

Smart Electromotor Controller

FESTO

Description

Fitting and
installation
Type SEC-AC-305
Type SEC-AC-508

Description

192 346
en 0007NH



Contents and general instructions

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Festo P.BE-SEC-AC-HW-EN en 0007NH

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Designated use

The SEC-AC (Smart Electromotor Controller) has been designed for use in control cabinets for supplying AC servo motors and for controlling their torque (current), speed and position.

The SEC-AC must be operated in a safe working environment. An EMERGENCY STOP circuit must be installed for the system.

Operate the SEC-AC only under the permitted ambient conditions.

The SEC-AC may only be used in stationary industrial and commercial use. The electromagnetic interference immunity of the power electronics is not designed for operation in mobile systems, in households or firms connected directly to the low voltage network.

Fit the SEC-AC with screening into an earthed control cabinet. Otherwise, the electromagnetic compatibility (EMC) of the power electronics will not be guaranteed. Use the SEC-AC only as follows:

- as designated
- in a technically faultless state
- without undertaking any modifications.

If used in conjunction with additional commercially-available components, such as sensors and actuators, the specified maximum limits (temperatures, electrical datas, torques, etc.) must be observed.

Please comply with national and local safety laws and regulations.

Target group

This manual is aimed at technicians trained in control and automation technology, fitters etc. who

- are working for the first time with digital drive controllers
- are already familiar with digital drive controllers, but who are installing a digital drive controller like the SEC-AC for the first time.

The aim of this manual

This manual will help you to carry out the first commissioning of the SEC-AC successfully.

In this manual you will find important information and acquire the basic knowledge necessary for operating the SEC-AC correctly.

Most work steps in this manual are divided into two parts:

- Description part: here you will learn important instructions and the aim of each individual work step.
- Instruction part: here you carry out the work step.

In the left-hand margin you will find symbols which simplify the orientation in this manual for you during commissioning.

As this manual is intended for the first commissioning of the complete SEC-AC product family, the regulator for which the work step is intended is always specified for each individual work step.

Contents and general instructions

Trade marks

All product names in this document may be registered trade marks. All trade marks in this document are only used for identifying the individual product.

Service

If you have any technical problems, please contact your local Festo Service.

Important user instructions

Danger categories

This manual contains instructions on the dangers which may occur if the product is not used correctly. These instructions are marked with a heading (Warning, Caution, etc.), printed on a shaded background and accompanied by a pictogram. A distinction is made between the following danger categories:



Warning

This means that there is a danger of serious human injury and damage to property if these instructions are not observed.



Caution

This means that there is a danger of human injury and damage to property if these instructions are not observed.



Please note

This means that there is a danger of damage to property if these instructions are not observed.



In addition, the following pictogram marks passages in the text which describe activities involving electrostatically sensitive components:

Electrostatically sensitive components: Incorrect handling may result in damage to the components.

Safety instructions



Warning

Inside the SEC-AC and on its connections there are high voltages which can be extremely dangerous.

Switch off the power supply of the SEC-AC, therefore, and wait for at least 5 minutes in order that the intermediate circuit can discharge before you connect or disconnect any plugs.



Warning

During installation, commissioning and maintenance you must observe the safety and accident prevention regulations valid for the specific application.

The following regulations apply but are not guaranteed to be complete:

- VDE 0100 Regulations for setting up high-voltage systems up to 1000 V
- VDE 0113 Electrical equipment in machines
- VDE 0160 Equipment in high-voltage systems with electronic operating methods

Marking special information

The following pictograms mark passages in the text containing special information.

Pictograms



Information:
recommendations, tips and references to other sources of information.



Accessories:
information on necessary or useful accessories for the Festo product.



Environment:
information on the environmentally-friendly use of Festo products.

Text markings

- The bullet denotes activities which can be carried out in any sequence.
- 1. Figures denote activities which must be carried out in the order specified.
- Hyphens denote general activities.

Contents and general instructions

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1. Summary of components

1.1 Summary

The SEC-AC servo regulators are fully digital AC servo regulators which can be adapted very flexibly to a large number of applications due to their extensive parametrizing possibilities.

The SEC-AC-508 is closely related to the SEC-AC-305. Apart from the different mains voltage and the connection for an external braking resistor on the SEC-AC-508, the two devices are fully compatible.

The SEC-AC Smart Electromotor Controllers must be fitted in a control cabinet. The circuitry can be carried out in uniform manner.

1.2 Features

- Full integration of all components for the controller and power units, evaluation of the rotary transducer (motor angle of rotation feedback) has been designed as a plug-in module.
- Slot for technological extensions. A CANopen field bus module as well as a Profibus module are available on request.
- Integration of all filters in the device necessary for complying with the EMC regulations in operation (industrial area), e.g. network filter, motor output filter, filter for supply as well as for the inputs and outputs.
- Integrated braking module with braking chopper enables braking energy to be dissipated via the internal braking resistors. Only SEC-AC-508: External resistors with up to several kW continuous output can be connected for considerable braking energy.
- Only SEC-AC-305:
For increasing the braking output, an additional external chopper with an additional braking resistor can be used.

1. Summary of components

- New mechanical concept:
The completely enclosed EMC-optimized metal housing has been designed for direct mounting and fastening onto the usual mounting plates in a control cabinet.
- Complete electrical isolation of the controller unit and the final output stage, digital inputs and outputs, analogue and control electronics in accordance with VDE 0160.
- 4-quadrant operation with complete continuous transfer between the quadrants.
- Droopless control in conjunction with a digital nominal value specification.
- Sinus-shaped current injection, therefore continuous torque compared with block-commutated controllers.
- Can be operated as a speed, torque or position regulator.
- Smooth or time-optimum positioning relatively or absolutely to a reference point.
- Speed and rotary angle synchronization with electronic gears via an incremental sensor input or CAN bus (on request).
- Short cycle times, the control dynamics are similar to those of an analogue regulator.
- Simple coupling to a higher-order controller, e.g. to a PLC.
- The digital controller permits error-tolerant operation, i.e. faults are recognized in good time and regulated when possible.

1. Summary of components

1.3 Controller unit

1.3.1 Brief description

The central component in the controller unit is a highly integrated 32-bit RISC micro controller of type HITACHI SH 7032.

Communication with higher-order controllers, PLCs or master computers is accomplished with the optional CAN bus interface, via the serial interface and via the digital inputs/outputs.

The ten external digital inputs and the five digital outputs are completely electrically isolated.

1.3.2 Analogue-digital converter

The analogue-digital converter is integrated in the SEC-AC. It digitizes analogue variables, e.g. the motor currents, analogue nominal values or the temperatures of the motor and the final output stage.

1.3.3 Digital-analogue converter

The digital-analogue converter serves for displaying digital control variables on an analogue monitor. This function is of help, e.g. with regulator optimizations. The SEC-AC has two analogue monitor devices.

1.3.4 Internal monitoring

A watchdog timer and extensive monitoring functions ensure very reliable operation of the controller unit.

The microcontroller and additional external hardware logic register error signals from the motor, from the rotary-angle evaluator and from the final output stage.

1. Summary of components

1.4 Final output stage

1.4.1 Brief description

Final output stage

The final output stage is a three-phase design.

The motors should be connected star-shaped, in order to prevent circulating currents in the motor. The intermediate circuit voltages comply with the standard European or international values.

Operation with lower intermediate circuit voltages is also possible (with reduction of output). If very fast components are used, signal distortions will be reduced to a minimum.

1.4.2 Power supply

SEC-AC-305

An external power unit is not necessary for rated outputs in the dimensioning range. Connection is made via the single-phase 230 V AC network.

EC-AC-508

These devices can be connected directly to the 400 V three-phase network.

1. Summary of components

1.4.3 Feeding back the braking energy

SEC-AC-305 and SEC-AC-508

The braking energy is fed back into the intermediate circuit where it creates a voltage increase.

Braking chopper with braking resistor

A braking chopper with braking resistor is integrated in the final output stage. If a certain limit value of the intermediate circuit voltage is exceeded during the feedback, the braking energy will be converted to heat by the internal braking resistors. Control of the braking chopper is carried out by software in the SEC-AC. The internal braking resistors are protected against overload.

SEC-AC-508

If, in a particular application, the output of the internal resistors is not sufficient, an external resistor can be connected as described in chapter 3.3.2.

Simultaneous operation of the internal and external braking resistors is not possible. The external resistors are not protected against overload automatically by the SEC-AC.

SEC-AC-305

If in a special, seldom used application case, the output of the internal resistors is not sufficient, an additional external braking chopper with additional braking resistor must be connected to the intermediate circuit.

Further information can be obtained from Festo.

1. Summary of components

1.4.4 Internal monitoring

The final output stage will be switched off very quickly by the controller unit if operating faults occur. A high degree of protection is ensured for the motor and the SEC-AC.

An extensive arrangement of sensors and monitoring functions ensure operational safety:

- measurement of the motor temperature
- measurement of the final output stage temperature
- recognition of device-internal earth connections (protective earth)
- recognition of connections between two motor phases only SEC-AC-508: recognition of connections at the output for the external braking resistor
- recognition of overvoltages in the intermediate circuit
- recognition of faults in the internal voltage supply

1. Summary of components

1.5 Displays

1.5.1 Brief description

During operation, the SEC-AC can assume various operating states. These states are communicated to the user via visual displays.

