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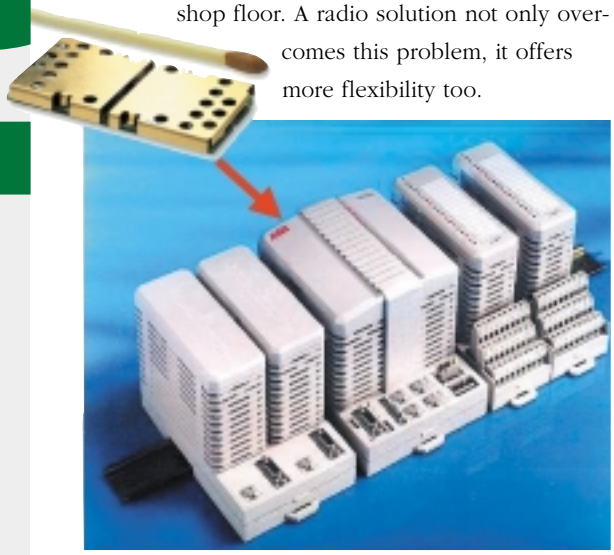
Bluetooth™ wireless link for ABB controllers

New communication options for system engineering, installation and maintenance are now available for new-generation controllers from ABB. Such communication needs to be robust and inexpensive. One option – infrared communication – falls short, as it needs an uninterrupted line of sight, and this cannot always be guaranteed on a busy shop floor. A radio solution not only overcomes this problem, it offers more flexibility too.



Ericsson, in cooperation with Nokia, Intel, IBM, and Toshiba, has pioneered a worldwide industrial standard for wireless communication between office equipment, networks, portable PCs and cellular phones. This new technology is named Bluetooth™.

Bluetooth technology is ideally suited as an option for ABB's next-generation controllers. It has the required range, functionality, and low price.

A Bluetooth-based radio interface has been developed and demonstrated for the new ABB controllers. The Bluetooth module, with transceiver, internal antenna, matching network, and connector for an external antenna, has been designed into the new controller's housing. Bluetooth drivers and software have been imported to the real-time operating system implemented in the new controller.

ABB Automation is the first industrial automation company to demonstrate an industrial application with a Bluetooth link. It allows seamless integration of ABB controllers with office automation equipment, and provides a flexible, reliable data connection supporting installation, commissioning and maintenance tasks.

High-temperature polymers

Innovative electrical insulation products are in the industry pipeline thanks to a revolutionary new epoxy technology developed by ABB. The new technology can conceivably be applied to a wide range of generator and high-voltage breakers, GIS switchgear, dry transformers, motors and generators, power electronics, and products for oil & gas applications.

Higher electrical loads and increased switching performance will mean that, in the future, service temperatures for MV and HV insulation products are likely to lie above 150°C, rather than the 105°C common today. This requires polymers with heat distortion temperatures above 200°C at maintained long-term mechanical and electrical performance.

Among the new epoxies being investigated are high-temperature hybrid resins, including standard epoxy/cyanateester and standard epoxy/polyurethane blends, as well as new duromeric polyetheramide systems. The purpose of the investigations is to see if the synergetic effects of blending these component materials enable the new epoxies to match the demanding profile of high-temperature applications.

Other applications include thermal barrier coatings for service temperatures between 150°C and 250°C.

Application areas for these include breaker surfaces, which are exposed to hot-spot gases induced by switching, and aluminium-based compressor wheels for turbochargers. Long-term heat-protection will allow higher operating temperatures, resulting in significant cost benefits.

Highlights of the laboratory work are new low-temperature hardening epoxies with high-temperature capability: collaboration with a German university has led to joint development of new filled epoxy systems reaching glass transition temperatures of up to 280°C with moderate cure temperatures below 120°C. These new epoxies combine superior thermo-mechanical and electrical behavior with short processing times. Patents have been applied for. A new toughening concept with starpolymers has been established and is being implemented.

Next-generation manufacturing for Tip Driven Integral Fan

What to do when a customer asks for a thin cooling fan capable of high flow rate and pressure? ABB's answer was to break radically with tradition and design a fan impeller which doubles as the rotor of the electric motor. How? By using a permanent magnet motor and embedding the magnets in the impeller. Intelligent speed control is provided by a frequency controller integrated in the fan housing.

