

# Mounting Instructions



## Servo drives ARS 2300 SE *Standard Edition*

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## Original instructions

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Revision Information	
Author:	Metronix Meßgeräte und Elektronik GmbH
Manual title:	Mounting Instructions "Servo drives ARS 2300 SE"
File name:	MI_ARS2300_SE_5p0_EN.docx
Version 5.0	November 2015

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## CONTENTS

<b>1</b>	<b>GENERAL .....</b>	<b>5</b>
1.1	Documentation.....	5
<b>2</b>	<b>SAFETY NOTES FOR ELECTRICAL DRIVES AND CONTROLLERS .....</b>	<b>6</b>
2.1	Used symbols .....	6
2.2	General notes .....	6
2.3	Danger resulting from misuse .....	8
2.4	Safety notes.....	8
2.4.1	General safety notes.....	8
2.4.2	Safety notes for assembly and maintenance .....	10
2.4.3	Protection against contact with electrical parts .....	11
2.4.4	Protection against electrical shock by means of protective extra-low voltage (PELV) .....	12
2.4.5	Protection against dangerous movements.....	12
2.4.6	Protection against contact with hot parts .....	13
2.4.7	Protection during handling and assembly .....	14
<b>3</b>	<b>TECHNICAL DATA .....</b>	<b>15</b>
<b>4</b>	<b>MECHANICAL INSTALLATION.....</b>	<b>19</b>
4.1	Important notes.....	19
4.2	Mounting.....	22
<b>5</b>	<b>ELECTRICAL INSTALLATION .....</b>	<b>23</b>
5.1	Pin assignment I/O communication [X1].....	24
5.2	Pin assignment Resolver [X2A] .....	25
5.3	Pin assignment Encoder [X2B].....	26
5.4	Pin assignment CAN [X4] .....	29
5.5	Wiring diagram Motor [X6] and Power Supply [X9].....	30
5.6	Pin assignment Incremental Encoder Input [X10].....	33
5.7	Pin assignment Incremental Encoder Output [X11] .....	34
5.8	Ethernet communication [X18].....	35
5.9	USB communication [X19].....	36
5.10	Pin assignment SAFE TORQUE OFF [X40].....	36
5.11	SD-/SDHC-/MMC-Card slot .....	37
5.11.1	BOOT-DIP-Switch.....	37
<b>6</b>	<b>FUNCTIONAL SAFETY TECHNOLOGY .....</b>	<b>38</b>
6.1	General.....	38

6.2	Achievable safety level, Safety function according to EN ISO 13849-1 / EN 61800-5-2 .....	38
<b>7</b>	<b>EMC-COMPLIANT CABLING.....</b>	<b>39</b>
7.1	Operation with long motor cables.....	40
<b>8</b>	<b>ADDITIONAL REQUIREMENTS FOR THE SERVO DRIVES CONCERNING THE UL APPROVAL .....</b>	<b>41</b>
8.1	Circuit protection .....	41
8.2	Wiring and environment regards.....	41
8.3	Motor temperature sensor.....	41

# 1 General

## 1.1 Documentation

This installation information serves the purpose of a safe use of the ARS 2300 SE series servo drives. 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 drives ARS 2300 SE"**: Description of the technical data and the device functionality plus notes concerning the installation and operation of the ARS 2302 SE, ARS 2305 SE and ARS 2310 SE servo drives (German version).
- ❖ **Product Manual "STO (Safe Torque Off) for the servo drives ARS 2000 SE"**: Description of the functional safety technology for the ARS 2000 SE servo drives with the safety function STO (German version).
- ❖ **Product Manual "Ethernet Technology Module"**: Description of the implemented Ethernet protocol (UDP).
- ❖ **Software Manual "Servo drives ARS 2000"**: Description of the device functionality and the software functions of the firmware including the RS232 communication. Description of the Metronix ServoCommander<sup>®</sup> parameterisation program with instructions concerning the start-up of the ARS 2000 servo drives.
- ❖ **CANopen Manual "Servo drives ARS 2000"**: Description of the implemented CANopen protocol as per DSP402.

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

Certificates and declarations of conformity for the products described in this manual can be found at <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.



Prior to the initial use you must read *chapter 2 Safety notes for electrical drives and controllers*, starting on *page 6* and *chapter 7 EMC-compliant cabling*, starting on *page 39*.

If the documentation in the language at hand is not understood accurately, please contact and inform your supplier.

Sound and safe operation of the servo drive requires proper and professional transportation, storage, mechanical installation, and project planning – with a consideration of the risks as well as the protective and emergency measures – plus the proper and professional electrical installation, operation, and maintenance of the devices.

Only trained and qualified personnel is authorised to handle electrical devices and systems:

## TRAINED AND QUALIFIED PERSONNEL

in the sense of this product manual or the safety notes on the product itself are persons who are sufficiently familiar with the project, 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 concerning the standards and accident prevention regulations for the application, or 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.
- ❖ First aid training.

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 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.



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



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 for safety and warranty reasons.



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



### **DANGER!**

**Inappropriate handling of the servo drive and non-compliance with 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 drive 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 replacement 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 (for example main switch, contactor, power switch).



The servo drive may be protected using an AC/DC sensitive 300 mA 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.



Preventive interference rejection measures should be taken for control panels, such as connecting contactors and relays using RC elements or diodes.



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.



For notes on installation corresponding to EMC, please refer to *chapter 7 EMC-compliant cabling*, starting on *page 39*. 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 are to be found in this product manual and must be met.

**DANGER!**

The general setup and safety regulations for work on power installations (for example 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 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 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, for example 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 servo drive 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 and up to 5 minutes thereafter. Contact may result in death or serious personal injury. Wait for this time prior to performing any work on the affected connections. Measure the voltages for your own protection. Contact with these high DC bus circuit voltages 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 servo drive.



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



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



Carry out work in the machine area only, if AC and/or DC supplies are switched off. Switched off output stages or servo drive enablings are no suitable means of locking. In the case of a malfunction the drive may accidentally be put into action.

This does not apply to drives with the special "Safe Stop" feature in accordance with EN 954-1 CAT 3 or with the "Safe Torque Off" feature in accordance with EN 61800-5-2.



Initial operation must be carried out with idle motors, to prevent mechanical damages for example due to the wrong direction of rotation.



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 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, for example a switch cabinet. The national regulations for safety/accident prevention 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 (see for example EN 60800-5-1).



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 EN 60204-1. In certain device constellations, however, mostly in the case of parallel connection of several servo drives in the DC bus or in the case of an unconnected brake resistor, this rapid discharge may be rendered ineffective. The servo drives 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 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 61800-5-1



#### **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 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!

## 2.4.7 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 (for example goggles, protective footwear, protective gloves).



Do not stand underneath hanging loads.



Remove leaking liquids on the floor immediately to prevent slipping.

