



*Smarter Motion
Control Solutions For Laser
Processing Systems*

**Accuracy.
Throughput.
Flexibility.**

30⁺ *Years of
Smarter
Motion*

ACS
MOTION CONTROL

Unique Capabilities. Unique Solutions.



About ACS

ACS Motion Control is a global company providing EtherCAT® network based high performance machine control systems for motion centric applications.

Since 1985, ACS Motion Control has provided state of the art control solutions to world leading equipment manufacturers.

ACS has its international headquarters in Israel with sales and support centers in the USA, Germany, China and South Korea.

Product Platform Flexibility and Scalability

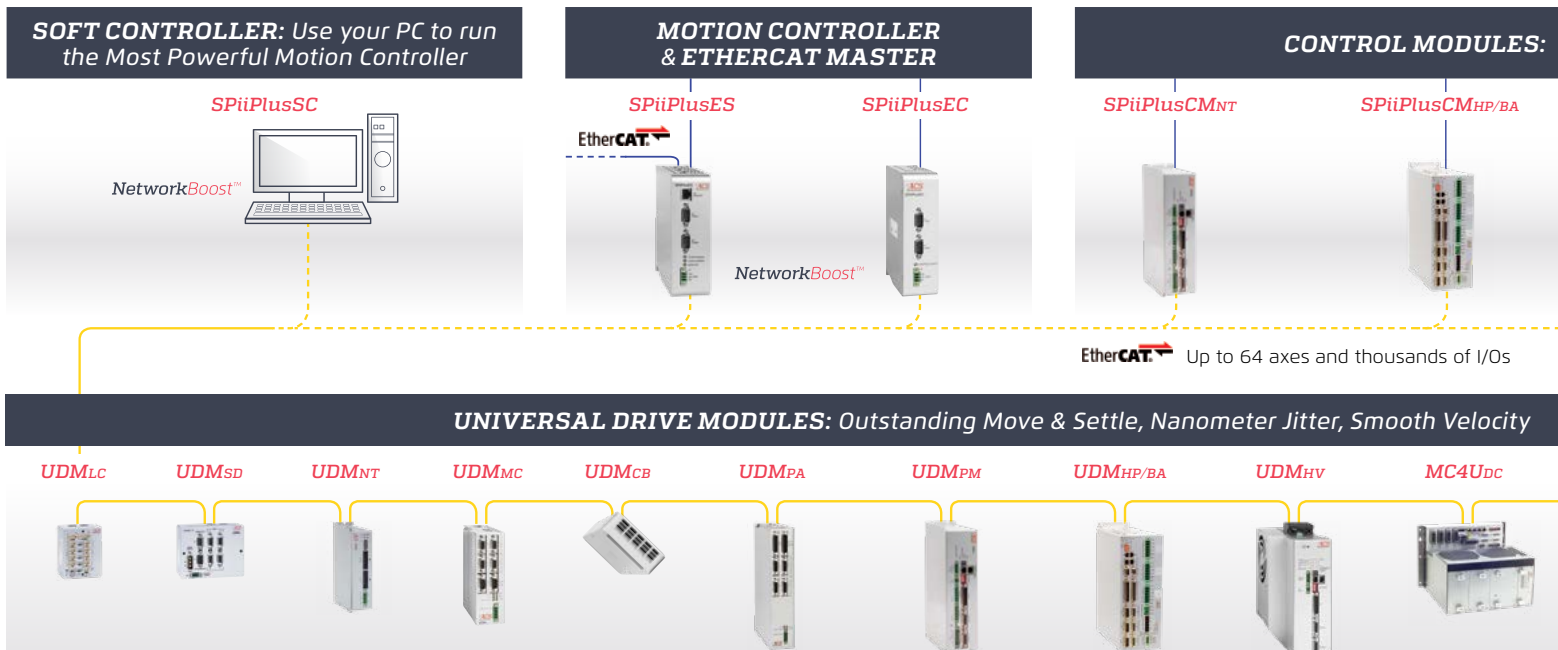
- › Industrial EtherCAT based control platform
- › Latest generation technologies (CPU, DSP, FPGA, Power Bridge...) combined with best in class control algorithms and software tools enable optimal performance
- › Universal drive technology allows use of any motor & stage technology

ACS Promise

We are always ready to rise to the challenge to deliver smart, best-performing motion control solutions for the most demanding applications, developed and supported in partnership with you and in-line with your needs.

Providing and Sustaining a Competitive Advantage

- › Organizational focus on serving the needs of OEMs
- › Motion control solutions that optimize machine accuracy and throughput, minimize downtime
- › Highly flexible architecture suitable for wide range of applications
- › Reduced time to market with comprehensive setup, simulation, and diagnostics tools.
- › Significant investment in R&D, application and support engineering
- › Partnerships with complementary suppliers reduce project risk and development effort



EtherCAT® is registered trademark and patented technology, licensed by beckhoff automation GmbH, germany



Motion Control Solutions for a Wide Range of Applications

Motion System Configuration Examples



Thin Film Patterning (See p. 4-5)

- › XYZ axes linear stages
- › Fixed or steered beam delivery
- › Few microns accuracy and repeatability



Precision Flatbed Cutting (See p. 6-7)

- › XX' axes linear gantry stage with overhead cross-bridge mounted YZ axes linear stages
- › Fixed beam delivery
- › Tens of microns accuracy, few microns repeatability



Wafer Scribing and Marking (See p. 8)

- › XYZ axes linear stages
- › Optional T axis rotary stage
- › Fixed or steered beam delivery
- › Few microns accuracy, sub-micron repeatability



Spot and Seam Welding (See p. 9)

