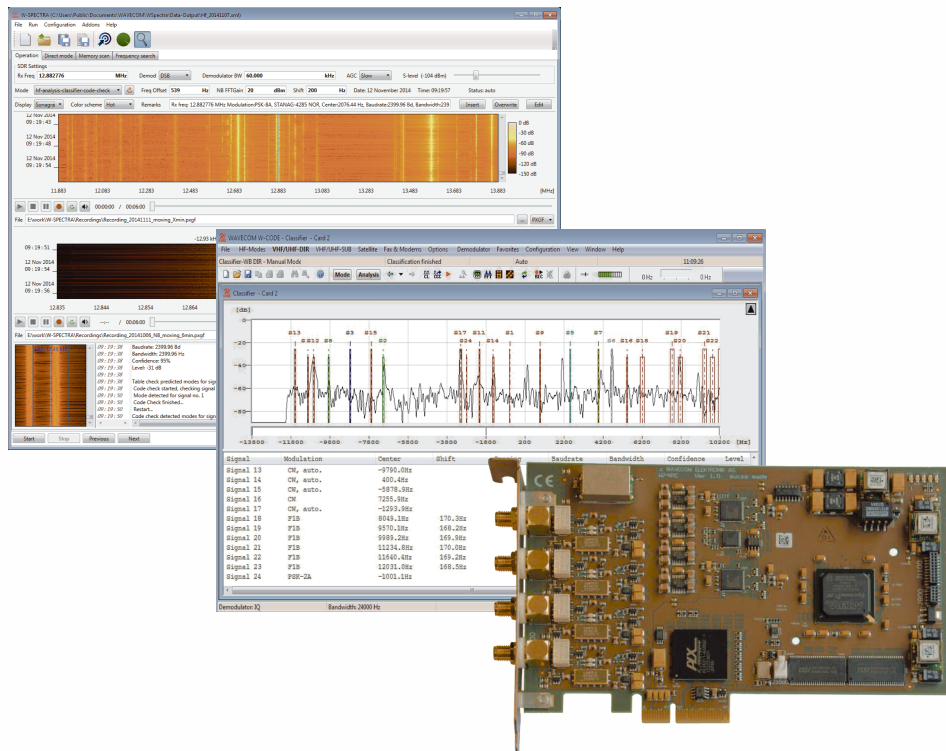


WAVECOM® Product Series



30 YEARS ACHIEVEMENT

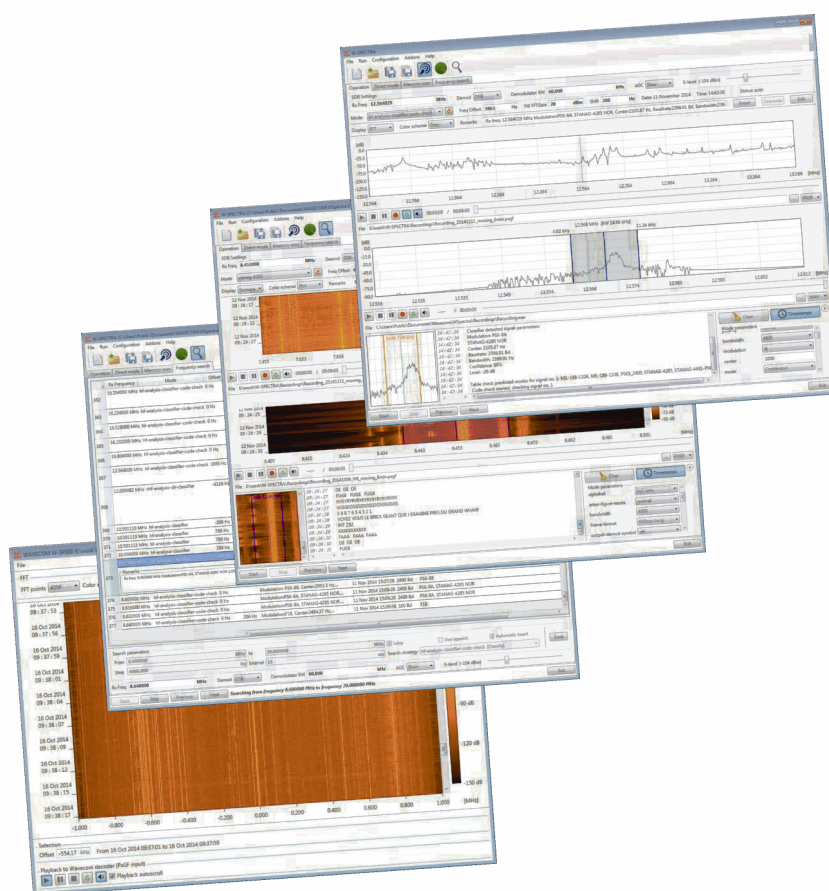
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WAVECOM® W-SPECTRA



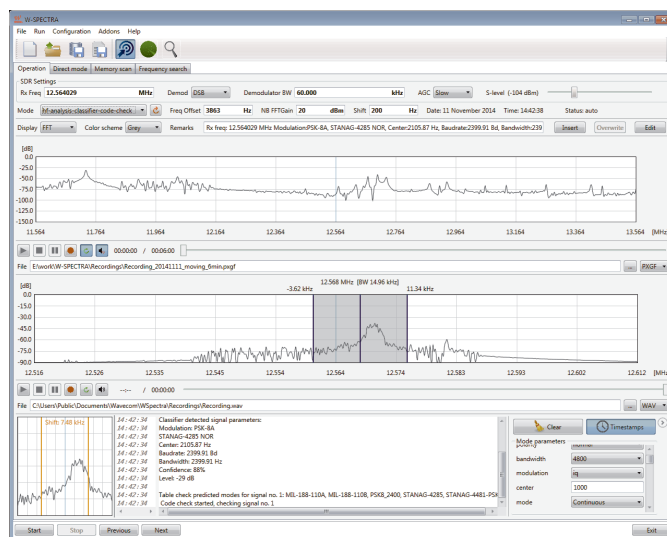
W-SPECTRA is a complete automatic monitoring system running through the entire radio spectrum from ELF to SHF. It provides all monitoring functions as direct control of receiver, classify, analyze, wideband IQ signal recording, decode and record results into database. Together with a spectra editing tool (W-SPEED), it can cut out any signal in frequency and time domains from a recording for further processing.

W-SPECTRA

Complete Automatic Spectrum Monitoring System

W-SPECTRA Main Features and Facts

- ◆ W-SPECTRA provides comprehensive real-time monitoring functions
- ◆ Intuitive graphical user interface: main operation tab covers all online monitoring activities
- ◆ Built-in bi-directional control of receivers (WiNRADiO G3xDDC)
- ◆ Three monitoring modes: Direct Mode, Memory Scan and Frequency Search
- ◆ Supports more than 220 decoder modes and protocols over ELF to SHF
- ◆ Wideband (2 MHz) and narrowband (96 kHz) FFT and sonagram display
- ◆ Wideband and narrowband IQ signal recording and playback
- ◆ On-the-fly signal recording with various important side information such as receiver frequency, bandwidth and timestamp for complete investigation of the whole spectrum
- ◆ Automatic demodulation and decoding to the content level of known signals
- ◆ Automatic search, classification and code check of signals over a user-defined frequency range and search strategy
- ◆ Automatic insertion of results into a database
- ◆ Classification and decoding results can be saved to files
- ◆ User configurable database template
- ◆ Database in XML format, easy to process by third-party applications
- ◆ Integrity check of database
- ◆ Spectrum editing: cut out a signal anywhere (in time and frequency domains) from a recording for classification and decoding



W-SPECTRA GUI Operation tab

Rx Frequency	Mode	Offset	Shift	Remarks	Date & Time	Baudrate	Modulation	Operator	CallSign	Location	Frame Format
10.600000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: PSK-4B, Center: 2158.9 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:09:20	2400 Bd	PSK-4B				
10.704000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: PSK-4B, Center: 2158.9 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:13:51	16 Bd	CW, man				
10.708000 MHz	HF-analysis-classifier-code-check 0 Hz	194 Hz		Modulation: F3B, Center: 402.78 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:14:03	75 Bd	F3B				
10.800000 MHz	HF-analysis-classifier-code-check 0 Hz	250 Hz		Modulation: F3B, Center: 200.69 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:18:20	75 Bd	F3B				
10.860000 MHz	HF-analysis-classifier-code-check 0 Hz	850 Hz		Modulation: F3B, Center: 300.87 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:22:42	75 Bd	F3B				
10.820000 MHz	HF-analysis-classifier-code-check 0 Hz	499 Hz		Modulation: PSK-3A, CS-12 NOR... Signal #1 predicted model(s)...	10 Nov 2014 09:28:26	100 Bd	PSK-3A, CS-12 NOR				
11.024000 MHz	HF-analysis-classifier-code-check 0 Hz	499 Hz		Modulation: F3B, Center: 300.87 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:28:26	100 Bd	F3B				
11.040000 MHz	HF-analysis-classifier-code-check 0 Hz	447 Hz		Modulation: F3B, Center: 200.69 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:29:30	47 Bd	F3B				
11.480000 MHz	HF-analysis-classifier-code-check 0 Hz	501 Hz		Modulation: F3B, Center: 200.69 Hz... Signal #1 predicted model(s)...	10 Nov 2014 09:47:42	50 Bd	F3B				
12.220000 MHz	HF-analysis-classifier-code-check 0 Hz	499 Hz		Modulation: F3B, Center: 200.69 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:18:45	50 Bd	F3B				
12.568000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: PSK-4B, STANAG-4285 NOR... Signal #1 predicted model(s)...	10 Nov 2014 10:34:22	2400 Bd	PSK-4B, STANAG-4285 NOR				
12.592000 MHz	HF-analysis-classifier-code-check 0 Hz	126 Hz		Modulation: F3B, Center: 200.69 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:35:30	50 Bd	F3B				
12.612000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: CW, auto, Center: 933.63 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:37:31	10 Bd	CW, auto				
12.660000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: PSK-4B, Center: 2887.5 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:38:41	2400 Bd	PSK-4B				
12.672000 MHz	HF-analysis-classifier-code-check 0 Hz	0 Hz		Modulation: CW, auto, Center: 2326.64 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:40:33	21 Bd	CW, auto				
12.700000 MHz	HF-analysis-classifier-code-check 0 Hz	846 Hz		Modulation: F3B, Center: 1119.17 Hz... Signal #1 predicted model(s)...	10 Nov 2014 10:40:33	50 Bd	F3B				

Automatic insertion of results into a database

W-SPECTRA

Complete Automatic Spectrum Monitoring System

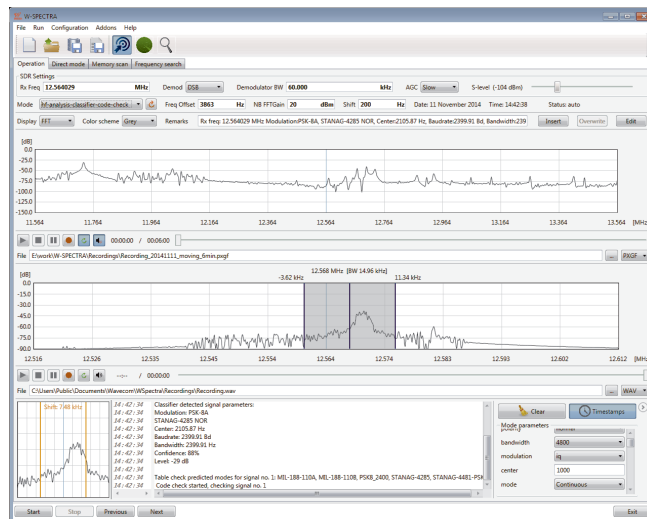
Typical Configuration

W-SPECTRA connects to a Software Defined Radio (SDR) and takes over its full control.

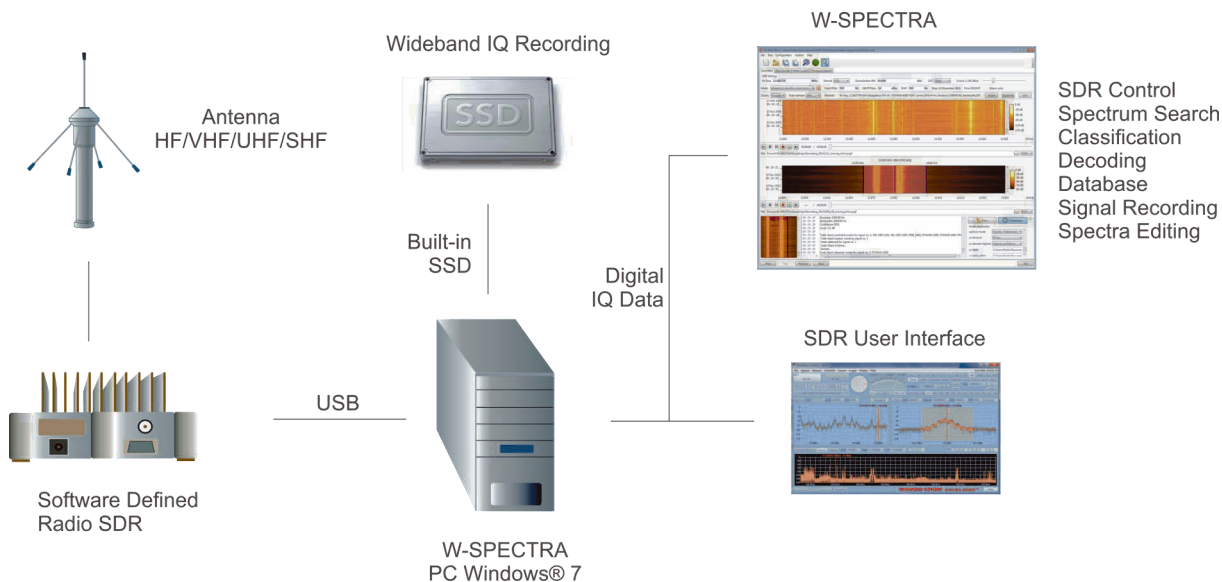
A built-in mass storage device (e.g., an SSD) can be used by W-SPECTRA for wideband IQ signal recording.

The "Operation" tab in the W-SPECTRA GUI contains four parts. All the monitoring activities are covered in this tab.

- ◆ Receiver control: set the receiver frequency, demodulator and bandwidth etc.
 - ◆ Wideband spectrum display (2 MHz), wideband IQ signal recording and play-back.
 - ◆ Narrowband spectrum display (96 kHz), narrowband IQ signal recording and play-back.
 - ◆ Classification and decoding result display
- W-SPECTRA can work in three modes: *Direct Mode*, *Memory Scan* and *Frequency Search*.



W-SPECTRA Operation GUI contains four parts



Example setup of a monitoring system with W-SPECTRA

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Direct (Built-in) Receiver Control

At start-up W-SPECTRA connects to a WinRADIo G3xDDC receiver and assumes full control.

The connection is bi-directional. User may set the receiver frequency, demodulator, demodulator bandwidth, AGC and squelch level directly in W-

SPECTRA GUI, it will reflect to the SDR GUI and vice-versa.

The Demodulator BW determines the bandwidth of the narrowband spectrum display.

The screenshot shows the 'SDR Settings' window in W-SPECTRA. It contains various controls for receiver configuration: Rx Freq (12.564029 MHz), Demod (DSB), Demodulator BW (60.000 kHz), AGC (Slow), S-level (-104 dBm), Mode (hf-analysis-classifier-code-check), Freq Offset (3863 Hz), NB FFTGain (20 dBm), Shift (200 Hz), Date (11 November 2014), Time (14:42:38), Status (auto), Display (FFT), Color scheme (Grey), and Remarks (Rx freq: 12.564029 MHz Modulation:PSK-8A, STANAG-4285 NOR, Center:2105.87 Hz, Baudrate:2399.91 Bd, Bandwidth:239). There are also buttons for Insert, Overwrite, and Edit.

Bi-directional receiver (SDR) control

With an "SDR settings" GUI W-SPECTRA can

- ◆ Configure the connection behavior to a receiver at start: preset the receiver frequency, demodulator bandwidth, AGC and squelch level.
- ◆ Recheck if a receiver is still online by Rescan.
- ◆ Connect and disconnect a receiver during running.

Three color indicators mean

- ◆ Yellow: the receiver is running properly and ready for connection to W-SPECTRA.
- ◆ Green: the receiver is now connected to W-SPECTRA and works properly.
- ◆ Black: the receiver is now not running (offline).

The screenshot shows the 'SDR settings' dialog box. It lists two receivers: RADiXON G33DDC - (11D28121) (indicated with a green dot) and RADiXON G39DDC - (11J07080) (indicated with a black dot). Below the list are 'Connect' and 'Disconnect' buttons. The 'Receiver startup settings' section includes fields for Rx Freq (10.000000 MHz), Dem BW (60.000 kHz), Demod (DSB), AGC (Slow), and S-Level (-70 dBm) with a slider. At the bottom are 'Rescan' and 'Close' buttons.

SDR settings GUI

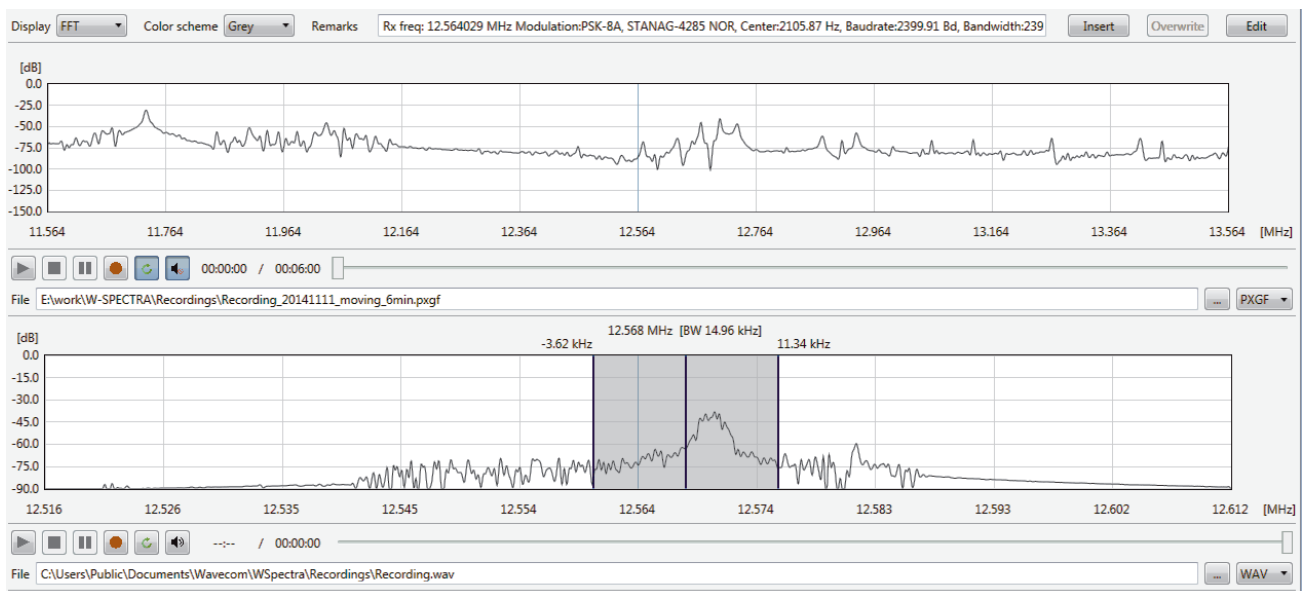
W-SPECTRA

Complete Automatic Spectrum Monitoring System

Wideband (WB) and Narrowband (NB) Spectrum Display and Media Player/Recorder

There are two spectrum displays in W-SPECTRA: wideband and narrowband.

- ◆ Wideband display is 2 MHz wide. It corresponds to the DDC1 of G3xDDC SDR.
- ◆ Wideband recording of DDC1 IQ signal in PXGF format with on-the-fly side information as receiver frequency, bandwidth and timestamp.
- ◆ Narrowband spectrum display corresponds to the DDC2 of G3xDDC SDR. Its bandwidth can be 24k, 48k or 96 kHz and is coupled with the SDR demodulator BW.
- ◆ Narrowband recording of the DDC2 IQ signal (96 kHz) in PXGF or .wav format.
- ◆ Playback of a recording in both Media Players. Signal is streamed to classifier or decoder for processing.
- ◆ Select any 96 kHz band from a WB recording for classification and decoding.
- ◆ Playback in real-time.
- ◆ The recorded side information (Rx Freq and timestamp) is displayed instantaneously in the main GUI Operation tab.
- ◆ Playback progress cursor can be moved to any position of the recording.
- ◆ Signal output to the speaker for sound monitoring purpose.



Wideband and narrowband spectrum and media player/recorder

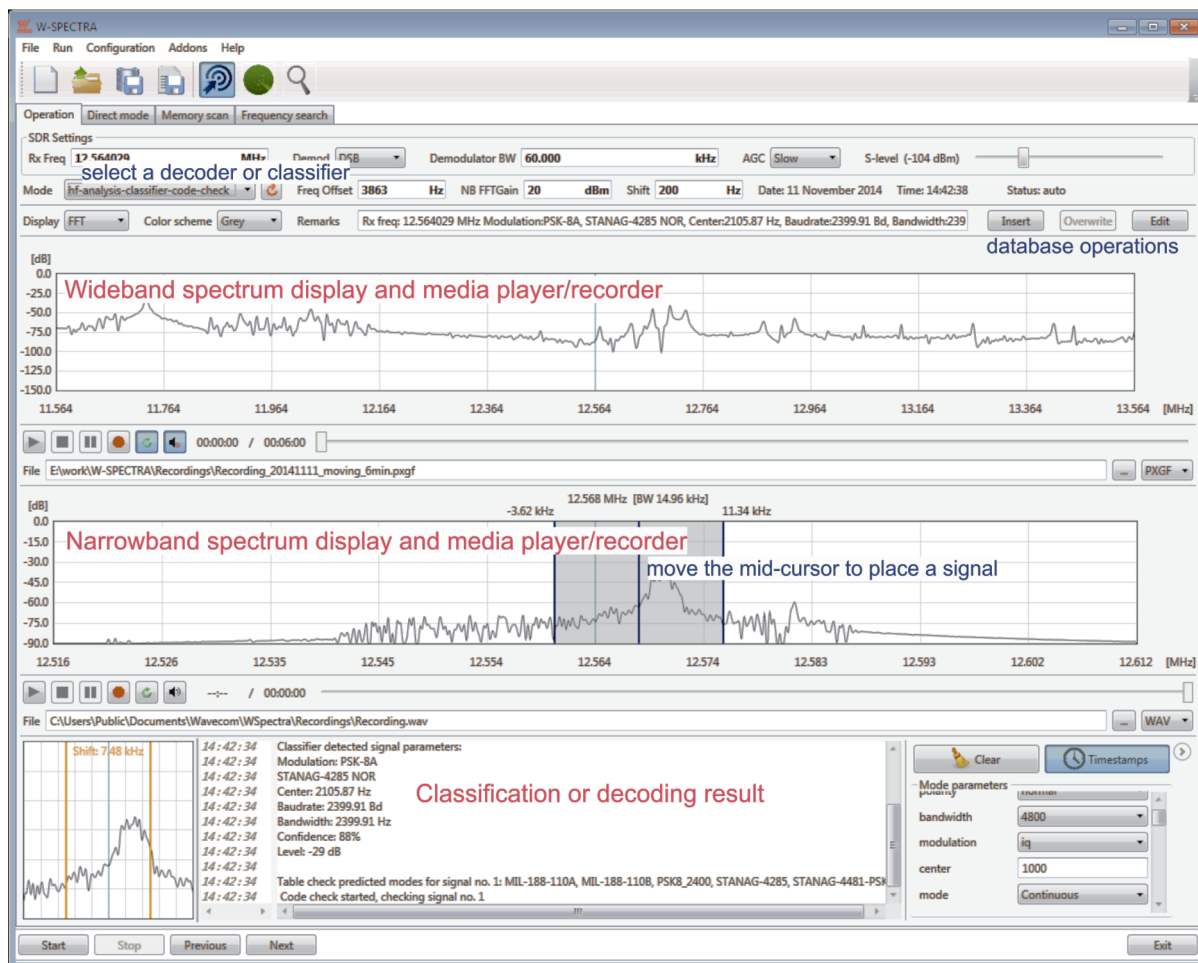
W-SPECTRA

Complete Automatic Spectrum Monitoring System

Three Operation Modes: Direct Mode, Memory Scan and Frequency Search

W-SPECTRA works in three operation modes: Direct Mode, Memory Scan and Frequency Search.

- ◆ A decoder or classifier can be set manually or automatically to process the signal selected by the middle cursor of the NB spectrum display. Results are displayed in the lower part of the GUI.
- ◆ All the three modes can work in a manual or automatic way. Four buttons (Start, Stop, Previous and Next) control the work flow.
- ◆ In each mode W-SPECTRA opens a database with a user defined template to record classification and decoding results.
- ◆ A small tuning FFT at the lower left corner can be used to measure the signal width.



W-SPECTRA GUI Operation tab (with comment)

W-SPECTRA

Complete Automatic Spectrum Monitoring System

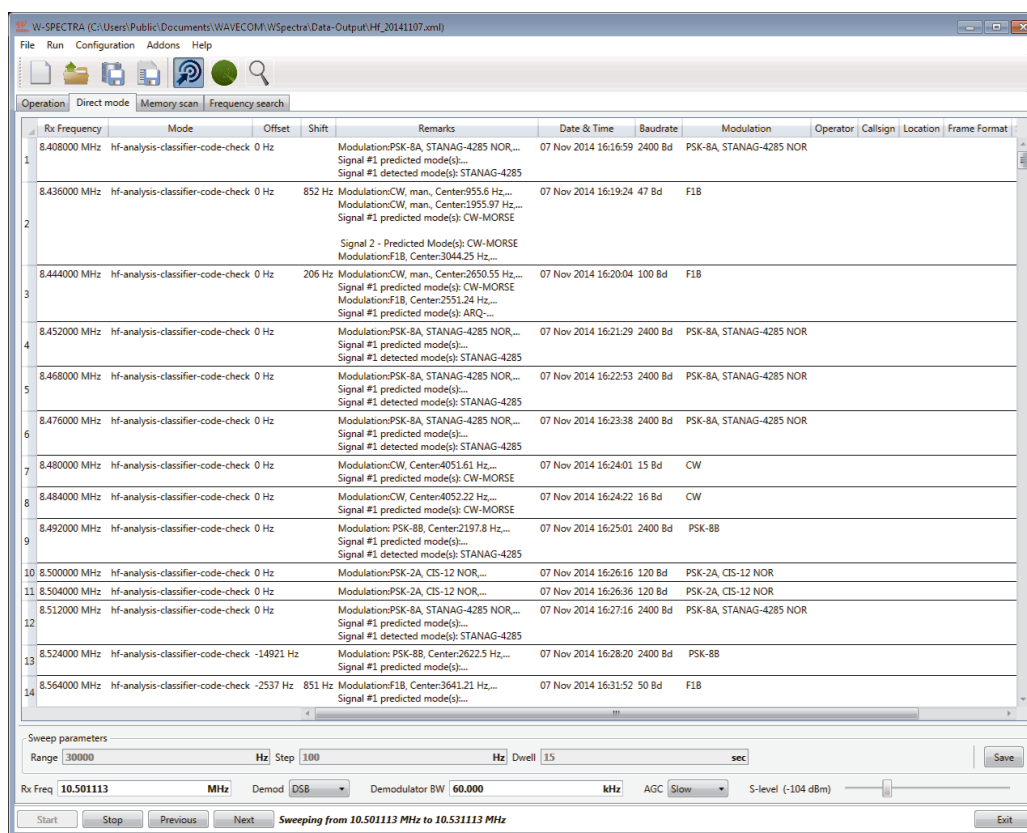
Direct Mode: First Things First to Begin Spectrum Monitoring

W-SPECTRA Direct Mode is designed for a user to begin the spectrum monitoring in a manual way.

- ♦ User can set the receiver frequency manually and turn on the classifier or a decoder to monitor and decode a signal.
- ♦ User can open a database in the “Direct Mode” tab and insert results.
- ♦ Direct Mode can also run automatically to sweep the spectrum in a small range so that a signal can be fine tuned to the spectrum middle.

There are four buttons in the last line of the GUI which have the following function:

- ♦ Start: start the sweep function. The receiver will jump to the next frequency according to the Step size and Dwell period.
- ♦ Stop: stop the sweep function.
- ♦ Previous and Next: jump manually to the previous and next frequency respectively according to the Step size.



Direct Mode tab with database and sweep parameters setting

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Memory Scan: Spectrum Monitoring and Verification

W-SPECTRA runs in Memory Scan mode over an existing database. Each database entry sets the receiver (SDR) and the decoder or classifier accordingly. In this way the spectrum is revisited and verified. User may insert a new entry into the database or just overwrite the old one. The four buttons in the last line of the GUI have the following function:

- ◆ Start: start the memory scan from the first database entry and jump to the next one after an Interval period.
- ◆ Stop: stop the memory scan function.
- ◆ Previous and Next: jump manually to the previous and next database entry respectively.

The screenshot displays the W-SPECTRA application window in Memory Scan mode. The main area contains a table with 14 rows of scan results. The columns are: Rx Frequency, Mode, Offset, Shift, Remarks, Date & Time, Baudrate, Modulation, Operator, Callsign, Location, and Frame. The table lists various signals detected, including PSK-8A, STANAG-4285 NOR, CW, and PSK-8B, with their respective frequencies and timestamps.

At the bottom of the window, the 'Scan parameters' section is visible. It includes fields for 'From row' (1), 'To row' (366), and 'Interval' (15 sec). There are also checkboxes for 'Loop' and a 'Save' button. Below this, the 'Rx Freq' is set to 8.436000 MHz, 'Demod' is DSB, 'Demodulator BW' is 60.000 kHz, 'AGC' is Slow, and 'S-level' is -104 dBm. At the very bottom, there are four buttons: 'Start', 'Stop', 'Previous', and 'Next', followed by the text 'Scanning from row 1 to row 366' and an 'Exit' button.

