

PC-based control of 1D/3D microphone winches delivers outstanding sound

## High-precision microphone positioning for concerts and recordings

SALZBRENNER media is a system provider for professional audio, video and media technology used in applications worldwide. The company, which is headquartered in Bittenheim, Germany, has more than 60 years of experience in designing, planning, building, installing and maintaining sophisticated projects in the field of entertainment technology. For the development of its 1D and 3D microphone winches, SALZBRENNER media selected Beckhoff as its control supplier.

Using TwinCAT 3 software and Embedded PCs, the company built a space- and cost-saving control solution for the PLC, drive and safety components.



Eliminating the need for local winch controllers brings cost savings and keeps the winch housings small with dimensions of only 60 by 60 by 20 cm. This is particularly appreciated in theaters and event facilities, where space is usually at a premium.



29 1D winches and one 3D microphone winch system in the performance hall of the WDR in Cologne ensure high-quality, precisely targeted audio recordings. Beckhoff drive technology is used to control and move the freely positionable flying frame on which seven microphones are installed.



At the 2019 Stage|Set|Scenery trade fair in Berlin, SALZBRENNER media presented with its MIC fly 1D/3D microphone winches, a newly developed system that ensures high-quality audio recordings through the precise use of microphone positioning technology in performance venues and studios. Its special feature is the cascading of the individual winches, which allows for 3D microphone travel in addition to simple up and down movements. "The first deployment of a four-point 3D winch was as part of a new audio system in the historic Klaus von Bismarck Hall in Cologne, the concert facility of the WDR broadcasting center," says Stefan List, project manager at

SALZBRENNER media. The system comprises a group of four synchronously operated winches. They move a flying frame on which up to eight microphones (two per winch) can be installed above the three-dimensional workspace. In the WDR facility, this covered an area of 7 by 9 m (23 by 29.5 ft) horizontally and 3 m (10 ft) vertically. The 3D travel of the microphones makes it possible to place them precisely above the orchestra and/or the individual instruments. The entire system for the WDR's concert hall comprises 29 1D winches for individual microphones and one 3D winch with seven microphones.

### Integrated concept for control, drive and safety technology

“We have been working with Beckhoff for roughly two years now,” says Stefan List. “We first got in touch with Beckhoff at an entertainment industry fair when we were looking for a control solution for our winches. We were impressed by the PC-based control solution’s high level of integration, which allowed us to combine sequential control, drive technology and safety technology in a single platform. As a specialist for custom-tailored solutions,

we were looking for a control technology that would be scalable in terms of performance and design to give us the flexibility we needed to realize the individual requirements of our customers. For the 3D winch control, we only needed to adapt the software.”

A Beckhoff CX5130 Embedded PC is used as the central controller for up to five of the MIC fly 1D winches. For installations with more winches, SALZBRENNER media uses the more powerful CX5140 Embedded PC with an Intel® Atom™ CPU (1.91 GHz, 4 processor cores). TwinCAT 3 PLC, HMI Web and NC PTP software cover all necessary functions ranging from sequencing to visualization to motion control. The compact drive solution consists of an EL7221-9014 EtherCAT servo terminal with One Cable Technology (OCT) and integrated safety technology (STO) as well as an AM8100 servomotor that is specially designed for use with the servo I/O modules.

The 3D winches are centrally controlled via a CX5120 Embedded PC, which communicates with the four winches via the powerful EtherCAT industrial Ethernet fieldbus. The TwinCAT-based software tool, which SALZBRENNER media developed for controlling the individual winches, could be extended for the 3D winches simply by adding NC-I and kinematic functionalities. Only the input and output terminals are installed in the winches themselves. “Through the centralized control approach and the coordination of the axes with TwinCAT NC I, they can be positioned with a precision of less than 1 cm. The possibility to dispense with local controllers also brings cost savings, and the winch housings could be made quite small with dimensions of 60 by 60 by 20 centimeters,” says the project manager. The small size is particularly appreciated in theaters and event facilities, where space is usually at a premium.

For the first time, the new audio system in the WDR’s historic Klaus von Bismarck Hall in Cologne includes a four-point 3D microphone winch system from SALZBRENNER media.

“For the first project in the WDR hall, we installed an AX5000 EtherCAT Servo Drive with integrated safety technology and the AM80xx servomotor with OCT for the 3D winches. For subsequent projects in the Baden-Baden Festival Hall and the broadcasting hall of Saarland Radio in Saarbrücken, we switched to the compact drive technology from Beckhoff for everything. This change was seamless because the same software can be used for all the different drive systems,” explains Stefan List. The operation of the winches is web-based via touch panels with a user interface that is easy to use for the stage staff as well as the musicians. Up to 200 presets can be saved and called up. The control panel can be permanently installed or mobile; it connects to the local area network.

### TwinCAT Kinematic Transformation handles complex cable pull calculations

Developed by Beckhoff and SALZBRENNER media, the software converts the space coordinates into specific rope lengths for the 3D winches to position the microphones based on the respective sound requirements. “We adjust the microphone positions based on the performance requirements or the instruments in the orchestra,” explains Stefan List. The control challenge involves, among other things, making sure that the wires holding the frame with the microphones are kept taut. Since each wire must be kept at a different length, these calculations are highly complex. “With the cable pull kinematics that Beckhoff has developed and made part of the TwinCAT kinematics library, they no longer have to be calculated in the PLC but can be called up directly from TwinCAT NC. This simplifies programming considerably,” explains Franz-Josef Klaus, engineer for motion control application software at Beckhoff.



