go2DECODE

Recognition • Demodulation • Decoding

Part of the product line go2SIGNALS
go2DECODE is a standalone software for signal recognition, demodulation, decoding, speech detection, signal recording and technical signal analysis. The software is designed for applications in civilian and military environments at government agencies, defence signal corps, homeland security agencies and telecommunication authorities.

### go2DECODE Features

- Fully automatic signal processing of radio and data signals
- Knowledge based recognition approach, using the analyst’s know-how
- Wide range of universal demodulators and standard decoders
- Automatic processing of adaptive transmission methods
- Speech detection and demodulation
- Determination and continuous tracking of signal characteristics
- IF/AF-recordings
- Displays for monitoring and manual analysis of unknown signals
- Definition and customisation of decoders with the Decoder Description Language
- Signal acquisition from digital or analogous receivers via LAN, USB, audio or file

### Radio monitoring: Beyond data decoding

The threat has changed:
Terrorism and asymmetrical warfare demand superiority of information. Acquisition of information means gathering and analysing information of all potential sources.

But also the signal scenario changed:
The increasing density of signals, the growing complexity and the use of modified standard modems are posing a challenge.

As every signal is a message, it is necessary to analyse new emissions and to automate the collection of information. In order to do this, the highly educated specialists have to be disburdened from work, which can be done automatically.
go2DECODE provides the most innovative solution for the automation of radio monitoring. It detects, classifies, demodulates and decodes known modems automatically. The system’s knowledge base is implemented as a database, describing well known standard modems.

Signal analysts fill up this signal parameter database with their knowledge about demodulation and decoding parameters.

go2DECODE demodulates and decodes adaptive transmissions without loss of information, e.g. changes in modulation.

Automatic radio monitoring

The recognition process obtains the information concerning the signal classes from this database. An adaptation to a changing scenario is possible by entering parameters of new modems (demodulator and decoding protocol parameters). The specialist can concentrate on the analysis of unknown emissions and the evaluation of automatically generated results.

go2DECODE allows for the manual analysis of these emissions as well as for the completely automatic searching, monitoring and production of the predefined modems.
Recognition and production

Standalone and system solutions

Although go2DECODE is optimised for standalone applications, it also will interact with other radio monitoring systems. 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.

Automatic recognition and decoding

go2DECODE’s signal detection and production is a multi-level process. The Automatic Production Channel (APC) buffers the incoming signal continuously. Buffering allows lossless demodulation in time respect. The APC checks the signal for the predefined modem types in the steps detection, recognition, demodulation and decoding.

Signal characteristics (e.g. centre frequency and baud rate) are determined and displayed. Decoded text will be displayed as plain text or as a formatted XML-stream.

Because of this multi-level process a modulation classification, a modem recognition and a complete production can be realised with go2DECODE. Thus even incomplete processing steps can lead to partial results. Quality criterions of all results are calculated and displayed.
Processing and recording

Processing of speech signals

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

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

The speech 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 of signals and bits

Apart from the demodulation and decoding of radio signals, the recording of signals is an important application in everyday use.

Signal recording not only yields the material for manual technical analyses of unknown signals but also for archiving the signals of interest. go2DECODE enables to record both IF as well as AF upon 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 speech detection. go2DECODE also allows the recording of the demodulated bit stream to a txt file or a proprietary “PROCITEC” file format that includes additional Meta data like the demodulation quality of each bit.
Manual signal analysis

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

An analysis display allows for the simultaneous interpretation of magnitude, frequency and phase of a signal to get a first impression of the used demodulation.

A Hell display and a bit display show information about the used coding. In each display double or harmonic cursors are offered. With this powerful tool-kit a detailed analysis can be done that allows the addition of a new modem into the list of automatically recognised modems.
Decoder Description Language (DDL)

For many reasons the user might wish to define and create own decoders, integrate existing ones or modify the integrated standard decoders. The evolutionary growing Decoder Description Language (DDL) is the particularly 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 detection and synchronising tasks but also for complex channel decoding methods. The decoders supplied have been created on the same basis, and operators can use these decoders as models for their own solutions.

