SPiiPlus UDMnt Universal Drive Module

Hardware Guide

Version NT 1.0

SPiiPlus UDMnt Universal Drive Module

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TRADEMARKS

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Changes in Version NT 1.0

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	New Document

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1 About this Document

The SPiiPlus UDMnt is an Ethernet based (EtherCAT slave) dual axis interface board for controlling third party drives. This document provides detailed hardware information for the SPiiPlus UDMnt.

1.1 Related SPiiPlus Tools

Table 1 Related SPiiPlus Tools

Tool	Description
SPiiPlus MMI Application Studio	A multipurpose user interface with the controller including: Program management, Motion management, Communication terminal, Four channel digital oscilloscope, Safety and I/O signals monitor, Signal tuning and adjustment, and a fully interactive simulator. Debugging tools and FRF are also included.

1.2 SPiiPlus Documentation

Table 2 Collateral Documentation

Document	Description
SPiiPlus ACSPL+ Command & Variable Reference Guide	Command and variables of high level language for programming SPiiPlus controllers.
SPiiPlus ACSPL+ Programmer's Guide	Command set and high level language for programming SPiiPlus controllers.
SPiiPlus COM Library Reference Guide	COM Methods, Properties, and Events for Communication with the Controller
MC4U Hardware Guide	Provides a detailed technical description of the MC4U Control Module - a completely integrated controller, including the SPiiPlus Motion Controller, Power Supplies, and Motor Drivers.
SPiiPlus MMI Application Studio User Guide	Provides a comprehensive guide for using the SPiiPlus MMI Application Studio.

1.3 Conventions Used in this Document

1.3.1 Text Formats

Several text formats and fonts, illustrated in **Table 3**, are used in the text to convey information about the text.

Table 3 Conventions

Text	Description
BOLD CAPS	ACSPL+ elements (commands, functions, operators, standard variables, etc.) when mentioned in the text. Software tool menus, menu items, dialog box names and dialog box elements.
bold	Emphasis or an introduction to a key concept.
Bold Blue	Links within this document, to web pages, and to e-mail addresses.
Italics Blue Text	Used to highlight referenced documentation.

1.3.2 Flagged Text

The following symbols are used for flagging text in tis document:

Note 	*Notes include helpful information or tips.*

Caution 	***A Caution describes a condition that may result in damage to equipment.***

Warning 	***A Warning describes a condition that may result in serious bodily injury or death.***

Advanced 	*Indicates a topic for advanced users.*

Model 	*Highlights a specification, procedure, condition, or statement that depends on the product model.*

1.4 Terms and Definitions

The following terms are used in this document.

Table 4 Terms

Term	Definition
A2D	Analog to Digital
D2A	Digital to Analog
FW	Firmware
HSSI	High-Speed Synchronous Serial Interface
HW	Hardware
I^2C	Inter-Integrated Circuit
MARK	Registration input that is used for latching current position with high precision
MPU	Motion Processing Unit
PEG	Position Event Generator
SPii	Second generation Servo Processor

2 SPiiPlus UDMnt Overview

The SPiiPlus UDMnt (Universal Drive Module) is a dual-axis card designed for incorporation in the MC4U Control Module to enable control peripherals over the Ethernet.

Note	*The SPiiPlus UDMnt is a network slave only, acting as an EtherCAT node.*

The SPiiPlus UDMnt supports axes in addition to the main axes of multi-axis machinery.

Figure 1 SPiiPlus UDMnt

This chapter provides technical details of the SPiiPlus UDMnt.

2.1 SPiiPlus UDMnt Dimensions

Table 5 presents the dimensions of the SPiiPlus UDMnt.

Note	*All dimensions are within ±0.5mm.*

Table 5 SPiiPlus UDMnt Dimensions

	Value
Length	112.8 mm
Width	162.7 mm
Height	38 mm

2.2 SPiiPlus UDMnt Interfaces

Table 6 presents details of the SPiiPlus UDMnt interfaces

Table 6 SPiiPlus UDMnt Interfaces (page 1 of 5)

	Description	**Remarks**
Control Supply Input		
Designation	24VDC 24RTN	
Quantity	1	
Input voltage	24Vdc ±10%	Reverse voltage may cause damage to the unit.
Input Power	Maximum input power: 19W	
Input current	Maximum input current: 0.9A @ 21.6V control supply input voltage	
Protection	The user should be able to keep the motion controller alive by supplying the 24Vdc logic supply.	
Power Supply		
Designation	VP+ VP-	
Quantity	1	
Input voltage	Up to 60 Vdc	Reverse voltage may cause damage to the unit.

