SPiiPlus HP Series
High Performance Motion Controllers

ACS MotionControl
Your Competitive Advantage

SPiiPlus CM-3 comprehensive motion control solution for three axes

SPiiPlus CM is part of the SPiiPlus line of motion control products & software tools

SPiiPlus CM

High Performance Multi-axis Motion Controllers with Integrated Digital Drives

SPiiPlus motion controllers and control modules deliver uncompromised accuracy and throughput for the most demanding applications. SPiiPlus products are widely used in the semiconductor manufacturing and inspection, electronic assembly and testing, medical imaging, and advanced digital printing industries.

The SPiiPlus CM (Control Module) combines a programmable motion controller, power supply, and up to three digital drives into a single standalone package. Each integrated digital drive is software configurable for AC servo/DC brushless, or DC brush motors. By implementing an HSSI network, together with DC brush or external stepper (indexer) drives and motors, the number of controlled axes can be increased to eight.

Digital drive supply voltages range from single phase 90Vdc -125Vdc, 100Vac -240Vac, three phase 230Vac (ph-ph) or the low voltage option 24Vdc to 120Vdc, 19Vac to 85Vac.

The SPiiPlus CM also supports both Sin-Cos and high-speed incremental encoders. An optional 4x to 65,536x internal programmable multiplier is available for any axis with Sin-Cos feedback.

The SPiiPlus CM can operate as a standalone module, or connected to a host computer. The RS-232 and RS-232/422 serial port protocols are supported, as well as Ethernet 10/100 BaseT. All ports can be used simultaneously.

The SPiiPlus CM features a versatile implementation of general purpose I/Os. Digital inputs can be used for hardware-based position registration, and digital outputs can trigger position-based events with sub-microsecond delays. Special high-power outputs provide mechanical brake activation.

Complex applications are easy to develop with ACSPL+, a compiled, high-level true multi-tasking language, optimized for motion control applications. ACSPL+ enables implementation of highly complex motion-time-event sequences with accurate positioning and timing. Up to nine ACSPL+ programs can simultaneously run on the controller. Programs can also be implemented by a host PC application running under Windows® 98/2000/ME/NT/XP using the DLL or the COM libraries provided for C, C++, Visual Basic®, LabView®, and more. In addition, extensive C/C++DLLs are available for On-Time® and Venturecom® RTX real-time operating systems.

A powerful suite of software tools provide easy setup, tuning and programming. Application development is particularly easy with a four-channel soft scope and multi-axis motion simulator.

The servo control algorithm executes at an uncompromised rate of 20kHz per axis regardless of the number of axes in use, providing very large bandwidth, exceptional dynamic tracking, fast settling, and excellent smoothness at low velocities.

The controller is manufactured under the ISO 9001 certified quality management system, meeting stringent safety and EMC standards.

Supported Motors:
AC Servo/DC Brushless
DC Brush
P-D Stepper

CE certification is currently for single phase drive supply only.

CSA certification is for single phase and three phase drive supplies.

SPiiPlus CM Highlights

- Handles demanding applications without compromising accuracy and throughput
- Integrated digital drives with sophisticated advanced 20kHz PWM current control and space vector modulation for higher velocity, lower position error, and reduced current at high velocities
- Wide range of motion modes, including point-to-point, jog, segmented, master-slave, and arbitrary path with PVT cubic interpolation
- Third-order profile generation with on-the-fly velocity, acceleration, jerk and target position changes
- Nanometer resolution with optional Sin-Cos encoder multiplier
- Software sinusoidal commutation, and commutation based on hall sensors
- Advanced control algorithm, including notch and low pass filters, with 20kHz execution rate
- Unique multi-axis motion simulator for rapid application development
- Extensive DLL and COM libraries for C, C++, Visual Basic™ and LabView™
- Optional Convolve Input Shaping ® algorithm to reduce vibration and settling time

For more information about the SPiiPlus and it's capabilities please refer to the SPiiPlus series brochure.

Specifications

Axis Configurations

	Supported Motors:	Axes Types And Names: To direct-connected Motors (DC Brush, DC Brushless)	To direct-connected Drives (Stepper (open loop))	To HSSI-networked Axes (DC Brush or brushless (commutation by drive))	Total Number of Axes
SPiiPlus CM-1...	Two HSSI (default)	X	Y	A,Y,B	4
	Four HSSI channels	X	Y,Z,T	A,Y,B,Z,C,T,D	8
SPiiPlus CM-2...	Two HSSI (default)	X,A	Y	Y,B	4
	Four HSSI channels	X,A	Y,Z,T	Y,B,Z,C,T,D	8
SPiiPlus CM-2...XY	Two HSSI (default)	X,Y	-	A,B	4
	Four HSSI channels	X,Y	Z,T	A,B,Z,C,T,D	8
SPiiPlus CM-3...	Two HSSI (default)	X,Y,A	-	B	4
	Four HSSI channels	X,Y,A	Z,T	B,Z,C,T,D	8

Specifications

Profile Generation

Trajectory Calculation Rate: programmable 0.5, 1 (default) or 2kHz.

