

Servo Positioning Controller ARS 2102 FS, 2105 FS and 2108 FS

designed for Functional Safety

Mounting Instructions

Version 9.0

1 General

1.1 Documentation

This installation information serves the purpose of a safe use of the ARS 2100 FS series servo positioning controller. It contains safety notes, which must be complied with.

Further information can be found in the following manuals of the ARS 2000 product range:

- ❖ **Product Manual “Servo Positioning Controller ARS 2100 FS”:** Description of the technical specifications and the device functionality as well as notes on the installation and the operation.
- ❖ **Software Manual “Servo Positioning Controller ARS 2000”:** Description of the software and firmware functions usable with the parameterisation program Metronix ServoCommander®.
- ❖ **CANopen Manual “Servo Positioning Controller ARS 2000”:** Description of the implemented CANopen protocol as per DSP402.
- ❖ **PROFIBUS Manual “Servo Positioning Controller ARS 2000”:** Description of the implemented PROFIBUS-DP protocol.
- ❖ **Sercos Manual “Servo Positioning Controller ARS 2000”:** Description of the implemented Sercos II protocol.
- ❖ **EtherCAT Manual “Servo Positioning Controller ARS 2000”:** Description of the implemented EtherCAT (CoE – CANopen over EtherCAT) protocol.
- ❖ **Product Manual “FSM 2.0 – STO”:** Description of the technical specifications and the device functionality.
- ❖ **Product Manual “FSM 2.0 – MOV”:** Description of the technical specifications and the device functionality (German version).

You can find all these documents on our homepage at the download area (<http://www.metronix.de/>).

2 Safety notes for electrical drives and controllers

2.1 Used symbols



Information

Important information and notes.



Caution!

Nonobservance may result in severe property damages.



DANGER!

Nonobservance may result in **property damages** and in **personal injuries**.



Caution! Dangerous voltages.

The safety note indicates a possible perilous voltage.

2.2 General notes

In case of damage resulting from non-compliance with the safety notes in this manual, Metronix Meßgeräte und Elektronik GmbH will not assume any liability.

Sound and safe operation of the servo drive controller requires proper and professional transportation, storage, assembly and installation as well as proper operation and maintenance. Only trained and qualified personnel may handle electrical devices:

TRAINED AND QUALIFIED PERSONNEL

in the sense of this product manual or the safety notes on the product itself are persons who are involved in the project planning, the setup, assembly, commissioning and operation of the product as well as all warnings and precautions as per the instructions in this manual and who are sufficiently qualified in their field of expertise:

- ❖ Education and instruction of standard specifications and accident prevention regulations, which are necessary in the application, and authorisation to switch devices/systems on and off and to ground them as per the standards of safety engineering and to efficiently label them as per the job demands.
- ❖ Education and instruction as per the standards of safety engineering regarding the maintenance and use of adequate safety equipment.
- ❖ Training in first aid.

The following notes must be read prior to the initial operation of the system to prevent personal injuries and/or property damages:



These safety notes must be complied with at all times.



Do not try to install or commission the servo drive controller before carefully reading all safety notes for electrical drives and controllers contained in this document. These safety instructions and all other user notes must be read prior to any work with the servo drive controller.



In case you do not have any user notes for the servo drive controller, please contact your sales representative. Immediately demand these documents to be sent to the person responsible for the safe operation of the servo drive controller.



If you sell, rent and/or otherwise make this device available to others, these safety notes must also be included.



The user must not open the servo drive controller for safety and warranty reasons.



Professional control process design is a prerequisite for sound functioning of the servo drive controller!



DANGER!

Inappropriate handling of the servo drive controller and non-compliance of the warnings as well as inappropriate intervention in the safety features may result in property damage, personal injuries, electric shock or in extreme cases even death.

2.3 Danger resulting from misuse



DANGER!

High electrical voltages and high load currents!
Danger to life or serious personal injury from electrical shock!



DANGER!

High electrical voltage caused by wrong connections!
Danger to life or serious personal injury from electrical shock!



DANGER!

Surfaces of device housing may be hot!
Risk of injury! Risk of burning!



DANGER!

Dangerous movements!

Danger to life, serious personal injury or property damage due to unintentional movements of the motors!

2.4 Safety notes

2.4.1 General safety notes



The servo positioning controller corresponds to IP20 degree of protection as well as pollution degree 2. Make sure that the environment corresponds to this degree of protection and pollution degree.



Only use replacements parts and accessories approved by the manufacturer.



The devices must be connected to the mains supply as per EN regulations, so that they can be cut off the mains supply by means of corresponding separation devices (e.g. main switch, contactor, power switch).



The servo drive controller may be protected using an AC/DC sensitive 300mA fault current protection switch, type B (RCD = Residual Current protective Device).



Gold contacts or contacts with a high contact pressure should be used to switch the control contacts.



As a precaution screening measures for switchgears must be met, as e.g. contactors and relays with RC elements and/or diodes wire.



The safety rules and regulations of the country in which the device will be operated must be complied with.



The environment conditions defined in the product documentation must be kept. Safety-critical applications are not allowed, unless specifically approved by the manufacturer.



The compliance with the limits required by national regulations is the responsibility of the manufacturer of the machine or system.



The technical data and the connection and installation conditions for the servo drive controller are to be found in this product manual and must be met.



DANGER!

The general setup and safety regulations for work on power installations (e.g. DIN, VDE, EN, IEC or other national and international regulations) must be complied with.

Non-compliance may result in death, personal injury or serious property damages.



Without claiming completeness, the following regulations and others apply:

VDE 0100	Erection of power installations with nominal voltages up to 1000 V
EN 1037	Safety of machinery - Prevention of unexpected start-up
EN 60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements
EN 61800-3	Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods
EN 61800-5-1	Adjustable speed electrical power drive systems Part 5-1: Safety requirements - Electrical, thermal and energy

EN 61800-5-2	Adjustable speed electrical power drive systems Part 5-2: Safety requirements - Functional
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems Part 1: General principles for design
EN ISO 13849-2	Safety of machinery - Safety-related parts of control systems Part 2: Validation

**More standards to be respected by the user:**

EN 574	Safety of machinery - Two-hand control devices
EN 1088	Safety of machinery - Interlocking devices associated with guards
EN 1037	Safety of machinery - Prevention of unexpected start-up
EN ISO 13850	Safety of machinery - Emergency stop

2.4.2 Safety notes for assembly and maintenance

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:



The servo drive controller must only be operated, maintained and/or repaired by personnel trained and qualified for working on or with electrical devices.

Prevention of accidents, injuries and/or damages:



Additionally secure vertical axes against falling down or lowering after the motor has been switched off, e.g. by means of:

- Mechanical locking of the vertical axle,
- External braking, catching or clamping devices or
- Sufficient balancing of the axle.



The motor holding brake supplied by default or an external motor holding brake driven by the drive controller alone is not suitable for personal protection!



Keep the electrical equipment voltage-free using the main switch and protect it from being switched on again until the DC bus circuit is discharged, in the case of:

- Maintenance and repair work
- Cleaning
- long machine shutdowns



Prior to carrying out maintenance work make sure that the power supply has been turned off, locked and the DC bus circuit is discharged.



The external or internal brake resistor carries dangerous DC bus voltages during operation of the servo drive controller and up to 5 minutes thereafter. Contact may result in death or serious personal injury.



Be careful during the assembly. During the assembly and also later during operation of the drive, make sure to prevent drill chips, metal dust or assembly parts (screws, nuts, cable sections) from falling into the device.



Also make sure that the external power supply of the controller (24V) is switched off.



The DC bus circuit or the mains supply must always be switched off prior to switching off the 24V controller supply.



Carry out work in the machine area only, if AC and/or DC supplies are switched off. Switched off output stages or controller enablings are no suitable means of locking. In the case of a malfunction the drive may accidentally be put into action, except drives with active safety function "Safe Torque Off".



Motor set up, automatic tuning and identification procedures must be done with free-wheeling motor to prevent mechanical damage due to unexpected motor movement.



Electronic devices are never fail-safe. It is the user's responsibility, in the case an electrical device fails, to make sure the system is transferred into a secure state.



The servo drive controller and in particular the brake resistor, externally or internally, can assume high temperatures, which may cause serious burns.

2.4.3 Protection against contact with electrical parts

This section only concerns devices and drive components carrying voltages exceeding 50 V. Contact with parts carrying voltages of more than 50 V can be dangerous for people and may cause electrical shock. During operation of electrical devices some parts of these devices will inevitably carry dangerous voltages.



DANGER!

High electrical voltage!

Danger to life, danger due to electrical shock or serious personal injury!

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:



Before switching on the device, install the appropriate covers and protections against accidental contact. Rack-mounted devices must be protected against accidental contact by means of a housing, e.g. a switch cabinet. The regulations VGB4 must be complied with!



Always connect the ground conductor of the electrical equipment and devices securely to the mains supply. Due to the integrated line filter the leakage current exceeds 3.5 mA!



Comply with the minimum copper cross-section for the ground conductor over its entire length as per EN 60617!



Prior to the initial operation, even for short measuring or testing purposes, always connect the ground conductor of all electrical devices as per the terminal diagram or connect it to the ground wire. Otherwise the housing may carry high voltages which can cause electrical shock.



Do not touch electrical connections of the components when switched on.



Prior to accessing electrical parts carrying voltages exceeding 50 Volts, disconnect the device from the mains or power supply. Protect it from being switched on again.



For the installation the amount of DC bus voltage must be considered, particularly regarding insulation and protective measures. Ensure proper grounding, wire dimensioning and corresponding short-circuit protection.



The device comprises a rapid discharge circuit for the DC bus as per EN60204 section 6.2.4. In certain device constellations, however, mostly in the case of parallel connection of several servo drive controllers in the DC bus or in the case of an unconnected brake resistor, this rapid discharge may be ineffective. The servo drive controllers can carry voltage until up to 5 minutes after being switched off (residual capacitor charge).

2.4.4 Protection against electrical shock by means of protective extra-low voltage (PELV)

All connections and terminals with voltages of up to 50 Volts at the servo drive controller are protective extra-low voltage, which are designed safe from contact in correspondence with the following standards:

- ❖ International: IEC 60364-4-41
- ❖ European countries within the EU: EN 50178/1998, section 5.2.8.1.



DANGER!

High electrical voltages due to wrong connections!

Danger to life, risk of injury due to electrical shock!

Only devices and electrical components and wires with a protective extra low voltage (PELV) may be connected to connectors and terminals with voltages between 0 to 50 Volts.

