Linear **Motors**

MOTION TECHNOLOGY

ABOUT ETEL LINEAR MOTORS

Over the last 20 years, direct drive linear motors have provided significant performance improvements in numerous applications covering a wide range of high-tech industries. Today, direct drive technology is recognized as a leading solution towards meeting the requirements of high productivity, improved accuracy, and increased dynamics of modern machinery.

Direct drive essentially means the load and motor are directly connected; or in other words, the motor "directly drives" the load. Significant improvement to stiffness and a more compact solution are among the benefits of this technology. In addition to providing high dynamic performance, linear motors reduce cost of ownership, simplify the design of the machine and eliminate wear and maintenance.

Since its founding in 1974, ETEL has been exclusively dedicated to the development of direct drive technology. Through numerous innovations and patented designs, ETEL continues to provide unmatched force efficiency for the most optimized designs.

What is a linear motor?

Linear motors are a special class of synchronous brushless servo motors. They work like torque motors, but are opened up and rolled out flat. Through the electromagnetic interaction between a coil assembly (primary part) and a permanent magnet assembly (secondary part), the electrical energy is converted to linear mechanical energy with a high level of efficiency. Other common names for the primary component are motor, moving part, slider or glider, while the secondary part is also called magnetic way or magnet track.

Since linear motors are designed to produce high force at low speeds or even when stationary, the sizing is not based on power but purely on force, contrary to traditional drives.

The moving part of a linear motor is directly coupled to the machine load, saving space, simplifying machine design, eliminating backlash, and removing potential failure sources such as ballscrew systems, couplings, belts, or other mechanical transmissions. Finally, the bandwidth and the stiffness of the motion system are much higher, giving better positional repeatability and accuracy over unlimited travel at higher speeds.

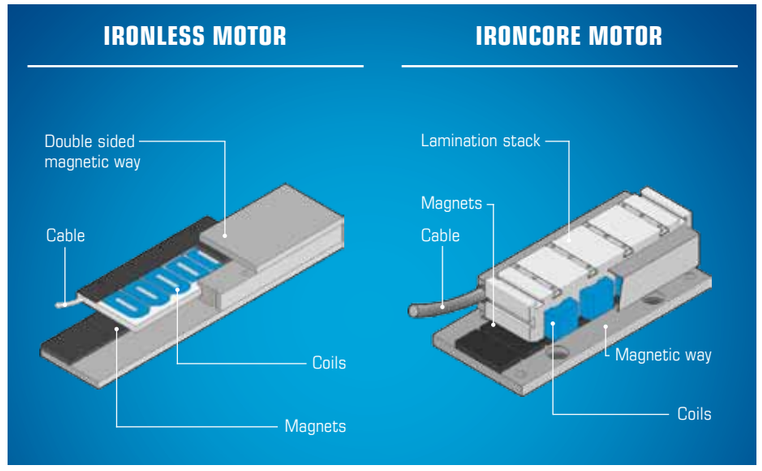
Given that frameless linear motors do not include a housing, bearings, or feedback device, the machine builder is free to select these additional components in order to best fit the application requirements.

Linear motor advantages

Key benefits inherent to the adoption of the linear motor technology include:

- High dynamics
- High accuracy
- Optimal speed control
- Very compact design
- Outstanding MTBF
- Low maintenance

These advantages are further explained in the following pages.

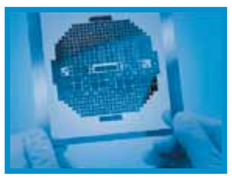


INDUSTRY SECTORS

Below are some examples of industry sectors where linear motors are successfully used, providing our customers in these areas a distinct competitive advantage.


Wafer and die level packaging


Process control


Lithography


Test and control equipment


Placement machines


Flat panel display (FPD)


Photovoltaic


Optics


Stamping / laser cutting


Medical

WHY ADOPT LINEAR MOTORS?

Reduced cost of ownership

Direct coupling of the payload to the motor's moving part eliminates the need for mechanical transmission elements such as leadscrews, timing belts, rack and pinion, and worm gear drives. Unlike brushed motors, there is no contact between the moving parts in a direct drive system. Therefore there is no mechanical wear resulting in excellent reliability and long lifetime. Fewer mechanical parts minimize maintenance and reduce the system cost. The direct drive technology intrinsic to a linear motor based system results in an efficient and effective gearless assembly.

Easy integration

ETEL linear motors are available in a wide range of sizes and can be easily adapted to most applications. ETEL's unmatched standard product offering includes ironless and ironcore linear motors. Each technology has specific advantages:

- Ironcore linear motors' configuration minimizes the volume required for integration in machines. They are very compact and produce the greatest force per package size.
- Ironless linear motors' shape is very thin and gives machine builders great flexibility in locating the motors. In addition, ironless motors provide no force ripple and have very low moving masses.