With more than 2,500 seats, the Baden-Baden Festival Hall is Germany’s largest opera and concert hall. As part of the renewal of the hall’s roughly 20-year-old sound and video systems during the 2020 summer break, a MIC fly 3D microphone winch system was installed to ensure highly precise audio recordings.

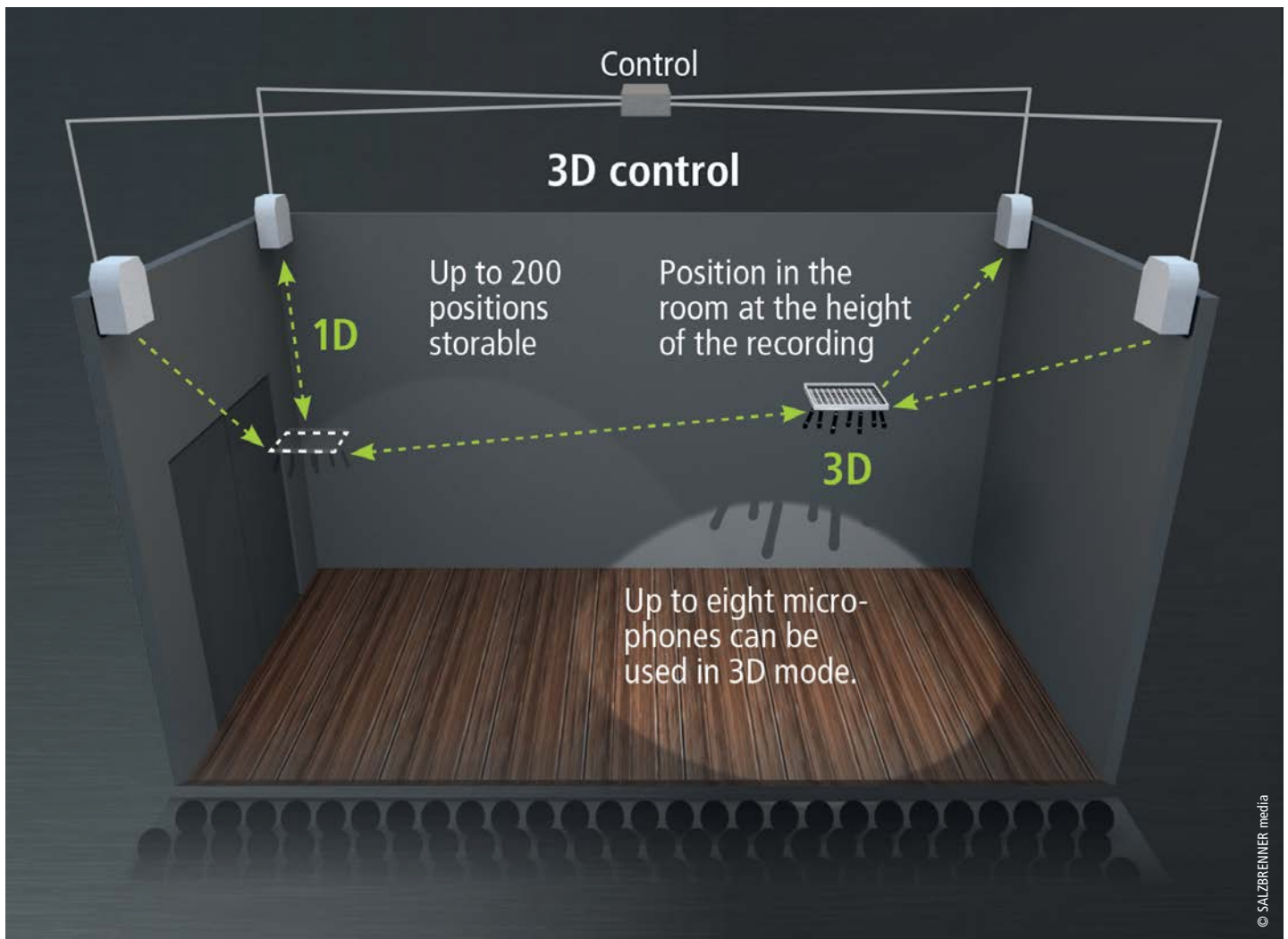


Diagram of the winch system for stage microphones

### TwinSAFE answers demanding stage safety requirements

"A unique selling point of the MIC fly winch is its compliance with the demanding DEKRA safety standards that stage technology applications must meet," says Stefan List. Since the microphone winches are installed above the orchestra, they are equipped with a complex safety system consisting of programmable acceleration and deceleration ramps, slack-line protection, uncoiling and overload protection as well as electronic cable monitoring. "The integrated safety control from Beckhoff allowed us to implement a very compact solution," continues the project manager. "It consists of an integrated EL1918 8-channel TwinSAFE input terminal with TwinSAFE Logic and the EK1914 EtherCAT Coupler with integrated digital standard and safety I/Os. The cable tension measurement, which monitors the force minimum and force maximum directly on the line, is carried out by a force sensor that is analyzed by the EL3356-0090 TwinSAFE SC input terminal. The winch speed monitoring is carried out by an incremental encoder being read by the EL5151-0090 TwinSAFE SC incremental encoder interface. Comparing the results of the safe speed sensor with the actual drive rotation ensures a high level of safety. Since the safety signals are also transmitted over EtherCAT, only a single cable must be run to each winch.

With Beckhoff, we have a partner who is experienced in entertainment applications of all sizes and whose system toolbox offers many interfaces that are relevant for our industry. SALZBRENNER media implements a broad range of media and stage applications, and we will surely use Beckhoff technology for many more projects in the future," concludes Stefan List.

More information:

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