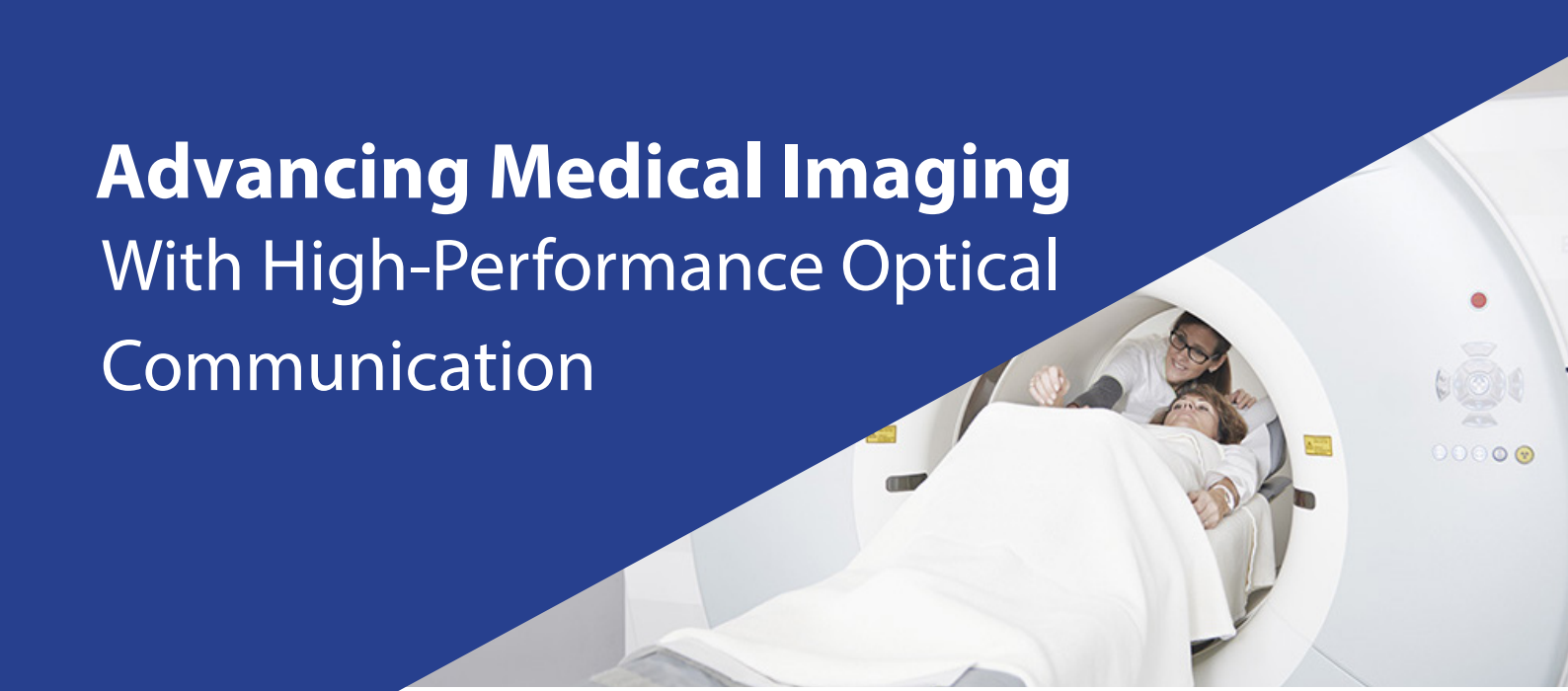


# Advancing Medical Imaging With High-Performance Optical Communication



  
**Firecomms**<sup>™</sup>  
enlightened innovation



*Firecomms fiber optic solutions deliver on the unique demands of the medical imaging industry, ensuring that data integrity is not compromised by the extreme operating conditions found in MRI, CT, PET, or X-ray systems. Firecomms' light sources use Resonant Cavity LED (RCLED) technology to achieve strong optical output at very low currents, while maintaining stability over decades of operation. Our robust receiver topologies guarantee error-free reception in high EMI fields.*

