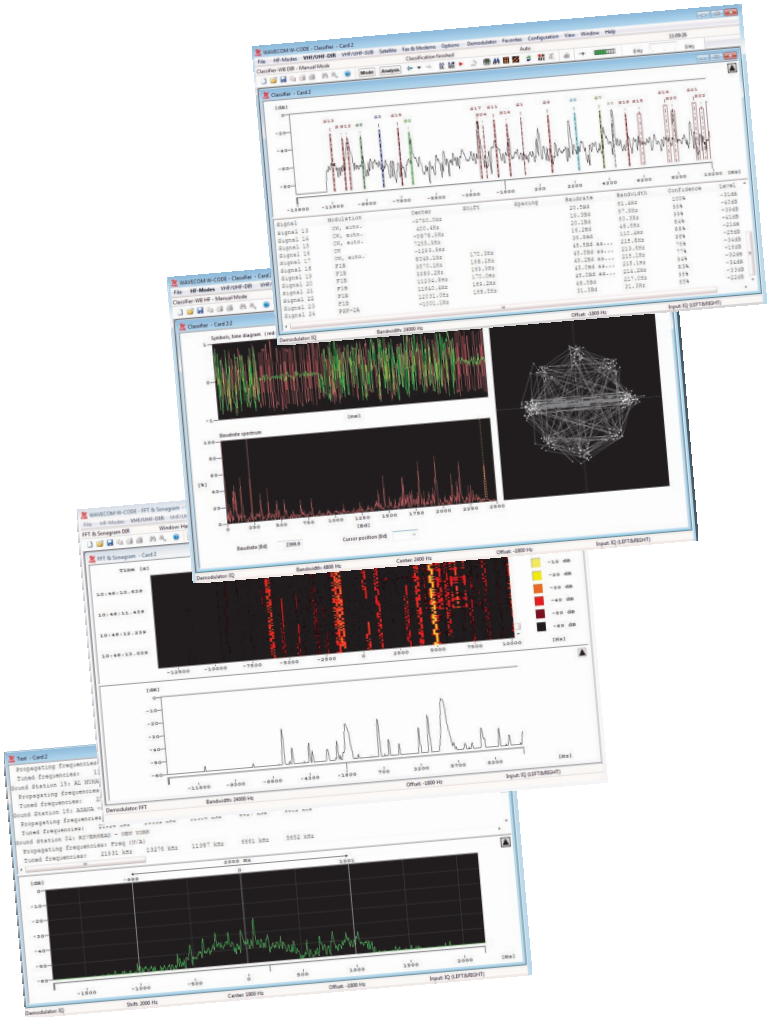
WAVECOM
NACHRICHTENTECHNIK

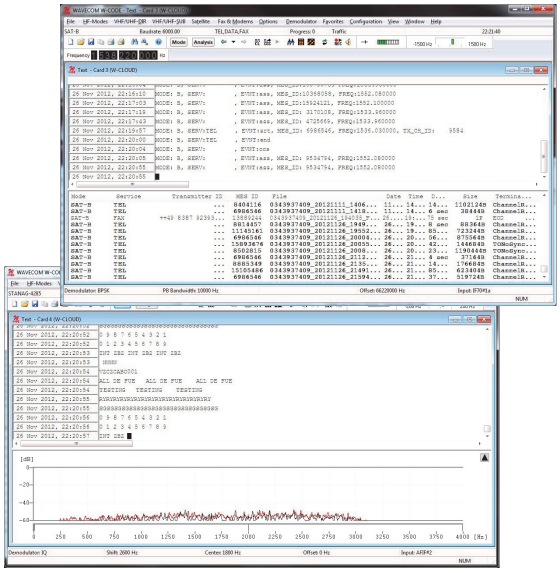
WAVECOM® W-CODE



W-CODE provides all functions required to classify, analyze, record, decode and process radio data communications throughout the entire radio spectrum from ELF to SHF. W-CODE is the new standard decoder software for all Wavecom products.

W-CODE Features and Facts

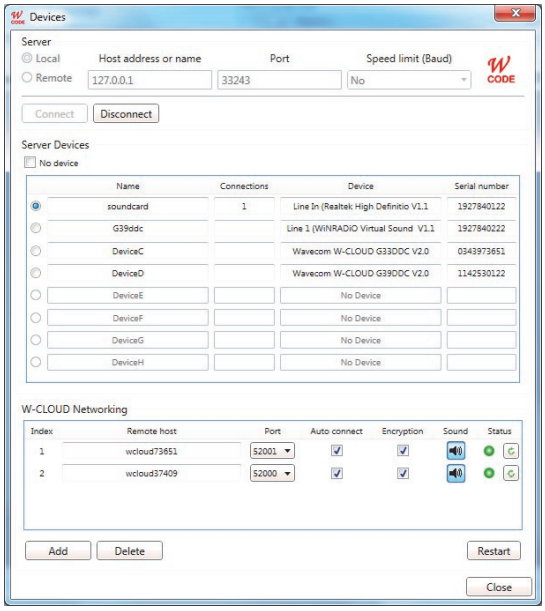
- W-CODE provides powerful signal analysis, signal processing and decoding
- Automatic classification, code check, demodulation and decoding to content level (text, live voice and image etc.) of signals
- Signal overview using real-time FFT spectrum, waterfall displays and manual signal measurements
- Automatic code check of known signals and unknown, pre-defined signals
- Supports more than 226 HF, VHF, UHF and satellite decoder modes and protocols without additional, costly licensing
- Supports worldwide remote monitoring of radio transmissions in any frequency band, anywhere via Internet, Ethernet-LAN, Wireless-LAN or Leased Lines
- Supports W-CLOUD high-quality I/Q data streams from a remote receiver
- Supports SDR (Software Defined Radio) I/Q data or external digital input
- Supports TCP/IP input streams using IP-CONF, GEW PXGF, ANSI/VITA-49, Virtual Audio Cable (VAC), WiNRADiO digital Virtual Sound Card (VSC) and host native sound card input with sampling rates of up to 192 kHz
- Supports W-PCIe and W-PCI dual and W74PC quad internal digital down converters (DDCs) up to 87.5 MHz
- Tested with a number of SDRs, e.g. WiNRADiO G39DDC, G33DDC, GEW GRXLAN, Perseus, RFSpace products, Rohde & Schwarz and MEDAV LR2
- Supports direct input and output of WAV files from integrated, digital Wavecom Media Player/Recorder.
- Decoded output can be saved to files or transferred to an external application using the XML based Remote Control Interface
- Multi-mode feature supporting up to eight simultaneous W-CODE instances



