ACTILINK-JD Documentation

Actuators for highly dynamic robots and machines

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1.2. Intended Use

Synapticon documentation contains information to ensure the safe and proper use of its products. As such, all Synapticon products should be handled, installed, and maintained by trained automation and control specialists who have knowledge of electrical systems and/or drive technology. These individuals should also be familiar with the applicable standards and requirements.

It is recommended to understand all components, safety information, and precautions for correct operation prior to use. Refer to, and retain, this documentation for reference.

ATTENTION
Synapticon products must be used in accordance with all specified safety requirements, i.e., all standards and regulations, applicable laws.

IMPORTANT
For actuators with Safe motion functions other than hardwired STO-SBC, functional safety is - by default - disabled by configuration.

Accordingly, the actuator shall never be assumed to be performing any safety function.

The functional safety expert is responsible for configuring safety according to the specific application requirements.

2. Table of Contents

3. Documentation Overview

3.1. Original Instructions

This document includes original instructions for using *ACTILINK-JD*. All product components described in this documentation are delivered in a specific hardware/software configuration. Any changes made to the hardware or software configuration that differ from the documented options, void any Synapticon liability in this regard.

3.2. Warnings

Boxes are used to indicate potentially dangerous situations as follows:

NOTE
Background information that is not necessarily required for basic operation but for optimal performance.

IMPORTANT
Required for correct functionality. Ignoring these facts may result in erratic behavior or lack of function.

ATTENTION
Indicates a situation that could possibly lead to serious accidents and/or destruction of the servo drive.

DANGER
If these warnings are ignored, hazardous and potentially fatal situations may arise from improper or careless use.

3.3. Reporting Errors

It is in our best interest to provide detailed, user-oriented and error-free documentation. If something is missing, incomprehensible or incorrect, go to Suggest Documentation Improvement and complete the form displayed there. In the “Link to documentation page” field, enter **ACTILINK-JD Documentation v1.0**.

3.4. Versioning

This documentation will be constantly updated and improved. The version in the footer reflects the current documentation release.

4. Overview

The ***ACTILINK-JD*** series actuators are quasi-direct-drive actuators featuring:

- a low gear-ratio gearbox with low transmission loss,
- a high dynamics motor with high power density, and
- a full-featured servo drive from the SOMANET Circulo series.

Figure 4.1 - ACTILINK-JD 08, ACTILINK-JD 10, and ACTILINK-JD 12

The ACTILINK-JD series offers torque from 17 to 110 Nm with a torque-to-weight ratio of maximum 70 Nm/kg. Additionally, the ***ACTILINK-JD DUO*** series will be released soon. It features dual stage planetary gearing with a hollow-shaft configuration, which offers double torque capacity.

4.1. Applications

The ACTILINK-JD series is ideal for light-weight and dynamic applications such as humanoid robots, robot dogs, and exoskeletons.

Figure 4.2 - ACTILINK-JD in robotic applications

4.2. Product Specifications

The ACTILINK-JD 08 and ACTILINK-JD 10/12 core specifications are described on the pages that follow.

4.2.1. ACTILINK-JD 08 Core Specifications

ACTILINK-JD				
Product Variant		AJD-08-20-300		
		ECS1SS	ECD2SS	ECD2SM
Supply Voltage	V	24 - 48 V, 48 V nominal, 60 V peak		
Performance Data with Supply Voltage 48 V				
Torque Density (Peak)	Nm/kg	33.3	27.4	26.6
Rated Output Power	W	170		
Max. Acceleration Torque	Nm	17		
Rated Torque	Nm	6		
No-Load Speed	rpm	400		
Rated-Load Speed	rpm	275		
Mechanical Characteristics				
Weight	g	510	620	640
Rotary Inertia (After Reduction)	kg·m²	0.0042		
Outer Diameter	mm	78.5		
Length *	mm	65.5	73	73
Emergency Stop Torque	Nm	30		
Emergency Stop Deceleration	rad/s²	6000		
Permissible Tilting Moment	Nm	3.3 * K		
Permissible Radial Load	N	162.2 * K		
Permissible Axial Load	N	103.9 * K		
Constant K for Permissible Load				
K, rated speed, 10000-hour lifetime		1		
K, speed = *v* rpm, lifetime = *t* hours		(10000 * [rated speed] / *t* / *v*) ^ (1/3)		
K, static		2.28		
Key Components				
Gear Type		Single-stage planetary		
Reduction Ratio		7.75		
Backlash	arcmin	< 22		
Integrated Drive		Synapticon Circulo 7 ***. Typical variants listed below.		
Drive Variant		CR7-48-24-ECAN, -ECANSM for SM variants		
Motor Encoder		19 bit absolute multi-turn **		
Output Encoder		S1 variants = no output encoder, D2 variants = 20 bit absolute on gear output		
Communication Protocol		EtherCAT DS402		

Safety Functions		SS = STO-SBC, SM = Safe Motion via FSoE (SIL 3, PL e, Cat. 3)
Miscellaneous		
Environmental Conditions		Operating temperature (ambient air): 0 to 50 °C. Storage temperature: -30 to 70 °C.

** Length includes the default connectors. By using custom connectors, the length can be decreased by a maximum 7 mm.*

*** Multi-turn sensing is available for the motor-side encoder; a battery must be added by the user according to the manual. For additional information, see Battery for Multiturn.*

**** For servo drive specifications, please refer to the Circulo documentation.*

4.2.2. ACTILINK-JD 10/12 Core Specifications

ACTILINK-JD							
Product Variant		AJD-10-60-200			AJD-12-120-200		
		ECS1SS	ECD2SS	ECD2SM	ECS1SS	ECD2SS	ECD2SM
Supply Voltage	V	24 - 48 V, 48 V nominal, 60 V peak					
Performance Data with Supply Voltage 48 V							
Torque Density (Peak)	Nm/kg	57.1	48.8	47.8	69.6	59.6	58.8
Rated Output Power	W	380			700		
Max. Acceleration Torque	Nm	60			110		
Rated Torque	Nm	20			40		
No-Load Speed	rpm	210			200		
Rated-Load Speed	rpm	180			167		
Mechanical Characteristics							
Weight	g	1050	1230	1255	1580	1845	1870
Rotary Inertia (After Reduction)	kg·m²	0.02			0.04		
Outer Diameter	mm	106			120		
Length *	mm	72.8	86.3	86.3	72.8	85.5	85.5
Emergency Stop Torque	Nm	105			210		
Emergency Stop Deceleration	rad/s²	4200			4200		
Permissible Tilting Moment	Nm	20.1 * K			25.8 * K		
Permissible Radial Load	N	839.9 * K			1121.9 * K		
Permissible Axial Load	N	629.9 * K			758.9 * K		
Constant K for Permissible Load							
K, rated speed, 10000-hour lifetime		1					
K, speed = *v* rpm, lifetime = *t* hours		(10000 * [rated speed] / *t* / *v*) ^ (1/3)					
K, static		2.30			2.00		
Key Components							
Gear Type		single-stage planetary					
Reduction Ratio		9			9		
Backlash	arcmin	< 13			< 11		
Integrated Drive		Synapticon Circulo 9 ***. Typical variants listed below.					
Drive Variant		CR9-48-60-ECAN, -ECANSM for SM variants					
Motor Encoder		20 bit multi-turn **					
Output Encoder		S1 variants = no output encoder, D2 variants = 20 bit on gear output					
Communication Protocol		EtherCAT DS402					

Safety Functions		SS = STO-SBC , SM = Safe Motion via FSoE (SIL 3, PL e, Cat. 3)
Miscellaneous		
Environmental Conditions		Operating temperature (ambient air): 0 to 50 °C. Storage temperature: -30 to 70 °C.

** Length includes the default connectors. By using custom connectors, the length can be decreased by a maximum 7 mm.*

*** Multi-turn sensing is available for the motor-side encoder; a battery must be added by the user according to the manual. For additional information, see Battery for Multiturn.*

**** For servo drive specifications, please refer to the Circulo documentation.*

4.2.3. Torque-Speed Capability

NOTE
Content coming soon.

4.2.4. Overload Capability

NOTE
Content coming soon.

4.2.5. Dynamic Model

NOTE
Content coming soon.

4.2.6. Power Efficiency

NOTE
Content coming soon.

4.2.7. System Polarity

The positive rotational direction is defined according to the right-hand screw rule, with the thumb pointing outward from the output shaft along the rotational axis, as shown in Figure 4.3 below.

