Analog Devices
Company Introduction
## Analog Devices At A Glance

<table>
<thead>
<tr>
<th>Founded</th>
<th>1965</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headquarters</td>
<td>Norwood, MA</td>
</tr>
<tr>
<td>Employees</td>
<td>~15,000</td>
</tr>
<tr>
<td>Countries</td>
<td>20+</td>
</tr>
<tr>
<td>Products</td>
<td>~45,000 SKUs</td>
</tr>
<tr>
<td>Customers</td>
<td>125,000</td>
</tr>
<tr>
<td>Publicly Listed</td>
<td>NASDAQ:ADI</td>
</tr>
<tr>
<td>Design Centers</td>
<td>~45</td>
</tr>
</tbody>
</table>

### What We Do
- Design, manufacture, and market a broad portfolio of solutions that leverage high performance analog, mixed-signal, and digital signal processing technology, including integrated circuits (ICs), algorithms, software, and subsystems.

### What We Deliver
- Solutions that sense, measure, power, connect, and interpret the world around us.
OUR CUSTOMERS GAIN VALUE THROUGH ANALOG DEVICES’ PERFORMANCE TECHNOLOGY AND EXPERTISE, STRATEGIC ACQUISITIONS, AND ADVANCEMENT FROM SILICON TO SOFTWARE TO CLOUD
DELIVERING INNOVATION THAT KEEPS OUR CUSTOMERS AHEAD OF WHAT’S POSSIBLE
Design and Support Resources

Accelerate Our Customer’s Journey from Research to Production

► Connecting the stages and driving consistency across the customer design journey with software, tools, models, and hardware.

- **Research**
  - Education and selection tools for matching ideas to solutions
  - Online behavioral models to test concepts quickly

- **Evaluate**
  - Common evaluation hardware and software
  - Evaluation platforms and development platforms

- **Design**
  - Online and downloadable design tools
  - Adoption of industry standards, such as Arduino, for ease of prototyping and reference designs

- **Production**
  - Online customer support
  - Communities
  - Forums
  - Wikis

- **Support Resources**
  - LTspice Simulation
  - EngineerZone® support community

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Active Learning Program:
- dedicated to inspiring students to better understand analog real world signals
- Enables integration of technology into course curricula, design and research projects

Support STEM initiatives including FIRST Robotics

Recruit the best and brightest minds
The most important thing in education: TextBooks and Labs

- Dr. Travis Collins
- Robin Getz
- Dr. Alex Wyglinski
- Dr. Di Pu

http://sdrforengineers.com
• United States (145)
• Ireland (33)
• Philippines (30)
• India (26)
• China (16)
• Germany (6)
• Malaysia (6)
• Japan (4)
• Singapore (3)
• Canada (2)
• Taiwan (2)
• Netherlands (1)
• Romania (1)
• Spain (1)
RadioVerse
FROM CHIPS,
TO SOFTWARE,
TO HDL,
TO SYSTEMS
Software Defined Radio is expanding into new applications

- Critical Comms
- Instrumentation
- SDR Portable Analyzers
- Cellular Testers
- Radar
- First Responder
- Drones & Robotics
- Femtocells
- Small Cell/ Picocells
- RRH & DAS
- Macro & Micro
- Repeaters
- Backhaul
- Massive MIMO
- IOT
- Robots!
Challenge

From devices/chips:

To Products:

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Industry/Customer Challenges for Software Defined Radio

- Reducing development time & system cost
- Balancing lower power & higher performance
- Need for higher integration, reliability, re-use and secure solutions
Communications and Radios are hard
Software Defined Radio makes it worse!

s[2\ell N + n] = \frac{1}{2N} \sum_{k=0}^{2N-1} p_k[\ell] e^{j2\pi nk/2N},
► Market Leading Radio Technologies
  - Advanced and innovative RF and mixed-signal solutions targeting applications where robust performance, power consumption, and footprint are critical success metrics.

