

## Press release/professional report

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# Smaller and more powerful: coin cells for more design freedom

## The CoinPower series from VARTA Microbattery

Designers of portable medical devices and electronic products are familiar with their challenges of space and weight reduction. There seems no limit to consumers' requirement for devices to be thinner, lighter, and sleeker. Consider an in-ear speaker or earbud. Its form factor is constrained by the size of the human ear and for this article provides a stand in for a medical device.

In electronics, the constant reduction in a circuit's size predicted by Moore's Law has helped designers do more in less space. But in the domain of energy storage, chemistry, not electronics, determines the pace of size reduction, and unfortunately chemistry has no equivalent of Moore's Law to drive reductions in the battery cell sizes.

Nevertheless, innovation in battery technology still provides answers to OEMs' demand for more energy in less volume. This article describes how improvements to a new type of coin cell from VARTA Microbattery are helping some of the industry's smallest electronics run longer between charges than ever before possible.

### From the pocket-style battery to the coin cell

In medical and consumer electronics, various types of lithium-ion technology have been widely adopted: lithium-ion chemistries for rechargeable batteries provide better ratios of energy capacity to volume and energy capacity to weight than any other battery chemistry in mass production. This is why most portable products with requirements for small size and light weight most contain lithium-ion rechargeable cells. In the past, OEMs faced extreme difficulties in scaling down lithium-ion batteries for use in devices much smaller than a mobile phone. A wireless headset using Bluetooth technology illustrates the problem.

In previous years, wireless headsets would use a custom lithium-ion battery assembly in which the cell was enclosed in aluminium foil to form a pouch. Flying leads made the connection to a host device. This complex assembly was relatively bulky. Worse, pouch-style batteries are difficult to handle on a production line. They require manual assembly, making them inherently prone to inconsistent quality and damage. In addition, the pouch enclosure is prone to premature failure when subjected to shock and vibration. This is undesirable in earphones which might be frequently dropped during fitness activities. Lastly, a custom part, unique to one customer, carries a higher supply-chain risk for the customer than a standard part, which is produced and stocked in high volume for multiple customers.

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These drawbacks led VARTA Microbattery to the development of an alternative for tiny devices such as wireless headsets. This was the VARTA CoinPower product: the industry's first rechargeable lithium-ion battery in a coin cell form factor to offer the energy capacity required by small wireless consumer devices. The first generation of these coin cells was available in 12 and 16-mm diameter versions and provide an average 3.7V output.

Behind the introduction of the CoinPower cells lay technologies patented by the company which allows for the automated production of coin cells with coiled electrodes. This method for coiling electrodes makes better use of the cylindrical space inside the case. In addition, VARTA Microbattery developed a patented design for closing the case. These technologies provide a higher energy density than previous li-ion coin cells with conventional stacked or layered electrodes. Automated production at the company's factory in Germany is highly repeatable and ensures that each manufactured unit operates according to its specification.

The higher capacity of the CoinPower product provides a crucial advantage to manufacturers of Bluetooth headsets. In the headset market, the different brands fight for the longest talk time with a single charge. This talk time depends both on the total power capacity of the device battery and on the power losses of the device circuit.

In addition, a coin cell with high capacity offers further advantages: Easy assembly into end equipment with almost no risk of damage, and a high level of precision in the mechanical design of the battery assembly, and high tolerance of shock and vibration.

It is important to note that a supporting electronic circuit is also small. A CoinPower cell requires only a standard circuit protection device, available at low cost from suppliers such as Seiko and Mitsumi, plus two passive components. A wide range of ICs for standard battery chargers can control the cell's charging process. The footprint of this circuitry is considerably smaller than the complex PCB generally implemented in custom battery packs. What's more, the supporting circuitry need not be close to the battery, giving system designers freedom to optimise their board layout and mechanical design.

Device manufacturers can avoid the design, production cost, and risk associated with custom battery packs because the battery is a standard part, and the supporting circuitry is easily implemented using standard components.

There is another important reason for the wide use of the first-generation product: safety. Most lithium-ion batteries work safely within their rated voltage and current limits. But over-current or over-temperature conditions can cause thermal runaway, leading the device to explode or catch fire. For this reason, a lithium-ion battery requires safety and protection circuitry to electrically disconnect the cell when it exceeds safety thresholds.

