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# SINGLE-BOARD ARCHITECTURE: AN INNOVATIVE WAY TOWARDS TABLET SATELLITE

**Abstract**

Due to the limits of size, mass, and power, the design and integration of micro-nano satellite are greatly challenged to achieve high function density. To solve this problem, the key is to develop a highly integrated architecture. In this paper, the main reasons leading to the relatively low function density of typical traditional satellite architectures are analyzed first. Then according to the features of micro-nano satellite, a highly integrated single-board architecture is proposed, based on which a micro-nano satellite design method is developed to realize high function density by three levels of integration. The first level is information integration based on integrated electronics system. Through repeated information flow optimization of power supply and distribution as well as telemetry link, stratified information integration and highly efficient onboard resource sharing are realized based on onboard computer, telemetry lower computer, and satellite data bus. The second level is no-cable component integration based on single mother board. Specific to low earth orbit satellite, a series of microminiaturized components are developed based on Commercial-off-the-shelf (COTS) products, which can be directly integrated onto the mother board by plugging or welding. Then the wires and harness can be avoided and the effective mass ratio can be improved. The third level is structure integration based on multi-functional structure. A multi-functional structure with grid layout is designed and optimized by Multidisciplinary Design Optimization (MDO) method, which can effectively support load bearing, thermal control, and Electro Magnetic Compatibility (EMC). To sum up, this single-board architecture features high function density, no internal wires and harness, high reliability, and flexible extension for future mission. Based on this architecture, the nano-satellite Tiantuo-1 (TT-1) was developed with the mass of 9.3 kilograms and the size of 410 mm by 425 mm by 80 mm, which exactly looked like a tablet computer. It was launched into space on May 10th 2012 and successfully completed the tasks of earth optical imaging, atomic oxygen density detection, and space-borne Automatic Identification System (AIS) receiver flight test. It continuously worked normally for 14000 orbit circles and 22000 hours. Fruitful scientific research data and application effects have been achieved, which greatly proves the efficacy and advantage of the single-board architecture.