

Bühler
Motor

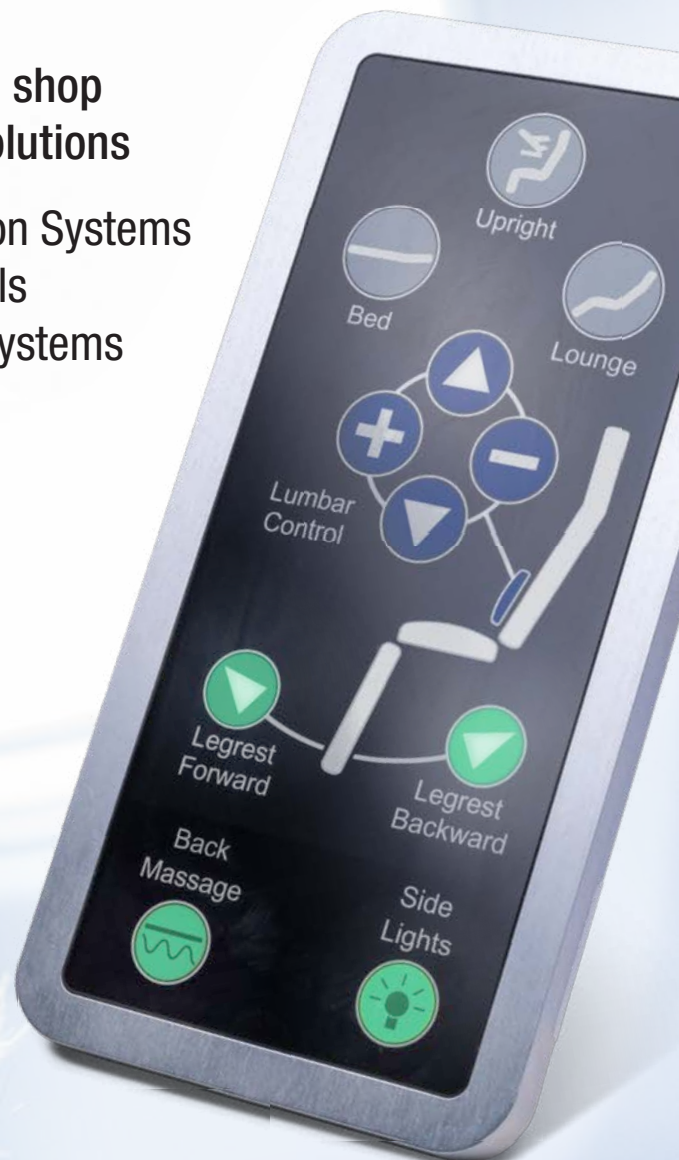


»» fast forward solutions

Upgrade Your Dreams

Your one-stop shop
for comfort solutions

- | Seat Actuation Systems
- | Control Panels
- | Pneumatic Systems



»» www.buehlermotor.com

Seat Actuation Systems

Customization

Control Panels

Pneumatic Systems



One-stop-shop for Comfort Solutions

Are you looking for state-of-the-art comfort components?
Or are you searching for an innovative seat control and
actuation system?

Bühler Motor is your one-stop shop not only for components,
but also for complete systems as well as customer specific
developments.

Your one-stop shop for Comfort Solutions



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Systems

- ▶ **PAXCOM Seat Actuation System:** an innovative system with our perfectly matched components.
- ▶ **Seat Comfort Integration:** we work with your other partners to provide you with a software and system solution integrating all electrical and control elements of your seat.

Components

- ▶ **Actuators** for seats, dividers and all cabin comfort requirements
- ▶ **Electrics and electronics** such as power supply, controllers and electrical harnesses
- ▶ **Control Panels**
- ▶ **Pneumatic Systems**
- ▶ **Lights**

Customer specific developments

- ▶ **Seat and cabin actuators**
- ▶ **Control Panels**
- ▶ **Lights**

Convincing Benefits for Passengers, Airlines and Seat Designers



One-stop-shop for Comfort Solutions



Flexible Seat Architecture

- ▶ Modular CAN-based Seat Actuation System scalable from Premium Economy and Cockpit Seats up to Business and Super First Class Seats
- ▶ Multiple Smart Actuator families available to support a variety of seat kinematics
- ▶ Just one power supply needed for up to 4 PAX
- ▶ Installation effort reduced, through to the simplified harness concept & quick-lock connectors
- ▶ Less calibration effort required during seat installations
- ▶ Easy configuration management

From digital MRO to predictive maintenance



Easy on site support enables us to permanently monitor and optimize the complete seat system.

