

## Floating Point FFT PMC/PMC-X Engine

### Features

- Convection cooled PMC/PMC-X
- Conduction cooling PMC/PMC-X -optional
- Front panel IO daughter card
- Up to four 32-bit complex floating point FFT/IFFT cores in parallel with integrated address generators, IEEE-754 compliant
- 256 to 1M points transforms
- 256Mbytes of DDR2 SDRAM for data buffering, 40Mbytes of QDR2 SRAM and DDR2 SRAM for long vectors or 2D transforms
- Embedded processor offers high level of programmability
- Development kit and program examples provided
- PCI-X, 32/64-bit 33/66MHz PCI interface
- 8 full-duplex Multi-Gigabit Transceivers on Front Panel daughter card

### Applications

- Radar/sonar signal processing
- Video processing (>100 frames/s for 1024x1024 images)
- Digital Filtering
- Spectral analysis
- Convolution/correlations
- Polyphase filterbanks
- Pulse compression
- SAR processing

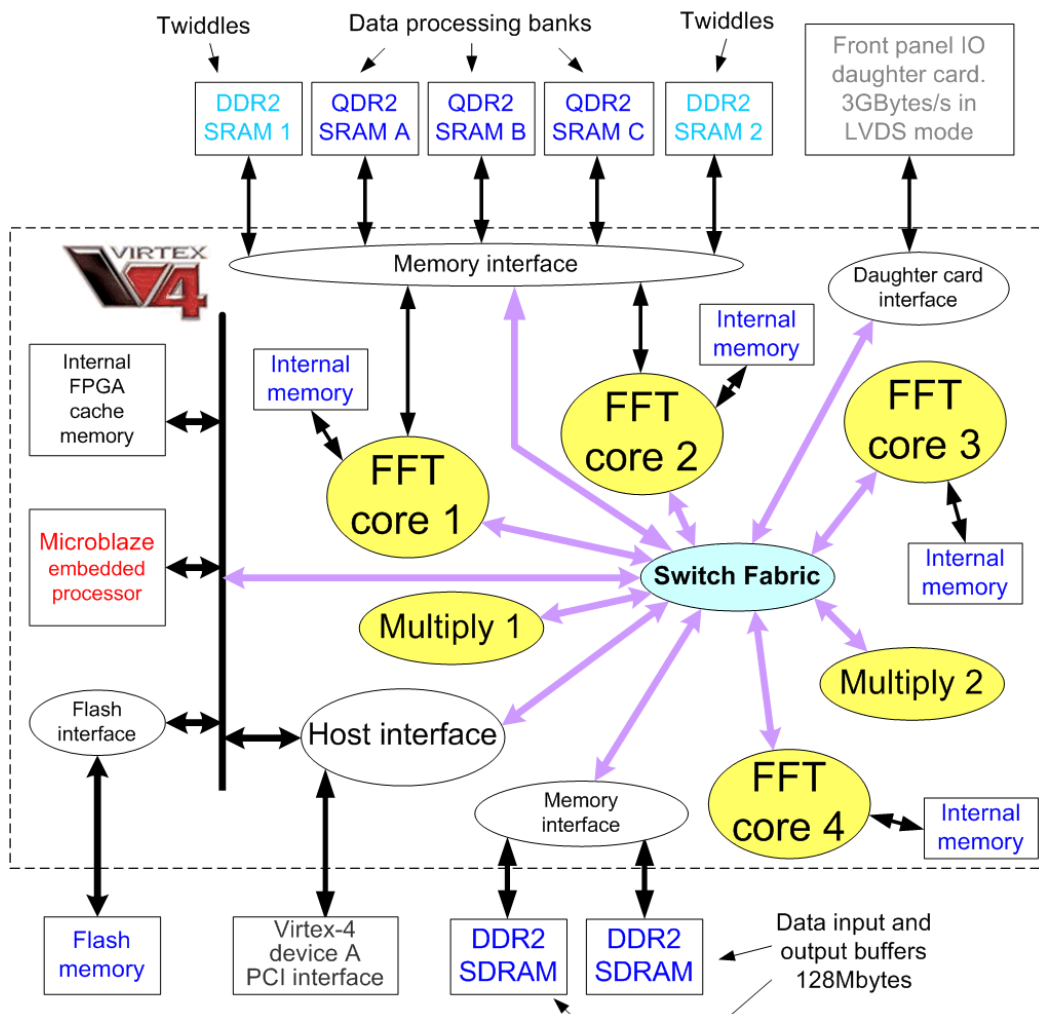


Figure 1 : 4FFT's FPGA architecture

## Description

4FFT is a high performance conduction cooled PMC/PMC-X module dedicated to applications that require the processing of floating point Fourier Transforms. Bundled with high speed interfaces, fast on-board memory resources and one FPGA dedicated to Digital Signal Processing algorithms, 4FFT is typically utilized to accelerate frequency-domain algorithms with several FFT/IFFT cores implemented in parallel. Fully PMC and PMC-X compatible, 4FFT can be used on any motherboard that complies with either standard.

## FFT core

Based on a radix-32 architecture, 4DSP's floating point FFT/IFFT core provides unequalled performances within the FPGA world with integrated address generators and flexible programmable transform lengths ranging from 256 to 1M points. Uniquely, up to four FFT/IFFT cores can be implemented in parallel in the XC4VLX160 Virtex-4 device along with complex multipliers to perform functions such as convolution and correlation. Table 1 gives an overview of the performances that can be achieved on 4FFT using several FFT/IFFT cores.

