

sodiraSDR – Software-Radio

Specification

Version of this document and SoDiRa software: 0.100 preview

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Common Informations

Program name:	sodiraSDR
Program Version:	0.100 Preview
Development Tools:	Delphi 5.0, Visual Studio 6.0 for c++ library abstractions
External Libraries used for main program:	nothing used, 99.99% selfmade coded
other used External Libraries:	libfaad, libcelt for Audiodecoding

Supported receiver

Internal direct supported receiver:

Sound card as real data based VLF receiver	tested
Sound card as real or IQ data based IF stage receiver	tested
Sound card with Elektor DRM 03/2004	(not tested since version 0.099)
Sound card with DRT1	(not tested since version 0.099)
Sound card with DRB30/DRB32	(not tested since version 0.099)
Sound card with Elektor USB IQ 05/2007	(not tested since version 0.099)
Sound card with HCJB Pappradio Version 1	(not tested since version 0.099)

ExtIO supported receiver:

basically all ExtIO receiver can be used, here will be listed some notes.

SDRPLAY RSP1	with ExtIO_SDRplay_RSP1.dll low border 100 kHz and high border 2000 kHz should be used to prevent dll messages no correct feedback of tuned frequency value
RTLSDR USB Stick	8 bit sampling data is not correct packed in a 16 bit container format (the lower bits are used not the upper), due to this a ADC fullscale correction is necessary
Perseus SDR	correct behavior with ExtIO_perseus2v4a release
Airspy mini	with extio_airspy_cmake_mgw-v1.0.5.dll no correct feedback of tuned frequency value

Tuning

Tuning accuracy and resolution

- exactly to 1 Hz
- only be possible if receiver support correct feedback of tuned frequency
- receiver tuning offset will be automatically corrected by an software tuning offset
- some ExtIO receiver will give incorrect feedback

Tuning range

- 0 Hz to 999,999,999,999 Hz (1 Thz minus 1 Hz) plus an offset caused by the ADC bandwidth
- The tuning range is depend on used receiver hardware

Manuell mode

- frequency is choosed by user action

Auto IF tuning

- frequency is chossed by an automatic spectrum peak detection
- tuning speed depends on receiver

Receiver tuning

- receiver frequency will be changed

Software tuning

- software frequency offset will be changed within the RF/IF1/ADC stage tuning range
- 10 steps per second speed

Shift tuning

- Receiver and software frequency will be changed together, the sum of booth is constant
- Tuning station will be halted but some interferences will be shift out

Search tuning

- Receiver frequency will be decreased or increased by a choosing step until a new station will be found
- stop point is detected by a spectrum band power detection

Direct enter tuning

- frequency can be direct entered by keyboard buttons

Digit tuning

- single frequency digit can be increased or decreased

Frequency manager tuning

- Frequency changing by choosing an item of the frequency manager

Signal processing working principle

Signal processing is divided into 3 stages:

1. ADC input signal is named to the RF / IF1 / ADC stage
 2. Demodulator input signal is named to the IF2 or Demodulator stage
 3. Audio signal stage
- the ADC input signal will be decimated / resampled to the Demodulator input signal samplerate
 - the demodulator output signal will be decimated / resampled to the audio signal samplerate

Within this 3 stages will be done the processing described below.

RF / IF1 / ADC stage processing

useable sample rates

- min 44100 Hz
- max sample rate is depend on host CPU power
- 5 MHz sample rate at 2 Ghz Intel CPU is tested
- all samplerate values between min and max are allowed

processing modules

- decimation and sample rate conversion to IF2 / demod stage sample rate
- frequency shifting
- impulse noise supression
- IQ balance controlling
- DC filtering
- spectrum calculation for graphical viewing

IF2 stage processing

sample rates

- 48k, 96k, 192k, 384k
- manually chooseable or automatically chosen by demodulation bandwidth and lowest CPU consumption

processing modules

- bandpass filtering / lowpass filtering
- demodulation / decoding
- level calculation
- spectrum calculation

demodulation modules

- Simple: high abstraction radio
- Universal: high configurable radio
- FM + RDS: RDS decoder and broadcast FM Radio
- DRM: DRM decoder for DRM30 and DRM+
- DCF77: Decoder for the DCF77 time signal
- RFSensors: Decoder for the 433 MHz and 868 MHz RF sensors

Audio stage processing

Samplerates	48k, fixed
Processing modules	low pass filtering high pass filtering DC filtering white noise suppression impulse noise suppression automatic gain control (AGC) manually gain control

Simple Receiver Module

AM

Demodulator bandwidth: 10 kHz
Demodulator type: envelope demodulator
Audio bandwidth: 5 kHz
DC filter: on
AGC: RMS mode, medium speed

AM stereo

Demodulator bandwidth: 10 kHz
Demodulator type: AM Stereo (C-QUAM)
Audio bandwidth: 5 kHz
DC filter: on
AGC: RMS mode, medium speed

LSB, USB

Demodulator bandwidth: 3 kHz
Demodulator type: AM unsynchronous
Audio bandwidth: 3 kHz
DC filter: on
AGC: RMS mode, medium speed

NFM

Demodulator bandwidth: 12.5 kHz
Demodulator type: FM
Audio bandwidth: 5 kHz
DC filter: on
AGC: RMS mode, medium speed

WFM mono, WFM stereo

Demodulator bandwidth: 130 kHz

Demodulator type: FM

Audio bandwidth: 15 kHz

DC filter: on

AGC: off

Deemphasis: on, 50us

Stereo decoder (FM Stereo Multiplex): off (WFM mono), on (WFM stereo)

RDS decoder: on

DRM30

Demodulator bandwidth: 10..20 kHz

Demodulator type: DRM30

Audio bandwidth: audio filter dissabled

DC filter: off

AGC: off

DRM+

Demodulator bandwidth: 96 kHz

Demodulator type: DRM+

Audio bandwidth: audio filter dissabled

DC filter: off

AGC: off

FM+RDS

Demodulator bandwidth: 25..250 kHz, raw and fine adjustable

max. carrier offset, locking range: full demodulator bandwidth range

AFC: not implemented, not necessary with accurate oscillators, small frequency offset will result in a DC offset that will be filtered out in the audio stage

Deemphasis: off, 50us, 75us

Audio bandwidth: 15 kHz or off (full audio output bandwidth)

FM Demodulator: Differentiator as high order FIR filter or as 1 order difference

Features:

- FM signal quality calculation (SNR, envelope constancy)
- FM Stereo multiplex pilot tone detection module
- RDS signal detection
- RDS decoding of PI (Programme identification), PS (Programme service), PTY (Programme type), RT (Radio text)....

DRM30/DRM+

DRM decoder is rebuilding, only limited functionality, please use SW version 0.099

DCF77 Decoder

AM time data decoding: yes

PM time data decoding: yes

Demodulator bandwidth: 1.0 kHz

max. carrier offset, locking range: -100...100 Hz

Time to decode: max. 1 min (signal is sufficient)

Time accuracy: 20 ms (using soundcard as ADC)

Features:

- time resolution for AM and PM calculation
- SNR for 1kHz bandwidth calculation
- time difference (System time offset to correct time) calculation
- system time can be set, synchronized up to 20 ms accuracy
- full data logging available (only as special feature)

RF Sensors

limited functionality

Version history of sodiraSDR:

0.100 Completely new internaly and GUI designed version