



# **AB5-3U Driver User Manual**

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## **Preface**

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## **About the User's Manual**

This user manual provides information and instructions on how to operate the AB5-3U driver card.

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# Chapter 1: Introduction

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## 1.1 GENERAL

The AB5-3U is a single axis amplifier card designed to drive up to 16 Nanomotion motor elements. The driver card enables the elimination of the inherent friction of the motor, thus simplifying the interface by allowing the use of almost any motion controller.

The driver is configured according to the type of motor(s) that it drives.

### **Features:**

- High precision (11 bits) control of the output power stage
- Interface to an analog command
- Discrete inputs enable feedback from external sources, such as emergency stop command, Enable, etc.
- Tri-color LED indicators
- Minimized sensitivity to cable length

## 1.2 OPERATING PRINCIPLES

The AB5-3U consists of a single card that converts the input command signal into corresponding PWM output signals. The card is designed to overcome the dead-zone and to enable smooth motion with higher precision on motor operation.

The output transformer-amplifier circuit converts the PWM output signal into a high voltage sine wave that drives the motor. The required DC voltages are supplied by an internal DC to DC converter that is fed from an external +24V power supply.

This square wave from the PWM Controller is filtered through the serial inductance circuit and is fed to the push-pull transformer circuit to produce a sine-wave high output voltage on the secondary coil of the transformer. The secondary coil and the motor capacitance serve as the LC resonance circuit.

The motor is a three-terminal component: “UP”, “DOWN” and “COMMON.” Voltage applied between the “UP” and “COMMON” terminals causes the motor to move in one direction; while voltage applied between the “DOWN” and “COMMON” terminals causes the motor to move in the opposite direction.

# Chapter 2: Connection Interfaces

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## 2.1 LED INDICATORS

	<b>LED 1</b>	<b>LED 2</b>
Vcc < 4.6V	Off	Off
Vcc > 4.6V; Motor not connected	Green	Off
Motor connected and disabled	Green	Orange
Motor connected and enabled	Green	Green
Over Current / Over Voltage	Green	Red

**Table 1: Led Indicators**

## 2.2 ANALOG INPUT SPECIFICATIONS

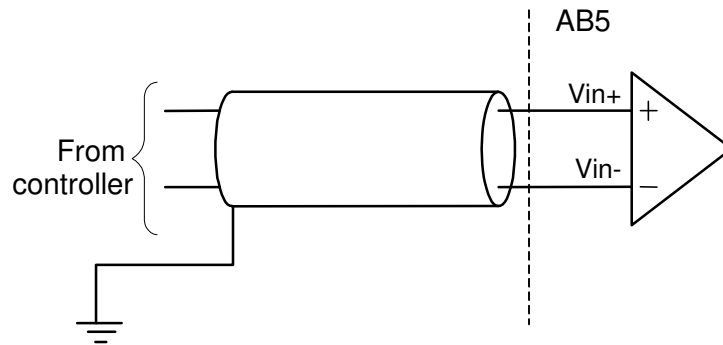
This section describes the specifications and connection configurations for a differential and for a single ended analog input.

### Analog input specifications

Signal type:	Differential or Single Ended
Input voltage range:	$\pm 10\text{V}$
Input impedance:	$10\text{K}\Omega$
Input low pass filter:	$2.7\text{KHz}$

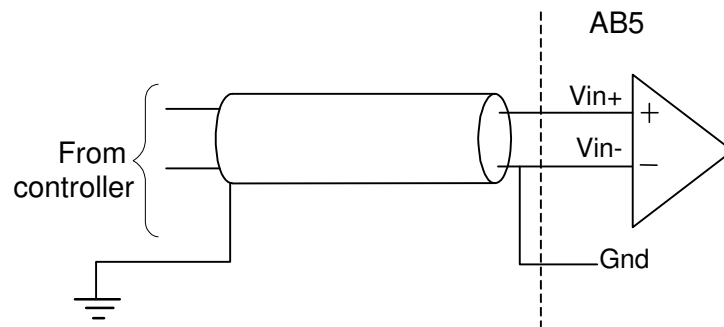
### Differential Connection

This connection provides noise immunity.



