

Stage & Entertainment Applications

Highly precise, safe and silent technology for theatre applications, theme park rides and sport simulators

Control Techniques™
Leroy-Somer™

EMERSON™
Industrial Automation

Driving technology advances in stage automation

Automation in entertainment related industries has been commonplace over the last two or three decades. As technology evolves, reaching higher levels of performance and creating ever-more complex motion and synchronization with scenery, props, lighting and sound, it is actually helping to shape the possibilities of dramatic effect in theatrical and amusement park installations. On top of this, it also ensures the safety of performers and audiences in many indoor and outdoor venues, on land and even at sea.

Control Techniques and Leroy-Somer are key players in this expanding market, where participants benefit from the advantages of automating venues and performances. These range from:

- Optimizing the dramatic effects of new technology through improved accuracy and synchronized movements of scenery, light and sound
- Silent operation of automation equipment during performances
- Increased safety systems where people and heavy moving parts are in close proximity
- Maximizing the capacity of venues with more stage performances possible and quicker production change-overs
- Modularization and distributed control of stage solutions to maximize flexibility and touring capabilities
- Enhancing reliability and repeatability of equipment
- Easier and reduced maintenance of stage effects
- Compact equipment in locations where space is at a premium

Our products are particularly appropriate for theatre applications, providing low acoustic noise operation and suitable bus systems for multi-drive networks with extensive communication capabilities for easy connectivity to overall control systems. Programmability of applications and onboard intelligence enables:

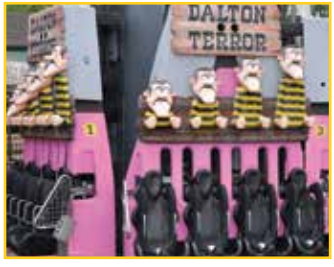
- Customized software for tailored operation
- Digital synchronization with load sharing for turning stages
- Switching between automatic (via analog input or bus) and emergency operation via preset speeds

We also provide special application solutions, such as digital lock with position balancing for lifting platforms or help with complex motion and automation of stage scenery. Distributed control within modular systems also helps to make our solutions compact, flexible and transportable.

Typical applications include:

- Stage and scenery automation for theatres, cruise ships and touring performances, such as:
  - Upper and lower stage machinery
  - Podium/platform control
  - Lighting rigging and array automation
  - Co-ordination of multiple screens/video backdrops
  - Stage elevators
  - Rotary platforms
  - Flexible co-ordinated winch control ranging from heavy scenery movements to flying actors
  - Mobile stage constructions
  - Safety curtain control
- Sports simulators:
  - Indoor sky diving
  - Cricket bowling machines
  - Interactive football games
- Theme park rides
- Film stunts
  - Usually involving rigging and accurate hoist control
- Old reel film editing machines
- Cable cars
- Rotational casting for set modelling







Global facilities and resources



Note that many countries have more than one of the facilities represented by the icons

An enhanced global presence that benefits all our customers

Through our integrated **Drives and Motors** organization, we have an extensive global presence that provides comprehensive local support and services. This includes:

5,500 employees

40+ Automation Centers

Providing excellent customer support for any product, automation solutions or service requirements

23 Manufacturing sites

Producing a comprehensive range of high quality products, optimized for industry-specific customer requirements

8 Engineering and Design facilities

Develops market leading products and feature-sets using the latest design technology

3 Regional despatch hubs

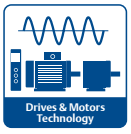
For quick delivery of product

Our extensive sales and service networks in Europe, Asia Pacific and the Americas are backed-up by hundreds of carefully selected distributors and service partners, often in remote locations, all over the world.

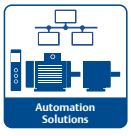


Globally organized expertise, development and support

Control Techniques and Leroy-Somer have operated globally for many years, providing unparalleled specialist drives and motors technology, expertise and customer care in a wide range of industries. Our high quality products with renowned reliability, automation knowledge and technical support have helped our customers meet and exceed their own requirements. Our business comprehensively delivers:



Matched drives and motors technology – enhancing performance and optimizing energy efficiency, offering industry-specific solutions for all customer requirements with best-in-class reliability.



Scalable automation solutions – industry-focussed small winch control applications to complete automation electrical installations for large scale theatre automation projects.



