AW5A91K5E2x1-30 - Controller

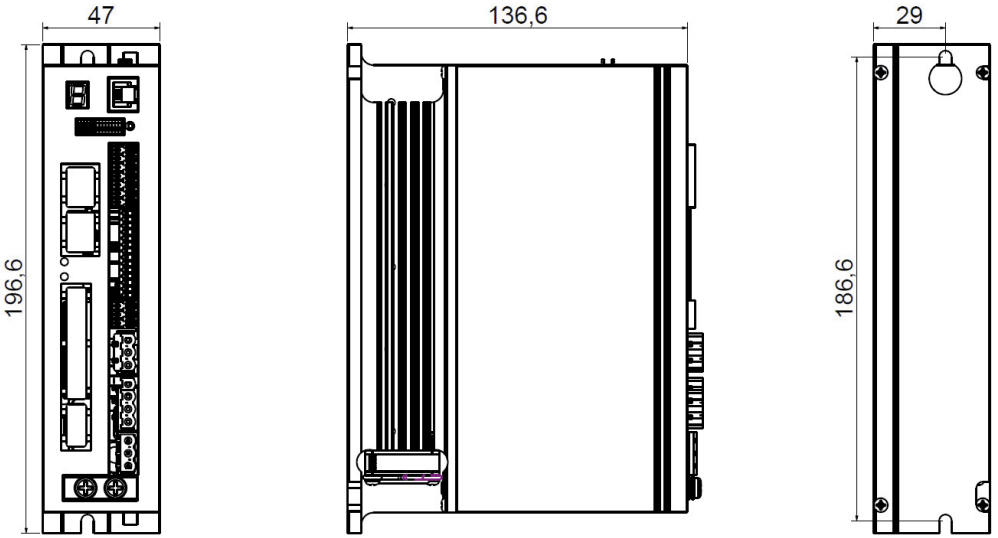
Installation instructions

Refer to installation use and maintenance manual for more information.

Brushless AC Servo drive technical data :

- *AC power supply: 85-265Vac monophase or triphase*
- *DC logic supply: 24 Vdc (mandatory and isolated)*
- *Phase current: continuous up to 5.2 Arms (peak of 12 Arms for 2s max with DCmax = 30%)*
- *Chopper frequency: ultrasonic 40KHz*
- *Protections against: over current, over/under voltage, overheating, short circuit between motor phase-to-phase and phase-to-ground*
- *Ethernet communication interface (Modbus TCP/IP protocol)*
- *Incremental Encoder Input: 5V Differential (RS422) or 5V single-ended TTL/CMOS*
- *Hall Signals Input: 5V single-ended TTL/CMOS*
- *Incremental Encoder Output: 5V Differential (RS422)*
- *Absolute Encoder Input: 5V BiSS-C or SSI interface*
- *Service SCI interface for programming and real time debugging*
- *Safe Torque Off (STO) inputs (opto-coupled)*
- *up to 16 digital inputs (opto-coupled)*
- *up to 12 digital outputs (opto-coupled)*
- *up to 2 analog inputs (isolated)*
- *up to 2 analog outputs (isolated)*
- *Dimensions: 196.6 x 136.6 x 47 mm (without connectors)*
- *Protection degree: IP20*
- *Pullution degree 2*
- *Overvoltage Category III*
- *Short Circuit Current: 5 KA*
- *Protection Class: Class I Equipment*
- *Working temperature 5°C ÷ 50°C; Storage temperature -25°C ÷ 55°C*
- *Humidity: 5% ÷ 85% not condensing*

Mechanical data

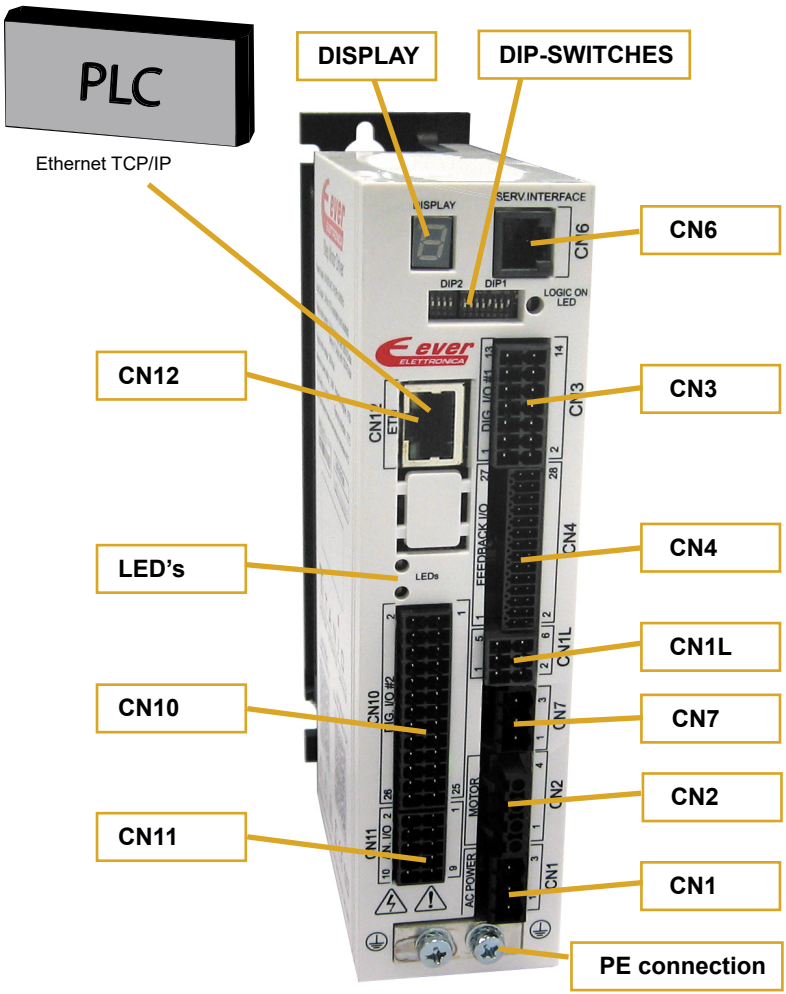


Models

MODELS IN THIS SHORT					
System Code	Fieldbus	Digital inputs	**Digital outputs**	Analog inputs	**Analog outputs**
AW5A91K5E2**2**1-30	Ethernet Modbus TCP/IP	4	3	0	**0**
AW5A91K5E2**G**1-30	Ethernet Modbus TCP/IP	16	12	2	2