	Rx Frequency	Mode	Offset	Shift	Remarks	Date & Time	Baudrate	Modulation	Operator	Callsign	Location	Frame
1	8.408000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-8A, STANAG-4285 NOR,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:16:59	2400 Bd	PSK-8A, STANAG-4285 NOR				
2	8.436000 MHz	hf-analysis-classifier-code-check	0 Hz	852 Hz	Modulation:CW, man, Center:955.6 Hz,... Modulation:CW, man, Center:1955.97 Hz,... Signal #1 predicted mode(s): CW-MORSE Signal 2 - Predicted Mode(s): CW-MORSE Modulation:F1B, Center:3044.25 Hz,...	07 Nov 2014 16:19:24	47 Bd	F1B				
3	8.444000 MHz	hf-analysis-classifier-code-check	0 Hz	206 Hz	Modulation:CW, man, Center:2650.55 Hz,... Signal #1 predicted mode(s): CW-MORSE Modulation:F1B, Center:2551.24 Hz,... Signal #1 predicted mode(s): ARQ-...	07 Nov 2014 16:20:04	100 Bd	F1B				
4	8.452000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-8A, STANAG-4285 NOR,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:21:29	2400 Bd	PSK-8A, STANAG-4285 NOR				
5	8.468000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-8A, STANAG-4285 NOR,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:22:53	2400 Bd	PSK-8A, STANAG-4285 NOR				
6	8.476000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-8A, STANAG-4285 NOR,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:23:38	2400 Bd	PSK-8A, STANAG-4285 NOR				
7	8.480000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:CW, Center:4051.61 Hz,... Signal #1 predicted mode(s): CW-MORSE Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:24:01	15 Bd	CW				
8	8.484000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:CW, Center:4052.22 Hz,... Signal #1 predicted mode(s): CW-MORSE Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:24:22	16 Bd	CW				
9	8.492000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation: PSK-8B, Center:2197.8 Hz,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:25:01	2400 Bd	PSK-8B				
10	8.500000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-2A, CIS-12 NOR,...	07 Nov 2014 16:26:16	120 Bd	PSK-2A, CIS-12 NOR				
11	8.504000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-2A, CIS-12 NOR,...	07 Nov 2014 16:26:36	120 Bd	PSK-2A, CIS-12 NOR				
12	8.512000 MHz	hf-analysis-classifier-code-check	0 Hz		Modulation:PSK-8A, STANAG-4285 NOR,... Signal #1 predicted mode(s):... Signal #1 detected mode(s): STANAG-4285	07 Nov 2014 16:27:16	2400 Bd	PSK-8A, STANAG-4285 NOR				
13	8.524000 MHz	hf-analysis-classifier-code-check	-14921 Hz		Modulation: PSK-8B, Center:2622.5 Hz,... Signal #1 predicted mode(s):...	07 Nov 2014 16:28:20	2400 Bd	PSK-8B				
14	8.564000 MHz	hf-analysis-classifier-code-check	-2537 Hz	851 Hz	Modulation:F1B, Center:3641.21 Hz,... Signal #1 predicted mode(s):...	07 Nov 2014 16:31:52	50 Bd	F1B				

Memory Scan mode with a database and scan parameters setting

W-SPECTRA

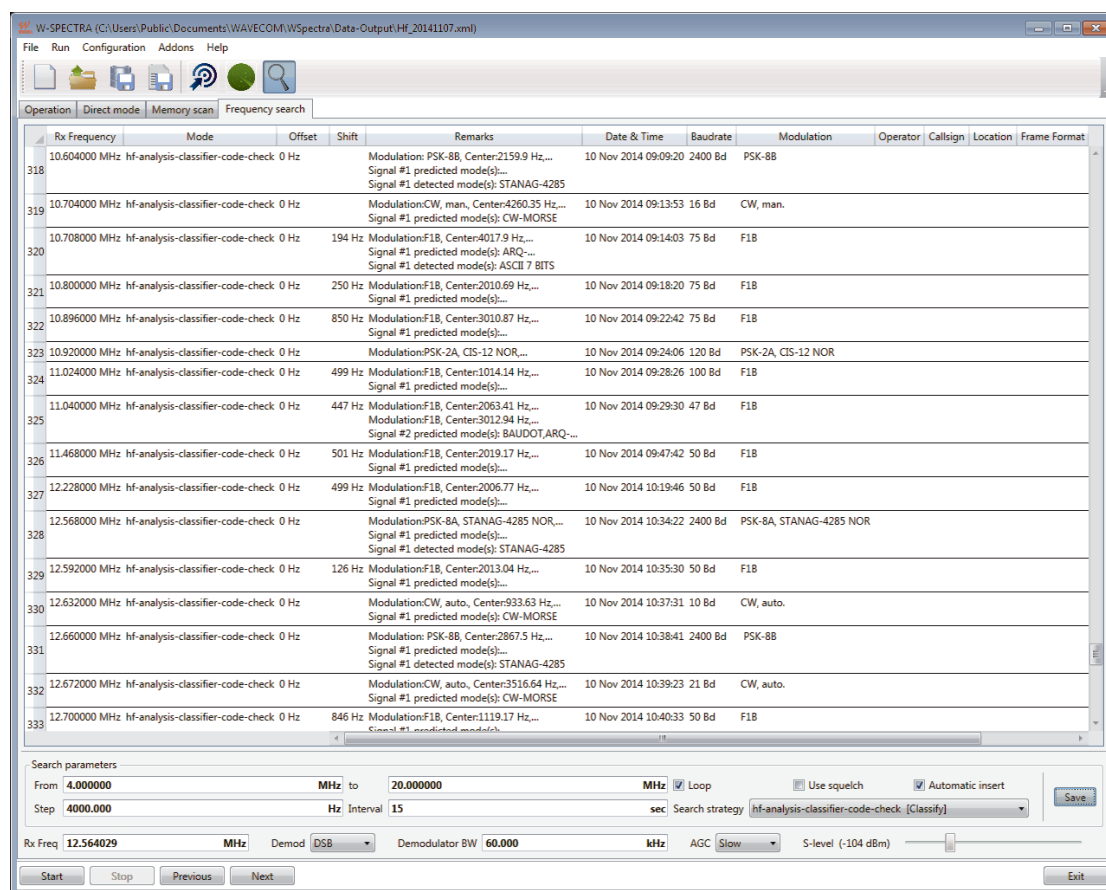
Complete Automatic Spectrum Monitoring System

Frequency Search: Automatic Spectrum Monitoring and Database Generation

With the Frequency Search mode W-SPECTRA can scan over an entire frequency band, e.g., HF band 3 — 30 MHz, run a classifier and code check (search strategy), search for signals and record the classification results into the database automatically.

The four buttons in the last line of the GUI have the following function:

- ◆ Start: start the frequency search from the first frequency defined and jump to the next frequency (+ Step) after an Interval period.
- ◆ Stop: stop the frequency search function.
- ◆ Previous and Next: jump manually to the previous and next frequency respectively according to the Step size.



Frequency Search mode with a database and search parameters setting

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Scan Delay in Automatic Modes

W-SPECTRA adopts a “scan delay” method when running in automatic mode. When the classifier and code check find a signal at a frequency the automatic jump to the next frequency / memory entry is hold on until the complete classifier code check result is delivered.

In this way W-SPECTRA delivers more precise, stable and reliable monitoring results. This method applies to all three operation modes: Direct Mode, Memory Scan and Frequency Search.

Automatic Classification and Decoding

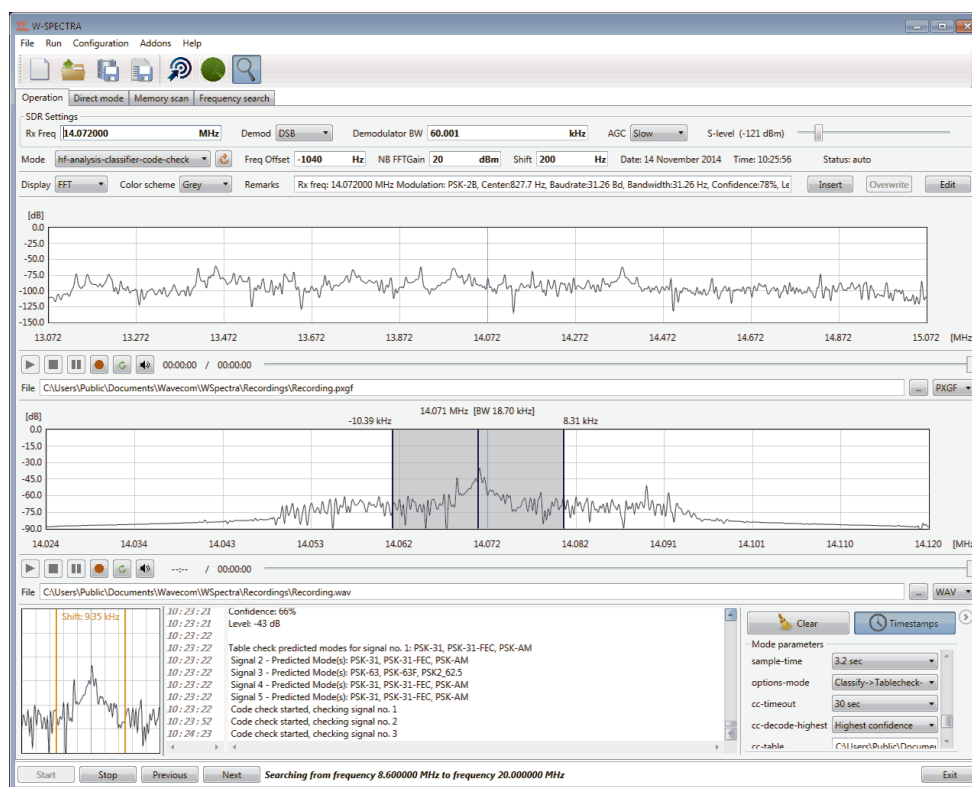
Powerful classification unit

The automation of the signal classification process relieves the operator from manual evaluation, which otherwise requires considerable skill and experience.

W-Classifier supports these functions

(W-Classifier-NB)

- ◆ Modulation type
- ◆ Baud rate or symbol rate
- ◆ Signal center frequency
- ◆ Number of carriers
- ◆ Frequency shift



Multiple signal classification and code check

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Automatic Classification and Decoding

- ◆ Carrier spacing or distance
- ◆ CW-Morse detection
- ◆ 8 kHz bandwidth (W-Classifier-NB)
- ◆ All signals within the classifier bandwidth are processed — multiple signal classification

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

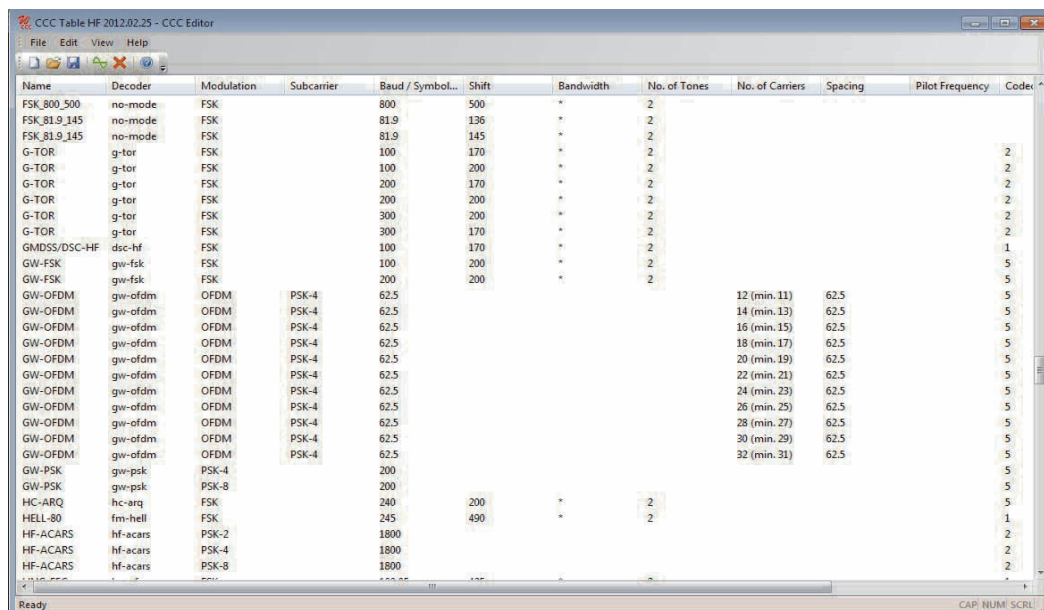
- ◆ Bandwidth up to 96 kHz
- ◆ Voice detection AM, FM, USB and LSB
- ◆ Baud rates up to 60 kBd

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 attempts 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 will check the sig-

nal against the entries of the selected mode list. The code check attempts to synchronize against classified modes, finally the signal will be forwarded to a decoder for output.

A *CCC Table Editor (under the menu Addons)* allows extending, modifying or deleting records in the table used for mode look-up. An input template containing all important parameters is avail-

able for each modulation type. All parameters, the record name and the file name are user selectable.



The screenshot shows the 'CCC Table Editor' window with a table containing various modulation parameters. The table has columns for Name, Decoder, Modulation, Subcarrier, Baud / Symbol..., Shift, Bandwidth, No. of Tones, No. of Carriers, Spacing, Pilot Frequency, and Code. The table lists various modulation types such as FSK, G-TOR, GMDSS/DSC-HF, GW-FSK, GW-OFDM, GW-PSK, HC-ARQ, and HELL-80, along with their respective parameters.

Name	Decoder	Modulation	Subcarrier	Baud / Symbol...	Shift	Bandwidth	No. of Tones	No. of Carriers	Spacing	Pilot Frequency	Code
FSK_800_500	no-mode	FSK		800	500	*	2				
FSK_819_145	no-mode	FSK		819	136	*	2				
FSK_819_145	no-mode	FSK		819	145	*	2				
G-TOR	g-tor	FSK		100	170	*	2				2
G-TOR	g-tor	FSK		100	200	*	2				2
G-TOR	g-tor	FSK		200	170	*	2				2
G-TOR	g-tor	FSK		200	200	*	2				2
G-TOR	g-tor	FSK		300	200	*	2				2
G-TOR	g-tor	FSK		300	170	*	2				2
GMDSS/DSC-HF	dsc-hf	FSK		100	170	*	2				1
GW-FSK	gw-fsk	FSK		100	200	*	2				5
GW-FSK	gw-fsk	FSK		200	200	*	2				5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				12 (min. 11)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				14 (min. 13)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				16 (min. 15)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				18 (min. 17)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				20 (min. 19)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				22 (min. 21)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				24 (min. 23)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				26 (min. 25)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				28 (min. 27)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				30 (min. 29)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				32 (min. 31)	62.5		5
GW-PSK	gw-psk	PSK-4		200							5
GW-PSK	gw-psk	PSK-8		200							5
HC-ARQ	hc-arq	FSK		240	200	*	2				5
HELL-80	fm-hell	FSK		245	490	*	2				1
HF-ACARS	hf-acars	PSK-2		1800							2
HF-ACARS	hf-acars	PSK-4		1800							2
HF-ACARS	hf-acars	PSK-8		1800							2

Classifier Code Check table editor

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Database Define and Check

W-SPECTRA records classification and decoding results into a database. The database is in XML format, which allows easy access by a third-party program. User can define a database template according to his needs. Each database template contains 6 mandatory fields:

- ◆ Rx Frequency
- ◆ Mode: decoder, classifier or code check running in W-SPECTRA
- ◆ Offset: offset of the middle cursor in the NB spectrum display, used to place a signal in the bandwidth
- ◆ Shift: bandwidth or shift of a signal
- ◆ Remarks: classification code check result auto-

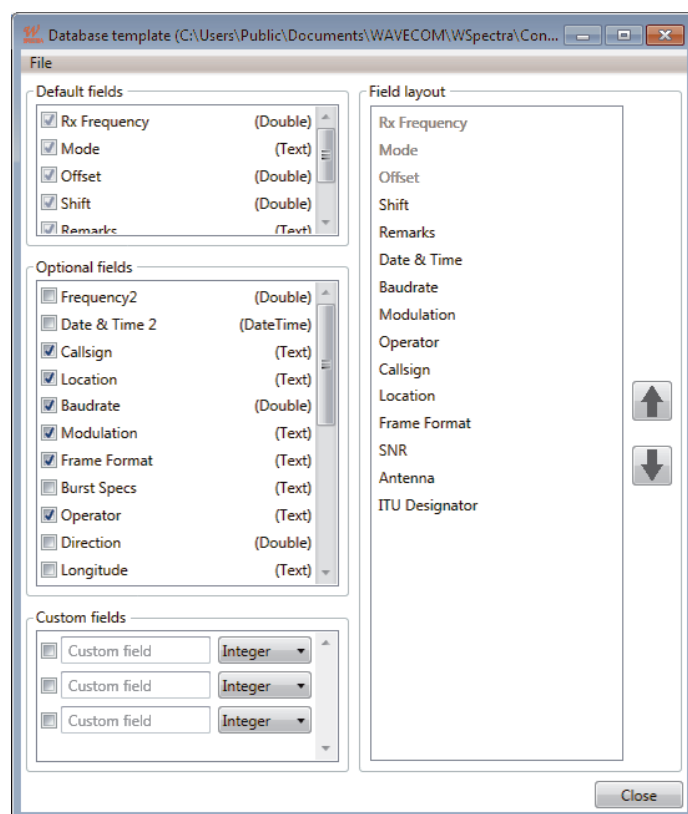
matically filled or free text manually editable

- ◆ Date & Time: date and time when the record is inserted into the database
- ◆ All the mandatory fields are accessible in the main GUI “Operation” tab

User can extend the template by choosing up to 23 predefined optional fields and defining up to 3 custom fields.

W-SPECTRA can verify the database integrity by

- ◆ Remove empty entries
- ◆ Remove duplicate entries: when all data fields have the identical content



Customize a database template

W-SPECTRA

Complete Automatic Spectrum Monitoring System

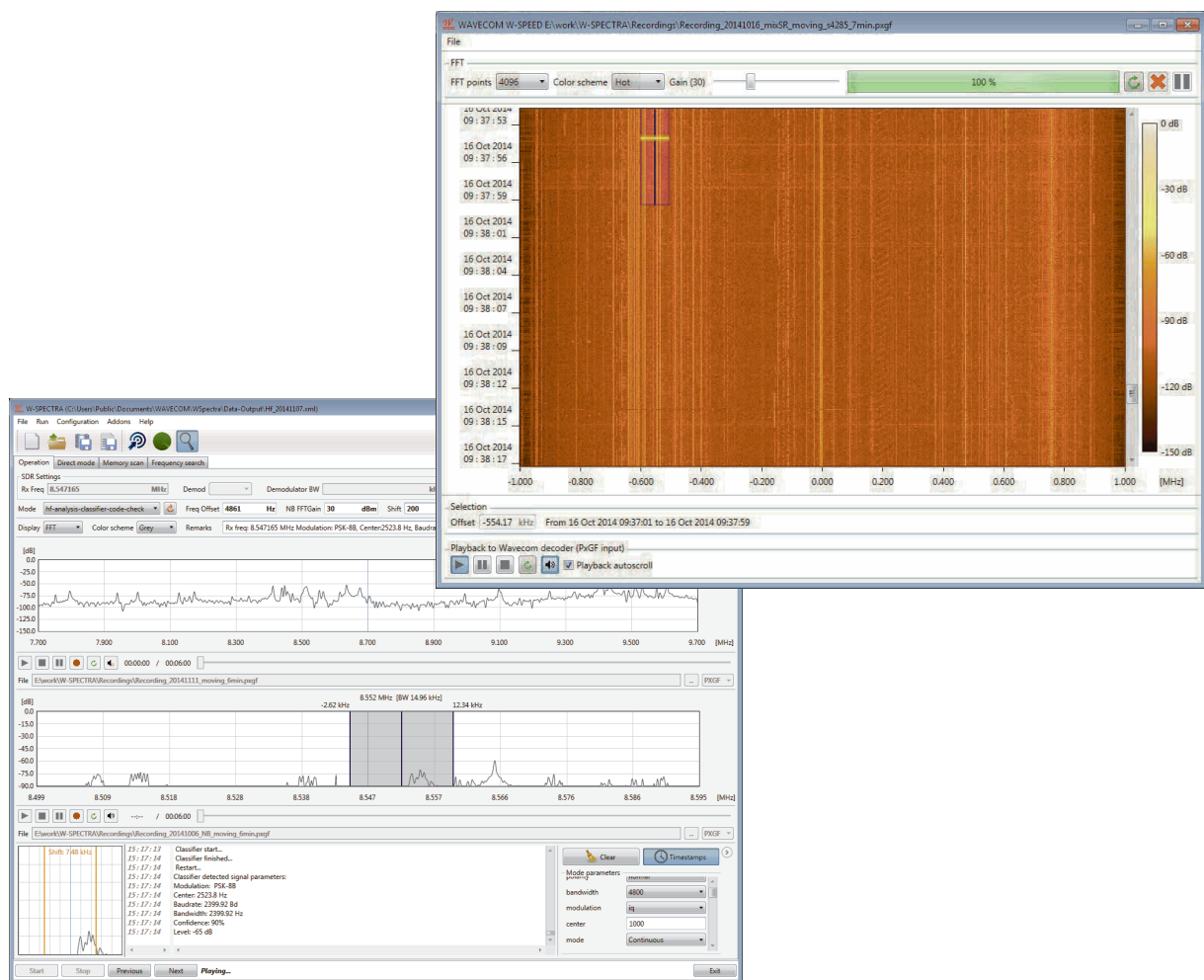
Spectra Editing (W-SPEED)

W-SPECTRA performs an online monitoring of signals within a 96 kHz bandwidth of the receiver frequency. For spectrum outside this bandwidth W-SPECTRA makes a wideband (2 MHz) IQ signal recording with various side information. The entire recorded spectrum can be processed (classified and decoded) by the Spectra Editing (W-SPEED) tool.

- ◆ Display the entire IQ recording in a 2-dimensional sonagram (frequency and time domains)

- ◆ User can choose an interesting signal by cutting it out in time and frequency domains
- ◆ Play the cut out signal to W-SPECTRA for afterwards classification and decoding
- ◆ Display the instantaneous receiver frequency (Rx Freq) in the main GUI "Operation" tab
- ◆ Output the signal to the speaker for acoustic monitoring purpose

1.



Use Spectra Editing to cut out an interesting signal for processing in W-SPECTRA

W-SPECTRA

Complete Automatic Spectrum Monitoring System

Technical Data and Overall Software Characteristics

Receiver Control

- ◆ Support WiNRADiO G3xDDC (e.g., G33DDC and G39DDC)
- ◆ Bi-directional control of the receiver
- ◆ Spectrum display wideband (up to 2 MHz) and narrowband (96 kHz) signals and process of them

W-SPECTRA Operation Modes

	Direct Mode	Memory Scan	Frequency Search
Description	Classify and decode a signal by setting a receiver frequency manually. Use „Sweep“ mode to catch a signal in a small range	Rescan and verify signals according to database entries. New result can be inserted into the database	Automatic search signals (classify and code check) over a predefined frequency band according to a search strategy. Results automatically inserted into a database
Start	Start to sweep over a defined frequency range	Start to rescan the spectrum according to the database entries	Start to search signals in a wide range of frequency
Stop	Stop sweeping	Stop rescan	Stop searching signals
Previous	Jump to the previous frequency according to the step size	Jump to the previous database entry	Jump to the previous frequency according to the step size
Next	Jump to the next frequency according to the step size	Jump to the next database entry	Jump to the next frequency according to the step size

Signal Recording and Playback

Media Player / Recorder	Wideband	Narrowband
Recording format	IQ PXGF	IQ PXGF and WAV
Bandwidth	Up to 2 MHz	96 kHz
Bits per sample	16 bits for I and Q	32 bits for I and Q
On the fly side information	Receiver frequency (Rx Freq), recording bandwidth and timestamp	Receiver frequency (Rx Freq), recording bandwidth and timestamp for PXGF format
Playback	<ul style="list-style-type: none">◆ WB spectrum display with side information◆ A selected 96 kHz band displayed in NB spectrum and processed by the classifier or decoder◆ Signal output to speaker for acoustic monitoring	<ul style="list-style-type: none">◆ Signal displayed in NB spectrum with side information◆ Selected signal processed by the classifier or decoder◆ Signal output to speaker for acoustic monitoring

W-SPECTRA

Complete Automatic Spectrum Monitoring System

W-Classifier-NB Technical Data

Bandwidth HF	4 kHz or 8 kHz (complex: 9.6 kHz)
Sampling interval (Ts)	1.6 sec or 3.2 sec
FSK	30 to 3000 Bd , Shift \leq 3500 Hz Modulation index: 0.5-20 Signal must be continuously present during sampling interval
FSK-4 (F7B)	30 to 300 Bd, Shift \leq 3500 Hz
MFSK	4-36 tones
PSK 2/4 Variant A/B	30 to 3000 Bd
PSK 8/16 Variant A/B	30 to 3000 Bd
MIL/STANAG	Classified to protocol
CIS-12	120 Bd, classified as one signal
OFDM	25-512 carriers $T_g/T_u = 1/1$ to $1/8$ ≥ 25 Bd
OQPSK	25 Bd to 30 kBd
CW-Morse	$T_s = 1.6$ s: 6 to 60 Bd $T_s = 3.2$ s: 3 to 60 Bd
Voice	No
Operation	FFT display of classified signals Continuous and single-pass mode Classifier Code Check with look-up table

W-Classifier-NB Quality of Modulation Classification

FSK	m = 0.8: 100-2400 Bd m = 0.8: 50 Bd m \geq 2: 100-2400 Bd m \geq 2: 50 Bd	12 db (Eb/N0) 15 db (Eb/N0) 14 db (Eb/N0) 16 db (Eb/N0)
PSK 2/4 Variant A/B	100-2400 Bd	14 dB (Eb/N0)
PSK 8/16 Variant A/B	100-2400 Bd	16 dB (Eb/N0)
CW-Morse	8-50 Bd	18 dB (Eb/N0)

W-Classifier-NB Accuracy of Measured Parameters

FSK	baud rate center frequency	0.3 % 2 % of baud rate
PSK	baud rate center frequency	0.2 % 0.15 % of baud rate
CW-Morse	baud rate	5 %

W-SPECTRA

Complete Automatic Spectrum Monitoring System

W-Classifier-WB Technical Data

Bandwidth HF/VHF/UHF/SHF	500 Hz to 96 kHz (complex: 160 kHz)
Sampling interval (Ts)	1.6 sec or 3.2 sec
FSK	30 to 60 kBd , Shift \leq 30 kHz Modulation index: $m = 0.5-20$ Signal must be continuously present during sampling interval
4-FSK (F7B)	30 to 300 Bd, Shift \leq 3500 Hz
MFSK	4-36 tones
PSK 2/4 Variant A/B	30 Bd to 60 kBd
PSK 8/16 Variant A/B	30 Bd to 60 kBd
MIL/STANAG	Classified to protocol
CIS-12	120 Bd, classified as one signal
OFDM	25 - 512 carriers $T_g/T_u = 1/1$ to $1/8$ ≥ 25 Bd
OQPSK	25 Bd to 30 kBd
CW-Morse	$T_s = 1.6$ s: 6 to 60 Bd $T_s = 3.2$ s: 3 to 60 Bd
Voice	AM, FM, USB, LSB
Operation	FFT display of classified signals Continuous and single-pass mode Classifier Code Check with look-up table

W-Classifier-WB Quality of Modulation Classification

FSK	$m = 0.8$: 100-2400 Bd $m = 0.8$: 50 Bd $m \geq 2$: 100-2400 Bd $m \geq 2$: 50 Bd	12 db (Eb/N0) 15 db (Eb/N0) 14 db (Eb/N0) 16 db (Eb/N0)
PSK 2/4 Variant A/B	100-2400 Bd	14 dB (Eb/N0)
PSK 8/16 Variant A/B	100-2400 Bd	16 dB (Eb/N0)
CW-Morse	8-50 Bd	18 dB (Eb/N0)

W-Classifier-WB Accuracy of Measured Parameters

FSK 100 - 60 kBd	baud rate center frequency	0.3 % 2 % of baud rate
PSK 100 - 60 kBd	baud rate center frequency	0.2 % 0.15 % of baud rate
CW-Morse 6 - 50 Bd	baud rate	5 %

W-SPECTRA

Complete Automatic Spectrum Monitoring System

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
Scan Delay		When CCC gets the first result, the automatic scan will hold on until the entire result comes.

