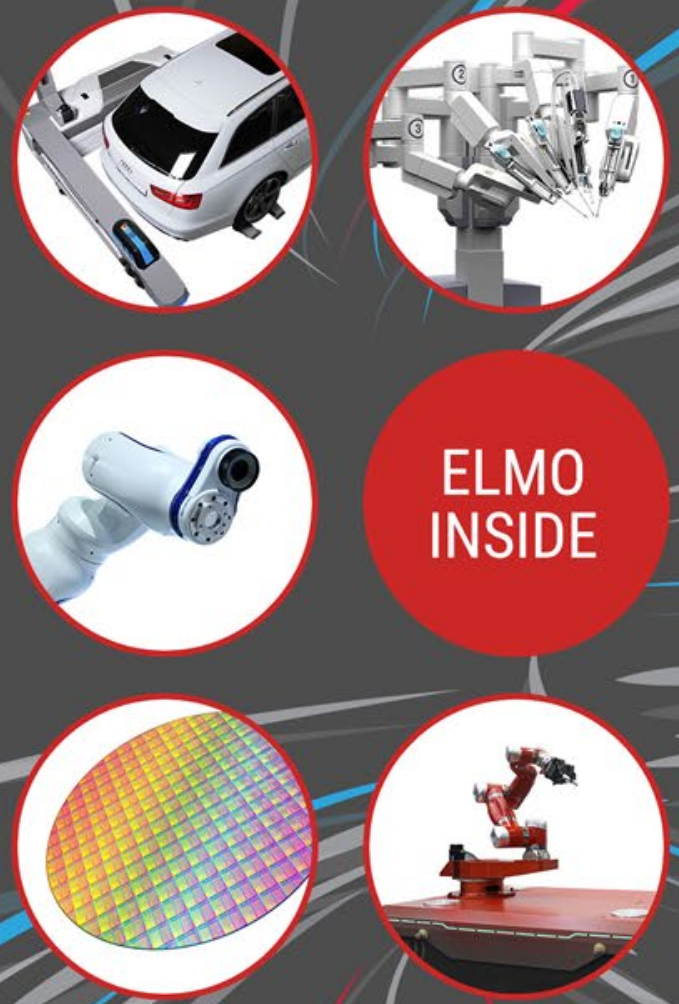
Elmo
Motion Control

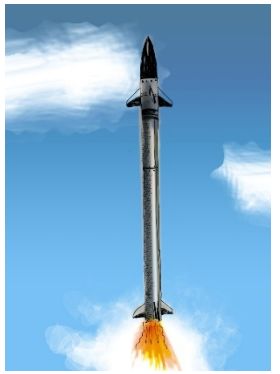
ELMO MOTION CONTROL

Company Overview

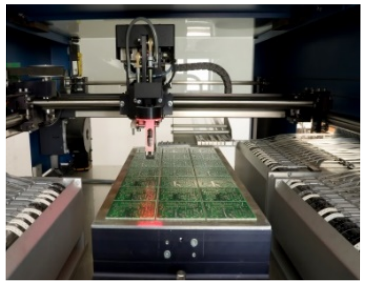


Any Application, Any Environment

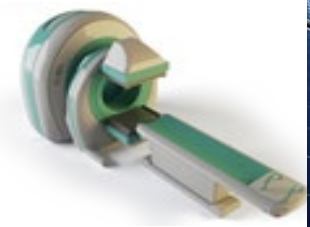
We are Elmo.
Over 3.5 Million Servos Installed

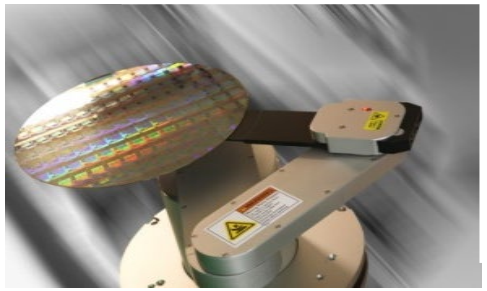













30 Years of Innovation

- Inspiring motion since 1988
- Israeli HQ, designing, manufacturing & distribution
- Over 300 employees including more than 70 R&D engineering
  experts focused on developing advanced products and applications
- Vast Global presence with manufacturing facilities in Israel and the EU

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From Start to Finish

To better meet the challenges and to respond to our customers needs,

We are in charge of the whole product chain:

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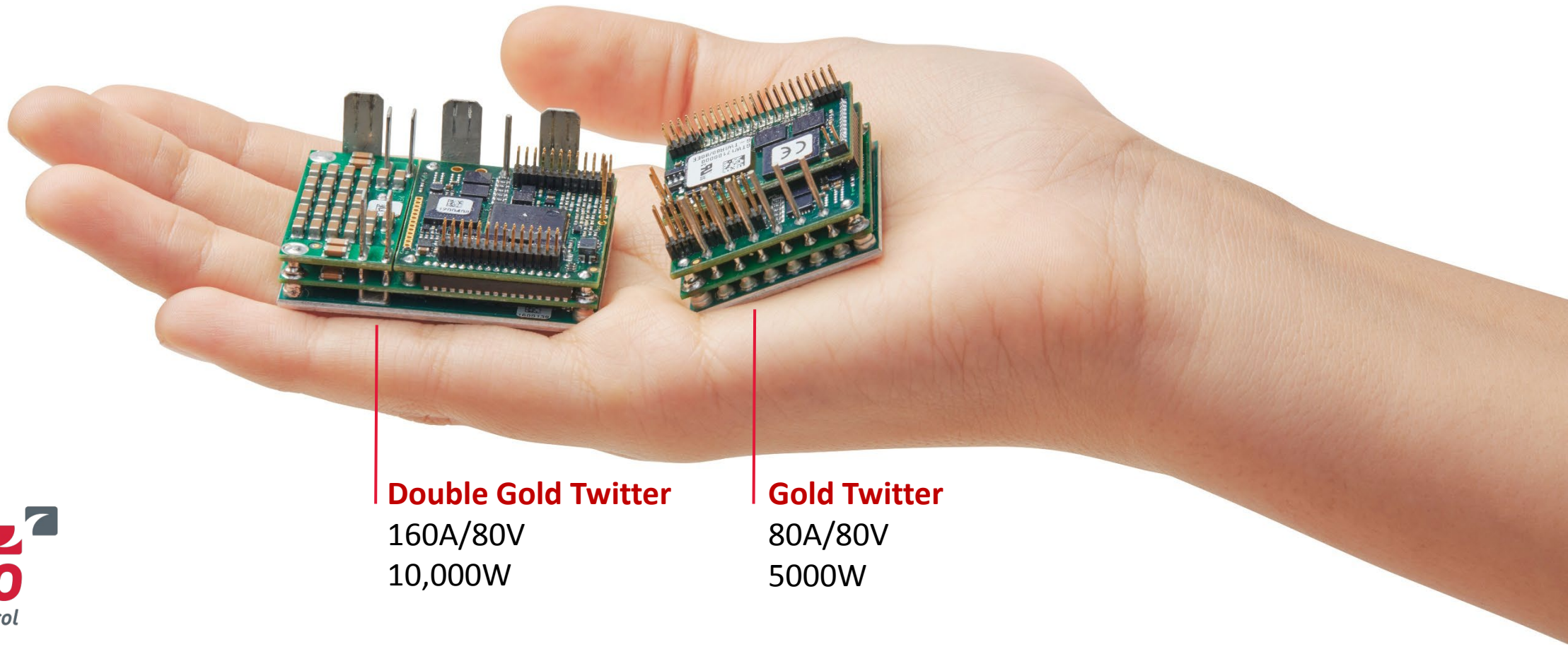
Where motion matters.

- ✓Printing
- ✓Machine tools
- ✓Medical equipment
- ✓Semiconductors
- ✓Solar
- ✓Electronics
- ✓Lab Automation
- ✓Unmanned vehicles
- ✓Military & Aerospace
- ✓Robotics
- ✓Packaging
- ✓Wood processing
- ✓Material handling
- ✓Navy & Avionics
- ✓Sorting

We’re known for size and power density… but …



Double Gold Twitter
160A/80V
10,000W

Gold Twitter
80A/80V
5000W

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There is much more

*Best results with Any Servo Load *Wide bandwidth >4.5 KHz **fast & accurate PI Vector Control *Safety Feedback, Advance commutation (>3KHz) *Smart Phase advancing *High current dynamics 2000:1 *60us current loop *Current Loop Gain Scheduling *60us Velocity loop *Velocity Loop Gain Scheduling *60us Position loop *Position Loop Gain Scheduling *Selectable 1:1:1 or 1:2:2 Servo control *60us Velocity loop *60us Position loop *High order filters on different control loop segments *Low Pass filters *High Pass filters *Notch and Anti-Notch filters *Lead lag filters *Filters on references

*Functional Safety (IEC 61800-5-2 , SIL-3): STO, SOS, SLS, SS1, SS2, SLT, SBC, SLA, SAR…*FIR *Glitch *LPF *High order general bi quad filters *Scheduled filters *Unlimited Control Numerical values *Automatic calibration Procedures*Commutation alignment*Phase sequencing *Current loop *offset adjustment *Current loop gain tuning *Current gain scheduling *Velocity loop offset adjustment *Velocity gain tuning*Velocity gain scheduling *Position gain tuning * and much servo capabilities *Any Feedback on the market support *Absolute serial * incremental Quadrature *Incremental Quadrature + Halls

*Digital Halls only *Analog Halls (single turn sin- cos) *Serial Single and Multi Turn *Resolver with wide frequencies support *Analog Sin-Cos Encoder *8192 Internal multiplier *reaching 500,000,000 counts/ revolution *SAFE I/O *Encoder Emulation outputs *PWM (Pulse Width Modulation)

Emulation, Quadrature Emulation *Current and velocity PWM Emulation *Wide reference inputs *Quadrature reference