System connections

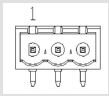
Connectors:



CN1: AC Power supply

3 positions, pitch 5.08mm double row, PCB header connector

CN1.1	ACin	PWR_IN	AC power supply input
CN1.2	ACin	PWR_IN	AC power supply input
CN1.3	ACin	PWR_IN	AC power supply input



CN7: Breaking resistor

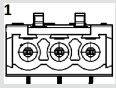
3 position, pitch 5.08mm single row connector

CN7.1	+DC_BUS	PWR_OUT	DC_BUS output
CN7.2	EXT_RES	PWR_IN	External Braking Resistor input
CN7.3	INT_RES		Reserved pin

CN2: Motor connection

3 position, pitch 5.08mm single row, PCB socket connector

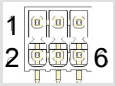
CN2.1	V	PWR_OUT	Motor phase V
CN2.2	U	PWR_OUT	Motor phase U
CN2.3	W	PWR_OUT	Motor phase W



CN1L: 24Vdc Logic Supply and STO inputs

6 positions, pitch 3.5mm double row, PCB header connector

CN1L.1	VLOG -	PWR_IN	Negative DC logic supply input
CN1L.2	VLOG +	PWR_IN	Positive DC logic supply input
CN1L.3	STO1 -	PWR_IN	STO1 input negative side
CN1L.4	STO1 +	PWR_IN	STO1 input positive side
CN1L.5	STO2 -	PWR_IN	STO2 input negative side
CN1L.6	STO2 +	PWR_IN	STO2 input positive side



LOGIC 24Vdc MANDATORY and ISOLATED

CN6: Service SCI Interface

RJ11, 6P4C, PCB header connector

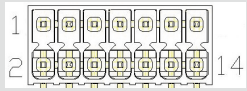
CN6.1	TX/RX	Transmit / Receive Line
CN6.2	$\overline{DE}$/RE	Drive Enable Negated / Receive Enable
CN6.3	+5V	+5V power out
CN6.4	GND	GND power out

NOTE: This connection is only possible with hardware and software provided by Ever Motion Solutions.

CN3: Digital Inputs / Outputs #1

14 positions, pitch 3.5mm double row, PCB header connector

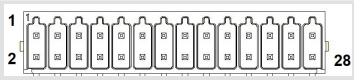
CN3.1	VSS#1	PWR_IN	Negative supply for digital outputs B0 on CN3
CN3.2	V-OUT	PWR_IN	24Vdc supply for digital outputs B0 on CN3
CN3.3	B0_OUT0	DIG_OUT	PNP digital output B0_OUT0
CN3.4	B0_OUT1	DIG_OUT	PNP digital output B0_OUT1
CN3.5	B0_OUT2	DIG_OUT	PNP digital output B0_OUT2
CN3.6	N.C.	---	Not connected
CN3.7	-B0_IN0	DIG_IN	Digital input B0_IN0 negative side
CN3.8	+B0_IN0	DIG_IN	Digital input B0_IN0 positive side
CN3.9	-B0_IN1	DIG_IN	Digital input B0_IN1 negative side
CN3.10	+B0_IN1	DIG_IN	Digital input B0_IN1 positive side
CN3.11	-B0_IN2	DIG_IN	Digital input B0_IN2 negative side
CN3.12	+B0_IN2	DIG_IN	Digital input B0_IN2 positive side
CN3.13	-B0_IN3	DIG_IN	Digital input B0_IN3 negative side
CN3.14	+B0_IN3	DIG_IN	Digital input B0_IN3 positive side



CN4: Feedback connection

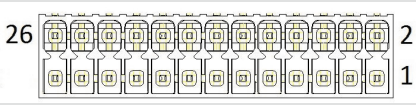
28 position, pitch 2.54mm double row, PCB header connector

CN4.1	SHIELD	/	Cable shield connection for feedback interface
CN4.2	SHIELD	/	Cable shield connection for feedback interface
CN4.3	N.C.	---	Not connected
CN4.4	N.C.	---	Not connected
CN4.5	DATA-	DIG_IN	Absolute encoder data input negative
CN4.6	DATA+	DIG_IN	Absolute encoder data input positive
CN4.7	CLK-	DIG_OUT	Absolute encoder clock output negative
CN4.8	CLK+	DIG_OUT	Absolute encoder clock output positive
CN4.9	HALL_C	DIG_IN	Hall signal C input
CN4.10	HALL_B	DIG_IN	Hall signal B input
CN4.11	HALL_A	DIG_IN	Hall signal A input
CN4.12	T_MOT	AN_IN	Temperature motor input
CN4.13	ENCZ-	DIG_IN	Encoder Zero differential input negative
CN4.14	ENCZ+	DIG_IN	Encoder Zero differential input positive
CN4.15	ENCB-	DIG_IN	Encoder Phase B differential input negative
CN4.16	ENCB+	DIG_IN	Encoder Phase B differential input positive
CN4.17	ENCA-	DIG_IN	Encoder Phase A differential input negative
CN4.18	ENCA+	DIG_IN	Encoder Phase A differential input positive
CN4.19	0VE	PWR_OUT	Negative side of supply
CN4.20	+5E	PWR_OUT	+5Vdc power supply output
CN4.21	OUT_ENCZ-	DIG_OUT	Encoder Zero differential output negative
CN4.22	OUT_ENCZ+	DIG_OUT	Encoder Zero differential output positive
CN4.23	OUT_ENCB-	DIG_OUT	Encoder Phase B differential output negative
CN4.24	OUT_ENCB+	DIG_OUT	Encoder Phase B differential output positive
CN4.25	OUT_ENCA-	DIG_OUT	Encoder Phase A differential output negative
CN4.26	OUT_ENCA+	DIG_OUT	Encoder Phase A differential output positive
CN4.27	0VE	PWR_OUT	Reference ground for feedback interface
CN4.28	0VE	PWR_OUT	Reference ground for feedback interface

