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RAC 4
Main Spindle Drive Controller

Project Planning Manual

DOK-DIAX01-RAC04******-PRJ1-EN-P

257388

Indramat

Chapter

Titel

RAC 4.1
Main Spindle Drive Controller

Type of documentation:

Project Planning Manual

Documenttype

DOK-DIAX01-RAC04******-PRJ1-EN-E1,44

Internal file reference

- 209-0042-4113-00

Reference

This electronic document is based on the hardcopy document with document desig.: 209-0042-4113-00 EN/12.93

This documentation is used:

This document serves:

– to introduce the drive controller

– to incorporate the drive controller into the mechanical design of the control cabinet

– to assist in mounting and installation

– to describe programming modules AS

– to explain the hardware delivered and appropriate storage conditions

Function of the additional documents

The additional technical documents are used

– when commissioning, operating and servicing

– to incorporate the drive controller into the electrical design of the control cabinet

The "documentation summary“ offers an overview of all technical documents of the main spindle drive controller and their contents.

The summary of the "additional documents“ lists all titles with their respective order numbers.

Change procedures

Designation of documentation up to present edition	Release-date	Coments
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DOK-DIAX01-RAC04******-PRJ1-EN-E1,44	Jul./97	First E-Dok

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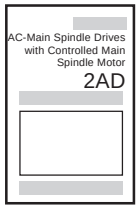
Dept ENA (KK, MR, FS)

Document Summary "AC- Main Spindle Drives with ...

Selection
(details, order)

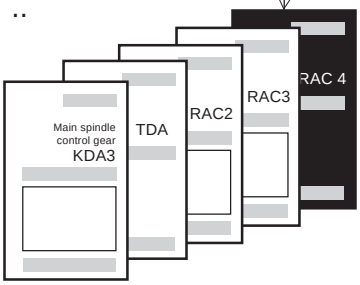


AC-Main Spindle Drives
with Controlled Main Spindle Motor 2AD

Selection Data
- Overview of the AC-Main Spindle Drive System
- Power ratings
- Application functions of the AC-main spindle drives
- Selection record and parts list
- Available versions

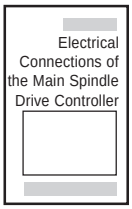
Project Planning
(Construction, Mounting, Installation)

This is the document you are looking at
..



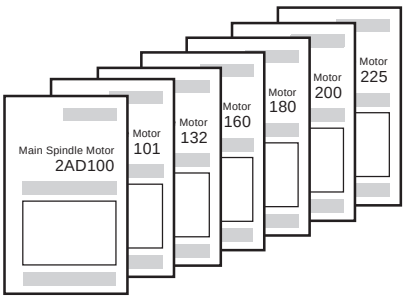
Main spindle drive controller

Project Planning
- Control cabinet plans
- AS programming module
- Delivery, storage, transport
- Mounting and installation guidelines



Electrical Connections of the Main Spindle Drive Controller

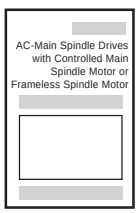
Project Planning
- General information on the electrical connections
- Drawings of the feedback and NC-connections of all main spindle drives
- Drawings of the power connections of all main spindle drives
- Plug accessories, convectioned cables



Main Spindle Motor

Project Planning
- Machine design plans
- Delivery, storage, transport
- Assembly and installation guidelines

Operation of the Main Spindle Drives
(Commissioning, Servicing, Diagnosing)

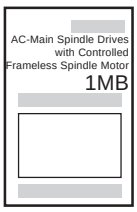


AC-Main Spindle Drives with Controlled Main Spindle Motor or Frameless Spindle Motor

Description of Application
- Starting up the AC-main spindle drives
- Using the drive controller
- The function of the drive controller
- Diagnosing and eliminating problems
- Parameters and interfaces overview

