13th INTERNATIONAL BEAM INSTRUMENTATION CONFERENCE
Sept. 9 -13, 2024 · Beijing, China
IBIC2024

The Development of New BPM Signal Processor at SSRF

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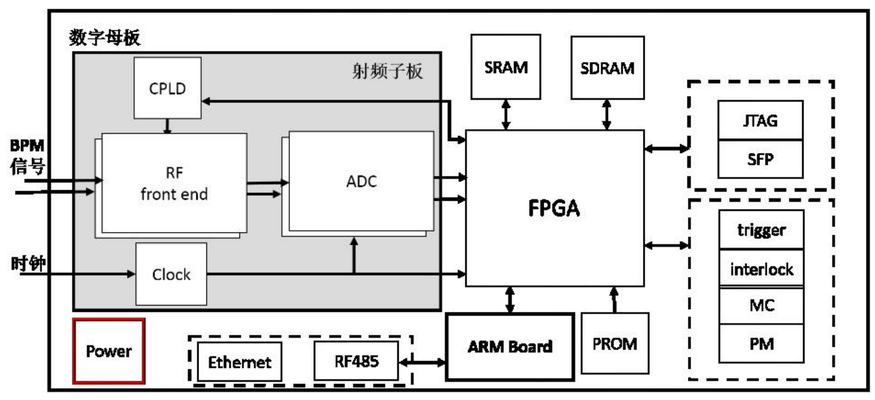
•Abstract

A BPM signal processor has been developed for SSRF since 2009. It composed of Virtex5 FPGA, ARM board, and 4 125MSPS sampling rate ADCs. Since then, electronic technology has made significant progress. Such as Zynq UltraScale+ MPSoC FPGA contains both hard-core ARM and high-performance FPGA, and ADCs with a sampling rate of 1GSPS have been applied in mass production. A new BPM processor with Zynq UltraScale+ MPSoC FPGA and 1GSPS ADCs is under development at SSRF. Due to the application of new technologies, the processor performance will be significantly improved. The new processor can also meet the needs of ultra-low emittance measurement for the new generation of light sources. This paper will introduce the design of the processor and the relative tests.

•BPM Signal Processor

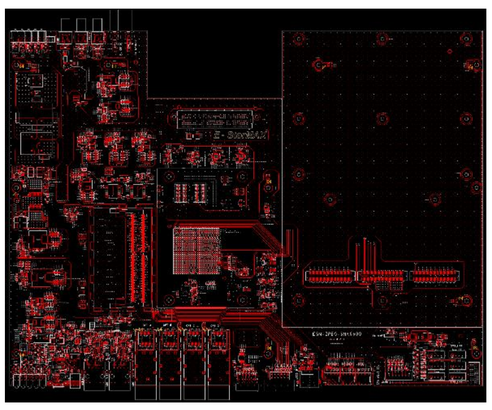
SSRF developed a new generation of digital backboard with a new generation of system-on-chip FPGA (Zynq UltraScale + MPSoC) as the core. It has 8GB PL DDR and more abundant external interfaces, whileupgrading the RF front board, increasing the pilot tone to improve the orbit stability.



Parameters	value
Channels	**4**
ADC bits	**16**
ADC Bandwidth	**650 MHz**
Max ADC rate	**125 MSPS**
FPGA	Xilinx ZCU15EG
Clock	Ext./Int.
PL DDR4	8GB
GPIO	12
Trigger	Ext./Self/Period
Interlock	Lemo
Ethernet	2×RJ45
SFP	4, UDP&Aurora
Software	Linux/EPICS