1.5.2 Ready-to-operate display

The green ready-to-operate LED on the front of the SEC-AC indicates the readiness to operate.

1.5.3 Operating mode and error display

Seven segment display The seven segment display on the front of the SEC-AC indicates the operating mode and shows any error messages.

1. Summary of components

1.6 Rotary transducer evaluation

The rotary transducer evaluating unit is incorporated on a plug-in board.

Different sensor adaptations are therefore possible. As standard, the SEC-AC operates with a resolver. It also possesses an additional incremental sensor input and an incremental sensor output. The sensor evaluation possesses the following features:

- a resolver resolution set at 16 bits
- an additional incremental sensor input (synchronizing input), the resolution can be set, internal 4-fold evaluation
- an additional incremental sensor output with fixed set resolution of 1024 inc/rev.

The incremental sensor inputs and output can be used, e.g. for synchronizing several SEC-ACs as electronic gears.

1.6.1 Serial interface

The serial interface with RS 232 specification serves for parametrizing the SEC-AC. Parametrizing is carried out in conjunction with the PC parametrizing program for WINDOWS/NT and a PC.

In applications in which high data transmission and the networking of several regulators are not required, the RS 232 can also be used for controlling the regulator.

1. Summary of components

1.7 User interfaces

1.7.1 Digital inputs

Ten digital inputs are available for the elementary control functions:

Positioning destination

For saving positioning destinations, the SEC-AC possesses a destination table in which the positioning destinations with individual positioning profiles can be saved and from which they can later be accessed. Four outputs serve for destination selection, a fifth input is used as the starting input.

Hardware limit switches

The hardware limit switches are used for setting safety limits to the area of movement. During reference travel, one of the two limit switches serves as the reference point for positioning control.

Two inputs are used for the hardware-controlled final output stage enable, as well as for the software-controlled regulator enable.

A high-speed sample input can be used for synchronizing tasks (master-slave mode).

1.7.2 Analogue inputs

The SEC-AC possesses two analogue inputs for the input level. The inputs have been designed as differential inputs, in order to ensure a high degree of immunity to interference. The analogue signals are digitized by the analogue-digital converter. The analogue signals serve for specifying nominal values (speed or torque) for the regulator.

1. Summary of components

1.8 Parametrizations

1.8.1 The parameter memory

The SEC-AC possesses two memory ranges in which it stores parameters. The FLASH memory is used for parameters which are loaded when the controller is switched on or after RESET. These parameters are retained even when the power supply is switched off. The internal memory (RAM) is used for parameters which are currently used for controlling. These parameters can be accessed with the parametrizing program.

The FLASH technology also enables a software update (e.g. for customer-specific software) to be loaded into the RS 232 at a later date.

1.8.2 The parametrizing program

The parametrizing program is a program for parametrizing, controlling and monitoring the operation of the SEC-AC via communication interfaces. It can be used with every AT-compatible PC as from 80486-processor with at least 16MB main memory, providing it is running with WINDOWS 95, 98 or WINDOWS NT. User-friendly operation under WINDOWS also facilitates work for users with only limited EDP knowledge.

1.8.3 CAN module (optional)

The optional CAN module operates in accordance with CAN-OPEN specifications with the CIA-DS 402 positioning profile.

1. Summary of components

1.9 Monitoring functions

1.9.1 Brief description

The SEC-AC possesses an extensive arrangement of sensors which monitor the faultless functioning of the controller unit, the final output stage, the motor and the communication with the peripherals.

Error memor

Any faults which occur are saved in the internal error memory. Most errors cause the controller unit to switch off the regulator and the final output stage. The regulator cannot be switched on again until the fault has been rectified and the error memory has been deleted by quitting (switch off the voltage or actuate the reset button above the figure display).

1.9.2 Monitoring the final output stage

The final output stage is monitored by extensive protective functions.

- Overcurrent and short-circuit monitoring:
This responds as soon as the current in the intermediate circuit exceeds twice the maximum current of the regulator. Short circuits between two motor phases are recognized as well as short circuits at the motor output terminals in respect of the positive and negative reference potential of the intermediate circuit and in respect of protective earth. When the error monitoring recognizes an overcurrent, the final output stage is switched off immediately, so that resistance to short circuits is guaranteed.
- Overvoltage monitoring for the intermediate circuit:
This responds as soon as the intermediate circuit voltage exceeds the operating voltage range. The final output stage is then switched off.
- Temperature monitoring for the heat sink: The heat sink temperature of the final output stage is measured with a linear temperature sensor. The regulator will be switched off when a certain defined temperature is exceeded.

1. Summary of components

1.9.3 Monitoring the motor

The SEC-AC possesses the following protective functions for monitoring the motor and the connected rotary transducer:

- Monitoring the rotary transducer:
An error of the rotary transducer causes the final output stage to be switched off. The carrier signal and the tracer signal are monitored.
- Measuring and monitoring the motor temperature:
The SEC-AC possesses an input for registering and monitoring the motor temperature.

1.9.4 I²t monitoring

The SEC-AC has I²t monitoring for limiting the medium loss of output in the final output stage and in the motor. As the loss of output occurring in the power electronics and in the motor increases in the most unfavourable case in squared value with the current flowing, the digitized current value will be accepted as a measure of the loss of output.

1.9.5 Automatic braking

The SEC-AC can directly control a parking brake with limited current consumption of up to 0.5 A. Operation of the holding brake can be carried out automatically with programmable delay times.

Fitting

Chapter 2

Festo P.BE-SEC-AC-HW-EN en 0007NH

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2. Fitting

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2. Fitting

2.1 Dimensions

2.1.1 Dimensions of the SEC-AC

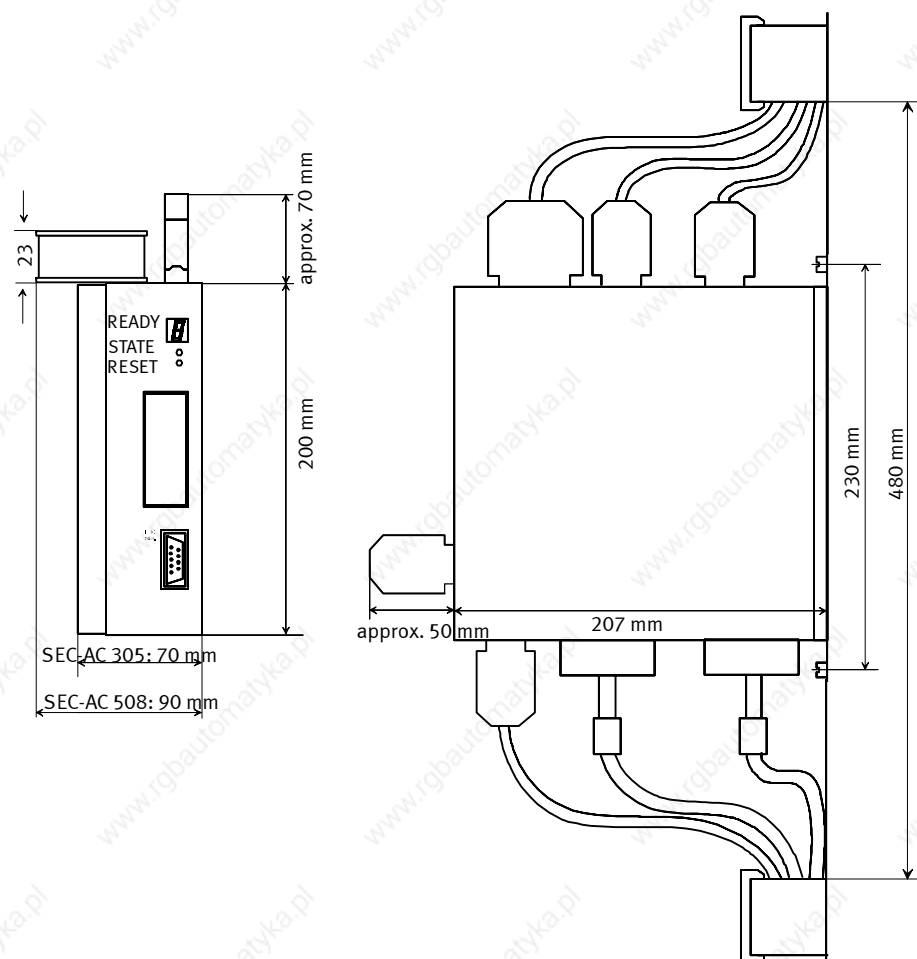


Fig. 2/1: Dimensions of the SEC-AC

2. Fitting



Please note

Connect the screening/shield with equal potential on the mounting plate. If necessary, in the case of X10 or X11, use an earthing screw above (e.g. with external regulators) and **always** below.

Fastening screws must not be used as earthing screws.