User Configurable Database

Database in XML format	Location	ITU Designator
Six mandatory fields	Baudrate	Remote Name
Rx Frequency (receiver frequency)	Modulation	Polarisation
Mode (decode or classifier running)	Frame Format	Satellite Name
Offset (middle cursor of the NB spectrum display)	Burst Specs	Satellite Position
Shift	Operator	Links to Templates
Remarks	Direction	Links to Files
Date & Time	Longitude	Links to Internet
23 optional fields	Latitude	Three custom fields free editable
Frequency 2	SNR	
Date & Time 2	Antenna	
Callsign	Elevation	

W-SPECTRA

Complete Automatic Spectrum Monitoring System

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)
CODAN-SELCAL
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
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)
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

W-SPECTRA

Complete Automatic Spectrum Monitoring System

VHF/UHF - Protocols

ACARS
AIS
APCO-25 (P25)
ASCII
ATIS (Selcal digital)
BIIS
CCIR-1 (Selcal analog)
CCIR-2 (Selcal analog)
CCIR-7 (Selcal analog)
CCITT (Selcal analog)
CTCSS
DCS-SELCAL
DGPS
DMR (with live voice)
dPMR (with live voice)
DTMF (Selcal analog)

DZVEI (Selcal analog)
EEA (Selcal analog)
EIA (Selcal analog)
ERMES
EURO (Selcal analog)
FLEX
FMS-BOS (Selcal digital)
GMDSS/DSC-VHF
GOLAY/GSC
MOBITEX-1200 (with OVLS)
MOBITEX-8000
MODAT (Selcal analog)
MPT-1327 (with ITA-5)
NATEL (Selcal analog)
NMT-450
NWR-SAME

NXDN (with live voice)
PACKET-1200
PACKET-9600
PCCIR (Selcal analog)
PDZVEI (Selcal analog)
POCSAG
PZVEI (Selcal analog)
SKYPER (POCSAG)
TETRA (with live voice)
VDEW (Selcal analog)
VDL-M2
X.25
ZVEI-1 (Selcal analog)
ZVEI-2 (Selcal analog)
ZVEI-3 (Selcal analog)
ZVEI-VDEW (Selcal digital)

Alphabets

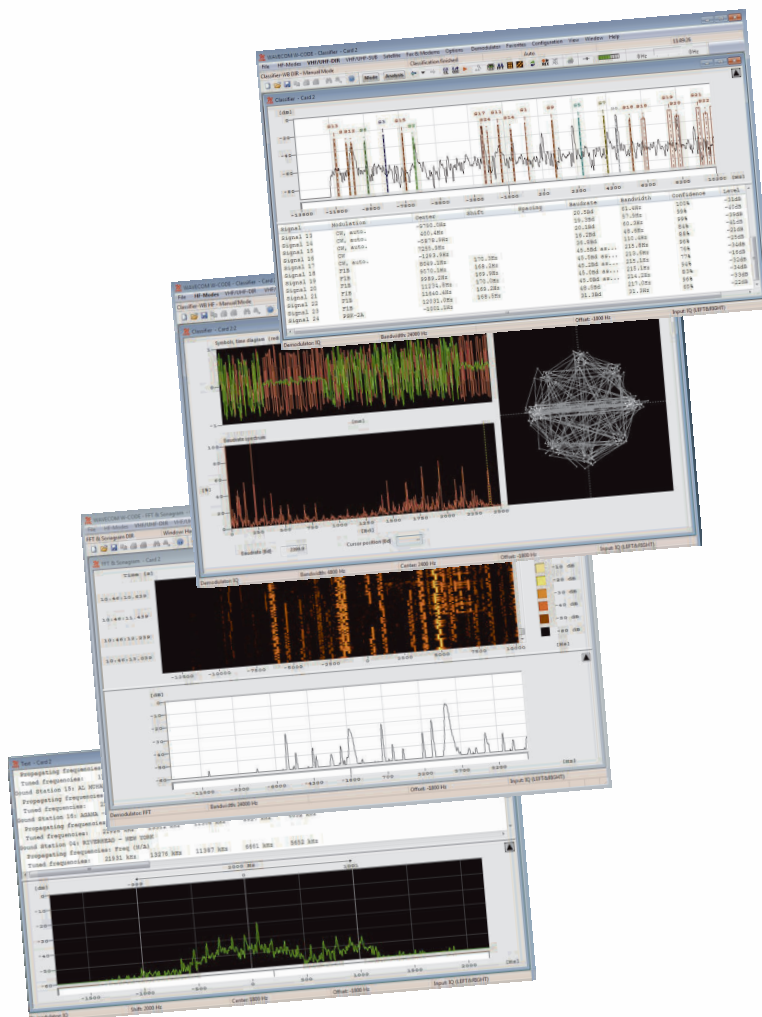
Chinese (7-bit ASCII)
HEX
ITA-1 Latin
ITA-2 Baghdad70 Arabic
ITA-2 Baghdad80 Arabic
ITA-2 Cyrillic
ITA-2 Danish-Norwegian
ITA-2 Hebrew
ITA-2 Latin
ITA-2 Latin Transparent

ITA-2 Swedish
ITA-2 TASS Cyrillic
ITA-2 Third Shift Cyrillic
ITA-2 Third Shift Greek
ITA-5 Bulgarian
ITA-5 Danish-Norwegian
ITA-5 French
ITA-5 German
ITA-5 Swedish
ITA-5 US

Morse Arabic
Morse Cyrillic
Morse Greek
Morse Hebrew
Morse Latin
Morse Scandinavian
Morse Spanish
User defined 5-bit alphabets based on UNICODE



WAVECOM® W-CODE



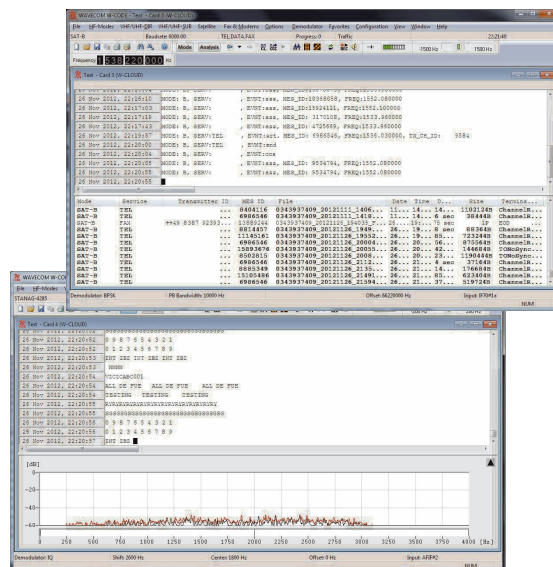
W-CODE provides all functions required to classify, analyze, record, decode and process radio data communications throughout the entire radio spectrum from ELF to SHF. W-CODE is the new standard decoder software for all Wavecom products.

W-CODE

Signal Analysis and Processing

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 of known 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, 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 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 concurrent W-CODE instances



Worldwide monitoring with W-CODE and W-CLOUD

Signal Analysis and Processing

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-PCle, W-PCI and W-QPCle. The number of supported interfaces is continuously growing. Using W-CODE prevents the locking to proprietary devices of software producers.


Devices

Server

☒ Local
 ☐ Remote

Host address or name

 Port

 Speed limit (Baud)

Server Devices

☒ No device

	Name	Connections	Device	Serial number
	soundcard	1	Line In (Realtek High Definition V1.1)	1927840122
	G39ddc		Line 1 (WINRADIO Virtual Sound V1.1)	1927840222
	DeviceC		Warecom W-CLOUD G330DC V2.0	0343973651
	DeviceD		Warecom W-CLOUD G390DC V2.0	1142530122
	DeviceE		No Device	
	DeviceF		No Device	
	DeviceG		No Device	
	DeviceH		No Device	

W-CLOUD Networking

Index	Remote host	Port	Auto connect	Encryption	Sound	Status
1	wcloud73651	52001	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
2	wcloud73409	52000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

The diagram illustrates the W-Cloud architecture, showing the flow of data and control between a Remote Site and a Central Site.

Remote Site:

- Antennas
- SDR (Software Defined Radio) supporting HF/VHF/UHF/SHF
- W-CLOUD Server / SDR Server

Central Site:

- Any PC or Workstation supporting W-PCIe, W-PCI, and Windows® 7
- Signal Classifier, Code Classifier, Data Analysis, Data Decoding, and Data Storage
- W-CODE (Wireless Code)
- Spectrum Display, RX Frequency, Bandwidth, and Functions
- SDR Client

Network:

- Internet, Ethernet LAN, Wireless LAN
- Encrypted, high quality I/Q stream

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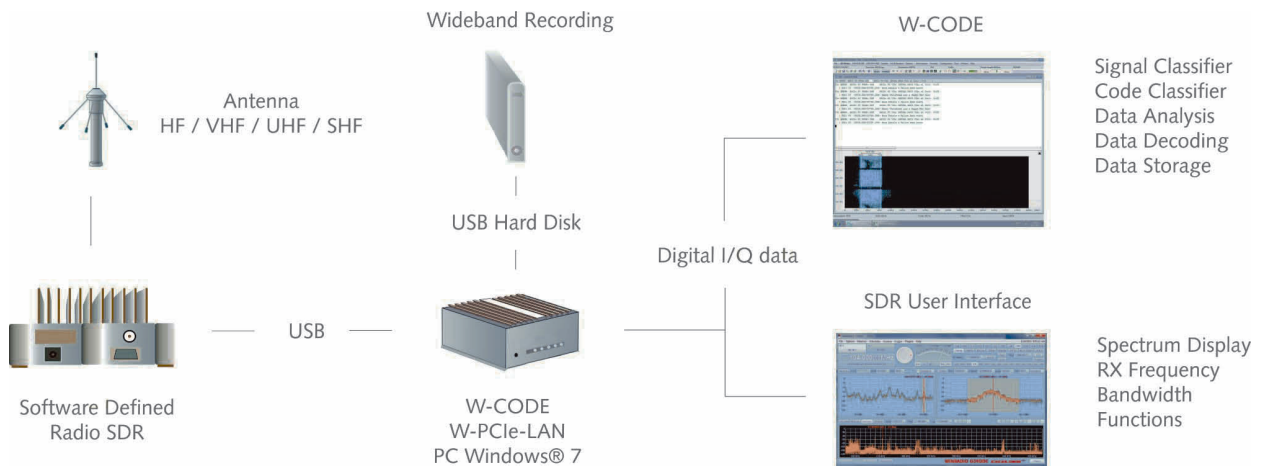
W-CODE

Signal Analysis and Processing

Signal Sources and Devices

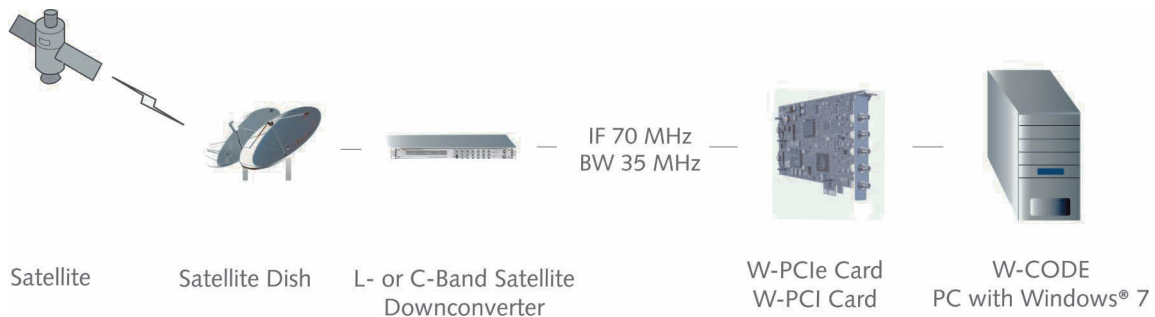
In this setup W-CODE and W-PCle-LAN works together with a Software Defined Receiver (SDR) via its direct IF I/Q interface. It is also possible to use a universal Virtual Audio Cable (VAC) as interface. Additional hardware is not required for this soft-

ware only solution. The W-PCle-LAN may even be replaced by an standard PC or workstation. Because data is digitally processed, any loss of quality is avoided.



Satellite communication decoding is also possible using W-CODE and W-PCle or W-PCI. In this configuration the interface card acts as a dual Direct

Down Converter (DDC). The receiving frequency is automatically and directly controlled from W-CODE.



W-CODE

Signal Analysis and Processing

W-CODE and W-PCle or W-PCI supports all types of receivers with IFs from 8 kHz to 21.4 MHz and even wideband receivers with 70 MHz IF. It is al-

so possible to use a sound card as input device.

Standard Receiver
HF, VHF, UHF, SHF

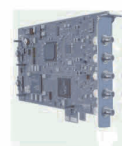


IF 8 kHz
to
IF 21.4 MHz
or AF

Wideband Receiver
HF, VHF, UHF, SHF



IF 70 MHz
+/- 15 MHz



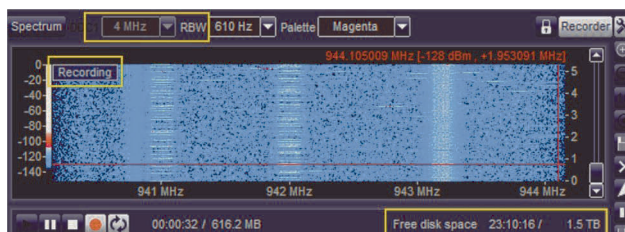
W-PCle Card
W-PCI Card



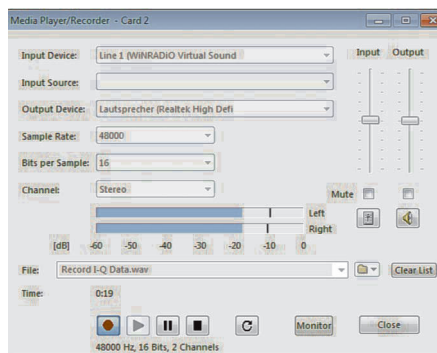
W-PCle-LAN
W-PCI-LAN
W-CODE
Windows®7

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 with W-CODE.



W-CODE

Signal Analysis and Processing

Automatic Classification and Decoding

Powerful classification unit

The automation of the signal classification process relieves the operator from manual evaluation, which otherwise requires considerable skill and experience.

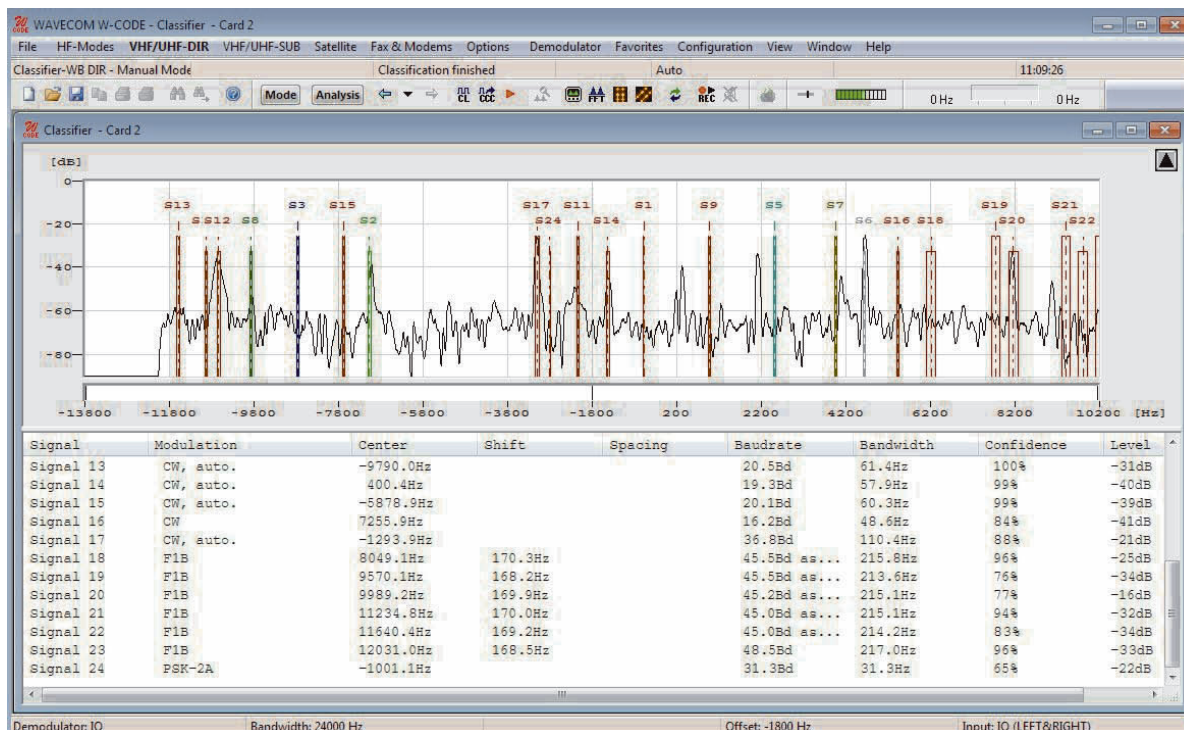
W-Classifier supports these functions (W-Classifier-NB)

- ◆ 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
- ◆ Baud rates up to 60 kBd



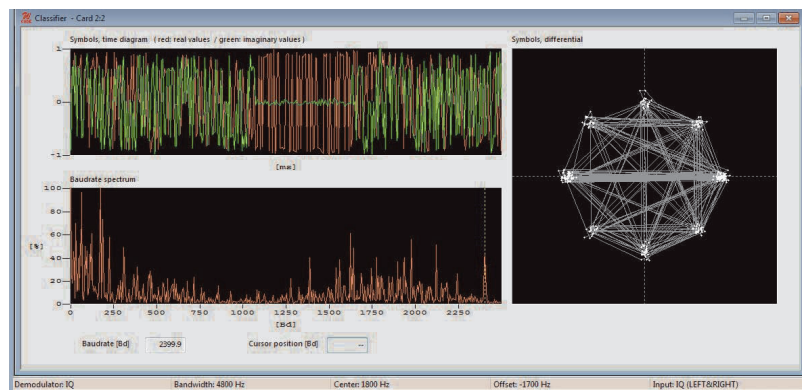
Wideband-Classifier display containing 24 identified signals

W-CODE

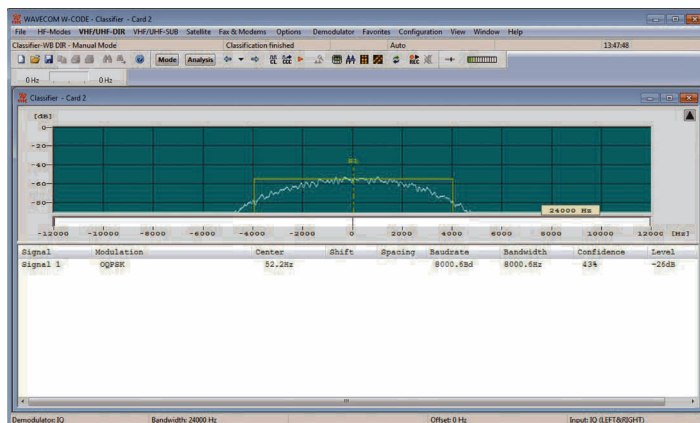
Signal Analysis and Processing

Automatic Classification and Decoding

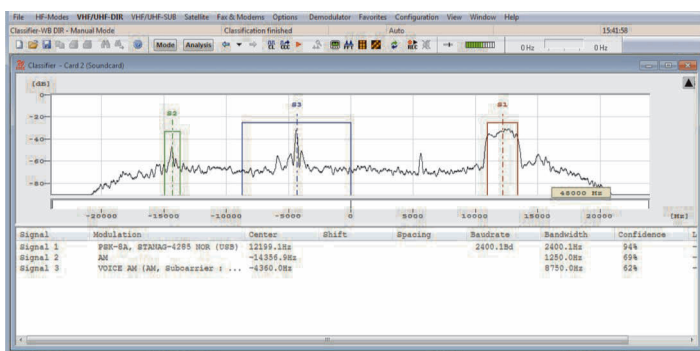
The Classifier also offers a number of signal analysis functions like symbol display, display of real and imaginary components of analyzed signals, baud rate spectrum and differential symbol display in a phase plane. Signal parameters may also be manually measured.



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



Analysis of a 8,000 Baud GMSK TETRAPOL signal



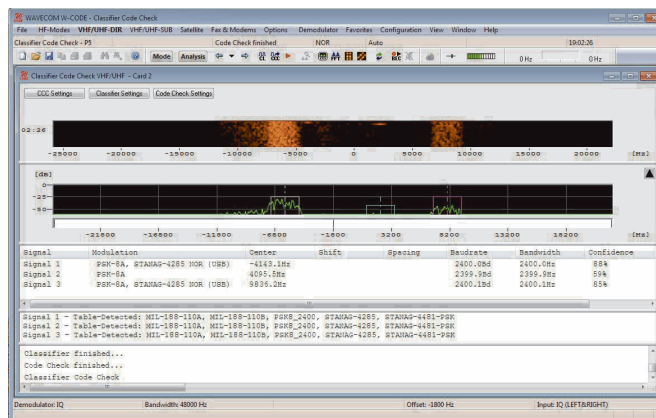
The monitored frequency band is displayed in a spectrum plane. After classification has completed, the classified signals are listed below the spectrum display.

Signal Analysis and Processing

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 will check the signal 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 and XML tables. Any table may be loaded from the Code-Check-Settings menu. Tables are divided according to frequency range, HF, VHF/UHF DIR, VHF/UHF SUB or satellite.



CCC Table HF 2012.02.25 - CCC Editor											
File Edit View Help											
Name	Device	Mutation	Subcarrier	Burst / Symbol...	Shift	Bandwidth	No. of Tones	No. of Carriers	Spacing	Pilot Frequency	Code
FSK_R0_300	no-mode	FSK	800	300 *	*	2					
FSK_R1_345	no-mode	FSK	819	136 *	*	2					
FSK_R1_345	no-mode	FSK	819	143 *	*	2					
G-TDR	g-tor	FSK	100	170 *	*	2					2
G-TDR	g-tor	FSK	100	200 *	*	2					2
G-TDR	g-tor	FSK	200	170 *	*	2					2
G-TDR	g-tor	FSK	200	200 *	*	2					2
G-TDR	g-tor	FSK	300	200 *	*	2					2
G-TDR	g-tor	FSK	300	170 *	*	2					2
GMSK_DPS-HF	dss-hd	FSK	170	170 *	*	2					2
GW-FSK	gew-fsk	FSK	100	200 *	*	2					5
GW-FSK	gew-fsk	FSK	200	200 *	*	2					5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			12 (min. 13)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			14 (min. 17)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			10 (min. 15)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			18 (min. 17)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			20 (min. 19)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			22 (min. 21)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			24 (min. 21)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			26 (min. 25)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			28 (min. 27)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			30 (min. 29)	62.5			5
GW-OFDM	gew-ofdm	OFDM	FSK-4	62.5			32 (min. 31)	62.5			5
GW-FSK	gewfsk	FSK-4									5
GW-FSK	gewfsk	FSK-8									5
HCA-RQ	hc-rsq	FSK	200	200 *	*	2					5
HELL-B0	fss-hell	FSK	245	400 *	*	2					1
HF-ACARS	hf-acars	FSK-2	1800								2
HF-ACARS	hf-acars	FSK-4	1800								2
HF-ACARS	hf-acars	FSK-8	1800								2

Signal Parameters Editor

Edit Signal: ☐ PSK ☐ MFSK ☒ PSK ☐ OFDM ☐ CW

Name: GW-OFDM Subcarrier: PSK-4

Decoder: gw-ofdm Symbol Rate: 62.5 Bd

Modulation: OFDM No. of Carriers: 16

Codecheck Count: 5 Minimum No. of Carriers: 15

☒ Recognition disabled Bandwidth: 937 Hz

ITU Designator: Spacing: 62.5 Hz

Comments: Guard 2 ms Pilot Frequency: Hz

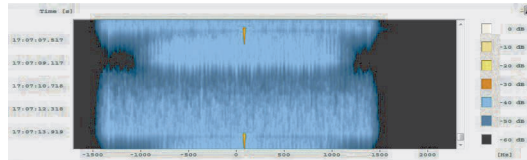
OK Cancel

W-CODE

Signal Analysis and Processing

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 226 transmission modes, all available as a default not requiring any additional license options.

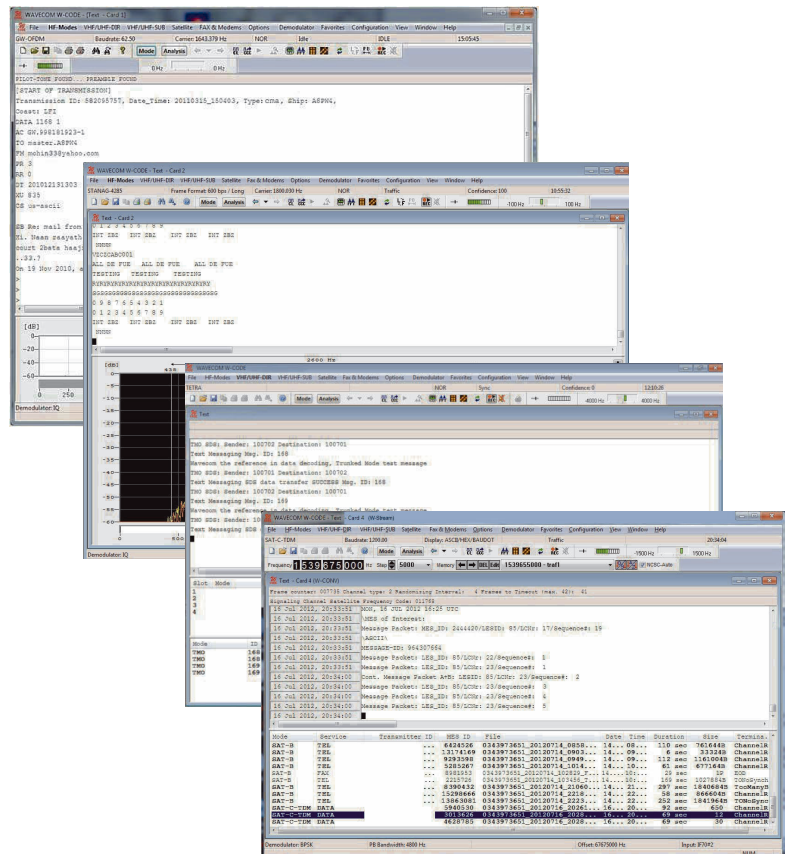


Decoded GW-OFDM from HF

Decoded STANAG-4285 from HF

TETRA decoded from UHF

Decoded satellite SAT-C-TDM transmission



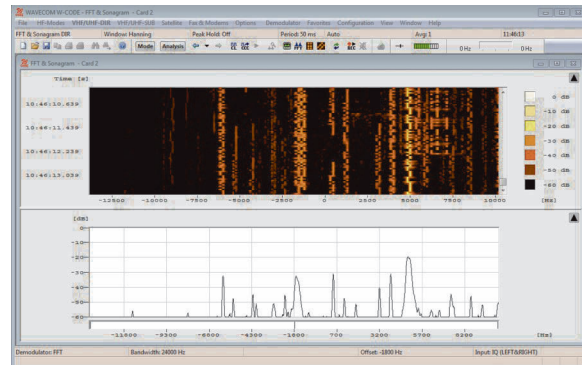
Live examples of decoding are available as flash movies at <http://www.wavecom.ch/product-presentation.php>

W-CODE

Signal Analysis and Processing

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 viewing 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.



Sonogram and FFT spectrum display

FFT
Sonogram
FFT & Sonogram
Waterfall
Oscilloscope

FSK Analysis
FSK Code Check

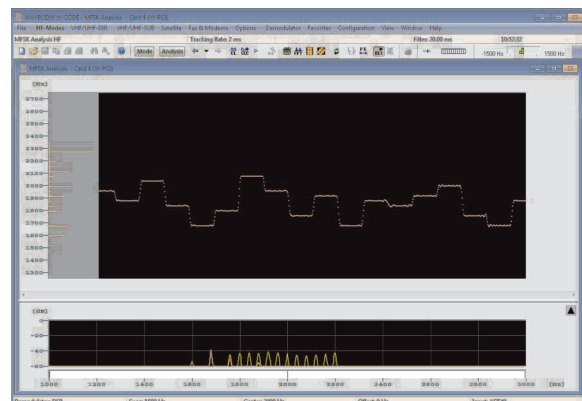
PSK Symbol Rate
PSK Phase Plane
PSK Code Check
MIL-STANAG Code Check

MFSK Analysis
MFSK Code Check

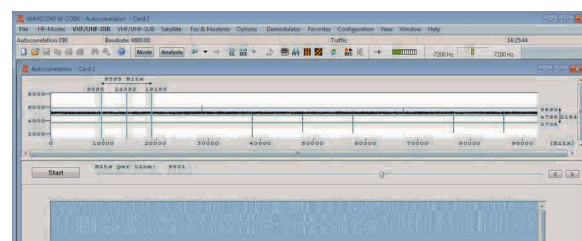
Classifier
Classifier Code Check

Autocorrelation
Bit Correlation
Bit Length Analysis

Demodulated Bit Stream



MFSK analysis with tone measurement, graphical display and FFT



Signal correlating at 9600 bits

Some analysis tools

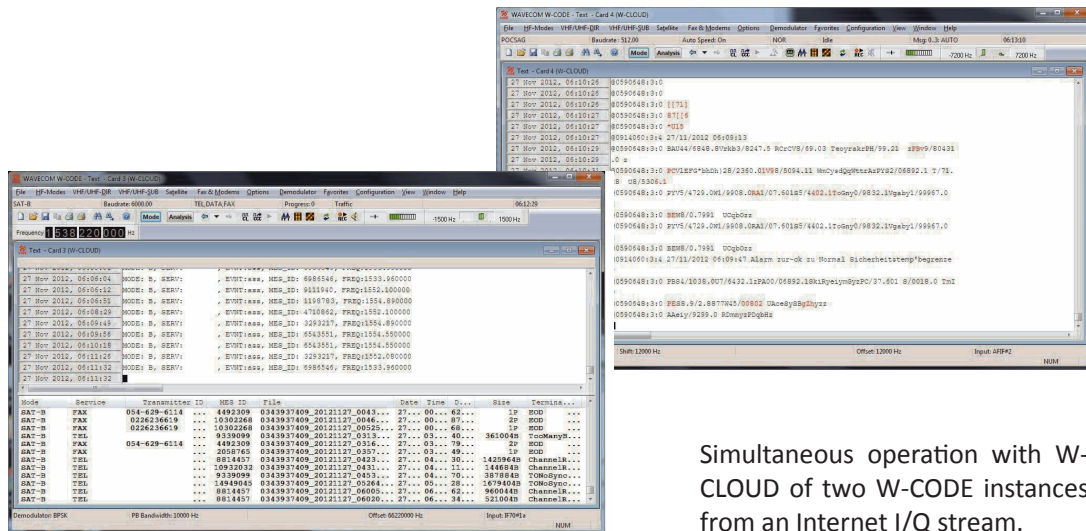
W-CODE

Signal Analysis and Processing

Simultaneous Processing of Multiple Signals

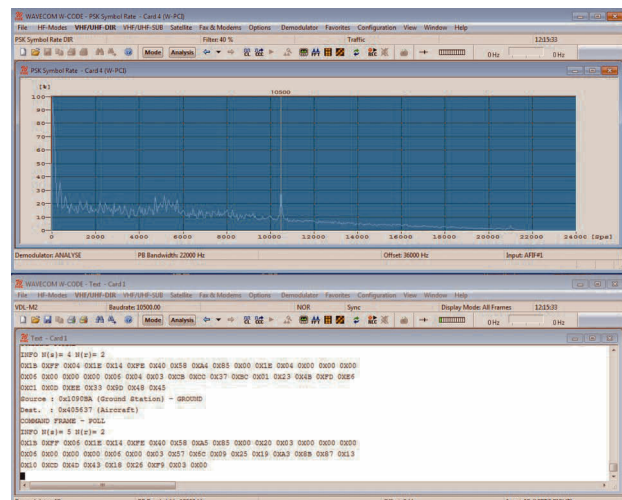
W-CODE allows up to eight concurrent instances and inputs on the same host PC/workstation. The instances are completely independent which facilitate their use. An advantageous “Workstation License” is available for such set-

ups. DDC or SDR may provide the input signal - additional hardware is not required. Notice: Beginning from software release V9.0.00, the input signal sources will be independently sharable between each W-CODE instance.



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-PCle also allow two inputs with complete DDC functionality. Software Defined Radio SDR multi-input will be available from Software V9.0.00.



