Software-Defined Radio Architectures Can Simplify Your System Design and Standardize Your Radio Platform

Software-defined radio (SDR) provides a reusable and “future proof” radio platform utilizing an RF-to-baseband transceiver and digital processor architecture. SDR can improve system performance, reduce system size, and minimize design risk and time to market by facilitating the use of available production ready hardware and software reference radio designs.

Analog Devices has led the industry in SDR-enabling products, from single-chip integrated programmable wideband transceivers, to high performance components for discrete signal chain designs. And now we have gone a step further by providing our SDR solutions within a complete ecosystem of seamless FPGA connectivity, enabling a rapid prototyping and development environment to simplify radio system design.

This brochure highlights the range and depth of Analog Devices’ software-defined radio technology and design support ecosystem.
**AD9361 Integrated Dual-Channel Wideband Transceiver IC**

The **AD9361** is a high performance, highly integrated RF transceiver IC intended for use in SDR architectures for applications such as wireless communications infrastructure, defense electronics systems, RF test equipment and instrumentation, and general software-defined radio platforms. Its high level of programmability and wideband capability make it ideal for a broad range of transceiver applications. The device combines an RF front end with a flexible mixed-signal baseband section and integrated frequency synthesizers, simplifying design-in by providing a configurable digital interface to a processor or FPGA. The AD9361 chip operates in the 70 MHz to 6 GHz range, covering most licensed and unlicensed bands, and supports channel bandwidths from less than 200 kHz to 56 MHz by changing sample rate, digital filters, and decimation, all programmable within the AD9361 IC.

**IC Features**

- Complete dual-channel integrated wideband transceiver on a single chip
- Tuneable band: 70 MHz to 6.0 GHz; 200 kHz to 56 MHz channel bandwidth
- Superior receiver sensitivity with a noise figure < 2.5 dB
- Highly linear broadband transmitter:
  - Tx EVM: ≤−40 dB
  - Tx noise: ≤−157 dBm/Hz noise floor
  - Tx monitor: ≥66 dB dynamic range with 1 dB accuracy
- Integrated fractional-N synthesizers with 2.5 Hz maximum local oscillator (LO) step size
- Complete integrated power supply solution available: the **ADP5040**

**Applications**

- General-purpose design suitable for any software-designed radio application
- MIMO radio
- Point to point communication systems
- Femtocell/picocell/microcell base stations
- Wi-Fi
- ISM
- Military/aeronautical
- Public safety
- Smart grid

The **AD9361** is ADI's programmable 2 × 2 integrated transceiver solution spanning the 70 MHz to 6.0 GHz band. This flexible high performance IC is featured on the **AD-FMCOMMS2-EBZ** board for seamless connection to a Xilinx FPGA development platform, facilitating rapid SDR prototyping and system development.
AD-FMCOMMS2-EBZ RF Rapid Development Board Incorporating the AD9361 Wideband Transceiver IC

The AD-FMCOMMS2-EBZ rapid development and prototyping board is a high speed analog module incorporating the AD9361, which seamlessly connects to and operates within the Xilinx FPGA development platform ecosystem. This board is a $2 \times 2$ I/Q transceiver configuration, which is fully customizable by software. It comes with downloadable Linux drivers and bare metal software drivers, schematics, board layout, and design-aid reference materials on the Analog Devices wiki site.

AD-FMCOMMS-EBZ Software-Defined Radio Rapid Development Board

The AD-FMCOMMS1-EBZ is an analog front end for a wide range of compute intensive FPGA-based radio applications. It contains the latest generation high speed data converter components and RFICs and provides a complete discrete transceiver signal chain. The AD-FMCOMMS1-EBZ provides a hardware platform that addresses a broad range of research, academic, industrial, and defense RF applications over the band of 400 MHz to 4 GHz. The module is customizable to a wide range of frequencies by software without any hardware changes, providing options for GPS or IEEE 1588 synchronization, and MIMO configurations.

Features
- Software tunable across wide frequency range (400 MHz to 4 GHz) with 125 MHz channel bandwidth (250 MSPS ADC, 1 GSPS DAC)
- Phase and frequency synchronization on both transmit and receive paths
- LPC FMC compatible, meets VITA specifications except card length
- Supports MIMO radio, with less than 1 sample sync on both ADC and DAC
- Includes schematics, layout, BOM, HDL, Linux drivers, and application software

www.analog.com
Discrete ICs for Software-Defined Radio Signal Chains

When you have unique SDR requirements, or configurability isn’t essential, ADI has the industry’s largest portfolio of data converters, amplifiers, synthesizers, and other high performance RFICs to meet the needs of the most demanding discrete signal chain designs. Examples of our RF signal chain components include:

**High Speed Data Converters**
- AD9250—dual 14-bit, 250 MSPS ADC with JESD204B serial output interface
- AD9129—14-bit, 5.6 GSps RF DAC with bypassable 2× interpolation

**Clock**
- AD9523—Low jitter clock generator with 14 outputs

**Power Management**
- ADP5040—1.2 A buck regulator and dual 200 mA LDOs
- ADP1755—1.2 A, low Vih, high PSRR LDO
- ADP5052—Quad buck regulator and 200 mA LDO

**PLL**
- ADF4351—wideband synthesizer with integrated VCO

**Power Detector**
- ADL5501—50 MHz to 6 GHz TruPwr™ detector

**Low Noise Amplifier**
- ADL5523—400 MHz to 4000 MHz low noise amplifier

**Transmit Amplifier**
- ADL5602—50 MHz to 4.0 GHz broadband, 20 dB linear amplifier
- ADL5320—400 MHz to 2700 MHz, ¼ W RF driver amplifier
- ADL5604—700 MHz to 2700 MHz, 1 W RF driver amplifier

Typical SDR transceiver block diagram. ADI has discrete solutions for the entire signal chain.

**Online RF Design Support**

Hundreds of reference circuits designed by application experts, addressing your most challenging needs.
- CN0239, Broadband 6 GHz Active Mixer with a Glueless Local Oscillator Interface
- CN0311, Broadband, Low Error Vector Magnitude (EVM) Direct Conversion Transmitter Using LO Divide-by-2 Modulator

ADI’s EngineerZone Support Community helps engineers get answers to technical questions about Analog Devices products and connect with their fellow engineers and experts around the globe.