The devices are intended as compact devices for mounting in series in a control cabinet or on a wall. Any number of SEC-ACs can be connected next to each other. The loss of output occurring in operation, together with the heating of the device depends on the output consumption. The cooling of the SEC-AC is performed by free convection or by forced convection (only SEC-AC-508) with the series fan supplied. For sufficient cooling, the upper and lower dimensions shown in Fig. 2/2 must be observed as a minimum.

- 1 Control cabinet wall
- 2 Fan (SEC-AC-508)

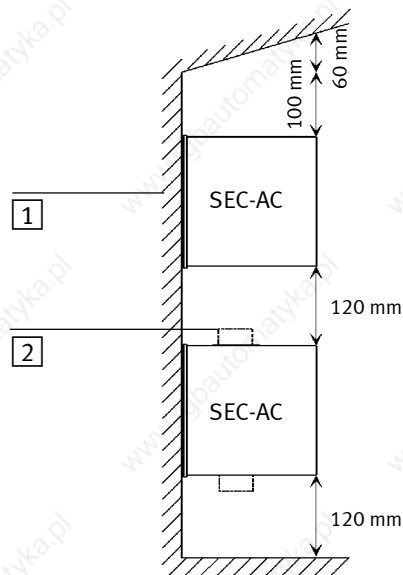


Fig. 2/2: Minimum distances for control cabinet or wall fitting

2. Fitting

2.2 Electromechanics

2.2.1 Front view

- 1 RESET
RESET key
- 2 STATE
7-segment display as status display
- 3 READY
Geady-to-operate display
- 4 Techno
Slot for CAN module (optional)
- 5 X5
Serial interface
- 6 Cool profile
- 7 Air channel (only SEC-AC-508)
- 8 Fan (only SEC-AC-508)

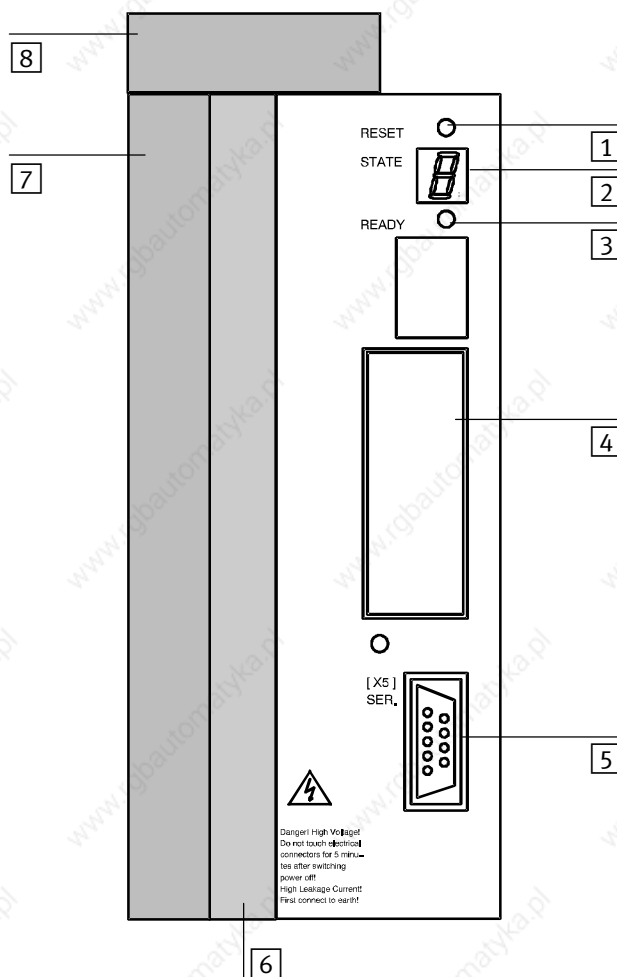


Fig. 2/3: Front view of SEC-AC

2. Fitting

2.2.2 Top view

- 1 X12
Connection for
external braking
resistor (only
SEC-AC-508)
- 2 X11
Incremental sen-
sor output
- 3 X10
Incremental sen-
sor input
- 4 X1
Digital and ana-
logue inputs and
outputs
- 5 Fan (only
SEC-AC-508)

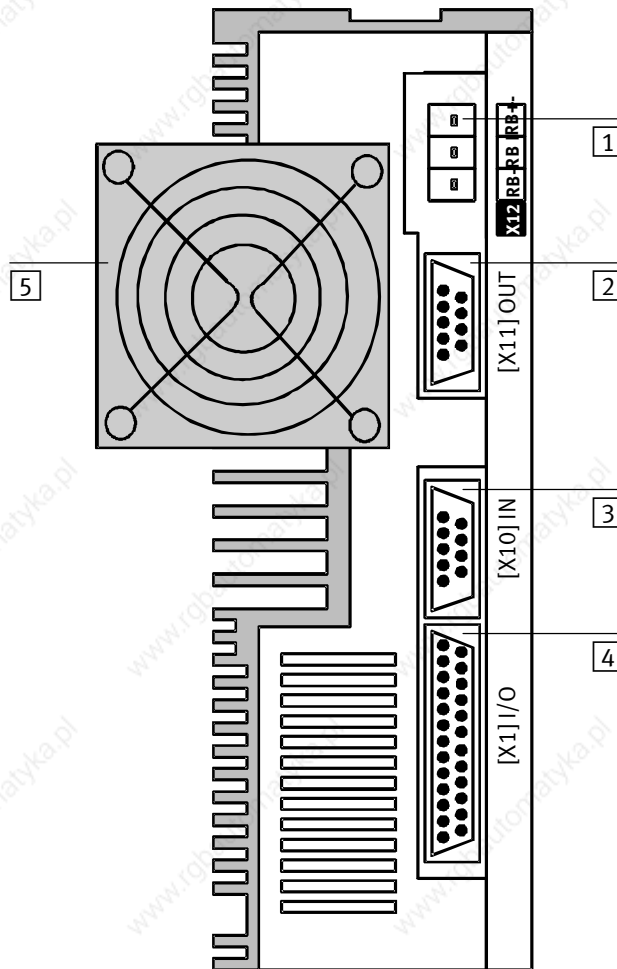


Fig. 2/4: Top view of SEC-AC

2. Fitting

2.2.3 Bottom view

- 1 X2
Phase-angle sensor input
- 2 X6
Power supply to motor, temperature sensor, parking brake
- 3 PE
Protective earth connection of SEC-AC
(max. 1 Nm)
- 4 FAN
Connection for fan (with SEC-AC-508 series standard)
- 5 X9
Power supply/ mains connection
- 6 Air channel (only SEC-AC-508)

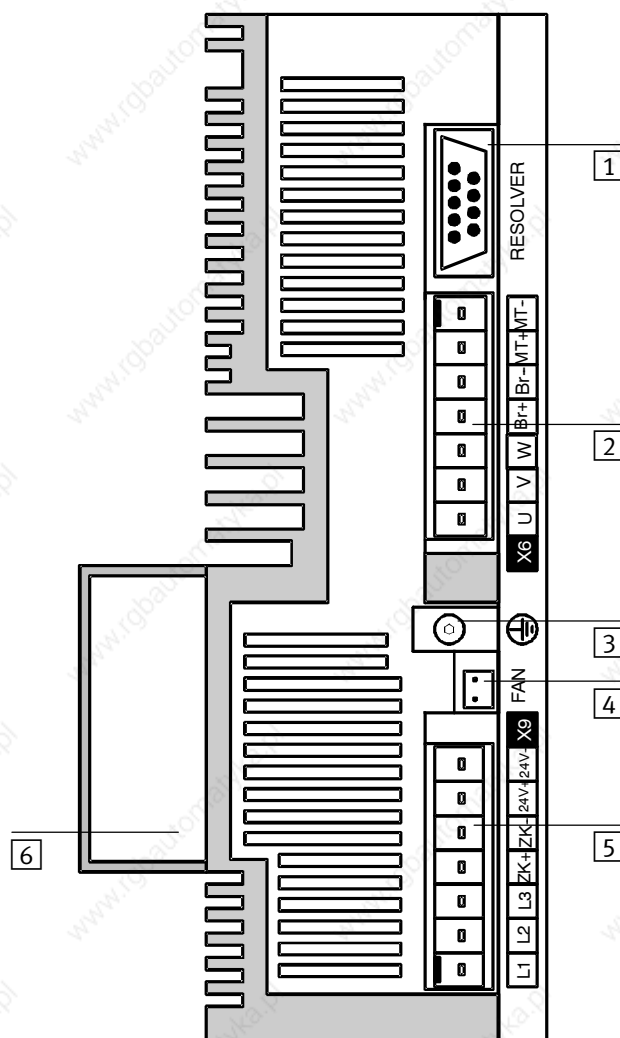


Fig. 2/5: Bottom view of SEC-AC

2. Fitting



Warning

The voltages at X12 can be as much as 800V!

Handle the plug with great care. Before touching the plug, switch off the device completely and wait 5 minutes.



Warning

Observe the plug assignment on connector X9. Swapping the connecting terminals can be very dangerous and will also cause damage to the device. Connection X6 can also carry dangerous high voltages.

Chapter 3

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3. Installation

3.1 Material

3.1.1 Manufacturer

**Caution**

Use only the cables listed below for connecting the system. Only then will the correct functioning of the system be guaranteed.