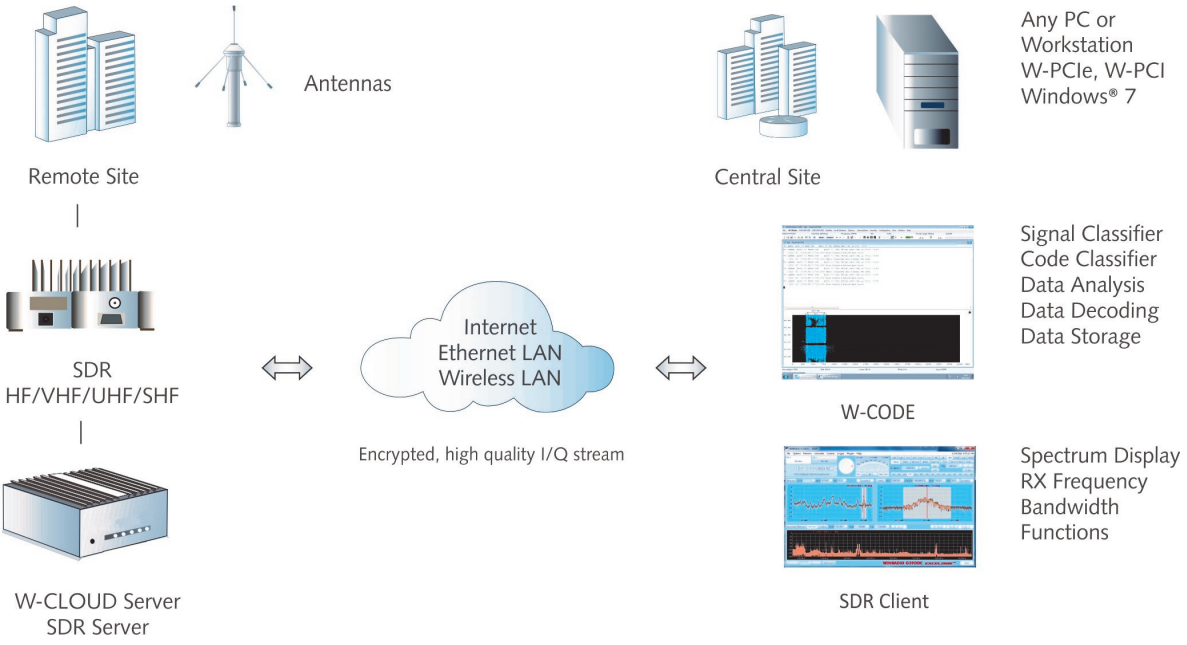
Worldwide monitoring with W-CODE and W-CLOUD

Signal Sources and Devices

The *W-CODE Device Selector* supports a great number of input interfaces and devices, e.g. IF I/Q streams produced by many receivers, Virtual Audio Cables (VAC), TCP/IP interfaces, W-CLOUD I/Q streams and the DDC signals of W-PCIe, W-PCI and W74PC. The number of supported interfaces is continuously growing. Using W-CODE prevents the locking to proprietary devices of software producers.
Today there is a demand for wideband storage which is met by directly connecting SDRs to low-cost hard disks. WiNRADiO G33DDC and G39DDC will for instance store bandwidths up to 4 MHz. W-CODE offers storage of narrow bandwidth I/Q streams up to 96 kHz using its native Media Player/Recorder. Expensive external and exotic recording devices belong to the past.



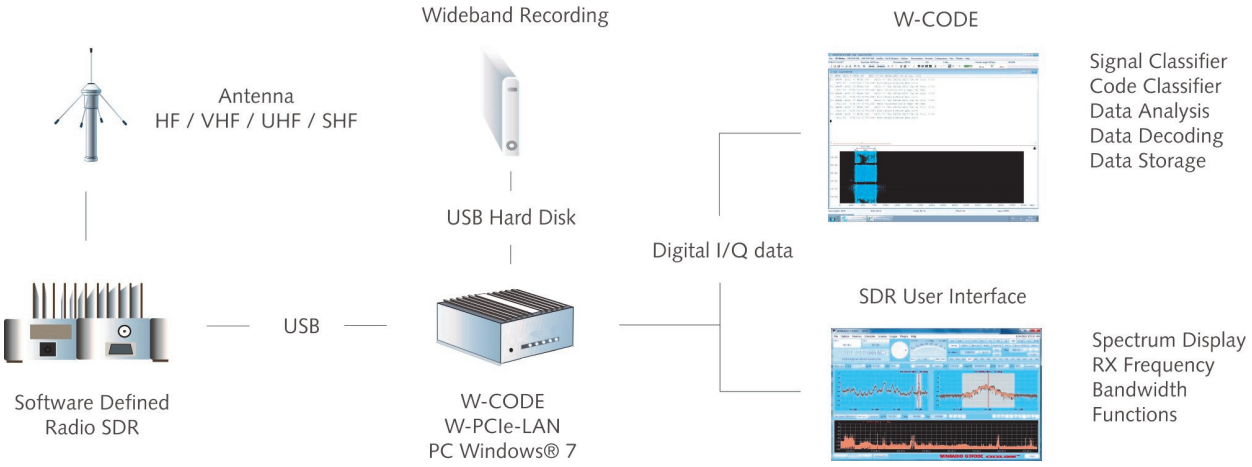
Quick and easy signal source settings



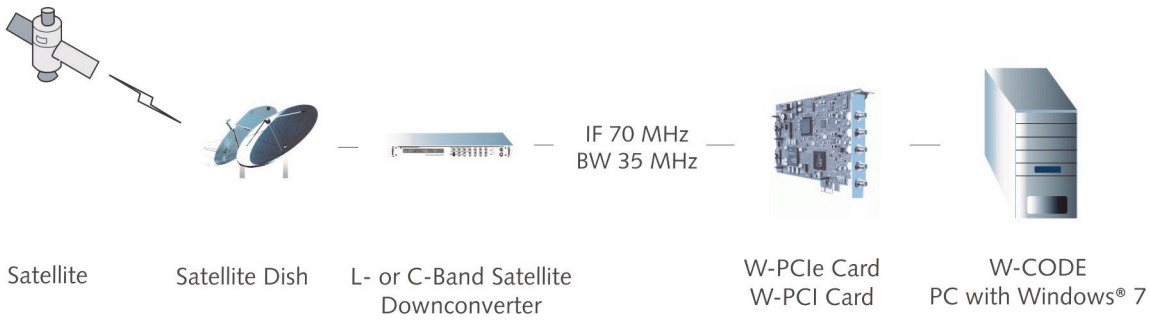
Example setup for remote signal acquisition using W-CLOUD and W-CODE

