

Class 5 SmartMotor™ Technology

*Delivering significant
industry advancements in
programmable integrated
servo systems*

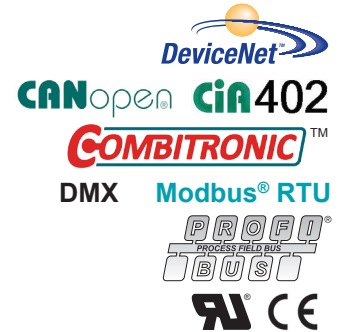


Advanced Programmable
SmartMotor with D-Style
Connectors



IP65 and Higher Industrial
SmartMotor with M-Style
Connectors

MOOG
ANIMATICS



Introducing **COMBITRONIC™** high-speed, transparent communications over CAN bus.

SMART The optional Combitronic™ technology uses a CAN serial port to join all SmartMotor™ servos where any motor's program can read from, write to or control any other motor simply by tagging a local variable or command with the other motor's CAN address. All SmartMotor™ servos become one multi-tasking, data-sharing system without writing a single line of communications code or requiring detailed knowledge of the CAN protocol.

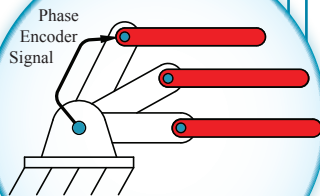
SMART This significant industry advancement allows any single axis to act as master to all other axes in the system. Each servo motor is capable of full access to and control of all motion parameters and I/O of all other servo motors. Any axis may trigger on inputs or status registers in any other axis with sub-millisecond response time, exceeding the abilities of most PLCs to control motion and I/O together. Now all SmartMotor servos on the network may freely act on system-wide conditions for efficient process control of the entire machine.

Advanced Class 5 SmartMotor Features Include:

Phase Adjust Mode

Enables applications (such as product tracking) where moves must be applied over a target in motion, automatically stabilizes pan & tilt applications, or allows arm end effectors to remain parallel to base while the mid arm section moves.

Phased origin stays referenced to base allowing commanded moves to be *dynamically* independent of the phase axis

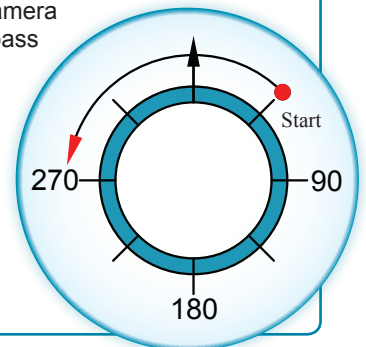


Modulo Count Mode

This is especially useful in rotary pan or azimuth controls for targeting systems, radar, and camera bases. Combined with the Combitronic interface, multi camera surveillance systems may easily pass off subject tracking from one pan & tilt to the next.

PML= 360 (Position Modulo Limit)
maintain counts between 0 and 359

PMT= 270 (Position Modulo Target)
take shortest path to Target Position

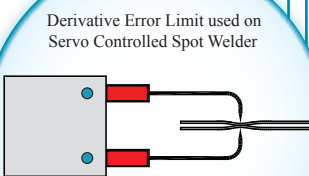


Derivative Error Limit

(Following error limit rate of change)

This feature quickly detects jams for safer operation, ensuring less chance of damage to equipment or injury to machine operators.

On contact with metal, the jaw stops immediately for minimal product deflection and maximum balance to each side

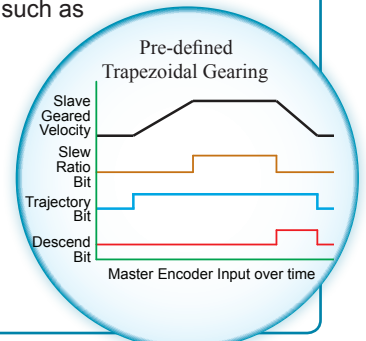


Expanded Electronic Gearing Functionality

Now includes separate, predefined Ascend, Slew and Descend distances defined by either master or slave encoder values for enhancing applications such as high-speed winders.