**Caution**

Incorrectly produced cables can damage the electronics and trigger unexpected movements of the slide.
Test each cable in accordance with the instructions on fitting the cables. Make sure that the cables are laid correctly and that the plugs have strain relief.

3. Installation



We recommend the following Festo cables for connecting our electric positioning systems:

	Designation	Part number
Cable set		
Cable set BSM 50/63/80, consisting of: motor cable KMTR-M-BSM-50/63/80-7 resolver cable KRES-M-BSM-7	KATP-M-BSM-50/63/80-7	00192333
Cable set BSM 90, consisting of: motor cable KMTR-M-BSM-90-7 resolver cable KRES-M-BSM-7	KATP-M-BSM-90-7	00192334
Motor cable (X6)		
Motor cable BSM 50/63/80 length 7 m	KMTR-M-BSM-50/63/80-7	00192335
Motor cable BSM 90 length 7 m	KMTR-M-BSM-90-7	00192336
Motor cable BSM 50/63/80 length x	KMTR-M-BSM-50/63/80-X	00192337
Motor cable BSM 90 length x	KMTR-M-BSM-90-X	00192338
Resolver cable (X2)		
Resolver cable 7 m	KRES-M-BSM-7	00192339
Resolver cable length x	KRES-M-BSM-X	00192340
Encoder cable (X11)		
Encoder cable 2.5 m	KENC-M-BSM-2,5	00192341
Encoder cable length x	KENC-M-BSM-X	00192342
Signal cable		
Null modem cable (cable/PC)	PS1ZK11	160786
Control cable (X10)	KES-SEC-AC-2,5	On request

The encoder cable is only required when a separate (external) position controller is used. In this case the SEC-AC is operated as a speed controller.

3. Installation

3.1.2 Plug for power cable X6



1 PHOENIX POWER-COMBICON plug, 7-pole without pins grid 7.62mm, PC 4/7-ST-7.62, included in delivery. Coding profile to avoid swapping the connections CP-HCC 4.

3.1.3 Plug for external braking resistor (only SEC-AC-508) (recommended for high braking power)



1 PHOENIX POWER-COMBICON plug, 3-pole without pins grid 7.62mm, PC 4/3-ST-7.62.



Included in delivery (inserted in X12). Remove the wire bridges on the plug if using an external braking resistor.

3.1.4 Plug for power supply to the SEC-AC



1 PHOENIX POWER-COMBICON plug, 7-pole without pins grid 7.62mm, PC 4/7-ST-7.62, included in delivery. Coding profile to avoid swapping the connections CP-HCC 4.

3.1.5 PE connection of the SEC-AC



Please use Festo cables.

The PE connection of the SEC-AC (network and motor) is made with an M5 threaded pin.

3.1.6 Interface cable for serial interface (zero modem)



2 D-SUB plug, 9-pin socket 2 housing for 9-pin D-SUB plug with locking screws 4/40 UNC screened cable, 3-core

3. Installation

3.2 Plug connectors and their pin assignments

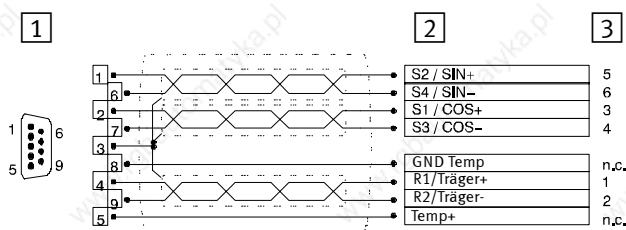
3.2.1 Rotary-angle sensor cable for motors with resolver, plug X2 (rotary-angle sensor evaluation)

- plug connector: D-Sub socket 9-pin
- mating connector: D-Sub plug 9-pin

The outer screening is always connected to protective earth (PE) (plug housing).

3. Installation

- 1 DSUB-plug to X2:
Resolver (view of
soldering side)
- 2 Resolveroutput
of motor
- 3 Pinassignment
Festo-Resolver
plug connector



Pin no.	Symbol	Specification
1	SIN+	Sine tracer signal
6	SIN-	Sine tracer signal inverted
2	COS+	Cosine tracer signal
7	COS-	Cosine tracer signal inverted
3	AGND	Analogue earth/ground; (inner screening)
8	AGND	Analogue earth/ground; (AGND for motor temperature sensor)
4	REF+	Carrier signal to resolver
9	REF-	Carrier signal to resolver inverted
5	MOT-TEMP	Motor temperature sensor (nout used with Festo drives)

Fig. 3/6: Assignment of plug connector X2 (resolver/encoder input)

3. Installation

3.2.2 Control signal plug with analogue monitor output X1 (digital and analogue inputs and outputs)

- plug connector: D-Sub plug connector 25-pin (socket)
- mating connector: D-Sub plug connector 25-pin (pin)

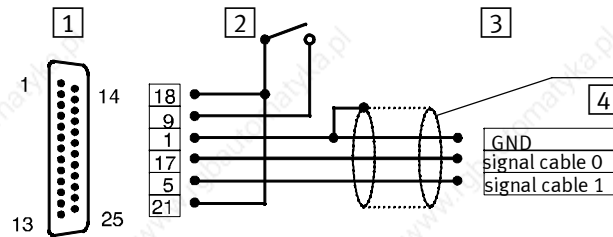
This circuit for plug connector X1 will suffice for the first commissioning. Further details see table.

With PLC interfaces the inputs:

- 21= final output stage enable
- 9 = regulator enable

must be treated separately.

- 1 DSUB-plug to X1 of ARS (view of soldering side)
- 2 Final stage and controller enable switch
- 3 BNC-plug of oscilloscope
- 4 Screening



Pin no.	Symbol	Value	Specification
1	AGND	0V	Analogue earth/ground
14	AGND	0V	Analogue earth/ground
2	Ain0	$\pm 10V \pm 5\%$ $R_i = 20K\Omega \pm 1\%$	Analogue nominal value input (A/B signals) channel 0 Differential max. 25 V input voltage
15	Ain0/		Reference connection, analogue connection channel 0

3. Installation

Pin no.	Symbol	Value	Specification
3	Ain1	$\pm 10V \pm 5\% R_i = 20K\Omega \pm 1\%$	Analogue nominal value input (A/B signals) channel 1 Differential max. 25 V input voltage
16	Ain1/		Reference connection, analogue connection channel 1
4	+VREF	+10V $\pm 5\%$	Reference voltage output (for optional nominal value potentiometer)
17	AMON0	$\pm 10V \pm 5\%$	Analogue monitor output 0
5	AMON1	$\pm 10V \pm 5\%$	Analogue monitor output 1
18	+24VDC	$\pm 24VDC \pm 20\%$	24 V DC digital voltage supply output (supply via power unit plug X9)
6	GND	GND	Digital earth/GND
19	Din0	POS-Bit 0	Position selection bit 0
7	Din1	POS-Bit 1	Position selection bit 1
20	Din2	POS-Bit 2	Position selection bit 2
8	Din3	POS-Bit 3	Position selection bit 3
21	Din4	ENA-PWR	Final output stage enable
9	Din5	ENA-CL	Regulator enable
22	Din6	END-0	Limit switch negative
10	Din7	END-1	Limit switch positive
23	Din8	START	Start positioning
11	Din9	SAMPLE	High-speed input
24	Dout0	READY	Ready-to-operate
12	Dout1	PRG-1	Freely programmable output
25	Dout2	PRG-2	Freely programmable output
14	Dout3	PRG-3	Freely programmable output

Fig. 3/7: Assignment of plug connector X1 (inputs and outputs)

3. Installation

3.2.3 X10 (additional incremental sensor input)

- plug connector: D-Sub socket 9-pin
- mating connector: D-Sub plug 9-pin

Pin no.	Symbol	Value	Specification
1	A	5V $R_i \approx 120 \Omega$	Input signal tracer A
6	A/	5V $R_i \approx 120 \Omega$	Input signal tracer A inverted
2	B	5V $R_i \approx 120 \Omega$	Input signal tracer B
7	B/	5V $R_i \approx 120 \Omega$	Input signal tracer B inverted
3	C	5V $R_i \approx 120 \Omega$	Input signal tracer C (zero pulse)
8	C/	5V $R_i \approx 120 \Omega$	Input signal tracer C inverted
4	Schirm	0V	Screening/shield connection
9	GND	0V	Digital earth/ground*)
5	+5VDC	+5VDC	Auxiliary voltage for external sensor + 5 V DC max. 100 mA*)

*) Not assigned with Festo cables

Fig. 3/8: Assignment of plug connector X10 (additional incremental sensor input for special functions)

3. Installation

3.2.4 X11 (additional incremental sensor output)

- plug connector: D-Sub socket 9-pin
- mating connector: D-Sub plug 9-pin

Pin no.	Symbol	Value	Specification
1	A	5V $R_a \approx 60 \Omega$	Output signal tracer A
6	A/	5V $R_a \approx 60 \Omega$	Output signal tracer A inverted
2	B	5V $R_a \approx 60 \Omega$	Output signal tracer B
7	B/	5V $R_a \approx 60 \Omega$	Output signal tracer B inverted
3	C	5V $R_a \approx 60 \Omega$	Output signal tracer C (zero pulse)
8	C/	5V $R_a \approx 60 \Omega$	Output signal tracer C inverted
4	Schirm	0V	Screening/shield connection ^{*)}
9	GND	0V	Digital earth/ground ^{*)}
5	+5VDC	+5VDC	Auxiliary voltage for external sensor + 5 V DC max. 100mA ^{*)}
^{*)} Not included in Festo cables 192341 or 132342.			

