Atlas
Motion by Summit Electronics

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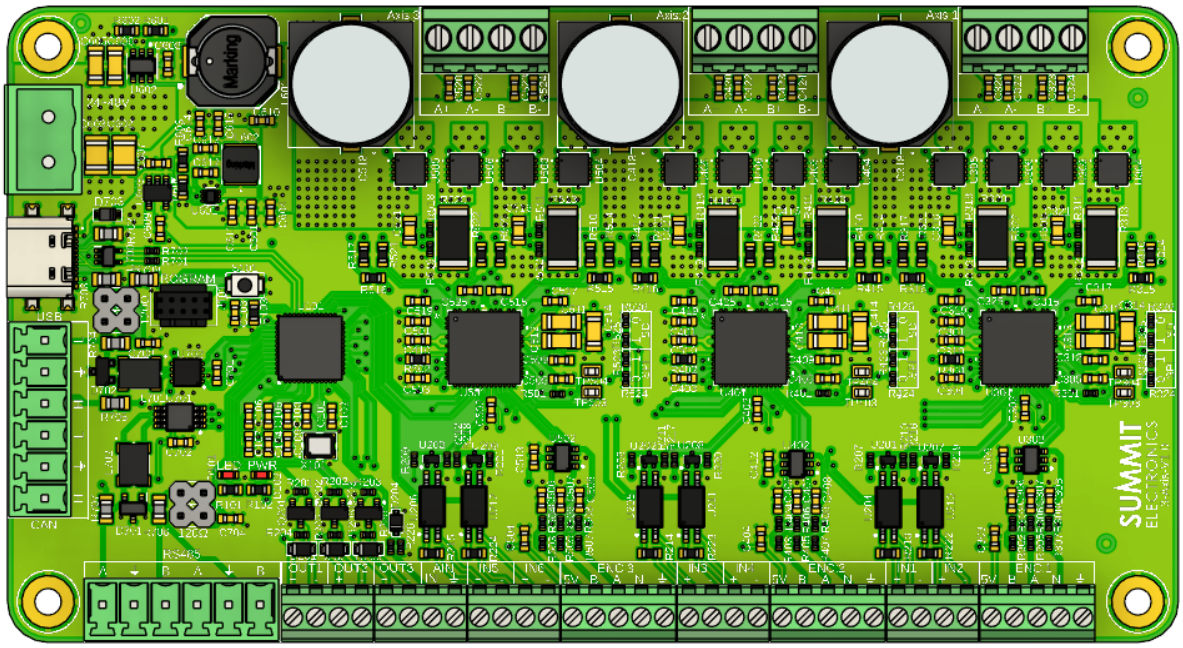
Atlas Control Step 3 Controller Board



Master Multi-Axis Motion

The premium Step 3 Stepper Motor Controller Board

RoHS COMPLIANT 2002/95/EC

SUMMIT ELECTRONICS

Atlas Control by Summit Electronics

We offer you the ultimate, compact “Smart Actuator” for motion control. The compact Atlas Control Step 1 and Step 3 stepper Motor Controller and Driver Boards based on an engine independent system. With a true Dutch design and the ADI Trinamic technology inside, you get real quality.

Take your Industrial, Medical or robotics project to the next level. If you are building a 3D printer, medicine dispenser or a custom packing machine: our Atlas Control Step 3 Stepper Motor Controller Board provides the synchronized, high-precision control your hardware demands. This all comes from a single, streamlined board. Stop juggling multiple individual drivers and unnecessary wiring. This heavy-duty, all-in-one solution delivers Dutch design for an unbeatable value, quality engineering, and state-of-the-art ADI Trinamic technology. Ideally combined with our Atlas Engines Stepper Motor.