With continuous data logging and analysis we avoid unplanned maintenance with advanced scheduled tasks. Knowing exactly what and when to service, lowers maintenance costs and increases passenger satisfaction. High availability, high passenger satisfaction and quick turn-around times lower your total cost of ownership.

'Data Analytics' not only helps to make predictive maintenance come true, it also gives valuable insights in usage patterns and passenger behavior. It's the basis for continuous improvement.



Outstanding Passenger Comfort

- ▶ Smooth, ergonomic seat motion through smart linear & rotary actuators utilizing brushless DC technology
- ▶ Silent seat motion, as a result of specially-designed motor controls and gear material selection
- ▶ A choice of capacitive glass control panels or tactile buttons for a high-end look-and-feel experience
- ▶ 4-way adjustable lumbar support with the quietest and smoothest operation in the industry



Simplified Maintenance and Data Logging

- ▶ Transparency through 'Data Analytics'
 - ▶ Ability to analyze passenger behavior
 - ▶ Evaluate actuator usage with captured data
 - ▶ Obtain seat status metrics for predictive maintenance (on request)
- ▶ Lower maintenance effort achieved as a result of the continuous data logging & analysis features in the simplified maintenance concept
 - ▶ BITE code display
 - ▶ On-aircraft software update possible
 - ▶ System status views
 - ▶ Maintenance operations
 - ▶ Downloadable log files from system controller
 - ▶ Automatic upload of log files for online report generation

