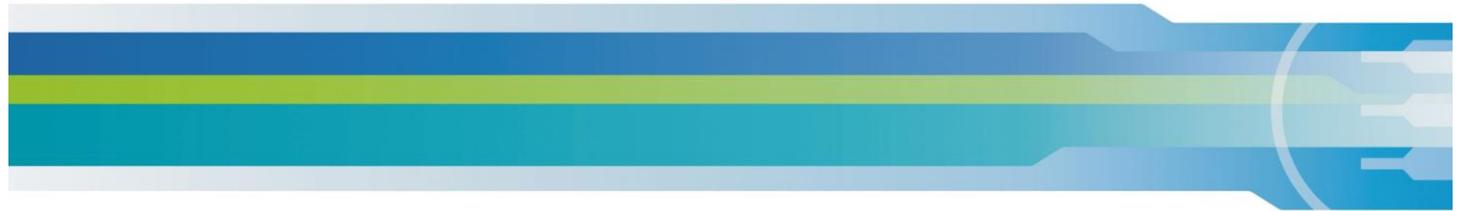


NET-CENTRICITY IN THE INDUSTRIAL MARKET: CUTTING EDGE REMOTE MONITORING TECHNOLOGY FOR WELDING

CASE STUDY

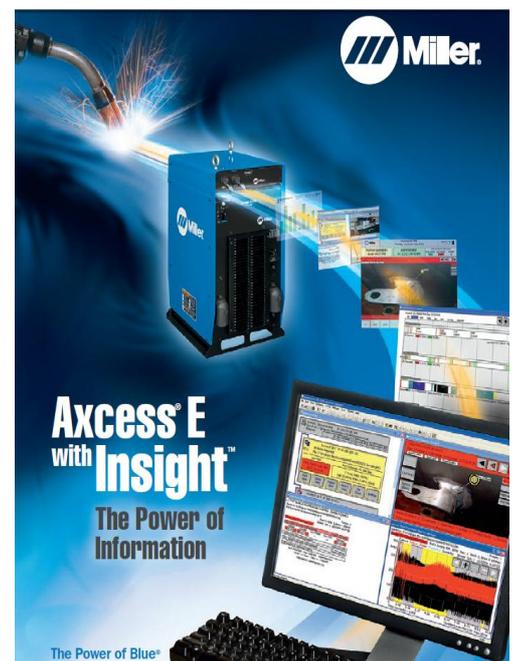


Abstract

Recent net-centric and remote monitoring advancements provide opportunities for the industrial market to improve efficiency, productivity and quality. Miller Electric Mfg. Co. is applying this leading edge technology to production welding within the industrial manufacturing industry segment. This technology has been developed to address a number of issues common to industrial production welding.

There is significant change taking place in the workforce of the welding industry. Baby boomers are quickly approaching retirement, some taking with them a lifetime of in-depth knowledge in the art of welding. They are being replaced by a new generation with much less experience. These less experienced welders tend to have lower productivity, coupled with a higher propensity for mistakes. Regardless of this fact, Miller's customers still must maintain quality standards and output efficiency. They require welding systems that will help catch human error and defects as early in the process as possible, so they can prevent small problems from becoming large, expensive problems. Miller's solution, the Axxess® E welding system, addresses this issue, and so much more.

The Axxess E is designed to easily connect via the factory floor network to provide valuable information to the operator, production management, maintenance, engineering, and plant management so they can take the proper actions that will improve their welding operation.



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Introduction

Miller Electric Mfg. Co., headquartered in Appleton, Wis., is a leading worldwide manufacturer of welding equipment including arc welders, engine drives, plasma cutters, personal safety equipment, and more. Miller sets the industry standard for reliability, quality and customer responsiveness, earning them the reputation of being one of the easiest companies to do business with in the welding industry.