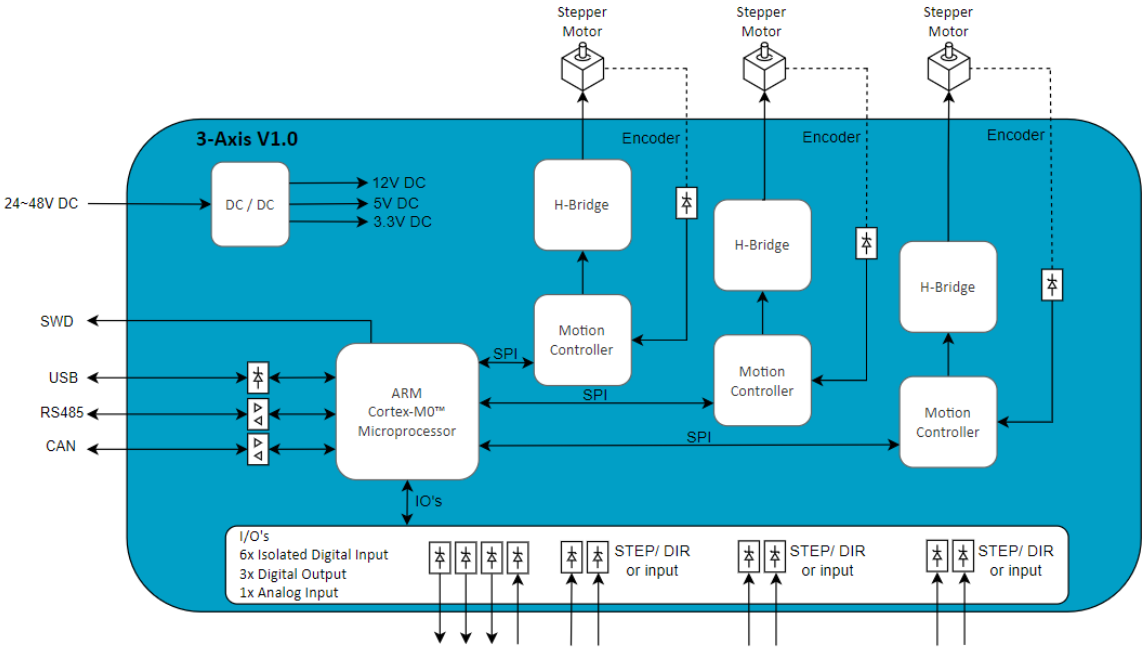
Content

1 Functional description

1.1 Product overview

The Atlas Control Step 3 Controller Board is a three axis motion controller module and 2-phase bipolar stepper motor driver with high torque and has sophisticated features like an ultra-low-noise chopper mode, and a programmable stall guard. The 3-axis board can be controlled and configured by the onboard STM32-Cortex M0+ microcontroller. Every axis offers an encoder input to allow for closed loop control. To allow for versatile use cases, the 3-axis board features a CAN bus with 2 connections making the board suitable for “daisy chaining”, Further it offers an RS485 bus interface, 6x isolated 5 to 12V Inputs, 3x 12V outputs and 1x 5V analog input for connecting external electronics.

1.2 Block diagram



1.3 Typical applications

- Compact Stepper Motor Driver
- Handling & Automation
- Stand-alone and multi Axis operation

2 General Specifications

2.1 Electrical Properties

Parameter:	Description
Rated Voltage:	24~48V DC (48V DC Max.)
Rated Current:	3A (~4A Peak)
Microprocessor:	STM32 Cortex M0
Interfaces:	FDCAN interface with classic CAN support RS485 interface USB interface (USB-C connector) STEP / DIR input (for each axis separated and shared with Isolated Digital Input) Encoder input (for incremental A/B/N encoder signals) SWD input (for programming STM MCU)
I/O's:	6x Isolated Digital Input (5-12V Max. / 50 mA) 3x Digital Output (12V / 200 mA) 1x Analog Input (5V Max.)

3 Electrical Specifications

3.1 Recommended Operating Conditions

Operating Condition	Description	Min.	Typ.	Max.
Operating temperature range		0˚C	~	+60˚C
$\mathbf{V_M} = \mathbf{V_{CC}}$	Power/ Motor Supply Voltage	23,8V	48V	48,2V
$\mathbf{I_M}$	Motor Current			3.0A (4A Peak)

IMPORTANT: Do not connect or disconnect motor during operation, as this can lead to voltage spikes which might exceed voltage limits of the driver and permanently damage the MOSFET's.