*Figure 1: Differential Analog Input Connection*

## Single Ended Connection



*Figure 2: Non-Differential (single ended)  
Analog Input Connection.*



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# Chapter 3: Installation

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## 3.1 SAFETY WARNINGS



### WARNINGS:

*To protect system and operators from high voltage due to pyroelectric effect (\*) always connect driver and motor to ground using ground screws.*

*(\*) During operation, motors do heat up. When the motor stops, it will cool down and an electric charge will be built. If the ground is disconnected this will produce high voltage in the driver box and motor housing. This effect is also true for baking procedure of vacuum applications.*

## 3.2 EXTERNAL POWER SUPPLY SPECIFICATIONS

*Use a stabilized 24V power supply (5% tolerance). Maximum current depends on motor type (see chapter 5).*

## 3.3 BEFORE OPERATING THE MOTOR

Before operating the AB5 please verify the following:

- The external power supply is capable of supplying the required power consumption of the AB5 (Section3.2)
- There is no command when switching the power to “ON”
- Make sure that all motors that are to be driven by the AB5 are preloaded.



***ATTENTION: The command should be limited according to the Envelope of Performance of the motor***

# Chapter 4: Specifications

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## 4.1 PIN ARRANGEMENT

*Table 5: I/O Ports Pin Description*

J5 Pins	J6 Pins	Name	Function	Description
B10	17	STEP	Input	Operate driver in Step Mode
Z10	18	ENABLE	Input	Enable – active low when no input at B14
B14	24	ENABLE SIGN	Input	Change enable signal logic to “active high”
D12	19	EMERGENCY STOP	Input	Disables the driver
B30,Z30	67,68	MOTOR CONNECTED	Input	Safety input. Motor operation is enabled only when this input is shorted to the ground. Must be connected to pin 6 of motor 9 pin d-type connector.
Z14	26	BRAKE	Input	Enable motor’s inherent brake
B12	20	FAULT	Output	Notify Over voltage\Over current.
D18	29	- Vin	Input	Negative analog command input (0 to –10V). Active when JMP2 is 1-2
D26	29	- Vin	Input	Negative analog command input (0 to –10V). Active when JMP2 is 2-3 (default)
B18	30	+ Vin	Input	Positive analog command input (0 to +10V). Active when JMP2 is 1-2
B26	30	+ Vin	Input	Positive analog command input (0 to +10V). Active when JMP2 is 2-3 (default).
D22, B22	47,48,49,50 51,52	MOTOR COMMON		Connected to the motor ‘COMMON’ terminal (black wire at pin 4 of motor 9 pin d-type connector)
D24, B24	55,56,57,58	MOTOR DOWN		Connected to the motor ‘DOWN’ terminal (white wire at pin 3 of motor 9 pin d-type connector)
B28, Z28	61,62,63,64	MOTOR UP		Connected to the motor ‘UP’ terminal (red wire at pin 5 of motor 9 pin d-type connector)

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D8, B8, Z8	4,5,6,7,36,37,38,39,40,41,42,43	+24V	Input	Power supply
D10	16,	USER VOLTAGE	Aux Input	3.3V external power supply for the opto-isolated type inputs.
D2	1	- 10V	Output	-10V supply for Joystick
D6	8	+ 10V	Output	+ 10V supply for Joystick
B6	9	Vcc	Output	+3.3V accessory power supply (250 mA Max)
Z2	3	SER_CLK	-	Reserved for future use
B2	2	SER_CS	-	Reserved for future use
D4, B4, Z4	11,12,13,14,15,21,22,27,28,31,32	GND		Ground
Z6	10	SER_DATA	-	Reserved for future use
D14	23	SET OFFSET	Input	Read command and remember as offset.
Z16	25	PTC	-	Reserved for future use
Z18	44	DC MODE	-	Reserved for future use

***Please note: Pins which are not connected are not listed.***

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## 4.1.1 Further Description of the Control Interface Signals and Their Functions.

NOTE: All inputs are opto-coupled and by default are activated low (shorted to ground).

Signal	Description
Fault	Open collector logic, activated low when either over voltage or over current protections are triggered.
Emergency_Stop	Safety input. Disables the card.
Enable	Enables driver operation.
Enable_Sign	When activated, inverts the “Enable” logic, making it active high.
-10V	Accessory voltage for powering a Joystick; Ground is at the GND pin.
+10V	Accessory voltage for powering a Joystick; Ground is at the GND pin.
User_Voltage	To enable external supply, change jumper JP2 on top board to position 3-4.
Step	<p>In this operation mode, the driver output to the motor is turned on and off for fixed time intervals defined in the hardware as follows:</p> <ul style="list-style-type: none"><li>• ON phase - 1/16 second</li><li>• OFF phase - 0.5 second</li></ul> <p>The amplitude of the output corresponds to the analog command input value and thus determines the speed of the motor.</p>
Brake	Turns off motor voltage, thus activating the inherent holding force of the motor.
Set Offset	Set command level in which the slide is in standstill. While applying this command level, using either a controller or a joystick, toggle “enable” off and then on again, and then short this pin (19) to ground. The driver will then “remember” this level of command as its zero. (Max 2.5V command)