Signal Sources and Devices

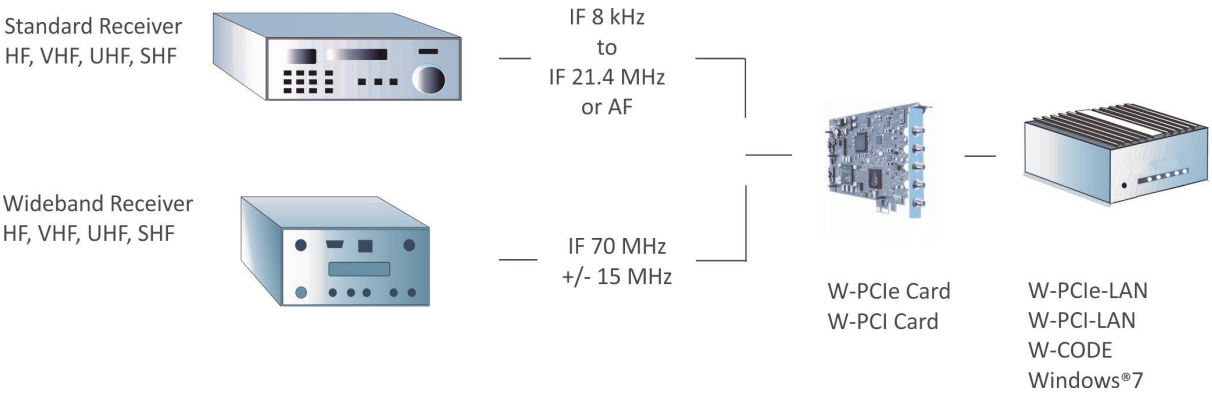
In this setup W-CODE and W-PCIe-LAN works together with a Software Defined Receiver (SDR) via its direct IF I/Q interface. It is also possible to use a universal Virtual Audio Cable (VAC) as interface. Additional hardware is not required for this software only solution. The W-PCIe-LAN may even be replaced by a standard PC or workstation. Because data is digitally processed, any loss of decoding quality can be avoided.



Satellite communication decoding is also possible using W-CODE and W-PCIe, W-PCI or W74PC. In this configuration the interface card acts as a dual Direct Down Converter (DDC). The receiving frequency is automatically and directly controlled by W-CODE.

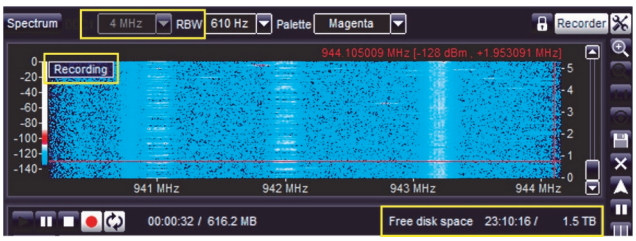


W-CODE and W-PCIe, W-PCI or W74PC supports all types of receivers with IFs from 8 kHz to 21.4 MHz and even wideband receivers with 70 MHz IF. It is also possible to use a sound card as an input device.

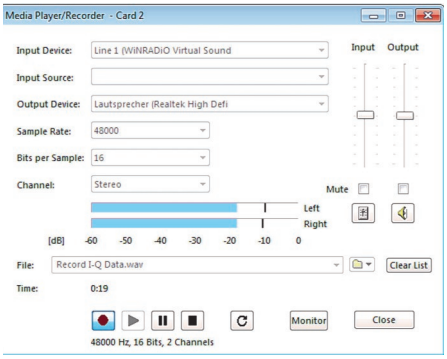


Wideband and Narrowband Recording

Example setup including a WiNRADiO G39DDC SDR for *wideband recording* of up to 4 MHz on a 3-4 TB hard disk via a standard USB 2.0 interface. Any off-the-shelf hard disk will do whether it is internal or connected via USB, LAN or W-LAN.



The W-CODE *Media Player/Recorder* records and saves signals from the selected input to digital I/Q WAV files. During playback of WAV files the signal is sent unprocessed to W-CODE and an audio signal is available for simultaneous monitoring. The Media Player/Recorder complements the rich analysis functions available in W-CODE.



Automatic Spectrum Analysis, Classification and Decoding

Powerful analysis and classification unit

Automatic spectrum analysis and signal classification process is winning more and more importance nowadays. It can conduct spectrum monitoring both in wide range (bandwidth) and round the hour with great preciseness and efficiency. This space and time advantage outperforms clearly a human operator, although the later has certain skill and experience.

W-CODE signal classification tools include:

- W-Spectrum Analysis (SA)
- W-Classifier-NB (Narrowband)
- W-Classifier-WB (Wideband)

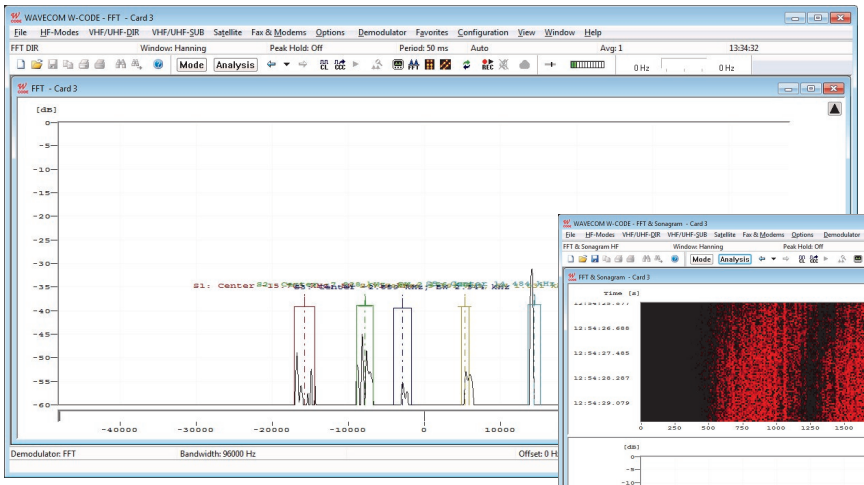
W-Spectrum Analysis (SA) can detect and measure all signals in a selected bandwidth with measuring parameters such as center (Hz), signal bandwidth (Hz), signal level (dB) and detection confidence (in percent).

Each signal can further contain a number of sub -signals with their parameters again.

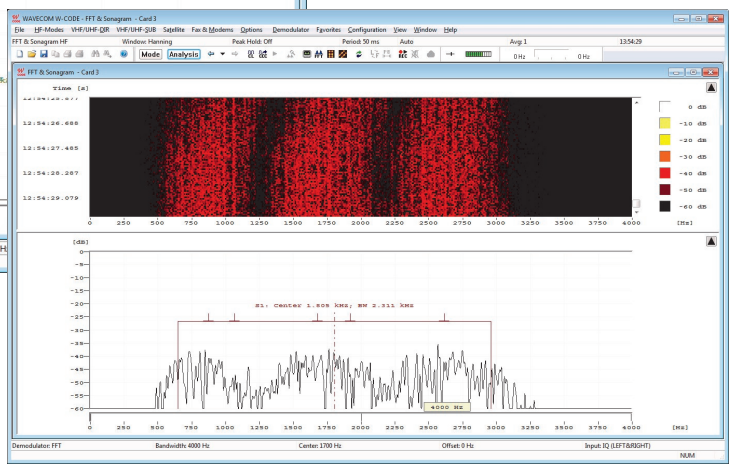
W-SA is integrated in FFT and FFT / Sonagram displays for all radio bands (HF, V/UHF, SAT etc). Detected signals are marked with their sub-signals and parameters.

Results of all detected signals and their sub-signals are delivered on the remote control interface (XML RCI) as well for third-party development.

Detected signals can be saved with their time-stamp as a structured XML file for database compatible display and analysis.



