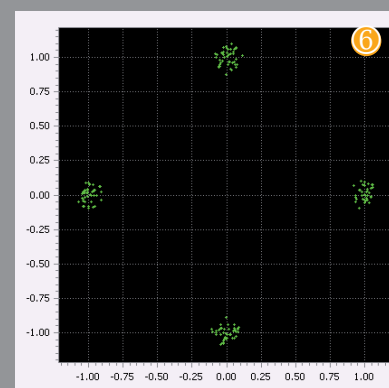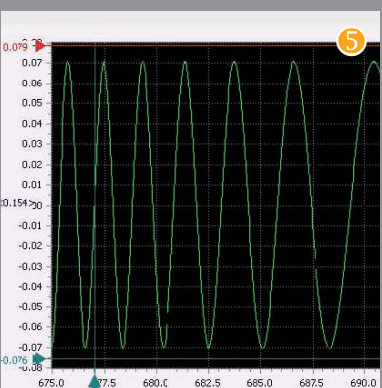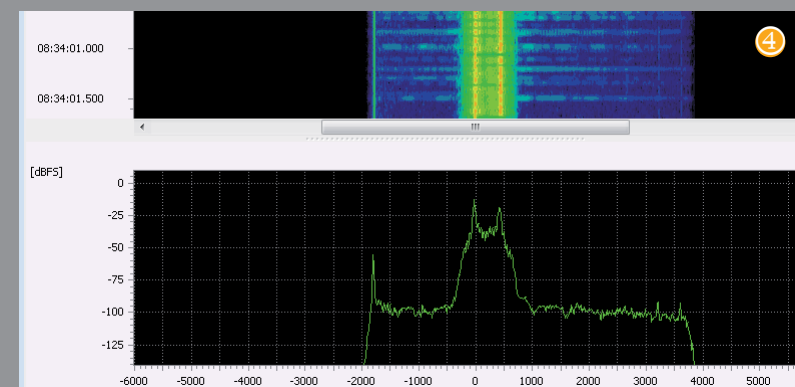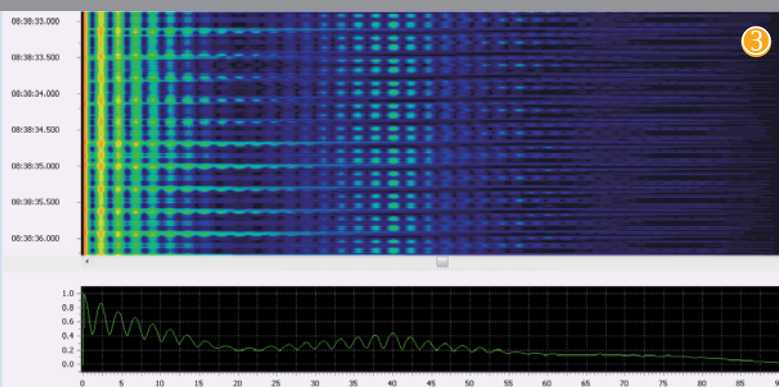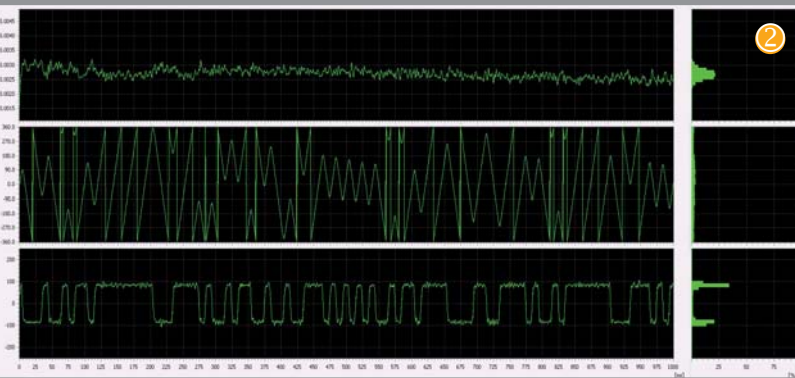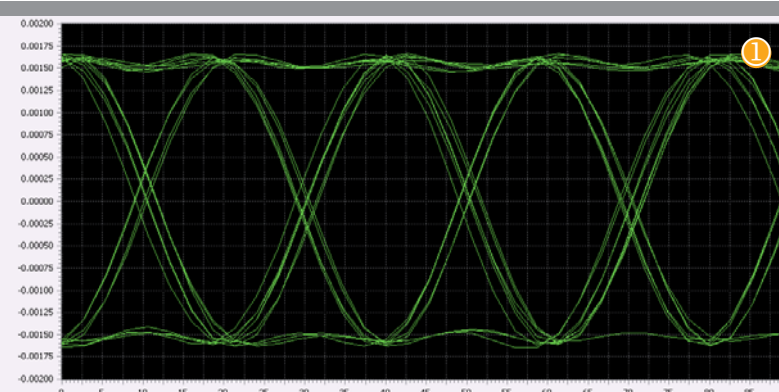
FUNCTIONS FOR EASY OPERATION