Dynamic performance

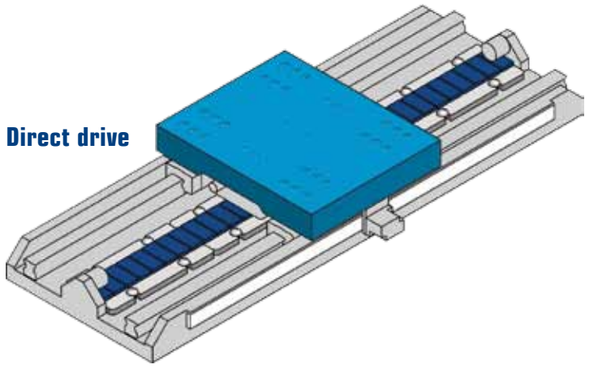
Linear motor applications have a wide range of dynamic performance requirements. Depending on the specifics of a system's duty cycle, the peak force and maximum speed will drive the selection of a motor:

- An application with a light payload that requires very high speed and acceleration will typically utilize an ironless linear motor (that has a very light moving part containing no iron). As they have no attraction force, ironless motors are preferred with air bearings, when the speed stability has to be below 0.1%.
- Ironcore motors produce greater force per package size by using laminations to concentrate the magnetic flux. With a larger continuous force, these motors fit very well to mid- and high-dynamic applications requesting high duty cycle.

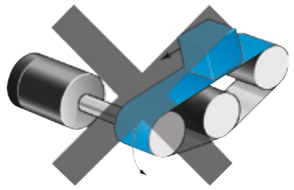
Wide force-speed range

Direct drive linear motors deliver high force over a wide range of speeds, from a stalled or low speed condition to high velocities. Linear motors can achieve very high velocities (up to 15 m/s) with a trade off in force for ironcore motors, as technology becomes limited by eddy current losses.

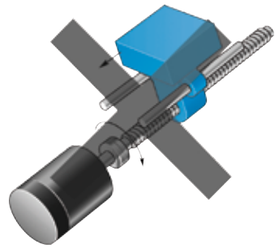
Linear motors achieve very smooth velocity regulation, with low ripple. The performance of a linear motor over its velocity range can be seen in a force-speed curve as shown opposite.



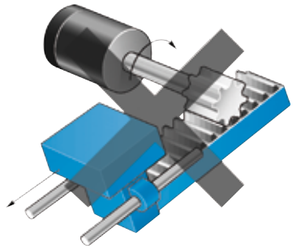
Direct drive



Conveyor / Timing belt

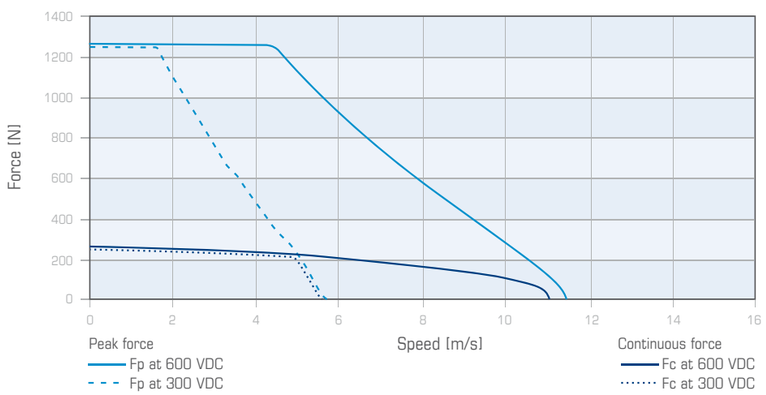


Lead screw



Rack & pinion

Force vs. speed for: LMG10-070-30B



WHY CHOOSE ETEL?

Patented technology

ETEL's patented ironcore design provides the industry's most efficient direct drive linear motor. The design is especially optimized to reach high force density together with the lowest possible force ripple.

Unmatched performance

A complete direct drive solution with ETEL motion and position controllers provide optimum system performance. A full ETEL solution enables machine builders to simplify integration in their machine thanks to a very consistent design. It also gives the customer the opportunity to focus on his core competence and technology while ETEL takes care of the motion system (refer to page 8 for more details).

Direct drive expertise

Focusing strictly on direct drive technology for over 30 years, ETEL's highly skilled workforce provides customers with a valuable technical resource. Providing attentive customer support from the early design phase to machine commissioning is part of ETEL's commitments.

High quality

High product quality is ensured by ETEL's use of modern development tools and thorough qualification procedures. All ETEL motors are manufactured in Switzerland according to highest quality standards.

Ease of integration

Compatibility of ETEL linear motors to a wide range of control electronics results in easy integration of a direct drive solution.

Product range

With standard motors from 72 to 704 mm in length and from 90 to 3700 N of peak force, ETEL offers one of the largest selection of ironless and ironcore linear motors on the market.

LINEAR MOTORS

During the last two decades, many linear motor variations have emerged on the market. Nevertheless, only a few were found to be practical, performing and economically viable. ETEL has always remained dedicated to the flat, synchronous, 3-phase linear motors with permanent magnet excitation. This family of motors represents more than 90 percent of industrial applications worldwide. They can be classified into ironcore and ironless motors.