Table 6 SPiiPlus UDMnt Interfaces (page 2 of 5)

	Description	Remarks
Input Power: UDMnt-2.5/5A UDMnt-5/10A	 450 W 800 W	@ Input voltage - 60 Vdc
Output Power UDMnt-2.5/5A UDMnt-5/10A	 350 W 700 W	@ Input voltage - 60 Vdc
Protection	Over voltage 72V.	
Power Bridge		
Designation	R S T	
Quantity	2	One per axis
Type	PWM, 3-phase	
Output Current	2.5A cont /5A peak 5A cont /10A peak	
Output Voltage	Up to 60Vdc	
Power Bridge architecture	Three-phase PWM bridge, 20 kHz	
Motor type connections	Any two- or three-phase motor	
Protection	Phase-to-phase short circuit >25A Over temperature	Over temperature protection on the heat sink >90°C
Digital Input		
Designation	IN0, IN1, IN2, IN3	
Quantity	4	
Type	Single-ended. Opto-isolated. 24Vdc ±10%.	
Truth Table	Input active - Logic state '1' Input inactive - Logic state '0'	
Input current	4.5 mA	
Default state	Logic state '0'	DSP Input state '1'
Safety Input		
Designation	RL LL	Right Limit Left Limit
Quantity	4	Two per axis (RL & LL)
Type	Single-ended. Opto-isolated. 24Vdc ±10%.	
Truth Table	Input active - Logic state '1' Input inactive - Logic state '0'	
Input current	4.5 mA	
Default state	Logic state '0'	DSP Input state '1'

Table 6 SPiiPlus UDMnt Interfaces (page 3 of 5)

	Description	Remarks
Digital Output		
Designation	OUT0, OUT1	Can also be used as mechanical brake outputs
Quantity	2	
Type	Single-ended. Opto-isolated. 24Vdc ±10%.	Drop voltage <2.5V
Truth Table	Output active - Logic state '1' Output inactive - Logic state '0'	
Max output current	50 mA per single output	
Default state	Digital Output Logic state '0'	DSP Output state '0'
Analog Input		
Designation	AIN0	
Quantity	1	
Type	Differential. ±10 V ±5%.	
Input impedance	$\geq$ 20 kΩ	
Resolution	12 bits	
Analog Output		
Designation	AOUT0	
Quantity	1	
Type	Differential. ±10 V ±10%. Filtered PWM	
Max differential current	$\leq$ 5 mA	
Resolution	10 bits	
Default state	Upon power-up output is 0V	
Offset	±50 mV at 0 V at 25ºC	
Ripple	50 mVp-p	
Digital Encoder		
Designation	A: CHA0± B: CHB0± I: CHI0±	In dual loop, encoder-1 can be used as secondary encoder.
Quantity	2	One per axis
Type	RS-422 compatible. Input impedance 120 Ω ±10%.	
Maximum input frequency	7.5 MHz	

Table 6 SPiiPlus UDMnt Interfaces (page 4 of 5)

	Description	Remarks
Encoder output supply	5 V, 250 mA	500 mA for all encoders. For more than 500 mA, the user has to provide an external supply.
Format	AqB and Index	
Diagnostic	Default states are not connected	Will support Encoder Not Connected.
Hall Sensor		
Designation	Channel A: HA Channel B: HB Channel C: HC	
Quantity	6	Three per axis (HA, HB and HC)
Type	Opto-isolated input. Source input type, (open cathode). Up to 7 mA current.	
Format	A, B, C	
Maximum input frequency	2 kHz	
Diagnostic	Default input state (no current), "111". Logic inputs state - 111	
Sin-Cos Encoder		
Designation	SIN± COS± SC_I±	
Quantity	2	One per axis
Type	Differential input Input impedance 120 Ω ±10%. Encoder voltage range 1 Vptp ±10% Input Voltage range: 1.25 Vptp	
Maximum speed	250 kHz	
Encoder output supply	5 V, 250 mA	500 mA for all encoders. For more than 500 mA, the user has to provide an external supply.
Format	Sin, Cos and Index	
Resolution	12 bits	