### 3 Technical data

Range	ARS 2302 SE	ARS 2305 SE	ARS 2310 SE
Metronix part number – <b>with</b> STO	9200-2302-30	9200-2305-30	9200-2310-30
Metronix part number – <b>without</b> STO	9200-2302-31	9200-2305-31	9200-2310-31
Auxiliary equipment	Counterplug PHOENIX Mini-Combicon MC1.5/8-STF-3.81 BK (only for devices <b>with</b> STO)		
Power connector set	9200-0230-20		
Signal connector set	9200-0200-00		
Shield connector set	9200-0202-00		
<b>Ambient conditions and qualification:</b>			
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%, not bedewing		
Protection degree	IP20		
Protection class	I		
Pollution degree	2		
CE conformity Low-voltage directive:  EMC directive::	2006/95/EC verified by application of the harmonised standard EN 61800-5-1  2004/108/EC verified by application of the harmonised standard EN 61800-3		
EC product type test certificate for the devices <b>with</b> STO	TÜV 01/205/5245.01/14		
cULus certification	Listed according to UL 508C, C22.2 No. 274-13		
<b>Dimensions and weight:</b>			
Dimensions including the mounting plate (H*W*D)	334,5 mm*69 mm*245,5 mm		
Housing dimensions (H*W*D)	250 mm*69 mm*240 mm		
Weight	approx. 3,7 kg		
<b>Performance data [X9]:</b>			
Supply voltage	3 x 230 ... 480 VAC [+/- 10%], 50...60 Hz		
Alternative DC supply	60 ... 700 VDC		
24V supply *) plus current consumption of a possibly connected holding brake and I/Os	24 VDC [± 20%] (1 A *)		
Intermediate circuit voltage for a supply voltage of 400 VAC	560 ... 570 VDC		

<b>Internal brake resistor [X9]:</b>			
Brake resistance	68 $\Omega$		
Pulse power	8,5 kW		
Continuous power	110 W		
Threshold limit	760 V		
Max. voltage	800 V		
<b>External brake resistor [X9]:</b>			
Brake resistance external	$\geq 40 \Omega$		
Continuous power	$\leq 5000 \text{ W}$		
Max. operating voltage (at output)	800 V		
<b>Motor connection specifications [X6]:</b>			
Specifications for operation with 3x 400 VAC [ $\pm 10\%$ ], 50 Hz			
Output power	1,5 kVA	3 kVA	6 kVA
Max. output power for 5 s	3 kVA	6 kVA	12 kVA
Output current	2,5 A <sub>RMS</sub>	5 A <sub>RMS</sub>	10 A <sub>RMS</sub>
Max. output current for 5 s	5 A <sub>RMS</sub> (7,5 A <sub>RMS</sub> for 2 s)	10 A <sub>RMS</sub> (15 A <sub>RMS</sub> for 2 s)	20 A <sub>RMS</sub>
Max. output current for 0.5 s	10 A <sub>RMS</sub>	20 A <sub>RMS</sub>	40 A <sub>RMS</sub>
Max. mains current for continuous operation	2,5 A <sub>RMS</sub>	5 A <sub>RMS</sub>	9 A <sub>RMS</sub>
Max. PWM frequency	16 kHz (software programmable)		
As a guideline: Power loss/efficiency (with regard to the rated output power)	typical 8%/92%		
<b>Maximum motor cable length for interference emission according to EN 61800-3</b>			
Category C2	l $\leq 50 \text{ m}$		
Category C3	l $\leq 50 \text{ m}$		
Cable capacity of a phase against shield or between two lines	C' $\leq 200 \text{ pF/m}$		
<b>Motor temperature monitoring:</b>			
Digital sensor	Normally closed contact: R <sub>cold</sub> < 500 $\Omega$ R <sub>hot</sub> > 100 k $\Omega$		
Analogue sensor	Silicon temperature sensor, for example KTY81, 82 or similar R <sub>25</sub> $\approx 2000 \Omega$ R <sub>100</sub> $\approx 3400 \Omega$		

<b>Resolver [X2A]:</b>	
Resolution	16 Bit
Delay time signal detection	< 200 $\mu$ s
Speed resolution	approx. 4 $\text{min}^{-1}$
Absolute accuracy of angle detection	< 5'
Max. rotational speed	16.000 $\text{min}^{-1}$
<b>Encoder evaluation [X2B]:</b>	
Parameterisable number of encoder lines	1 – 2 <sup>18</sup> lines/rev
Angular resolution / Interpolation	10 Bit / period
Encoder signals A, B	1 V <sub>pp</sub> differential; 2.5 V offset
Encoder signal N	0.2 to 1 V <sub>pp</sub> differential; 2.5 V offset
Commutation track A1, B1 (optional)	1 V <sub>pp</sub> differential; 2.5 V offset
Input impedance encoder signals	Differential input 120 $\Omega$
Limit frequency	f <sub>Limit</sub> > 300 kHz (high-resolution signal) f <sub>Limit</sub> ca. 10 kHz (commutation track)
Additional communication interface	EnDat (Heidenhain) and HIPERFACE <sup>®</sup> (Sick-Stegmann)
Output supply	5 V or 12 V; max. 300 mA; current limited, control via sensor lines set point programmable via software
<b>Digital inputs and outputs [X1]:</b>	
Signal level	24V (8V...30V) active high, conforming with EN 61131-2
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 power stage (enable at High)
DIN5	Servo drive enable at High, acknowledge error with falling edge
DIN6	Limit switch input 0
DIN7	Limit switch input 1
DIN8	Control signal Start positioning or Homing switch for homing or saving of positions
DIN9	Control signal Start positioning or Homing 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. 2 A
<b>Analogue inputs and outputs [X1]:</b>		
High-resolution analogue input: AIN0	±10 V input range, 16 Bit, differentially, < 250 µs delay time	
Analogue 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
Analogue 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
Analogue outputs: AOUT0 and AOUT1	± 10 V output range, 10 mA, 9 bit resolution, $f_{\text{Limit}} > 1 \text{ kHz}$	
<b>Incremental encoder input [X10]:</b>		
Parameterisable number of encoder lines	1 – 2 <sup>28</sup> lines/rev	
Trace signals: A, #A, B, #B, N, #N	As per RS422 specification	
Max. input frequency	1000 kHz	
Pulse direction interface: CLK, #CLK, DIR, #DIR, RESET, #RESET	As per RS422 specification	
Output supply	5 V, max. 100 mA	
<b>Incremental encoder output [X11]:</b>		
Number of lines	Programmable 1 – 2 <sup>13</sup> and 2 <sup>14</sup> lines/revolution	
Connection level	Differential / RS422 specification	
Encoder signals A, B, N	As per RS422 specification	
speciality	N-Trace disconnectible	
Output impedance	$R_{a,\text{diff}} = 66 \Omega$	
Limit frequency	$f_{\text{Limit}} > 1,8 \text{ MHz (lines/s)}$	
Edge triggering (min. pulse width)	Can be limited by parameters	
Output supply	5 V, max. 100 mA	
<b>Ethernet [X18]</b>	RJ 45, 10/100 MBaud, UDP communication	
<b>USB [X19]:</b>	According to USB 2.0, USB-B, slave-client	
<b>SD-/SDHC-/MMC-Card</b>	File systems FAT12, FAT16, FAT32	

