8 points checklist

selecting the right type of power supply of mobile applications

When developing new battery-operated devices, the decision regarding the type of power supply required is often left too late or given too little attention. This is particularly the case today when so many mobile gadgets – or wearables – are in development.

Since its beginnings in around 1780 with the Italian physician Luigi Galvani, the field of electrochemical battery technologies has not developed at the same speed as the semiconductor industry where Moore's law applies. The fundamental principles of primary and secondary cells have been investigated at length. The central electromotive series are known. This seems to have lulled developers into a false sense of security. In the back of their minds, there is the sense that everything is doable. All of the specifications required in the future are available. We'll think about the battery once we've sorted out the rest of the design. In many cases, this can result in surprises when it comes to finalizing designs for new devices.

The energy supply is essential

As the power supply for the application, the battery often constitutes a significant – and large – part of the device. Of course, as a developer, it is much more interesting to pack as many functions as possible into one device. But it is worth bearing in mind that the battery also has to be able to supply the required amount of energy over the entire application scope. This can result in some very contradictory requirements. The battery should last as long as possible and, of course, the device should work perfectly anywhere in the world, from the North Pole to the jungle. The cell must not take up a lot of space and the cost of the batteries should be kept to a minimum as well. When all of these factors are taken into account, it may well become clear that the preferred type of power supply is not feasible under these conditions.

Encourage early discussions about relevant details

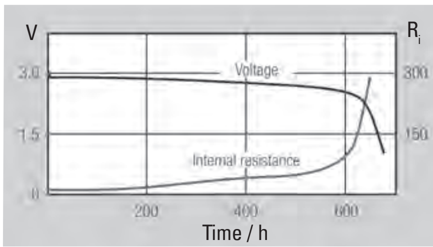
The following points and questions should therefore be considered and resolved at an early stage of device development. This can help to avoid redesign costs on the one hand, and also enables battery manufacturers and power supply providers to offer the necessary support and check what is possible within the specified framework.

1) What are the required voltage ranges?

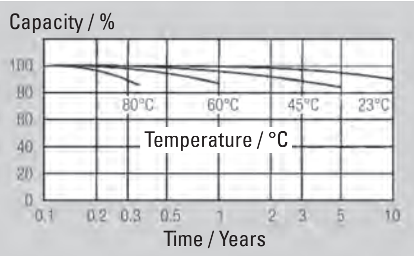
The nominal voltage should be the operating voltage (on average) of the application where possible. The cut-off voltage should fit optimally into the voltage window of the battery chemistry and take into account the load peaks.

2) What kind of current does the application use?

Current load profiles, which reflect the load of the application as precisely as possible, are becoming more and more important, as higher loads are required for brief periods, e.g., for radio transmissions. Experience shows that pulse loads are sometimes converted into average currents, which can lead to miscalculations of the required capacity. It is extremely important to take into account pulse peaks. Higher pulses result in a higher voltage drop, which means that it is not always possible to use the entire nominal capacity of a battery. Therefore, in most cases, dividing the nominal capacity of a battery by the average current load will not produce the service life of the application. In most cases, the functional life of a battery which is loaded with pulses can only be estimated by means of simulations, empirical →



Typical discharge curve: Renata CR2540N at 3.3kΩ



Self-discharge-rate referring to the ambient temperature

values, or qualification tests.

3) What temperature range can be expected in operation?
The temperatures that the battery will be exposed to must be specified, and both the standard case and worst-case scenarios must be taken into account. The maximum and minimum values to be expected must be defined, along with the performance profile that is expected from the battery at these extreme temperatures. The more precisely these specifications can be defined, the more certain it is that the battery will meet the requirements. The self-discharge (see point 5) over the service life must be considered in this context. At low temperatures, self-discharge can be disregarded again, but the increased internal resistance will then impair the pulse capability of the cell. This means that the voltage drop increases and the available power drops.

4) What is the minimum requirement in terms of the service life for the application?
When developing an application, it is also important to think about typical end user behavior with regard to the battery:
- Is a simple disposable solution required or does the application need a rechargeable cell?
- How long does the device need to be functional as a minimum in the case of disposable solutions?
- Will the battery always be charged before using the application?
- What is the typical charging behavior?
- How long should one battery charge last?
- Will the application be in constant, regular use?
- How long is the typical usage period that the application is expected to get through without interim charging?

5) How long will the application be in storage before being put into operation? What are the storage conditions?
People often forget that cells discharge even when they are not in use. At a room temperature of 20°C, the annual self-discharge of a 3 V lithium button cell can be between 0.5% - 2% (depending on the manufacturer) of the nominal capacity. As a rule of thumb, the self-discharge roughly doubles for every 10°C increase in temperature. This means that, at 30°C, the self-discharge increases to 2%. At 40°C, it increases to 4%, and so on. In accordance with IEC60086-1, the ideal storage conditions are between +10°C and +25°C. Storage above +30°C must be avoided! At temperatures below +20°C, the self-discharge will remain stable at around 0.5% to 2%. The batteries can be stored at lower temperatures, but "defrosting" them quickly before use may result in condensation which can cause creepage currents, corrosion or even short-circuits. Depending on the battery type, there may even be further complications.
The general rule is that the self-discharge rate can vary considerably depending on the chemical system. The data sheets from the manufacturers should provide relevant information.

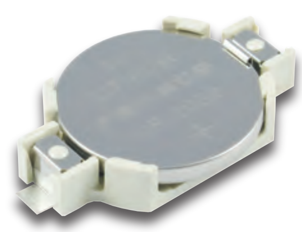
6) What are the desired dimensions for the battery?
The framework conditions are set either by technical specifications or by human ergonomics. The available volume and any restrictions regarding a dimension and/or the weight will have a significant impact on the available options for battery technologies. The volume is of course directly linked to the potential capacity and is often the determining factor for hand-held devices or smaller applications. The most commonly used designs are prismatic cells, round button cells, and cylindrical cells.

7) How should the battery be contacted in the application?
If a holder is used, the holder and contacting can be integrated directly into the housing design. Requirements regarding battery replacement, mechanical and electrical safety, and reliability are particularly crucial here. The contacting, battery holders, and spring contacts must be tailored toward the application and the weight of the cell. In addition, the specifications are determined by the soldering procedure used during manufacturing. Details regarding the occurrence of vibrations can also play a key role. If the contacting is not fixed (e.g., in the case of smaller button cells), the spring contacts can be plated in gold for very demanding applications. The transition resistance is very low and gold is particularly resistant to many other materials. If there is a permanent connection between the application and the power supply, litz wires or metal contacts on the battery should be considered as an alternative. Welded-on or soldered arresters should always be fitted by the manufacturer. The battery may become damaged if soldering lugs or pins are attached directly to the cell in an improper manner, e.g., using a soldering iron.

8) What kind of mechanical forces is the application subjected to?
It is important to consider the effects of impacts, centrifugal forces, and bending on both the cells and the contacts. Manufacturers often find that such requirements are not included in a standard specification. All specific requirements that are not included in the standard specification should be described as precisely as possible and a qualification test should be agreed with the supplier as necessary.

Conclusion

While ensuring all due discretion in development projects, it is important to note that the quality of advice provided by battery suppliers depends directly on having access to detailed information regarding the application. Specific questions to evaluate a possible power supply can only be answered on the basis of detailed information. The signing of a non-disclosure agreement (NDA) may be considered on a pro forma basis if there is no other way of passing on information.



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