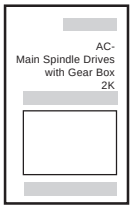
Figure 1: Document Summary

... controlled Main Spindle Motor or Frameless Spindle Motor"



AC-Main Spindle Drives with Controlled Frameless Spindle Motor 1MB

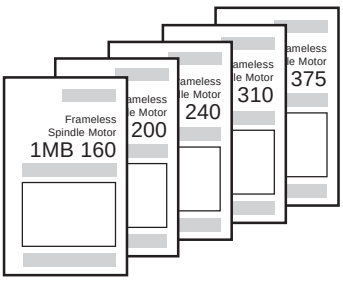
Selection Information
- Overview of the AC-Main Spindle Drive System
- Power ratings
- Application functions of the AC-main spindle drives
- Selection records and parts list
- Available versions

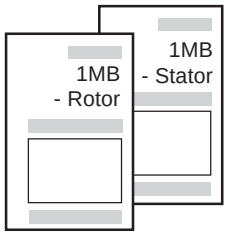


AC-Main Spindle Drives with Controlled Main Spindle Motor 2AD and Changeable Planetary Gear Boxes 2K

Selection Information
- Overview of the AC-Main Spindle Drive System
- Power rating
- Order guidelines

Selection (details, order)

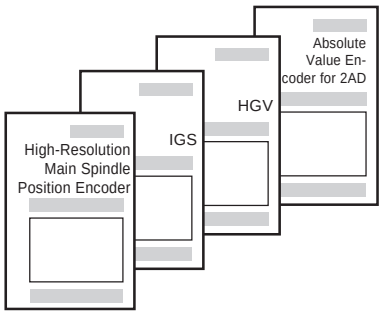




Frameless Spindle Motor

Project Planning
- Machine construction plans
- Integration into cooling system
- Electrical and coolant connections
- Delivery

Mounting Instructions
- Delivery, handling, transport
- Mounting
- Cooling guidelines



Additional Documentation

- High-resolution main spindle position encoder
- Incremental encoder output IGS
- Junction for high-resolutioin main spindle position encoder HGV
- Attachment absolute value encoder for 2AD 132, 2AD 160, 2AD 180

Project Planning (Construction, Mounting, Installation)

Operation of the Main Spindle Drive (Commissioning, Operating, Diagnosing)

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1. Presentation of the RAC 4.1 Main Spindle Drive Controller