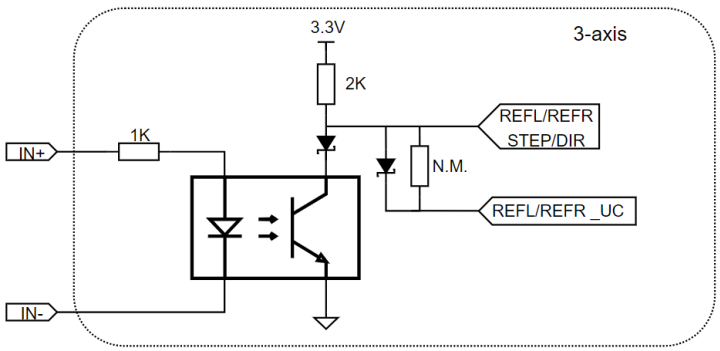
IMPORTANT: Wrong polarity can damage the 3-axis board.

3.2 I/O's Electrical Ratings

Parameter	Description	Min.	Typ.	Max.
V_{in}	Input voltage	5V		12V
I_{in}	Input current		11mA	
$I_{f,opto}$	Forward current optocoupler			50mA
V_{out}	Output voltage		12V	12,1V
I_{out}	Output Current			200mA
V_{Analog}	Analog voltage	0V		5,1V
ADC Resolution	Resolution		12 bit	

3.2.1 Digital Input

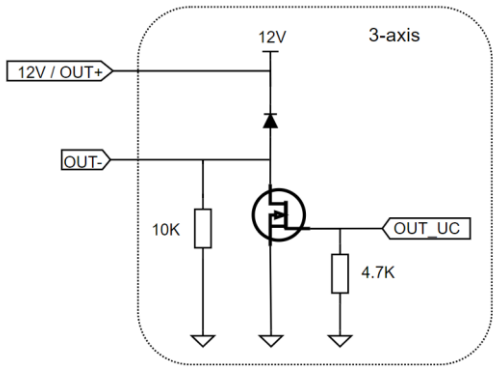
Input 1, 3 and 5 can be configured as REFL / STEP input or general input.
Input 2, 4 and 6 can be configured as REFR / DIR input or general input.
Both STEP and DIR signals can be configured to be sent from the onboard MCU, when the N.M. resistor is fitted with a 0 Ohm resistor. Alternatively the STEP / DIR signals can be provided externally through IN+/IN- without adjusting the resistors. (Note: TMC5160 should be put in SD_MODE mode if STEP/DIR is required, see Chapter 3.5 for more details on SD_MODE).



Due to limitations of the optocoupler, the maximum STEP frequency is limited to around 20KHz.

3.2.2 Digital Output

Output 1, 2 and 3 are general outputs, controlled by a MOSFET's driven by the MCU. Each output switches a 12V load connected between 12V/OUT+ and OUT-. A flyback diode is connected across the load to protect the MOSFET from voltage spikes generated by inductive loads.

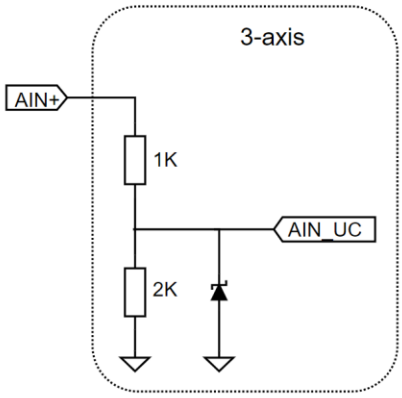


3.2.3 Analog Input

AIN is connected to a voltage divider with the following conversion rate:

$$Vout = \frac{2K}{1K + 2K} \cdot 5V = 3.3V$$

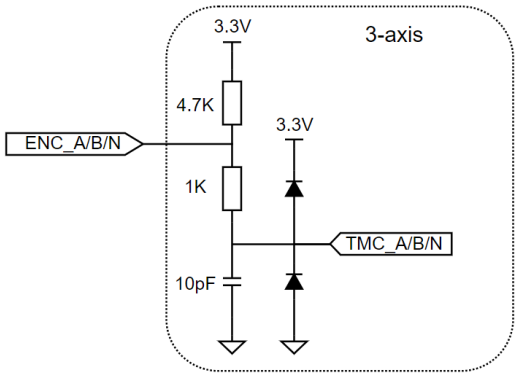
The voltage clamp is set at 3.3V to protect the MCU from overvoltage.