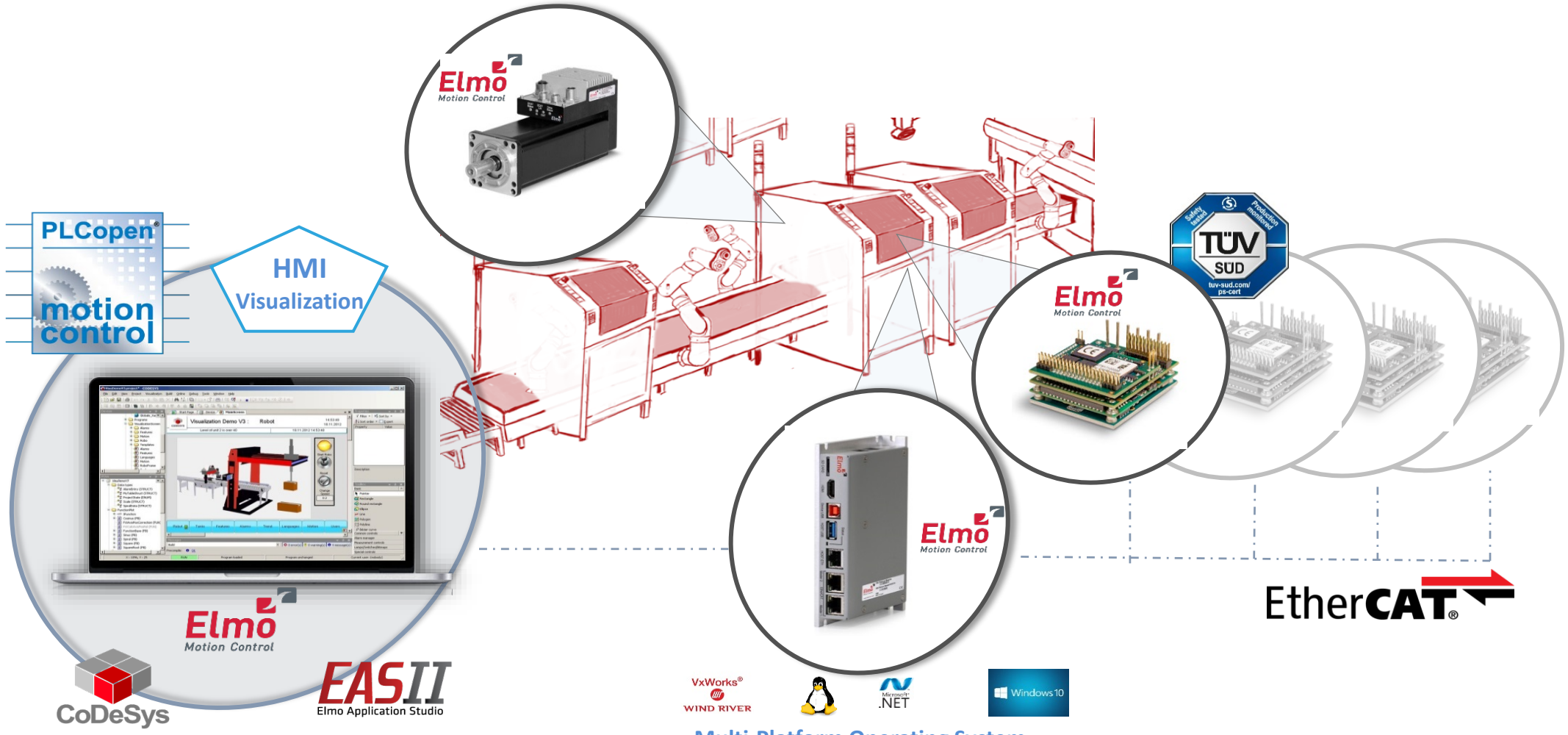
*Pulse & Direction reference, CW/CCW reference, 50/100% PWM reference *PL-e, CAT-4 (ISO 13849) *Advance Real Time Programming Environment *Full Redundancy *Elmo proprietary programing language *ECAM *1D Error correction *Output Compare *Master-Slave Follower *Modulo *Dynamic "electronic" Braking *Dual Loop*MIMO Gantry* Planar Motor * PWM Follower* Fast Event Capture Inputs

*Wide Homing methods *two advanced independent motion profilers *2 Analog inputs supports current, velocity, position loop* "By the Book" standardized IEC61158 EtherCAT

Highest density of power and intelligence

Elmo Motion Control

Making Smart Machines Smarter



Multi-Platform Operating System

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Motion in Perfect Harmony

ONE harmonious orchestra creating perfectly tuned

and **coordinated motion control symphony**

Motion Symphony

EASII
the ultimate software tool for fast & easy motion implementation

Perfectly Tuned Servo Drives

Powerful, Smartest, Smallest & Simplest

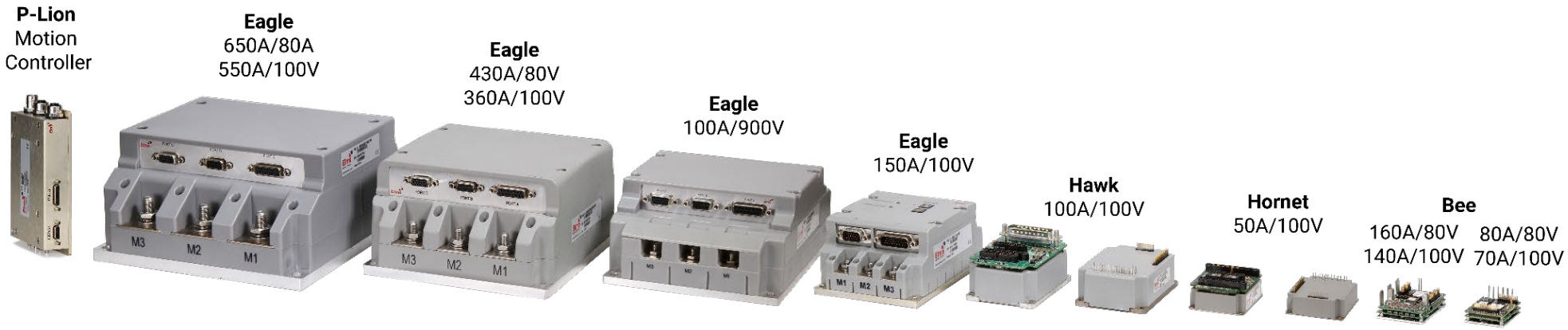
Brilliant Maestro

Advanced EtherCAT multi-axis controller

Elmo Motion Control

Out 10 Technology Commandments

- ✓ Perfect Servo & Motion Control
- ✓ Smallest & Lightest
- ✓ Ultra Efficient Power Conversion
- ✓ Highest Power & Intelligence Density
- ✓ Ruggedness
- ✓ Negligible EMI (Electro Magnetic Interferences)
- ✓ Utmost Reliability
- ✓ Easy to Integrate, Simple to Operate
- ✓ Precise & Efficient Networking
- ✓ Top Safety.