► Radio Design Environment
  - we provide board support packages, software, tools, reference designs, and modules

► Accessible Expertise
  - support and education with our technical experts
SDR Journey

Research
- Education and selection tools for matching ideas to solutions
- Behavioral models to test concepts quickly
- Make vs buy
  - SOM
  - Partner Hardware
  - Custom Hardware

Evaluate
- Common evaluation hardware and software
- Evaluation platforms
- Development systems
- Prototyping systems
- Integration with industry tools
- Automation with standard test equipment

Design
- Online customer support
- Communities
- Forums
- Wikis
- Advanced tool flows for automatic HDL generation
- HDL reference designs
- Schematics, gerbers

Production
- Test procedures for ADI platforms
- Connectivity to test equipment
- Videos, and descriptions of board tests
- Modular, pre-tested hardware (SOM)
As developers move, their hardware/software requirements change

Research
- AD9361 Behavioral Simulation
- PlutoSDR Streaming to GNU Radio or IIO Scope

Algorithm Development
- GNU Radio / Python reference implementation
- Hardware streaming

Design Elaboration
- GNU Radio C++ modeling
- Simulink modeling
- Hardware streaming
- Data type conversion

Prototype
- Deployment to development board
- Design optimization
- HDL Integration
- Driver Integration

Production
- Deployment to custom hardware
- Validation with complete hardware solution

PlutoSDR
Streams over USB
Includes: Host Libraries (libiio, libad9361-iio), GUI Software, GNU Radio and MATLAB application interfaces

RFSoM+FMC Carrier or Eval FMC + FPGA Carrier
Streams over USB/Ethernet, allows access to FPGA and local CPU (standalone operation), blue wire to HW
Includes above plus: Device Drivers, HDL interfaces, HDL libraries, Schematics, Gerber

PackRF or RFSoM + Custom Carrier
Prototype field testing, trials or bake off
Includes above plus standard peripheral access (screen, battery, GPS, PoE, Audio, etc)

Custom
Does whatever you want
Could include one or more or none of ADI: Host Libraries, GUI Software, Device Libraries, Device Drivers, HDL, Schematics, Gerber
RadioVerse Evaluation and Prototyping Hardware

**AD-FMCOMMS2**
- **AD9361**
- 2 x Rx, 2 x Tx
- Tuning range: 2.2 GHz – 2.6 GHz
- 70 MHz – 6 GHz
- 200 kHz – 56 MHz channel bandwidth

**AD-FMCOMMS3**
- **AD9364**
- 1 x Rx, 1 x Tx
- 70 MHz – 6 GHz tuning range
- 200 kHz – 56 MHz channel bandwidth
- Shipping Now!

**ARRADIO**
- **AD9361**
- HSMC, not FMC
- 2 x Rx, 2 x Tx
- 2.2 GHz – 2.6 GHz tuning range
- 200 kHz – 56 MHz channel bandwidth
- Shipping Now!

**AD-FMCOMMS4**
- **AD9364**
- 1 x Rx, 1 x Tx
- 70 MHz – 6 GHz tuning range
- 200 kHz – 56 MHz channel bandwidth
- Shipping Now!

**AD-FMCOMMS5**
- **AD9361**
- 4 x Rx, 4 x Tx
- Synchronized RF
- 70 MHz – 6 GHz tuning range
- 200 kHz – 56 MHz channel bandwidth
- Shipping Now!

**ADRV9371-N/PCBZ**
- **AD9371**
- 2 x Rx, 2 x Tx, 2 x Obs, 1 x Sniffer
- Tuning range: 1.8 GHz – 2.6 GHz
- 300 MHz – 6 GHz
- Tx synthesis bandwidth 250 MHz
- Rx BW: 8 MHz to 100 MHz
- DPD actuator and adaptation engine for PA linearization

**ADRV9375-N/PCBZ**
- **AD9375**
- 2 x Rx, 2 x Tx, 2 x Obs, 1 x Sniffer
- Tuning range: 75 MHz - 6 GHz tuning range
- Tx synthesis bandwidth 450 MHz
- Rx BW to 200 MHz

