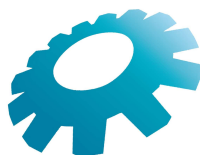




AGA1xx

Central-i DC Power Amplifier

Product Manual



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Revision History

Version	Description	Date
2.9	Updated the fonts.	17 September 2026
2.8	Updated Analog Input connection diagram.	26 December 2025
2.7	Updated electrical interface connection diagrams and pinout drawings. Revised the connector pin names to match the terminal names of electrical interface connection diagrams. Corrected Bi-directional differential I/Os quantities for AGA102 and AGA103. Revised the Central-i connector pin name and description. Corrected I/O Power and I/O Power Return pin description for connector X7, X10 and X12. Added Hall sensor pin recommended and description for AGA110, AGA101 and AGA102. Added thermostat option to PT100 port. Deleted AqB encoder disconnected function. Updated system connection and wiring diagram. Corrected I/O power silkscreen to 5-28VDC for AGA110/101/102.	9 July 2025
2.6	Updated voltage specifications.	2 April 2025
2.5	Updated voltage specifications. Updated connector information for electrical interfaces. Updated pinout tables and diagrams for Central-i interfaces. Added safety inputs specifications and updated Safety Circuitry. Updated manual cover. Various, minor text corrections.	20 July 2023
2.4	Added mating connector part numbers for encoder port.	9 March 2023
2.3	Correction for AGA103: port name for Central-i connector.	2 March 2023
2.2	Corrections/updates for AGA110: AGA110 does not include power inverted polarity protection. AGA110 standards certification is pending. AGA110 variant with 7.0 A _{rms} cont, 14.0 A _{rms} peak is only model currently available. Added AGA110 photo in section General Description.	27 February 2023
2.1	Minor text and format corrections.	14 February 2023



Version	Description	Date
2.0	Added AGA110 product documentation. Replaced all pinout and dimensions diagrams with improved images. New system grounding diagram. Updated mating connector tables. AGA101/AGA102 – Encoder pinouts corrected. PT100 in AGA103 only (correction).	9 February 2023
1.2	AGA103 Interface X1: I/Os – correction (Halls). AGA101 Interfaces X7, X10 and X12: I/Os – correction (digital outputs). Electrical/Mechanical Specifications – corrected table format. Corrected minor typos.	7 October 2021
1.1	Deleted: AGA101 sin/cos configuration option on Aux Encoder port in Technical Specifications. Added: AGA103 isolated digital output circuit diagram. Minor text corrections.	4 August 2021
1.0	Initial release	2 August 2021

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Warranty

This product is warranted to be free of defects in material and workmanship and conforms to the specifications listed in this manual, for a period of 12 months from the shipment date from factory.



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1 Product Description

1.1 General Description

The AGA1xx is a series of DC amplifiers controlled by an AGM series Central-i master. The master controller reads encoder values and current samples from the amplifiers, performs control loops calculation, and generates PWM commands for the amplifiers.

Communication between AGA1xx amplifiers and master controller is through a fast Central-i fieldbus, which supports 16 kHz sample rate motion profiler and all servo loops.

The amplifiers are equipped with digital I/Os and analog inputs suitable for typical actuators and applications. The digital outputs are capable of sourcing up to 300 mA or sinking up to 500 mA, which is sufficient for driving most external devices and end effectors, and eliminates the need for an external relay circuit.

The AGA1xx amplifiers are compact, ideal for mounting close to the actuator, such as the link in an articulated robot arm.



Figure 1. AGA1xx Amplifier Series



1.2 Part Numbering

1.2.1 AGA110 Product Variants

Product Description	Part Number Format
Remote amplifier	AGA110-CI-5Dxx

CI: Central-i communication

5D: 80–190 VDC power supply

xx: Continuous and peak current options

- **07:** 7.0 A_{rms} continuous, 14.0 A_{rms} peak

Example: AGA110-CI-5D07 indicates 7.0 A_{rms} continuous current and 14.0 A_{rms} peak current

1.2.2 AGA101 Product Variants

Product Description	Part Number Format
Remote amplifier	AGA101-CI-2Dxx

CI: Central-i communication

2D: 12–90 VDC power supply

xx: Continuous and peak current options

- **01:** 1.4 A_{rms} continuous, 2.8 A_{rms} peak
- **02:** 2.8 A_{rms} continuous, 5.6 A_{rms} peak
- **05:** 5.6 A_{rms} continuous, 11.2 A_{rms} peak

Example: AGA101-CI-2D02 indicates 2.8 A_{rms} continuous current and 5.6 Arms peak current

1.2.3 AGA102 Product Variants

Product Description	Part Number Format
Amplifier	AGA102-CI-1Dxx

CI: Central-i communication

1D: 12–48 VDC power supply

xx: Continuous and peak current options

- **01:** 1.4 A_{rms} continuous, 2.8 A_{rms} peak

Part Numbering



- **02:** 2.8 A_{rms} continuous, 5.6 A_{rms} peak
- **05:** 5.6 A_{rms} continuous, 11.2 A_{rms} peak

Example: AGA102-CI-1D05 indicates 5.6 A_{rms} continuous current and 11.2 A_{rms} peak current

1.2.4 AGA103 Product Variants

The AGA103 has no product variants. It has 2.8 Arms continuous current and 5.6 Arms peak current.

Product description	Part numbers
Amplifier	AGA103-CI-1D03

CI: Central-i communication

1D: 12—48 VDC power supply



1.3 System Design

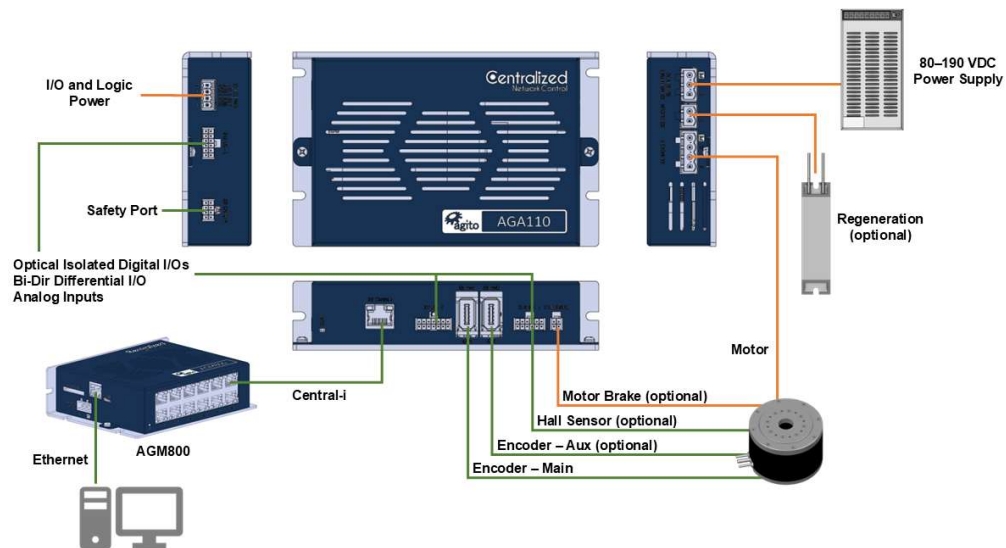


Figure 2. AGA110 System Connection and Wiring

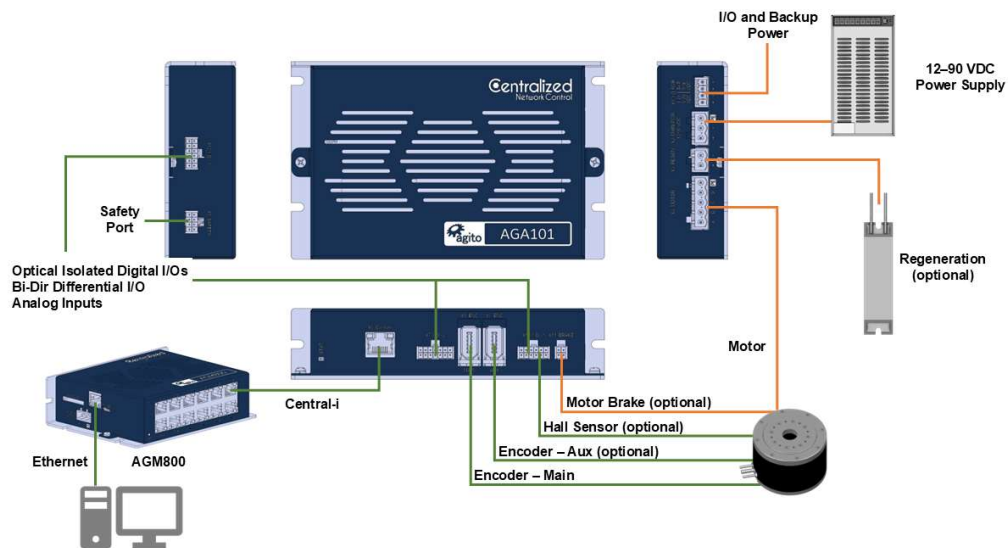


Figure 3. AGA101 System Connection and Wiring

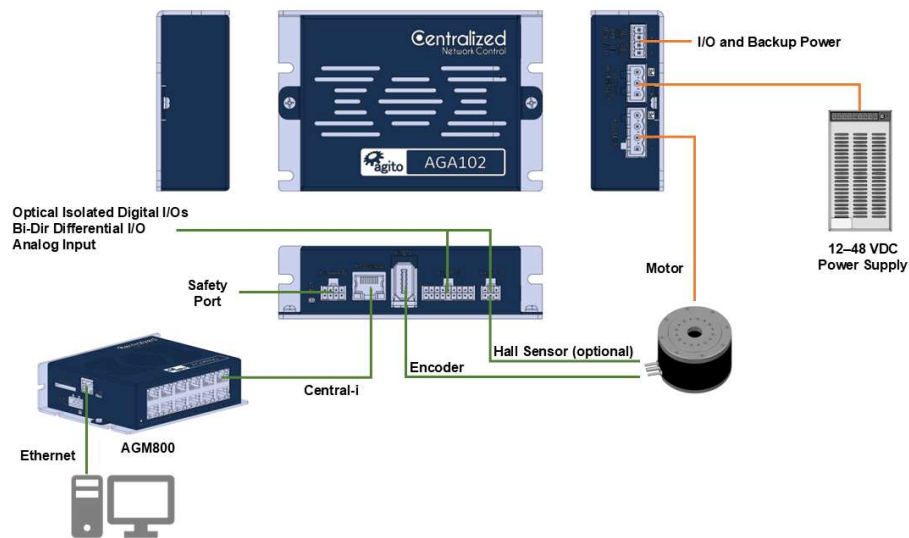


Figure 4. AGA102 System Connection and Wiring

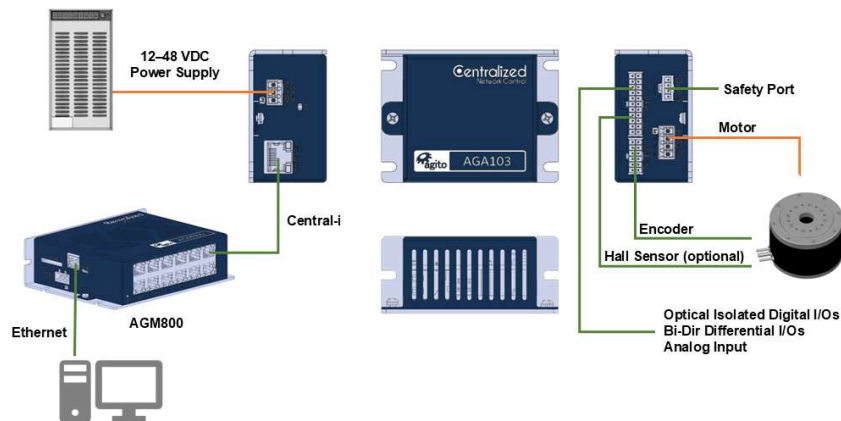


Figure 5. AGA103 System Connection and Wiring



1.4 Technical Specifications

Electrical/Mechanical Specifications

Feature	AGA110	AGA101	AGA102	AGA103
Number of axes	1	1	1	1
Nominal supply voltage	80–190 VDC	12–90 VDC	12–48 VDC	12–48 VDC
Minimum supply voltage	70 VDC	11 VDC	11 VDC	11 VDC
Maximum supply voltage	200 VDC	95 VDC	55 VDC	55 VDC
Continuous output current (internally limited by firmware)	7.0 A _{rms}	1.4 2.8 5.6 A _{rms}	1.4 2.8 5.6 A _{rms}	2.8 A _{rms}
Peak output current (Internally limited by firmware)	14.0 A _{rms}	2.8 5.6 11.2 A _{rms}	2.8 5.6 11.2 A _{rms}	5.6 A _{rms}
Peak current time	2 sec	3 sec	3 sec	3 sec
Output frequency	0 – 599 Hz	0 – 599 Hz	0 – 599 Hz	0 – 599 Hz
Over-current protection	40 A _{rms}	10 20 40 A _{rms}	10 20 40 A _{rms}	20 A _{rms}
Isolated digital inputs (see Note 1)	11	11	7	5
Isolated digital outputs (see Note 2)	3	3	2	2 (see Note 3)
Bi-directional differential I/Os (RS422)	1	1	1	2
Analog inputs	2 (12-bit)	2 (12-bit)	1 (12-bit)	1 (12-bit)
Analog outputs	–	–	–	–
PT100/Thermostat	–	–	–	1
Brake outputs	1	1	–	–
Regeneration outputs	1	1	–	–
Encoder port – Main	Configurable as AqB, Sin/Cos 1Vpp, Absolute BiSS-C, Absolute EnDat2.2, SSI			
Encoder port – Auxiliary	Configurable as AqB, Absolute BiSS-C, Absolute EnDat2.2, SSI		–	
Motor types	Voice coil, Brushed/ brushless linear/rotary, 2-phase stepper (open/closed loop, micro-stepping)			
Communication	Central-i			
PWM frequency	16 kHz			



Feature	AGA110	AGA101	AGA102	AGA103
Power supply to external devices	Voltage: 5V Overall max. current: 0.5A			

Note 1: Isolated digital inputs can be configured as NPN or PNP, in groups of 3 or 4.

Note 2: Isolated digital outputs can sink up to 500 mA or source up to 300 mA.

Note 3: AGA103: digital isolated outputs can be configured only as NPN (sink).

Encoder Ports Specifications

Feature	Specification
Encoder types	Incremental AqB, Sin/Cos Absolute: EnDat 2.2, BiSS-C
Power supply to encoder	AGA110: 0.5A per encoder port AGA101: 0.5A per encoder port AGA102: 0.5A per encoder port AGA103: 0.3A per encoder port
Max. cable length	20 m
Incremental encoder (AqB)	Hardware: Differential RS422/RS485 Max. input frequency: 6.25 MHz Termination: 120 W Commutation: Auto-phasing, Hall sensors
Sin/Cos encoder	Hardware: Differential RS422/RS485, 1V pk-pk @2.5V Max. input frequency: 250 kHz Termination: 120 W Max interpolation: 13 bits (x 8192) Commutation: Auto-phasing, Hall sensors
Absolute BiSS-C	Hardware: Differential RS422/RS485, clock (MA), data (SLO) Clock frequency: 1 MHz Max. position bits: 32 bits Commutation: Auto-phasing, by absolute offset
Absolute EnDat 2.2	Hardware: Differential RS422/RS485, clock, data Clock frequency: 1 MHz Max. position bits: 32 bits Commutation: Auto-phasing, by absolute offset
Hall sensor	Opto-isolated 5V with internal or external power supply



I/O Specifications

Feature	Specification
Power supply for optically isolated I/Os	Voltage: 5–28 VDC
Optically isolated digital inputs	Type: PNP/NPN Propagation delay: 10 μ s Max. frequency: 100 kHz
Optically isolated digital outputs	Type: Sink/Source Max current: 0.5A (for Sink type), 0.3A (for Source type) Propagation delay: 10 μ s Max. frequency: 100 kHz
Bi-directional differential I/Os	Hardware: Differential RS422 Propagation delay: 100 ns Max. frequency: 2 MHz Bi-dir differential output voltage: 2.3 VDC
Analog inputs	Operational voltage: ± 10 V Resolution: 12 bits
Safety inputs	2 independent inputs Voltage: 5–24 VDC
Static brake output	Operational voltage: 24V Maximum current: 3A

Central-i Specifications

Feature	Specification
Topology	Star (peer to peer)
Cycle time	61 μ s
Connector type	RJ-45 (Cat5e cable)
Cable length	Up to 20 m Longer cables, up to 100 m, are possible with special hardware
Physical layer	Dual channel RS485 full duplex
Baud rate	20 Mbps (per channel)
Synchronization between nodes	8 nanoseconds



AGA110 Dimensions and Weight

Feature	Specification
Unit dimensions (max)	H=162 mm, W=36.50 mm, D=102 mm
Package dimensions	H=210 mm x W=50 mm x D=140 mm
Unit weight	306 g
Shipping weight	410 g

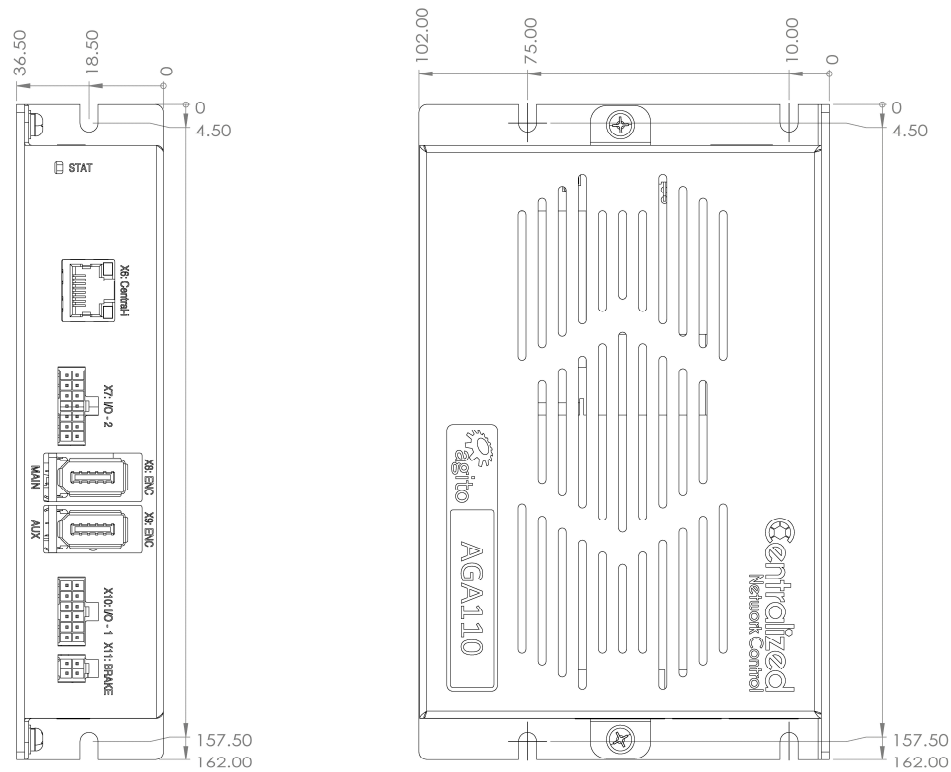


Figure 6. AGA110 Dimensions (mm)