Starting point is a demodulated bitstream supplied by an appropriately parameterised demodulator. DDL permits to analyse and process said bitstreams so as to generate the decoded message contents 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 go2DECODE installations and to other PROCITEC radio monitoring systems. The Decoder Description Language (DDL) ensures a high decoding quality, i.e. fast synchronisation, selectivity, error correction abilities etc.
Decoder Development

Decoders are preferably created and tested using tools explicitly provided for this purpose. This way, decoder developers obtain the best possible insight into the entire modem function flow. With the look and feel of modern software development tools the DDL based decoder development is done by means of the integrated development environment, consisting of an editor, a compiler and a decoder debugger (go2DECODE Professional).

The decoder source code is written using the Decoder Editor which is optimised for this kind of work. This editor offers special tools for automatic command completion and context-related help functions. Correct command functions and keywords are highlighted in colour for visual checks. In the event of syntax errors, the integrated Decoder Compiler provides detailed error descriptions and, in case of success, generates an executable decoder programme.

In addition the optional debugging functionality serves to verify the executable decoders. This application allows to analyse the decoding procedure in detail. In an advanced mode, the Decoder Debugger can be operated with further analysing possibilities in an environment with all signal processing components of the system. This permits for example to analyse the behaviour of decoder-controlled demodulators when processing adaptive transmission methods or the interaction of several modems in automatic demodulation and decoding.

Software based signal generator

go2DECODE contains a software based signal generator. 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 frequencies, baud rates, pulse shapes, or burst lengths 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 which can be stored and reloaded.
### Technical specifications

#### Decoder development

**Editor**  
- Automatic command completion  
- Content related help  
- Syntax highlighting  

**Compiler**  
- Generation of binary decoder files  
- Detailed code check and error messages  

#### Demodulators

<table>
<thead>
<tr>
<th>Universal demodulators</th>
<th>Coquelet</th>
<th>FSK 2 matched filter</th>
<th>Multitone (FSKn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3E</td>
<td>CW, morse</td>
<td>GMSK</td>
<td></td>
</tr>
<tr>
<td>ASK 2</td>
<td></td>
<td>J3E (USB, LSB)</td>
<td></td>
</tr>
<tr>
<td>ASK2PSK2</td>
<td>F1A</td>
<td>MDPSK 2, 4, 8, 16 A/B</td>
<td></td>
</tr>
<tr>
<td>ASK2PSK8</td>
<td>F3E</td>
<td>MPSK 2, 4, 8, 16 A/B</td>
<td></td>
</tr>
<tr>
<td>Clover II</td>
<td>F6</td>
<td>MSK</td>
<td></td>
</tr>
<tr>
<td>Clover 2000</td>
<td>F7B</td>
<td>Multi Modem</td>
<td></td>
</tr>
<tr>
<td>Clover 2500</td>
<td>FSK 2, 3, 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fast equalizer using known training sequences (via DDL)

Primary demodulation SSB/AM/FM

#### Speech detection, demodulation, recording

- Modulation types: AM, FM, USB, LSB, DSB
- Detection: speech / no speech
- Determination of nominal frequency and voice pitch
- Demodulation
- AF Recording

#### Other available decoders

Our set of standard HF/V UHF and military decoders is subject to continuous development. You find a more detailed list of the available decoders on our website, listing the primary name of a decoder and also his various alias names.
## Technical specifications

### Decoder Description Language (DDL)
- 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, fonts, channels
- Control of demodulation and decoding
- Setting of demodulator parameters
- Selected speech codecs
- Branches and sub-routines
  (special functions on request)
- Soft decision

### Decoder Debugger (included in PROCEED Professional only)
- 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

### Manual analysis

#### Signal displays
- Spectrum / sonagram
- Spectrum
- Constellation display
- Time domain / eye-pattern display
- Autocorrelation display
- Analysis display (magnitude, frequency and phase)
- Hell display
- Bit display

#### Squaring: 0, 1, 2, 3

#### Windowing
- Rectangle
- Hanning
- Hamming
- Kaiser
- Flat-top
- Blackman

#### Cursors: harmonic, cross-hair, 2 cursor modes

#### Centre frequency adjustable

#### Operation modes: online / offline

### Signal recordings

#### Types: IF / AF

#### Start / Stop
- Manual by operator
- Automatic by trigger

#### Trigger types
- Configurable squelch level
- Signal detected
- Transmission method recognised
- Transmission method unknown
- Speech detected