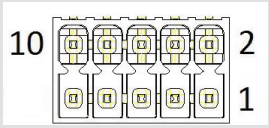


System connections

CN10: Digital I/O #2			
26 positions, pitch 3.5mm double row, PCB header connector			
CN10.1	+24Vdc	PWR_IN	24Vdc supply for digital outputs B1 on CN10
CN10.2	VSS#2	PWR_IN	Negative reference for digital inputs and outputs on CN10
CN10.3	VSS#2	PWR_IN	Negative reference for digital inputs and outputs on CN10
CN10.4	B0_OUT3	DIG_OUT	PNP digital output B0_OUT3
CN10.5	B1_OUT0	DIG_OUT	Digital output B1_OUT0 (PNP)
CN10.6	B1_OUT1	DIG_OUT	Digital output B1_OUT1 (PNP)
CN10.7	B1_OUT2	DIG_OUT	Digital output B1_OUT2 (PNP)
CN10.8	B1_OUT3	DIG_OUT	Digital output B1_OUT3 (PNP)
CN10.9	B1_OUT4	DIG_OUT	Digital output B1_OUT4 (PNP)
CN10.10	B1_OUT5	DIG_OUT	Digital output B1_OUT5 (PNP)
CN10.11	B1_OUT6	DIG_OUT	Digital output B1_OUT6 (PNP)
CN10.12	B1_OUT7	DIG_OUT	Digital output B1_OUT7 (PNP)
CN10.13	B0_IN8	DIG_IN	Digital input B0_IN8
CN10.14	B0_IN9	DIG_IN	Digital input B0_IN9
CN10.15	B0_IN10	DIG_IN	Digital input B0_IN10
CN10.16	B0_IN11	DIG_IN	Digital input B0_IN11
CN10.17	B0_COM_IN	PWR_IN	Reference common inputs B0 on CN10
CN10.18	B1_IN0	DIG_IN	Digital input B1_IN0
CN10.19	B1_IN1	DIG_IN	Digital input B1_IN1
CN10.20	B1_IN2	DIG_IN	Digital input B1_IN2
CN10.21	B1_IN3	DIG_IN	Digital input B1_IN3
CN10.22	B1_IN4	DIG_IN	Digital input B1_IN4
CN10.23	B1_IN5	DIG_IN	Digital input B1_IN5
CN10.24	B1_IN6	DIG_IN	Digital input B1_IN6
CN10.25	B1_IN7	DIG_IN	Digital input B1_IN7
CN10.26	B1_COM_IN	PWR_IN	Reference common inputs B1 on CN10



CN11: Analog I/O			
10 positions, pitch 3.5mm double row, PCB header connector			
CN11.1	AVSS	PWR_OUT	Negative output reference for analog outputs
CN11.2	OUT_AN0	AN_OUT	Analog output 0 positive side
CN11.3	AVSS	PWR_OUT	Negative output reference for analog outputs
CN11.4	OUT_AN1	AN_OUT	Analog output 1 positive side
CN11.5	-IN_AN0	AN_IN	Analog input 0 negative side
CN11.6	+IN_AN0	AN_IN	Analog input 0 positive side
CN11.7	-IN_AN1	AN_IN	Analog input 1 negative side
CN11.8	+IN_AN1	AN_IN	Analog input 1 positive side
CN11.9	AGND	PWR_OUT	Negative output reference for potentiometer
CN11.10	VPOT	PWR_OUT	Voltage supply output for potentiometer

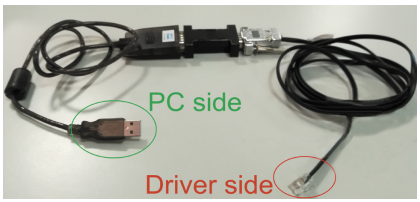


CN12: Ethernet Interface
RJ45, 8 positions shielded, PCB header connector
RJ45 connector
100BASE-TX (100Mb/sec) port
Accept standard Ethernet cable (CAT5 or higher)

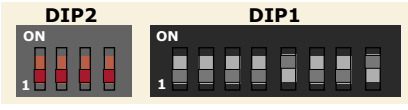
Service SCI connection

This connection is <u>only</u> possible with hardware and software provided by Ever.
Kit code: SW5_SERV00-SL or SW5-SERV00-EE.

PC — Service SCI connection KIT — **Drive**



Dip-Switched Settings



The functionality of the Dip-Switches depends on the Firmware installed on the drive. (Refer to the Software Manual).