AGA101 Dimensions and Weight

Feature	Specification
Unit dimensions (max)	H=162 mm, W=36.50 mm, D=102 mm
Package dimensions	H=210 mm x W=50 mm x D=140 mm
Unit weight	306 g
Shipping weight	410 g

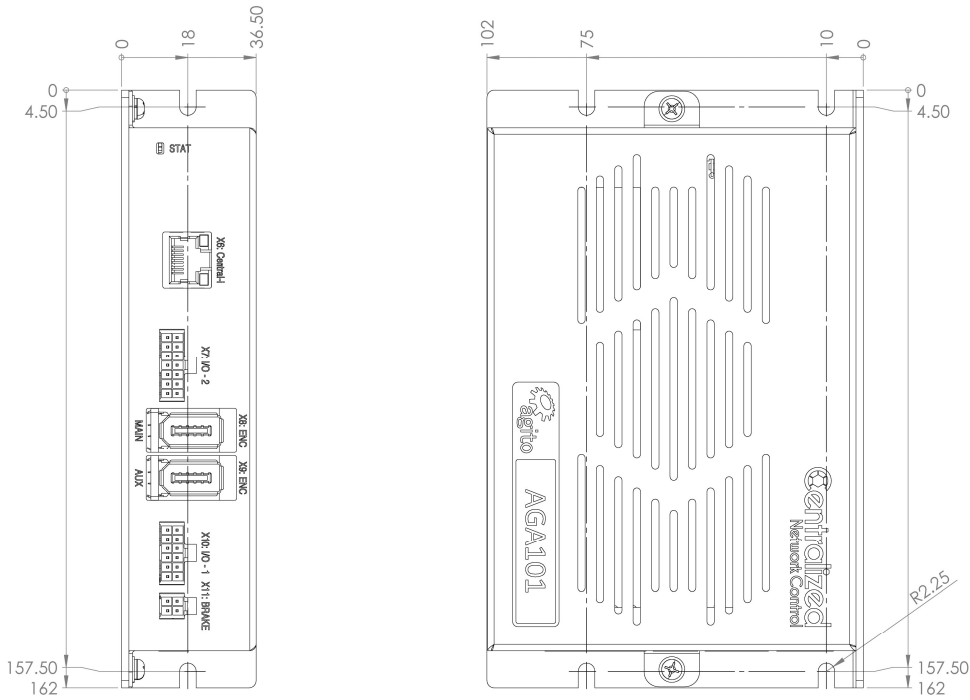


Figure 7. AGA101 Dimensions (mm)



AGA102 Dimensions and Weight – AGA102

Feature	Specification
Unit dimensions (max)	H=120 mm, W=33 mm, D=82 mm
Package dimensions	H=170 mm x W=50 mm x D=120 mm
Unit weight	200 g
Shipping weight	286 g

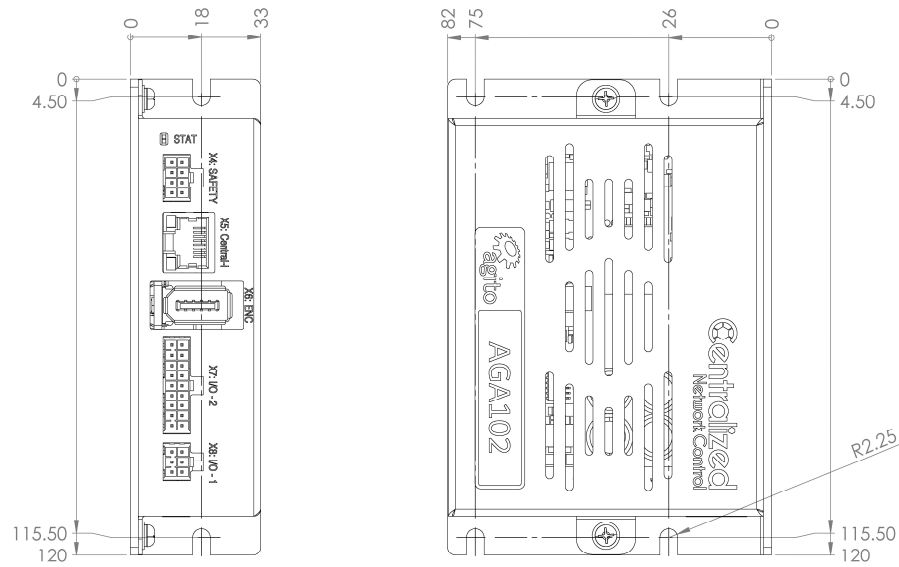


Figure 8. AGA102 Dimensions (mm)



AGA103 Dimensions and Weight

Feature	Specification
Unit dimensions (max)	H=80 mm, W=35 mm, D=60 mm
Package dimensions	H=170 mm x W=50 mm x D=120 mm
Unit weight	118 g
Shipping weight	204 g

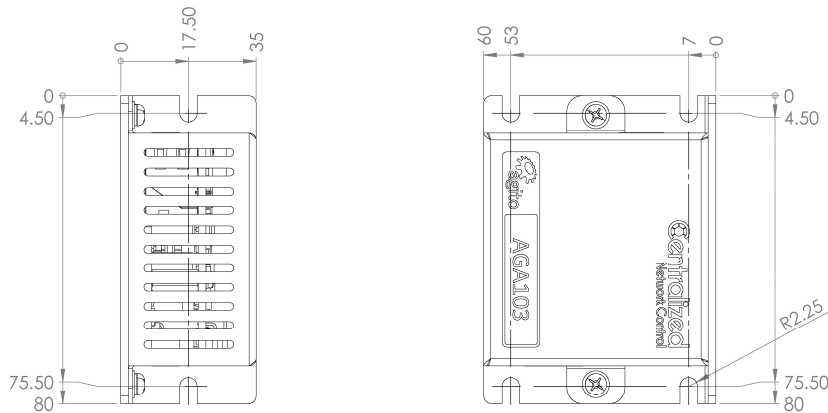


Figure 9. AGA103 Dimensions (mm)

1.5 Environmental Specifications

The operational range may be additionally limited by the internal temperature protection of the product. It is the user's responsibility to avoid operating the product in environmental conditions that do not conform to the defined limits.

Environmental Specifications

Feature	Specification
Operating (ambient) temperature	0°C to 50°C
Storage temperature	-20°C to 70°C
Operating humidity	< 90%
Storage humidity	< 40%
Pollution degree	2
Vibration	per 1G @ 150 Hz according to IEC 60068-2-6 – <i>under testing</i>
Operating conditions	IP20



2 Safety

2.1 Safety Symbols

Safety symbols indicate a potential for personal injury or equipment damage if the prescribed precautions and safe operating practices are not followed.

The following safety symbols are used in the product documentation.

Safety Symbols

Symbol	Meaning	Description
	Hazardous voltage	Indicates hazards arising from dangerous voltages.
	Earthing PE (protective earth)	Identifies any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.
	Caution, hot surface	Indicates the marked item can be hot and should not be touched without taking care.

2.2 Safety Guidelines

To achieve optimum and safe operation of the product, it is important to follow the safety procedures specified in this manual.

- Only qualified personnel may install, maintain, or repair the product. Before starting installation, maintenance or operation, ensure that all system components are connected to protective earth ground (PE).
- The PE wire must be colored green-yellow, in accordance with local electrical wiring standards.
- This product contains electrostatic-sensitive components. Proper handling procedures must be observed to avoid damage to the product.
- To avoid electric arcing and hazards, never connect or disconnect any connector while the power source is on.
- The maximum power supply voltage connected to the product must comply with the ratings provided in this manual.
- Always disconnect the power cables before servicing the product.
- Pay attention to safety symbols on the product or in the manual. Follow proper safety precautions when installing or operating the product.



Attention

All power connectors must be securely tightened before any operation.



Warning

Power, Motor, and Regeneration interfaces are high power. Do not touch these connectors when the amplifier is powered.



Warning

Capacitors on the DC bus can retain hazardous voltages after input power has been removed.



Attention

Do not attempt to hinder or override the product's or system's fault detection or protection circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment.

2.3 Compliance

Standards Compliance

Description	Standard
Safety requirements – Electrical, thermal and energy	IEC-61800-5-1 (see Note below)
EMC requirements and specific test methods	IEC-61800-3 (see Note below)

This product is intended to operate in a machine or equivalent end-product. The machine or end-product must comply with any necessary safety standard as typically required for the same type of machine or end-product. It is the responsibility of the machine or end-product manufacturer to ensure the final machine or end-product meets the requirement of any safety and EMC regulations.

Note: Certification is pending for AGA110.



3 Installation

3.1 Unpacking and Packing

Save the original box and packing materials in case you need to pack and return the product to the manufacturer.

To unpack the product:

1. Carefully remove the product from the box and the packing materials.
2. Visually inspect the product to ensure that there is no damage. If any damage has occurred, report it immediately to the carrier that delivered the package.
3. After unpacking, locate the part number label on the product, and make sure it matches the product your ordered, and that the voltage meets your specific requirements.

3.2 Mounting

3.2.1 Mounting the AGA1xx

The heatsink on the back of the AGA1xx includes holes/slots for mounting the unit.

The AGA1xx is mounted using 2 M4 screws. It is important to mount the product on metal panel for both grounding and secure connections.

The heatsink of the AGA1xx is electrically conductive and serves as the protective earth (PE) ground of the product. However, it is critical to ensure the PE screws are electrically conducting between the PE of AGA1xx and the PE of main power supply in the system. For details, refer to the section Grounding.

All cables connected to the product must be securely constrained to avoid vibration that causes stress concentration at the cables or connectors which may result in breakage of electrical conductivity.



Warning – Metal Base Plate for Heat Dissipation

The product is supplied with mounting plate built into the heatsink. At full power operation, the heat sink can be quite warm, around 45°C. It is recommended to mount the product on a large metal panel to help dissipate the heat generated in the product.



3.2.2 Mounting Multiple Power Amplifiers

When mounting multiple amplifiers within a cabinet, clearance between units must be at least 5 mm. In addition, top and bottom clearance must be at least 50 mm.

Ambient temperature in the cabinet must not exceed limit defined in the section *Environmental Specifications*.

If amplifiers are mounted on a backplane, the backplane temperature must not exceed the ambient limit defined in the section *Environmental Specifications*.

It is recommended to install a cooling fan at the bottom of the cabinet for best circulation.

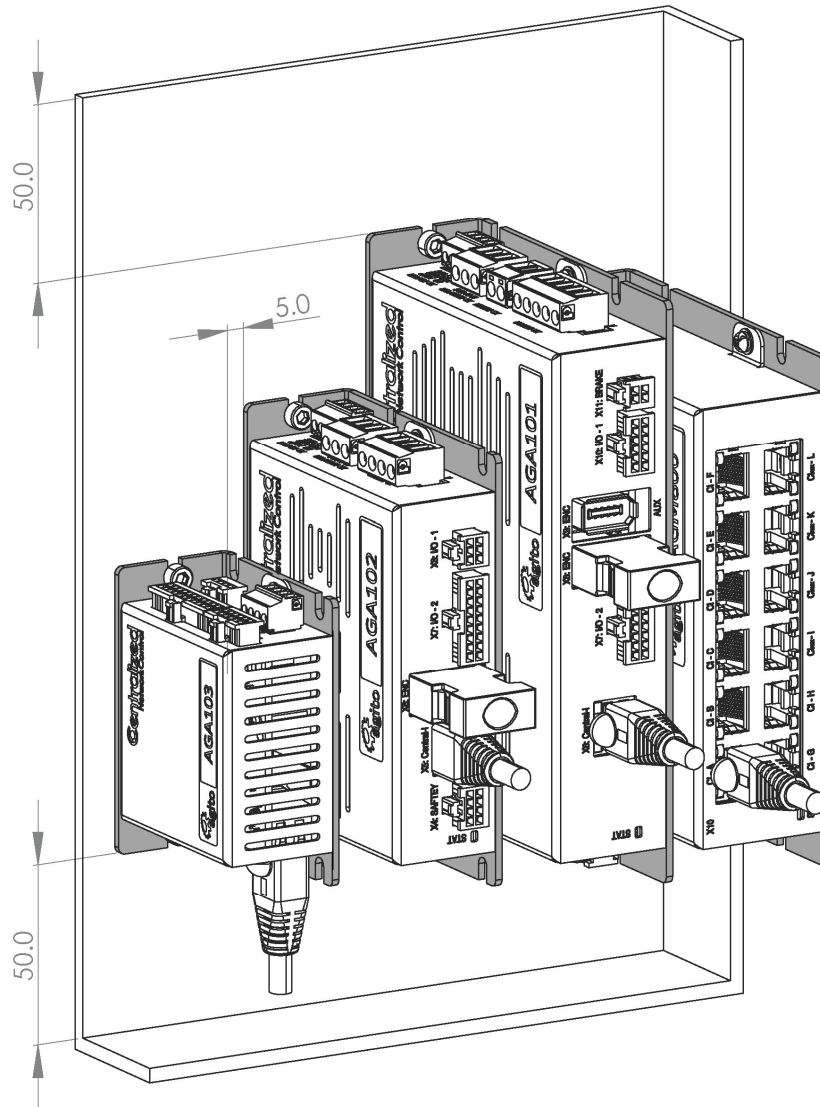


Figure 10. Mounting Multiple Amplifiers within Cabinet



3.3 Electrical Installation

3.3.1 Power Supplies

Several power sources are required for AGA1xx operation when the amplifier is connected to external devices.

The power sources provide power to the motor and brake, and to logic and I/Os circuits.

Power Source	Description	AGA110	AGA101	AGA102	AGA103
Main power	Supplies power to the motor.	80–190 VDC	12–90 VDC	12–48 VDC	12–48 VDC
Backup power	Supplies power to the logic circuits. If not connected, the Main power supply provides logic power.	9–36 VDC Mandatory	9–36 VDC Optional	9–36 VDC Optional	–
Isolated I/Os power	Optional. Supplies power to the optically isolated I/O circuits.	5–28 VDC	5–28 VDC	5–28 VDC	5–28 VDC
Brake power	Optional. Supplies power to the motor brake.	12–48 VDC, 3A	12–48 VDC, 3A	–	–

3.3.2 Wire and Cable Guidelines

To prevent EMI and ensure high performance of the system, be sure to comply with the following guidelines:

- Use twisted pair shielded wires for control, feedback and communication.
- Always use shielded cables for motor connection.
- Keep all wires and cables as short as possible.
- Keep the motor cables as far as possible from the control, feedback and communication lines and cables.
- Wire impedance must be as low as possible. Refer to the wire gauge definitions for each electrical interface.



3.3.3 Regeneration (AGA110 and AGA101 only)

AGA110 and AGA101 use the main DC power input to output controlled electrical power through the phases of the motor. The motor converts this electrical power to mechanical power that moves the load.

During motor deceleration and stopping, the inertia of the load drives the movement of the motor, not the servo drive. Due to back EMF, the motor acts as a generator and returns energy to the DC bus supply, which causes the DC bus voltage to increase to undesirable level.

Maximum allowable DC bus voltage is 90 VDC. To prevent excessive DC bus voltage, a regeneration resistor can be connected to the X3 REGEN connector to dissipate excess regenerated energy and prevent it from reaching undesirable levels. The regeneration resistor starts to dissipate energy at 85 VDC.

Regeneration voltage threshold parameters are software configurable and can be modified according to the motor's maximum voltage specification.



Warning

DC Vbus is monitored, and motors will be disabled if voltage is too high. However, there is no protection against the connection of an excessive voltage power supply that will damage the product.

For connection details, refer to the section *Interface X3: Regeneration*

3.3.4 Grounding

It is recommended to install the AGA1xx on a metal backplane for better power dissipation, reduced EMI, and grounding connection. Make sure the plate is not painted.

The heatsink of the AGA1xx is electrically conductive and serves as the protective earth (PE) ground of the product. However, it is critical to ensure the PE screws are electrically conducting between the PE of AGA1xx and the PE of the main power supply in the system.

The main power input (Main PWR) connector includes a PE pin. Make sure to connect PE to this pin or to the amplifier's metal heatsink.

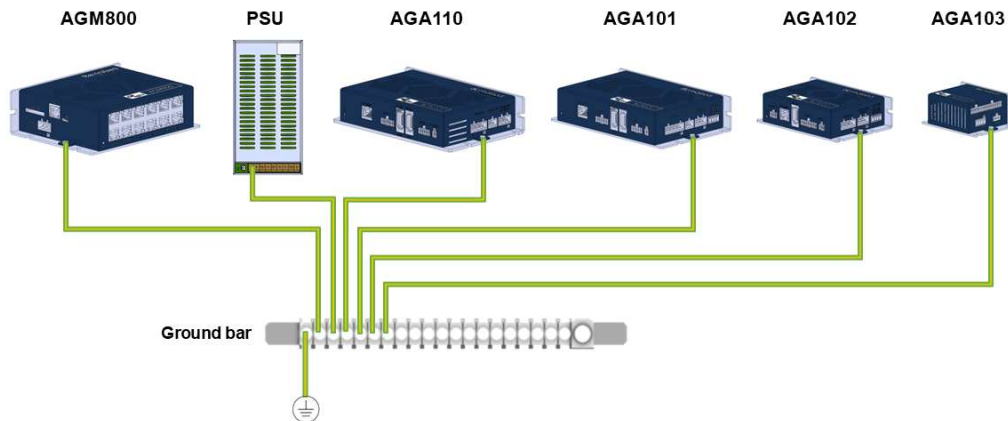


Figure 11. System Grounding

Ground Domains

The following table shows the ground domains in the AGA1xx system:

- GND. Reference voltage for digital/analog circuits and signals.
- PGND. High voltage ground domain (internal)
- General. Usually at DC potential close to GND but not connected internally.

Ground Domains

Name	Ground Domain	Notes
DC power input	GND (I/O return)	External DC power supply
Central-i communication	General	Isolated for Central-i remote devices
Isolated digital inputs/outputs	General	Isolated
Differential inputs/outputs (not isolated)	GND	
Analog inputs/outputs (not isolated)	GND	
Brake control output	General	External DC power supply
Regeneration output	PGND	

Grounding Policy

Grounding of the product must comply with the following guidelines:

- The enclosures and other external parts that may be touched by the user are in the safe domain.



