



# Vibration & EMI Monitoring of MRI

## using the WavePort/PE8™

Medical

### Application Note #53

## Application Summary

Before Philips Medical Systems, Cleveland, Ohio, installs an MRI (magnetic resonance imaging) machine in a hospital, clinic, or other facility, its engineers and technicians perform an extensive environmental study of the site. This is a procedure for measuring all magnetic disturbances or stray electromagnetic fields and mechanical vibrations that might be present. The disturbances can be generated by any number of different sources, such as cars, trucks, trains, or any similar "chunk" of metal or iron, either stationary or moving in the vicinity.

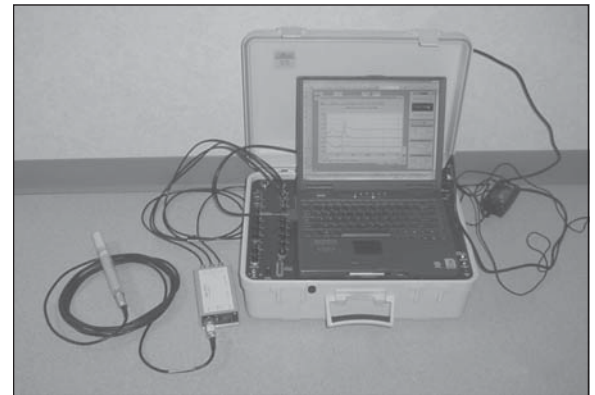
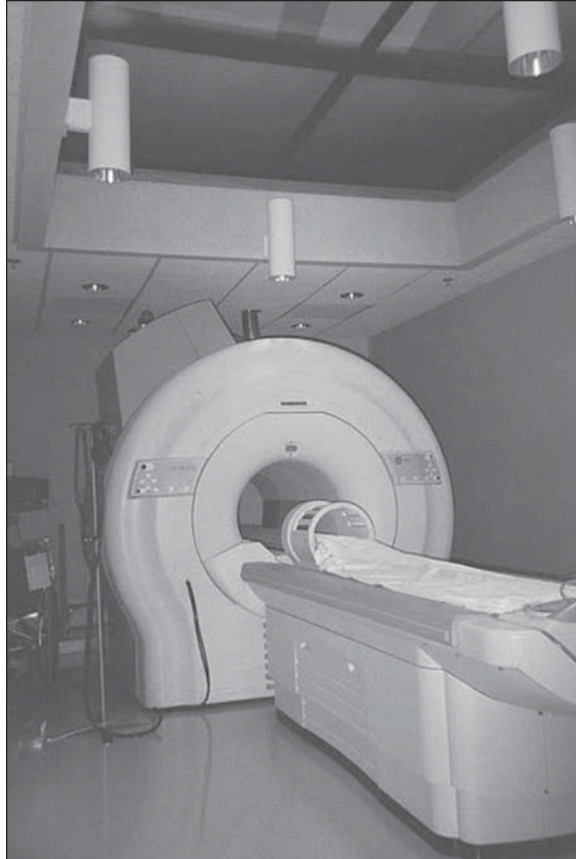
These types of large metal objects can produce a magnetic field disturbance with an intensity that depends on its distance from the site where the MRI machine will be installed. Even small fields, as little as 400 nanotesla, are considered large magnetic disturbances because they interact with the magnetic fields generated by the MRI for imaging and manifest in either ac or dc interference or a combination. Another ac magnetic disturbance

comes from ac fields generated by high-power transformers, utility lines, or a variety of machines or devices running large amounts of ac current.

In addition to magnetic field disturbances, technicians measure mechanical vibrations in both vertical and horizontal directions with respect to the MRI machine axes. In order for the site to be approved, the floor must be perfectly steady, no extraneous vibrations are allowed. The technicians look for machinery near by that could conduct vibrations through the floor, such as those that receive power from utility lines to drive motors and move machine components, as well as air conditioning units, fans, and similar equipment.

## Potential Solution

The test gear that Philips initially used to make these measurements consisted of a collection of individual instruments including large analyzers, oscillators, and charge amplifiers for sensors. The wide variety of boxes was relatively expensive, somewhat time-consuming to set up, and cumbersome for the engineers and technicians to transport.



