



# Class 5 SmartMotor™ Technology

*Delivering significant industry  
advancements in programmable  
integrated servo systems*



CANopen CiA402



## 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, write or control any other motor simply by tagging a local variable or command with the other motor's CAN address. All SmartMotor™ units become one multi-tasking, data-sharing system without writing a single line of communications code or requiring detailed knowledge of the CAN protocol.

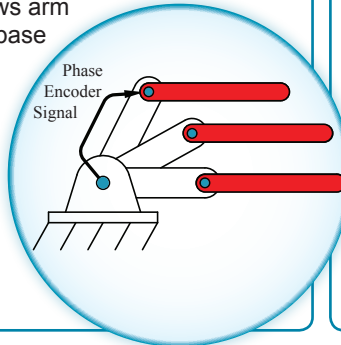
**SMART** This significant industry advancement allows any single axis to act as master to all other axes in the system, with each servo motor being capable of full access to and control of all motion parameters and I/O of all other servo motors. Any axis may trigger on inputs or status registers in 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 upon system wide conditions for efficient process control of the entire machine design.

## 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

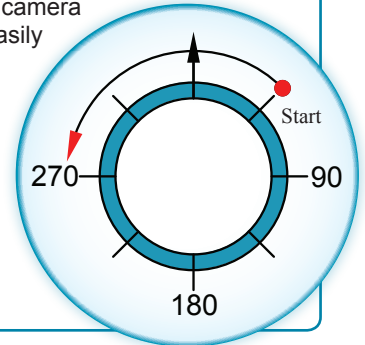


### Modulo Count Mode

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 more 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

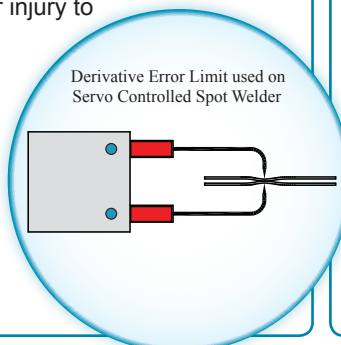


### Derivative Error Limit

(Rate of change of following error limit)

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

Jaw stops immediately upon making contact with metal for minimal product deflection and maximum balance to each side

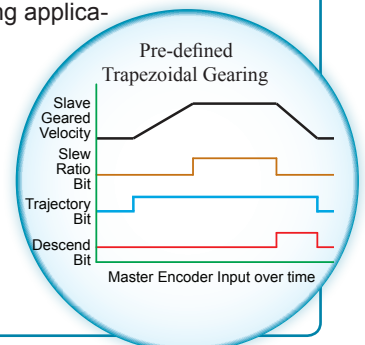


### Expanded Electronic Gearing Functionality

Now includes separate Ascend, Slew and Descend pre-defined distances that may be defined off of 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.

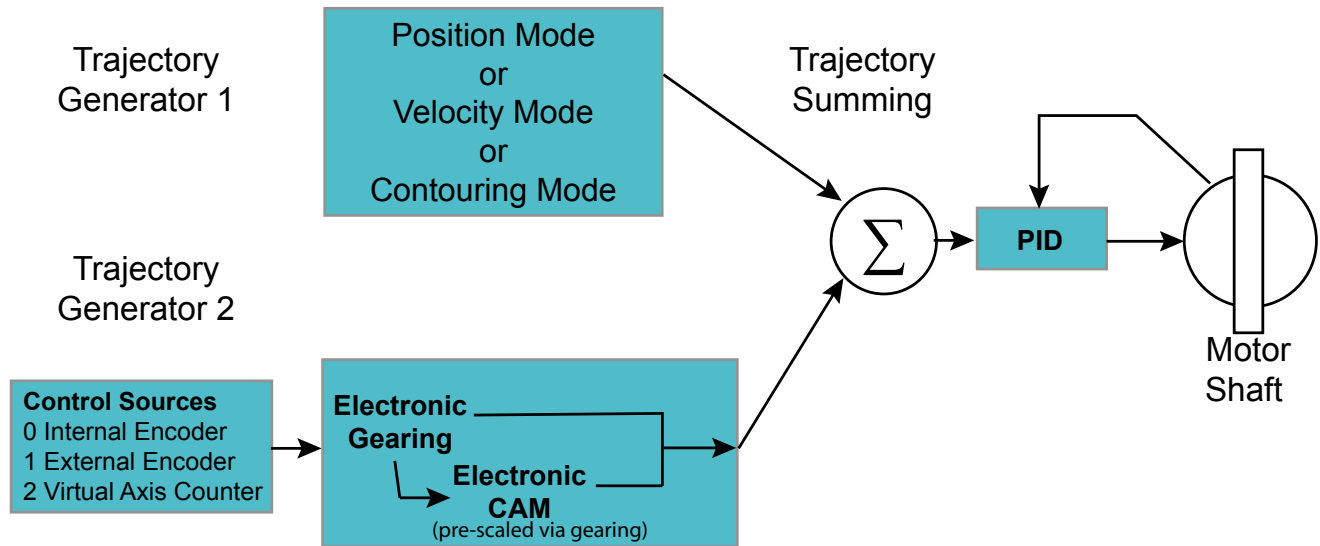
Automatic transitions in and out are ideal for high speed labeling applications