Position Range: $\pm 4x10^{15}$ counts.

Velocity: $160x10^{9}$ counts/second.

Acceleration: up to $4x10^{15}$ counts/second^2.

Control

Position (P) loop + velocity loop (PI, 2'nd order low-pass and Notch filters).

Sampling Rate: 20 kHz.

Accuracy: ±1 count.

Velocity Accuracy:
Long term: 0.005%.
Short term: 0.01%-0.5% (system-dependent).

Position and Velocity Feedback

Feedback Types: Any combination of incremental digital encoders, Sin-Cos encoders (optional), analog inputs or custom HSSI feedback modules.

Incremental Digital Encoder
Quantity: One per direct-connected or HSSI-networked motor.

The SPiiPlus CM-1 provides a secondary feedback via the A axis encoder.
Type: Three-channel, differential, incremental, RS-422.
A&B,I; UP-DN,I; CLK-DIR, I.
Maximum rate: 30 million encoder counts/second.
Index pulse duration: >200nsec.

A&B type requirements:
- A, B line cycle >200nsec.
- A, B low and high states >100nsec.
- A to B edge separation >25nsec.

UP-DN, CLK-DIR types requirements:
- Pulse width >100nsec.

Sin-Cos Analog Encoder (optional)
Quantity: One per direct connected motor. The SPiiPlus CM-1 provides a secondary feedback via the A axis encoder. Each Sin-Cos encoder uses two analog inputs.
Type: Three-channel, differential, incremental, 1Vptp.
Programmable multiplication factor: 4x to 65,536x.
Maximum rate: Up to 250,000 sine periods/second. Higher rates are available on request.
Maximum acceleration with Sin-Cos encoder: 10^{8} sine periods/second^2.

Integrated Digital Drives

Quantity: One, two or three.
Type: PWM, digital current control with space vector modulation.
PWM Frequency: 20kHz.
Current loop sampling rate: 20kHz.
Control algorithm: PI.
Current resolution: 14 bit.
Bus voltage: Up to 340V.
Drive short circuit capability: 5kA
Phase current (sine wave amplitude):
- SPiiPlus CM-1/2/3-A: 5A continuous; 10A peak (1 second). Maximum power per axis is 1370W continuous, 2740W peak.
- SPiiPlus CM-1/2/3-B: 10A continuous; 20A peak (1 second). Maximum power per axis is 2740W continuous, 5480W peak.

Total Power Consumption for all Axes:
- SPiiPlus CM-1/2/3-A: 4800W continuous, 7200W peak. (1 second)
-SPiiPlus CM-1/2/3-B: 4800W continuous, 7200W peak. (1 second)

Signals to Direct-connected P/D Stepper Drives

P/D Stepper Drive Commands
Quantity: Two or three, depending on the model.
Type: Pulse/Direction commands, differential, RS-422.
Maximum rate: Four million pulses per second.

Drive Enable Output
Quantity: One per stepper drive.
Type: Two terminal, may be used as source (open emitter) or sink (open collector).
Output voltage range: 5Vdc to 24Vdc.
Output current: 50mA.
Propagation delay: <1msec.

Drive Fault Input
Quantity: One per stepper drive.
Type: Two terminal, may be used as source (open emitter) or sink (open collector).
Input voltage: 5Vdc (±10%) or 24Vdc (±20%), automatic detection.
Propagation delay: <1msec.

I/O

Safety Inputs
Quantity: One dedicated E-stop.
Left limit and right limit per axis.
Type: Single-ended, opto-isolated,
can be configured as sink (default) or source.
Input safety voltage range: 5Vdc (±10%) or 24Vdc (±20%), automatic detection.
Propagation delay: <1msec.

General Purpose Digital Inputs
Quantity: Eight.
Type: Single-ended, opto-isolated, can be configured as sink (default) or source.
Input voltage: 5Vdc (±10%) or 24Vdc (±20%), automatic detection
Propagation delay: < 1msec.

Registration Mark (Position Capture) Digital Inputs
Quantity: Two per X axis and two per Y axis.
Type: Differential, RS-422.
Propagation delay: < 0.1µsec.
Note: These inputs can be configured for general purpose use.

