

# CPT Basic Hardware and Software Components: Electronics and Software

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## **Abstract**

The detailed structure and functions of the electronics and the software of the Charged Particle Telescope (CPT) are presented. The performance requirements of the critical analog and digital parts are given. The basic electronic components are defined and selected. A First order calculation of the power consumption, volume and mass of the electronics is presented.

The electronics of CPT consist of the following elements: charge sensitive preamplifiers and shaping amplifiers for signal collection from the detectors, fast discriminators for trigger and event characterisation, pulse height sampling circuits and A/D conversion electronics, logic for the coincidence analysis of the discriminator pulses, and a computer for data analysis and storage.

The analog electronics of CPT are based on integrated, quadruple-gain preamplifiers followed by fast and slow filter amplifiers. The signals from the slow filter amplifiers are pulse height analysed, whereas the fast signals are fed into a discriminator bank. The discriminators create inputs to the logic circuits identifying the valid event conditions, producing status and control signals, and defining conditions representing various particle species at different energy ranges, which are recorded in counters.

The digital electronics are implemented as a distributed system by using several Field Programmable Gate Arrays (FPGA). Each amplifier block has its own FPGA controlling the A/D-conversion. In addition, each CPT telescope has a main logic circuit divided in several functional units. Each of the telescopes also has its own microprocessor. These are controlled by a main processor, which also serves as the data interface to the spacecraft.

The primary tasks of the main processor are to collect the data from the sensor processors and transmit them to the spacecraft data handling system. In addition of control functions, important tasks of the sensor processors are to collect, analyse, and compress the data from the sensors.

Based on a selection of the primary components, the power consumption of the electronics is estimated to be 6.5 W. The mass of the analog and digital electronics printed circuit boards, without the power supply, is estimated to be 740 g.