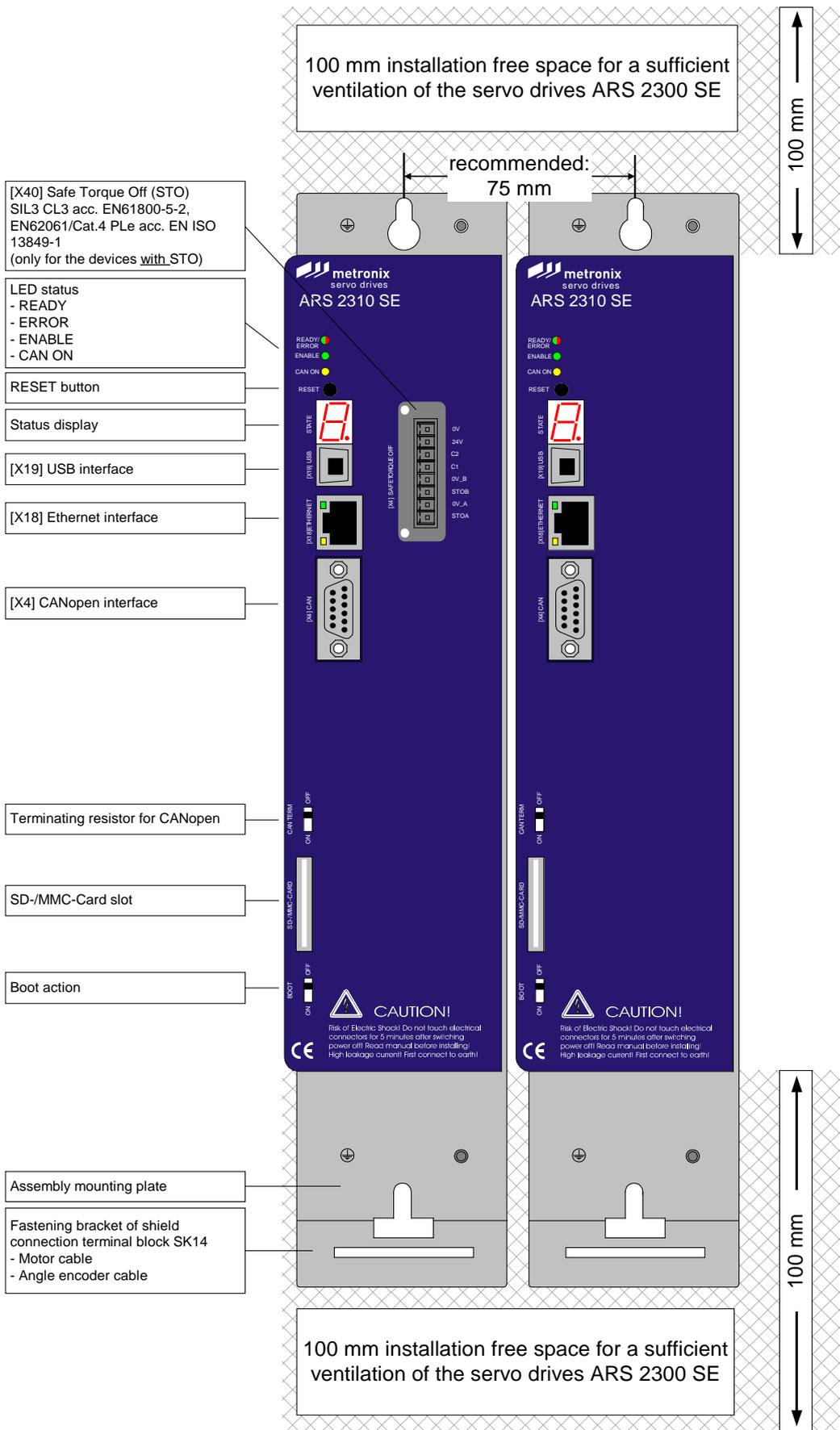
# 4 Mechanical installation

## 4.1 Important notes

- ❖ Only use the servo drive ARS 2300 SE 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 free spaces:
  - Keep a minimum distance of 100 mm to other components each above and underneath the device to ensure sufficient venting.
  - For optimal wiring of the motor cable and angle encoder cable on the bottom of the device an installation free space of 150mm is recommended!
- ❖ Mounting distance:
  - The servo drive ARS 2300 SE 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 drives ARS 2300 SE are subject to high thermal stress, a mounting distance of 75 mm is recommended!



The device views and connections of the following illustrations for the servo drive ARS 2302 SE also apply to the servo drives ARS 2305 SE and ARS 2310 SE!



