ziehm imaging

Mobile C-arm high-frequency generators

Monoblock vs. split-block generators and intellgent heat management with Advanced Active Cooling

Generators are the heart of any X-ray system, as they are the power source for the high-voltage energy needed to accelerate electrons and generate X-rays inside the tube. The generator design in mobile C-arms directly influences imaging performance, dose efficiency, and system reliability.

There are two main approaches today: high-frequency monoblock generators and conventional split-block designs.

Ziehm Imaging is driving innovation by incorporating the market's most powerful monoblock generator in a mobile C-arm and combining it with advanced pulse technology to achieve revolutionary performance.

Comparison of monoblock and split-block generators

In split-block systems, the generator and X-ray tube are separate components. While this design has been in use for decades, it requires extensive cabling and additional insulation, which can increase system complexity and maintenance cost. A monoblock generator, by contrast, integrates the high-voltage tank, X-ray tube, and transformer into a single, compact unit. This offers a highly reliable and more stable high-level X-ray output, while making the system easier to maintain.

Advantages of high-frequency monoblock generators

This type of generator offers several benefits:

- **Higher reliability:** Fewer cables and connections mean less risk of failure and lower maintenance requirements.
- **Improved image quality:** Shorter power paths enable faster and more stable voltage rise times, resulting in consistent X-ray output.
- **Compact design:** A monoblock unit requires less space compared to a split-block system with identical power output, which allows for smaller C-arm designs and improved maneuverability in the OR.
- **Sharper pulses:** Lower overall dose and heat build-up due to clear-cut pulses that deliver radiation without overlapping.

This makes monoblock technology a more modern and efficient solution compared to older split-block designs.

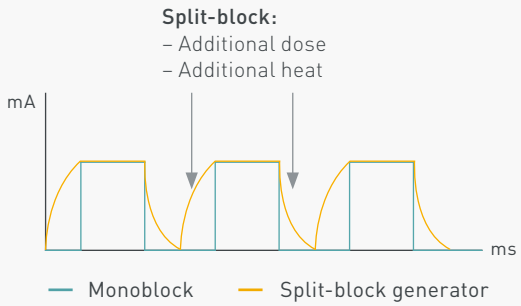

Figure 1: Comparison of monoblock and split-block generators: The split-block design leads to additional dose and thermal load due to overlapping pulse rise and fall times.

Figure 2: Dose levels of pulsed vs. continuous fluoroscopy: Pulsed fluoroscopy reduces patient dose by limiting X-ray emission to short, intermittent bursts.

Pulsing technology for optimized imaging and dose management

Modern mobile C-arms employ pulsed fluoroscopy to balance image quality and patient safety. Instead of a continuous beam, the generator emits short, well-defined pulses, which reduce patient dose and heat load while preserving high-contrast imaging.

Adaptive motion control further optimizes dose by increasing pulse rates during movement to prevent blur and lowering them when anatomy is at rest. High-frequency monoblock generators support this approach by delivering precise pulses essential for consistent image quality at minimal exposure.

The importance of active cooling

Only about 1 % of a generator's energy is converted into X-rays, while the remaining 99 % is released as heat, which means a powerful cooling system is required.

Split-block designs often rely on passive air cooling, which can limit performance during long or demanding procedures.

Ziehm Imaging's monoblock generators, on the other hand, can be combined with **Advanced Active Cooling**, which includes a liquid cooling circuit and heat exchanger.

Not only does this approach ensure thermal stability but also allows for continuous imaging during complex surgeries without the need to shut down, making them especially suitable for high-demand clinical environments.

Ziehm Imaging uses Advanced Active Cooling technology, ensuring highly efficient heat dissipation and reliable performance. The system intelligently manages heat by dynamically adjusting operating parameters, supporting uninterrupted imaging even in demanding clinical applications.

Power requirements in clinical practice

Ziehm Imaging offers the broadest power spectrum for mobile C-arms on the market – from compact 2.4 kW all the way up to a high-performance 30 kW generator – the most powerful one available today. Even at 2.4 kW, intelligent generator control, advanced heat management, and powerful image processing with ZAIP[1] ensure excellent image quality for everyday applications such as orthopedics, trauma, and pain management.

Conclusion

In mobile C-arms, high-frequency monoblock generators are a significant evolution from conventional split-block systems. With their compact design, higher reliability, and superior output stability, they provide clear advantages in clinical use. Additionally, the use of active liquid cooling components ensures uninterrupted operation even during long procedures. Ziehm Imaging's mobile C-arms employ a broad generator range, including a 2.4 kW or 30 kW system. This broad power spectrum offers the right choice for every clinical scenario – from everyday surgeries to the most complex interventions.

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References
1. Niral M Sheth, Ali Uneri, Patrick A Helm, Wojciech Zbijewski, Jeffrey H Siewerdsen: Technical assessment of 2D and 3D imaging performance of an IGZO-based flat-panel X-ray detector. In: Medical Physics Volume 49; 2022
2. Steven Freestone, Richard Weisfield, Carlo Tognina, Isaias Job, and Richard E. Colbeth: Analysis of a new indium gallium zinc oxide (IGZO) detector. In: Physics of Medical Imaging; 2020

[1] ZAIP features advanced real-time algorithms and filters designed to increase image quality.

Figure 3: Advanced Active Cooling: Optimal thermal management by automatically adjusting the pulse frequency combined with a powerful cooling circuit.