AB5-3U Driver

User Manual

PRELIMINARY

Rev 1.0 April 2004

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Preface

About the User's Manual

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

Table of Contents

Chapter 1: Introduction

1.1 GENERAL

The AB5-3U is a single axis amplifier box designed to drive Nanomotion motors. The driver enables the eliminating of the inherent friction of the motor, thus simplifies interfacing to it, 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.
- tricolor 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 enables smooth motion with higher precision on motor operation.

The output transformer-amplifier circuit converts the PWM output signal into a sine wave high voltage 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

2.1 LED INDICATORS

	LED 1	LED 2
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

Please note: Leds on first models are mounted on top board; in later models leds will be provided on a wire, enabling them to be mounted to the front panel.

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:	±10V
Input impedance:	10KΩ
Input low pass filter:	2.7KHz

Differential connection

This connection provides noise immunity.

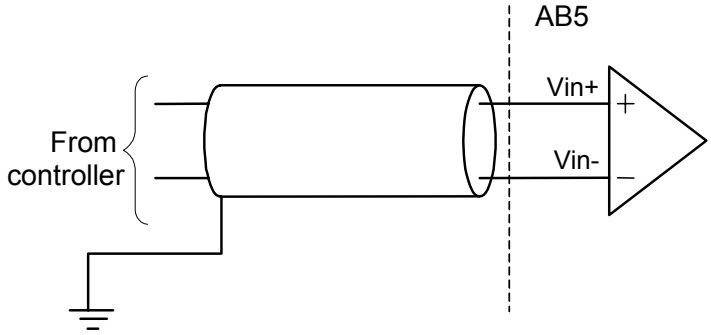


Figure 1: Differential Analog Input Connection

Single Ended connection

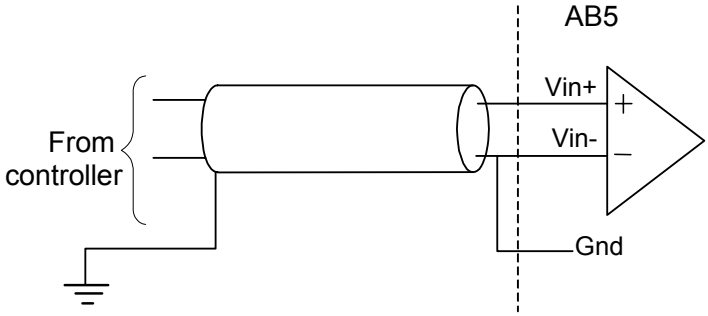


Figure 2: Non-Differential (single ended) Analog Input Connection.

Chapter 3: Installation

3.1 SAFETY WARNINGS

WARNINGS:

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

(*) During operation motors are heated up. When motor stopped it will cool down and electric charge will be built. If earth is disconnected this will produce high voltage on 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 power supply 24V (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 (see the annexed document)***

Chapter 4: Specifications

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
D16	34	RIGHT LIMIT SWITCH	Input	Disables the driver
B16	35	LEFT LIMIT SWITCH	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 conector.
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 conector)
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 conector)
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 conector)
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 also not listed.

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	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: • ON phase - 1/16 second • OFF phase - 0.5 second The amplitude of the output corresponds to the analog command input value and thus determines the speed of the motor.
Brake	Turns off motor votage, 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.

4.2 PARAMETERS AND CONDITIONS

Electrical specifications

Power Input	+24VDC ±5%
Power Consumption without Load	+24VDC/0.3A

Supply Voltage	**Maximum Current Consumption**	**Applicable For**
24V +/-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

4.3 HEAT DISSIPATION CONSIDERATIONS USING THE AB5 DRIVER

AB5 driver for Nanomotion motor presents new opportunities for driving Nanomotion motors. It enables working with the piezomotor with practically no dead band. This is done with a new excitation mode where the motor operates linearly. Still 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 compare to normal drive mode. In continues operation when the motor is not disabled at stop ("Brake Off"), the motor consumes power at all time and therefore have lower thermal EOP. In the next page the motor velocity-force curves are presented with a table of allowable operation duty cycle and continue operation.

In vacuum the motor should 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 that, the motor should be disabled to allow cool down for 400 seconds.

Thermal EOP with AB5 driver					
	Duty-Cycle			Maximal continuous operation time [sec]	
Curve	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

