

Best Innovations 2006

ABB has been at the forefront of technical innovation for many years. The following set of short stories provides a taste of the company's achievements in 2006, which range from a novel sensor for measuring oxygen concentrations to a programmable light switch. ABB's interests in communication, automation and safety are illustrated in these stories, showing that ABB's reputation for excellence in innovation is well deserved.

Safe robots don't need higher fences

Today's high-speed industrial robots can lift and swing payloads of up to 600 kilograms, so their fragile human co-workers must keep out of the way.

This is usually done by fencing off robot work stations, but these traditional methods are expensive and not very flexible. Now there's a better way to keep the workplace safe. ABB's SafeMove is a reconfigurable software and hardware package that cuts costs and increases the flexibility of robot installations, without sacrificing safety.

SafeMove is based on the latest advances in redundant software, electronic safety technology and safety regulations. It reliably monitors robot speed and position, instantly detecting

unwanted or suspicious deviations. When it detects a safety hazard in a robot, SafeMove executes an emergency stop, shutting the machine down within milliseconds. SafeMove also offers other new functions, including electronic position switches, programmable safe zones, safe speed limits, safe standstill and automatic brake tests that make setting up robot safety functions much easier.

By eliminating the need for traditional safety enclosures, SafeMove software encourages new workplace configurations that allow man and machine work closer together, safely.

For example, a robot might present a heavy object to a human worker, who could then perform tasks on it that are difficult to automate.

Conversely, a worker might load small parts directly into the robot gripper, eliminating the need for separating turntables, receiving fixtures or roll doors. The robot could then do the work – perhaps in tandem with another robot, or another human worker.

The configurations are endless, and ABB is working with partners and customers on flexible manufacturing concepts to turn SafeMove software into cost savings for customers. SafeMove will be launched by ABB Robotics in the first quarter of 2007.

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For more information on SafeMove, see "Taming the robot" on page 11 of this issue.



ABB data-transmission system sets new records

Power network operators use many communication channels, including their own power lines, to ensure the safe and uninterrupted flow of power.

Power line carrier (PLC) transmissions are reliable and cost effective ways to send important data over long distances.

In a power network, vital signals are exchanged in real time, between many essential locations, to ensure optimum control and protection of the entire power system. The communications infrastructure supporting this continuous coordination must therefore be fast and reliable.

ABB's latest PLC system, the groundbreaking ETL600, set a new record by transmitting via a 380-kV high-voltage power line over a distance of more than 100 kilometers using 32 kHz bandwidth at a speed of 320 kbit/s, very close to the theoretical limit.

In addition to its speed, the ETL600 also offers flexibility.

Electrical noise in AC (alternating current) transmission lines increases during thunderstorms, rain or snowfall, and affects the quality of PLC links. Many PLC systems are therefore designed for worst-case weather conditions, transmitting at low speeds, even in good weather. This is a waste of scarce communication capacity.

ABB's ETL600 adjusts to weather conditions automatically, which means it will run at maximum speed whenever possible, slowing down only temporarily in response to bad weather.

ABB has more than 60 years' experience transmitting data over power lines. Its PLC systems are currently being used in a 1,000-kV AC power line in Russia and a 1,146-kilometer-long 500-kV DC line in South Africa – two more records!

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For more information on the ETL 600, see "Making power lines sing" on page 50 of ABB Review 2/2006.



ABB voltage indicator makes the workplace safer

VisiVolt is a voltage indicator designed to minimize the risk of electrocution for workers on indoor and outdoor medium-voltage systems.

Electrical accidents have many causes; equipment malfunction combined with a momentary distraction can be fatal. Poorly trained workers may approach a live distribution panel instead of one that has been disconnected, with deadly consequences.

The VisiVolt indicator can be permanently installed, directly on current bars and conductors, using simple fittings. This compact device indicates the presence of a voltage by displaying a large and highly visible "lightning" arrow symbol on its liquid crystal display (LCD), providing an active

reminder of the potential hazards of working in and around electrical systems.

Due to its unique structure – invented by ABB – the VisiVolt's LCD acts as both the display unit and the sensor element. The LCD detects the electric field around the conductor on which it is installed. The device requires no electronic circuitry, making it extremely robust and durable.

In the dangerous environment of medium-voltage systems, VisiVolt will warn workers that a particular part of

the system is live – before it is too late. Since it can indicate the voltage status of every section of a distribution system, VisiVolt can also help to localize faults. It is particularly useful in systems where voltage indicators have rarely been used, such as open indoor switchgear panels and outdoor installations.

