Fobos PRO

Product Overview

Fobos PRO is a next-generation general-purpose software-defined radio (SDR) receiver with USB 3.0 data and power connectivity.

Key Improvements

- Wider frequency coverage
- Increased IQ sampling bandwidth
- Faster frequency scanning
- Improved sensitivity
- Reduced spurious responses
- Lower power consumption
- Enhanced robustness



Main features

- Double frequency conversion heterodyne
- Two coherent direct sampling channels
- Precise 14-bit ADC
- Frequency coverage: 0.1 MHz - 8.825 GHz
- Up to 64 MS/s IQ sampling rate
- Fully continuous IQ data stream
- Frequency scanning up to 20 GHz/s
- Clock-in and clock-out options
- EMI shielding
- Conformal coating
- Robust milled aluminum housing

Applications

- SIGINT / COMINT
- Spectrum monitoring and surveillance
- Wideband waveform digitization
- Amateur radio (HF, VHF, UHF)
- Test and measurement
- Wireless, cellular and IoT
- Radio astronomy
- HF/VHF telemetry

Specifications

Parameter	Value
Operation modes	- two-channel direct sampling - double conversion heterodyne
Frequency tuning range	- no tuning in direct sampling mode - 50..8800 MHz in heterodyne mode
Tuning resolution	<1 Hz
Frequency coverage	100 kHz ... 32 MHz (direct sampling mode) 25 MHz ... 8.825 GHz (heterodyne mode)
Synthesizer setting time, typ.	280 µs
Synthesizer phase noise, 6 GHz @10 kHz offset, typ.	-90 dBc/Hz
Gain control range	95 dB (heterodyne mode)
IQ sample rate / receive bandwidth	8–64 MS/s / up to 64 MHz (arbitrary values)
ADC resolution	14 bits
Blocking Dynamic Range	86 dB (direct sampling mode) 82 dB (heterodyne mode)
IQ Image rejection	56 dB (combined)
Adjacent channel rejection @16-64 MS/s, typ.	65 dB
Main RF Image rejection, typ.	60 dB
Maximum RF input	+10 dBm
Power source	3.8 - 5.5 V nominal
Current consumption	360 mA in idle state 510 mA in hot-start mode 580 mA in direct sampling mode 600 mA in full band operating mode
Clock source	- internal - external, selectable within API
External clock input	10 MHz, high impedance, 1 V p-p
Clock output	10 MHz, 50 Ohm, 3.0 V p-p permanent
Internal clock reference phase noise, 10 MHz @10 kHz offset, typ.	-130 dBc/Hz
Frequency stability	±0.5 ppm
Input reradiation, max., within specified frequency ranges	-109 dBm (HF1/HF2 port, 0.1-25 MHz) -95 dBm (RF port, 25-1100 MHz) -70 dBm (RF port, 1100-8000 MHz)
USB control latency, typ.	0.8-1.2 ms
Operating Temperature	-20...+60 °C
Overall dimensions, not exceeding	115 × 61 × 20 mm
Weight, no more than	160 g

Connectivity

Fobos PRO SDR provides the following RF and clocking connectivity:

- 1 × RF Input, primary Rx path (double heterodyne, frequency coverage: 25-8825 MHz)
- 2 × RF Input, auxiliary Rx path (coherent direct sampling, frequency coverage: 0.1 - 32 MHz)
- 1 × Clock input
- 1 × Clock output

Simple and robust gold-plated SMA female connectors provide suitable connectivity and compatibility with the vast majority of RF devices, connectors and cables. ESD protection is included for all RF inputs.

Fobos PRO SDR has conventional data and power connectivity

- USB 3.0 Type-B connector for power, control, and data transfer (5 Gbit/s USB 3.2 Gen 1)
- Power control jumper for additional onboard configurations

SDR has the GPO header, providing

- 8 software controlled digital outputs
- +3.3 V, 100 mA power line
- ground (GND)

The main purpose of GPO port is to control embedded and auxiliary devices. It is fully compatible with Octopus 8-channel RF commutator.

The GPO connector is located inside the main aluminum enclosure and is not accessible in the standard configuration. Custom configurations are available upon request.

Operation modes

Heterodyne Mode

The primary operation mode is double frequency conversion heterodyne. The waveform is accepted through the main RF input, and passed through primary Rx path: preselector, LNA, first mixer, IF filters, second mixer with built-in low pass IQ filters, ADC.

The heterodyne provides continuous frequency tuning from 50 to 8800 MHz. For example, at an IQ sample rate of 64 MS/s and a selected bandwidth of 50 MHz, tuning to 50 MHz provides simultaneous reception from 25 to 75 MHz, while tuning across the full range provides continuous frequency coverage 25 - 8825 MHz.

Gain control is available over a total range of 95 dB including LNA (0, 16, 33 dB) and VGA (0..62 dB, 2 dB step).

Direct Sampling Mode

Auxiliary operation mode is two-channel coherent direct sampling. The waveform is accepted via auxiliary HF1 and HF2 inputs, filtered, amplified and passed to ADC. At a 64 MS/s sample rate, this mode provides frequency coverage from 0.1 to 32 MHz. Both channels have aligned tracing and are sampled simultaneously. It is suitable for coherent signal acquisition and processing applications. There is no frequency tuning and gain control in this mode.

Caution! Most general-purpose SDR software does not deal with directly sampled waveforms properly. It may cause a spectral wrapping and aliasing in the display.

Caution! Direct sampling signal path is not a fully functional HF receiver. External filters, amplifiers and/or attenuators should be used to provide proper operation in real world HF bands.

Sampling and data processing

The IQ sample rate can be set from 8 to 64 MS/s. Lower bound is limited by minimal filter bandwidth. Upper bound is limited by data stream integrity and stability. Arbitrary sample rate values are supported within this range.

In both modes, the entire digitized data stream is sent to the host PC for processing by software. No signal processing is done on the board, providing maximal purity of the digitized waveform and simplicity of the processing pipeline.

Additional protection

Fobos PRO SDR receiver's core board has conformal coating providing moisture protection.

Software support

Fobos PRO SDR receiver is fully supported by the existing libfobos-sdr-agile library since version 3.3.0. All existing features are fully compatible and usable. New features are added and supported. Full source code and application examples can be found in the GitHub repository:

https://github.com/rigexpert/libfobos-sdr-agile

Library releases and builds containing full source code, Windows x86 and x64 binaries, tools, guides, and current firmware files can be found in the releases section:

https://github.com/rigexpert/libfobos-sdr-agile/releases/

Compatible software

- µSDR - https://sourceforge.net/projects/u-sdr/
- SDRSharp and HDSDR ExtIO plugins - https://rigexpert.com/files/software/FobosSDR/
- Soapy SDR plugin for Fobos SDR - https://github.com/rigexpert/SoapyFobosSDR
- SDRangel - https://github.com/f4exb/sdrangel/releases
- Spectrozir SA - https://spectrozir.com/