Seat Actuation



PAXCOM System

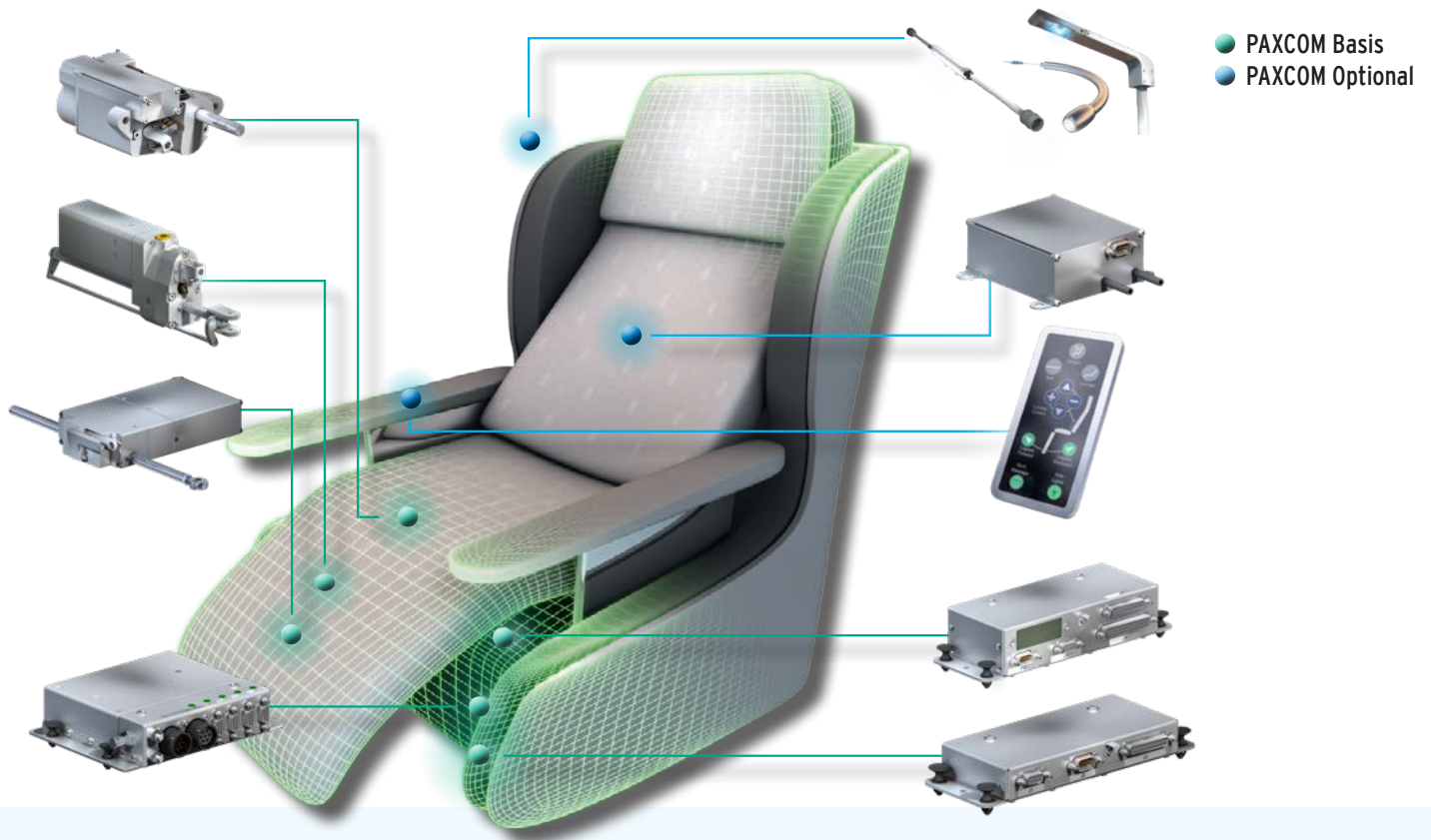
- ▶ An intelligent system for seat control and actuation to provide bespoke solutions for your seat kinematics
 - ▶ Modular CAN-based Seat Actuation System
 - ▶ Scalable from Premium Economy and Cockpit Seats up to Business and Super First Class Seats
- ▶ Enhanced connectivity for easy integration of discrete and/or smart buyer-furnished equipment (BFE)
- ▶ Multiple smart actuator families available to support a variety of seat kinematics
- ▶ Innovative maintenance concept with advanced data logging and analysis
- ▶ Smooth and ergonomic seat motion, optimized seat kinematics and enhanced reliability for best possible passenger comfort experience

Compliance

Airbus:

- ▶ 2520M1F001200, Electrical Seat Actuation System
- ▶ ABD0100, Equipment Design - General Requirements for Suppliers
- ▶ ABD0031, Fire Worthiness Requirements - Pressurized Section of Fuselage

Maximized User Comfort



Boeing:

- ▶ D6-36440, Standard Cabin System Requirements Document
- ▶ D6-44588, Electrical Requirements for Utilization Equipment Installed on Commercial Transport Airplanes
- ▶ D6-51377, Airplane Fire Worthiness Design Criteria - Pressurized Compartments

Others:

- ▶ RTCA D0160G, Environmental Conditions and Test Procedures for Airborne Equipment
- ▶ RTCA D0178B, Software Considerations in Airborne Systems and Equipment Certification



Seat Actuation

PAXCOM Actuators: Linear, Rotary, Compact

- ▶ Smart actuator including integrated motion controller
 - ▶ Brushless DC drive motor - servo drive behavior
 - ▶ High-precision positioning
 - ▶ Smooth, silent movement
 - ▶ Customized start/stop ramp and obstacle detection
 - ▶ Enhanced data logging & analysis capabilities
- ▶ Modular gear reduction system
 - ▶ Variable force/torque range
 - ▶ Variable speed range
- ▶ Customized stroke lengths and mounting attachments
- ▶ Manual override
- ▶ Simple calibration for rotary actuator; plug-and-play for linear and compact actuator
- ▶ Easy configuration management
- ▶ Compact design, low weight
- ▶ Designed to support a variety of seat kinematics