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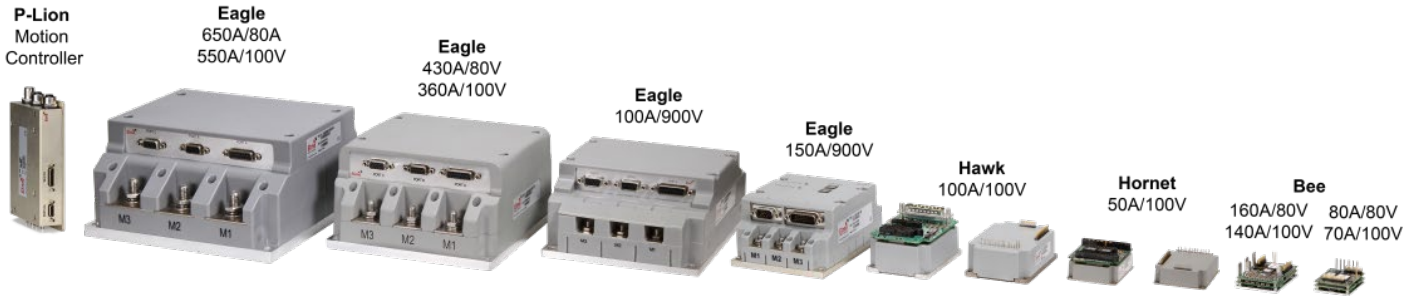
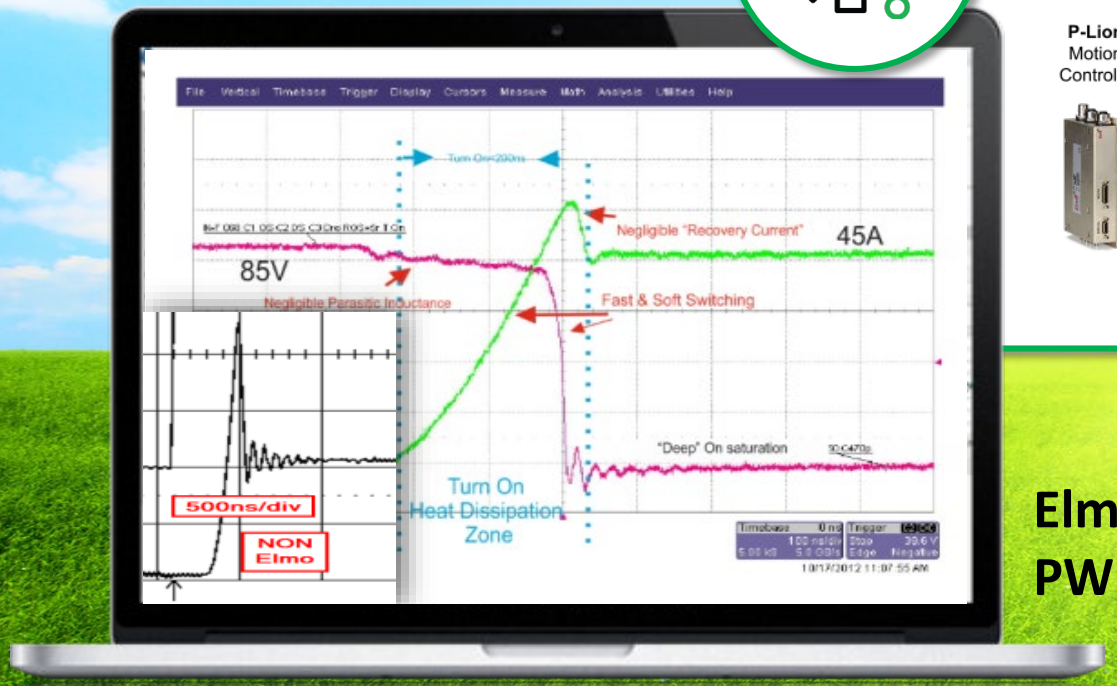
Ultra Efficient

Green Motion Control

With ultra Efficient Power Conversion

Elmo servo drives are **99% efficient** in power conversion |**Minimal heat** generated| **Minimal EMI** |





Elmo's proprietary FASST PWM switching technology

Multi Axis Motion Controller over EtherCAT for any Machine

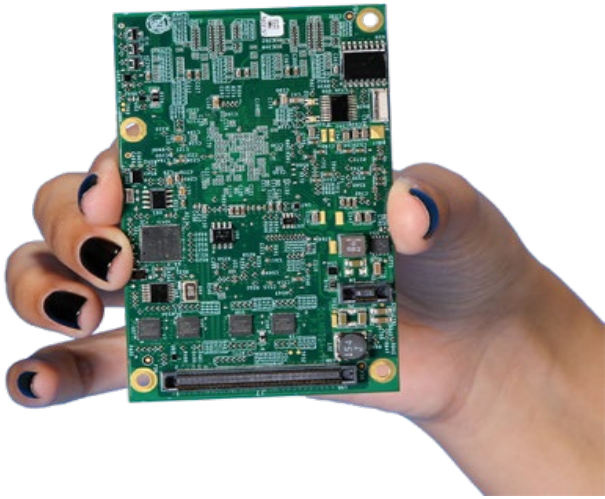
Gold Maestro

P-MAS I/O

Platinum Maestro

P-Lion

P-BLM P-MAS Board level (embedded)



