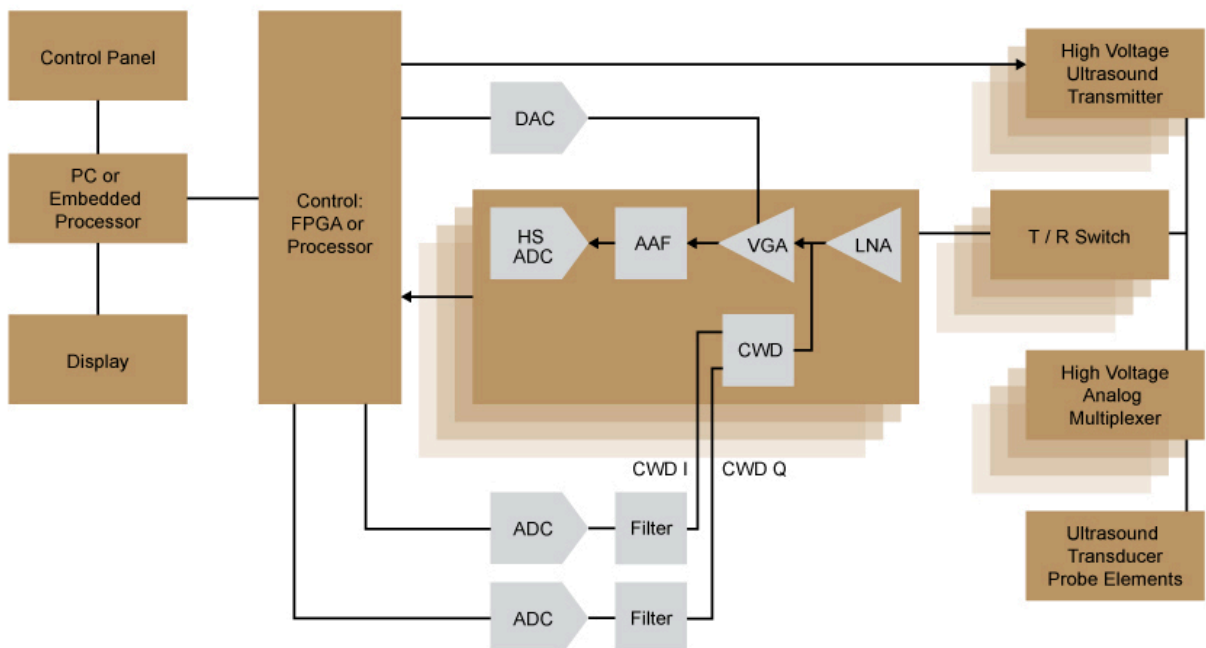


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Requirements & specs

- Price: BOM + PCB + Manufacturing
- Channels
- ADC bits and dynamic range
- ADC
- Total delay: analog + ADC + processing + image formation + transmission + display
- GLOPS
- Power requirement
- Thermal (active or passive cooling)

