# XMC Module Xilinx Zynq UltraScale+ RFSOC

## Overview

**PanaTeQ's XMC-RFSOC-A** is a XMC module based on the Zynq UltraScale+ RFSoC device from Xilinx.

The Zynq® UltraScale+™ RFSoC family integrates key subsystems for multiband, multi-mode cellular radios and cable infrastructure (DOCSIS) into an SoC platform that contains a feature-rich 64-bit quad-core ARM® Cortex™-A53 and dual-core ARM Cortex-R5 based processing system.

Combining the processing system with UltraScale™ architecture programmable logic and RF-ADCs, RF-DACs, and soft-decision FECs, the Zynq UltraScale+ RFSoC family is capable of implementing a complete software-defined radio including direct RF sampling data converters, enabling CPRI™ and gigabit Ethernet-to-RF on a single, highly programmable SoC.

Zynq UltraScale+ RFSoCs integrate up to 16 channels of RF-ADCs and RF-DACs. The RF-ADCs can sample input frequencies up to 4GHz at 4GSPS with excellent noise spectral density. The RF-DACs generate output carrier frequencies up to 4GHz using the 2nd Nyquist zone with excellent noise spectral density at an update rate of 6.554GSPS.

The RF data converters also include power efficient digital down converters (DDCs) and digital up converters (DUCs) that include programmable interpolation and decimation, NCO, and complex mixer. The DDCs and DUCs can also support dual-band operation.

The board can be ordered with different versions of the Zynq UltraScale+ RFSoC family of devices, coupled up to 8GB 64-bit DDR4-2400 Processing Memory with 8-bit ECC.

Up to 4GB 32-bit of DDR4-2400 is also available as the Programmable Logic Memory, allowing data streaming signal processing applications. 64GB of soldered eMMC managed NAND Flash is available for local data storage.

Frond-end Analog I/O interfaces are available using on-board **RF connectors**.

The board can act as a **PrPMC** in the system.

A large number of the Zynq Ultrascale+ RFSOC PS peripherals are available on the XMC connectors: ETH 1000Base-T, USB 3.0/2.0 , SATA 3.1, RS-232/422/485, DisplayPort 1.2, GPIOs.

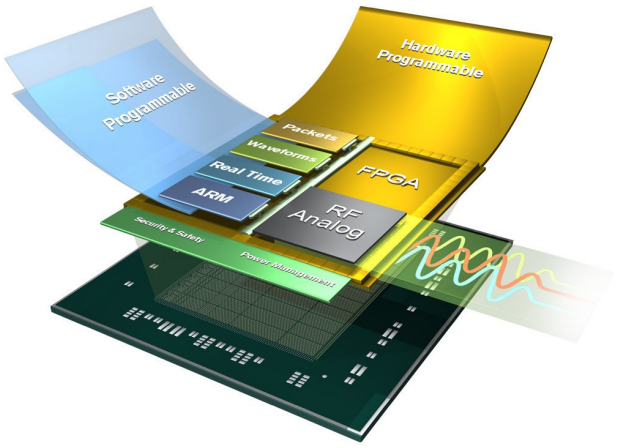
PanaTeQ's XMC-RFSOC-A-PSDK-A is also available for developers