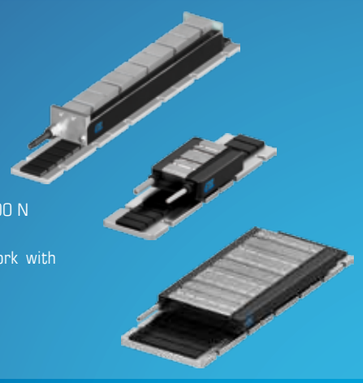
The ironcore construction enables an exceptional peak force density, as well as unparalleled thermal efficiency, which is a significant advantage for thermal-drift-sensitive precision machines. The LMA is a mid-size motor optimized for application requesting high continuous force. The LMG is smaller, optimized for high dynamic applications and provides a high peak-to-continuous force ratio. In case an upgrade is requested by the application, the LMS is highly similar to LMG in terms of integration but provides about 30% more continuous force. This makes the LMS perfectly suited for high duty cycle axes. The ILF is a small size motor perfectly suited for very high dynamic and low moving mass applications. The ILM is a more powerful version of the ILF. These motor types also provide a highly linear behavior perfectly suited for the most demanding scanning applications where zero attraction force and outstanding speed stability are requested.

PERMANENT MAGNETS SYNCHRONOUS LINEAR MOTORS

STANDARD PRODUCTS

Ironcore motors

- Speed up to 15 m/s
- Acceleration up to 20 g
- Peak force from 279 to 3700 N
- Low force ripple
- All linear motors types work with same MWD magnetic way



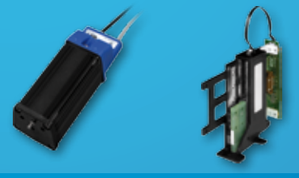
Ironless motors

- Speed up to 20 m/s
- Acceleration up to 30 g
- Peak force from 90 to 2500 N
- Option: forced air cooling
- No attraction force
- No force ripple

TYPE	DESCRIPTION	APPLICATIONS
LMA	• Highest continuous force • Optimized for high duty cycle application • 600 VDC compliant	• Wafer inspection systems • Chip placement machines • Flip-chip / die bonders • Wire bonders • PCB drilling • PCB testing machines • Flat panel display equipment • Medical equipment • General automation
LMG	• Compact design • Economic • High peak force • 600 VDC compliant	
LMS	• Compact design • Economic • High continuous force • 600 VDC compliant	
ILM	• High force • Air cooling option available • Low mass glider • Zero force ripple	• Wafer inspection systems • Chip placement machines • Flip-chip / die bonders • Wire bonders • Very high dynamic axes • PCB testing machines • Air bearing systems • CMM measuring machines • Optical equipment manufacturing • Medical equipment
ILF	• Medium force • Very low mass glider • Zero force ripple	

INTEGRATED MOTORS

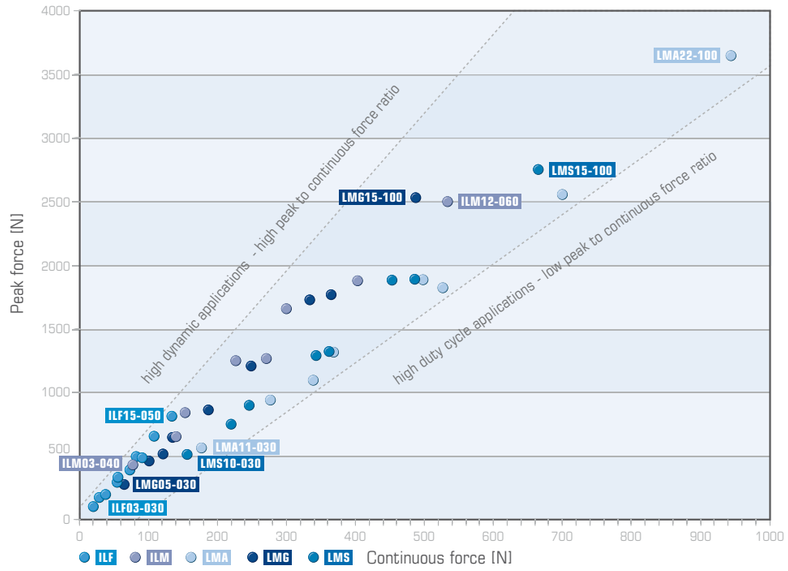
ETEL motor design competences serve also more complex requests such as fully integrated axes. In fact, motors can be designed to perfectly fit a very specific form factor to satisfy customer applications. This process ultimately provides highly integrated motion systems with unique performance.



- Chip placement machines
- Flip-chip / die bonders
- Wire bonders
- PCB testing machines
- Very high dynamic axes

Linear motors range

ETEL offers the most comprehensive standard linear motor range in the industry. With more than 50 models to choose from, almost any requirement can be satisfied.