Medical imaging applications such MRI, CAT scan, PET or X-ray use very high voltages to power transmit coils or X-ray tubes. Significant electromagnetic interference (EMI) is generated in the medical equipment environment so medical imaging designers look to fiber optic transmission media to protect patients and equipment against the effects of these unwanted signals. For the transmission of control signals to motors or transmitting coils, Firecomms DC-1 MBd or DC-5 MBd transmitters and receivers are widely used with Plastic Optical Fiber (POF) and Plastic/Polymer Clad Silica (PCS) fibers to galvanically isolate the transmission while providing immunity from EMI. Higher speed Firecomms DC-10 MBd or DC-50 MBd fiber optic transceivers are equally suited to MR magnet, patient table motor, or gradient control systems.

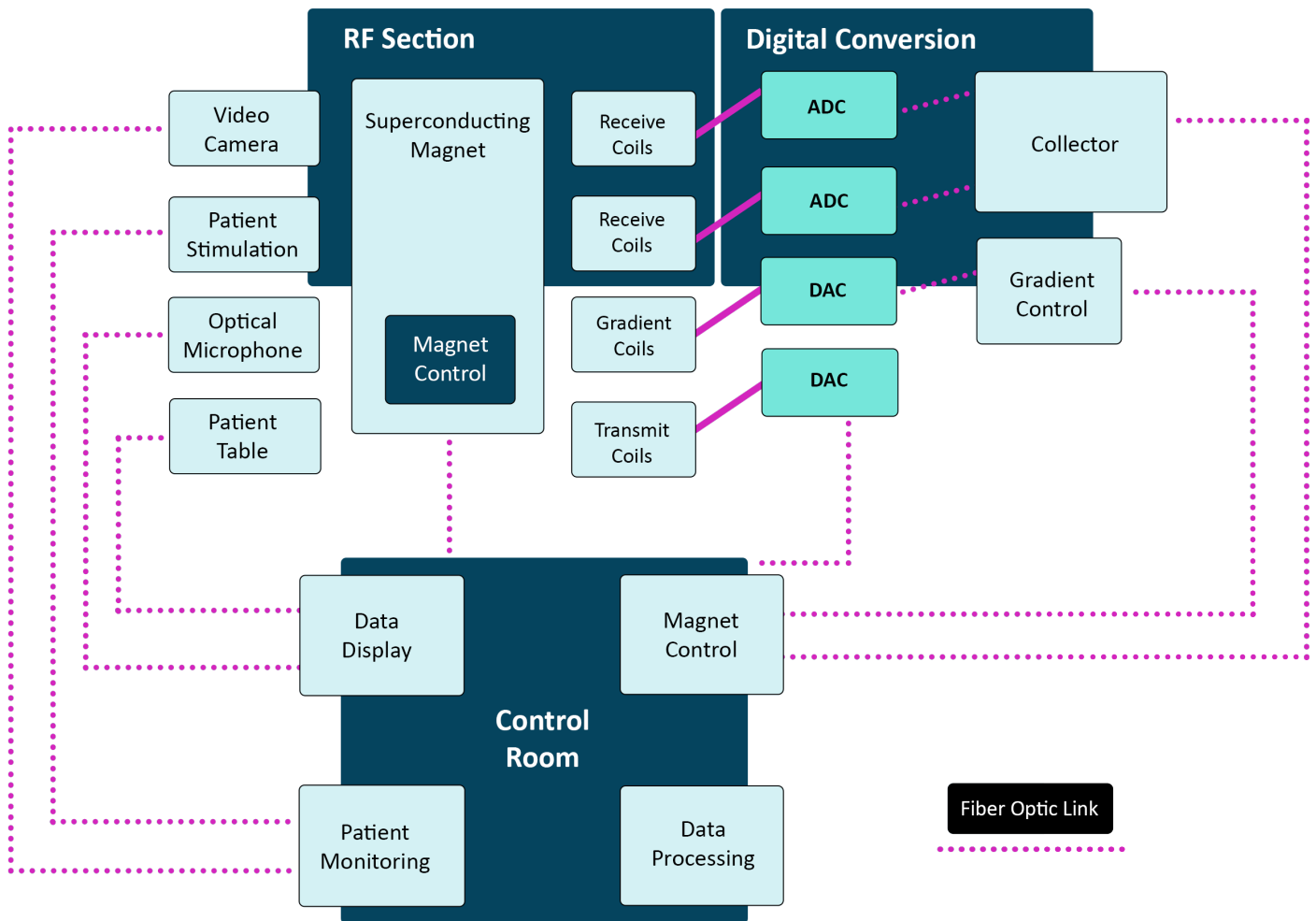
As it is advantageous to digitize the RF signal received in imaging applications directly in the coil to enhance the signal-to-noise ratio (SNR) of the received images, Firecomms has custom designed non-magnetic fiber optic transceivers to operate within the strong magnetic fields of MR and imaging equipment. Our range of transceivers that operate at 125 MBd or 250 MBd data rates are suitable for this purpose. Taking it a step further, Firecomms Gigabit transceivers allow the aggregation of multiple data streams from the RF coils to be transmitted to the control room for data processing. Utilizing optical cables for this purpose also provides the advantage of considerably reducing the number and cost of bulky RF cables. Patient monitoring equipment, such as video cameras, linked with fiber optic cables prevents patient injury within the coil. Firecomms Gigabit Ethernet transceivers are available in non-magnetic packages to protect against these occurrences.