W-CODE

Signal Analysis and Processing

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-SELCAL
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
FELDHILL
FM-HELL
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)
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
WISEL
WEATHER-FAX

W-CODE

Signal Analysis and Processing

VHF/UHF - Protocols

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

SATELLITE - Protocols

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

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

W-CODE

Signal Analysis and Processing

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

Analysis Functions

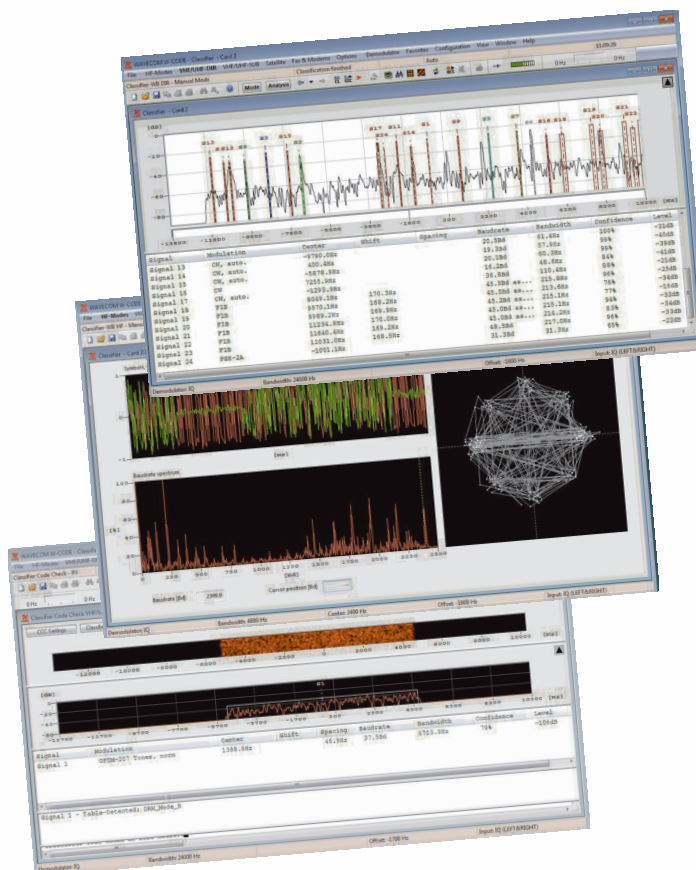
Autocorrelation up to 200.000 bits	MFSK analysis graphical display of MFSK tone spectrum with histogram
Automatic analysis and decoding software for all data and FAX-G3 modulation types	Phase plane analysis HF BPSK, QPSK, OQPSK, DPSK and I/Q 10-2400 Baud
Automatic CRC recognition of all PACTOR-II and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

Overall Software Characteristics

<ul style="list-style-type: none"> Media Player/Recorder, recording and playback of signals 	<ul style="list-style-type: none"> SERIAL LINK, serial data output to PC serial interface COM 1 - 16
<ul style="list-style-type: none"> ALARM MONITOR, automatically detected text-string saving to HD or network SMS output 	<ul style="list-style-type: none"> STANAG5066 parser in MIL-STD and STANAG codes
<ul style="list-style-type: none"> Automatic insertion of time stamps 	<ul style="list-style-type: none"> TCP/IP direct data (IQ and PCM) interface for streaming and for digital receivers (PXGF, IP-CONF, VITA-49)
<ul style="list-style-type: none"> Synchronized PSK and FSK raw bitstream available through remote control interface 	<ul style="list-style-type: none"> TCP/IP remote control with Wavecom GUI, full functionality over LAN or Internet (encrypted and speed optimized)
<ul style="list-style-type: none"> File formats TXT, JPG, BMP, Unicode, WAVECOM (with timestamps) 	<ul style="list-style-type: none"> Unlimited scroll-back buffers for text and graphics
<ul style="list-style-type: none"> PSK, FSK and MFSK baudrate history display with full graphical recall, averaging and cursor functions 	<ul style="list-style-type: none"> Up to 8 decoders may be installed in one host PC
<ul style="list-style-type: none"> FSK shift history display with graphical recall, averaging and cursor functions 	<ul style="list-style-type: none"> WiNRadio VSC and Virtual Audio Cable (VAC) support
<ul style="list-style-type: none"> Configurable message type for most MIL-STD and STANAG codes 	<ul style="list-style-type: none"> Sound card input, 8-bit and 16-bit, 8 kHz to 192 kHz, stereo and mono left/right
<ul style="list-style-type: none"> Pass-band filters in most modes 	<ul style="list-style-type: none"> USB-license-dongle
<ul style="list-style-type: none"> Pass-band tuning in FFT display in most modes 	<ul style="list-style-type: none"> WAV files playback and decoding, loop mode
	<ul style="list-style-type: none"> XML Remote Control Interface API for C++ and C#, XML over TCP/IP



WAVECOM® W-Classifier



The ability to rapidly identify unknown signals has become an essential requirement in signal analysis. The W-CLASSIFIER provides all functions required to automatically classify multiple signals throughout the full radio spectrum from HF to SHF.

W-Classifier

Automatic Signal Classification

W-CLASSIFIER Overview

The automation of the signal classification process relieves the operator from manual evaluation, which otherwise requires considerable skill and experience.

W-Classifier supports these functions

- ◆ 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 for the Narrowband Classifier (W-Classifier-NB, WCL61PC)
- ◆ All signals within the classifier bandwidth are processed

Additional functions for Wideband (W-Classifier-WB)

- ◆ 96 kHz bandwidth for the Wideband Classifier
- ◆ Voice detection AM, FM, USB and LSB
- ◆ Baud rate up to 60 kBd

Application

The classifier can be used in a number of configurations

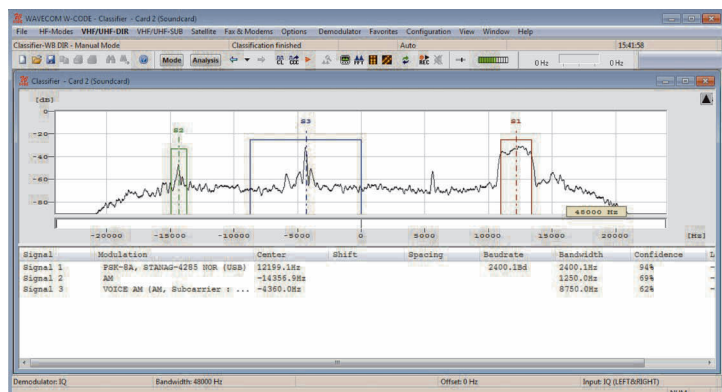
- ◆ Local use as a PC application
- ◆ Remote control via W-CLOUD client-server mode
- ◆ Remote use via LAN with standard W-CODE

application instances in client-server mode

- ◆ Remote control from other applications using third party software (using TCP/IP and XML)
- ◆ Remote control via Microsoft Remote Desktop Protocol

Spectrum Display

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



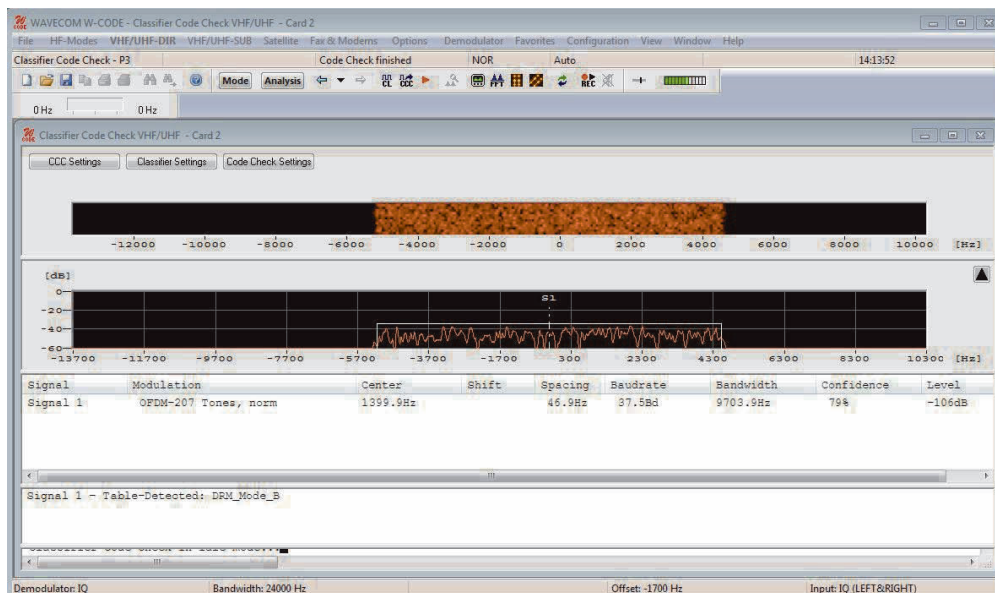
W-Classifier

Automatic Signal Classification

CLASSIFIER-CODE-CHECK (CCC)

The Classifier-Code-Check is a versatile analysis tool for the classification of known and unknown signals and the determination of the mode (protocol) in use. The CCC will attempt to process all signals within the bandwidth of the narrowband or wideband classifier. The classifier attempts to

classify the input signals according to their modulation formats. The table check will check the signal against the entries of an XML-formatted mode list. The code check will attempt to synchronise against classified modes. Finally the signal may be forwarded to a decoder for output.



Classifier-Code-Check (CCC) with table detected DRM Mode B (OFDM)

Classifier-Code Check process levels

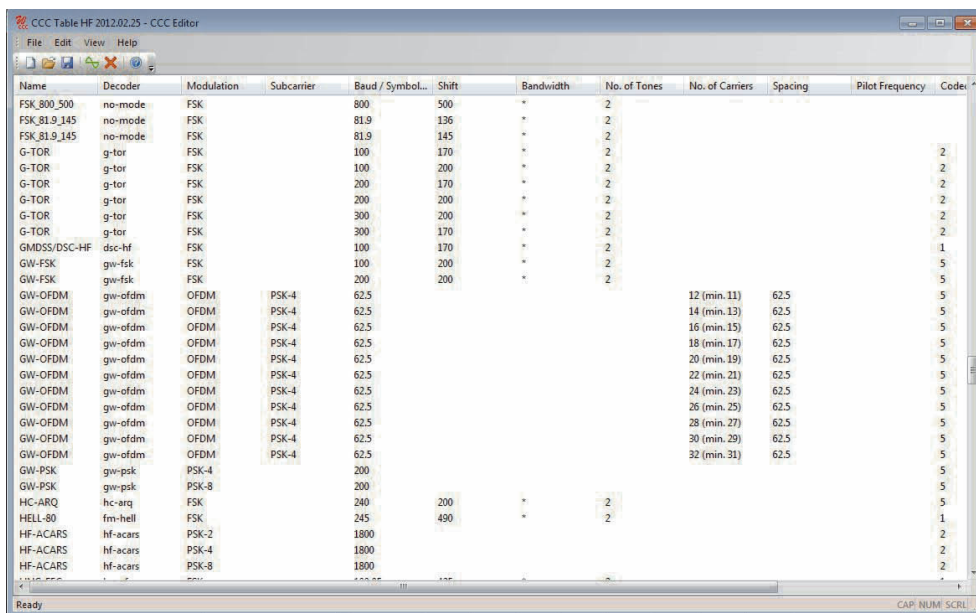
Process Level	P1	Classification is performed, but no decoding
	P2	Classification and table check are performed, but no decoding
	P3	Classification, table check and code check are performed, but no decoding
	P4	Classification and table check are performed and finally the signal is decoded if a mode with 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-Classifier

Automatic Signal Classification

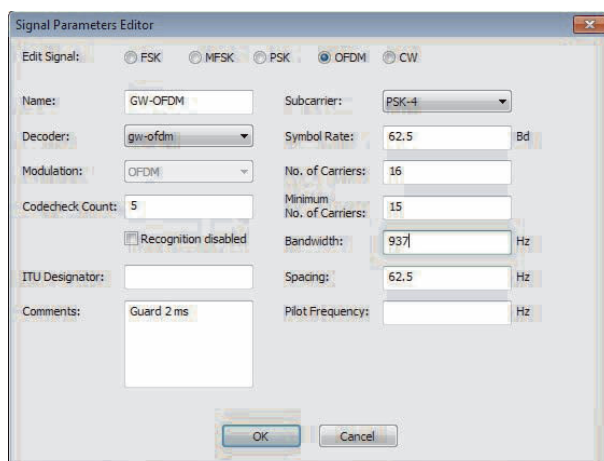
CLASSIFIER-CODE-CHECK (CCC) EDITOR

An XML table editor allows extending, modifying or deleting records in the XML table used for mode look up. An input template containing all important parameters is available for each modulation type. All parameters, record name and file name is user selectable.



Name	Decoder	Modulation	Subcarrier	Baud / Symbol...	Shift	Bandwidth	No. of Tones	No. of Carriers	Spacing	Pilot Frequency	Code...
FSK_800_500	no-mode	FSK		800	500	*	2				
FSK_819_145	no-mode	FSK		819	136	*	2				
FSK_819_145	no-mode	FSK		819	145	*	2				
G-TOR	g-tor	FSK		100	170	*	2				2
G-TOR	g-tor	FSK		100	200	*	2				2
G-TOR	g-tor	FSK		200	170	*	2				2
G-TOR	g-tor	FSK		200	200	*	2				2
G-TOR	g-tor	FSK		300	200	*	2				2
G-TOR	g-tor	FSK		300	170	*	2				2
GMDSS/DSC-HF	dsc-hf	FSK		100	170	*	2				1
GW-FSK	gw-fsk	FSK		100	200	*	2				5
GW-FSK	gw-fsk	FSK		200	200	*	2				5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				12 (min. 11)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				14 (min. 13)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				16 (min. 15)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				18 (min. 17)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				20 (min. 19)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				22 (min. 21)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				24 (min. 23)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				26 (min. 25)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				28 (min. 27)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				30 (min. 29)	62.5		5
GW-OFDM	gw-ofdm	OFDM	PSK-4	62.5				32 (min. 31)	62.5		5
GW-PSK	gw-psk	PSK-4		200							5
GW-PSK	gw-psk	PSK-8		200							5
HCI-ARQ	hc-arq	FSK		240	200	*	2				5
HELL-80	fm-hell	FSK		245	490	*	2				1
HF-ACARS	hf-acars	PSK-2		1800							2
HF-ACARS	hf-acars	PSK-4		1800							2
HF-ACARS	hf-acars	PSK-8		1800							2

User defined list of modes for automatic recognition



Signal Parameters Editor

Edit Signal: ☐ FSK ☐ MFSK ☐ PSK ☒ OFDM ☐ CW

Name: Subcarrier:

Decoder: Symbol Rate: Bd

Modulation: No. of Carriers:

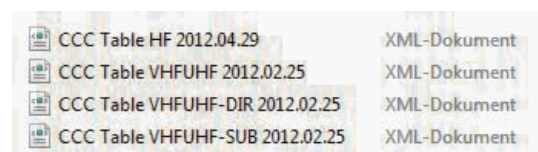
Codecheck Count: Minimum No. of Carriers:

☐ Recognition disabled Bandwidth: Hz

ITU Designator: Spacing: Hz

Comments: Pilot Frequency: Hz

An unlimited number of XML tables may be set up. Any table may be loaded from the "Code-Check-Settings" menu.



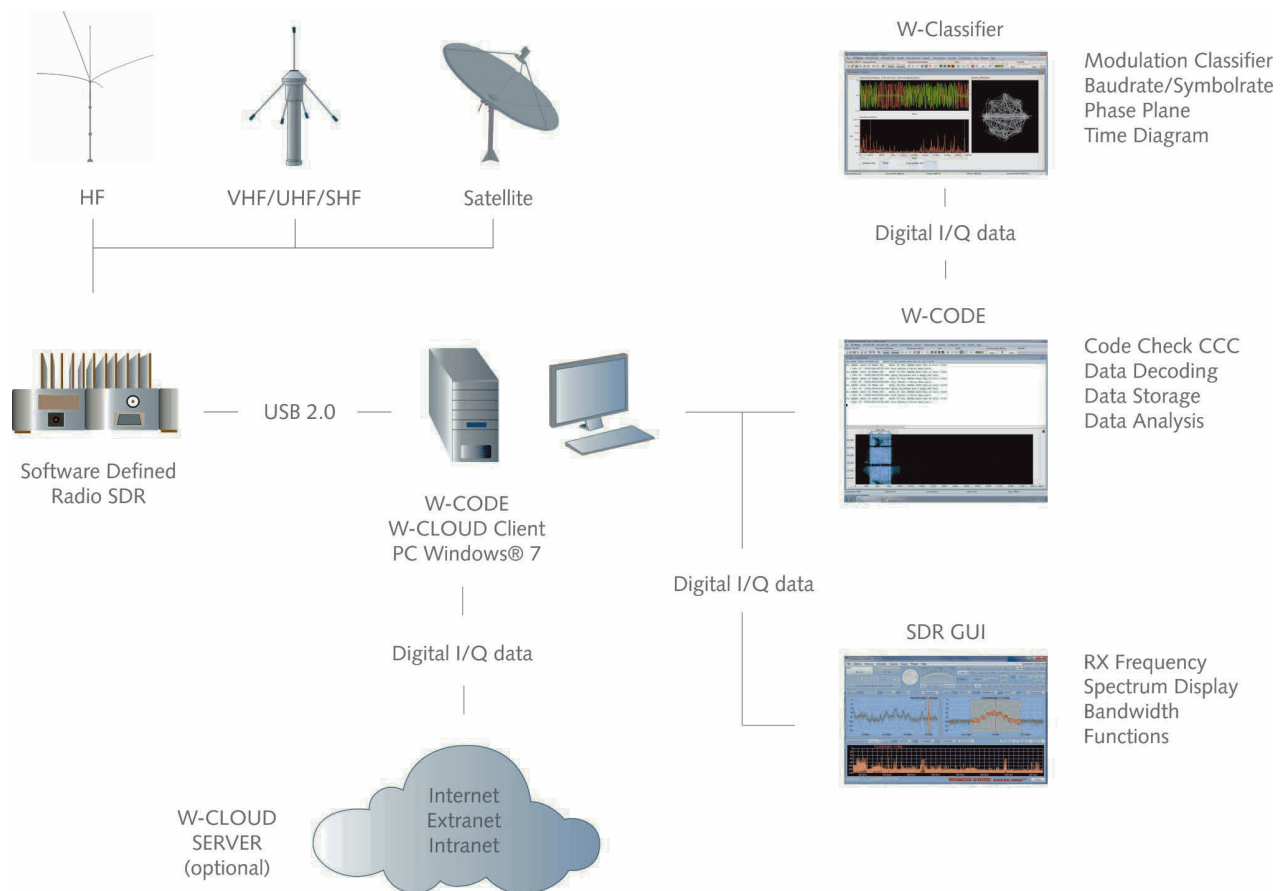
CCC Table HF 2012.04.29	XML-Dokument
CCC Table VHFUHF 2012.02.25	XML-Dokument
CCC Table VHFUHF-DIR 2012.02.25	XML-Dokument
CCC Table VHFUHF-SUB 2012.02.25	XML-Dokument

Classifier-Code-Check Editor input template

W-Classifier

Automatic Signal Classification

W-CLASSIFIER Application in Conjunction with a Modern SDR



W-CODE and W-CLASSIFIER provides all functions required to analyze, decode and process radio data communications throughout the radio spectrum from HF, VHF, UHF to SHF. W-CLASSIFIER accepts input from the host built-in sound card, a number of SDRs, analog or digital audio outputs, WAV files, I/Q data or TCP/IP streams.

W-Classifier

Automatic Signal Classification

W-Classifier-NB Technical Data

Bandwidth HF	4 kHz or 8 kHz (complex: 9.6 kHz)
Sampling interval (Ts)	1.6 sec or 3.2 sec
FSK	30 to 3000 Bd , Shift \leq 3500 Hz Modulation index: 0.5-20 Signal must be continuously present during sampling interval
FSK-4 (F7B)	30 to 300 Bd, Shift \leq 3500 Hz
MFSK	4-36 tones
PSK 2/4 Variant A/B	30 to 3000 Bd
PSK 8/16 Variant A/B	30 to 3000 Bd
MIL/STANAG	Classified to protocol
CIS-12	120 Bd, classified as one signal
OFDM	25-512 carriers $T_g/T_u = 1/1$ to $1/8$ ≥ 25 Bd
OQPSK	25 Bd to 30 kBd
CW-Morse	$T_s = 1.6$ s: 6 to 60 Bd $T_s = 3.2$ s: 3 to 60 Bd
Voice	No
Operation	FFT display of classified signals Continuous and single-pass mode Classifier Code Check with look-up table

W-Classifier-NB Quality of Modulation Classification

FSK	m = 0.8: 100-2400 Bd m = 0.8: 50 Bd m \geq 2: 100-2400 Bd m \geq 2: 50 Bd	12 db (Eb/N0) 15 db (Eb/N0) 14 db (Eb/N0) 16 db (Eb/N0)
PSK 2/4 Variant A/B	100-2400 Bd	14 dB (Eb/N0)
PSK 8/16 Variant A/B	100-2400 Bd	16 dB (Eb/N0)
CW-Morse	8-50 Bd	18 dB (Eb/N0)

W-Classifier-NB Accuracy of Measured Parameters

FSK	baud rate center frequency	0.3 % 2 % of baud rate
PSK	baud rate center frequency	0.2 % 0.15 % of baud rate
CW-Morse	baud rate	5 %

W-Classifier

Automatic Signal Classification

W-Classifier-WB Technical Data

Bandwidth HF/VHF/UHF/SHF	500 Hz to 96 kHz (complex: 160 kHz)
Sampling interval (Ts)	1.6 sec or 3.2 sec
FSK	30 to 60 kBd , Shift \leq 30 kHz Modulation index: $m = 0.5-20$ Signal must be continuously present during sampling interval
4-FSK (F7B)	30 to 300 Bd, Shift \leq 3500 Hz
MFSK	4-36 tones
PSK 2/4 Variant A/B	30 Bd to 60 kBd
PSK 8/16 Variant A/B	30 Bd to 60 kBd
MIL/STANAG	Classified to protocol
CIS-12	120 Bd, classified as one signal
OFDM	25 - 512 carriers $T_g/T_u = 1/1$ to $1/8$ ≥ 25 Bd
OQPSK	25 Bd to 30 kBd
CW-Morse	$T_s = 1.6$ s: 6 to 60 Bd $T_s = 3.2$ s: 3 to 60 Bd
Voice	AM, FM, USB, LSB
Operation	FFT display of classified signals Continuous and single-pass mode Classifier Code Check with look-up table

W-Classifier-WB Quality of Modulation Classification

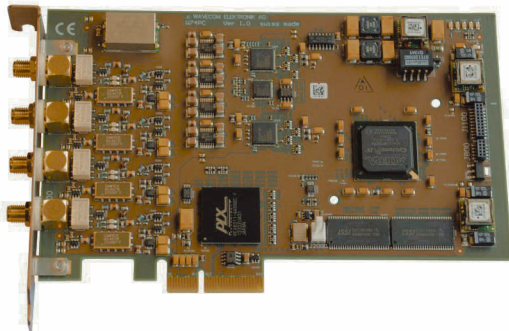
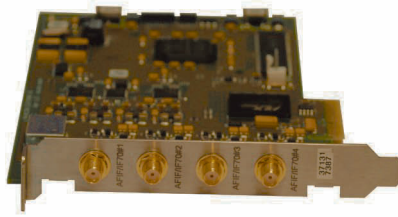
FSK	$m = 0.8$: 100-2400 Bd $m = 0.8$: 50 Bd $m \geq 2$: 100-2400 Bd $m \geq 2$: 50 Bd	12 db (Eb/N0) 15 db (Eb/N0) 14 db (Eb/N0) 16 db (Eb/N0)
PSK 2/4 Variant A/B	100-2400 Bd	14 dB (Eb/N0)
PSK 8/16 Variant A/B	100-2400 Bd	16 dB (Eb/N0)
CW-Morse	8-50 Bd	18 dB (Eb/N0)

W-Classifier-WB Accuracy of Measured Parameters

FSK 100 - 60 kBd	baud rate center frequency	0.3 % 2 % of baud rate
PSK 100 - 60 kBd	baud rate center frequency	0.2 % 0.15 % of baud rate
CW-Morse 6 - 50 Bd	baud rate	5 %



WAVECOM® W74PC



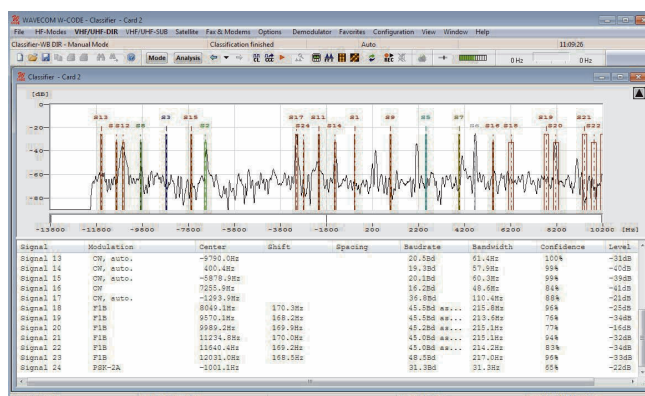
W74PC offers four completely independent Digital Down Converter (DDC) inputs at IF and AF level, ideally suited for connection to narrowband and broadband receivers and wideband down converters. W74PC delivers a modern complete solution in classification, decoding and monitoring with various interfaces in hardware and software.

W74PC

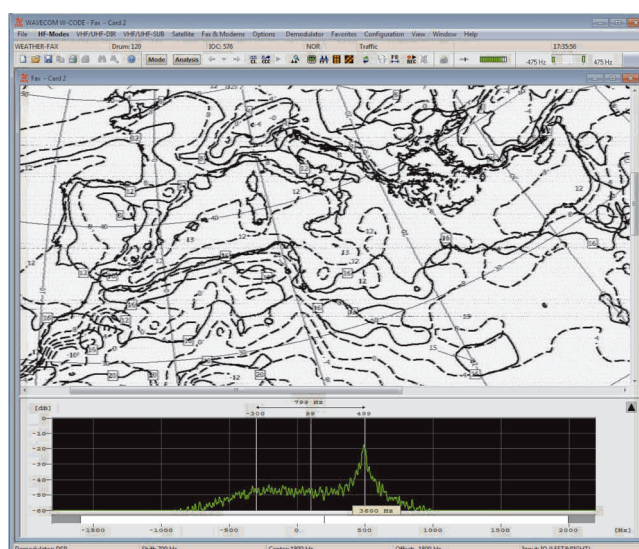
The Complete Solution for Decoding and Monitoring

W74PC Features and Facts

- ◆ W74PC offers four high-quality DDC inputs with wideband frequency range. The DDCs extract the narrowband signal of interest from a broadband input signal. The extracted signal is then used for further analysis, decoding and recording
- ◆ W74PC card in a compact design: four SMA connectors, each switchable to AFIF (0-25 MHz) and IF 70 MHz by a mini signal relay
- ◆ W74PC does not need a USB license dongle. The key is integrated in the card
- ◆ W74PC provides all functions required to analyze, decode, record and process radio data communications throughout the radio spectrum from HF, VHF, UHF to SHF
- ◆ W74PC supports automatic classification, code check, demodulation and decoding to content level of known signals and predefined unknown signals
- ◆ The easy-to-use graphical user interface (GUI) with well-structured pull-down menus allows an operator to rapidly get familiar with W74PC decoder software
- ◆ A W74PC card can be controlled from anywhere via the Internet, an Ethernet LAN or a W-LAN
- ◆ W74PC supports remote control from other applications using third party software with TCP/IP and XML
- ◆ The implementation of complex systems for monitoring is limited only by the performance of the hardware and software
- ◆ System components can be individually configured according to the requirements of the customer



Classifier-WB display containing 24 identified signals



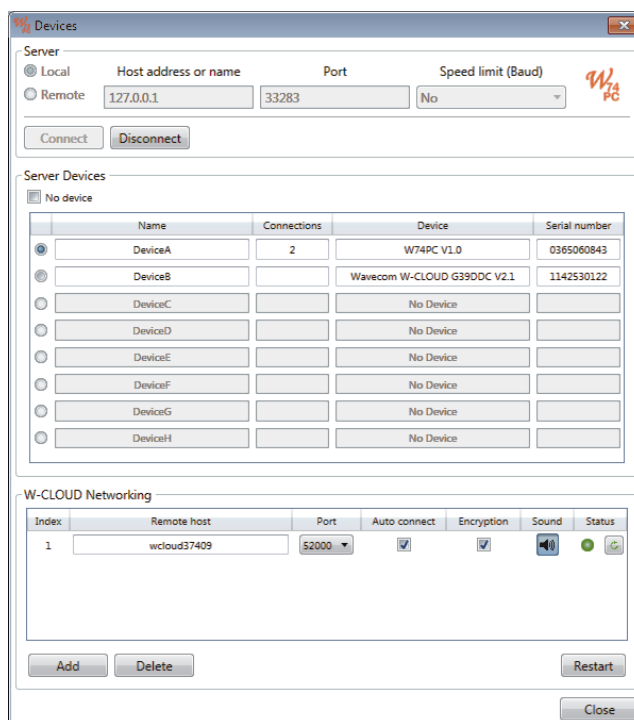
Decoded Weather-FAX from HF

W74PC

The Complete Solution for Decoding and Monitoring

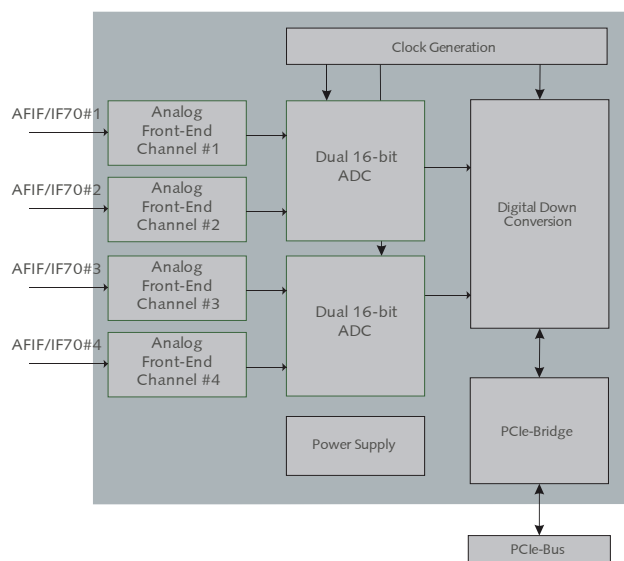
Signal Sources and Devices

- ◆ The application processing the W74PC input is compatible to W-CODE. The Device Selector supports a great number of input interfaces and devices. W74PC supports dual IF inputs from 0 – 25 MHz or 70 MHz +/-17.5 MHz
- ◆ W74PC is a universal signal interface and may be installed in any PC with PCIe x4 card slots
- ◆ A number of other interfaces, e.g. SDR I/Q data or digital TCP/IP input streams using W-CLOUD, IP-PXGF, Virtual Audio Cable (VAC) or WiNRADiO Digital Bridge Virtual Sound Card (VSC) are also available with W74PC



Device Selector in W74PC

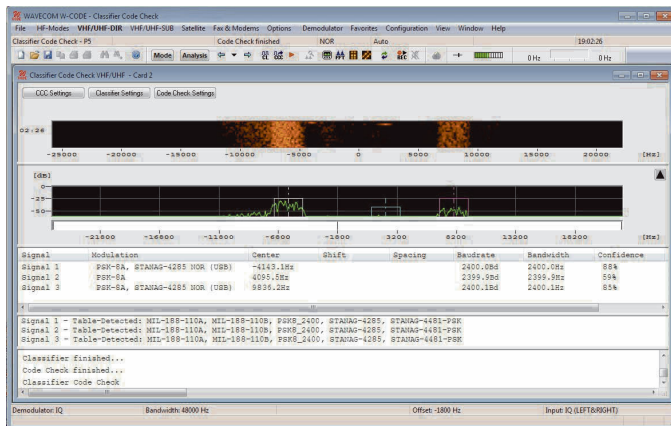
- ◆ W74PC is configured with four independent Digital Down Converters (DDC) corresponding to the well-known Software Defined Radio (SDR) technology