With an array of status bits available, all portions of the move may be used for I/O triggering

Automatic transitions in and out are ideal for high speed labeling applications



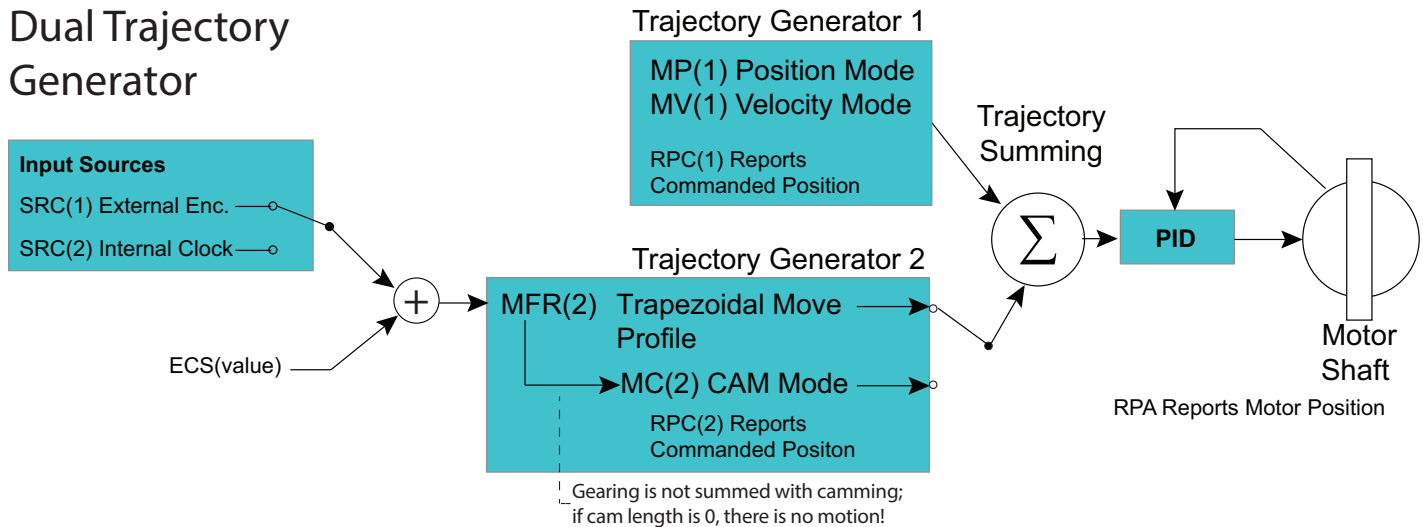
New in Class 5

Dual Trajectory Path Generators

The processor now has the ability to sum in Positioning, Velocity or Contouring Mode profiles on top of Electronic Gearing or Camming profiles.

This includes **Virtual Axis Gearing and Camming** where independent profiles may be run off of a virtual time base separate from Position or Velocity Modes or summed in on top of them.

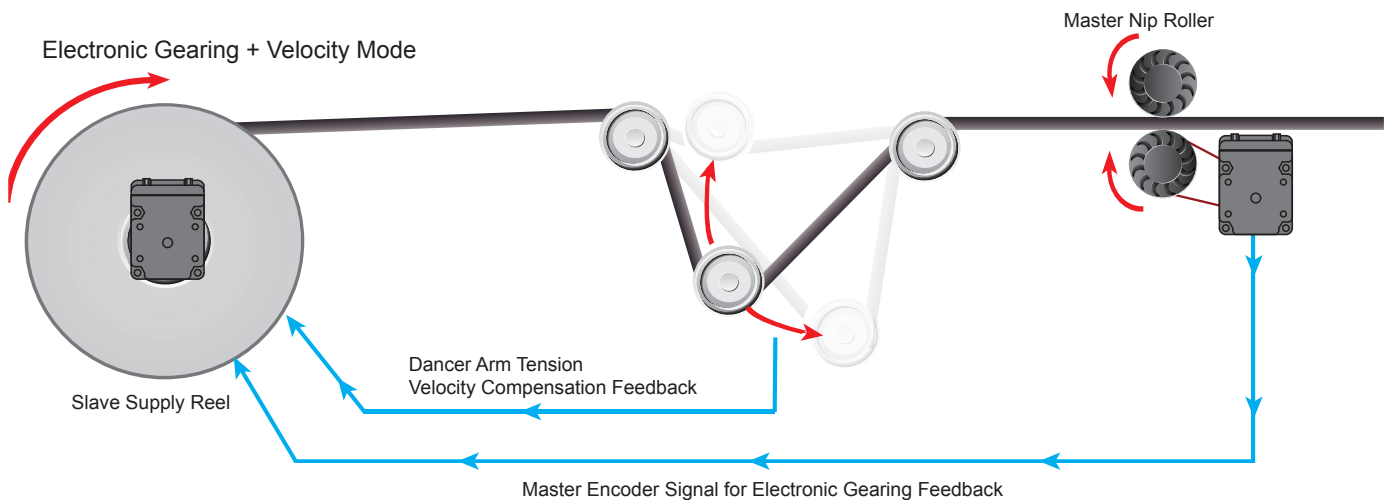
Dual Trajectory Generator



Example

Velocity Mode and Electronic Gearing Summed Together:

Electronic Gearing ensures instant response to master nip-roller speed, while Velocity Mode is controlled by the tension arm. The net effect provides *constant tension over the change in supply reel radius*.