FFT/IFFT transform size	# of cores in parallel	Processing time	Sustained throughput	Internal/External FPGA memory
256	4	1.4 $\mu$ s	181 MSPS	Internal
512	4	2.4 $\mu$ s	213 MSPS	Internal
1024	4	4.4 $\mu$ s	234 MSPS	Internal
2048	4	12.2 $\mu$ s	167 MSPS	Internal
4096	4	23.6 $\mu$ s	173 MSPS	Internal
8192	4	47.3 $\mu$ s	173 MSPS	Internal
16384	4	94.5 $\mu$ s	173 MSPS	Internal and External
32768	3	252 $\mu$ s	130 MSPS	Internal and External
65536	2	1ms	65 MSPS	External
131072	2	2ms	65 MSPS	External
262144	2	4ms	65 MSPS	External
524288	2	8ms	65 MSPS	External
1048576	2	16ms	65 MSPS	External

**Table 1: Floating point FFT/IFFT performances on 4FFT with complex data input**

## Architecture and programmability

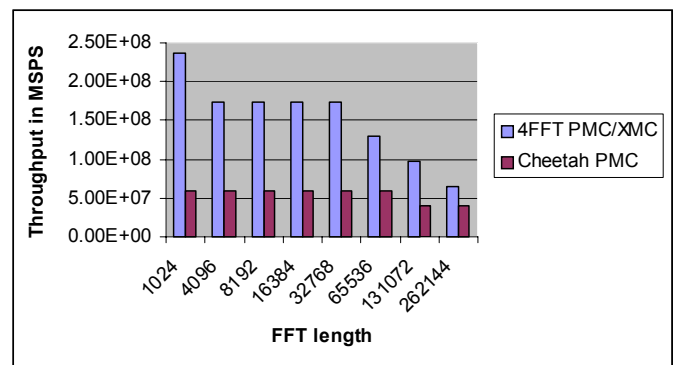
4FFT's FPGA architecture shown on Figure 1 has been designed to offer flexibility combined with high performances. A Microblaze embedded processor executes the algorithm described in a user's program. It controls the non-blocking Switch Fabric and passes settings to the IP cores and interfaces attached to it. Data can flow from any source to any destination and undergo the required transforms. The original architecture featured in this document can be modified upon request in order to meet specific requirements.

## Data types

All calculations are performed in 32-bit IEEE-754 floating point format. 4FFT can however accept fixed point 2's complement formats on its inputs such as 16-bit integer or 32-bit integer.

## 4FFT's benchmark

The graph below shows a comparison between the Cheetah PMC and 4FFT's performances. Please note that the Cheetah PMC is a double-width PMC module whereas 4FFT PMC/PMC-X is a single width module. If two 4FFT cards were to be used, the 4FFT's figures below can be doubled.