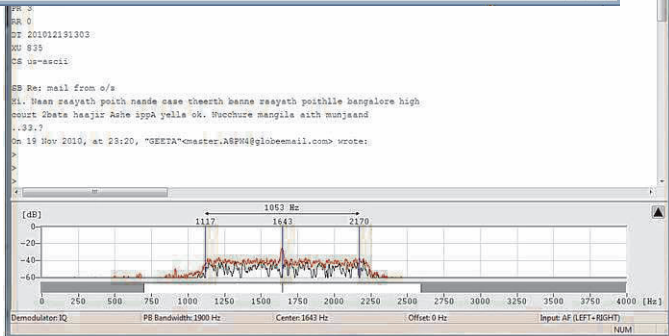
W74PC

The Complete Solution for Decoding and Monitoring

Wide Range of Application

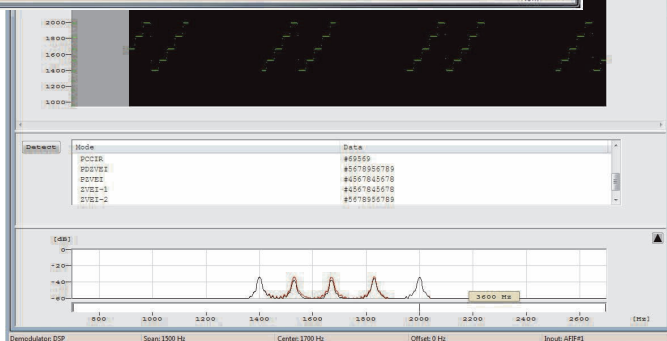


Automatic Signal Classification

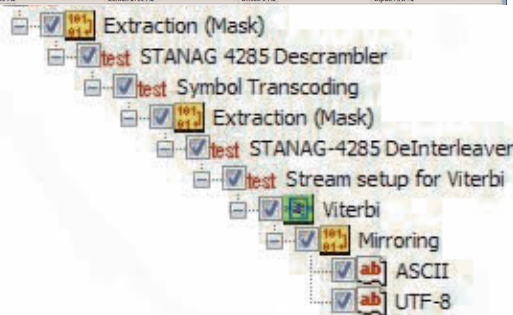


Data Decoding

Signal Analysis



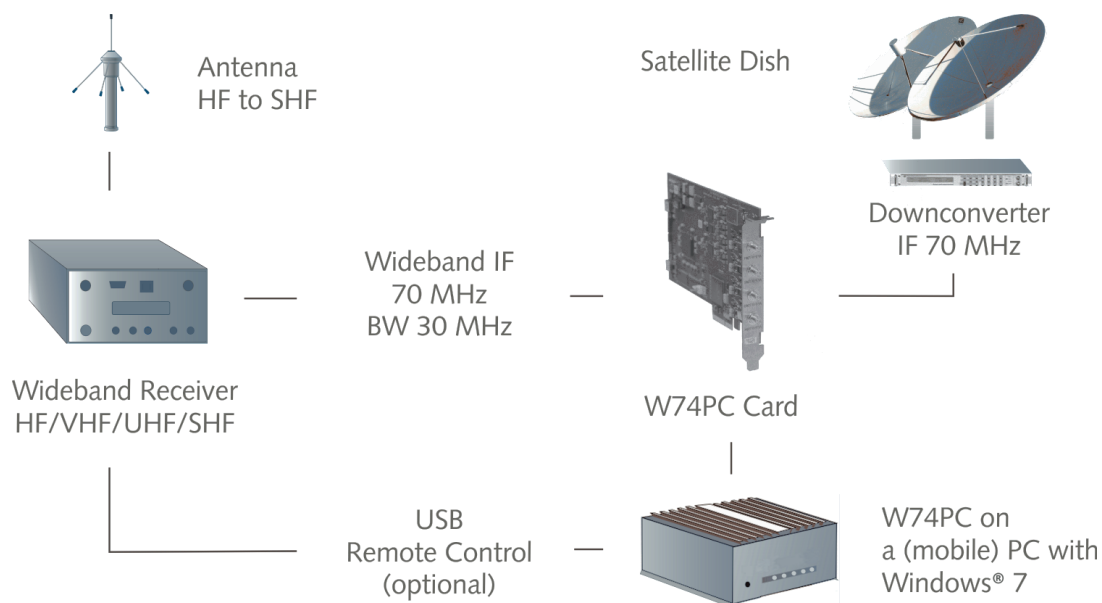
Bit Analysis



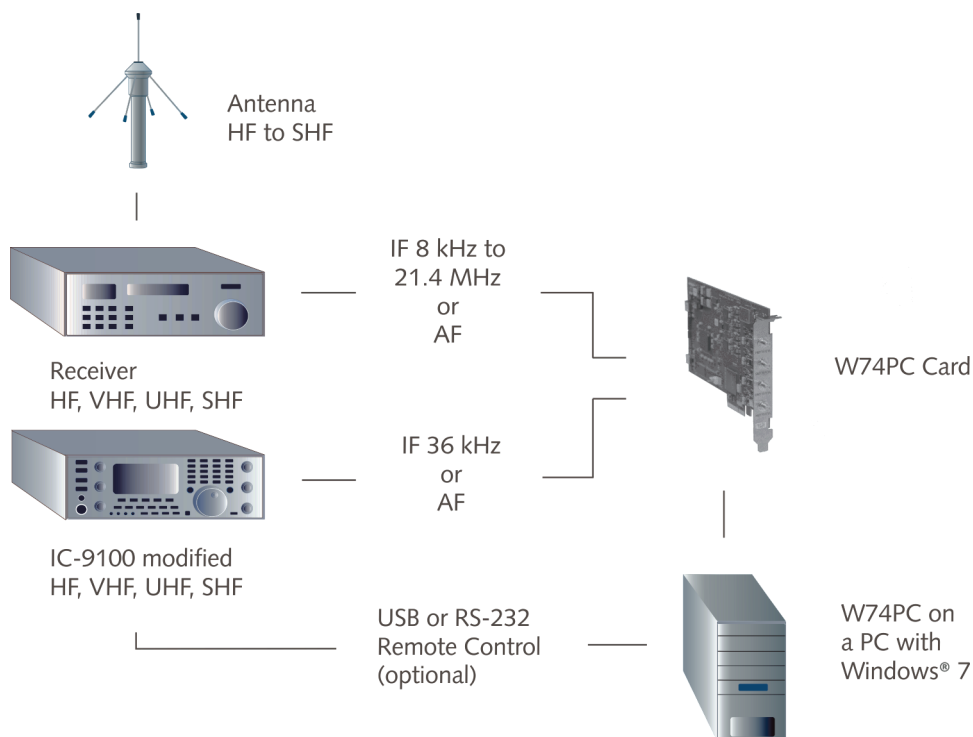
W74PC

The Complete Solution for Decoding and Monitoring

Practical Application



W74PC and wideband receiver configuration



W74PC and IF or AF configuration

W74PC

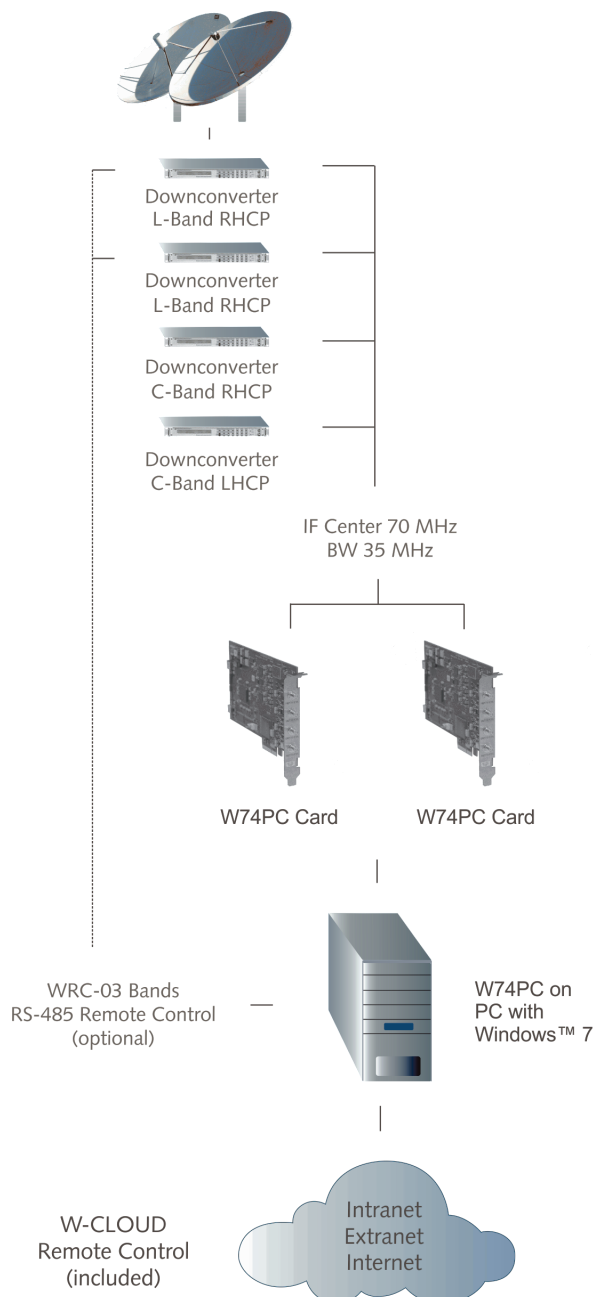
The Complete Solution for Decoding and Monitoring

Satellite Application

Inmarsat monitoring is an integral part of the wide range of modes available for the Wavecom suite of decoders. W74PC decoder functions include

- ◆ Real-time voice (Inmarsat B and M), data and fax decoding
- ◆ SAT-AERO decoding
- ◆ Remote control interface enabling customers to build their own customized monitoring system
- ◆ Output can be fed to optional W-SAT -email decoder

The Inmarsat system covers four ocean regions, each served by a satellite. A Network Coordination Station (NCS) in each region assigns a free traffic frequency, timeslot or logical channel to the session between the Mobile Earth Station (MES) and the Land Earth Station (LES). After the session has terminated, the frequency, time slot or logical channel is returned to the common resource pool.







W74PC

The Complete Solution for Decoding and Monitoring

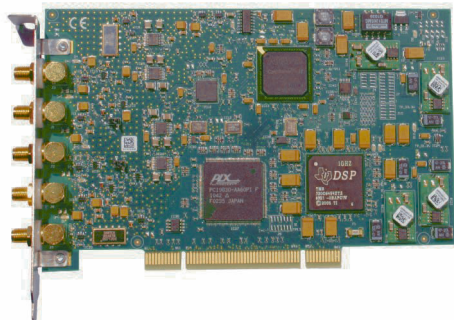
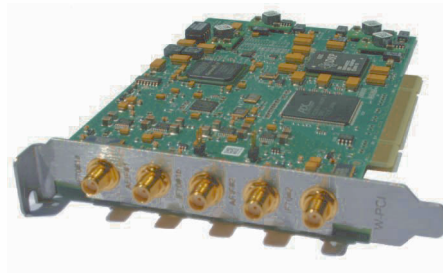
W74PC Card Specifications and Technical Data

Inputs	AFIF#1 — AFIF#4	IF70#1 — IF70#4
Connector	SMA female	SMA female
Frequency range	50 Hz to 25 MHz	52.5 MHz to 87.5 MHz (SAW filter)
Bandwidth	5 kHz to 500 kHz	5 kHz to 500 kHz
Frequency raster DDC	< 1.0 Hz	< 1.0 Hz
Signal level	2 mVrms to 0.5 Vrms	20 mVrms to 2.5 Vrms
Input impedance	> 1 kOhm	50 Ohm
Input max sampling rate	98.304 MHz	98.304 MHz
Input sampling rate jitter	< 1 ps (RMS 12 kHz to 20 MHz)	< 1 ps (RMS 12 kHz to 20 MHz)

Card type	Half-size PCIe card (PCI Express x 4 slot)
Number of concurrent, independent inputs	Four SMA connectors: AFIF/IF70#1 — AFIF/IF70#4, each switchable by a mini signal relay
Dimensions (L x W x H)	168 x 106 x 22 mm
Weight	0.15 kg
Power requirement (typical values)	< 25W
Bus interface	PCIe x4 Link 2 Gbit/s
Operating temperature range	0 °C to 50 °C
Case temperature range	0 °C to 55 °C
Storage temperature range	0 °C to 70 °C
Relative humidity	10 to 90 % (non-condensing)
A/D converter	2 x AD9268 dual 16 bit ADC
Dynamic range	> 60 dB
Digital down converter DDC	FPGA Cyclone IV
Oscillator and clock	High stability temperature compensated crystal oscillator Low phase noise clock distribution
Watchdog for on-board generated voltages	Yes
License key	Built-in license, no external USB dongle necessary
Conformity	   



WAVECOM® W-PCI



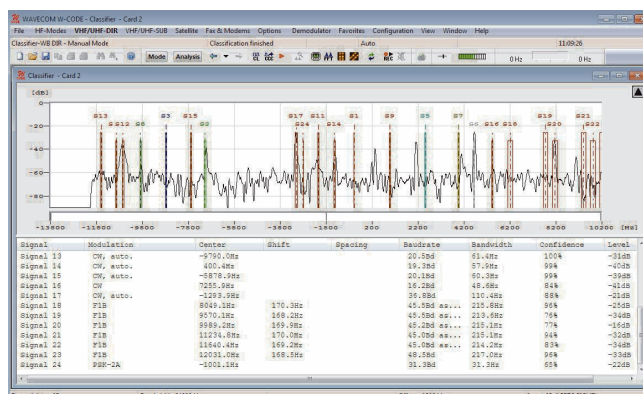
W-PCI offers two completely independent Digital Down Converter inputs (DDC) at IF and AF level, ideally suited for connection to narrow and broadband receivers and wideband down converters. W-PCI delivers a modern complete solution with various interfaces in hardware and software.

W-PCI

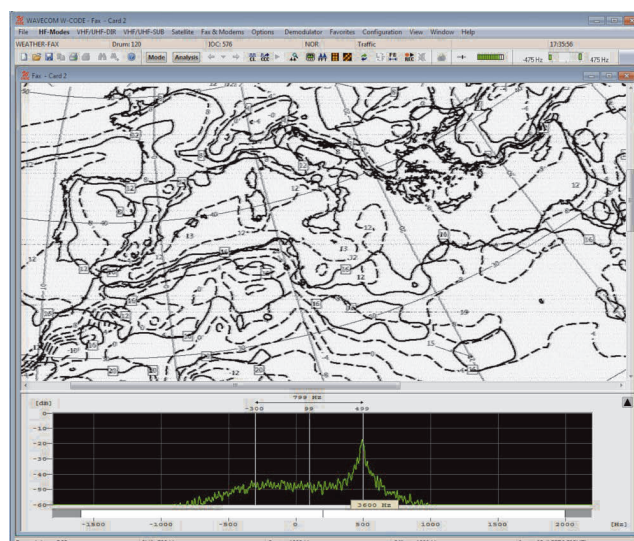
The Preferred Hardware Decoder

W-PCI Features and Facts

- ◆ W-PCI offers two high-quality DDC inputs with wideband frequency range. The DDCs extract the narrowband signal of interest from a broadband input signal. The extracted signal is then used for further analysis, decoding and recording
- ◆ W-PCI card does not need a USB license dongle. The key is integrated in the card
- ◆ W-PCI provides all functions required to analyze, decode, record and process radio data communications throughout the radio spectrum from HF, VHF, UHF to SHF
- ◆ W-PCI supports automatic classification, code check, demodulation and decoding to content level of known signals and predefined unknown signals
- ◆ The easy-to-use graphical user interface (GUI) with well-structured pull-down menus allows an operator to rapidly become familiar with W-PCI decoder software
- ◆ A W-PCI card may be controlled from anywhere via the Internet, an Ethernet LAN or a W-LAN
- ◆ W-PCI supports remote control from other applications using third party software with TCP/IP and XML
- ◆ The implementation of complex systems for monitoring is limited only by the performance of the hardware and software
- ◆ System components can be individually configured according to the requirements of the customer



Classifier-WB display containing 24 identified signals



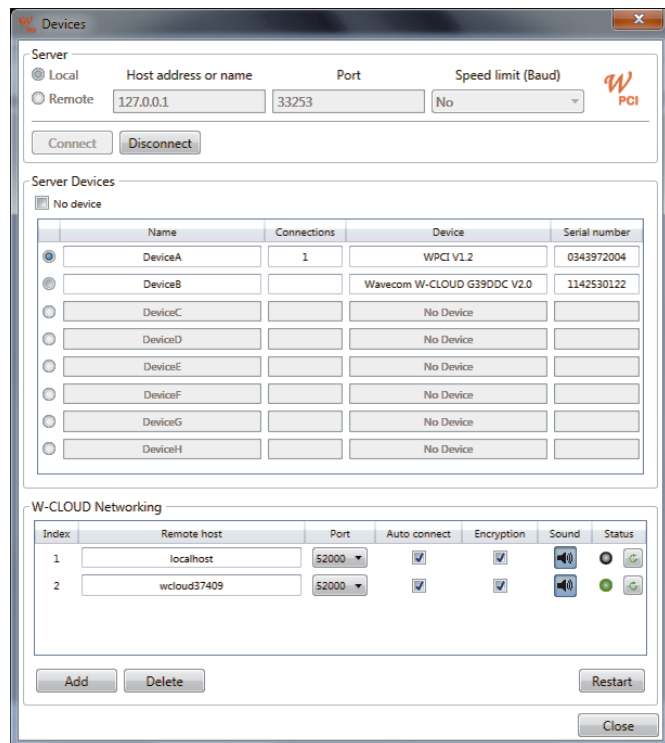
Decoded Weather-FAX from HF

W-PCI

The Preferred Hardware Decoder

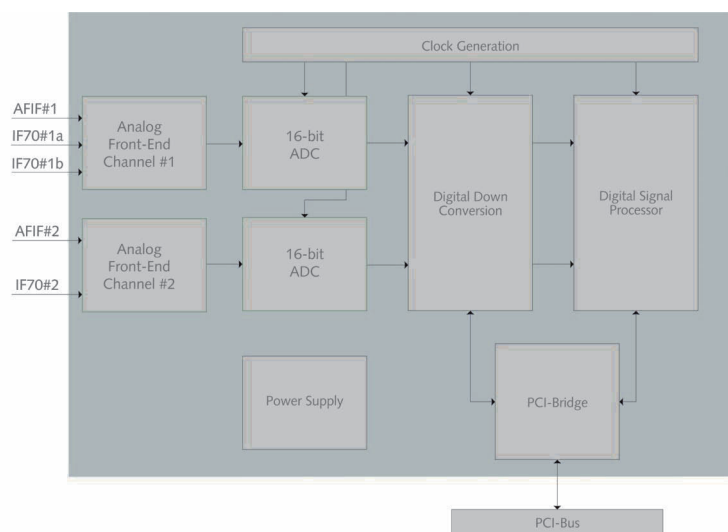
Signal Sources and Devices

- ◆ The application processing the input from W-PCI is compatible with W-CODE. The Device Selector supports a great number of input interfaces and devices. W-PCI supports dual IF inputs from 0 – 25 MHz or 70 MHz +/-17.5 MHz
- ◆ W-PCI is a universal signal interface and may be installed in any PC with PCI 32-bit card slots
- ◆ A number of other interfaces, e.g. SDR I/Q data or digital TCP/IP input streams using W-CLOUD, IP-PXGF, Virtual Audio Cable (VAC) or WiNRADiO Digital Bridge Virtual Sound Card (VSC) are also available with W-PCI



Device Selector in W-PCI

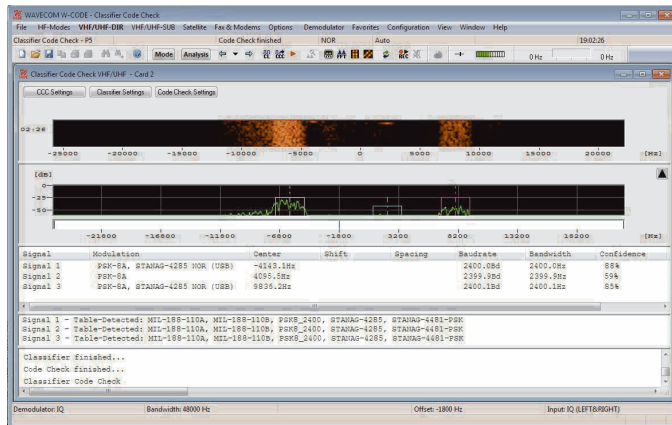
- ◆ W-PCI is configured with two independent Digital Down Converters (DDC) corresponding to the well-known Software Defined Radio (SDR) technology



W-PCI

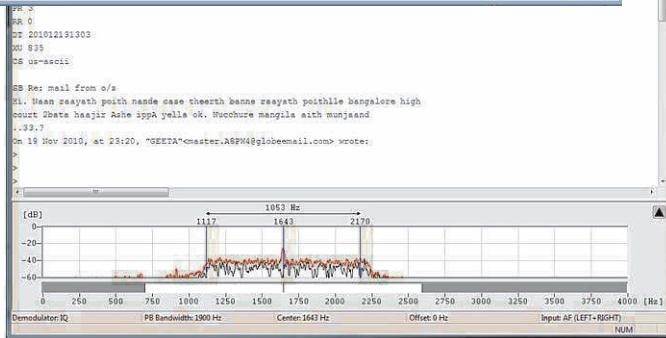
The Preferred Hardware Decoder

Wide Range of Application

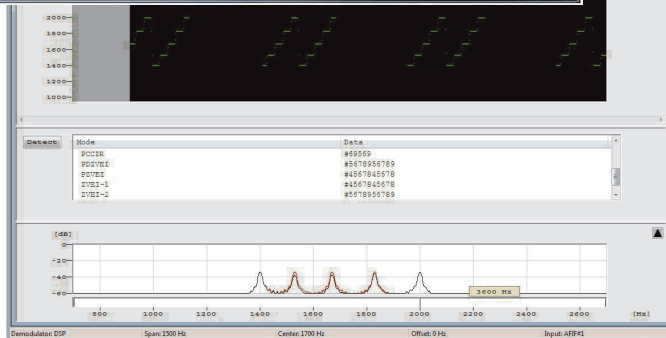


Automatic Signal Classification

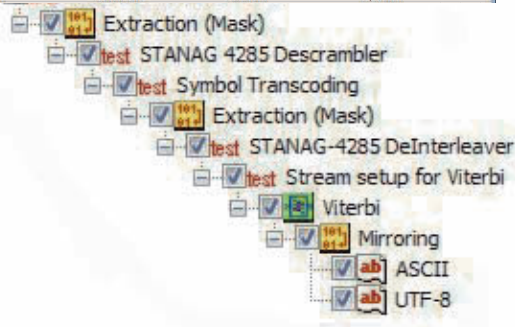
Data Decoding



Signal Analysis



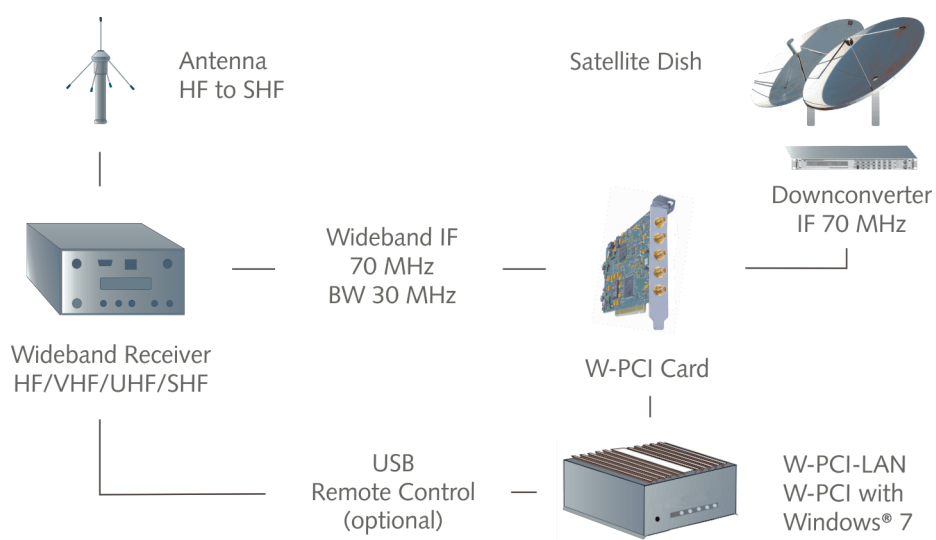
Bit Analysis



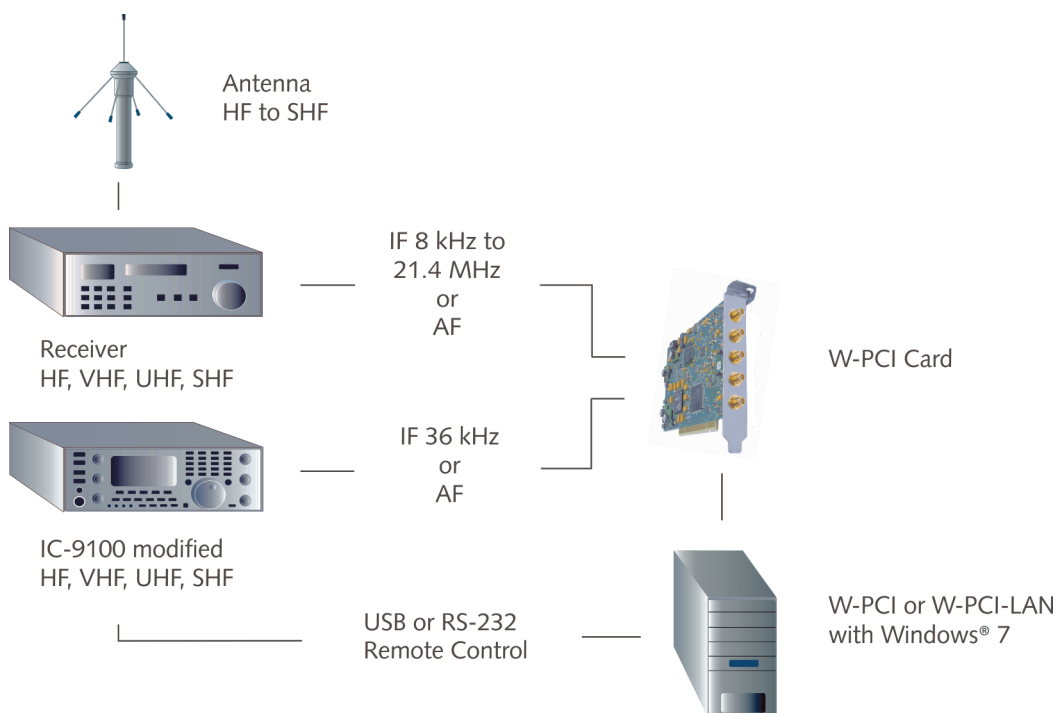
W-PCI

The Preferred Hardware Decoder

Practical Application



W-PCI and wideband receiver configuration



W-PCI and IF or AF configuration

W-PCI

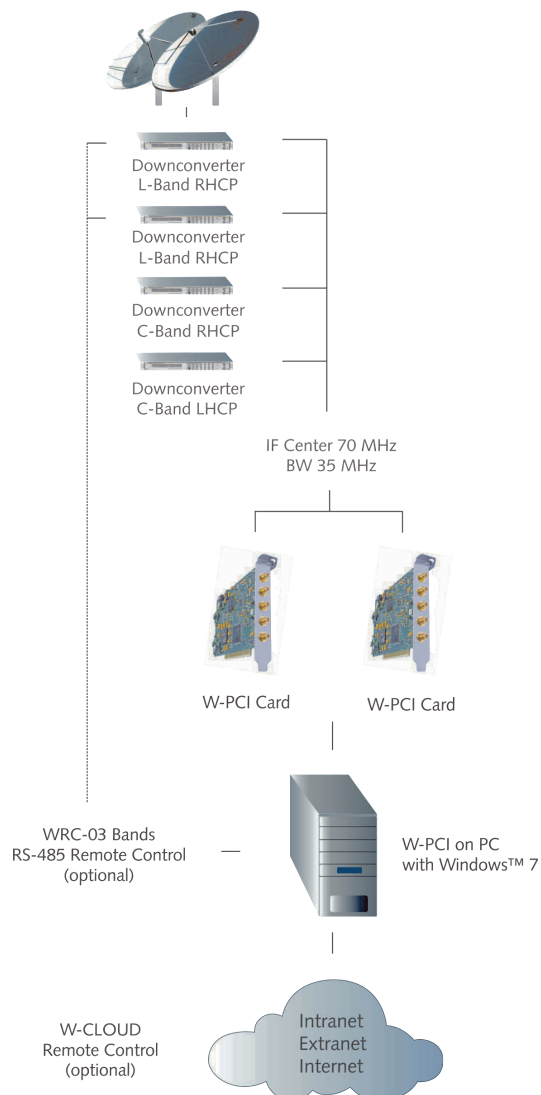
The Preferred Hardware Decoder

Satellite Application

Inmarsat monitoring is an integral part of the wide range of modes available for the Wavecom suite of decoders. W-PCI decoder functions include

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- ◆ SAT-AERO decoding
- ◆ Remote control interface enabling customers to build their own customized monitoring system
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W-PCI

The Preferred Hardware Decoder

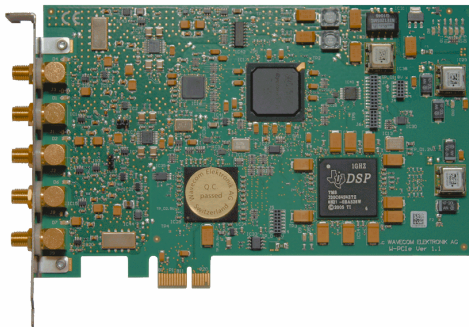
W-PCI Card Specifications and Technical Data

Inputs	AFIF#1 and AFIF#2	IF70#1a, IF70#1b and IF70#2
Connector	SMA female	SMA female
Frequency range	50 Hz to 25 MHz	52.5 MHz to 87.5 MHz (SAW filter)
Bandwidth	5 kHz to 500 kHz	5 kHz to 500 kHz
Frequency raster DDC	1.0 Hz	1.0 Hz
Signal level	2 mVrms to 0.5 Vrms 20 mVrms to 2.5 Vrms with 20 dB attenuator (jumped)	20 mVrms to 2.5 Vrms
Input impedance	> 1 kOhm	50 Ohm
Input max sampling rate	92.16 MHz	92.16 MHz
Input sampling rate jitter	1 ps (RMS 12 kHz to 20 MHz)	1 ps (RMS 12 kHz to 20 MHz)

Card type	Half-size PCI card
Number of concurrent, independent inputs	2 AFIF#1 or IF70#1a or IF70#1b -with- AFIF#2 or IF70#2
Dimensions (L x W x H)	168 x 106 x 22 mm
Weight	0.15 kg
Power requirement (typical values)	+3.3V @ 1.0 A +12V @ 0.4 A
Bus interface	32-bit 3.3V PCI slot 100 Mbytes/s
Operating temperature range	0 °C to 50 °C
Case temperature range	0 °C to 55 °C
Storage temperature range	0 °C to 70 °C
Relative humidity	10 to 90 % (non-condensing)
A/D converter	AD9268 dual 16 bit ADC
Dynamic range	> 60 dB
Digital down converter DDC	FPGA Cyclone II 50K
DSP	TI DSP320C6454
Watchdog for on-board generated voltages	Yes
Conformity	   



WAVECOM® W-PCle



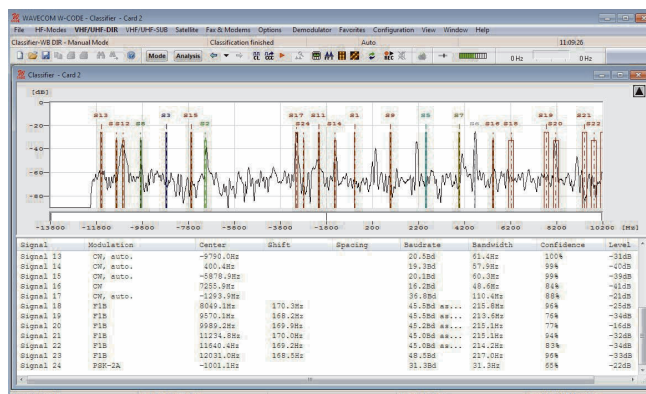
W-PCle offers two completely independent Digital Down Converter inputs (DDC) at IF and AF level, ideally suited for connection to narrow and broadband receivers and wideband down converters. W-PCle delivers a modern complete solution with various interfaces in hardware and software.