- The AGA1xx must be connected to protective earth (PE) and connected to the building's ground. PE is protected with an earth-leakage circuit breaker (ELCB); hence it is safe to touch. Refer to Figure 11.
- The power inputs, motor connectors, and regeneration outputs are not safe to touch, and may be exposed if the connector is not populated.
- Digital ground (GND) is assumed to have the same potential (at least in DC) as PE. That means GND is connected to PE at some point in the system.
- GND is not connected to PE within the amplifier. The system designer must decide where to connect them. It is recommended to connect PE to GND on the DC power supply.
- PGND is connected directly to mains wires, hence it is just as dangerous as mains to the user.
- All shielded cables, including but not limited to motor, encoders, and power input, have their shield connected to PE as part of the external metal enclosure.
- It is critical to avoid ground loops in the system. A ground loop allows currents to return by two or more different paths, causing electromagnetic interference or even damage to wires.
- The system designer must carefully examine all GND connections in the system to ensure that no loops are created, and that all GND-referenced signals have a GND wire nearby (for both return currents and common mode voltage).



3.4 Communication – Central-i

The AGA1xx amplifiers use Central-i for communication with a centralized controller module.

The Central-i motion control platform includes a multi-axis motion controller, distributed amplifiers and sensors, and control software. The master controller performs all the control functions, including trajectory and position, velocity, and current loops. The Central-i digital protocol enables communication and synchronization of the remote devices.

A bi-colored LED marked **STAT** on AGA110, AGA101 and AGA102, and **ST** on AGA103 shows the status of communication between the amplifier and the Central-i master controller.

Central-i Status LED indicator

Color	LED	Meaning
Green	On steady	Amplifier communicating with master controller
Red	On steady	Amplifier not communicating with master controller

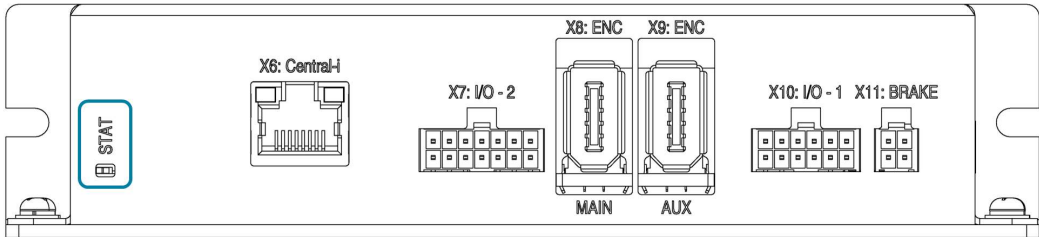


Figure 12. Status (LED) Indicator (AGA101)



3.5 AGA110 and AGA101 – Electrical Interfaces

AGA110 and AGA101 have identical electrical interfaces, except for the following:

- X2: Main Power Connector
- X4: Motor Connector

3.5.1 Interface X2: Main Power



Note – The Main Power interfaces are different on AGA110 and AGA101



Supply voltages for the AGA110 and AGA101 are as follows:

	AGA110	AGA101
Nominal supply voltage	80–190 VDC	12–90 VDC
Minimum supply voltage	70 VDC	11 VDC
Maximum supply voltage	200 VDC	95 VDC



Attention – Reverse polarity protection

AGA110 does not have reverse polarity protection. It is strongly recommended that you verify polarity with a multimeter before powering the device with newly-connected cables.

AGA101 includes reverse polarity protection to prevent damage if polarity is inverted at the power input.



Note – Optional scheme for isolated power supplies

The amplifier can support fully isolated power supplies, one for the power circuitry to drive the motor, and one for the digital logic. If you are interested in such a scheme, contact Technical Support.

The AGA110 currently adopts this scheme.



AGA110 Interface X2

Connector X2 is used to supply 80–190 VDC to the AGA110.

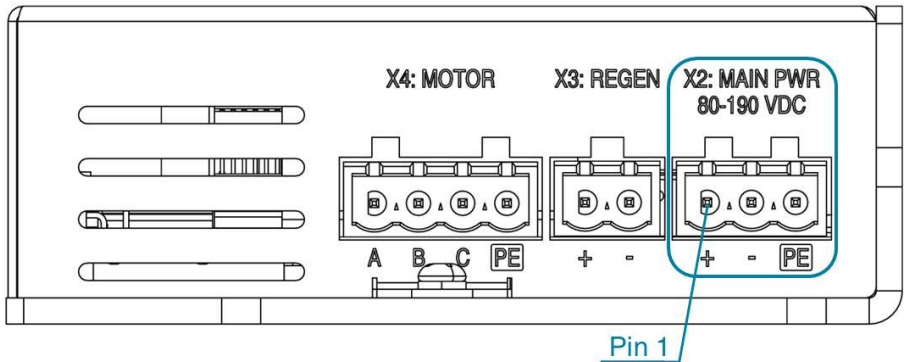


Figure 13. Power Connector (AGA110)

Connector X2: MAIN PWR

Pin #	Name	Description
1	Main Power	Power input: 80–190V, up to 10A continuous Provide power to drive the motor. For logic power, please refer to connector X1 details.
2	GND	Ground – power return
3	PE	Protective earth

Mating connector options	Degson 15EDGK-3.5-04P-14-00A Phoenix Contact 1757022
Pitch	5.08 mm
Wiring	12–24 AWG, insulation rated for 320V

AGA101 Interface X2

Connector X2 is used to supply 12–90 VDC to the AGA101.

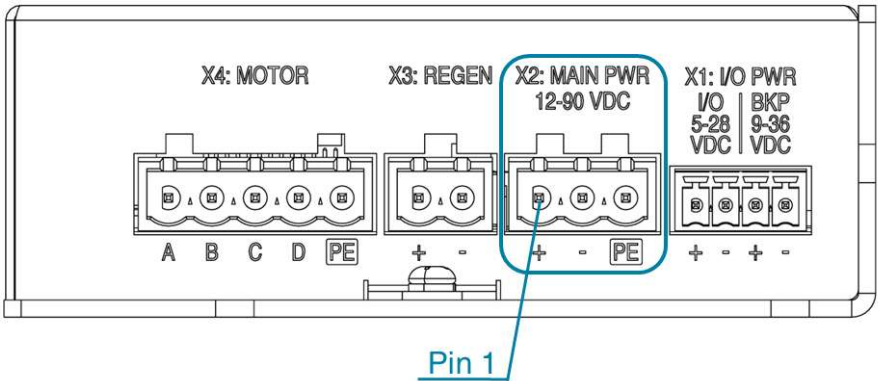


Figure 14. Power Connector (AGA101)

Connector X2: MAIN PWR

Pin #	Name	Description
1	Main Power	Power input: 12–90V, up to 8A continuous Provide power for motor and logic circuits.
2	GND	Ground – power return
3	PE	Protective earth

Mating connector options	Degson 15EDGK-3.5-04P-14-00A Phoenix Contact 1757022
Pitch	5.08 mm
Wiring	12–24 AWG, insulation rated for 320V

3.5.2 Interface X5: Safety

Connector X5 is used for the hardware safety function that disables power to the motor.

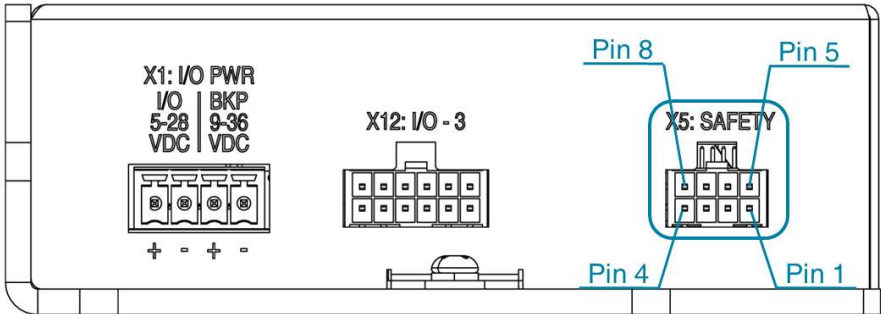


Figure 15. Safety Connector (AGA110)

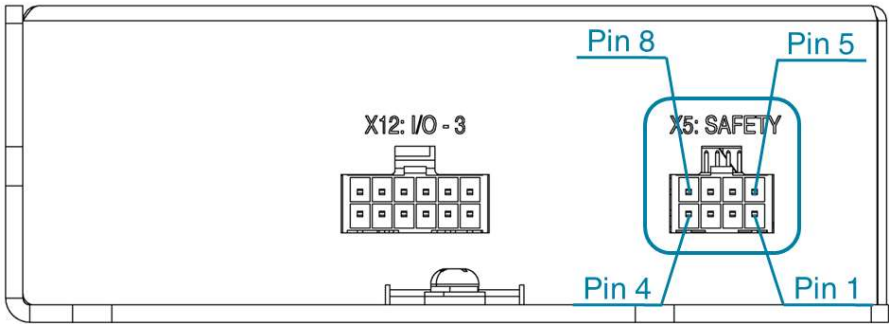


Figure 16. Safety Connector (AGA101)

Connector X5: SAFETY

Pin #	Name	Description
1	5V	5V supply for safety circuits
2	Feedback -	Safety Feedback negative (emitter) output
3	Safety 2 -	safety Input 2 negative input
4	Safety 1 -	safety Input 1 negative input
5	GND	Ground
6	Feedback +	Safety Feedback positive (collector) output
7	Safety 2 +	safety Input 2 positive input
8	Safety 1 +	safety Input 1 positive input

Mating connector options	Samtec	IPD1-04-D-K and CC79L-2630-01-
Wiring	26 AWG, insulation rated for 100V	

- The safety circuitry consists of two input channels, labeled Safety 1 and safety 2. Both input channels support a voltage range of 5 VDC to 24 VDC. It is recommended to use 24 VDC for the input voltage as it provides better electromagnetic interference (EMI) immunity.
- Safety 1 and Safety 2 function independently, thus providing safety redundancy. Each one can disable the power to the motor.
- Both Safety 1 and Safety 2 disable the power to the motor through hardware circuitry, without any software intervention.
- Both Safety 1 and Safety 2 are defined with a positive pin (+) and a negative pin (-). However, the opto-coupler at the safety Input has two input diodes, which enable operation at "positive" or "negative" input voltage. The input is activated when current is sufficient at one of the input diodes, regardless of the current direction. This enables NPN or PNP connection to the safety inputs.



- The safety Input protection logic is designed so that both Safety Inputs must be powered to enable motor operation. Leaving a safety Input disconnected prevents motor operation. This logic is required to ensure that a disconnected safety cable is considered an unsafe condition by the control unit. When sufficient current is driven through a safety Input, the state of this input is Safe. When insufficient current is driven through a safety Input, the state of this input is Unsafe.
- The two Safety Inputs must be in the Safe state to enable motor operation.
- Both Safety 1 and Safety 2, although acting on the drive hardware directly, are also monitored by the controller software. The controller software generates a feedback signal to the user (Safety Feedback), which is also an isolated signal. This feedback is generated by the software and is activated if at least one of Safety 1 or Safety 2 signals is in the Unsafe state.
- The electrical characteristics of the Safety 1 and Safety 2 are identical to those of all other isolated digital inputs of the controller.
- The safety inputs implemented in the product are currently pending certification Functional Safety Standards.



Note – Safety Bypass

To bypass the safety circuit on the AGA110/AGA101, do the following on connector X5:

- Connect pin 1 to both pin 7 and pin 8.
- Connect pin 5 to both pin 3 and pin 4.

Or use bypass plug from Agito. Part number: C-AGD301-SFT

Safety Connection Diagram Example

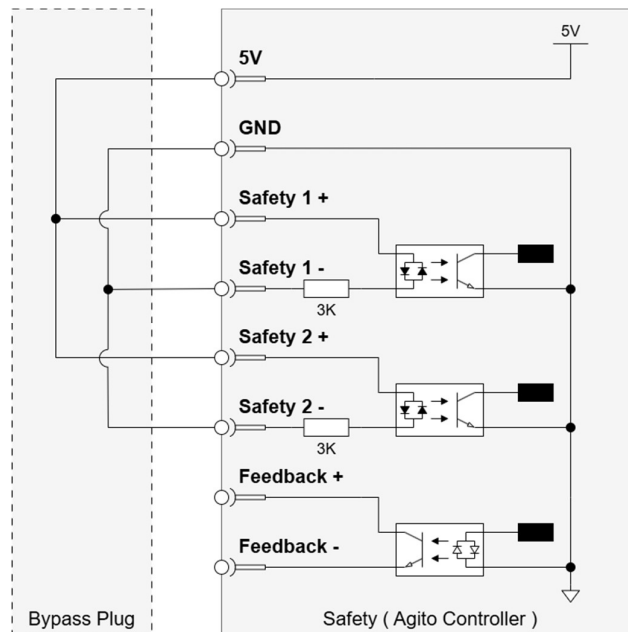


Figure 17. Safety Bypass

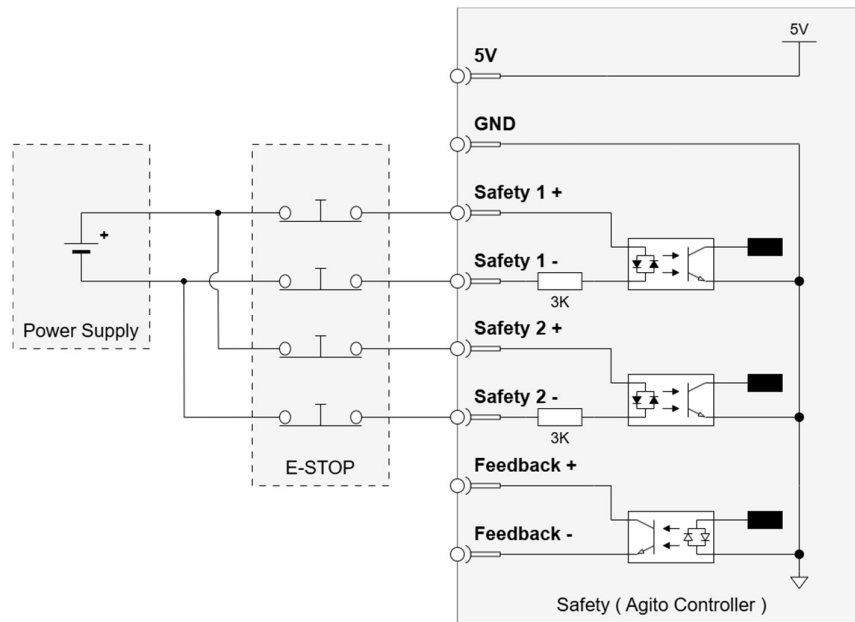


Figure 18. Safety with E-STOP

3.5.3 Interface X1: I/O and Backup Power

Connector X1 has two functions. It supplies DC power supply to the isolated I/Os. Optionally, it provides backup power for the logic components.

The amplifier includes protection to prevent damage if polarity is inverted at the power input.

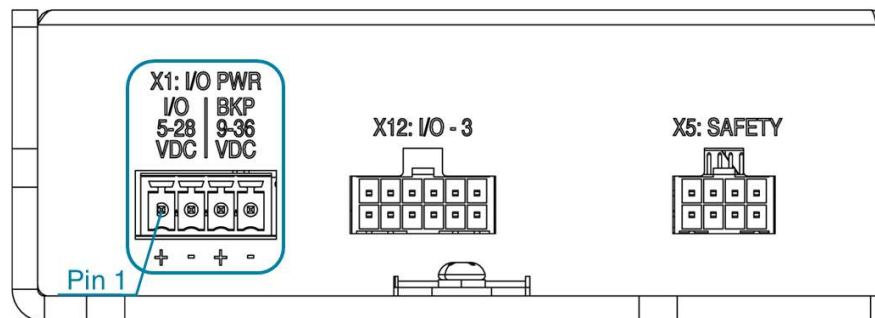


Figure 19. I/O and Backup Power Connector (AGA110)

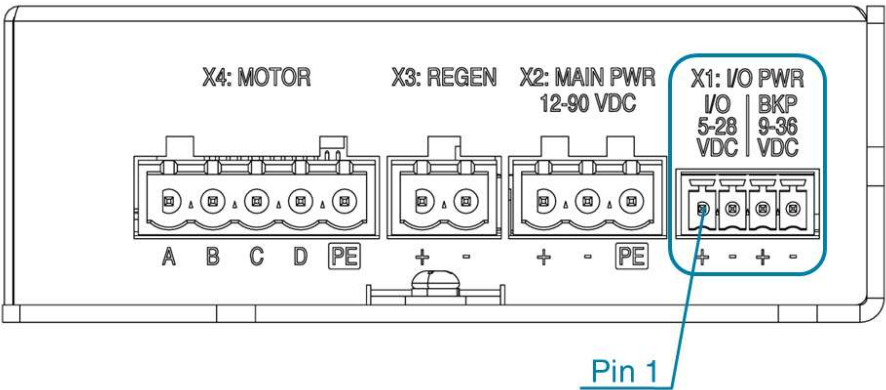


Figure 20. I/O and Backup Power Connector (AGA101)

Connector X1: I/O PWR

Pin #	Name	Description
1	I/O Power	5–28 VDC – user supplied I/O power input, up to 2A
2	I/O Power Return	Ground – I/O power return
3	Backup/logic power	9–36 VDC – backup/logic power, up to 50W For AGA110, it is mandatory and provides power to the logic circuits.
4	Backup power GND	Ground – backup/logic power return

Mating connector options	Degson 15EDGK-3.5-04P-14-00A Phoenix Contact 1840382
Pitch	3.5 mm
Wiring	16–28 AWG, insulation rated for 160V



Warning – Hot plugging is forbidden!

Plug or unplug the power connector only when power is off! Plugging the power connector when power is on may cause power surges through connected devices and possibly damage them.

3.5.4 Interface X4: Motor

Connector X4 serves to supply power to the motor, which can be a 3-phase brushless motor, a single phase brushed motor or a voice coil motor, or a stepper motor.



Note – The Motor interfaces are different on AGA110 and AGA101



Note – Stepper voltage range

A bipolar stepper motor has two independent phases (4 wires in total). You must connect the (-) wire of both phases together, to pin 3 on connector X3.

This connection implies a limitation of the voltage that will be applied to the stepper.

For example, if the power supply to the unit is 24V, each phase of the stepper motor will be limited to 12V.

With suitable selection of the power supply this should impose no limitation on the stepper motor operation.