- › XYZ axes linear stages
- › Typically 1, optionally up to 3, rotary axis stages
- › Fixed beam delivery
- › Tens of microns accuracy, few microns repeatability



Stent/Tube Cutting

- › A axis rotary stage mounted on X axis linear stage
- › Optional additional linear axis stages
- › Fixed beam delivery
- › Few microns accuracy and repeatability



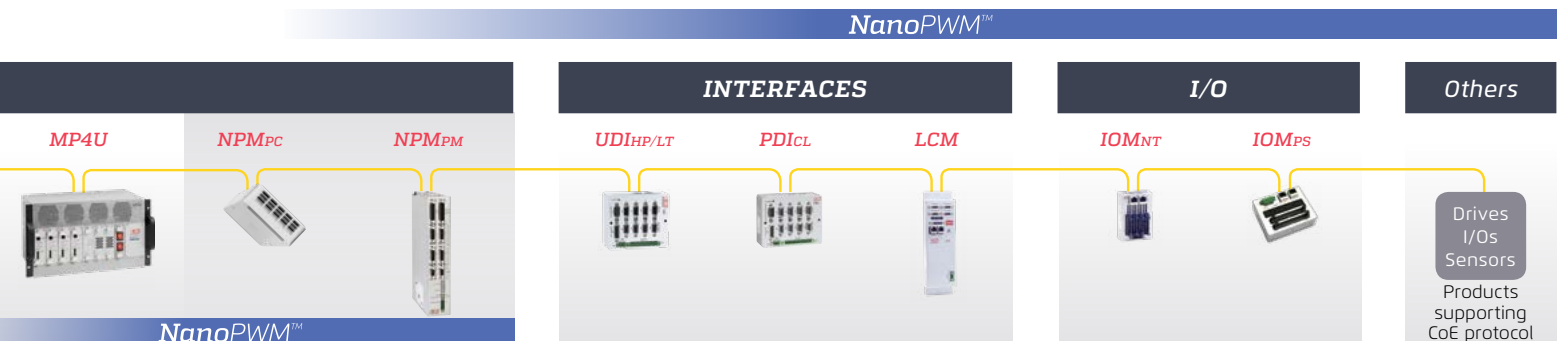
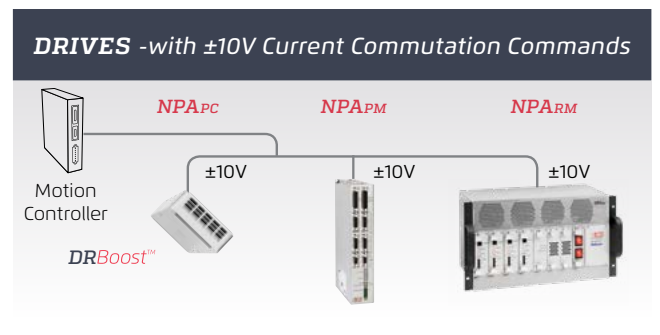
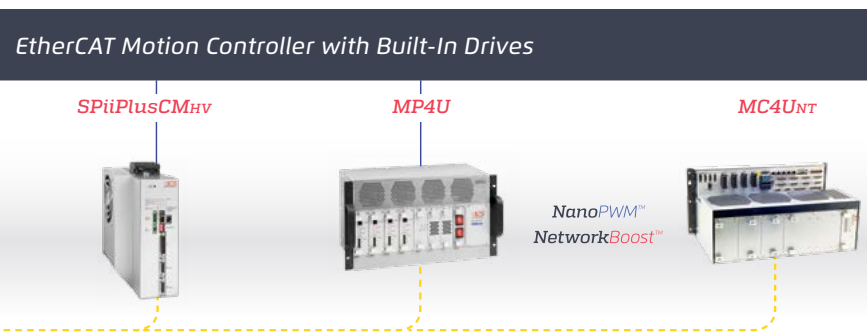
PCB/FPC Via Drilling

- › XYZ axes linear stages
- › Optional A and/or B axis rotary stages
- › Fixed or steered beam delivery
- › Few microns accuracy and repeatability



3D Micromachining and Additive Manufacturing

- › XYZ axes linear stages + 1 or 2 rotary axes stages
- › Fixed beam delivery
- › Few microns accuracy and repeatability





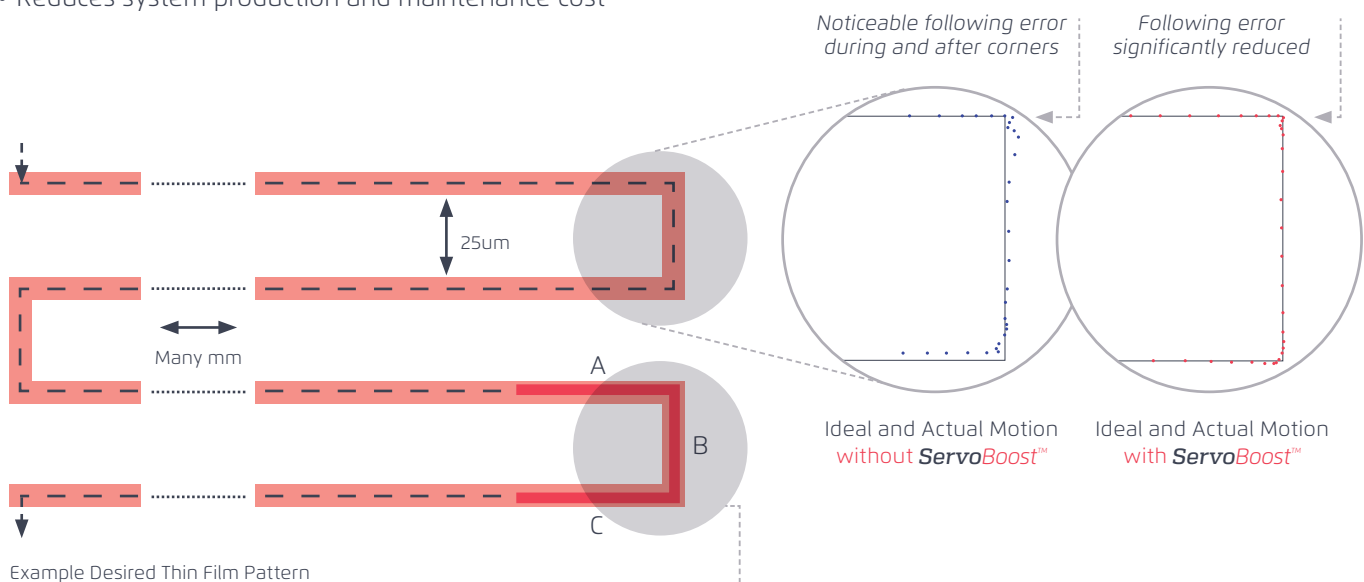
› The Challenge:

Accurately controlling laser beam tip position and orientation relative to the substrate while processing is of fundamental importance for ultra high precision processes such as thin film patterning. When axis velocities and accelerations are high in order to maximize throughput, minimizing following error of motion stages becomes a significant challenge.

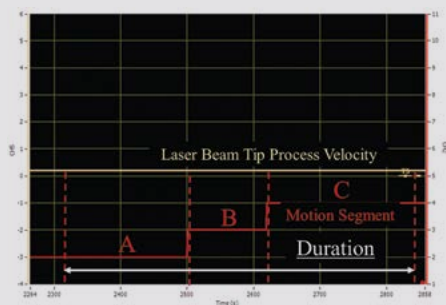
› The Solutions:

ServoBoost™

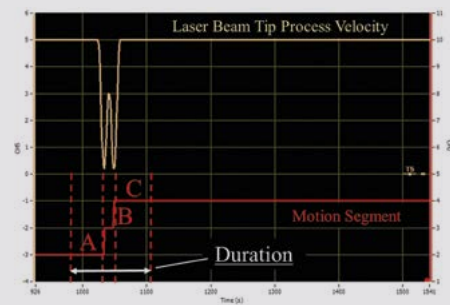
- An advanced control algorithm based on modern control theory
- Compensates and attenuates disturbances in real time such as cogging, resonances, changes in load, non-linear friction
- Increases servo bandwidth and stability
- Reduces system production and maintenance cost



Advanced Profile Generation for Laser Processing



Without Lookahead Algorithm
Process Velocity Must Be Low to Minimize Deviation at Corners -
Low Throughput



With Lookahead Algorithm
Process Velocity Can Be High and is Automatically Reduced During Corners -
High Throughput!

- Sophisticated high order look-ahead algorithm avoids exciting resonances
- Corner rounding
- Smooth on the fly profile adjustments
- Optimize throughput and accuracy and extend life of mechanics





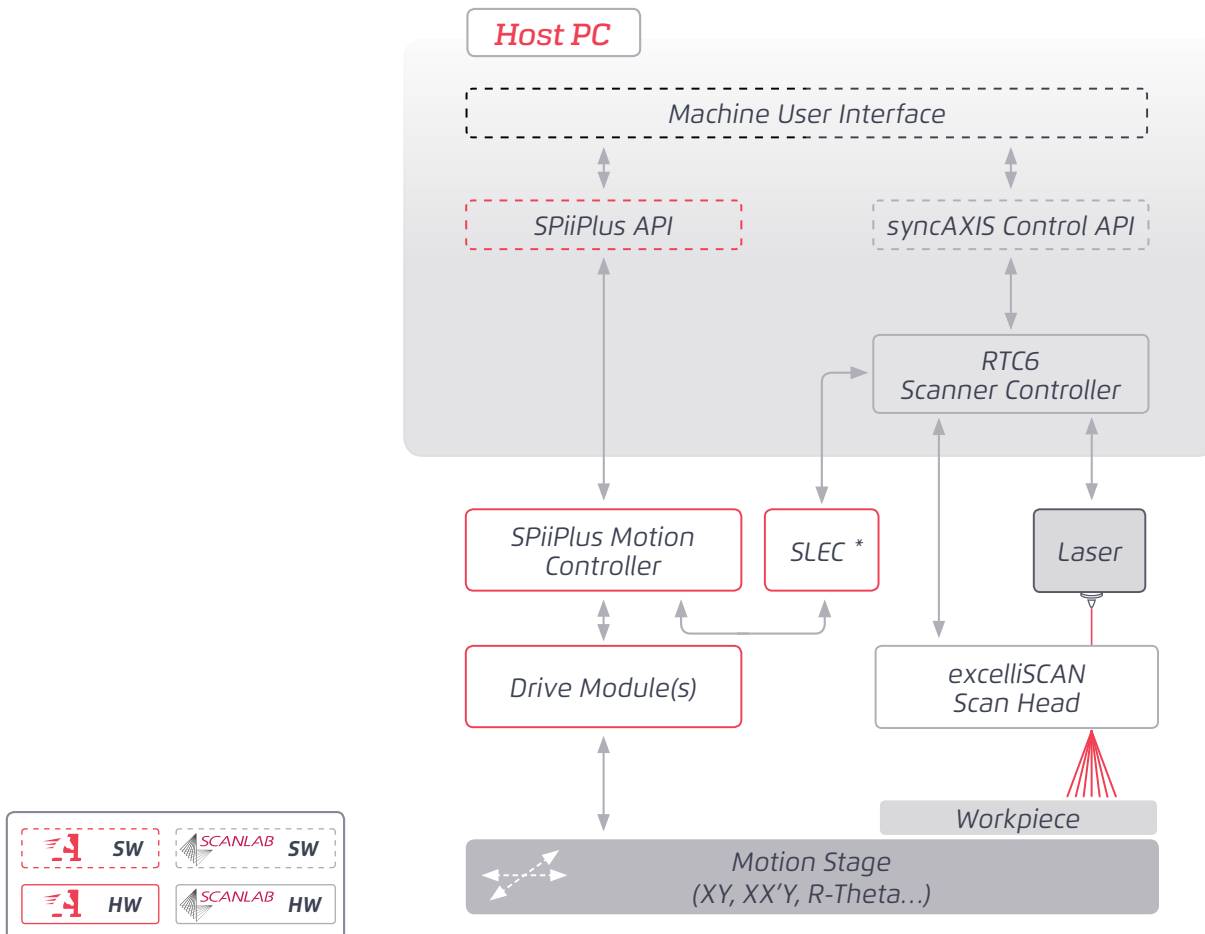
› The Challenge:

Traditional laser processing of large workpieces with galvo scanners and motion stages involves a step and scan approach, which is subject to stitching errors and limits throughput. To achieve the highest possible throughput and accuracy, a sophisticated solution is required.

› The Solution:

XLSCAN

- A unique and revolutionary eXtra Large SCAN machining solution co-developed by  **SCANLAB** and  **ICS**
- Best in class galvo scanner solution + Best in class motion control solution = Significantly increased throughput for machining of large workpieces with the highest possible accuracy
- Key Advantages of Simultaneous Motion
 - › Very large field of view
 - › Major throughput increase (up to 40 % more compared with conventional systems)
 - › No stitching errors, Enhanced accuracy
 - › Smooth processing with high dynamics and no stage vibrations
- Scalable to support multiple scan heads
- Processing of three-dimensional workpieces supported through integration of excelliSHIFT Z-scanner



* EtherCAT to SL2-100 Synchronization Node



› **The Challenge:**

Tightly synchronizing the motion and laser control, for example triggering laser pulsation at exact positions during motion, becomes more and more difficult as machine throughput and pulse frequencies increase.

› **The Solutions:**

LCM - The powerful Laser Control Module synchronizes the firing of the laser to the position of the part being processed.

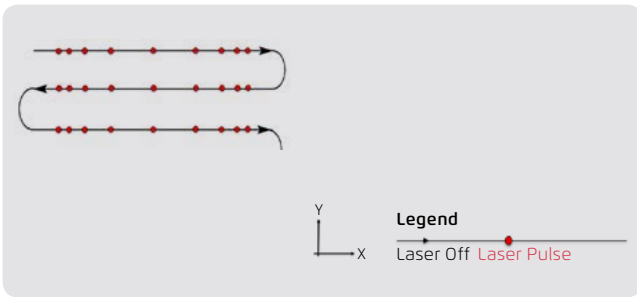
- The LCM can be used with any ACS controller and drives. Supporting pulse frequencies up to 10MHz, capable of triggering a laser at positions with submicron accuracy and repeatability.
- Uniquely suitable for absolute encoder based systems, in addition to incremental encoder based systems



LCM

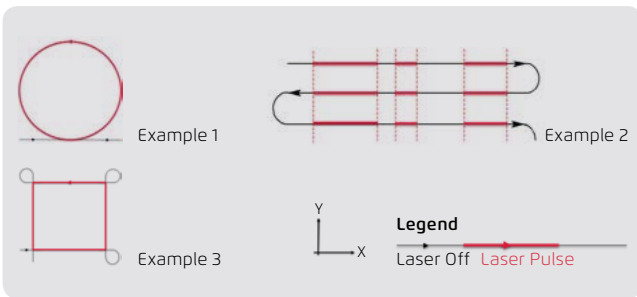
Array Based Pulse Firing Mode

Pulsating the Laser at Pre-Defined Positions Along the Path



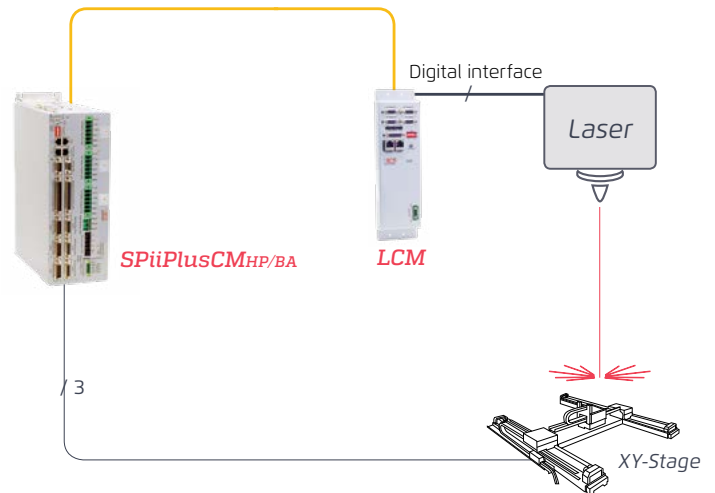
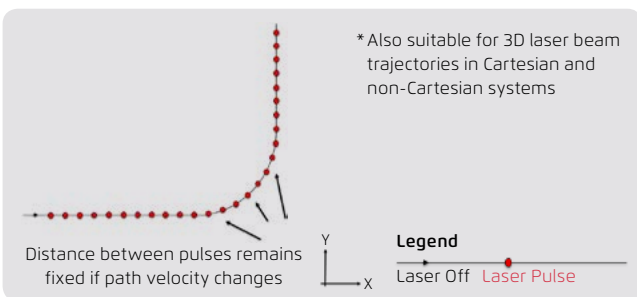
Array Based Pulse Gating

