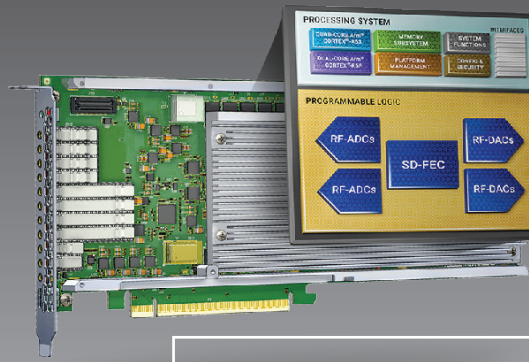




**RFX 771**  
PCIe RFSoc Card



Preliminary Product Info

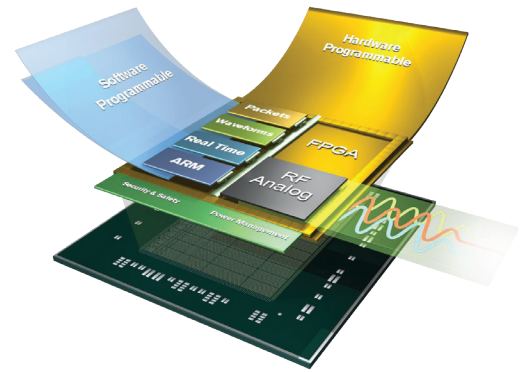
## RFSoc Amplified Transceiver Card with PCIe Data Plane

Available with optional amplification and filtering on the card

The BittWare RFX 771 card is a digital direct sampling transceiver featuring the third generation AMD Zynq® UltraScale+™ RFSoc. This innovative solution uses the RFSoc for direct sampling between 50 MHz and 6 GHz. The card implementation optionally integrates filters and amplification, displacing external devices. Integrating this on the card results in higher performance and reduced cost. The RFX 771 uses PCIe for data movement. Buy it from us in our WaveBox Sigma, a server specifically optimized for the RFX 771. Or install it into your own server.

The AMD Zynq® UltraScale+™ RFSoc integrates RF-class A/D and D/A converters into the Zynq® FPGA fabric and multi-core ARM processor subsystem, creating a multi-channel data conversion and processing solution on a single chip.

The RFX 771 offers PCIe Gen 3 x16 bandwidth, which is 16 GB/sec at the physical level. Sending packets through a host CPU to host DRAM will deliver roughly 10 GB/sec. Get twice that bandwidth by configuring PCIe as dual Gen 4 x8 paths—which is twice the PCIe bandwidth that even the future Versal RF can deliver. However, this option comes with a few restrictions and errata. If you need more than that, talk to us about our RFX 880 product that uses Ethernet instead of PCIe.



