

LOGISTICS

ACOPOS 6D heralds a new era of productivity

Conventional industrial production plant is typically set up with a single use case in mind, and is not always easy to adapt. B&R's ACOPOS 6D changes all that with magnetically levitated shuttles that carry parts freely through the production process. ACOPOS 6D is ideal for small-batch production with frequent design and dimension changes.



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Today's production machinery takes up a lot of space – but only a fraction of its footprint contributes to the production process directly. Far more real estate is dedicated to carrying products from place to place via conveyor belts, rotary tables, carousels, etc. This seemingly immutable

Track systems facilitate dynamic adaption of a process step – but what if the process sequence changes constantly?

feature of manufacturing has another downside: lack of flexibility. To meet the demands for smaller batches, shorter life cycles and increasing personalization, the shackles of rigidly sequential production – once the mainstay of efficient mass production – must be thrown off. A completely new approach to product transport is needed.

More flexible with track systems

New technologies, especially track systems such as SuperTrak and ACOPOStrak [1] from B&R (a company acquired in 2017 by ABB) have made production much more flexible and mass customization economically feasible. Track systems move each product independently and can provide a motion control axis at processing

stations. Not only that, but track systems also allow product flows to divide and merge at full speed. By adding multiple instances of slower stations, productivity bottlenecks are removed.

Mass customization

Track systems facilitate the dynamic adaption of a particular process step for a customized part. But what happens if the sequence of steps itself is constantly changing? How can the linear model of product transport be dissolved entirely to create a multidimensional manufacturing space where each product moves independently from station to station without being bound to a rigid, sequential production flow? B&R's ACOPOS 6D provides the solution.



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01 B&R's modular ACOPOS 6D uses magnetic levitation to bring unprecedented flexibility to manufacturing lines. (B&R is an Austrian automation company that became a business unit of the ABB Group in 2017.)

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02 Magnetic levitation technology makes it possible to move and manipulate products with six degrees of freedom.





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ACOPOS 6D: the future of manufacturing

ACOPOS 6D is based on the principle of magnetic levitation: Shuttles with integrated permanent magnets float smoothly and silently over the surface of electromagnetic motor segments, carrying production parts at a height of 0.5 to 4.0 mm →01–02. The modular motor segments measure 240 x 240 mm and can be arranged in any configuration. Ten shuttle sizes carry payloads of 0.6 to 14 kg and accelerate at 20 m/s² up to speeds of 2 m/s. This performance enables ACOPOS 6D to cover a much more extensive range of applications than comparable systems, both in terms of scope and granularity. Shuttles can move freely in two-dimensional space, rotate and tilt along three axes and offer precise control over levitation height. Taken together, that gives the shuttles six degrees of motion control freedom (thus the “6D” in the product name).

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03 In a reversal of the normal situation, an ACOPOS 6D shuttle can move a workpiece for precision machining, allowing the CNC tool to be mounted rigidly.

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04 The shuttle can also act as a high-precision weigh station.

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05 ACOPOS 6D can be synchronized with microsecond accuracy with the B&R vision system and all other B&R components.

ACOPOS 6D has a straightforward construction – there are only three components to work with:

- The 6D controller
- Motor segments
- Shuttles

ACOPOS 6D was developed in cooperation with Planar Motors Inc. (PMI), a company with over 15 years of research and development experience in magnetic levitation technology for industrial manufacturing. PMI (in which ABB is a shareholder) has a rich intellectual property portfolio in the magnetic levitation field. It is intended that PMI will continue to drive research and development and B&R will contribute its know-how in the areas of industrialization, sales and service.

Simple setup and operation

ACOPOS 6D offers nearly limitless possibilities in machine design, yet is remarkably easy to set up.

Unlike comparable systems, each ACOPOS 6D shuttle is assigned a globally unique ID. At startup, the controller immediately knows each shuttle’s location on the motor segments, so production can begin without time-consuming homing sequences or manual input by an operator.

A shuttle’s location is known to within ±5 µm at all times, making ACOPOS 6D perfectly suited for applications with strict positioning

requirements. This positional awareness also allows collision-free paths for each shuttle to be calculated without any additional sensors. Paths are chosen to also minimize energy consumption. ACOPOS 6D also has decentralized intelligence.