- In each display double, cross-hair or harmonic cursors are available.

- Search frequency and bandwidth are shown as well as the nominal frequency in addition to the live signal currently being monitored in the spectrum / spectrogram display

- The absolute signal time is shown and switching between line and dot drawing mode is easily possible.

- Easy adjustment of the zoom factor with „Ctrl + mouse wheel" in the results and the bit display

① Eye pattern display
② Analysis display
③ Autocorrelation display
④ Spectrum / spectrogram display
⑤ Time display
⑥ Constellation display
⑦ Bit display
⑧ Hell display

FUNCTIONS
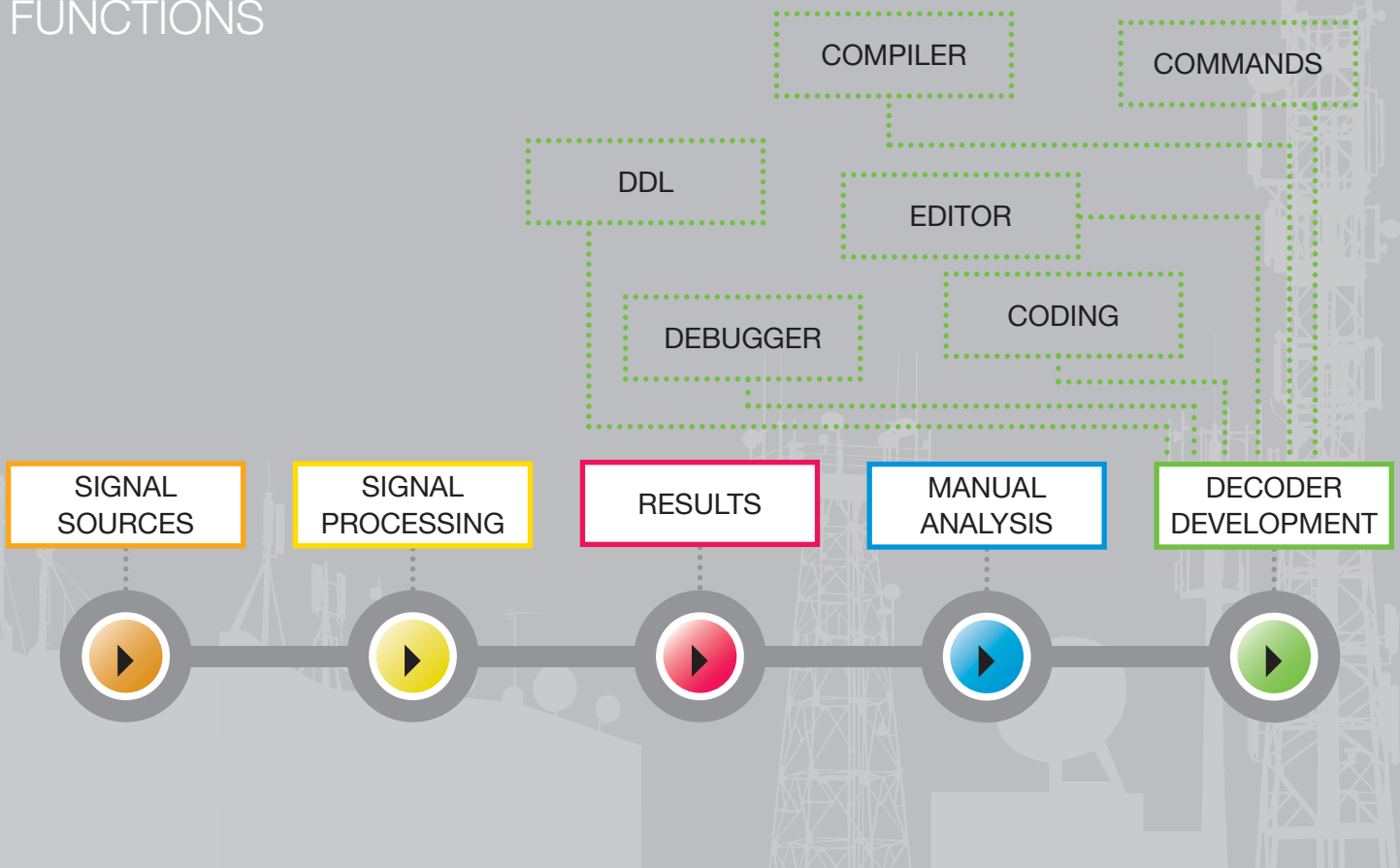
Functions: Decoder development