W-Spectrum Analysis detects 5 signals in an HF band (96 kHz bandwidth)



W-Spectrum Analysis detects one STANAG-4285 signal with its sub-signals, display bandwidth 4 kHz

Automatic Spectrum Analysis, Classification and Decoding

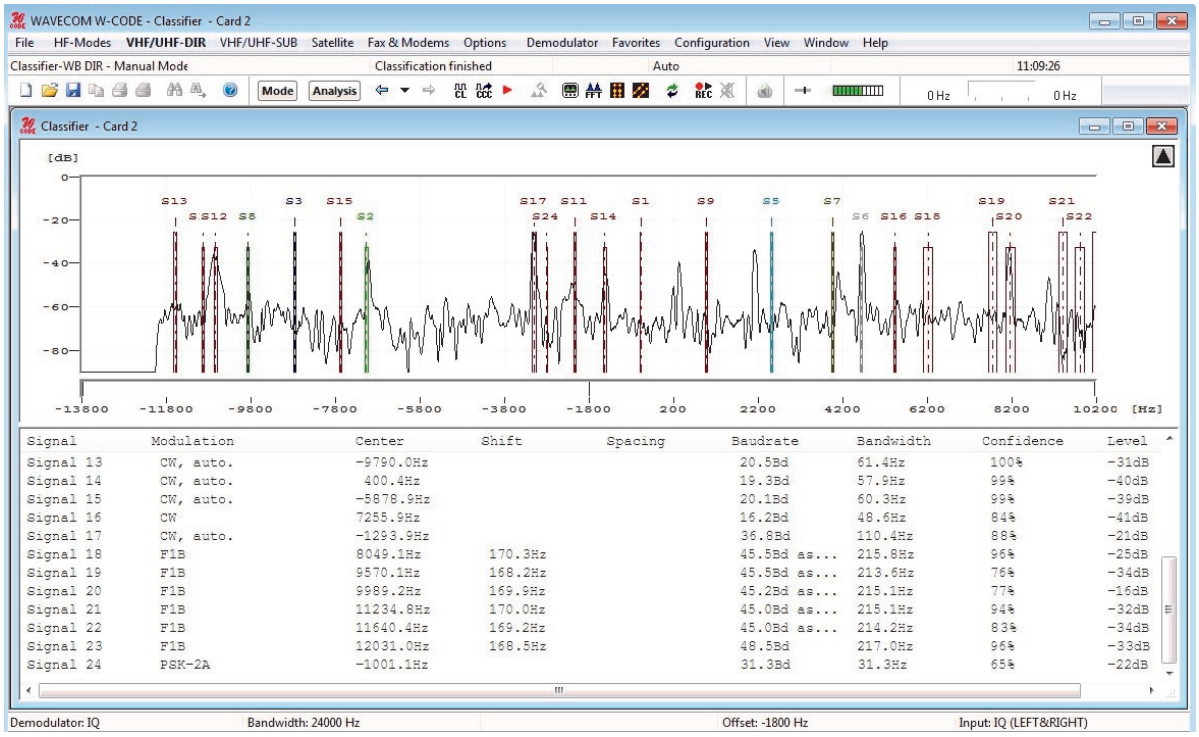
Powerful analysis and classification unit

W-Classifier measures a signal in its parameters:

- Modulation type
- Baud rate or symbol rate
- Signal center frequency
- Number of carriers
- Frequency shift
- Carrier spacing or distance
- CW-Morse detection
- 8 kHz bandwidth (W-Classifier-NB, WCL61PC)
- All signals within the classifier bandwidth are processed

Additional functions for wideband classification (W-Classifier-WB)

- Bandwidth up to 96 kHz
- Voice detection AM, FM, USB and LSB. Demodulated voice output to the speaker for live monitoring
- Baud rates up to 60 kBd

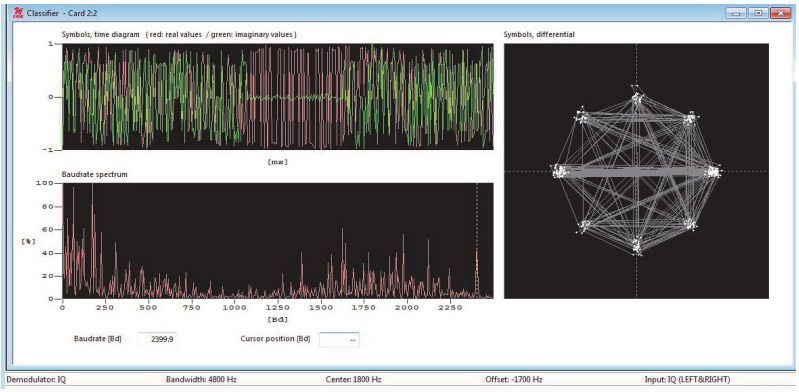


Wideband-Classifier display containing 24 identified signals

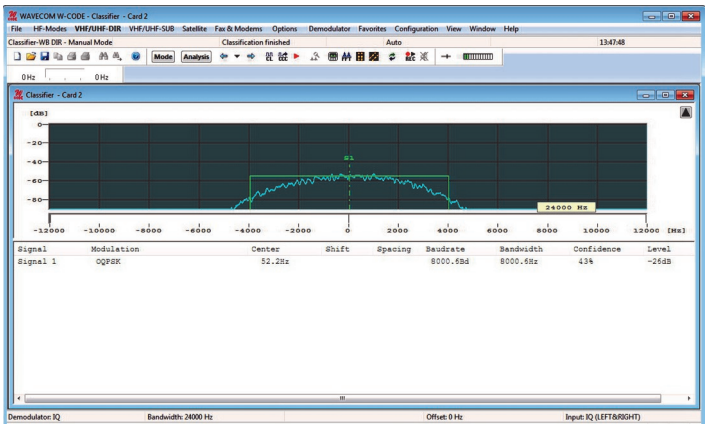
Automatic Spectrum Analysis, Classification and Decoding

Powerful analysis and classification unit

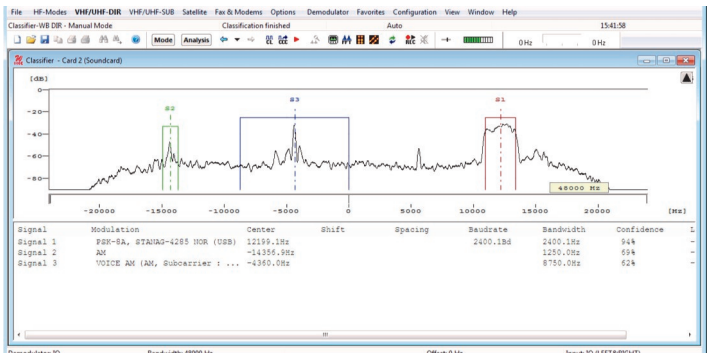
The Classifier also offers a number of signal visualising functions like symbol display, display of real and imaginary components of the analyzed signals, baud rate spectrum and differential symbol display in a phase plane. Signal parameters can also be measured manually.