Table 6 SPiiPlus UDMnt Interfaces (page 5 of 5)

	Description	Remarks
Diagnostics	Encoder not connected detection in software level.	The Sin and Cos signals come into the DSP analog directly and into the DSP AqB through the switch. The Sin-Cos Index comes into the DSP digital input and into the DSP AqB through the switch.
EtherCAT		
Designation	Transmit: ETH#_TX± Receive: ETH#_RX±	Where # can be 1 or 2.
Quantity	2	Input and Output
Type	EtherCAT protocol	
Speed	100 Mbps	
Protection	Galvanic Isolated ESD protected	

2.3 EtherCAT Network Cable Limitation

Caution	
	***For proper operation of the unit installed in an EtherCAT network strict adherence to the cable length limitations given in this section is required.***

The minimum cable length between units in an EtherCAT network is 1m; the maximum length is 25m.

Note	
	*ACS Motion Control recommends using BECKHOFF ZK1090-9191-0250 cable, or its equivalent.*

3 Safety and EMC Guidelines

3.1 General Safety Guidelines

Warning	
	***Read and understand the following precautions before operating the SPiiPlus UDMnt!***

Under emergency situations the unit should be completely disconnected from any power supply. The Left/Right Limits on ACS Motion Control products are designed for use in conjunction with customer-installed devices to protect driver load. The end user is responsible for complying with all Electrical Codes.

3.1.1 Emergency Stop Device

1. Locate an emergency stop device at each operator control station and other operating stations where an emergency stop may be required.
2. The emergency stop device shall disconnect all electrical equipment connected to the SPiiPlus UDMnt from their respective power supplies.
3. It will not be possible to restore the circuit until the operator manually resets the emergency stop.
4. In situations with multiple emergency stop devices the circuit shall not be restored until all emergency stops devices are manually reset.

3.1.2 Fail-Safe Logic Recommendation

ACS Motion Control recommends connecting all safety inputs (limit inputs and emergency stop input) with a fail safe logic. The intention is that during normal operation the inputs are active. When a safety event happens (or the input wire is cut) the input becomes zero and the controller identifies that as a fault.

3.1.3 Initial Logic State of Outputs

The relevance of analog and digital output pins is product and model dependent. The initial logic state of the inactive analog and digital pins is undefined. They may carry a potential of 5V relative to ground.

3.2 Grounding

Grounding system electrical components is crucial.

Warning	
	***Verify that all electric circuits and electrical components, including motion controllers, power drives, motors, etc., have a grounding system. The grounding of AC and DC equipment shall be in accordance with section 29 CFR 1910.304(g) of Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.304 Paragraphs (g)(1) through (g)(9) of this section contain grounding requirements for systems, circuits, and equipment.***

3.2.1 Digital Input and Gounding

Figure 2 depicts the grounding of digital input.

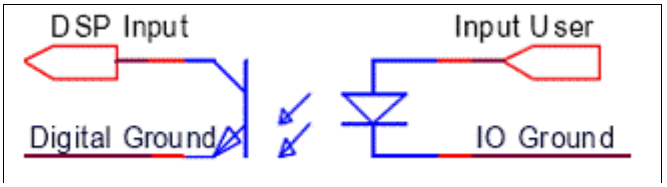


Figure 2 Digital Input

The user must supply the 24V input to operate the unit.

3.2.2 Digital Output and Grounding

Figure 3 depicts the grounding when the user turns on the output.

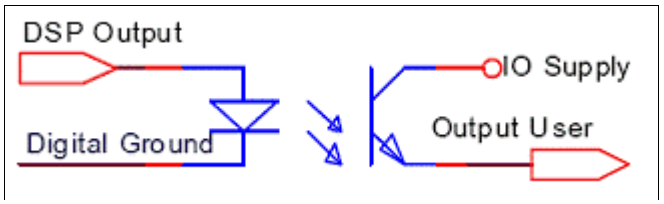


Figure 3 Digital Output and Grounding

3.3 Fault & Error Handling

If, from any reason, communication with the master is lost, the SPiiPlus UDMnt goes into the Alarm state. In the Alarm state the following occurs:

- System LED does not blink during software command.
- I/O remains in its last state.
- Drive Enable goes to default state (disable).