3.3 Encoder Electrical Ratings

Parameter	Description	Min.	Typ.	Max.
V_{enc}	Encoder Voltage output		5V	
$A_{High\ Level}$	Input for incremental encoder	2.3V	3.3V	3.6V
$B_{High\ Level}$	Input for incremental encoder	2.3V	3.3V	3.6V
$N_{High\ Level}$	Input for incremental encoder	2.3V	3.3V	3.6V

The Atlas Control Step 3 Controller Board offers 3 separate encoder inputs. An external incremental A/B/Z encoder can be connected to the encoder connector to create a closed loop system.



3.4 Motor Current

The TMC5160 drivers on the 3-axis board operate in current-control mode. The driver current may be programmed in the software for motor coil currents up to 3A, the CS value is limited to 23 in the library due to CS 23 being the max ~3A value. please note this table is different for every stepper motor used. Start your test with a low CS setting and scale up slowly. Do not cross the stepper motor and 3-axis board's current rating.

Below DC input current is measured on the input side of the PCB, at 48V, with 1 stepper active.

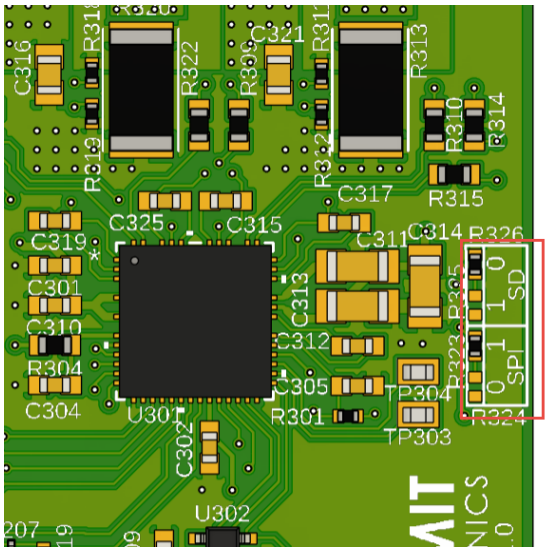
Motor Current setting [CS]	DC input current [mA]	AC Motor coil current [mA]
1	80	228
2	95	355
3	95	570
4	103	690
5	111	816
6	119	920
7	125	1022
8	137	1140
9	150	1264
10	165	1386
11	180	1510
12	198	1633
13	216	1754
14	223	1880
15	257	2005
16	270	2125
17	302	2250
18	327	2374
19	344	2495
20	390	2618
21	407	2745
22	444	2880
23	484	2998

3.5 TMC5160 mode

The Atlas Control Step 3 Controller Board is by default set up to be in SPI_MODE, meaning it's controlled by the MCU using the SPI interface. This mode is recommended to get the most out of the functionality and special features offered by the TMC5160 chip. If STEP / DIR control is required, the TMC5160 should be put in SD_MODE.

