

Magnetic Resonance Imaging Compatible Transducers

Magnetic Resonance safe or compatible products for connection to PowerLab systems and for use in a Magnetic Resonance environment are available from ADInstruments.

Background

Magnetic Resonance Imaging (MRI) uses large static magnetic fields and pulsed radio frequency (RF) energy to construct images of tissue.

Human tissue is made up of atoms. The nucleus of an atom contains protons and neutrons that wobble or spin about an axis. Hydrogen is unique as it has only a single proton in the nucleus, and spinning of the single proton causes the atom to behave like a small magnet.

By absorbing a photon of a certain frequency the spin state of the atomic nuclei can change. This is called the resonance frequency (Larmor frequency) and is the R in MRI. Photons are supplied by a pulsed radio frequency (RF) source.

Normally the magnetic moments are randomly aligned. In a static magnetic field the moments of the hydrogen nuclei are aligned or orientated in the direction of the magnetic field. An MRI scanner uses a RF pulse to provide a photon to push the hydrogen nuclei into higher energy state. When the RF is turned off the high-energy state decays or relaxes to the natural state, and by recording the frequency changes as the nuclei decay, an image of the local area can be constructed. MRI has the advantage of being able to resolve smaller and softer tissues such as nerve and blood vessels than older or more conventional techniques such as computed tomography (CT) scanning.

The hydrogen nucleus has the strongest magnetic moment and is the most easily detected and is abundant in water and tissues. Water accounts for approximately fifty-five percent of human body weight, and the water content rises to ninety percent for some soft tissues. Water is the greatest contributor to any MR signal, except in tissues where lipids are highly concentrated. Bone contains little water and therefore is almost invisible to MRI.

Other materials with magnetic susceptibilities can interact with the magnetic field or the high (RF) energy of an MRI scanner to distort the image as the fluctuating magnetic fields can induce electrical currents in conductive metal components and looped wire. There are many people who cannot safely be scanned with MRI because they have vascular stents or pacemakers. Also orthopaedic screws, plates or artificial joints in the area of a scan can cause distortions on the images.

Two terms are used when referring to products in an MR scanner:

MR safe indicates that something presents no risk to a subject when used in the MR room, but may affect the quality of the image

MR compatible indicates that it is MR safe and does not affect the quality of the signals and its operation is unaffected by the MR scanner.

In general, products are considered MRI safe if they are non-metallic such as plastic or silicon based products, or non-ferromagnetic. Ferromagnetic materials include iron, nickel and cobalt. These remain magnetized when a magnetic field is removed. Paramagnetic materials contain unpaired electrons and include materials contain iron, oxygen, magnesium and cadmium.

A transducer can be considered MR compatible or safe if there are no paramagnetic or ferromagnetic parts in the transducer, such as iron or stainless steel screws.

Another consideration for a transducer is the excitation and signal carrying wires. To be considered MR safe the wires should be shielded and neither paramagnetic, nor ferromagnetic. Amplifiers such as Bridge amplifiers and PowerLabs should be placed outside the room containing the magnets and cabling to the transducers should be connected to the transducers through a plate in the wall.

The method of electrode attachment to the subject is also an important consideration. In most cases the electrodes are attached using Ag/AgCl electrodes such as for GSR or ECG/EMG electrodes.

The RF signals from the MRI scanners can be attenuated by encasing the transducer and by better signal line covering.

Visit our MRI products page for a list of compatible products available through ADInstruments. For further information about these and any other products please contact your nearest ADInstruments representative.

The following is a list of other products and accessories, which can be used with ADInstruments products.

Grass Electrodes

www.grass-telefactor.com/products/electrodes/electprecintro.html

Conmed Electrodes

www.conmed.com/products_ECGelectrod_SSE1.htm

Radiotranslucent Lead Wires

www.conmed.com/products_ECGcables_EKG.html

Pulse Oximeter

Nonin for human and veterinary use (www.nonin.com)

Pressure sensors

Millar Mikro-Tip pressure catheters are available from ADInstruments.

For more information contact your nearest ADInstruments representative.