Signal generators are required for a wide range of applications in research, development, production, and testing. Application examples include electrolytic coating or demagnetization of metallic materials. Several solutions are already commercially available. However, most signal generators have limited flexibility, resulting in inadequate output power, limitations in terms of sinusoidal output voltage, limited maximum frequency, etc. Such generators are only suitable for certain applications. Aixcon's aim therefore was to develop a versatile, and at the same time, cost-effective device that can be used in a wide range of industrial applications.

Flexible, modular, powerful

The result is a modular system, based on a signal source and a power section. The signal source consists of a CX9020 Embedded PC, TwinCAT PLC software and several EtherCAT Terminals with eXtreme Fast Control technology (XFC). The main signal generation component is realized using the EL4732 XFC analog output terminal with oversampling. The oversampling technique, i.e. the output of up to 100 time-correlated analog output values per PLC and fieldbus cycle, ensures that the power section can be supplied with high-frequency control signals with a relatively “small” and therefore inexpensive CPU (1 GHz ARM Cortex™). The following functions are possible:

- Base frequency 0 to 1 kHz
- Superimpositions of 0 up to 2.5 kHz
- Offset, duty factor, rise times, amplitudes and frequency modulation
- Sweeping
- Output power between 4 kW and 144 kW
- Signal types: sine, triangle, rectangle, trapezium, DC, individual curves

Simple handling, parameterization and programming

The function generator can optionally be operated via a database or a web interface. The CX9020 already includes a web interface without requiring an add-on. It communicates with the TwinCAT PLC via ADS DLL. This means that any computer can be used as a configuration system without additional Aixcon or Beckhoff software. But that’s not all: the Aixcon software function block (FB_aix_function_generator), which is part of the TwinCAT application software on the CX9020, enables selection of the signal types mentioned above without further programming. Based on configurable parameters such as amplitude, frequency, offset, duty factor and trapezium symmetry, it is possible to realize any current or voltage curves. Likewise, it is possible to modulate functions that are superimposed on the basic function.

Versatile, powerful and modular

XFC automates function generator for laboratory and industrial applications

The experts at Aixcon, based in Stolberg (Rhineland), Germany are specialists for control technology in power electronics. Aixcon engineers have been developing high-performance power supply units ever since the company was established in 1994. The latest product is a freely programmable function generator for alternating currents with an output power of up to 144 kW. The signal generator is realized via a CX9020 Embedded PC with TwinCAT automation software and analog EtherCAT oversampling terminals for generating the required high clock rates.

The Aixcon function generator is a modular system, based on the signal source/controller and the power section.
As an alternative to web-based operation, the function generator can also be combined with a FileMaker database. To this end, Aixcon developed a TwinCAT FileMaker plug-in, which conveniently makes data available on the FileMaker. In addition, user-friendly FileMaker interfaces can be created.

### Versatile application options

The new, modular function generator represents a freely programmable AC power source for a wide range of applications in research and industry. The CX9020 Embedded PC with TwinCAT software and XFC technology provides a robust, industry-proven technological platform for Aixcon developments. The permitted ambient temperatures between -20 °C and +60 °C in conjunction with the standard IEC 61131 programming tools of TwinCAT PLC enable application in the laboratory (research) as well as in harsh industrial environments (testing, production). Thanks to the wide range of configurable parameters it is possible to generate almost any signal type. A large number of standard signals are already included in the system, without the need for further programming.

### Beckhoff XFC technology

Using eXtreme Fast Control (XFC), which is based on a combination of different high performance technologies (see below), it is possible to achieve very short cycle and response times, high-precision synchronization and very high sampling rates (or signal generation) via oversampling terminals. XFC is the optimized control and communication architecture for maximum performance, based on:

- **TwinCAT**, the ultra-fast real-time control software
  - Real-time under Microsoft Windows with cycle times down to 50 μs
  - Programming XFC real-time tasks according to IEC 61131-3
  - The standard features of Windows and TwinCAT are XFC-compatible.

- **EtherCAT**, the ultra-fast industrial Ethernet communication technology
  - with 1,000 local digital I/Os in 30 μs
  - No sub-bus required, since EtherCAT is available right down to the individual I/O terminals
  - Optimized application of standard Ethernet controllers, e.g. Intel® PC chipset architecture
  - Extended real-time functions, based on distributed clocks
  - Synchronization
  - Time stamping
  - Oversampling

- **EtherCAT Terminals**, the ultra-fast I/O technology
  - complete I/O range for all signal types
  - digital and analog high-speed I/Os
  - timestamping and oversampling enable very high time resolution (down to 10 ns).

- **Industrial PCs**, the ultra-fast control CPU
  - with high-performance real-time motherboards
  - compact form factors available, optimized for control applications

### The oversampling principle

Process data are usually transmitted exactly once per communication cycle. Conversely, this means the temporal resolution of process data directly depends on the communication cycle time. Higher temporal resolution is only possible through the reduction in cycle time – with associated practical limits.

Oversampling data types enable multiple sampling of process data within a communication cycle and subsequent (inputs) or prior (outputs) transfer of all data contained in an array. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one. Sampling rates of 200 kHz can be realized easily, even with moderate communication cycle times.