Fotolia © Tyler Olsson



PAXCOM Power Supply

- ▶ 115V AC variable frequency power input
- ▶ 4 PAX outlets
- ▶ Integrated enable/disable function ('Kill Switch') also for individual outlets
- ▶ Quick-lock plugs
- ▶ Modular system for connector input box
- ▶ Thermal management
- ▶ Short circuit protection
- ▶ Low weight, high power density
- ▶ RS485 interface to 3rd party devices

PAXCOM Discrete Line Controller (DLC)

- ▶ Easy integration of discrete and smart buyer-furnished equipment (BFE) including lighting, sensors, switches, and much more
- ▶ Integration of up to two 5x5 Matrix control panels
- ▶ Bespoke software packages for automatic updates of all devices in the seat system
- ▶ BITE data logging
- ▶ Analog and digital inputs for integration of all possible switch and sensor types
- ▶ Pulse Width Modulation (PWM) output channels from 5V to 24V

PAXCOM Extended Seat Interface Device (eSID)

Same basis as the PAXCOM Discrete Line Controller, plus:

- ▶ BITE-Code display, based on OLED technology
- ▶ Extended connectivity & maintenance functionality
 - ▶ Continuous data logging of BITE and usage data
 - ▶ Simplified data analytics
 - ▶ Single point access for maintenance & software update (USB interface)
 - ▶ RS485 interface to 3rd party devices
 - ▶ RS232 interface to 3rd party devices
 - ▶ Ethernet interface
 - ▶ HW and SW architecture for potential future needs



Control Panels

Control Panels

We provide control units designed to your requirements and to those of your airline customer.

In our glass panels, capacitive touch sensors, combined with a robust glass surface, provide the passenger with a superior tactile and visual experience. Shape, colors, lighting schemes, frames and interface are customized as required. The passenger receives immediate feedback through lighting cues on the panel.

Our mechanical panels with depressable buttons can also be customized to various shapes and sizes. With the right back-lighting, this technology provides a visual and tactile feedback to the passenger.



Fully customizable

- ▶ Button and frame design
 - ▶ Size, shape, color, surface finish and function
- ▶ Background lighting and brightness levels
 - ▶ Lighting for buttons, areas or entire screen
 - ▶ Brightness modes e.g. sleep, standby and active
 - ▶ Day and night design options
- ▶ Button functionality and lighting
 - ▶ Light intensity and timing fully customizable
 - ▶ Aura and pulsating lighting
 - ▶ Predefined button combinations possible for crew and maintenance
- ▶ Supported interfaces
 - ▶ Discrete lines
 - ▶ CAN, RS-232, RS-485, matrix

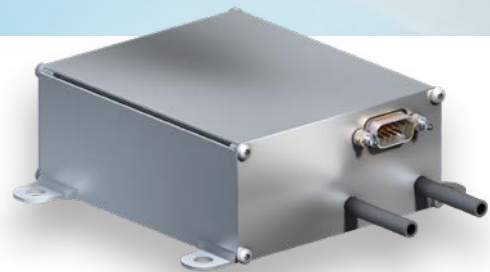
Lower TCO

Our PCUs convince with a proven MTBF (Mean Time Between Failure) of more than 2 millions flight hours. This translates into less downtime, less maintenance and less repair. Over the long run you do not only benefit from a higher passenger satisfaction, but also from a lower total cost of ownership.





