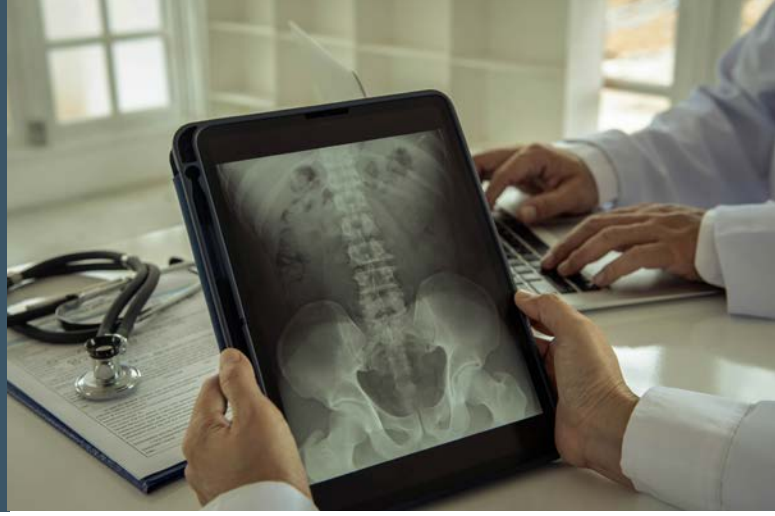
VICOR

Case study:
Portable X-ray system



Bidirectional converter shrinks battery array to one cell

Customer's challenge

New solid-state X-ray technology allows medical X-ray scanners to be more portable and battery operated, enabling medical professionals to check patients in any location. Medical X-rays typically need a short pulse of high-intensity radiation energy, which can conveniently be stored and supplied to the X-ray diode by a supercapacitor, in this case charged to 28V. Normally the 28V would be sourced from a number of Li-ion batteries in series. However, in a portable application, this type of battery array and charging system is too large and too heavy. The key goals were:

- Find an alternative to heavy and bulky multiple-cell battery solutions
- Fast charging of the supercapacitor requires a high current pulse
- Long battery life to minimize the need for recharging

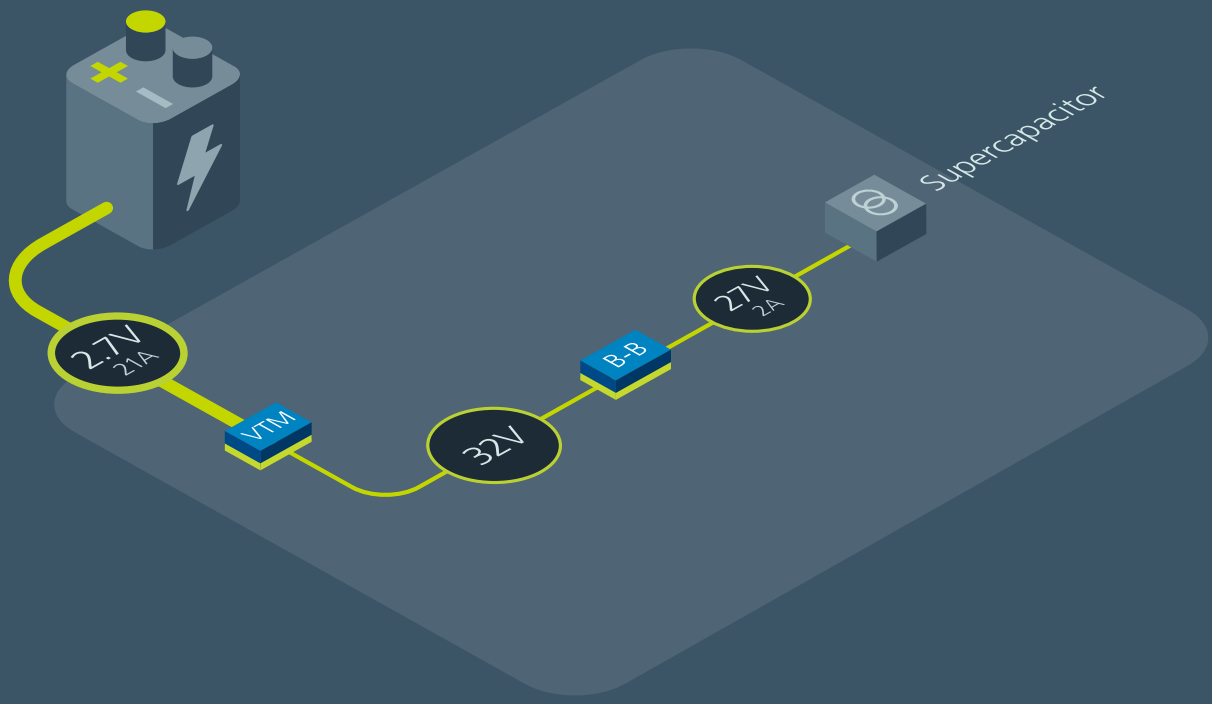
The Vicor solution

Use of a bi-directional DC-DC converter reduced the battery array to just one 2.7V Li-ion cell, reducing size and weight significantly compared to a typical boost converter solution. In addition, the bi-directional converter delivered higher efficiencies when charging the supercapacitor from a low voltage source, extending battery life. Key benefits were:

- Ultra-small, lightweight solution (8.6cm^2 footprint, 16g weight) compared to a boost converter solution
- Unique bi-directional converters (DC-DC transformer) available as standard products
- Higher efficiency achieved using low-loss Sine Amplitude Conversion topology

Bi-directional VTM, operating in reverse mode, enabled highly-efficient x12 transformation

The Power Delivery Network: A Vicor VTM, operating in reverse, stepped-up the 2.7V input to provide a nominal 32V rail with an efficiency of more than 94%. For the supercapacitor charging circuit, a ZVS Buck-Boost converter regulated the 32V and provided the necessary current limiting. This architecture was accomplished in a footprint of just 8.6cm^2. To analyze this power chain, go to **Vicor Whiteboard** online tool.



VTM™ current multiplier

Isolated fixed-ratio

Input: 0 – 60V

Output: 0 – 55V

Current: Up to 130A

Peak efficiency: 97%

As small as
22.83 x 8.52 x 4.9mm

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ZVS buck regulator

Non-isolated regulated

Input:12V (8 – 18V),
24V (8 – 42V), 48V (30 – 60V)

Output: 2.2 – 16V

Current: Up to 22A

Peak efficiency: 98%

As small as
10.0 x 10.0 x 2.56mm

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