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WHITE PAPER

Battery Management Technology White Paper

Battery Management Technology

1. Impedance Tracking Battery Life Technology

The camera uses Texas Instruments (TI) impedance tracking technology to calculate the remaining battery life. The impedance tracking technology, a self-adaptive algorithm with TI patent technology, can remember the battery change during its usage and get the accurate battery life by combining the algorithm and the battery chemical property. There are two ways to realize the technology:

- 1) Get the battery life by using the open circuit voltage (look-up table) is easier. It can get the battery life by using the open circuit voltage look-up table. The battery aging changes under different power loadings, different temperatures, and the battery voltage and life also change dynamically. To get the accurate calculating, it should be corrected based on the temperature and battery lifespan. This way is suitable for the constant power loading to get the accurate battery life.
- 2) Calculating the battery based on the coulomb meter is a way by checking the current and voltage to accumulate points. This way is more accurate to calculate the battery life in and out and is suitable for the full charging and discharging loading, e.g., the electrical tool. More current it discharges, more accurate the calculation. It is not suitable for the low power loading that works for a long time, and it may accumulate the deviation. The low power camera is not suitable for the coulomb meter because its low power consumption. If adopts the way of the coulomb meter, the open circuit voltage should be used together for improving the accuracy.

2. Black Box Design

The battery contain a black box (512KB FLASH) which can track abnormal temperature, short circuit protection, charging overcurrent, discharging overcurrent, and the over voltage protection. The RTC chip can record the date. The master computer can get that information and the master camera can get those remotely. If the battery fails, the black box can track the battery's historical exceptions. The allowed maximum number of the recorded logs are 3270 and each log contains the time that the exception occurs (accurate to seconds), the current protection status (overvoltage, undervoltage, overcurrent, over temperature, low temperature, short circuit and AFE exception), the current voltage, current temperature and battery power.

3. Standard Battery Replaceable

Hikvision battery is designed by the RS-485 standard protocol that is defined by Hikvision to ensure the system can work properly when upgrading the battery capacity. The system can recognize different batteries intelligently and ensure the accuracy of the battery power. If a battery does not support RS-485 protocol, the battery power may not accurate and the battery information cannot be get.

4. Low Battery Self-Depletion

Battery of our company has rather low battery self-depletion and can be stored for a long period. If the battery is not used for communication, it is under sleep mode. Moreover, we adopt Texas Instruments (TI) battery fuel gauge, protective chip, and impedance track technology to reduce battery self-depletion.

The BMS design shows great concerns to the factors that affect battery self-depletion and reduces the self-depletion from various aspects to solve the problem that the battery has exhausted and users cannot debug the device when they receive the device due to long-term storage and transportation. The major advantages of this design are as follow:

- 1) Customized solar charge controller. For the traditional controller, it consumes 10 mA even the controller is not connected to the solar panel. The consumption is a rather high value (0.1 W) for a complete system. Based on the same equipment and settings, the system with our low power solar charge controller can improve the battery life up by 10% according to our test.
- 2) Ultra-low-power MCU. This design adopts ultra- low-power MCU to make sure the device performs excellently under either running or sleep status and the battery energy can be put to best use.
- 3) Low power RS-485 circuit with unique design. The circuit design we adopt can make sure the power is thoroughly cut off under non-communication status. Furthermore, the RS-485 circuit is separately placed so that the battery will not be burned when short circuit occurs to the signal cable and the battery.
- 4) Adopts Analog-front-End (AFE) chip from TI, the top chip design company of AFE. TI chip, as the core of the battery design, can make sure low power and high reliability.

5. Battery Insulation Technology

The battery insulation technology protects the interior of the battery from the exterior high temperature. The battery adopts aluminum case and will not be damaged during the burning process. We also adopt the pressure relief valve to balance the internal and external

air pressure to prevent explosion due to high internal air pressure. The battery reaches IP67 waterproof rating. The major advantages are as follow:

- 1) The battery chip is supported by the internal bracket to protect the battery from force caused by vibration and to prevent extrusion between batteries.
- 2) The wrapper between the battery and the case includes not only the EVA foam for buffer, but also FR4 material for supporting. FR4 material can also function as heat insulation and flame retardant and stay its original shape under high temperature.
- 3) The battery reaches IP67 waterproof rating and is equipped with pressure relief valve to prevent case explosion and relevant injury due to the imbalance between internal and external air pressure caused by force majeure.