## New in Class 5: Dual Trajectory Path Generators

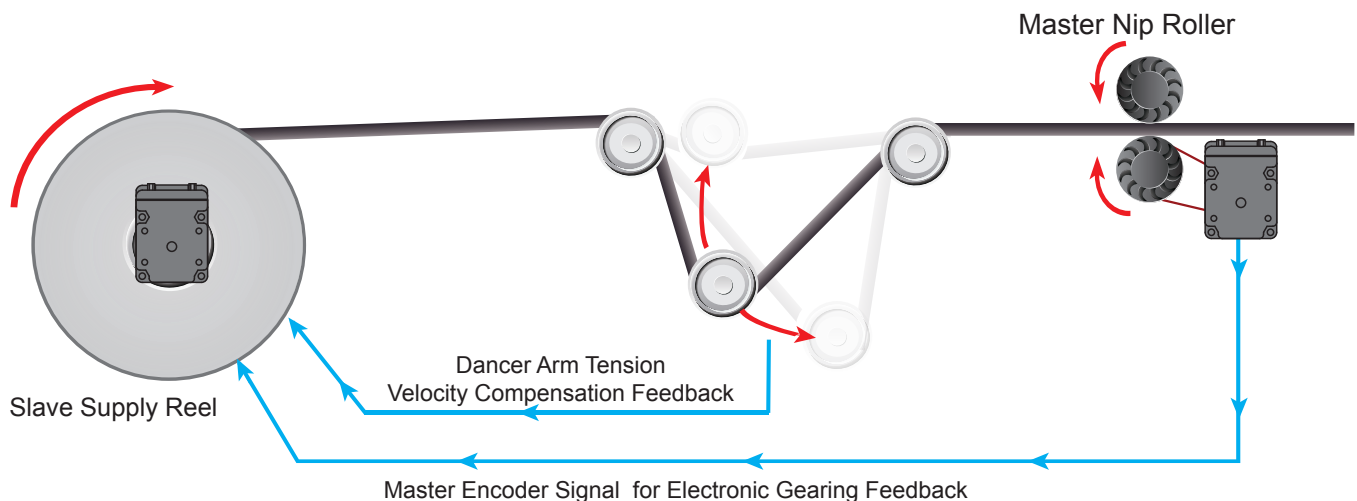
The processor now has the ability to sum in Positioning, Velocity, or Contouring Mode profiles on top of Electronic Gearing or Camming profiles.

This also included 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.



## 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 is assurance of constant tension over the change in supply reel radius.



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

The only prerequisites for setting up Combitronic communications is to ensure each axis has a unique address and baud rates match.

Combitronic communications have further been architected to coexist invisibly with CANopen and DeviceNet protocols. This means that an array of SmartMotor™ servos can be set up as slaves to an external CANopen master, for example, and still be communicating with each other while the additional communications go undetected by the CANopen master without data collision.