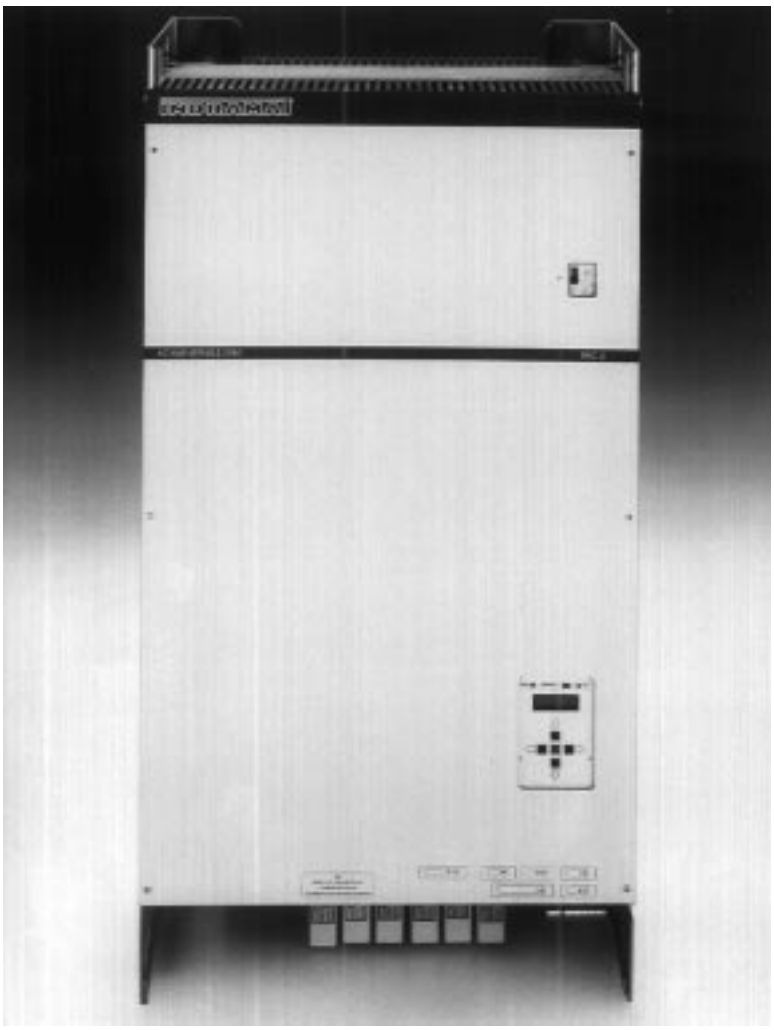


Figure 2: Main Spindle Drive Controller RAC 4.1

The main spindle drive controller RAC 4.1 provides intelligent digital control of INDRAMAT asynchronous main spindle motors 2AD and frameless spindle motors 1MB from 52 and to 93 kW continuous power motor output at the output shaft.

Main Spindle Drive

Drives implementing drive controller RAC 4.1 are characterized by high stiffness and an extensive speed range at constant power. This makes them particularly well-suited for use as main spindle drives on numerical controlled machine tools.

Spindle Positioning

In addition to the extensive range of speed variation, the AC-main spindle drive with RAC 4.1 also has an internal automatic position control loop and, upon receiving a signal, independently positions the spindle, e.g., for the purpose of changing a workpiece. Maximum resolution is 1/4 000 000 revolutions. The drive controller's internal automatic position control loop is closed either by motor feedback (with direct drive or gear 1:1), or by an additional, optional spindle feedback (change speed gear, belt gear).

C-Axis-Operation

The AC-main spindle drive with RAC 4.1 is also capable of processing the spindle as a servo-axis (C-axis) with extreme precision in the automatic position control loop. The main spindle drive is equipped with high-resolution feedback for the low speeds which this requires. The drive controller acknowledges rotor position by using a resolution of maximum 1/4 000 000 revolutions. This means that even the lowest speeds can be precisely controlled.

Drive Controller for Direct Mains Connection

The RAC 4.1 can be directly connected to three-phase supply networks with 3*400V, 50Hz, +/-15% or 3*460V, 60Hz, +/-10%. Mains contactor and emergency shutdowns are integrated. The energy regenerated during braking is fedback into the three-phase supply network. This also happens in emergency off situations. In the event of a power failure, the drive with the RAC 4.1 can shutdown the main spindle by using d.c. current braking.

Ventilation

The heat sink for the power electronics and the fan have been built into the housing of the main spindle RAC drive controller. The cooling air is guided through the unit in an air shaft.

The RAC drive controller can be cooled by using either outside or inside control cabinet air. Either is possibile in every RAC. The necessary structural change is simple and can be performed without accessories.

Cooling with Air Inside the Control Cabinet

The cooling air stream is drawn into and blown out of the cabinet from within.

Cooling with Air Outside the Control Cabinet

The cooling air stream is sucked into and blown out of the control cabinet through cut-outs in the backwall of the control cabinet. The heat due to energy loss is fed into the control cabinet's outside air.