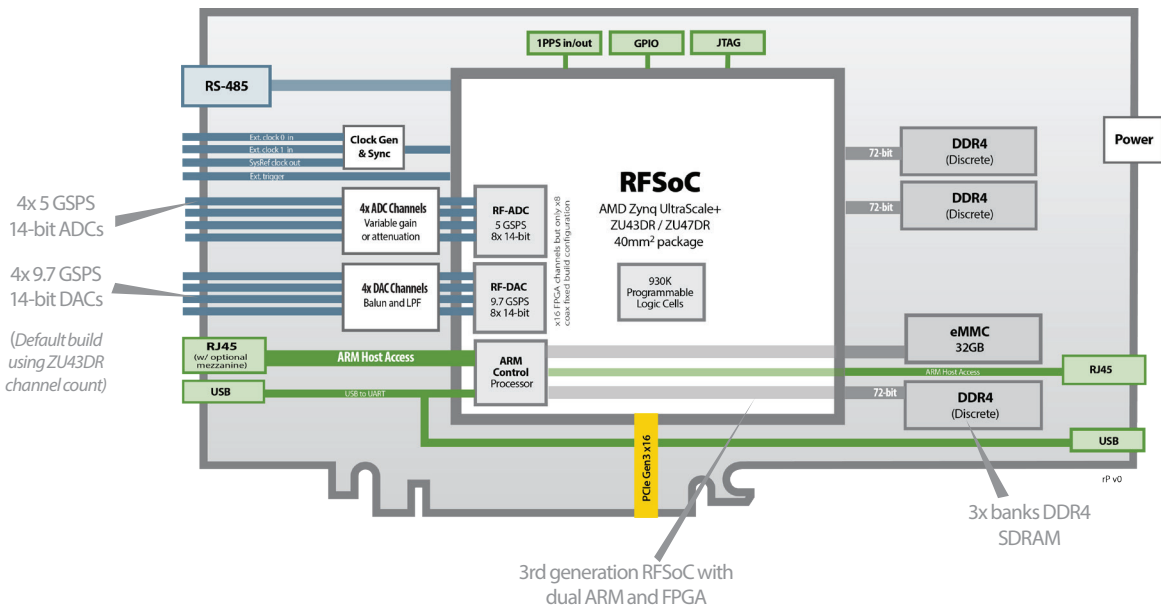
## key features

Third Generation AMD Zynq® UltraScale+™ RFSoc

Variable gain-controlled RF inputs

Gen3 x16 or dual Gen4 x8 PCIe

Single-slot form factor



4x 5 GSPS 14-bit ADCs  
4x 9.7 GSPS 14-bit DACs  
(Default build using ZU43DR channel count)

3rd generation RFSoc with dual ARM and FPGA

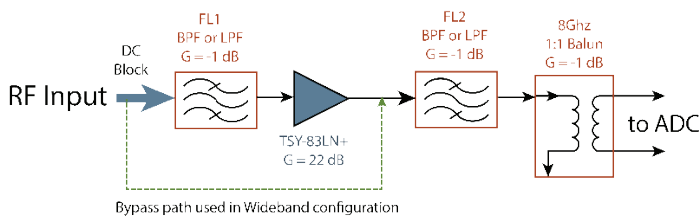
3x banks DDR4 SDRAM

# RFX 771

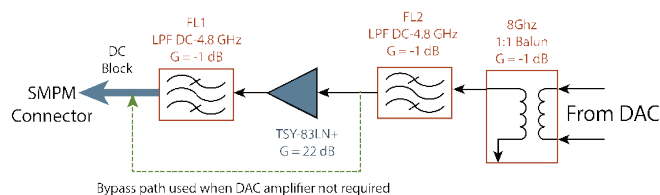
PCIe RFSoc Card

## ADC Front End Options

The RFSoc chip at 5 GSPS offers a 2.5 GHz bandwidth at up to 6 GHz. Aliasing challenges require filtering in the path. The RFX 771's "Wideband" configuration targets customers willing to provide most filtering and amplification external to the card. BittWare provides only a DC block and a 6 GHz LPF. The RFX 771 also offers build options for on-card bandpass filtering and amplification with filters available for Nyquist 1, 2 and most of 3. BittWare plans a future build option that provides a mixer for up and down conversion up to 35 GHz. To learn more, ask for our 35 GHz data sheet.



## Transmit Side



## Included IP

BittWare RFX cards ship with an application that converts between analog data and timestamped, VITA-49.2 packets. It works in both ADC and DAC directions. The application also transfers raw data between the RFSoc and the ARM memory or eMMC. The RFSoc's ARM Processing System runs Linux and acts as a control plane. More specifically, BittWare has integrated card management functions through customized Linux drivers. BittWare has also ported AMD's RF Tool application, a socket library that configures an RFSoc chip. Above both Linux and RF Tool, BittWare provides its own RFUtils commands and examples. RFUtils can generate synthetic waveforms as well as load and stream waveforms from files. All of this is fully supported by BittWare and we provide source code.

BittWare also supplies an unsupported port of AMD's RF Analyzer which we use to help characterize our cards. The RFX 771 version of BittWare's application uses a PCIe "data mover" to transfer the VITA 49 packets into host memory. That data mover might be a third-party offering that customers can also license, if interested.

## Customize the ADC and DAC count

The ZU47DR chip has eight ADC channels and eight DAC channels. However, the RFX 771 front panel only has room for eight coax channel connections. BittWare designed an analog signal path that can, as a build option, operate as either an ADC or a DAC. This flexibility allows BittWare to offer RFX 771 variants with any number of ADC or DAC channels, provided the total number does not exceed eight. Our off-the-shelf version of the RFX 771 uses the less-expensive ZU43DR chip and its fixed four ADC and four DAC channel count.

## Analog Characterization Data

BittWare fully tests and documents the analog characteristics of each RFX 771 configuration, be it wideband or amplified, with 8 ADC channels or 8 DAC channels (to mention the extreme possibilities). That data is available for each significant printed circuit board (PCB) revision, roughly one month after a new PCB passes through manufacturing. The reports are available to customers through [developer.bittware.com](http://developer.bittware.com).

## Chassis Options

BittWare offers a WaveBox Sigma chassis that holds up to two RFX 771 cards in 1U. There is an x86 dual CPU motherboard inside with a dedicated PCIe slot for each CPU. The WaveBox mezzanine is optional—most customers will not need one. If your application needs a mezzanine, the RFX 771 becomes a two slot card.



