Linear Transport Systems Revolutionize Intralogistics Operations

Presented by:
Jeff Johnson
Linear Transport Systems
Linear Transport Systems – combine rotary and linear technology
Linear Transport Systems – benefits

- Increased Efficiency by enabling continuous product flow
- Reduced Footprint: ability to create space-saving geometries
- Reduce Time to Market: simplifies software and hardware engineering
- Unlimited Applications: flexible use of motion & mechanical tooling
- Eliminate Downtime: change lot sizes via software functionality
A revolutionary distribution system

- Outstanding dynamics allows selective processing without interrupting continuous product flow.
  - Individual movers can work independently on multiple products.
  - Products can be transported individually or in groups.
  - Synchronization with selective stopping and starting at any position.
  - Maximum positioning accuracy and jerk-free accelerations.
Linear Transport Systems – basic functions
Functioning as a distribution system

- Freely-selectable track layouts and number of movers.
  - Individual and group controllability.
  - Ease of integration into existing environments.
  - Implementation of motion and handling tasks to allow new and innovative mechanical designs.
A distribution system for product sortation

• Functions as a distribution system.
  ▪ XTS splits incoming product stream into multiple lanes.
  ▪ Flexibility, with lanes easily added or removed.
Gapping asynchronous product flow

- XTS makes it easy to implement gap control.
- Uses distance adjustments that synchronize product arriving at different intervals.
- Creates consistent gap of product to downstream process.
Grouping products

- Multiple movers can work together to clamp or hold products.

- XTS can combine multiple products arriving on multiple conveyors into predefined and easily changeable groups and move them to the next station.

- Operations can adapt to product width, stack height and number of stacks without manual changeover.

- Distance between movers and motion profile can be changed on the fly without stopping.
Rotating product with kinematics

- With circulating kinematics, the transported product can be influenced in X and Y directions.

- With two XTS systems arranged in parallel, the manipulator is synchronized to the product and shifts it on the belt at full speed.

- Product can even be rotated slightly using appropriate kinematics.
Unlimited application possibilities

Push product or change spacing.
Reduce or increase product speed.

Clamp and move product.

Apply kinematics in linear motion for lifting or pressing.
Unlimited application possibilities

- With multiple movers and innovative tooling, XTS can also transport and discharge product.
Unlimited application possibilities

- Kinematics in linear motion for turning product or closing a cap.
The modular XTS system: reduces time to market
The modular XTS system: motor modules
XTS motor modules: everything incorporated in a single mechatronic component

<table>
<thead>
<tr>
<th>System properties</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. force</td>
<td>100 N</td>
</tr>
<tr>
<td></td>
<td>80 N at standstill</td>
</tr>
<tr>
<td></td>
<td>at 2 m/s</td>
</tr>
<tr>
<td>Continuous force</td>
<td>30 N (at &lt; 30 °C temperature increase in the motor compared to mounting frame)</td>
</tr>
<tr>
<td>Speed</td>
<td>4 m/s at 48 V DC supply</td>
</tr>
<tr>
<td>Acceleration</td>
<td>&gt; 100 m/s² (without payload)</td>
</tr>
<tr>
<td>Positioning accuracy</td>
<td>&lt; ±0.15 mm at 1.5 m/s possible within a straight module</td>
</tr>
<tr>
<td>Absolute accuracy</td>
<td>&lt; ±0.25 mm possible within a straight module</td>
</tr>
<tr>
<td>Repeatability</td>
<td>&lt; ± 10 µm (stillstand unidirectional)</td>
</tr>
<tr>
<td>Max. system length</td>
<td>&gt; 100 m (dependent on computing power, no system limit)</td>
</tr>
<tr>
<td>Power consumption per motor module at 24 V DC</td>
<td>30 W/m for communication, electronics, position feedback</td>
</tr>
<tr>
<td>Length per infeed</td>
<td>max. 3 m voltage supply, EtherCAT</td>
</tr>
<tr>
<td>Protection rating</td>
<td>motor modules: IP 65</td>
</tr>
<tr>
<td>Approvals</td>
<td>CE, UL</td>
</tr>
</tbody>
</table>
XTS motor modules: everything incorporated in a single mechatronic component

- Motor, Coil Package
- Power Electronics
- Position Feedback
- EtherCAT
- Power Supply
- Mechanical Interfaces