A robust mechanical construction and use of advanced materials ensure a long lifetime for this fan design. Manufacturing costs are kept low by speeding up development and prototyping, and by maintaining cost awareness at the highest level throughout the product design and production stages.

All the fan manufacturing processes have to be able to respond very fast to customer requirements and product modifications. The customers are best-of-class OEMs in the telecommunications business, where lead times are extremely short and productivity is very high. The productivity indicator in this sector is typically about 3, compared with an average of 1.5 to 1.7 at ABB at the time. Thus, ABB has had to take a completely new look at its manufacturing processes, production control and logistics.

One way to achieve short lead times and more flexible manufacturing is to make use of modular product design and assembly, or Design for Variation (DFV). This enables a fan to be built up from a set of modules designed for fast, automated assembly. A system with interchangeable components allows late variations in production as well as better responsiveness and a smaller work-in-progress inventory.

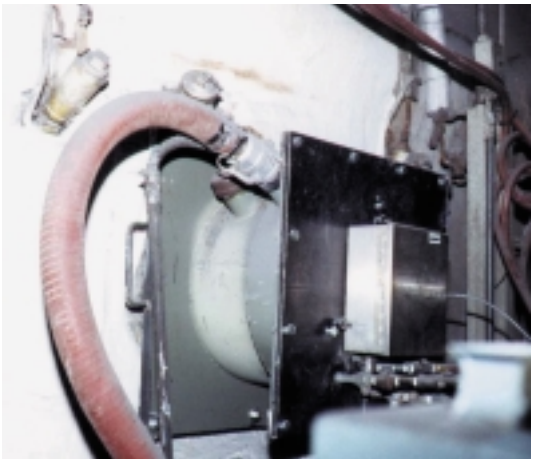
The new business approach aims at a productivity indicator better than 2.5. Through 'agile manufacturing' with fully automated assembly, throughput is reduced to just a few hours. Design and production of the TDIF are geared to e-Commerce.

New carbon in ash instrument

Coal-burning power plant performance is about to get a boost from another ABB innovation: on-line monitoring of unburned coal in fly ash. Unburned carbon in ash (CIA) represents lost energy, which makes it a cause of increased fuel costs. High levels of unburned carbon in fly ash not only produce useless fly ash, they are also a financial liability, since the ash has to be disposed of in landfills. Contrasting with this is fly ash with a low carbon content, which brings in revenues when sold as raw material for concrete production. Finally, CIA monitoring addresses the increasingly important issue of plant compliance with lower boiler emissions.

ABB's response to this need was to launch a project to develop the world's first on-line instrument for real-time monitoring of the unburned fuel in coal-fired boiler ash. Integrated into the control system, it minimizes emissions and at the same time helps to produce saleable fly ash. Extreme demands are made on the design of such an instrument, as it has to operate continuously in the harsh environment of a modern coal boiler. High temperatures (400°C) and the fouling nature of the ash itself made this a significant challenge to the ABB team.

The meter is based on microwave measurement techniques. The instrument is a rugged microwave



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resonance cavity which is mainly sensitive to the carbon content. The sensor was designed with an extremely high sensitivity due to the low ash concentration prevailing in the flue gas. This is in the ppm range (a concentration roughly equivalent to 5 pixels out of the 1 million on a computer screen).

An ABB Corporate Research cross-laboratory project produced this long desired measurement instrument. By providing operators with real-time data of the unburned fuel, power plant performance can now be optimized.

Whether used as a stand-alone instrument or integrated in a closed-loop control system, ABB's CIA instrument provides reliable low-maintenance performance.

Pressure and temperature sensing with hair-thin optical fibers

Pressures and temperatures are the most important parameters for controlling oil extraction in oil fields - and they have to be measured hundreds or even thousands of meters below the earth's surface.

ABB DOGS™ (Downhole Optical Gauge System) is capable of accurately measuring pressures to 1000 bar and temperatures to 230°C at multiple locations along an oil production pipe. Infrared light is sent via an optical fiber from an offshore platform to the sensor heads in the well. There, the light is encoded with the pressure and temperature information and then returned to the platform.