Virtually every area within a manufacturing environment can be monitored for output, productivity and quality. Historically, this has not been the case for the welding function... until now. As Miller sought to evolve their Axxess product platform roadmap, they saw an opportunity to tap into the power of networking to make welding data and information more accessible and useful. A networked solution, along with a sophisticated weld monitoring system, can help reduce the learning curve for newer welders by providing step-by-step visual instructions. It also can provide the ability to quickly alert operators to potential problems. In addition to what the operator sees, manufacturing staff needs to access the machine via a series of intuitive web pages that can be viewed from anywhere; factory floor, manager's office, or even from a remote site. With this as a goal, Miller began to develop the next generation of Axxess welding equipment, which they call the Axxess E (for Ethernet). Miller's Axxess E is an extension of the very successful Axxess platform, which boasts an installed base of over 10,000 units.

Miller has also integrated a very powerful weld monitoring application in the Axxess E product called Insight™. When used with the PC application Insight Centerpoint™, operators can be guided in the production of a component via step-by-step instructions. In addition, the software can alert the operator to potential issues such as missed welds, over or under-sized welds, welds outside of acceptable parameter limits, and more. The software can also collect data relative to cell downtime, which can be very useful in pinpointing bottlenecks. The monitoring system also provides information to assess cycle times, productivity, quality, OEE, and consumption of filler metal

and shielding gas. If a problem arises, the detailed data can help operations managers quickly identify where the error occurred, and whether it was a result of a hardware defect, operator error, or something else. The key benefit to Miller's customer is early detection of mistakes or defects. The earlier in the process a problem is detected, the lower the cost to address it, as shown in Figure 1.

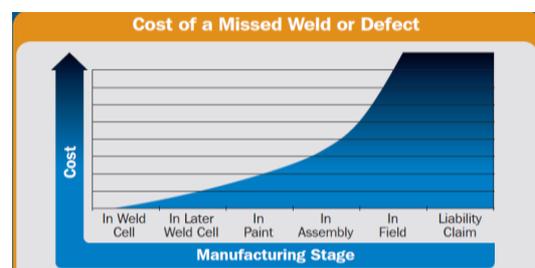


Figure 1: A missed or defective weld can have a damaging effect on cost, increasing dramatically further down the manufacturing process.

The Axxess E product gives Miller a true advantage in its market. This powerful new platform is an integrated solution, unlike other products that require external monitoring devices with many additional parts and increased expense and complexity. Competitive systems can produce vast amounts of raw data, but the user is forced to take that data and try to make sense of it. Miller's Axxess E with Insight™ is the only system that can turn raw data into information that can readily be used to drive informed decisions aimed at improving the welding operation. With Miller's Axxess E product line, customers can quickly identify a problem, locate exactly where it occurs, and fix the problem permanently to truly increase efficiency and quality, and drive out unnecessary costs.

The Challenge: I/O options, Headless, and Software

Miller had several hardware requirements for the embedded solution to power the Axxess E. In terms of communications and I/O, Miller wanted to integrate modern protocols such as Ethernet to allow for the remote monitoring and interface capability via a web page that is easily accessible regardless of time or location. The new platform would still need CAN and USB capabilities for

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backwards compatibility and easy retrofitting with older Axxess systems. These hardware requirements merged various protocols and standards into a package that needed to be connected to quickly and be able to reliably deliver precise data for software analysis.

In addition, since all of the information would be available via a Web page, the embedded solution needed to be headless and without an LCD display. Including an unnecessary display would only add cost and complexity to the end solution.

The software selection was the final challenge for Miller. The long-term roadmap for the new Axxess E platform includes a family of Ethernet-based products that will be rolled out in a very controlled manner, according to various vertical market needs. As a result, Miller chose the Windows CE operating system, which allowed for expansion through future product extensions. Furthermore, Miller wanted to use as much off-the-shelf middleware as possible to improve expansion and portability across product versions.

However, Miller's programmers came from embedded backgrounds with most of their software development expertise performed in standard C languages. The Axxess E product would be their first experience porting Windows into a welder and Miller did not have any Windows programmers. Therefore, in choosing an embedded provider, Miller needed to work with a company that could provide adequate support to get ahead of the learning curve.