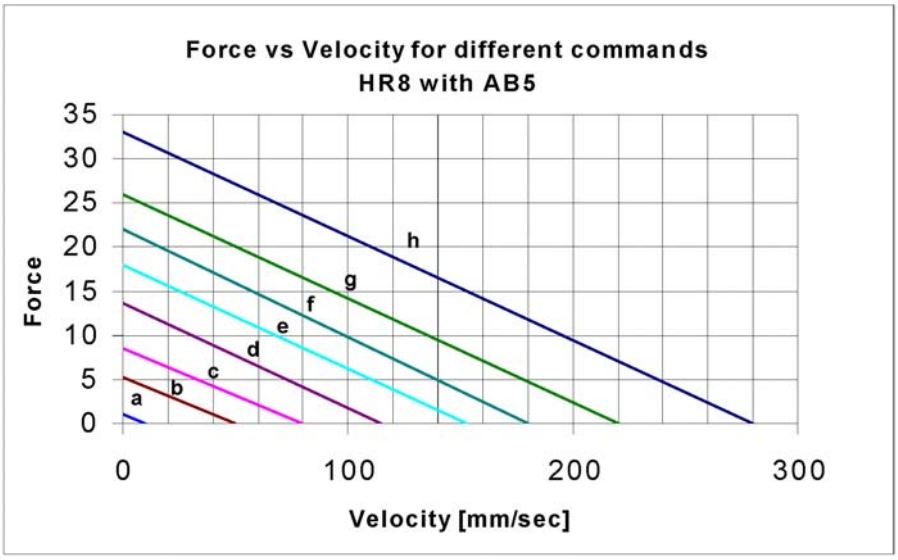
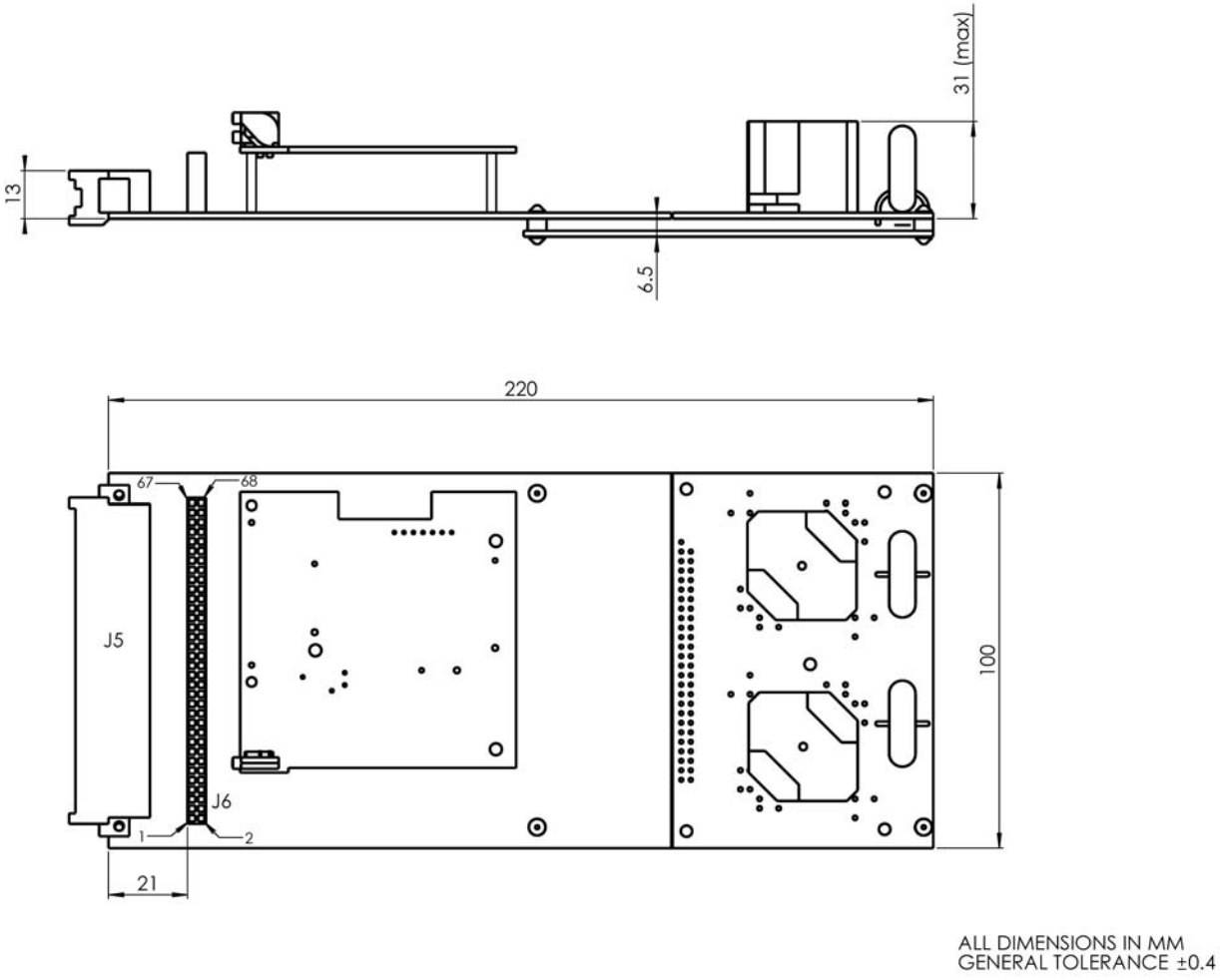


Figure 1: EOP Considerations

4.4 BOARD LAYOUT



ALL DIMENSIONS IN MM
GENERAL TOLERANCE ±0.4