FAQs

Exploring Concerns for Designing and Testing Medical Devices

How can Vector Network Analyzers be used for testing in the medical industry?

There are several principal areas where a vector network analyzer (VNA) is used in the medical industry. First, “body coils” are used in MRI to excite a proton resonance in human tissue so that internal images may be produced. These coils must be tuned to a specific frequency (Larmor frequency) in order to achieve the best sensitivity. A VNA may be used to measure this resonance and is an important tool for body coil design.

Secondly, a VNA may be used to measure the dielectric constant of a material, a property which is unique to every material. The dielectric constant may be used to identify tissue types such as fat, muscle, or tumor. “Smart” scalpels with built-in dielectric measurement can be utilized to excise a tumor from healthy tissue. This technology is still in development but is very promising.

“Wearable” medical technology requires the development of efficient antennas which operate properly when the device is oriented in different ways or is in close contact with the human body. A VNA is crucial for evaluating antenna performance in this application. Portability, size, and ease-of-use are important factors to consider with both testing areas. With those features there are as few roadblocks to usage as possible.

Why do I need to be concerned about wireless coexistence when designing devices for medical applications?

With the proliferation of electronic devices in medical care it is critical that devices do not needlessly radiate interfering signals. Intentional radiation should be low power and carefully controlled. Bedside drug delivery systems often communicate to the nurse’s station wirelessly. Interfering with that link could be a very serious matter. Designers of systems with wireless links must be cognizant of the operating environment in this setting. A VNA might be used to characterize the antenna systems for wireless devices to evaluate gain and radiation pattern in order to verify effective radiated power (ERP) to ensure that interference to other devices is minimized.

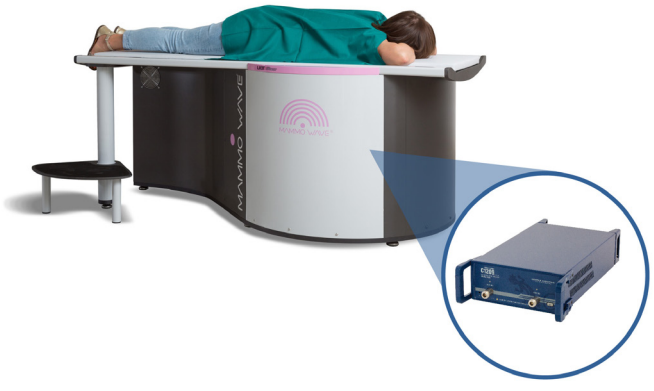
What are the possible consequences of not taking wireless coexistence into account?

In the case of medical equipment and devices, you could risk the chance of device interference where consequences can be life-threatening, like with pacemaker devices. For other systems, from automotive to industrial, the consequences include data losses and miscommunications, which could easily lead to crashes and downtime or simply inaccurate historical data. None of these results are ideal, but some are obviously more destructive and/or serious than others.

As Internet of Things (IOT) devices become more prevalent we’ll begin to see many benefits as our devices share data and react in beneficial ways. These devices will proliferate and we’ll become dependent on them. It will be imperative to properly manage interference, and this will be very difficult because there will be so many kinds of devices manufactured all over the world. The consequences can vary from being late to an appointment because an alarm malfunctioned to fatality in a hospital setting because a monitoring device was “jammed” by a device brought in by the patient.

What is the best way to address the concern of wireless coexistence when designing devices that will be used in a shared environment?

Devices must meet FCC part 15 requirements at a minimum. Proper circuit design to minimize spurious signals and maximize efficiency of the desired signals is important for this. A VNA measures the signal reflected back to the instrument port relative to the signal transmitted into the device under test. VNAs are a critical tool for evaluating RF circuit performance and the filters required to reject signals which might otherwise be radiated and interfere with other systems.



How do measurement instruments account for cybersecurity while working with my testing results?

USB VNAs are designed for secure environments. Taking traditional network analyzers in or out of secure environments is a lot of work, requiring removable hard drives, data purging procedures, and oversight over those data purging procedures. With USB network analyzers the computer that stores and processes the data is separate from the measurement module. This means that as long as the computer remains in the secure area, all concerns about data security are eliminated, and the data measurement module can easily move between laboratories and sites. The measurement module has only volatile memory, so no data is retained, and the separate PC can be made secure following standard security protocols.

How do I use time domain to detect the change in impedance for medical materials measurement?

The time domain measurement mode allows the designer to measure the characteristic impedance of a transmission line over distance or to determine the position of an impedance change. A coaxial transmission line with an air dielectric may be immersed in a fluid. The fluid might have layers with different dielectric constant. As the fluid replaces the air in the transmission line, the dielectric constant at each level may be easily evaluated.

What if I run into issues with integrating the VNA into my wireless medical testing device?

When working with any technology it is wise to stay connected with the manufacturer. Often their team of experts have run into a wide variety of concerns before and can answer your questions easily. For example, Copper Mountain Technologies provides easy access to its support personnel through multiple methods, depending on the needs and comfort level of the user.

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