Multi Axis Motion Controller over EtherCAT for any Machine

*__Communication from any host type.__ *Win32 API's. .NET API's. Linux API's. VxWorks API's. __*Standard Industrial Communication Protocols__ Modbus RTU. Ethernet/IP. __*User Defined Communication Protocols.__ Open TCP/IP and UDP protocols. __*Many Host Programming Environments.__ G-MAS PLCOpen 61131-3 IEC Programming. G-MAS Developer Studio GDS for C/C++ programming. Microsoft Visual Studio Programming. __*Advanced Elmo Motion Block Library (EMBL) support.__ Tens of *'Easy to Use and Implement'* Motion Blocks supported just a block drag away.*__EtherCAT Field Bus Communication.__ Full Ethercat Diagnostics tools. Full 'Network Health' user defined Error policies. Full support for Ethercat CoE DS402. Support for wide range of Ethercat IO's. Ethercat Drives 3rd party support. Ethercat EoE and FoE support. *__CANopen Field Bus Communication.__ CANopen network diagnostics. CANopen DS301 DS402 Support. CANopen DS401 IO Devices Support. CANopen DS406 CAN Encoder Devices Support. CANopen Virtual CAN Encoder Support. CANopen Gateway to Elmo Drives. __*Single Axis Motion.__ By the book PLCOpen motion standard. Huge Motion and Administrative Buffers. Simple Point-to-Point Motion. Full Jerk Support. Motion Blending. Virtual Axis Support. G-MAS Motion PVT and PT Table Support. G-MAS Superimposed Motion. Network Limits Support. G-MAS Motion In Target Monitoring. Advanced ECAM support. Advanced Position and Velocity Gearing Support. *__Multi Axis Motion.__ By the book PLCopen motion standard for Group Motion. G-MAS Group Coordinated Motions. G-MAS Coordinate Systems and Kinematics. Motion Blending. G-MAS Group Polynomial Motion Segments. G-MAS Group Motion PT and PVT Support. Spline Support. Network Group Limits (Safe Zones) Support. G-MAS Delta Robot support. G-MAS Scara Robot support. G-MAS 3 link Robot Support. G-MAS support for Flying Vision ™ . Tracking Conveyor Support. Tracking Rotational Table support. __*Advanced 1-D, 2-D and 3-D Real Time Error Correction support. *Advanced Hardware Core.__ Based on a Dual Core (2 × 1.5 GHz) processor system. Practically unlimited amount of Memories (both DRAM – 4GB and Flash – 4GB). User Flash Memory device support (Micro SD / USB Disk On Key). *__Enhanced Field Bus Support__ EtherCAT Master with Full redundancy support. EtherCAT Slave Network supporting for Network Bridging capabilities. *__More and Faster External Communication__ Fast Host 10/100/1000 (Giga Bit) Ethernet .USB Device connectivity (480 Mbps). USB 3 Host connectivity (5 Gbps).
*__HDMI connectivity *Flexible HW Connectivity.__ Serial ports encoders/ A2D / D2A __*RTC. * Industrial Version Grading available.__
__*Software Performance Enhancements__ Real Time, Multi-Core process optimization. Deterministic Real Time Programming, and Multi-Tasking for both IEC-61131-3 and C++. __*Up to 96 Axes.__
__* Network Cycle Update Rate.__ Up to 8 axes: at 100µs.

Elmo Motion Control

Elmo Application Studio (EAS)

Simplifying Motion

The Motion Interface that does it all

Simple multi axis motion implementations

Advanced tools for machine building, testing and performance enhancements

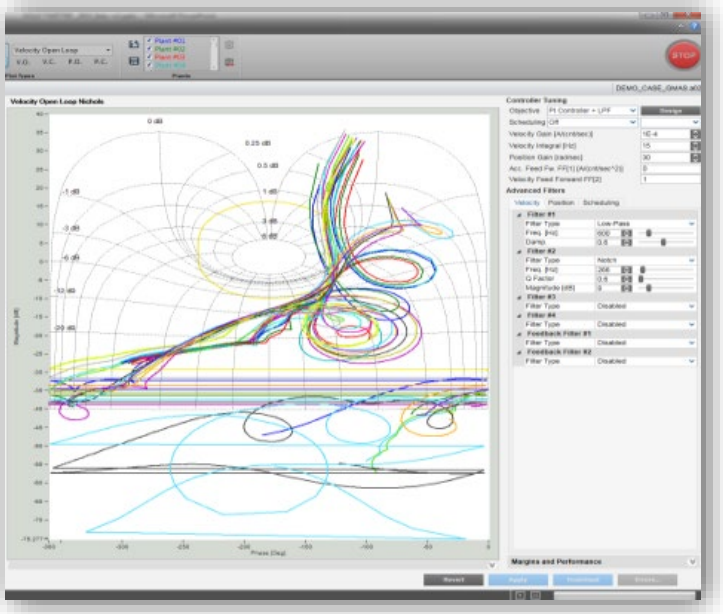
Visual 2D/3D tools for simulations and recording of profiles