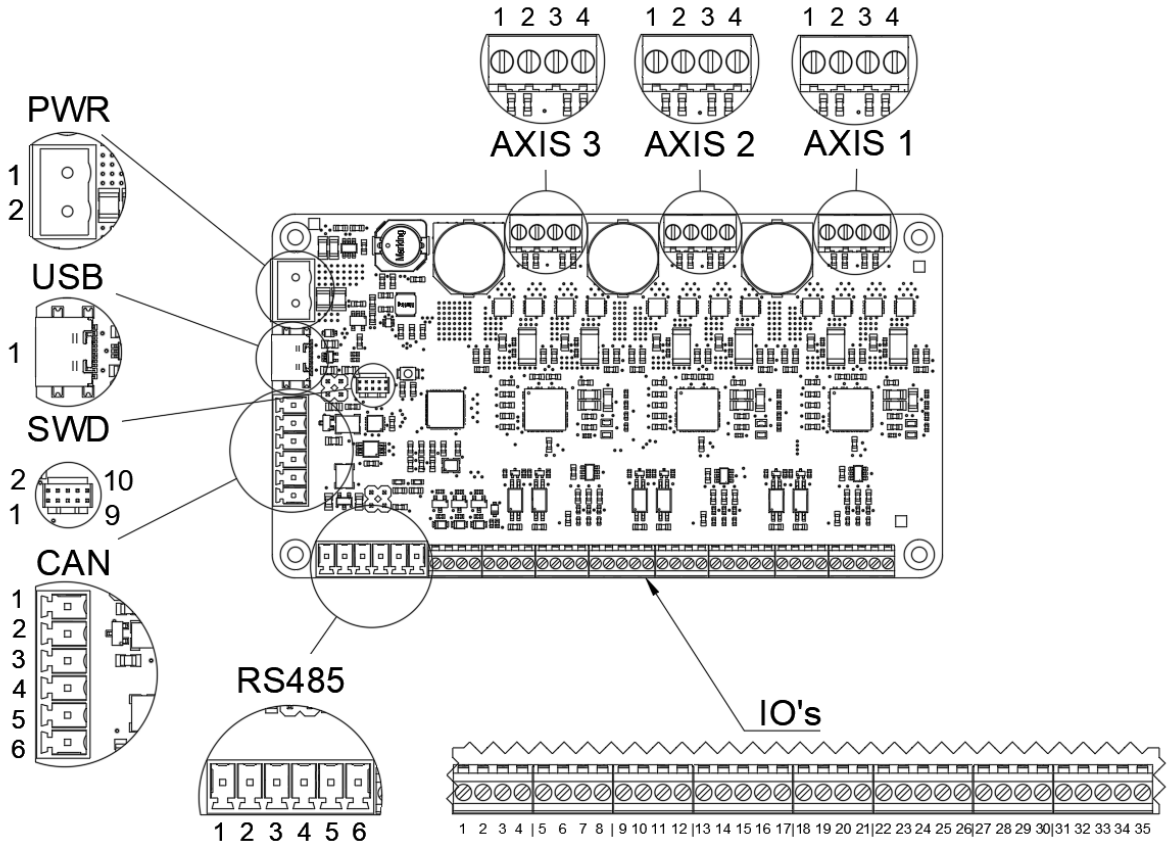
This can be achieved by adjusting onboard resistors, as marked on the board.

Axis no.	SPI_MODE	SD_MODE	Resistors
Axis 1	SPI = 1, SD = 0	SPI = 0, SD = 1	R326, R325, R323, R324
Axis 2	SPI = 1, SD = 0	SPI = 0, SD = 1	R426, R425, R423, R424
Axis 3	SPI = 1, SD = 0	SPI = 0, SD = 1	R526, R525, R523, R524



4 Mechanical specifications

4.1 Pin Assignment



Connector Name	#	Function	Notes
PWR	1	VM	24 ~ 48V DC
	2	GND	
USB	1	USB	USB-C fixed 5V PWR input, and USB data communication