**PACKRF**
- **ADRV9361** reference design
- Battery, PoE, Screen, Audio, GPS, IMU
- 70 MHz – 6 GHz tuning range
- 200 kHz – 56 MHz channel bandwidth
- 1 GB DDR + 32 MB FLASH
- Ethernet + USB Phy

**ADRV-DPD1**
- **AD9375** + 250 mW PA
- 2 Rx, 2 Tx
- LTE Band 7
- 2500 to 2570 Uplink
- 2620 to 2690 MHz Downlink
- 2 PA’s, 2 LNAs, duplex filters

**ADRV9009-ZU11EG**
- 2 x **ADRV9009** + Zynq Ultrascale
- 75 MHz to 6 GHz tuning range
- Rx BW 200 MHz
- Tx synthesis bandwidth 450 MHz
- Integrated LO and Phase synch between all channels and Modules
- 4G x4 w/ECC PS; 4G (2Gb x32 x2 Banks) PL
- USB3, USB2, PCIe 3.0 x8, QSFP+, SFP+, 1Gb Ethernet x2, and CPRI

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RF System-On-Module(ADR9009-ZU11EG)

**Tuning Range:** 75 MHz to 6 GHz

**Bandwidth:** 200 MHz Receiver,
450 MHz Transmitter and Observation Receiver

**Functionality:**
- Two Tx, Two Rx/Orx (shared channels)
- Shared LO (TDD only)
- Quad Core A53 ARM
- 600k system logic cells
- 2,520 DSP Slices
- 4G x64 w/ECC PS; 4G (2Gb x32 x2Banks) PL
- USB3, USB2, PCIe 3.0 x8, QSFP+, SFP+, 1Gb Ethernet x2, and CPRI

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AD-FMCOMMS11-EBZ

► Description
- The AD-FMCOMMS11-EBZ board is a system platform board for Direct to RF (DRF) transmitter and observation receiver architecture.
- Using high sample rate RFDAC(s) and RFADC(s), a number of components in previous generation upconvert and down convert stages can be eliminated, such as mixers, modulators, IF amplifiers and filters.

► Features & Specifications
- 650-4GHz RF Synthesis and Observation Platform (low end limited by RF transformer)
  - Direct RF Synthesis Transmitter (AD9162)
    - 16-bit, 10.2GSPS RFDAC JESD204B interface
    - 100 MHz TO 4000 MHz RF/IF Digitally Controlled VGA (ADL5240) and a gain 31dB
  - Direct RF Sampling Observation Receiver (AD9625)
    - 12-bit 2.5GSPS RFADC JESD204B interface
    - Digital Attenuator (HMC1119) up to 31.75dB
    - 60dBc SFDR up to 3.6GHz
- No external clocking sources or power necessary
- Designed to work with FMC Compatible FPGA Platforms from Xilinx and Altera

► Source Code & Software
- Linux Drivers
- HDL Code
- ADI IIO Oscilloscope
- JESD204B Interface Framework

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Projects are not bespoke

bespoke /beˈspōk/: made to order

Infrastructure

- GNU Radio
- MATLAB
- JESD204 Interface Framework
- Python
- SPICE
- No-OS Drivers
- Linux Kernel
- Base HDL

Projects

- ADALM-PLUTO
- ADALM2000
- ADRV9009
- FMCOMMS5
- PACKRF
- FMCOMMS2
- FMCOMMS4

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# Resources reach across market verticals

### Technology

<table>
<thead>
<tr>
<th>Comms Infrastructure</th>
<th>Military Applications</th>
<th>Wireless Video Transmission</th>
<th>SDR</th>
<th>IoT End Node, IoT Gateway</th>
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<tbody>
<tr>
<td>AD9361</td>
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### EVB & Tools


### ADI Reference Designs

- ADRV-DPQ Small Cell Radio Reference Design
- ADRV9361, ADRV9364, ADRV9008 SOM
- ADRV9361, ADRV9364, ADRV9009 SOM
- ADRM-PLUTO

