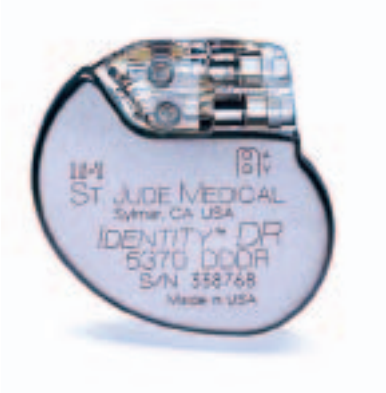
Pacemakers

NVE Corporation
Eden Prairie, Minnesota

What happens to your heart when you are active? If you just ran a mile, your heart is going to be beating two to three times faster than when it's at rest. But sometimes there is a malfunction. When the heart cannot keep pace with the body, because it either beats too slow or too fast, doctors insert a pacemaker.



▲ *St. Jude Medical, a pacemaker manufacturer, is using NVE Corporation's giant magnetoresistive (GMR) sensors, which are highly stable and sensitive magnetic sensors, to replace the reeds of conventional pacemakers. The GMR sensors are an order of magnitude more sensitive than the reed, and they are solid-state devices, not mechanical.*

St. Jude Medical is manufacturing pacemakers using NVE Corporation's giant magnetoresistive (GMR) sensors, which are highly stable and sensitive magnetic sensors that replace the reeds of conventional pacemakers. Pacemakers must be tuned to the specific needs of each person's body. Physicians use magnetics to tune the pacemaker from outside the body. The device in the pacemaker that responds to the magnetic signals is usually a reed switch. However, NVE's GMR sensors are replacing the reeds in St. Jude's pacemaker line of products. The GMR sensors are an order of magnitude more sensitive than the reed, and they are solid-state devices, not mechanical. Mechanical devices have a known failure mechanism and may take longer to clear the U.S. Food and Drug Administration (FDA). GMR sensors have no known failure mechanism, allowing them to pass FDA quicker.

Giant Magnetoresistive Sensors

Description: Highly stable and sensitive magnetic sensors that are made of giant magnetoresistive materials

Price Range: $2-$5/sensor

Customer Base: St. Jude Medical, Inc., Agilent Technologies, Motorola, Inc., Cyprus Semiconductor Corporation, Honeywell, Inc., and Digi-Key Corporation

Benefits: 1. High sensitivity (one order of magnitude or more than a reed), 2. Small size, 3. High impedance and low power

Additional Applications

Industrial Automation: Can be used in pneumatic cylinder positioners

Surveillance: Can be used in high-sensitivity, low-power, passive, small magnetometers, otherwise known as metal detectors

Giant Magnetoresistive Sensors

The U.S. Department of Commerce, in collaboration with other U.S. government entities, conducted a survey of more than 3,000 firms to assess the development and adoption of biotechnology in industry. While firms in several different industries are developing and applying biotechnologies, 72 percent were concentrated in human health applications. Of the human-health-focused companies surveyed, the main focus was in therapeutic and diagnostic technology. Diagnostics deals with the analysis and investigation of signs and symptoms exhibited by an organism for the purpose of diagnosing disease and injury. The GMR effect, in which an applied magnetic field changes certain materials' resistance to current flow, sets NVE's biosensor apart from other magnetic sensors for biological diagnostics. By using GMR materials, NVE produced smaller, lower-power, solid-state magnetic biosensors with extremely high sensitivity and is actively exploring other applications on biomedical devices.

Company Vision

"NVE's vision is to continue to be a leader in the practical commercialization of spintronics, which is a nanotechnology many experts believe represents the next generation of microelectronics. Product realization of spintronic products is occurring at NVE in the form of magnetic field sensing and switching, and data acquisition, transfer, and storage."