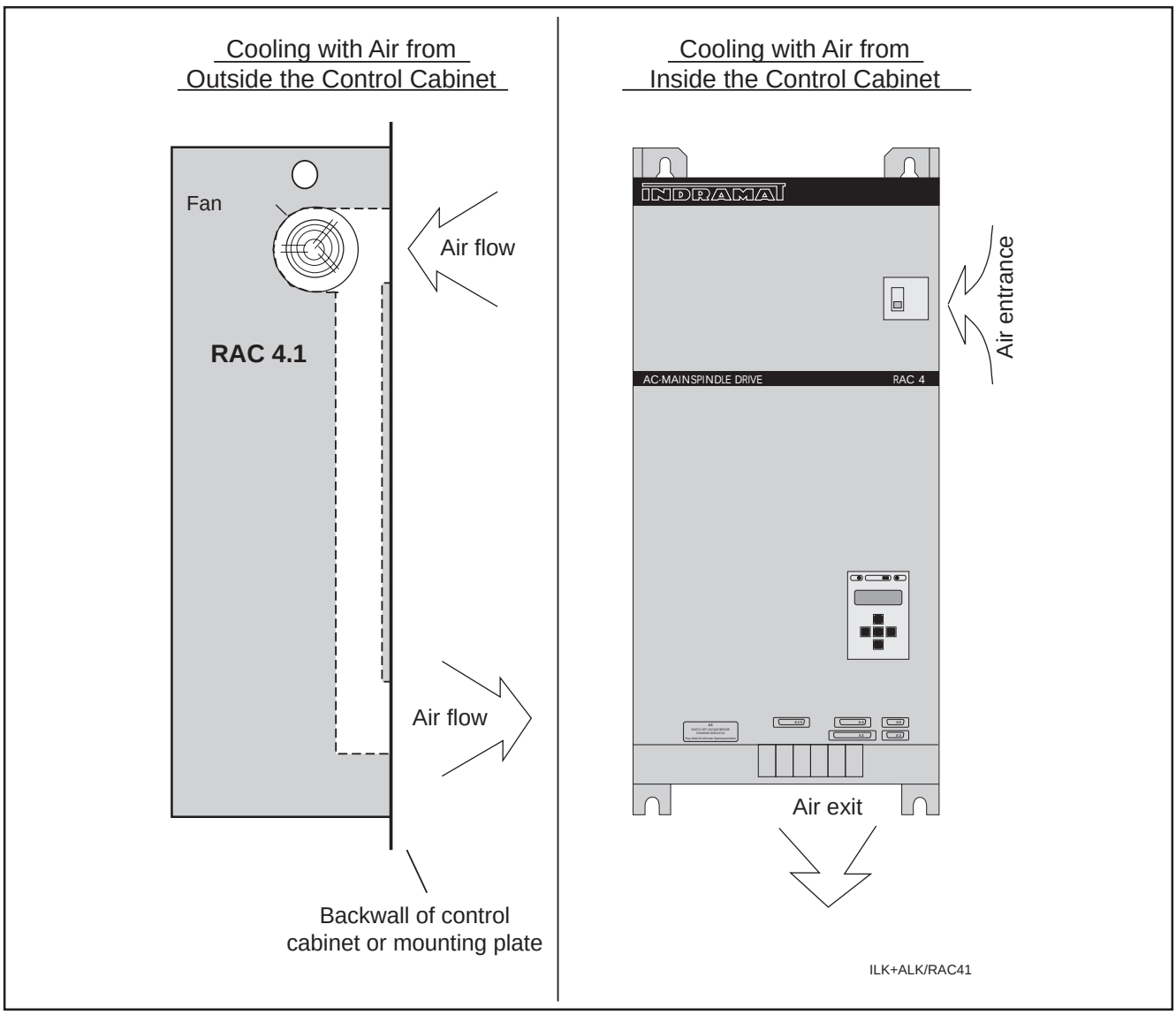


Figure 3: Possible Cooling Methods in the RAC 4.1

Hose Cooling

If for structural reasons it should not be possible to have cut-outs in the backwall of the control cabinet, then the RAC 4.1 drive controller can also be equipped with hose ventilation.

The cooling air is sucked in over a hose outside of the control cabinet and then blown out again.

