Nutaq
ZeptoSDR

Zynq-based, Agile SDR Solution

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Nutaq **ZeptoSDR**

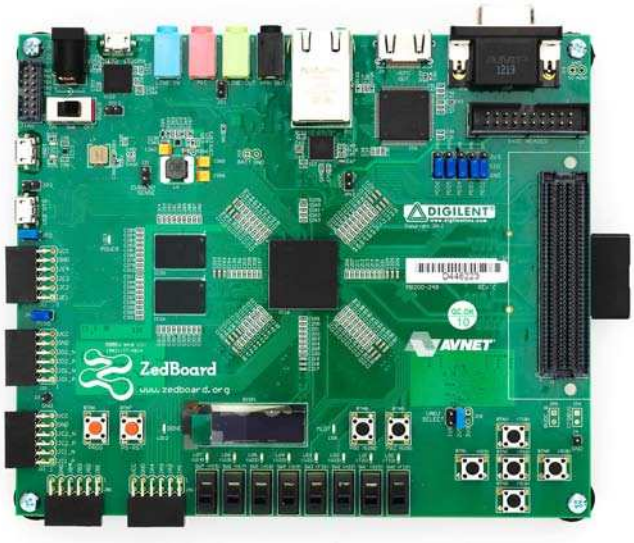
Nutaq's ZeptoSDR is a fully packaged, agile SDR solution comprised of the Zynq-based Zedboard and the Nutaq Radio420S, which also supports GNU Radio.

The ZeptoSDR is for developers who want to:

- Develop a complete software defined radio solution, targeting the UHF Band.
- Utilize a powerful yet low power Zynq-based Zedboard solution.
- Shorten external-to-embedded host migration time using Nutaq's identical APIs.
- Use a high performance, shielded radio to target a wide frequency range.
- Accelerate their development cycle using the GNU Radio development environment.
- Achieve accuracy and time savings provided by an auto-calibrated radio solution.
- Utilize a robust, packaged, air-cooled portable SDR system.
- Benefit from collaborative development with the Zedboard and GNU Radio communities.