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

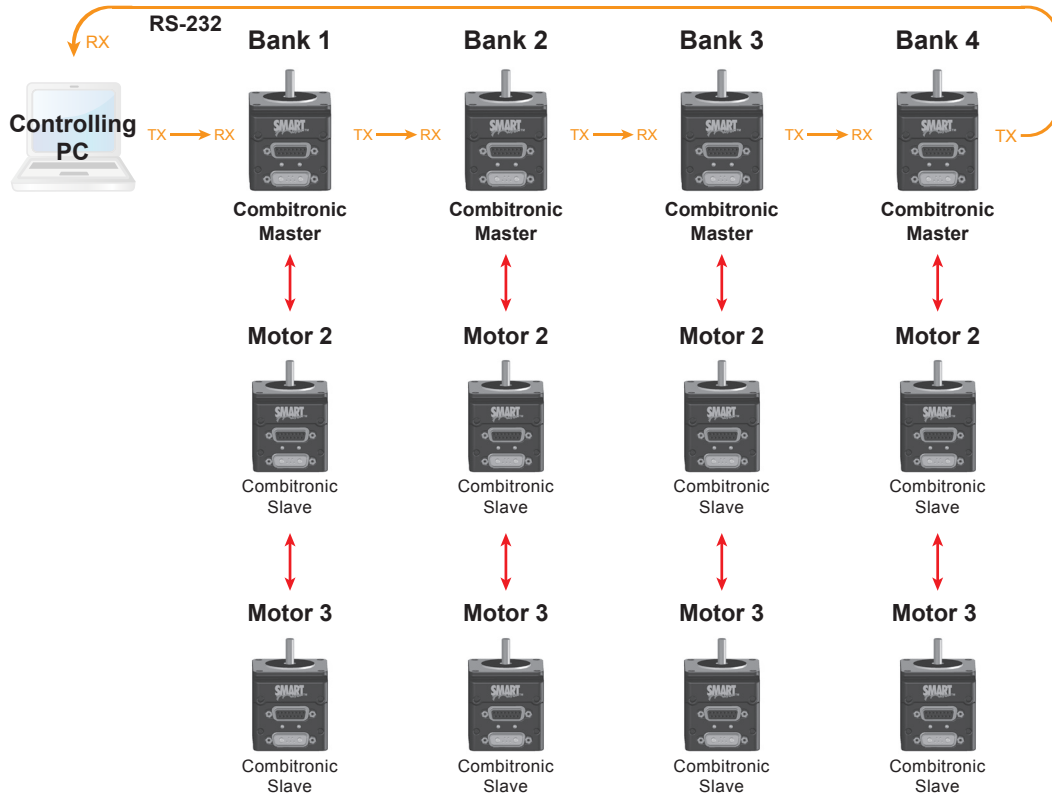
```
WHILE PA:3 < PA:4 LOOP      'Wait for Motor 3 to pass Motor 4
```