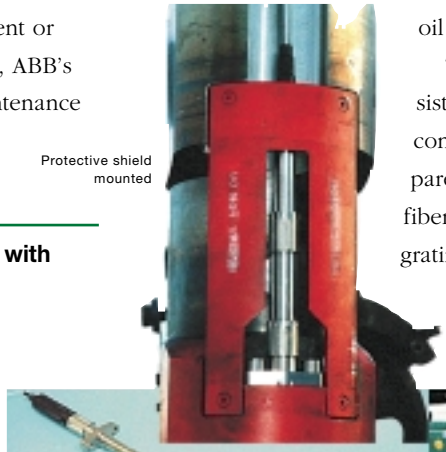
In modern oilfields, a network of production pipes is used to extract oil from different zones at various depths. DOGS™ permits reliable and precise control of the oil flow in these pipes even at the extreme temperatures of deep wells. Conventional electronic measuring systems could not survive in these conditions.

ABB laboratory tests have shown that the sensor satisfies the rigorous requirements of the oil industry. But two important questions remained: First, how can a sensor be inserted into a well, along with several tons of steel pipe, without damaging the hair-thin, fragile glass fiber? Second, how can the fiber be reliably fed through several pressure barriers along the pipe?

To answer these questions, ABB Offshore Systems UK and ABB Corporate Research, Switzerland, tested the sensor in an experimental well in Aberdeen, Scotland, to verify the delicate installation procedure.

The installation and subsequent test run were successful. After several hours in the well, the sensor was brought back to the surface intact. During its stay at the bottom of the well, pressure and temperature were accurately monitored. This spring, the first sensor will be delivered to an ABB customer and installed in an oil field in the Far East.

The sensor head consists of a steel tube which contains specially prepared segments of optical fiber, so-called fiber Bragg gratings. These fiber segments are exposed to the oil pressure and temperature. They receive light from the source on the platform via a connecting fiber, and return some of this light to the platform for detection. Pressure and temperature are encoded in the wavelengths (color) of the returned light.



Protective shield mounted

Sensor head and optical fiber leads

The sensor head is inserted and exposed to the oil in a side pocket of the oil extraction pipe. After insertion, the sensor is covered by a protective plate and the entire structure is lowered into the well. While it is being lowered, measures are taken to enable the cable to pass safely through the different pressure barriers under the surface.

From idea to perfect product in just 6 months!

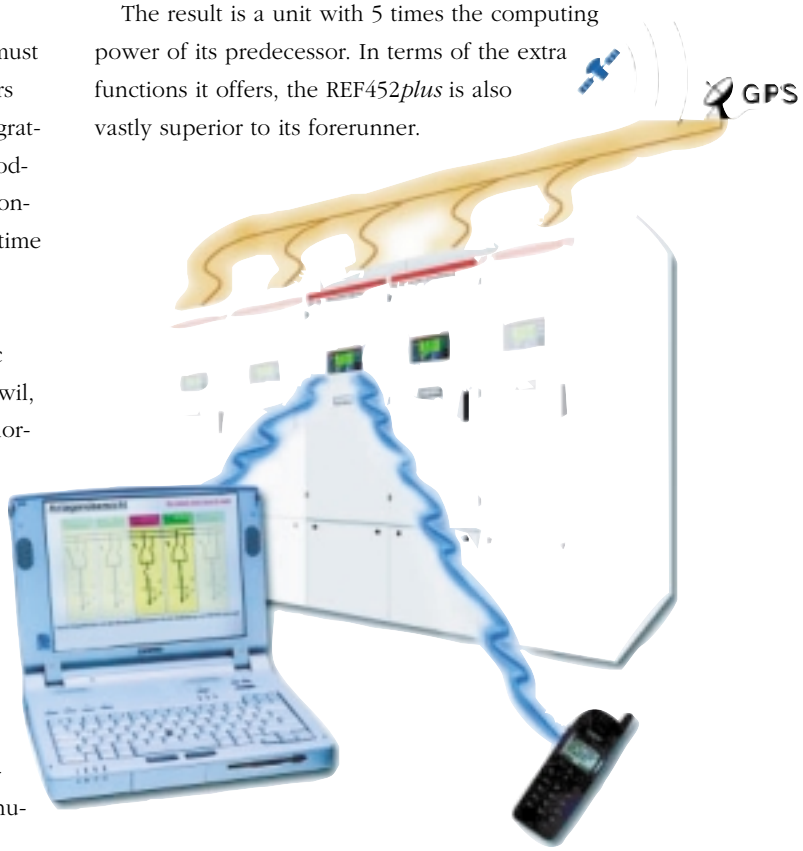
On your marks, get set, go! That was how it must have seemed to the ABB scientists and engineers who took the company's first product with integrated webserver and GPS from idea to finished product in just 26 weeks. The futuristic Switchbay Control Unit REF542*plus* was exhibited for the first time early in March at the Hanover Fair and is now commercially available.