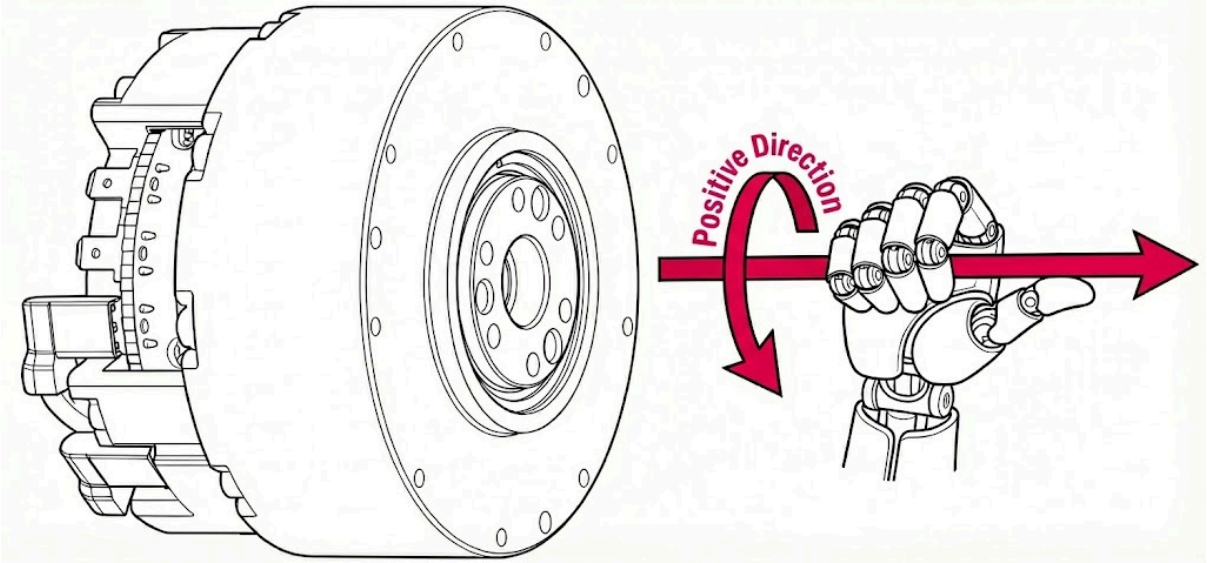


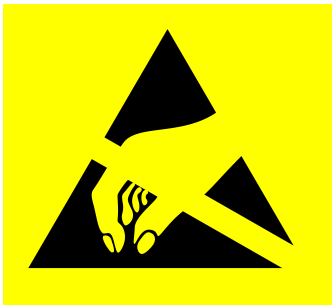
Figure 4.3 - Positive rotation direction of the actuators

NOTE
In early samples before April 2025, the polarity was not strictly defined. For early-sample users, the polarity can be checked using the objects below in the Object Dictionary. A common approach is to SDO-read the objects and define the rotation direction accordingly during the initialization of the control program.

Positive direction	Objects to read
CCW viewing the output shaft	0x2110:5, Encoder 1 Polarity == 1 AND 0x2112:5, Encoder 2 Polarity == 1
CW viewing the output shaft	0x2110:5, Encoder 1 Polarity == 0 AND 0x2112:5, Encoder 2 Polarity == 0

5. Safety and Product Information

5.1. Handling Instructions



All Synapticon products feature sensitive electronic devices; use the following guidelines when handling them.

- Protective devices - Check all protective devices and do not remove or bypass them. Also ensure that all emergency switches are operational.
- Grounding electrical components - Make sure to ground all conductive components to avoid any electric shocks.
- Shutting the machine down - Make sure that the machine is secured by a lock-out mechanism or other method so that it cannot be restarted by mistake.
- Monitoring tightening torques - Check all components and connections to comply with the recommended tightening torques.

NOTE
This product cannot be used independently; it must be installed into a machine.

ATTENTION
Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective bags until you are ready to install them.

5.1.1. Safety During Operation

Follow these safety rules when operating this product:

- Do not work on the motor or motor cable - or loosen any electrical connections - when they are live. Additionally, only work on the motor when the voltage has dropped to < 50 V. Additionally, make sure that the protective conductor is properly connected.

- Operate the servo drive according to its technical specifications. Make sure that sufficient cooling exists and once switched off, allow all components to cool down.

- Do not touch any components during operation, or immediately after operation.

- Make sure that all components are safely secured.

ATTENTION
The product can be hot during operation! Overheating protection exists in the system to avoid product damage - but not against any personal injury. Follow all safety precautions in order to avoid any problems.

5.1.2. Safety After Operation

It is important to check that all safety-related devices are functioning properly. Additionally, make sure to de-energize and turn-off any components before placing hands on them.

5.2. Magnetic Sensitive Devices

External magnetic fields can disrupt the operation of the integrated encoders. If possible, the device should be isolated from all external magnetic fields; in the worst case, the external magnetic field density should not exceed 5 mT during operation. For additional information. contact Support.

5.3. Name Plate

The following is a sample ACTILINK-JD name plate.

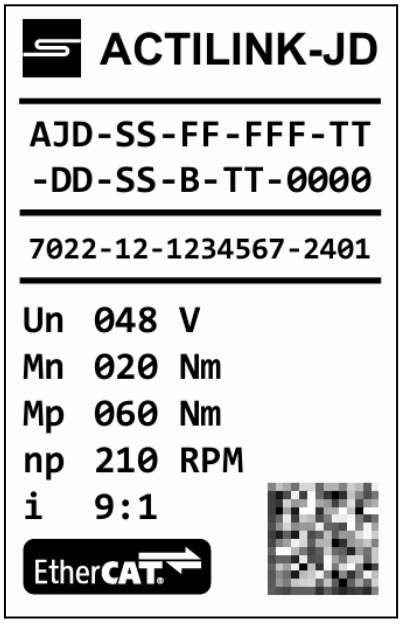


Figure 5.1 - Example ACTILINK-JD name plate

5.4. Manufacturer Part Number (MPN)

Below is an image of the schema used to describe the Synapticon-assigned, unique part number that is used to identify ACTILINK-JD.

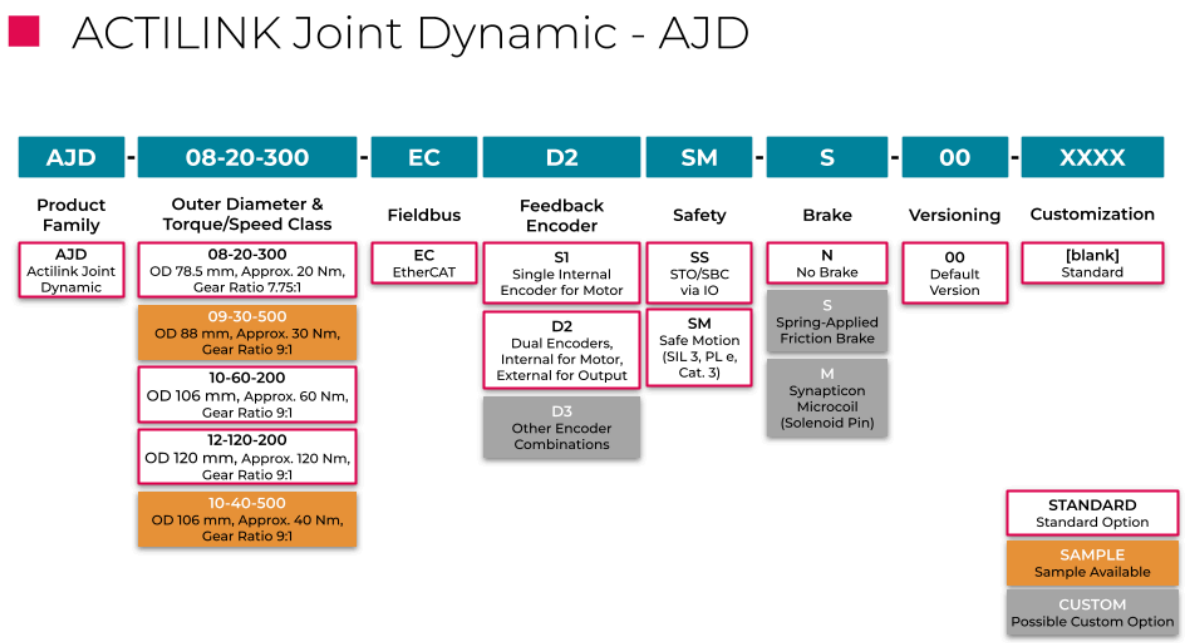


Figure 5.2 - ACTILINK-JD MPN schema

6. Mechanical Installation

6.1. CAD Data Download

Use this link to access CAD data including 3D models of all variants.

6.2. Mounting Interfaces and Mounting Instructions

The ACTILINK-JD mounting interfaces are specified in the CAD images below with colors illustrating the design's purpose.

Use the threaded holes on the axial positioning surface to secure the parts.

IMPORTANT
Ensure that the correct tightening torque is applied after calculating the load in the application, and apply screw-locking adhesives, such as Loctite 243, against vibrations.

IMPORTANT
For radial positioning, use exactly two dowel pins for positioning whenever possible. Using more than two pins will over-constrain the assembly and must be avoided. The dowel pins also serve as torque-transmitting elements during emergency stops. If dowel pins cannot be used, the cylindrical fit surface may be employed for radial location instead as denoted below.