Only connect voltages and circuits with protection against dangerous voltages. Such protection may be achieved by means of isolation transformers, safe optocouplers or battery operation.

2.4.5 Protection against dangerous movements

Dangerous movements can be caused by faulty control of connected motors, for different reasons:

- ❖ Improper or faulty wiring or cabling
- ❖ Error in handling of components
- ❖ Error in sensor or transducer
- ❖ Defective or non-EMC-compliant components
- ❖ Software error in superordinated control system

These errors can occur directly after switching on the device or after an indeterminate time of operation.

The monitors in the drive components for the most part rule out malfunctions in the connected drives. In view of personal protection, particularly the danger of personal injury and/or property damage, this may not be relied on exclusively. Until the built-in monitors come into effect, faulty drive movements must be taken into account; their magnitude depends on the type of control and on the operating state.

**DANGER!**

Dangerous movements!

Danger to life, risk of injury, serious personal injuries or property damage!

For the reasons mentioned above, personal protection must be ensured by means of monitoring or superordinated measures on the device. These are installed in accordance with the specific data of the system and a danger and error analysis by the manufacturer. The safety regulations applying to the system are also taken into consideration. Random movements or other malfunctions may be caused by switching the safety installations off, by bypassing them or by not activating them.

2.4.6 Protection during handling and assembly

Handling and assembly of certain parts and components in an unsuitable manner may under adverse conditions cause injuries.

**DANGER!**

Risk of injury due to improper handling!

Personal injury due to pinching, shearing, cutting, crushing!

The following general safety notes apply:



Comply with the general setup and safety regulations on handling and assembly.



Use suitable assembly and transportation devices.



Prevent incarcerations and contusions by means of suitable protective measures.



Use suitable tools only. If specified, use special tools.



Use lifting devices and tools appropriately.



If necessary, use suitable protective equipment (e.g. goggles, protective footwear, protective gloves).



Do not stand underneath hanging loads.



Remove leaking liquids on the floor immediately to prevent slipping.

2.4.7 Protection against contact with hot parts

**DANGER!**

Housing surfaces may be hot!

Risk of injury! Risk of burning!



Do not touch housing surfaces in the vicinity of heat sources! Danger of burning!



Before accessing devices let them cool down for 10 minutes after switching them off.



Touching hot parts of the equipment such as the housing, which contain heat sinks and resistors, may cause burns!

3 Technical data

Range	ARS 2102 FS	ARS 2105 FS	ARS 2108 FS
Metronix part number with FBA module	9200-2102-20	9200-2105-20	9200-2108-21
Metronix part number with STO module	9200-2102-22	9200-2105-22	9200-2108-22
Metronix part number with MOV module	9200-2102-23	9200-2105-23	9200-2108-23
Power connector set	9200-0210-20		9200-0218-20
Signal connector set	9200-0200-00		
FBA module	9200-0150-00		
STO module	9200-0151-00		
MOV module	9200-0152-00		
Ambient conditions and qualification:			
Admissible temperature ranges	Storage temperature: -25°C to +70°C		
	Operating temperature: 0°C to +40°C +40°C to +50°C at reduced power 2,5%/K		
Admissible installation height	Mounting height maximum 2000 m above msl, above 1000 m above msl with power reduction 1% per 100 m		
Humidity	Relative humidity up to 90%, no bedewing		
Protection degree	IP20		
Protection class	I		
Pollution degree	2		
CE conformity Low-voltage directive:	2006/95/EC verified by application of the harmonised standard EN 61800-5-1		
EMC directive:	2004/108/EC verified by application of the harmonised standard EN 61800-3		
cULus certification	Listed according to UL 508C, C22.2 No. 274-13		
Dimensions and weight:			
Dimensions: H*W*D	261*54,6*205 mm	261*54,6*205mm	261*54,6*205mm
Weight	c. 2,0 kg	c. 2,1 kg	c. 1,8 kg
Performance data [X9]:			
Supply voltage	1 x 100 .. 230 VAC [± 10%], 50...60 Hz		
Alternative DC supply	60 .. 380 VDC		60 .. 320 VDC

Range		ARS 2102 FS	ARS 2105 FS	ARS 2108 FS
24V supply *) plus current consumption of a possibly connected holding brake and I/Os		24 VDC [$\pm 20\%$] (0,55 A) *)	24 VDC [$\pm 20\%$] (0,65 A) *)	24 VDC [$\pm 20\%$] (0,65 A) *)
Intermediate circuit voltage for a supply voltage of 230 VAC		320 VDC (without PFC) 380 VDC (with PFC active)		320 VDC
Performance data of PFC stage for a nominal supply voltage of 230 VAC [$\pm 10\%$]:				
Continuous power output		500 W	1000 W	no PFC
Peak power output		1000 W	2000 W	no PFC
Internal brake resistor [X9]:				
Brake resistance		60 Ω	60 Ω	37 Ω
Pulse power		2,8 kW	2,8 kW	3,9 kW
Continuous power		10 W	20 W	25 W
Threshold limit	(without PFC)	389 V	389 V	389 V
	(with PFC active)	440 V	440 V	no PFC
Max. voltage	(without PFC)	400 V	400 V	400 V
	(with PFC active)	460 V	460 V	no PFC
External brake resistor [X9]:				
Brake resistance external		$\geq 50 \Omega$	$\geq 50 \Omega$	$\geq 25 \Omega$
Max. operating voltage (at output)		460 V		400 V
Motor connection specifications [X6]:				
Specifications for operation with 1x 230 VAC [$\pm 10\%$], 50 Hz				
Output power		0,5 kVA	1,0 kVA	1,5 kVA
Max. output power for 5 s		1,0 kVA	2,0 kVA	3,0 kVA
Output current		2,5 A _{RMS}	5 A _{RMS}	8 A _{RMS}
Max. output current for 5 s		5 A _{RMS}	10 A _{RMS}	16 A _{RMS}
Max. output current for 0,5 s		10 A _{RMS}	20 A _{RMS}	32 A _{RMS}
Max. mains current for continuous operation		2,4 A _{RMS}	4,7 A _{RMS}	10 A _{RMS} (no PFC)
Max. PWM frequency		20 kHz (software programmable)		
As a guideline: Power loss/efficiency (with regard to the rated output power)		typical 8% / 92%		

Range	ARS 2102 FS	ARS 2105 FS	ARS 2108 FS
Maximum motor cable length for interference emission according to EN 61800-3 for PWM ≤ 10 kHz			
Category C2	1 ≤ 25 m		
Category C3	1 ≤ 25 m		
Cable capacity of a phase against shield or between two lines	C' ≤ 200 pF/m		
Derating of the cable length (see also <i>chapter 7.1 Operation with long motor cables</i> on page 40)			
f _{PWM} = 12 kHz	1 ≤ 21 m		
f _{PWM} = 16 kHz	1 ≤ 15 m		
f _{PWM} = 20 kHz	1 ≤ 12 m		
Motor temperature monitoring:			
Digital sensor	Normally closed contact: R _{cold} < 500 Ω R _{hot} > 100 kΩ		
Analog sensor	Silicon temperature sensor, e.g. KTY81, 82 or similar R ₂₅ ≈ 2000 Ω R ₁₀₀ ≈ 3400 Ω		
Resolver [X2A]:			
Resolution	16 Bit		
Delay time signal detection	< 200 μs		
Speed resolution	ca. 4 min ⁻¹		
Absolute accuracy of angle detection	< 5'		
Max. rotational speed	16.000 min ⁻¹		
Encoder evaluation [X2B]:			
Parameterisable number of encoder lines	1 – 2 ¹⁸ lines/rev		
Angular resolution / Interpolation	10 Bit / period		
Encoder signals A, B	1 V _{PP} differential; 2.5 V offset		
Encoder signal N	0.2 to 1 V _{PP} differential; 2.5 V offset		
Commutation track A1, B1 (optional)	1 V _{PP} differential; 2.5 V offset		
Input impedance encoder signals	Differential input 120 Ω		
Limit frequency	f _{Limit} > 300 kHz (high-res. signal) f _{Limit} ca. 10 kHz (commutation track)		
Additional communication interface	EnDat (Heidenhain) and HIPERFACE (Stegmann)		
Output supply	5 V or 12 V; max. 300 mA; currentlimited control via sensor lines Setpoint programmable via software		
Digital inputs and outputs [X1]:			
Signal level	24V (8V...30V) active high, conforming with DIN EN 61131-2		

Range	ARS 2102 FS	ARS 2105 FS	ARS 2108 FS
Logic inputs general			
DIN0	Bit 0 \ (Least significant Bit)		
DIN1	Bit 1, \ Target selection for positioning		
DIN2	Bit 2, / 16 targets selectable from target table		
DIN3	Bit 3 / (Most significant Bit)		
DIN4	Control input stage enable at High		
DIN5	Controller enable at High, clear error high-low transition at Low		
DIN6	End switch input 0		
DIN7	End switch input 1		
DIN8	Control signal Start positioning		
DIN9	Home switch for homing or saving of positions		
Logic outputs general	Galvanically separated, 24 V (8 ...30 V) active high		
DOUT0	Operational state	24 V, max. 100 mA	
DOUT1	Freely configurable	24 V, max. 100 mA	
DOUT2	Freely configurable, optional use as input DIN10	24 V, max. 100 mA	
DOUT3	Freely configurable, optional use as input DIN11	24 V, max. 100 mA	
DOUT4 [X6]	Holding brake	24 V, max. 1 A	
Analog inputs and outputs [X1]:			
High-resolution analog input: AIN0	±10 V input range, 16 Bit, differentially, < 250 µs delay time		
Analog input: AIN1	Optionally, this input can also be parameterized as digital input DIN AIN1 with a switching threshold at 8 V.	±10 V, 10 Bit, single ended, < 250 µs delay time	
Analog input: AIN2	Optionally, this input can also be parameterized as digital input DIN AIN2 with a switching threshold at 8 V.	±10 V, 10 Bit, single ended, < 250 µs delay time	
Analog outputs: AOUT0 and AOUT1	±10 V output range, 9 bit resolution, $f_{Limit} > 1$ kHz		
Incremental encoder input [X10]:			
Parameterisable number of encoder lines	1 – 2 ²⁸ lines/rev		
Trace signals	As per RS422 specification		
Max. input frequency	1000 kHz		
Pulse-direction interface	As per RS422 specification		
Output supply	5 V, max. 100 mA		

