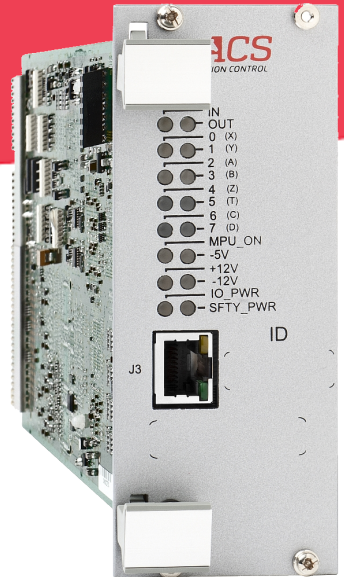


# MC4U

## EtherCAT® Master and Drive Controllers



The SPiiPlusNT (NT - Network Controller) is designed for incorporation in the MC4U. Once plugged into an MC4U, the MC4U becomes also an EtherCAT master designated MC4Unt. It manages the EtherCAT network with up to 64 axes of motion and countless number of I/Os and sensor modules. The SPiiPlusNT also includes Servo Processors for controlling local drives that reside within the same MC4Unt enclosure.

Like all SPiiPlus products, the SPiiPlusNT uses the same ACSPL+ high level programming language and is supported by the same set of software tools such as the SPiiPlus MMI Application Studio and API for host application development.

The SPiiPlusDC (DC - Drive Controller) is also designed for incorporation in the MC4U. Once plugged into an MC4U, the MC4U becomes an EtherCAT slave designated MC4Udc. The MC4Udc is a drive module with up to 8 drives.

The SPiiPlusNT Master generates the motion trajectories for all the axes, transmitting the data over the EtherCAT network, and the SPiiPlusDC executes the real-time control of the drives and axes.

**NetworkBoost™** (optional) - Network failure detection and recovery with ring topology.

### *The following versions are available:*

- > SPiiPlusNT-HP - High Performance EtherCAT master, with 4 or 8 built in drives for applications with up to 64 network axes
- > SPiiPlusNT-LT - Economical EtherCAT master controller, with 4 or 8 built in drives for applications with up to 64 network axes
- > SPiiPlusNT-LD - High Performance EtherCAT master Linear Drive controllers, with 4 or 8 built in drives for applications with up to 64 network axes
- > SPiiPlusDC-HP - High Performance EtherCAT slave Drive Controllers, 4 and 8 axis versions
- > SPiiPlusDC-LT - Economical EtherCAT slave Drive Controllers, 4 and 8 axis versions
- > SPiiPlusDC-LD - High Performance EtherCAT slave Linear Drive controllers, 4 and 8 axis versions

## Profile Generation

Motion Profile generation rate: 1,2,4 or 5kHz  
(see HW guide for details)

## Servo

A standard comprehensive set of powerful algorithms to enhance accuracy, move & settle time, smooth velocity, stability and robustness.

- > Advanced PIV cascaded structure
- > Loop shaping filters
- > Gain Scheduling
- > Gantry MIMO control
- > Dual feedback / loop control
- > Disturbance rejection control

## Optional (HP version only)

**ServoBoost™** algorithm that provides better, more consistent servo performance, insensitive to noise and large changes in the system.

## Feedback

Feedback types: incremental digital encoders, Sin-Cos encoders (optional), Absolute encoders (optional) analog inputs and 3 digital hall inputs for initiating commutation.

### Incremental Digital Encoder:

One per axis, A&B,I; UP/DN,I; CLK/DIR,I.  
Type: RS-422.

Max. rate: 40 million encoder counts/sec.

Sin-Cos Encoder (optional)

SPiiPlusNT-HP/LD and SPiiPlusDC-HP/LD:

Multiplication factor: From x4 to x65,536

Rate: Up to  $500 \times 10^3$  or (LD version)  $4 \times 10^6$  sine periods/sec

Note: Consult factory for higher rate options

Sin-Cos offset, gain, phase compensation:  
programmable with automatic calibration.  
Offset is hardware compensated, +/-50% of signal range.