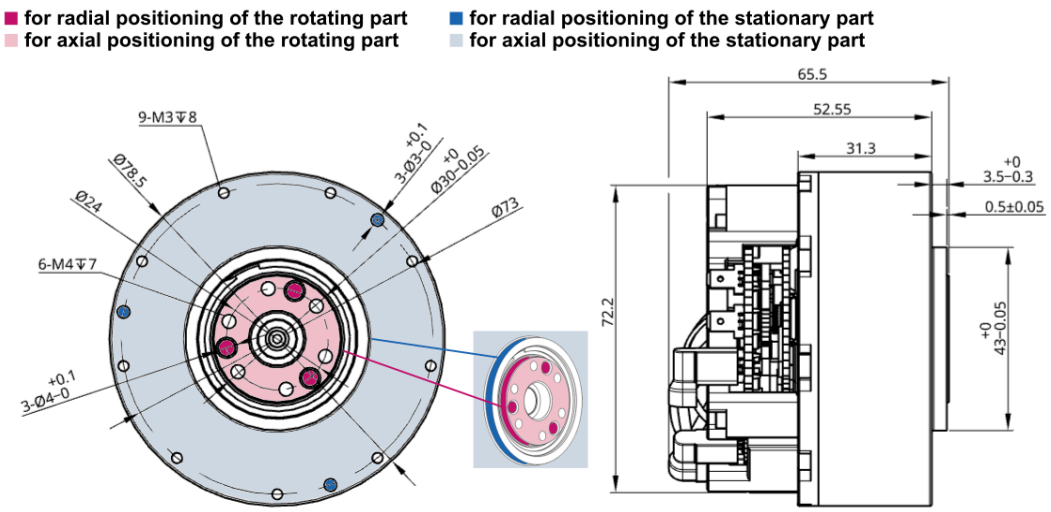


Figure 6.1 - AJD-08-20-315-ECS1xx mechanical interfaces

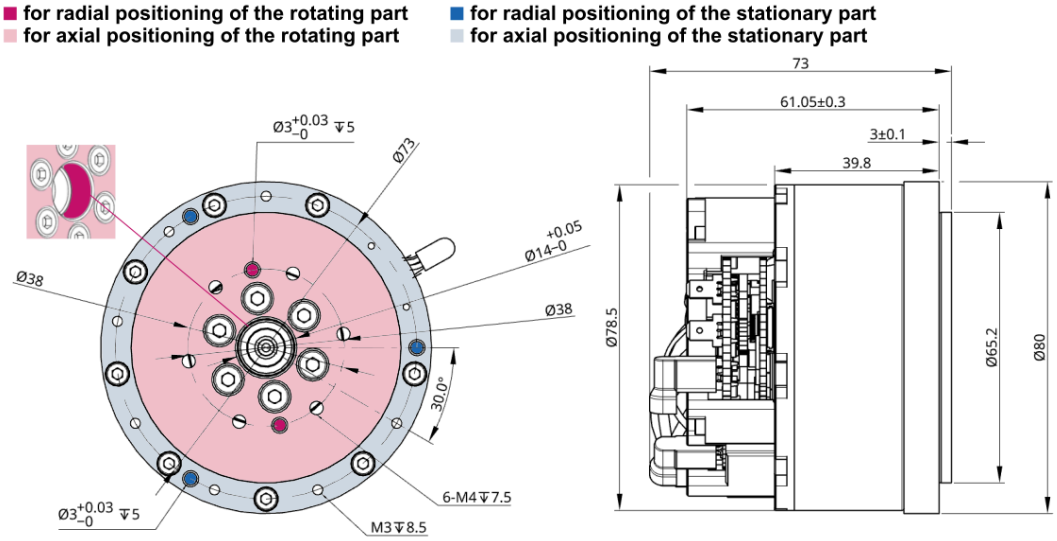


Figure 6.2 - AJD-08-20-315-ECD2xx mechanical interfaces

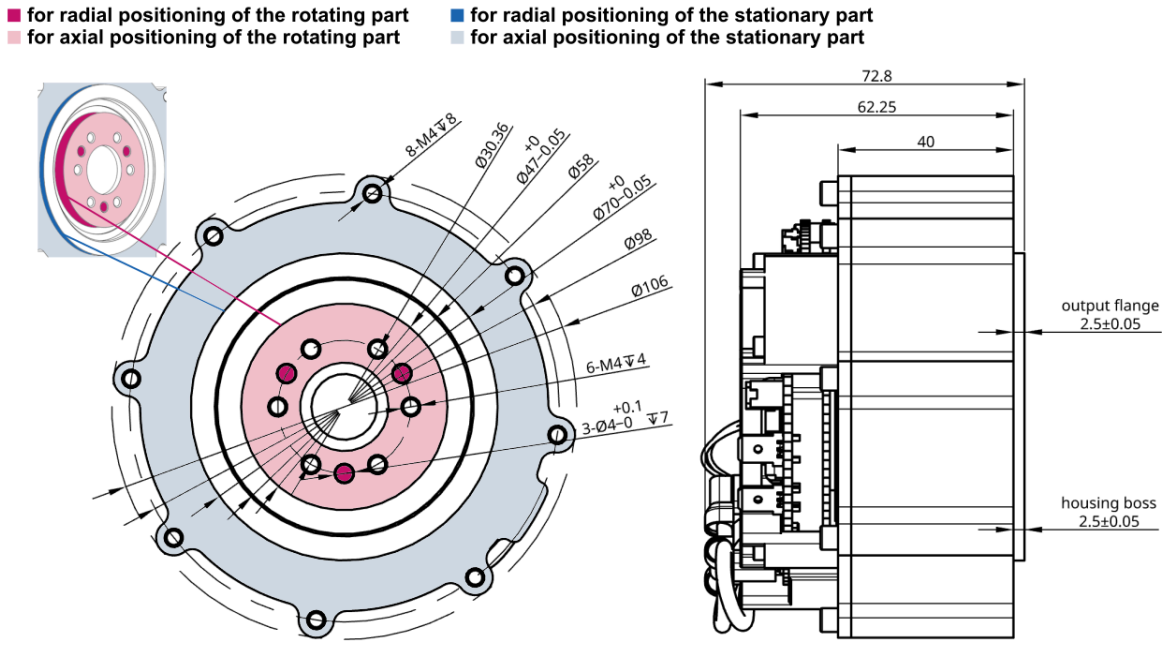


Figure 6.3 - AJD-10-60-195-ECS1xx mechanical interfaces

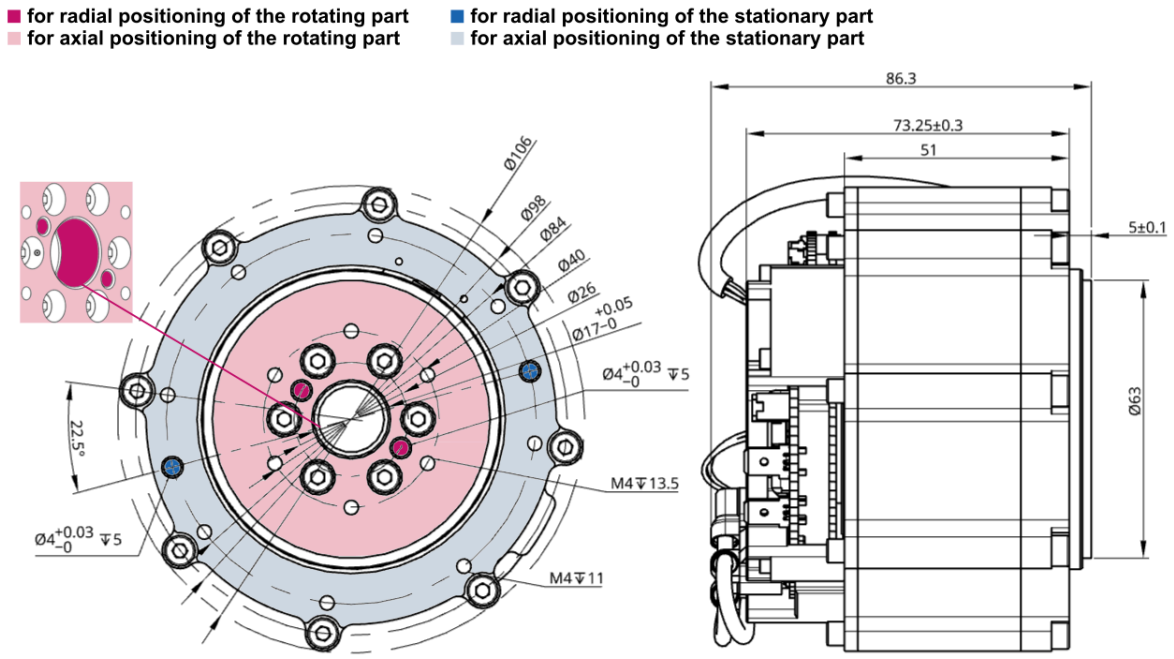


Figure 6.4 - AJD-10-60-195-ECD2xx mechanical interfaces

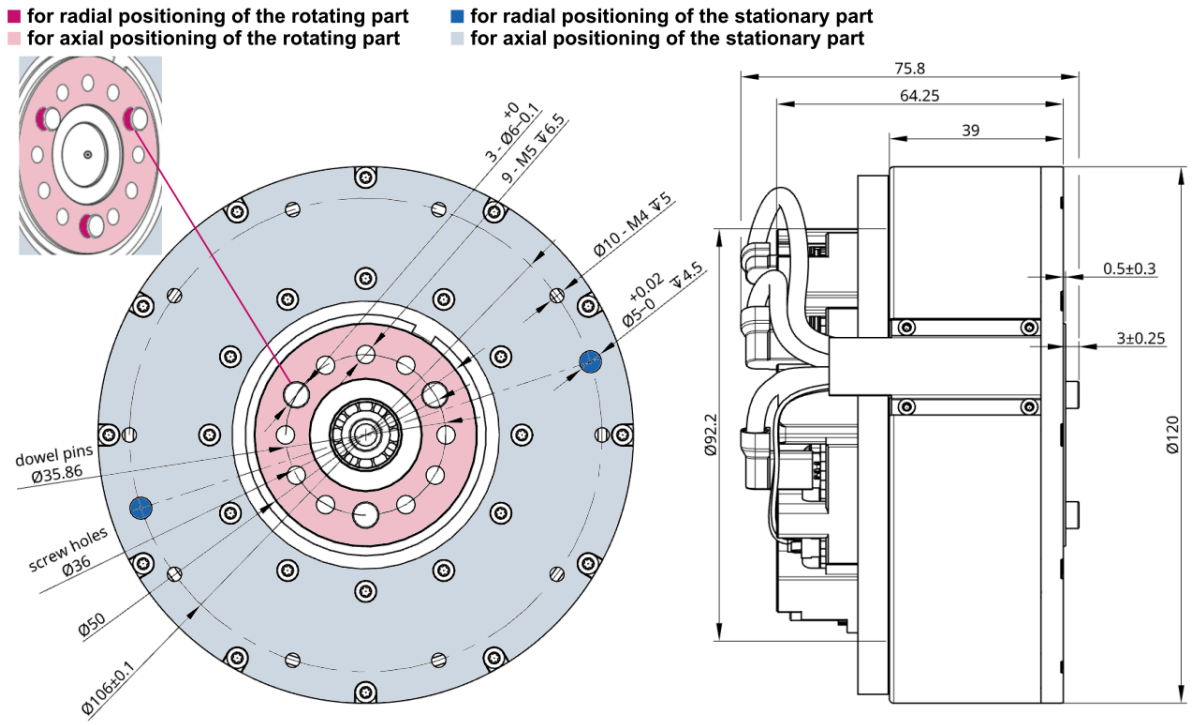


Figure 6.5 - AJD-12-120-200-ECS1xx mechanical interfaces

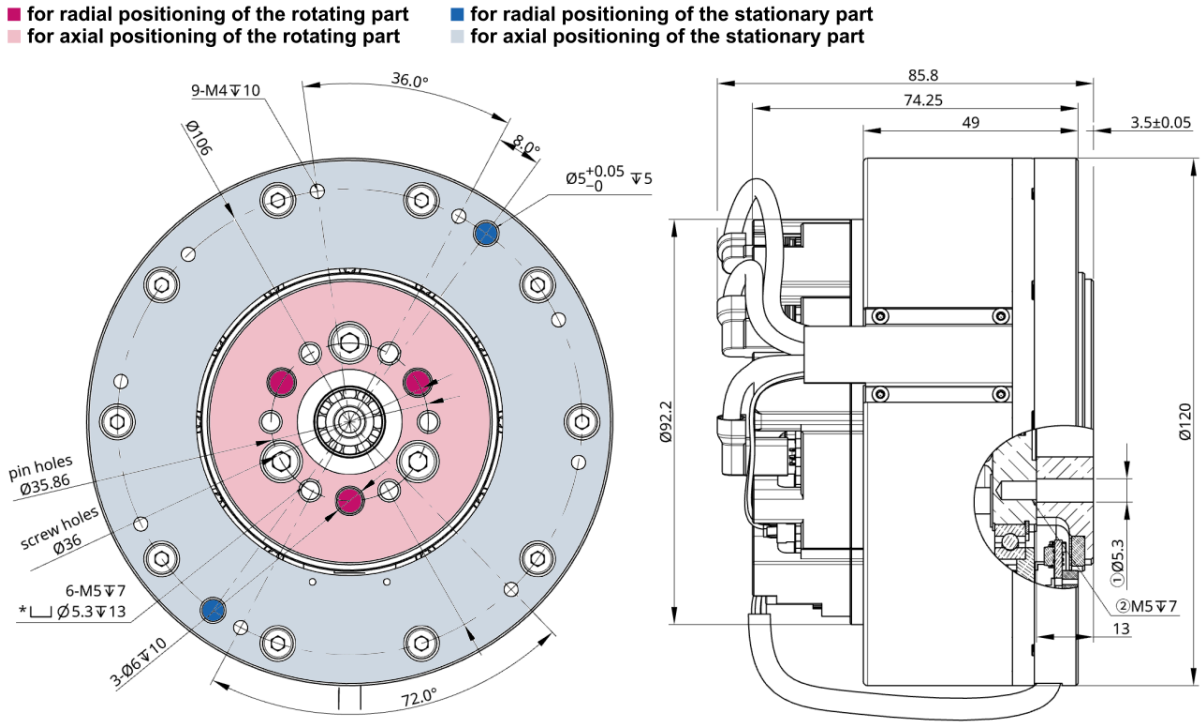


Figure 6.6 - AJD-12-120-200-ECD2xx mechanical interfaces

7. Electrical Installation

For a comprehensive overview on how to properly make cables and connect SOMANET Circulo-based products, refer to the Cabling Assembly Handbook. Additionally, sample cables are available for purchase at Synapticon.

The following subsections provide essential information for the electrical installation of ACTILINK-JD actuators.

7.1. Electrical Connection for Basic Functioning

Each actuator requires two sets of cables for basic functioning: power and communication. Typically, actuators are connected in a daisy chain in robots, as illustrated in the figure below.