## Key Features & Applications

- **Control signal transmission** - Firecomms DC-1 MBd to DC-50 MBd fiber optic transceivers with POF or PCS fibers provide reliable, interference-free communication for components operating inside MRI systems, such as the main magnet controls, patient table motors, and gradient control units.
- **RF signal digitization** directly at the coil enhances signal-to-noise ratio (SNR) and image quality, enabled by custom non-magnetic transceivers operating at 125 Mbps or 250 Mbps.
- **Gigabit transceivers** enable data aggregation from multiple RF coils to the control room, reducing the number and cost of bulky RF cables.
- **Patient monitoring systems** (e.g., video cameras) using fiber optic links help ensure safety and electrical isolation within MRI coils.

# MRI Application Diagram



## Fiber Optic Communications for Medical Imaging Applications

Firecomms products with Plastic Optical or Plastic Clad Fiber (POF/PCS) links offer many advantages in medical imaging applications:

- EMI/RFI immunity ideal for industrial, harsh, noisy environments
- Galvanic isolation between transmitter and receiver, ideal for harsh, noisy industrial environments
- Visible spectrum operation enables eye-safe, fast troubleshooting
- Low power option
- Resilient to bending and vibrations
- Durable, flexible and lightweight
- High reliability for extended machine uptime
- Industrial temperature in range of -40 oC to +85 oC
- Reduced maintenance cycle time provides up to a 20-year life-cycle on transceivers and cables
- Simplified field installation for easy termination of large core optical fibers in custom distances

## Medical Robotics Solutions

Medical robots place some of the highest demands on signal integrity, flexibility, sterility, and safety. Traditional copper cabling introduces challenges: electromagnetic interference, bulky harnesses, limited bending life, and galvanic coupling risks.

With proven tolerance to repeated motion, intrinsic EMI immunity, and galvanic isolation, our solutions enable scalable, high-bandwidth, ultra-reliable links through robotic joints, arms, and sensor chains. Whether you're streaming high-definition endoscopic video, coordinating multi-axis servo control, or integrating force/torque sensors, our optical communications backbone offers a robust, medically compatible foundation for next-generation robotic systems.

Optical communication, especially through POF, enhances the performance and reliability of medical robots across various applications. In surgical arms, flexible fiber cabling efficiently transmits control and sensor data while reducing noise, bulk, and component count. Imaging robots benefit from high-speed, interference-free data transfer for endoscopic and microscopic systems, while non-metallic fibers enable safe use near MRI and CT equipment. Rehabilitative and assistive robots rely on POF's resilience to repeated motion and bending, maintaining signal integrity during patient interaction. Even hospital logistics and sterilization robots use optical links to ensure reliable communication in humid, high-temperature, or chemically exposed environments, making fiber-based connectivity a cornerstone of modern medical robotic systems.

