Motion Control
ABOUT ETEL MOTION CONTROL

ETEL is the world leading supplier for direct drive and advanced motion systems. It supports high-tech industries with a comprehensive range of products. Linear and torque motors, positioning systems, motion control hardware and software help customers get the most out of ETEL’s direct drive solutions as quickly as possible. The full ETEL solution allows machine builders to simplify integration in their machine thanks to a very consistent design. It also gives customers the opportunity to focus on their core competence and technology while ETEL takes care of motion systems development.

MOTION CONTROL RANGE

ETEL’s motion control solutions have been integrated into leading edge machines of various high-tech industries for more than twenty years. ETEL’s range of motion and position controllers allows machine builders to drive linear and rotary direct drive motors with the highest performance regulation in a minimal footprint. Its decentralized architecture ensures the same level of performance and speed regardless of the number of axes driven in the machine. Distributed architecture also makes cabling easier to manage and to maintain in the field. Last but not least, the software environment simplifies software development, machine installation, and maintenance.

MULTI-AXIS MOTION CONTROLLERS

UltimET Light motion controller is the master on the TransnET bus and can manage up to 63 axes. More significantly, the real-time communication performance will be the same regardless of the number of axes.

To provide the right solution to its customers, ETEL have designed multiple versions of the motion controller: the UltimET Light smart gateway is designed for price sensitive applications requiring synchronized movements. The UltimET Light including interpolation is a version that is best suited for more complex interpolated movements.

In all its versions, UltimET light gives access to advanced control features by providing slave to slave communication capability between the different position controllers. Among these, we can mention:

- 3D mapping: provides corrections of a stage’s known mechanical errors
- Gantry control: provides advanced algorithms to optimize gantry motion system performance.
- Fast triggers: provides nanosecond reaction time to fire events in a 2D workspace

Finally, UltimET light is available in multiple hardware formats to best suit the machine architecture and customers’ requirements in terms of communication speed:

- PCI or PCIe variants: best suited for high speed applications requiring real-time deterministic communication.
- TCP/IP variant: best for stand-alone machines, in which the motion control application is far from the machine PC.

COMMUNICATION

TransnET is a gigabit ethernet based field bus designed to be the communication channel in ETEL’s distributed motion control architecture. TransnET manages the real-time commands between the UltimET Light motion controller and AccurET position controllers driving up to 63 motors at the same time. It allows for handling of highly reliable deterministic synchronization and interpolation.

In addition, the TransnET nanosecond jitter allows for master to slave, slave to master, or slave to slave communication within the same cycle. This is a major advantage for high-end machines, since most require extensive slave to slave communication to perform at their best performance.

Input and output interfaces

Each AccurET controller has embedded inputs and outputs to interface external devices or precisely trigger process tasks. On top of the embedded IOs, ETEL provides an optional IO board to extend the number of interfaces.

Finally, UltimET Light can also be used to communicate to external WAGO modules and push the number of IOs even further.
The AccurET position controllers cover a wide range of voltage and current levels in a compact solution. This makes the integration of various axes in a single machine easier than ever. The modular design makes AccurET position controllers a very compact solution.

- Each controller can drive two axes and a single power supply can be used for multiple AccurETs sharing the same DC bus voltage.
- Optional boards can be mounted directly inside the AccurET, such as the UltimET TCP/IP motion controller or the I/O board.
- No rack is needed, making the required volume only dependent on the number of driven axes.
- Simplified power and communication cabling as well as modular cooling unit make the machine installation and maintenance easy to perform.

Machine builders will appreciate this cost effective, compact and quickly integrated design.

Increase the accuracy and throughput of your machine with AccurET

By using high quality current loop: parasitic movements can be avoided thanks to extreme low noise. In addition, the regulator architecture makes the overall position loop bandwidth reach outstanding levels. Last but not least, the AccurET advanced feedforward feature helps in identifying and compensating friction, viscosity, motor ripple and other repeatable behavior.

AccurET is also optimized to ease and improve the overall machine performance in terms of accuracy. By providing features such as 3D mapping, nanosecond reaction triggers, trajectory filters, etc., the machine control is drastically improved and any process related action will take place precisely at the right time and the right moment while disturbances are being rejected.

Once these features are brought together, AccurET minimizes tracking errors during axes movement and therefore dramatically reduces the motion and the settling time. All this is directly translated into an increased machine throughput and better overall accuracy.

Reach outstanding performance with the unique AccurET VHP

For the most demanding applications, ETEL developed a unique Very High Performance position controller range called AccurET VHP. This range of product is equipped with both specific hardware and software that maximizes the performance.

AccurET VHP position controllers are compatible with all the other AccurET controllers and can be dedicated to the most demanding axes of a multi-axis motion system. In fact, it is the same decentralized architecture as used in the AccurET modular. This allows an important part of the machine control software to be located at the axis level. In addition to the benefits of ETEL controllers such as high computation power, fast and real-time communication bus and state of the art control algorithms, ETEL’s VHP range provides outstanding signal to noise ratio.

AccurET VHPs are successfully used in areas such as:

- Process control
- Wafer inspection
- Lithography
- Wafer and die level packaging
- Test and control equipment

For more information, refer to our AccurET Modular leaflet.