There are two recovery options for Alarm state:

1. Power the 24 Voff and then on.
2. Reset bit using the **FCLEAR** command.

4 SPiiPlus UDMnt Connectors

This chapter details the SPiiPlus UDMnt on-board connectors and connectivity.

4.1 J1 - 24V Control Supply

Label: J1
Connector Type: PHOENIX MC 1,5/ 5-GF-3,81
Mating Type: PHOENIX MC 1,5/ 5-STF-3,81

The pinout for J1 is given in **Table 7**.

Table 7 J1 - 24V Control Supply Connector Pinout

Pin	Name	Description
1	24VDC	+24 V dc control supply
2	24VRTN	+24 V dc control supply return
3	ENC_SUP	Encoder external supply
4	ENC_RTN	Encoder external return
5	Shield	Electrical ground

4.2 J2 - Drive Supply

Label: J2
Connector Type: PHOENIX MC 1,5/ 3-GF-3,81
Mating Type: PHOENIX MC 1,5/ 3-STF-3,81

The pinout for J2 is given in **Table 8**.

Table 8 J2 - Drive Supply Connector Pinout

Pin	Name	Description
1	VP+	Drive Power Supply "+"
2	VP-	Drive Power Supply "-"
3	Shield	Electrical ground

4.3 J3 - Phases

Label: J3
Connector Type: PHOENIX MC 1,5/ 5-GF-3,81
Mating Type: PHOENIX MC 1,5/ 5-STF-3,81

The pinout for J3 is given in **Table 9**.

Table 9 J3 - Phases Connector Pinout

Pin	Name	Description
1	R0	Phase - R0
2	S0	Phase - S0
3	T0	Phase - T0
4	Shield	Electrical ground

4.4 J4 - Phases

Label: J4
Connector Type: PHOENIX MC 1,5/ 5-GF-3,81
Mating Type: PHOENIX MC 1,5/ 5-STF-3,81

The pinout for J4 is given in **Table 10**.

Table 10 J4 - Phases Connector Pinout

Pin	Name	Description
1	R1	Phase - R1
2	S1	Phase - S1
3	T1	Phase - T1
4	Shield	Electrical ground

4.5 J5 - Digital & Analog I/O

Label: J5
Connector Type: AMTEK BOX HEADER-16 2.54mm
Mating Type: HEADER-16 female 2.54mm

The pinout for J5 is given in **Table 11**.

Table 11 J5 - Digital & Analog I/O Connector Pinout

Pin	Name	Description
1	IN0	Digital input
2	IN1	Digital input
3	IN2	Digital input
4	IN3	Digital input
5	OUT0	Digital output
6	OUT1	Digital output
7	RL0	Right limit
8	LL0	Left limit
9	RL1	Right limit
10	LL1	Left limit
11	IO_SUP	I/O Supply
12	IO_RTN	I/O Return
13	AIN+	Analog input
14	AIN-	Analog input
15	AOUT+	Analog output
16	AOUT-	Analog output

Note

The IO_SUP/IO_RTN has to be supplied from an external 24V source.

4.6 J6 - Encoder0

Label: J6
Connector Type: AMTEK BOX HEADER-20 2.54mm
Mating Type: HEADER-20 female 2.54mm

The pinout for J6 is given in **Table 12**.

Table 12 J6 - Encoder0 Connector Pinout

Pin	Name	Description
1	5U	Encoder supply
2	5U_RTN	Encoder ground
3	CHA0-	Encoder signal
4	CHA0+	Encoder signal
5	CHB0-	Encoder signal
6	CHB0+	Encoder signal
7	CHI0-	Encoder signal
8	CHI0+	Encoder signal
9	HA0	Hall
10	AB0	Hall
11	HC0	Hall
12	--	Not connected
13	5F	Encoder supply
14	5F_RTN	Encoder ground
15	SIN0-	Encoder signal
16	SIN0+	Encoder signal
17	COS0-	Encoder signal
18	COS0+	Encoder signal
19	SC_I0-/DATA0-	Encoder signal/Hyperface
20	SC_I0+/DATA0+	Encoder signal/Hyperface

4.7 J7 - Encoder1

Label: J7
Connector Type: AMTEK BOX HEADER-20 2.54mm
Mating Type: HEADER-20 female 2.54mm

The pinout for J7 is given in **Table 13**.