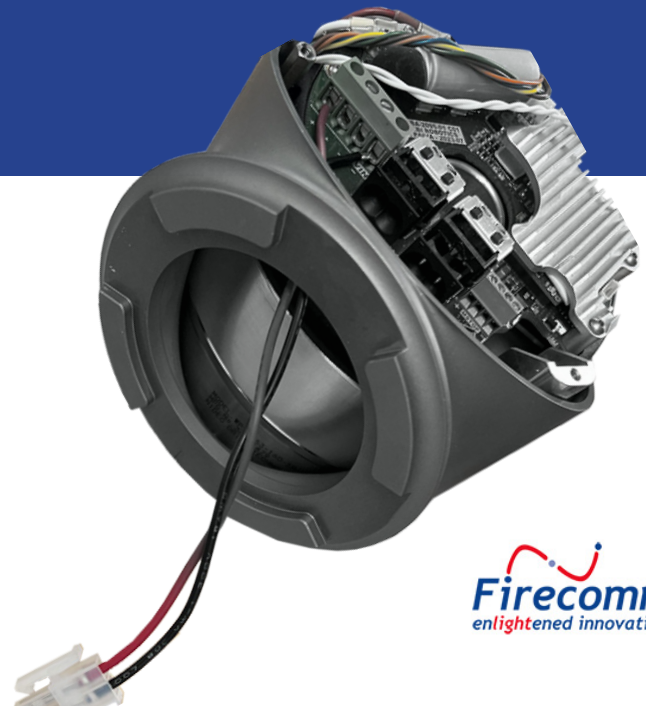
Medical robots demand exceptional signal integrity, flexibility, sterility, and safety, but traditional copper cabling often falls short due to EMI, bulkiness, limited bending life, and galvanic coupling.

Optical fiber (especially POF) overcomes these limits by offering:

- **Intrinsic EMI immunity and galvanic isolation**
- **High-bandwidth, ultra-reliable data links**
- **Flexible, lightweight, and durable cabling for repeated motion**

Applications across medical robotics:

- **Surgical robots:** transmit control and sensor data with minimal noise and bulk
- **Imaging robots:** deliver interference-free, high-speed video for endoscopic and microscopic systems
- **Rehabilitation & assistive robots:** maintain signal integrity under constant movement
- **Hospital logistics & sterilization robots:** ensure reliable operation in humid or chemically exposed environments



# Fiber Optic Communications for Medical Robotics

Firecomms products with Plastic Optical or Plastic Clad Fiber (POF/PCS) links offer many advantages in medical robotics solutions:

- **Flexible, high-durability fiber.** POF provides excellent mechanical flexibility and is tolerant of bending, torsion, and repeated motion cycles. In industrial tests, POF has been shown to exceed 25 million torsional cycles without measurable degradation, far beyond typical high-flex copper cables in similar applications.
- **Compactness and weight.** POF cables can be made in small diameters, and can be integrated as hybrid cables carrying both fiber and power conductors. This helps reduce bulk and weight in mobile or articulated segments.
- **Ease of field termination / modularity.** Use of plugless or minimal termination techniques (e.g. OptoLock® style designs) allows fiber cables to be cut and terminated on-site, facilitating custom runs in robots with tight space constraints.
- **Bandwidth scaling.** The fiber supports a range of data rates: low-speed serial (DC to 1/5/10/50 MBd) for control & command traffic, up to 125/250 Mbps or even gigabit-scale for video, imaging, or high-throughput sensor data.



## Firecomms Solutions

To ensure compatibility and versatility, Firecomms offers the widest choice of fiber optic solutions with our range of transmitter, receiver and transceiver products in four different connector configurations: OptoLock®, SMI, LC and RedLink® :

- Industrial Ethernet Transceivers (100 Mbps-1 Gbps)
- Analog Transmitters & Receivers
- Industrial RedLink® Transmitters & Receivers (DC-1/5/10/50 MBd)