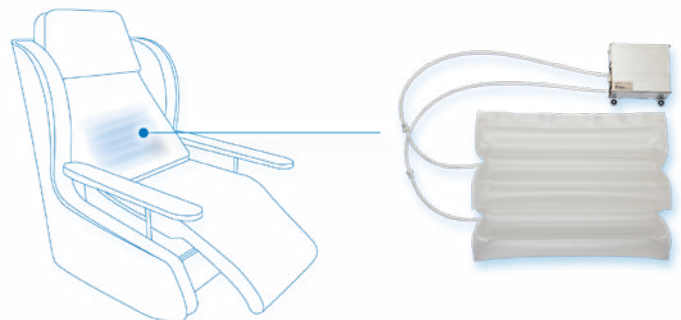
Pneumatic Systems

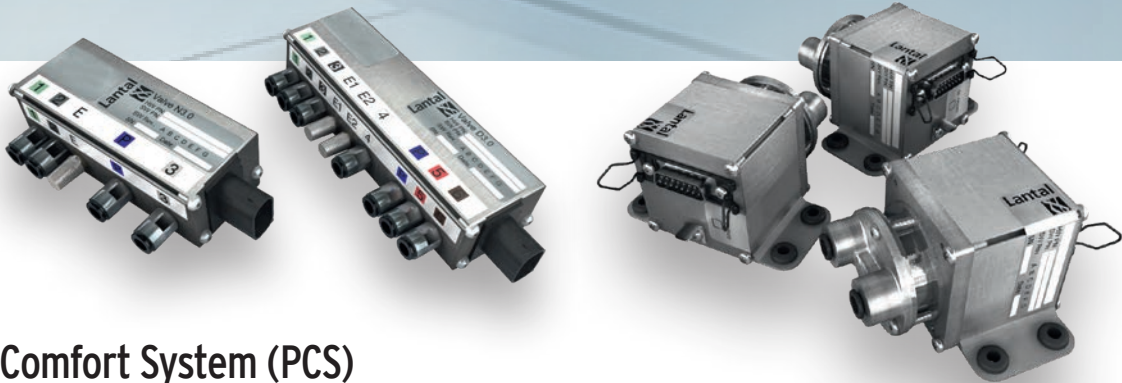


Lumbar System

The 4-way Lumbar System ensures a very high level of passenger comfort

- ▶ Low Power Consumption
- ▶ Very low noise
- ▶ Very low weight
- ▶ Massage function available
- ▶ A differentiator in the premium economy segment
- ▶ Can be installed into nearly every seat structure
- ▶ Standard cushion size which is customizable to customer needs
- ▶ Tube length adaptable to the seat structure
- ▶ Supported interfaces: CAN, RS-485





Pneumatic Comfort System (PCS) by Caynova

- ▶ Smart technology for enhanced passenger comfort
- ▶ Lowest operating cost through weight savings and no scheduled replacements
- ▶ Passengers can select personal cushion firmness
- ▶ Integrated lumbar support and full body massage
- ▶ Can be cleaned and sanitized on the spot, fluids cannot penetrate cushion

For further information please visit: www.caynova.com



© Lantal Textiles AG

Your Idea – our Solution



Bespoke solutions

As well as adapting our existing product portfolio where necessary, we offer our customers bespoke solutions.

Over the past 20 years we have developed comprehensive know-how in the design and qualification of electrical and electronic seat components and systems.

We are the perfect partner to assess your customized requirements and to develop solutions from an early stage. Our success is based on a clear understanding of the requirements of your entire seat system combined with a strong interdisciplinary team (electrical, electronic, mechanical and pneumatic engineering, together with system and software engineering).



Actuators

We develop and produce actuators which meet all the exact requirements of your seat kinematics, installation space and electrical interfaces.

- ▶ Applicable to other cabin equipment, such as privacy dividers
- ▶ More than 100.000 flying

Lighting

We develop innovative lighting for seats, and have a proven portfolio of feature and ambient lighting solutions.

Indication Panels

Using the same technology as on our control panels we can provide you with bespoke high quality indication panels for business and first class seats. These can be used to display static or dynamic information such as TTL position, seat numbers, seat position, 'do not disturb' or attendant call.



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Fast Forward Solutions ...

... for the Challenges of the Seat Actuation Industry

- ▶ Experienced system supplier
- ▶ Quality competence
- ▶ Innovative & reliable product
- ▶ Comprehensive knowledge in systems, mechanical, electronic and software engineering
- ▶ Responsive, worldwide support
- ▶ Qualification know-how

Nuremberg, DE ●
 Hradec Králové, CZ ●
 Monheim, DE ●
 Uhldingen-Mühlhofen, DE ●

Yokohama, JP ●
 Shanghai, CN ●

Hong Kong, CN ●
 Zhuhai, CN ●

● Headquarters
 ● Production Plants
 ● Tech / Sales Center

Fast and Flexible

Bühler Motor stands for highly-efficient, cost-optimized solutions with a small package size, customized to your specific needs.