**Figure 1: Servo drive ARS 2300 SE with and without STO: Front view – Installation free space and mounting distance**

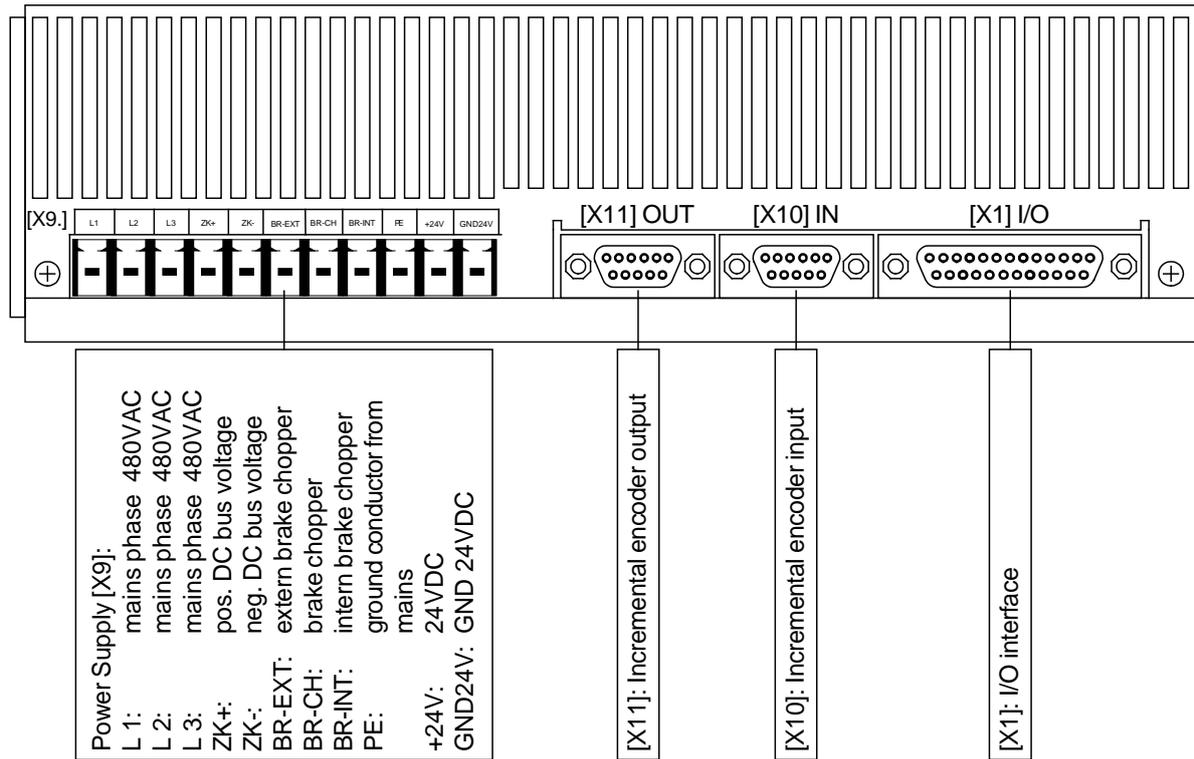


Figure 2: Servo drive ARS 2302 SE: Top view

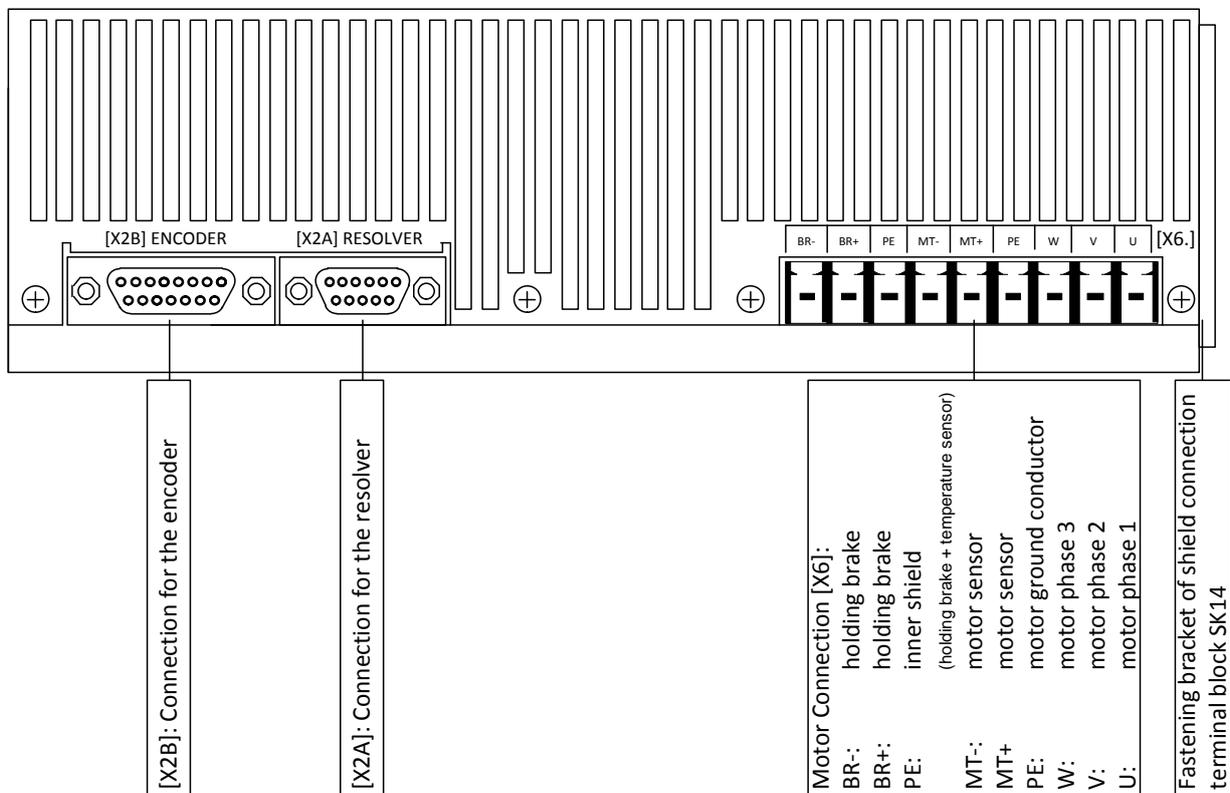


Figure 3: Servo drive ARS 2302 SE: Bottom view



## 5 Electrical installation



If they have the same DC bus voltage, it is possible to couple multiple servo drives of the ARS 2300 FS / SE series.



Caution!

Operation with DC bus coupling together with devices of the ARS 2100 FS / SE series is not allowed.

## 5.1 Pin assignment I/O communication [X1]

Pin No.	Denomination	Values	Specification
1	AGND	0V	Shield for analogue signals, AGND
	14	AGND	Reference potential for analogue signals
2	AIN0	$U_{on} = \pm 10V$ $R_1 \geq 30k\Omega$	Set point input 0, differential, max. 30V input voltage
	15		
3	AIN1	$U_{on} = \pm 10V$ $R_1 \geq 30k\Omega$	Set point inputs 1 and 2, single ended, max. 30V input voltage
	16		
4	+VREF	+10V	Reference output for set point potentiometer
	17	AMON0	$\pm 10V$ Analogue monitor output 0
5	AMON1	$\pm 10V$	Analogue monitor output 1
	18	+24V	24V / 100mA Auxiliary voltage for IOs at X1
6	GND24	corresponding GND	Reference potential for digital I/Os
	19	DIN0	POS Bit0 Target selection positioning Bit0
7	DIN1	POS Bit1	Target selection positioning Bit1
	20	DIN2	POS Bit2 Target selection positioning Bit2
8	DIN3	POS Bit3	Target selection positioning Bit3
	21	DIN4	FG_E Power stage enable
9	DIN5	FG_R	Input servo drive 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 assignment Resolver [X2A]

Pin No.	Denomination	Values	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 (0 V)	Reference potential temperature sensor
4	R1	$7V_{RMS} / 5-10kHz$ $I_A \leq 150mA_{RMS}$	Carrier signal for resolver
9	R2	GND (0V)	
5	MT+	$+3,3V / R_i=2k\Omega$	Motor temperature sensor, normally closed contact, PTC, NTC, KTY



In addition, a low-impedance connection of the outer cable shield to the housing of the servo drive has to be established. Therefore, the outer cable shield of the angle encoder cable must be connected to the housing of the angle encoder connector.

D-SUB connector  
at X2A

Resolver output at the  
motor

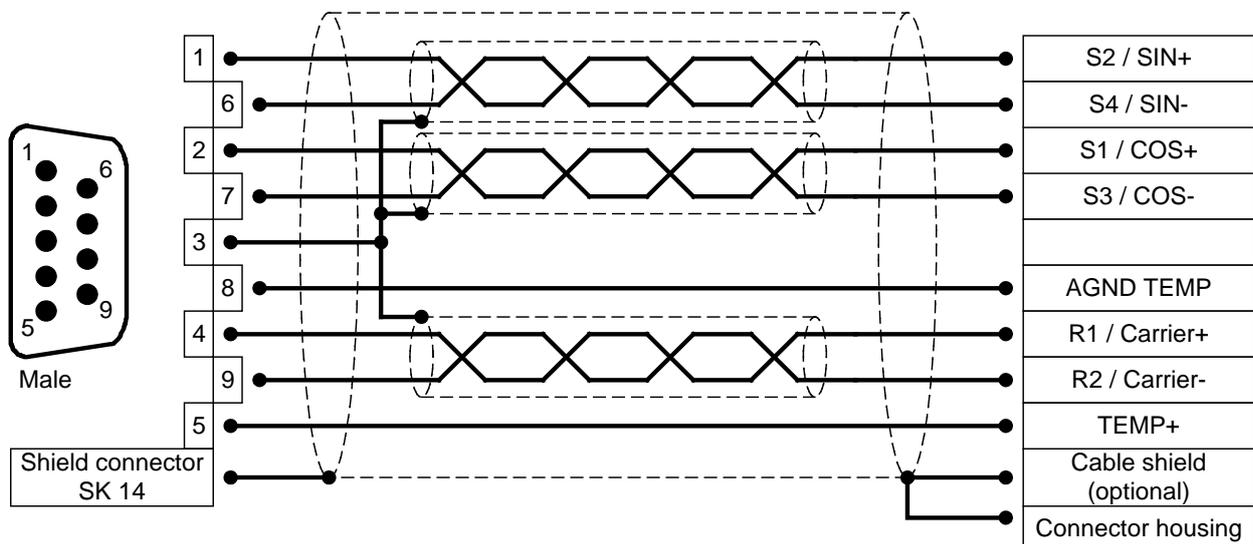


Figure 5: Pin assignment: Resolver connection [X2A]

- ❖ The outer shield is always connected to PE (connector housing) on the servo drive.
- ❖ The three inner shields are connected on one side of the servo drive ARS 2300 SE to Pin 3 of [X2A].

### 5.3 Pin assignment Encoder [X2B]

At the 15-pole D-Sub connection [X2B], motors with encoder can be fed back. The possible incremental encoders for the encoder connection are divided into several groups. The universal encoder input [X2B] can be used for one of the described encoder types.

- ❖ Analog incremental encoder
- ❖ Incremental encoder with serial communication interface (for example EnDat, HIPERFACE®)
- ❖ Digital incremental encoder