Turning the Laser On/Off at Pre-Defined Positions Along the Path



Fixed Distance Pulse Firing Mode

Triggering Laser Pulses at Precise Positions with Fixed Distance Interval





› The Challenge:

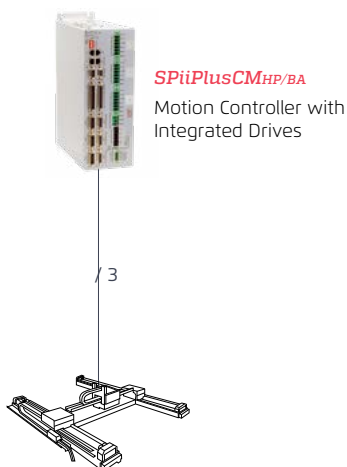
Large format flatbed cutters span a wide travel range and often employ large gantry stages to provide high velocities and accelerations, which can be challenging to control.

› The Solutions:

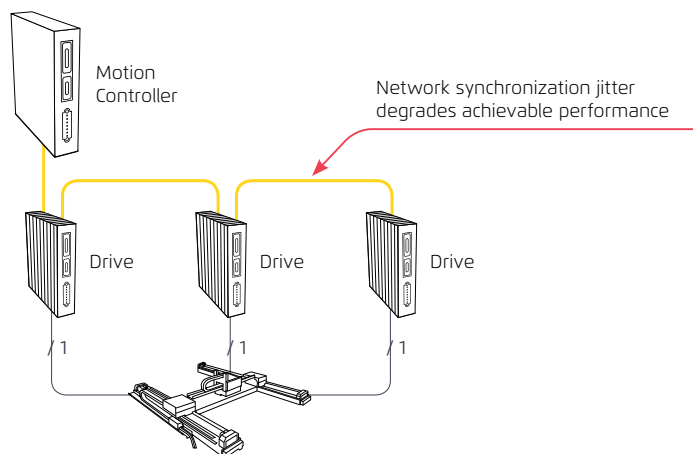
Gantry Control Algorithm

- Control an entire gantry system from one multi-axis drive, eliminating the effect of network synchronization jitter.
- Independent/decoupled MIMO control of linear and yaw degrees of freedom prevents servo loops from ‘fighting’ each other.
- Dynamic cross axis position compensation ensures consistent performance over entire XY travel range.
- Suitable for dual feedback gantry systems (rotary/linear, optical/laser).

ACS Multi-Axis Drive Gantry Control - Performance Optimized



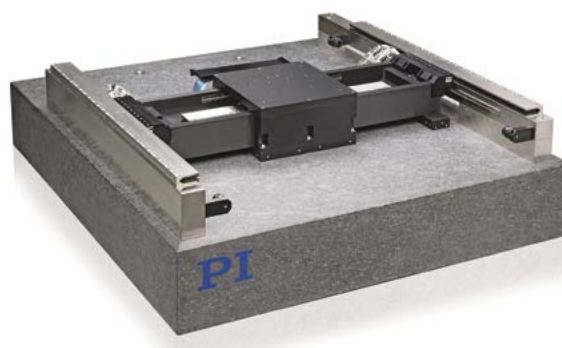
Independent Drive Gantry Control - Performance Limited



- Suitable for controlling both compliant and non-compliant yaw designs.



*Compliant yaw design maintains high degree of mechanical stiffness and provides large yaw travel range.
Gantry stage image provided by ALIO Industries.*



*Non-compliant yaw design maintains high degree of mechanical stiffness and minimizes yaw travel range.
Gantry stage image provided by PI.*



› The Challenge:

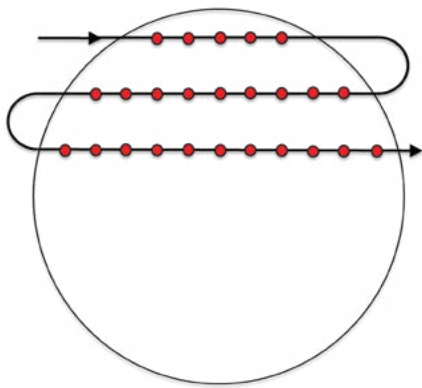
Wafer scribing often requires precise laser pulsing or gating outputs synchronized to motion, typically during raster scan type motions. Wafer marking typically demands a high throughput yet economical marking solution. A single machine may need to provide both functionalities.

› The Solutions:

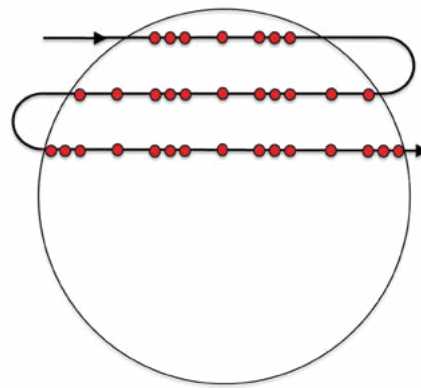
PEG for high precision laser pulsing / gating