General Purpose Digital Outputs
Quantity: Eight.
Type: Single-ended, opto-isolated. Can be configured as sink (default) or source.
Outputs voltage: 5Vdc (±10%) or 24Vdc (±20%).
Propagation delay: <1msec.
Maximum current per single output: <350mA
Maximum current per all outputs: <350mA
Note: All outputs are protected against overload and short circuit.

Position Event Generator (PEG) Digital Outputs
Quantity: One PEG pulse per each of X and Y axis. Four PEG states per each of X and Y axis.
Type: Differential, RS-422.
Propagation delay: < 0.1µsec.
PEG position compare accuracy:
±1 quadrature count up to 5,000,000 counts/second.
PEG generated pulse width range: 25nsec to 1.6msec.
Edge separation between two PEG events: Minimum 200nsec.
Number of PEG pulses in random (table based) mode: Up to 30,000.
Number of PEG events in incremental mode: Unlimited.

Mechanical Brake Outputs
Quantity: Three.
Type: Single-ended, opto-isolated, source type.
Outputs voltage: 1V ptp or 10V ptp.
Maximum current per output: 1A.
Note: These outputs can be used for general purpose.

Analog Inputs
General: Analog inputs also serve as Sin-Cos encoder inputs. Each Sin-Cos encoder uses two analog inputs.
Type and Quantity:
- In SPiiPlus CM-1/2/3: two/four/six analog inputs (respectively), differential 1V ptp or 10V ptp, 14-bit resolution, signal- to-noise ratio of 62dB (3 sigma) equivalent to ±6 AIN counts.
- In SPiiPlus CM-3 or SPiiPlus CM-2...XY: two additional analog, single-ended, ±10V, 14-bit resolution, for joystick implementation.

Analog Outputs
Quantity: One (with one HSSI channel), two (with more than one HSSI channel).
Signal-to-noise ratio: = 46dB (3 sigma) equivalent to ±50mV or ±3 AOUT counts.
Type: Single ended, ±10V, 10-bit resolution.

Expanded Digital I/O
Quantity: Up to 256 inputs and 252 outputs using 16 optional HSSI-IO16 modules.
Type: Opto-isolated, 5Vdc or 24Vdc.

HSSI Expansion Bus
Quantity: up to four HSSI channels (optional).
Type: Differential, RS-422.
Each channel provides 64 input bits and 64 output bits, sampled and updated at 20kHz.

Multi-processor Architecture
Motion Processor Unit (MPU): PC104+.
Real-time controllers: 120MHz SPii Servo Processors, one per two axes.
Controller power-up time: 25 seconds.

Memory
RAM memory: 16Mb.
Flash memory: 16Mb.

Communication Channels
Serial ports: one RS-232. One RS-232/422. Up to 115,200bps.
Ethernet channel: TCP/IP 10/100 Mbits/sec (10/100 BaseT).
Note: Simultaneous communications through all channels is supported.

Power Supplies
Control Section
Voltage: 24Vdc (±20%).
Current: Up to 4A.

Mechanical Brake Supply
Voltage: 5-30Vdc.
Current: Up to 3A.

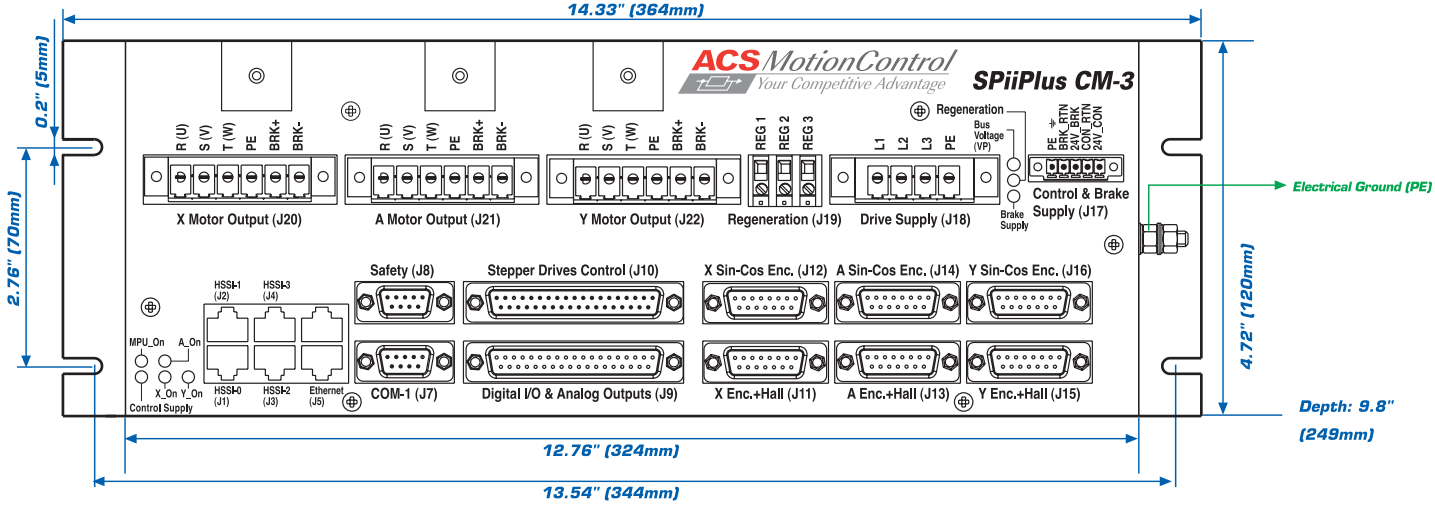
I/O Section
Voltage: 5Vdc (±10%) or 24Vdc (±20%).
Current: Up to 0.8A.

