Update on the Development of the Rad-Hard TM/TC MS-ASIC

(Abstract)

I. Content

The preliminary structure of the paper is described below:

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II. Abstract

This work presents the status of the TM/TC MS-ASIC development (telemetry and telecommand mixed-signal application specific integrated circuit) and describes its final implemented features and target applications.

TM/TC MS-ASIC integrates in a single chip solution the functionality of many electrical and electronic components used on spacecraft subsystems. Its main goal is to replace these components, and hence to reduce area and weight of the PCBs (printed circuit boards) implementing these subsystems. Some examples of units located in the spacecraft platform that could benefit from this replacement are RTU/RIU (remote terminal and remote interface units, respectively); additionally, ICU (instrument control unit) used in the instruments of the payload can also profit from this approach. Consequently, the overall spacecraft can be cheaper, lighter, and more compact, which is aligned with the emerging trend in the space industry towards reduced-size satellite fleets.

The TM/TC MS-ASIC is implemented with UMC L180 technology, taking advantage of the DARE180U libraries. In fact, the available catalog of DARE180U IO cells was enlarged in the frame of the project (and in the benefit of the DARE users' community) to cover the cold-spare functionality of the digital communication interface. To reduce risks and development time, the IP of a ΔΣ modulator with suitable performance was reused in this development; additionally, other available IPs were tailored with additional functionalities (low-dropout regulators with over-voltage and over-current protections) or enhanced performances (internal voltage reference). The design has been hardened against radiation effects applying validated techniques in previous projects. The design will be packaged in a custom CQFP-100.

The function of the TM/TC MS-ASIC is to acquire telemetries and to generate telecommands from sensors and for actuators included in other spacecraft subsystems, such as the propulsion, the AOCS (altitude and orbit control system) or the SADE (Solar Array Drive Electronics). Some examples of these sensors and actuators are thermistors, gauges, magnetometers, star trackers, sun sensors, reaction wheels, control moment gyroscopes, magnetorquers, flow control and latch valves or catalytic bed heaters. To increase the voltage range of the analogue channels, telemetries can be acquired using external sensing networks biased with an internal control. The result is that 54/27 [0; 10] V single ended / [-10; 10] V differential channels limited in band up to 50 kHz can be acquired with 11 ENOB. Telecommands allow bi-level, single pulse, hysteresis, pulse-width modulation, and voltage monitoring alarm functionalities with frequencies from 100Hz to 10MHz. Communications interface is implemented as a redundant SPI bus at 20MHz.

The project is currently at the beginning of the validation phase, where extensive tests will be carried out to check the requirements of the design. Additionally, a system prototype combining in a PCB the test chip of the ΔΣ modulator together with digital core implemented in a PROASIC3 FPFA was validated with excellent results.

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V. COMMENTS

No additional comments.