## Key Features

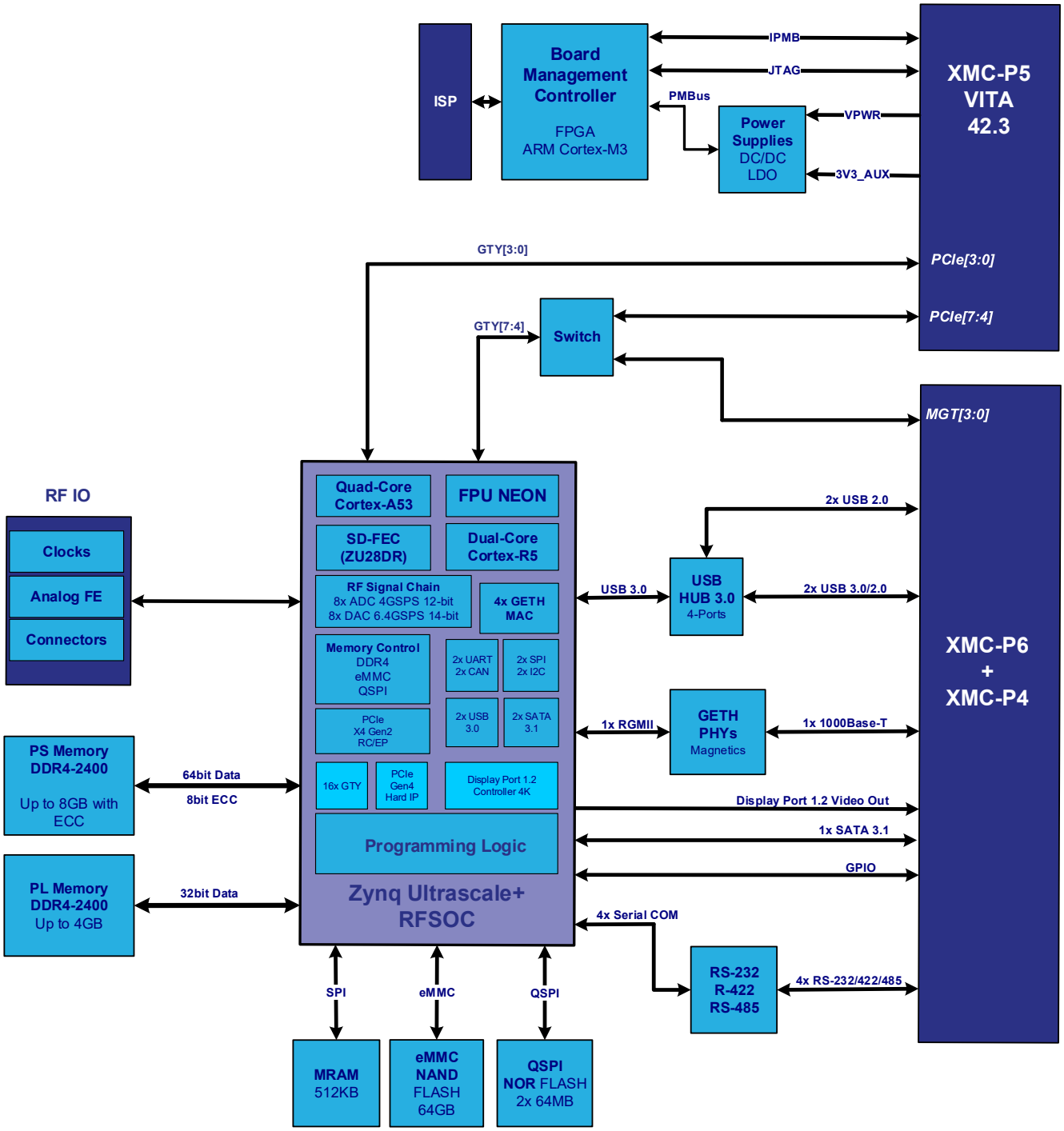
- Vita 42.3 XMC Compliant
- Xilinx Zynq UltraScale+ RFSOC
- ZU25DR/ZU27DR/ZU28DR FFVE-1156 Package
- Up to 8GB DDR4-2400 64-bit PS memory with 8-bit ECC
- Up to 4GB DDR4-2400 32-bit PL memory
- eMMC 64GB (V4.51), MRAM 512KB
- Up to PCIe x8 Gen1/2/3/4 on XMC-P5
- 4x GTY on XMC-P6 (muxed with XMC-P5)
- 1x Display Port 1.2 Video Out on XMC-P6
- 1x ETH 1000Base-T on XMC-P4
- 2x USB 3.0/2.0, 2x USB 2.0, 1x SATA 3.1 on XMC-P6
- 1x DisplayPort 1.2 on XMC-P6
- 4x RS.232/422/485 and GPIO on XMC-P4
- Up to 20x Front Panel RF IO
- Board Management Controller ARM Cortex-M3 based
- Air Cooled and Conduction Cooled