Fig. 3/9: Assignment of plug connector X11 (additional incremental sensor output for special functions and when a separate external position transducer is used)

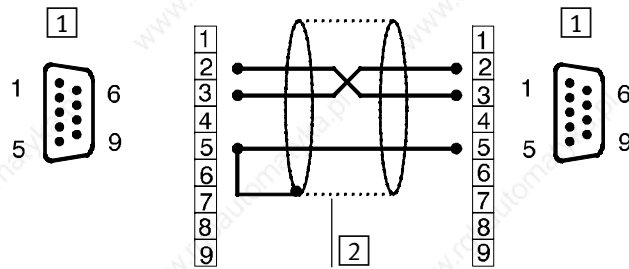
3. Installation

3.2.5 X5 (serial interface/serial test interface)

- plug connector: D-Sub plug 9-pin
- mating connector: D-Sub socket 9-pin

1 View of plug side

2 Screening



Pin no.	Designation	Specification
1	—	—
6	—	—
2		Receiver cable as per RS232 specification
7	—	—
3	TXD	Sender cable as per RS232 specification
8	—	—
4	—	—
9	—	—
5	GND	Relevant earth/ground is connected to GND of digital part

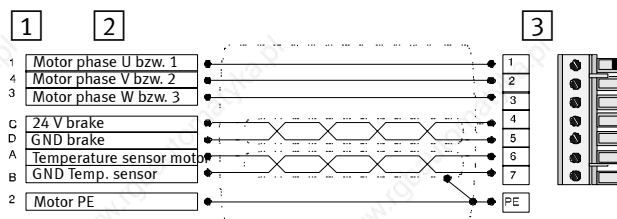
Fig. 3/10: Assignment of plug connector X5 (serial interface)

3. Installation

3.2.6 X6 (motor supply, power supply, parking brake and temperature sensor)

- plug connector: Phoenix Power-Combicon 7-pin, PC 4/7-G-7.62
- mating connector: Phoenix Power-Combicon 7-pin, PC 4/7-ST-7.62

- 1 Pinassignment of Festo motor plug connector
- 2 Connection plug on motor side
- 3 PHOENIX-POWER-COMBI-CON to X6



Pin	Symbol	Meaning/remarks
1	U	Motor connection phase 1
2	V	Motor connection phase 2
3	W	Motor connection phase 3
4	Br+	Control of 24 V parking brake in the motor
5	Br-	Relevant earth/ground connected to 24GND
6	MT+	Temperature sensor (normally closed contact)
7	MT-	Earth/GND for temperature sensor

Fig. 3/11: Assignment of plug connector X6 (motor connection)

3. Installation



Please note

The temperature sensor in the motor (normally-closed contact) can be wired either via the the sensor cable or the power cable (depending on the motor). The unused connection remains in each case unwired.

In Festo drive packages the temperature sensor is wired via the motor cable.

The parking brake is supplied with power by the power supply for the SEC-AC.

If the parking brake requires more than 0.5 A, it cannot be supplied directly by the SEC-AC. The tolerances in the voltage supply must also be observed (see section 2.2).

If necessary, a relay must be inserted in the circuit between the SEC-AC and the parking brake, as shown in the diagram below.

- 1 SEC-AC
- 2 Power unit
- 3 Brake
- 4 Motor
- 5 Free-running diode
- 6 Resistor and capacitor for spark extinguisher

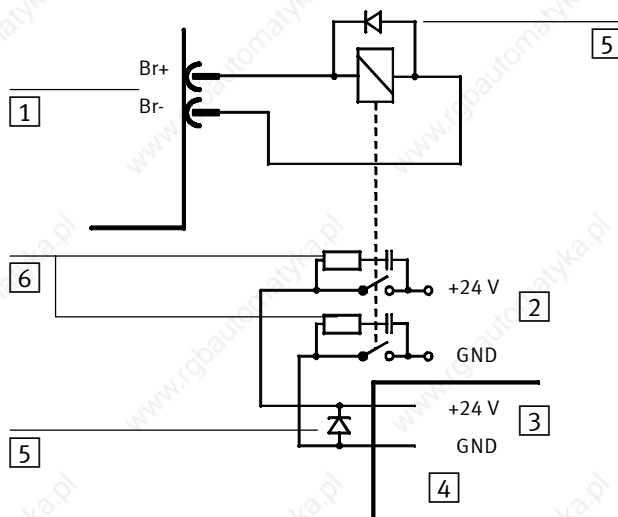


Fig. 3/12: Connecting a parking brake to the SEC-AC

3. Installation

3.2.7 Power supply cable for the SEC-AC

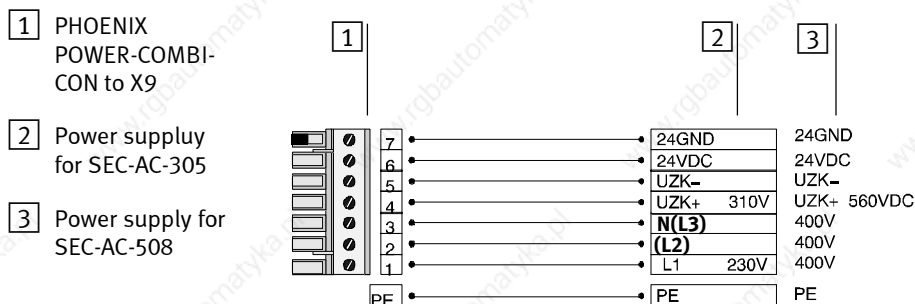


Fig. 3/13:

3.3 Power supply of the SEC-AC

The SEC-AC receives its power supply via plug connector X9.

Specifications:

1. Voltage for electronics: 24 V DC (20%, 0.5 A
If you are using a motor with a parking brake, you must make sure that the tolerances of the voltage supply for the parking brake are observed. Note here that an additional voltage drop of approx. 1.5 V can occur in the SEC-AC.
2. Final output stage
The voltage supply for the power unit can be made via the mains input voltage or the intermediate circuit supply.

3. Installation

3.3.1 X9 (power supply of the SEC-AC)

- plug connector: Phoenix Power-Combicon 7-pin, PC 4/7-G-7.62
- mating connector: Phoenix Power-Combicon 7-pin, PC 4/7-ST-7.62

Pin	Symbol	Meaning/remarks	
		SEC-AC-305	SEC-AC-508
1	L1	AC input (230Veff)	AC input (400Veff, cond.-cond.)
2	(L2)		
3	N(L3)	AC input N-conductor	
4	UZK+	Positive intermediate circuit voltage	
5	UZK-	Negative intermediate circuit voltage	
6	24V+	24 V DC auxiliary supply	
7	24V-	Earth/GND for auxiliary supply	

Fig. 3/14: Assignment of plug connector X9 (power unit)

3.3.2 X12 (braking resistors only SEC-AC-508)

- plug connector: Phoenix Power-Combicon 3-pin, PC 4/7-G-7.62
- mating connector: Phoenix Power-Combicon 3-pin, PC 4/7-ST-7.62

Pin	Symbol	Meaning/remarks
1	RB+	External braking resistor, positive terminal
2	RBI	Terminal for internal braking resistors
3	RB-	External braking resistor, negative terminal

Fig. 3/15: Assignment of plug connector X12 (braking resistors)

3. Installation



Please note

The mating connector is included in delivery. There must be a bridge on this plug between terminals RB- and RBI in order that the internal braking resistors can be operated.



Warning

There is an intermediate circuit potential (up to 800V) at these terminals! Select a suitably insulated cable. Before starting work, switch off the device completely and wait 5 minutes. This bridge must be removed in order that the external braking resistors can be operated. Simultaneous operation of the internal and external braking resistors is not possible. The bridge between RB- and RBI is already fitted when the device is supplied from the factory.

The following external braking resistors are recommended:

Wire-wrapped tube resistor type DEZ 140406-75R 75 Ω 370 W

Supplied by: Gielen+Notnagel GmbH
Friedrich Wöhler Straße 65
53117 Bonn
Germany

Single-tube fixed resistor type EfmA 7 82(/2,8A 650 W

Supplied by: Heine Spezialwiderstände GmbH
Schlüterstraße 29
01277 Dresden
Germany

Braking resistors with a higher output are also available from the suppliers named.

3. Installation

Fitting the connecting cable



Please note

Connection to the mains power supply and the fitting of mains switches, transformers, safety devices and network filters may only be carried out by qualified personnel.