- Standard feature for all ACS drive modules

Incremental PEG

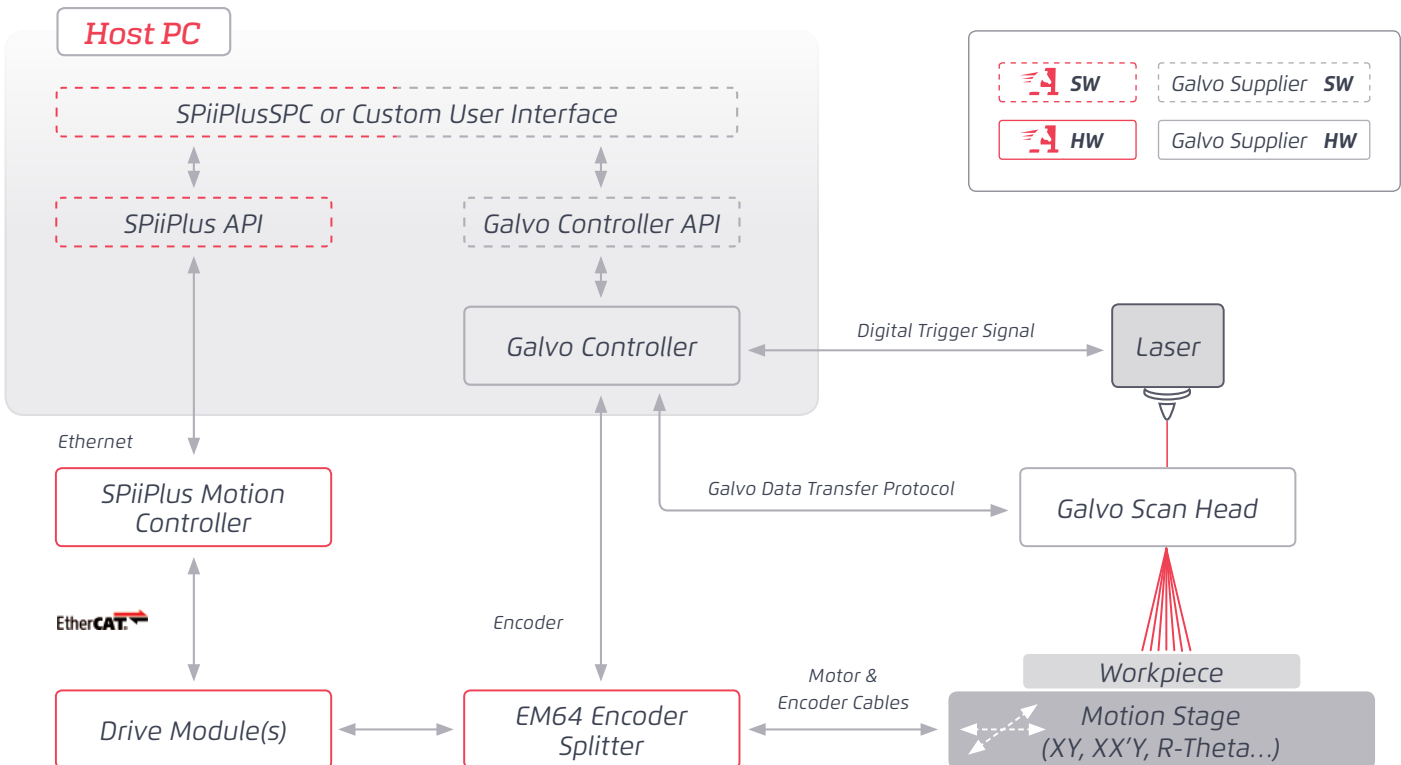


Random



SPiiPlusSPC with integrated mark on the fly

- Use standard ACS motion controller products with standard galvo scanner products (supporting mark on the fly)





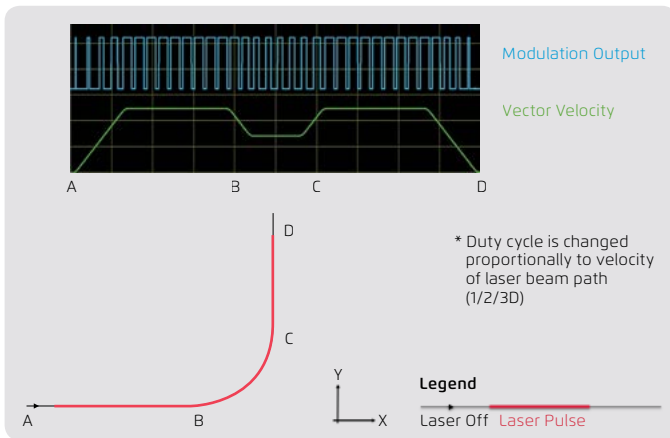
> The Challenge:

Dynamically controlling laser beam power as a function of coordinated multi-axis motion is often critical to ensure reliable and successful laser welds, and a common control platform should be suitable for economical as well as high performance applications.

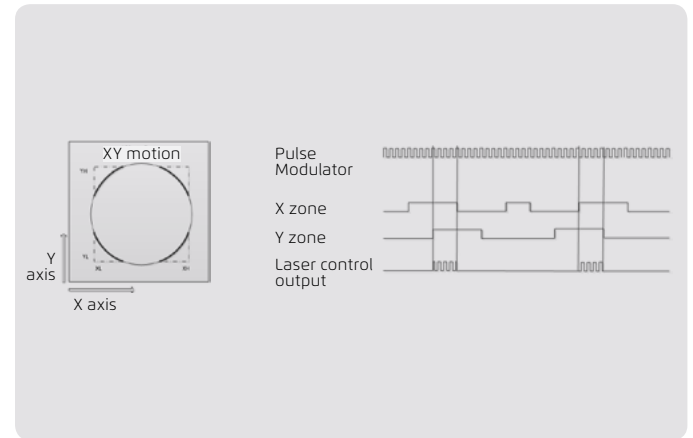
> The Solutions:

Laser Control Module for Synchronizing Power Control with Motion

PWM Modulation as a Function of Velocity

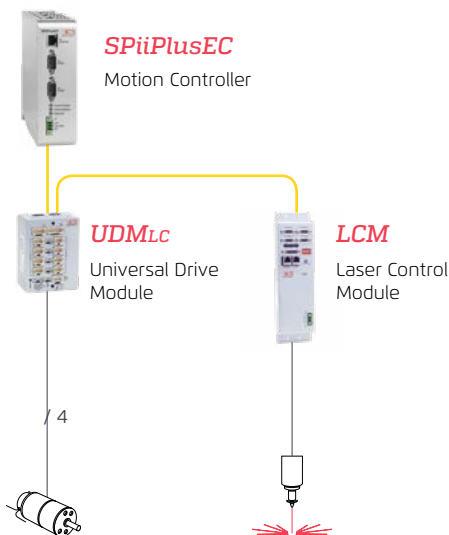


Axis Range Windowing & Digital Modulation

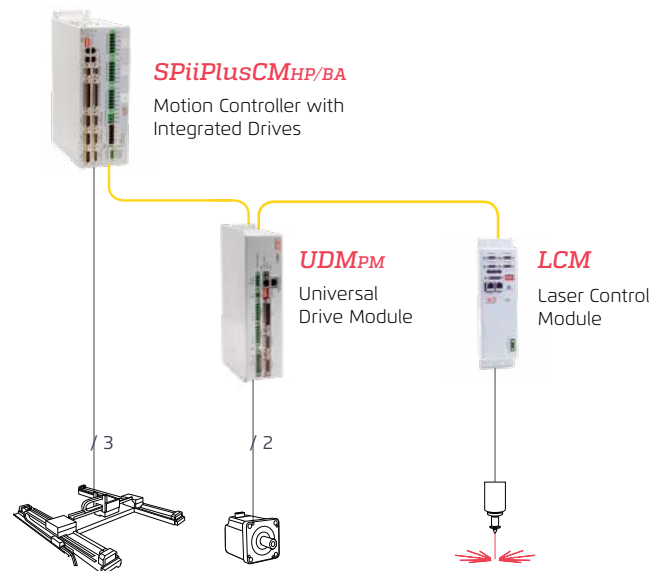


SPiiPlus Common Control Platform Architecture

Economical solution for controlling lower precision/power stages



High performance solution for controlling higher precision/power stages



• Common software tools and programming implementation – easy portability between all drive and controller form factors.

• **EtherCAT** Network based solution provides powerful flexibility

Maximizing Machine Flexibility with Powerful Software Tools and Capabilities



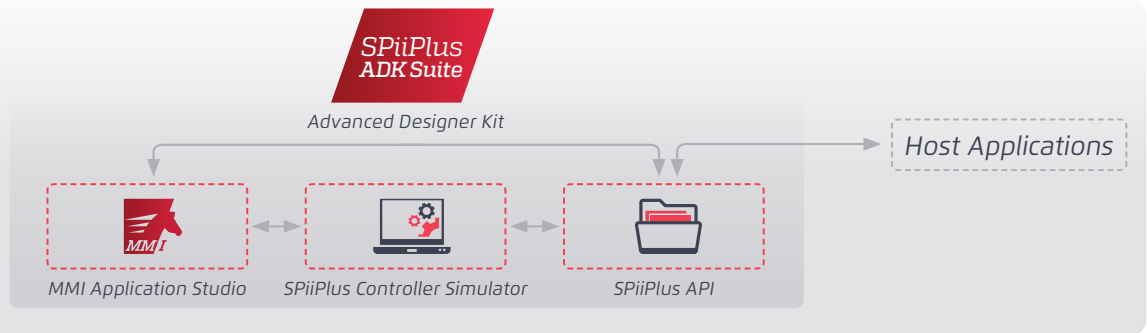
> The Challenge:

A laser processing system provider may be required to modify a machine's functionality to meet unique requirements for different applications. Integration of new motion axes and peripherals into the control system must be straightforward. Performance and stability requirements may also be pushed to the limits of the mechanical capabilities, requiring sophisticated software tools to ensure reliable operation.

> The Solution:

SPiiPlus ADK Suite

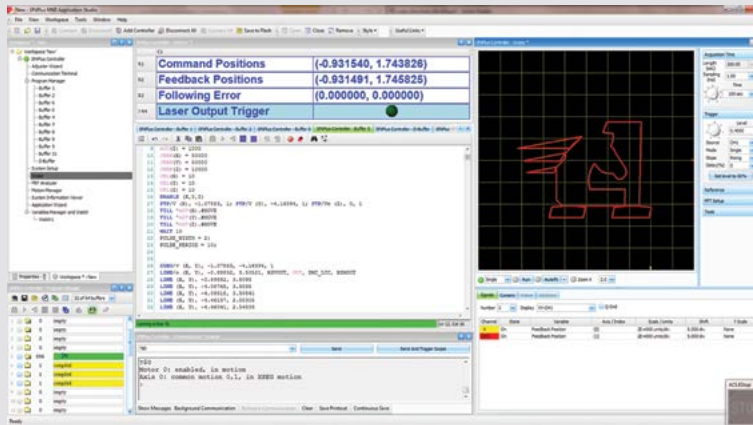
Host PC



MMI Application Studio

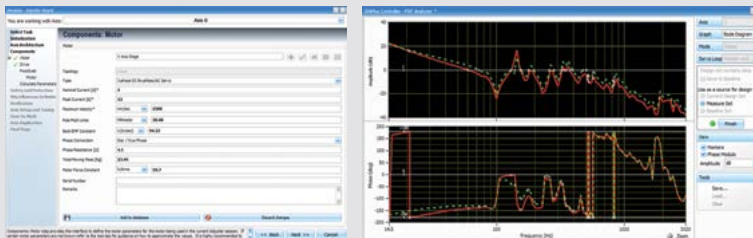
Program Editor & Manager
Multi-Channel Scope
Variable Watches
Communication Terminal