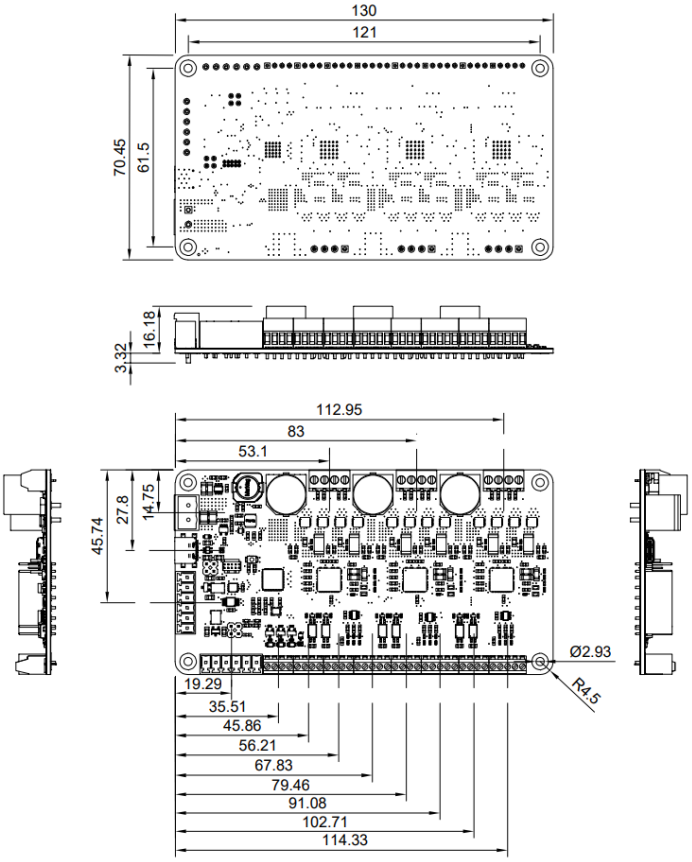
SWD	1	3.3V	STM Microprocessor program / Debug
	2	SWDIO	
	3	GND	
	4	SWCLK	
	5	GND	
	6	N.C	
	7	N.C	
	8	N.C	
	9	GND	
	10	NRST	
CAN	1	CANL	1 Channel CAN bus, 2 access points for daisy chaining
	2	GND	
	3	CANH	
	4	CANL	
	5	GND	
	6	CANH	
RS485	1	A	1 Channel RS485 bus, 2 access points for daisy chaining
	2	GND	
	3	B	
	4	A	
	5	GND	
	6	B	
I/O	1	OUT1+	Digital Output, OUT_1+ is connected to 12V, 50mA max
	2	OUT1-	
	3	OUT2+	Digital Output, OUT_2+ is connected to 12V, 50mA max
	4	OUT2-	
	5	OUT3+	Digital Output, OUT_3+ is connected to 12V, 50mA max
	6	OUT3-	
	7	AIN	Analog Input (5V max)
	8	GND	
	9	Axis3_IN5+	Digital input / REFL / STEP input on Axis 3, Optocoupler input R = 1KOhm 5/12V, 200mA max
	10	Axis3_IN5-	
	11	Axis3_IN6+	Digital input / REFR / DIR input on Axis 3, Optocoupler input R = 1KOhm 5/12V, 200mA max
	12	Axis3_IN6-	

I/O	13	Axis3_ENC_5V	
	14	Axis3_ENC_B	
	15	Axis3_ENC_A	
	16	Axis3_ENC_N	
	17	GND	
	18	Axis2_IN3+	Digital input / REFL / STEP input on Axis 2, Optocoupler input R = 1KOhm 5/12V, 200mA max
	19	Axis2_IN3-	
	20	Axis2_IN4+	Digital input / REFR / DIR input on Axis 2 Optocoupler input R = 1KOhm 5/12V, 200mA max
	21	Axis2_IN4-	
	22	Axis2_ENC_5V	
	23	Axis2_ENC_B	
	24	Axis2_ENC_A	
	25	Axis2_ENC_N	
	26	GND	
	27	Axis1_IN1+	Digital input / REFL / STEP input on Axis 1, Optocoupler input R = 1KOhm 5/12V, 200mA max
	28	Axis1_IN1-	
	29	Axis1_IN2+	Digital input / REFR / DIR input on Axis 1, Optocoupler input R = 1KOhm 5/12V, 200mA max
	30	Axis1_IN2-	
	31	Axis1_ENC_5V	
	32	Axis1_ENC_B	
	33	Axis1_ENC_A	
	34	Axis1_ENC_N	
	35	GND	
Axis 1	1	A+	Stepper motor connection for Axis 1
	2	A-	
	3	B+	
	4	B-	
Axis 2	1	A+	Stepper motor connection for Axis 2
	2	A-	
	3	B+	
	4	B-	
Axis 3	1	A+	Stepper motor connection for Axis 3
	2	A-	
	3	B+	
	4	B-	

Connector Name	Connector on 1-axis	Mating Connector
PWR	STB1001V-5-2	STB2040V-5-2
USB	USB type C female	USB type C Male
SWD	FTSH-105-01-L-D-K	
CAN	STB1000VH-3.5-6	STB2000V-3.5-6
RS485	STB1000VH-3.5-6	STB2000V-3.5-6
I/O	MX308-2.54-04P & 05P	None
Axis 1	DG380-3.5-04P	None
Axis 2	DG380-3.5-04P	None
Axis 3	DG380-3.5-04P	None