Maximum acceleration:  $4 \times 10^8$  sine periods/sec<sup>2</sup>

SPiiPlusNT-LT and SPiiPlusDC-LT:

Multiplication factor: From x4 to x4,096

Sin-Cos offset gain, phase compensation:

programmable with automatic calibration.

Rate:  $250 \times 10^3$  sine periods/sec

Maximum acceleration:  $4 \times 10^8$  sine periods/sec<sup>2</sup>

### Hall inputs:

Quantity: A set of three per axis.

Single-ended, 5V, source, opto-isolated

Input circuit current: <7mA

Absolute Encoder (optional):

EnDat 2.1/2.2 (Digital only), Smart-ABS,

Panasonic, Biss-C, SSI, Hiperface, Sanyo Denki.

## Drive interface

Analog commands (SPiiPlusNT/DC-LD only):

Two per axis

Type:  $\pm 10V$ , differential, 16 bit resolution.

Offset compensation: programmable,

0.3mV resolution.

PWM Drive Commands: 3 phases per axis.

Control algorithm: digital PI filters with field

oriented control and space vector modulation.

PWM frequency: 40kHz on the motor.

Current loop sampling rate: 20kHz

Current feedback resolution:

SPiiPlusNT/DC-HP: 16 bit

SPiiPlusNT/DC-LT: 12 bit

SPiiPlusNT/DC-LD: 16 bit

## Digital I/O

Note: It is recommended to use a dedicated supply for digital I/O. See Power Supplies section.

### Safety Inputs:

#### Emergency stop input:

Type: two-terminal, sink or source, opto-isolated.

#### Left and right limit inputs:

One pair per axis

Type: single-ended, sink (default) or source, configurable by jumper, opto-isolated.

Supply: 5V or 24V

Input current: 4-14mA

### Digital Inputs:

#### General purpose inputs:

Quantity: eight. Type: single-ended, 5V or 24V, sink (default) or source, opto-isolated.

Input current: 4-14mA

#### MARK (position capture) inputs:

Quantity: Up to four. Refer to SPiiPlusNT user manual for detailed information.

Type: RS-422

Propagation delay: <0.1 $\mu$ sec

Note: additional four MARK inputs (MARK2), single-ended and opto-isolated, are available through general purpose digital inputs IN4, IN5, IN6 and IN7

### Digital Outputs:

#### General purpose outputs:

Quantity: eight. Type: single-ended, 5V or 24V, sink (default) or source, optoisolated, 100mA per output

#### Mechanical Brake Outputs:

Quantity: one per axis. Type: single-ended, 5V, source only, opto-isolated, 7mA per output. By default, configured as dynamic brake.

Note: general purpose digital outputs can be configured as Mechanical Brake Outputs

#### PEG (Position Event Generator) pulse outputs:

For details, refer to "SPiiPlusNT PEG and MARK Operations" Application Note.

Quantity: six. Type: RS-422.

Propagation delay: <0.1 $\mu$ sec.

PEG pulse width: 25nsec to 1.7msec.

PEG position accuracy:  $\pm 1$  count at speeds up to  $18 \times 10^6$  counts/sec.

Refer to SPiiPlusNT user manual for detailed information.

**PEG state outputs:** Quantity: Up to six.

> Time base peg support

> Improved incremental PEG support

> Fast random PEG loading support

Type: RS-422. Propagation delay: <0.1 $\mu$ sec

Refer to SPiiPlusNT user manual for detailed information.

## Power Supplies

Power Supply Voltage/Current: +5Vdc ( $\pm 10\%$ )/2.7A, -5Vdc ( $\pm 10\%$ )/0.1A,  $\pm 12Vdc$  ( $\pm 5\%$ )/0.6A. Supplied internally from the power supply module enclosed in the MC4U

### Configuration I/O Supply Voltage/Current:

+5Vdc ( $\pm 10\%$ )/1A, or 24Vdc ( $\pm 10\%$ )/1A

**Safety Supply Voltage/Current:** +5Vdc ( $\pm 10\%$ )/1A, or 24Vdc ( $\pm 10\%$ )/1A.

Six LEDs on the front panel indicate the status of all above power supplies.