## Front Panel IO daughter card

The FM480 provides a User Selectable daughter card for Front Panel IO in accordance with IEEE 1386.1. A/D converters with high digitization rates, D/A waveform generators, LVDS, FPDP, extra memory resources (up to 512Mbytes SDRAM), camera link, video encoders and decoders as well as many other standards or proprietary interfaces provide connectivity to the system. The maximum data bandwidth between the Virtex-4 and the daughter card is 3Gbytes/s in LVDS mode. Eight Multi Gigabit transceivers are also available on the daughter card.

## Software support

4FFT is available with a full software support package, including a development kit, program examples, drivers and API.

## Power

Max current at 5V: 4A  
Max current at 3.3V: 4A

## Interfaces to motherboard

PCI-X 64-bit 133MHz, 3.3V  
PCI 64/32-bit 66MHz, 3.3V  
PCI 64/32-bit 33MHz, 3.3V

## Environment

Operating temperature:

- 0°C to +70°C (Commercial)
- -40°C to +85°C (Industrial)

Optional conduction cooling

Convection cooling 600LFM minimum if conduction cooling not used

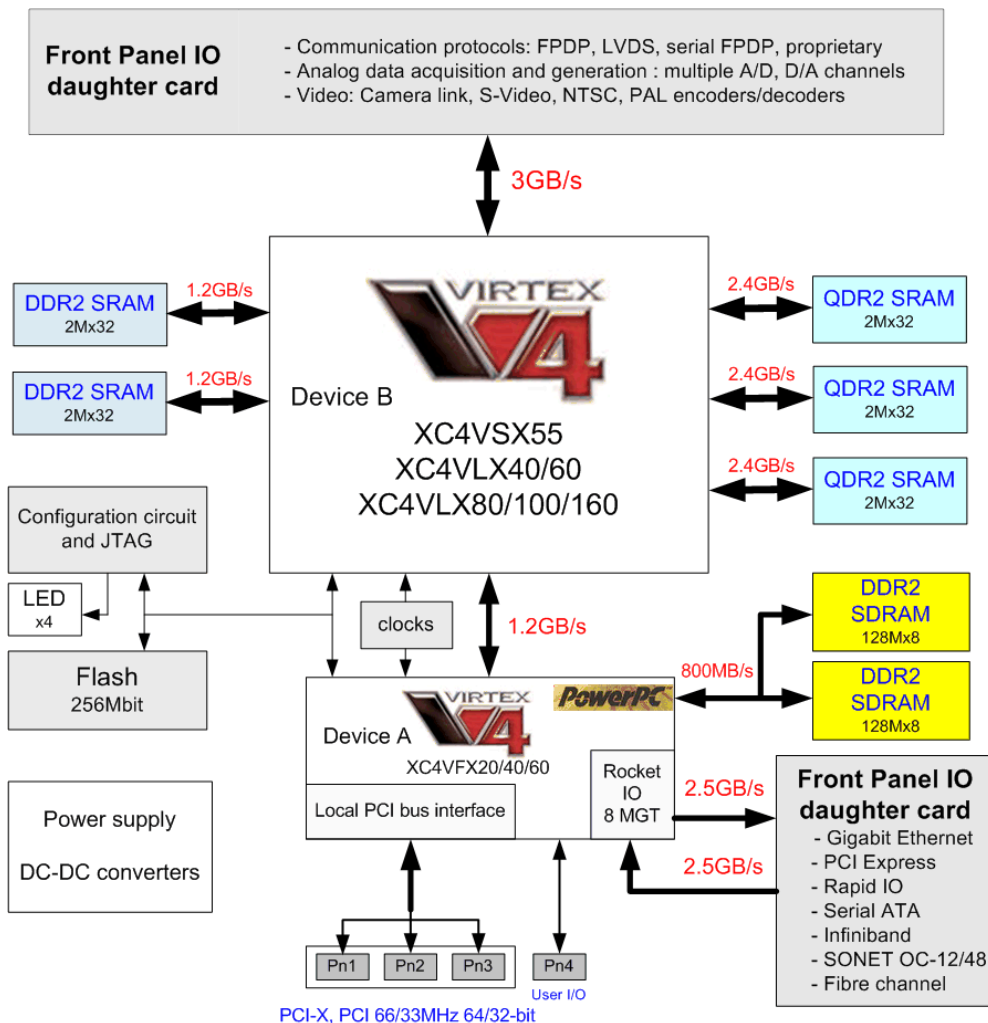


Figure 2: PMC/PMC-X block diagram

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