Classifier with 2,400 Baud 8-PSK STANAG-4285 HF signal



Analysis of an 8,000 Baud GMSK TETRAPOL signal

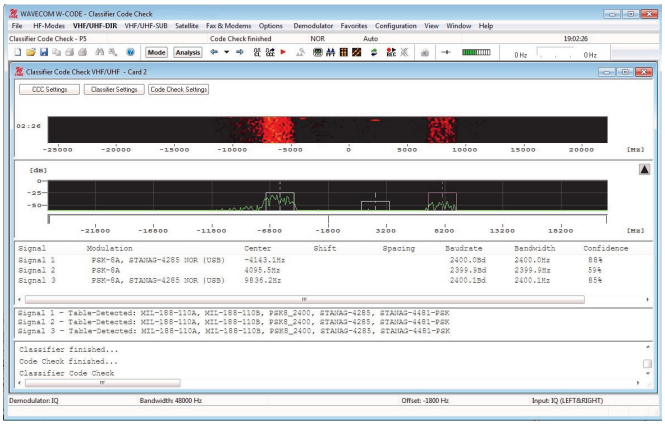


The monitored frequency band is displayed in a spectrum plane. After classification has completed, the classified signals are listed below the spectrum display.

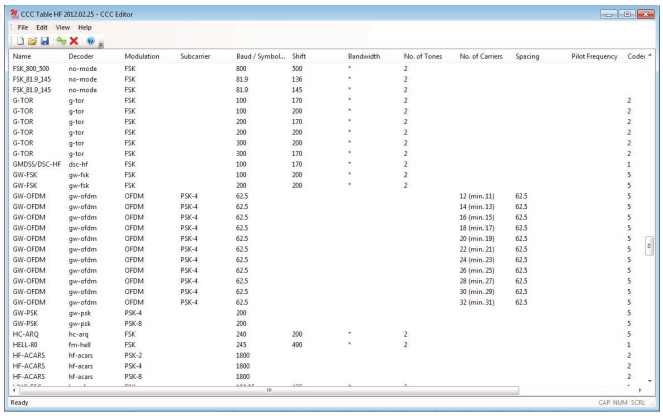
Automatic Spectrum Analysis, Classification and Decoding

Powerful analysis and classification unit

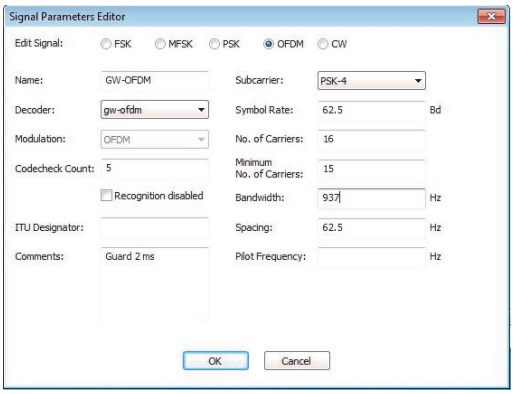
The *Classifier-Code-Check CCC* is a versatile analysis tool for the classification of known and unknown signals and the determination of the mode in use. The CCC will attempt to process all signals within the bandwidth of the classifier. The classifier attempts to classify the input signals according to their modulation formats. The table check works through the signals against the entries of the selected mode list. The code check will attempt to synchronize against classified modes, finally the signal will be forwarded to a decoder for output.



A *CCC Table Editor* allows extending, modifying or deleting records in the database used for mode look-up. An input template containing all important parameters is available for each modulation type. All parameters, the record name and the file name are user selectable.

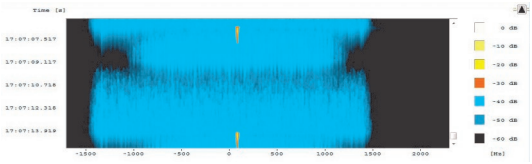


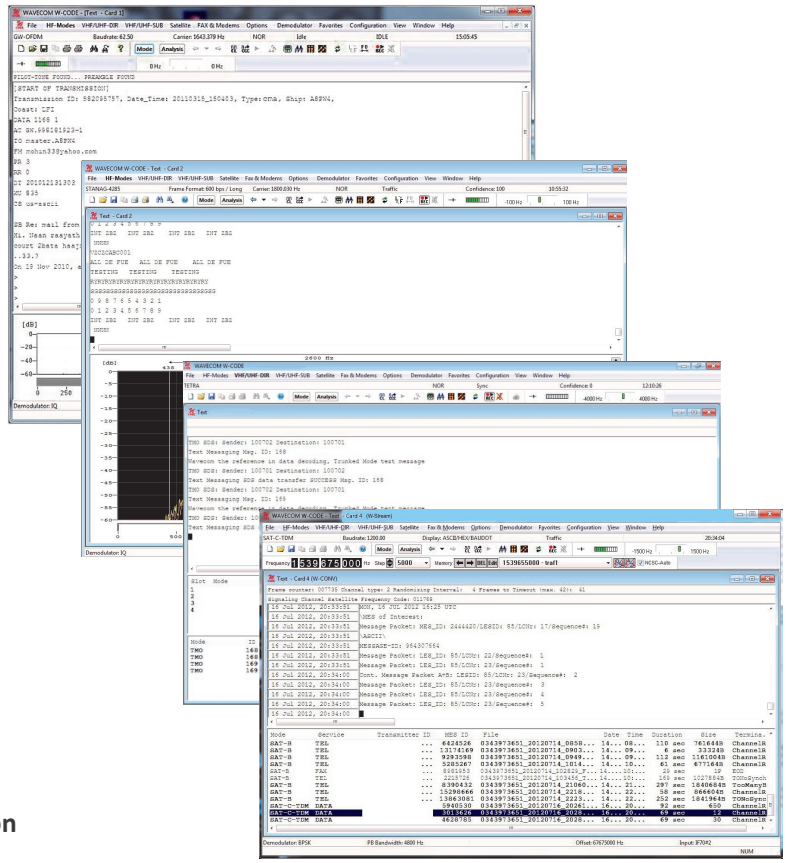
The *Signal Parameters Editor* allows the entry of an unlimited number of transmission modes, protocols in an XML tables. Any table can be loaded from the Code-Check-Settings menu. Tables are composed according to their frequency range (HF, VHF/UHF DIR, VHF/UHF SUB or satellite).



Decoders and Demodulators

The implementation of complex systems for monitoring is only limited by the number of decoders and the performance of the hardware and software. A wide range of system default settings can be configured, e.g., input signal level, measuring interval, center frequency and demodulator type. W-CODE contains more than 230 transmission modes, all available in a standard package, not requiring any additional license.