## Typical Applications

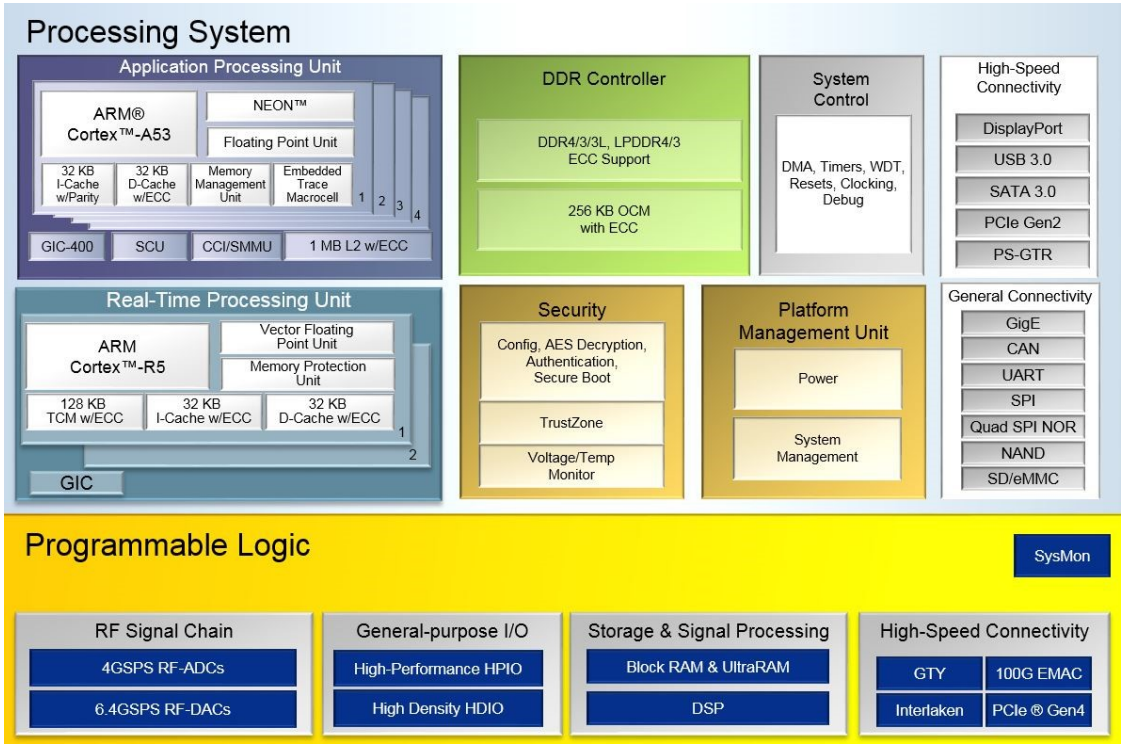
- Instrumentations
- MILCOM
- Software Defined Radio,
- Massive MIMO
- Electronic Warfare,
- Signal Intelligence
- LIDAR/RADAR/SONAR Systems



# Block Diagram



# Xilinx Zynq Ultrascale+ RFSOC Processing System Highlights




## Applications processing unit (APU) with quad-core ARM® Cortex™-A53 processors up to 1.5GHz:

- Next-generation ARMv8 architecture supporting 32- or 64-bit data widths
- Ideal for Linux and bare-metal SMP/AMP application systems

## Real-time processing unit (RPU) with dual-core ARM Cortex-R5 processors up to 600MHz:

- Low-latency, highly deterministic performance APU offloading

## Integrated RF Signal Chain:

- 8x ADC 4GSPS 12-bit
- 8x DAC 6.4GSPS 14-bit

## Integrated high-speed peripherals:

- PCIe® Gen1 or Gen2 root complex and integrated Endpoint block in x1, x2, and x4 lanes
- USB 3.0/2.0 with host, device, and OTG modes
- Gigabit Ethernet with jumbo frames and precision time protocol
- SATA 3.1 host
- Dedicated quad transceivers up to 6Gb/s

## General and boot peripherals:

- CAN, I2C, QSPI, SD, eMMC, and NAND flash interfaces
- GPIO, UART, and trace ports
- 6-port DDR controller with ECC, supporting x32 and x64 DDR3, DDR3L, LPDDR3, LPDDR4, DDR4
- Integrated platform management unit (PMU) supporting multiple power domains
- Integrated configuration security unit (CSU)
- TrustZone support
- Peripheral and memory protection

# Board Specifications

## XMC Interfaces

- VITA 42.3 Specifications compliant
- XMC P5: Up to 8 lanes PCIe Gen1/2/3 (2x PCIe x4 ot 1x PCIe x8)
- XMC P6: 4x MGT GTY @ up to 28 Gb/s connected to/from Zynq RFSOC Programming Logic
- XMC P4; 1x ETH 1000BASE-T, 4x RS-232/422/485, GPIO
- XMC P6: 1x SATA 3.1, 1x Display Port 1.2 VIDEO OUT, 2x USB 3.0/2.0, 2x USB 2.0
- XMC P5: IPMI EEPROM, Temperatures, Voltages, Currents, Board Management Controller (BMC), JTAG

## Xilinx Zynq Ultrascale+ RFSOC

- Supported Devices:**ZU25DR** / **ZU27DR** / **ZU28DR** FFVE1156 package (Speed Grade –1/2/3)
- Processing System : Quad-Core ARM A53, Dual-Core ARM R5, 2x SATA, 2x USB, 4x GETH MACs
- Programmable Logic: 678K Logic Cells (ZU25DR) / 930K Logic Cells (ZU27DR) / 930K Logic Cells (ZU28DR)
- On-Chip Memories: 41.3Mb (ZU25DR) / 60.1Mb (ZU27DR) / 60.1Mb (ZU28DR)
- DSP Slices: 3145 (ZU25DR) / 4272 (ZU27DR) / 4272 (ZU28DR)
- High Speed Serial Links: 8 full duplex, high performance, GTY Multi-Gigabit Tranceivers (MGT) @ up to 28 Gb/s
- Supported by PanaTeQ's FPGA Development Kit (**PAN-FDK**)