#### File formats: WAVE / PROCITEC RAW
### Technical specifications

#### Compatible receivers (digital IF)

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Bitstream</th>
<th>ExtIo software interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;S EB 200</td>
<td>SDR 14</td>
<td></td>
</tr>
<tr>
<td>R&amp;S EM 510</td>
<td>SDR IQ</td>
<td></td>
</tr>
<tr>
<td>R&amp;S EM/PR 100</td>
<td>WINRADIO</td>
<td></td>
</tr>
<tr>
<td>IZT 30XX</td>
<td>WJ 86XX</td>
<td></td>
</tr>
<tr>
<td>IZT 32XX</td>
<td>WJ 87XX</td>
<td></td>
</tr>
<tr>
<td>Perseus</td>
<td>ExtIo software interface</td>
<td></td>
</tr>
<tr>
<td>others on request</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Minimum PC hardware/software

**Notebook or Desktop**
- CPU: Intel i5, min. 2 GHz
- Memory: ≥ 2 GByte RAM
- HDD: ≥ 50 GB
- Screen Resolution: 1280 x 1024 Pixel
- Soundcard for analog IF input
- 1 Gbit/s Ethernet for digital IF input

**Operating System**
- Windows 7/8

**Localisation**
- English

**Documentation**
- PDF on DVD
- Online-Help

### Data acquisition

<table>
<thead>
<tr>
<th>Data acquisition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital IF</td>
<td>(complex baseband I/Q)</td>
</tr>
<tr>
<td>Analog IF</td>
<td></td>
</tr>
<tr>
<td>Digital AF</td>
<td>(WAV 8, 16, 32 Bit)</td>
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<tr>
<td>PROCITEC IF File Format RAW</td>
<td></td>
</tr>
<tr>
<td>others on request</td>
<td></td>
</tr>
</tbody>
</table>

### Result files

**Decoding results**
- TXT-File with decoded text
- XML-File with decoded text and metadata

**Signal recordings**

**Speech recordings**

**Bitstream**
- PROCITEC REC (bits and quality of each bit)
- TXT (bits)
## Technical specifications

### Signal generator (included in go2DECODE Professional)

<table>
<thead>
<tr>
<th>Modulation generation</th>
<th>Coding generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Generation of single and multi channel, continuous and burst signals</td>
<td>- Binary, Baudot, ASCII, HC ARQ, ITA2</td>
</tr>
<tr>
<td>- Modulation types</td>
<td>- Differential/absolute coding</td>
</tr>
<tr>
<td>- ASKn</td>
<td>- Convolutional encoding / Viterbi</td>
</tr>
<tr>
<td>- PSKn (single and multi channel)</td>
<td>- CCITT standards V.17 … V.33</td>
</tr>
<tr>
<td>- QAMn (single and multi channel)</td>
<td>- Variable bit stream, bit order, parity</td>
</tr>
<tr>
<td>- ASKnPSKm (single and multi channel)</td>
<td>- Various scrambling algorithms</td>
</tr>
<tr>
<td>- NCPFSKn</td>
<td></td>
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<tr>
<td>- FSKn (single and multi channel)</td>
<td></td>
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<tr>
<td>- MSK (single and multi channel)</td>
<td></td>
</tr>
<tr>
<td>- QAMn (single and multi channel)</td>
<td></td>
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<tr>
<td>- GMSK (single and multi channel)</td>
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<tr>
<td>- F7B</td>
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<tr>
<td>- TFM3</td>
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<tr>
<td>- TFM5</td>
<td></td>
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<tr>
<td>- Morse</td>
<td></td>
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<tr>
<td>- Sine</td>
<td></td>
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<tr>
<td>- Rectangle</td>
<td></td>
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<tr>
<td>- Saw tooth</td>
<td></td>
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<tr>
<td>- Triangle</td>
<td></td>
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<tr>
<td>- Modulation of speech signals</td>
<td></td>
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<tr>
<td>- AM and FM modulation</td>
<td></td>
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<tr>
<td>- Support of LSB and USB</td>
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<tr>
<td>- Speech input from .wav files</td>
<td></td>
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<tr>
<td>- Primary modulation</td>
<td></td>
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<tr>
<td>- USB, LSB, AM, FM</td>
<td></td>
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<tr>
<td>- Variable modulation parameters</td>
<td></td>
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<tr>
<td>- Attenuation</td>
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<tr>
<td>- Centre frequency</td>
<td></td>
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<tr>
<td>- Baud rate</td>
<td></td>
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<tr>
<td>- Pulse shapes: RC pulse, RC/RRC spectrum, Gauss pulse</td>
<td></td>
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<tr>
<td>- Burst parameters</td>
<td></td>
</tr>
</tbody>
</table>