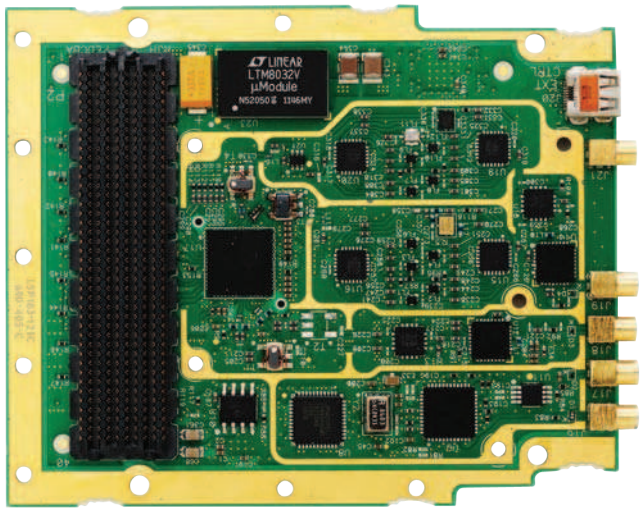
What's Inside

ZedBoard



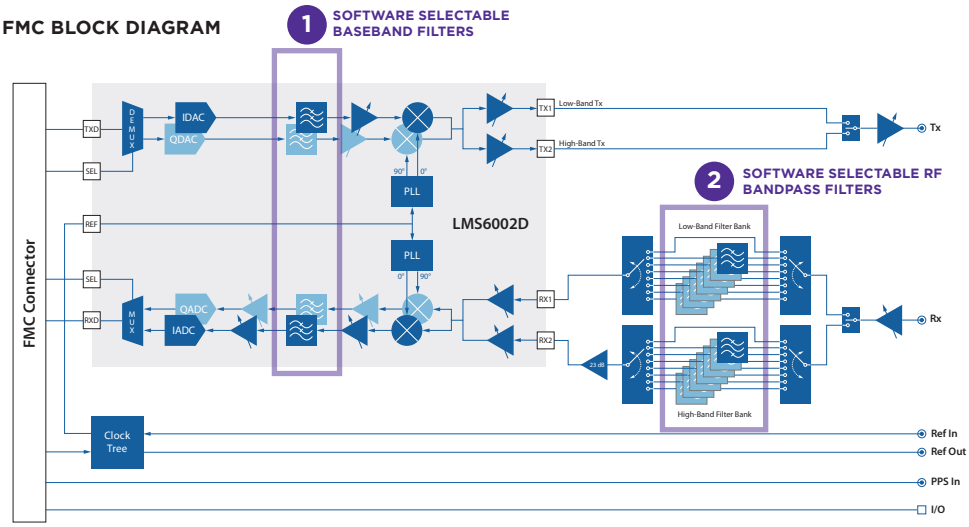
Zedboard Baseboard

Nutaq

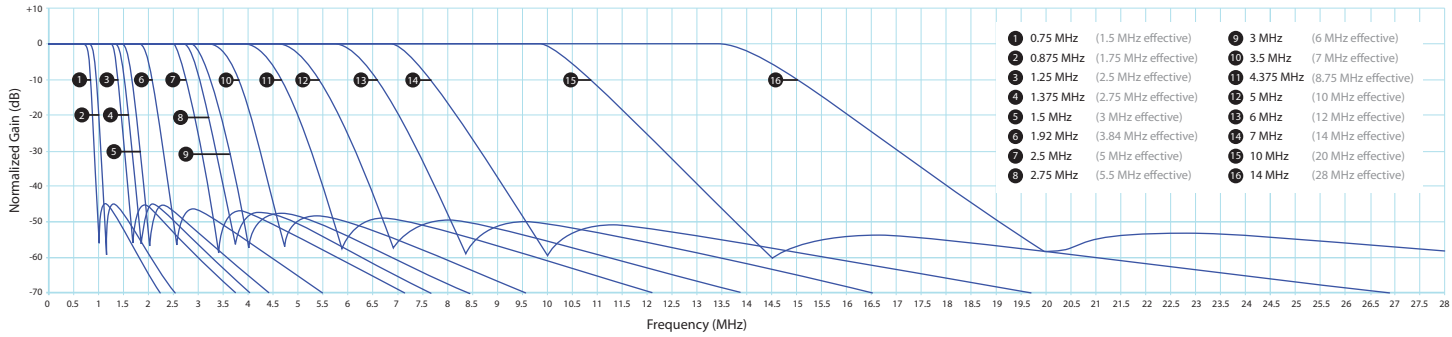


Radio420S FMC

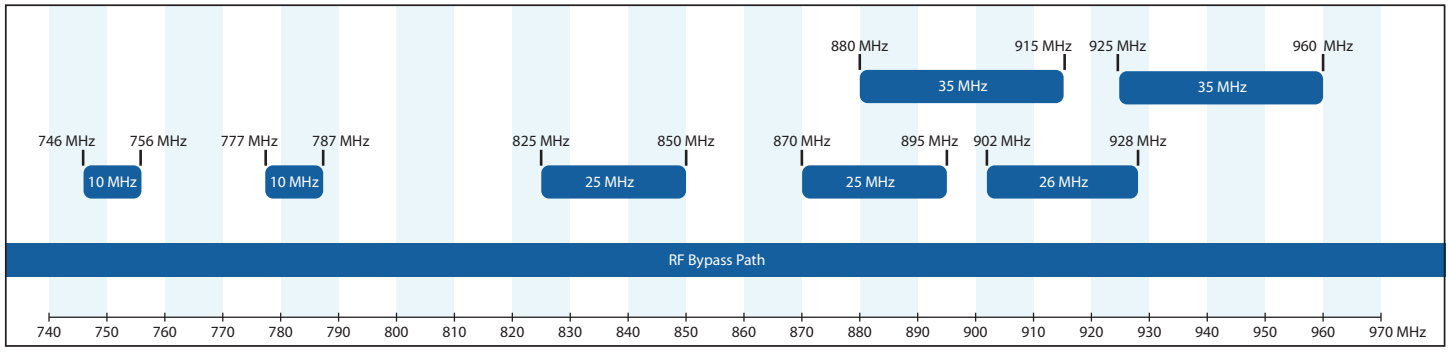
RADIO420S FMC BLOCK DIAGRAM

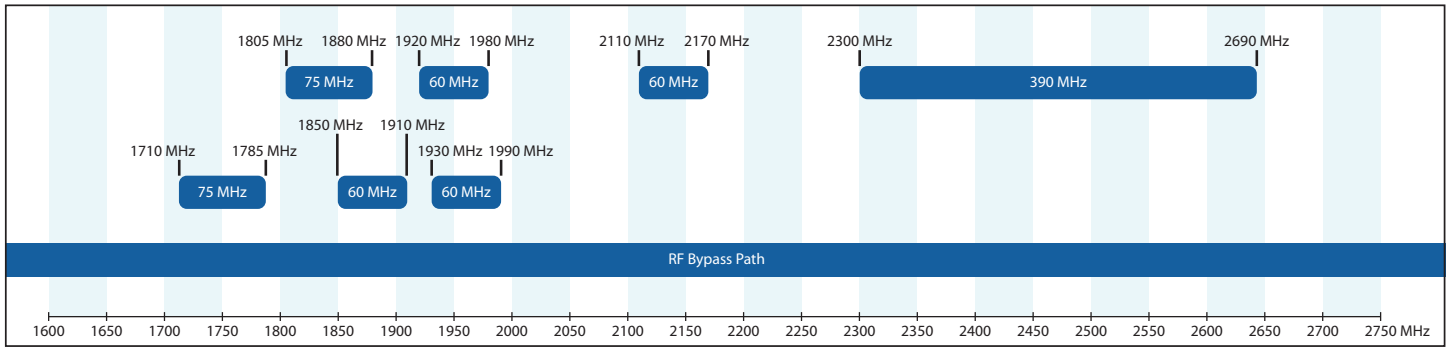


1 SOFTWARE SELECTABLE BASEBAND FILTERS



2 SOFTWARE SELECTABLE RF BANDPASS FILTERS





Radio420S FMC

Nutaq's Radio420S is an FMC card that gives waveform developers agile control over their RF interface by enabling them to:

- Tune the frequency: Wide range from 300MHz to 3.8GHz.
- Avoid interference: 14 selectable RF bandpass filters.
- Isolate the band of interest: Selectable baseband bandwidth from 1.5 to 28 MHz.
- Achieve high quality SNR: Shielded, auto-calibrated radio.

Radio420S FMC Highlights

- Wide frequency range : 300MHz – 3.8 GHz
- Software selectable baseband bandwidth: 1.5 – 28.0 MHz
- Software selectable RF bandpass filters (for standard wireless applications) or full-bandwidth bypass option
- Maximum output power: 10 dBm
- Input sensitivity: –103 dBm (<1.5 GHz), –90 dBm (>1.5 GHz)
- Software programmable Tx/Rx analog dynamic range: 70 dB
- Separate Tx and Rx antennas on the front panel
- Independent Tx/Rx path for FDD/TDD modes
- Selectable clock reference input: Internal or external (via front panel)
- Equipped with an onboard, low-jitter reference clock, cross-point switch, and synchronization PLL
- Front panel I/O expander for external control (such as interfacing with an external Tx PA)
- Shielded for noise immunity

Radio420S FMC Performance

Transmitter

- RF range (-3dB):
  - Low band: 300-1600 MHz
  - High band: 1500-3800 MHz
- Frequency resolution: 2.4 Hz
- PLL settling time (50 kHz bandwidth): 20Qs (excluding programming time)
- Wideband noise floor: -124 dBc/Hz
- Output: IMD3: -60 dBc
- Spur:
  - Inband: -100 dBc
  - Adjacent channel: -60 dBc
- Total gain control: 70 dB
- P1 db output:
  - Low band: 10 dBm (typical)
  - High band: 5 dBm (typical)
- Carrier suppression: -50 dBc (typical)
- Sideband suppression: -45 dBc
- Output impedance: 50 ff

