Nanosatellite OBC

WWW.CLYDE.SPACE
Nanosatellite Onboard Computer
Clyde Space’s Onboard Computer (OBC) is our flagship Command and Data-handling subsystem, it has been designed with low power consumption and radiation-tolerance in mind to support commercially reliable service-guarantee, whilst maintaining the cost benefits of utilising COTS components.

Performance & Reliability

Low Power Consumption
The Clyde Space OBC system has been designed to consume 350-400mW of power whilst operating, delivering an impressive 4mj/DMIP which we believe makes our OBC the most power efficient COTS nanosatellite computer system currently available.

Reliability
Worst Case Analysis (WCA) has been performed in order to ensure that the system reliability meets Clyde Space Standards. This takes into considerations drifts of parameters of the different components in the system, failure rates, temperature drifts, manufacturing processes, radiation, operation environment and mission lifetime.

Memory Capacity
The main processing memory is provided by 8 MB of EDAC protected external non-volatile memory, which allows for deep sleep modes with zero-boot and zero-sleep times. Additionally 4 GB of NAND flash memory is available to store critical and safeguard information, including configuration and boot parameters, mission and system, logs, post mortem and mass memory storage with a total capacity of 4GB. Memory is implemented as two independent and separate banks which can be used to avoid a single point of failure. Non critical memory can be further expanded through the use of a micro SD card.

Fault Monitoring
Soft and hard watchdog timers are used to detect and recover from a hung state. Expiry of the watchdog results in power cycling of the OBC. Hardware counters and status registers for each of these mechanisms/effects are exposed via a hardware register and are available for the bootloader and application software. Counters detail the number of EDAC errors detected and corrected (including figures on SEC-DED corrections and latch-up events). The application can monitor them and undertake appropriate preventive or corrective actions (such as memory scrubbing and self-testing). Interrupts can also be triggered in response of these events.

Smart Fusion 2 FPGA
Clyde Space has designed the system around a Smart Fusion 2 FPGA, which has been selected by analysis to determine the most radiation-tolerant FPGA fabric and design layout. Our FPGA incorporates an ARM Cortex M3 Softcore processor which can operate in excess of 150 MHz delivering upwards of 180 DMIPS.
Technology Readiness Level

The Clyde Space small satellite OBC is fully developed and currently at TRL 8; it is expected to reach TRL 9 flying aboard several Clyde Space satellites in the latter half of 2016.

OBC Radiation Protections

The computer is designed with several mechanisms in place in order to mitigate the effects of SEE:

- Latch-up current monitoring and limiter (SEL protection).
- Memories are protected via a SEC-DED code to safeguard against SEU bit flips. EDAC Scrubbing is performed in software and can be entered via an optional exception. Our EDAC provides data and address protection to guard against address/control signal transients within the memory subsystem.
- SEFI transient within memory banks are handled by an automated hardware/software retry mechanism. Independent power supply to memory banks, coupled with the use of non-volatile memories, provide a mechanism for implementation of a retry after power cycling mechanism which makes memory latch-up completely transparent to application software.
- Peripheral FIFOs (RS485, CAN and UART) are protected via a SEC-DED code.
- A watchdog timer/heartbeat mechanism is implemented to recover from SEE within all subsystems.
- Fault handling is performed in cooperation with the bootloader. SEEs do not trigger automatic computer switchover nor entry into safe modes. However hard double faults will trigger entry into safe mode or automatic switchover (if enabled). For this purpose, a section of the safeguard/non-volatile memory may contain configurations and state variables for the bootloader.

Quality and Product Assurance

At Clyde Space, we ensure that all product production and test adheres to a strict quality control policy. This policy is a result of extensive experience in the design and manufacture of small satellite subsystems. This approach has been proven time and again on numerous spacecraft, even when using what the space industry would traditionally refer to as non-flight component (i.e. plastic encapsulated and commercial components). Our boards are assembled and inspected by ESA qualified assembly technicians.

All testing of flight hardware is performed in our self-contained, ESD controlled laboratory area or cleanroom. We operate a strict quality control system where every piece of hardware is independently visually inspected to ensure uncompromised build quality. Furthermore, our technical review process ensures that the hardware receives peer review at throughout the project.

For further information on our test facilities please refer to our website www.clyde.space

SPACE IS AWESOME
Our industry leading Off-The-Shelf OBC has been designed, built and tested utilising our extensive mission experience.

The OBC provides a highly integrated robust computing platform for space applications. The advanced power management features allow for modular controllable and protected power delivery providing an impressive 4mJ/DMIP energy usage.

EDAC and latch-up protection as well as TMR protection are used to deliver a no-compromise reliable computing platform. Non-volatile MRAM memory provides a zero-boot and zero-sleep times which can be used to provide further energy savings, whereas the inclusion of 4GB of SLC flash memory provides ample space for mission data storage.

Furthermore, the extensive set of peripherals allow for high integration, cost and power reduction of typical missions.

Key Features

- Reliability - Robust against single event effects due to extensive modular protections systems (i.e. power delivery, memory content and address protection via CS custom EDAC codes, TMR registers)
- Fast and power efficient cortex M3 processor delivering upwards of 140 DMIPS.
- Use of SEE immune components including the memory which is based on a non-volatile magneto-resistive RAM
- Zero-boot time and ultra-low power saving modes
- Extensive on-board peripherals, including 3D magnetometers, gyros, RTC, watchdog and timers.
- The inclusion of 4GB of SLC flash memory provides ample space for mission data storage.
- Optional GPS Chip can further enhance capability.
- Wide range of high-speed interfaces including SpaceWire compatibility

Visit our website www.clyde.space to purchase our OBC

Our OBC is designed to work optimally with our ADCS and the Clyde Space Battery and EPS range.

For more information and for quote consultation please contact enquiries@clyde.space

SPACE IS AWESOME