Range	ARS 2102 FS	ARS 2105 FS	ARS 2108 FS
Incremental encoder output [X11]:			
Number of lines	Programmable $1 - 2^{13}$ and 2^{14} lines/revolution		
Connection level	Differential / RS422 specification		
Encoder signals A, B, N	As per RS422 specification		
speciality	N-Trace disconnectible		
Output impedance	$R_{a,diff} = 66 \Omega$		
Limit frequency	$f_{Limit} > 1,8 \text{ MHz (lines/s)}$		
Edge triggering (minimum pulse width)	Can be limited by parameters		
Output supply	5 V, max. 100 mA		
Ethernet [X18]:	RJ45, 10/100 MBaud (auto select)		
USB [X19]:	According to USB 2.0, USB-B, slave-client		
SD card slot:	SD, SDHC and MMC - FAT12, FAT16 and FAT32		

3.1 Supported motor feedback systems

Listing of supported motor feedback systems, valid from april 2009

Type	Notes	Protocol
Heidenhain EnDat encoder:		
ROC 400 ECI 1100/1300 ECN 100/400/1100/1300	Single-turn absolute encoder with or without analog signal.	EnDat 2.1 (01/21) EnDat 2.2 (22)
ROQ 400 EQI 1100/1300 EQN 100/400/1100/1300	Multi-turn absolute encoder with or without analog signal.	EnDat 2.1 (01/21) EnDat 2.2 (22)
LC 100 / 400	Absolute linear encoders .	EnDat 2.1 (01) EnDat 2.2 (22)
Stegmann HIPERFACE® Encoder:		
SCS60/70 SCM60/70	Single- / multi-turn encoder with analog incremental signal. Line count 512 (fix). Number of multi-turn revolutions: +/- 2048 U.	HIPERFACE®
SRS50/60/64 SCKxx SRM50/60/64 SCLxx	Single- / multi-turn encoder with analog incremental signal. Line count 1024 (fix). Number of multi-turn revolutions: +/- 2048 U xx = 25 / 35 / 40 / 45 / 50 / 53	HIPERFACE®
SKS36 SKM36	Single- / multi-turn encoder with analog incremental signal. Line count 128 (fix). Number of multi-turn revolutions: +/- 2048 U	HIPERFACE®
SEK37/52 SEL37/52	Single- / multi-turn encoder with analog incremental signal. Line count 16 (fix). Number of multi-turn revolutions: +/- 2048 U	HIPERFACE®
L230	Absolute length measuring system with analog incremental signal. Resolution: 156,25 µm. Measuring length max. ca. 40 m.	HIPERFACE®
Yaskawa Σ-Encoder:		
Σ (sigma 1)	Digital incremental encoder with zero-pulse	Yaskawa-OEM-protocol
Analog incremental encoder:		
ROD 400 ERO 1200/1300/1400 ERN 100/400/1100/1300	Heidenhain, encoder with zero- and reference pulse	
Digital incremental encoder:		
CDD50	Stegmann, encoder with hall sensors	
Resolver:		
Standard	transmission ratio typ. 0,5 +- 10 %, Input supply typ. 7 Vrms	

4 Mechanical installation

4.1 Important notes

- ❖ Only use the servo positioning controller ARS 2100 FS as a built-in device for switch cabinets
- ❖ Mounting position vertical with supply lines [X9] on top
- ❖ Mount to control cabinet plate using a fastening strap
- ❖ Installation spaces: Keep a minimum distance of 100 mm to other components each above and underneath the device to ensure sufficient venting.
- ❖ The servo positioning controller ARS 2100 FS may be installed adjacently in one switch cabinet without a gap, proper usage and installation on a heat-dissipating rear panel provided. Please note that excessive heat may cause premature aging and/or damaging of the device. In case the servo positioning controller ARS 2100 FS are subject to high thermal stress, a space of 59 mm is recommended!



The connections of the following illustrations for the servo positioning controller ARS 2102 FS also apply to the servo positioning controller ARS 2105 FS and ARS 2108 FS!

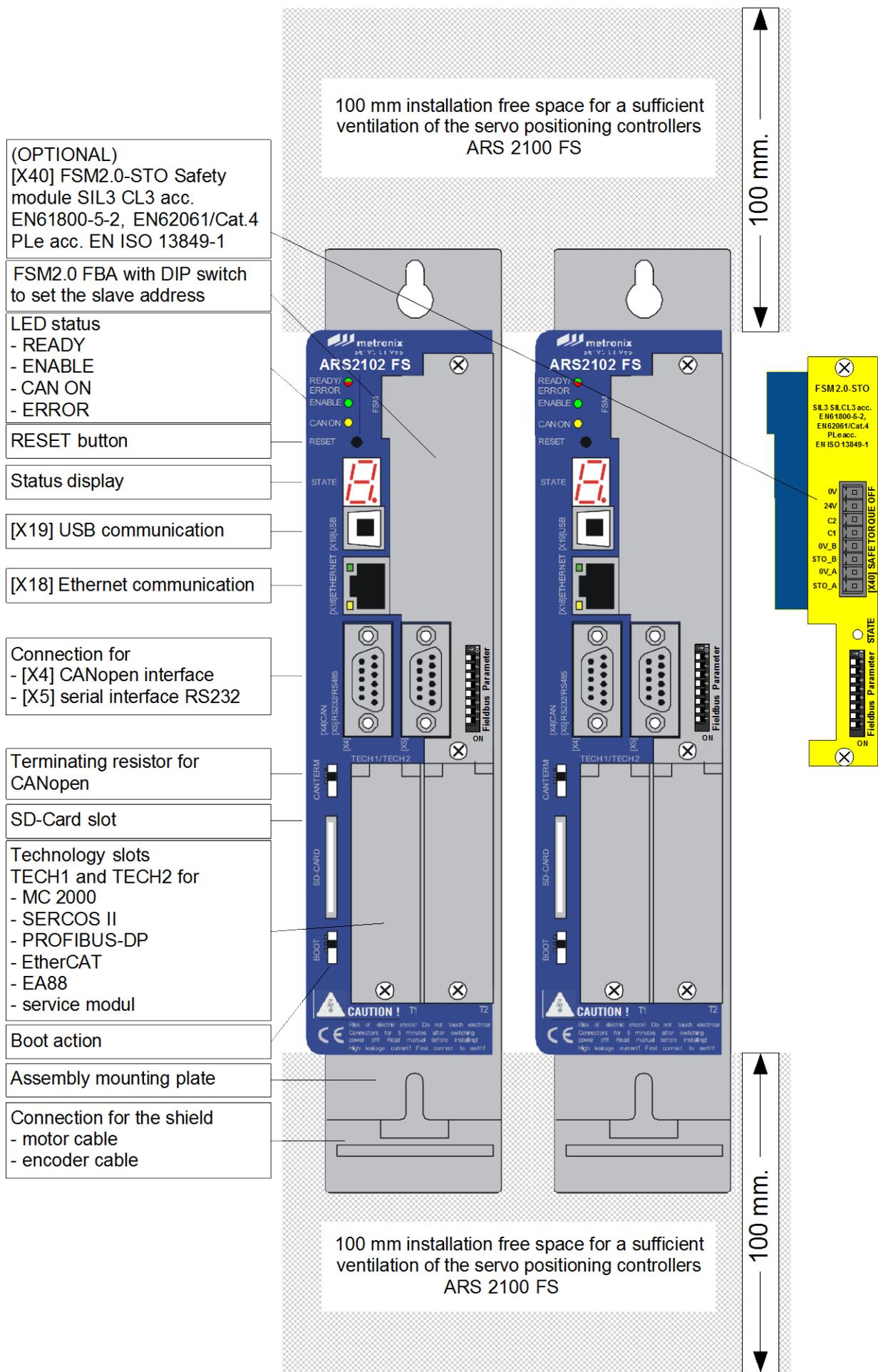


Figure 1: Servo positioning controller ARS 2100 FS: Front view and Installation space

