The objective of most design engineering teams at most European manufacturing companies is to create differentiated products that can support premium pricing. Valuable features, superior performance and outstanding design are the means by which European products can compete against low-cost competition from elsewhere in the world.

It is clear to see how engineering teams can implement this high-value strategy in the design of the core product. But should it also apply to peripheral parts of the design? It certainly can do – and as this article will show, it is even possible to differentiate a portable product by adding value to its battery charger.

So what's wrong with a standard charger?

Today, most lithium-ion battery-powered products equipped with an external charger use a standard, off-the-shelf charger. And in fact, a properly specified standard charger can be a good choice. Of course, the main benefit of a standard li-ion battery charger is that it is cheap. In addition, units bought from a reputable manufacturer will:

- Operate safely – li-ion batteries pose a fire hazard if they are charged at a temperature above their rated maximum. A charger should have fail-safe circuitry that stops the charge current if the maximum temperature threshold is crossed
- Regulate the input current – li-ion batteries require a carefully regulated charging input, changing from current-controlled to voltage-controlled as the battery nears its full capacity
- Last as long as the end product is built to last

In other words, if the product specification calls for basic battery-charging functions and safe operation at minimum cost, a standard charger is suitable.

But for premium products, the problem with a standard charger is precisely that it is standard: it looks and operates in exactly the same way as most other chargers. The typical attributes of a premium end product, on the other hand, include:

- Attractive mechanical design – manufacturers such as Apple have set a high standard for the aesthetic appearance of portable products, so now a premium product is expected to be sleek, glossy and attractive
- Unusual or innovative functionality – premium product manufacturers constantly innovate to bring new, useful features to their users
- Ultra-high quality and reliability – there is no acceptable failure rate for a premium product that is subject to normal usage
Standard chargers fall short in every respect. Standard charger manufacturers follow the Henry Ford school of product marketing: “Any colour the customer wants so long as it is [matt] black.” The best that can be said of the appearance of a standard charger is that the user will not notice it.

Chargers also provide nothing to surprise or engage the user. There is nothing else to do with the charger other than to plug it into a wall socket.

And standard chargers implement standard charging routines, with no ability to optimise for extended battery lifetimes.

In fact, there are two main ways in which a charger design can be enhanced in order to reflect the premium positioning of a high-end portable product: by adding to the charger’s functionality; and by improving the way the user interacts with it.

Enhanced functionality
The battery charger has a marked impact on the longevity and safety of the battery that it charges. Improving the charging and protection features in the charger can lead to improvements in battery performance that are noticeable to the end user, as well as to a reduction in the risk of malfunctions or hazards such as fire.

The process for charging a li-ion battery is much more complex than that for charging other battery types such as nickel metal-hydride or lead-acid. It has to be carefully regulated in relation both to the voltage of the battery, which falls as the battery is discharged and rises as the battery regains charge, and to the battery’s temperature. In general terms, a higher input current will charge the battery faster, but tend to degrade the battery more quickly: the cycle life of a fast-charged battery will be shorter.

A standard charger will offer a standard input current. A premium charger, though, can offer a charging function specially suited to the application (see Figure 1). For instance, the typical use case for professional handheld power tools is intensive operation during daylight hours only. This means that the battery may be recharged overnight so that it is ready again for use the following morning.

With a period as long as 12 hours available for charging, the input current can be set at a low level: this slows the ageing of the battery, and results in a longer cycle life than an equivalent fast-charged battery. A custom battery charger can be designed to optimise the charging routine for the length of time available for charging, and the ambient temperature in which it will be charged.

The opposite case also applies. Most mobile phone users want the period between the battery becoming fully discharged and it being available for use again to be as short as possible. The same requirement for fast charging can also apply in many professional applications in which handheld equipment is used intensively and is required at all times.

Standard chargers tend to offer a 1A maximum charge current for li-ion batteries – a level that is suitable for most commercially available li-ion cells. But in fact, the current tolerance of lithium cells varies widely. While lower-quality cells will suffer considerable damage if exposed to an input of more than 1A, others, such as those manufactured by Samsung, can tolerate as much as a 2A input. For applications requiring fast-charging, therefore, a custom charger can be precisely matched to the tolerance of the specified cell in order to take the charge current to its maximum allowable value.

More complex customisations can provide other useful functions that serve to improve the user’s experience of operating the battery. For instance, if the voltage of a li-ion battery falls below 3V, it is regarded as being deeply-discharged or over-discharged. A special charging routine is required for such a deeply discharged battery, using a low input current until the battery recovers to a normal state. A smart charger can use information about the battery’s voltage to regulate the charge current appropriately.

Fig. 1: variation in charge current has a dramatic effect on the length of time it takes to fully charge a typical li-ion battery.
It could be argued that, while extended battery cycle life is of value to the end user, it is not obvious: the user might not notice that they have not needed to replace the battery even after many charge/discharge cycles. But long life and reliability are hallmarks of premium products: the same applies to safety. Any charger that has the approvals required by law for operation in regions such as Europe and North America will have basic safety and protection features. A premium charger will often extend these features: custom chargers provided by VARTA Microbattery, for instance, include a temperature sensor in the charger. For their over-temperature protection circuitry, standard chargers rely on the temperature sensor in the battery pack. If this sensor or its signal path should fail, however, the over-temperature protection circuit will not work. The addition of a redundant temperature sensor in the charger provides a safety back-up.

For a premium product manufacturer, this offers extra assurance that their reputation will not be tainted by publicity about malfunctions or even fires attributable to their battery.

A better user experience
If the additional functionality of a custom li-ion battery charger is not always visible to the end user, its appearance and user interface most definitely are. A standard charger’s matt black plastic does not reflect the sleek, ‘cool’ look of many premium consumer products, for instance. A supplier of custom chargers should be able to match any kind of brand design. The plastic housing of a charger can be rendered in any colour, matt or glossy, and with a flawless finish revealing no rough edges or unsightly gaps (see Figure 2). The shape of the charger can also be customised to provide a distinctive outline or to fit a particular brand’s design style, and to offer customised markings on the exterior of the charger or on its label.

Customisation of a charger also allows for useful interaction between the charger and the user. Figure 2 shows how indicator LEDs can provide notifications, for instance to show when the battery is being charged, is fully charged, and to denote an error state. But full customisation allows for a wider range of notifications to be provided, through additional LEDs, or patterns of blinking.

Easily overlooked opportunity to add value
Manufacturers pay exhaustive attention to every detail of a premium product’s design. If a portable product’s battery charger is excluded from this attention, the manufacturer misses an opportunity to bring extra value to the user and to heighten the user’s appreciation of the product’s quality. And customisation of a charger entails a relatively small increase in cost compared to a standard charger. A beautiful, feature-rich and innovative charger is worth paying a little extra for.

If you are interested in learning more about FDA-qualified batteries for use in medical devices, please contact your nearest VARTA Microbattery sales office. Details can be found at www.varta-microbattery.com.

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