Local customized services – from audit & consultation, commissioning & start-up to maintenance and training, ensuring total support throughout the lifetime of your application to guarantee peak performance.

Product features that match the key requirements of stage applications

Theatres and concert halls contain many hundreds of drives and motors that are used throughout shows to manage stage scenery, lighting rigs and also as an integral part of many dynamic performances. Our cutting edge technology contains a wide range of features that are ideally suited to and proven in many such applications, along with hundreds of thousands of safety-critical industrial solutions all over the world.



Unidrive M700 and Unimotor fm/hd servo solutions are the perfect match for theatre applications

Silent operation during theatre productions

- Our latest generation drives provide:
  - Market-leading high switching frequencies (up to 16 kHz) throughout the power range
  - Higher current at high switching frequencies with minimal de-rating
  - Intelligent thermal management using multi-speed fans
- Our fan-less servo motor ranges provide silent and dynamic operation and are designed to work optimally with our high-performance drives.

High performance products with easy integration and safety features

High performance drives and motors

- Perfect synchronization of multiple axes
- Precise positioning to 0.1 mm (0.004 in) accuracy
  - Flexible encoder interface supporting 15 different encoder types without the need for additional interface cards. Includes Incremental, SinCos, SSI, EnDat 2.2 and Hiperface
- Power to move heavy loads in theatre applications
- High overload capability (up to 200 %) and extremely fast current control algorithms eliminate nuisance tripping
- Full torque at zero speed
- High speed travel up to zero gravity

Easy integration for numerous devices on a network

- Secondary bus systems allow multiple connection points for control and monitoring of numerous devices, including HMI and I/O
- Wide range of communications protocols to integrate with multiple drives, other vendor equipment and PLCs, including:
  - EtherCAT - high speed comms for high precision motion control
  - Ethernet - remote and multiple winch control
  - PROFINET RT - easy connectivity, common connectors & cables
- Intelligent diagnostics

Drive onboard safety features to meet SIL 3/PLe standards

- Single and dual Safe Torque Off functions
- Additional SI-Safety programmable module with advanced safety features

Compact and modular products

- Small frame sizes across the whole power range
- Modular systems for exact sizing of high power applications with option to build in redundancy

Flexibility

- Onboard intelligence allows decentralized control of modular equipment within a system
  - Dedicated/customized software on apps
  - Simplifies system and eliminates complexity in PLC/ controller
  - Easy programming on multiple drives with portable memory storage
- I/O for multiple wired commands for local drive control
- Numerous mounting possibilities
- Duty assist to ensure even wear and tear of equipment (larger systems)



Driving technology advances in stage automation

When audiences visit theatres or concerts, they want to be dazzled by the performance and the overall spectacle of the occasion. They expect bigger and better stage management and clever effects that have taken weeks of design, planning and construction – ***and which have to perform flawlessly, night after night!*** *Our drive and motor technology ensures each and every performance meets and exceeds the expectations of the audience with reliable, safe and accurate control solutions.*

Crucial drive & motor criteria

ACCURACY	Improved accuracy and synchronized movements of scenery, lighting and sound equipment
SAFETY	Increased safety systems where people and heavy moving parts are in close proximity
SILENCE	Silent operation of automation equipment during performances
COMMUNICATION	Requires 2 independent / redundant communication channels for automatic & emergency control e.g. Ethercat & Ethernet, allowing remote access
FLEXIBILITY	Modularization and distributed control of stage solutions to maximize flexibility and touring capabilities
RELIABILITY	Enhanced reliability and repeatability of equipment leads to easier and reduced maintenance of stage effects
ENERGY SAVING	Regenerative energy technology reduces energy consumption and is kinder to the environment

Safety curtain control

Integration with safety systems enables the fireproof curtain to be raised using winches and, in the event of an emergency, dropped using gravity, protecting the audience from danger.