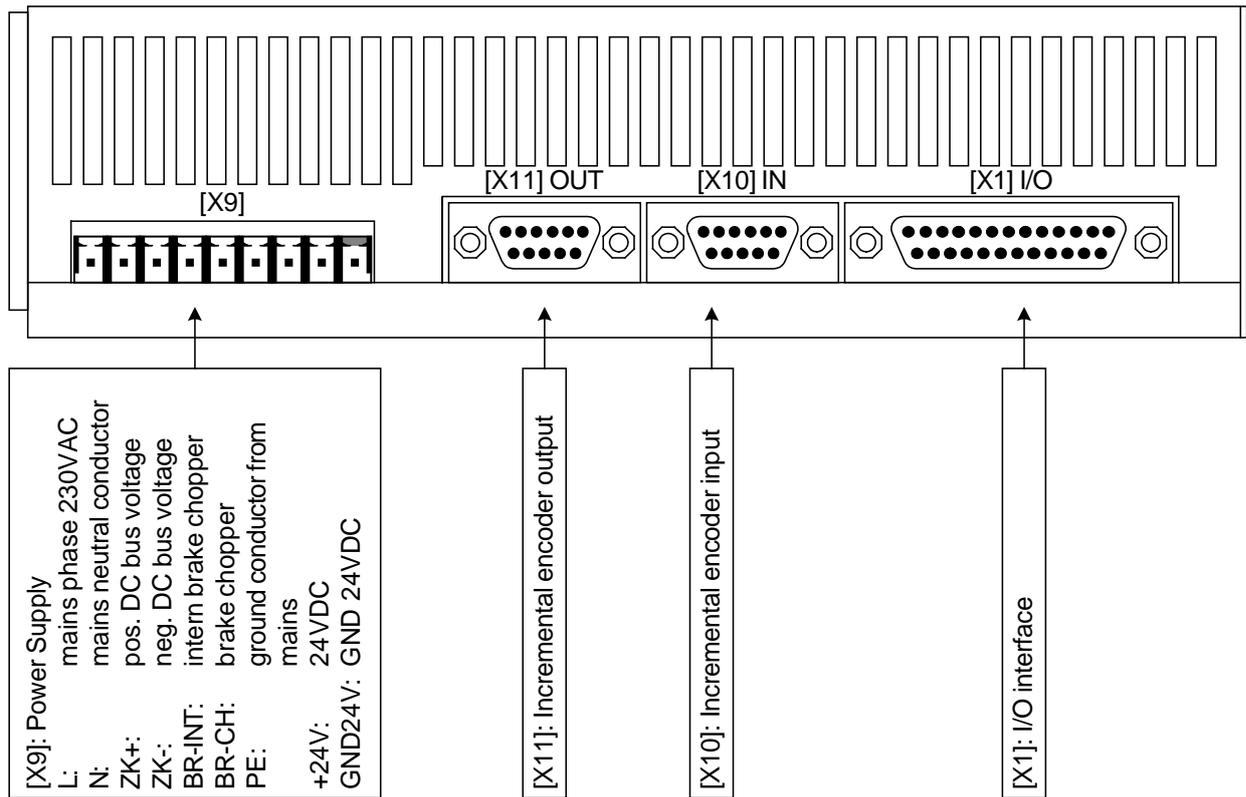


Figure 2: Servo positioning controller ARS 2102 FS: Top view

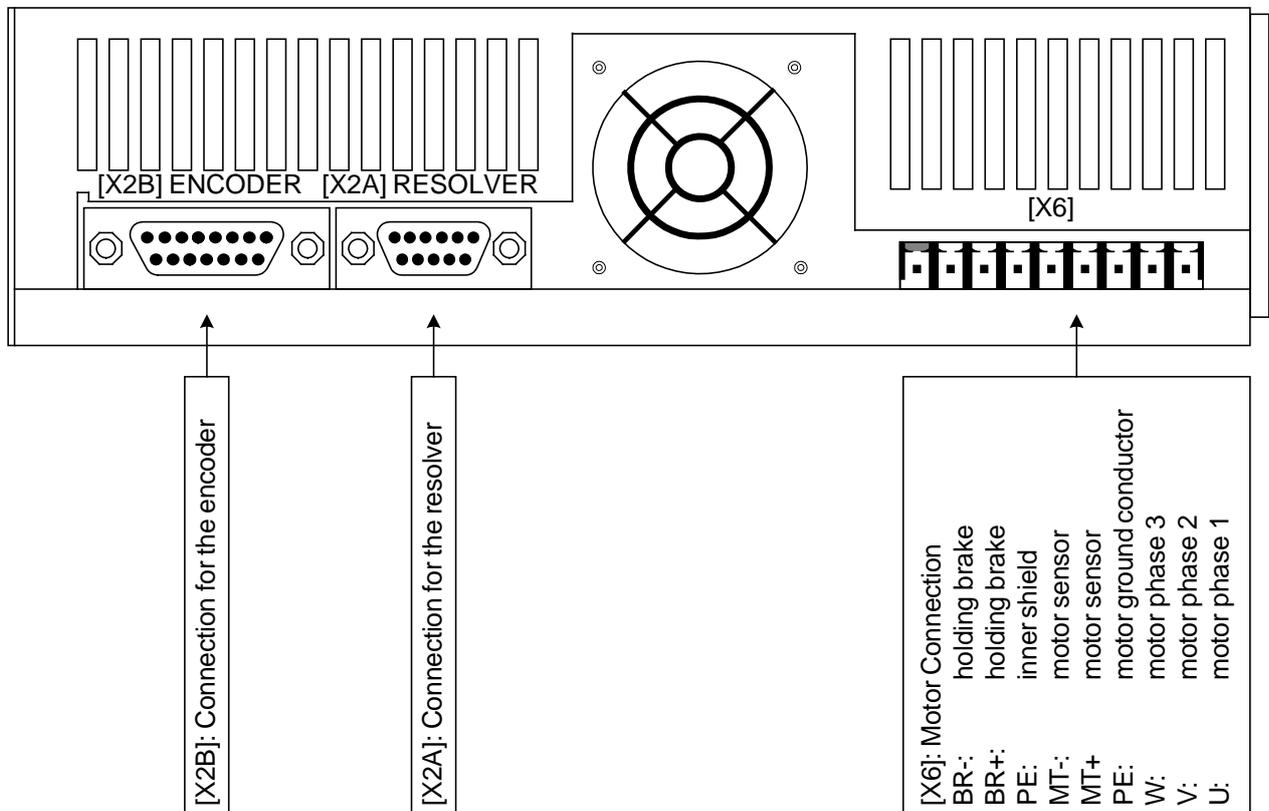


Figure 3: Servo positioning controller ARS 2102 FS: Bottom view

4.2 Mounting

The servo positioning controller ARS 2100 FS has attachment lugs on the top and the bottom of the device. These are used to mount the servo positioning controller vertically to a control cabinet plate. The lugs are part of the cooling body profile, thereby providing optimum heat transmission to the control cabinet plate.

Please use M5 screws for the mounting of the servo positioning controller ARS 2102 FS, ARS 2105 FS and ARS 2108 FS.

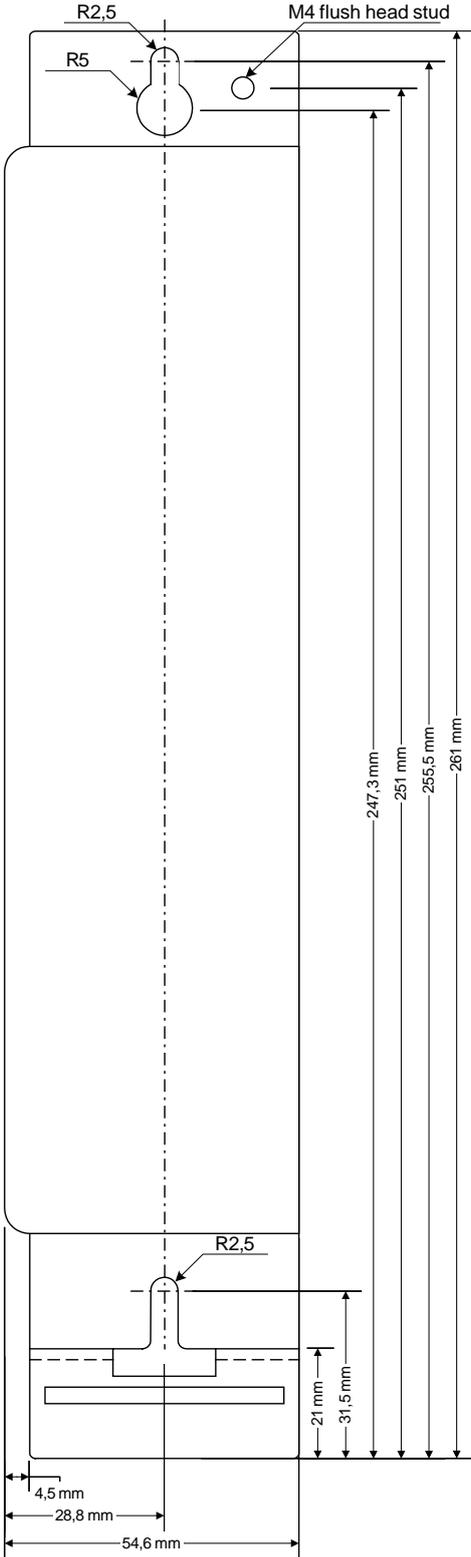


Figure 4: Servo positioning controller ARS 2100 FS: Mounting plate

5 Electrical installation



Caution!

DC bus coupling is not allowed while the PFC stage is active. This can otherwise result in damages to the servo positioning controller.



Caution!

When the DC buses are connected, the power supplies must be connected to the same mains phase.

This means, if two ARS 2105 FS are coupled in the DC bus, only the connection L1/N is possible for both devices. It is not allowed to connect the DC Busses if the devices are connected to different mains phases.

It is forbidden to supply device 1 via L1/N and device 2 via L2/N, when the DC buses are coupled.



Caution!

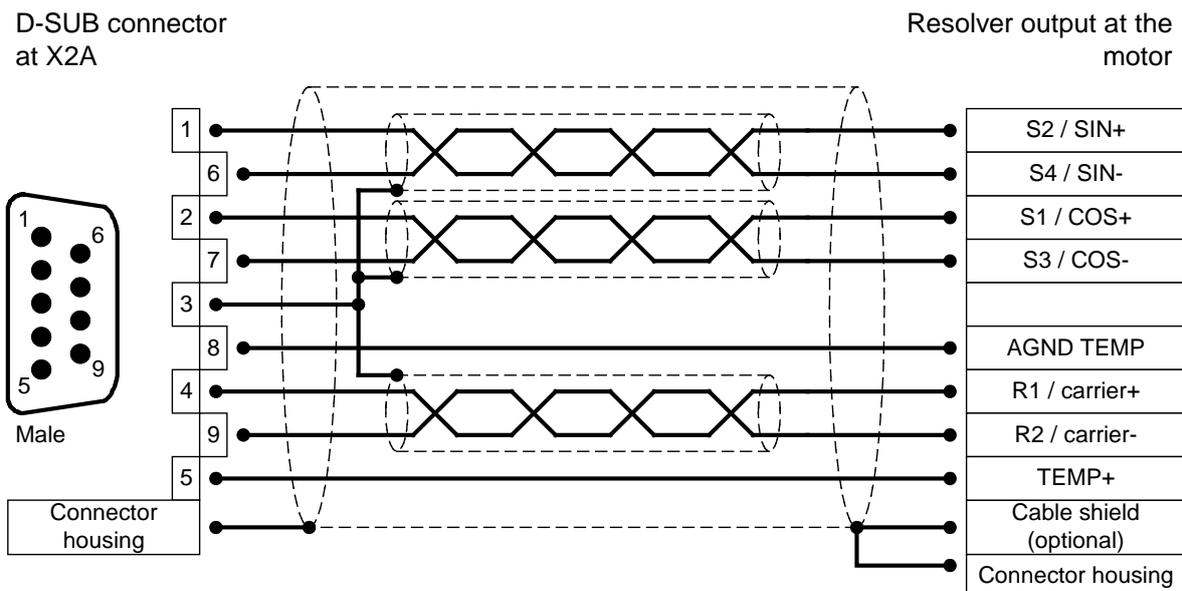
Operation with DC bus coupling together with devices of the ARS 2300 FS series is not allowed.