Decoder Description Language (DDL)

For many reasons the user might wish to define and create own decoders or modify the integrated standard decoders. The evolutionary growing Decoder Description Language (DDL) is the suitable tool kit for this task.

More than 100 commands e.g. for pre-processing, searching, reading, transformation and output formatting can easily be learned and used like a standard programming language. The set of commands is designed not only for plain detecting and synchronising tasks but also for complex channel decoding methods. All decoders supplied have been created on the basis of DDL. Operators can use the supplied sources as template for their own solutions.

Starting point is a demodulated bit stream produced with a correct parameterised demodulator. DDL allows to analyse and process these bit streams in a way, that the decoded message content is obtained in the end. This way, even modern channel decoding methods can be applied in a few steps only.

The decoders can be deployed to other go2SIGNALS installations e.g. go2MONITOR. The DDL ensures a high decoding quality, i.e. fast synchronization, selectivity, easy error correction etc.

Decoder development tools

Decoders are preferably created and tested using specialised tools. This way, decoder developers obtain the best possible insight into the entire modem function flow. go2DECODE's DDL based decoder development tools consists of an editor, a compiler and a debugger.

The editor is used to create and modify the source code. The editor offers automatic command completion and context-sensitive help. Correct commands, functions and keywords are highlighted in colour for visual checks. In the event of syntax errors, the integrated compiler provides detailed error messages and it generates an executable decoder programme, if compilation is error free.