Table 13 J7 - Encoder1 Connector Pinout

Pin	Name	Description
1	5U	Encoder supply
2	5U_RTN	Encoder ground
3	CHA1-	Encoder signal
4	CHA1+	Encoder signal
5	CHB1-	Encoder signal
6	CHB1+	Encoder signal
7	CHI1-	Encoder signal
8	CHI1+	Encoder signal
9	HA1	Hall
10	AB1	Hall
11	HC1	Hall
12	--	Not connected
13	5F	Encoder supply
14	5F_RTN	Encoder ground
15	SIN1-	Encoder signal
16	SIN1+	Encoder signal
17	COS1-	Encoder signal
18	COS1+	Encoder signal
19	SC_I1-/DATA1-	Encoder signal/Hyperface
20	SC_I1+/DATA1+	Encoder signal/Hyperface

4.8 J8 - EtherCAT1 (Master)

Label: J8
Connector Type: RJ45
Mating Type: Ethernet plug

The pinout for J8 is given in **Table 14**.

Table 14 J8 - EtherCAT1 Connector Pinout

Pin	Name	Description
1	TD_0+	Positive transmit signal
2	TD_0-	Negative transmit signal
3	RD_0+	Positive receive signal
4	--	Not connected
5	--	Not connected
6	RD_0-	Negative receive signal
7	--	Not connected
8	--	Not connected

4.9 J9 - EtherCAT2 (Slave)

Label: J9
Connector Type: RJ45
Mating Type: Ethernet plug

The pinout for J9 is given in **Table 15**.

Table 15 J9 - EtherCAT2 Connector Pinout

Pin	Name	Description
1	TD_0+	Positive transmit signal
2	TD_0-	Negative transmit signal
3	RD_0+	Positive receive signal
4	--	Not connected
5	--	Not connected
6	RD_0-	Negative receive signal
7	--	Not connected
8	--	Not connected

5 SPiiPlus UDMnt Indicators and Switches

This chapter details the SPiiPlus UDMnt LED indicators and DIP switches.

5.1 SPiiPlus UDMnt LED Indicators

Table 16 provides details of the LED indicators located on the SPiiPlus UDMnt (shown in **Figure 4**).

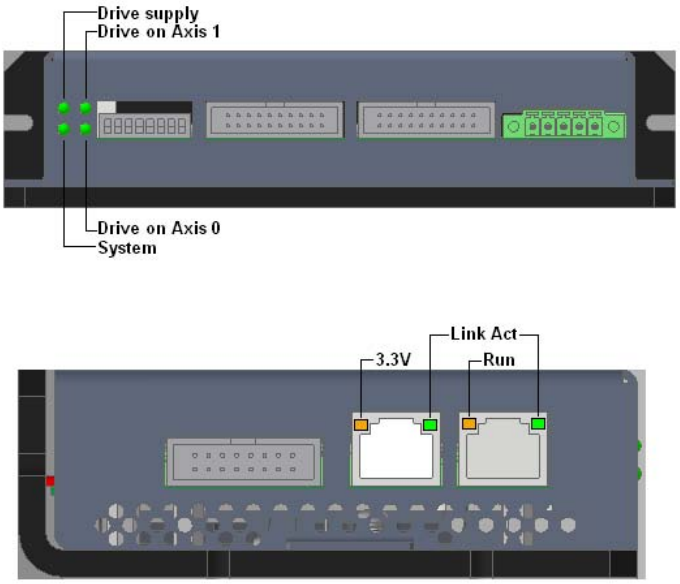


Figure 4 SPiiPlus UDMnt LEDs

Table 16 SPiiPlus UDMnt LED Indicators

Label	Description	Remarks
3.3V	Yellow LED ❑ Off - no power ❑ On - power supply is ok.	Located on the RJ45 Ethernet connector output port.
Link Act	Two green LEDs ❑ Off - No link ❑ Blinking - Link and activity ❑ On - Link without activity	One per each Ethernet port.