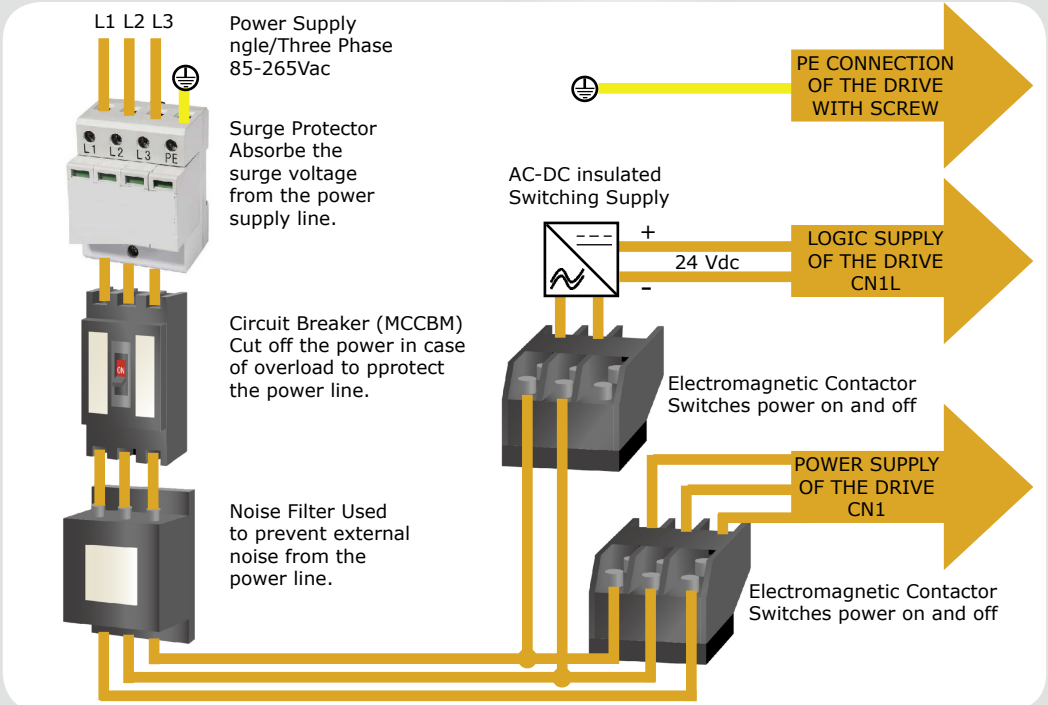
NOTE: the device reads the Dip-Switches only during the Power up. If it's necessary a setting change, shut down the system, change the settings and start up the system again to make the changes operating.

The default configuration of the DIPs is :
- DIP1.5 and DIP1.8 = ON other contacts DIP1 = OFF
- DIP2 = all OFF

Display Status

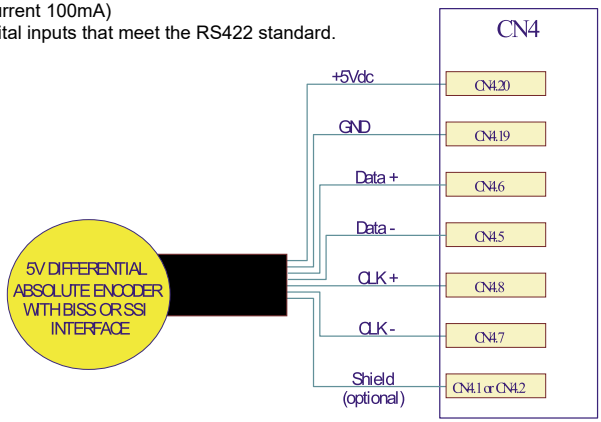
Operational statuses and their signals	
0	Missing Operating System: no software application stored on drive
U	Firmware update: Updating of new software in progress.
1	Initialization: the drive executes the start-up procedure (a few seconds after the start-up procedure has begun).
S	Correct functioning
S + 1	Warning: Power supply is near to the limit
S + 3	Warning : Drive temperature is near to the maximum value
S + n	Warning: EEprom near Write Overrun
S + 8	Warning: EEprom near End of Life
S flashing	Enable OFF, current zero
- flashing	$I_{nominal}$ not computed
E + 3	Error: expired e3PLC software trial
F + 0	Error: Security intervention of watchdog
F + 1	Error: Internal Software Error
F + 2	Error: Missing calibration values
F + 3	Error: Management EEPROM
F + 4	EEPROM fail
F + 6	Error: e3PLC application error
F + n	Error: EEprom Write Overrun
F + U	Error: Feature Unavailable
P + 0	Open motor phases
P + 1	Over/under voltage
P + 2	Over current on the motor output
P + 3	Over temperature of the drive;
P + 5	Missing Torque Enable ("Missing Safe Torque Off")
P + 6	Drive Over Power Protection and /or Current Regulation out of range
P + n	e3PLC User Protection (generated by setting bit #0 of e3PLC_User_Settings)
P + 9	Motor feedback error

Power & Logic Supply connections



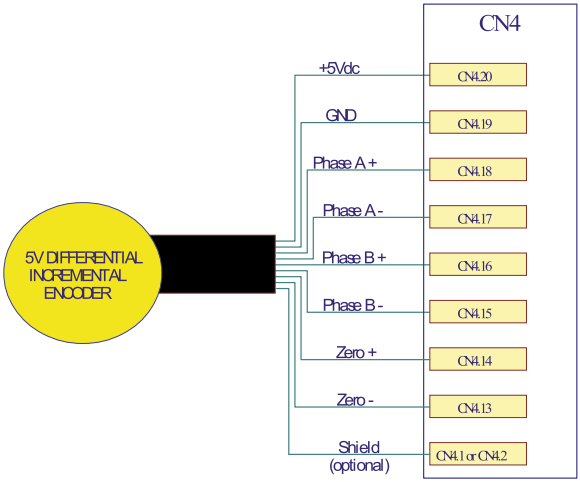
Absolute Encoder input connection

(Maximum supply current 100mA)
Differential 5Vdc digital inputs that meet the RS422 standard.

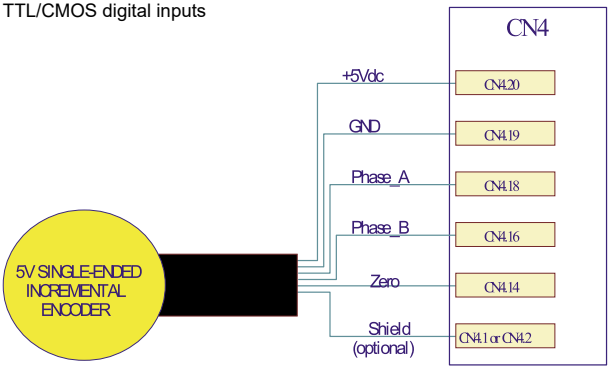


Incremental Encoder input connection

(Maximum supply current 100mA)
Differential 5Vdc digital inputs that meet the RS422 standard.