Lighting rigging / array automation

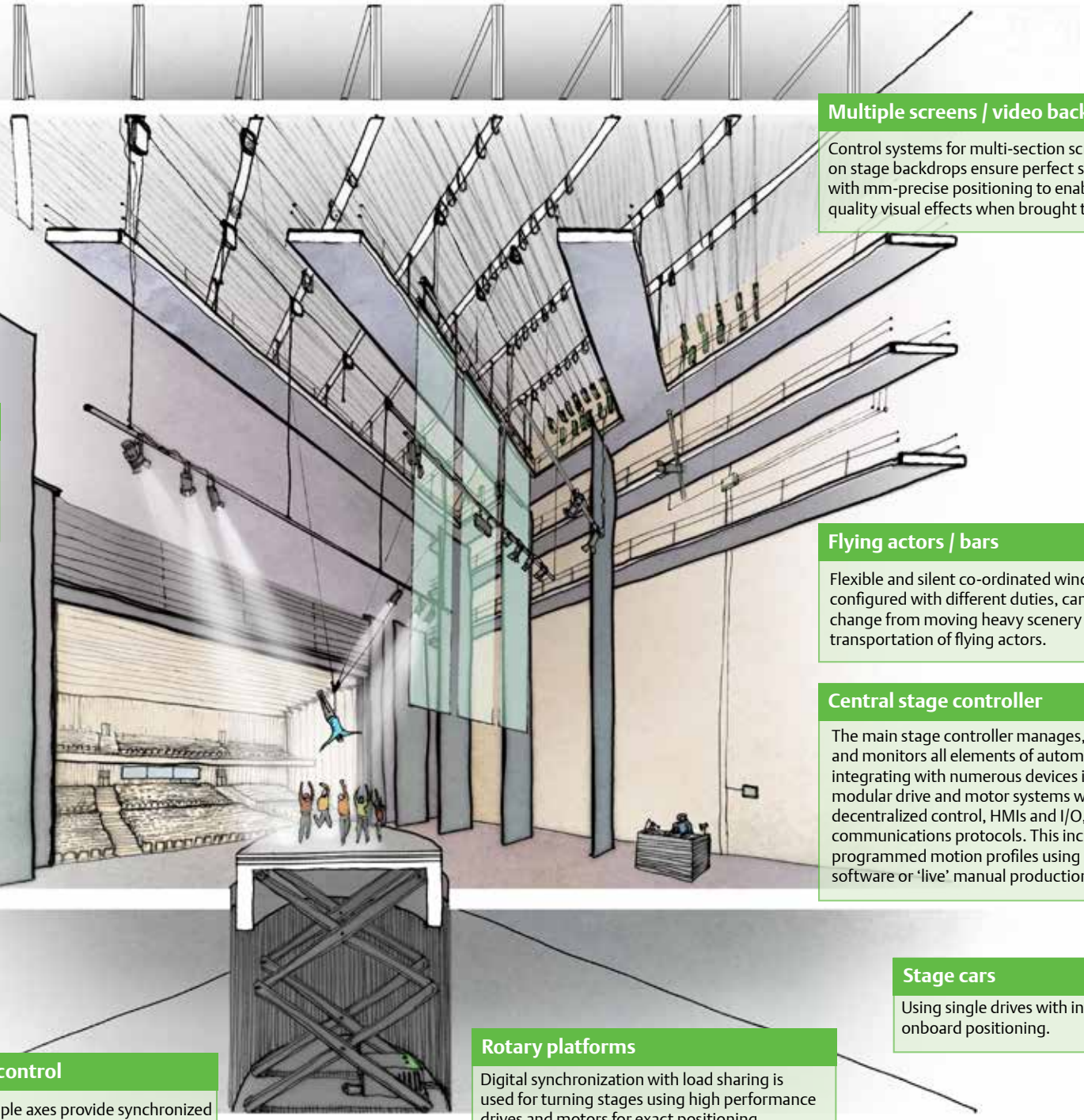
Complex motion and synchronization of lighting to sound and scenery movements optimizes the dramatic effect in theatrical and stage performances.

Stage elevators

Special application solutions, such as digital lock with position balancing are perfect for lifting platforms or helping with complex motion and automation of stage scenery. Silent operation is crucial to ensure theatrical illusion is maintained.

Podium / platform

Drive systems with multi movement of platforms enabling versatile scener



Multiple screens / video backdrops

Control systems for multi-section screens and on stage backdrops ensure perfect synchronism with mm-precise positioning to enable high quality visual effects when brought together.

Flying actors / bars

Flexible and silent co-ordinated winch control, configured with different duties, can quickly change from moving heavy scenery to transportation of flying actors.

Central stage controller

The main stage controller manages, synchronizes and monitors all elements of automation, integrating with numerous devices including modular drive and motor systems with decentralized control, HMIs and I/O, using communications protocols. This includes pre-programmed motion profiles using customized software or 'live' manual production.