AGA110 Interface X4

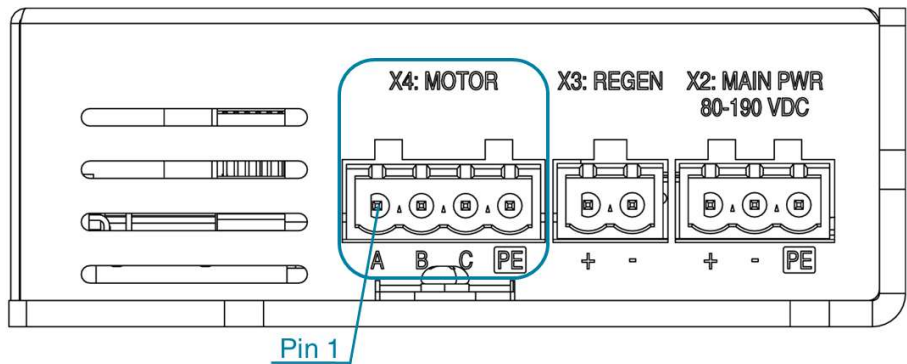


Figure 21. Motor Connector (AGA110)

Connector X4: MOTOR

Pin #	Label	Brushless Motor	Brushed or Voice Coil Motor	Stepper Motor
1	A	Motor phase A	Motor phase +	Motor phase 1+
2	B	Motor phase B	Motor phase -	Motor phase 2+
3	C	Motor phase C	Not connected	Motor phases 1- and 2- (see Note above)
4	PE	GND_EARTH Protective earth	GND_EARTH Protective earth	GND_EARTH Protective earth

Mating connector options	Degson 2EDGK-5.08-04P-14-00A Phoenix Contact 1757035
Pitch	5.08 mm
Wiring	12-24 AWG, insulation rated for 320V



AGA101 Interface X4

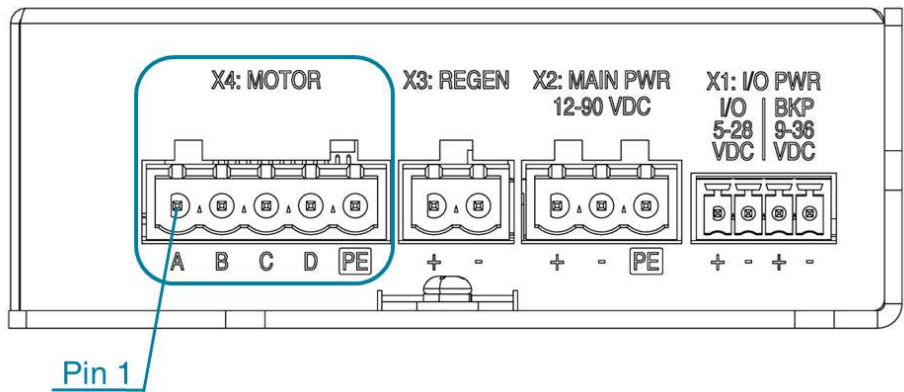


Figure 22. Motor Connector (AGA101)

Connector X4: MOTOR

Pin #	Label	Brushless Motor	Brushed or Voice Coil Motor	Stepper Motor
1	A	Motor phase A	Motor phase +	Motor phase 1+
2	B	Motor phase B	Motor phase -	Motor phase 2+
3	C	Motor phase C	Not connected	Motor phases 1- and 2- (see Note above)
4	D	Not connected	Not connected	Not connected
5	PE	GND_EARTH Protective earth	GND_EARTH Protective earth	GND_EARTH Protective earth

Mating connector options	Degson 2EDGK-5.08-04P-14-00A Phoenix Contact 1757035
Pitch	5.08 mm
Wiring	12-24 AWG, insulation rated for 320V



3.5.5 Interface X3: Regeneration

Connector X3 is used to connect an external power resistor to dissipate energy generated by the motor, typically during deceleration. The motor-generated energy will charge up the internal capacitor. When the internal capacitor is fully charged, the bus voltage will increase. When bus voltage is higher than the operating limit of the product, it will trigger over-voltage protection and disable the motor. To prevent this from happening, users can connect an external power resistor to dissipate the unwanted energy.

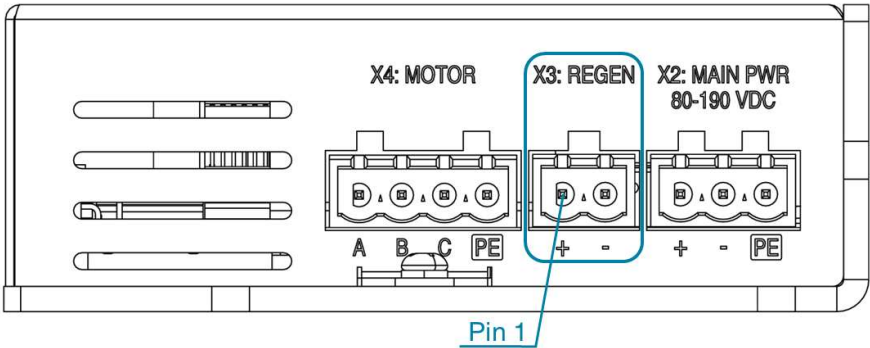


Figure 23. Regeneration Connector (AGA110)

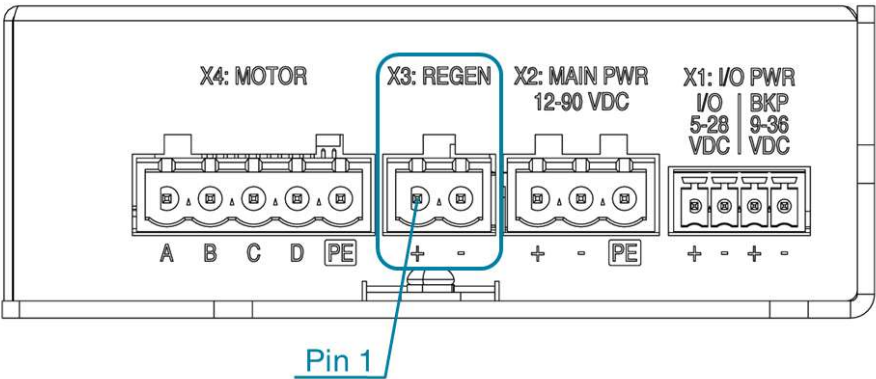


Figure 24. Regeneration Connector (AGA101)

Connector X3: REGEN

Pin #	Name	Description
1	Internal DC Bus	The internal DC bus power
2	Regeneration	To be connected to an external regeneration resistor. Limited to 16A. The external regeneration resistor must be connected between pins 1 and 2 of this connector.

Mating connector	Degson 2EDGK-5.08-02P-14-00A Phoenix Contact 1757019
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Pitch	5.08 mm
Wiring	12–24 AWG, insulation rated for 250V

3.5.6 Interface X11: Brake

Some motors may have a static brake, which is engaged when the motor is not enabled. Connector X11 is used for this functionality.

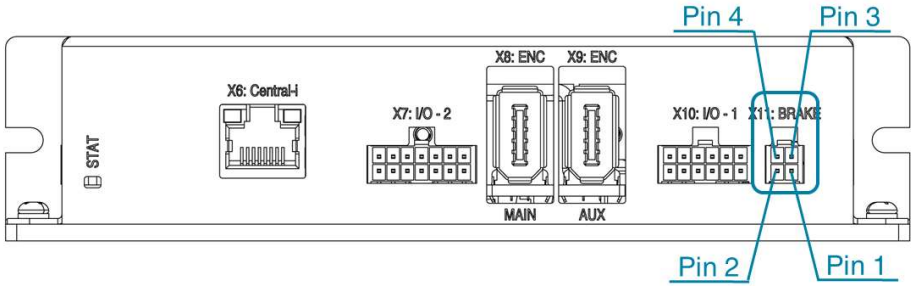


Figure 25. Brake Connector (AGA110 & AGA101)

Connector X11: BRAKE

Pin #	Name	Description
1	Brake -	Static brake output for motor. Open-drain output with built-in flyback diode to the Brake Power for direct connection into inductive load. Up to 3A operation.
2	VBrake	Brake Power. Power supply for the brake isolated circuits. Up to 48 VDC.
3	VBrake Return	Return for Brake Power
4	NC (not connected)	Not used

Mating connector options	Samtec	IPD1-02-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V	



Brake Connection Diagram Example

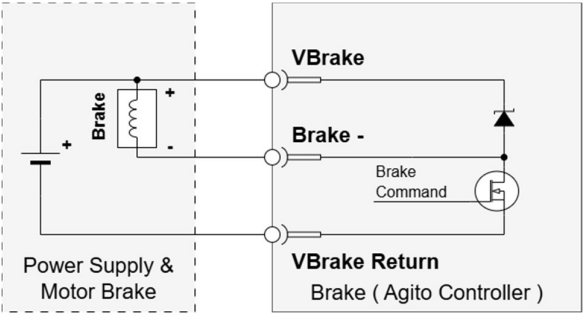


Figure 26. Brake



3.5.7 Interfaces X8 and X9: Encoders

X8 and X9 are identical connectors. Each one serves as an interface to a single encoder.

Typically, X8 is used for the motor encoder. X9 is used for the secondary feedback device in a dual-loop control system.

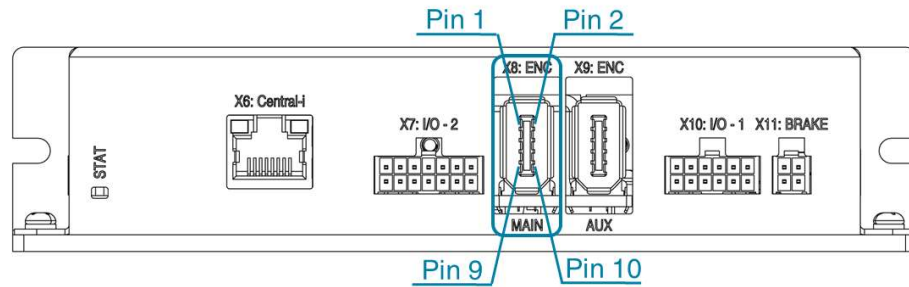


Figure 27. Main Encoder Connector (AGA110 & AGA101)

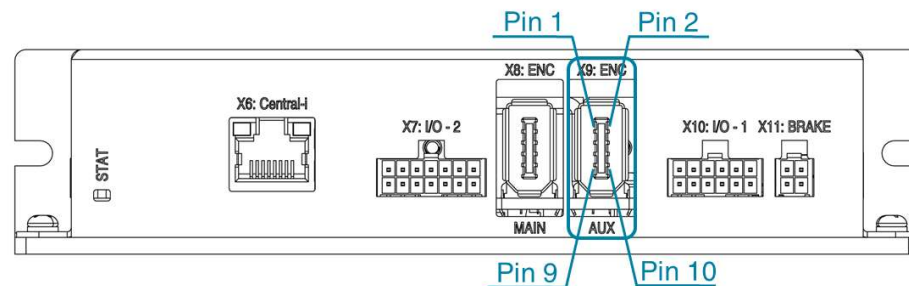


Figure 28. Auxiliary Encoder Connector (AGA110 & AGA101)

Connectors X8/X9: ENC

Pin #	Name	Encoder Types				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
1	5V					5V power supply. Limited to 0.5A.
2	GND					5V return and reference for differential signals
3	Encoder_1+			Clock+	Clock+	Clock+ pin for absolute encoders
4	Encoder_1-			Clock-	Clock-	Clock- pin for absolute encoders
5	Encoder_2+	A+	Sin+			A+ (for AqB) or sin+ (for analog sin/cos)
6	Encoder_2-	A-	Sin-			A- (for AqB) or sin- (for analog sin/cos)



Pin #	Name	Encoder Types				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
7	Encoder_3+	B+	Cos+			B+ (for AqB) or cos+ (for analog sin/cos)
8	Encoder_3-	B-	Cos-			B- (for AqB) or cos- (for analog sin/cos)
9	Encoder_4+	Z+	Z+	Data+	Data+	Data+ for absolute encoders, or Z+ for both AqB and analog sin/cos encoder
10	Encoder_4-	Z-	Z-	Data-	Data-	Data- for absolute encoders, or Z- for both AqB and analog sin/cos encoder

Mating connector options	SUNCHU	SC-10-4P
	3M:	36210-0100PL and 36310-3200-008
Wiring	26 AWG, insulation rated for 100V	



Note – Incremental encoder interface

By default, the product does not support single-ended encoder. For use of single-ended encoder, contact Technical Support.



Note – 5V supply limitation

The 5V supply provided at pin 1 on each connector (X8 and X9) is limited to 0.5A per connector.

The maximum total current provided by all the 5V pins in the product is limited to 1.5A.

3.5.8 Interfaces X7, X10 and X12: I/Os

Connectors X7, X10 and X12 are used for connecting external I/O devices to the amplifier.

For schematics and more information about these interfaces, refer to the section *I/O Connection Diagram Example*.



Interface X7

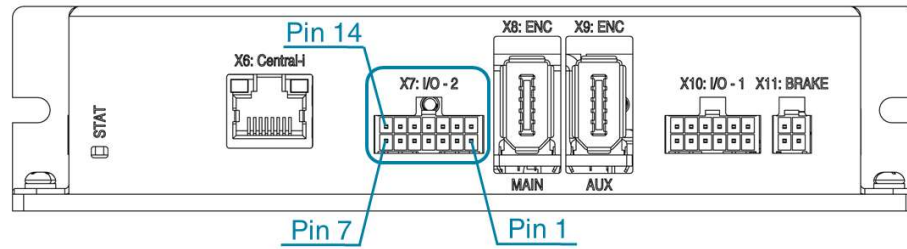


Figure 29. I/O-2 Connector (AGA110 & AGA101)

**Connector X7: I/O-2**

Pin #	Name	Software Representation	Description
1	I/O Power Return		Isolated I/O power return. Connected internally to interface X1 pin 2, I/O Power Return, which is connected to user's power supply.
2	I/O Power		Isolated I/O power. Connected internally to interface X1 pin 1, I/O Power, which is connected to user's power supply.
3	Digital Output 1	DOutPort.bit(0)	Isolated digital output 1. Programmable sink or source.
4	Digital Output Common Power (1 to 3)		Common power pin for isolated digital outputs 1 to 3.
5	Digital Input 6	DInPort.bit(5)	Isolated digital input 6 (NPN or PNP, depending on the connection of the group's common pin).
6	Digital Input Common (5 to 7)		Common pin (power or return, depending on external connection) for digital inputs 5 to 7.
7	Bi-Dir Diff I/O +	DInPort.bit(11) DOutPort.bit(3)	Bi-directional differential I/O + Software configurable: BiDirConfig.bit(0) = 0 for input BiDirConfig.bit(0) = 1 for output
8	PE		Protective earth connection.
9	Digital Output 3	DOutPort.bit(2)	Isolated digital output 3. Programmable sink or source.
10	Digital Output 2	DOutPort.bit(1)	Isolated digital output 2. Programmable sink or source.
11	Digital Output Common Return (1 to 3)		Common power return pin for isolated digital outputs 1 to 3.
12	Digital Input 7	DInPort.bit(6)	Isolated digital input 7 (NPN or PNP, depending on the connection of the group's common pin).
13	Digital Input 5	DInPort.bit(4)	Isolated digital input 5 (NPN or PNP, depending on the connection of the group's common pin).
14	Bi-Dir Diff I/O -		Bi-directional differential I/O -



Mating connector options	Samtec Inc. IPD1-07-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V

Interface X10

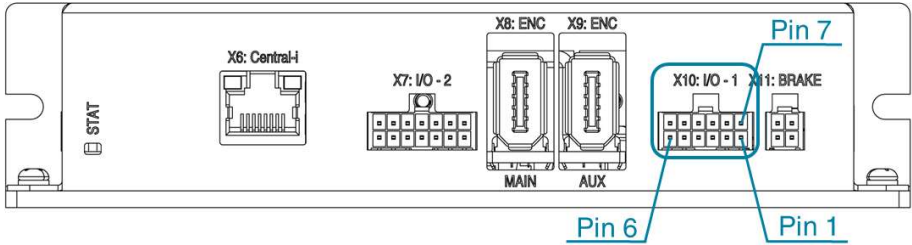


Figure 30. I/O-1 Connector (AGA110 & AGA101)

**Connector: X10: I/O-1**

Pin #	Name	Software Representation	Description
1	I/O Power Return		Isolated I/O power return. Connected internally to interface X1 pin 2, I/O Power Return, which is connected to user's power supply.
2	I/O Power		Isolated I/O power. Connected internally to interface X1 pin 1, I/O Power, which is connected to user's power supply.
3	Digital Input 4	DInPort.bit(3)	Isolated digital input 4 (NPN or PNP, depending on the connection of the group's common pin).
4	Digital Input 2 (e.g. Hall B)	DInPort.bit(1)	Isolated digital input 2 (NPN or PNP, depending on the connection of the group's common pin).
5	Digital Input Common (1 to 4)		Common pin (power or return, depending on external connection) for digital inputs 1 to 4.
6	Analog Input 1	AIInPort[1]	Analog input 1, $\pm 12V$, 12-bit.
7	PE		Protective earth.
8	GND		Ground.
9	5V		5V supply to Hall sensors. Connect to pin 5 when using digital inputs 1 to 3 for Hall sensors.
10	Digital Input 3 (e.g. Hall C)	DInPort.bit(2)	Isolated digital input 3 (NPN or PNP, depending on the connection of the group's common pin).
11	Digital Input 1 (e.g. Hall A)	DInPort.bit(0)	Isolated digital input 1 (NPN or PNP, depending on the connection of the group's common pin). To use as Hall input, go to the Agito PCSuite Digital Input page, and configure as Hall A.
12	Analog Input return 1		Analog input 1 return. Not connected internally to GND.

Mating connector options	Samtec Inc. IPD1-06-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V



Note – 5V supply limitation

The 5V supply provided at pin 9 on connectors X10 and X12 is limited to 0.5A (for both pins combined).
The maximum total current provided by all the 5V pins in the product is limited to 1.5A.