Applications

- Carpet manufacturing
- Converting and flexible packaging
- Fiber optic cable
- Film (photographic, packaging)
- Filters
- Metals, including foils and sheet
- Newspapers
- Nonwoven textiles
- Packaging (rigid) including corrugators
- Paper
- Plastic sheet and film
- Printing (commercial)
- Roll flooring
- Solar cells and panels
- Tags and labels
- Tapes (adhesive)
- Textiles
- Rubber and tires
- Wallpaper
- Wire and cable

Combitronic technology operates over a standard “CAN” (Controller Area Network) interface but has no need for a dedicated master. Each Moog Animatics' SmartMotor servo connected to the same network communicates on an equal footing, sharing all information and, therefore, sharing all processing resources. An array of Moog Animatics' SmartMotor servos becomes one giant parallel-processing system when equipped with the Combitronic interface.

The only configuration prerequisites for Combitronic communications are that each axis has a unique address and baud rates match.

Further, Combitronic communications have been architected to coexist invisibly with CANopen and DeviceNet protocols. This means, for example, that an array of SmartMotor™ servos can be configured as slaves to an external CANopen master. Through Combitronic technology, they can still communicate with each other without detection by the CANopen master and without data collision.

The following code holds in a WHILE loop until the position of Motor 3 exceeds the position of Motor 4.

```
WHILE PA:3 < PA:4 LOOP 'Wait for Motor 3 to pass Motor 4
```

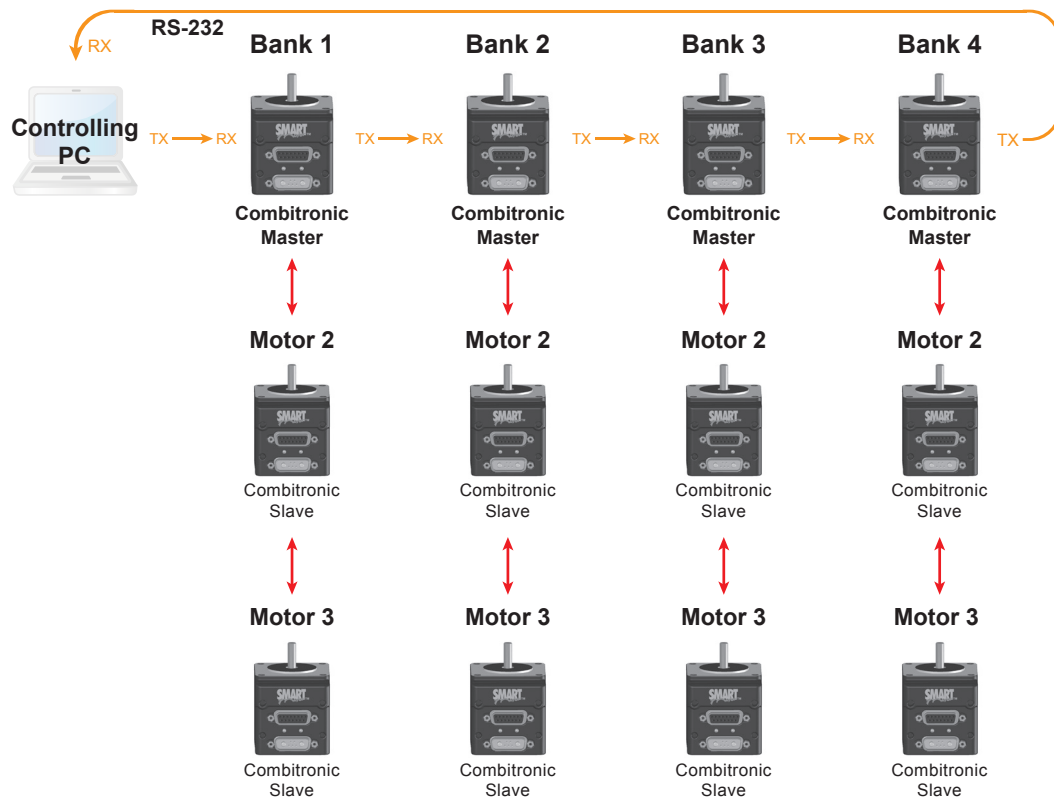
As shown, any single SmartMotor can actively grab dynamic data from one or more SmartMotors on the network as needed, without the need for code residing in the other SmartMotor servos.

