High Linearity Wideband RF-to-Digital Transceiver
RF-7902

Features

- Integrated RF and Digital IF Processing in a single 3U OpenVPX slot
- High linearity, wideband RF Transceiver, 200 MHz to 2.7 GHz
- 14-bit ADC 490 MSPS, 16-bit DAC 980 MSPS
- Fast-frequency hopping up to 3000 hops/sec
- Up to 170 MHz Receiver analog bandwidth
- Up to 400 MHz Transmitter analog bandwidth
- Xilinx Virtex-5 SX95T-2 User FPGA for flexible IF signal processing
- High-speed serial connection to host processor
- Software drivers and API, FPGA interface libraries, and example code included
- Digital Down Converter (DDC) and Digital Up Converter (DUC) IP included
- Rugged conduction- or air-cooled form factors available
- Designed to operate with host SBC, VPX-1131, VPX-1151, and VPX-8320 as part of Spectrum’s SDR-7000 family
- Not subject to US ITAR control

Applications

- Wideband Datalinks (eg. UAV, UGV, USV)
- Ground Mobile Communications
- Air-to-Ground Communications
- Communications Electronic Warfare
- SIGINT – COMINT/ELINT
- Satellite Ground Terminals
- Cognitive Radio
- Software Defined Radio (SDR) and Waveform Development

RF-7902 RF-to-Digital Transceiver
System Block Diagram

www.spectrumsignal.com
Fig. 1. Local Oscillator phase noise at 1 GHz (typical).

Fig. 2. Noise figure versus RF frequency using a QAM 16 signal (typical).

Fig. 2. SFDR versus RF frequency, 170 MHz bandwidth, input power -20 dBm and -30 dBm (typical).

Fig. 3. IIP3 versus RF frequency, input power -20 dBm (typical).

Fig. 4. SNR versus Input Power with 850 MHz RF input frequency attenuator step 4 dB over 0 to 76 dB LO (typical). SNR measured using a QAM 16 signal at 546,875 symbols per second using EVM.

Fig. 6. Adjacent Channel Leakage Ratio (ACLR) at 800 MHz, 5 MHz bandwidth NPR signal, output power -1 dBm, 12dB PAPR backoff in DAC (typical).
### Specifications

| [general] | **RF-to-Digital Transceiver** | Single channel full-duplex RF transceiver with Xilinx Virtex-5 FPGA
|          | **Form Factor** | 3U OpenVPX (VITA 65) Module
|          | **Compatible with Module Profiles** | MOD3-PAY-1D-16.2.6-1, MOD3-PAY-1D-16.2.6-2, MOD3-PAY-2F-16.2.7-1, and MOD3-PAY-2F-16.2.7-2. For other module profiles, please contact Spectrum. |
| [RF - Receiver] | **Receiver Type** | Digitizing single-conversion superheterodyne
|          | **Input Frequency Range** | 200 MHz to 2.7 GHz
|          | **Internal Analog IF Frequency** | User programmable from 20 MHz to 190 MHz
|          | **Internal Analog IF Filtering** | 170 MHz LPF (BPF and other options, contact Spectrum)
|          | **Analog Bandwidth** | 170 MHz standard, narrower bandwidth available
|          | **Frequency Switching Time** | 20 µs (dual switching synthesizer)
|          | **Maximum Hop Rate** | 3,000 hops/sec with 10:1 dwell-to-tune time ratio
|          | **Analog Frequency Step** | 400 kHz, smaller step sizes achieved digitally
|          | **Maximum RF Input Power Level** | -10 dBm
|          | **IIP3** | +10 dBm between 300 to 2700 MHz, +5 dBm between 200 to 300 MHz, two tone -20 dBm input power, gain adjusted for -1dBFS
|          | **Gain Adjustment** | 78.75 dB adjustment range in 0.5 dB steps
|          | **Noise Figure** | 2.8 dB at full gain at 800 MHz RF with image rejection filter
|          | **LO SSB Phase Noise @ 1 GHz** | -86 dBc/Hz @ 100 Hz offset
|          | **Spurious Free Dynamic Range (SFDR)** | 75 dBc (typical) @ 1 GHz RF, 70 MHz IF, 10 MHz BW, input power -20 dBm
|          | **Noise Floor** | -140 dBm/Hz measured at 805 MHz in presence of a full power output CW signal at 850 MHz
|          | **Adjacent Channel Leakage Ratio** | -65 dBc at full output power, 850 MHz, 5 MHz bandwidth NPR signal
|          | **Non-Harmonic Output Spurious** | -60 dBc at 1.4 GHz at maximum power level
|          | **Internal Reference Oscillator** | 10 MHz, +/- 2.0 ppm @ room temp
|          | **Internal A/D Conversion** | Intersil ISLA214P50 14 bit at 490 MSPS
|          | **Image Rejection** | User-supplied external filter. Contact Spectrum for custom filtering.
| [RF - Transmitter] | **Transmitter Type** | Direct Up-Conversion
|          | **Output Frequency Range** | 200 MHz to 2.7 GHz
|          | **Output Power** | -31 dBm to -3.7 dBm @ 10 dB PAPR, +6.3 dBm CW in 0.5 dB steps
|          | **OIP3** | +30 dBm at 1950 MHz to +32 dBm at 300 MHz at full power
|          | **P1 dB** | +22 dBm at 800 MHz
|          | **Noise Floor** | -140 dBm/Hz measured at 805 MHz in presence of a full power output CW signal at 850 MHz
|          | **Adjacent Channel Leakage Ratio** | -65 dBc at full output power, 850 MHz, 5 MHz bandwidth NPR signal
|          | **Non-Harmonic Output Spurious** | -60 dBc at 1.4 GHz at maximum power level
|          | **Internal D/A Conversion** | Analog Devices AD9122 16 bit interpolating DAC at 980 MSPS
|          | **Internal Baseband Interface** | Zero IF (I/Q) or Complex IF.
|          | **Frequency Switching Time** | 20 µs (dual switching synthesizer)
|          | **Maximum Hop Rate** | 3,000 hops/sec with 10:1 dwell-to-tune time ratio
|          | **Analog Frequency Step** | 400 kHz, smaller step sizes achieved digitally
|          | **Harmonic Rejection** | User-supplied external filter. Contact Spectrum for custom filtering.
| [IF Processing] | **User FPGA** | Virtex-5 SX95T-2 (optional V5LX155T or SX50T). SX95T-2 has 94,208 logic cells, 640 DSP48E slices, and 8,784 kb total BRAM.
|          | **FPGA IP** | DDC and DUC included (user programmable IF bandwidth, IF frequency, and decimation)
|          | **Memory** | 512 MB DDR2 SDRAM.
| [external interfaces] | **Control** | PCIe from host SBC
|          | **Analog Connectors** | 6 SMA, 50-ohm, single-ended (see block diagram)
|          | **Analog GPIO** | 2x 12b 100 kSPS DAC, 2x 12b 100 kSPS ADC. Software support as a future option.
|          | **Trigger/Interrupt Interface** | PCIe
|          | **High-Speed Serial Interfaces** | One PCIe Gen1 x8 from FPGA to PCIe switch (2 GB/s full duplex)
|          | **FPGA Programming** | Programming via JTAG or load from onboard 16 MB Flash
|          | **FPGA Debug** | Debug via JTAG with Xilinx JTAG device
|          | **Digital GPIO** | 8x LVDS pairs, 11x 3.3V LV TTL (5 are 5V tolerant), all via VPX P1/P2 connectors
|          | **Co-Ax GPIO** | Two co-ax single-ended available through the front panel (3.3V, 5V tolerant) (1PPS, IRIG-B, sync, trigger, control)
| [electrical/mechanical] | **Supply Voltage (DC)** | 5V, +12V
|          | **Power Estimate** | 27 W booted. 30 W for full duplex operation.
|          | **Size** | 3U OpenVPX form factor
**environmental**