D-SUB connector at X2B

Output of the analogue incremental encoder interface at the motor

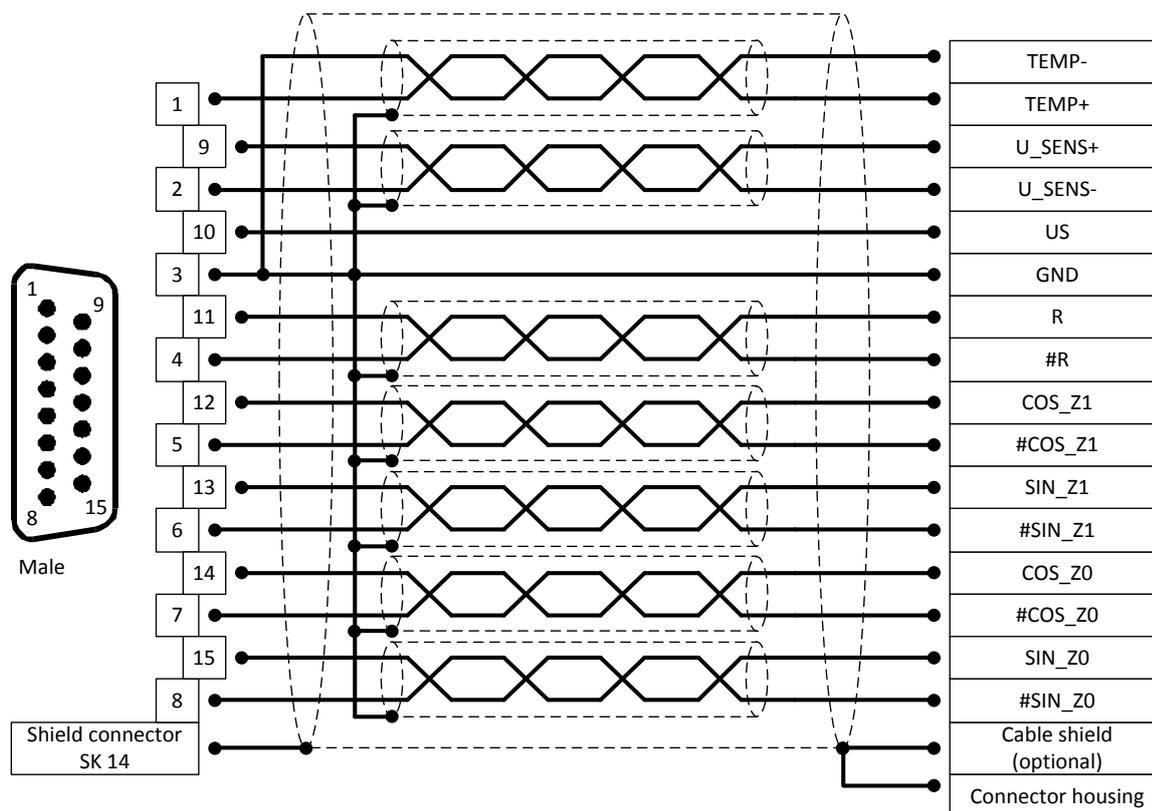


Figure 6: Pin assignment: Analog incremental encoder [X2B]

**i** In case of wrong activated voltage supply, the encoder can be destroyed! Make sure the correct supply voltage is activated, before connected to [X2B]!

Therefore, start the parameterization software Metronix ServoCommander® and select **Parameters/Device parameters/Angle encoder settings**.

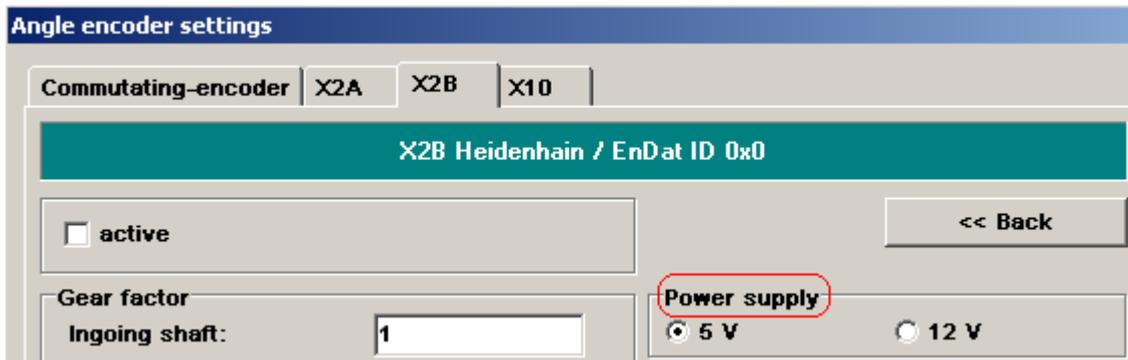
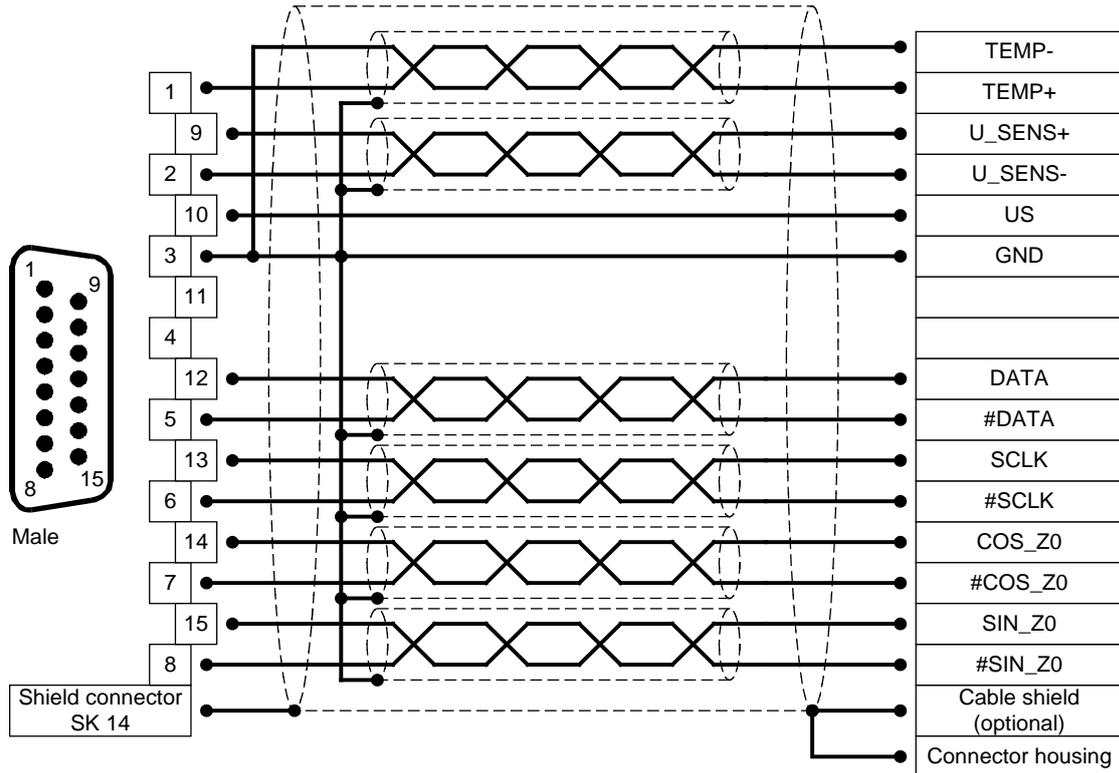


Figure 7: Metronix ServoCommander®: Angle encoder settings [X2B]

D-SUB connector at X2B

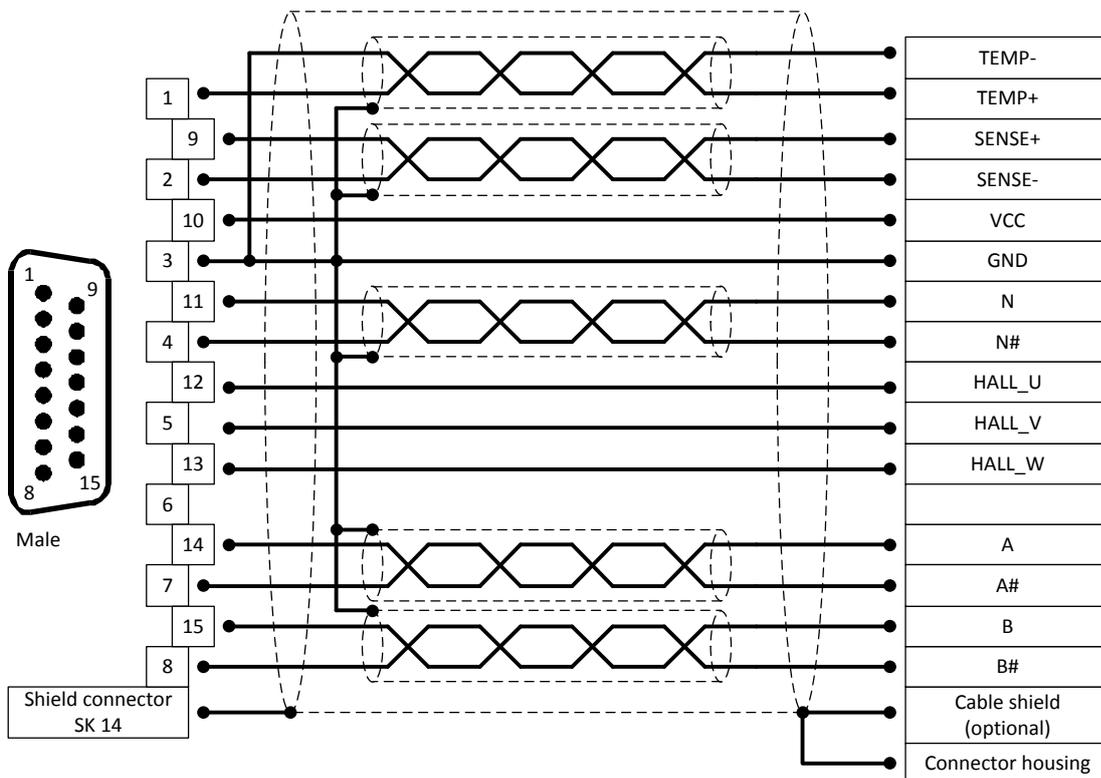
Output of the incremental encoder with serial communication interface at the motor