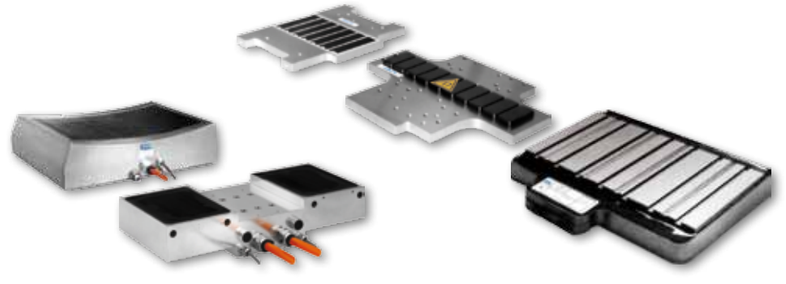


Custom motors

With over 30 years of direct drive innovation, ETEL has the expertise to quickly and efficiently adapt existing products into custom solutions. The process is made simple due to the modular and flexible design of our linear motors. ETEL can also develop a completely new motor design to address a particularly demanding or unusual requirement.

ETEL's experience also includes:

- Ironcore and ironless motors
- Single and double excitation
- Transverse flux
- Long stator
- Combined motor (linear/rotary)
- Linear motors for very large diameter rotary axes
- High and low temperatures
- Vacuum
- UL certified
- Aerospace motors
- Specific magnetic ways
- Multiple motors integration



DIRECT DRIVE SOLUTION

To achieve optimum performance from a direct drive motor it must be built to the necessary standards of precision and stiffness as part of a complete direct drive solution. In addition to the motor, the four key components of a direct drive system are the electronics, encoder, bearings and machine structure. Each of the four components is briefly described in the following paragraphs.

Electronics

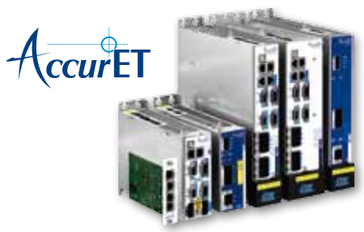
The best linear motor performance is achieved when integrated with a fully digital controller with extremely high bandwidth capability like the ETEL AccurET position controllers family.

In a direct drive system, the controller can benefit from a very precise position feedback due to the fact that there is no transmission in between the feedback device and the load. Because of this high quality feedback signal, a high-end controller (such as ETEL's AccurET) can compute advanced control algorithms at a very high frequency. Ultimately, the precision and the dynamics of the axis are drastically increased.

Some key factors to be taken into account when selecting a controller are listed below:

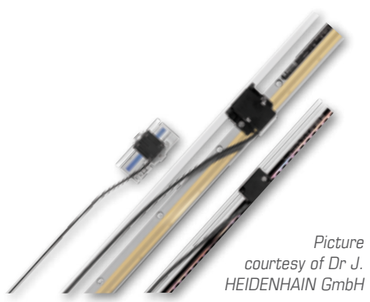
- High frequency control loops (current, speed, and position loops)
- High current and position loop bandwidths (typically >2 kHz and >100 Hz respectively)
- High encoder interpolation factor to ensure adequate speed and position resolution
- Advanced control algorithms (PID with feed-forward, state space regulators, observers, notch filters, etc)
- Advanced features: gantry control, 3D mapping, ability to compensate for detent force, stick slip, temperature drift, and other system repeatable phenomena

ETEL offers a complete range of state-of-the-art position and motion controllers which are widely used in various leading industries.

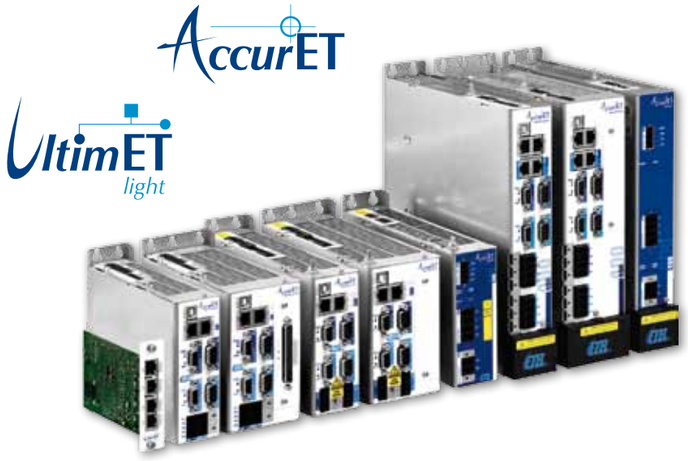


Encoders

High precision, high resolution feedback is essential for achieving optimum performance using direct drive. Direct coupling of the load to the drive improves accuracy but the best performance can only be achieved with the appropriate feedback device. This requires an absolute or incremental optical encoder with a high line count. When combined with the high interpolation capability of the electronics, resolutions down to the nanometer range can be achieved.



