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Abstract
In order to satisfy the throttling and multiple restart characteristics of the hybrid rocket engine and guarantee the controllability and security of hybrid rocket, the test launch and control system for hybrid vehicle needs to achieve ground power control, serial communication with the flight control computer and the telemetry system, onboard thermal battery activation, battery voltage acquisition, power conversion, pressure monitoring, valve control, booster ignition, power-off and remote pressure relief in emergency. Considering the complexity of the test launch and control system for hybrid system and the advantages of Field Programmable Gate Array (FPGA), such as, a large number of I/O ports, ability to efficiently implement large-scale systems and programmability, a FPGA based test launch and control system for a type of hybrid vehicle was designed. Many conducted ground and flight experiments have proved that the system has superior performance in integration, universalization, miniaturization, automation and can perfectly meet the needs of the hybrid vehicle.

Keywords-hybrid vehicle, test launch and control system, FPGA, internal logic

Introduction

Hybrid rocket engines use liquid oxidizer and solid fuel as propellants, which have advantages such as safety, low cost, throttling and multiple restart capabilities [1-2]. The hybrid rocket engine presents extensive application prospects in the fields of sounding rocket, launch boost, small satellite propulsion system, and manned space-ship [3]. As the representative, US Lockheed Martin Company and NASA combined to develop "HYBRID Sounding Rocket" (HYSR) project in 1995 to verify rocket performance with high thrust, break through key technologies in pressure boost with helium and transmission system, in experimental system and so on to advance maturity of its engineering technique. In 2002, they launched the largest hybrid rocket to this day, whose length was 17.4m, diameter was 0.6m, valid loading was 360kg and flight time was 219s, which proved to the world the hybrid vehicle's development potential, sparked a research boom all over the world. In China, Beihang University launched China's first hybrid vehicle "buaa.2" successfully on December 5, 2008 and "buaa.3", which realized the variable thrust during flight on April 25, 2012 [4-6].