System Diagrams



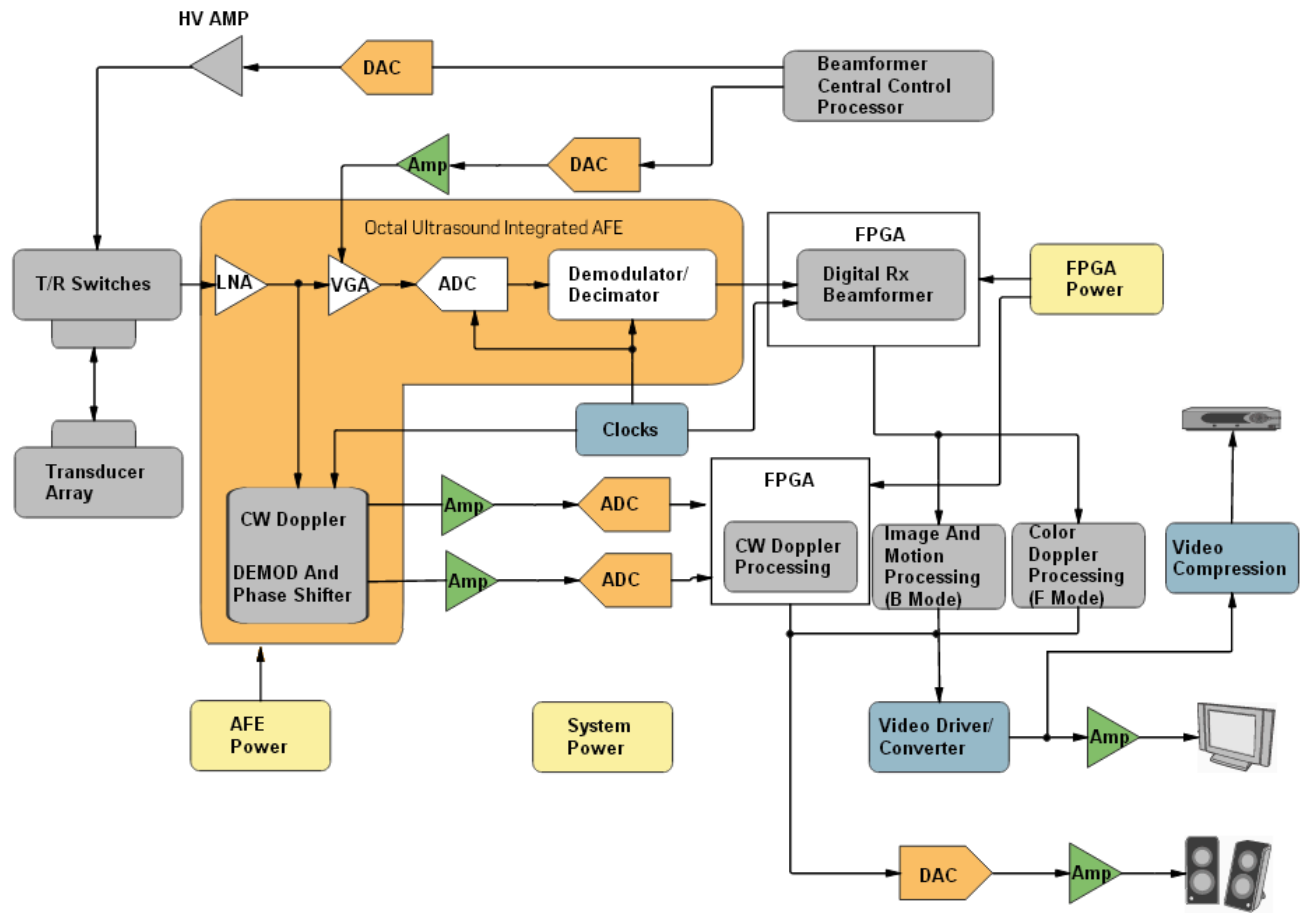
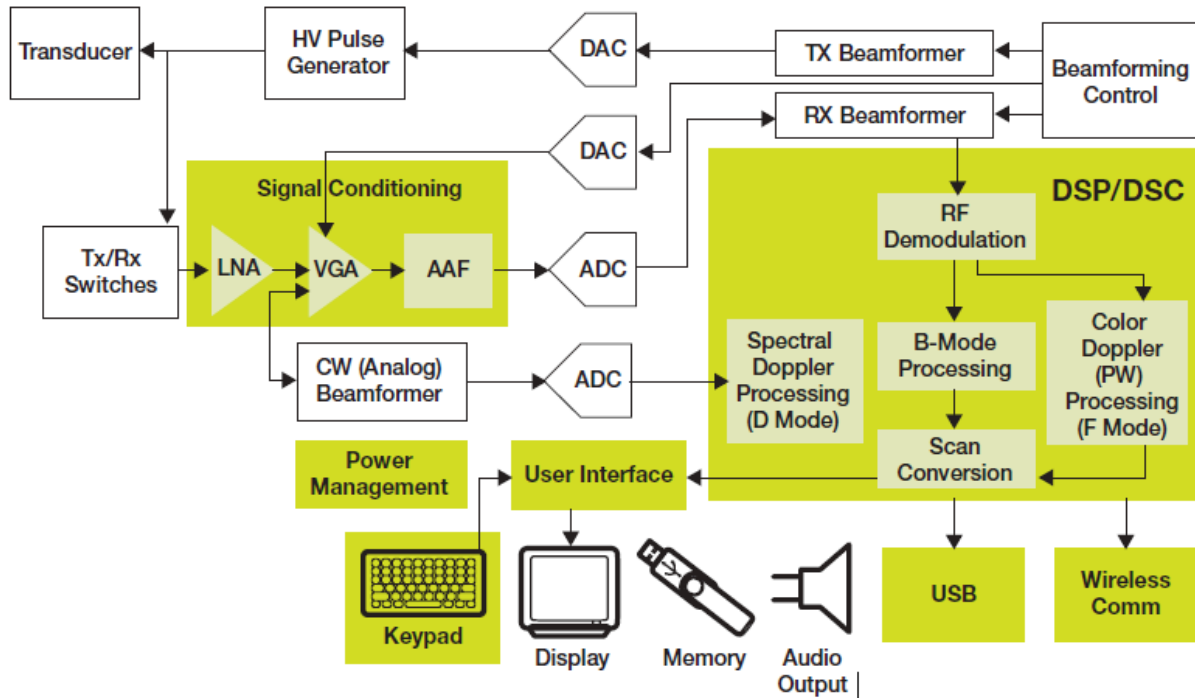