With its internal capabilities: advanced development, prototype sample construction and test centers, Bühler Motor is perfectly positioned to realize even the largest projects safely, within a tight timeframe.

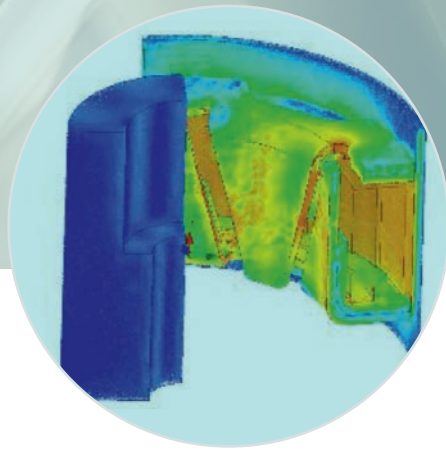
Lifecycle Management

From the beginning, Research and Development, Manufacturing Planning, Quality Management, Sales and Purchasing are also part of the team. From the start of the project to the end of production, you always have one responsible partner you can contact.

Strong enough to meet the toughest demands

- ▶ More than 1.450 employees worldwide
- ▶ 11 locations on 3 continents
- ▶ More than 120 engineers
- ▶ More than 20 million units per year

Engineering, Quality and Production Competence ...



System Expertise

Immersing ourselves in our customers' systems and applications is one of our greatest strengths.

Our Advance Development group allows us to anticipate future development needs within our target markets, independent of customer projects, and to develop viable solutions there.

As a result, we are able to offer our customers complete systems with control panels, actuators, power supplies, comfort components and third party equipment, along with electronics, sensors and software - all from a single source.

Technology Development

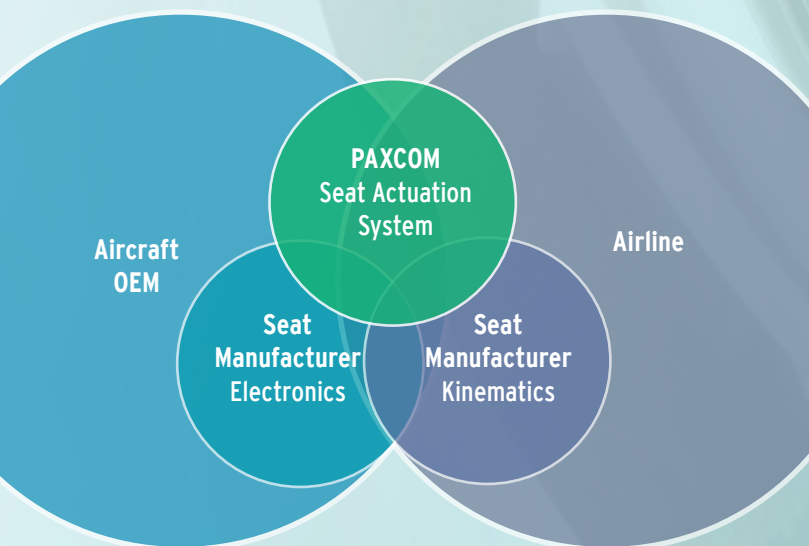
Bühler Motor's Technology Development team looks far into the future. It identifies and investigates technical trends in our core markets and new technologies being developed in other branches.

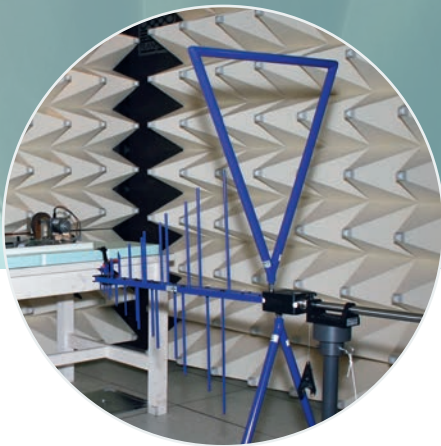
Advance Development

Our Advance Development unit supports us with new fully-developed and tested solution components. This allows us to react to customer requirements faster and more cost-effectively.