5.1 Pin configuration I/O [X1]

Pin No.	Denomination	Value	Specification
1	AGND	0V	Shield for analog signals, AGND
	14	AGND	Reference potential for analog signals
2	AIN0	$U_{on} = \pm 10V$ $R_I \geq 30k\Omega$	Setpoint input 0, differential, max. 30V input voltage
	15	#AIN0	
3	AIN1	$U_{on} = \pm 10V$ $R_I \geq 30k\Omega$	Setpoint inputs 1 and 2, single ended, max. 30V input voltage
	16	AIN2	
4	+VREF	+10V	Reference output for setpoint potentiometer
	17	AMON0	Analog monitor output 0
5	AMON1	$\pm 10V$	Analog monitor output 1
	18	+24V	Auxiliary voltage for IOs at X1
6	GND24	corresponding GND	Reference potential for digital I/Os
	19	DIN0	POS Bit0
			Target selection positioning Bit0 (LSB)
7	DIN1	POS Bit1	Target selection positioning Bit1
	20	DIN2	POS Bit2
			Target selection positioning Bit2
8	DIN3	POS Bit3	Target selection positioning Bit3 (MSB)
	21	DIN4	FG_E
			Power stage enable
9	DIN5	FG_R	Controller enable
	22	DIN6	END0
			Input end switch 0 (locks $n > 0$)
10	DIN7	END1	Input end switch 1 (locks $n < 0$)
	23	DIN8	START
			Input for positioning start
11	DIN9	SAMP	High-speed input
	24	DOUT0 / READY	24V / 100mA
			Output operational
12	DOUT1	24V / 100mA	Output freely programmable
	25	DOUT2	24V / 100mA
			Output freely programmable
13	DOUT3	24V / 100mA	Output freely programmable

5.2 Pin configuration Resolver [X2A]

Pin No.	Denomination	Value	Specification
1	S2	$3,5V_{RMS} / 5-10kHz$	SINE trace signal, differential
6	S4	$R_i > 5k\Omega$	
2	S1	$3,5V_{RMS} / 5-10kHz$	COSINE trace signal, differential
7	S3	$R_i > 5k\Omega$	
3	AGND	0V	Shield for signal pairs (inner shield)
8	MT-	GND	Reference potential temperature sensor
4	R1	$7V_{RMS} / 5-10kHz$ $I_A \leq 150mA_{RMS}$	Carrier signal for resolver
9	R2	GND	
5	MT+	$+3,3V / R_i=2k\Omega$	Motor temperature sensor, normally closed contact, PTC, NTC, KTY



- ❖ The outer shield is always connected to PE (connector housing) on the controller side.
- ❖ The three inner shields are connected on one side of the servo positioning controller ARS 2100 FS to PIN 3 of [X2A].

5.3 Pin configuration Encoder [X2B]

At the 15-pole D-Sub connection [X2B], motors with encoder can be feedback. The possible incremental encoders for the encoder connection are divided into several groups.

- ❖ Standard incremental encoders with and without commutation signals
- ❖ Stegmann encoders with HIPERFACE®: single- and multi-turn encoders with analog incremental signals
- ❖ Encoders with EnDat interface
- ❖ Serial encoders with and without analog signal

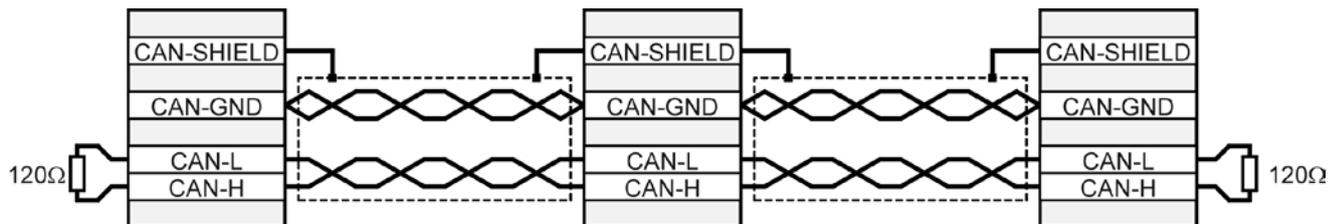
Pin No	Incremental encoder with serial communication interface (e.g. EnDat, HIPERFACE)		Analog incremental encoder		Digital incremental encoder	
	MT+	U_SENS+ U_SENS-	US	GND	MT+	U_SENS+ U_SENS-
1	Motor temperature sensor, normally closed contact, PTC, NTC, KTY	Motor temperature sensor, normally closed contact, PTC, NTC, KTY	Motor temperature sensor, normally closed contact, PTC, NTC, KTY	Motor temperature sensor, normally closed contact, PTC, NTC, KTY	Motor temperature sensor, normally closed contact, PTC, NTC, KTY	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
2	Sensor cables for encoder supply	Sensor cables for encoder supply	Sensor cables for encoder supply	Sensor cables for encoder supply	Sensor cables for encoder supply	Sensor cables for encoder supply
3	Supply voltages for high-resolution incremental encoder	Supply voltages for high-resolution incremental encoder	Supply voltages for high-resolution incremental encoder	Supply voltages for high-resolution incremental encoder	Supply voltages for high-resolution incremental encoder	Supply voltages for high-resolution incremental encoder
4	Reference potential encoder supply and motor temperature sensor	Reference potential encoder supply and motor temperature sensor	Reference potential encoder supply and motor temperature sensor	Reference potential encoder supply and motor temperature sensor	Reference potential encoder supply and motor temperature sensor	Reference potential encoder supply and motor temperature sensor
5		Reset pulse trace signal (differential) from high-resolution incremental encoder	Reset pulse trace signal (differential) from high-resolution incremental encoder	Reset pulse trace signal (differential) from high-resolution incremental encoder	Reset pulse trace signal (differential) from high-resolution incremental encoder	Reset pulse trace signal (differential) from high-resolution incremental encoder
6		COSINE commutation signal (differential) from high-resolution incremental encoder	COSINE commutation signal (differential) from high-resolution incremental encoder	COSINE commutation signal (differential) from high-resolution incremental encoder	COSINE commutation signal (differential) from high-resolution incremental encoder	COSINE commutation signal (differential) from high-resolution incremental encoder
7		SINE commutation signal (differential) from high-resolution incremental encoder	SINE commutation signal (differential) from high-resolution incremental encoder	SINE commutation signal (differential) from high-resolution incremental encoder	SINE commutation signal (differential) from high-resolution incremental encoder	SINE commutation signal (differential) from high-resolution incremental encoder
8		COSINE trace signal (differential) from high-resolution incremental encoder	COSINE trace signal (differential) from high-resolution incremental encoder	COSINE trace signal (differential) from high-resolution incremental encoder	COSINE trace signal (differential) from high-resolution incremental encoder	COSINE trace signal (differential) from high-resolution incremental encoder
9		SINE trace signal (differential) from high-resolution incremental encoder	SINE trace signal (differential) from high-resolution incremental encoder	SINE trace signal (differential) from high-resolution incremental encoder	SINE trace signal (differential) from high-resolution incremental encoder	SINE trace signal (differential) from high-resolution incremental encoder
10		A trace signal RS422 (differential) from digital incremental encoder	A trace signal RS422 (differential) from digital incremental encoder	A trace signal RS422 (differential) from digital incremental encoder	A trace signal RS422 (differential) from digital incremental encoder	A trace signal RS422 (differential) from digital incremental encoder
11		B trace signal RS422 (differential) from digital incremental encoder	B trace signal RS422 (differential) from digital incremental encoder	B trace signal RS422 (differential) from digital incremental encoder	B trace signal RS422 (differential) from digital incremental encoder	B trace signal RS422 (differential) from digital incremental encoder

*) Heidenhain encoder: A = SIN_Z0; B = COS_Z0; C = SIN_Z1; D = COS_Z1

5.4 Pin configuration CAN [X4]

Pin No.	Denomination	Value	Specification
1	-	-	Not occupied
6	GND	0V	CAN-GND, galvanically connected to GND in controller
2	CANL	*)	CAN-Low signal line
7	CANH	*)	CAN-High signal line
3	GND	0V	See Pin no. 6
8	-	-	Not occupied
4	-	-	Not occupied
9	-	-	Not occupied
5	Cable shield	PE	Connection for cable shield

*) External terminating resistor 120Ω required on both ends of the bus

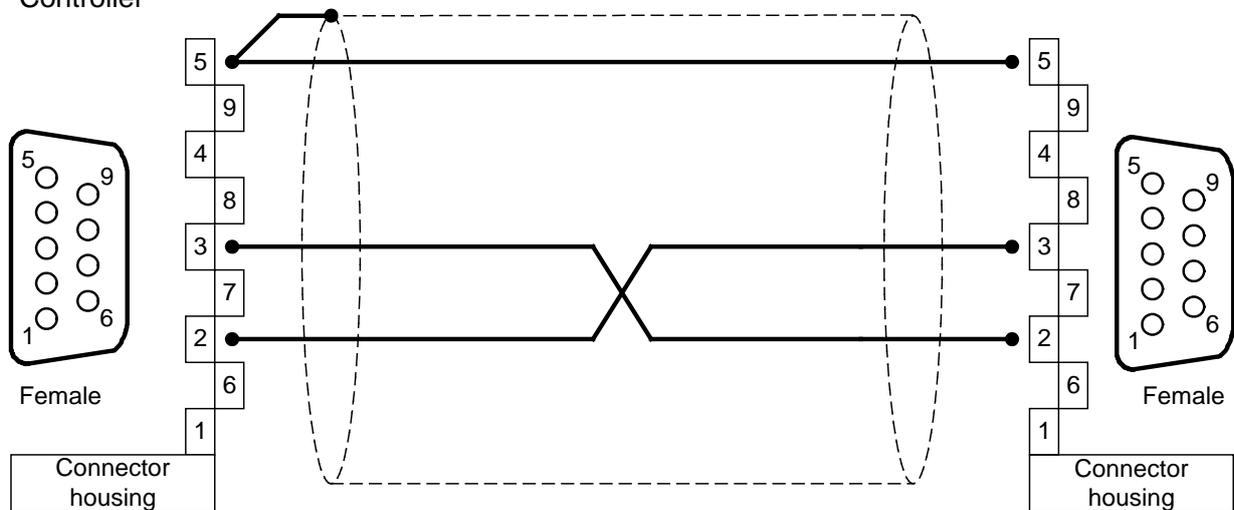


5.5 Pin configuration RS232 [X5]

Pin No.	Denomination	Value	Specification
1	-	-	Not occupied
6	-	-	Not occupied
2	RxD	10 V / $R_I > 2k\Omega$	Receive line, RS232 specification
7	-	-	Not occupied
3	TxD	10 V / $R_A < 2k\Omega$	Transmitting line, RS232 specification
8	-	-	Not occupied
4	+RS485	-	Reserve for option RS485 Interface
9	-RS485	-	Reserve for option RS485 Interface
5	GND	0V	Interfaces GND, galvanically connected to DGND