Caution

- Do not connect any cable to the electronics and do not disconnect any cable while the system is still connected to the power supply. Otherwise the device will be damaged.
- Before installation, check all the cables once again, as incorrect connection assignments may lead to serious malfunctioning.
- Disconnect the SEC-AC and the motor from the mains power supply and wait 5 minutes (for intermediate circuit discharge) before you connect or disconnect any plugs.
- Always connect the SEC-AC to the protective earth (PE) of the power supply network.
- Always connect the screening cables of the motor to the earth connection of the SEC-AC before you commission the motor.



Caution

Avoid the parallel routing of motor cables and signal cables over long distances. Use only screened cables for connecting the motor and paired twisted cables for the signal cables.

3. Installation



In this way you will avoid electromagnetic interference which can impair reliable operation of the system.



Caution

Make sure that the cables are fitted with strain relief. With beam and multi-axis operation, mechanically stressed cables must be laid in a drag chain.

3. Installation

3.3.3 Summary of connections

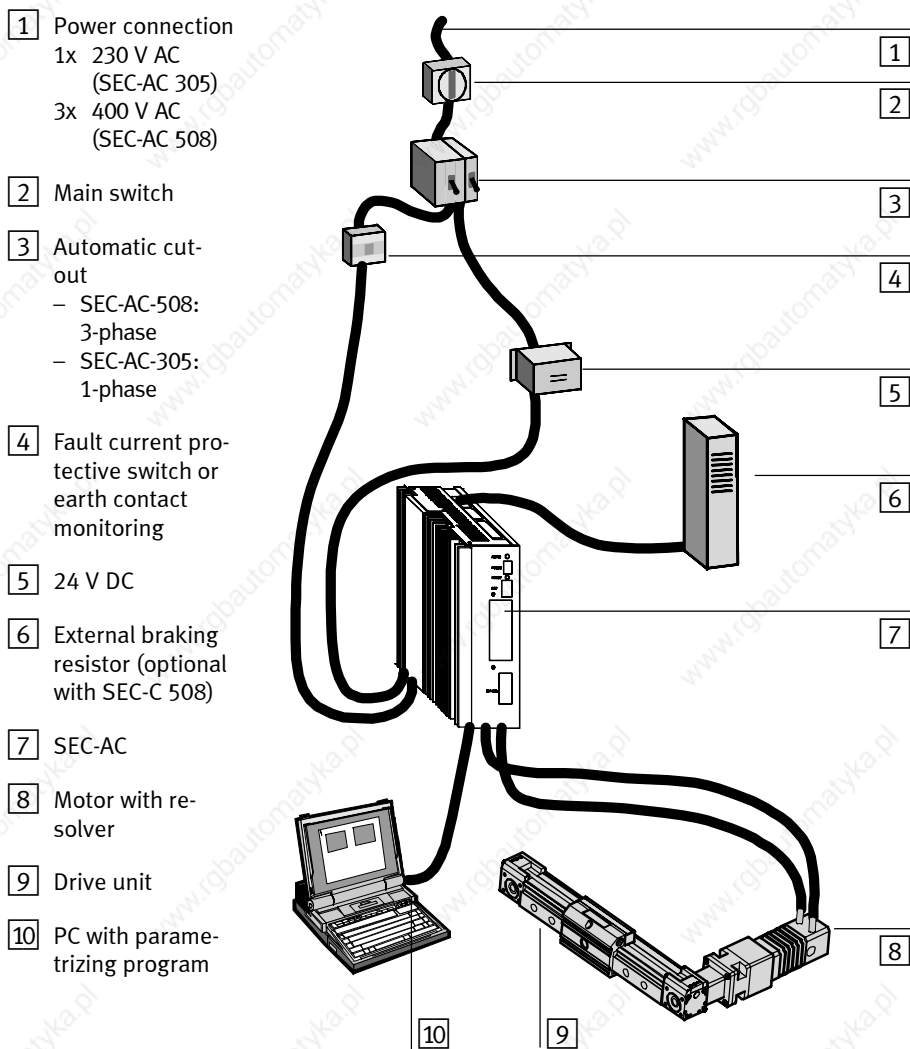


Fig. 3/16: Complete layout of the SEC-AC with motor and PC

3. Installation

3.3.4 SEC-AC complete system

The diagram in Fig. 3/16 on the previous page represents the complete SEC-AC system. The following components are required for operating the SEC-AC:

SEC-AC

- Mains power switch
- Automatic circuit breaker
- FI protective switch (depending on design guideline alternative Ground current registering)
- SEC-AC
- Motor with motor cable
- Network cable
- A PC with serial connecting cable will be required for parametrizing.

3.3.5 Connecting the PC to the SEC-AC (X5)

1. Insert the D-Sub plug of the serial interface cable into the socket for the serial interface of the PC. Tighten the locking screws.
2. Insert the D-Sub plug of the serial interface cable into socket **X5:SER** of the SEC-AC. stecken. Tighten the locking screws.
3. Check all plug connectors again.

3. Installation

3.3.6 Connecting the motor to the SEC-AC

1. Insert the plug for the power cable into the appropriate socket on the motor and tighten it.
2. Insert the PHOENIX plug into socket **X6** on the SEC-AC.
3. Connect the PE cable of the motor and the screening cable to the PE earth terminal of the SEC-AC.
4. Insert the resolver plug into the resolver output socket on the motor and tighten it.
5. Insert the 9-pin D-Sub resolver plug into socket **X2** on the SEC-AC and tighten the locking screws.
6. Connect the screening connection of the resolver cable to the PE earth terminal of the SEC-AC.
7. Check all plug and screening connectors again.

3.3.7 Connecting the external braking resistor to the SEC-AC (if required, only with SEC-AC-508)

1. Make sure that the power supply is switched off (wait at least 5 minutes).
2. Connect the housing of the braking resistor to the PE (e.g. on the SEC-AC).
3. Remove the bridge between RB- and RBI on connector X12.
4. Connect the braking resistor to terminals RB+ and RB- of connector X12.

3. Installation

3.3.8 Connecting the SEC-AC to the power supply

1. Make sure that the power supply is switched off.
2. Insert the PHOENIX plug into socket X9 on the SEC-AC.
3. Connect the PE-cable of the network to the PE earth terminal.

3.3.9 Fitting the control signal plug

1. Insert the control signal plug into socket **X1** on the SEC-AC. Tighten the locking screws.



Warning

When connecting the motor phases, note that different manufacturers of servo motors specify different phase sequences. If necessary, phases U and W must be swapped.

3.4 Complete summary of the SEC-AC system

3.4.1 Wiring the connections

The SEC-AC should be connected to the power supply and to the motor as shown in Fig. 3/17.