Table 16 SPiiPlus UDMnt LED Indicators

Label	Description	Remarks
Run	Yellow, LED ❑ Off -The device is in the INITstate ❑ Blinking (slow) -The device is in the PRE-OPERATIONALstate ❑ Single Flash -The device is in the SAFE-OPERATIONAL state ❑ On -The device is in the OPERATIONAL state ❑ Flickering (fast) -The device is in the BOOTSTRAP state	Located on RJ45 Ethernet connector input port.
System	Green LED ❑ On - DSP ok. ❑ Blinking - Software command.	Located on the top.
Drive on	Green LED ❑ On - indicates that the drive is on. ❑ Off - indicates that the drive was disabled by command, no fault	
Drive fault	Red LED ❑ Off - Drive is ok. ❑ On - Indicates drive fault	

5.2 SPiiPlus UDMnt DIP Switch

The DIP switch located on the SPiiPlus UDMnt is used for setting the EtherCAT network identification number (network ID). Available code from 0 to 256 decimal. SW/1 is the least significant bit of the 8-bit code, SW/8 is the most significant bit.

6 SPiiPlus UDMnt Installation

The SPiiPus UDMnt Universal Drive Module comes installed on a heat sink (shown in **Figure 5**). The unit is designed to operate in temperature ranges of 0° - +40°C, assuming there is sufficient airflow to dissipate the heat away. This can be achieved either by ventilation or by mounting the unit on a heat conducting surface. Spacing between SPiiPlus UDMnt units must be at least 5 cm.

Caution	
	***If the total output power is more than 250W, a cooling fan is required.***

This chapter presents instructions for mounting the SPiiPlus UDMnt unit.

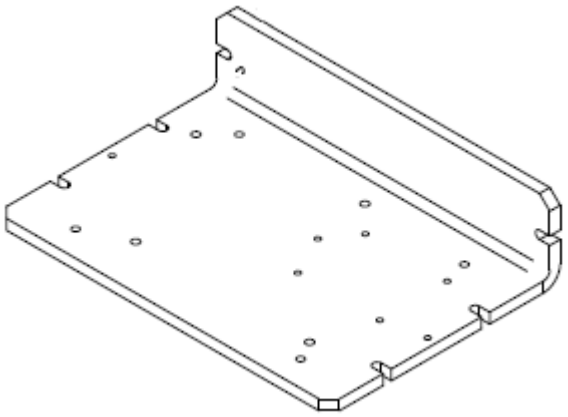


Figure 5 SPiiPlus UDMnt Heat Sink

The dimensions of the heat sink are shown in **Figure 6**, **Figure 7** and **Figure 8**