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Waveguide: simple, reliable, low-cost communication

ABB has developed a simple and reliable wireless method of transmitting data in switchgear installations that is cheaper and needs less maintenance than traditional cable-based switchgear communications.

Switchgear protects expensive electrical equipment by instantly turning off power during unexpected surges.

Reliable grids depend on high quality switchgear communication, and for this ABB Waveguide is an excellent choice.

ABB's Waveguide uses low-power electromagnetic waves inside a closed system to transmit data. This is done with a hollow conductor, an antenna, which re-

ceives and transmits modulated electromagnetic waves, and a coaxial connection to the protection and control unit.

Waveguide improves on traditional communication systems by avoiding the use of copper cables, which are sensitive to electromagnetic interference, and fiber optic cables, which have poor mechanical properties and are more complex to install.

Waveguide's rectangular conductor is made of aluminum and its dimensions are defined by the electromagnetic waves being used. Trapping the signal inside an enclosure avoids radiation and external interference, and the field can be accessed easily by inserting antennas into the Waveguide.

The signal is transmitted with virtually no loss because it is reflected by two parallel surfaces.

Research shows the Waveguide can transmit up to 22 times more information than cables, making it well suited to the new global standard in substation communication (IEC 61850).

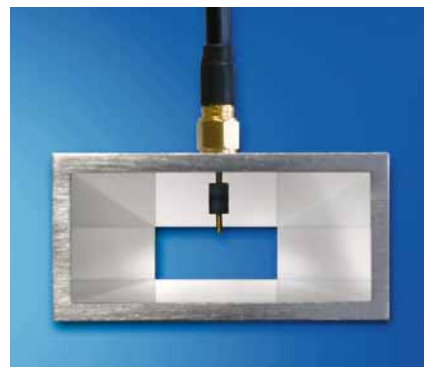
Wireless signals in Waveguide are protected from external interference and the environment is protected from the radio signals. The system is easy to install, virtually maintenance free, and robust enough to withstand the harsh environment of a substation.

The concept was displayed with great success at the Hanover Fair 2006.

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For more information, see "Data pipeline" on page 26 of this issue.



Precision machines hold heavy loads

ABB's new FlexPLP machine can perform precision tasks and hold heavy objects within the tight, narrow confines of a factory production line.

The FlexPLP (Flexible Programmable Lean Positioner) is unlike regular industrial robots that are equipped with extendible arms and handle various materials at high speeds over long, measured distances. These robots have many uses, but they occupy appreciable space and for many production purposes, two arms are better than one.

That is why ABB developed the FlexPLP, a machine that provides precise manipulation and an ability to posi-

tion heavy loads precisely in constrained spaces.

FlexPLP can support three times its own weight, yet is small enough to operate in an automotive production line. It could, for example, do the fine detail work of positioning locator pins and then carry a car underbody to the next point in the production line. FlexPLP is thus a highly flexible bodyshop all in itself.

ABB used the idea of parallel kinematic machines (PKM) as a basis for creating the FlexPLP, and worked for



18 months on the invention. The best known PKMs are ABB's three-armed Flexpicker and the six-legged motion simulator platforms known as Hexapods. FlexPLP was designed to address the PKMs' most serious disadvantage: the amount of space they need.

By clever arrangement of newly designed servo-cylinder pairs, ABB created a modular positioner for motion along three axes. Despite its unusual appearance, FlexPLP surpasses existing machine concepts of similar cost in terms of payload, repeatability and space efficiency.

Automotive factories are the first of many possible applications for these versatile machines, which have the potential to improve production in any industry.

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Further information on FlexPLP can be found in the factbox on page 8 of this issue.

New switch cuts losses and increases power flow

Capacitor banks are commonly used to compensate for reactive power in medium-voltage distribution systems. They are, for the most part, fixed or breaker-switched, without being synchronized to the voltage and current waveform. They are adjusted only seasonally or, at best, weekly

By comparison, sub-transmission level capacitor banks are often equipped with synchronized switching to reduce over-voltages, and may be switched daily or even hourly.

The ideal solution for capacitor banks at the distribution level is to be adjusted more frequently, like those at the sub-transmission level. An ability

to follow hourly load variations would further minimize power losses and increase the maximum power flow in the distribution system. However, this is not current practice because circuit breakers are not designed for a high number of switching operations. Furthermore, the current solution can cause over-voltages and high in-rush currents in applications where a malfunction may have expensive consequences.