Picture courtesy of Dr J. HEIDENHAIN GmbH



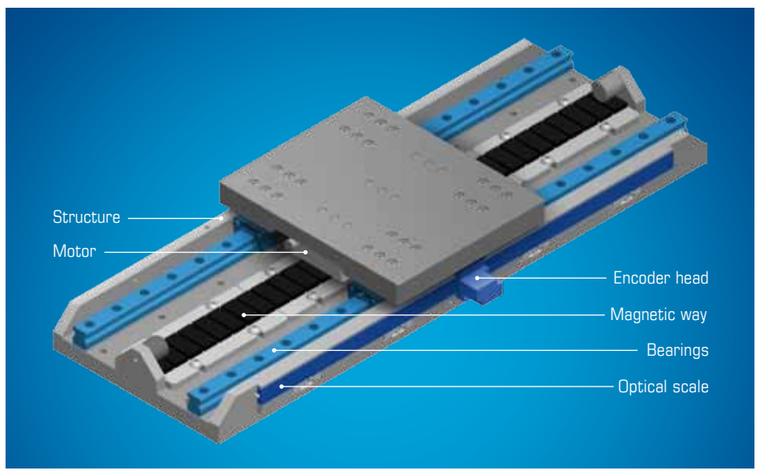
Electronics

ETEL's AccurET/UltimET controller family is especially designed for a variety of electronics and semiconductor related applications, where extremely high precision is needed without any compromise on throughput.

They can provide:

- High position accuracy
- Close to zero settling time
- High dynamics
- Multi-axis interpolation
- Fast communication bus
- And much more…

For more information, refer to our **Motion Control** brochure.



Bearing

Bearing selection is dependent on a system's dynamic load and accuracy requirements. Applications that require high stability, accuracy, and repeatability will typically utilize high stiffness bearings to meet their performance needs. Mechanical bearings are often the only wear-prone components in a direct drive based system. The most commonly used bearings are:

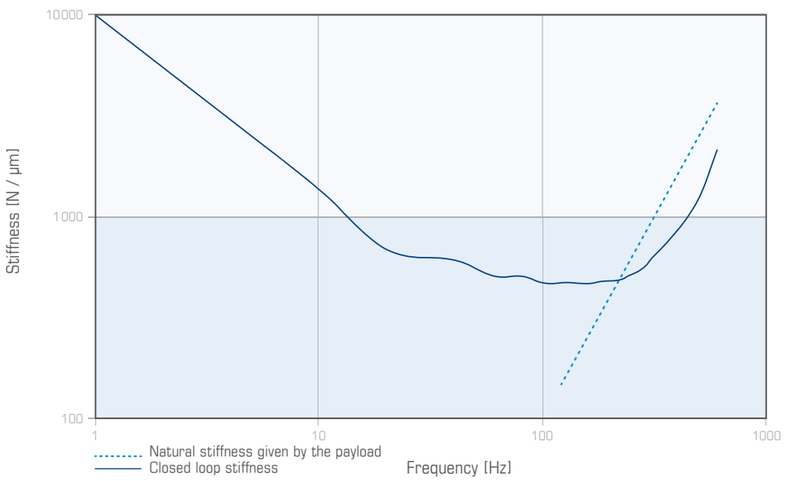
SPECIFICATIONS

	PLAIN FRICTION	CROSS ROLLERS	RECIRCULATION	AIR
PRECISION	✲	✲✲✲	✲✲✲✲	✲✲✲✲
SPEED	✲	✲✲	✲✲✲✲	✲✲
SMOOTHNESS	✲	✲✲✲	✲✲✲	✲✲✲✲
STIFFNESS	✲	✲✲✲	✲✲✲	✲✲
TRAVEL	✲✲✲	✲	✲✲✲	✲✲
LOAD	✲✲	✲✲	✲✲✲	✲
COST	✲✲✲✲	✲✲	✲✲	✲

✲ least desirable / ✲✲✲✲ most desirable

Structure

Special attention must be paid to the machine's structural stiffness. In most applications the structure should be designed with a natural frequency above 200 Hz. Finite element analysis is typically used as a design validation tool. A high performance control loop and high performance components (motors, electronics, and encoder) combined with an optimized mechanical design will lead to better system rigidity.



LINEAR MOTOR SELECTION

Many factors must be taken into consideration when choosing a linear motor to ensure outstanding system performance. This brochure provides a basic overview of some of the key selection factors that should be taken into account when choosing a linear motor. For detailed calculation and sizing information, please refer to the ETEL linear motors handbook, or ask an ETEL application and support engineer for assistance.

Motor sizing

The first step in a linear motor sizing is to define the force and motion requirements for the application. The maximum required acceleration and the payload mass are used to determine the peak force. The force required for each move within the cycle can then be used to determine the continuous force.

The amount of heat produced by motor power dissipation will determine the temperature increase of the structure. Power dissipation is estimated by calculating the continuous force and all additional sources of force such as friction, machining force, static force due to an offset load and external perturbations.

Under static conditions with an applied load, one motor phase can get disproportionately hot, because the power dissipation is not shared equally among all three phases. To ensure smooth operation under these conditions a stall force calculation should be performed.

In rare cases, the detent force may impact speed stability, especially if the position control regulation bandwidth is limited. ETEL's position controllers provide the ability to compensate the detent force for high accuracy applications.