180° curve (clothoid) in 500 mm

45° curve in 250 mm for Ø 637 mm

-22.5° curve in 250 mm for Ø 1273 mm

22.5° curve in 250 mm for Ø 1273 mm
XTS motor modules: flexible track layouts

- S-shape
- Rectangle
- Square
- Straight, open track

... and others
XTS Track Management: new flexibility in motion control

- Track sections can be moved.
- Exchange movers between tracks.
- Motor modules and movers remain fully operational at all times.
- Maximum flexibility without downtime.
- Small footprint combined with maximum parts buffer capacity.
The modular XTS system: guide rails and movers
The modular XTS system: guide rails and movers – comparison

- high level of dynamics
- low costs
- lubricant-free
- 0.8/1.25kg load

- higher loads
- higher process forces
- maximized service life
- 10kg loads
Application example: cosmetics filling line – groninger & Co. GmbH, Germany
Application example: optical inspection system – GEFASOFT, Germany
The modular XTS system: the control system
The control system: software and programming

- The XTS extension in TwinCAT 3 automation software decouples servo algorithms from the hardware components and calculates them centrally.
The control system: software and programming

Regarding application programming, a mover appears like a “normal” servo axis.

- All motion control functions are available, for example:
  - flying saw
  - electrical gear unit
  - cam plates

- Functional extensions handle typical XTS requirements:
  - automatic accumulation
  - collision and jerk avoidance
  - centrifugal force limitation
The control system: software and programming – XTS Configurator and XTS Viewer

- System configuration is automated to the greatest possible extent.
- Axis and control parameters of the movers can be copied.
- Intuitive online visualization of the moving movers in 2D.
- Diagnostic and simulation tool.
XPlanar: Flying Motion
XPlanar: free-floating movers for non-contact movement

A planar mover incorporating permanent magnets levitates above planar tiles that generate a magnetic field and detect the mover position.
XPlanar system: flying magnets with six degrees of freedom

- XPlanar floor
  - needs-based layout
  - choice of surface finishes
  - no wear

- XPlanar mover
  - passive component
  - no electronics
  - no mechanics
  - easy to clean

- XPlanar tile
  - highly integrated
  - flexible use
  - simple implementation
XPlanar system: minimum components, maximum design flexibility

- **TwinCAT**: software platform for control and engineering
- **EtherCAT G fieldbus**: high performance
- **Industrial PC**: scalable hardware platform
- **XPlanar mover**: free positioning in 4 sizes
- **XPlanar tiles**: free layout configuration

*POWERED BY POSSIBILITIES.*
XPlanar movers: reaching every point in every way

- carries loads of up to 6 kg – even more in a group
- tilting by 5° for transport and handling of liquids
- special planar modules for rotating movers by 360° – increased flexibility
- lifting, lowering, weighing: variable in height by up to 5 mm
- wall and ceiling travel: vertical and upside down
XPlanar tile: planar motor with integrated position feedback

- The planar tile is highly integrated and unites all relevant functions.
- The mover positions are detected by the tiles.
- A power supply unit supplies the output stages with power.
- Super-flat coils generate the travelling magnetic field.
- EtherCAT G establishes a broadband connection to the Industrial PC.
- The tiles can be connected in series on a carrier construction on the machine side.
XPlanar system: high flexibility in geometry and application

- planar tiles in the 24 x 24 cm format
- arbitrary application-specific track geometries

**Floor layout**
- compact layout
- short transport routes
- flexible use

**Track layout**
- connects different systems
- accommodates buffer zones
- simplifies congestion avoidance
XPlanar system: high flexibility in geometry and application

- Ring shapes
- Large tile floors
- Waiting zones
- Free-form shapes
XPlanar system: high flexibility in geometry and application

**Ring shapes**
for the flow of product around a processing station

**Large tile floors**
ideal for long routes

**Waiting zones**
can be set up directly alongside the track

**Free-form shapes**
provide a match for any space requirements
XPlanar system: high flexibility in geometry and application

Overtaking

Parking

Divider

Infeed and outfeed
XPlanar system: high flexibility in geometry and application

**Overtaking**
Movers can change lanes and accelerate.

**Parking**
Movers can be extracted from the product flow.

**Divider**
simple flow division, e.g. diversion of a product flow into several channels

**Infeed and outfeed**
for example, into or out of contaminated areas
XPlanar software: commissioning and track management

Stage 1
a predefined endless track
XPlanar software: commissioning and track management

Stage 2
several interconnected tracks
XPlanar software: commissioning and track management

Stage 3
fully automatic path calculation: all movers can move freely.
XPlanar: product overview
XPlanar starter kit: fully functional for a fast introduction