Interface X12

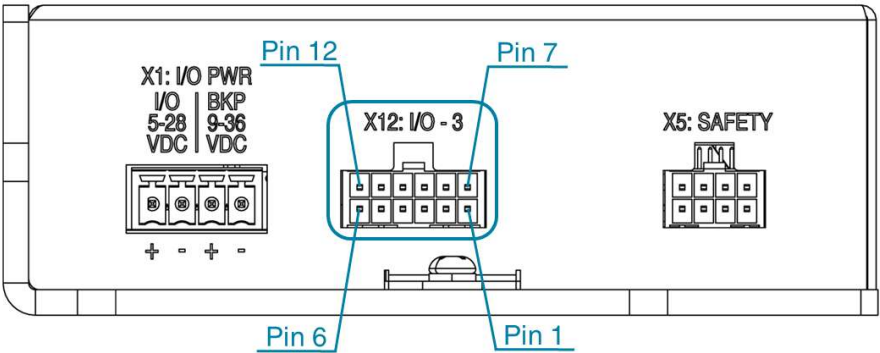


Figure 31. I/O-3 Connector (AGA110)

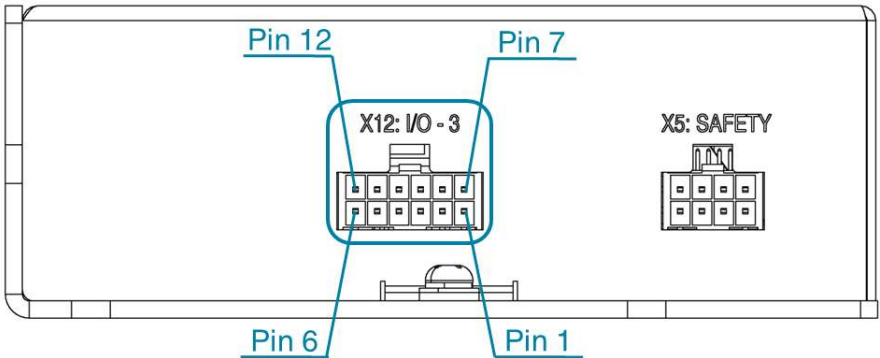


Figure 32. I/O-3 Connector (AGA101)

Connector X12: I/O-3

Pin #	Name	Software Representation	Description
1	I/O Power Return		Isolated I/O power return. Connected internally to interface X1 pin 2, I/O Power Return, which is connected to user's power supply.
2	I/O Power		Isolated I/O power. Connected internally to interface X1 pin 1, I/O Power, which is connected to user's power supply.



Pin #	Name	Software Representation	Description
3	Digital Input 11	DInPort.bit(10)	Isolated digital input 11 (NPN or PNP, depending on the connection of the group's common pin).
4	Digital Input 9	DInPort.bit(8)	Isolated digital input 9 (NPN or PNP, depending on the connection of the group's common pin).
5	Digital Input Common (8 to 11)		Common pin (power or return, depending on external connection) for digital inputs 8 to 11.
6	Analog Input 2	AIInPort[2]	Analog input 2, $\pm 12V$, 12-bit.
7	PE		Protective earth.
8	GND		Ground.
9	5V		5V supply for external I/O circuits. Limited to 0.5A.
10	Digital Input 10	DInPort.bit(9)	Isolated digital input 10 (NPN or PNP, depending on the connection of the group's common pin).
11	Digital Input 8	DInPort.bit(7)	Isolated digital input 8 (NPN or PNP, depending on the connection of the group's common pin).
12	Analog Input Return 2		Analog input 2 return. Not connected internally to GND.

Mating connector options	Samtec	IPD1-06-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V	



Note – 5V supply limitation

The 5V supply provided at pin 9 on connectors X10 and X12 is limited to 0.5A (for both pins combined).

The maximum total current provided by all the 5V pins in the product is limited to 1.5A.

I/O Connection Diagram Example

Isolated Digital Input 1 to 4, 5 to 7, 8 to 11

- Isolated digital inputs are organized as groups with a dedicated common pin. This enables connection to different voltage supplies. Each group is fully isolated and independent of the other groups.



- Digital Input Common are grouped by digital inputs 1 to 4, 5 to 7 and 8 to 11.
- Each group can be connected as NPN or PNP interfaces, depending on the wiring of the group's common pin. If the common pin is connected to power (5V to 28V), then the inputs of this group can be used with external NPN devices (external current sinking devices). If the common is connected to the GND of some external power, then the inputs can be used with external PNP devices (external current sourcing devices).
- The input circuit of the opto-couplers includes two diodes. This enables use as NPN or PNP.
- One group can be wired to interface external NPN devices and another group can be wired to interface PNP devices. However, within a group, all interfaces (NPN or PNP) must be the same, as they are based on the connection of the group's common pin.

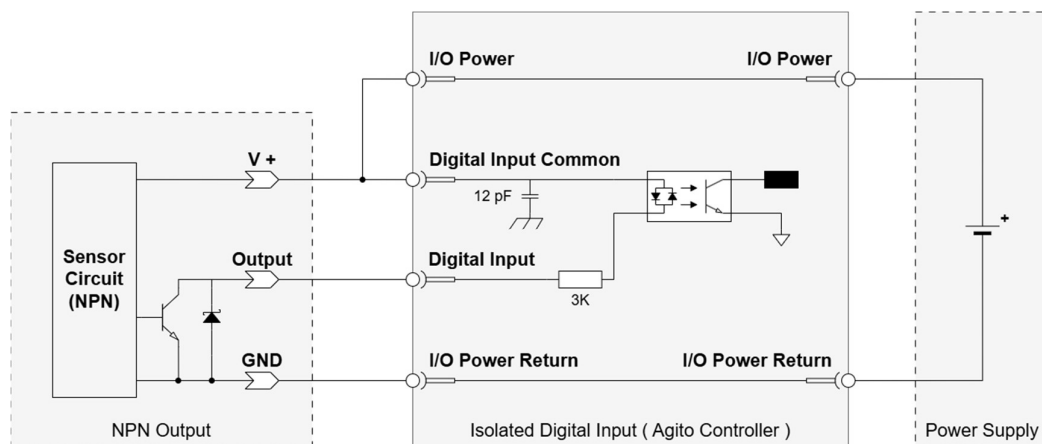


Figure 33. Digital Input with NPN Sensor

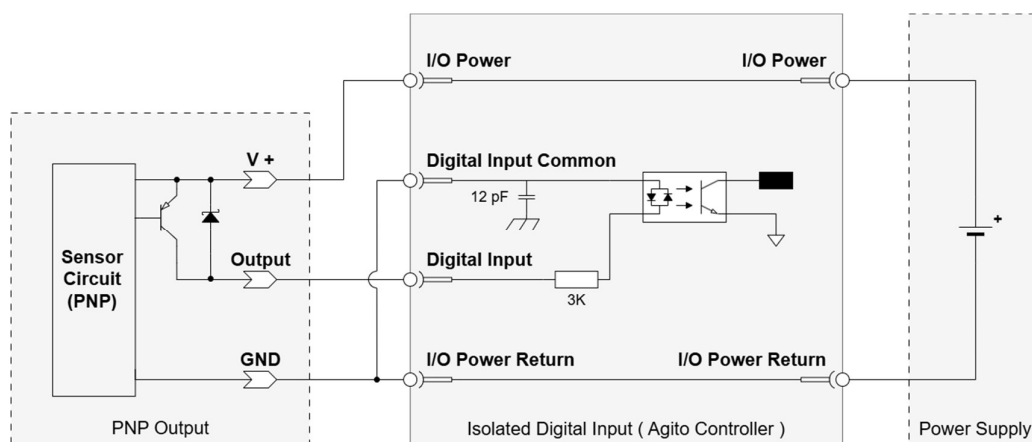


Figure 34. Digital Input with PNP Sensor



Isolated Digital Output 1 to 3

- The digital output interface circuit is identical for all 3 outputs.
- Each output can be programmed (by a software parameter) to act as a current sourcing output (up to 300 mA) or as a current sinking output (up to 500 mA).
- Digital Output Common Power is shared by all 3 outputs.
- The outputs are designed for resistive loads. For inductive loads, an external flyback diode is required.
- Digital output specifications:
 - Digital Output Common Power voltage range is between 5V and 28V.
 - Maximal load current, per each output:

Sink mode, any Digital Output Common Power voltage:	500 mA
Source mode, at 24V Digital Output Common Power:	300 mA
Source mode, at 5V Digital Output Common Power:	60 mA (see Note below)



Note – 5V Digital Output Common Power source mode limitation.

When using 5V Digital Output Common Power, higher current (but less than the absolute maximum value of 250 mA) can be driven. However, the output high voltage will drop significantly. To maintain output high voltage at >4.5V, limit the current to 60 mA.

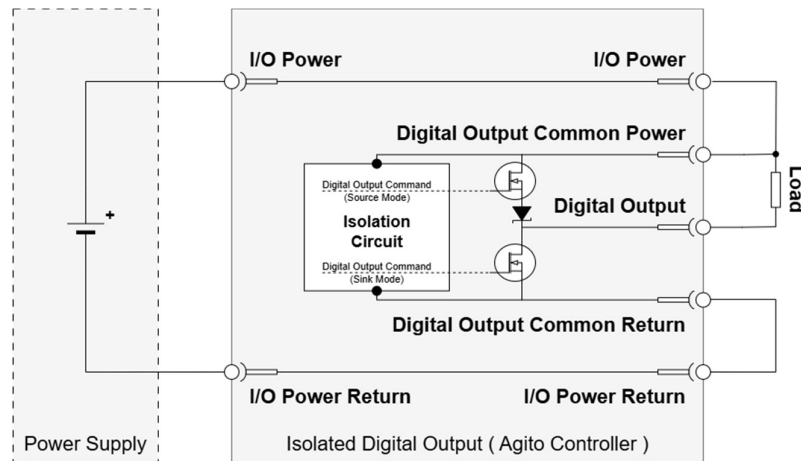


Figure 35. Digital Output (Sink Mode)

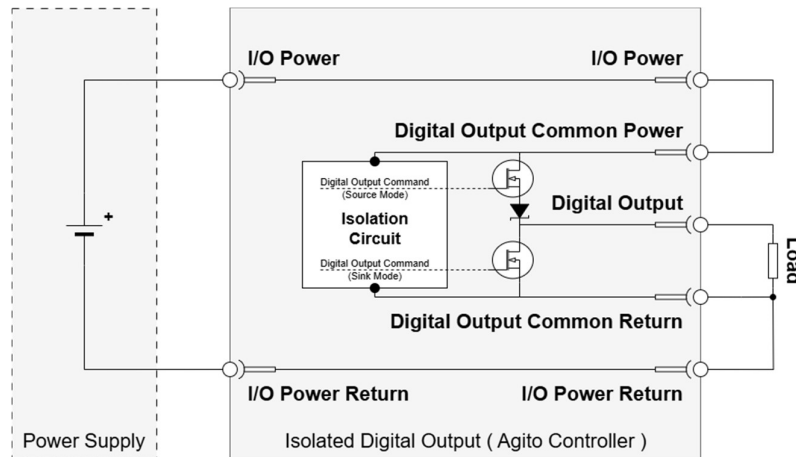


Figure 36. Digital Output (Source Mode)

Bi-directional Differential I/O

- The bi-directional differential output is configurable by software to be a differential output or differential input.
- Both + and - pins are pulled up to 3.3V.
- There is a 120Ω termination resistor between the + and - pins.

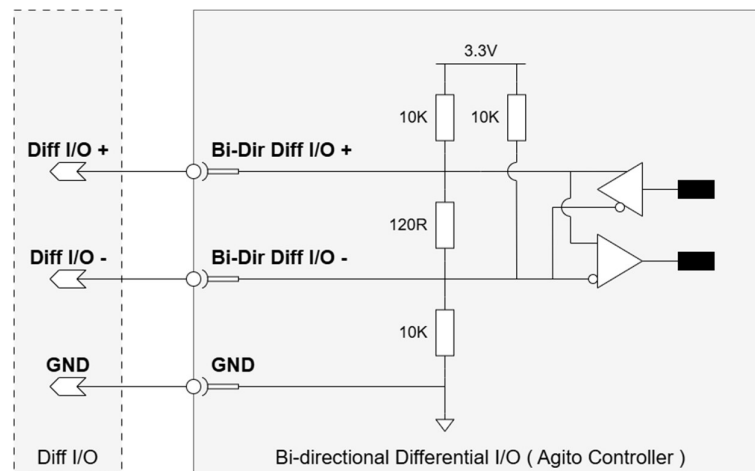


Figure 37. Bi-directional Differential I/O

Analog Input 1 to 2

- The electrical interfaces of all analog inputs are identical on all AGA1xx models.
- The analog input range is -12V to +12V, and resolution is 12 bits.



- The analog input is designed for standard differential analog input, with a simple input circuit, having an input resistance of ~60 kΩ.
- For single-ended analog inputs, be sure to connect the return line to GND. Do not leave it unconnected.
- Input circuit bandwidth: 1 kHz, -40 dB/decade
- The controller software provides the following parameters to control the analog input reading:
 - Filter
 - Offset
 - Deadband
 - Gain

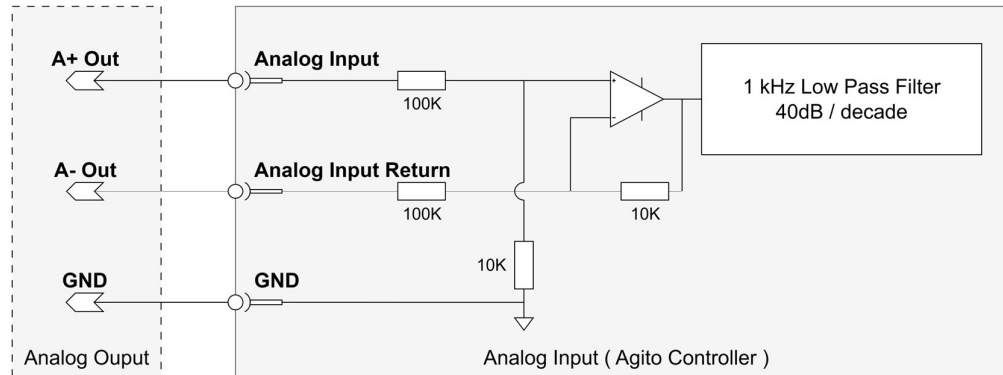


Figure 38. Analog Input

Hall Sensor

- Motor Hall sensor can be connected to opto-isolated digital inputs 1, 2, and 3 on connector X10 (I/O-1). In Agito PCSuite the first input must be configured to mode 23-Hall A.
- It is recommended that Hall sensor be used with incremental encoder. Typically, Hall sensor is called Ha Hb Hc, or Hu Hv Hw, or H1 H2 H3, which correspond to the motor phases. A typical Hall sensor is an open collector (NPN) type and requires a 5 VDC power supply.
- Motor Hall sensors are wired as standard digital inputs.

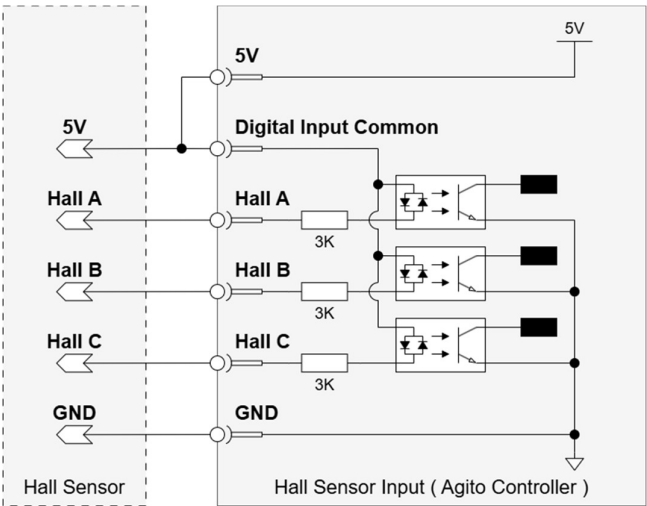


Figure 39. Hall Sensor



3.5.9 Interface X6: Central-i

Connector X5 is used for communication with the Central-i master controller, such as the AGM800, and other remote amplifiers and devices.

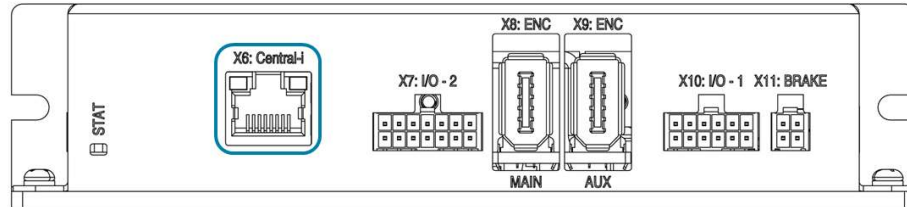


Figure 40. Central-i Communication Connector (AGA110 & AGA101)

Connector X6: Central-i (RJ45)

Pin #	Name	Description
1	DATA_0+	Data channel 0+
2	DATA_0-	Data channel 0-
3	DATA_1+	Data channel 1+
4	DATA_2-	Data channel 2-
5	DATA_2+	Data channel 2+
6	DATA_1-	Data channel 1-
7	V_REMOTE	Power supply to remote unit's communication module
8	GND	GND

Connector type	RJ45 LAN 10/100Base-T connector
Mating connector	Any CAT5e compatible shielded connector
Cable	CAT5e or higher, standard Ethernet straight cable



3.6 AGA102 – Electrical Interfaces

3.6.1 Interface X2: Main Power

Connector X2 is used to supply 12–48 VDC to the AGA102. The input voltage is connected directly to the amplifier power bridge to drive the axis motor. The input voltage also supplies the power for the amplifier internal logic.



Supply voltages for the AGA102 are as follows:

- Nominal supply voltage 12–48 VDC
- Minimum supply voltage 11 VDC
- Maximum supply voltage 55 VDC



Attention – Reverse polarity protection

AGA102 includes reverse polarity protection to prevent damage if polarity is inverted at the power input.



Note – Optional scheme for isolated power supplies

The amplifier can support fully isolated power supplies, one for the power circuitry to drive the motor, and one for the digital logic. If you are interested in such a scheme, contact Technical Support.

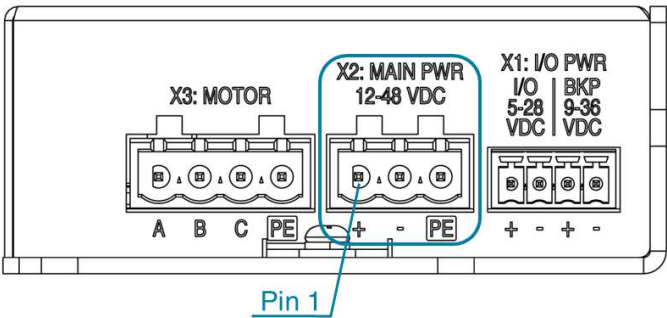


Figure 41. Power Connector

Connector J2: Power

Pin #	Name	Description
1	Main Power	Power input: 12–48V, up to 8A continuous
2	Power GND	Power GND
3	PE	Earth ground connection

Mating connector options	Degson 2EDGK-5.08-03P-14-00A Phoenix Contact 1757022
Connector pitch	5.08 mm
Wiring	12–24 AWG, insulation rated for 320V



3.6.2 Interface X4: Safety

Connector X4 is used for the hardware safety function that disables power to the motor.