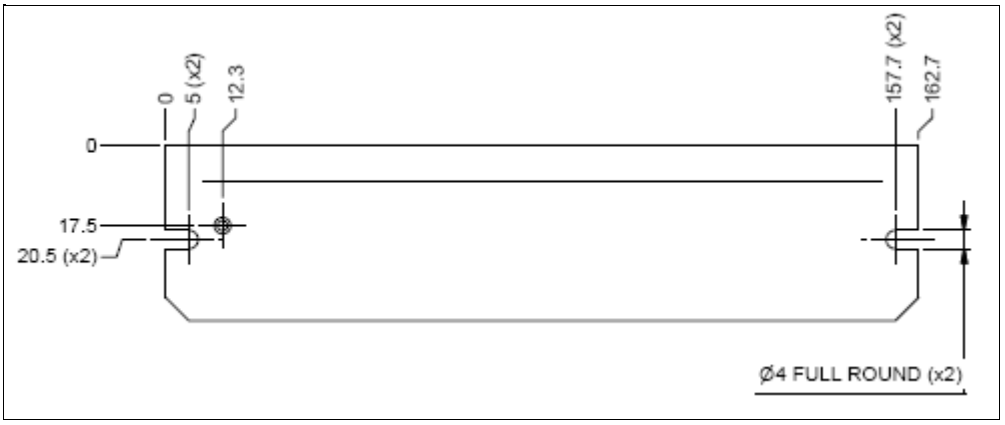


Figure 6 SPiiPlus UDMnt Heat Sink Back Plate

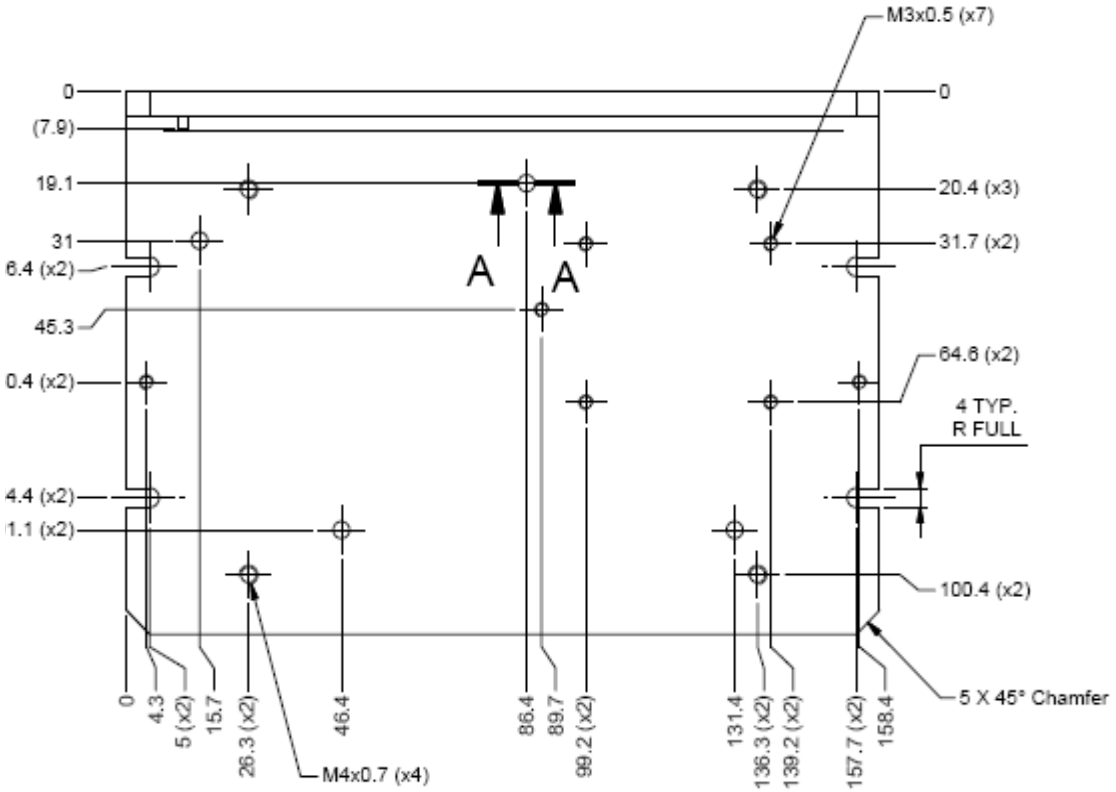


Figure 7 SPiiPlus UDMnt Heat Sink Shelf

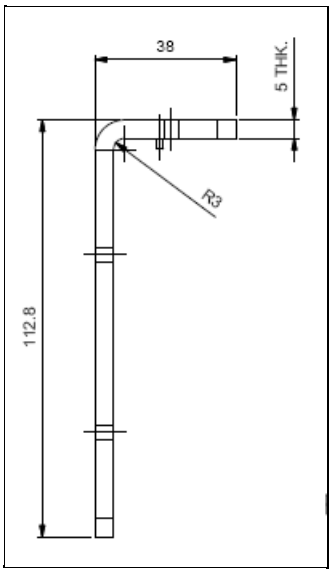
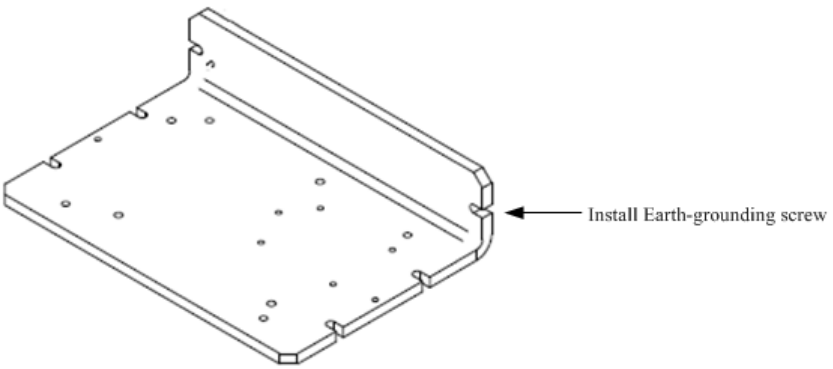