In addition the debugger is used to verify the executable decoders. This application allows to analyse the decoding procedure in detail. In an advanced mode, the debugger can be operated with further analysing possibilities together with all signal processing components of the system. E.g. to analyse the behaviour of decoder-controlled demodulators when processing adaptive transmission methods or the interaction of several modems in automatic demodulation and decoding.
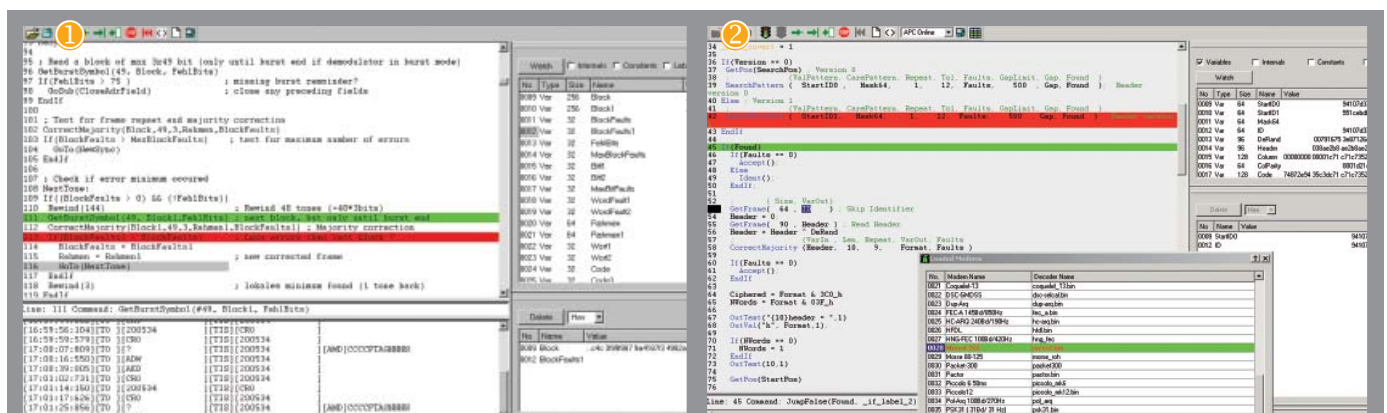
① Debugging of decoders with breakpoints
② The advanced mode of the Decoder Debugger allows for analysis of the interaction of decoders

Technical specifications

Specifications overview

Data acquisition	Digital IF stream (complex baseband I/Q); Soundcard; Digital AF (WAV 8, 16, 32 Bit); Others on request
Localization	English or German; Others on request
Documentation	PDF User manual / PDF Online-Help
Recommended PC hardware	Notebook or Desktop; CPU: Intel i5, min. 2 GHz; Memory: ≥ 2 GByte RAM, HDD: ≥ 10 GB, Screen Resolution min. 1280 x 1024 Pixel, Soundcard for analog IF input, 1 GBit/s Ethernet for digital IF input
OS	Windows 7 / 10 64 bit, Linux (CentOS/Redhat 6/7) 64 bit

Features

Software Feature	Remarks	
Alphabets	Can be added to the decoder source code, free configurable Requires go2DECODE Standard or Professional	
Decoders	Our list of standard, military and PMR decoders is subject to continuous development. You find a current list of available decoders on our website: www.procitec.de	
Voice detection, demodulation, recording	Modulation types: AM, FM, USB, LSB Detection: voice yes/no Nominal frequency Voice Pitch Automatic audio demodulation and recording	
Demodulators	Analogue Selcal ASK 2, 4 ASK2PSK4 ASK2PSK8 ASK4PSK8 Chirp Clover II Clover 2000 Clover 2500 Coquelet DPSK 2, 4, 8, 16 A/B F1A FM / F3E F6/F7B FSK 2 matched FSK 2, 3, 4 disc. FSK 2,3 auto shift MSK / GMSK J3E (USB, LSB) LINK 11 MDPSK 2, 4, 8, 16 A/B MFSK 2 Morse	MPSK 2, 4, 8, 16 A/B MT63 MultiModem MultiTone (FSKn) OFDM OQPSK Pactor II, III, IV PSK 2, 4, 8, 16 A/B PSK data aided (mode controlled by decoder) QAM 16, 32, 64, 128, 256 TFM3 THROB / THROBX Automatic frequency, amplitude and symbol rate control Fast equalizer using known training sequences (via DDL) Primary demodulation USB/LSB/AM/FM Automatic burst synchronization