3. Installation

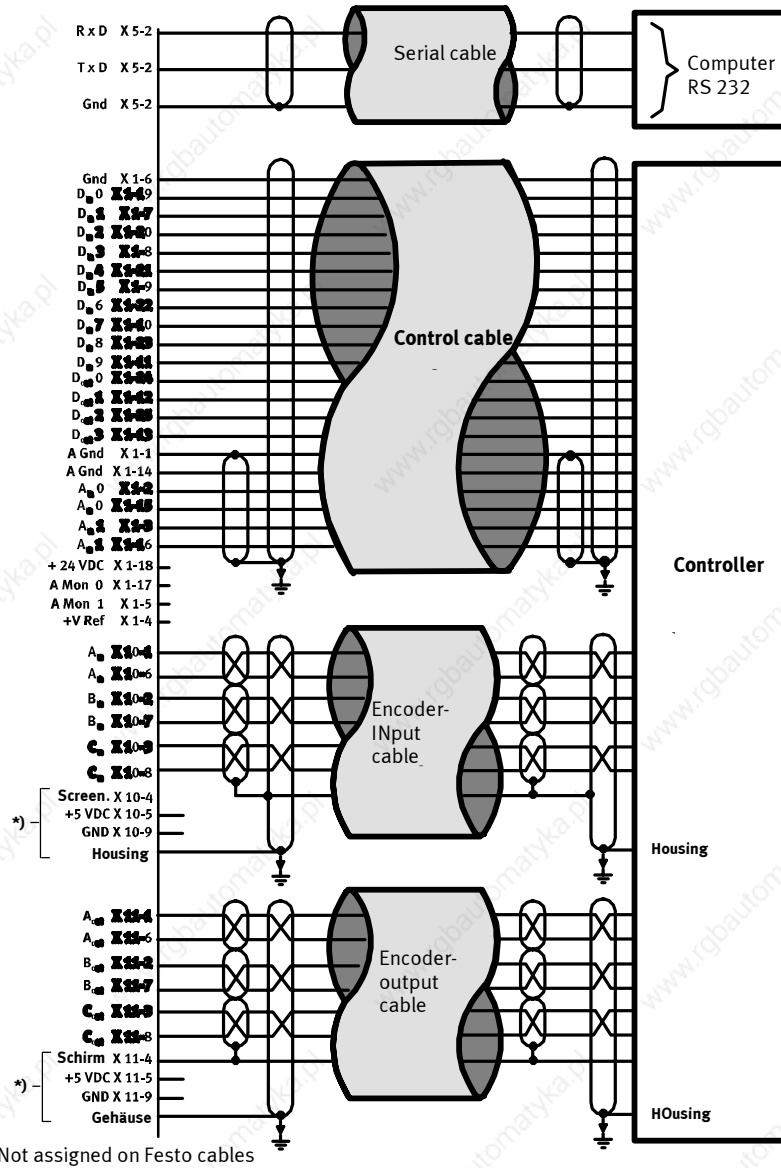
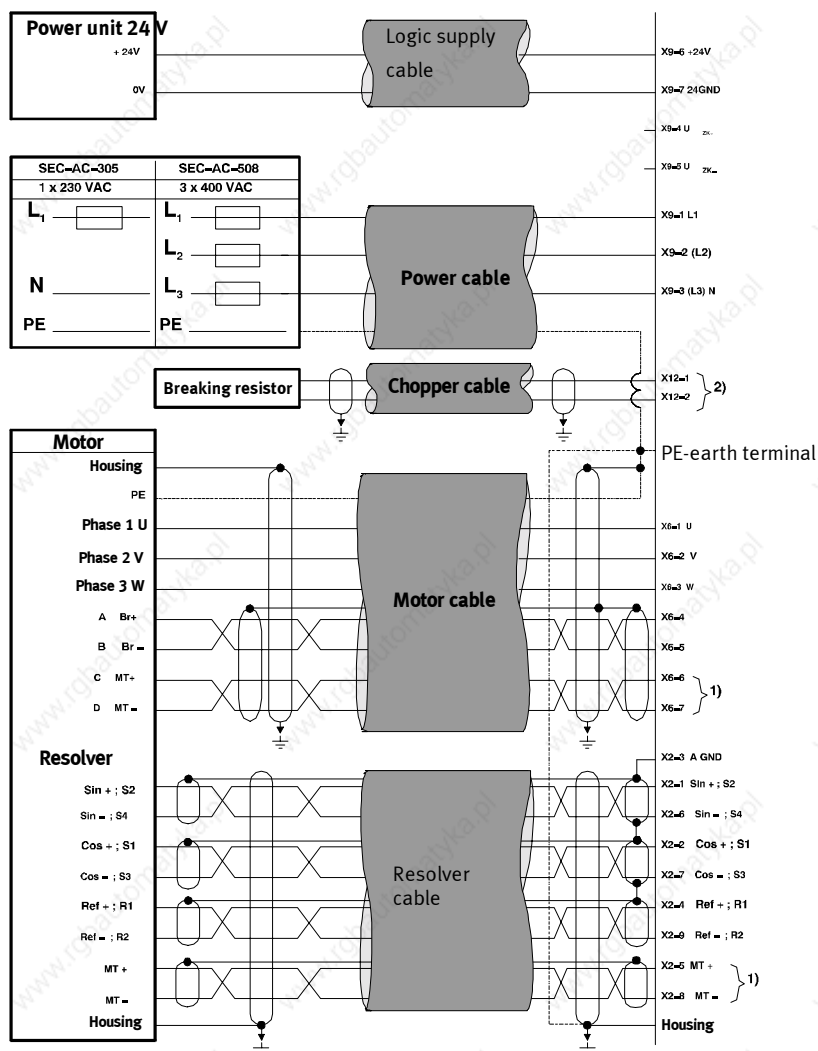


Fig. 3/17: Connecting to the power supply and the motor

3. Installation



- 1) Monitoring of motor temperature either by motor or resolver plug
- 2) Only with SEC-AC-508

Fig. 3/18: Logical circuitry

3. Installation



Caution

The SEC-AC-508 does not have internal fuses for the 400V_{AC}- or 560V_{DC}-inputs. An automatic circuit breaker is therefore provided. If the SEC-AC-508 is operated with only one or two current phases, high PE-leakage currents may occur. Only one automatic circuit breaker, in which all three phases are switched off together, may therefore be used.



Caution

The SEC-AC must first be connected to X1, X10...X12. The operating voltages for the intermediate circuit and the electronic DC voltage supply must not be switched on until commissioning is started. If the operating voltage connections are connected with incorrect polarity, or if there is excessive operating voltage, or if the connections for the operating voltage and the motor are swapped, the device will be damaged. The SEC-AC must be connected to operating earth via the **PE** connection.

A 24 V power supply is required for operating the electronic components of the SEC-AC. This voltage supply must be connected to terminals 24V+ and 24V-. The power supply for the final output stage must then be connected (either AC or DC is possible at the appropriate input). The two power supplies may be switched on simultaneously.

3. Installation

3.5 PE protective conductor and screening connections

3.5.1 Connecting instructions

The screening of the motor cable is wired together with the PE inner conductor of the motor cable to the central PE connecting point on the SEC-AC.

The PE connection to the network as well as the screening for the resolver cable and, if applicable, the encoder cable, is also wired to this star point. This star point must be connected to the central earthing point of the complete control cabinet by means of a cable (copper band) with a large cross-sectional area (short cable to the assembly plate). The Festo motor cable already contains this connecting band in the end piece.

Special EMC protective measures must be observed in the case of longer lengths.



Warning

For safety reasons, all PE protective conductors must be connected before commissioning.

The PE connection to the network is wired to the central PE connecting point on the SEC-AC.

Make sure that the earth connections between the devices and the mounting plate are of sufficient dimensions to enable HF interference to be discharged.

3. Installation

3.5.2 Electrical isolation

In designing the SEC-AC, we have placed great importance on providing a high degree of immunity to interference. For this reason, individual function blocks have been designed as electrically isolated units. Signal transmission within the SEC-AC is made via an optocoupler.

A distinction is made between the following isolated areas:

- the final output stage with intermediate circuit and network input
- the control electronics with analogue signal processing
- the 24V supply and digital inputs and outputs

3.6 Measures for observing EMC guidelines

If correctly fitted and if all connections are correctly wired with Festo cables, the regulators in the SEC-AC product family will comply with the regulations of the relevant technical standards EN 50081 (interference emission) and EN 50082 (immunity to interference).

The interference emission and immunity to interference of a device always depend on the complete drive concept, which consists of the following components:

- the power supply
- the SEC-AC controller
- the motor
- the electromechanical parts
- the design and type of wiring
- the higher-order controller

In order to increase immunity to interference and to reduce interference emission, motor restrictors and network filters have already been fitted into the SEC-AC, so that the regulator as such fulfils the EMC requirements without additional screening and filter measures, providing a suitable motor cable is used (see chapter 3.1). This cable must not be longer than 10 m.

If longer cables are used, we recommend that additional external network filters be switched in near to the device power supply (e.g. from Schaffner).



Caution

If you touch D-SUB plug connectors which are not assigned, there is a danger of ESD (electrostatic discharge), which can damage the SEC-AC or other parts of the system. In order to avoid such discharges, you should use protective caps which are obtainable from trade dealers.

3. Installation

Diagnosis and error treatment

Chapter 4

4. Diagnosis and error treatment

4.	Diagnosis and error treatment	4-1
4.1	Status display	4-3
4.2	Error messages of the SEC-AC	4-4

4. Diagnosis and error treatment

4.1



Status	Description
	Controller enabled
	Revolving outer segments – Display of relative direction of rotation of motor – Display of relative motor speed

Fig. 4/1: Status list

4. Diagnosis and error treatment

4.2 Error messages of the SEC-AC



Caution

- Switch off the power supply before starting error treatment.

The SEC-AC possesses an error memory for saving and displaying even short error signals, e.g. overcurrent. Errors cannot be reset automatically by the SEC-AC. They must be quitted by the user by means of the reset button above the 7-segment display.

All errors which occur are shown on the 7-segment display. The flashing two-figure error codes clearly indicate the type of error. If there are several errors at the same time, the error with the lowest code will be displayed. The following table lists the error messages which can be displayed on the SEC-AC.

4. Diagnosis and error treatment

Error code	Meaning/function	Remedy
0-8	Rotary-angle sensor error	<ul style="list-style-type: none"> • Check plug connector X2 and rotary- angle sensor cable on SEC-AC and motor
0-7	Overvoltage in intermediate circuit	<ul style="list-style-type: none"> • Check voltage sources and their connecting cables. <ul style="list-style-type: none"> - Do they fulfil the specifications? - Is the pin assignment of the connecting cables correct? • Fault occurs when motor is braked. The internal braking resistor is overloaded. Adapt positioning cycle, if necessary, use an external braking module (SEC-AC-305) or external braking resistor (SEC-AC-508).
0-6	Overcurrent or short circuit in final output stage/motor	<ul style="list-style-type: none"> • Check motor temperature. If the motor is hot, • Check the current regulator setting. • Check the connecting cable to the motor. Is there an earth connection or short circuit?
0-5	Failure in power supply for electronic	You cannot rectify this fault. Please contact your Festo service.
0-4	Excessive temperature in final output stage	<ul style="list-style-type: none"> • Check the fitting of the SEC-AC. If necessary use a fan.
0-3	Excessive temperature in motor	<ul style="list-style-type: none"> • Check the motor temperature. If the motor is hot, • set the rated and maximum currents correctly. • Check plug connector X6 and the connecting cable from the SEC-AC and the motor. • Make sure the cable is not broken. Is a motor connected?
0-2	Undervoltage in intermediate circuit	<ul style="list-style-type: none"> • Check voltage sources and their connecting cables. <ul style="list-style-type: none"> - Do they fulfil the specifications? - Is the pin assignment of the connecting cables correct?