Decoded GW-OFDM from HF

Decoded STANAG-4285 from HF

TETRA decoded from UHF

Decoded satellite SAT-C-TDM transmission

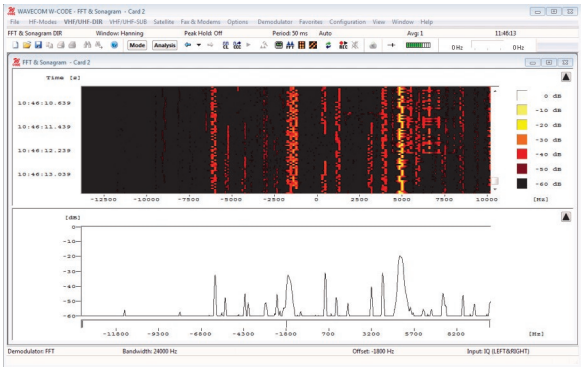
Live examples of decoding are available as flash movies at
http://www.wavecom.ch/product-presentation.php

Measurement and Analysis

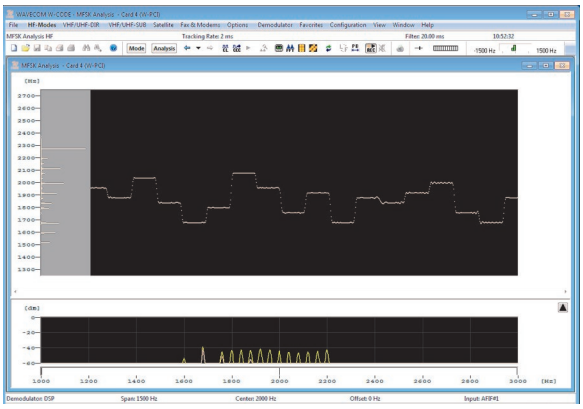
The determination of signal characteristics is assisted by a large number of analysis and measurement functions. The numerous integrated analysis tools contain several different methods and visualization options for HF, VHF, UHF, SHF and satellite emissions. The GUI assists the operator in analyzing the important signal parameters. Dynamic zoom functions allow magnification of details in any selected window and the scroll buffering feature makes it possible to move backward and forward in time over the input signal.

FFT Sonagram FFT & Sonagram Waterfall Oscilloscope
FSK Analysis FSK Code Check
PSK Symbol Rate PSK Phase Plane PSK Code Check MIL-STANAG Code Check
MFSK Analysis MFSK Code Check
Classifier Classifier Code Check
Autocorrelation Bit Correlation Bit Length Analyis
Demodulated Bit Stream

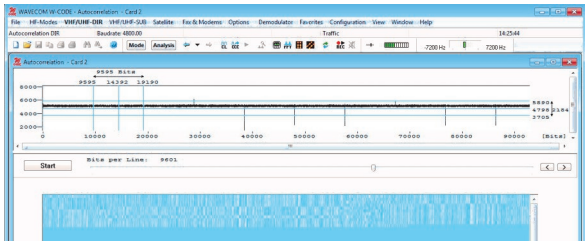
Some analysis tools



Sonagram and FFT spectrum display



MFSK analysis with tone measurement, graphical display and FFT

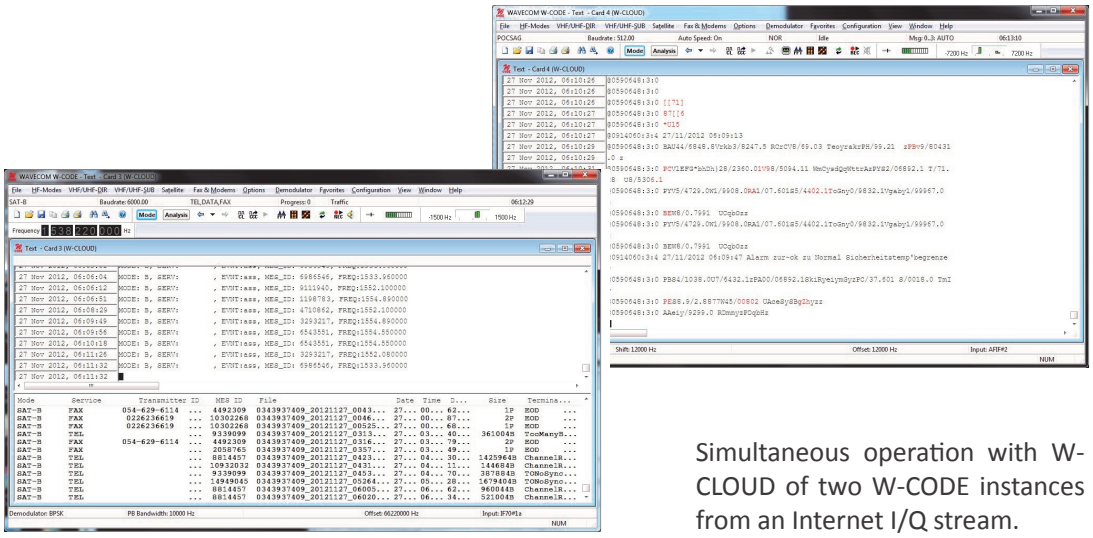


Signal correlating at 9600 bits

Simultaneous Processing of Multiple Signals

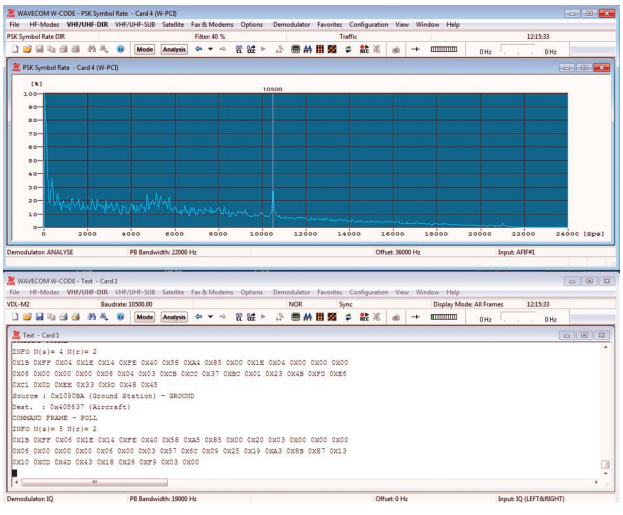
W-CODE allows up to eight simultaneous instances and inputs on the same host PC or workstation. The instances are completely independent. DDC or SDR may provide the input signal, additional hardware is not required. W-CODE license is measured on its decoding capacity. Each instance occupies a license when running.

An advantageous “Workstation License” with a proper number of licenses can be configured on one single license carrier (USB dongle). This can be plugged in a PC, all W-CODE instances in a same network can capture licenses from the license carrier in a first come-first serve fashion.



Simultaneous operation with W-CLOUD of two W-CODE instances from an Internet I/Q stream.

Simultaneous decoding and symbol rate analysis using two W-CODE instances. This setup can be further expanded as required. W-PCI and W-PCIe also allow two inputs with complete DDC functionality. Software Defined Radio SDR multi-input is available since Software V9.0.00.