Features

Software Feature	Remarks	
GUI	Easy and intuitive to operate user interface Input spectrogram with live audio Manual and automatic demodulator and decoder control Different analysis displays for manual signal analysis Specialized signal analyzing cursor measurement functions Modem editor with demodulator and decoder settings Decoder editor and compiler (DDL)	
Input Audio (DANA)	Up to 10 MHz sampling rate (note: functionality may be limited for sampling rates higher than 2 MHz) Playlist (files) Loop mode IQ / real files Remove DC Filtering Mirror FM demodulation Time source (File/System clock) Sample rate converter Center frequency tuning Streaming TCP/IP	
Input Files (DANA)	Digital IF (complex baseband I/Q 32 Bit), Sampling rate <= 10 MHz (note: functionality may be limited for sampling rates higher than 2 MHz) Playback of standard wav files. Digital AF (WAV 8, 16, 32 Bit) Playback of Perseus and WiNRADiO WAV recordings with correct frequency display	
Input TCP/IP Streaming	Generic PROCITEC/PLATH format VITA 49 (on request) PXGF (on request)	
Signal recordings	Types: IF / AF Start / Stop - Manual by operator - Automatic by trigger Trigger types - Configurable squelch level - Signal detected - Transmission method recognized - Transmission method unknown - Voice/Morse detected File formats: WAV	
Compatible receivers	AirSpy CommsAudit CA7851 Grintek GRX Lan IZT R3xxx series IZT R4000 (SignalSuite) Microtelecom PERSEUS NARDA NRA-3000 RX NARDA NRA-6000 RX NARDA IDA 2 PLATH SIR 2110/2115 PLATH SIR 5110/5115	R&S EM100 / PR100 RFSPACE SDR-14 RTLSDR/Noxon USB-sticks SDRplay RSP ThinkRF WSA5000-427 WiNRADiO G31DDC WiNRADiO G33DDC WiNRADiO G39DDC Generic VITA 49 receiver support Other generic "Winrad ExtIO" supported receivers Note: not all listed receivers are supported with Linux operating systems

Technical specifications

Features	
Software Feature	**Remarks**
ISO 9001:2015	Company is certified (not only hardware)
License	USB-Dongle (WIBU-KEY/Codemeter) License sharing with license server
Output	Decoding results TXT-File with decoded text XML-File with decoded text and metadata Signal recordings Voice recordings Bitstream *.rec files (bits and quality of each bit) Bitstream *.txt files (bits)
Sonagram Viewer (SoVi)	Standalone application for spectrum/spectrogram display
ResultViewer (PMO)	Display of: Decoder output, demodulated audio files (CW, TETRA etc.), text output (ALE, HFDL, etc.), binary files
Signal Generator (SOMO)	For standard test signals. Requires go2DECODE-Professional; detailed description see below
Decoder Development	Modification of standard decoders Definition of new decoders Integration of existing decoders, requires go2DECODE-standard or professional; detailed description see below
Soundcard Interface (DANA)	Analog input WiNRADiO VSC Virtual-Audio-Cable (VAC) etc.
Third party decoder	Interface to the DDC channel output Interface to the bitstream output Streaming and control interface with DDL
Training	Very short training period Same technology as in large decoding systems

Analysis	
Analysis	**Items**
Displays	Spectrum Spectrogram/Sonagram Autocorrelation I/Q Constellation Eye pattern Time domain (oscilloscope) with additional histogram Analysis (magnitude, frequency and phase) with additional histogram Hell Bit
Signal squaring	Squaring: 0, 1, 2, 3
Windowing	Rectangle Hanning Hamming Kaiser Flat Top Blackman
Cursors	Harmonic Crosshair 2 cursor modes
Center frequency	Adjustable
Operation modes	Online / offline

Technical specifications

Decoder Development (optional)	
Decoder Development	**Items**
Basic functions	Modification of standard decoders Definition of new decoders Integration of existing decoders
Function library	Pre-processing Symbol conversions Descrambling procedures Channel selections Pattern search Burst detection Forward/backward time jumps Deinterleaving Check and correction procedures: CRC, Hamming, Viterbi, BCH, Reed-Solomon Elementary arithmetic and bit manipulations Table handling Various output formats, alphabets, channels Control of demodulation and decoding Setting of demodulator parameters Selected voice codecs Branches and sub-routines (special functions on request) Soft decision
Decoder Editor	Automatic command completion Content related help Syntax highlighting
Compiler	Generation of binary decoder files Detailed code check and error messages