4.3 Module Dimensions

Unit: mm

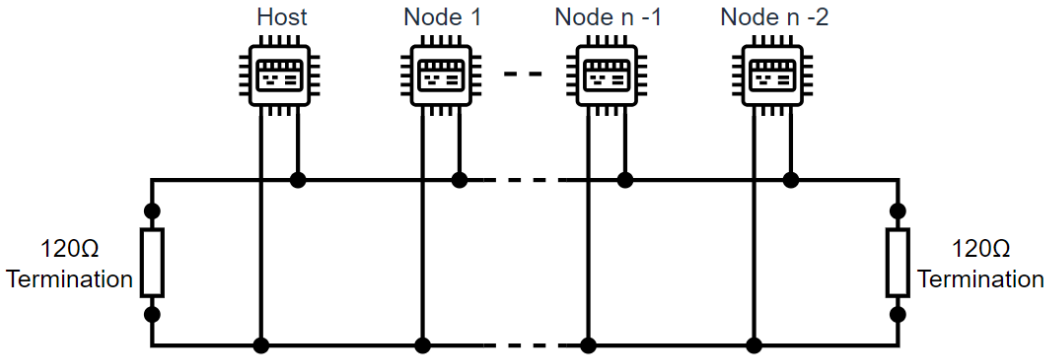


5 Communication

5.1 CAN bus

Bus structure:

The CAN network topology should follow a linear bus structure, where all nodes are connected along a single communication line. The physical wiring between the bus and each node, as well as between nodes, should be kept as short as possible to minimize signal reflections and maintain signal integrity. Long stubs and branches can cause distortion, resulting in communication errors.



Bus termination:

CAN bus termination resistors are located on the front of the 3-axis PCB. Four pins are provided and can be connected using 2.54 mm jumper bridges, as shown in the image below. The bus is terminated using a 120 Ω resistor, which is a standard value to match the characteristic impedance of typical CAN cables. The termination jumpers are not connected by default and should be manually installed when termination is required, usually at both physical ends of the CAN bus.

Number of Nodes:

The Atlas Control Step 3 Controller Board module uses the TJA1042TK/3/1 CAN transceiver, which presents a high differential input impedance of approximately 19 kΩ. This means that each node places minimal DC load on the bus, so the theoretical maximum number of nodes is not limited by the transceiver input resistance.
However, practical limits on the number of nodes stem from the total bus electrical characteristics:

- Unit Load: Each transceiver adds a unit load to the bus, and the CAN standard typically supports up to 30 unit loads per segment. Using transceivers with lower unit loads can increase this number.
- Bus Capacitance and Length: The overall bus length and cable capacitance affect signal propagation and timing. Longer cables increase delay and reduce the maximum achievable bitrate.
- Stub Length: The length of the wiring stub between each node and the main bus line should be kept as short as possible (preferably less than 30 cm) to avoid reflections and signal degradation.
- Bit Rate: Higher bit rates require shorter bus lengths to maintain signal integrity. For example, a 1 Mbps CAN network is typically limited to around 40 meters of bus length, whereas lower bit rates allow longer cables.

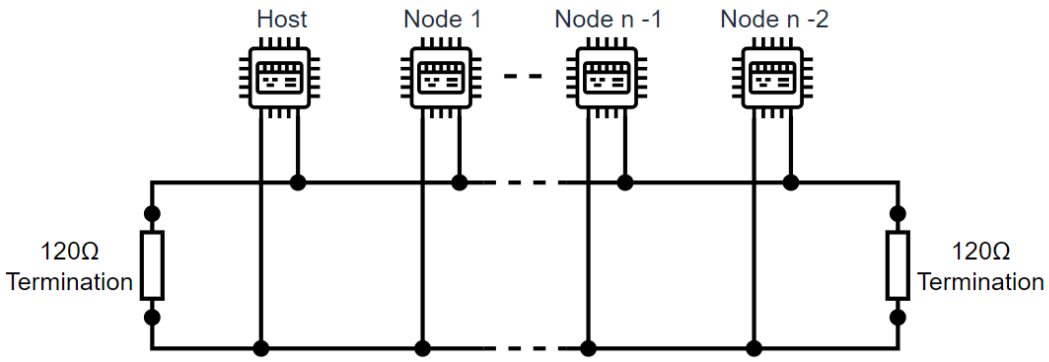
To ensure reliable communication, it is recommended to:

- Use 120 Ω termination resistors at each end of the CAN bus.
- Keep stub lengths as short as possible.
- Limit the number of nodes per bus segment to approximately 30 when using standard unit-load transceivers.
- For networks requiring more nodes or longer cable lengths, consider using CAN repeaters or segmented buses.

5.2 RS485 bus

Bus structure:

The RS485 network topology should follow a linear bus structure, where all nodes connect along a single communication line. To maintain signal integrity and minimize reflections, wiring between the bus and each node, as well as between nodes, should be kept as short as possible. Long stubs and excessive branching can cause signal distortions, leading to communication errors or data loss.



Bus termination:

Termination resistors for the RS485 bus are located on the front of the 3-axis PCB. Four pins are provided and can be connected using 2.54 mm jumper bridges, as shown in the image below. The RS485 bus is terminated using a 120 Ω resistor to match the characteristic impedance of typical RS485 cables. Termination jumpers are not connected by default and must be manually installed when termination is required, typically at both ends of the bus line.

Number of Nodes:

The Atlas Control Step 3 Controller Board uses the SN65HVD3085EDGKR RS485 transceiver, The RS-485 standard specifies that a compliant driver must be able to driver 32 unit loads (UL), where 1 unit load represents a load impedance of approximately 12 kΩ. The SNx5HVD308xE is a 1/8 UL transceiver, which means it can connect up to 256 receivers to the bus.

However, the practical number of supported nodes is influenced by several factors:

- **Load per Node:** RS485 transceivers have a specified input impedance, and the RS485 standard defines unit loads. The SN65HVD3085EDGKR is designed to present a low unit load (1/8th unit load), enabling more nodes to be connected without exceeding the bus loading limits.
- **Bus Length and Cable Characteristics:** The maximum bus length depends on the data rate and cable type. Longer cables increase signal attenuation and propagation delay, limiting achievable baud rates.
- **Stub Length:** Similar to CAN, the length of stubs connecting each node to the main bus should be minimized (ideally less than 30 cm) to avoid reflections.

- **Termination and Biasing:** Proper termination at both ends of the bus, along with biasing resistors to maintain a known idle state, are critical for reliable communication.

To ensure reliable operation:

- Use 120 Ω termination resistors at each end of the RS485 bus.
- Keep stub lengths as short as possible.
- For applications requiring more nodes or longer cable runs, repeaters or segmented bus architectures should be used.

5.3 USB

The example software configures the USB interface of the Atlas Control Step 3 as VCP (Virtual COM port).
This allows for serial communication with the board at 115200 baud using a serial monitor tool.

Besides USB communication, this connector can also be used to supply the low voltage segments (5V) of the 3-axis board. This allows the board to be programmed and debugged, but will not allow stepper motor control.

The USB can also be used to flash new software onto the MCU using the DFU (Device Firmware Update) mode. More details can be found in the Summit_Stepper_Driver_Module_SDK_User_Guide.pdf

6 Software

The Atlas Control Step 3 can be programmed using STMCubeIDE, using the SWD interface available on the board.

The Software Development Kit (SDK) contains libraries, header files, and example code to interface with Summit Stepper driver modules.

The SDK can be downloaded from the official Summit GitHub repository.

Link: https://github.com/Summit-Electronics

More details regarding software setup, building and flashing can be found in the document: Summit_Stepper_Driver_Module_SDK_User_Guide.pdf

Technical support

For all product questions please contact us via info@summit-electronics.com.

Ordering information

Order your modules via www.summit-electronics.com or info@summit-electronics.com. Please contact us for more information. Customization of the product is available on request.

Document Information	
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Subtitle	Summit Motion Atlas series
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Product Status

Active, (Mass production)

This document applies to the following products:

Name	Type number	version	Product Status
Atlas Control	Step 3 Controller Board	1.0	Available