- APS9000
  - starter kit for planar motor technology
  - 6 (2 x 3) APS1003 planar motor tiles
  - 4 APM1003 movers
  - IPC
  - software
  - pre-installed, ready for operation

- APS9001
  - starter kit for planar motor technology
  - 12 (4 x 3) APS1003 planar motor tiles
  - 4 APM1003 movers
  - IPC
  - software
  - pre-installed, ready for operation
XPlanar tiles

**APS1003-0000**
planar tile

- 4 active areas
- 110/230 V AC/24 V DC
- 240 mm x 240 mm x 67 mm (L x W x H)
- 4.0 kg

**APS2003-0000**
planar tile

- rotor area
- 110/230 V AC/24 V DC
- 240 mm x 240 mm x 67 mm (L x W x H)
- 4.0 kg
XPlanar movers

- **APM1002-0000**
  - planar mover
  - aluminum body, hard coated
  - bottom side inox coated
  - 95 x 95 x 12 mm, 0.39 kg
  - 0.4 kg payload

- **APM1003-0000**
  - planar mover
  - 155 x 155 x 12 mm, 1.27 kg
  - 1.5 kg payload

- **APM1005-0000**
  - planar mover
  - 155 x 275 x 12 mm, 2.5 kg
  - 3.0 kg payload

- **APM1004-0000**
  - planar mover
  - 275 x 275 x 12 mm, 5.0 kg
  - 6.0 kg payload
# XPlanar: technical data

<table>
<thead>
<tr>
<th>Mover</th>
<th>Technical data</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>4 m/s</td>
<td></td>
</tr>
<tr>
<td><strong>Acceleration</strong></td>
<td>20 m/s²</td>
<td>without load</td>
</tr>
<tr>
<td><strong>Max. load</strong></td>
<td>6 kg</td>
<td>at low speed</td>
</tr>
<tr>
<td><strong>Flight height without load</strong></td>
<td>5 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Flight height 1 kg load</strong></td>
<td>1 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Max. angle of rotation (±)</strong></td>
<td>360°, ±15°</td>
<td></td>
</tr>
<tr>
<td><strong>Positioning accuracy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Position resolution</strong></td>
<td>1 μm (X, Y, Z), 0,001° (A, B, C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.001° (A, B, C)</td>
<td></td>
</tr>
<tr>
<td><strong>Absolute accuracy (±)</strong></td>
<td>150 μm (X, Y, Z)</td>
<td>at 25° C, per module</td>
</tr>
<tr>
<td></td>
<td>0.15° (A, B)</td>
<td>at 25° C</td>
</tr>
<tr>
<td></td>
<td>0.2° (C)</td>
<td>at 25° C</td>
</tr>
<tr>
<td><strong>Repeatability (±)</strong></td>
<td>&lt; 50 μm (X, Y, Z)</td>
<td></td>
</tr>
</tbody>
</table>
## XPlanar: technical data

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>Technical data</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>In standby mode per planar module</td>
<td>13 W</td>
<td></td>
</tr>
<tr>
<td>Per mover, 1 mm flight height, unloaded, at standstill</td>
<td>40 … 60 W</td>
<td>position dependent</td>
</tr>
<tr>
<td>Per mover, 1 mm flight height, unloaded, in motion</td>
<td>105 W</td>
<td></td>
</tr>
<tr>
<td>Per mover, 2 mm flight height, unloaded, at standstill</td>
<td>50 … 75 W</td>
<td>position dependent</td>
</tr>
<tr>
<td>Per mover, 2 mm flight height, unloaded, in motion</td>
<td>115 W</td>
<td></td>
</tr>
</tbody>
</table>
Intelligent transport systems

- Intelligent transport technology does not replace conveyor belts.
- XTS and XPlanar clear the way for completely new, innovative material handling concepts.
For more information:

Speaker email: j.johnson@beckhoff.com
Website: www.beckhoffautomation.com

Or visit MODEX Booth 4026
Contact

Beckhoff Automation LLC
Headquarters
13130 Dakota Ave
Savage, MN 55378
USA

Phone: 952-890-0000
Fax: 952-890-2888
E-Mail: beckhoff.usa@beckhoff.com
Web: www.beckhoffautomation.com

© Beckhoff Automation GmbH & Co. KG

All images are protected by copyright. The use and transfer to third parties is not permitted.

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this presentation may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

The information provided in this presentation contains merely general descriptions or characteristics of performance which in case of actual application do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressively agreed in the terms of contract.