FIGURE 3.2a: ULTRASOUND GENERAL BLOCK DIAGRAM



NXP Technology

Hardware Design

Embedded Computing Platforms

ZYNQ based

Modules

- Links from [Xilinx](#)
- [Trenz-electronic.de](#)
- [PicoZed](#)

TI [AM5728](#)

Used in [BeagleBoard-X15](#)

Features:

- **CPU**: Dual (AM5728) Cortex A15 processor @ up to 1.5 GHz
- **GPU**: Dual core PowerVR SGX544 3D GPU, Vivante GC320 2D GPU
- **DSP**: 2×700-MHz TMS320C66x
- **MCU**: 2×ARM Cortex-M4 microcontrollers (MCUs)

- 4×32-bit programmable real-time units (PRUs)

Benchmarks

- [TI](#)

[AM57x Processors](#)

Modules

- [Phytec](#)

TI [66AK2E02](#)

Features

- Up to Four ARM Cortex-A15 Processor Cores at up to 1.4-GHz
- One TMS320C66x DSP Core Subsystem (C66x CorePacs), Each With

TI Ultrasound solutions http://www.ti.com/solution/ultrasound_system

Adapteva

<https://www.parallella.org/>

Other DSP vendors

- Analog Devices
- NXP
- [Ceva](#)

Mobile SoC

nVidia Tegra TK1

Dev-board [NVIDIA Jetson TK1](#) (own one)

Benchmarks

Modules

- [Toradex](#)
- [K1-som-tegra-k1](#) \$150

nVidia Tegra X1

Dev-board [Jetson TX1](#) (own)

Benchmarks:

Modules:

Qualcomm Snapdragon S820

Features:

- Quad ARMv8 core
- [Hexagon DSP](#)
- GPU

List of devices

- https://en.wikipedia.org/wiki/List_of_Qualcomm_Snapdragon_devices#Snapdragon_820_and_821

SoM (WiFi, Audio, BLE)

- [Open-q-820-usom](#)
- Inforce [Micro-SoM](#) unit cost \$260
 - [410 ~ \\$80](#)
- [Eragon 820](#) \$260
 - Snapdragon 410 [SoM](#) \$75
- [Compulab](#)
- [Variscite](#)

Benchmarks

[Mediatek](#)

Components

ADI

ADI [Ultrasound](#) product range

[Frontends](#)