Electronics Development

As products become significantly more sophisticated, electronics play an increasingly important role. To meet these demands, we rely on a focused team of experts, which make up our Electronics Development team.





Engineering Services

Utilizing simulations, our own prototyping unit and our internal test capabilities, we are able to produce prototypes faster, therefore safeguarding your concept.

Simulation

- ▶ Electronic component switching (Spice)
- ▶ Strength calculations
- ▶ Motor design and magnetic circuit simulations
- ▶ Flow simulations
- ▶ Simulations of complex systems
- ▶ Vibration analyses
- ▶ Temperature field calculations
- ▶ Injection molding simulations (Moldflow)

Testing

- ▶ EMC measurements: insulation and high-voltage tests, ESD tests and electrical parameter tests
- ▶ Environmental tests: climate and thermal shock, salt spray, thawing and shakers
- ▶ Acoustic tests in operating noise chamber
- ▶ Atmospheric pressure chamber for qualification testing
- ▶ Durability tests under mechanical loads and in various media

Prototyping

- ▶ System testing with seat mechanics and breadboard units
- ▶ Electronic component assembly and test
- ▶ Final mounting of subassemblies
- ▶ Mechanical finishing
- ▶ 3D printing
- ▶ Separate ESD area
- ▶ Gear cutting
- ▶ Electrostatic coating, balancing, magnetizing
- ▶ Laser labelling

... from a Single Source



100% Quality

From the first sketch until dispatch - quality is an integral part of the processes at Bühler Motor. Quality is not only a question of process optimization, but also of design.

Our development projects are consistently managed within the scope of the APQP process based on the level of project maturity.

Quality Assurance System

- ▶ EN 9100
- ▶ ISO 9001
- ▶ EASA Part 21G (No DE.21G.0253)
- ▶ EASA Part 145 (No DE.145.0466)
- ▶ IATF 16949

Environmental Management System

- ▶ ISO 14001

Workplace Safety Management System

- ▶ ISO 45001



Industrialization

Bühler Motor is able to establish the processes and procedures necessary to successfully bring your product into full-scale production.

This includes

- ▶ The advance development of new technologies in regards to assembly processes and plastic injection molding.
- ▶ The development, construction and sourcing of plastic injection molding tools and related peripheral automation.
- ▶ The development, fabrication and sourcing of fixtures from one-piece-flow assembly to fully-automatic assembly lines.
- ▶ The planning, production, and procurement of all quality assurance measurement and testing equipment.

Manufacturing Technology

- ▶ Expertise for assembly of complex aerospace components
- ▶ Testing according to Acceptance Test Procedure (ATP)
- ▶ Magnet-, micro- and plastic-injection molding
- ▶ Stator and armature winding
- ▶ Metal and plastic laser welding
- ▶ 1+2K gluing processes
- ▶ Robotic applications