A team from the group 'Embedded Electronic Systems' at ABB Corporate Research Ltd in Dättwil, Switzerland, joined with ABB Sace and ABB Calor-Emag to make the seemingly impossible possible. It goes almost without saying that getting a product as innovative and complex as the REF542*plus* to market in such a short time would hardly be feasible without some major contributions from Corporate Research. The REF542*plus* is also one of ABB's first products to have an integrated webserver, ie its own Internet address. This feature – a 'world's first' - allows the status of the control unit to be continuously monitored over the Internet and different operating data to be checked. Another important benefit of the integrated web technology is that no specially developed operating unit is needed. Simply connect a notepad or a laptop, and start the Internet browser. A newly developed 'normal' operating unit for the REF542*plus* is available as an option.

It is also the first product of its kind to be equipped with GPS (Global Positioning System). Instead of being used to determine the location, the GPS feature will be exploited as a highly precise 'clock' and synchronizing source. This will make it possible to reconstruct interruptions caused by faults or failures in electric grids.

ABB Switchbay Control Units protect and control medium-voltage substations all over the world. Since the figure for annual units produced is estimated to be high, it was crucial to keep product costs as low as possible, ie 30% below those of comparable products. This emphasized the importance of a very short development period, and put the onus on having a well-oiled team that not only brought the necessary know-how with it but also knew how to work independently. Even the drawback of fast-changing product costs in today's electronic components market can be compensated for by shortening the time to market.

The result is a unit with 5 times the computing power of its predecessor. In terms of the extra functions it offers, the REF452*plus* is also vastly superior to its forerunner.



Laser beams and paper machines – perfecting the papermaking process

Paper that jams in the copying machine; paper bags that split open, spilling your groceries; blurred photos in magazines that defy the keenest eye!

These common problems are often caused by low-quality paper. Small problems that can become very big problems for papermakers when customers complain and return shipments.

To avoid these problems, papermakers have attempted to measure paper quality in a process known as 'fiber orientation'. This process detects how microscopic pulp fibers are placed as the pa-

per is being made. However, with conventional systems, by the time a problem is discovered many tons of paper may have already gone to waste.

ABB recently unveiled the world's first online and real-time measurement of fiber orientation using laser beams and advanced sensor technology. The new technology provides the pulp and paper industry's fastest measurement of fiber orientation.

The 'AccuRay Fiber Orientation Sensor' measures fiber orientation on both sides of the sheet with 36,000 high-speed measurements per second. Measuring both sides of the sheet is crucial because poor fiber orientation on one side can lead to an overall bad sheet.

The important technology leap for ABB came when a physicist discovered that a laser directed along the 'grain' of fiber orientation (that is, with all the fibers pointing in one direction) results in an arced reflection. Conversely, if the laser is directed against the grain, a vertical reflection occurs. So, you can accurately determine the orientation of fibers with lasers and detectors placed on both sides of the sheet.

Measuring these parameters in real time allows papermakers to control the quality of paper while it is being made. Eliminating problems early allows for more high-quality paper at a lower cost.

ABB chose a special high-grade laser for its ability to withstand harsh paper machine environments. Three lasers on each side of the sheet pulse at high speeds while synchronized to avoid interference with lasers on the other side of the sheet. Any disturbing patterns of reflection are immediately noted online.

Twelve of the dual-sided sensors have been sold since its introduction. According to customers, payback for the sensor is less than one year. ABB is also developing software that will automatically control various elements of the paper machine as a problem is detected. When this software is released, payback will be even better.

New body shop shows the way in automated manufacturing

A car factory in full production conjures images of sparks flying around the most advanced automation systems. Heavy body framing systems and robotics combine to build sleek machines of pleasure and comfort. In the end, a steady stream of identical vehicles pour from production lines into lots where they await shipping in perfectly aligned rows.