*Before installing MRI (magnetic resonance imaging) equipment in a hospital or clinic, engineers on Philips' customer and sales support team visit the site and measure magnetic disturbances and mechanical vibrations that can affect the image. Its engineers must shield and isolate the room from vibrations, or find a more suitable location. Philips has IOtech WavePort/PE8s currently at three locations; New York, Chicago, and Atlanta, with a fourth one planned for Irvine, Calif.*



## IOtech's Solution

When it came time to purchase additional test equipment, Vishnu Srivastava, Staff Engineer at Philips decided to take a long, hard look at possible alternative instruments that could do the job for less cost and be more portable. He found a solution in the IOtech WavePort/PE8™ data acquisition system. The WavePort/PE8 is a rugged, portable package based on the WaveBook/516™ digitizer architecture for high-speed waveform acquisition and analysis. It contains eight channels of voltage input plus eight channels of ICP® (accelerometer or microphone) input. "Considering these three variables to be measured," says Srivastava, "the WavePort/PE8 really satisfies our purpose. We eliminated all the separate pieces, and now have everything we need all in one IOtech WavePort/PE8." The WavePort is specifically designed for harsh environments and for being transported frequently between multiple locations. The case is made of ABS plastic with space available for mounting a notebook PC. It comes with single and multiple-channel analog triggers that are set with programmable level and slope.

Srivastava programs his own special software modules, which are used with the companion DASyLab® software package, tailored specifically for measuring ac and dc fields and mechanical vibration. After setting up the modules in the WavePort/PE8, he needed less than four hours to make it run under the control of one laptop computer.

Srivastava uses special magnetic sensors to measure the electromagnetic field variations in the X, Y, and Z-axes that range from 0 to 400 nanotesla. The maximum that can be tolerated is 500 nanotesla for both ac and dc disturbances, and they must be measured with high accuracy. He uses three channels each for ac and dc field measurements and two channels of vibration in the horizontal and vertical directions.

## Conclusion

Philips Medical Systems engineers use an IOtech WavePort to measure magnetic disturbances and physical vibrations in a prospective site before installing an MRI machine. The environmental study lets them know where electrostatic

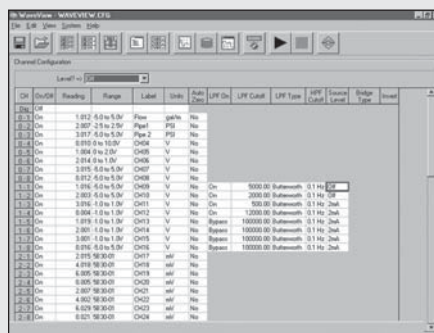
and electromagnetic shielding should be placed, and the type of vibration isolation needed. The WavePort's portability and small size makes it ideal for the engineers to carry safely from one site to another.

## WavePort/PE

The WavePort™ series of products are designed for applications where the system may be exposed to harsh environmental conditions, or where it is often transported from one location to the other. WavePorts are packaged in a high-impact plastic ABS package, and are comprised of WaveBook™ and WBK/DBK Series options inside.

### WavePort/PE Features

- Ruggedized packaging for transportable and field applications
- Based on WaveBook/516™ architecture
- Available with several different channel and signal conditioning configurations
- Convenient BNC signal connections
- Internal UPS (Uninterruptible Power Supply)



WaveView™ graphical data acquisition and display software is included with all WaveBook systems. Using WaveView software's spreadsheet-style interface, you can easily set up your application and begin taking data within minutes of connecting your hardware, with no programming required.

WaveBook™, WavePort™, WaveView™, and Out-of-the-Box™ are the property of IOtech; all other trademarks and tradenames are the property of their respective holders. 030104.

### Included Software

- WaveView™ for Out-of-the-Box™ setup, acquisition, and real-time display:
  - Scope mode for real-time waveform display
  - Logger mode for continuous streaming to disk
- eZ-Analyst™ for real-time spectrum analysis
- Export data in third-party formats
- Includes drivers for Visual Basic®, Delphi™, C++ for Windows®, DASyLab®, and LabVIEW®
- ActiveX/COM development tools