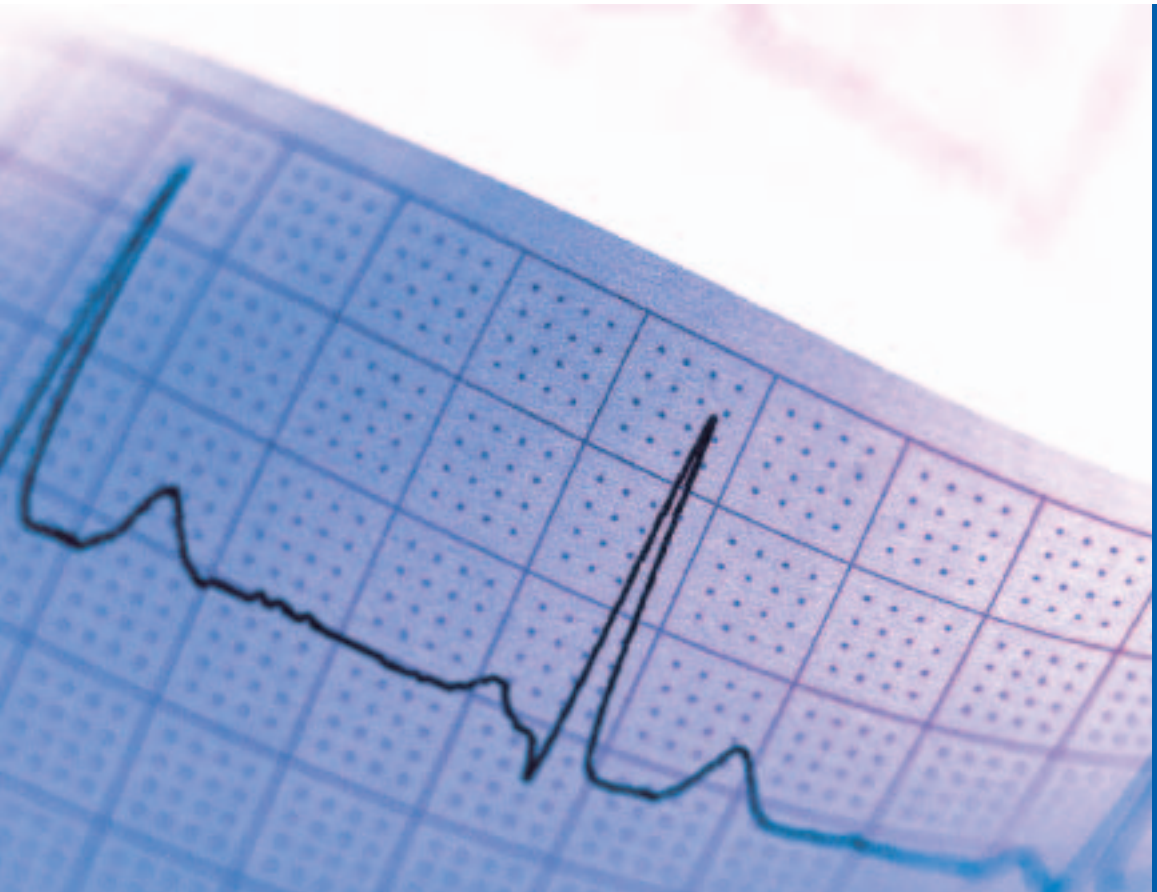
Robert Schneider,
Director of Marketing

GMR magnetic sensors are made of sandwiches of thin films consisting of alternative layers of magnetic and nonmagnetic materials. In these devices a conductive nonmagnetic interlayer separates two magnetic layers. Combined this way, the materials' resistance to current is high. An external magnetic field causes the magnetic fields in all layers to line up in the same direction, so electric resistance drops dramatically. With their high degree of stability and sensitivity, the GMR sensors can replace more conventional magnetic sensor technologies, such as anisotropic magnetoresistance, variable reluctance, or Hall-effect sensors.

MDA Application

Years Funded: 1992-2003

NVE was funded to develop GMR materials and processing technology. GMR sensors are ideal for use in space because of their radiation hardness and ability to operate over a wide temperature range. GMR sensors could replace certain optoelectronics, which are slower than magnetics and very susceptible to radiation. The GMR materials can also be applied to high-density, static magnetoresistive random access memory (MRAM), which can store information and never lose it. The sensors use less power and provide quicker access to the stored information as well.



Company Profile

Business Overview: Originally, known as Nonvolatile Electronics, Inc., NVE Corporation is now a publicly traded company specializing in spintronics—a nanotechnology that uses an electron's spin rather than its charge to sense, store, or transmit digital data.

Founded: 1989

Employees: 70

2003 Revenues: $9.46 million

Facility: The company is housed in a 20,000-square-foot facility and is capable of manufacturing 40 million devices per year.

Partners: Agilent Technologies, Honeywell, Cyprus Semiconductor, and Motorola

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