Design of base station backup power system constructed with ladder battery

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Abstract. With the vigorous development of new energy technologies, the scale of the electric vehicle market continues to grow, and the number of electric vehicles has risen sharply. The problem that comes with it is that a large number of decommissioned power batteries are in urgent need of treatment. The power battery that has been retired from the whole vehicle still has objective capacity and large utilization value. Finding a suitable way to use the ladder is a commonly accepted treatment method. The communication base station backup power supply has a huge demand for energy storage batteries, which is in line with the characteristics of large-scale use of the battery by the ladder, and has become one of the main application fields of the battery. In view of the characteristics of the base station backup power system, this paper proposes a design scheme for the low-cost transformation of the decommissioned stepped power battery before use in the communication base station backup power system.

1. Introduction
At present, the number of home base stations in mobile cellular systems exceeds 70 million. In the early stage, there were many small access nodes randomly deployed, which brought great challenges to network resource allocation, interference management, and energy efficiency problems. Energy is expected in 2020. Consumption will increase by 40%. Therefore, it is urgent to solve the energy consumption problem of mobile communication networks.

With the Ministry of Industry and Information Technology dividing the spectrum for the commercial networking of the three operators, in 2019, the three major operators in China began to build 5G trial networks in some large cities. Among them, China Unicom and China Telecom 5G use 3.5GHz high-band networking, which will inevitably require a large number of new base stations, and sharing China Mobile base stations will effectively improve site utilization, save investment, reduce site selection difficulties, and shorten construction period. However, while increasing the sharing rate, it will inevitably bring a series of problems to the original organic room, such as insufficient external capacity, insufficient rectifier modules, and insufficient space in the equipment room.

In view of the characteristics of the base station backup power system, this paper proposes a design scheme for the low-cost transformation of the decommissioned stepped power battery before use in the communication base station backup power system.
2. Overall Design
The communication base station backup power system usually consists of the battery itself and a battery management system (BMS). The BMS is the core part of the backup power system. Its functions include the collection, monitoring and protection of the battery cell voltage, current and temperature, and the battery pack SOC. The calculation, as well as the on-off control of the main circuit charge and discharge MOS tube.

Power battery modules decommissioned from electric vehicles usually come with BMS, but the BMS generally only has the function of single voltage and temperature acquisition, which is not enough to realize the complete function of the backup power system. Usually, the use of decommissioned batteries in the backup power supply field requires disassembly, disassembly, and reassembly of the battery pack, and then the BMS dedicated to the backup power supply can be completed. The entire process takes a lot of manpower and time, and the cost is high.

The system fully considers the reusability of the module in design, and uses the module BMS to collect the battery voltage and temperature information, which can greatly reduce the hardware cost of the ladder system. The system uses STM32 microcontroller as the controller, integrated main circuit MOS switch, shunt, RS485 and control panel to achieve other functions of BMS. The schematic diagram of the system is shown in Figure 1.

![Figure 1. Schematic diagram](image)

3. System hardware design

3.1. Targeted Patent Portfolio
The backup power BMS is divided into power module, CAN interface module, current detection module, MOS switch module, RS485 interface module and button indicator module according to the functions to be realized by each module. The hardware structure of the system is shown in Figure 2.
Figure 2. Hardware Structure

Power Module: Unlike the electric vehicle BMS, the BMS of the base station backup power supply requires power directly from the battery. The power module contains two levels of DC/DC conversion: 48V to 12V and 12V to 5V. 12V is used to power the battery module BMS and MOS switch drive; 5V generates 3.3V through the LDO, which is used together for power supply of the STM32 system and surrounding interfaces.

CAN interface module: CAN interface is mainly a CAN transceiver, here uses NXP TJA1051T. STM32 integrates the controller supporting CAN2.0B, and connects to the battery module with BMS through CAN interface to obtain the voltage and temperature information of the unit.

Current Detection Module: The current detection module is responsible for collecting the current information of the main circuit for system protection and battery SOC estimation. Specifically, it includes a shunt connected to the main circuit and a bidirectional current sampling chip. TI's INA226 is used here.

MOS switch module: In order to save cost, the main circuit switch uses back-to-back MOS tube to achieve independent control of charging and discharging. The withstand voltage of the MOS tube should be above 100V, and the specific parallel logarithm is determined by the specific operating current.

RS485 interface module: The system realizes remote communication with the background through RS485 interface. Here, the isolation method is required. The adopted scheme is ADI's ADM2587E.

Key indicator module: The button and indicator are located on the device panel for device startup, battery indicator and alarm indication.

4. System software design

The software functions of BMS are complex, and the system is designed with a layered architecture based on functional components. The software structure is shown in Figure 3. From the lower network, it is the device driver layer, the common component layer, the functional task layer, and the product application layer.
Figure 3. Software System Structure

The device driver layer is mainly used for abstract hardware interfaces, and provides standard API functions upwards for cross-platform porting.

Common components The main upper-layer system provides a variety of basic functional components, including timers, messaging, online upgrades, and online debugging.

The functional task layer is responsible for performing some common tasks of the BMS, such as collecting voltage and temperature information, collecting current information, controlling MOS switch on and off, SOC estimation, and alarm and exception handling through the CAN component.

The product application layer mainly performs some functions related to the specific application scenarios of the backup power system.

In the above component development architecture, the functionality of each BMS is developed as a component. Each component is executed as a task, supporting polling tasks, timing tasks, or interrupting task execution. Most BMS tasks rely on data such as current, voltage, temperature, etc. The software platform performs the sampling work and provides the interface supply task to query the sampling results. Decoupling between components through the data abstraction layer is more conducive to component development mode. The event mechanism allows efficient communication between tasks, avoiding the need to reduce execution efficiency by polling.

5. Conclusion
The base station backup power system designed in this paper can quickly and cost-effectively use the decommissioned battery of the electric vehicle without disassembling the module, which not only greatly prolongs the service life of the power battery, but also effectively solves the problem of recycling the decommissioned battery.

Under the trend of new energy, with the popularization of electric vehicles, it is the general trend to provide good solutions for the use of decommissioned batteries and promote the healthy development of the industry. The base station backup power supply has a huge demand for energy storage batteries. With advanced technology and reasonable processes, it can play an important role in the utilization of electric vehicle decommissioning batteries.
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