Receiver

- RF range (-3dB):
  - Low band: 300-1600 MHz
  - High band: 1500-3800 MHz
- PLL settling time (50 kHz loop bandwidth, 1 ppm): 20Qs (excluding programming time)
- Wideband noise floor: -100 dBFS
- Sensitivity (SNR=5 dB and bandwidth=200 kHz):
  - Low band: -103 dBm
  - High band: -90 dBm
- Rx gain control:
  - Low band: 79 dB
  - High band: 73 dB
- Absolute maximum input power: -13 dBm
- Wideband gain rolloff:
  - Low band: 8 dBm (typical)
  - High band: 10 dBm (typical)
- IMD3:
  - Low band: -61 dBc to -56 dBc
  - High band: -50 dBc to -45 dBc
- SFDR: 50 dBc
- Input impedance: 50 Ω

Zedboard Baseboard: Zynq-7020 All Programmable SOC

Waveform developers using the ZeptoSDR have access to the many benefits offered by the tightly coupled dual core ARM Cortex-A9 and the Artix-7 series FPGA on the Zynq-7020, which will allow them to:

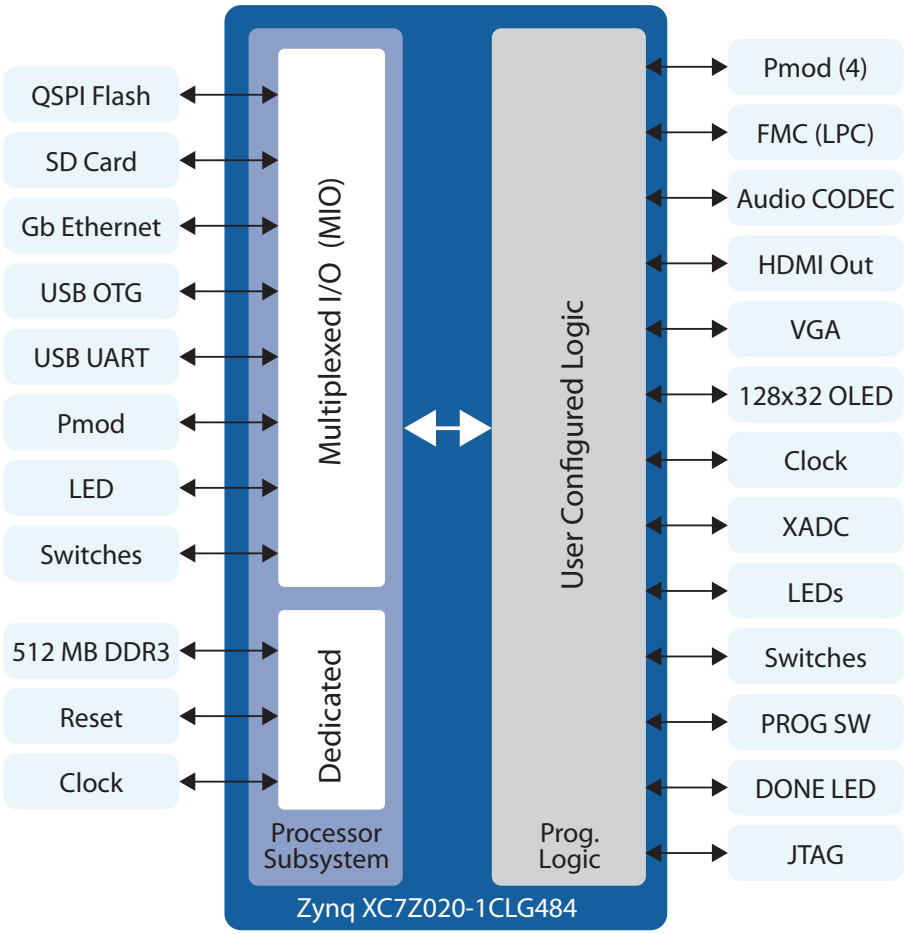
- Target the Xilinx Artix-7 FPGA for intensive processing such as down-conversion, up-conversion, and other PHY layer elements such as OFDM.
- Target The SoC's Dual Core ARM Cortex-A9 for the upper protocol layers.
- Exceed the performance of a discrete FPGA-processor solution, achieving higher bandwidth with lower latency.