Comprehensive application development environment



Adjuster Wizard

Step by step configuration of axis parameters including one parameter tuning



FRF Analyzer

Verify and optimize machine stability and performance

- Full featured libraries and controller simulator for easily developing and debugging the user interface
- Powerful multi-tasking real time programming environment
- Programming with ACSPL+, Standard RS-274 and User Defined G & M Codes



Minimizing Time to Market with User Interface Platforms

> The Challenge:

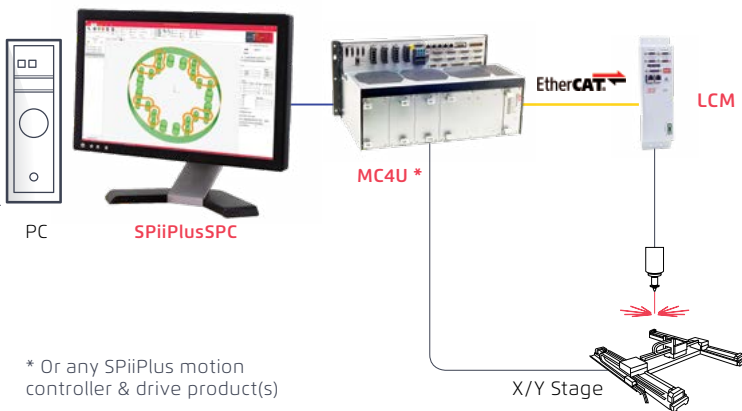
Software development for laser processing equipment can be quite complex, especially when distributed development teams handle multiple machine configurations. Powerful development and simulation tools with comprehensive yet customizable functionality can reduce development effort by weeks or months.

> The Solutions:

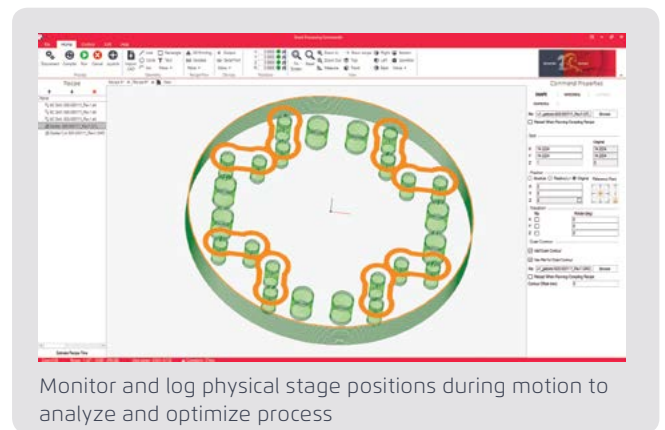
User Interface Platforms



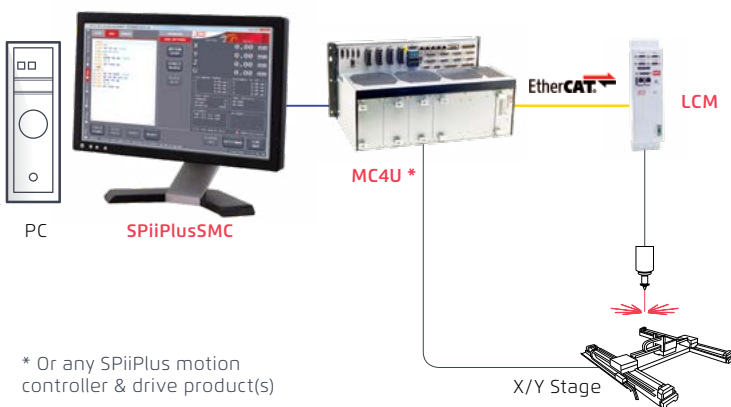
- > Leverages SPiiPlus EtherCAT® based motion control product line for direct CAD to Motion based machine control
- > Import variety of CAD files (DXF, DWG, Gerber, NC Drill, STL, etc.), create and execute sophisticated process recipes
- > Customization via C# Plugins to meet unique application/machine interface requirements



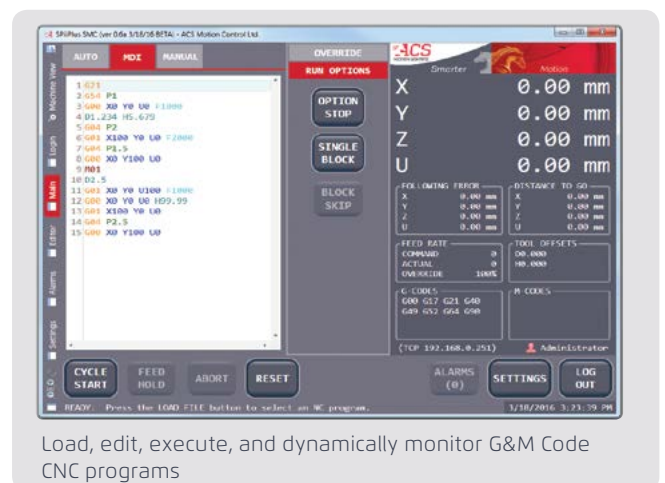
* Or any SPiiPlus motion controller & drive product(s)



- > Leverages the SPiiPlus EtherCAT® Based Motion Control Product Line for CNC Control
- > Accepts NC files with Standard RS-274 G & M Codes, support for User Definable G & M Codes



* Or any SPiiPlus motion controller & drive product(s)



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