As can be seen, any single Animatics servo can now actively grab dynamic data from one or more servos on the network as needed, without the need for code residing in the other SmartMotor servos. The IF condition below 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 positon
30:0=0          'set origin to zero on all Bank 3 motors
1RPA:2         'report Bank 1 Motor 2 actual position
OG             'Send Go command to RS232 motors only
2G:0          'Send Go command to all Bank 2 motors
OG:0          'Send Go command to all motors on all
```

# Class 5 Specifications



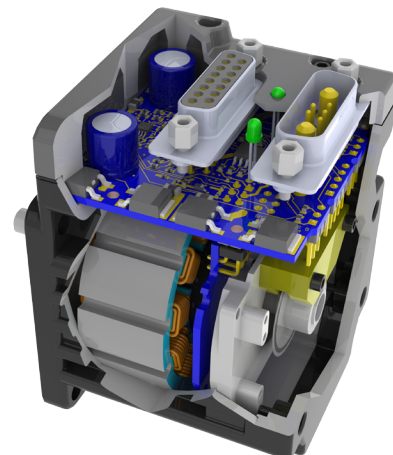
Power & Encoder		
Drive Power:	24-48VDC	
Control Power:	24-48VDC (must be supplied separately when DE option is ordered)	
Expanded I/O:	24VDC isolated (must be supplied)	
Commutation:	Trapezoidal (Default) Enhanced Trapezoidal based on Encoder Position Sinusoidal	
Encoder Resolution:	23 Frame: 4000 counts per revolution (Class 5) 34 Frame: 8000 counts per revolution (Class 5)	
Processor/Clocks:		
Processor Clock Speed:	32MHz	
PWM Switching Frequency:	16KHz	
CPU Regulator Frequency:	140KHz +/-10% load dependant	
Drive Stage Regulator:	100MHz	
PID Update Rates:		
PID1:	16KHz	62.5 $\mu$ sec update rate
(Default) PID2:	8KHz	125 $\mu$ sec update rate
PID4:	4KHz	250 $\mu$ sec update rate
PID8:	2KHz	500 $\mu$ sec update rate
Programming:		
Code:	Command Interpretive Text Based	
Program:	32K Program/32K Data Storage	
Subroutines:	up to 1000	
Stack Pointers:	10 deep for GOSUB RETURNS 10 Deep for Nested SWITCH statements 10 Deep for Nested WHILE Statements 3 Deep for Nested Trig Functions	
Communications:		
RS-232:	9600 to 115200 Baud	9600 default
RS-485:	9600 to 115200 Baud	9600 default
(Optional) CAN Bus:	125K to 1MBaud	125000 default

## Additional Features:

- Optional: 10 additional points of isolated 24V I/O source up to 300mA and read both digital and analog signals
- New processor delivers 5 times faster program execution speeds than previous generation SmartMotors™
- 4 times faster PID update rate (down to 62.5 $\mu$ sec) enables ultra precise motion
- Communication speeds up to 115.2 KBaud in both the RS-232 and RS-485 ports
- Optional CANopen (CiA 402) communications with high speed contouring to sub-millisecond synchronization
- New sinusoidal commutation capability delivers smooth and quiet motion, even at low speeds
- Up to 128 character math operations on a single line, now including floating point variables and trigonometric functions
- 8-level priority stacked user-definable interrupts and 4 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

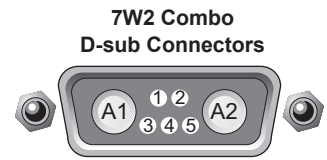
## Modes of Operation:

- Position Mode, 32-bit signed position register
- Velocity Mode, closed loop on position, not frequency
- Torque Mode, +/- 10-bit resolution
- Gear Mode (24-bit variable electronic gearing)
- Step/Direction Mode (24-bit variable step ratio)