Stage cars

Using single drives with intelligent onboard positioning.

Rotary platforms

Digital synchronization with load sharing is used for turning stages using high performance drives and motors for exact positioning.

control

ple axes provide synchronized above and below stage, y during performances.

Leveraging global knowledge to maximize performance when the show must go on

Experienced sales and technical teams throughout our Automation Center network can provide the know-how and support in identifying the correct product feature-set and capabilities to meet the specific entertainment application requirements. With such an impressive list of global references, we are able to leverage and mobilize our worldwide expertise in stage solutions locally. This knowledge, backed by our local engineering support, ensures the maximization of our product capabilities in any application.

Partnering to push the boundaries

We have a number of long term partnerships with leading entertainment industry specialists in niche market segments, such as stage system integrators and OEMs. We have provided thousands of products to integrate into the most complex of entertainment automation projects, providing all the functionality, integration requirements and positional accuracy required. Our industrial automation experience means we can provide software development for special applications, such as incorporating servo motors for complex multi-axes motion.

Scalable drive and motor solutions

Entertainment projects we are involved in can vary from the provision of products for single small stage hoists up to complex motion applications including hundreds of drives on a single network that integrate with full control systems in stage (upper and lower) and auditorium automation including scenery movements, lighting and sound synchronization. This includes modernization projects or completely new installations. Our drive control systems easily integrate with existing HMIs, motors or other vendor equipment which remain fully operational and are tailored to the exact site, stage or performance requirements. Also the same control system is present across the whole drive power range, allowing OEMs and system integrators to develop their own scalable solutions using our equipment.

Simple yet powerful stage control

The high performance motion controller onboard our drives enables the main stage controller to send simple commands to the drive to position the motor without having to centrally embed the position control loops. This reduces the processor workload of the central stage controller and frees up communication bandwidth. The built-in functions include homing (also known as datuming), absolute and relative positioning and even electronic gearing allowing the motion on multiple axes to be synchronized.



Comprehensive support, as required

Working with many entertainment industry specialists and integrators, we know most key project tasks are managed in-house. However we have significant automation solutions project management and engineering experience across a wide range of applications and can provide support to help OEMs bring new products to market faster and system integrators to bring projects to a successful conclusion, including:

- Expertise in the specification of drives and motors, along with software tools for sizing
- Help with engineering design that incorporates:
  - Drives, motors and integrated intelligence and programming to provide silent operation and highly accurate synchronized motion
  - Integrated safety controls (SIL 3/PLe) onboard drive to integrate with customer safety systems
- Customized software application development to the specific requirements of the application and location, including:
  - Comprehensive motion profiles with safety and efficiency of movement at its core
  - Integration with PLC and HMI software
- Assembly of tailored electrical cubicles and control panels
- On site drive commissioning, start-up and optimization
- Detailed project documentation
- Training



Customized solutions to heighten performances

To help with the task of creating spectacular performances and innovative theatrical effects, we have software tools to help with set-up, optimization and easy programming. These can incorporate stage and scenery movements, lighting effects and sound, including pre-programmed actions and manual overrides.

Flexibility to maximize possibilities

Our stage solutions increase stage availability with automation providing quick change-over between scenes, simplifying the process of set-up for different matinee and evening performances. Ultimate flexibility in set-design and operation is possible as all winches can configured for different duties from single actor to heavy scenery. Usually incorporated into a grid system, winches can allow for positioning and complex movements and transportation of props anywhere on stage to 0.1 mm (0.004 in) accuracy.

Safety and accuracy

Many stage and entertainment applications are safety critical as there is minimal space with heavy moving objects all around actors, audiences or users. Some installations, such as safety curtains, are designed specifically for emergency situations. Our products are safety certified to SIL 3/PLe. Continuous real-time monitoring can occur during set building and performances through highly accurate load calculations based on current drawn from motors and checked against load cells. We can incorporate anti-collision and anti-swing features into control systems, while allowing time for operators to react.

Precise positioning and speed control guarantees quick movements silently, with encoder feedback ensuring high accuracy motion profiles. Matched drive and motors plus synchronization ensure the highest levels of performance and safety.