**PLEASE NOTE: JUMPER JMP1 IS FOR FACTORY USE ONLY AND SHOULD REMAIN SET ON 1-2. DO NOT CHANGE.**

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## 4.2 PARAMETERS AND CONDITIONS

### Electrical Specifications

**Power Input** +24VDC  $\pm$ 5%  
**Power Consumption without Load** +24VDC/0.3A

Supply Voltage	Maximum Current Consumption	Applicable For
24V $\pm$ 5%	2A	E1 to E4
	3A	E8
	6A	E16
	12A	E32

### Environmental Specifications

**Operating Temperature** 0°C to 50°C  
**Storage Temperature** -40 to 70°C  
**Operating Humidity** Up to 80% Non condensing

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## 4.3 HEAT DISSIPATION CONSIDERATIONS USING THE AB5 DRIVER

The AB5-3U driver presents new opportunities for driving Nanomotion motors. It enables working with the Nanomotion motor with practically no dead band. This is done with a new excitation mode where the motor operates linearly. The advantage of Nanomotion inherent brake is kept and a brake command can be sent to the driver so that motor voltage is set to zero, producing the motors inherent holding force.

In this new drive mode the thermal EOP is changed due to higher power consumption of the motor as compared to normal drive mode. In continuous operation when the motor is not disabled at stop ("Brake Off"), the motor consumes power at all times and therefore has a lower thermal EOP. On the following page the motor velocity-force curves are presented with a table of allowable operation duty cycle and continue operation.

**In vacuum environments, the motor should ideally operate in brake mode only. Nevertheless, it may be operated in continuous mode as long as the maximum continuous operation time is not exceeded. After operation, the motor should be disabled and allowed to cool down for 7 minutes.**

Thermal EOP with AB5 driver					
Curve	Duty-Cycle			Maximal continuous operation time [sec]	
	Ambient - 25°C Continues Mode	Ambient - 25°C Brake mode	Vacuum Brake mode	Ambient 25°C	Vacuum
A	100%	100%	56%	-	500
B	100%	100%	54.0%	-	450
C	100%	100%	45.0%	-	280
D	100%	100%	33.0%	-	170
E	99%	99%	23.0%	-	100
F	53%	58%	15.0%	170	66
G	33%	48%	11.0%	77	44
H	17%	28%	6.5%	32	25

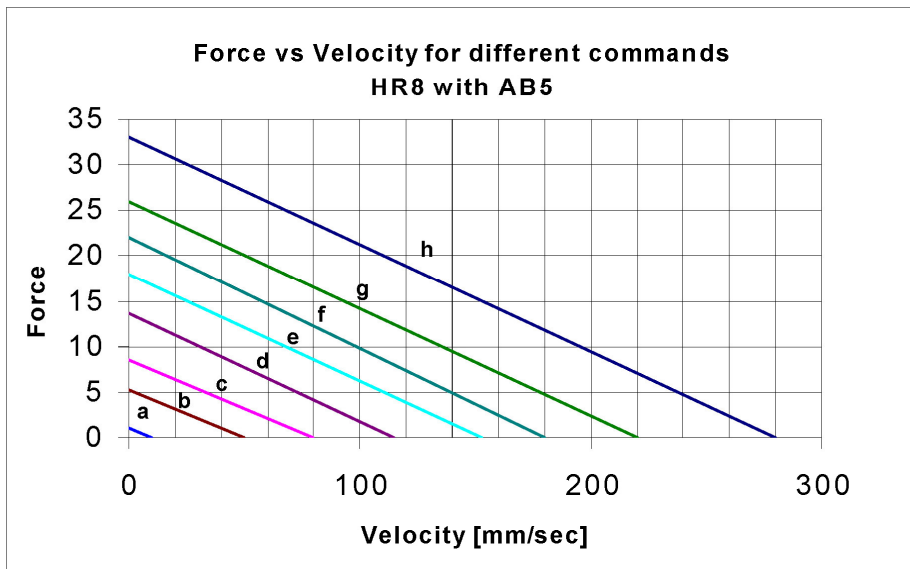


Figure 1: EOP Considerations



## 4.4 BOARD LAYOUT