Servo
Positioning
Controller

PC



5.6 Wiring diagram Motor [X6] and Power Supply [X9]

ARS 2100 FS

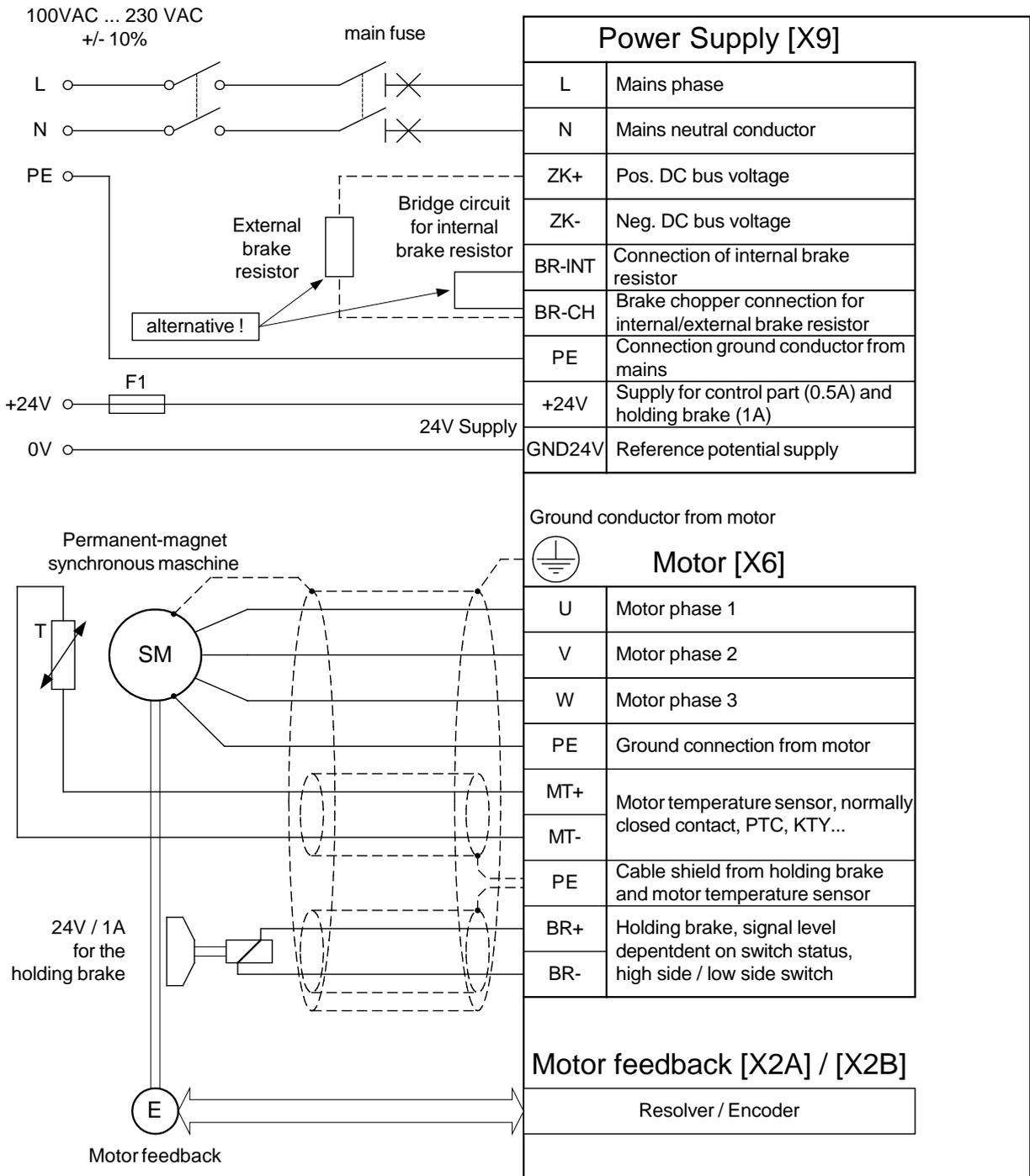
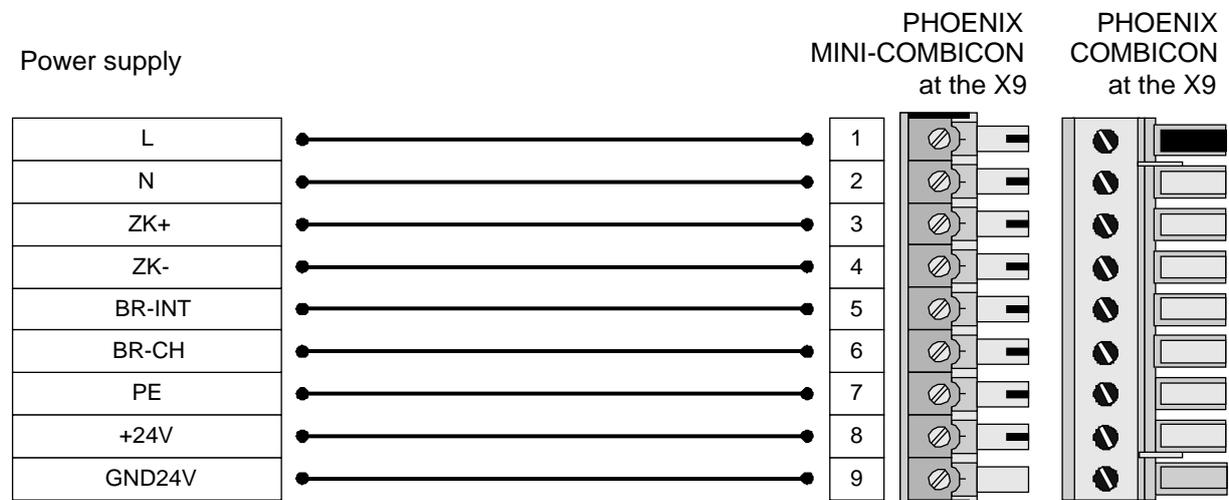


Figure 5: Connection to power supply [X9] and motor [X6]

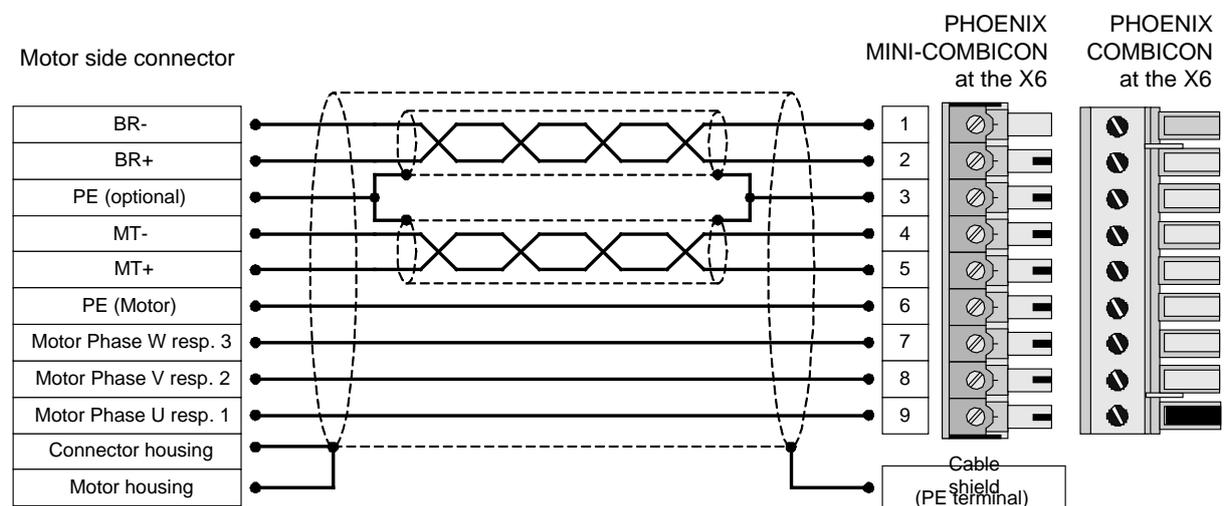
The servo positioning controller ARS 2100 FS is connected to the supply voltage, the motor, the brake resistor and the holding brakes as shown in Figure 5. The operation of the servo positioning controller ARS 2100 FS requires a 24V supply source for the electronics, which is connected to the terminals +24V and GND24V. The connection to the supply for the power output stage is either made to terminals L1 and N for AC supply or to ZK+ and ZK- for DC supply.



	ARS 2102 FS and ARS 2105 FS:	PHOENIX MINI-COMBICON MC 1,5/ 9-ST-5,08
	ARS 2108 FS:	PHOENIX COMBICON MSTB 2,5/9-ST-5,08

The motor is connected to the terminals U, V, W via motor cable to [X6].

The motor temperature switch (PTC or normally closed contact) and motor analog temperature sensor (e.g. KTY81) is connected to the terminals MT+ and MT- via motor cable to [X6] or is connected via the encoder cable to [X2A] or [X2B].



	ARS 2102 FS and ARS 2105 FS:	PHOENIX MINI-COMBICON MC 1,5/ 9-ST-5,08
	ARS 2108 FS:	PHOENIX COMBICON MSTB 2,5/9-ST-5,08

- ❖ Connect the inner shields to PIN 3; maximum length 40 mm.
- ❖ Length of unshielded cores maximum 35 mm.
- ❖ Connect total shield on controller side flat to PE terminal; maximum length 40 mm. Use shield clamp (SK14) or connect to PE screw terminal
- ❖ Connect total shield on motor side flat to connector or motor housing; maximum length 40 mm.



The cable shield of the motor cable must also be connected to the controller housing (PE screw terminal).

The connection of the shaft encoder via the D-Sub connector to [X2A] / [X2B] is roughly shown in Figure 5.

The servo positioning controller ARS 2100 FS must be connected to ground with its PE connection.

