RFx: A low-SWaP multichannel RF tuner and digitizer

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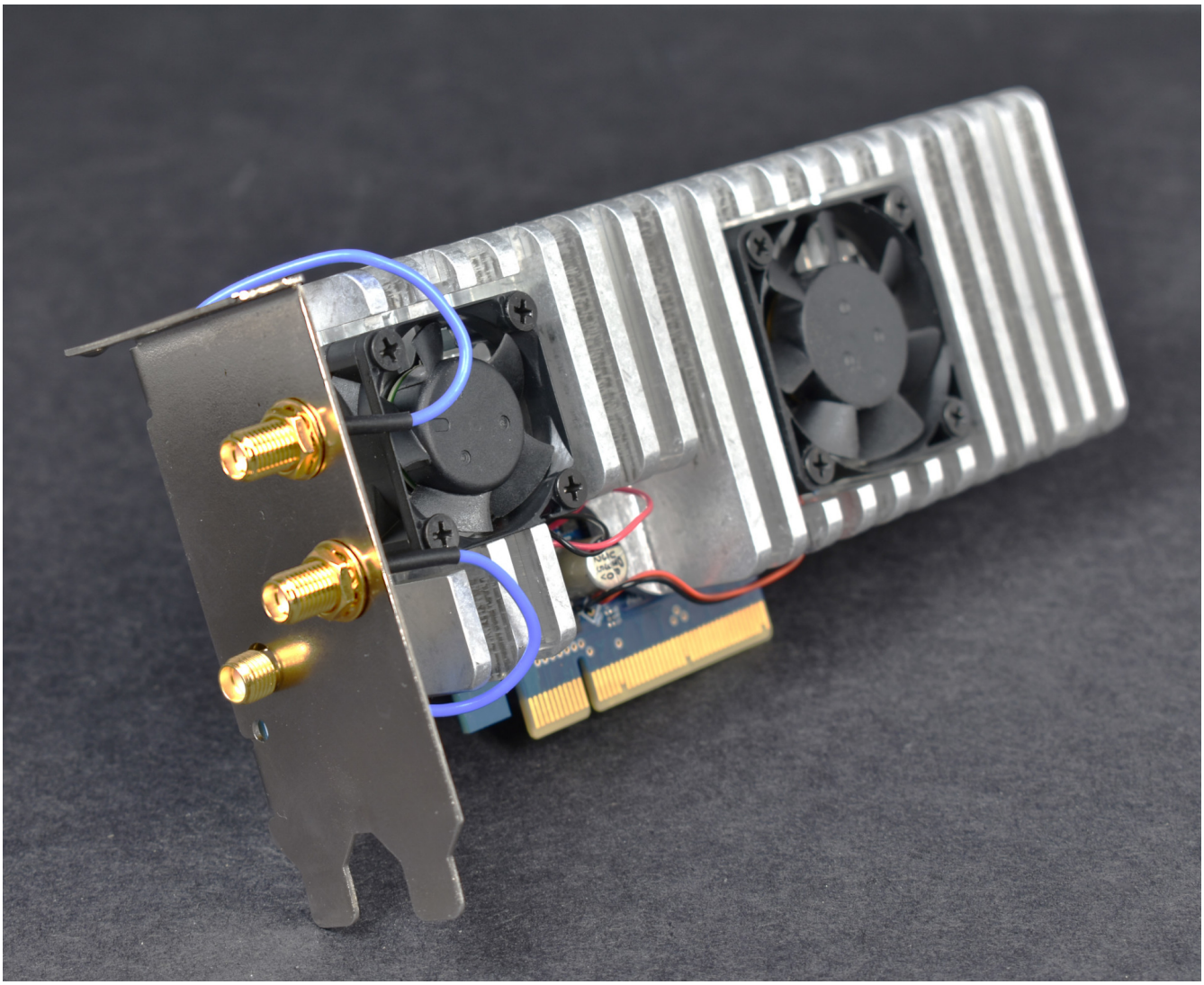


Description

The RFx is a multichannel RF tuner and digitizer on a low-profile, low-SWaP PCIe 3.0 board. It has two RF analog tuners with multiple digital tuners per RF input. Each RF tuner provides a 125 MHz

complex baseband signal, downconverted from a 0.4–6.0 GHz signal. The baseband signal is digitized by a 14- or 16-bit ADC and processed by a Xilinx Kintex 7 FPGA (options available) which implements automatic gain control (AGC), DC removal, adaptive I/Q balancing, and a bank of digital tuners. Complex data from the digital tuners can be streamed directly or packetized in VITA-49 Radio Transport (VRT) format for downstream processing. Local oscillators and sample clocks are locked to a 10 MHz reference (internal or external).