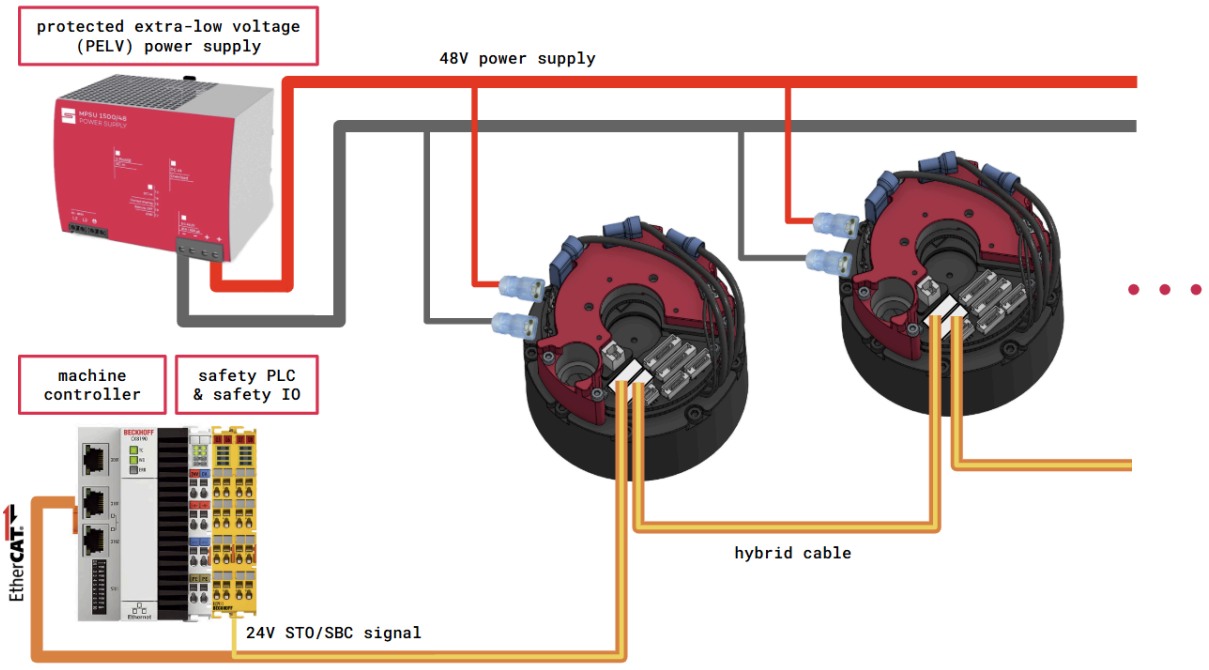
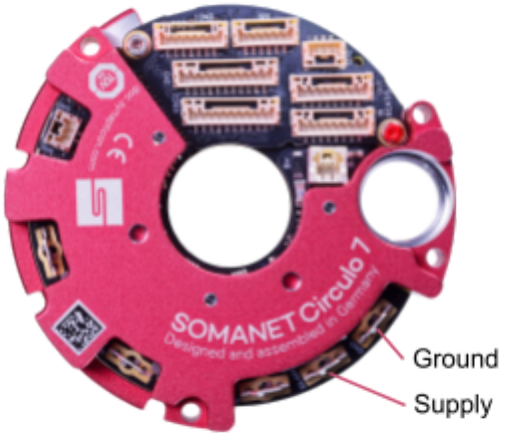


Figure 7.1 - Electrical connection of AJD actuators.

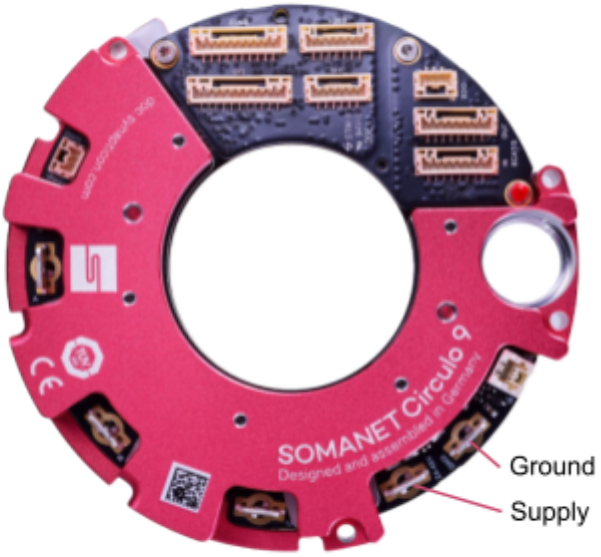
7.1.1. Power Supply

Refer to the image below for information regarding connecting power to the actuators. The cable should be selected based on the current consumption.

Circulo 7 on ACTILINK-JD 08



Circulo 9 on ACTILINK-JD 10 & 12



ATTENTION

No reverse polarity protection! Always ensure that the power cables are connected correctly, otherwise the drive may be damaged beyond repair!

IMPORTANT

Use a protected extra-low voltage (PELV) power supply. In mobile applications such as AGVs, batteries serve as the primary power source, making the use of PELV between the battery and the servo drive rather uncommon. To prevent damage to the battery in the event of a short circuit, it is crucial to implement short circuit protection mechanisms. These protections can include devices such as fuses and PPTC devices, among others.