Tools to **increase** machine **accuracy** and **throughput**

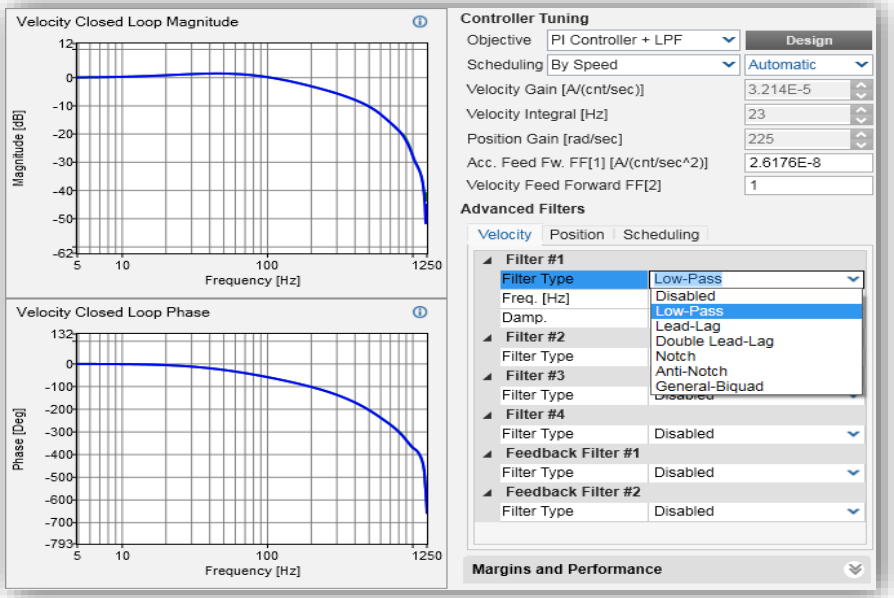
Saves time in setting up a system, and simulating, and commissioning a robot/machine

Advanced Tuning Tools

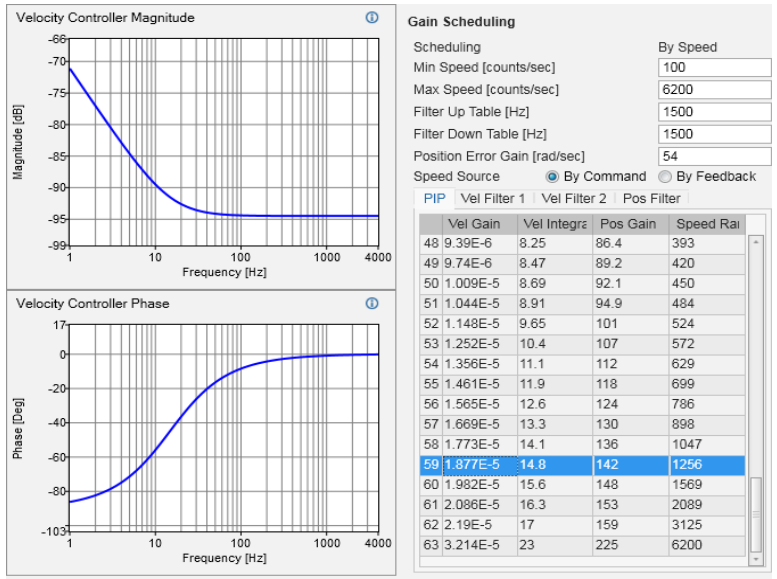
Enable manufacturers to achieve optimum performance at any position, with any load



Plant design



Filter design



Gain Scheduling

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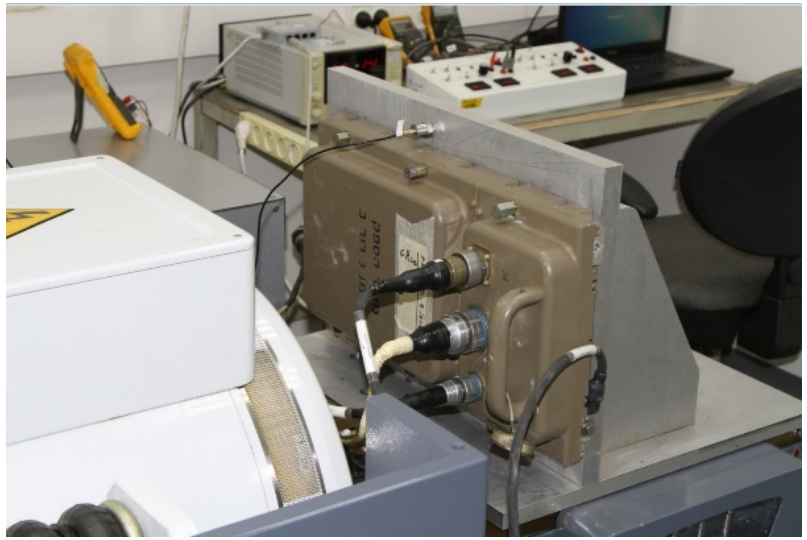
Qualification & Verification

Intensive Environmental, Safety and EMC testing according to the STDs

Elmo has “In house” capabilities to the perform most of the required tests.



Mechanical Vibration & Shock

Environmental Chambers, Cycles &Extreme Temperature

X Ray 4 Design & Manufacturing verification

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Standard Compliance

Functional Safety

The GOLD Line Servo Drives are the Smallest to comply to the STO (Safety Torque Off), SIL3 & Category 3, PL e,

Safe Torque Off (STO) Safety Standard	Item
IEC 61800-5-2:2007 SIL 3	Adjustable speed electrical power drive systems – Safety requirements – Functional
EN ISO 13849-1:2008 Cat 3, PL e	Safety of machinery — Safety-related parts of control systems.
EN 61508-1:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-2:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-3:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems

CERTIFICATE

No. Z10 13 08 84596 001

Holder of Certificate: Elmo Motion Control Ltd.
60 Amal St. P.O. Box 3078
49516 Petach-Tikva
ISRAEL

Factory(ies): 84596

Certification Mark:

Product: Safety Related Programmable Electronic

Model(s): Drive System GOLD LINE

Parameters: Safety Function: STO (EN 61800-5-2)
PL e, CAT 3 (EN ISO 1
SIL 3 (EN 61508)

Further approvals can be found in the report below.