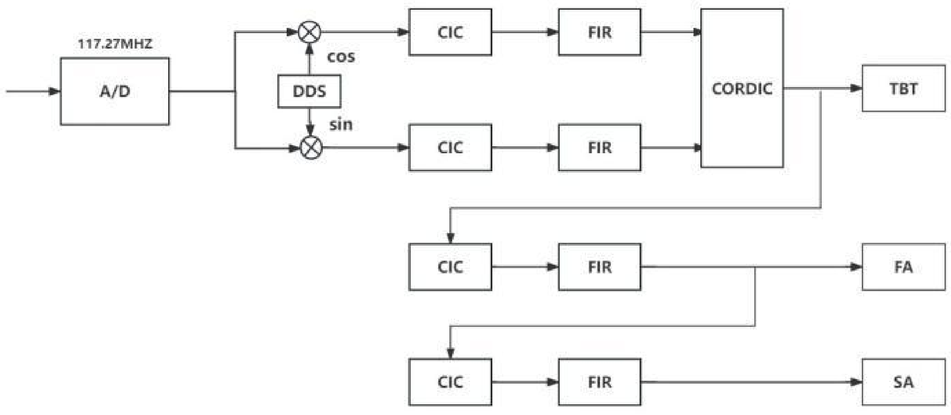
•BPM digital signal processing

New RF analog front-end with pilot compensation functions and integration with the ADC board



Digital processing backboard

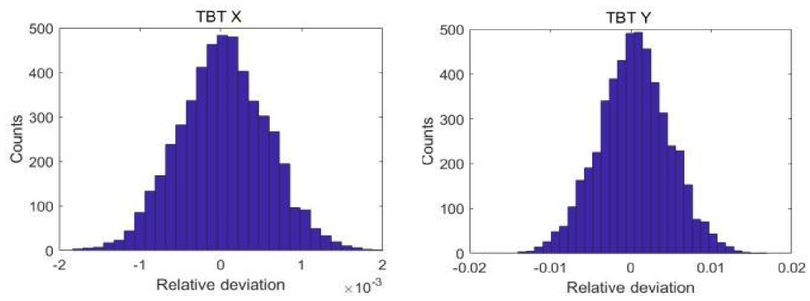
RF analog front-end



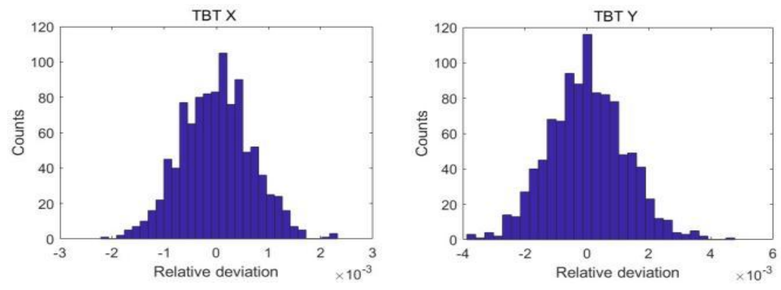
DDC of quadrature demodulation

•Pilot compensation

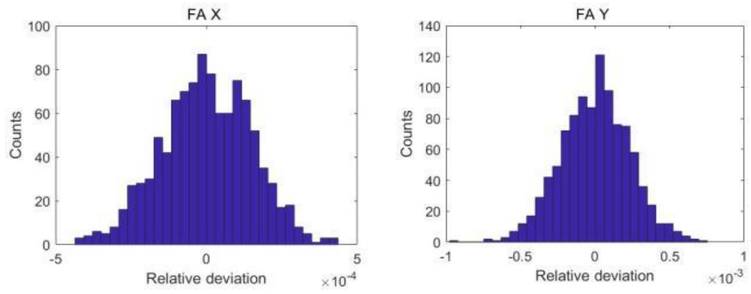
No pilot compensation TBT, X relative deviation is 0.748 μm, the Y resolution is 0.857 μm



Pilot compensation TBT, X relative deviation is 0.392 μm, the Y resolution is 0.496 μm



Pilot compensation FA, X relative deviation is 86 nm, the Y resolution is 93 nm,



•Conclusion

Based on the pilot compensation scheme, SSRF developed a new BPM digital signal processor prototype with pilot function on the basis of the original self-developed BPM signal processor, and carried out equipment testing and data analysis in the laboratory and storage ring, and obtained that the beam position resolution has been significantly improved.