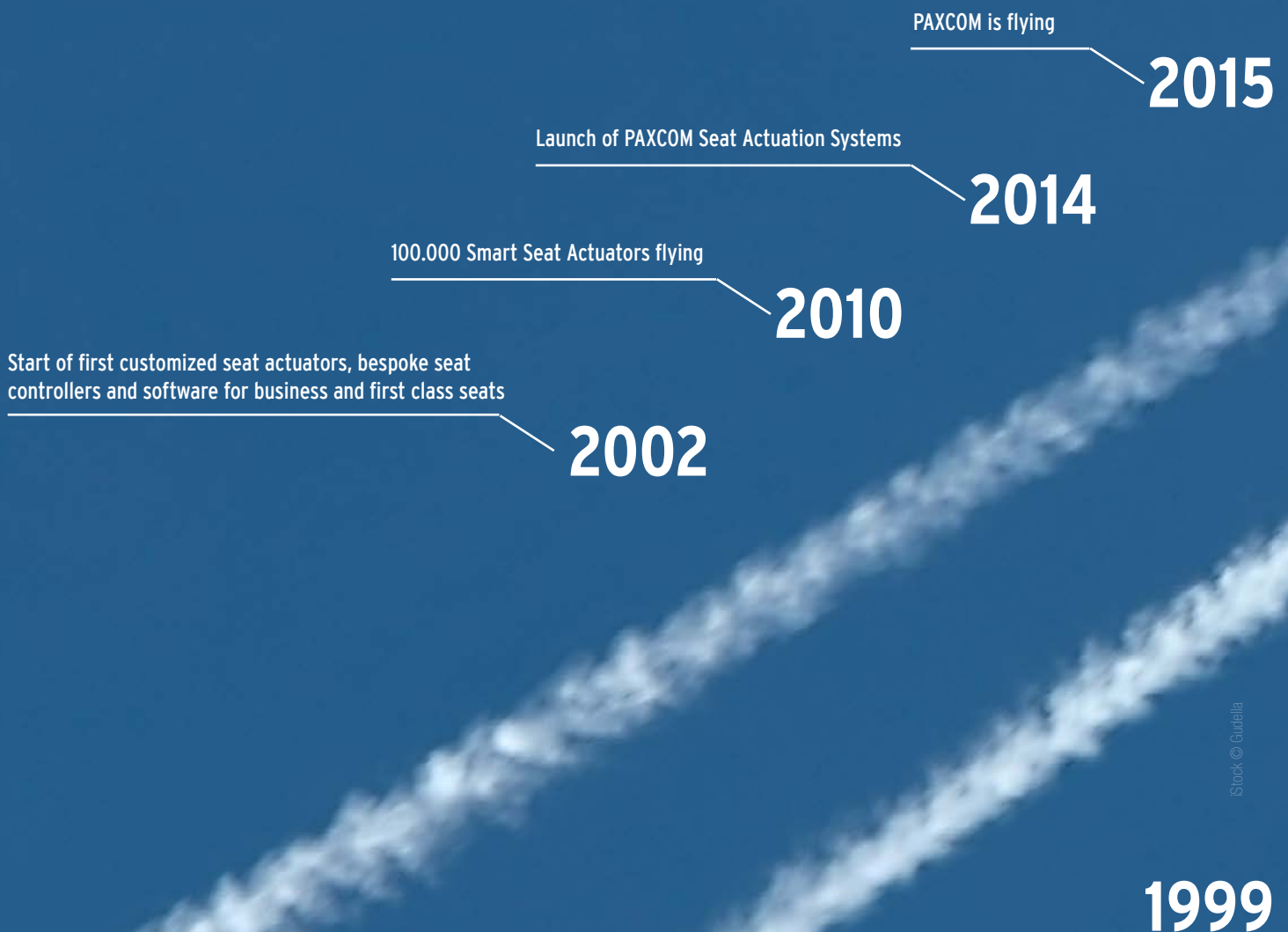
Milestones

Technical precision has always been the focus of the company, which was founded in 1855 in Triberg in the German Black Forest as a clock manufactory. In 1892 the company was taken over by Josef Furtwängler, the great-great-grandfather of today's generation of shareholders. Even before 1900, the product range was expanded to include wind-up drives for the toy industry.

In order to be closer to its customers in the up-and-coming toy industry, the company finally moved its production to Nuremberg, the company's current headquarters, in 1925. In 1955, almost one hundred years after its foundation, Bühler Motor succeeded in producing the first Bühler electric motor, the so-called "brass motor".

In the late 1960s the first automobile applications were installed. From 1974, the company started to expand internationally and opened further locations worldwide. Today, Bühler Motor is a dynamic, family-owned system supplier of customized drive solutions.

40 Airlines flying with Bühler Motor components



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R&D project i+sCabin, sponsored
by DLR, Boeing ecoDemonstrator

2019

2018



Acquisition of Dornier Technologie Systems,
now operating as Bühler Motor Aviation

2017

Winner of Crystal Cabin Award in
the category Premium Class & VIP

2013

Launch of product family Glass Control Panels

2011

Launch of product family Pneumatic Systems

2004

First Aircraft Seat Components and Software
for Seat Actuation

2000

First Aircraft Projects: Aircraft Test Benches



Detroit, US
 Morrisville, US
 Chihuahua, MX
 Nuremberg, DE
 Uhldingen-Mühlhofen, DE
 Monheim, DE
 Hradec Králové, CZ
 Shanghai, CN
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