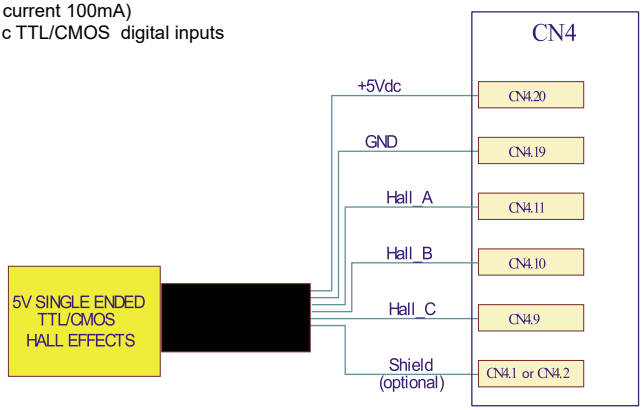


Single-Ended 5Vdc TTL/CMOS digital inputs



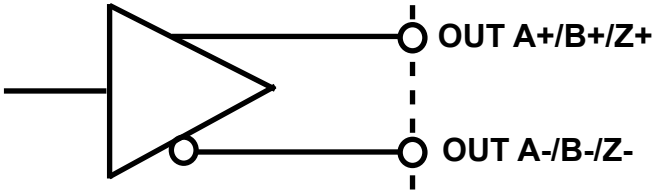
Hall signals input connection

(Maximum supply current 100mA)
Single-Ended 5Vdc TTL/CMOS digital inputs



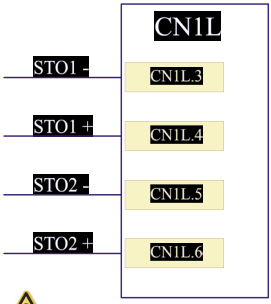
Incremental encoder output connection

Outputs reports the used interface for encoder input : Differential or Single-Ended.
Differential 5V digital outputs that meets RS422 standard.



Safe Torque Off inputs (STO)

2 terminals, 24V compatible (optoisolated)



STO1	STO2	Drive Status	Motor Status
+24Vdc	+24Vdc	Enable	SW controlled
+24Vdc	Not connected	Disable	Stop for inertia
Not connected	+24Vdc	Disable	Stop for inertia
Not connected	Not connected	Disable	Stop for inertia

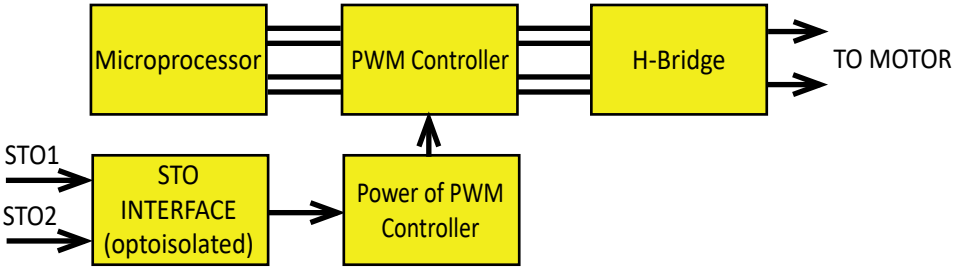
STO inputs are optoisolated, shall not be used the same 24Vdc of logic supply for their connection.

Safety specifications		
Safety function	STO	Safe Torque Off
Category	4	In accordance with EN ISO 13849-1
Performance Level	PLe	In accordance with EN ISO 13849-1
Safety Integrity Level	SIL3	In accordance with EN ISO 13849-1 table 3
DC_{avg} [%]	99	Average Diagnostic Coverage
PFH_D [1/h]	6.44×10^{-9}	Probability of dangerous failure per hour
T Service Life [Years]	20	In accordance with EN ISO 13849-1
Type test	The STO function has been certified by an independent testing body.	

Refer to the “Safety Manual_STO on SW5-AW5 Series” for more details of the Safe Torque Off function characteristics.

Safe Torque Off inputs (STO)

Principle of operation:



The drive has a safety feature that is designed to provide the Safe Torque Off (STO) function. Two input signlas are provided which, when not connected, prevent the upper and lower devices in the PWM outputs from being operated by the digital control core. This provides a positive OFF capability that cannot be overridden by the control firmware, or associated hardware components. When both STO signals are activated (current is flowing in the input diodes of the optocouplers), the control core will be able to control the on/off state of the PWM outputs.

If not using the STO feature, both signals must be connected to a 24Vdc supply in order enabled the drive.

If a drive in operation mode is disabled by STO signal, it immediately finish to produce torque but the motor continues to run by inertia until it can stop.

Braking Resistor connection

Internal circuit drives external breaking resistor when the mechanical energy of the motor is converted back into electrical energy that must be dissipated before it charges the internal capacitors to an overvoltage condition.
Cut-In Voltage +DC_BUS > 390 Vdc : output is on, external breaking resistor is dissipating energy
Drop-Out Voltage +DC_BUS < 380 Vdc : output is off, regen resistor not dissipating energy
Tolerance ±2 Vdc for either Cut-In or Drop-Out voltage
DC Bus Capacitance : 750uF

Input voltage	Energy Absorpion Capacity of the DC Bus
120Vac	46.24 joules
230Vac	17.36 joules

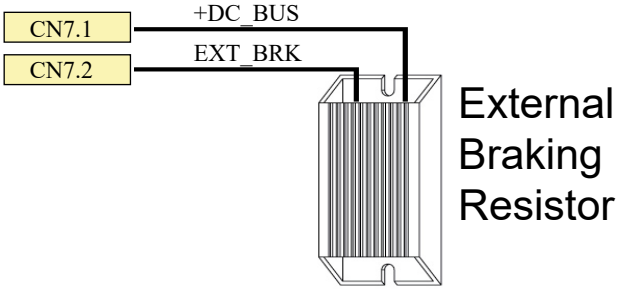
- INTERNAL RESISTOR

CN7.2 and CN7.3 MUST be connected with the jumper bar (as default).
CN7.1 MUST remain disconnected when the internal breaking resistor is used.