Environmental Compliance

Specification	Details
Approved IEC60068-2-78	Environmental testing – Damp heat, steady state
Approved IEC60068-2-6	Environmental testing –Vibration (sinusoidal)
Approved IEC60068-2-2	Environmental testing – Dry heat
Approved IEC60068-2-27	Basic environmental testing procedures - Shock

Safety Compliance

The GOLD Servos meets the most severe STDs

Specification	Details
Recognized UL61800-5-1	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Approved IEC/EN 61800-5-1	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Conformity with CE 2006/95/EC	Low-voltage directive 2006/95/EC

EMC Compliance

Specification	Details
Approved IEC/EN 61800-3	Adjustable speed electrical power drive systems
In compliance with EN 55011 Class A with EN 61000-6-2: Immunity for industrial environment, according to: IEC 61000-4-2 / criteria B IEC 61000-4-3 / criteria A IEC 61000-4-4 / criteria B IEC 61000-4-5 / criteria B IEC 61000-4-6 / criteria A IEC 61000-4-8 / criteria A IEC 61000-4-11 / criteria B/C	Electromagnetic compatibility (EMC)
Approved IEC 61326-3-1	Electrical equipment for measurement, control and laboratory use. Standard required for STO.

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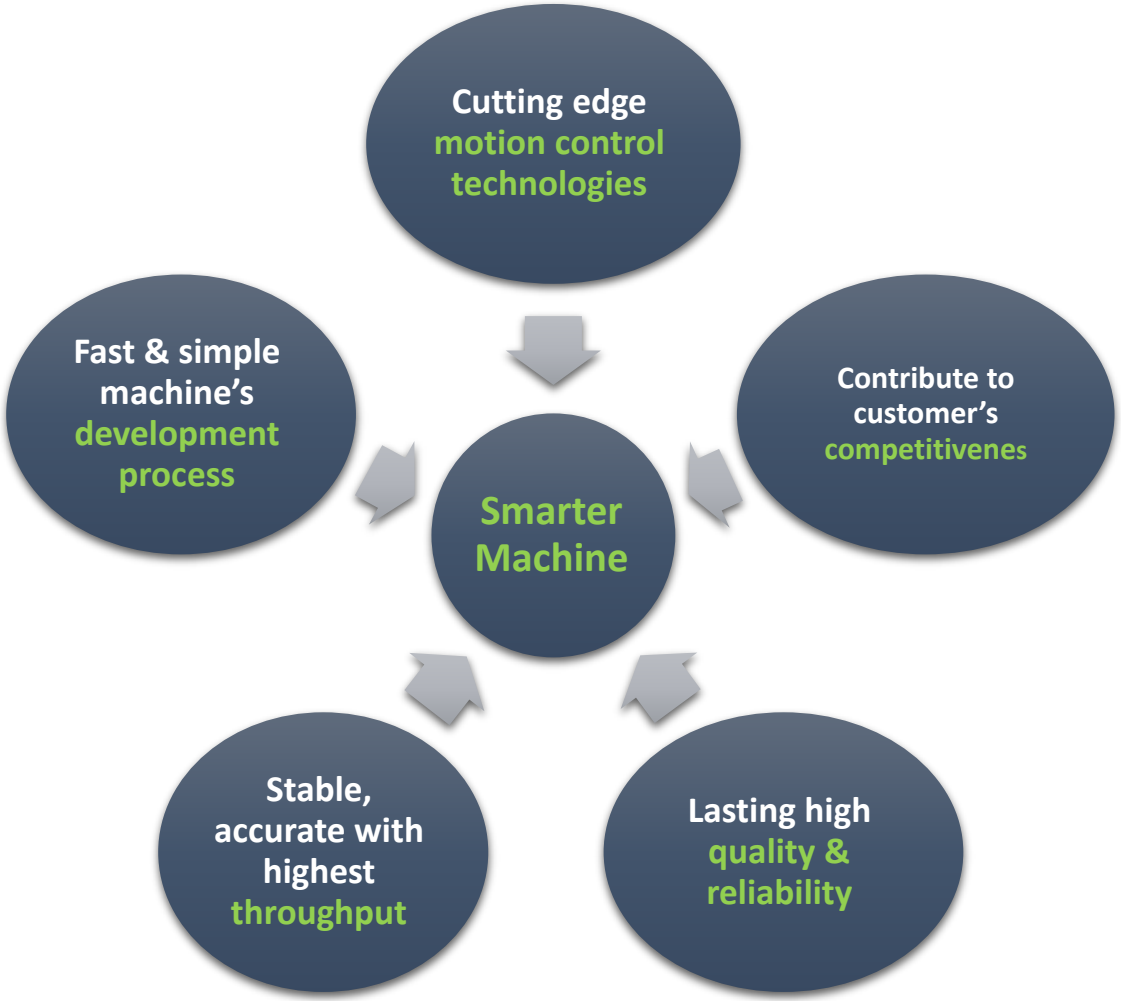
5 Commandments to for “Smarter Machine”



