

CONNECTIVITY FOR PORTABLE **Medical Equipment,** The Future of Healthcare

Healthcare providers are implementing more portable medical devices in clinical and in-home care settings to improve patient care accessibility and streamline clinical workflows. Point-of-care integration with diagnostic tools, monitoring equipment, and ventilators improves patient outcomes through continuous monitoring and early intervention. Designed for demanding, high-impact environments, portable medical devices must withstand vibrations and rigorous usage. As home healthcare rapidly grows, the components in these devices must deliver high-density, high-speed performance in smaller, more ruggedized designs. Internal connectors for portable medical equipment are critical for ensuring reliability and withstanding shock, drops, and other physical stressors while also enabling simplified designs and assemblies.



MARKET OVERVIEW

The portable medical devices industry is transforming, driven by the growing focus on remote healthcare delivery, point-of-care diagnostics, and cloud-based healthcare solutions. Continuous

monitoring of vital health parameters and controlling disease progression are key drivers in this market. Advanced communication capabilities and cloud connectivity now enable seamless data integration and real-time analysis, allowing immediate clinical intervention when needed. Interoperability and seamless data exchange between healthcare systems have become crucial for product development and market adoption. OEMs are also developing specialized and sophisticated portable medical equipment tailored for specific conditions including cardiac monitoring, respiratory care, and diagnostic imaging.

According to **MORDOR Intelligence** the Portable Medical Devices Market size is projected to grow from at USD 90.84 billion in 2025 to USD 143.13 billion by 2030.

The miniaturization of connectors has revolutionized the development of advanced mobile medical equipment. Portable equipment, such as ventilators and patient monitors, often moves with patients, whether throughout a hospital or in their homes. Diagnostic equipment frequently travels between rooms to support multiple patients. This constant movement makes bumps and impacts inevitable, posing a risk of device failure if not properly addressed during the design process.



CONNECTIVITY REQUIREMENTS

The portable medical device market is undergoing rapid innovation, with manufacturers prioritizing compact, user-friendly, and efficient designs. The following are key connectivity requirements for portable medical device connectivity solutions.

Reliability in Miniature Footprints

Miniaturization is essential for portability. Flexible printed circuit (FPC)-to-board connectors are ideal for space-constrained applications, offering compact size, cost-effectiveness, and tool-free installation. FPC-to-board connectors in high-vibration applications benefit from a positive locking system to ensure secure connectivity, even surviving impact. For example, blade lock systems provide secure mating with a clear tactile click and have a simple and effective lever that enables quick locking and unlocking.

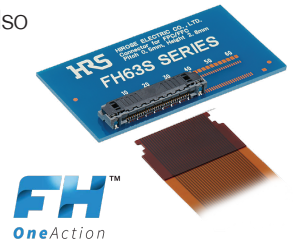
These connectors also typically utilize leaf contacts that only offer one point of contact per position. The dual-beam design provides two points of contact per pin and helps further ensure rugged connectivity and high reliability. To further optimize performance, dual-beam designs can vary the vibration characteristics and contact forces of each beam. This approach expands the frequency range, reduces resonance, and improves resistance to shock and vibration. For example, one unique, high-reliability FPC-to-board design can feature a 0.5N contact force on the first beam and a 0.35N contact force on the second beam.

FFC/FPC Connectors

Often used to connect wires to portable medical equipment internal circuitry, FPC/FFC connectors like the One Action FH™ Series connectors simplify the mating process (insert FPC without operating the actuator), while keeping the benefits of the actuator-style ZIF connectors (improved retention force and the ability to unmate the connector via the actuator). One Action locking connectors come with the latch closed, allowing mating without the need to open the latch.

Connectors like the One Action FH63S Series reduce the average mating time from 3 seconds with traditional connectors to 1 second or less. For high-volume production by trained operators, this simplified process saves both time and costs.

The One Action locking design also supports robotic assembly; robots can insert flex cables into the connectors without human intervention, further enhancing efficiency and reducing production costs.



Within portable medical equipment systems, the FH63S supports specific demands like high temperatures, vibration requirements and tight space requirements.

Data Transmission

Modern floating board-to-board connectors (supporting a wide range of positions and stack heights) offer transmission speeds of greater than 10Gb/s. This marks a significant improvement over earlier-generation connectors limited to 3Gb/s, ensuring compatibility with today's medical imaging equipment and providing future-proof performance for advanced mobile medical designs.