For those intending to use the Zynq-7000 series for deployment purposes, the Zynq enables low cost, low power solutions which will ultimately yield a cheaper BOM cost and faster NRE cycles.

Specifications

- Xilinx XC7Z020-1CLG484
  - Includes Dual Arm Cortex-A9, up to 667 MHz
  - Includes Xilinx Artix-7 (85K Logic Cells; 276 GMACs; 220 Programmable DSP Slices)
- 512 MB DDR3, 226 Mb Quad SPI Flash
- 4GB SD Card included
- 1x GigE
- 1x USB OTG, 1x USB UART
- FMC LPC
- HDMI, VGA, 128x32 OLED
- Slide switches, Push button switches
- Audio I/O CODEC (line in/out, headphone, Mic)
- Xilinx XADC header
- Debug JTAG/DAP
- Combines the Xilinx Zynq with Nutaq's Linux embedded OS framework
- Supports GigE access from remote Linux/Windows PC

ZEDBOARD BASEBOARD: BLOCK DIAGRAM



Software Key – Features

Nutaq Board Support Development Kit (BSDK)

Nutaq's BSDK is a suite of tools which significantly reduces the time spent on low value-added tasks such as programming interfaces, adjusting FPGA constraints, debugging Host drivers, etc.

The suite includes:

- Radio logic interfaces (in the Artix-7) and calibration routines (in the ARM Cortex-A9)
- Development frameworks
- Identical external and embedded APIs
- CCE (Communication Control Engine) Application that interprets API calls from the host and maps them to the associated embedded API calls.
- Linux external host drivers
- Real Time Data Exchange (RTDEx), which is an efficient Linux based data-streaming API between the external host and the ARM Cortex-A9
- Application examples

GNU Radio Embedded Demos

- SISO QAM 64 OFDM Wireless HD Video TRX
- Embedded GNU Radio on Zynq ARM-9
- Remote Gnu Radio examples
- Dynamic radio configuration example
- Wireless audio transceiver example (GMSK)
- Embedded DDS example
- GigE remote streaming example

What's Included

- ZeptoSDR
  - Avnet's Zedboard
  - Nutaq's Radio420S FMC card
- 2x MMCX male to SMA female cables + 2x FRS antennas
- Nutaq GNU Radio Plug-in
- Nutaq BSDK (Board Software Development Kit) software
- Xilinx ISE® WebPACK™ software with a device locked ChipScope license
- 12 V AC/DC power supply
- 4 GB SD Card
- Micro-USB cable
- USB Adapter: Male Micro-B to Female Standard-A
- ZeptoSDR Quick Start Guide
- Zedboard Getting Started Guide

Available OFDM PHY trranceiver reference design

A complete model-based OFDM QAM64 FPGA PHY layer is available for the ZeptoSDR. An FPGA-based OFDM PHY layer is implemented using Xilinx System Generator and mapped on Zynq FPGA. The reference design shows real-time HD wireless video transmission between two transceivers through RF interfaces (2x ZeptoSDR or 1x Loopback). Signal constellation and other parameters are directly accessible from the GNU Radio environment. The Simulink and GNU Radio models are provided as source files. Contact info@nutaq.com

ZeptoSDR GNU Radio Plug-In

GNU Radio

The ZeptoSDR features seamless integration to the GNU Radio model-based design tool, combining a graphical development environment (or Python script commands) and automatic code generation. Using GNU Radio can greatly accelerate the development of applications, shorten the development cycle and reduce project costs.

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2150 Cyrille-Duquet, Quebec City (Quebec) G1N 2G3 CANADA
T. 418-914-7484 | 1-855-914-7484 | F. 418-914-9477
info@nutaq.com