HF - Protocols

- ALE-400
- ALF-RDS
- ALIS
- ALIS-2
- ARQ6-90
- ARQ6-98
- ARQ-E
- ARQ-E3
- ARQ-M2-242
- ARQ-M2-342
- ARQ-M4-242
- ARQ-M4-342
- ARQ-N
- ASCII
- AUM-13
- AUTOSPEC
- BAUDOT
- BR-6028 (ITA-2 and ITA-5)
- BULG-ASCII
- CHN 4+4
- CHU
- CIS-11
- CIS-12 (HEX output)
- CIS-14
- CIS-36
- CIS-36-50
- CIS-50-50
- CLOVER-2 (ARQ, all CRCs)
- CLOVER-2000 (ARQ, all CRCs)
- CLOVER-2500
- CODAN-CHIRP
- CODAN-SELCAL
- CODAN-3212
- CODAN-9001
- COQUELET-8
- COQUELET-13
- COQUELET-80
- CV-786
- CW-MORSE
- DCS SELCAL
- DGPS
- DUP-ARQ
- DUP-ARQ-2
- DUP-FEC-2
- EFR
- FEC-A
- FELDHELL
- FM-HELL
- FT8
- GMDSS/DSC-HF
- G-TOR
- GW-FSK
- GW-OFDM
- GW-PSK
- HC-ARQ
- HF-ACARS (HF-DL)
- HNG-FEC
- ICAO-SELCAL (ANNEX 10)
- LINK-11 (CLEW)
- MD-674
- MFSK-16
- MFSK-20
- MFSK-8
- MIL-188-110-16TONE (-110A/B App. A)
- MIL-188-110-39TONE (-110A/B App. B)
- MIL-188-110A Serial Tones, 75-4800 bps
- MIL-188-110A-MOD
- MIL-188-110B (App. C) STANAG 4539
- MIL-188-110B 3200-12800 bps
- MIL-188-141A (ALE)
- MIL-188-141B (BW0, BW1, BW4 data)
- MIL-188-141B (BW2, BW3 ID)
- MIL-M-55529 NB/WB
- OLIVIA
- PACKET-300/600
- PACTOR (all CRCs)
- PACTOR-FEC (all CRCs)
- PACTOR-II (all CRCs)
- PACTOR-II-AUTO (all CRCs)
- PACTOR-II-FEC (all CRCs)
- PACTOR-III (all CRCs)
- PACTOR-4
- PICCOLO-MK12
- PICCOLO-MK6
- POL-ARQ
- PRESS-FAX
- PSK-10
- PSK-125 (BPSK, QPSK) with FLARC
- PSK-125F
- PSK-220F
- PSK-250 (BPSK, QPSK) with FLARC
- PSK-31 (BPSK, QPSK)
- PSK-31-FEC
- PSK-63 (BPSK, QPSK) with FLARC
- PSK-63F
- PSK-AM
- ROBUST-PACKET
- RUM-FEC
- SI-ARQ
- SI-AUTO
- SI-FEC
- SITOR-ARQ
- SITOR-AUTO
- SITOR-FEC
- SP-14
- SPREAD-11, 21, 51
- SSTV Automatic
- SSTV Martin 1, 2, 3, 4
- SSTV Robot 8s, 12s, 24s, 36s
- SSTV SC-1 16, 32s
- SSTV SC-1 8s, 16s, 32s
- SSTV Scottie 1, 2, 3, 4
- SSTV Wraase SC-1 24s - 96s
- SSTV Wraase SC-2 20s - 180s
- STANAG 4285 75-3600 bps
- STANAG 4415 75 bps (NATO ROBUST)
- STANAG 4481-FSK (KG-84)
- STANAG 4481-PSK
- STANAG 4529 75-1800 bps
- STANAG 4539 3200-12800 bps
- STANAG 5065-FSK
- SWED-ARQ
- THROB
- THROBX
- TWINPLEX
- VISEL
- WEATHER-FAX

VHF/UHF - Protocols

ACARS	EEA (Selcal analog)	PACKET-9600
AIS	EIA (Selcal analog)	PCCIR (Selcal analog)
APCO-25 (P25, with live voice)	ERMES	PDZVEI (Selcal analog)
ASCII	EURO (Selcal analog)	POCSAG
ATIS (Selcal digital)	FLEX	PZVEI (Selcal analog)
BIIS	FMS-BOS (Selcal digital)	SKYPER (POCSAG)
CCIR-1 (Selcal analog)	GMDSS/DSC-VHF	TETRA (with live voice)
CCIR-2 (Selcal analog)	GOLAY/GSC	TETRAPOL (with live voice)
CCIR-7 (Selcal analog)	MOBITEX-1200 (with OVLS)	VDEW (Selcal analog)
CCITT (Selcal analog)	MOBITEX-8000	VDL-M2
CTCSS	MODAT (Selcal analog)	X.25
DCS-SELCAL	MPT-1327 (with ITA-5)	ZVEI-1 (Selcal analog)
DGPS	NATEL (Selcal analog)	ZVEI-2 (Selcal analog)
DMR with decryption (basic, ARC-4 and AES modes *) and live voice	NMT-450	ZVEI-3 (Selcal analog)
dPMR (with live voice)	NWR-SAME	ZVEI-VDEW (Selcal digital)
DTMF (Selcal analog)	NXDN with decryption (basic, DES and AES) and live voice	
DZVEI (Selcal analog)	PACKET-1200	

*) with license of Motorola Solutions®

SATELLITE - Protocols

AMSAT-P3-D	INMARSAT-B-TEL (forward, with live voice)	INMARSAT-M-TEL (forward, with live voice)
INMARSAT-AERO-P (L-band)	INMARSAT-B-TELEX-MM (forward)	INMARSAT-mM-DATA (forward)
INMARSAT-AERO-C (L-band)	INMARSAT-B-TELEX-SM (forward)	INMARSAT-mM-FAX (forward)
INMARSAT-AERO-R (C-band)	INMARSAT-C-EGC (Enhanced Group Call)	INMARSAT-mM-TEL (forward)
INMARSAT-AERO-T (C-band)	INMARSAT-C-TDM	INMARSAT-mM-HSD (High Speed Data)
INMARSAT-B-C-TFC (return)	INMARSAT-C-TDM-EGC	INMARSAT-mM-C-HSD (C band High Speed Data)
INMARSAT-B-Data (forward)	INMARSAT-C-TDMA	NOAA-GEO SAT
INMARSAT-B-FAX (forward)	INMARSAT-M-DATA (forward)	ORBCOMM
INMARSAT-B-HSD (forward, high speed data)	INMARSAT-M-FAX (forward)	

FAX-G3 and MODEM - Protocols

FAX-G3 T4 / T6 / JPEG / JBIG T.30 protocol with ECMM	BELL103	V.26 / V.26bis
FAX-G3-V.17	BELL212A	V.32 / V.32bis
FAX-G3-V.27ter	V.21	V.34 / V.34bis
FAX-G3-V.29	V.22 / V.22bis	V.90
FAX-G3-V.34hdx	V.23	V.92

Alphabets

Chinese (7-bit ASCII)	ITA-2 Swedish	Morse Arabic
HEX	ITA-2 TASS Cyrillic	Morse Cyrillic
ITA-1 Latin	ITA-2 Third Shift Cyrillic	Morse Greek
ITA-2 Baghdad70 Arabic	ITA-2 Third Shift Greek	Morse Hebrew
ITA-2 Baghdad80 Arabic	ITA-5 Bulgarian	Morse Latin
ITA-2 Cyrillic	ITA-5 Danish-Norwegian	Morse Scandinavian
ITA-2 Danish-Norwegian	ITA-5 French	Morse Spanish
ITA-2 Hebrew	ITA-5 German	User defined 5-bit alphabets based on UNICODE
ITA-2 Latin	ITA-5 Swedish	
ITA-2 Latin Transparent	ITA-5 US	