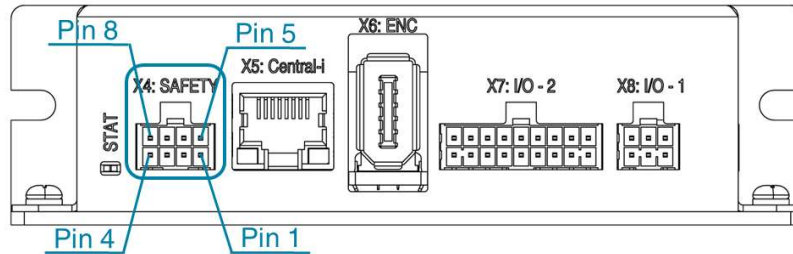


Figure 42. Safety Connector

Connector X4: SAFETY

Pin #	Name	Description
1	5V	5V supply for safety circuits
2	Feedback -	Safety feedback negative (emitter) output
3	Safety 2 -	Safety input 2 negative input
4	Safety 1 -	Safety input 1 negative input
5	GND	Ground
6	Feedback +	Safety feedback positive (collector) output
7	Safety 2 +	Safety input 2 positive input
8	Safety 1 +	Safety input 1 positive input

Mating connector options	Samtec	IPD1-04-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V	

- The safety circuitry consists of two input channels, labeled Safety 1 and Safety 2. Both input channels support a voltage range of 5 VDC to 24 VDC. It is recommended to use 24 VDC for the input voltage as it provides better electromagnetic interference (EMI) immunity.
- Safety 1 and Safety 2 function independently, thus providing safety redundancy. Each one can disable the power to the motor.
- Both Safety 1 and Safety 2 disable the power to the motor through hardware circuitry, without any software intervention.
- Both Safety 1 and Safety 2 are defined with a positive pin (+) and a negative pin (-). However, the opto-coupler at the Safety Input has two input diodes, which enable operation at "positive" or "negative" input voltage. The input is activated when current is sufficient at one of the input diodes, regardless of the current direction. This enables NPN or PNP connection to the safety inputs.



- The Safety Input protection logic is designed so that both Safety Inputs must be powered to enable motor operation. Leaving a Safety Input disconnected prevents motor operation. This logic is required to ensure that a disconnected safety cable is considered an unsafe condition by the control unit. When sufficient current is driven through a Safety Input, the state of this input is Safe. When insufficient current is driven through a Safety Input, the state of this input is Unsafe.
- The two Safety Inputs must be in the Safe state to enable motor operation.
- Both Safety 1 and Safety 2, although acting on the drive hardware directly, are also monitored by the controller software. The controller software generates a feedback signal to the user (Safety Feedback), which is also an isolated signal. This feedback is generated by the software and is activated if at least one of Safety 1 or Safety 2 signals is in the Unsafe state.
- The electrical characteristics of Safety 1 and Safety 2 are identical to those of all other isolated digital inputs of the controller.
- The safety inputs implemented in the product are currently pending certification Functional Safety Standards.



Disabling Safety function

If the Safety function is not required in your application, you can disable it by using a jumper plug from Agito. Part number: C-AGD301-SFT

Safety Connection Diagram Example

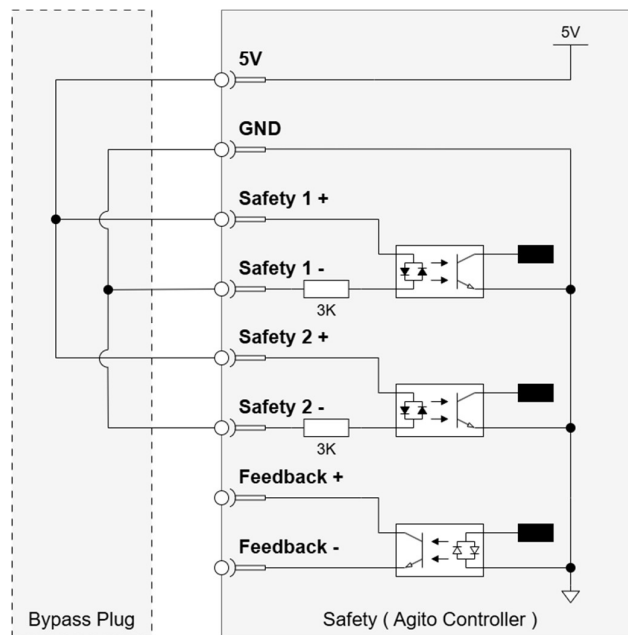


Figure 43. Safety Bypass

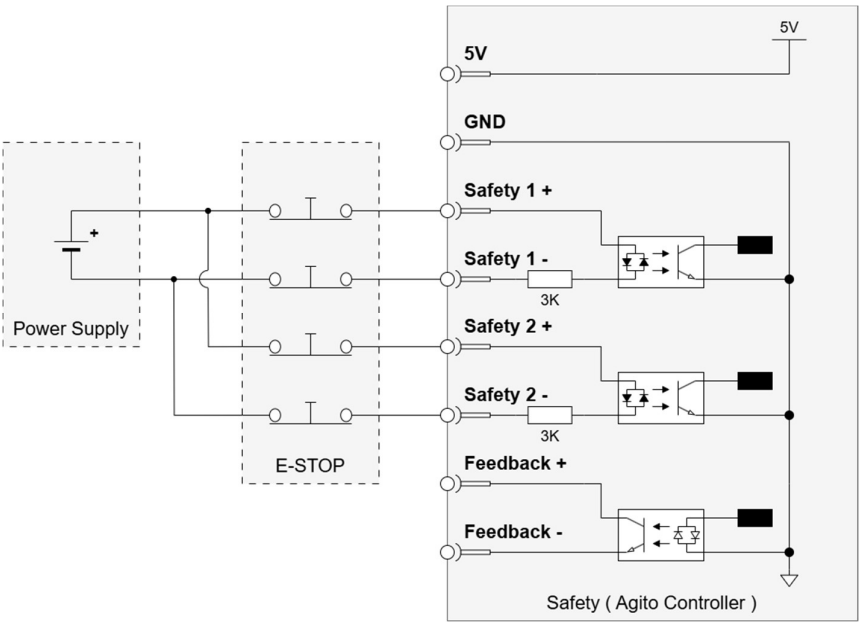


Figure 44. Safety with E-STOP

3.6.3 Interface X1: I/O and Backup Power

Connector X1 has two functions. It supplies DC power supply to the isolated I/Os. Optionally, it provides backup power for the logic components.

The amplifier includes protection to prevent damage if polarity is inverted at the power input.

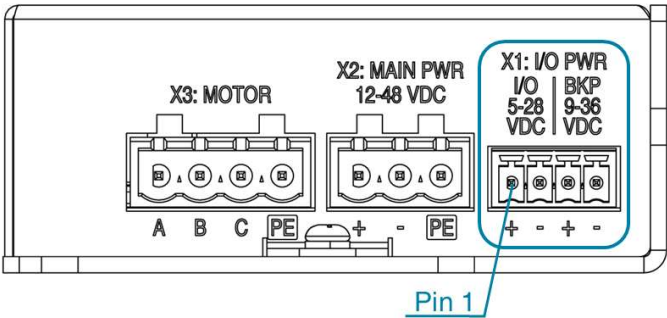


Figure 45. I/O and Backup Power Connector

Connector X1: I/O PWR

Pin #	Name	Description
1	I/O Power	5–28 VDC – user supplied I/O power input, up to 2A Connected internally to interface X7 pin2, I/O Power.
2	I/O Power Return	Ground – I/O power return Connected internally to interface X7 pin1, I/O Power Return.



Pin #	Name	Description
3	Backup/logic power	9–36 VDC – backup/logic power, up to 50W
4	Backup power GND	Ground – backup/logic power return

Mating connector options	Degson 15EDGK-3.5-04P-14-00A Phoenix Contact 1840382
Connector pitch	3.5 mm
Wiring	16–28 AWG, insulation rated for 160V



Warning – Hot plugging is forbidden!

Plug or unplug the power connector only when power is off! Plugging the power connector when power is on may cause power surges through connected devices and possibly damage them.

3.6.4 Interface X3: Motor

Connector X3 serves to supply power to the motor, which can be a 3-phase brushless motor, a single phase brushed motor, a voice coil motor, or a stepper motor.

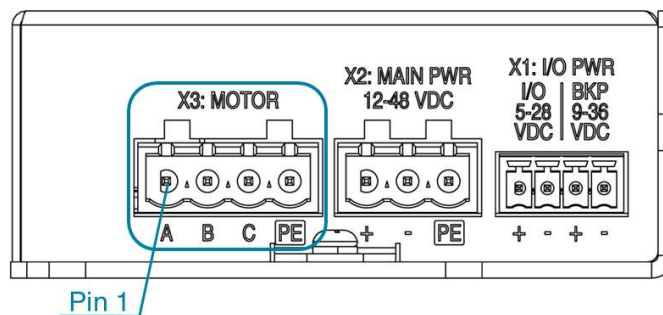


Figure 46. Motor Connector

Connector X3: MOTOR

Pin #	Label	Brushless Motor	Brushed or Voice Coil Motor	Stepper Motor
1	A	Motor phase A	Motor phase +	Motor phase 1+
2	B	Motor phase B	Motor phase -	Motor phase 2+
3	C	Motor phase C	Not connected	Motor phases 1- and 2- (see Note below)
4	PE	GND_EARTH Protective earth	GND_EARTH Protective earth	GND_EARTH Protective earth

Mating connector options	Degson 2EDGK-5.08-04P-14-00A Phoenix Contact 1757035
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Connector pitch	5.08 mm
Wiring	12 – 24 AWG, insulation rated for 320V



Note – Stepper voltage range

A bipolar stepper motor has two independent phases (4 wires in total). You must connect the (-) wire of both phases together, to pin 3 on connector X3.

This connection implies a limitation of the voltage that will be applied to the stepper.

For example, if the power supply to the unit is 24V, each phase of the stepper motor will be limited to 12V.

With suitable selection of the power supply this should impose no limitation on the stepper motor operation.

3.6.5 Interface X6: Encoder

Connector X6 serves as an interface to a single encoder.

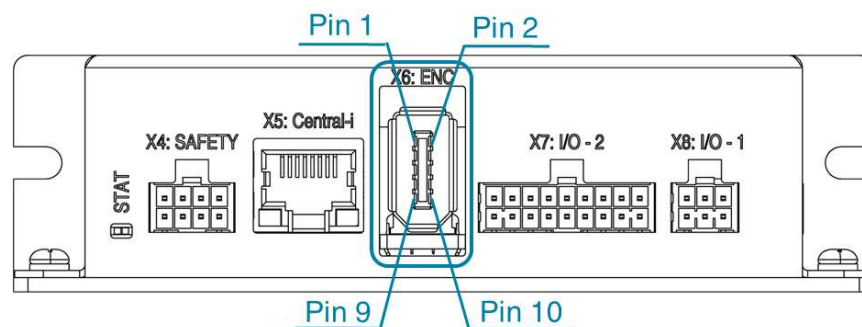


Figure 47. Encoder Connector

Connectors X6: ENC

Pin #	Name	Encoder Types				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
1	5V					5V power supply. Limited to 0.5A.
2	GND					5V return and reference for differential signals
3	Encoder_1+			Clock+	Clock+	Clock+ pin for absolute encoders
4	Encoder_1-			Clock-	Clock-	Clock- pin for absolute encoders
5	Encoder_2+	A+	Sin+			A+ (for AqB) or sin+ (for analog sin/cos)



Pin #	Name	Encoder Types				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
6	Encoder_2-	A-	Sin-			A- (for AqB) or sin- (for analog sin/cos)
7	Encoder_3+	B+	Cos+			B+ (for AqB) or cos+ (for analog sin/cos)
8	Encoder_3-	B-	Cos-			B- (for AqB) or cos- (for analog sin/cos)
9	Encoder_4+	Z+	Z+	Data+	Data+	Data+ for absolute encoders, or Z+ for both AqB and analog sin/cos encoder
10	Encoder_4-	Z-	Z-	Data-	Data-	Data- for absolute encoders, or Z- for both AqB and analog sin/cos encoder

Mating connector options	SUNCHU SC-10-4P 3M: 36210-0100PL and 36310-3200-008
Wiring	AWG 26, insulation rated for 100V



Note – Incremental encoder interface

By default, the product does not support single-ended encoder. For use of single-ended encoder, contact Technical Support.



Note – 5V supply limitation

The 5V supply provided at pin 1 on connector X6 is limited to 0.5A.
The maximum total current provided by all the 5V pins in the product is limited to 1.5A.

3.6.6 Interfaces X7 and X8: I/Os

Connectors X7 and X8 are used for connecting external I/O devices to the amplifier.

For schematics and more information about these interfaces, refer to the section *I/O Connection Diagram Example*.



Interface X7

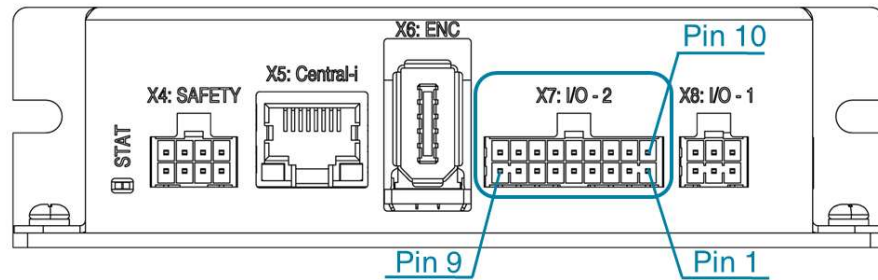


Figure 48. I/O-2 Connector

Connector X7: I/O-2

Pin #	Name	Software Representation	Description
1	I/O Power Return		Isolated I/O power return. Connected internally to interface X1 pin 2, I/O Power Return.
2	I/O Power		Isolated I/O power. Connected internally to interface X1 pin 1, I/O Power.
3	Digital Output Common Return (1 to 2)		Common power pin for isolated digital outputs 1 to 2
4	Digital Output Common Power (1 to 2)		Common return pin for isolated digital outputs 1 to 2)
5	Digital Input 7	DInPort.bit(6)	Isolated digital input 7 (NPN or PNP, depending on the connection of the group's common pin)
6	Digital Input 5	DInPort.bit(4)	Isolated digital input 5 (NPN or PNP, depending on the connection of the group's common pin).
7	Digital Input Common (4 to 7)		Common pin (power or return, depending on external connection) for digital inputs 4 to 7.
8	Bi-Dir Diff I/O +	DInPort.bit(7) DOutPort.bit(2)	Bi-directional differential I/O + Software configurable: BiDirConfig.bit(0) = 0 for input BiDirConfig.bit(0) = 1 for output
9	Analog Input	AlnPort.bit(0)	Analog input, $\pm 12V$, 12-bit.
10	PE		Protective earth.



Pin #	Name	Software Representation	Description
11	GND		GND for 5V and differential signals.
12	5V		5V supply for external I/O circuits. Limited to 0.5A.
13	Digital Output 2	DOutnPort.bit(1)	Isolated digital output 2, programmable sink or source.
14	Digital Output 1	DOutnPort.bit(0)	Isolated digital output 1, programmable sink or source.
15	Digital Input 6	DInPort.bit(5)	Isolated digital input 6 (NPN or PNP, depending on the connection of the group's common pin).
16	Digital Input 4	DInPort.bit(3)	Isolated digital input 4 (NPN or PNP, depending on the connection of the group's common pin).
17	Bi-Dir Diff I/O -		Bi-directional differential I/O -
18	Analog Input Return		Analog input return. Not connected internally to GND.

Mating connector options	Samtec IPD1-09-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V

Interface X8

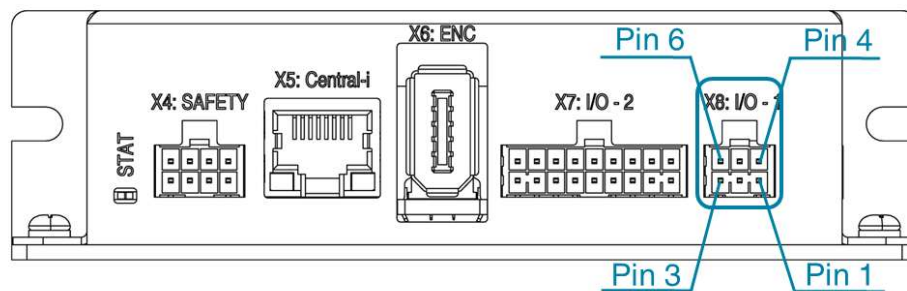


Figure 49. I/O-1 Connector

Connector X8: I/O-1

Pin #	Name	Software Representation	Description
1	5V		5V supply to Hall sensors. Connect to pin 3 when using digital inputs 1 to 3 for Hall sensors.



Pin #	Name	Software Representation	Description
2	Digital Input 2 (e.g. Hall B)	DinPort.bit(1)	Isolated digital input 2 (NPN or PNP, depending on the connection of the group's common pin).
3	Digital Input Common (1 to 3)		Common pin (power or return, depending on external connection) for digital inputs 1 to 3.
4	GND		Ground for 5V and differential signals.
5	Digital Input 3 (e.g. Hall C)	DinPort.bit(2)	Isolated digital input 3 (NPN or PNP, depending on the connection of the group's common pin).
6	Digital Input 1 (e.g. Hall A)	DinPort.bit(0)	Isolated digital input 1 (NPN or PNP, depending on the connection of the group's common pin). To use as Hall input, go to the Agito PCSuite Digital Input page, and configure as Hall A.

Mating connector options	Samtec	IPD1-03-D-K and CC79R-2630-01-L
Wiring	26 AWG, insulation rated for 100V	



Note – 5V supply limitation

The 5V supply provided at pin 12 on connector X7 and pin 1 on connector X8 is limited to 0.5A for both pins combined.
The maximum total current provided by all the 5V pins in the product is limited to 1.5A.

I/O Connection Diagram Example

Isolated Digital Input 1 to 3, 4 to 7

- Isolated digital inputs are organized as groups with a dedicated common pin. This enables connection to different voltage supplies. Each group is fully isolated and independent of the other groups.
- Digital Input Common are grouped by digital inputs 1 to 3 and 4 to 7.
- Each group can be connected as NPN or PNP interfaces, depending on the wiring of the group's common pin. If the common pin is connected to power (5V to 28V), then the inputs of this group can be used with external NPN devices (external current



sinking devices). If the common is connected to the GND of some external power, then the inputs can be used with external PNP devices (external current sourcing devices).

- The input circuit of the opto-couplers includes two diodes. This enables use as NPN or PNP.
- One group can be wired to interface external NPN devices and another group can be wired to interface PNP devices. However, within a group, all interfaces (NPN or PNP) must be the same, as they are based on the connection of the group's common pin.

