A Rad-Hard 3-Channel 104 dB SINAD 3.2 kSps Sigma-Delta ADC

Keywords: Sigma-Delta ADC, Radiation Hardened ADC, Multichannel ADC, Magnetometer

Technical Summary

Pacific Microchip Corp. has developed a radiation hardened 3-channel sigma-delta ADC targeted for fluxgate magnetometers which can be used for the NASA's planetary exploration missions. The ADC achieves 16.5-bit ENOB at 3.2 kS/s rate. The ADC can operate over a temperature range from -40°C to +125°C. Radiation hardening is achieved through application of ELT structures, additional guard rings, triple-modular redundant (TMR) registers for resilient data storage, readout through majority voting and glitch filtering.

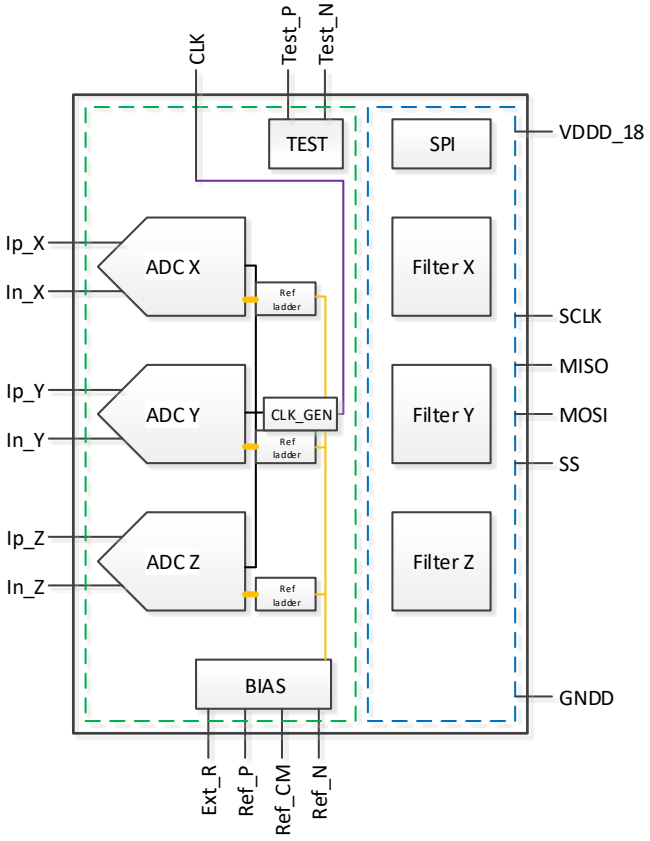


Figure 1 - Block Diagram

The ADC is available in a 44-pin CQFP package (Figure 3).

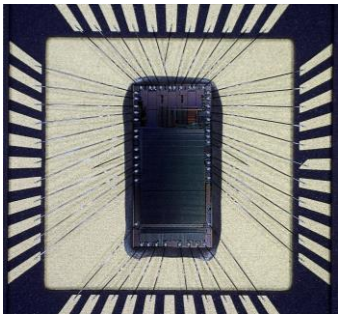


Figure 2 - Wire-Bonded Die Photo

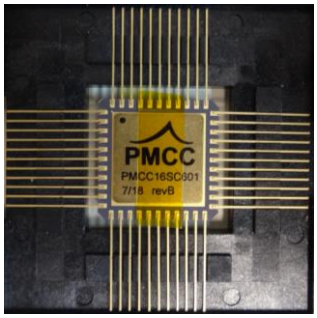


Figure 3 - Fully-Assembled CQFP Package

Operational Capabilities

The ADC offers radiation hardness and a low power consumption with reasonable conversion rate and accuracy. The specific capabilities include:

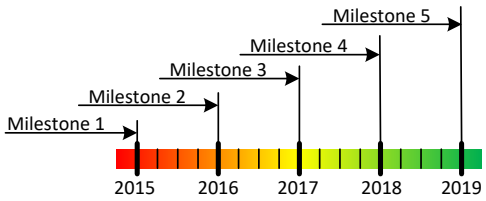
- 3 independently operated channels
- Typical clock frequency 1.6384 MHz
- Sampling rate of 3.2 kS/s (512 down-sampling factor)
- 2Vpp differential input swing
- ENOB > 16.5-bit
- Input signal bandwidth > 1.6 KHz
- Convenient output data interface
- Extended temperature range -40°C to +125°C
- Power consumption 21 mW/channel
- SPI interface for ASIC control and data output
- 180 nm CMOS technology, ELT structures
- 1.8V and 3.3V power supplies
- 44-pin CQFP package

Development Objectives & Milestones

Pacific Microchip Corp. designed, fabricated, and characterized a prototype version of the SD ADC through a NASA-sponsored effort. Improvements were made in a subsequent chip revision which satisfies all project requirements.

Significant developmental milestones include:

- Milestone 1: Feasibility is proven through simulation
- Milestone 2: Prototype ADC chip is taped out
- Milestone 3: Prototype chip is fabricated and tested
- Milestone 4: Final chip is designed and taped out
- Milestone 5: Final chip is fabricated and tested



Aerospace / Space / Military Applications

The rad-hard SD ADC is suitable for applications requiring high precision in power-constrained environments.

- Spaceborne magnetometers, inertial sensors (accelerometers, gyroscopes), and other precision instrumentation
- Earth and space science missions

Commercial Applications

- Receivers, space communication and navigation systems
- High precision measurement electronics
- Medical electronics
- Automotive electronics and portable devices

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