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### **Higher security due to Current Interruption Device**

The advantage of the VARTA CoinPower cell is that it offers an integrated protection mechanism, independent of external circuitry, which shuts the cell down before it enters an unsafe, over-current condition. This provides an extra level of protection for the user's safety. This Current Interruption Device is a mechanical fuse: when the pressure inside the cell rises above a certain level – as happens when the cell is charged at an excessive current or voltage – the upper and lower casings come apart by a small, controlled amount sufficient to break the circuit and permanently disconnect the battery. CoinPower cells are actually rated to withstand extreme 12V/3C over-charging conditions, which put a far greater stress on the cell than industry standards specify.

The li-ion coin cell, then, has become the preferred battery choice for manufacturers of extremely space-constrained, portable devices which require a high energy capacity of 50 mAh or more. It has found uses in consumer devices, and medical and industrial equipment, in which durability, high capacity and long cycle life are important.

The advantages of the original CoinPower product now have been extended with the introduction of the 'A2' and 'A3' series of cells. Improvements to the chemistry and production techniques of CoinPower cells have increased their capacity, as well as extending their cycle life. The dimensions and energy capacity of these cells provide the best fit for the size and shape of the human ear, and for the requirements of manufacturers of earphones and 'true wireless' technology.

Standard cycle life ratings for rechargeable batteries measure the fully charged capacity of the cell, as a percentage of its capacity when new, after 500 charge/discharge cycles at an operating temperature of 20°C. The formal specifications supplied by VARTA Microbattery show that, when stressed by executing 500 fast charge/fast discharge (1C/1C) cycles in the laboratory, the CoinPower A3 cells still retain more than 80% of their original capacity. Under gentler operating conditions (0.2C/0.2C), this value for remaining capacity rises to more than 85% after 500 cycles. In real-world applications, users are able to achieve outstanding cycle-life performance: customers typically report cells lasting for more than 1,000 cycles when mounted in an end product.

### **Future trends in small form-factor lithium coin cells**

Consumer device manufacturers' demand for higher capacity in a small space is not easing up. One recent device which is stretching the limits of cell capacity is the so called 'true wireless' headset: twin wireless ear buds without cable connections. In this product, each earbud has a radio – rather than the single radio in a conventional wireless headset. Hence, each earbud requires a battery.

To meet the product requirements, VARTA Microbattery was developing a third generation of its CoinPower product for launch in Dec 2016. The cell provides an additional 20% more capacity and energy density thanks to improvements in the battery chemistry, electrode design, and production techniques. This new product is also available in a 14mm diameter cell, adding to the 12mm and 16mm diameter versions

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available already.

This and other developments will meet the requirement for robust, easy-to-assemble batteries with a high capacity in the coin-cell form factor. The CoinPower cell will ensure that patients and other equipment users can enjoy long run-times between charges, long cycle life and at the same time enjoying the advantages of precise, highly automated cell production in Germany.

### About VARTA AG

As the parent company of the Group, VARTA AG is active in the business segments Microbatteries and Energy Storage Solutions through its operating subsidiaries VARTA Microbattery GmbH and VARTA Storage GmbH. As one of the two largest worldwide manufacturers of hearing aid microbatteries by volume, which are produced, sold and marketed via the brand power one as well as via white label for leading hearing aid manufacturers and battery brands, VARTA Microbattery GmbH is a pioneer in the microbattery sector. In addition, VARTA Microbattery GmbH strives to leverage its hearing aid microbattery expertise to the growth market of rechargeable microbatteries for consumer electronics and a variety of industrial applications. Through its subsidiary VARTA Storage GmbH, the Group also focuses on the design, system integration and assembly of stationary lithium-ion energy storage systems for residential households and customized battery storage systems for OEM customers. The Group's operating subsidiaries are currently active in more than 75 countries around the world with four production and assembly facilities in Europe and Asia, as well as distribution centers in Asia, Europe and the United States.

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**Photos:**



The CoinPower series of cells from VARTA Microbattery come in three sizes.

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