**Figure 8: Pin assignment: Incremental encoder with serial communication interface (for example EnDat, HIPERFACE®) [X2B]**

D-SUB connector at X2B

Output of the digital incremental encoder at the motor



**Figure 9: Pin assignment: Digital incremental encoder [X2B]**

Pin No	Incremental encoder with serial communication interface (e.g. EnDat, HIPERFACE)		Analogue 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...
9	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
2	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
10	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
3						
11						
4						
12	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)	Bidirectional RS485 data line (differential) (EnDat / HIPERFACE)
5						
13	Clock output RS485 (differential) (EnDat)	Clock output RS485 (differential) (EnDat)	Clock output RS485 (differential) (EnDat)	Clock output RS485 (differential) (EnDat)	Clock output RS485 (differential) (EnDat)	Clock output RS485 (differential) (EnDat)
6						
14	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	COSINE trace signal (differential) from high-resolution incremental encoder
7						
15	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	SINE trace signal (differential) from high-resolution incremental encoder
8						

\*) Heidenhain Encoder: A = SIN\_Z0; B = COS\_Z0; C = SIN\_Z1; D = COS\_Z1

## 5.4 Pin assignment CAN [X4]

Pin No.	Denomination	Values	Specification
1	-	-	Not occupied
6	GND	0V	CAN-GND, galvanically connected to GND in servo drive
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

\*)-For terminating the CAN bus on both ends, an integrated 120 Ohm resistor is provided and can be switched on with the CAN Term switch at the ARS 2000 SE front.

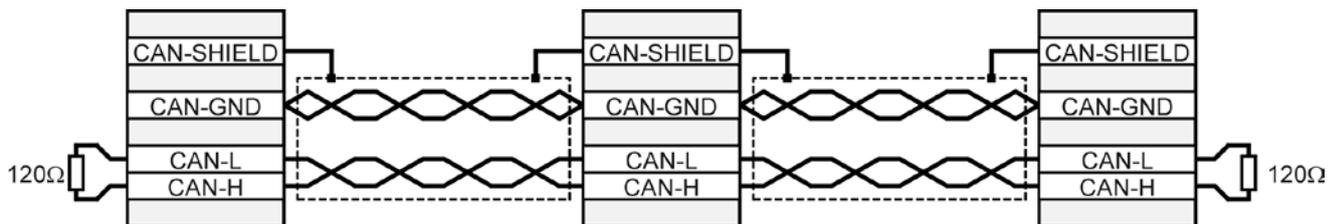
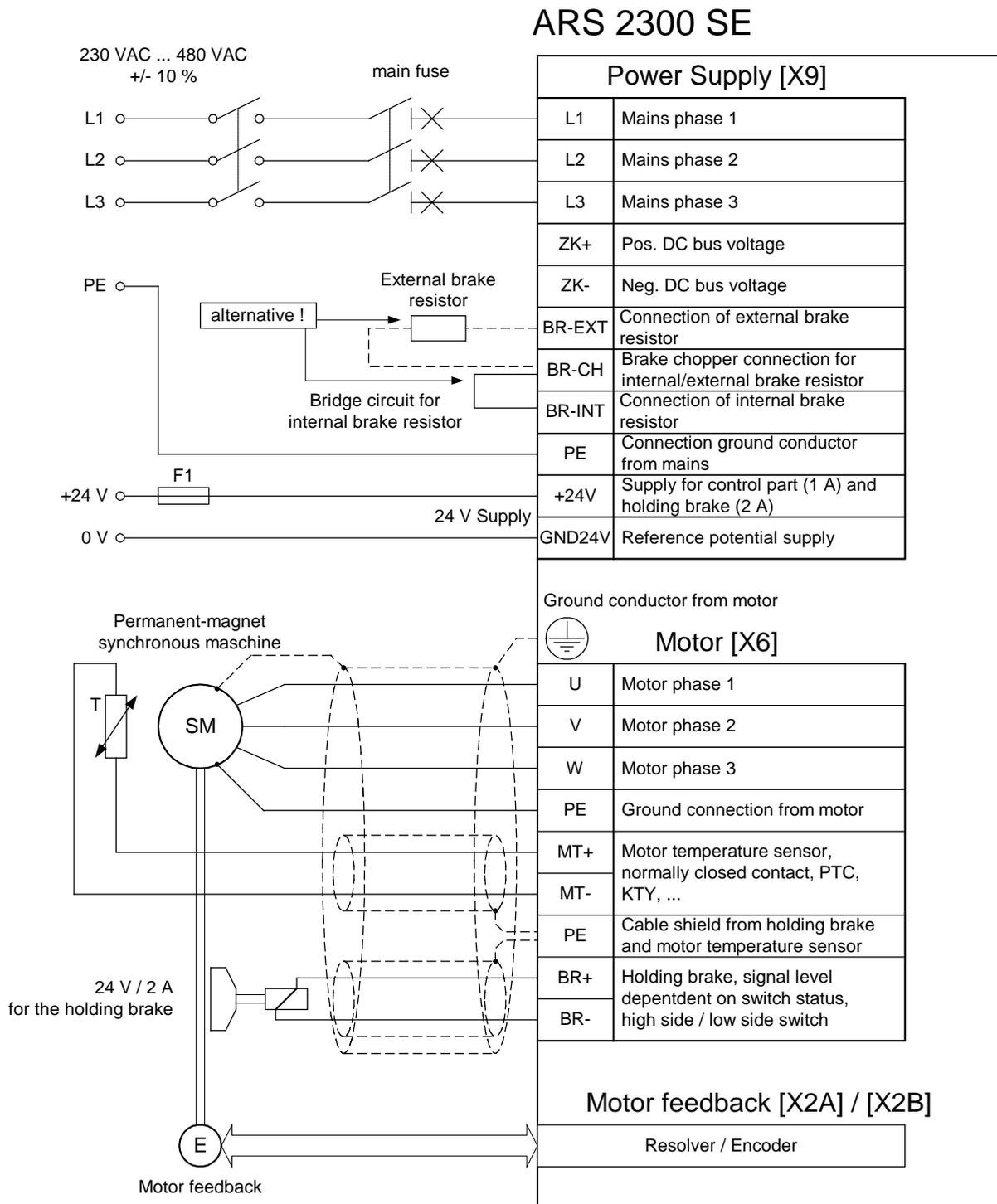