The drive is equipped with an internal breaking resistor of 47Ω 50W (drive mounted on appropriate heatsink).
In some applications, the internal regeneration resistor might not be enough to absorb all foldback current. In these cases, a larger wattage regeneration resistor needs to be connected externally, to prevent drive from over voltage warnings.

- EXTERNAL RESISTOR

Before connecting an external breaking resistor you MUST disconnect the jumper bar placed between CN7.2 and CN7.3.
CN7.3 MUST remain disconnected when an external breaking resistor is used.

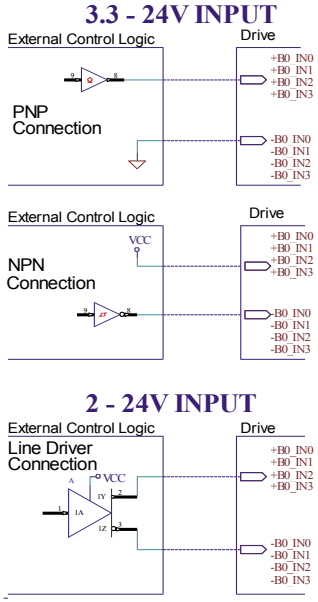


External braking resistor must be placed more than 50mm from the drive on notflammable and heat resistant surfaces. The metal case of the braking resistor can reach high temperatures. Take all necessary measures to avoid possible contacts in the final installation.

+DC_BUS is an High-Voltage circuit (up to 400Vdc) so take all necessary measures to avoid possible contacts in the final installation.

Digital input connection (B0_IN0 to B0_IN3)

Differential PNP, NPN and Line Driver type.



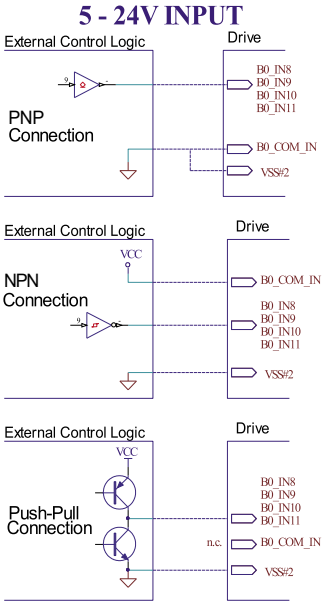
B0_IN0 and B0_IN1			
Characteristics	**MIN.**	**MAX.**	**Unit**
Supply voltage	**2** (1)	**24**	**Vdc**
Inputs frequency	**--**	**10**	**kHz**
Threshold switching voltage	**1.61** (1)	**--**	**Vdc**
Current at 2 Vdc	**--**	**2.53**	**mA**
Current at 3.3 Vdc	**--**	**5.84**	**mA**
Current at 5 Vdc	**--**	**6.28**	**mA**
Current at 24 Vdc	**--**	**8.75**	**mA**

B0_IN2 and B0_IN3			
Characteristics	**MIN.**	**MAX.**	**Unit**
Supply voltage	**2** (1)	**24**	**Vdc**
Inputs frequency	**--**	**500**	**kHz**
Threshold switching voltage	**1.61** (1)	**--**	**Vdc**
Current at 2 Vdc	**--**	**2.53**	**mA**
Current at 3.3 Vdc	**--**	**5.84**	**mA**
Current at 5 Vdc	**--**	**6.28**	**mA**
Current at 24 Vdc	**--**	**8.75**	**mA**

(1) N.B.: it's recommended to use 2 Vdc digital inputs only in differential Line-Driver configuration to have more noise immunity.

Digital inputs connection (B0_IN8 to B0_IN11)

Single-Ended PNP, NPN, Push-Pull



Characteristics	MIN.	MAX.	Unit
Supply voltage	**5**	**24**	**Vdc**
Inputs frequency	**--**	**100**	**Khz**
Threshold switching voltage	**2**	**--**	**Vdc**
Current at 5 Vdc	**--**	**2**	**mA**
Current at 24 Vdc	**--**	**12**	**mA**

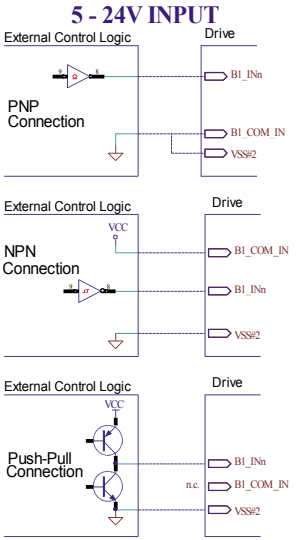
N.B.: All these inputs must be connected with the same configuration (PNP, NPN or Push-Pull).

Digital inputs connection (B1_IN0 to B1_IN7)

Single-Ended PNP, NPN, Push-Pull

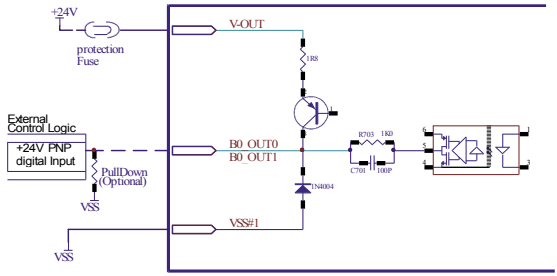
N.B.: All these inputs must be connected with the same configuration (PNP, NPN or Push-Pull).