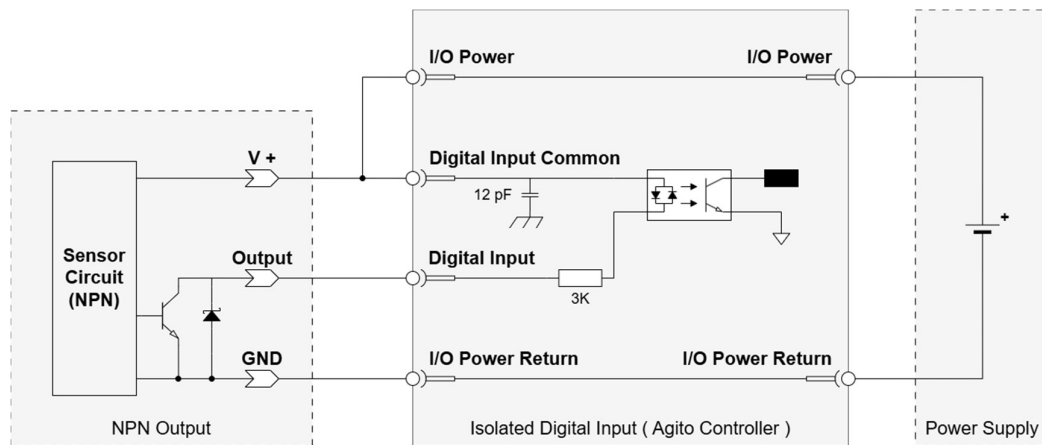


Figure 50. Digital Input with NPN Sensor

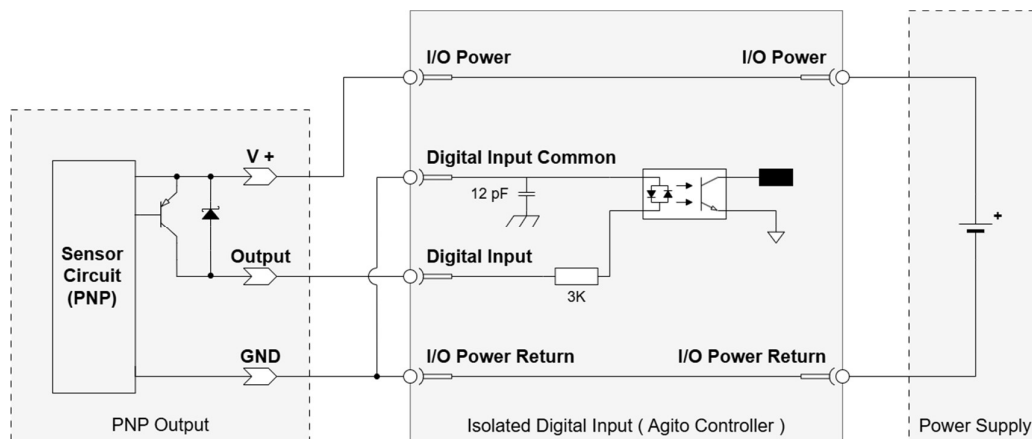


Figure 51. Digital Input with PNP Sensor

Isolated Digital Output 1 to 2

- The digital output interface circuit is identical for all 2 outputs.
- Each output can be programmed (by a software parameter) to act as a current sourcing output (up to 300 mA) or as a current sinking output (up to 500 mA).



- Digital Output Common Power is shared by all 2 outputs.
- The outputs are designed for resistive loads. For inductive loads, an external flyback diode is required.
- Digital outputs specifications:
 - Digital Output Common Power voltage range is between 5V and 28V.
 - Maximal load current, per each output:

Sink mode, any Digital Output Common Power voltage:	500 mA
Source mode, at 24V Digital Output Common Power:	300 mA
Source mode, at 5V Digital Output Common Power:	60 mA (see Note below)



Note – 5V Digital Output Common Power source mode limitation.

When using 5V Digital Output Common Power, higher current (but less than the absolute maximum value of 250 mA) can be driven. However, the output high voltage will drop significantly. To maintain output high voltage at >4.5V, limit the current to 60 mA.

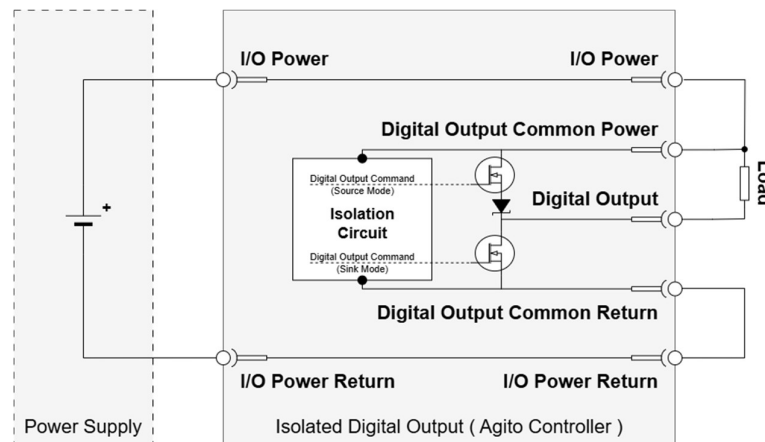


Figure 52. Digital Output (Sink Mode)

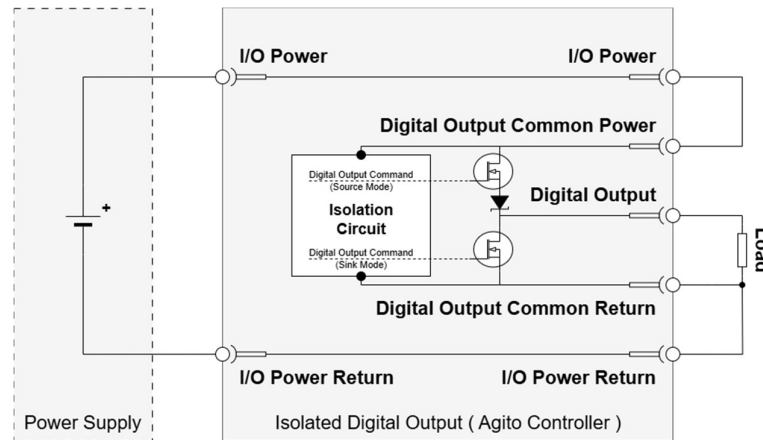


Figure 53. Digital Output (Source Mode)

Bi-directional Differential I/O

- The bi-directional differential output is configurable by software to be a differential output or differential input.
- Both + and - pins are pulled up to 3.3V.
- There is a 120Ω termination resistor between the + and - pins.

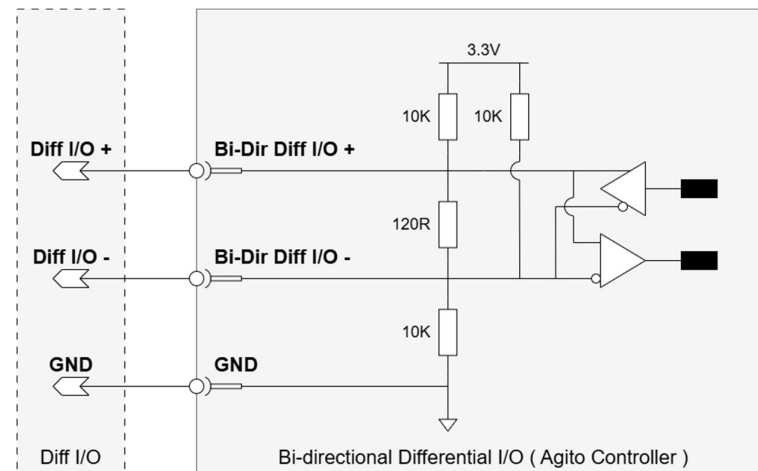


Figure 54. Bi-directional Differential I/O

Analog Input

- The electrical interfaces of all analog inputs are identical on all AGA1xx models.
- The analog input range is -12V to +12V, and resolution is 12 bits.
- The analog input is designed for standard differential analog input, with a simple input circuit, having an input resistance of ~60 kΩ.



- For single-ended analog inputs, be sure to connect the return line to GND. Do not leave it unconnected.
- Input circuit bandwidth: 1 kHz, -40 dB/decade
- The controller software provides the following parameters to control the analog input reading:
 - Filter
 - Offset
 - Deadband
 - Gain

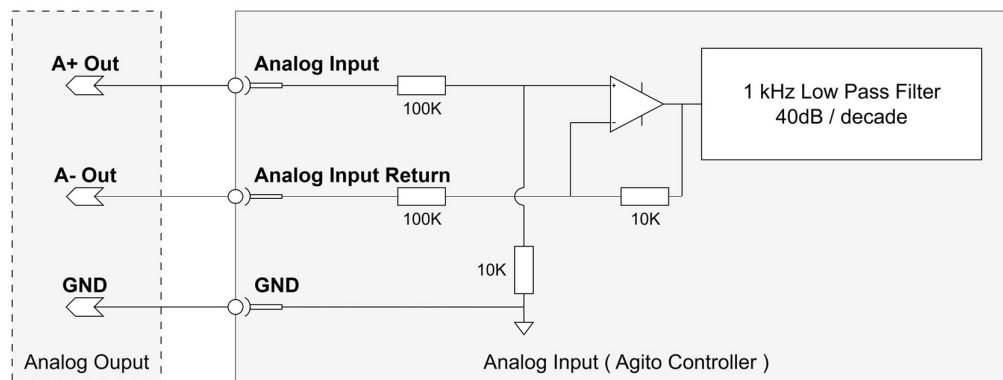


Figure 55. Analog Input

Hall Sensor

- Motor Hall sensor can be connected to opto-isolated digital inputs 1, 2, and 3 on connector X8(I/O-1). In Agito PCSuite the first input must be configured to mode 23-Hall A.
- It is recommended that Hall sensor be used with incremental encoder. Typically, Hall sensor is called Ha Hb Hc, or Hu Hv Hw, or H1 H2 H3, which correspond to the motor phases. A typical Hall sensor is an open collector (NPN) type and requires a 5 VDC power supply.
- Motor Hall sensors are wired as standard digital inputs.

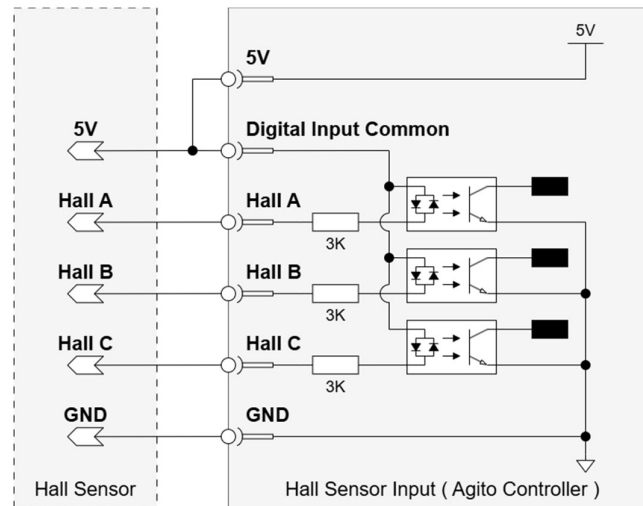


Figure 56. Hall Sensor



3.6.7 Interface X5: Central-i

Connector X5 is used for communication with the Central-i master controller, such as the AGM800, and other remote amplifiers and devices.

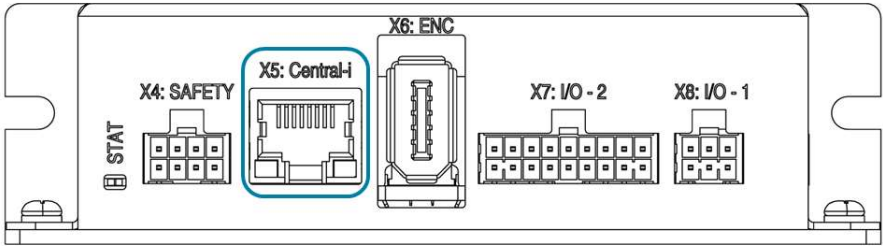


Figure 57. Central-i Communication Connector

Connector: Central-i (RJ45)

Pin #	Name	Description
1	DATA_0+	Data channel 0+
2	DATA_0-	Data channel 0-
3	DATA_1+	Data channel 1+
4	DATA_2-	Data channel 2-
5	DATA_2+	Data channel 2+
6	DATA_1-	Data channel 1-
7	V_REMOTE	Power supply to remote unit's communication module
8	GND	GND

Connector type	RJ45 LAN 10/100Base-T connector
Mating connector options	Any CAT5e compatible shielded connector
Cable	CAT5e or higher, standard Ethernet straight cable



3.7 AGA103 – Electrical Interfaces

3.7.1 Interface X5: Main Power

Connector X2 is used to supply 12–48 VDC to the AGA103. The input voltage is connected directly to the amplifier power bridge. The input voltage drives the axis motor. It also supplies the power for the amplifier internal logic.



Supply voltages for the AGA103 are as follows:

- Nominal supply voltage 12–48 VDC
- Minimum supply voltage 11 VDC
- Maximum supply voltage 55 VDC



Attention – Reverse polarity protection

AGA103 includes reverse polarity protection to prevent damage if polarity is inverted at the power input.



Note – Optional scheme for isolated power supplies

The amplifier can support fully isolated power supplies, one for the power circuitry to drive the motor, and one for the digital logic. If you are interested in such a scheme, contact Technical Support.

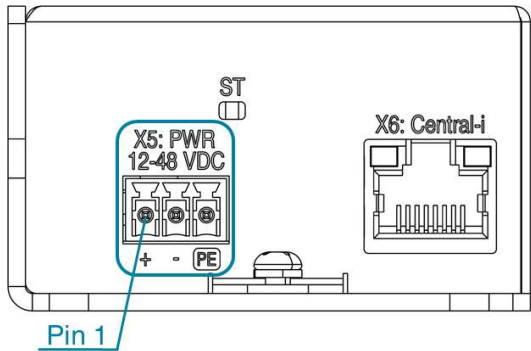


Figure 58. Power Connector

Connector X5: PWR

Pin #	Name	Description
1	Main Power	Power input: 12–48V, up to 8A continuous
2	GND	Ground
3	PE	Protective earth
Mating connector options		Degson 15EDGK-3.5-03P-14-00A Würth Elektronik 691361100003
Pitch		3.50 mm
Wiring		AWG 16–26, insulation rated for 300V



3.7.2 Interface X4: Safety

Connector X4 is used for the hardware safety function that disables power to the motor.

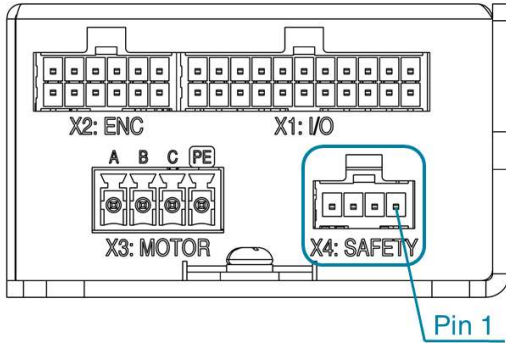


Figure 59. Safety Connector

Connector X4: SAFETY

Pin #	Name	Description
1	5V	5V supply for safety circuits
2	Safety +	Safety Input positive input
3	Safety -	safety Input negative input
4	GND	Ground

Mating connector	Samtec	IPD1-04-S and CC79R-2630-01-L
Wiring	AWG 26, insulation rated for 100V	

- safety Input disables the power to the motor through hardware circuitry, without any software intervention.
- safety Input is defined with a positive pin (+) and a negative pin (-). However, the opto-coupler at the safety Input has two input diodes, which enable operation at "positive" or "negative" input voltage. The input is activated when current is sufficient at one of the input diodes, regardless of the current direction. This enables NPN or PNP connection to the safety inputs.
- The safety Input protection logic is designed so that safety Input must be powered to enable motor operation. Leaving a safety Input disconnected prevents motor operation. This logic is required to ensure that a disconnected safety cable is considered an unsafe condition by the control unit. When sufficient current is driven through a safety Input, the state of this input is Safe. When insufficient current is driven through a safety Input, the state of this input is Unsafe.
- The safety Input must be in the Safe state to enable motor operation.
- The electrical characteristics of the safety Input is identical to those of all other isolated digital inputs of the controller.



- The safety inputs implemented in the product are currently pending certification Functional Safety Standards.



Disabling Safety function

If the Safety function is not required in your application, you can disable it by using a bypass plug from Agito. Part number: C-AGA103-SFT

Safety Connection Diagram Example

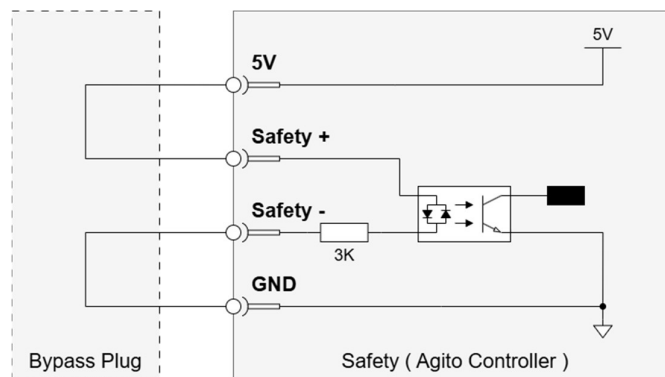


Figure 60. Safety Bypass (AGA103)

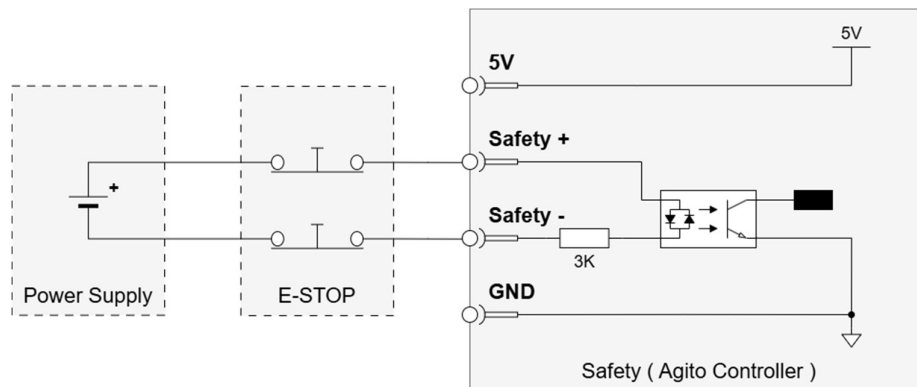


Figure 61. Safety with E-STOP (AGA103)



3.7.3 Interface X3: Motor

Connector X3 serves to supply power to the motor, which can be a 3-phase brushless motor, a single phase brushed motor, a voice coil motor, or a stepper motor.