Microchip

Microchip [Medical Ultrasound Imaging System](#) : T/R switch, pulser, [HV7351](#) : eight channel monolithic high-voltage ultrasound transmitter with built-in programmable digital transmit-beamforming

ST

Pulser : [STHV800](#) dev board [steval-ime013v1](#)

Maxim

Maxim ultrasound imaging [solutions](#)

Companies / Products

Portable Ultrasound

- Signostics
 - [USCAN](#)
 - [Handscan review](#) special offer price ~ USD 4400
- GE [Vscan](#)
 - [Teardown](#) (May 11 possibly old version)
 - Components
 - Xilinx #[XC5VSX35T](#) "Virtex 5" FPGA ~ \$477
 - TI #[AFE5851](#) AFE: 16 Channel VGA with ADC ~ \$89 @ 100u
 - TI #[TMS320DM6446](#) "DaVinci" Digital Media SoC ~ \$ 37 @ 1ku
 - TI #[SN74AVC24T245](#) 24-bit Bus Transceiver
 - Xilinx #[XC2C256](#) "Cool Runner II" 256-macrocell CPLD
 - TI #[TLV320AIC32](#) Stereo Audio CODEC
 - SN74CBTLV3257 Low-Voltage 4-Bit 1-of-2 FET Multiplexer/Demultiplexer
 - [ADM1062](#) Super Sequencer® with Margining Control and Temperature Monitoring
 - [TPS62110](#) Adjustable, 1.5-A, 17-V Vin Step-Down Converter in QFN-16
 - [TPS54350](#) 4.5V to 20V Input, 3A Synchronous Step-Down SWIFT™ Converter with Low-Side Gate Driver

- TS922, TS922A Rail-to-rail, high output current, dual operational amplifier
 - TPS7301Q LDO
 - SN74CBTLV3245A LOW-VOLTAGE OCTAL FET BUS SWITCH
 -
 - <http://www3.gehealthcare.com/en/products/categories/ultrasound/voluson>
- Philips [lumify](#) (front-end is on the probe, DSP is done on the Smartphone)
 - Suspected components:
 - Xilinx Virtex?
 - [Supported](#) VGA + ADC + Switch
 - AD9271|AD9273|AD9276|AD9278|AD9279|AD9674|
 - Motion sensor (Gyro)
 - [PGA5807A](#) or [AFE5808](#)
 -
 - Optimized code using [ARM neon](#)
 - Android App uses
 - [dcmtk](#)
 - QT5
 - Android [svg](#)
 -
- [Sonon 300](#)
- [Butterfly Networks](#) ultrasound-on-a-chip

Components, shops

<http://ultrasound-parts.com/>

Echopen Designs

Bitmaker

[Bitmaker](#) design based on OMAP , the Objective is to be similar to Ultramark

- [OMAP-L138](#)

Luc [Murgen](#)

To Read

- <https://github.com/kelu124/echomods/blob/master/goblin/Readme.md>
- http://wiki.echopen.org/index.php/ATL_Access_10PV
- <https://github.com/kelu124/murgen-dev-kit/tree/master/hardware>
- <https://kelu124.gitbooks.io/echomods/content/Chapter2/tobo.htm>
- <https://github.com/kelu124/murgen-dev-kit/tree/master/hardware>
- <https://github.com/kelu124/echomods>
- http://wiki.echopen.org/index.php/Challenge:the_echOpen_shield
- <https://kelu124.gitbooks.io/echomods/content/>
- [http://wiki.echopen.org/index.php/Worklog - Digging in the shield option](http://wiki.echopen.org/index.php/Worklog-Digging_in_the_shield_option)

Existing codes

- <https://github.com/takeshineshiro>
- <https://github.com/20E214/>
- <https://kitwaremedical.github.io/SlicerITKUltrasoundDoc/Installation.html>
<https://github.com/KitwareMedical/ITKUltrasound/>

TODO

- https://github.com/echopen/PRJ-medtec_sigproc/blob/master/SigProc_101/SigProc-101.ipynb
- Look at FPGA codes
- Read <http://www.insight-journal.org/browse/publication/722>
-