W-PCle

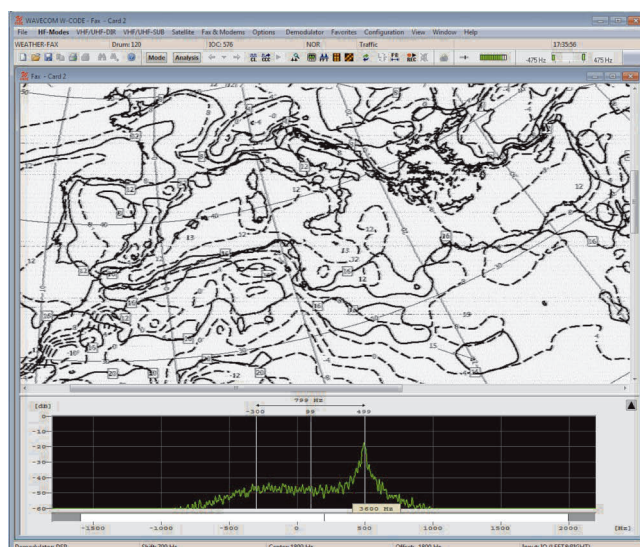
The Preferred Hardware Decoder

W-PCle Features and Facts

- ◆ W-PCle offers two high-quality DDC inputs with wideband frequency range. The DDCs extract the narrow-band signal of interest from a broadband input signal. The extracted signal is then used for further analysis, decoding and recording
- ◆ W-PCle card does not need a USB license dongle. The key is integrated in the card
- ◆ W-PCle provides all functions required to analyze, decode, record and process radio data communications throughout the radio spectrum from HF, VHF, UHF to SHF
- ◆ W-PCle supports automatic classification, code check, demodulation and decoding to content level of known signals and predefined unknown signals
- ◆ The easy-to-use graphical user interface (GUI) with well-structured pull-down menus allows an operator to rapidly become familiar with W-PCle
- ◆ A W-PCle card may be controlled from anywhere via the Internet, an Ethernet LAN or a W-LAN
- ◆ W-PCle supports remote control from other applications using third party software with TCP/IP and XML
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Classifier-WB display containing 24 identified signals



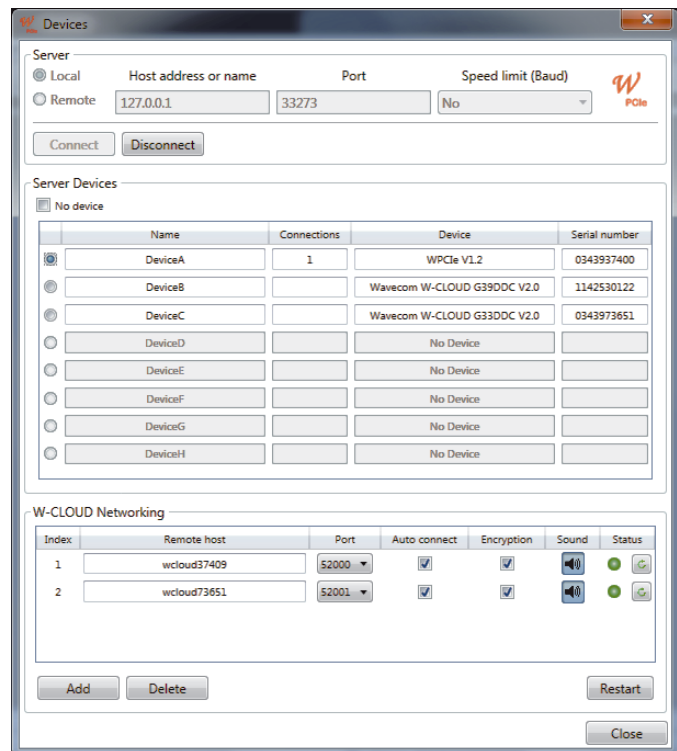
Decoded Weather-FAX from HF

W-PCle

The Preferred Hardware Decoder

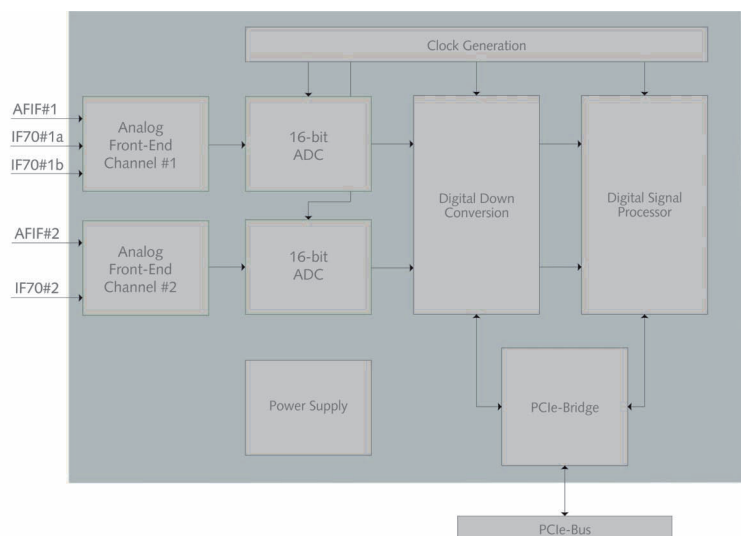
Signal Sources and Devices

- ◆ The application processing the input from W-PCle is W-CODE. The Device Selector supports a great number of input interfaces and devices. W-PCle supports dual IF inputs from 0 – 25 MHz or 70 MHz +/-17.5 MHz
- ◆ W-PCle is a universal signal interface and may be installed in any PC with PCIe x1 card slots
- ◆ A number of other interfaces, e.g. SDR I/Q data or digital TCP/IP input streams using W-CLOUD, IP-PXGF, Virtual Audio Cable (VAC) or WiNRADiO Digital Bridge Virtual Sound Card (VSC) are also available with W-PCle



Device Selector in W-PCle

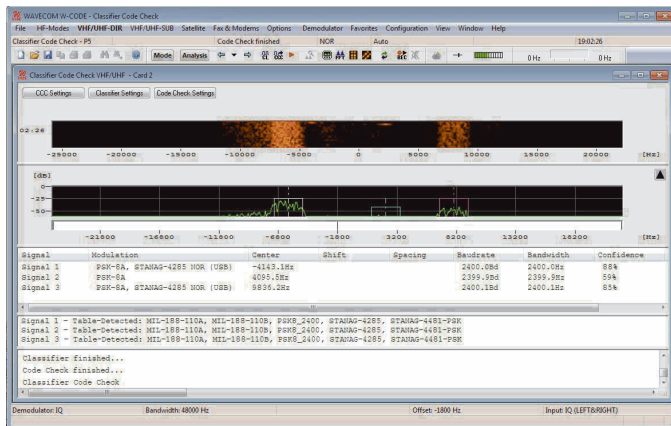
- ◆ W-PCle is configured with two independent Digital Down Converters (DDC) corresponding to the well-known Software Defined Radio (SDR) technology



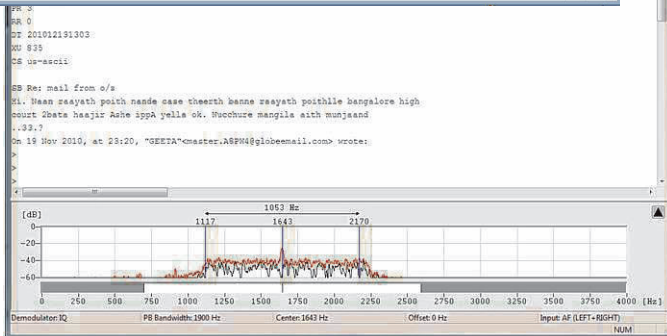
W-PCIe

The Preferred Hardware Decoder

Wide Range of Application

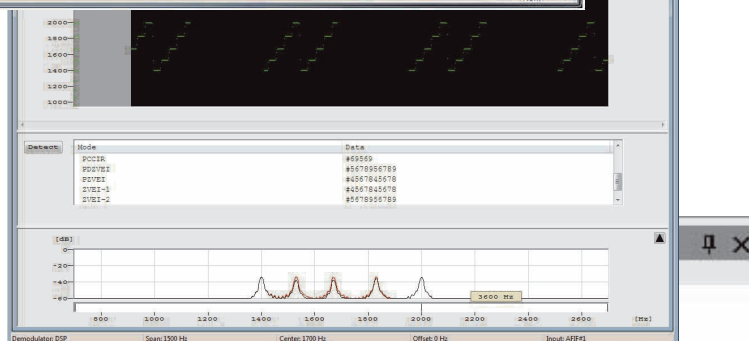


Automatic Signal Classification

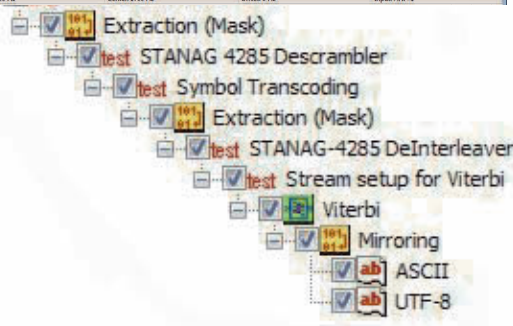


Data Decoding

Signal Analysis



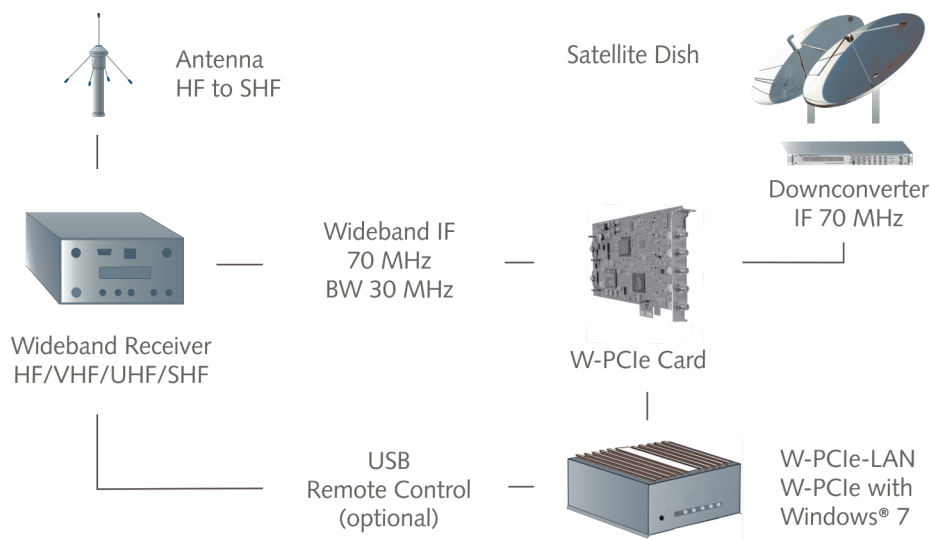
Bit Analysis



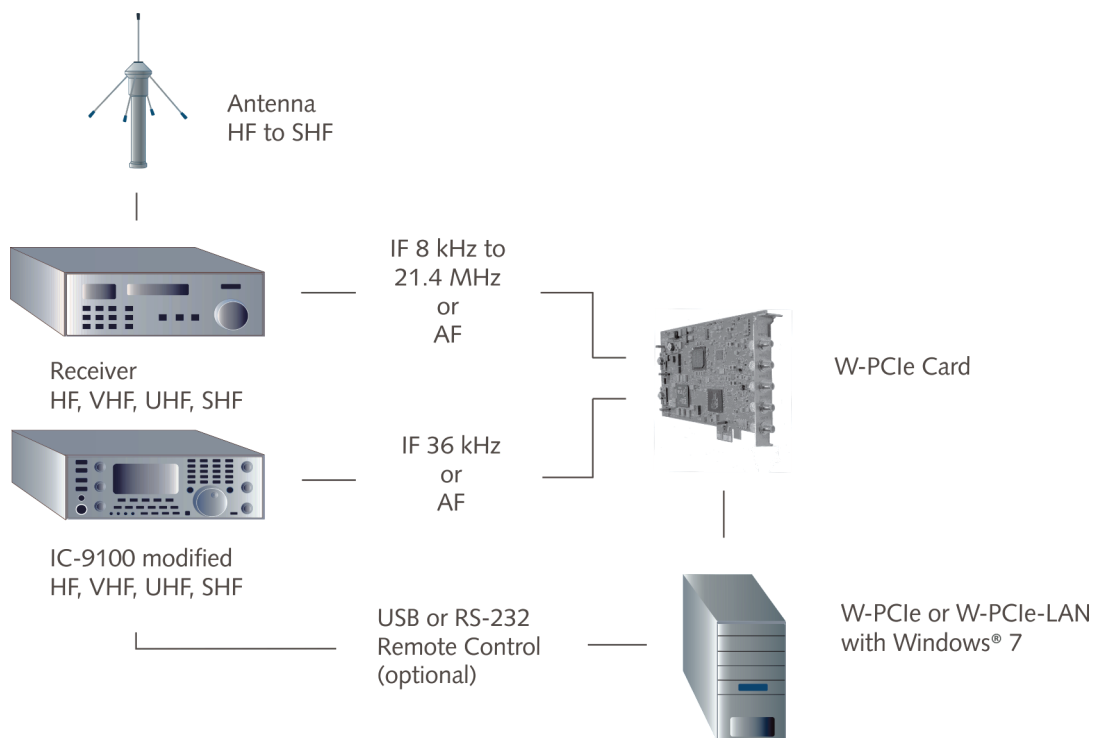
W-PCIe

The Preferred Hardware Decoder

Practical Application



W-PCIe and wideband receiver configuration



W-PCIe and IF or AF configuration

W-PCIe

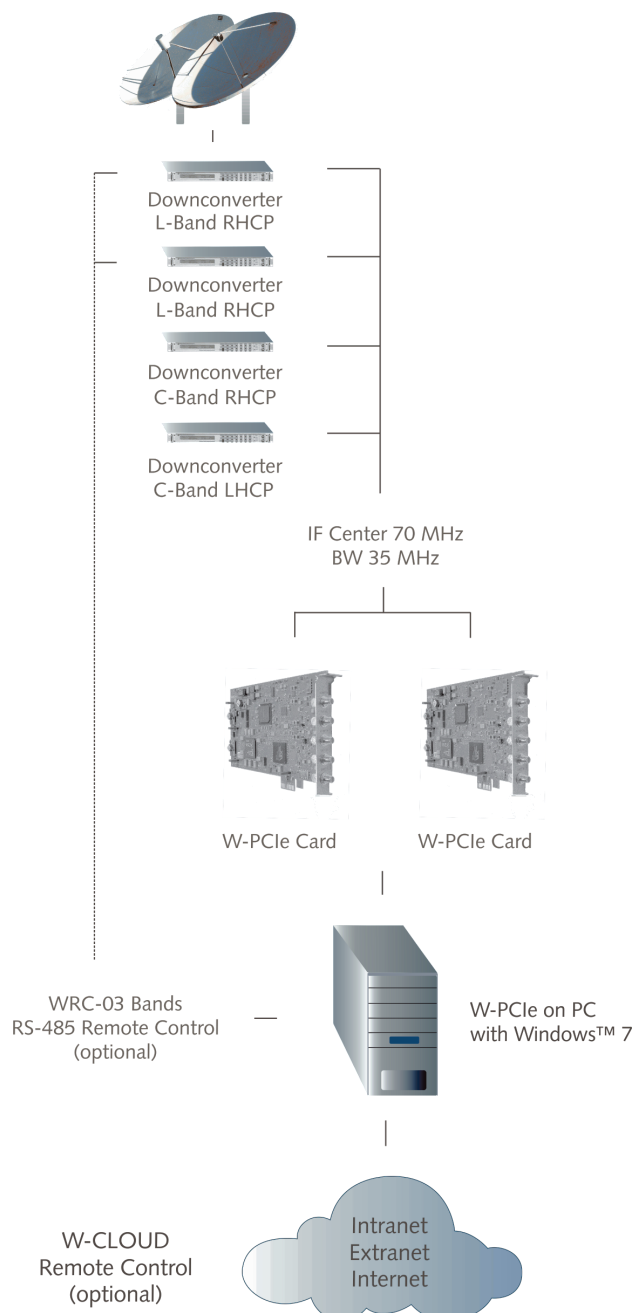
The Preferred Hardware Decoder

Satellite Application

Inmarsat monitoring is an integral part of the wide range of modes available for the Wavecom suite of decoders. W-PCIe decoder functions include

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- ◆ SAT-AERO decoding
- ◆ Remote control interface enabling customers to build their own customized monitoring system
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W-PCle

The Preferred Hardware Decoder

W-PCle Card Specifications and Technical Data

Inputs	AFIF#1 and AFIF#2	IF70#1a, IF70#1b and IF70#2
Connector	SMA female	SMA female
Frequency range	50 Hz to 25 MHz	52.5 MHz to 87.5 MHz (SAW filter)
Bandwidth	5 kHz to 500 kHz	5 kHz to 500 kHz
Frequency raster DDC	1.0 Hz	1.0 Hz
Signal level	2 mVrms to 0.5 Vrms 20 mVrms to 2.5 Vrms with 20 dB attenuator (jumped)	20 mVrms to 2.5 Vrms
Input impedance	> 1 kOhm	50 Ohm
Input max sampling rate	92.16 MHz	92.16 MHz
Input sampling rate jitter	1 ps (RMS 12 kHz to 20 MHz)	1 ps (RMS 12 kHz to 20 MHz)

Card type	Half-size PCIe card (PCI Express)
Number of concurrent, independent inputs	2 AFIF#1 or IF70#1a or IF70#1b -with- AFIF#2 or IF70#2
Dimensions (L x W x H)	168 x 106 x 22 mm
Weight	0.15 kg
Power requirement (typical values)	+3.3V max. 1.0 A +12V max. 0.5 A
Bus interface	PCIe x1 Link 2 Gbit/s
Operating temperature range	0 °C to 50 °C
Case temperature range	0 °C to 55 °C
Storage temperature range	0 °C to 70 °C
Relative humidity	10 to 90 % (non-condensing)
A/D converter	AD9268 dual 16 bit ADC
Dynamic range	> 60 dB
Digital down converter DDC	FPGA Cyclone IV 55K
DSP	TI DSP320C6454
Watchdog for on-board generated voltages	Yes
Conformity	   



WAVECOM® W-PCI-LAN



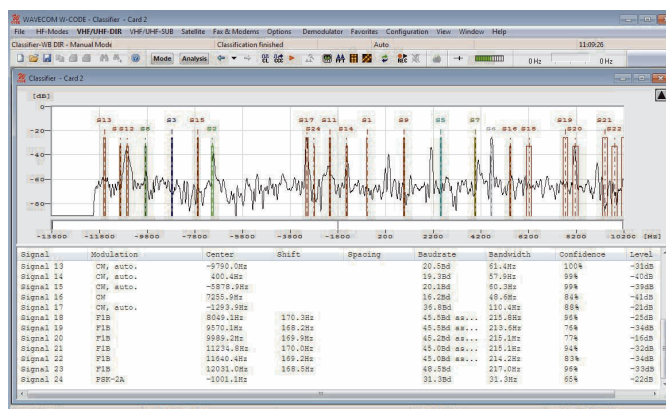
The W-PCI-LAN decoder offers all the functions of the W-PCI decoder hardware and software plus all the advantages of a compact computer system. The device is implemented in a ruggedized aluminium box. W-PCI-LAN offers two completely independent Digital Down Converter inputs (DDC) at IF and AF level. W-PCI-LAN delivers a modern complete solution with various interfaces in hardware and software.

W-PCI-LAN

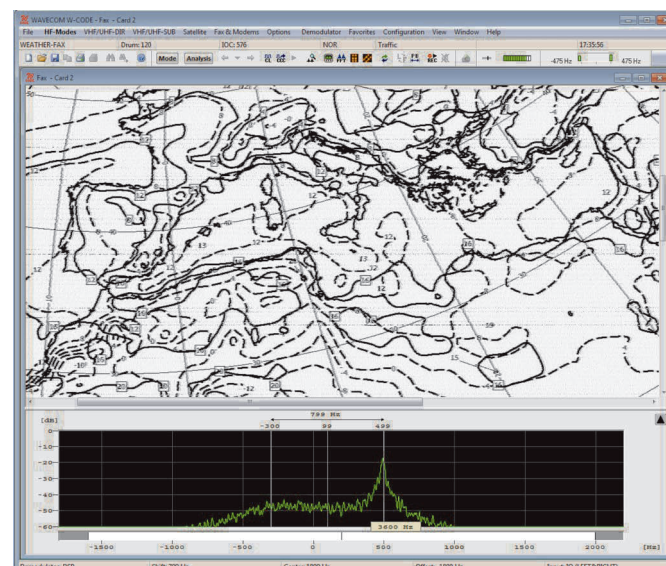
Complete Decoder System

W-PCI-LAN Features and Facts

- ◆ W-PCI-LAN provides all functions required to analyze, decode, record and process radio data communications throughout the radio spectrum from HF to SHF
- ◆ W-PCI-LAN offers automated or manual monitoring of radio data and voice communications from HF to SHF bands
- ◆ W-PCI-LAN can be connected to a PC or notebook via LAN or may operate as a stand-alone system. As the W-PCI-LAN operates from 9-30 V DC power sources, it is very well suited for mobile use
- ◆ W-PCI-LAN offers two high-quality DDC inputs with wideband frequency range. The DDCs extract the narrowband signal of interest from a broadband input signal. The extracted signal is then used for further analysis, decoding and recording
- ◆ W-PCI-LAN supports Software Defined Radios (SDR), W-CLOUD, VSC, standard VACs and all I/Q data or digital inputs
- ◆ Built-in SSD (1 TB) suitable for wideband signal recording
- ◆ System components can be individually configured according to the requirements of the customer
- ◆ W-PCI-LAN supports remote control from other applications using third party software with TCP/IP and XML
- ◆ A W-PCI-LAN decoder can be controlled from anywhere across the network, and its output can be sent to one or more applications on the network



Classifier-WB display containing 24 identified signals



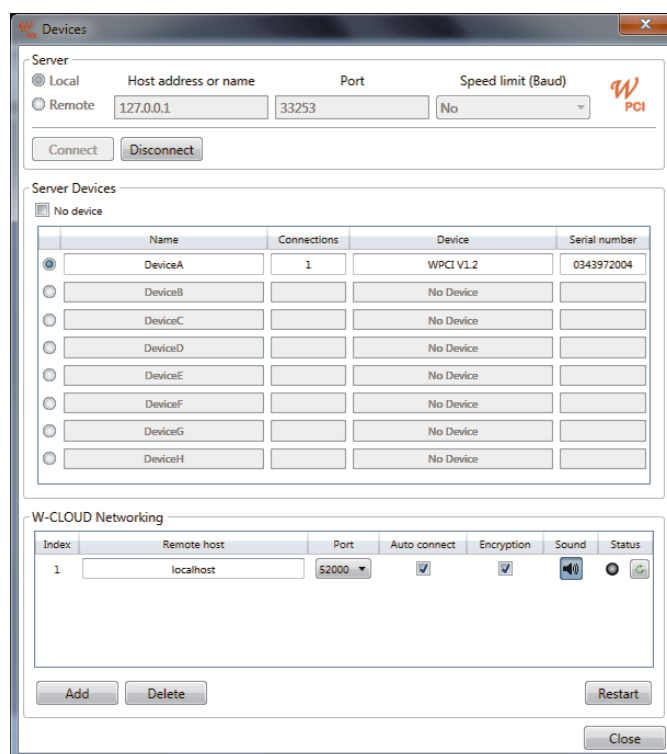
Decoded Weather-FAX from HF

W-PCI-LAN

Complete Decoder System

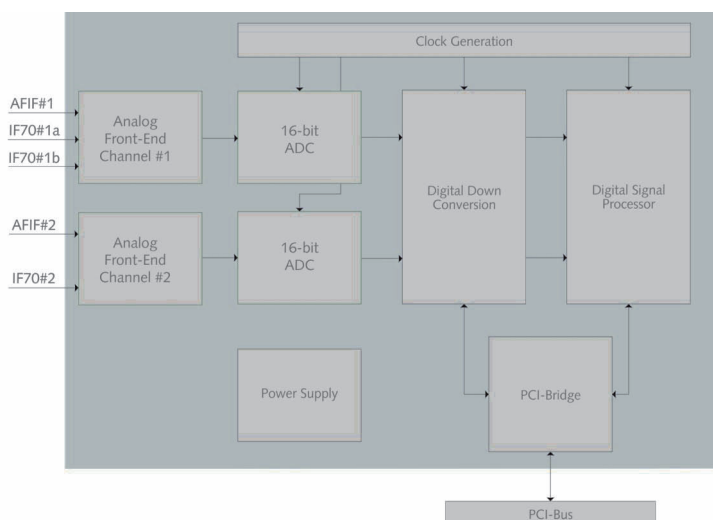
Signal Sources and Devices

- ◆ W-PCI-LAN supports a great number of input interfaces and devices. The application processing the signal sources and devices for W-PCI-LAN is compatible with W-CODE
- ◆ A number of other interfaces, e.g. SDR I/Q data or digital TCP/IP input streams using W-CLOUD, IP-PXGF, Virtual Audio Cable (VAC) or WiNRADiO Digital Bridge Virtual Sound Card (VSC) and built-in soundcard input with sampling rates of up to 192 kHz are also available with W-PCI-LAN
- ◆ W-PCI-LAN is tested with a number of SDRs, e.g. WiNRADiO G33DDC and G39DDC, Grintek GRXLAN, Perseus, netSDR, SDR-IP, Rohde & Schwarz and MEDAV LR2
- ◆ Supports direct digital I/Q input and output of WAV files with integrated Wavecom Media Player/Recorder



Device Selector in W-PCI

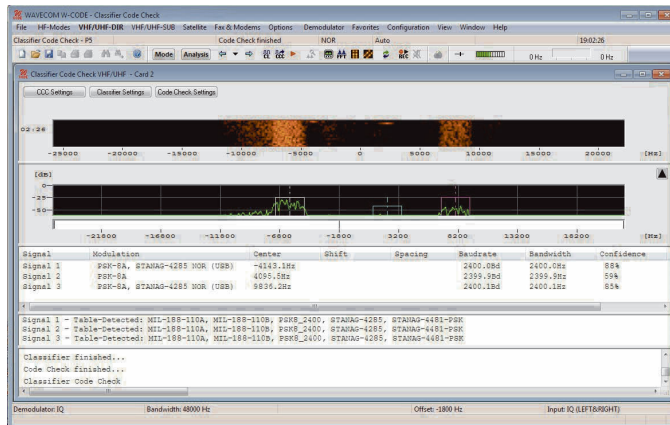
- ◆ W-PCI-LAN offers two completely independent DDC (Digital Down Converter) inputs at IF and AF level from 0 – 25 MHz or 70 MHz +/-17.5 MHz. The two DDCs extract the narrow-band signal of interest from a broad-band input signal
- ◆ DDCs correspond to the well-known Software Defined Radio (SDR) technology