WaveBox

# RFX 771

PCIe RFSoc Card

## Board Specifications

RFSoc	<ul style="list-style-type: none"><li>AMD Zynq UltraScale+ RFSoc<ul style="list-style-type: none"><li>ZU43DR (G1517 package), core speed grade -2</li><li>Contact BittWare about ZU47DR RFSoc card configuration</li></ul></li></ul>
Analog	<p><i>Default build using ZU43DR channel count</i></p> <ul style="list-style-type: none"><li>4x 5 GSPS 14-bit ADCs<ul style="list-style-type: none"><li><b>Wideband build option</b> provides -1 to -28 dB gain from 50 MHz to 6 GHz with a 6 GHz LPF</li><li><b>1st Nyquist (L-Band)</b> build option provides +22 to -27 dB on all 4 channels, constrained between 500 MHz and 2.5 GHz by filters FL1 and FL2</li><li><b>2nd and 3rd Nyquist filters</b> are also available on amplified channels as a special order</li></ul></li><li>4x 9.7 GSPS 14-bit DACs<ul style="list-style-type: none"><li>Range of about +3 to -24 dBm</li><li>With the amplifier, about +20 to -24 dBm</li><li>High power end of those ranges is a function of frequency</li><li>Constrained by a 4.8 GHz LPF</li></ul></li><li>Programmable clocks</li><li>External reference and triggers</li><li>Push-on SMPM connectors with optional SMA pigtails (SSMC connectors instead as a special order)</li></ul>
Host interface	<ul style="list-style-type: none"><li>x16 Gen3 or bifurcated dual x8 Gen4 interfaces* direct to PL</li></ul>
On-board flash	<ul style="list-style-type: none"><li>PS connects to a pair of 2Gb QSPI parts configured in "Dual Parallel" mode. The PS boots from the QSPI to configure itself, then pulls the logic bitstream from the QSPI and configures the PL</li><li>32GB eMMC for ARM disk</li></ul>
External memory	<ul style="list-style-type: none"><li>Processing system: 16GB, 64-bit DDR4-2400 with ECC</li><li>Programmable logic: 32GB, 2x banks 64-bit DDR4-2666 with ECC (our example uses it as 36GB no ECC, 72-bit)</li></ul>
External digital interfaces	<ul style="list-style-type: none"><li>Processing system<ul style="list-style-type: none"><li>Dual RJ45 Ethernet, one on the optional mezzanine, second inside the chassis</li><li>Single USB for UART and JTAG, dual connectors. One on the front panel, second inside the chassis.</li></ul></li></ul>

Cooling	<ul style="list-style-type: none"><li>Standard: single-width passive heatsink</li><li>Contact BittWare for other cooling options</li></ul>
Electrical	<ul style="list-style-type: none"><li>On-board power derived from PCIe slot</li><li>Power dissipation is application dependent</li><li>Typical max power consumption 50W</li></ul>
Environmental	<ul style="list-style-type: none"><li>Designed to operate between +5C and +40C chassis air inlet temperature, noncondensing (air temperature inside the chassis between +5C and +60C)</li></ul>
Quality	<ul style="list-style-type: none"><li>Manufactured to IPC-A-610 Class 2</li><li>RoHS compliant</li><li>CE, FCC, UKCA &amp; ICES approvals</li></ul>
Form factor	<ul style="list-style-type: none"><li>¾-length, standard-height PCIe single-slot card (x16 mechanical); optional mezzanine requires second slot</li><li>BittWare's WaveBox Sigma chassis was specifically designed to house RFX 771 cards</li></ul>

## Development Tools

Firmware development	BittWare provides interface software support for an example bitstream that fully configures the RFSoc chip using a scripting language running on the RFSoc's ARM. AMD Vivado development tools are fully supported for development of custom designs.
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## Deliverables

- RFX 771 RFSoc Transceiver
- Data capture and relay example - Full source code
- 1-year hardware warranty

\* Dual PCIe Gen 4 x8 with restrictions and errata.

## Sales Order Numbers

Contact BittWare for sales order numbers. For **initial evaluation**, we urge customers to buy an RFX 771 integrated into a WaveBox Sigma chassis:

- Wideband:** order WaveBox-Sigma-Eval-1
- Nyquist 1:** order WaveBox-Sigma-Eval-2

**Interested in purchasing?** We offer direct sales at BittWare.com, or you can check stock with our distributors at BittWare.com/rfx771.

To learn more, visit [www.BittWare.com](http://www.BittWare.com)

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