Debugger	Debugging
	- Breakpoints on lines of code
	- Single-step mode for lines of code
	- Display of variable contents in various formats and displays
	- Editing of variable contents
	- Display of all input data packages
	- Display of internal data buffer and current read position
	  Advanced analysis of recognition, demodulation and decoding
	- Breakpoints in several decoders of one modem list
	- Comparison of the decoder behaviour in search phase and
	  decoding phase
	- Monitoring the current demodulator state

SOMO Signal Generator (optional)	
SOMO Signal generator	**Items**
Modulation generation	- Generation of single and multi channel, continuous and burst signals - Modulation types - ASKn - PSKn (single and multi channel) - QAMn (single and multi channel) - ASKnPSKm (single and multi channel) - NCPFSKn - FSKn (single and multi channel) - MSK (single and multi channel) - GMSK (single and multi channel) - F7B - TFM3 - TFM5 - Morse - Sine - Rectangle - Saw tooth - Triangle - input from .wav files - Primary modulation:USB, LSB, AM, FM - Variable modulation parameters - Attenuation - Center frequency - Baud rate - Pulse shapes: RC pulse, RC/RRC spectrum, Gauss pulse - Burst parameters
Coding generation	Binary, Baudot, ASCII, HC ARQ, ITA2 Differential/absolute coding Convolutional encoding / Viterbi CCITT standards V.17 … V.33 Variable bit stream, bit order, parity Various scrambling algorithms
Channel simulation	AWGN Multipath propagation: Watterson (ITU) and enhanced ITS model
Output	Soundcard / Wav Files / network stream

Subject to modifications, available from software version 17.2.

Order guide

x = included o = as option available	Automatic processing	Signal analysis	Edit of demodulator / decoder	Decoder Debugger	Signal generator (SOMO)	Recording / replay	Standard set of decoders	Set of military decoders [1]	Set of PMR decoders [2]
Software go2DECODE Light	x					x	x	o	o
Software go2DECODE Standard	x	x	x			x	x	o	o
Software go2DECODE Professional	x	x	x	x	x	x	x	o	o

Export conditions:

[1] In case of an export from the Federal Republic of Germany an export permission must be granted by the German authorities. Enduser certificate is required.

[2] In case of an export from the European Union an export permission must be granted by the German authorities. Enduser certificate is required.

go2DECODE Training

This training course familiarises the participant with all go2DECODE components and functions and their practical use. It focuses on delivery of basic knowledge and signal analysis. Configuration and parameter setting of demodulators and decoders for automatic detection of new modems will be explored in more depth. Skills will be gained in practical authentic situations using live signal recordings.

This training offers the possibility to handle individual tasks and queries as well as discussing the signal samples provided by the participants.

Training content:

- Field of application for go2DECODE
- Introduction to the user interface
- Fundamentals of digital signal modulation
- Use of signal analysis functions
- Creation of new transmission modes for automatic detection and production

DDL Training

In this training course, participants are introduced to the fundamentals of the Decoder Description Language (DDL). The essential functions will be explained in detail and the commands of this easy to learn programming language will be explained.

Building on the participant's prior knowledge of the principles of channel coding and the fundamentals of bit error correction procedures, existing decoders will be modified and adapted to individual requirements. Following this training course, participants will be able to modify and to create new decoders. This training course is adresses to technical employees who are familiar with programming, modification and adaptation of signal decoding software.