Modularity for compact and scalable systems

There are many benefits of modular control systems in stage and amusement park applications. They can provide redundancy in theatrical performance, if there is an issue with any of the individual modules, the remaining winch movements can carry on unhindered. Also they are compact solutions; often a single drive controls two winches (synchronized or independently) where cabinets can be mounted onto the winch frame. Distributed onboard intelligence and easy connectivity to centralized control systems make our automation solutions scalable for different sized venues and easily transported touring equipment.

Technology proven in industry, with energy saving features

The reliability of our technology is proven in hundreds of thousands of industrial applications, often in harsh environments. Our products are tested to be resistant to mechanical shock and vibration levels well above what you expect in live performance venues. Cost effective automation is also supplied through a series of energy saving drive features, such as:

- Common DC bus operation enabling braking energy to be recycled
- Low power standby mode consumption
- Rectifiers for energy recovery
- Low losses with efficiency up to 98 %



Comprehensive product ranges and experience in a wide range of entertainment applications

There is such a wide and varied selection of applications that can be broadly grouped under 'entertainment' that it is impossible to mention them all. However, we can provide many references that range from theme park rides, sports simulators to interactive water and light features to name but a few.

To automate these, we provide comprehensive and reliable AC, DC and servo solutions, including asynchronous and permanent magnet synchronous technology, that maximize energy savings, performance and safety. Our drives, motors, geared motors and brakes and drives operate optimally together and integrate seamlessly with third party vendor equipment. Key products include:

- Unidrive M industrial drive family has defined feature-sets to optimize performance and productivity across a wide range of applications. Includes industry standard Ethernet IEEE 1588 V2 comms, IEC 61131-3 motion & automation programming and high speed I/O.
- Dyneo® Permanent Magnet and IMfinity® IE2/3 induction variable speed solutions offer leading levels of energy saving.
- Unimotor fm/hd dynamic brushless AC servo motor ranges, provide high peak torque, low inertia solution for complex applications.
- Flexible FFB brake motors are reliable and robust while providing high performance and safe braking in demanding applications.
- Range of helical bevel and worm geared motor technologies to meet various requirements.



Here are a number of typical applications that highlight how our technology and engineering capabilities have made a big impression to audiences and users around the world:

Royal Shakespeare Theatre renovation



Description: Full back-drop/scenery & lighting array automation system, including servo drives and motors package with onboard motion control and encoders for double winch control

Key Benefits: Silent operation, versatile & quick change-over, reliability, comms, integration with external control, compact, high performance.

Touring generator sets and winching systems for stage and scenery applications



Description: Mobile stage construction and scenery control system using modular AC drives and Ethernet communications

Key benefits: Easily transportable & demountable construction, precision lifting, robust & reliable electronics, compact system using open Ethernet communications.

Interactive football attraction



Description: Servo solution with for target control and ball retrieval system, with Profibus communications used for PLC integration to start/stop activity.

Key benefits: Distributed intelligence and high level onboard programming so no need for central controller, high speed communication for performance, encoder feedback for exact positional control and effective multiple redundancy for reliability.

Indoor sky diving simulator



Description: Fully engineered free standing drive cabinets with high speed comms, synchronizing 12 fans to a maximum of 2.4 MW (3,200 hp) to keep sky divers airborne with instant adjustment based on specific weight of users. Also temperature monitored for accurate ventilation.

Key benefits: Precise air control, maximum energy efficiency, cost effective operation, instant fan speed adjustment per individual sky diver.

Choreographed water fountain & light show



Description: 22 axis motion control system for synchronizing complex water profiles and 78 lights, with sensors allowing visitor interactivity influencing performance using Modbus communications.

Key benefits: Synchronized water & light show sequences, centralized system that is easy to program & configure, accurate multi-axis control with remote access via Ethernet.

Theme park ride – zero gravity drop tower



Fail-safe TÜV approved system using motion controller, drives, encoder and magnetic braked motors for world leading drop tower. Allows continuous operation at low speed with braking energy efficiently dissipated.

Key benefits: Faultless & precise movement, highly reliable with more uptime increasing foot flow and reduced maintenance costs.