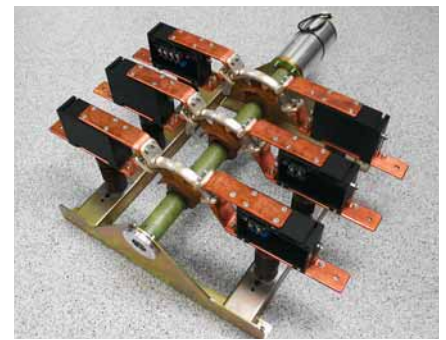
ABB has now developed and patented a novel switching mechanism designed for stepwise-controllable capacitor banks. It consists of diodes, rotating contacts, a motor drive and a control system. The switch is arc-free, and features synchronized make and break. It maintains more than a million operations, allowing frequent switching operations with negligible switching over-voltages and in-rush currents.

Low in-rush current enables capacitor banks switched in parallel to operate without in-rush limiting reactors. It is now possible to compensate for reac-

tive power with a number of smaller parallel capacitor banks operated stepwise, instead of switching one large bank.

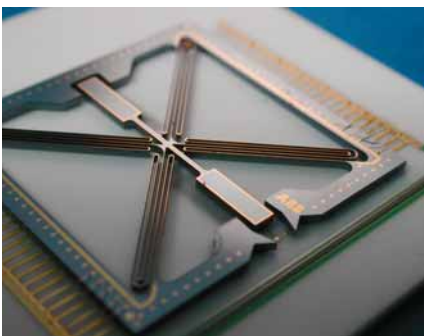
Finally, the switch avoids dangerous restrikes, making it ideally suited to frequent switching operations close to the load and thereby optimizing the system performance.

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Revolutionary change in oxygen measurement

Hartmann & Braun, which became part of ABB in Germany in 1998, has been successfully developing paramagnetic oxygen sensors for more than 40 years. Now the company has returned to the drawing board to improve on classic oxygen sensors.



These manually assembled devices comprise an electromechanical module and an optical readout system. Their performance is good, but it could be better.

In response to this challenge, ABB has developed an innovative new sensor that will expand the application range of gas analyzers in the future.

The new sensor uses a cutting-edge silicon micro-electromechanical chip, developed at ABB's Corporate Research Center in Ladenburg, Germany. The chip is encased in a ceramic housing with integrated electro-optical components and optimized magnetic excitation.

The chip's main advantage over the classical paramagnetic solution is the drastically reduced volume of the sensor chamber. This cuts response time from three seconds to just one. In markets where speed is essential – such as monitoring combustion en-

gines – this is a significant breakthrough.

The planar sensor chip is a key feature of the sensor's layered structure, which allows automated assembly and cost-efficient mass-production. The sensor is also highly resistant to corrosive gases and has negligible sensitivity to gases other than oxygen.

Thanks to low production costs and quicker response times, the new sensor is expected to change the way oxygen is measured – it competes in price and performance with classic, high-performance paramagnetic sensors, as well as the low-cost electrochemical devices.

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For more information on this new device, see "Microsystems at work" on page 68 of this issue.

Variable light control with just one switch

The Busch Comfort Switch can be used to control lighting in a variety of modes from manual to fully automatic.

The switch is mounted flush with the wall and is equipped with an infrared movement detector that provides four modes of operation, from basic manual mode to fully automatic.

Other settings can be programmed into the switch to turn lights on automatically in response to the movement detector and to stay on until switched off manually. Alternatively, the light can be switched on manually

and turned off automatically after a pre-determined time, if no movement is detected. In the "maximum comfort" mode, the light comes on if the infrared sensor detects a movement and switches itself off after a pre-set time.

Each mode and pre-set time can be adjusted with the help of potentiometers on the back of the switch's sensor. Manual mode is indicated by the activation of a light-emitting diode (LED) incorporated into the switch. This LED also helps users to find the switch in the dark.



The Busch Comfort Switch has two-wire technology combined with an external input, which means that it can be integrated into any two-way or cross connection, making it particularly useful in refurbishments. It can be combined with incandescent lamps as well as high and low-voltage halogen lamps.

The movement sensor has a detection range of more than 170°, ensuring immediate detection of anyone entering a room. The switch is suitable for use in both private and public areas, such as bathrooms, cellars, hallways and stairways.

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Compatibility tool boosts grid reliability

ABB has developed a simple software tool to analyze compliance of substation automation devices and systems with a new global substation standard.