## External Memories

- Up to 8GB of DDR4-2400 Processor System (PS) memory, 64-bit data, 8-bit ECC
- Up to 4GB of DDR4-2400 Programmable Logic (PL) memory, 32-bit data, no ECC
- 64GB eMMC v4.51 of managed NAND Flash memory. HS200 support @ up to 100MB/s
- 512KB of SPI MRAM (NVRAM)
- 2x 512Mb of QSPI NOR Flash memory for booting Zynq RFSOC Programmable Logic and Firmware Processing System

## RF-ADC

Tile oriented (8 RF-ADC channels)
- Four RF-ADCs and one PLL per tile
- 12-bit resolution
- Implemented as either 4 channels of 2.058GSPS, or 2 channels of 4.096GSPS (device dependent)

Decimation filters
- 1x, 2x, 4x, 8x
- Full bandwidth data-rate support
- 80% pass band, 89dB stop-band attenuation

## RF-DAC

Tile oriented (8x RF-DAC channels)
- Four RF-DACs and one PLL per tile
- 14-bit resolution
- Sampling speed 6.554GSPS per RF-DAC
- 4GHz full power output bandwidth

## Front RF I/O

- Up to 20 RF I/O (8x ADC, 8x DAC, 2x RefClkIn, 2x Trigger)

## Board Management Controller (BMC)

- .Based on Microsemi SmartFusion Customizable System-on-Chip (**cSoC**) with on-chip ARM Cortex-M3 at up to 100MHz
- Real-Time Monitoring+Alarms: Voltages, Currents, Temperatures, 6-Axis Accelerometer, Magnetometer and Humidity
- Reset Management, Power-Up and Power-Down Sequencing. Buit-In Test (**BIT**) with Watchdogs (Avionics type)
- Large private 32MB Event Log Flash Memory.
- UART communication with host
- Smart Power Management technology using LTM467x wiith PMBus
- Hardware Ready for full Vita 46.11 compliance

## Environnemental Specifications

- Commercial Ruggudized 0-50C
- Conduction Cooled –40C to 70C at Thermal Interface

## Product Codification

The XMC-RFSOC-A can be assembled with different versions of the Zynq Ultrascale+ RFSOC devices and various amounts of memory storage. The cooling technique et ruggedization level are also available options. The following table shows the product coding for all these options.

**XMC-RFSOC–A–[A][1][N]–[AS]**

| | Device Size | System Logic Cells | DSP Slices | Memory | SD-FEC |
|---|---|---|---|---|---|
| A | XCZU25DR | 678K | 3145 | 41.3 Mb | No |
| B | XCZU27DR | 930K | 4272 | 60.5 Mb | No |
| C | XCZU28DR | 930K | 4272 | 60.5 Mb | Yes |

| | Device Speed Grade |
|---|---|
| 1 | Slowest |
| 2 | Mid |
| 3 | Fastest |

| | PS / PL Memory Size |
|---|---|
| N | 4GB/2GB |
| M | 8GB/4GB |

| | Ruggedization Level | VITA 47 |
|---|---|---|
| AS | Air Standard | EAC4 |
| AR | Air Rugged | EAC6 |
| CC | Conduction Cooled | ECC3 |
| CR | Conduction Rugged | ECC4 |

## Ordering Information

The following product references are offered by PanaTeQ as standard products. Other combinations of devices, speed grade, memory and cooling can be specially ordered. Please contact us for details

| Reference | Device | Speed | Memory PS/PL | Ruggedization Level |
|---|---|---|---|---|
| **XMC-RFSOC-A1N-AS** | ZU25DR | -1 | 4GB/2GB | Standard Air Cooled |
| **XMC-RFSOC-B1N-AS** | ZU27DR | -1 | 4GB/2GB | Standard Air Cooled |
| **XMC-RFSOC-C1N-AS** | ZU28DR | -1 | 4GB/2GB | Standard Air Cooled |

| Reference | Description |
|---|---|
| **XMC-RFSOC-A-PSDK-A** | XMC-RFSOC-A System Development Kit |
| **IOC-XMC-RFSOC-A** | IO Carrier for XMC-RFSOC-A |
| **VPX3C-RFSOC-A** | 3U VPX Carrier for XMC-RFSOC-A |
| **PCIeC-RFSOC-A** | PCIe Carrier for XMC-RFSOC-A |

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