Characteristics	MIN.	MAX.	Unit
Supply voltage	**5**	**24**	**Vdc**
Inputs frequency	**--**	**250**	**Hz**
Threshold switching voltage	**2,5**	**--**	**Vdc**
Current at 5 Vdc	**--**	**2**	**mA**
Current at 24 Vdc	**--**	**12**	**mA**



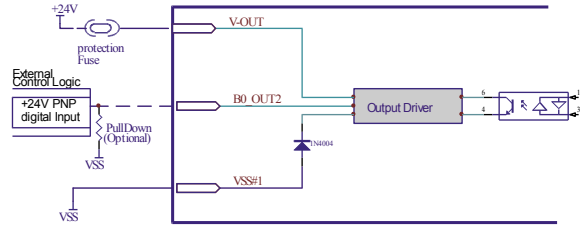
Digital outputs connection (B0_OUT0 and B0_OUT1)

PNP with VOUTmax=24Vdc, IOUTmax=100mA, Fmax = 500KHz



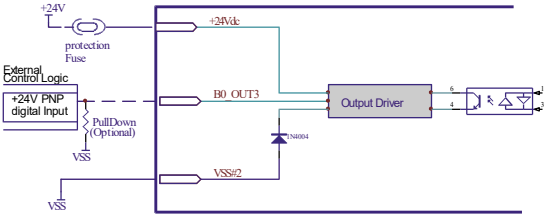
Digital outputs connection (B0_OUT2)

PNP with VOUTmax=24Vdc, IOUTmax=1.3A, Fmax = 1KHz



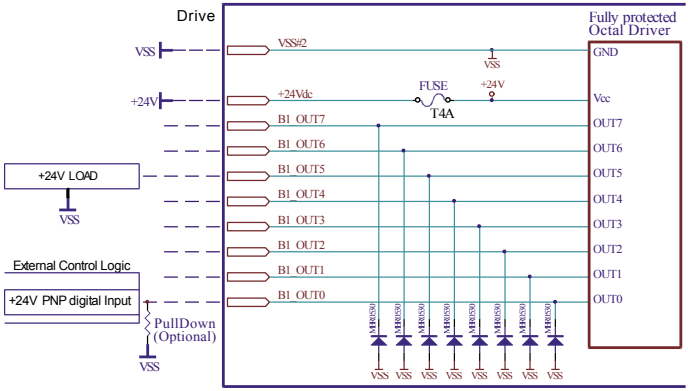
Digital outputs connection (B0_OUT3)

PNP with VOUTmax=24Vdc, IOUTmax=500mA , Fmax = 1KHz



Digital outputs connection (B1_OUT0 and B1_OUT7)

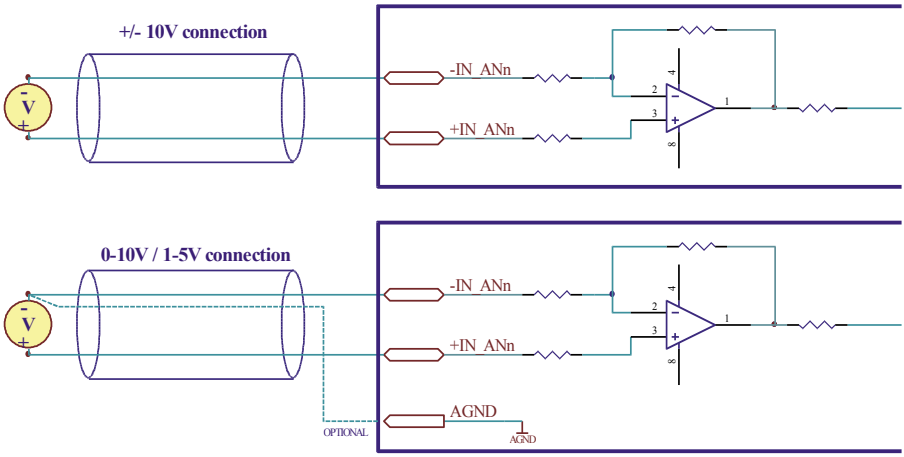
PNP with VOUTmax = 24Vdc, IOUTmax = 100mA, Fmax = 250Hz



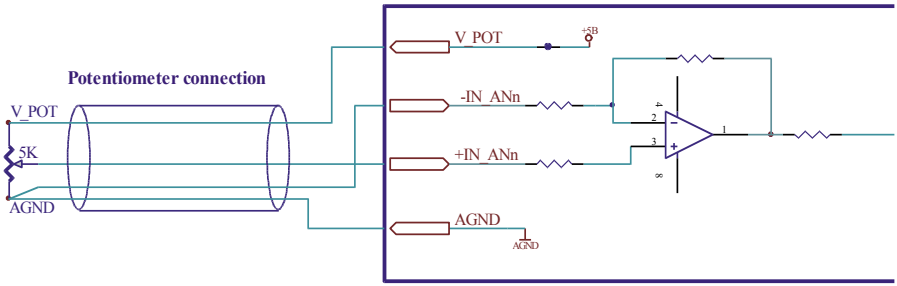
Analog inputs connection

Isolated configurable analog inputs. The resolution of the analog inputs depends from the type of the connection which could be defined by software: differential or potentiometer.

Differential connection

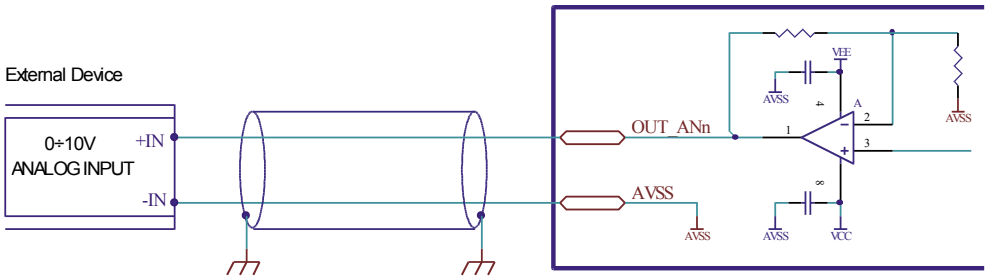


Potentiometer connection



Analog outputs connection

0-10V isolated analog outputs.