The Solution: Eurotech Platform with Windows CE

Due to the headless requirement, Miller quickly narrowed the choice of embedded solutions to two, one of which was Eurotech's TurboIXP module based on the Intel IXP465 processor. The Eurotech module supported Windows CE as well as Miller's communications and I/O requirements such as Ethernet, DeviceNet, CAN 2.0, and USB capabilities, making it an ideal fit. Eurotech was willing to work very closely with Miller to help their programmers get up to speed on the Turbo IXP's operating system.

Miller ultimately chose Eurotech based on their hardware offering and business model, which defines success when the customer is successful. The Eurotech development process was more about trust rather than just the bottom line, qualities that match Miller's own core principles.

"We were sold on Eurotech's business model which is very compatible with Miller's," says Knut Froland, Business Development Manager at Miller. "For example, competitors would disable drivers and only support them at additional cost, clearly showing they were focused more on their bottom line. Eurotech, on the other hand, was looking towards getting us to production. We received very quick and effective responses, and Eurotech even brought in additional consultants when necessary to get our product to market faster."

By building a close relationship, Eurotech and Miller quickly and effectively resolved key issues and concerns in developing the Axxess E embedded platform. For example, because Miller's application contained more synchronous processes than typical applications, a software bug in the CAN drivers was uncovered during Beta testing. Miller contacted Eurotech and worked immediately with a lead software engineer who was able to deliver a fix within 24 hours. The fast response from Eurotech's support and engineering team ensured that Miller could successfully complete Beta testing with minimal disruptions to the project schedule.

On the software side, the Axxess E comes with the Insight™ weld monitoring application integrated into each system. Available in three different levels of capability, the Insight™ tool delivers critical analysis capability, including Part Tracking™, totalization of passed or failed parts, downtime, missing welds, automation cell states, summary reports, and much more. Each Axxess E can serve up web pages for configuration, diagnostics, and "snapshots" of welding performance information. Figures 2 and 3 show examples of the types of information available via these web pages. In Figure 2, the viewer can see basic machine information as well as details on the voltage, wire feed, and inductance for a specific process occurring at that station. Figure 3 shows how the user can use Miller's patent-pending customer

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web page creation tool to create a customized page that will monitor more advanced welding performance details.

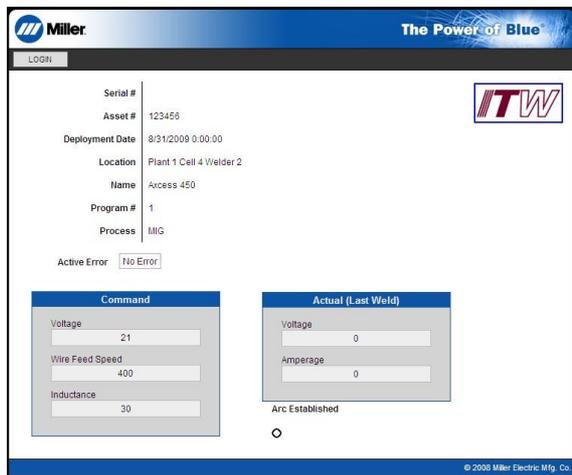


Figure 2: An example login page for Insight shows details on the last weld for a specific station and welder.

Also available for those customers who need more detail is the feature-rich Insight Centerpoint™ PC application which is a powerful graphical user interface ideal for operators and managers who want information on all welding data and system settings. Examples of how the data from Insight Centerpoint™ can be viewed are shown in Figure 4. In Figure 5, one can see the Human Machine Interface (HMI) that is used by the operator to guide them through the creation of a component. The HMI also provides summary information when the part is complete, including: number of welds completed versus expected, welding wire used, shielding gas used, deposition rate, fault statistics, and much more.

