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Smart Batteries for Medical Devices

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Portable medical devices have benefitted hugely from various advanced technologies which were initially developed for consumer electronic devices such as notebook computers and smart phones, when coupled with these enabling technologies they are being developed faster, made easier to use, and now perform more reliably than ever before.

One continuing complaint from consumers is ‘battery life’. If the battery in your notebook computer runs out while you are writing a report it is annoying, if the battery fuel gauge on your smartphone jumps instantly from 25% to 0% and then shuts off while you are on the train home then it can be frustrating – but in either case no real harm is done. However if a doctor in a hospital is transporting a patient connected to a battery powered portable ventilator or, similarly a paramedic is working on a patient in the street using a battery powered aspirator, then the batteries used to power the portable medical equipment must be completely reliable or patient care could be at risk. These batteries must work each and every time and never let the medical professional, or their patients down when they need them most.

The Traditional ‘Dumb Battery’

Traditional battery systems used in medical devices are usually charged by an internal or external charger which uses a pre-programmed charge regime that makes go / no-go decisions based on the battery voltage and temperature. Such systems cannot handle upgrades in battery capacity or technology and may also attempt to charge a battery that is damaged - this raises safety concerns.

When being discharged in the host device, the traditional battery cannot provide any form of run time prediction and host devices must resort to crude voltage measurements to provide an approximation of remaining capacity. Such systems become unreliable with changes in temperature and are also affected by battery ageing due to an increase in resistance, resulting in a reduction in the voltage under load.

These traditional battery systems are also known as ‘dumb batteries’ and are unsuitable for modern medical devices where safety is paramount and accurate runtime predictions are required.

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The Smart Alternative

Understanding how much runtime remains is vital for users of portable medical devices. If a medical professional cannot rely on the battery fuel gauge then they lose confidence in their ability to use the device away from the AC supply and suffer from runtime anxiety – the worry that they cannot complete their task before the battery energy is depleted.

A good battery integrator will gain a deep understanding of how the medical device will be used and design an electronic fuel gauge system into the battery which constantly tracks the charge, rest and discharge activity. These electronic systems factor-in the prevailing environmental conditions and even the age of the battery to provide a runtime prediction which can be as accurate as ±1%. This runtime prediction is automatically communicated to the device which then displays it in a format the user can easily understand – the battery will even communicate warnings when runtime becomes critical so the user can take action and charge the battery or replace it with another.

As safety is paramount, a battery integrator will include active protection circuitry into the design. These protection circuits monitor the voltage of each cell in the battery and prevent its charge or discharge if one or more cells is in an over-charged or over-discharged condition. The battery is also protected against over temperature conditions or if discharge currents exceed predetermined levels. Industry best practice dictates that secondary over-charge protection is included when designing Lithium Ion batteries to prevent them from becoming unsafe should both the charger and active protection fail. Secondary over-charge protection activates a non-resettable fuse, permanently preventing further operation.

Robust communications between battery, host device and charger are vital for reliable operation of any battery powered system. Most smart batteries are compliant with the Smart Battery Specification (SBS), utilizing System Management Bus (SMBs) communication. One advantage of such a system is that components from different vendors can be used seamlessly.

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Smart chargers

Smart chargers work with smart batteries to maximize safety, reduce charge time and extend product life. When a smart battery is inserted into a smart charger the battery communicates its specific charging requirements to the charger. The charger responds by providing the voltage and current until the battery tells it to stop charging, the battery may amend its charging criteria during charging if environmental conditions change.

Chemistry independence and future proofing

One of the main advantages of a smart charger is its ability to adapt to an unknown future. Smart chargers respond to the charge requests made by the battery, which means they can be used with batteries of different voltages, capacities, chemistry or manufacturer. Such a system provides the OEM with peace of mind that their smart charger will be compatible with existing and future ranges of batteries - meaning fewer chargers are required and chargers last longer in the field.

Conclusion

The market for portable medical devices is growing quickly and traditional battery systems lack the fuel gauging capabilities required by OEMs. Smart batteries have emerged as the answer, providing accurate runtime information that device users can rely on whilst increasing system safety.

Battery integrators continue to play an important part in providing OEMs with the best battery technology available which allows medical professionals to take their equipment and skills closer to their patients where they can make a real difference - after all, the outcome for the patient is what matters most.