- Contouring Mode (from Host) fully capable for CNC applications
- Modulo Count Mode

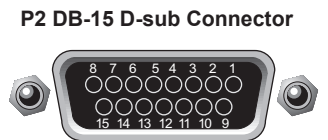


# Class 5 Connector Pinouts

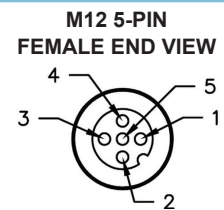
PIN	MAIN POWER	Specifications:	P1
1	I/O – 6 “G” command or GP	25mAmp sink or source 10Bit 0-5VDC A/D	Redundant connection on I/O connector
2	RS-232 Transmit	50mAmps max	
3	RS-232 Transmit	Com(0)	115.2KBaud max
4	RS-232 Transmit	Com(0)	115.2KBaud max
5	RS-232 Ground		
A1	Main Power: +20-48VDC		
A2	Ground		



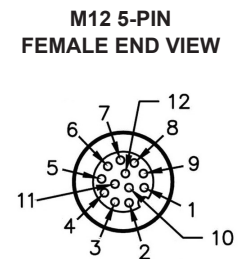
PIN	I/O CONNECTOR (5VTTL I/O)	Specifications:	P2
1	I/O – 0 GP or enc. A or step input	25mAmp sink or source 10Bit 0-5VDC A/D	1.5MHz max as enc or step input
2	I/O – 1 GP or enc. B or dir. input	25mAmp sink or source 10Bit 0-5VDC A/D	1.5MHz max as enc or dir. input
3	I/O – 2 Positive over travel or GP	25mAmp sink or source 10Bit 0-5VDC A/D	
4	I/O – 3 Negative over travel or GP	25mAmp sink or source 10Bit 0-5VDC A/D	
5	I/O – 4 GP or RS-485 A Com(1)	25mAmp sink or source 10Bit 0-5VDC A/D	115.2KBaud max
6	I/O – 5 GP or RS-485 B Com(1)	25mAmp sink or source 10Bit 0-5VDC A/D	115.2KBaud max
7	I/O – 6 “G” command or GP	25mAmp sink or source 10Bit 0-5VDC A/D	Redundant connection on Main Power Connector
8	Phase A encoder output		
9	Phase B encoder output		
10	RS-232 transmit com(0)		115.2KBaud max
11	RS-232 transmit com(0)		115.2KBaud max
12	+5VDC out	50mAmps max	
13	Ground		
14	Ground		
15	Main Power: +20-48VDC	IF-DE option, control power separate from main power	



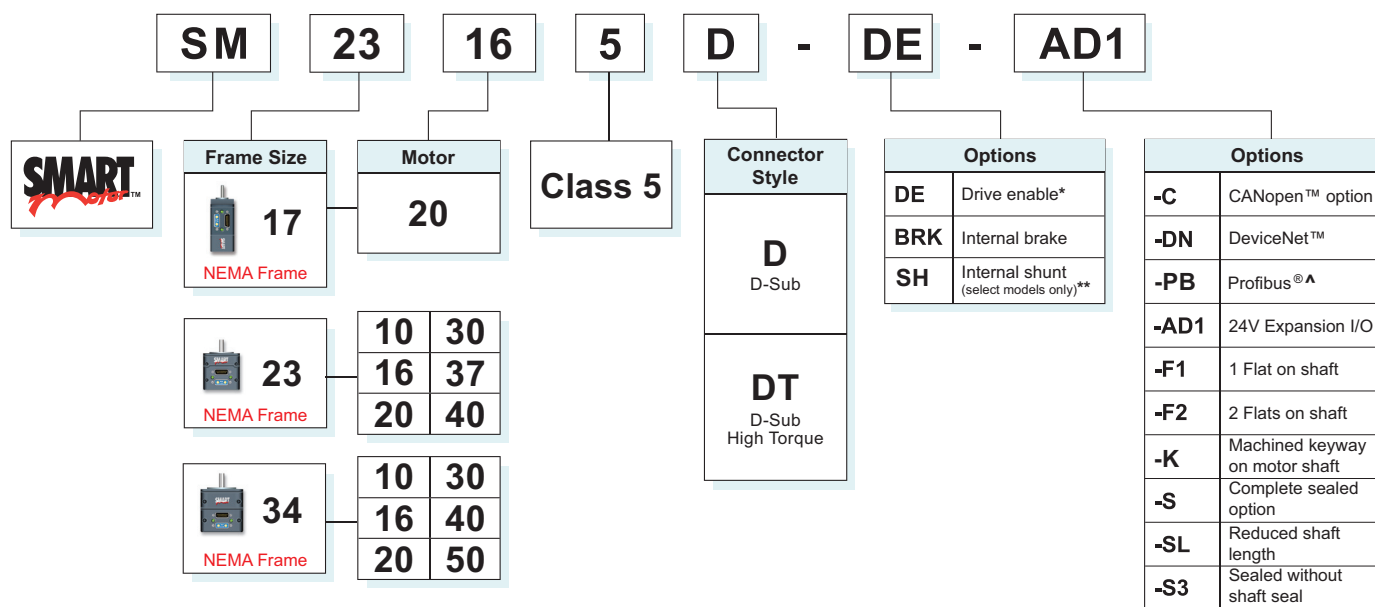
PIN	GND-I/O	Connection:	P3
1	NC	NC	
2	NC	NC	
3	GND_CAN	Isolated CAN ground	
4	CAN-H	1M Baud max	
5	CAN-L	1M Baud max	



PIN	Isolated 24VDC I/O Connector	Max Load (sourcing)	P4
1	IO – 16 GP	150mAmps	
2	IO – 17 GP	150mAmps	
3	IO – 18 GP	150mAmps	
4	IO – 19 GP	150mAmps	
5	IO – 20 GP	300mAmps	
6	IO – 21 GP	300mAmps	
7	IO – 22 GP	300mAmps	
8	IO – 23 GP	300mAmps	
9	IO – 24 GP	300mAmps	
10	IO – 25 GP	300mAmps	
11	+24Volts input		
12	GND-I/O		



## Animatics Class 5 SmartMotor™ Part Numbering Guidelines



\* Separate drive & control power

<sup>^</sup> Profibus option only available on SM23165D & SM23165DT products and without brake or 24V I/O

\*\* SM34165D & SM34165DT are the only models that can have an internal shunt.

## Animatics Class 5 SmartMotor™ Available Option Combinations

NEMA 17 FRAME	BRAKE	24VIO	CAN bus
	-BRK	-AD1	-C or -DN
SM17205D			•
		•	
		•	•
	•		

NEMA 34 FRAME	BRAKE	24VIO	CAN bus
	-BRK	-AD1	-C or -DN
SM34165D** SM34165DT** SM34105D SM34205D SM34305D SM34405D			•
		•	
		•	•
	•		
	•		•
	•	•	•

\*\*SM34165D & SM34165DT are the only models that can have an internal shunt.

NEMA 23 FRAME	BRAKE	24VIO	CAN bus
	-BRK	-AD1	-C or -DN
SM23165D SM23165DT			•
		•	
	•	•	•
SM2337D SM2337DT SM23105D SM23205D SM23305D SM23405D			•
		•	
		•	•
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	•		•
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