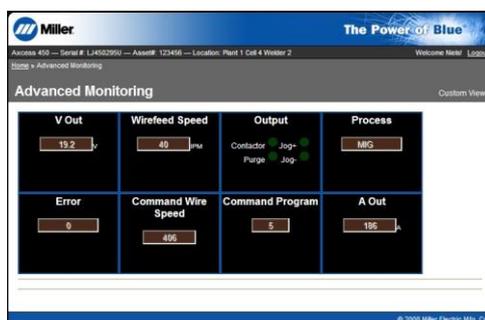


Figure 3: Advanced monitoring capabilities show summaries of voltage, outputs, amperage, and more for a station.



Figure 4: The Access E with Insight Centerpoint™ software empowers both operators and managers to optimize production and output



Figure 5: This example output from Insight Centerpoint™ shows the operator interface that guides the operator and monitors each weld for current, voltage, wire feed speed, shielding gas (optional), and duration.

Insight Reporter™ is another PC application that provides a library of pre-configured management reports which provide vital information on productivity, quality, and more.

By incorporating the key features of the embedded platform with cutting-edge software offerings, the Access E is an innovative product which delivers on three key areas vital for any welding operation: improved quality, reduced costs, and increased productivity. The product allows managers to understand all aspects of their welding operation. In addition, the Access E can be configured and deployed per specific customer needs and capabilities; as a fleet of systems connected over a factory's Ethernet network or as a single system connected directly to a

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PC with periodic connections as needed. The left-hand diagram in Figure 6 shows an example configuration where each welding station consists of the Access E system with a PC, all connected to an SQL server. The right-hand diagram shows a configuration where a station is connected periodically via Ethernet cable to a PC that can extract welding data

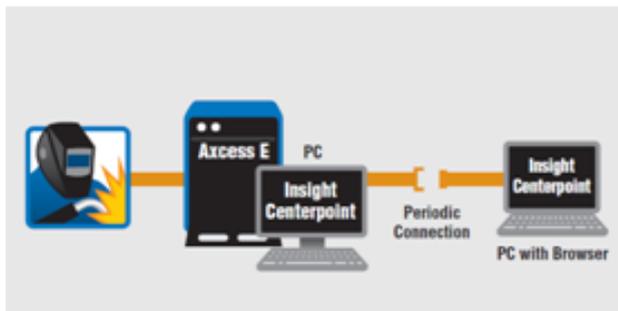
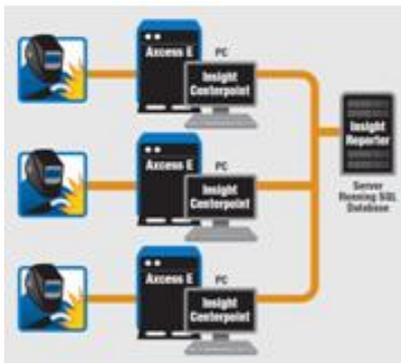


Figure 6: With the Access E, it is easy to configure for unique situations as shown in the two examples.

The Result: Access E from Miller Welding

The Access E has been very well received by the marketplace. Many of Miller's existing customers are excited that they can better control their welding operation because they finally have the information they need to pinpoint issues and get them resolved. In addition, Miller has designed a field-installable module that can be added to any standard Access system to upgrade it to an E. Miller is also targeting a large number of new customers who see the benefits of increased welding process control; from what is happening at the arc itself, to cell diagnostics, to downtime, etc.

Miller continues to expand the capabilities of the Access E product. For example, the company has been working with various partners to integrate more functionality, something which is done very easily through the Windows CE platform which offers the right amount of flexibility for product growth.

As more customers adopt the Access E, Miller will ramp up production and add new features. In addition to manual welding, the Access E can also be adapted to robotic welding, showing that the Eurotech platform is an ideal solution for a diverse range of MIG welding needs. As part of this future roadmap, Miller continues to work very closely with Eurotech on the Access E family including researching new technologies and product offerings that will help Miller continue to support a range of welding needs with this exciting product.

In the meantime, the Access E delivers what no other welding power source can: valuable, real-time knowledge for operators, engineers, and managers to help reduce costs, increase productivity, and enhance quality

More information on Miller can be found at www.millerwelds.com.