W-PCI-LAN

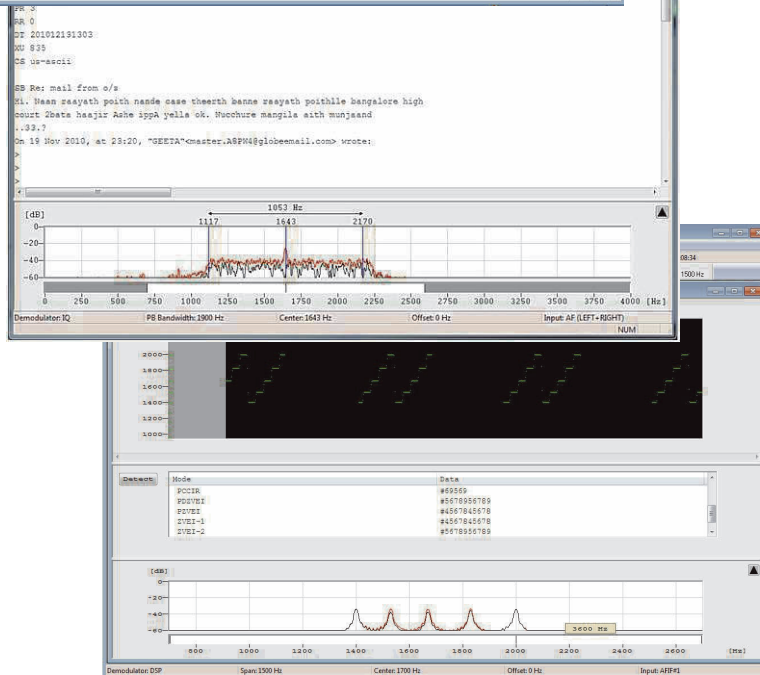
Complete Decoder System

Wide Range of Application



Automatic Signal Classification

Data Decoding



Signal Analysis

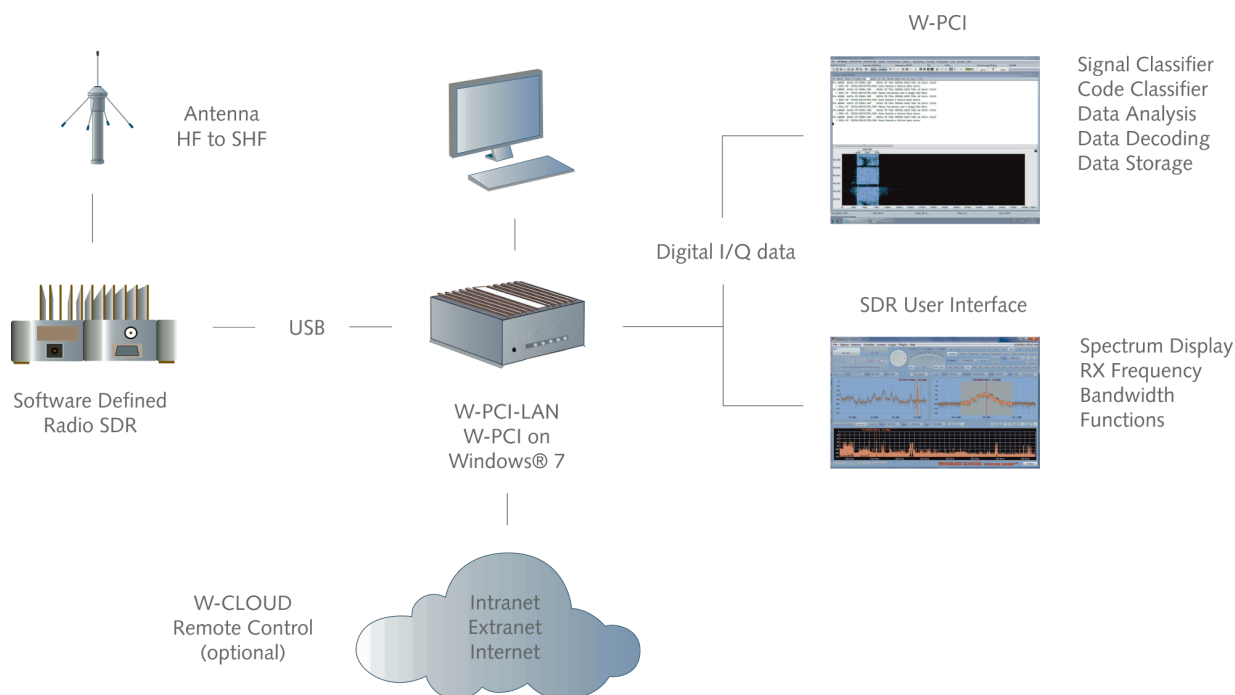
Bit Analysis

- ☒ Extraction (Mask)
- ☒ test STANAG 4285 Descrambler
- ☒ test Symbol Transcoding
- ☒ Extraction (Mask)
- ☒ test STANAG-4285 DeInterleaver
- ☒ test Stream setup for Viterbi
- ☒ Viterbi
- ☒ Mirroring
- ☒ ASCII
- ☒ UTF-8

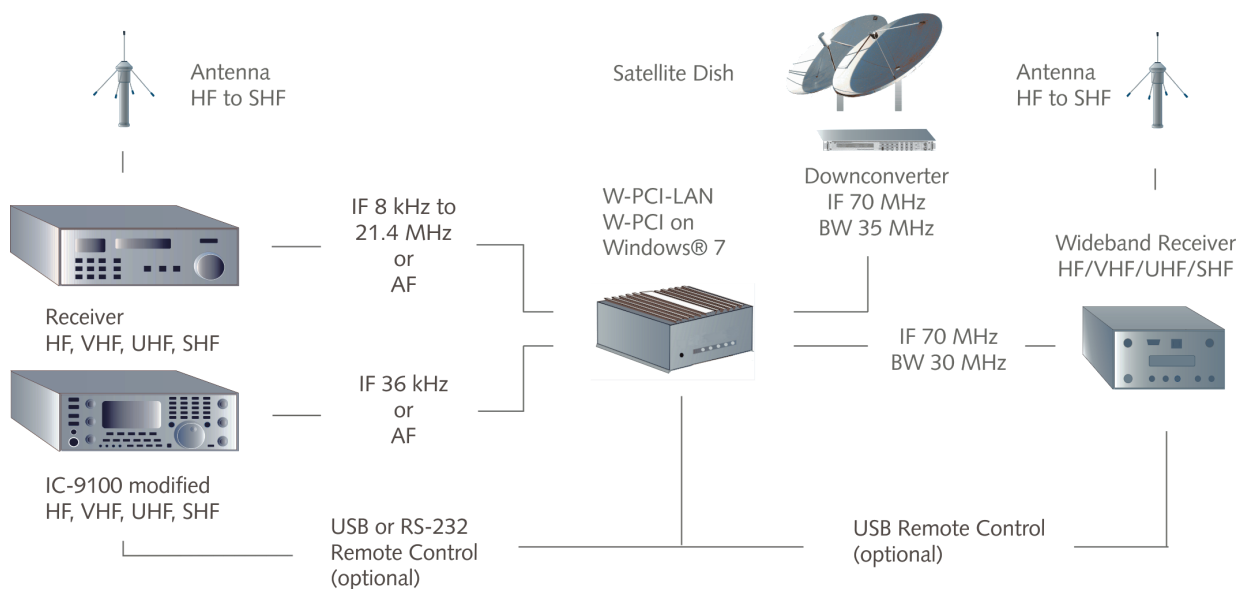
W-PCI-LAN

Complete Decoder System

Practical Application



A W-PCI-LAN and WinRADIO SDR configuration







A W-PCI-LAN and IF receiver / downconverter configuration

W-PCI-LAN

Complete Decoder System

W-PCI-LAN Computer Specifications and Technical Data





Dimensions (LxWxH)	268 x 195 x 100 mm
Weight	5.0 kg
DC power requirement (typical values)	9-30 V (max. 120 W)
AC power requirement (typical values)	100-240 V, 50-60 Hz, 2 Amp.
Operating temperature	- 5 °C to 55 °C (According to IEC60068-2-1, IEC60068-2-2, IEC60068-2-14)
Case temperature range	-5 °C to 55 °C
Storage temperature range	-20 °C to 70 °C
Relative humidity	10 to 93 % (non-condensing)
Operating system (OS)	Windows 7 Professional, 32-bit, English Windows 7 Professional, 64-bit, English (optional)
CPU	Intel® Core™ i5-520M PGA Processor (3MB Cache)
CPU Clock	2.4 GHz
Controller	Mobile Intel® QM57 Platform Controller Hub
Memory	4 GB DDR3-RAM, PC1333 CL9 240-pin memory DIMM
Hard disk (HDD) for operating system	250 GB, 7200, 64MB cache, 24h/7d
Solid state disk (SSD) for data storage	1000 GB, 540 MB/s, 1 GB cache
W-PCI-LAN	1 slot for W-PCI 1 slot free
W-PCIe-LAN	1 slot for W-PCIe x1
Ethernet / LAN	2 x 10MB/100MB/1GB
USB	2 x USB 2.0 (front) 4 x USB 2.0 (rear)
Serial ports	3 x RS232 1 x RS232/422/485
Audio	1 x Mic-In 1 x Speaker-Out
eSATA	2 ports
Video	1 x DB-15 VGA port, 1 x DVI-I port (1280 x 1024)
Keyboard/Mouse	2 x PS/2 or USB
Conformity	  <small>Trade Name: NISCOM Model Number: Nise 3500P2 Tested To Comply with FCC Standards</small>  <small>EN 60601 Compliant</small> 

W-PCI-LAN

Complete Decoder System

W-PCI Card Specifications and Technical Data

Inputs	AFIF#1 and AFIF#2	IF70#1a, IF70#1b and IF70#2
Connector	SMA female	SMA female
Frequency range	50 Hz to 25 MHz	52.5 MHz to 87.5 MHz (SAW filter)
Bandwidth	5 kHz to 500 kHz	5 kHz to 500 kHz
Frequency raster DDC	1.0 Hz	1.0 Hz
Signal level	2 mVrms to 0.5 Vrms 20 mVrms to 2.5 Vrms with 20 dB attenuator (jumped)	20 mVrms to 2.5 Vrms
Input impedance	> 1 kOhm	50 Ohm
Input max sampling rate	92.16 MHz	92.16 MHz
Input sampling rate jitter	1 ps (RMS 12 kHz to 20 MHz)	1 ps (RMS 12 kHz to 20 MHz)

Card type	Half-size PCI card
Number of concurrent, independent inputs	2 AFIF#1 or IF70#1a or IF70#1b -with- AFIF#2 or IF70#2
Dimensions (L x W x H)	168 x 106 x 22 mm
Weight	0.15 kg
Power requirement (typical values)	+3.3V @ 1.0 A +12V @ 0.4 A
Bus interface	32-bit 3.3V PCI slot 100 Mbytes/s
Operating temperature range	0 °C to 50 °C
Case temperature range	0 °C to 55 °C
Storage temperature range	0 °C to 70 °C
Relative humidity	10 to 90 % (non-condensing)
A/D converter	AD9268 dual 16 bit ADC
Dynamic range	> 60 dB
Digital down converter DDC	FPGA Cyclone II 50K
DSP	TI DSP320C6454
Watchdog for on-board generated voltages	Yes
Conformity	   



WAVECOM® W-PCle-LAN



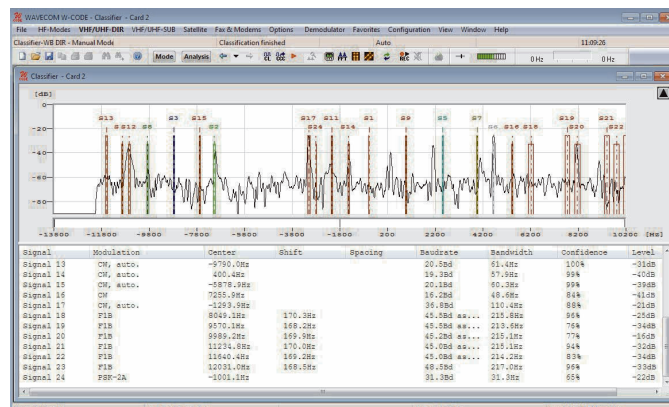
The W-PCle-LAN decoder offers all the functions of the W-PCle hardware and software decoder plus all the advantages of a compact computer system. The device is implemented in a ruggedized aluminium box. W-PCle-LAN offers two completely independent Digital Down Converter inputs (DDC) at IF and AF level. W-PCle-LAN delivers a modern complete solution with various interfaces in hardware and software.

W-PCle-LAN

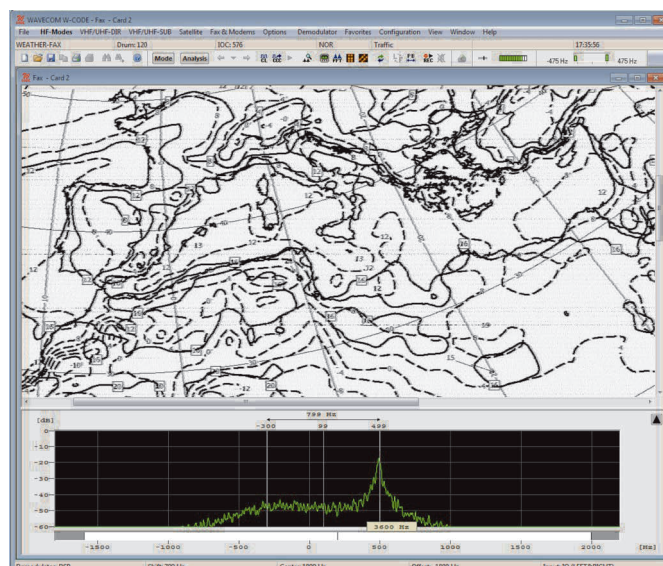
Complete Decoder System

W-PCle-LAN Features and Facts

- ◆ W-PCle-LAN provides all functions required to analyze, decode, record and process radio data communications throughout the radio spectrum from HF to SHF
- ◆ W-PCle-LAN offers automated or manual monitoring of radio data and voice communications from HF to SHF bands
- ◆ W-PCle-LAN can be connected to a PC or notebook via LAN or may operate as a stand-alone system. As the W-PCle-LAN operates from 9-30 V DC power sources, it is very well suited for mobile use
- ◆ W-PCle-LAN offers two high-quality DDC inputs with wideband frequency range. The DDCs extract the narrowband signal of interest from a broadband input signal. The extracted signal is then used for further analysis, decoding and recording
- ◆ W-PCle-LAN supports Software Defined Radios (SDR), W-CLOUD, VSC, standard VACs and all I/Q data or digital inputs
- ◆ Built-in SSD (1 TB) suitable for wideband signal recording
- ◆ System components can be individually configured according to the requirements of the customer
- ◆ W-PCle-LAN supports remote control from other applications using third party software with TCP/IP and XML
- ◆ A W-PCle-LAN decoder can be controlled from anywhere across the network, and its output can be sent to one or more applications on the network



Classifier-WB display containing 24 identified signals



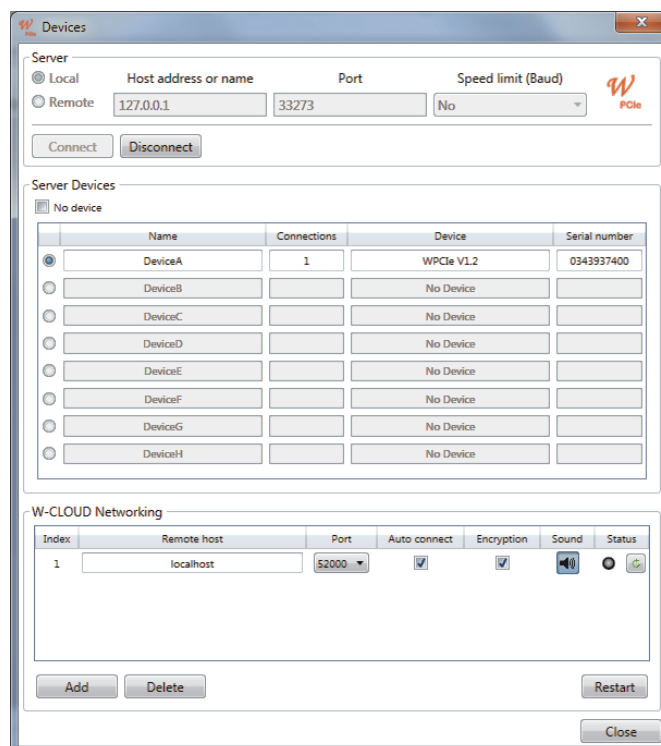
Decoded Weather-FAX from HF

W-PCle-LAN

Complete Decoder System

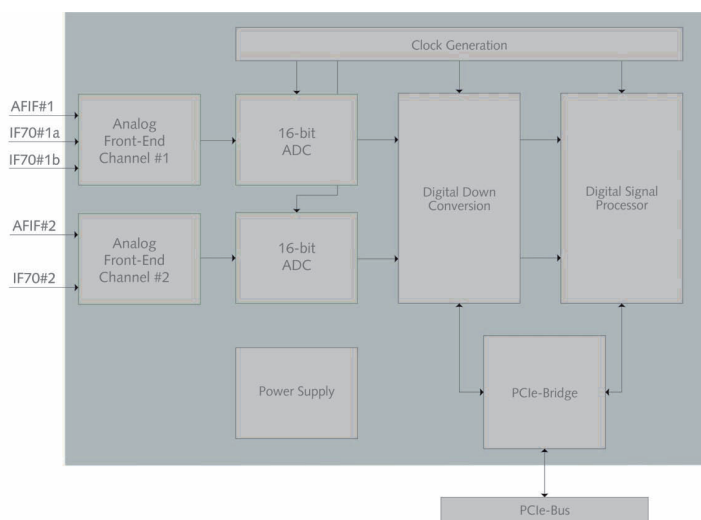
Signal Sources and Devices

- ◆ W-PCle-LAN supports a great number of input interfaces and devices. The application processing the signal sources and devices for W-PCle-LAN is compatible with W-CODE
- ◆ A number of other interfaces, e.g. SDR I/Q data or digital TCP/IP input streams using W-CLOUD, IP-PXGF, Virtual Audio Cable (VAC) or WiNRADiO Digital Bridge Virtual Sound Card (VSC) and built-in soundcard input with sampling rates of up to 192 kHz are also available with W-PCI-LAN
- W-PCle-LAN is tested with a number of SDRs, e.g. WiNRADiO G33DDC and G39DDC, Grintek GRXLAN, Perseus, netSDR, SDR-IP, Rohde & Schwarz and MEDAV LR2
- ◆ Supports direct digital I/Q input and output of WAV files with integrated Wavecom Media Player/Recorder



Device Selector in W-PCle

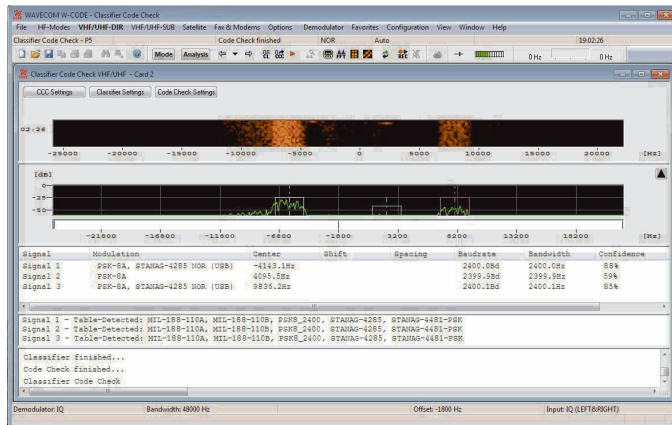
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- ◆ DDCs correspond to the well-known Software Defined Radio (SDR) technology



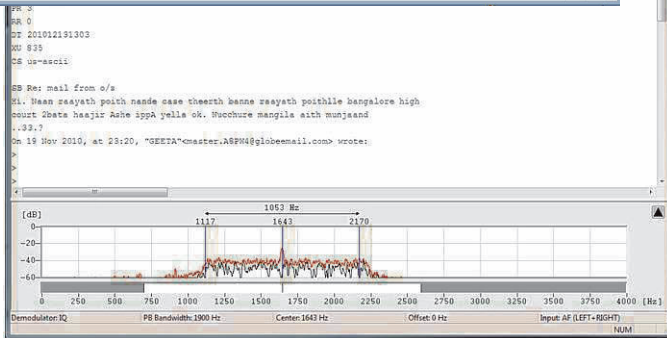
W-PCIe-LAN

Complete Decoder System

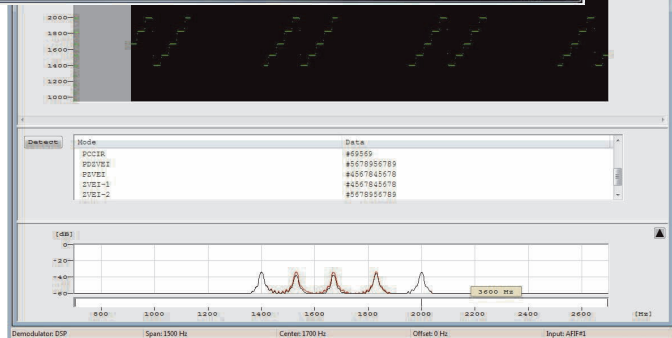
Wide Range of Application



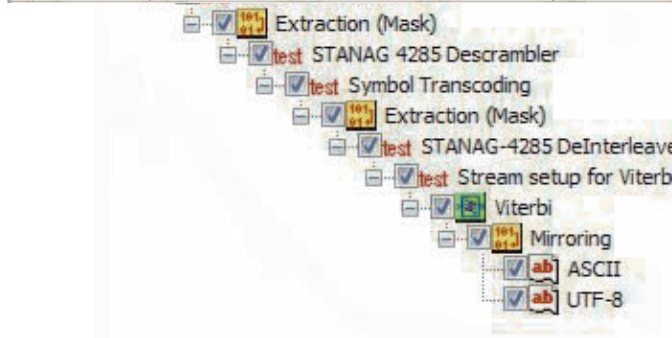
Automatic Signal Classification



Data Decoding



Signal Analysis



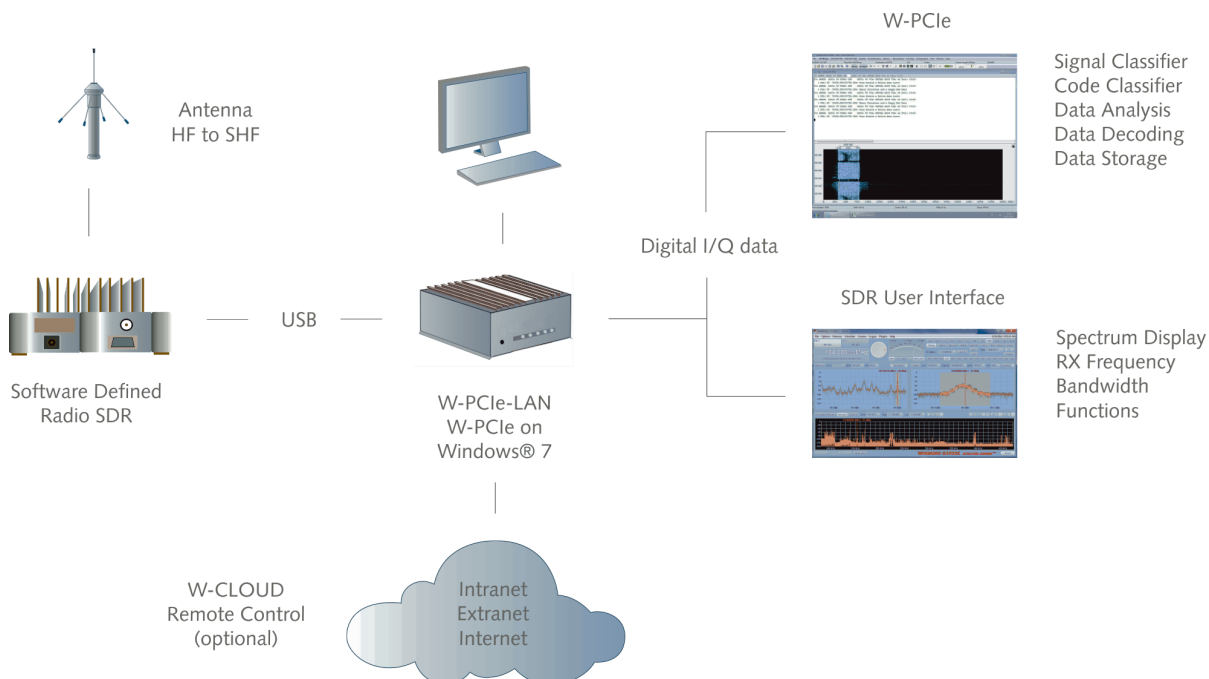
Bit Analysis

- Extraction (Mask)
- test STANAG 4285 Descrambler
- test Symbol Transcoding
- Extraction (Mask)
- test STANAG-4285 DeInterleaver
- test Stream setup for Viterbi
- Viterbi
- Mirroring
- ASCII
- UTF-8

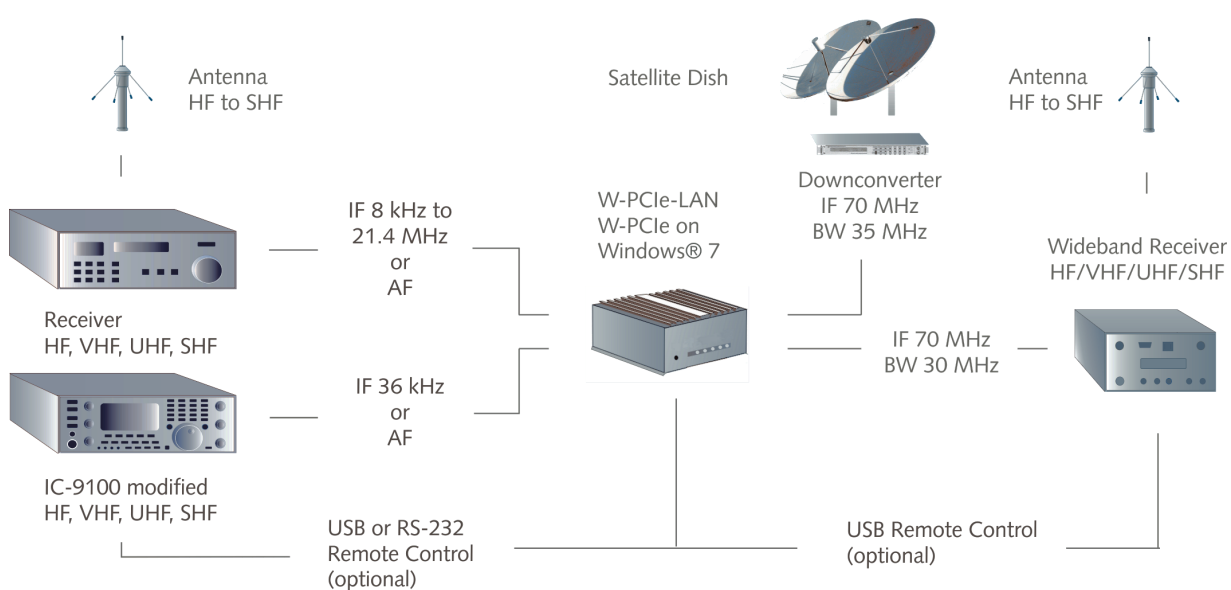
W-PCle-LAN

Complete Decoder System

Practical Application



A W-PCle-LAN and WinRADIO SDR configuration







A W-PCle-LAN and IF receiver / downconverter configuration

W-PCIe-LAN

Complete Decoder System

W-PCIe-LAN Computer Specifications and Technical Data





Dimensions (LxWxH)	268 x 195 x 100 mm
Weight	5.0 kg
DC power requirement (typical values)	9-30 V (max. 120 W)
AC power requirement (typical values)	100-240 V, 50-60 Hz, 2 Amp.
Operating temperature	- 5 °C to 55 °C (According to IEC60068-2-1, IEC60068-2-2, IEC60068-2-14)
Case temperature range	-5 °C to 55 °C
Storage temperature range	-20 °C to 70 °C
Relative humidity	10 to 93 % (non-condensing)
Operating system (OS)	Windows 7 Professional, 32-bit, English Windows 7 Professional, 64-bit, English (optional)
CPU	Intel® Core™ i5-520M PGA Processor (3MB Cache)
CPU Clock	2.4 GHz
Controller	Mobile Intel® QM57 Platform Controller Hub
Memory	4 GB DDR3-RAM, PC1333 CL9 240-pin memory DIMM
Hard disk (HDD) for operating system	250 GB, 7200, 64 MB cache, 24h/7d
Solid state disk (SSD) for data storage	1000 GB, 540 MB/s, 1 GB cache
W-PCI-LAN	1 slot for W-PCI 1 slot free
W-PCIe-LAN	1 slot for W-PCIe x1
Ethernet / LAN	2 x 10MB/100MB/1GB
USB	2 x USB 2.0 (front) 4 x USB 2.0 (rear)
Serial ports	3 x RS232 1 x RS232/422/485
Audio	1 x Mic-In 1 x Speaker-Out
eSATA	2 ports
Video	1 x DB-15 VGA port, 1 x DVI-I port (1280 x 1024)
Keyboard/Mouse	2 x PS/2 or USB
Conformity	  <small>Trade Name: NISECOM Model Number: Nise 3500P2 Tested To Comply with FCC Standards</small>  <small>EN 60601 Compliant</small> 

W-PCIe-LAN

Complete Decoder System

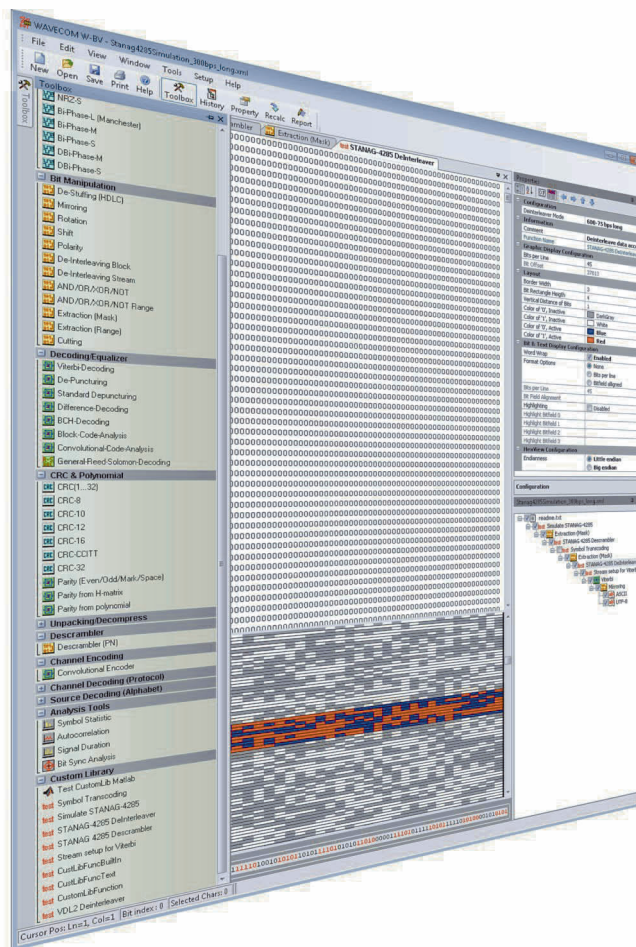
W-PCIe Card Specifications and Technical Data

Inputs	AFIF#1 and AFIF#2	IF70#1a, IF70#1b and IF70#2
Connector	SMA female	SMA female
Frequency range	50 Hz to 25 MHz	52.5 MHz to 87.5 MHz (SAW filter)
Bandwidth	5 kHz to 500 kHz	5 kHz to 500 kHz
Frequency raster DDC	1.0 Hz	1.0 Hz
Signal level	2 mVrms to 0.5 Vrms 20 mVrms to 2.5 Vrms with 20 dB attenuator (jumped)	20 mVrms to 2.5 Vrms
Input impedance	> 1 kOhm	50 Ohm
Input max sampling rate	92.16 MHz	92.16 MHz
Input sampling rate jitter	1 ps (RMS 12 kHz to 20 MHz)	1 ps (RMS 12 kHz to 20 MHz)

Card type	Half-size PCIe card (PCI Express)
Number of concurrent, independent inputs	2 AFIF#1 or IF70#1a or IF70#1b -with- AFIF#2 or IF70#2
Dimensions (L x W x H)	168 x 106 x 22 mm
Weight	0.15 kg
Power requirement (typical values)	+3.3V max. 1.0 A +12V max. 0.5 A
Bus interface	PCIe x1 Link 2 Gbit/s
Operating temperature range	0 °C to 50 °C
Case temperature range	0 °C to 55 °C
Storage temperature range	0 °C to 70 °C
Relative humidity	10 to 90 % (non-condensing)
A/D converter	AD9268 dual 16 bit ADC
Dynamic range	> 60 dB
Digital down converter DDC	FPGA Cyclone IV 55K
DSP	TI DSP320C6454
Watchdog for on-board generated voltages	Yes
Conformity	   



WAVECOM® W-BitView



Today, the possibility to analyze and process demodulated signals with unknown protocols is important. W-BitView is a standalone application for analyzing unknown signal; signals with unknown protocols can be further analyzed and processed to retrieve the transmitted data. The software can also be used as a postprocessor for decoded data.