Total services and support to ensure optimized operation for the lifetime of your application

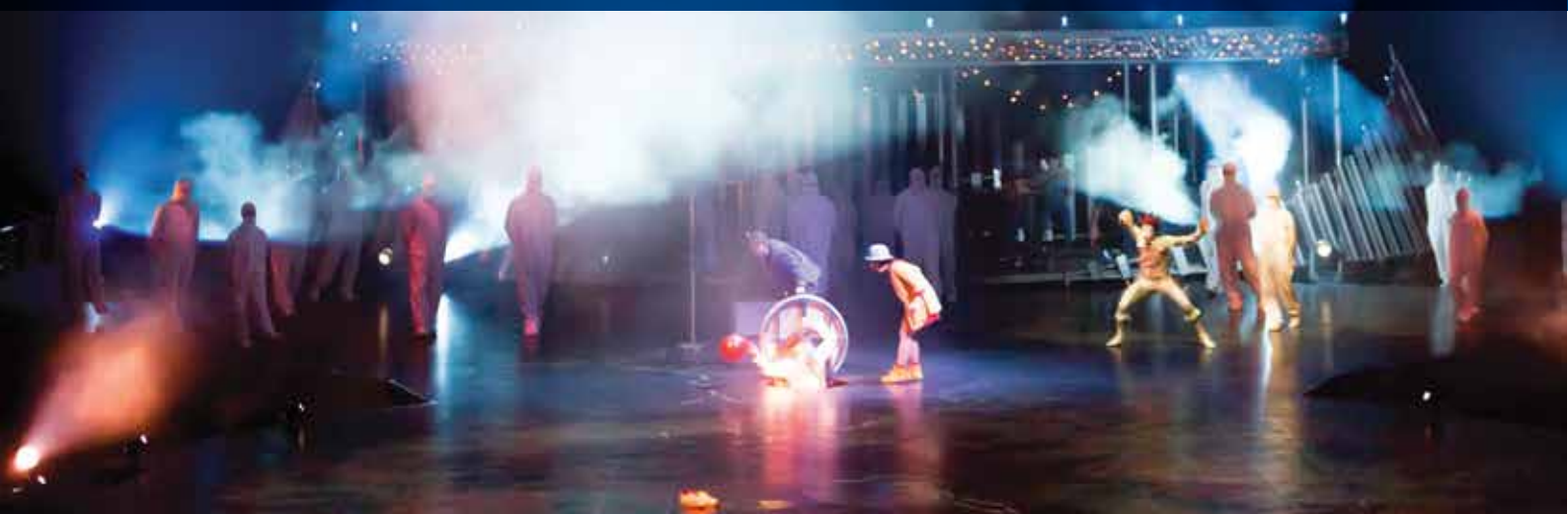
We want our relationship with you to develop over many years, continuously adding value as requirements and technology evolves. Comprehensive maintenance and servicing is available to ensure trouble-free operation, along with the following offerings:

- Management of future equipment requirements or retrofit projects
- Upgrades to hardware/software as technologies advance
- On-site software development for fine-tuning automation
- Provision of add-on functionality as your needs expand
- Global aftersales support in all world areas
- Technical support
- Maintenance support and field servicing capability (including checks on safety critical applications such as safety curtains)
- Comprehensive training, ranging from scheduled programs at local training centers to fully customized courses for your applications at the performance venue
- User documentation
- Quick provision of spares or replacement system components
- Emergency services by skilled local support teams
- 24 hour web and remote support services

Venues that currently use our drive and control technology, with many other references available:

AIDA Cruise ships (Germany)
Auditorium Parco della Musica, Rome (Italy)
Cirque de Soleil, Las Vegas (USA)
Colon Opera and Actors House, Buenos Aires (Argentina)
Daejeon Culture & Arts Center (South Korea)
Friedrichstadtpalast, Berlin (Germany)
Gran Teatre del Liceu, Barcelona (Spain)
Hangzhou Grand Theatre (China)
Jiangsu Grand Theatre (China)
Metropolitan Opera House, New York (USA)
National Kaohsiung Center for Arts (Taiwan)
Olympics Scoreboard (basketball arena), Beijing (China)
Palau de les Arts Reina Sofia, Valencia (Spain)
Pilsen Theatre (Czech Republic)
Royal Opera House, London (UK)
Schiller Theater, Berlin (Germany)
Seoul Art Centre (South Korea)
Shanghai Disney Resort (China)
Sungnam Art Centre (South Korea)
Tabakov Theatre Studio, Moscow (Russia)
Teatro Real, Madrid (Spain)
Theater Basel (Switzerland)

Contact your local Automation Center to find out more about our entertainment application capabilities.



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