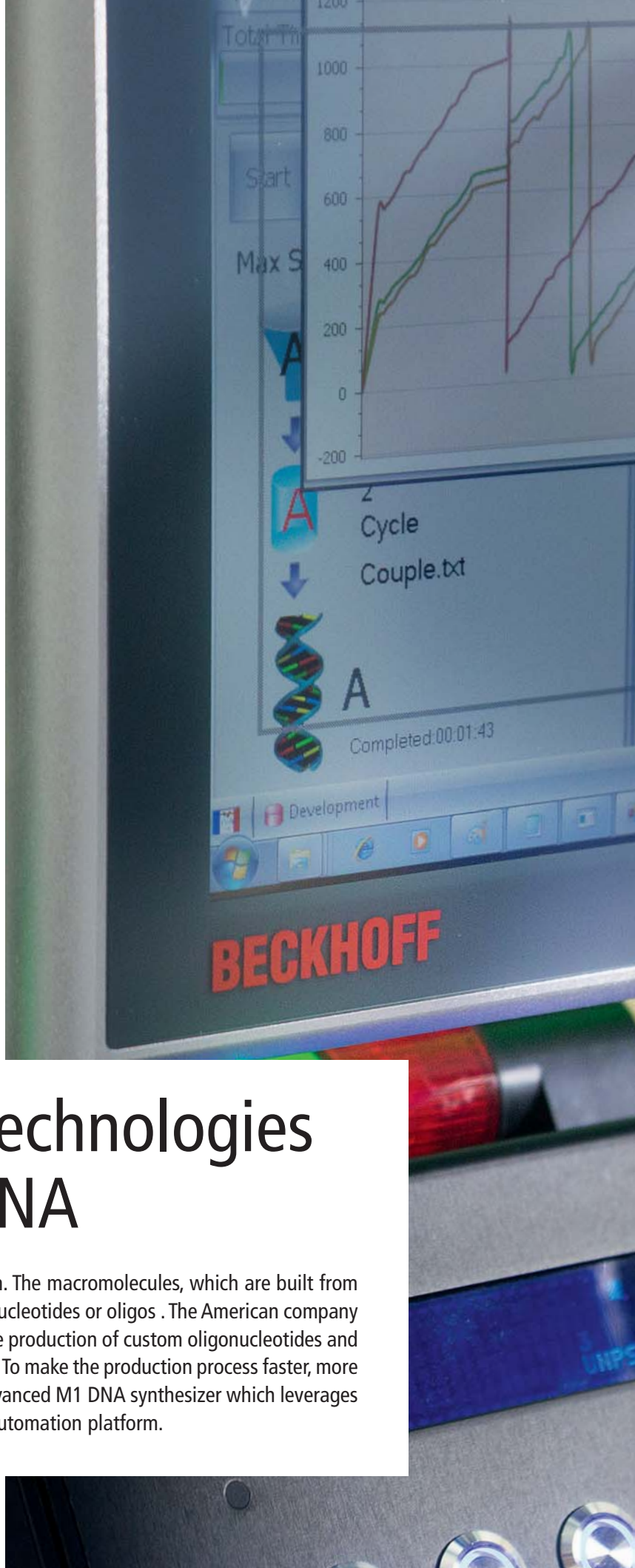

The continuous glass front panel of the CP3916 multi-touch panel is resistant to chemicals and can even be operated with gloves.

High-performance controller optimizes data handling and cuts space requirements in half

Integrated DNA Technologies creates custom DNA

Synthesized nucleic acid chains are used in gene research. The macromolecules, which are built from individual modules (nucleotides), are referred to as oligonucleotides or oligos . The American company Integrated DNA Technologies (IDT) is a global leader in the production of custom oligonucleotides and services for gene synthesis in a wide range of applications. To make the production process faster, more accurate, and more efficient, IDT depends on its highly advanced M1 DNA synthesizer which leverages PC- and EtherCAT-based control with TwinCAT 3 as the automation platform.