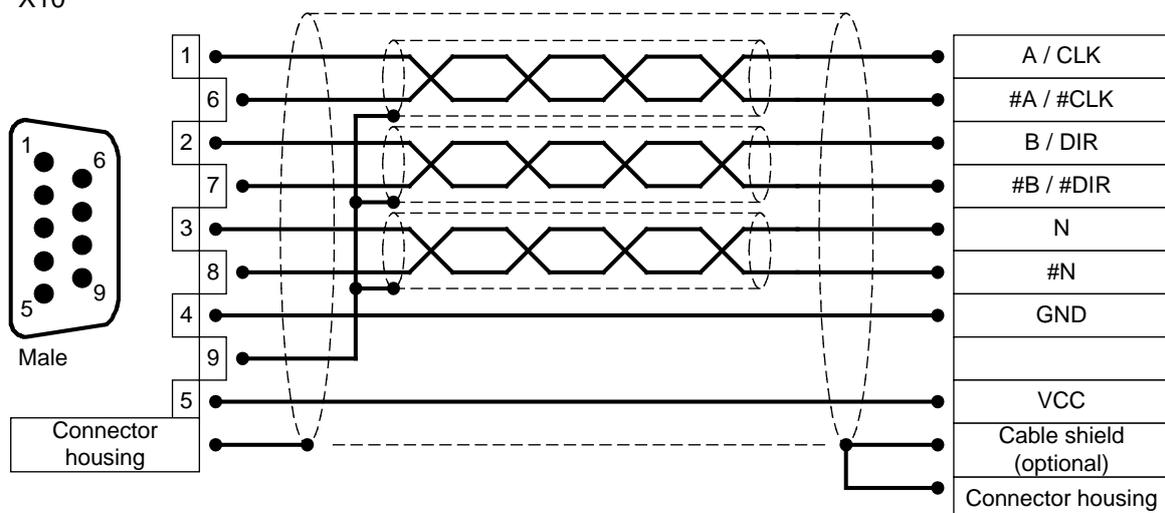
The ARS 2100 FS must be completely wired first. Only then may the operating voltages for the DC bus and the electronics supply be switched on. In the case of inversed wiring of the operating voltage connections, excessive operating voltage or in the case of confusing the connections for operating voltage and motor the servo positioning controller will be damaged.

5.7 Pin configuration Incremental Encoder Input [X10]

Pin No.	Denomination	Value	Specification
1	A / CLK	5V / $R_1 \approx 120\Omega$	Incremental encoder signal A / Stepper motor signal CLK pos. polarity as per RS422
6	#A / #CLK	5V / $R_1 \approx 120\Omega$	Incremental encoder signal A / Stepper motor signal CLK neg. polarity as per RS422
2	B / DIR	5V / $R_1 \approx 120\Omega$	Incremental encoder signal B / Stepper motor signal DIR pos. polarity as per RS422
7	#B / #DIR	5V / $R_1 \approx 120\Omega$	Incremental encoder signal B / Stepper motor signal DIR neg. polarity as per RS422
3	N	5V / $R_1 \approx 120\Omega$	Incremental encoder index pulse N pos. polarity as per RS422
8	#N	5V / $R_1 \approx 120\Omega$	Incremental encoder index pulse N neg. polarity as per RS422
4	GND	-	Supply GND for encoder
9	GND	-	Shield for the connection cable
5	VCC	+5V \pm 5% 100mA	Auxiliary supply, load with 100mA maximum, short circuit-proof

D-SUB
connector at
X10

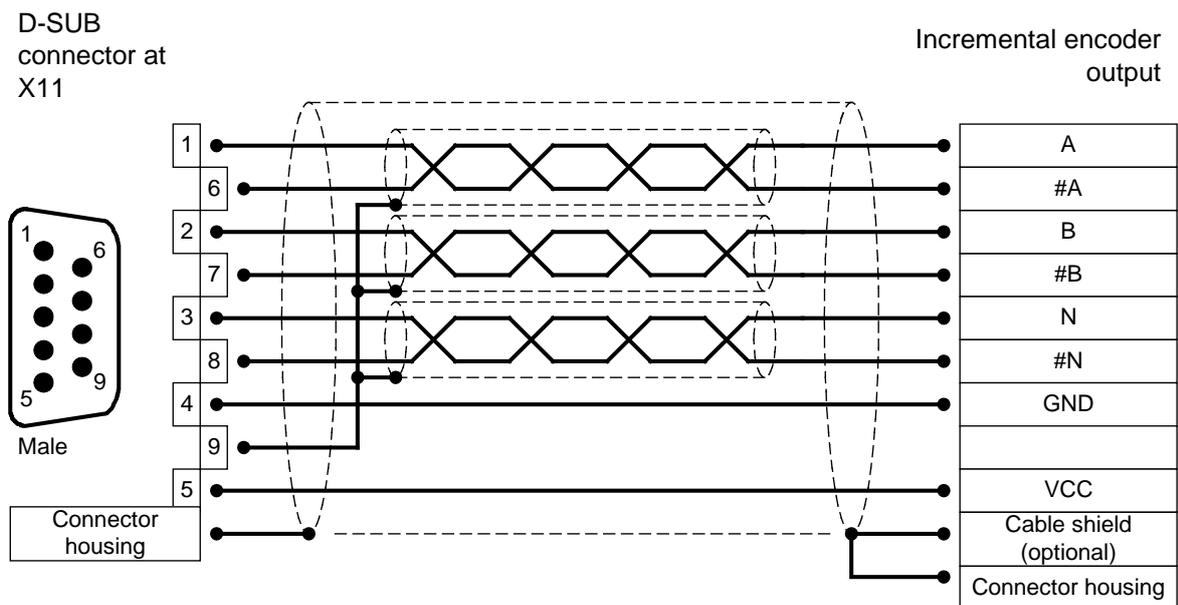
Incremental encoder input



5.8 Pin configuration Incremental Encoder Output [X11]

Pin No.	Denomination	Value	Specification
1	A	5V / $R_A \approx 66\Omega$ *)	Incremental encoder signal A
6	#A	5V / $R_A \approx 66\Omega$ *)	Incremental encoder signal #A
2	B	5V / $R_A \approx 66\Omega$ *)	Incremental encoder signal B
7	#B	5V / $R_A \approx 66\Omega$ *)	Incremental encoder signal #B
3	N	5V / $R_A \approx 66\Omega$ *)	Incremental encoder index pulse N
8	#N	5V / $R_A \approx 66\Omega$ *)	Incremental encoder index pulse #N
4	GND	-	Reference GND for encoder
9	GND	-	Shield for connection cable
5	VCC	+5V \pm 5% 100mA	Auxiliary supply, to be loaded with maximal 100mA, short-circuit-proof

*) The value for R_A is the differential output resistance



5.9 Ethernet communication (UDP interface) [X18]

The UDP communication enables the connection of the ARS 2100 FS servo positioning controller to the Ethernet fieldbus system. The communication via the UDP interface [X18] is realised with the aid of a standard cabling.

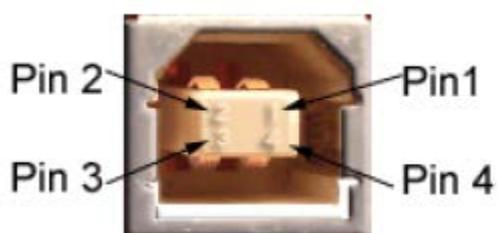
UDP interface [X18]	Values
Function	Ethernet, 10/100 MBaud (auto select)
Connector type	RJ45

5.10 USB communication [X19]

The ARS 2100 FS servo positioning controller comprises a USB (universal serial bus) communication interface, which is for connection via PC and for using the parameterisation tool Metronix ServoCommander®.

The USB communication interface requires no auxiliary power supply.

USB interface [X19]			
Connector type	USB-B		
Standard	2.0		
Transmission rate	Support for both full-speed (12 Mbps) and high-speed (480 Mbps) modes		
Communication protocol	Metronix specific (generic device)		
Functionality	Slave-Client		
Pin configuration			
	1	VCC	+5 VDC
	2	D-	Data -
	3	D+	Data +
	4	GND	Ground



5.11 SD/SDHC/MMC card slot

The ARS 2100 FS servo drive comprises a SD/SDHC/MMC card slot for the support of Firmware downloads (initialisation via boot switches) and uploads and downloads of parameter sets.

SD card slot	
Card types	SD, SDHC and MMC
File systems	FAT12, FAT16 and FAT32
Functions	Load a parameter set (DCO file), save the current parameter set (DCO file), load a firmware file
File names	Only file and directory names according to the 8.3 standard are supported.

5.11.1 BOOT-DIP-Switch

During a restart/reset, the BOOT-DIP-Switch is used to determine whether to perform a firmware download from the SD/MMC card or not. The position of the switch is shown in Figure 1.

- ❖ BOOT-DIP-Switch in position "ON" → firmware download requested
- ❖ BOOT-DIP-Switch in position "OFF" → firmware download not requested

When there is no SD/MMC card in the card slot of the servo drive and the BOOT-DIP-Switch is in the position "ON" (firmware download requested), the error 29-0 is triggered after a restart/reset.

This error stops all further performances. This means that there is no communication possible via USB.

6 Functional Safety (optional)

6.1 Overview module types and integrated Functional Safety

Module type	Integrated Functional Safety	
FSM 2.0 - FBA	none	<p>FBA = Fieldbus activation</p> <p>This module is equipped with DIP switches for activation and controlling the fieldbus communication.</p> <p>The functionality of the DIP switches is identical to the functionality of the DIP switches of the modules FSM 2.0 – STO and FSM 2.0 - MOV.</p>
FSM 2.0 – STO	STO	<p>“Safe Torque Off” (STO) with SIL3 in accordance with EN 61800-5-2 / EN 62061 / IEC 61508 or category 4 / PL e in accordance with EN ISO 13849-1.</p>
FSM 2.0 – MOV	STO, SS1, SS2, SOS, SLS, SSR, SSM, SBC	<p>Safety functions in accordance with EN 61800-5-2, SIL3 in accordance with EN 61800-5-2, EN 61508 and EN 62061 , PL e in accordance with EN ISO 13849-1¹⁾</p>
<p>¹⁾ Maximum achievable classification, limitations dependent on the safety function as well as circuitry and the encoders.</p>		

6.2 FSM 2.0 – FBA

6.2.1 Fieldbus specific functional assignment of the DIP switches

DIP switch	Functionally of the DIP switch (fieldbus specific with technology module)			
	CAN (in the basic device)	PROFIBUS	Sercos (without DIP switch)	EtherCAT
	8	Communication: 1: On 0: Off	Communication: 1: On 0: Off	Communication: 1: On 0: Off ¹⁾
	7	Baudrate: 11: 1 MBaud 10: 500 kBaud	Slave address respectively address offset ²⁾ : 0 .. 127 valid range: 3 .. 125	Baudrate: 11: 16 MBaud 10: 8 MBaud 01: 4 MBaud 00: 2 MBaud
	6	01: 250 KBaud 00: 125 kBaud		
	5	Node address respectively address offset ²⁾ :	Drive address respectively address offset ²⁾ :	No function ¹⁾
	4			
	3			
	2			
1				

¹⁾ If all DIP switches == 0: automatic start-up of EtherCAT is activated → EtherCAT is switched on.
If at least one of the DIP switches 1 to 7 <> 0 and DIP switch 8 == 0: no automatic start-up of EtherCAT
→ EtherCAT is switched off.