In order to comply with cURus certification according to the UL 61800-5-1 standard, the following requirements must be met:

File number E363861

Earting system

IT or TN (not corner earthed).
The drive shall considered only for use in system voltage where the maximum voltage between the ungrounded conductors and ground does not exceed 150 V

Maximum lenght of the cables

CABLE	LENGHT
AC Power Supply	No limitation
24VDC Logic Supply & STO	No limitation
Motor	< 30m
Feedback	< 30m
Input & Output	< 30m
Fieldbus	< 30m

Motor and braking resistor cables must be shielded

Fuses on AC Power Supply

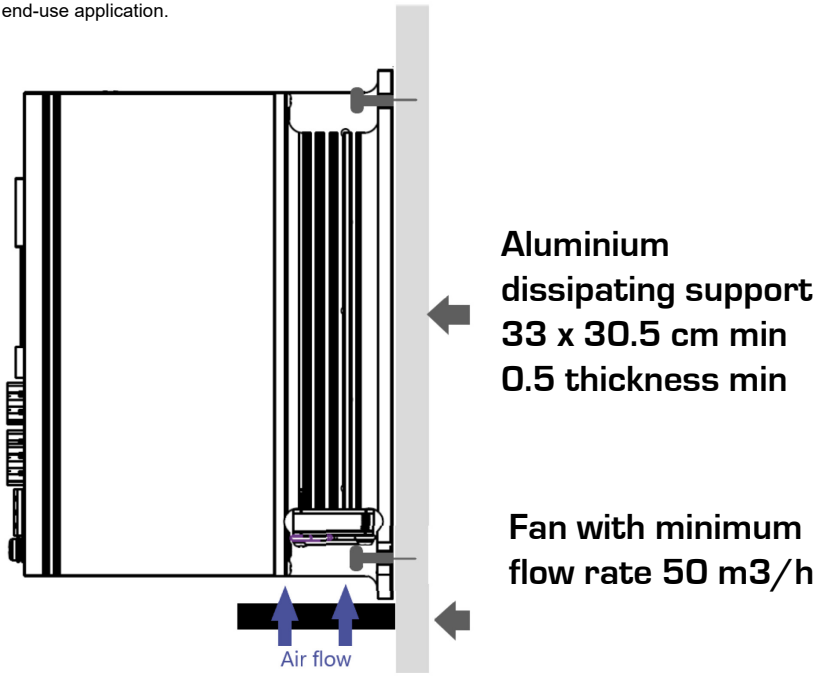
In the final installation use only Cooper Bussmann FWX-20 A14F fast fuses on AC bus with 20Arms of current, 250Vac voltage and interrupt rating 200KA or any equivalent UL Listed or UL Recognized External Semiconductor Fuses, on condition that these fuses have the same ratings of the above fuse in particular with “Peak-let-trough-current Ip“ and “Clearing I2t”.

Discharge time of the capacitors on the AC power supply

CAUTION – Risk of Electric Shock
Time required for the discharge of the capacitors after the removal of the AC power supply: 4 minutes.

Dissipation

To reach the maximum performances with 100% of duty cycle, the drive shall be fixed on the side to an aluminum heat-sink with dimension of 330x305 mm with 5 mm in thickness and with an external R/C Fans, Electric (GPWV2/8) with an Air flow rate minimum of 50 m3/h positoned on the bottom side of the device like indicated in the picture above.
Use with a smaller aluminum heat-sink and a lower Fan Air Flow shall be taken into consideration in the end-use application.



Mating connectors

Connector	Description
CN1	Phoenix 1762208 (Green) or 1759509 (Black)
CN1L	Phoenix 1790111 (Green) or 1708329 (Black)
CN2	Phoenix 1786187 (Green) or 1701895 (Black)
CN3	Phoenix 1790153 (Green) or DFMC 1,5/ 7-ST-3,5 BK (Black)
CN4	Phoenix 1844691
CN10	Phoenix 1790218 (Green) or DFMC 1,5/13-ST-3,5 BK (Black)
CN11	Phoenix 1790237 (Green) or 1812542 (Black)
CN12	RJ45 for Ethernet standard cables (CAT5 or higher)

Cables section

Function	Cable	
	Minimum	Maximum
Power supply and PE	0.5 mm² (AWG20)	2.5 mm² (AWG12)
Motor output	0.5 mm² (AWG20)	2.5 mm² (AWG12)
Feedback	0.12 mm² (AWG26)	0.5 mm² (AWG20)
Logic supply and Inputs / Outputs	0.5 mm² (AWG20)	1.3 mm² (AWG16)
Communication interfaces	Ethernet standard cables CAT5 or higher	

Verify the installation

- Check all connection: power supply, logic supply, STO inputs and inputs/outputs
- Make sure all settings right for the application.
- Make sure the power supply is suitable for the drive.
- If possible, remove the load from the motor shaft to avoid that wrong movements cause damage.
- Enable the current to the motor and verify the applied torque.
- Enable a movement of some steps and verify if the rotation direction is the desired one.
- Disconnect the power supply, connect the load on the motor and check the full functionality.

Analysis of malfunctions

When one of the following situations occur, the drive doesn't function correctly and it is reported an error.

DEFECT	CAUSE	ACTION
The external fuse to the drive burns	May be due to a wrong connection of the power supply.	Adjust the connection and recover the fuse. Use a fuse suitable for the application.
Over temperature protection.	May be due to a duty cycle	Increase the air flux and if it is possible chose a motor with higher torque at same current value.
Over current protection.	May be due to a short circuit on the motor power stage.	Shut down the power supply and check if the motor is damaged
Noisy motor movement with vibrations.	May be caused due to a state of resonance.	Increase the resolution of the step angle and/or change the motor velocity to avoid resonance area
The motor produce torque but doesn't rotate	May be caused due to a wrong connection of the I/O's.	Check the connection of the I/O's

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