ETEL's motors are available in several winding configurations. The winding should be chosen to match the speed requirements of the application and the voltage and current specifications of the electronics. Note that the force/speed characteristic of a motor changes with the winding.

Detent effects

Thanks to a patented design, ETEL has the expertise to manufacture ironcore linear motors with very low detent effects. The patented design uses an innovative combination of open slots, orthocyclic windings and fractional pole pitch. This solution significantly reduces detent effects without any skewing of laminations or magnets which would result in lower force density. Furthermore, detent effects at the motor extremities are eliminated by the use of specially-shaped teeth.

Motor constant

The motor constant, Km, is one of the key parameters for comparing permanent magnets synchronous motors relative efficiency. It shows the relationship between force produced and resulting power losses. A motor with a higher value of Km is a more efficient generator of force.

Km is determined by the design and construction of the motor. This parameter is related to the internal design of the motor (copper filling factor, electromagnetic design, etc). Therefore, it is a better indicator of motor performance than the force constant, Kt (Nm/Arms), which relates force output to the supplied current. Kt is easily adjusted by changing the wire gage in the winding. Kt is useful for matching a motor to a servo amplifier, but it does not provide information about the motor's efficiency.

Thanks to a patented design, ETEL is able to significantly increase the packing efficiency of ironcore linear motors' slots (increase in Kt) and to decrease the amount of copper wire extending beyond the slots (reduction of ohmic loss). Moreover, it leads to an important increase in continuous thrust and better thermal behavior (resulting in an improved Km).

Thermal considerations

The performance of the motors as well as the overall machine behavior are closely related to heat transfer. As with any other kind of electrical motor, heat is generated during operation. Unless it is removed by an efficient cooling system, this heat will be transferred in the machine structure and the motor's surroundings. Depending on the application (precision requested, dynamics, duty cycle) heat could prevent machine from reaching its specifications. Thus it has to be taken into account in the early design phase.

To help in selecting the right motor and getting the best machine performance, ETEL defines in its motor data sheets an assumed exchange surface for each motor type. It represents the surface to which the motor is mounted for optimal heat transfer. This value is very important and closely related to the motor continuous force (Fc). However, once mounted in the machine, the exchange surface will most likely be different. Two scenarios can occur:

- The real machine exchange surface is higher than the assumed one. Then the motor performance can be increased. Higher continuous force or less heat at a given duty cycle.
- The real machine exchange surface is lower than the assumed one. This is the case for example when a thermally insulating layer is added in between the motor and the carriage. In this case, thermal transfer is limited as well as motor performance.

Do not hesitate to contact your ETEL's representative for technical support during machine design phase.

Data sheets

ETEL linear motors information is available in the corresponding ironcore and ironless motors data sheets. They include the specifications, performance as well as the force vs. speed curves of each standard ETEL motors. For more information about the linear motors or to download the data sheets, refer to our website: www.etel.ch

Handbook

For more information on motor selection and integration, ask for the ETEL linear motors handbook from our website.

ETEL Sizing Tool

ETEL has developed a powerful sizing tool that can simulate the customers' machine operation. This tool will help you getting the very best "performance/price" ratio that can be obtained on your specific application. Do not hesitate to contact your ETEL's representative for technical support during the machine design phase.

CASE STUDIES

ETEL linear motors in PCB drilling

In the PCB drilling applications, the requirement for precision is made more challenging due to high masses and very high throughput. In these kinds of machines, accuracy is very frequently below 4 µm while masses to be accelerated at about 1.5 g are typically in the range of 300 kg for the main X and Y axes. ETEL linear motors have been selected to achieve this task. In addition to X and Y, the very dynamic drilling Z-axes are also moved by ETEL linear motors.

A typical motion cycle includes the positioning of X and Y axes followed by the synchronized drilling movement of all Z axes. In this type of application, the motor's peak force is important because of the high accelerations needed to reach an incredible throughput of 800 cycles per minute. In addition to that, the extremely high duty cycle imposes a very efficient motor design. With ETEL LMGs one can obtain a very high continuous force in a small volume and with limited heat dissipation. The use of ETEL motors combined with an optimal machine design and top performing drilling processes makes this machine belong to the very high-end of PCB drilling machines.

In addition to the ETEL's ironcore linear motors, this application is fully equipped with ETEL position and motion controllers. The high performance of the ETEL controllers together with an optimal software design allows reliable interpolation and synchronization of all axes (X, Y and up to 12 Z) during drilling programs that can last more than 12 hours representing 600'000 drillings.

Picture courtesy of Posalux SA

ETEL linear motors in AOI systems

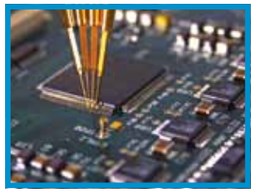
In many manufacturing processes, inspection is a crucial step to ensure final product functionality and reliability. ETEL is present in a wide range of Automated Optical Inspection (AOI) systems providing high precision and maximized throughput by using direct drive linear motors.