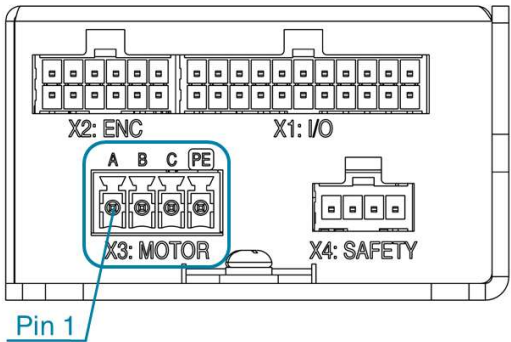


Figure 62. Motor Connector

Connector X3: MOTOR

Pin #	Name	Brushless Motor	Brushed or Voice Coil Motor	Stepper Motor
1	A	Motor phase A	Motor phase +	Motor phase 1+
2	B	Motor phase B	Motor phase -	Motor phase 2+
3	C	Motor phase C	Not connected	Motor phases 1- and 2- (see Note below)
4	PE	Protective earth	Protective earth	Protective earth

Mating connector options	Degson 15EDGK-3.5-04P-14-00A Würth Elektronik 691361100004
Pitch	3.50 mm
Wiring	AWG 16-26, insulation rated for 300 V



Note – Stepper voltage range

A bipolar stepper motor has two independent phases (4 wires in total). You must connect the (-) wire of both phases together, to pin 3 on connector X3.

This connection implies a limitation of the voltage that will be applied to the stepper.

For example, if the power supply to the unit is 24V, each phase of the stepper motor will be limited to 12V.

With suitable selection of the power supply this should impose no limitation on the stepper motor operation.



3.7.4 Interface X2: Encoder

Connector X2 serves as an interface to a single encoder.

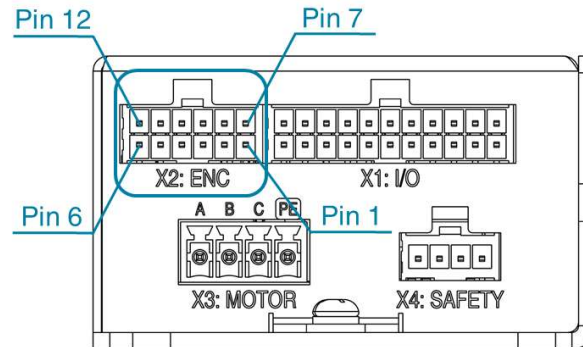


Figure 63. Encoder Connector

Connector X2: ENC

Pin #	Name	Encoder Type				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
1	5V					5V power supply. Limited to 0.3A.
2	Encoder_1+			Clock+	Clock+	Clock+ pin for absolute encoders
3	Encoder_2+	A+	Sin+			A+ (for AqB) or sin+ (for analog sin/cos)
4	Encoder_3+	B+	Cos+			B+ (for AqB) or cos+ (for analog sin/cos)
5	Encoder_4+	Z+	Z+	Data+	Data+	Data+ for absolute encoders, or Z+ for both AqB and analog sin/cos encoder
6	PE					Protective earth
7	GND					5V return and reference for differential signals
8	Encoder_1-			Clock-	Clock-	Clock- pin for absolute encoders
9	Encoder_2-	A-	Sin-			A- (for AqB) or sin- (for analog sin/cos)
10	Encoder_3-	B-	Cos-			B- (for AqB) or cos- (for analog sin/cos)
11	Encoder_4-	Z-	Z-	Data-	Data-	Data- for absolute encoders, or Z- for both AqB and analog sin/cos encoder



Pin #	Name	Encoder Type				Description
		AqB	Sin/Cos	BiSS-C	EnDat 2.2	
12	PE					Protective earth

Mating connector options	Samtec	IPD1-06-D-K and CC79R-2630-01-L
Wiring	AWG 26, insulation rated for 100 V	



Note – 5V supply limitation

The 5V supply provided at pin 1 on connector X2 is limited to 0.3A.
The maximum total current provided by all the 5V pins in the product is limited to 1.5A.



3.7.5 Interface X1: I/Os

Connector X1 is used for connecting external I/O devices to the amplifier.

For schematics and more information about these interfaces, refer to the section *I/O Connection Diagram Example*.

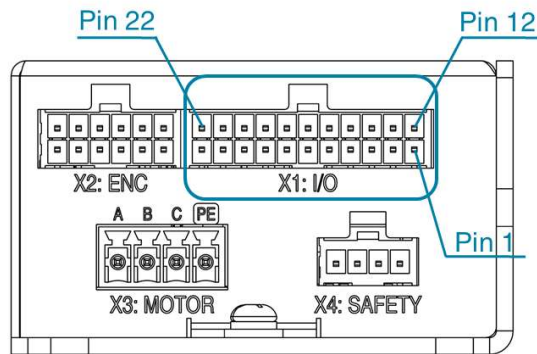


Figure 64. I/O Connector

Connector X1: I/O

Pin #	Name	Software Representation	Description
1	5V		5V supply to Hall sensors. Connect to pin 4 when using digital inputs 3 to 5 for Hall sensors.
2	GND		Ground for 5V.
3	Bi-Dir Diff I/O 2 -		Bi-directional differential I/O 2-
4	Digital Input Common (3 to 5)		Common pin (power or return, depending on external connection) for digital input 3 to 5.
5	Digital Input 4 (e.g. Hall B)	DInPort.bit[3]	Isolated digital input 4 (NPN or PNP, depending on the connection of the group's common pin).
6	Digital Input 3 (e.g. Hall A)	DInPort.bit[2]	Isolated digital input 3 (NPN or PNP, depending on the connection of the group's common pin). To use as Hall input, go to the Agito PCSuite Digital Input page, and configure as Hall A.
7	Digital Input 2	DInPort.bit[1]	Isolated digital input 2 (NPN or PNP, depending on the connection of the group's common pin).



Pin #	Name	Software Representation	Description
8	Digital Input 1	DInPort.bit[0]	Isolated digital input 1 (NPN or PNP, depending on the connection of the group's common pin).
9	Digital Input Common (1 to 2)		Common pin (power or return, depending on external connection) for digital input 1 to 2.
10	Digital Output 1	DOutPort.bit[0]	Isolated digital output 1, sink only.
11	Digital Output 2	DOutPort.bit[1]	Isolated digital output 2, sink only.
12	Bi-Dir Diff I/O 1 -		Bi-directional differential I/O 1-
13	Bi-Dir Diff I/O 1 +	DInPort.bit[5] DOutPort.bit[2]	Bi-directional differential I/O 1+ BiDirConfig.bit(0) = 0 for input BiDirConfig.bit(0) = 1 for output
14	Bi-Dir Diff I/O 2 +	DInPort.bit[6] DOutPort.bit[3]	Bi-directional differential I/O 2+ BiDirConfig.bit(1) = 0 for input BiDirConfig.bit(1) = 1 for output
15	Digital Input 5 (e.g. Hall C)	DInPort.bit[4]	Isolated digital input 5 (NPN or PNP, depending on the connection of the group's common pin).
16	Analog Input Return		Analog input return. Not connected internally to GND.
17	Analog Input	AlnPort[0]	Analog input, $\pm 12V$ full scale, 12-bit.
18	Temp+		PT100+ /Thermostat+
19	Temp-		PT100- /Thermostat-
20	Digital Output Common Power		Common power pin for isolated digital outputs.
21	Digital Output Common Return		Common power return pin for isolated digital outputs.
22	PE		Protective earth.

Mating connector options	Samtec	IPD1-11-D-K and CC79R-2630-01-L
Wiring	AWG 26, insulation rated for 100 V	



Note – 5V supply limitation

The 5V supply provided at pin 1 on connector X1 is limited to 0.3A.
The maximum total current provided by all the 5V pins in the product is limited to 1.5A.



I/O Connection Diagram Example

Isolated Digital Input 1 to 2, 3 to 5

- Isolated digital inputs are organized as groups with a dedicated common pin. This enables connection to different voltage supplies. Each group is fully isolated and independent of the other groups.
- Digital Input Common are grouped by digital inputs 1 to 2 and 3 to 5.
- Each group can be connected as NPN or PNP interfaces, depending on the wiring of the group's common pin. If the common pin is connected to power (5V to 28V), then the inputs of this group can be used with external NPN devices (external current sinking devices). If the common is connected to the GND of some external power, then the inputs can be used with external PNP devices (external current sourcing devices).
- The input circuit of the opto-couplers includes two diodes. This enables use as NPN or PNP.
- One group can be wired to interface external NPN devices and another group can be wired to interface PNP devices. However, within a group, all interfaces (NPN or PNP) must be the same, as they are based on the connection of the group's common pin.

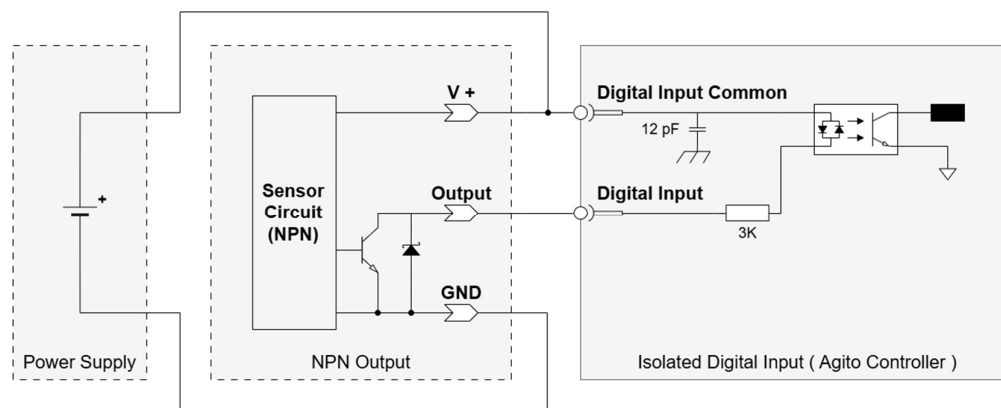


Figure 65. Digital Input with NPN Sensor (AGA103)

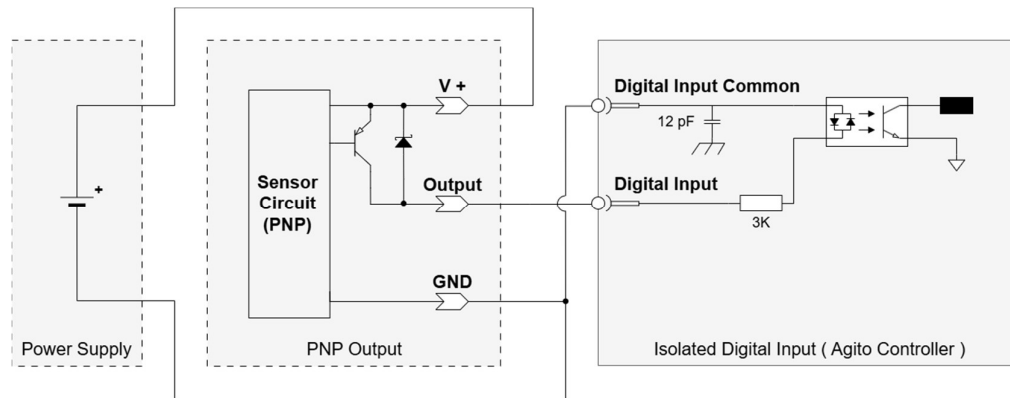


Figure 66. Digital Input with PNP Sensor (AGA103)

Isolated Digital Output 1 to 2

- Digital Output Common Power is shared by the 2 outputs.
- The outputs are designed for resistive loads. For inductive loads, an external flyback diode is required.
- Digital outputs specifications:
 - Digital Output Common Power voltage range is between 5V and 28V.
 - Maximal load current, per each output:

Sink mode, any Digital Output Common Power voltage:	500 mA
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Note – AGA103

In AGA103, the digital isolated outputs can be configured only as sink mode.

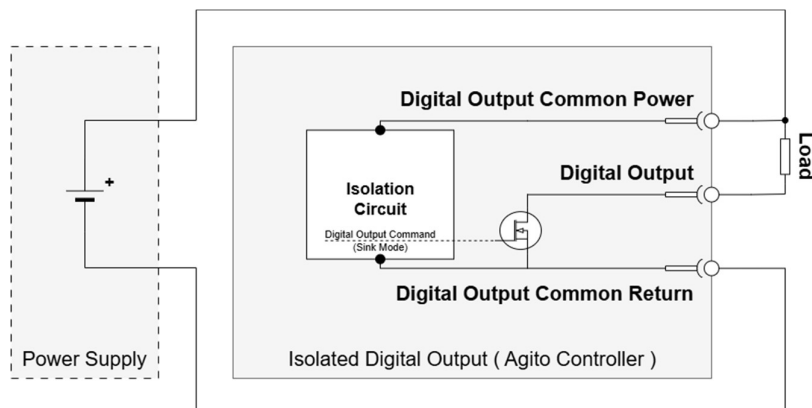


Figure 67. Digital Output (AGA103 Sink only)



Bi-directional Differential I/O 1 to 2

- The bi-directional differential output is configurable by software to be a differential output or differential input.
- Both + and - pins are pulled up to 3.3V.
- There is a 120Ω termination resistor between the + and - pins.

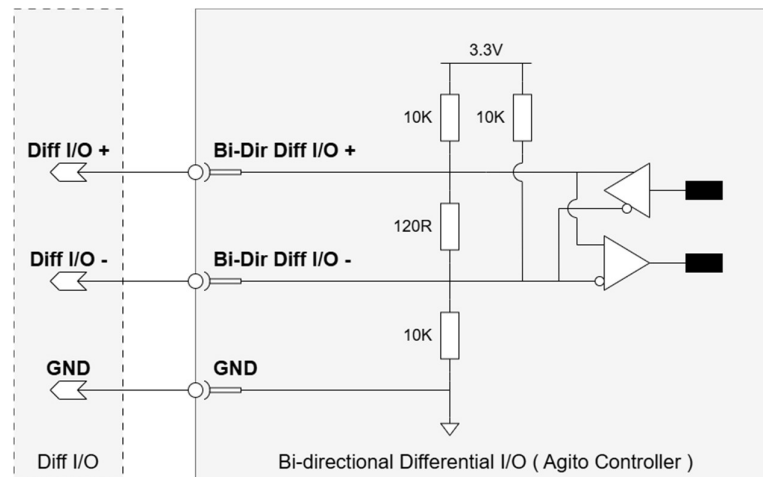


Figure 68. Bi-directional Differential I/O

Analog Input

- The electrical interfaces of all analog inputs are identical on all AGA1xx models.
- The analog input range is -12V to +12V, and resolution is 12 bits.
- The analog input is designed for standard differential analog input, with a simple input circuit, having an input resistance of ~60 kΩ.
- For single-ended analog inputs, be sure to connect the return line to GND. Do not leave it unconnected.
- Input circuit bandwidth: 1 kHz, -40 dB/decade
- The controller software provides the following parameters to control the analog input reading:
 - Filter
 - Offset
 - Deadband
 - Gain

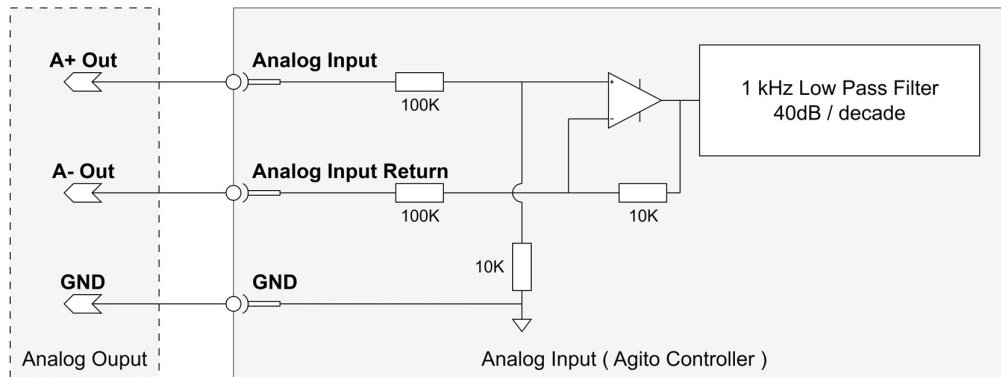


Figure 69. Analog Input

Hall Sensor

- Motor Hall sensor can be connected to opto-isolated digital inputs 3, 4, and 5 on connector X1(I/Os). In Agito PCSuite the first input must be configured to mode 23-Hall A.
- It is recommended that Hall sensor be used with incremental encoder. Typically, Hall sensor is called Ha Hb Hc, or Hu Hv Hw, or H1 H2 H3, which correspond to the motor phases. A typical Hall sensor is an open collector (NPN) type and requires a 5 VDC power supply.
- Motor Hall sensors are wired as standard digital inputs.

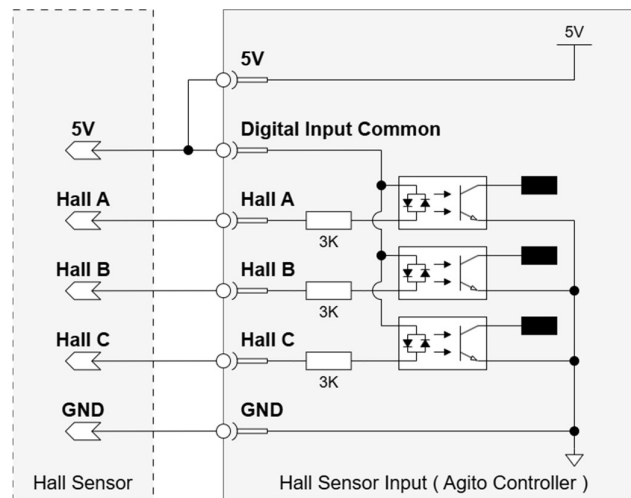


Figure 70. Hall Sensor



3.7.6 Interface X6: Central-i

Connector X6 is used for communication with the Central-i master controller, such as the AGM800, and other remote amplifiers and devices.

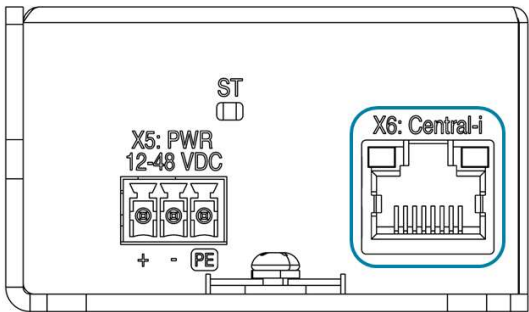


Figure 71. Central-i Communication Connector

Connector X6: Central-i (RJ45)

Pin #	Name	Description
1	DATA_0+	Data channel 0+
2	DATA_0-	Data channel 0-
3	DATA_1+	Data channel 1+
4	DATA_2-	Data channel 2-
5	DATA_2+	Data channel 2+
6	DATA_1-	Data channel 1-
7	V_REMOTE	Power supply to remote unit's communication module
8	GND	GND

Connector type	RJ45 LAN 10/100Base-T connector
Mating connector options	Any CAT5e compatible shielded connector
Cable	CAT5e or higher, standard Ethernet straight cable
Wiring	AWG 26, insulation rated for 100 V