Features

- 2 RF inputs
- Complex signal bandwidths up to 125 MHz
- Wideband frequency range, 0.4—6.0 GHz
- 14- or 16-bit ADC (one per RF input)
- Xilinx Kintex 7 FPGA with digital tuners
- Automatic gain control (AGC)
- DC removal
- Adaptive I/Q balance processing
- I/Q and VITA-49 Radio Transport (VRT) output formats
- Synchronized output for antenna diversity
- Reference I/O (10 MHz, 1 pps)

Applications

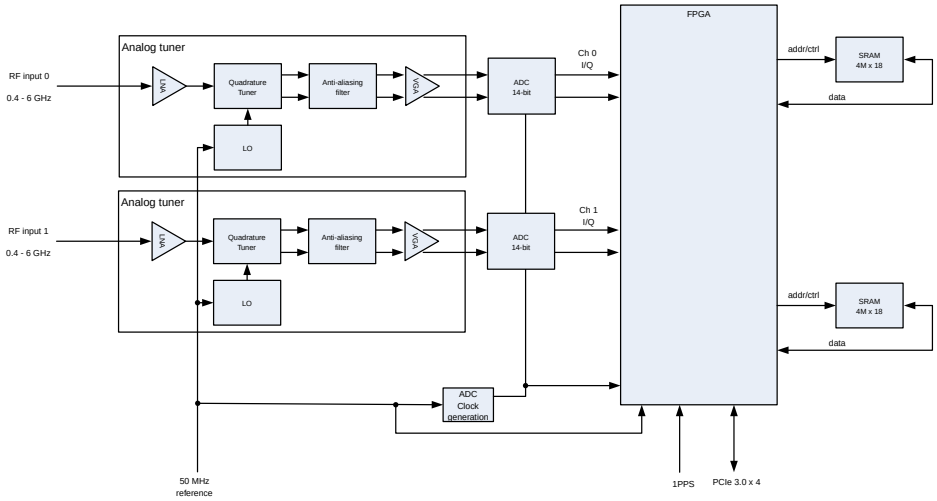
- Signal surveillance
- Wideband signal acquisition and analysis
- Software-defined radio

Specifications

Data Formats	RF input with I/Q and VITA-49 Radio Transport (VRT) output	
RF Tuner Options	ADC	14 or optional 16 bits
	FPGA	Xilinx Kintex 7 XC7K160T or optional 410T
RF Tuner Parameters	Maximum input power without damage	13 dBm
	Input frequency range	0.4—6.0 GHz
	Input impedance	50 Ω
	NF	< 6.0 dB (typical)
	VSWR	< 1.7:1 (typical)
	IIP3	≥ 6.0 dBm*† with 10 MHz tone spacing
	P1dB	> -9.0 dBm† (typical)
	IMD2 / IMD3	≥ 50.0 / 40.0 dBc*
	Image rejection ratio	> 50.0 dB (typical)*
	SFDR	≥ 50.0 dBc* (AGC on)
	* Over input frequency range; for frequency-dependent details, see the typical performance characteristics on the following pages.	
	† AGC off; AGC on enables higher values.	
Radio Interfaces	2 RF Inputs	SMA
Other Interfaces	10 MHz reference I/O	SMA or U.FL
	1 pps I/O	U.FL
Power	Input voltage range	12 VDC
	Consumption	14W when idle, 23.5W when running
Physical	Weight	1.25 lbs (20 ounces).
	Dimensions	6.98" x 2.71" x 1.15" (including connectors)
Environmental	Temperature (operating / non-operating)	0° to 55° C / -40° to 70° C (ambient)
	Humidity (operating / non-operating)	1% to 90%, non-condensing at 40° C
Software	SoapySDR plugin, GNURadio source block and example GNURadio Companion flowgraphs	

Diagrams

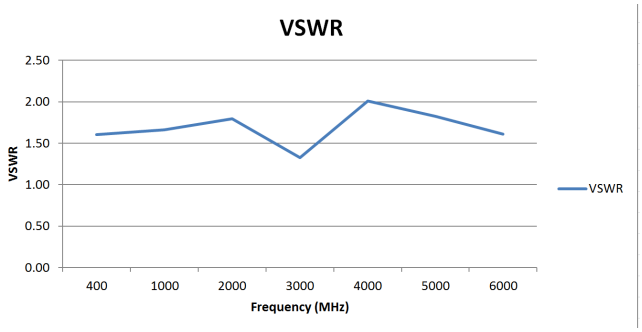
RFx (simplified)



Typical Performance Characteristics

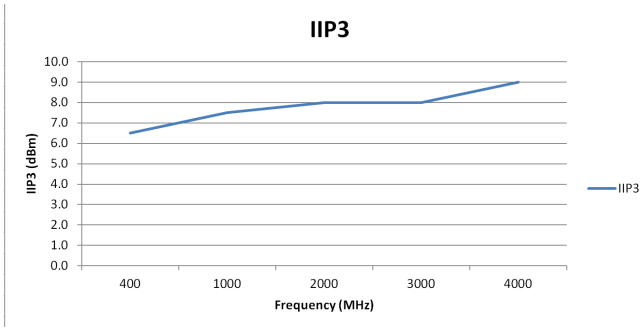
VSWR

Test conditions: Manual gain set to 0 dB.



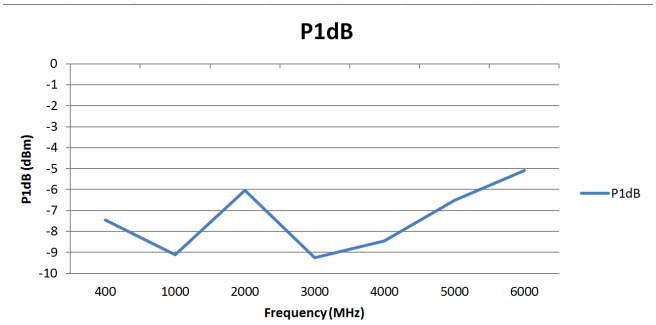
IIP3

Test conditions: 10 MHz tone spacing; manual gain set to 0 dB.



P1dB

Test conditions: Manual gain set to 0 dB.



IMD2 / IMD3

Test conditions: Test tone level set to -20 dBm; manual gain set to 0 dB.