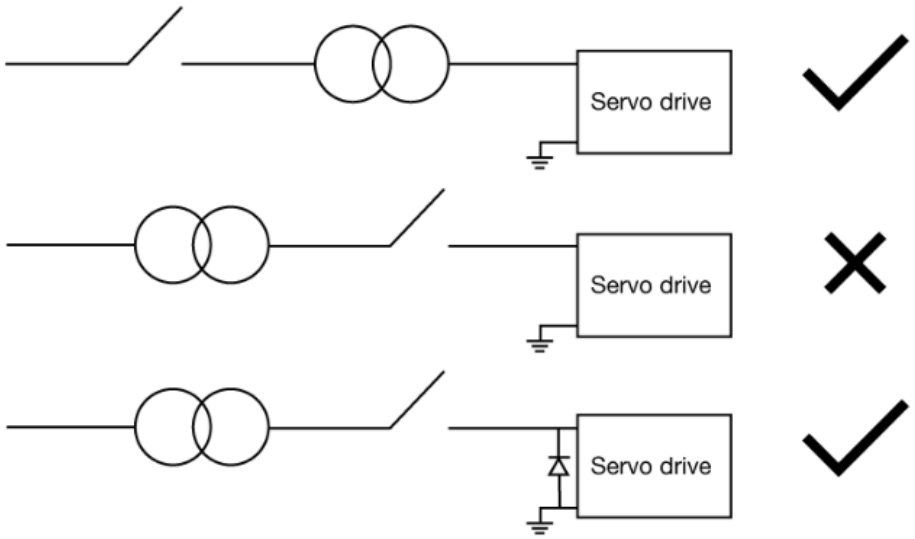
Warning about using contactors behind the power supply

ATTENTION

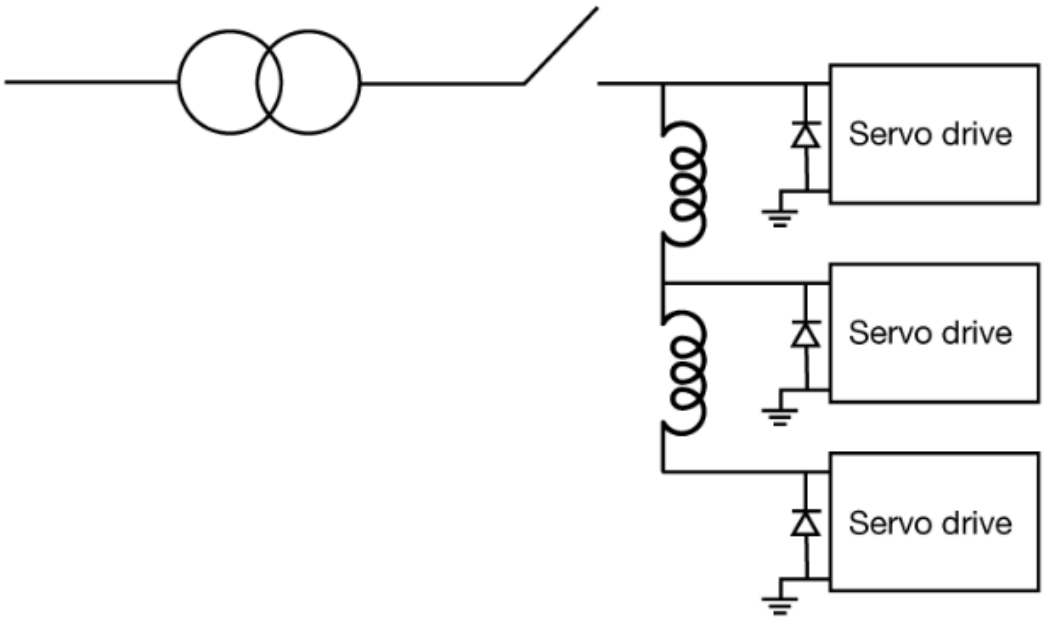
Synapticon servo drives are designed for voltages between 24 V_{DC} and 48 V_{DC} (58 $V_{DC; Max,cont}$ 60 $V_{DC;Max,peak}$); they should be run with an appropriate extra-low voltage supply. Do not use contactors behind the power supply as the transient-voltage-suppression diodes could get damaged due to the power-up voltage increase (Surge). This is likely to occur when the power-up occurs quickly and can lead to complete failure of the servo drive.

If contactors behind the power supply are used, it is necessary to include an uni-directional TVS diode type 1.5KE62A-E3/54* between the Main Power Supply and Ground of the terminal.

** This model has been successfully tested by Synapticon. Other products with the same specifications may also be appropriate but cannot be recommended.*



When running several servo drives behind a contactor, use an uni-directional TVS diode on each drive because of the wiring inductances.



7.1.1.1. Functional Earthing

The Functional Earth (FE) of the actuator, and the Ground (GND) of the power, are electrically isolated in the actuator. For connecting the FE of the actuator to the FE of the system, use electrically conductive screws to secure the actuator to the system.

NOTE
The outer surface of the actuator is not electrically conductive.

NOTE
Protective Earthing is not required for safety in Extra-Low Voltage systems.

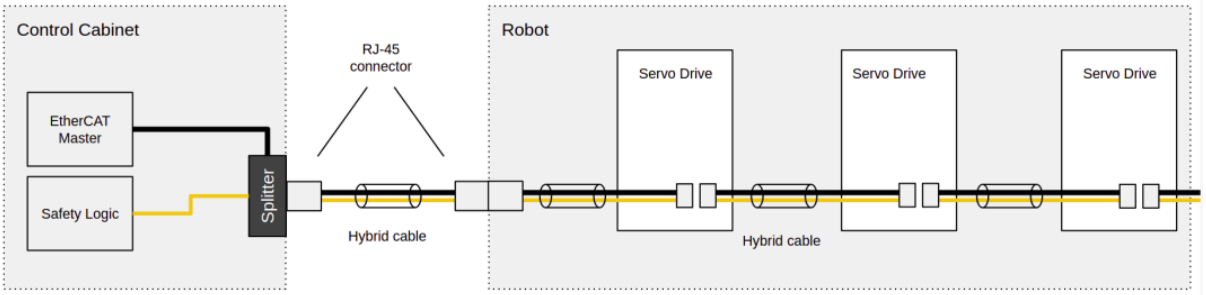
7.1.2. Communication and STO-SBC

Circulo 7 on ACTILINK-JD 08

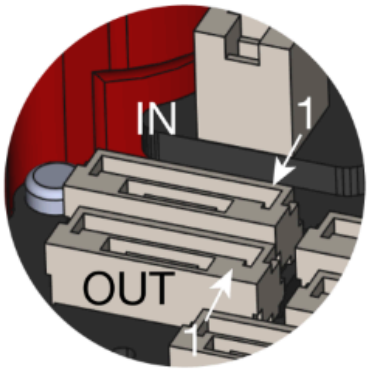
Circulo 9 on ACTILINK-JD 10 & 12

NOTE

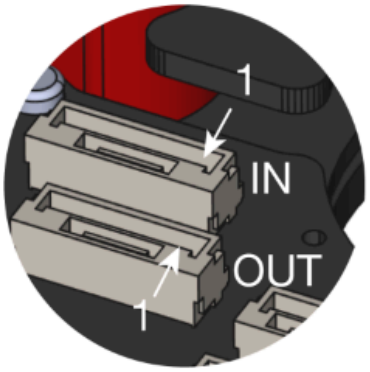
These connectors feature both pins - for EtherCAT as well as for STO/SBC - to facilitate true daisy chaining. Details for the required hybrid cable can be found in the image below.



Circulo 7



Circulo 9



Pin #	
1	STO-SBC In 1
2	STO-SBC In 2
3	Safety GND
4	RX_N
5	RX_P
6	TX_N
7	TX_P
8	FE

IMPORTANT
The Safety GND is an isolated signal from the drive GND.

7.1.2.1. STO-SBC Safety Inputs

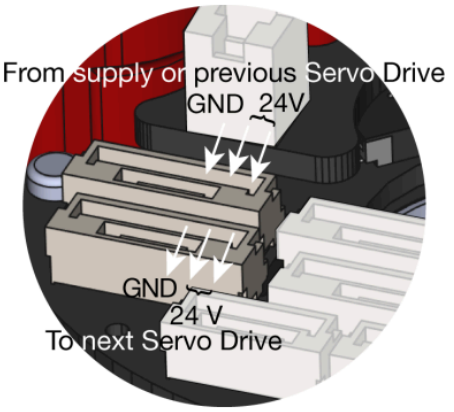
The voltage level of the safety inputs is specified below. For properly using the STO-SBC function, please refer to the detailed documentation here.

Voltage level	24 V logic Type 1
V IH	15 V to 24 V
V IL	0 V to 5 V

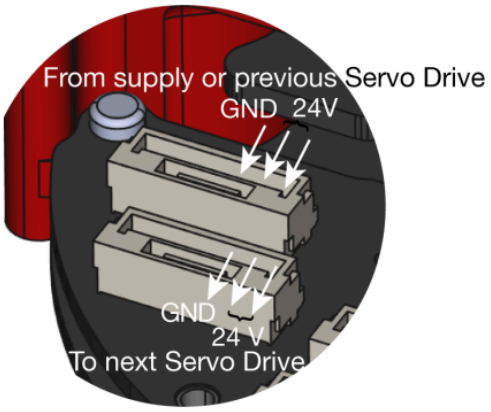
ATTENTION

When not using the STO-SBC feature, attach a +24 V supply to Pin 1 and 2 and Ground to Pin 3. It is possible to daisy-chain these signals to other servo drives.