### Partners

- Benetel, NXP, Skyworks, HJX, Ettus/NI, Nanosemi
- Epiq, Ettus/NI, Vadatech, Panateq
- SIHID, Simpulse, Taisync, Lingwo
- Epiq, Ettus/NI, Vantec, HJX, Simpulse, Arrow, Panateq, Rincon
- Simpulse, Vantec

### 3rd Party COTS Products

- Ettus B200/210, B200mini, N300/300, NI USRP 2900/2901
- Epiq Sidekiq / Matchstiq / Quadratiq / Maveriq / Flying Fox
- Ettus N300/300, E320/320/322/323, B200/210/200mini
- Vadatech AMC597/VPX597/ FMC214
- 4 wireless video/data link solutions based on AD936x
- Arrow ARRadio
- Epiq Sidekiq Z2 / MiniPCIe / M.2 / X2 / X4
- Ettus N300/300, E320/320/322/323, B200/210/200mini, NI USRP 2900/2901
- Vantec vPrism, vChameleon
Wideband Transceivers in the Real World

Sidekiq X4
- Dual ADRV9009
- FMC

Sidekiq Z2
- AD9364
- +
- Linux computer
- MiniPCIe

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Sidekiq Z2 – An Integrated Wideband Transceiver System

- Complete dual-core Linux computer + flexible RF transceiver on a MiniPCIe card.
  - Similar in function to ADALM-PLUTO.
  - Enhancements include: RF filtering, industrial rated components, 1PPM TCVCXO, dual-core processor, full 70MHz to 6GHz tuning range

- Capable of running Epiq’s suite of signal processing applications locally
  - RF spectrum analyzer
  - Cell tower survey
  - Cell phone activity detection
  - Point-to-Point data link
Sidekiq Z2 Evaluation Kit

Sidekiq Z2

Simple Carrier Card
• SMA x 2,
• USB-C
• power input (6V-17V DC)

I/O Breakout Board
• JTAG
• serial console
• GPIO access

Supported by Analog Devices' IIO open source software/FPGA reference design

Epiq Solutions
www.epiqsolutions.com
sales@epiqsolutions.com

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Sidekiq X4

- VITA57.1 (FMC) Card
- Based on dual Analog Devices' ADRV9009 RFIC
- SSMC (convection cooled) or MMCX (conduction cooled) connector interface
- **Rx**
  - Two Phase coherent Rx pairs (75 MHz to 6 GHz) with phase sync
  - <8 dB target NF and > +8 dBm target IIP3
  - 16-bit A/D converters, up to 200 MHz BW
  - Phase noise improved by another ~5-7 dB
  - Rx pre-select filtering
- **Tx**
  - Two phase coherent Tx pairs (75 MHz to 6 GHz) with phase sync
  - +5 dBm Tx output power
  - 14-bit D/A converters, up to 200 MHz BW
  - Phase noise improved by another ~5-7 dB over current Sidekiq X2
- 10 MHz + PPS input
Solution

► Devices
► HDL
► Software, drivers, libraries
► Simulation,

► Tool Integration
► Schematics, Gerbers
► System on Module
► Partners

To Products:
Thanks
Community

Connect with Engineering Experts and Resources

Access exclusive content to stay informed.

► Get support from ADI engineers covering nearly 100 forums
► Read one of our engaging blogs

► Read the technical journal 25,000 engineers rely on

► Subscribe to get alerts and news delivered to your inbox
Workshops

► Introduction to the ADALM-PLUTO SDR, Linux’s IIO, and Open-Source Toolchains
  - This workshop will provide a thorough and practical introduction to the AD9361, the ADALM-PLUTO SDR, and other IIO based hardware and the open-source software toolchain (IIO utils and GNU Radio).
  - Hands on, bring your own laptop
  - Register with Eventbright

► Systems Programming on the IIO based radios within the IIO Framework
  - In this workshop, we will demonstrate how IIO can be leveraged to control FPGA IP through a remote host PC and locally on an embedded system.
  - Laptops provided
  - Register with Eventbright

► Location:
  - Sierra A+B
  - Tuesday: 15:45 - 17:30
  - Wednesday: 12:45 - 15:15