## Certifications

CE: Yes

Electrical Safety: IEC61010-1

EMC: EN 61326-1

UL: UL508C

Functional Safety: IEC 61800-5-1, 61800-5-2 pending

## Standards and Environment

Operating Temperature: 0°C to 55°C

Storage Temperature: -40°C to 70°C

Humidity: 90%RH, non-condensing

The controllers are CE (EMC), UL certified and RoHS compliant

## Analog I/O

### Analog Inputs:

Unused Sin-Cos encoder inputs can be used as general purpose analog inputs.

Quantity: up to 16

Type: 1Vptp, differential

Resolution and SNR:

SPiiPlusNT/DC-HP/LD: 16 bit, SNR>72db

SPiiPlusNT/DC-LT: 12 bit, SNR>52db

SPiiPlusNT-HP/LD and SPiiPlusDC-HP/LD:

Quantity: Four dedicated general purpose inputs.

Type:  $\pm 10V$ , differential

Resolution: 16 bits

SPiiPlusNT-LT and SPiiPlusDC-LT:

Quantity: up to four when axes number 3

and/ or 7 Sin-Cos encoders are not used.

These inputs can be used for general

purpose. Type:  $\pm 10V$ , differential.

Resolution: 12 bits

### Analog Outputs:

Quantity: 2, 4

Type:  $\pm 10V$ , PWM filtered

Resolution: 10bit

## Communication Channels

Serial: two RS-232. Up to 115,200bps

Ethernet: one, TCP/IP, 10/100 Mbits/sec

Simultaneous communication through all channels is

fully supported. Modbus protocol as master or slave is

supported via all channels

EtherCAT: SPiiPlusNT: one or two master ports,

SPiiPlusDC: one input, one output, 100 Mbit/sec,

supporting CoE and FoE protocols

## Motion Processor Unit (MPU)

Processor Type: Multi-core Intel Atom CPU (model depends on controller configuration)

RAM: 1GB

Flash: 2GB

## MPU/EtherCAT Cycle Rate

The following options are available for MPU Cycle Rate:

For Maximum Number of Axes = 2, 4, or 8: 2 kHz

(default), 4 kHz, 5 kHz

For Maximum Number of Axes = 16 or 32: 2 kHz (default),

4 kHz

For Maximum Number of Axes = 64: 1 kHz (default), 2

kHz

NetworkBoost™ and Segmented Motion (XSEG)

features functionality can be limited as a function of MPU Cycle Rate and Number of Axes. Please refer to Software Documentation or contact ACS for more details.

## Supported EtherCAT Slaves

All ACS SPiiPlus Platform EtherCAT slave products are

supported. 3rd party EtherCAT drives can be controlled via

DS402 CoE protocol in Cyclic Synchronous Position (CSP)

mode.

ACS recommends qualification of 3rd party EtherCAT

drives and I/O devices. Refer to ACS website for latest list

of qualified devices and contact an ACS representative to

discuss qualification options.

### Field Upgrades

For controllers ordered from the factory with Maximum Number of Axes equal to 32 or less and Maximum MPU Cycle Rate of 2kHz (default), the following field upgrade options are available:

Maximum Number of Axes	Maximum MPU Cycle (kHz)
2	4, 5
4	4, 5
8	4
16	4
32	2

It is not possible to field upgrade a controller ordered with 32 axes or less to 64 axes.

For controllers ordered from the factory with Maximum Number of Axes equal to 64 and Maximum MPU Cycle Rate of 1kHz (default), the following field upgrade options are available:

Maximum Number of Axes	Maximum MPU Cycle (kHz)
64	2