- Temperature: 0 to +55 degrees C (air-cooled)  
  -40 to +70 degrees C (conduction-cooled)
- Shock and Vibration: Conduction-cooled version: ANSI/VITA 47, Level ECC3
- Conformal coating available on request.
- RoHS: 5 of 6 compliant (Pb solder exemption).
- MTBF: Estimated at >300,000 hours (GB, GC, 30 deg C), per MIL-HDBK-217 FN2
- Parts Count Method, Relex v8.0

**software**

- Application Libraries: quicComm™ Software Development Kit with APIs and examples running on Host SBC  
- Operating System: Green Hills INTEGRITY 11  
- Fedora Linux 14
- Digital Up/Down Converter: FPGA-based DDC and DUC reference design provided featuring polyphase filter with variable bandwidth. User can control IF bandwidth, IF frequency and decimation with software to achieve frequency steps as small as 117 Hz.

**host SBC**

- Freescale QorIQ P3041 CES Creative Electronic Systems RIOV-2473 running Green Hills INTEGRITY 11, with RTM-6240 rear transition module.  
  For more information, visit www.ces.ch.
- Intel i7 Emerson Network Power IVPX7225 running Fedora Linux 14, with IVPX7225-RTM-1 rear transition module.  
  For more information, visit www.emersonnetworkpower.com.
- For other SBCs, please contact Spectrum.

**ordering information**

- 650-00632 RF-7902-CAC-SX95T-2 200-2700MHz Fast Tuning RF-Digital Transceiver  
- 3U OpenVPX

**future options**

- Contact Spectrum Sales for options listed in this section.**  
- User FPGA: V5LX155T or SX50T
- Analog GPIO: Software support for low speed ADC and DAC, e.g., Audio, Analog Control/Sensors
- Internal Analog IF Filtering: 70 MHz BPF, 140 MHz BPF, or custom filtering, contact Spectrum
- High-Speed Serial Interface: Configure 2 bi-directional high-speed serial lanes for SRIO or Aurora
- Multi-board: Coherent operation across multiple RF-7902 modules
- RF Filtering: Contact Spectrum for external filter options
- Self Diagnostics: Built-In-Test (BIT)
- SCA BSP: Software Communications Architecture Board Support Package
- Object Request Broker: CORBA ORB
- Host: Contact Spectrum to discuss alternative host SBCs
- Operating System: Wind River VxWorks

**Notes:**

- Where applicable, RF specifications use a 10 MHz BW, Noise Power Ratio test signal. Contact Spectrum for other plots and specifications.
- Individual specifications on this datasheet are subject to change without notice. Do not specify compliance with this document.