²⁾ If necessary, the addresses will be added as an offset of a predefined base address of the corresponding bus system.
The base address can be predefined in the Metronix ServoCommander[®] and can then be saved in the parameter set of the ARS 2000 FS.



Please note that the module FSM 2.0 – FBA does **not** offer any safety functionalities.

6.3 FSM 2.0 – STO

6.3.1 Features

The Functional Safety Module FSM 2.0 – STO serves as an expansion of the servo positioning controller ARS 2000 FS.

- ❖ It reaches the function “Safe Torque Off” (STO) with SIL3 according to EN 61800-5-2 / EN 62061 / IEC 61508 or category 4 / PL e according to EN ISO 13849-1.
- ❖ It is equipped with a floating feedback contact.
- ❖ It can be simply plugged into the basic unit from the outside, so that it can be used for upgrading systems that are already equipped with ARS 2100 FS servo positioning controllers.
- ❖ It is exclusively suitable for the ARS 2000 FS product range.
- ❖ It offers a user-friendly parameterisation with the Metronix ServoCommander® software.



DANGER!

The function STO as a sole safety function is not sufficient for drives under permanent torque, such as hanging loads.



DANGER!

For drives, the function STO must be validated after installation and after any changes of the installation.

This validation must be documented by the commissioning engineer.

6.3.2 Pin assignment [X40]

Pin no.	Name	Value	Specification
8	0V	0 V	Reference potential for internal controller supply
7	24V	+24 V DC	24 V supply out
6	C2		Feedback contact for the state “STO” to an external control
5	C1		
4	0V_B	0 V	Reference potential for STOB
3	STOB	0 V / 24 V	Control input B for the function STO
2	0V_A	0 V	Reference potential for STOA
1	STOA	0 V / 24 V	Control input A for the function STO



The functionality of the DIP switches is identical to the functionality of the DIP switches of the module FSM 2.0 – FBA.

6.4 FSM 2.0 – MOV

6.4.1 Features

The Functional Safety Module FSM 2.0 – MOV serves as an expansion of the servo positioning controller ARS 2000 FS to implement the safety functions:

- ❖ STO – Safe Torque Off
- ❖ SS1 – Safe Stop 1
- ❖ SS2 – Safe Stop 2
- ❖ SOS – Safe Operating Stop
- ❖ SLS – Safely-Limited Speed
- ❖ SSR – Safe Speed Range
- ❖ SSM – Safe Speed Monitor
- ❖ SBC – Safe Brake Control
- ❖ When suitable position transmitters are used and with suitable activation of the safety module, the requirements are fulfilled in accordance with EN 61800-5-2 up to and including SIL3 and in accordance with EN ISO 13849-1 up to and including Category 4 / PL e.
Depending on the encoders used for position recording, it is possible that only SIL2 is implemented
- ❖ It is equipped with a floating feedback contact.
- ❖ It can be simply plugged into the basic unit from the outside, so that it can be used for upgrading systems that are already equipped with ARS 2100 FS servo positioning controllers.
- ❖ It is exclusively suitable for the ARS 2000 FS product range.
- ❖ It offers a user-friendly parameterisation with the Metronix ServoCommander® software including the SafetyTool.

**DANGER!**

The function STO as a sole safety function is not sufficient for drives under permanent torque, such as hanging loads.

**DANGER!**

For drives, the safety functions must be validated after installation and after any changes to the installation.

This validation must be documented by the commissioning engineer.

6.4.2 Pin assignment [X40]

Pin	Designation	Description (factory setting ¹⁾)
X40A plug connector		
1	DIN40A	Digital input 40, two-channel (Factory setting: Emergency stop switching device, STO and SBC request)
2	DIN40B	
3	DIN42A	Digital input 42, two-channel
4	DIN42B	
5	DOUT40A	Digital output 40, two-channel
6	DOUT40B	
7	DIN44	Digital input 44 (Factory setting: Brake feedback)
8	DIN45	Digital inputs 45, 46, 47 (Factory setting: Mode selector switch)
9	DIN46	
10	DIN47	
11	DIN48	Digital input 48 (Factory setting: Error acknowledgement).
12	DIN49	Digital input 49 (Factory setting: Terminate safety function on rising edge).
X40B plug connector		
13	DIN41A	Digital input 41, two-channel
14	DIN41B	
15	DIN43A	Digital input 43, two-channel
16	DIN43B	
17	DOUT41A	Digital output 41, two-channel
18	DOUT41B	
19	DOUT42A	Digital output 42, two-channel
20	DOUT42B	
21	C1	Signal contact, relay contacts (Factory setting: Safe state reached, no safety condition violated). – Opened: “Safety function not active” – Closed: “Safety function active”
22	C2	
23	GND24	0 V, reference potential for DINx / DOUTx / +24 V
24	+24 V	24 V output, auxiliary supply, e.g. for safety peripherals (24 V DC logic supply of the motor controller).
¹⁾ Function when the device is delivered or after resetting to factory settings (advanced parameterisation)		



The functionality of the DIP switches is identical to the functionality of the DIP switches of the module FSM 2.0 – FBA.

6.5 Mechanical installation FSM 2.0

As a standard, the ARS 2100 FS series servo positioning controllers come supplied with the module FSM 2.0 – FBA (short “FBA module”) integrated in the FSM slot.

You can remove the FBA module and replace it with a Functional Safety Module FSM 2.0 – STO or FSM 2.0 – MOV (short “safety module”).



DANGER!

The servo positioning controller must be disconnected from any current-carrying connections prior to the installation of the module.

To remove the FBA module from the servo positioning controller and then insert the safety module module, please proceed as follows:

1. Remove the two fastening screws of the FBA module with a suitable Phillips screwdriver.
2. Loosen the FBA module a few millimetres by levering it slightly at the recesses of the upper and lower edges of the front plate.
3. Remove the FBA module completely from the FSM slot.
4. Push the safety module module into the open FSM slot so that the lateral guides hold the board.
5. Push the safety module module into the slot and carefully into the connector at the backside of the servo positioning controller until it reaches the stop.
6. Screw the safety module module onto the front side of the housing of the servo positioning controller with the two fastening screws.
7. Ensure that the front plate of the safety module module has conducting contact with the housing of the servo positioning controller.

7 EMC-compliant cabling

The following must be considered for an EMC-compliant setup of the drive system:

- ❖ In the first environment, the servo positioning controller ARS 2100 FS must be installed in a steel switch cabinet. In most cases a standard model will sufficiently attenuate emitted interference. The cable shields must be connected with the switch cabinet housing by means of metal cable glands.
- ❖ In the second environment the servo positioning controller ARS 2100 FS can also be used without a steel control cabinet. Installation in a control cabinet (possibly plastic), however, is still necessary to guarantee proper usage.
- ❖ The control cabinet bed plate must be conducting (zinc-coated design). The imperative central grounding point should also be located on the control cabinet bed plate.
- ❖ The signal lines must be as far away from the power cables as possible. They should not be placed parallel. If intersections cannot be avoided, they should be perpendicular (i.e. at a 90° angle), if possible.
- ❖ In order to keep the leakage currents and the losses in the motor connection cable as small as possible, the servo positioning controller ARS 2100 FS should be located as close to the motor as possible (see also the following chapter).
- ❖ The shield of the motor cable is connected to the housing of the servo positioning controller ARS 2100 FS (shield connection terminal). In the first environment the shield of the motor cable also has to be connected to the control cabinet housing by means of metal cable glands.
- ❖ The mains-end PE connection is connected to the PE connection point of the supply connection [X9].
- ❖ The inner PE conductor of the motor cable is connected to the PE connection point of the motor connection [X6].
- ❖ Motor cable and angle encoder cable must be shielded.
- ❖ Unshielded signal and control lines should not be used. If their use is inevitable they should at least be twisted.
- ❖ Even shielded cables will inevitably have short unshielded ends (unless shielded connector housings are used). In general, the following applies:
 - Connect the inner shields to the corresponding pins of the connectors; Maximum length 40 mm.
 - Length of the unshielded cores 35 mm maximum.
 - Connect the total shield on the controller side flat to the PE terminal; Maximum length 40 mm.
 - Connect the total shield on the motor side flat to the connector housing or motor housing; Maximum length 40 mm.



DANGER!

For safety reasons, all PE ground conductors must be connected prior to initial operation.

The EN 50178 regulations for protective earthing must be complied with during installation!

7.1 Operation with long motor cables



Compliance with the EMC standard EN 61800-3 is only guaranteed for motor cable lengths of up to 25 m. For cable lengths beyond this a new measurement of the interference emission may possibly be required.

In applications involving long motor cables and/or unsuitable motor cables with an inadvertently high cable capacity, the filters may be thermally overloaded. To avoid such problems we highly recommend the following procedure for applications that require long motor cables:

- ❖ With cable lengths of more than 25 m use only cables with a capacitance per unit length between the motor phase and the shield of less than 150 pF/m!.
(Please contact the motor cable supplier, if necessary.)
- ❖ For motor cable lengths of more than 25 m and up to 50 m the following derating applies regardless of the EMC qualification (see also *Derating of the cable length* on page 12):

PWM frequency	up to 5 kHz	5,5 kHz	6 kHz	7 kHz	8 kHz
Max. motor cable length	50 m	45 m	40 m	35 m	30 m

8 Additional requirements for the servo drives concerning the UL approval

This chapter gives further information concerning the UL approval of the ARS 2102 FS, ARS 2105 FS and ARS 2108 FS.

8.1 Circuit protection



In case of a required UL-certification the following data for the main fuse are to be considered:

Listed Circuit Breaker according to UL 489, rated 277 Vac, 16 A, SCR 10 kA

8.2 Wiring and environment regards

- ❖ Use 60/75 or 75°C copper (CU) wire only.
- ❖ The terminal tightening torque is 0.22...0.25 Nm.
- ❖ To be used in a Pollution Degree 2 environment only.

8.3 Motor temperature sensor



Motor overtemperature sensing is not provided by the drive according to UL.

When a UL-certification is required, then in order to prevent motor overtemperatures the servo drives may only be operated in connection with motors that are provided with an integrated motor temperature sensor. The sensor has to be connected to the servo drive and the temperature monitoring has to be activated accordingly on the software side.