Training content:

- Creation and modification of decoders
- Program structure, function and commands and interfaces of the DDL
- Use of the decoder debugging function
- Practical exercise: writing a simple decoder
- Methods for bit error recognition and correction

go2SIGNALS

... monitoring a connected world

PROCITEC GmbH

Rastatter Strasse 41

75179 Pforzheim

Germany

Phone: +49 7231 155 61-0

Fax: +49 7231 155 61-11

Email: sales@procitec.de

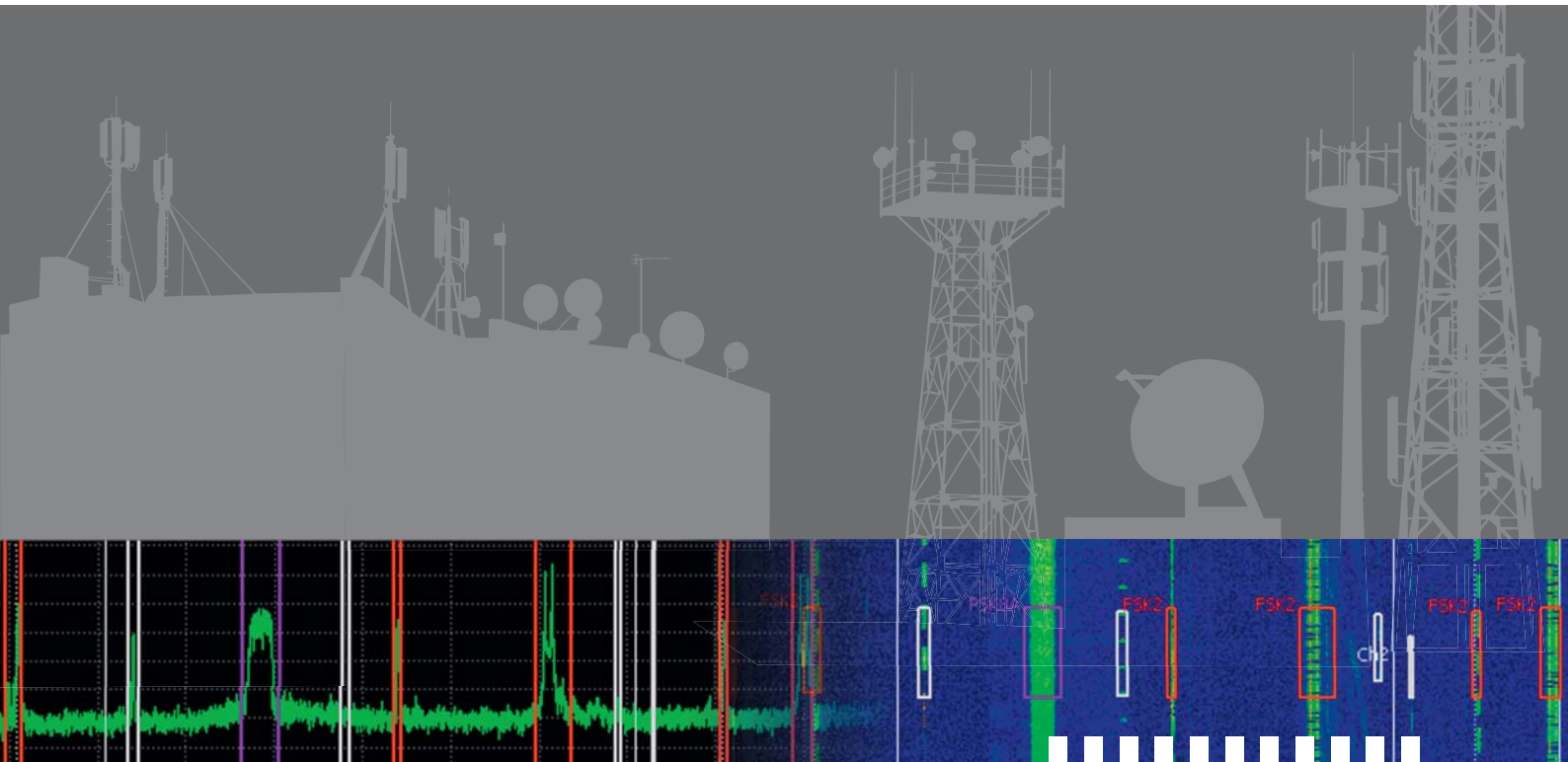Further information on

www.go2signals.de

www.procitec.de

go2DECODE

go2MONITOR

go2ANALYSE