The following IF condition stops motion if Motor 5 slows down.

```
IF VA:5 < 10000 'If real time speed in Motor 5 drops below 100000
  X 'Stop motion in this motor
ENDIF
```

Combitronic™ with RS-232 Interface

This configuration bypasses the need for a host CAN bus device or CAN bus interface for a PC, allowing standard RS-232 ASCII to control multiple motors. Combitronic technology allows pass-through communications between RS-232 and CAN bus.



```
2PT:3=1234 'Set Bank 2 Motor 3 target position
30:0=0 'Set origin to zero on all Bank 3 motors
1RPA:2 'Report Bank 1 Motor 2 actual position
0G 'Send Go command to RS232 motors only
2G:0 'Send Go command to all Bank 2 motors
0G:0 'Send Go command to all motors on all
```

Class 5 Specifications

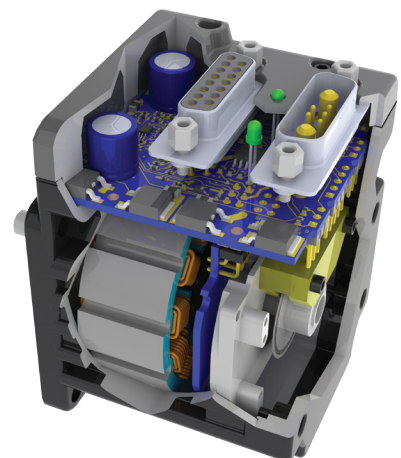
Power & Encoder		
Drive Power:	+20 – 48 VDC	
Control Power:	+20 – 48 VDC (must be supplied separately when DE option is ordered)	
Expanded I/O:	+24 VDC isolated (must be supplied)	
Commutation:	Trapezoidal (Default)	
	Enhanced Trapezoidal based on Encoder Position	
	Sinusoidal	
Encoder Resolution:	23 Frame: 4000 counts per revolution (Class 5)	
	34 Frame: 8000 counts per revolution (Class 5)	
Processor/Clocks:		
Processor Clock Speed:	32 MHz	
PWM Switching Frequency:	16 kHz	
CPU Regulator Frequency:	140 kHz ±10% load dependent	
Drive Stage Regulator:	100 MHz	
PID Update Rates:		
PID1:	16 kHz	62.5 μsec update rate
(Default) PID2:	8 kHz	125 μsec update rate
PID4:	4 kHz	250 μsec update rate
PID8:	2 kHz	500 μsec update rate
Programming:		
Code:	Command Interpretive Text Based	
Program:	32K Program/32K Data Storage	
Subroutines:	Up to 1000	
Stack Pointers:	10 Nested GOSUB() and/or Interrupt calls	
Communications:		
RS-232:	2400 to 115200 Baud	9600 Baud default
RS-485:	2400 to 115200 Baud	9600 Baud default
(Optional) CAN Bus:	20K to 1M Baud	125000 Baud default

Additional Features:

- Optional: 10 additional points of isolated 24V I/O source (up to 300 mA) that read both digital and analog signals
- New processor delivers program execution speeds that are five times faster than the previous generation of SmartMotors
- PID update rate is four times faster (reduced to 62.5 μ sec) and enables ultra-precise motion
- Communication speeds up to 115.2 kBd in both the RS-232 and RS-485 ports
- Optional CANopen (CiA 402) or DeviceNet (Profile 16 ODVA) communications with high speed contouring to sub-millisecond synchronization
- New sinusoidal commutation capability delivers smooth and quiet motion, even at low speeds
- Math operations with up to 64 characters on a single line, now includes floating point variables and trigonometric functions
- Eight (0-7) priority-stacked (0=highest), user-definable interrupts (can also interrupt regular code execution); four user-definable, independent timers
- Increased I/O interrupt assignments make registration applications a snap
- Software programmable limits can be used as programmable electronic cam switch triggers
- Enhanced parameter and function-based syntax
- Increased system status bit registers for advanced diagnostics

Modes of Operation:

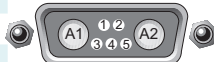
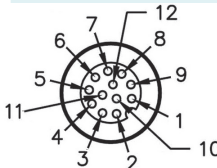
- Position Mode, 32-bit signed position register
- Velocity Mode, closed loop on position, not frequency
- Torque Mode, $\pm$ 16-bit resolution
- Gear Mode, 24-bit variable electronic gearing
- Cam Mode, cubic spline interpolated, dynamically scalable
- Contouring Mode (from host), fully capable for CNC applications
- Modulo Count Mode
- Electronic Camming



Class 5 Connector Pinouts

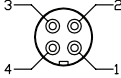
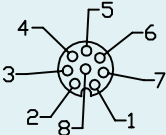
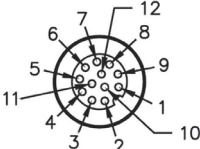
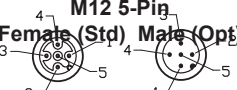
D-Style SmartMotor

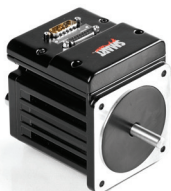


PIN	MAIN POWER	P1
1	I/O – 6 GP, Index Input or “G” Command	7W2 Combo D-Sub Connector 
2	+5 VDC Out	
3	RS-232 Transmit	
4	RS-232 Receive	
5	Common Ground (Typ. SIG Ground)	
A1	Main Power +20-48 VDC	
A2	Common Ground (Req'd POWER Ground)	
PIN	I/O CONNECTOR (5V TTL I/O)	P2
1	I/O – 0 GP or Encoder A or Step Input	P2 DB-15 D-Sub Connector 
2	I/O – 1 GP or Encoder B or Direction Input	
3	I/O – 2 Positive Overtravel or GP	
4	I/O – 3 Negative Overtravel or GP	
5	I/O – 4 GP, IIC or RS-485 A (Com Ch. 1)	
6	I/O – 5 GP, IIC or RS-485 B (Com Ch.1)	
7	I/O – 6 GP, Index Input or “G” Command	
8	Phase A Encoder Output	
9	Phase B Encoder Output	
10	RS-232 Transmit; For -CDS, CAN-L Only	
11	RS-232 Receive; For -CDS, CAN-H Only	
12	+5 VDC Out	
13	Common Ground (Typ. SIG Ground)	
14	Common Ground	
15	Main Power +20-48 VDC	
Note: I/O ports input impedance = 5 kohm (5 kohm pull-up resistor)		
PIN	CAN bus	P3
1	NC	M12 5-Pin Female 
2	+V	
3	-V (Ground, Not Common)	
4	CAN-H	
5	CAN-L	
PIN	Isolated 24 VDC I/O Connector	P4
1	I/O – 16 GP	M12 12-Pin Female End View 
2	I/O – 17 GP	
3	I/O – 18 GP	
4	I/O – 19 GP	
5	I/O – 20 GP	
6	I/O – 21 GP	
7	I/O – 22 GP	
8	I/O – 23 GP	
9	I/O – 24 GP	
10	I/O – 25 GP	
11	+24 Volts Input	
12	Ground-I/O (Not Common)	

M-Style SmartMotor



PIN MAIN POWER		P1
1	Control Power In	M16 4 Pin Male 
2	Chassis Ground	
3	Control, Com, I/O and Amplifier Ground	
4	Amplifier Power In	
PIN Communications Connector		P2
1	Control, Com, I/O and Amp Ground	M12 8-Pin Female End View 
2	RS-485 B, Com ch. 0	
3	RS-485 A, Com ch. 0	
4	Encoder A+ Input/Output	
5	Encoder B- Input/Output	
6	Encoder A- Input/Output	
7	+5 V Out	
8	Encoder B+ Input/Output	
PIN 24 V Isolated I/O		P3
1	I/O – 0 GP	M12 12-Pin Female End View 
2	I/O – 1 GP	
3	I/O – 4 GP	
4	I/O – 5 GP or Index	
5	I/O – 6 GP or “G” Command	
6	I/O – 7 GP	
7	I/O – 8 GP or Brake Line Output	
8	I/O – 9 GP	
9	Not Fault Out	
10	Drive Enable Input	
11	+24 Volts Out	
12	Ground Common	
Note: I/O ports input impedance > 10 kohm		
PIN 24 V I/O Connector		P4
1	+24 Volts Out	M12 5-Pin Female End View 
2	I/O – 3 GP -Limit	
3	Ground	
4	I/O – 2 GP +Limit	
5	I/O – 10 GP	
Note: I/O ports input impedance > 10 kohm		
PIN CAN Connector		P5
1	NC	M12 5-Pin Female (Std) Male (Opt) 
2	+V	
3	-V (Ground)	
4	CAN-H	
5	CAN-L	