Circulo 7

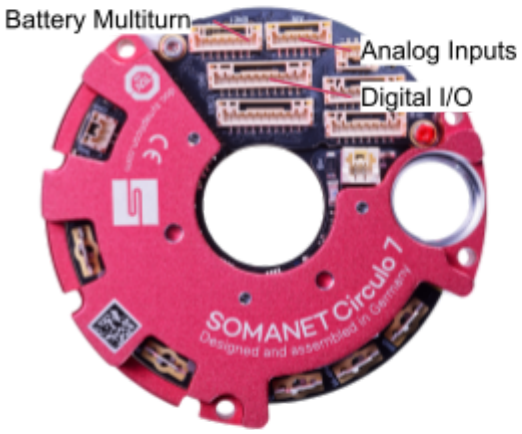


Circulo 9

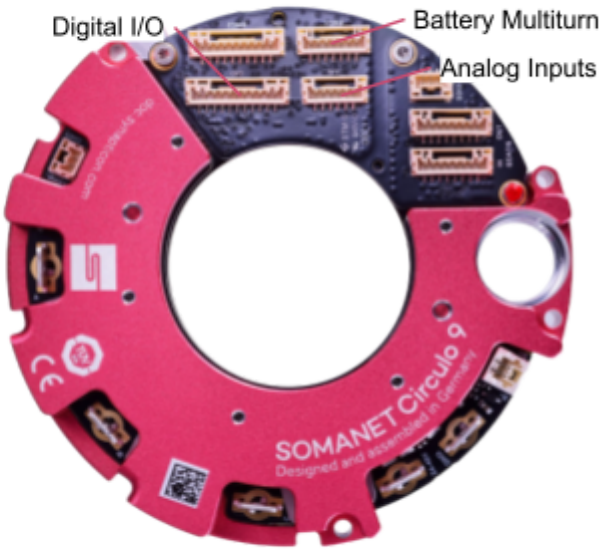


7.2. Electrical Connection for Additional Features

Circulo 7 on ACTILINK-JD 08



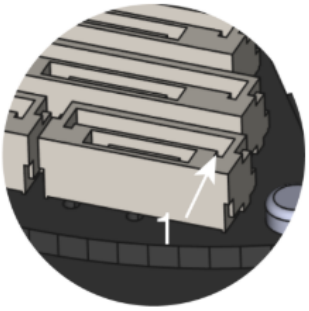
Circulo 9 on ACTILINK-JD 10 & 12



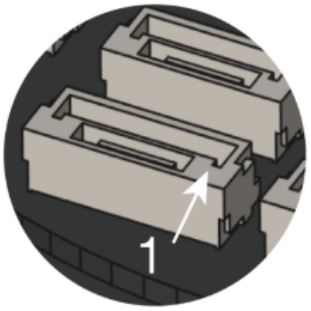
7.2.1. Battery Multiturn

A battery can be attached to enable multiturn sensing of the motor encoder. Refer to the pinouts below for connecting a battery.

Circulo 7



Circulo 9



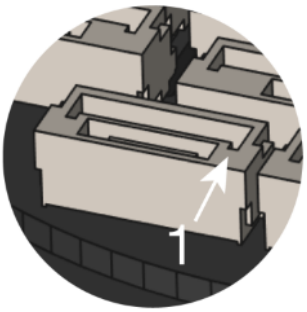
Pin #	Battery for Multiturn
1	•
2	•
3	•
4	Ground
5	•
6	•
7	V_BAT

For selecting a suitable battery, see Battery for Multiturn.

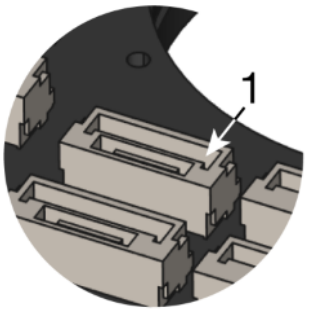
After connecting a battery, configurations must be performed in OBLAC Drives to configure the encoder. The operations are explained here.

7.2.2. Analog Inputs

Circulo 7



Circulo 9



Pin #	Signal	Function	Object Mapping
1	+5 V *	Supply for external use **	
2	Analog In 2 -	Differential -	Analog input 2 (0x2402)
3	Analog In 2 +	Differential +	Analog input 2 (0x2402)
4	GND	Ground	
5	Analog In 1	Single-ended 0-5 V	Analog input 1 (0x2401)
6	•	Not connected	

** The supply is protected against short to ground and keeps the current below 400 mA in a continuous short.*

*** The current capacity of 5 V output is shared between all connectors and the total consumption is limited to 250 mA.*

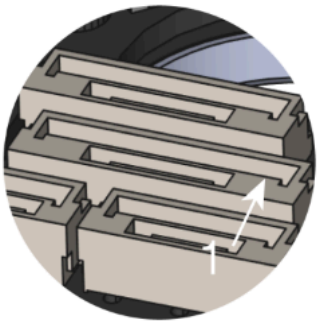
The Analog Inputs have a 12 bit resolution.

For additional information on the analog input, see: Analog input specification. For information on scaling, see: Analog Input Scaling.

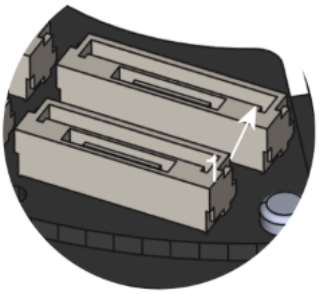
For details about measuring analog signals, see: Configuring analog inputs.

7.2.3. Digital I/O

Circulo 7



Circulo 9



Pin #	GPIO	BiSS-C (LVTTL)	SSI (LVTTL)	SPI (only for custom firmware)	LED
1	+3.3 V OUT *				
2	Digital I/O 1 (Fast Push-Pull max 3.3/5.5 V)	SLO	Data	SCK	Data
3	Digital I/O 2 (Fast Push-Pull max 3.3/5.5 V)	MA	Clock	MISO	Data
4	Ground				
5	Digital I/O 3 (Fast Push-Pull max 3.3/5.5 V)	•	•	MOSI	Data****
6	Digital Output 4 (Slow Push-Pull) **	•	•	SS	Data****
7	+5 V OUT ***				
8	Digital I/O 5 (Slow Bi-Directional) *****	•	•	•	Data****
9	Digital I/O 6 (Slow Bi-Directional) *****	•	•	•	Data****
10	Ground				
11	Digital IN 7 (Slow 24 V)	•	•	•	•

** This is a +3.3 V supply that can provide up to 250 mA for external use.*
The supply is protected against short to ground and keeps the current below 400 mA in a continuous short.

*** Current output capacity of digital outputs 1, 2, 3, and 4 is ± 20 mA (Sink and source).*

**** The current capacity of 5 V output is shared between all connectors and the total consumption is limited to 250 mA.*
The supply is protected against short to ground and keeps the current below 400 mA in a continuous short.

***** The recommended value of the pull-up resistor is 2.2 kΩ.*

****** Current output capacity of digital outputs 5 and 6 is ± 0.5 mA.*

NOTE
The Digital I/Os are **globally** configurable as 3.3 V or 5 V.
This configuration occurs in the object 0x2214 “GPIO global options”.

NOTE
Each Digital **IO** must be configured as a Digital Input or Output via object 0x2210 (“GPIO”).
The object can also be used to activate a pull-down resistor.
Changes may require the user to powercycle the servo drive.

7.3. Cables and Connectors

7.3.1. Mating Connectors

Circulo 7

Manufacturer: JST

Connector Description	**Mating Part**	**Crimping Contact**	**Wire Measurement AWG**	**Wire Measurement mm-squared**
Digital IO	GHR-11V-S	SSHL-002T-P0.2 [1]	28	0.0810
Battery Multiturn	GHR-07V-S	SSHL-002T-P0.2 [1]	28	0.0810
Analog In	GHR-06V-S	SSHL-002T-P0.2 [1]	28	0.0810
EtherCAT / STO-SBC In/Out	GHR-08V-S	Customized cable	28-32	0.0810-0.0320
Brake Connector	ZER-02V-S	SZE-002T-P0.3 [2]	28	0.0810

[1] *Crimped cable from JST Sales America can be used, part number: AGHGH28K305.*

[2] *Crimped cable from JST Sales America can be used, part number: ASZESZE26K305.*

Circulo 7

Manufacturer: TE Connectivity

Connector Description	**Mating Part**	**Wire Measurement AWG**	**Wire Measurement mm-squared**
24V-48V Supply	3-350816-2 [3] 3-350815-2 [4]	14-16	2.0809-1.3087
24V-48V Supply (piggyback) [6]	1217151-1 (non isolated) [3,5] 62026-2 (non isolated) [3]	14-18 16-18	2.0809-0.8230 1.3087-0.8230

[3] These terminals are in loose-piece for terminating with manual hand-held tools.

[4] These terminals are in the strip version for feeder machines.

[5] This connector is not UL certified.

[6] With piggyback connectors, the connections will be out of the Circulo diameter; consider this in your mechanical design!

Circulo 9

Manufacturer: JST

Connector Description	Mating Part	Crimping Contact	Wire Measurement AWG	Wire Measurement mm-squared
Digital IO	GHR-11V-S	SSHL-002T-P0.2 [1]	28	0.0810
Battery Multiturn	GHR-07V-S	SSHL-002T-P0.2 [1]	28	0.0810
Analog In	GHR-06V-S	SSHL-002T-P0.2 [1]	28	0.0810
EtherCAT / STO-SBC In/Out	GHR-08V-S	Customized cable	28-32	0.0810-0.0320
Brake Connector	ZER-02V-S	SZE-002T-P0.3 [2]	28	0.0810

[1] Crimped cable from JST Sales America can be used, part number: AGHGH28K305.

[2] Crimped cable from JST Sales America can be used, part number: ASZESZE26K305.

Circulo 9

Manufacturer: TE Connectivity

Connector Description	Mating Part	Wire Measurement AWG	Wire Measurement mm-squared
24V-48V Supply	4-520448-2 [3] 4-520447-2 [4]	10-12	5.2612-3.3088

[3] These terminals are in loose-piece for terminating with manual hand-held tools.

[4] These terminals are in the strip version for feeder machines.

Circulo 9

Manufacturer: Molex

Connector Description	**Mating Part**	**Wire Measurement AWG**	**Wire Measurement mm-squared**
24V-48V Supply (piggyback) [6]	0190130033 [3]	10-12	5.2612-3.3088

[3] These terminals are in loose-piece for terminating with manual hand-held tools.

[4] These terminals are in the strip version for feeder machines.

[6] With piggyback connectors, the connections will be out of the Circulo diameter; consider this in your mechanical design!