W-BitView

Bit Stream Analysis Software

W-BitView Overview

- ◆ Direct data import from the W-PCI, W-PCle, W-CODE, W61PC or W51PC decoder
- ◆ .NET application
- ◆ User can add own functions (MatLab or C#)
- ◆ Offline, stand-alone application
- ◆ Bit manipulation tool
- ◆ Bit display tools (text, graphics)
- ◆ Multiple analyses may be processed simultaneously
- ◆ Auto-update functionality
- ◆ Report generator for parameter and data (ASCII or XML)
- ◆ Drag and drop of functions
- ◆ Re-arrange functions in tree view
- ◆ Nested docking
- ◆ Auto hide
- ◆ Toolboxes for all functions

What is Bit Analysis?

Bit analysis is the process of finding patterns in a seemingly random and incoherent stream of bits. The goal is to transform the bit stream into clear text, or into reliable, cryptographic text, for further processing – these objectives require that all

framing, protocol overhead, checksums, and other extraneous data should be removed. The BitView provides the user with a set of sophisticated and highly specialized tools to ease and accelerate this process, and facilitate the recovery of useful data.

What W-BitView Offers

BitView enables the user to analyze bit streams. The range of available functions includes the display of a bit stream in various formats, simple bit stream manipulations, as well as statistical and mathematical functions, and functions based on coding theory. The tools are directed at users with experience in both coding theory and mathematics; in particular, to fully exploit some of the more complex functions a comprehensive mathematical knowledge is a requirement.

All analysis and processing steps, including the necessary parameters involved, are logged as is

each function used and its parameters. The log file is saved in ASCII (XML) format as may be edited with most text editors. It may be loaded to repeat the saved analysis steps, which enables analysis sessions to be documented and stored for later automatic rerunning, without user intervention.

The W-BitView Tool is an excellent companion to other Wavecom decoder products. W-BitView is a native .NET C# Winforms application. W-BitView offers the important feature of using custom project templates and all MATLAB Toolboxes.

W-BitView

Bit Stream Analysis Software

Using W-BitView

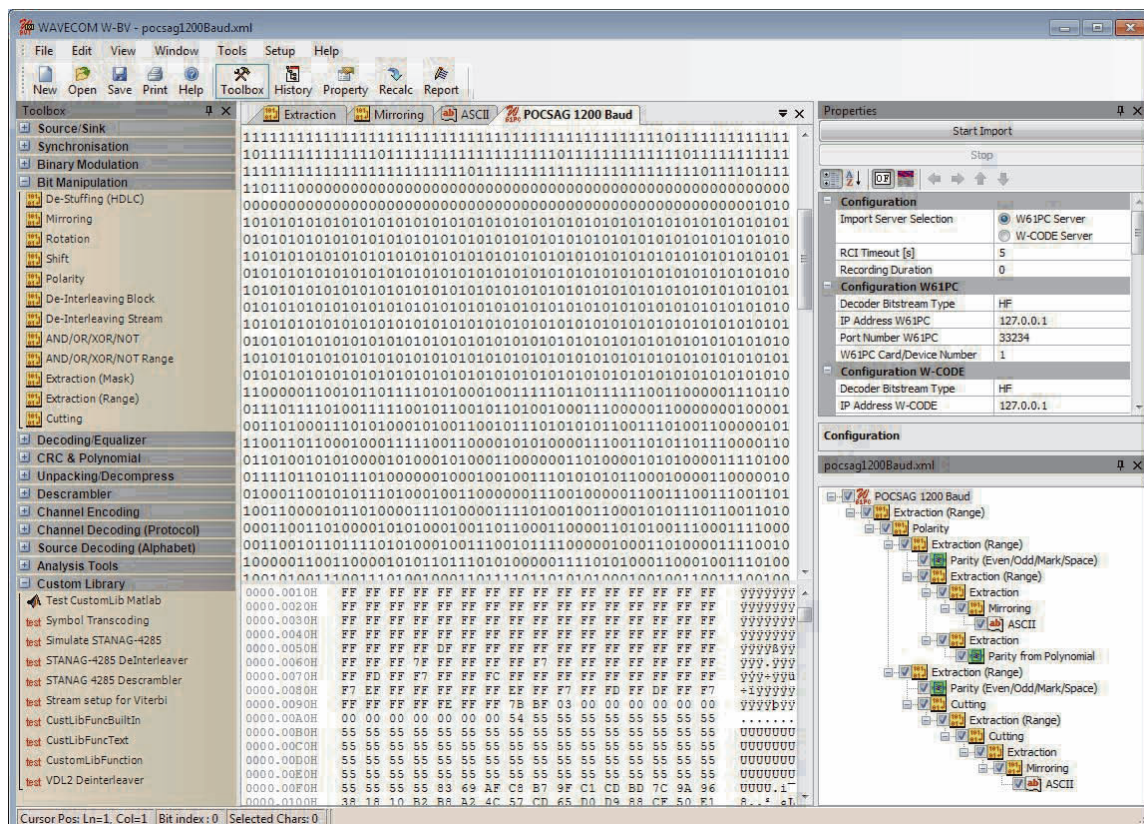
The initial steps in the bit analysis process depend on what is known about the signal, and on the skill and experience level of the user. Prior knowledge of the source, language, frequency, modulation mode, time of capture, etc. are useful pieces of information which may facilitate the analysis of the bit stream.

The various classification tools available from the Wavecom decoders should then be used. These allow a fully automatic determination of modulation type and coding format, or at least the determination of certain essential parameters of

the signal, e.g. baud rate and frequency shift.

Using the autocorrelation function will tell the operator whether the bit stream contains repeating patterns, e.g. synchronization words, HDLC flags or start-stop bits.

While the Wavecom decoders contain a wealth of tools and modes, their focus is on real-time analysis; BitView gives the user the opportunity to analyze and experiment repeatedly offline with captured data in order to recover the signal content.



POCSAG Decoding Example

W-BitView

Bit Stream Analysis Software

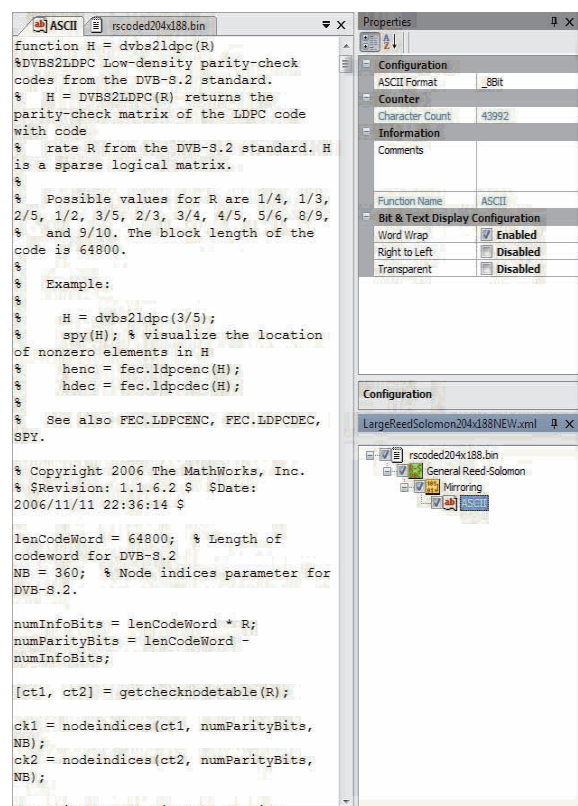
Custom Functions

The user may expand the functionality of BitView by adding custom functions developed in Visual Studio C# .NET. Project templates are included with the BitView package. The user may use these templates as a starting point for his development work. The .NET DLL templates come in two flavors, with and without MATLAB linking. This feature allows

bit stream manipulation in MATLAB to be included in a custom function. The procedure is described in detail in the BitView manual. A MATLAB Runtime is installed together with BitView and is required in order to allow a MATLAB function to work in a .NET environment without the user acquiring a complete MATLAB system.

MATLAB™ Runtime Library

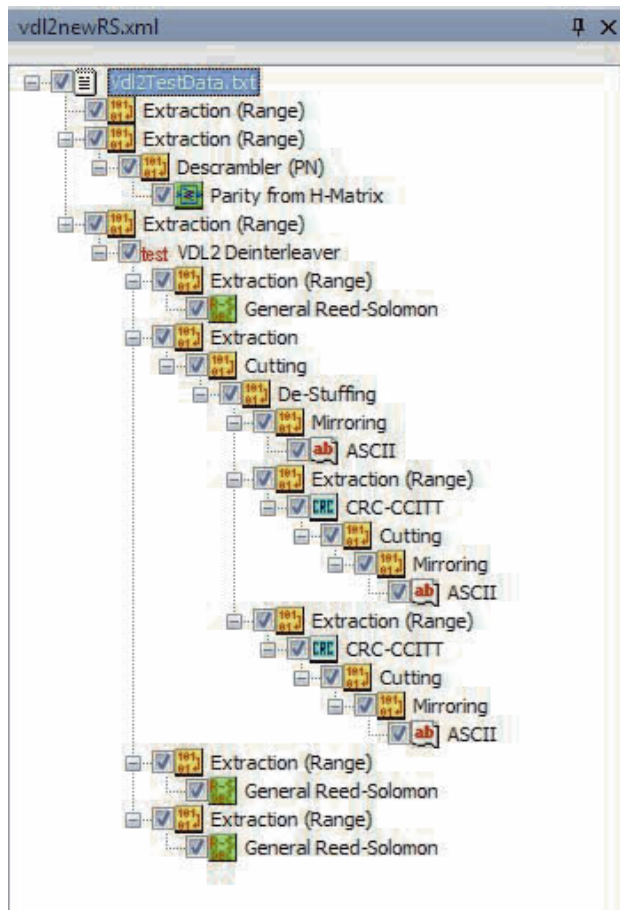
MATLAB includes numerous toolboxes with several thousand functions for a multitude of applications. One such toolbox is called the Communications Toolbox including error detection and correction, interleaving, modulation and demodulation, equalizing and many other functions. Similar functions developed in C# are also found in BitView, e.g. a Reed-Solomon Decoder. Although complex features like block code analysis are found in MATLAB, they must be developed by the user in the proprietary programming language of MATLAB. To do so the built-in functions are used. For instance way a clever student has in this way developed a MATLAB program for the analysis of block codes and convolutional codes, which was published with his master thesis. This feature would have been very difficult to realize in .NET C# and was the reason for the integration of MATLAB in W-BitView. For the experienced MATLAB user this combination is very useful.



Reed-Solomon Example

W-BitView

Bit Stream Analysis Software



Flow chart with VDL-M2

W-BitView Analysis Set Examples

Example	Analysis_BCH63_51 Analysis_ConvDataR1-2-K7 Analysis_RUM-FEC_164_Scrambled Baudot150 GenPseudo NewDepuncturingTest psk-31 rumfec-164 Stanag Scrambling sequence Stanag4285Simulation_300bps_long Stanag4285Simulation_2400bps_long Stanag4285Simulation_2400bps_short vdl2newRS	Analysis_BVTest.zip Analysis_Packet-300_2-V11 Analysis_s4285_5N1_V11 Fec-a-96-sreg72 LargeReedSolomon204-188NEW pocsag1200Baud reed-solomon-testNEW sitor-A Stanag4285-600-long-new Stanag4285Simulation_1200bps_long Stanag4285Simulation_2400bps_long_Noise unzip
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W-BitView

Bit Stream Analysis Software

W-BitView Toolbox Functions

Signal Source/Sink	Import Text Data Import Hex Data Import Binary Data Import "Demodulated Bitstream" from W-CODE, W-PCIe, W-PCI or W61PC Export Text Data Generate Pseudo-Noise
Synchronization	Preamble
Binary Modulation	NRZ-I NRZ-M NRZ-S Bi-Phase-L (Manchester) Bi-Phase-M Bi-Phase-S DBi-Phase-M DBi-Phase-S
Bit Manipulation	De-Stuffing (HDLC) Mirroring Rotation Shift Polarity De-Interleaving Block De-Interleaving Stream AND/OR/XOR/NOT AND/OR/XOR/NOT Range Extraction (Mask) Extraction (Range) Cutting
Decoding/Equalizer	Viterbi-Decoding De-Puncturing Standard De-puncturing Difference-Decoding BCH-Decoding Block-Code-Analysis Convolutional-Code-Analysis General-Reed-Solomon-Decoding
CRC & Polynomial	CRC (1...32) CRC-8 CRC-10 CRC-12 CRC-16 CRC-CCITT CRC-32 Parity (Even/Odd/Mark/Space) Parity from H-matrix Parity from polynomial
Unpacking/Decompress	Unzip
Descrambler	Descrambler (PN)

W-BitView

Bit Stream Analysis Software

W-BitView Toolbox Functions

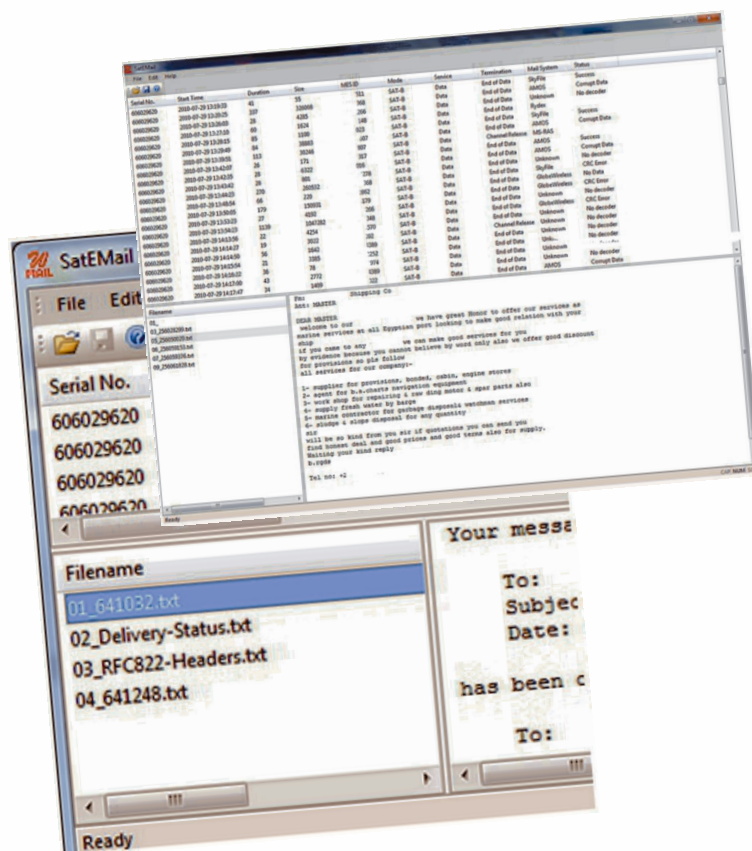
Channel Encoding	Convolutional Encoding	
Channel Decoding (Protocol)	ARQ-E FEC-A HNG-FEC ITA-3 (M.342) PSK-31 (Varicode)	SITOR BAUER RUM-FEC ITA-5
Source-Decoding (Alphabet)	Latin (5 bit) Third-Shift-Cyrillic (5 bit) Arabic-Baghdad-70 (5 bit) Bulgarian (5 bit) Swedish (5 bit) Danish-Norwegian (5 bit) German ITA-2 US ITA-2 UNICODE (16 bit) UTF-8 Pager-Numeric	Tass-Cyrillic (5 bit) Hebrew (5 bit) Arabic-Baghdad-80 (ATU-80) (5 bit) Bulgarian (8 bit) Swedish (7 bit) Danish-Norwegian (7 bit) French ITA2 ASCII ITA-5 UTF-7 Code Page Decoding
Analysis Tools	Symbol Statistics Signal Duration	Autocorrelation Bit Sync Analysis
Custom Library	Test CustomLib Matlab Simulate STANAG-4285 Stream setup for Viterbi Test CustLibFuncText Test VDL2 Deinterleaver	Symbol Transcoding STANAG-4285 Descrambler Test CustLibFuncBuildIn Test CustLibFunction

W-BitView Properties and Configuration

Function	Configuration Input Server Bit Counter Graphic Display Configuration Bit & Text Display Configuration File Information Graphic Layout Configuration HexView Configuration Input Device Configuration for W-CODE or W61PC
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WAVECOM® W-SAT-email-Decoder



Satellite communications systems play an increasingly important role in today's communication networks, carrying voice, fax, and data signals. The Wavecom Satellite Email Decoder is a standalone application which can decode data streams acquired from a wide range of different satellite reception equipment.

W-SAT-email-Decoder

Satellite e-mail Extractor

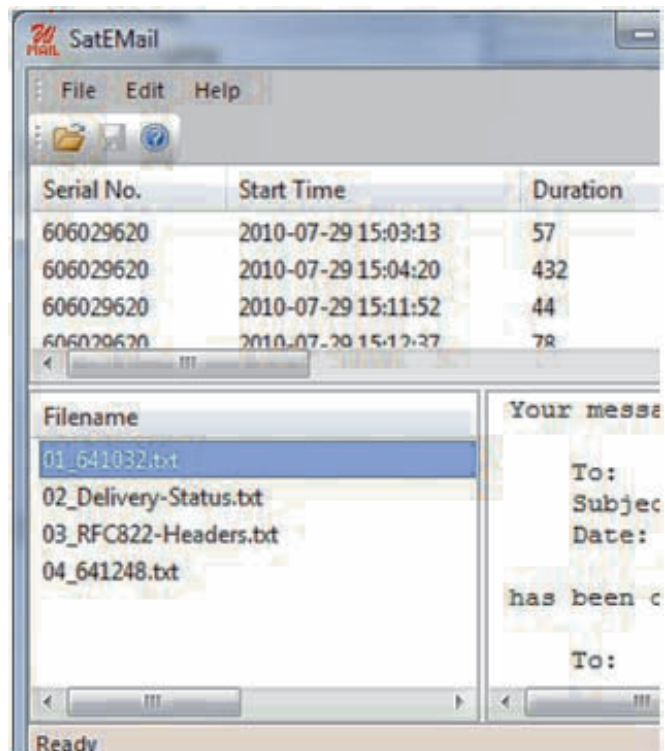
W-SAT-email-Decoder Overview

The W-Sat-email-Decoder takes as its input a session file and the corresponding text files, as produced by a Wavecom decoders, or any text file from an external source containing emails.

After protocol decoding and possible decompression, the email(s) and possible attachment(s) are output as files.

The decoding process is fully automatic, and so excellent decoding results can be achieved with almost no user interaction – all the user has to do is to load the data files. With the user-friendly GUI (see screenshot above), data files may be loaded individually or by directory into the decoder, after which the decoding process starts.

Once decoding has completed, the user can read email contents and browse any attachments. Status messages offer an easy-to-interpret indication of the success of the decoding.



Email text and attachments (pictures, PDF files, spreadsheets, etc.) can be extracted from the data streams and saved.

Metadata for each data stream, such as MES ID and mode, is provided by a session list file automatically generated by the Wavecom INMARSAT or other Satellite decoders. The file may also be manually edited by the user according to his particular requirements.

W-SAT-email-Decoder

Satellite e-mail Extractor

W-SAT-email-Decoder Application

◆ AMOS	(Mails and attachments)
◆ Dualog	
◆ GlobeWireless	(Mails and attachments)
◆ GTMail	
◆ MS-RAS PPP	
◆ Rydex	(Mails and attachments)

◆ se@COMM	(Iridium)
◆ SkyFile	(Mails and attachments)
◆ UUCP	
◆ UUPlus	(Iridium)
◆ Xdatos	(Iridium)
◆ ZModem	

MS-RAS PPP Explanation

PPP (Point-to-Point Protocol) is not an email application, but a transport protocol for upper layer protocols including TCP/IP and various email application protocols. The Wavecom Satellite Email De-

coder decodes PPP sessions and converts them into PCAP-formatted files. This allows PPP sessions to be further examined using WireShark – an open source protocol analysis application.

What do I need ?

To produce the data files to be decoded, two system components are necessary: An adequate satellite receiver system, and a decoder to produce the data stream from the received signal (see the application notes).

Wavecom recommends its W-PCle, W-PCI and W-CODE decoders. However the Wavecom Satellite

Email Decoder is compatible with other decoders able to store decoded data in a supported file format. For details on supported file formats, please refer to the appropriate Wavecom decoder manual.

W-SAT-email-Decoder DLL

For advanced users who wish to integrate the satellite email decoding library into their own software environment, Wavecom offers a DLL interface

upon request. The DLL allows the developer to access the decoders from his own application.



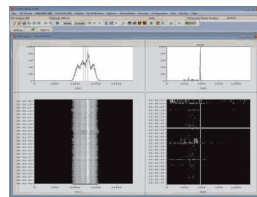
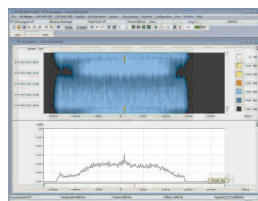
WAVECOM® W-Signal-Library

19 files; 754,020,352 bytes

```
C:\[ Audio ]\HF-MODES\MIL-STANAG\HF-ACARS
HD-ACARS (New York) (3).wav
HF-ACARS Island (1).mp3
HF-ACARS (Bahrein).wav
HF-ACARS (Canary Island).wav
HF-ACARS (Iceland).WAV
HF-ACARS (New York) (1).wav
HF-ACARS (New York) (2).wav
HF-ACARS (New York) (3).mp3
```

8 files; 45,850,828 bytes

```
C:\[ Audio ]\HF-MODES\MIL-STANAG\LINK-11
LINK-11 (1).wav
LINK-11 (2).WAV
LINK-11 (3).WAV
LINK-11 (4).wav
LINK-11 (5).mp3
LINK-11 (PSK-4).wav
LINK-11 (SLEW) (1).wav
LINK-11 (SLEW) (2).wav
Link11 (USB).wav
```

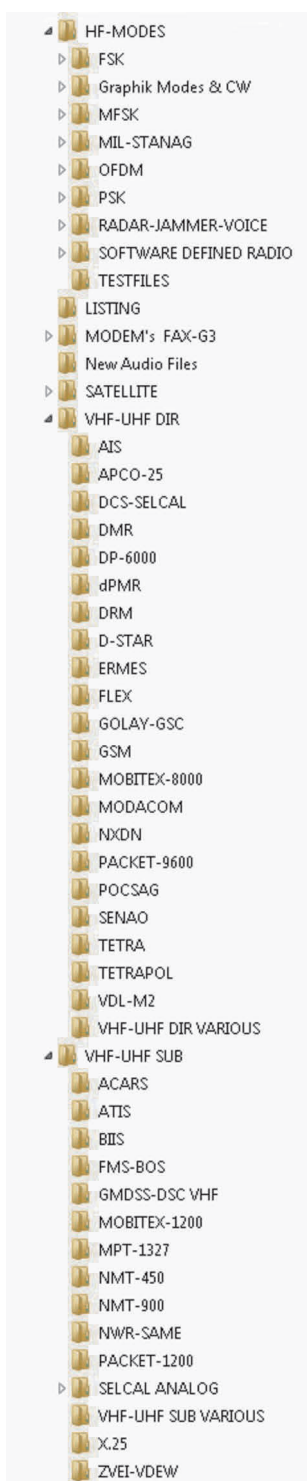


The identification of signals is one of the main objectives of signal monitoring and surveillance. Thus the W-Signal-Library collection of reference signals is a must for comparative analysis, training of operators or performance tests of equipment and software applications.

W-Signal-Library

A Collection of Reference Signals

W-Signal-Library Features



- ◆ Hundreds of source and channel encoding formats
- ◆ Numerous modulation formats
- ◆ All frequency ranges from VLF to EHF represented
- ◆ Size of recorded signals about 40 GB
- ◆ WAV format

```
GW OFDM (26 - CARRIER).WAV
GW OFDM (28 - CARRIER).WAV
GW OFDM (3).wav
GW OFDM (30 - CARRIER).WAV
GW OFDM (4).wav
GW OFDM (5).wav
GW OFDM (6).WAV
GW OFDM (7).wav
GW OFDM (8).wav
GW OFDM (Error free) (1).wav
GW OFDM (Error free) (2).wav

20 files; 107'914'032 bytes

C: \[ Audio ] \HF - MODES\OFDM\OFDM UNKNOWN
OFDM 44.5 Bd.wav

1 file; 9'288'682 bytes

C: \[ Audio ] \HF - MODES\OFDM\OFDM_112
OFDM_112_22.2 (22.2 Bd, Pilot Tone) (1).wav
OFDM_112_22.2 (22.2 Bd, Pilot Tone) (2).wav
```

W-SIGNAL-LIBRARY

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The signals of this unique collection have been recorded from real transmissions across the entire radio spectrum from VLF to EHF, across all radio services, fixed, maritime mobile, land mobile, civilian and military and including all types of modulation formats, source and channel encodings, encrypted and clear text.

In addition, W-Signal-Library contains a comprehensive collection of fax and modem communication signals as well

as selective call signals.

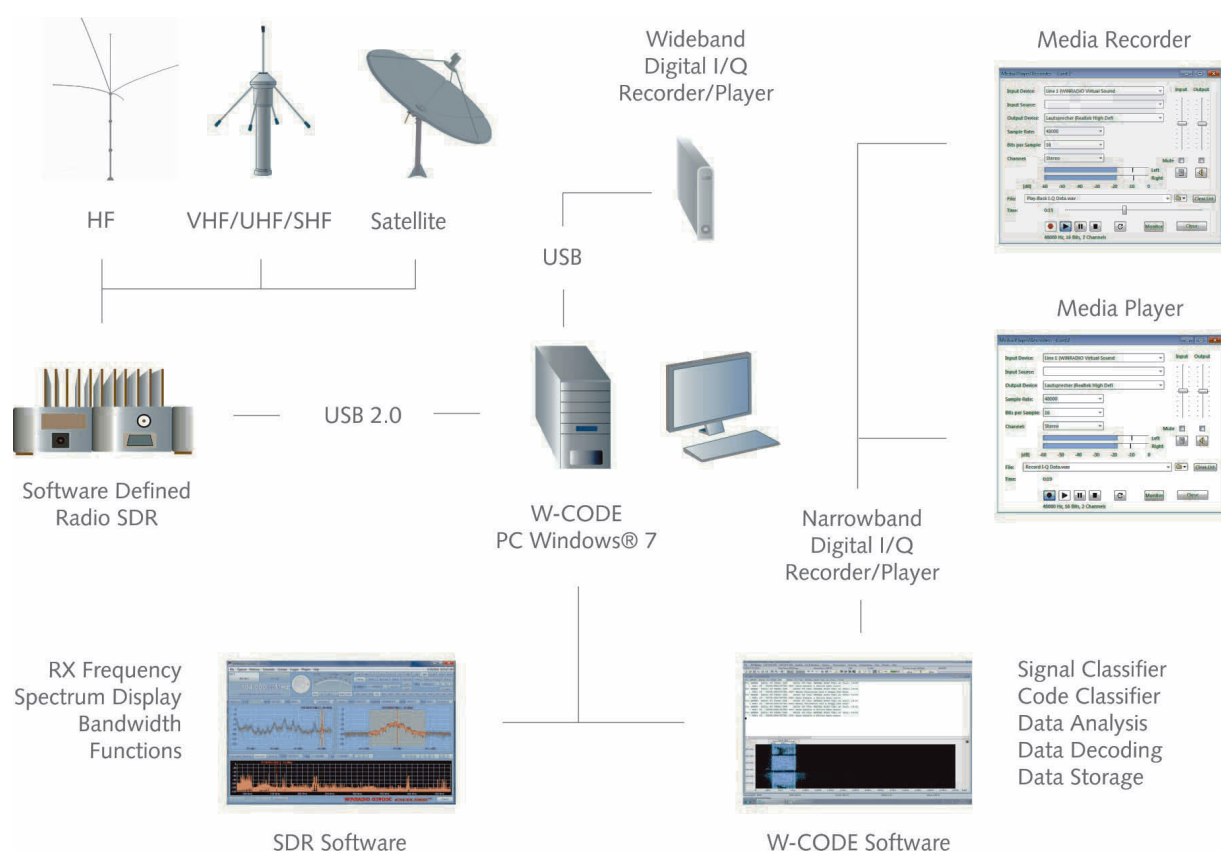
The signals may be played back using the built-in media player of the Wavecom suite of decoders, allowing instant classification and analysis or any other analysis tool or playback application to process the WAV files.

The current size of the library is approximately 40 GB and it is updated regularly. The signal library is available on a 64 GB USB-Stick.

W-Signal-Library

A Collection of Reference Signals

Example setup for digital I/Q recording using W-CODE and a SDR



In-phase and quadrature (I/Q) signal

Advanced modulation formats require that both the phase and amplitude of the demodulated signal is analyzed. The standard analysis method and also the less suitable method interprets a signal in polar coordinates, i.e. in both magnitude and angle. However, it is much easier to analyze a signal by decomposing it in its in-phase (sine) and quad-

rature (cosine) components. Since these signals are orthogonal the decomposition effectively creates two independent signals occupying the same spectral space. The two signals may then be investigated in just magnitude or in both magnitude and angle.



WAVECOM Product Series

The Complete Solution for Decoding and Monitoring

WAVECOM
NACHRICHTENTECHNIK

Since 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 com-

munication 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/decoder-online-help/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

	<i>Minimum</i>	<i>Recommended</i>
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

Distributors and Regional Contacts

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



WAVECOM ELEKTRONIK AG, Hammerstrasse 8
8180 Buelach, Switzerland
Phone +41 44 872 70 60 Fax +41 44 872 70 66
E-Mail: sales@wavecom.ch
Internet: www.wavecom.ch

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