Demodulators

AM for METEOSAT and NOAA-GEOSAT FAX transmissions	FFSK, 10-12000 Baud, Shift 50 Hz-16 kHz
BPSK, 10-12000 symbols/s	FSK, 10-2400 Baud, Shift 50 Hz-3.5 kHz Center frequency 0.5 kHz-3.5 kHz
CTCSS	GFSK, 10-12000 Baud, Shift 50 Hz-16 kHz
CW Morse, 10-500 WPM, Center frequency 0.5 kHz-3.5 kHz, Bandwidth 100 Hz-1.2 kHz, AFC On/Off	Mark-Space FSK, 10-300 Baud, Shift 50 Hz-3.5 kHz Center frequency 0.5 kHz-3.5 kHz
DPSK, DBPSK, DQPSK, D8PSK, D16PSK, 10-12000 symbols/s	MFSK, Tone length 4-1000 ms, max. 64 Tones Shift 50 Hz-3.5 kHz
DTMF	OFDM, 12-32 carriers, DQPSK, 62.5 symbols/s
DXPSK, dual carrier adaptive modulation, 2DPSK-D16PSK, 100 Baud	OQPSK, 10-12000 symbols/s
FAX-G3-V.17, FAX-G3-V.27ter, FAX-G3-V.29 FAX-G3-V.34hdx	QPSK, 10-12000 symbols/s
BELL103, BELL212A, V.21, V.22/V22bis, V.23 V.26/V26bis, V.32/V.32bis, V.34, V.90, V.92	Software AM demodulator for VHF/UHF SUB IF inputs
	Software FM demodulator for VHF/UHF SUB IF inputs

Classifier Code Check (CCC) with look-up table and XML-editor for all modulation variants

Process Steps	P1	Only classification is performed, but no decoding
	P2	Classification and table check are performed, but no decoding
	P3	Classification, table check and code check are performed, but no decoding
	P4	Classification and table check are performed and finally the signal is decoded if a mode with an associated, valid detector was found
	P5	Classification, table check and code check are performed and finally the signal is decoded if a mode with an associated, valid detector was found

W-CODE

Signal Analysis and Processing

WAVECOM NACHRICHTENTECHNIK

Analysis Functions

- Autocorrelation up to 200.000 bits
- Automatic analysis and decoding software for all data and FAX-G3 modulation types
- Automatic CRC recognition of all PACTOR-II and PACTOR-II -FEC systems
- Automatic message type detection (ITA-2, ITA-5 and sync/ async), LSB/MSB for STANAG and MIL-STD modes
- Bit correlation analysis. Raw FSK analysis - graphical display of demodulated data on a raster time line. For visual recognition of character and block lengths
- Bit length analysis. Graphical display of demodulated data, with automatic calculation of bit length and bit pattern display
- Code check for PSK, FSK, MFSK and MIL-STANAG modes
- Manual measurement of the frequency shift(s) with movable cursors
- Oscilloscope, real time, resolution up to 200 us/div
- MFSK analysis graphical display of MFSK tone spectrum with histogram
- Phase plane analysis HF BPSK, QPSK, OQPSK, DPSK and I/Q 10-2400 Baud
- Phase plane analysis VHF/UHF-DIR BPSK, DPSK, QPSK and OQPSK 100-12000 Baud
- Phase plane analysis VHF/UHF-SUB BPSK, QPSK, OQPSK, DPSK and I/Q 50-4000 Baud
- Real-time FFT, averaging: 1-64 values, bandwidth 0.5, 1, 2, 4, 24, 48 kHz and 96 kHz and adjustable cursors, 20 frames/sec
- Sonagram and FFT tuning display
- Sonagram, real-time display with cursor functions and history (full scrolling)
- Sound card calibration tool
- Graphical data display for selcal signal analysis
- Waterfall, real-time display with cursor functions

Overall Software Characteristics

- Media Player/Recorder, recording and playback of signals
- ALARM MONITOR, automatically detected text-string saving to HD or network SMS output
- Automatic insertion of time stamps (in 1 ms)
- Synchronized PSK and FSK raw bitstream available through remote control interface
- File formats TXT, JPG, BMP, Unicode, WAVECOM (with timestamps)
- PSK, FSK and MFSK baudrate history display with full graphical recall, averaging and cursor functions
- FSK shift history display with graphical recall, averaging and cursor functions
- Configurable message type for most MIL-STD and STANAG codes
- Pass-band filters in most modes
- Pass-band tuning in FFT display in most modes
- End-to-end decryption option to get clear voice and text output
- Live voice to output decoded / decrypted voice to the speaker in real-time
- SERIAL LINK, serial data output to PC serial interface COM 1 - 16
- STANAG5066 parser in MIL-STD and STANAG codes
- TCP/IP direct data (IQ and PCM) interface for streaming and for digital receivers (PXGF, IP-CONF, VITA-49)
- TCP/IP remote control with Wavecom GUI, full functionality over LAN or Internet (encrypted and speed optimized)
- Unlimited scroll-back buffers for text and graphics
- Up to 8 decoders may be installed on one host PC
- WiNRadio VSC and Virtual Audio Cable (VAC) support
- Sound card input, 8-bit and 16-bit, 8 kHz to 192 kHz, stereo and mono left/right
- License on a USB dongle or SD card
- WAV files playback and decoding, loop mode
- XML Remote Control Interface API for C++ and C#, XML over TCP/IP

W-CODE

Signal Analysis and Processing

WAVECOM NACHRICHTENTECHNIK

Since more than thirty years Wavecom Elektronik AG has developed, manufactured and distributed high quality devices and software for the decoding and retrieval of information from wireless data communication in all frequency bands. The nature of the data communication may be arbitrary, but commonly contains text, images and voice. The company is internationally established within this industry and maintains a longstanding, world-wide network of distributors and business partners.

Product Information

Products	http://www.wavecom.ch/product-summary.php
Datasheets	http://www.wavecom.ch/brochures.php
Specifications	http://www.wavecom.ch/product-specifications.php
Documentation	http://www.wavecom.ch/manuals.php
Online help	http://www.wavecom.ch/content/ext/DecoderOnlineHelp/default.htm
Software warranty	One year free releases and bug fixes, update by DVD
Hardware warranty	Two years hardware warranty
Prices	http://www.wavecom.ch/contact-us.php

System Requirements and Ordering Information

	Minimum	*Recommended*
CPU	P4 Dual-Core 2.4 GHz	Core i5 or Core i7 2.8 GHz
Memory	2 GB RAM	4 - 8 GB RAM
OS	Windows XP	Windows 7 32-bit or Windows 7 64-bit

Product Code	Description
WCODE	Standard decoder software for all products. Client and server (floating) license
WLV	Vocoder live voice output to the speaker. Option for W-CODE, W74PC, W-PCIe, W-PCI and W-SPECTRA
WCPT	End-to-end decryption option to get clear voice and text. For W-CODE, W74PC, W-PCIe, W-PCI and W-SPECTRA

Distributors and Regional Contacts

You will find a list of distributors and regional contacts at http://www.wavecom.ch/distributors.php

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