RF Engines Ltd,
Innovation Centre
St Cross Business Park
Newport
Isle of Wight
PO30 5WB
Tel +44 (0)1983 550330
Fax +44 (0)1983 550340
E-Mail Info@rfel.com

RF Engines' 1GHz Spectrometer Core drives unprecedented performance enhancements in radio astronomy

Date: 26 April 2005

RF Engines Ltd, Newport, Isle of Wight, UK, the world-leading supplier of signal processing technology for FPGA, has announced a new **Spectrometer IP core** for FPGA that enables the rapid development of very wideband spectral analysis systems. The new core is based on RF Engines' HyperSpeed Fast Fourier Transform (FFT) technology, and makes possible unprecedented advances in radio astronomical receivers that operate in the frequency domain.

The Max-Planck-Institut für Radioastronomie (MPIfR), Bonn, is already making use of a 100MHz Spectrometer core in receivers at its 100 meter radio telescope and has acknowledged the improvement over traditional spectrometers. A recent paper, (Astronomy & Astrophysics, in press) published jointly by the MPIfR and the Radioastronomisches Institut of Bonn University, explains how this novel technique far outperforms existing technologies. It states that the technique, used for analysis of signals from astronomical objects, "can be considered prototypical for spectrometer development in future radio astronomical applications", and identifies the significant improvements in bandwidth, sensitivity and cost.

The new core takes a 1GHz sampled signal at its input and converts this to a frequency power spectrum, using a digital band filter and a 16K-point FFT, in continuous real-time. This enables a 400MHz bandwidth of radio spectrum with a passband ripple of only 0.001dB to be analysed with a frequency resolution of 30.5kHz. The combination of very wide bandwidth and fine resolution performance has been achieved within a single FPGA device, ensuring that the technology is both quick to implement and is extremely cost effective compared with traditional techniques.

The Spectrometer Core has initially been demonstrated on the AC210 and AC240 platforms recently announced by Acqiris (www.acqiris.com). These high quality platforms include the high speed Analog to Digital Converter (ADC) required to digitise the signal at 1GHz, and a Xilinx Virtex II Pro 70 FPGA to perform the signal processing. RF Engines has a roadmap to enhance the performance of the Spectrometer Core to take advantage of the full 2GHz sample rate available on the AC240, and to increase the FFT length to the 32K-points.

"We are extremely pleased to be working with the Max-Planck-Institut für Radioastronomie in an area which is pushing the boundaries of receiver technology," said John Summers, VP Sales and Business Development, RF Engines. "Their latest radio astronomy receiver gives a practical demonstration of the dramatic technology advances that can be achieved through

the use of FPGA technology and RF Engines' design capabilities. This project had particularly aggressive timescales, and further validates our modular IP approach to building high performance signal processing systems."

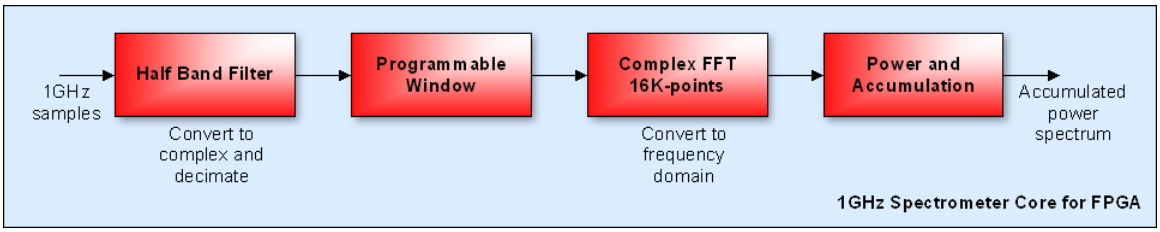
Technical Description

The Spectrometer Core receives 8-bit samples from the ADC at a continuous sample rate of 1GHz, and then processes this data in four main stages. First, a Half Band Filter (HBF) converts samples to a complex format, and reduces the sample rate by a factor of two, which eases the subsequent processing requirements. This is then followed by a windowing function, which weights the data in order to control the filtering performance of the FFT. The window coefficients are user programmable at run-time, allowing the performance characteristics of the system to be modified for changing operational scenarios.

The 16K-point HyperSpeed FFT forms the central element of the system, performing the conversion from the time-domain to frequency-domain, and includes bit reversing to sort the data in natural frequency order. The FFT is built using a highly parallel architecture in order to achieve the very high sample rate.

The final stage of processing is to convert the frequency spectrum to a power representation, and accumulate successive results. This accumulation stage has the effect of averaging together a number of power spectra, thereby reducing the background noise and improving the detection of weak signals. This stage also helps to reduce the amount of data produced by the system, and eases any subsequent interface bandwidth requirements and processing loads. Output from the core is in a 32-bit floating-point format, which allows data to be efficiently post-processed by a standard desktop computer.

The core is supported by a bit-true model, which allows potential users to simulate the core within their own particular signal environment. This allows the precise performance of the system to be known in advance of the hardware implementation, and dramatically reduces the risk of redesign or implementation problems.



A block diagram of RF Engines 1GHz Spectrometer Core for FPGA

The Future

RF Engines is already working on enhancements to the spectrometer system, and has indicated that the next release of the product will support sample rates up to 2GHz and transform sizes of 32K-points. This will allow even wider bandwidths (means: 1 GHz) to be analysed or finer resolution spectral analysis.

In addition to providing an FPGA core for customers to integrate into their own hardware, RF Engines is also well progressed towards providing complete Spectral Analysis solutions, which will include the hardware platform and graphical user interface software. These systems will provide users with an "out-of-the-box" solution to high performance real-time

spectral analysis, and will meet a broad range of applications in the telecommunications, instrumentation and scientific industries.

RF Engines

RF Engines Limited (RFEL) is a UK based designer, providing high specification signal processing cores, system on chip designs, and FPGA based board solutions for applications in the defence, communications and instrumentation markets. These applications include base stations, wireless and wireline broadband communications systems, satellite communications systems, test and measurement instrumentation, as well as defence systems. More specifically, RFEL is a solutions provider for projects requiring complex front end, real-time, wide and narrow band, flexible channelisation. RFEL provides a range of standard cores covering multiple FFT and unique PFT techniques, as well as system design services for specialist applications.

For further information, please see the website at www.rfel.com or contact RF Engines at Innovation Centre, St Cross Business Park, Newport, Isle of Wight, PO30 5WB, Great Britain. Tel +44 (0) 1983 550330. E-mail info@rfel.com

Press information and illustrations can be obtained from Nigel Robson, Vortex PR, Island House, Forest Road, Guernsey, GY8 0AB, Great Britain. Tel +44 (0) 1481 233080. E-mail nigel@vortexpr.com

Max-Planck-Institut für Radioastronomie

The Max-Planck-Institut für Radioastronomie is based in Bonn, Germany. Technological efforts in the institute cover the whole spectrum from radio, over (sub)millimetre, to far-infrared wavelengths. The institute is currently commissioning a novel submillimetre wavelength telescope in the Chilean high Atacama desert (APEX), which will provide unprecedented observing opportunities. At the earliest possible, the MPIfR will operate the new spectrometers also at this unique facility.

For further informations, please see the website at www.MPIfR-Bonn.MPG.de or contact Dr. Bernd Klein, head of Digital Electronics, Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany. Tel +49 (0) 228 525-286. E-mail bklein@MPIfR-Bonn.MPG.de