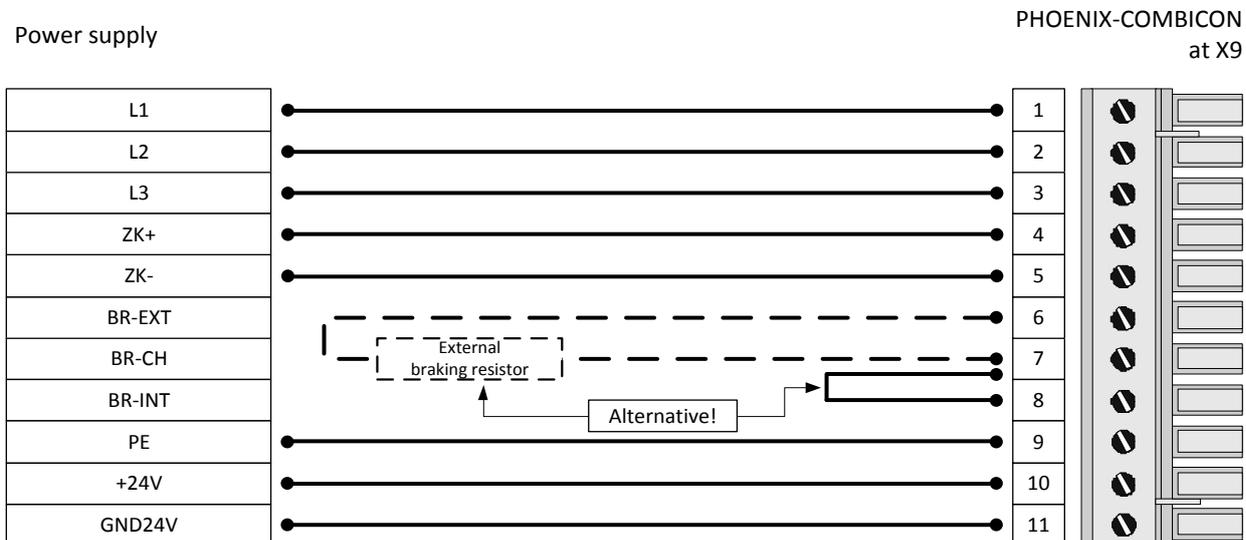
Figure 10: CAN bus cabling example

## 5.5 Wiring diagram Motor [X6] and Power Supply [X9]



**Figure 11: Connection to power supply [X9] and motor [X6]**

The servo drive ARS 2300 SE 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 drive ARS 2300 SE 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, L2 and L3 for AC supply or to ZK+ and ZK- for DC supply.

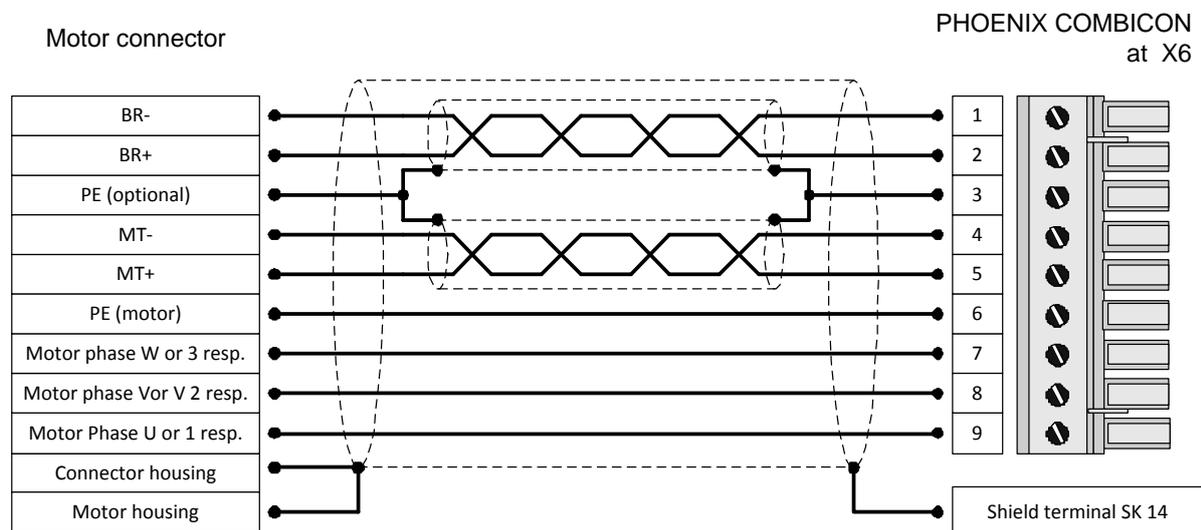


**Figure 12: Supply [X9]**

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

Digital motor temperature sensors are connected to the terminals MT+ and MT- at motor connector [X6].

Analogue motor temperature sensors are connected via the encoder cable to [X2A] or [X2B].



**Figure 13: Motor connection [X6]**

- ❖ Connect the inner shields to Pin 3; maximum length 40 mm.
- ❖ Maximum length of unshielded cores 35 mm.
- ❖ Connect total shield on the servo drive flat to PE terminal; maximum length 40 mm. Use shield clamp (SK14) or connect the shield 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 servo drive housing (PE screw terminal).

The connection of the shaft encoder via the D-Sub connector to [X2A] / [X2B] is roughly shown in *Figure 11*.

The servo drive ARS 2300 SE must be connected to ground with its PE connection.

The ARS 2300 SE must be completely wired first. Only then the operating voltages for the DC bus and the electronics supply may be switched on.



**Caution!**

The servo drive will be damaged

- ❖ in the case of inversed wiring of the operating voltage connections,
- ❖ in the case of excessive operating voltage or
- ❖ in the case of confusing the connections for operating voltage and motor!



The signals for the temperature sensor "MT-" (PIN 4) and "MT+" (PIN 5) on the motor connector plug [X6] are not situated on safety extra-low voltage (PELV - protective extra-low voltage). The connections are designed for non-PELV temperature sensors. The isolation to PELV is part inside the ARS 2300 SE.

## 5.6 Pin assignment Incremental Encoder Input [X10]

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

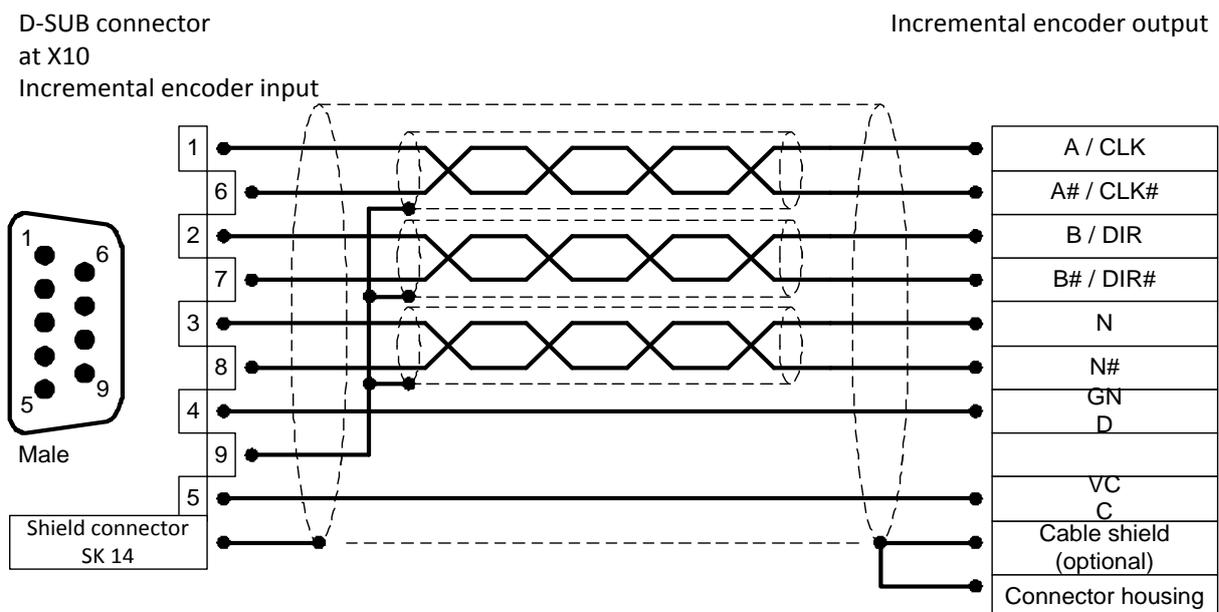


Figure 14: Pin assignment: Incremental Encoder Input [X10]

## 5.7 Pin assignment Incremental Encoder Output [X11]

Pin No.	Denomination	Values	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 (short-circuit-proof), load with 100mA maximum