These automation systems come at a price. There are some tasks, such as welding, that require great precision and strength at the same time; factors that dictate the use of so-called hard automation. More, the machines used in production are controlled by mechanics rather than programmable software, making them inflexible and expensive.

As a result, car manufacturers are forced to make and sell the same model for as long as possible to recuperate their tooling investment. The inability to alter the model range is incompatible with consumer demand. Consumers want an ever-changing selection of new cars. This puts a premium on shop floor flexibility.

Hard automation is extremely reliable for producing the same vehicle over and over again, but it is slow to adapt. ABB has developed a new body framing system that uses flexible robots to hold the car pieces together during welding. It is far more

flexible than its predecessors and speeds up the process of delivering new model variants to market.

Traditionally, car body framing needed large and heavy machinery to operate large and heavy tooling. Stiff frames for holding car body panels in place were needed to deliver very precise welding by robots. The precision is vital: if parts are out of place by less than a millimeter, quality suffers, and major components like doors and windows will not open or close.

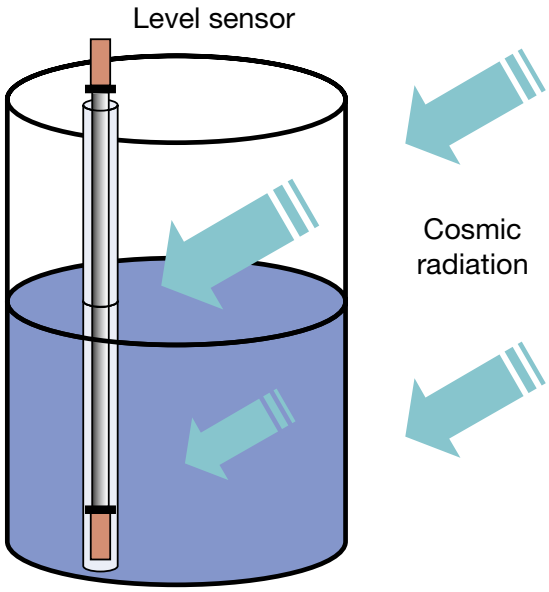
ABB has replaced this heavy machinery with three flexible robots, which take the panels, place them in position and hold them tightly while the welding robots apply the welds.

The software tells the robots what to do. Different body panels and frames can be programmed into the system as required.

The system is designed for extreme precision and consistency. Like its predecessor, it can resist the jolt of the welding process.

The result is a much more advanced framing system that uses tooling a quarter the weight of conventional systems – while being as stiff as needed.

And, those perfectly aligned rows of new cars will vary in make, model and size, the way consumers want them.



Novel sensor uses cosmic rays

The idea that 'there's no such thing as a free lunch' has been proved wrong by scientists at ABB Corporate Research in Dättwil, Switzerland. They have developed a sensor, originally conceived for the world's first subsea oil/water/gas separation tanks in the North Sea, which can use the limitless supply of 'free' cosmic energy coming at us from the cosmos.

The sensor, which is also suitable for many above-ground applications, usually has a vertical array of radioactive sources to measure the density of an oil/water/gas mixture. This density is the clue to when the oil has separated, because oil absorbs less of the gamma radiation striking the detector than the water does.

The gamma rays which make it through the oil/water mixture hit a scintillator (glass) rod and cause tiny flashes of light which race out up and down the rod. The arrival times at the top and bottom of the tube are compared to determine where in the tube the flash arose. This enables the height of the oil to be worked out (more flashes than the water part). The flash arrival times are around a thousand millionth of a second apart! Almost unbelievably, there are single-chip solutions on the market to measure these intervals.

It was an 'accident' in the laboratory that led to the discovery that cosmic radiation could be used as a 'radioactive' source for measurement purposes. During development, the equipment was left on in the lab in the absence of any sources and the researchers were astounded on their return to discover a very accurate density profile had been recorded! It turned out that there was sufficient 'background' radiation to do the job – earth's natural radiation and cosmic rays.

The latter arise in mysterious gamma ray showers which partly have their origin at the edge of the observable universe. Using them enables you to take a break between measurements, and they could be used in industrial level applications where the level doesn't change too fast – thus greatly reducing administrative effort (no authorization or protection measures required, no disposal problems).