Figure 8 SPiiPlus UDMnt Heat Sink Side View

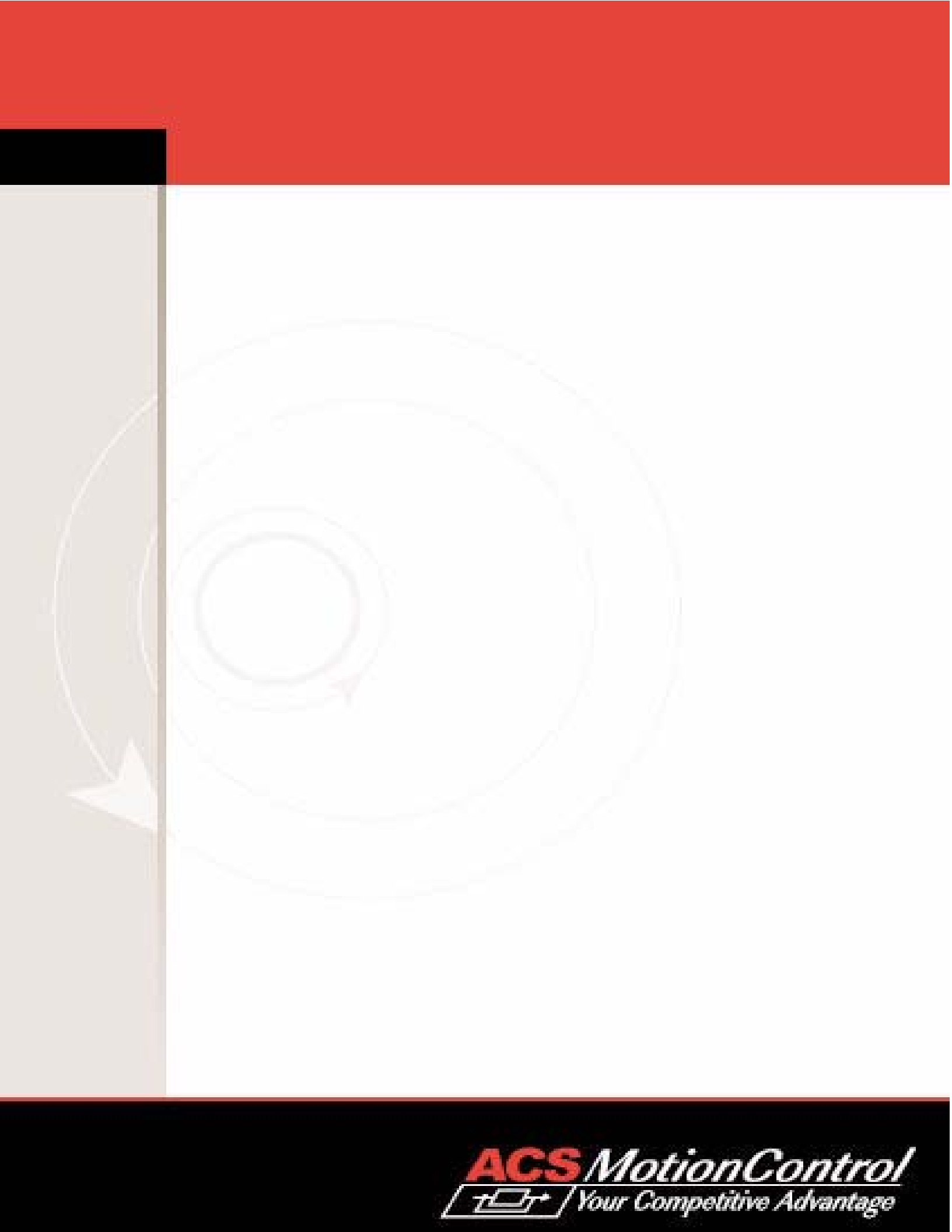
Caution	
	***The Heat Sink must be secured with an Earth-ground screw as shown in the figure.*** 

There are two ways that the SPiiPlus UDMnt can be mounted:

- Horizontally
- Vertically

Figure 9 Hoizontal Mount

Figure 10 Vertical Mount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