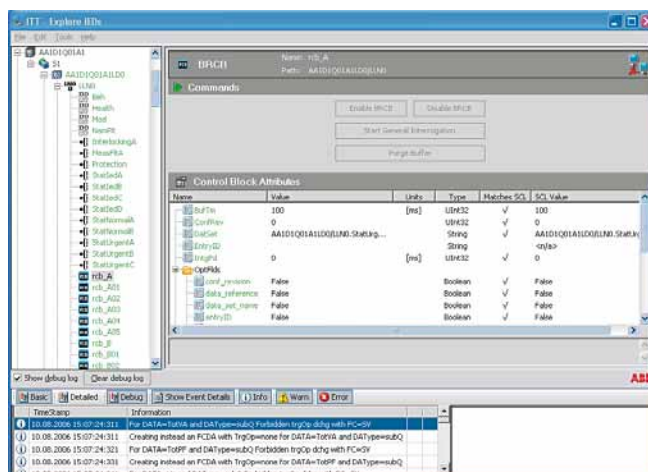
Substation automation devices are like fuses that protect the electricity network and guarantee a reliable power supply. They communicate using a protocol, or language, that is chosen by the manufacturer. Until recently, many different languages were available, but this has now changed with the introduction a new global language – the IEC 61850 standard.

As a system integrator, ABB must ensure that all devices are working harmoniously by measuring key quality fig-

ures and demonstrating that the systems meet the required specifications. Building on the experience gained during the implementation of IEC 61850, ABB has developed a set of tools to support the process of testing and commissioning compliant systems.

The software enables substation automation engineers to analyze 61850-based systems quickly and reliably by just plugging a laptop into a substation communication network.

The software searches for automation devices in a network, inspects their configuration and examines network traffic. It helps to detect network problems and inspects the implementation of the 61850 protocol. It always verifies engineering data against actual data loaded on physical devices, checking for inconsistencies, which may manifest during or after the activation of a substation automation system.



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ABB drive features built-in PROFINET IO industrial Ethernet

In the world of control automation, low-cost Ethernet industrial protocols, capable of handling large amounts of data at very high speeds, are becoming essential

PROFINET IO is an important and open Ethernet communications standard. It focuses on programmable controller data exchange, and connects to higher-level control systems.

ABB now demonstrates the ACS 350, the first compact general-machinery

drive with PROFINET IO support. Running on top of the drive's PROFINET IO protocol is a PROFIdrive profile, both of which are standardized by Profibus International. PROFIdrive is a common drive application interface that allows unified device access methods, independent of the physical drive employed.

ABB's Ethernet communication module makes it possible for a general machinery drive to take advantage of enhanced diagnostic features and cen-



tral engineering schemes available in networked technology.

PROFINET IO is especially important in the European market and meets the requirements of many application areas. It is designed for real-time applications and available controllers usually operate with cycle times of as little as one millisecond. Standard management and engineering tools can be used to configure and maintain any device from any vendor. This makes ABB's ACS 350 with a PROFIdrive profile all the more attractive to customers.

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ABB has the right mix for cement makers

The most important aspect of modern cement plant quality control is the Raw Mix Proportioning (RMP) system. The RMP system defines the proportions in which the main raw minerals of the cement-making process (limestone, clay, sand and iron ore) are mixed. ABB's solution to RMP optimization is proving popular.

The goal is to ensure that the resulting mixture (raw meal) has the correct chemical composition, while maintaining the lowest possible material cost. This is extremely important, because variations in the chemical composition of raw meal can increase fuel consumption and decrease cement quality.



The task of RMP control is made particularly difficult by the highly variable chemical composition of the minerals that are dug out of the ground. To meet this challenge, ABB has developed an innovative, state-of-the-art solution for the RMP problem.

The solution is part of the Optimize^{IT} Expert Optimizer suite. It executes online control of the cement kiln feeders, where the various raw minerals are stored. This guarantees an

optimal trade-off that balances deviations in quality targets and material cost.

The system's control algorithm is based on the latest control technologies, such as Model Based Control, which allow the cement plant's dynamic behavior to be simulated using mathematical models of the feeders, conveyor belts, mills, silos, etc. This allows the effect of different control actions to be predicted and appropriate action to be taken. The crucial mixing operation becomes predictive, rather than reactive.

ABB was the first to come up with an advanced model-based application for the RMP process. A successful pilot installation has led to dozens of orders from cement manufacturers around the world.

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See also "Cementing profitability" on page 59 of this issue.