### Operating Modes
- Online: 20/40 kHz bandwidth
- Offline: bandwidth of several MHz

### Output: Soundcard / Wave Files
## Order guide

<table>
<thead>
<tr>
<th>Feature</th>
<th>Software go2DECODE Light</th>
<th>Software go2DECODE Standard</th>
<th>Software go2DECODE Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Demodulation</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Decoding</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Analysis</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Decoder Debugger</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Software based signal generator (SOMO)</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Set of non-military decoders and demodulators</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### Options

- **MIL Military Package**
  - Set of Military-demodulators and Decoders*

- **PMR Professional Mobile Radio Package**
  - Set of PMR-demodulator and Decoders**

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* In case of an export / reexport from the Federal Republic of Germany a permission must be granted by the German authorities. An enduser certificate is required.

** In case of an export / reexport from the European Union an export permission must be granted. An enduser certificate is reequired.
Trainings

As a leading supplier of software in the field of radio monitoring PROCITEC comprises a variety of trainings. The trainers are specialists with a wide range of expert knowledge not only in the principles of radio monitoring but also in the usage of the software solution. The training process is based on a modern training method with lectures and practical exercises.
### Basic Training go2DECODE

**Focus**
The course contains a detailed presentation of all go2DECODE components, which are demonstrated in many practical examples. In addition, participants will verify their understanding of signal analysis and modem type composition by use of various types of recorded signals. Part of the time will be reserved for discussing individual tasks and problems as well as analysing signals provided by the participants.

**Objectives**
After the training, participants will be able to understand the functions and handling of go2DECODE, and will acquire basic skills in analysing modulated signals and creating suitable modems for manual or automatic signal detection and production.

**Target Audience**
Operators, analysts and supervisors

**Knowledge Required**
The participant should be familiar with fundamentals of communication technology.

**Contents**
- General software introduction
- Fundamentals of digital signal modulation
- User interface overview
- Signal interfacing and adjustments
- Signal simulation tool SOMO
- Rapid pre-classification of modulation types
- Analysing signals
- Setting up demodulators
- Analysis of demodulation results
- Setting up modems and modem lists
- Automatic production and signal recording
- General training with recorded signals
- Introduction to Decoder Description Language (DDL)
- Special questions and individual tasks

**Duration**
4 days, 32 training-blocks (of 45 min)

### Training Decoder Description Language

**Focus**
The course contains a presentation of the principles and potentials of DDL. Major vital commands will be discussed in detail. Depending on the participants' previous knowledge this includes various basic principles of channel coding and fundamentals of forward error correction methods. Participants will mainly use the convenience of go2DECODE’s Decoder Development Environment to verify their understanding.

**Objectives**
Participants will learn the potentials and general usage of the Decoder Description Language. This includes basic skills in coding principles as far as required in applying the provided functions. Based on the understanding of existing decoders, these will be modified and adjusted to individual needs. When using DDL in practice after this training, all skills and experience needed to write new decoders will be rapidly acquired.

**Target Audience**
Technical staff involved in writing, modifying and adjusting decoders.

**Knowledge Required**
The participant should have basic skills in communication technology. Experience in any other programming language will be helpful.

**Contents**
- Introduction and overview
- Basic steps to create and modify decoders
- Basic language structure
- Main language elements
- Discussion of simple decoder programs
- Use of editor and compiler
- Detailed discussion of vital commands
- Special aspects of automatic production
- Exercises in writing simple decoders
- Methods of error correction and detection

**Duration**
4 days, 32 training-blocks (of 45 min)