For instance, in PCB inspection systems, where line space is in the range of 15 microns, a combination of high performance optical system and motion system is necessary to get the best possible yield out of the production line. In case of IC substrate inspection, the structures to be controlled can go down to a few microns in size for substrates typically used in chip-scale or ball grid array packages. Moreover, the precision requested have to be ensured over a wide surface without any compromise to performance or machine throughput. A precise point-to-point motion with extremely short in-position-time is made possible by using ETEL direct drive technology.

Pictures courtesy of Camtek Ltd.

Thanks to the ETEL LMG series of ironcore linear motors, one can safely design flexible machines that achieve exceptional detection skills in a wide range of AOI tasks. The high force density of ETEL motors allows a very compact design that helps maximizing the working area, as well as increasing the overall machine throughput. In addition, quality and reliability are two of the many key points that customers benefit from ETEL products to ensure a stable, maintenance-free and very long machine lifetime. Finally the extended range of standard LMG motors makes machine development roadmap easier by providing a stable motion system design to continuously meet the evolving specifications.

ETEL product range in flying probe tester machines



ETEL has been present in the electronics industry since many years providing best performing motion control solutions. In flying probe tester machines, throughput and precision are key factors to success. Nowadays, machines equipped with ETEL's LMG motors provide the highest throughput on the market without any compromise on precision. The main axes of the illustrated machine are driven by ETEL's LMG motors, allowing extremely high speed dual-sided probing with a motion resolution of less than 20 nm. ETEL's standard ironcore linear motors together with an optimized machine design contribute to make these flying probe tester machines a point of reference on the market.

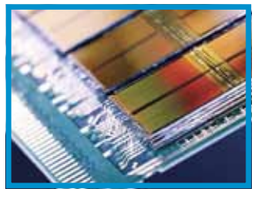
In this case, the fast and precise motion control of up to 24 axes is ensured by ETEL position and motion controllers. The optimal fit between ETEL motors and motion controllers as well as the advanced features provided by ETEL controllers provide outstanding performance in such applications.

Additionally, the 15 g Z-axis motion of the testing probe is provided by a unique custom motor design developed in synergy with our customer. This unique and fully integrated Z-axis design is made to exactly fit the application needs maximizing performance and reducing costs of ownership.

Finally, this ETEL based direct driven machine is able to achieve outstanding probing accuracy and throughput level. Such performance would be impossible to reach with other types of motion technologies like reluctant planar motors or rotary based systems.

Pictures courtesy of SPEA Spa

ETEL product range in wire bonding applications



ETEL is present in the majority of the critical stages during the IC manufacturing process. From the very early lithography process to the final pick and place machines, ETEL provides the best suited direct drive motors to fulfill highly demanding applications. Wire bonding is one of these important processes during semiconductor device fabrication were ETEL is strongly present to help our customers reaching outstanding machine performance.

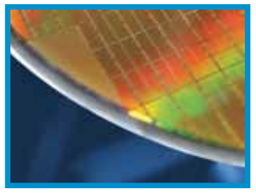
Many variants of wire bonding exist and might lead to slightly different key specifications when designing the motion system. However, speed, precision, and reliability are in any case the most important requirements. Some of the most famous technology leading companies in the wire bonding industry use ETEL solutions to reach unmatched performance levels.

The very wide range of ETEL linear motors and controllers provides a solution to perfectly fit the most demanding requirement of such high-end machines. On one hand, the use of ETEL ironless motors provides low moving mass for very high dynamic axes to finally obtain the fastest bonder in this market segment. On the other hand, ironcore motors are also used to maximize the force density and thus to reach the largest possible bonding area in a given volume. By using ETEL AccurET controllers and some of the most advanced features currently available on the motion control market, one can reach extreme precision levels in the micro meter range without any compromise on the machine throughput.

Pictures courtesy of Hesse GmbH

ETEL'S LINEAR MOTORS IN HIGH-END MOTION PLATFORMS

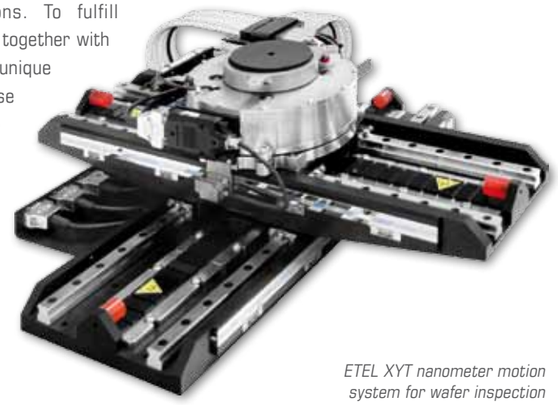
ETEL technology in wafer inspection motion systems



ETEL linear motor technology is used in the most advanced motion systems required by the semiconductor industry. A combination of the very best technology available is required when absolute accuracy levels go down to the sub-micrometer level and when position stability requirements are in the nanometer range. At these levels, any component weakness can compromise the entire machine performance. This is the reason ETEL delivers complete motion platforms based on the very best components and mechanical design skills.