Safety Inputs Section
Voltage: 5Vdc (±10%) or 24Vdc (±20%).
Current: Up to 0.2A.

Drive Power Section
Single phase supply:
Voltage: 90Vdc to 125Vdc or 100Vac to 240Vac, or Low Voltage option 24-120Vdc
Current: up to 18A RMS-up to 4800W continuous, 7200 peak (one second)
Three phase supply:
Voltage: 230Vac phase-to-phase.
Current: per phase up to 18A RMS for a total of 8200W for all phases continuous, 12300 peak (one second)
Regeneration: Module provides internal regeneration shunt resistor 100Ω/100W (continuous). If required, an external shunt resistor (>13Ω) can be connected.

Environment
Operating temperature: 0°C to 40°C.
Storage temperature: -40°C to 85°C.
Humidity: 90% RH, non-condensing.

Layout & Dimensions



How To Order

SPiiPlus CM and Software

• SPiiPlus CM

Example: **SPiiPlus CM - 2 - A - E - M2 - H4 - LV - XY - I**

Number of integrated drives:
[1] for one drive, [2] for two drives or [3] for three drives

Current level (sine wave amplitude) of the integrated drives:
[A] - for 5A continuous/10A peak, [B] for 10A continuous/20A peak*

Communication channels:
[E] - for RS-232, RS-422 and Ethernet 10/100 BaseT channels

Number of Sin-Cos encoder multipliers:
[M0] - for no multipliers, [M1] for one, [M2] for two, [M3] for three

Optional field:
[H4] - four HSSI channels and SPii processors

Optional field:
[LV] - low voltage drive supply option 24Vdc to 120Vdc or 19Vac to 85Vac

Optional field:
[XY] - for SPiiPlus CM2, the two internal drives are connected to X and Y axes (instead X and A)

Optional field - Convolve Input Shaping ® algorithm to reduce vibration and settling time
[I] - Input Shaping ® enabled

* In a standard order, the drives are either all type A, or all type B.

Each SPiiPlus controller comes with the SPiiPlus ADK (Advanced Development Kit) intended for programmers who develop ACSPL+ based applications and host based programs. The CD includes:

- **SPiiPlus MMI** -for axis configuration, servo tunning, programming, debugging and viewing parameters by advanced software tools including a soft-scope.
- **SPiiPlus Library** - for host programming in C, C++ or Visual Basic
- **SPiiPlus Utilities** - for upgrading firmware and recovering from errors
- **SPiiPlus Simulator** - for fast application development and debugging
- **SPiiPlus FRF** - for analyzing motion frequency response
- Hardware, software, setup, and programming guides in PDF format
- ACSPL+, C/C++ and COM training files and programming examples
- MATLAB/Simulink servo algorithms models

Additional Products

• SPiiPlus CM-ACC

The SPiiPlus CM Accessories Kit includes all user-side matting connectors.

• HSSI-IO16

I/O expansion module provides 16 additional opto-isolated digital inputs and 16 opto-isolated digital outputs per module. Up to four HSSI-IO16 units can be daisy chained to an HSSI channel, providing a total of 64 inputs and 63 outputs per channel. For more information, refer to the HSSI-IO16 data sheet.

• HSSI-ED2

Two-axis distributed interface module for for DC brush, Nanomotion motors or DC brushless motors (commutated by the drive). Includes: two motor drive interfaces with ±10V torque command, two 3-channel quadrature (A&B, I) encoder inputs, four limit switch inputs, and eight/eight general-purpose opto-isolated digital I/O. For more information, refer to the HSSI-ED2 data sheet.

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