7.3.2. Maximum Cable Lengths

Please observe these maximum allowed values for cables:

Cable Type	Maximum Cable Length
Main supply cable	30 m
EtherCAT cable	30 m
Brake cable	3 m
Encoder battery cable	30 m
Digital I/O cable	3 m
Analog inputs cable	3 m

7.3.3. Making Cables

For information on making cables, refer to the Cabling Assembly Handbook.

7.3.4. Cables Available at Synapticon

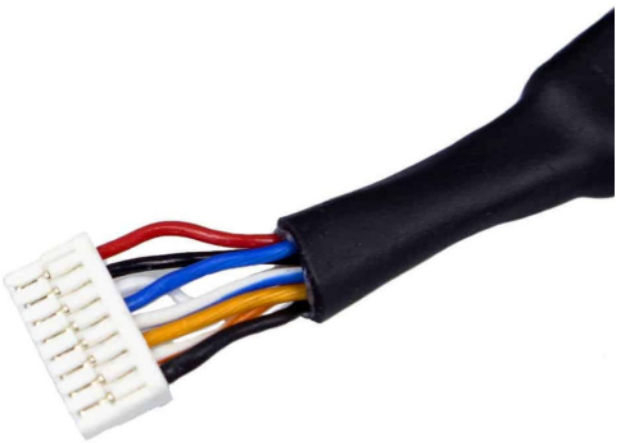
For reference, listed below are the cables made by Synapticon.

7.3.4.1. Ethernet+3S Y-Splitter Cable, Master to Drive (2m)

SOMANET Circulo supports a hybrid cable that allows daisy chaining of EtherCAT and STO/SBC. This Y-splitter cable is required for connecting SOMANET Circulo to the Master PC (RJ45) and the STO/SBC.

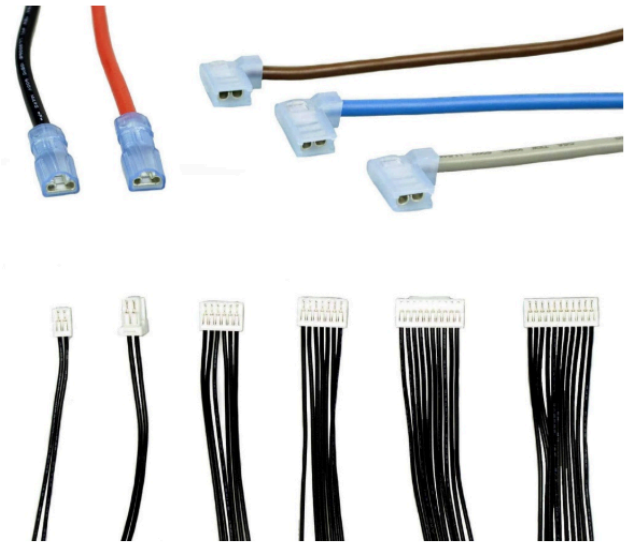
7.3.4.2. Ethernet+3S Cable, Drive to Drive

SOMANET Circulo features a hybrid cable that allows daisy chaining of EtherCAT and STO/SBC. This Y-splitter cable is required for connecting SOMANET Circulo to the Master PC (RJ45) and the STO/SBC. Lengths available are: 0.35m and 0.75m.



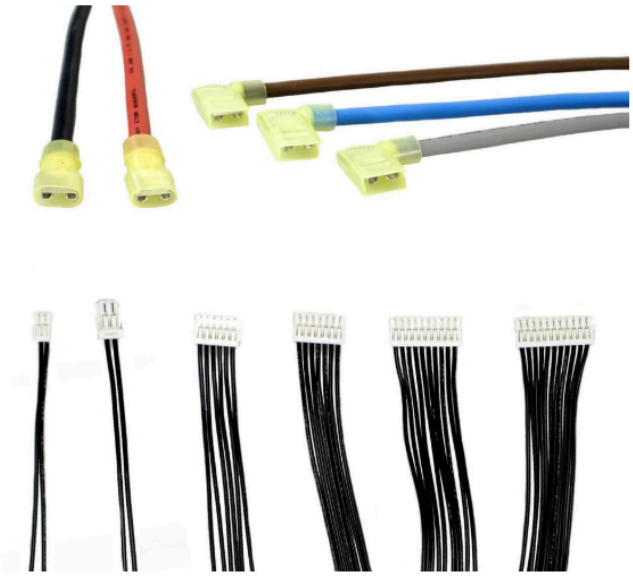
7.3.4.3. SOMANET Circulo 7 I/O Cable Kit

This kit contains the wires and connectors that are required for power and I/O to SOMANET Circulo 7, which is used in ACTILIKN-JD 08.



7.3.4.4. SOMANET Circulo 9 I/O Cable Kit

This kit contains the wires and connectors that are required for power and I/O to SOMANET Circulo 9, which is used in ACTILINK-JD 10 and ACTILINK-JD 12.



8. Using the Product

The product is delivered fully preconfigured and ready for immediate use, with only application-specific functions requiring on-site commissioning.

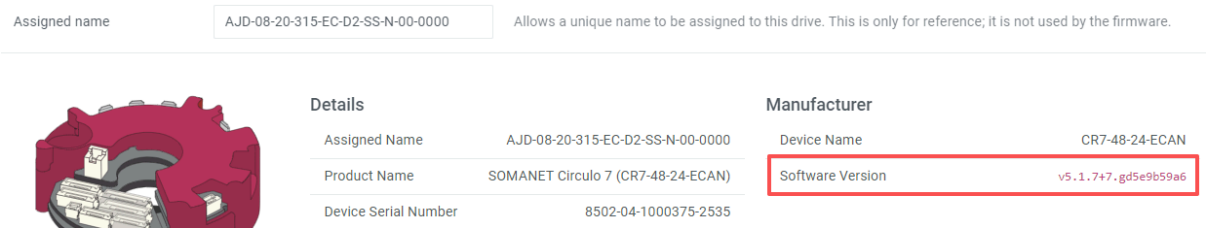
8.1. OBLAC Drives for Commissioning

Detailed documentation is available for the installation and use of OBLAC Drives, the all-in-one commissioning software.

> **NOTE**
> If OBLAC Drives cannot be used in the facility, the actuator is configurable using any EtherCAT master. For additional assistance, contact Support.
>
> APIs are available for automatic commissioning.

8.2. Firmware Version and Functionality

The actuator firmware version can be read in OBLAC Drives.



> **NOTE**
> If OBLAC Drives is not available, scan the QR code on Circulo and contact Support for help.

The firmware functionality description can be found according to the firmware version here.

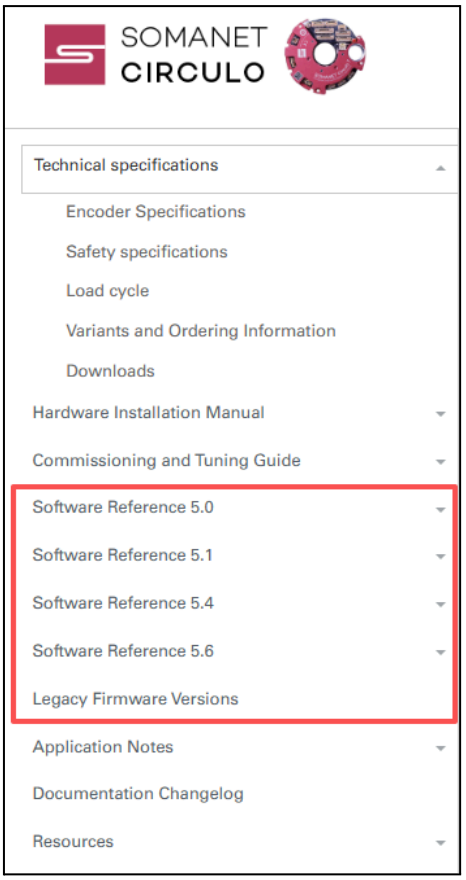


Figure 8.1 - SOMANET Circulo menu highlighting the available firmware versions

8.3. Commissioning Items

As most features are preconfigured, only a few items require commissioning at applications:

- Control gains of velocity and position control
- GPIO
- Protection for overvoltage, undervoltage, overcurrent
- Velocity feedforward is by default enabled.
- Quick stop is configured as the default action when a fault is triggered. The quick stop deceleration value is configured based on the capability of the actuator, and with heavy load, the deceleration value should be decreased.
- Command smoothing By default, Synapticon configures a 3rd-order FIR filter for master frequency 1 kHz.

8.4. Thermal Protection

The ACTILINK-JD thermal limit comes from the motor magnet and winding, which should be kept below 150 °C. Two thermal protection mechanisms are configured in ACTILINK-JD to prevent overtemperature: thermistor monitoring and motor I2T. Besides this, the Circulo servo drive is additionally protected against overheating of the electronic components.

8.4.1. Thermistor Monitoring

A negative temperature coefficient (NTC) thermistor is installed at the motor winding. The datasheet can be downloaded here, and a CSV sheet can be downloaded here for extracting the temperature-resistance conversion.

By default, the External Scaled Measurement object (0x2038:1) is configured to feedback the resistance value in Ω. A lower threshold (2271 Ω = 140 °C) is configured to raise an error when the thermistor reports over 140 °C. Users are allowed to raise the lower threshold for a conservative temperature limit; configuring a higher temperature limit is not allowed.

For reading the motor winding temperature online, two common methods can be used to convert resistance to temperature value:

- a Lookup table, or
- a polylogarithmic function:

$$T = -0.2486\left(\log_{10} R\right)^4 + 2.559\left(\log_{10} R\right)^3 + 6.351\left(\log_{10} R\right)^2 - 183.5\left(\log_{10} R\right) + 619.1$$

where *T* is the temperature in °C, *R* is the thermistor resistance in Ω.

8.4.2. Motor I2T

Additionally, Synapticon configures an I2T protection to avoid overheating. The protection is conservative, and once the limit is reached, an error would be raised according to the default configuration (0x200A:1, Motor i2t and combined stall Protection - Error Reaction).