ETEL has always focused on developing advanced control features to make its position controllers unique in the market. From the first prototype commissioning to the serial production of machines, ETEL advanced features provide a simple access to major time savings, thorough enhancement and increased precision.

ETEL advanced features start to bring advantages at a very early stage of a machine design. For instance, Identification Tools, are available to allow a one-click evaluation of machine mechanical design, identify resonances and adapt controller settings. While commissioning the machine, other tools like Friction Compensation and Stage Protection can be used to cancel out repeatable errors and to secure system behavior in case of unexpected events.

In addition, the core of ETEL unique features is designed to bring higher throughput together with the most stringent position accuracy levels. Trajectory Filters have the ability to adapt trajectory shapes to minimize settling times. In combination with Dual Encoder Feedback capabilities and/or Gantry Control functions, outstanding performance can be reached with minimal tuning effort.

ETEL develops functions that are continuously setting the next milestones in motion control. In fact, with the Fast Trigger feature, AccurET controllers can react to a real position crossing event in 1D or 2D within a few nanoseconds. This opens new possibilities at the machine control level.

Last but not least, ETEL Force Control algorithm is the flagship of advanced software features. With zero stop time and milli-Newton accuracy levels, accurate placement with force control can be performed at the highest ever throughput and with a precision never achieved till now.

For more information, refer to our Motion Control leaflet.
SOFTWARE ENVIRONMENT

ETEL motion control architecture: access to various levels for optimal performance

ETEL motion control architecture provides different levels of access, from motion sequences embedded in the controller to EDI (ETEL Device Interface) software library to interact with ETEL controllers from the machine PC. In parallel, ETEL provides a commissioning software (ComET) to enable a user-friendly access to the controller fine tuning and for monitoring the machine status and performance.

A very flexible and powerful structured programming language including mathematical functions (logic, arithmetic, trigonometric, etc.) has been designed so the user can run any kind of motion sequence directly on the UltimET or AccurET controllers. In fact, up to 3 simultaneous multi-axis motion sequences running at 100 μs sample period can be embedded on the UltimET and run in parallel. While the AccurET level, 2 motion sequences per motor can run as well.

AccurET and UltimET can naturally be accessed from the machine PC by using the ETEL Device Interface (EDI) library. This provides all necessary tools to have the code related to the machine motion embedded in the overall machine control software.

• Software for time/accuracy optimization of complex trajectories.
• AccurET can run two multi-axis structured code motion sequences on each axis.
• AccurET and UltimET can naturally be accessed from the machine PC by using the ETEL Device Interface (EDI) library.
• EDI Library provided to interface machine software with ETEL controllers.

Once the first automatic setting is completed, the customer can use advanced tools to setup the system’s protections, or fine tune any of the parameters.

User friendly tools help the customer to get the most performance out of their machine design. For instance, an identification tool helps with analyzing the system’s behavior. Its immunity to disturbances can be checked, helping the user to optimize the machine design during the development phase, or the parameter set at the commissioning stage for improved machine reliability.

A multi-axis scope can register and display position, current, speed or any physical value, assisting in the fine tuning of the system at development or maintenance phase, as well as in assessing final performance of the machine once the process is running.

• High trajectory fitting error (~100nm)
• Speed reduced by a factor of 2 to 20
• Minimal trajectory fitting error (<2nm)

IMP

The Interpolated Motion Planning (IMP) takes care of three important value-added steps of the customers’ trajectory generation:

• Geometry fitting: pre-processes the optimal trajectory within customer defined boundaries
• Automatic transition: automatically optimizes transition from one pattern to the next
• Trigger placement: places events along the trajectory and sets the AccurET fast trigger functions

Using IMP for trajectory generation can lead to unprecedented throughput increase without compromise on accuracy.

TRAINING AND SUPPORT

High level competences

Customer satisfaction is crucial to us. ETEL not only focuses on supplying reliable products, but also on offering high quality support. In order to better serve its customers, ETEL developed a variety of competences allowing ETEL to propose the appropriate skills depending on machine builders support requirements:

• ETEL’s hotline is operated by qualified engineers having detailed product knowledge, not only on motion controllers, but also on direct drive motors and systems, which is critical to provide efficient service. Moreover, on-site support can also be organized whenever it is required.
• ETEL organizes standard or customized training courses on request at its facilities in Switzerland or in regional subsidiaries as ETEL is part of the HEIDENHAIN group. These training courses are conducted by motion control and direct drive specialists.
• OEMs and standard machine builders may require help integrating ETEL products in their machine. Application engineers can specifically focus on their application to get the best outcome.
• We reach nanometer stability on several hundreds of machines a year. Our mechatronic experts can provide valuable help in your machine and motion control optimization.

FORWARD INTEGRATION

ETEL is pushing one step further its Forward Integration strategy. From now on, an advanced motion platform from ETEL does not only include the advanced motion system and its associated state-of-the-art motion controllers, but can also benefit from ETEL’s proprietary active isolation system.

This makes ETEL the only motion system supplier able to cover such a wide scope of supply.
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