4. Diagnosis and error treatment



Please note

If error 0-3 occurs, it may be that the motor does not possess a temperature sensor. In this case the relevant input on plug connector X6 must be short-circuited.

RES button

Each error message will only be deleted when the cause of the error is rectified and when the error is subsequently quitted. In order to quit an error, press the RES button.



Please note

Please note that all the parameter modifications, which you have carried out, will be lost when you press the RES button, if they have not been saved in the FLASH memory.

When an error has been rectified and quitted, the next error code will be displayed.

Technical Appendix

Appendix A

Festo P.BE-SEC-AC-HW-EN en 0007NH

A-1

A. Technical Appendix

Contents

A.1	ANPASSEN! Technische Daten Feldbusknoten CP FB13-E	A-3
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A. Technical Appendix

A.1 Technical specifications

A.1.1 SEC-AC-305

SEC-AC-305	
Power supply – V_{rated} [-30 % .. +15%] – V_{CC} [-20 % .. +20 %] current consumption 24 V	– 230 VAC or 310 VDC with UZK supply 24 V DC*) – approx. 0.35A **)
Rated output – with DC supply – with AC supply	1500 VA 1000 VA
Peak power max. 10 s	3000 VA
Network supply voltage	1 * 230 V AC -30 %...+10 %, 50/60 Hz
Intermediate circuit voltage	max. 340 V DC, 5 A
Rated current per phase	5 A_{eff}
Peak current per phase max. 10 s $\Delta 10 A_{eff}$	10 A_{eff}
Braking chopper Internal resistor (external extension only via additional braking module) – pulse output – continuous output – response threshold – load tolerance	100 Ω 1,3 kVA 25 W 375 V 0.5 : 25 s
Ambient temperature	0 °C bis 50 °C ***): at rated output 1kW; motor current 5 A_{eff} under follow- ing conditions: output reduction 30W/°C as from 35 °C
Storage temperature	-25 °C bis 60 °C ***)
*) Observe tolerance of a parking brake, if used. Additional voltage drop in SEC-AC: approx. 2V **) plus current consumption of a parking brake, if used ***) Moisture condensaton is not permitted during operation	

A. Technical Appendix

SEC-AC-305	
Humidity	0...90 %, non condensing
Outer dimensions	H • W • D: approx. 200 mm • 70 mm • 210 mm (without plugs)
Housing	IP 20
Weight	Approx. 2.5 kg
Connecting cable to motor	max. 50m, screened cable C' < 200 pF/m with lengths > 5 m additional EMC components necessary
Voltage endurance for cable	min. 1500 V
Nominal value inputs for speed and current – Ain0, Ain0/ – Ain1, Ain1/	±10 V, R _i = 20 kΩ, offset adjust ± 0.1 V ±10 V, R _i = 20 kΩ, offset adjust ± 0.1 V
Monitor settings – output level – representable variables	2 analogue outputs with 8-bit resolution at X1 ±10 V voltage output, short-circuit resistant freely standardized, e.g. nominal and actual current values, rotary angle electric or mechanical, nominal and actual speed value
General logic inputs – Din0 – Din1 – Din2 – Din3 – Din4 – Din5 – Din6 – Din7 – Din8 – Din9 – Reset (electrically)	isolated, 12...30 V, active high – Bit 0 \\ – Bit 1, \ target selection for positioning – Bit 2, / 16 destinations can be selected from – Bit 3 / destinations window – Control input for final output stage enable at high – Regulator enable at high, quit at low – Limit switch input 1 – Limit switch input 2 – Control signal start positioning – Control signal Sync for coupling in master-slave mode – Reset button on the front

A. Technical Appendix

SEC-AC-305	
General logic outputs – Dout0: ready-to-operate – Dout1: freely configurable – Dout2: freely configurable – Dout3: freely configurable – Dout4: holding brake	Electrically isolated – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 500 mA via external 24 V supply *)
Monitor settings – Overvoltage in intermediate circuit – Undervoltage in intermediate circuit – Overcurrent in intermediate circuit – Supply voltage – Thermo-protection of motor – Thermo-protection of final output stage – Fault in rotary angle sensor	– Approx. 400 V – programmable, can be switched off – short-circuit monitoring – all controller-internal voltages – normally-closed contact – 100 °C heat sink temperature – common error
Displays on device – ready-to-operate display – error and status messages	– LED – Seven-segment display
Terminal interface – level – plug connector	Serial – RS 232, 9600...57600 bit/s, – 9-pin. D-Sub
Interference emission	EN 50 081 part 2, basic standard industrial area **)
Immunity to interference	EN 50 082 part 2, basic standard industrial area **)
*) Observe voltage tolerance of a parking brake, if used. Additional voltage drop in SEC-AC: approx. 1.5 V **) External filters are not necessary.	

A. Technical Appendix

A.1.2 SEC-AC-508

SEC-AC-508	
Supply voltage – V_{rated} [-15 % .. +20 %] – V_{CC} [-20 % .. +20 %] current consumption 24V	– 3 • 400 V _{AC} or 560 V _{DC} at UZK-supply 24 V DC *) – approx. 0.45A **)
Network supply voltage	3 • 400 V AC -20 %..+20 %, 50/60 Hz
Intermediate circuit voltage	Max. 680 V DC
Rated output – with DC supply – with AC supply	4000 VA 4000 VA ***)
Rated current per phase	8 A _{eff}
Peak power (5kHz/) max. 2 s	9000 VA
Peak current per phase (5kHz intermediate pulse frequency)	16 A _{eff}
Internal braking resistor – pulse output – continuous output – response threshold – ratio of switch-on time to switch-off time (approx.)	150 Ω 3,2 kW 20 W 750 V 0.2 s : 35 s
External braking resistor – pulse output – continuous output – operating voltage	minimum 60 Ω max. 7,5 kW max. 3 kW 750 V
Weight	Approx. 2.6 kg
Connecting cable to motor	max. 50m, screened cable (C' < 200 pF/m) With lengths > 10 m additional EMC components required
*) Observe voltage tolerance of a parking brake, if used. Additional voltage drop in SEC-AC: approx. 2 V. **) plus current consumption of a parking brake, if used. ***) forced ventilation required.	

A. Technical Appendix

SEC-AC-508	
Voltage endurance for cable	min. 1500 V
Ambient temperature	0°C bis 50°C*): at rated output 4kW; motor current 8Aeff under following conditions: output reduction 100W/°C as from 40°C
Storage temperature	-25 °C bis 60 °C *)
Humidity	0..90 %, non condensing
Outer dimensions	H • W • D: approx. 223 mm • 70 mm • 210 mm (without plugs)
Housing	IP 20
Nominal value inputs for speed and current – Ain0, Ain0/ – Ain1, Ain1/	± 10 V, R _i = 20 kΩ, offset adjust ± 0,1 V ± 10 V, R _i = 20 kΩ, offset adjust ± 0,1 V
Monitor settings – output level – representable variables	2 analogue outputs with 8-bit resolution at X1 ± 10 V voltage output, short-circuit resistant freely standardized, e.g. nominal and actual current values, rotary angle electric or mechanical, nominal and actual speed values
General logic inputs – Din0 – Din1 – Din2 – Din3 – Din4 – Din5 – Din6 – Din7 – Din8 – Din9 – ResetΔElectrically	Isolated, 12..30 V, active high – Bit 0 \\ – Bit 1, \ target selection for positioning – Bit 2, / 16 destinations can be selected from – Bit 3 / destinations window – Control input for final output stage enable at high – Regulator enable at high, quit at low – Limit switch input 1 – Limit switch input 2 – Control signal start positioning – Control signal Sync for "flying saw" – Reset button on the front
*) Moisture condensaton is not permitted during operation.	

A. Technical Appendix

SEC-AC-508	
General logic outputs <ul style="list-style-type: none"> – Dout0: ready-to-operate – Dout1: freely configurable – Dout2: freely configurable – Dout3: freely configurable – Dout4: holding brake 	Electrically isolated <ul style="list-style-type: none"> – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 100 mA via external 24 V supply – 24 V, 500 mA via external 24 V supply *)
Monitor settings <ul style="list-style-type: none"> – Overvoltage in intermediate circuit – Undervoltage in intermediate circuit – Overcurrent in intermediate circuit – Supply voltage – Thermo-protection of motor – Thermo-protection of final output stage – Fault in rotary angle sensor 	Approx. 800 V programmable (phase failure recognition) short-circuit monitoring all controller-internal voltages normally-closed contact 80 °C heat sink temperature common error
Displays on device <ul style="list-style-type: none"> – ready-to-operate display – error and status messages 	LED Seven-segment display
Terminal interface <ul style="list-style-type: none"> – level, baud rate – plug connector 	Serial RS 232, 9600...57600 bit/s, 9-pin. D-Sub
Interference emission	EN 50 081 part 2, basic standard industrial area **)
Immunity to interference	EN 50 082 part 2, basic standard industrial area **)
*) Observe voltage tolerance of a parking brake, if used. Additional voltage drop in SEC-AC: approx. 1.5 V **) External filters are not necessary.	

A. Technical Appendix

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