Users are allowed to increase the I2T peak time and change the I2T protection mode to release more performance after understanding the thermal effect.

8.4.3. Circulo Hardware Protection

The temperature of the core board and the inverter are measured and the values are available through objects 0x2030 (Core temperature) and 0x2031 (Drive temperature). The unit is given in m°C.

When the measured temperature approaches 95% of the permissible value, a warning is triggered in the Error Report Object. When the measured temperature reaches the limit, an error is triggered and the drive is stopped.

8.5. Work with EtherCAT

8.5.1. EtherCAT Slave Information (ESI)

EtherCAT masters commonly use ESI files to recognize devices.
Check the firmware version installed in your ACTILINK-JD and download the ESI file here.

8.5.2. CANopen over EtherCAT (CoE)

Refer to the documentation here.

8.5.3. File Access over EtherCAT (FoE)

Refer to the documentation here.

8.5.4. Fail Safe over EtherCAT (FSoE)

Refer to the documentation here. Note that FSoE is only available for variants with Safe Motion.

8.5.5. Synchronization via Distributed Clock

Please refer to the documentation here.

8.5.6. Application Example

An example with TwinCAT is provided as a reference.
See: Using EtherCAT Devices with TwinCAT

8.6. Error/Warning Messages and Logging

Synapticon provides comprehensive error feedback and a brief operation logging saved in the servo drive. The logging is accessible via OBLAC Drives and via FoE using any EtherCAT master.

> **NOTE**
> It is suggested to use the manufacturer-specific object “Error Report Object”, which reports detailed error types.

9. Functional Safety

IMPORTANT
For actuators with Safe motion functions other than hardwired STO-SBC, functional safety is - by default - disabled by configuration.

Accordingly, the actuator shall never be assumed to be performing any safety function.

The functional safety expert is responsible for configuring safety according to the specific application requirements

9.1. Safety Functions

ACTILINK-JD provides STO-SBC and FSoE Safe Motion for safety options (SS or SM in MPN).

Each of these are described in the text that follows.

For additional information beyond what is listed, refer to the SOMANET Circulo Safety Specifications.

9.2. STO-SBC (Standard)

SOMANET Circulo provides two drive-integrated safety functions as a hardware solution according to EN 61800-5-2:2017:

- STO (Safe Torque Off) and
- SBC (Safe Brake Control).

9.2.1. STO (Safe Torque Off)

STO (Safe Torque Off) prevents torque creation in the motor and enables an uncontrolled stop in accordance with stop category 0 of IEC 60204-1:2016. STO can be used where torque removal is required to prevent an unexpected start-up.

9.2.2. SBC (Safe Brake Control)

SBC (Safe Brake Control) prevents an electrical current from being supplied to the brake output; therefore, the external brake closes safely. It is used in conjunction with STO or SS1 to prevent axis movement in a torque-free state, e.g., due to gravity.

> **NOTE**
> Activating SBC independently of, or with a delay to, STO is not possible. When STO is active, SBC will also be activated. If a brake is connected, it will be engaged.To prevent damaging the brake, a Safe Stop Category 1 (SS1) is recommended.

9.3. Safe Motion/FSoE (optional)

In SOMANET Circulo Safe Motion, the following safety functions are applicable:

Stopping functions (No encoder feedback)

- STO (Safe Torque Off)
- SBC (Safe Brake Control, will be part of the STO function)
- SS1 (Safe Stop 1) with time monitoring

Stopping functions (Requires encoder feedback)

- SS1 (Safe Stop 1) with ramp monitoring
- SS2 (Safe Stop 2) with ramp monitoring
- SOS (Safe Operating Stop)

Monitoring functions (Requires encoder feedback)

- SLS (Safely Limited Speed)
- SMS (Safe Maximum Speed)

Definitions not mentioned previously in the STO-SBC (Standard) section are described below.

9.3.1. Safe Stop 1 (SS1)

SS1 causes a motor to stop both safely and quickly. It switches the motor to torque-free mode after reaching the defined limits - when the speed is accepted as zero - by activating STO. When SS1 is activated, the drive performs a controlled stop and activates STO and SBC (if configured) when the parameterized safety delay time ends.

9.3.2. SS2 (Safe Stop 2)

SS2 safely takes the motor to a standstill state. Once the motor has stopped, the SOS function is activated. When SS2 is activated, the drive performs a controlled stop and activates SOS . As opposed to SS1, the drive stays powered thereafter. Additionally, standstill is safely monitored (SOS).

9.3.3. SOS (Safe Operating Stop)

With SOS, the stopped motor remains in position and is monitored so that it stays within a defined position range. The drive remains powered and enabled.

9.3.4. SLS (Safely Limited Speed)

SLS monitors the drive to ensure that a specific speed limit is not exceeded. If the speed limit violated a defined limit, violation is triggered.

9.3.5. SMS (Safe Maximum Speed)

In contrast to all other implemented safety functions, SMS is always active if enabled by configuration. SMS is designed to generally ensure that the speed never exceeds the defined value.

10. Downloads

10.1. OBLAC Drives Tools

OBLAC Drives Tools

This is commissioning and tuning software that includes setup files for Windows and Linux. Versions later than 25.0.0 should be used.

10.2. CAD Data

Use this link to access CAD data including 3D models as well as drawings of all variants.

10.3. Device Descriptions

Device Descriptions for EtherCAT (ESI) are available online.
Check the installed firmware version for the correct ESI.

10.4. Certifications

Declaration of Conformity SOMANET Circulo

Declaration of Conformity SOMANET Circulo Cable Kit

EC-type examination

Certificate Safety Functions

Statement SOMANET Circulo Mechanical immunity (Shock and Vibration tests)

ETHERCAT CONFORMANCE TEST CERTIFICATE

Regulation (EC) No 1907/2006 - (REACH) certificate

RoHS DirectivE 2011/65/EU and 2015/863/EU Statement SOMANET Circulo

10.4.1. TÜV SÜD

STO-SBC safety certificate

10.4.2. UL

Certificate of Compliance UL-recognized SOMANET Circulo

10.5. PDFs and Menus

SOMANET Circulo Object Dictionary 5.1

Link to the Software Reference 5.1 Menu

Cabling Assembly Handbook

10.6. Application Notes and Supporting Files per Fieldbus Version

10.6.1. EtherCAT / TwinCAT

Using EtherCAT with TwinCAT

Controlling Synapticon Devices Using TwinCAT3 - a Quick Start Guide

TwinCAT3 Motion Control Library for Synapticon Drives

Using Synapticon TwinCAT3 Library - Demo Documentation

Drive Operations through File Access over EtherCAT (FOE)

10.7. Changelog

Documentation Changelog for all products

10.8. Marketing Literature and Company Information

For additional ACTILINK-JD product information, refer to the ACTILINK-JD Web site.

Go here to access additional Synapticon company, product, and marketing information.

11. Maintenance Procedures

11.1. Cleaning

Because dust and/or other particles can adversely affect electronic and mechanical parts and/or cause failure, it is recommended to clean all components regularly. Before doing so, however, make sure that the unit has been turned-off and is not energized.

DANGER
Operating a unit while performing any cleaning activity can lead to severe injuries!

In general, a damp cloth is all that is required to clean parts. Additionally, a non-aggressive cleaning substance, such as *isopropanol*, can be used with the cloth to help remove any accumulated dirt or grease.

ATTENTION
Clean your parts carefully. Never immerse ACTILINK-JD into any liquid solution, or use a spray solution on it, as doing so can cause substantial damage.

11.2. Service Intervals

The operating hours for components vary. Below is a list of actions required for a particular component when service on that component is recommended.

Component	Action	Interval
Ball bearing	Replace bearing	10000 hours
Shaft sealing ring	Replace sealing	5000 hours
Cables	Visual inspection. Replace if perceivable damage.	On demand, or scheduled device inspection*
Connector sockets	In case of damage, contact service/vendor.	500 mating cycles
Integrated motor	Visual inspection, Check for any wear, mechanical damage, or scrapings.	On demand, or scheduled device inspection*
Connections	Inspect all electrical connections for signs of corrosion, looseness, or damage. Tighten any loose connections.	On demand, or scheduled device inspection*
Configuration	Back-up configuration settings.	After initial configuration and after every configuration change
Thermal health check	Read out motor and drive temperature via software and compare to similar situations in other devices or at earlier points in time. Changes of more than 10°C without known cause should be investigated.	On demand, or scheduled device inspection*
Diagnostic test STO	Test STO functionality by activating STO once - passed if STO is activated without any failure appearing.	3 months / 1 year**

** Devices are generally maintenance free. For heavy duty or rough environment applications, Synapticon recommends to execute the specified checks based on a regular interval, with typical intervals between 6 and 12 months.*

*** The testing frequency depends on the required safety level:*
- one test per year for SIL 2, PL d / category 3
- one test per three months for SIL 3, PL e / category 3

12. Quality and Compliance

Synapticon develops with a focus on cybersecurity and systematic failure avoidance to deliver a highly performant and reliable product.

12.1. Standards and Compliance

Synapticon SOMANET Circulo adheres to the following standards and compliance requirements, which can be viewed and downloaded below.

12.2. Certifications

Declaration of Conformity SOMANET Circulo

Declaration of Conformity SOMANET Circulo Cable Kit

EC-type Examination Certificate

Certificate Safety Functions

Statement of SOMANET Circulo Mechanical Immunity (Shock and Vibration tests)

EtherCAT Conformance Test Certificate

Regulation (EC) No 1907/2006 - (REACH) certificate

RoHS DirectivE 2011/65/EU and 2015/863/EU Statement SOMANET Circulo

TÜV SÜD

STO-SBC Safety Certificate

UL

Certificate of Compliance UL-recognized SOMANET Circulo