- Advanced Motion Controller
- Motor
- Servo Drive
- Encoder
- Amplifier
- I/O
- Communication Busses



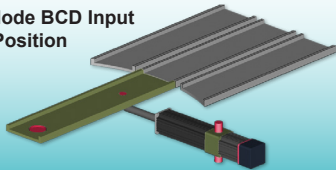
Below are some of the many applications that can use the SmartMotor

- Anode wire welding
- Automatic web tensioning/alignment*
- Auto-progression, adjusting parts indexers
- Audio/visual mobility*
- Bearing inserters/presses
- Capacitor manufacturing
- Cappers*
- Centrifuges
- CNC applications
 - CNC machining*
 - CNC training*
- Compression/tension testing
- Coordinate measuring machines
- Cut-to-length gage stops
- Dashboard controls (button/switch) testing
- Destructive testing
- Dicers
- Fillers
- Flexible tooling machines*
- Gimbal-mounted accelerometer testing
- Glass tube cutting
- Glue dispensers
- GPS-guided steering/drive control*
- High-accuracy, three-axis positioning*
- High-axis-count, coordinated motion*
- High-speed indexing labelers
- Hydroelectric turbine nozzle control
- Infeed/outfeed stackers
- Input/output stacker, wafer handling*
- Linear and rotary motion*
- Manual handwheel override
- Nut/bolt/screw drivers
- Pan & tilt bases*
- Paper feeders/folders
- Parts inspection and repositioning*
- Parts redirectors
- Phase gearhead adjusting
- Pick & place palletizers
- Plasma cutting*
- Positive displacement pumps
- Shock load testing
- Step/tapered spool winders
- Tactile switch testing
- Tire tread grinding
- Topographical mapping
- Transformer coil winders
- Turbine blade grinding
- Ultrasound testing*
- Vertical load control*
- Vision-guided laser marking*
- Vision inspection
- Voice coil winders
- Wafer handlers
- Web guide
- Web tensioning
- Wire bonding
- Woodworking*

* To read the case study or application note, visit www.animatics.com/applications

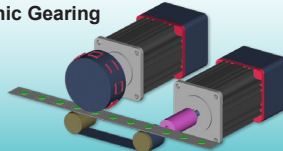
Three-Position Parts Diverter

Position Mode
BCD Input
Absolute Position
Mode



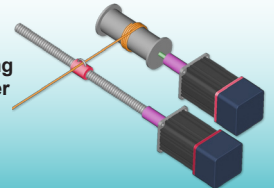
Print & Die Cut Alignment

Follow Mode with Phase
Offset Electronic Gearing



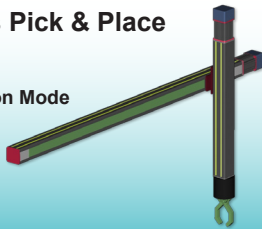
Traverse & Take-up Spool Winders

Velocity Mode &
Electronic Gearing
Summed Together



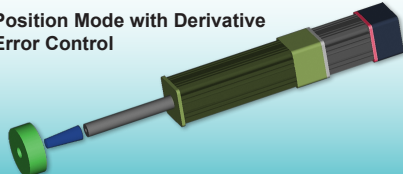
Multi-Axis Pick & Place

Position Mode
Absolute Position Mode



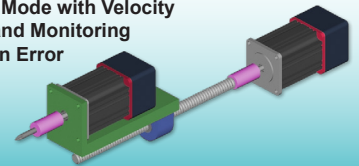
Programmable Force Press-to-Fit

Position Mode with Derivative
Error Control



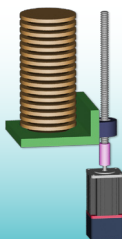
Drill & Tap/Nut Runner

Follow Mode with Velocity
Mode and Monitoring
Position Error



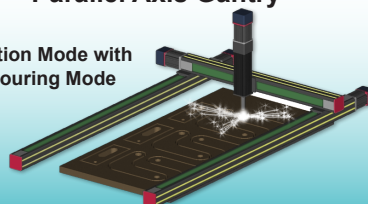
Input/Output Stacker

Position Mode
Absolute Position Mode
Relative Position Mode



Parallel Axis Gantry

Position Mode with
Contouring Mode



High-Speed Parts Counter & Verification

Velocity Mode or Follow
Mode with High-Speed
Counter Input