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ACOPOS 6D uses magnetic levitation to carry production parts smoothly and silently over the surface of motor segments.

All this planning occurs in a dedicated controller – connected to the machine network via POWERLINK (a real-time protocol for standard Ethernet) – which means it has no impact on the performance of the network or machine control system. Other systems use a centralized system architecture, which requires expensive and complex infrastructure that is usually difficult to scale up.

The shuttles can also be used as axes in processing stations – ie, a CNC tool can be mounted rigidly and the shuttle moves the part as required →03.

Space savings

Up to four shuttles can be controlled simultaneously on each ACOPOS 6D segment – a feat unmatched by rival systems and one that delivers a smaller machine footprint and up to four times the processing density. Moreover, tight shuttle formations with no gaps further improve space utilization and enable groups of shuttles to collaborate to carry larger or heavier products.

Since each shuttle can also serve as a high-precision scale (precision: ±1 g), weighing stations can be eliminated, saving further space.

Scalability

Since ACOPOS 6D is modular and decentralized, there are virtually no restrictions on the number of shuttles or segments that can be used on one production line: One ACOPOS 6D Controller can handle up to 200 motor segments and 50 shuttles and multiple ACOPOS 6D Controllers can

be synchronized for larger systems →04. Furthermore, because ACOPOS 6D is fully integrated into the B&R ecosystem, shuttles can be synchronized with servo axes, robots, track systems and machine-vision cameras with microsecond precision →05.

Power and cooling

ACOPOS 6D runs off 48 to 60 V DC, unlike the 110 V AC, or more, required by similar products. Depending on acceleration, speed and payload, shuttle power consumption is about 15 to 50 W.

ACOPOS 6D makes it possible to turn the concept of swarm production into reality.

This energy efficiency often renders active cooling unnecessary. In highly dynamic applications with a large number of shuttles and high rates of acceleration, performance can be increased through active cooling. If needed, motor liquid cooling is easy to implement via the pre-installed piping →06.

ACOPOS 6D in the field

ACOPOS 6D is suited for a wide range of applications, especially where:

- High precision is crucial.
- The order of processing steps varies.
- Items are produced in small batches.

ACOPOS 6D is perfect for processes or environments that are sensitive to contamination – eg, cleanrooms or food and beverage plants – as the magnetic levitation eliminates contact and, thus, abrasion and associated particle shedding. Shuttles and motor segments comply with protection class IP67 as standard. Stainless steel shuttles are also available, and by placing a stainless steel cover over the motor segments, ACOPOS 6D's IP level can be raised to IP69K.

Pilot customers in battery cell production, food and beverage, printing and pharmaceuticals are currently working with ACOPOS 6D. Features such as anti-sloshing algorithms that control

acceleration, deceleration and tilt on curves are particularly appreciated.

ACOPOS 6D and track systems like ACOPOStrak and SuperTrak complement each other and will be used together in many applications. ACOPOS 6D implementation is useful wherever one or more of its unique capabilities – eg, six degrees of freedom, high precision or cleanroom suitability – is required. If it is possible to cover an application's requirements with a track system, that is the more economical solution.

Gliding into the future of manufacturing

ACOPOS 6D makes it possible to turn the concept of swarm production into reality. Swarm production is a concept where individual products navigate their own path through the manufacturing system. There is no rigidly preprogrammed sequence of production steps; each product moves independently to just the stations it needs →07. This approach makes it much easier to implement small-batch and mixed-batch production. Different products can be produced on the same machine simultaneously.

The contactless, noiseless, flexible and precise performance of ACOPOS 6D thus heralds a transition from strictly linear production to an open, adaptive manufacturing space – nothing less than a revolution in the way products are manufactured, assembled and packaged.

Pilot applications using ACOPOS 6D are running now and series availability and completion of all certifications are planned for the end of 2021. •

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06 The segments are equipped with an integrated water cooling system and can be daisy-chained.

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07 Dissolving the traditional model of linear product transport creates a multidimensional production space.

Reference

[1] C. Klingler-Deise-roth, "Intelligent transport for production lines," *ABB Review* 2/2018, pp. 68–73.



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