\*) The value for  $R_A$  is the differential output resistance

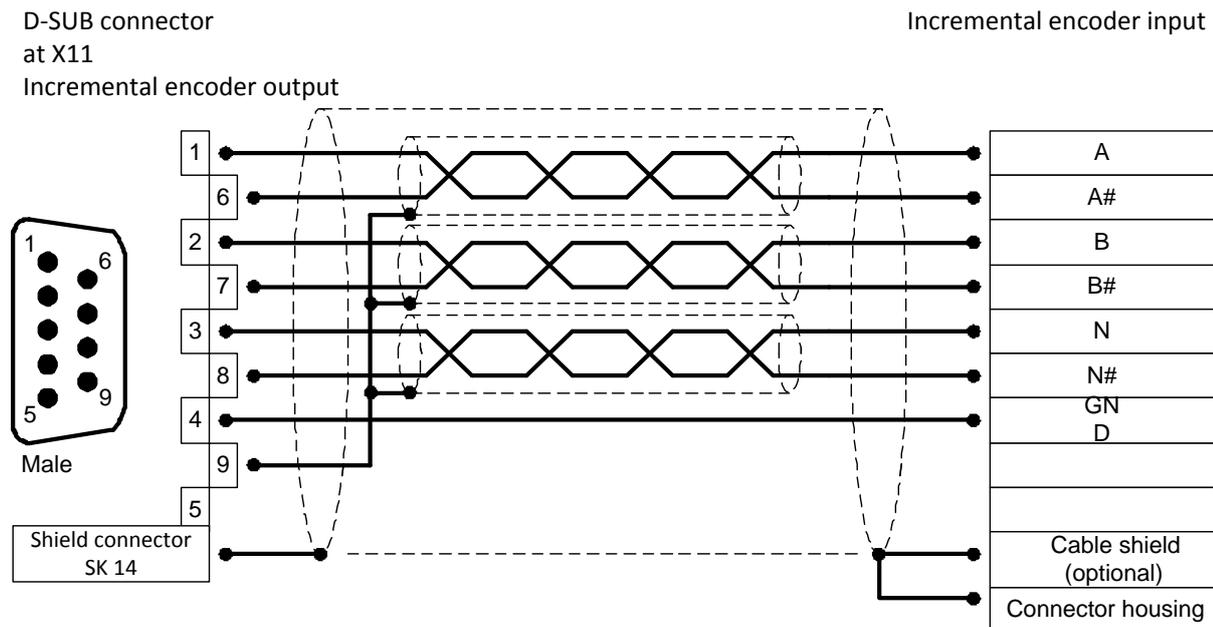
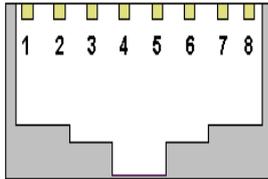


Figure 15: Pin assignment: Incremental Encoder Output [X11]

## 5.8 Ethernet communication [X18]

Ethernet interface [X18]	
Functions	UDP communication, 10/100 MBaud, automatic selection
Connector type	RJ 45 socket
Communication protocol	UDP communication
Pin No.	Specification
1	Transmission signal + ( TX+ )      Pair 3
2	Transmission signal- ( TX- )      Pair 3
3	Receiver signal + ( RX+ )      Pair 2
4	nc      Pair 1
5	nc      Pair 1
6	Receiver signal- ( RX- )      Pair 2
7	nc      Pair 4
8	nc      Pair 4



**Figure 16:** Pin assignment: Ethernet interface [X18]

## 5.9 USB communication [X19]

The ARS 2300 SE servo drive 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]		
Functions	USB 2.0, Slave-Client, 12 MBaud to 480 MBaud	
Connector type	USB-B, no current consumption from the bus (integrated power supply)	
Communication protocol	Metronix specific (generic device)	
Pin assignment		
1	VCC	+5 VDC
2	D-	Data -
3	D+	Data +
4	GND	GND

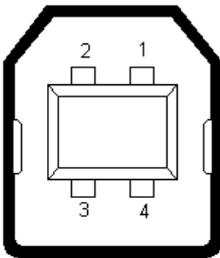


Figure 17: Pin assignment: USB interface [X19]

## 5.10 Pin assignment SAFE TORQUE OFF [X40]

For further information concerning the safety function please refer to the Product Manual "Servo drives ARS 2300 SE", chapter 6 "Functional safety technology" and the Product Manual "STO (Safe Torque Off) for the servo drives ARS 2000 SE".

Pin No.	Denomination	Value	Specification
1	STO-A	0 V / 24 V	Control input A for STO function.
2	0V-A	0 V	Reference potential for STO-A.
3	STO-B	0 V / 24 V	Control input B for STO function.
4	0V-B	0 V	Reference potential for STO-B.
5	C1	–	Monitoring contact for state „STO“ to an external plc.
6	C2		
7	24V	+24 V DC	Auxiliary supply 24 V DC
8	0V	0 V	Reference potential for auxiliary supply.

## 5.11 SD-/SDHC-/MMC-Card slot

The ARS 2300 SE 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 technology

This chapter provides information on the ARS 2000 SE servo drives with the integrated safety function STO („Safe Torque Off“).

## 6.1 General

The servo drive ARS 2300 SE series devices with STO are delivered with integrated functions for safety-related motion monitoring and motion control.

Use the function “Safe Torque Off” (STO) whenever you have to reliably disconnect the energy supply to the motor in your particular application.

## 6.2 Achievable safety level, Safety function according to EN ISO 13849-1 / EN 61800-5-2

The servo drive ARS 2300 SE series devices with integrated Safe torque Off (STO) function fulfill the basic test requirements

- Category 4 / PL e according to EN ISO 13849-1,
- SIL CL 3 according to EN 61800-5-2 / EN 62061 / IEC 61508,

and can be used in applications up to cat. 4 / PL e according to EN ISO 13849-1 and SIL 3 to EN 62061 / IEC 61508.

The achievable safety level depends on the other components used to achieve a safety function.



For further information please refer to the Product Manual “STO (Safe Torque Off) for the servo drives ARS 2000 SE”.

## 7 EMC-compliant cabling

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

- ❖ Suitable installation and suitable wiring of all connection cables provided, the servo drives ARS 2300 SE fulfill the requirements of the corresponding product standard EN 61800-3. This standard refers to “classes” and so-called “environments”. The first environment includes mains supplies serving residential buildings and the second environment includes mains supplies exclusively serving industrial buildings.
- ❖ The servo drive ARS 2300 SE 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 for usage in the first environment.
- ❖ 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.
- ❖ In order to keep the leakage currents and the losses in the motor connection cable as small as possible, the servo drive ARS 2300 SE should be located as close to the motor as possible (see also the following chapter *Operation with long motor cables, page 40*).
- ❖ Motor cable and angle encoder cable must be shielded.
- ❖ The shield of the motor cable must be connected to the housing of the servo drive ARS 2300 SE (shield connection terminal). The cable shield also has to be connected to the associated servo drive so that the leakage currents can flow back into the servo drive causing the leakage. 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 must be connected to the PE connection point of the supply connection [X9].
- ❖ The inner PE conductor of the motor cable must be connected to the PE connection point of the motor connection [X6].
- ❖ 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 (that is at a 90° angle), if possible.
- ❖ 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 servo drive plane to the PE terminal; Maximum length 40 mm.
  - Connect the total shield on the motor side plane 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 61800-5-1 regulations for protective earthing must be complied with during installation!

## 7.1 Operation with long motor cables

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 50 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.)
- ❖ If the cables are longer than 50 m, the frequency of the power stage must be decreased.

Both measures are also good for the EMC behaviour of the entire drive:

The servo drive generates less and less severe interference and the emission of interference into the mains is reduced.

## 8 Additional requirements for the servo drives concerning the UL approval

This chapter gives further information concerning the UL approval of the ARS 2302 SE, ARS 2305 SE and ARS 2310 SE.

### 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 480Y/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.