Some of our customers

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Coming Soon| Platinum Drive

Integrated Functional Safety
IEC 61800-5-2

Safety Feedback
3 ports for in/out, dual absolute encoder support

Safety I/O
SIL-3 PL-e, Safe brake output

THE ULTIMATE SERVO WITH THE BEST OF SAFETY

Safety over EtherCAT®

In compliance with:

SIL-3 : (IEC-61800-5-2, Functional safety of electrical safety related systems)
IEC-61800-5-2 Adjustable speed electrical power drive systems)

PL-e , CAT-4 : (ISO 13849, Safety of machinery, safety related parts of control systems)

*certificate pending

Elmo Motion Control

Coming Soon| Platinum Drive

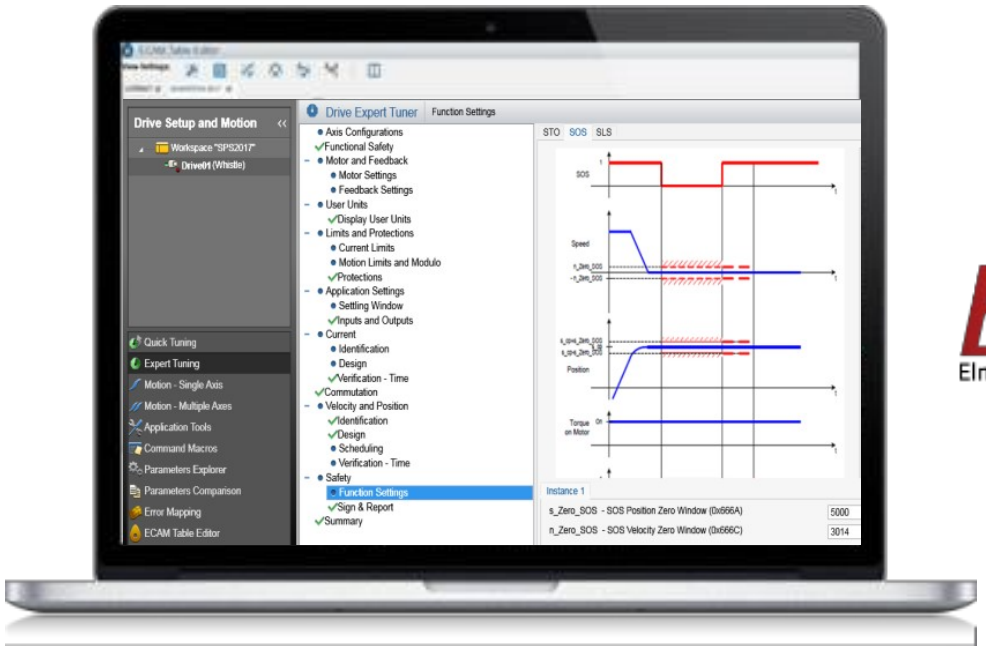
- Improved **Servo Performance**
- Faster **Processing**
- Enhancing System Capabilities: Faster Communications, Larger Memory, Enhanced Interfaces
- **FFS – Full Functional Safety**
- **Over EtherCAT network Safety (FSoE)**

Elmo Motion Control

Coming soon…

Fast & Simple Safety Implementation

The world's most advanced motion implementations software is now where you can **easily customize your robot's Functional Safety.**



SOS (Safe Operating Stop) Implementation

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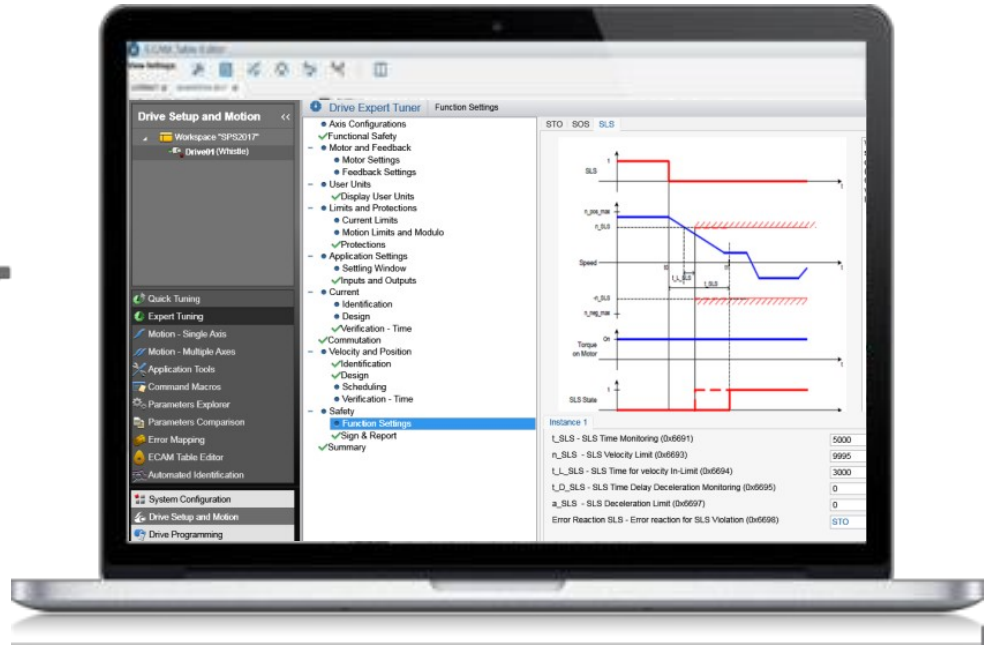

SLS (Safely Limited Speed) Implementation

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THANK YOU