Enhanced Performance

High-speed connectors are engineered with specialized contact designs that incorporate a ground contact between adjacent differential pairs. This reduces crosstalk, delivers superior impedance matching, and minimizes insertion loss, even with short rise times.

Shielding

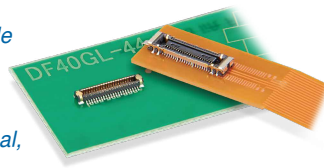
Enabling point-of-care diagnostics and cloud-based healthcare, high-speed connectors must deliver excellent electromagnetic interference (EMI) and radiofrequency interference (RFI) performance. This is particularly important with healthcare equipment that monitors patients and relays valuable data back to medical professionals. Interconnects used in medical tests and monitoring applications must be perfectly matched—even minor interference can compromise data integrity, affecting clinical decision-making. High-speed data connectors achieve this protection with metal shielding and grounding designs, ensuring precise and reliable operation.

Hirose's DF40GL Series is a low-profile board-to-board and FPC-to-connector, among the industry's smallest



with a positive blade locking mechanism. Featuring a metal shield with ground leads, it delivers excellent EMI performance. Designed to reduce mounting area requirements to create additional space for optimized antenna designs and larger batteries, the series stands 1.5mm high, has a depth of just 3.68mm, and has a 0.4mm pitch, and operates at USB 3.1 Gen. 2 speeds of up to 10Gbps.

The Hirose DF40GL Series delivers reliable board-to-board connectivity in a slim, low-profile design—ideal for space-constrained applications like medical, industrial, and consumer electronics.



Simplified OEM Designs

Hybrid signal and power board-to-board connectors, like the FX23 Series, play a crucial role in facilitating high-speed transmission and power transfer between different components within portable medical equipment systems. By combining signal and power into one multi-functional connector, OEMs save printed circuit board (PCB) space and often eliminate the need for additional power connectors. This allows for enhanced functionality without sacrificing size or performance.

These hybrid connectors also streamline the manufacturing and assembly process by reducing the number of individual connectors that need to be soldered or attached to the PCB. This can lead to faster assembly times and potentially lower manufacturing costs.

Hybrid signal and power connectors, like the FX23 Series, take this efficiency further. They offer high-speed

transmission up to 16Gb/s with four built-in 3A power contacts on each side of the connector housing. The floating contact mechanism reduces mechanical stress on SMT leads, enhances ease of use, and simplifies assembly—especially when mating multiple connectors on the same PCB. These features contribute to faster production times, lower costs, and reliable performance.

Simplified Assembly

Board-to-board connectors that feature a floating contact mechanism offer a degree of play between the contacts during mating to simplify assembly. These highly reliable floating contacts can allow a connector to absorb alignment errors of $\pm 0.8\text{mm}$ or more in X and Y axis directions, eliminating alignment issues when mating. The unique floating contact structure is also particularly convenient when mating multiple connectors on the same PCB, and especially so in space-constrained medical applications where it can provide significant assembly time and cost savings. By self-centering in both the X and Y directions, the floating structure ensures correct and safe mating, reducing stress on mounted parts, decreasing solder cracking, and enhancing reliability.

Board Retention

For stronger board retention, through hole reflow process minimizes manual soldering for through-hole metal posts in SMT contact connectors. Combined with floating contacts, this process solves the problem of solder joints coming loose in portable medical equipment subject to frequent shock and vibration.



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Empowering Medical Device Innovation with Intelligent Connectivity

Modern portable medical devices require connectors that are smaller, faster, and more durable than ever. In the past, designers were forced to consider application requirements and potential trade-offs between size, performance, and robustness when choosing a solution. Now, smaller size does not mean lower data rates and increased fragility. Cost-effective FPC connectors provide compact designs with reliable positive locking and zero insertion force for simplified installation. Meanwhile, hybrid connectors with floating contact mechanisms ensure high-speed data transmission, secure power delivery, and enhanced durability—meeting the demanding requirements of portable medical technology.

Heilind supports these evolving needs by offering a wide range of Hirose connectors, expert guidance, and value-added services to help engineers select and implement the best solutions for next-generation medical devices.



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