Cycle
<none>

IDT has manufactured and supplied oligos for molecular biology research for more than 25 years. Approximately 44,000 individual nucleic acid sequences leave the company's facilities each day, shipped to more than 82,000 customers all over the world. "Genetic research applications involve an inherent level of complexity with regard to the types of oligos needed. Each of the 44,000 sequences is custom-manufactured to the customer's exact requirements," explains Dan Brock, senior scientist at IDT. "Just like snowflakes, each DNA sequence we produce is unique." Since the company has streamlined its manufacturing process to an exceptional degree, most orders received before 1 PM local time reach the customer by the next morning. "IDT is known not only for its production volume and speed – we also focus closely on customer service and quality," says lead automation engineer Owen Piette. "Each oligo we produce undergoes a complete quality control process."

Compact and efficient: CX2020 with TwinCAT 3 as control platform

"When we selected the control platform for our M1 DNA synthesizer, we focused especially on expandability and compact design, in addition to speed and value for the money," explains Owen Piette. As a result, IDT employs a CX2020 Embedded PC for the M1 along with the TwinCAT 3 automation software platform. "Compared with the prior solution, which involved four separate synthesizers, each with its own controller, we now have a single platform, which reduces the hardware costs of the control system significantly," adds the automation expert.

"IDT has always embraced Microsoft operating systems and tools. Since most of our programming is done in .NET, the Windows-based automation platform from Beckhoff works very well for us and makes it easy to design our systems on this hardware," says Owen Piette. "The fact that TwinCAT 3 is embedded in Visual Studio® makes for a clean data transfer and simplifies the system's integration into our MES systems. This is a critical requirement, considering the large number of data points in our customer applications. Since we generate a special recipe for each synthesis, which generates huge amounts of data, robust information management is critical for the success of our production process."

Complete monitoring functionality based on EtherCAT

The numerous sensors in the M1 generate large amounts of data, tracking every aspect of the synthesis. This enables IDT scientists to generate nucleic acid products exactly tailored to customer specifications. IDT constantly monitors the chemicals and reagents, down to the smallest details of the reaction. This ensures that all processes are executed according to plan. "The quick response time of EtherCAT in the microsecond range delivers the necessary speed and the throughput we require for this type of monitoring," explains IDT systems engineer Ryan Witt. He adds: "The real-time throughput rate and high accuracy of Beckhoff EL series EtherCAT I/O Terminals provide a previously unheard-of level of monitoring functionality in our applications."

Dan Brock, senior scientist at IDT, checks the status of the M1 DNA synthesizer.

Dan Brock lists additional benefits: "We can monitor the reactions much more closely during the entire process and determine with pinpoint accuracy when and where problems occur. It's almost like an EKG. We can see the machine's heartbeat and determine any irregularities and proactively address them. With real-time monitoring via EtherCAT, we no longer have to wait until downstream quality control catches an error. This saves hours in the entire process."

Compact solution takes up little space

The CX2020 is linked to a series of EtherCAT I/O Terminals. The high-density EL2809 16-channel digital output terminal, for example, connects binary control signals from the controller to the actuators at the process level. At the other end, a group of electrically-isolated EL1819 EtherCAT digital input terminals receives and transmits signals. EL3068 and EL4008 analog terminals provide the interface to various field devices. The barcode scanners used for logging and authorization are connected via EL6002 serial interfaces. "The EtherCAT I/O system is a compact solution that requires little space," says

Ryan Witt. "We can now install four synthesizers in the space that previously housed two devices." Owen Piette mentions another advantage: "With the central controller, we were able to reduce the assembly time for the synthesis containers by an impressive 66 percent."

For the HMI of the compact synthesizer, a CP3916 multi-touch panel with a 15.6-inch display is used. "Since the panel's glass front is resistant to chemicals, it is perfect for use in our synthesis process. Users can even operate it with gloves," explains Dan Brock.

Ready for future expansions

"Overall, PC-based control with EtherCAT provides an ideal mix of price, performance, and flexibility," notes Owen Piette. "The centralized control from Beckhoff saved IDT around $4,500 per system compared with other control systems, because we didn't have to buy a separate PLC for each of the four synthesizers in the M1." The automation expert also points out the investment protection of the PC-based solution: "The flexibility and expandability of the PC platform enable us to easily upgrade the system. When one of our scientists requests enhancements or improvements in the future, implementing them will be a lot easier and less time-consuming than before."

A CX2020 Embedded PC with a directly linked I/O terminals and TwinCAT 3 automation software is used as the central controller for the M1 synthesizer.

Further information:
eu.idtdna.com
www.beckhoffautomation.com