In wafer inspection tools, very high accuracy and throughput are key specifications. To fulfill demanding applications, ETEL combines the use of LMG linear motor together with ETEL AccurET/UltimET position and motion controllers and their unique features specifically designed for this high-end industry. Ultimately, these key components are part of a larger optimized mechanical design to reach unmatched performance.

As an example, the stage shown on the right can achieve 1g accelerations and 1m/s speed together with precision levels of 1.5 microns and repeatability of 200 nanometers at the tool point. Thanks to the overall motor, control, feedback, and mechanical package, short move-and-settle within a sub-nanometer window can be reached.



ETEL XYT nanometer motion system for wafer inspection

ETEL specific motor design in short stroke actuators

ETEL short stroke actuators for flying probe testers

In many different industries, highly integrated actuators are requested. In such cases where the form factor is the most critical specification of the motion system, it might happen that conventional linear motors cannot fulfill the application needs. In this case, ETEL motor experts are able to provide a motor design with the best performance to volume ratio.

ETEL develops a wide range of short stroke actuators to address diversified needs in applications such as: pick & place, IC's testing, flying probe testing, etc. In each of these applications, the form factor is of major importance to fit a high-end direct driven axis in the machine environment. The motors are designed specifically and integrated together with bearings and feedback devices in the most suitable form factor. This deep integration process leads to a cost effective and high performance solution that fits to the exact requirements of the targeted process.

ETEL short stroke actuators can be based on different motor technologies depending on the motion requirements. In such products, ETEL mainly uses miniaturized 2-phase or 3-phase ironless motors as well as single phase moving magnets or voice coil type motors. Ultimately, one can achieve extremely high dynamics (up to 180 g acceleration) together with a micrometer precision level thanks to integrated optical encoders. These very small and light actuators can operate maintenance free for billions of cycles with an extremely high throughput (30 cycles per second). ETEL's uniqueness is to merge compactness, performance, and reliability to achieve what can certainly not be achieved by combining conventional technologies.

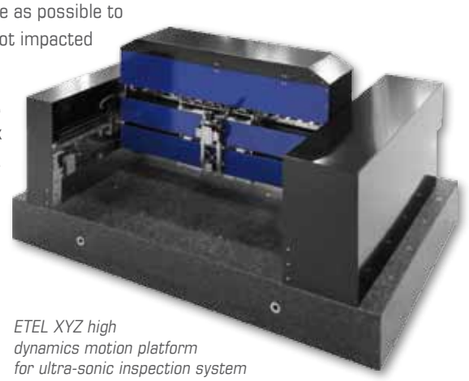
ETEL short stroke actuators for IC testing handlers

AOI / pick and place

In the majority of microelectronic component manufacturing processes, a non-destructive inspection phase is mandatory. This phase is crucial to ensuring the product functionality and reliability. Since it is an in-line process, it must be as fast and as precise as possible to guarantee the overall throughput of the line is not impacted by these control procedures.

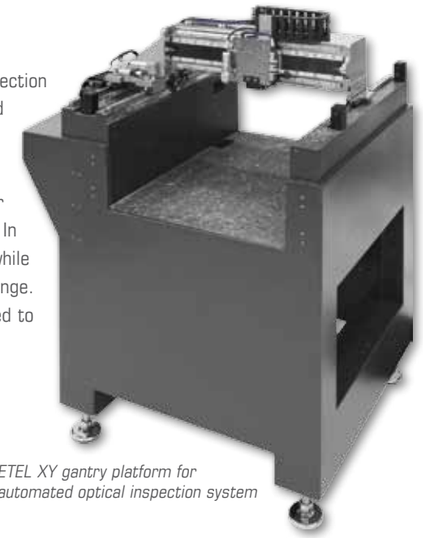
Depending on the type of product inspected, whether passive components to more complex ICs, different inspection technologies such as optical, X-ray, or acoustic are used. ETEL is present in a wide range of 2D and 3D Automated Optical Inspection (AOI) machines to bring high precision and maximized throughput by using complete motion systems equipped with linear motors.

In an inspection machine, there are normally two key systems to be synchronized to reach the best performance level: the motion platform and the inspection system itself. By delivering complete motion platform including the motion controllers, ETEL can guarantee the key motion specifications of the machine. This enables the OEMs to focus on their core competences in terms of inspection system, defect recognition software, etc. while having the assurance that the required precision, repeatability and throughput are guaranteed by ETEL as the experienced motion system supplier.



ETEL XYZ high dynamics motion platform for ultra-sonic inspection system

In the electronic back-end industry, AOI stages are generally less demanding than wafer inspection systems but are typically more dynamic with a larger working environment. In some applications, the inspection area covered by the X-Y axes can be larger than 1m^2 while maintaining an absolute accuracy below 10 microns and repeatability in the micron range. Moving speeds faster than 2 m/s are common and accelerations of 3 g can be ensured to achieve high dynamics, without compromising precision.



ETEL XY gantry platform for automated optical inspection system

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