Mounting parts are needed if hose cooling is used. These are supplied as accessory kits. The hose itself is not included in the accessory kit, but can be ordered from INDRAMAT.

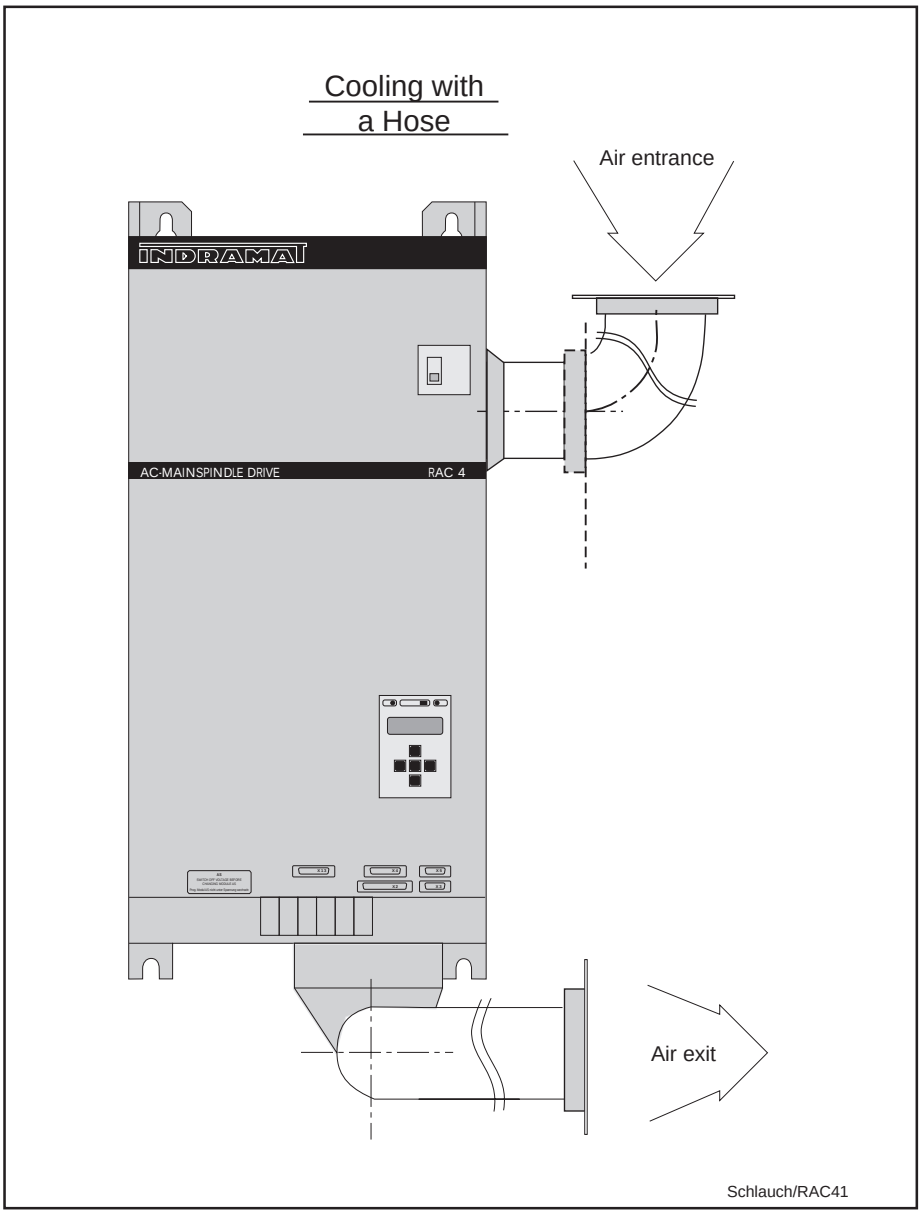


Figure 4: Cooling the RAC 4.1 with a hose

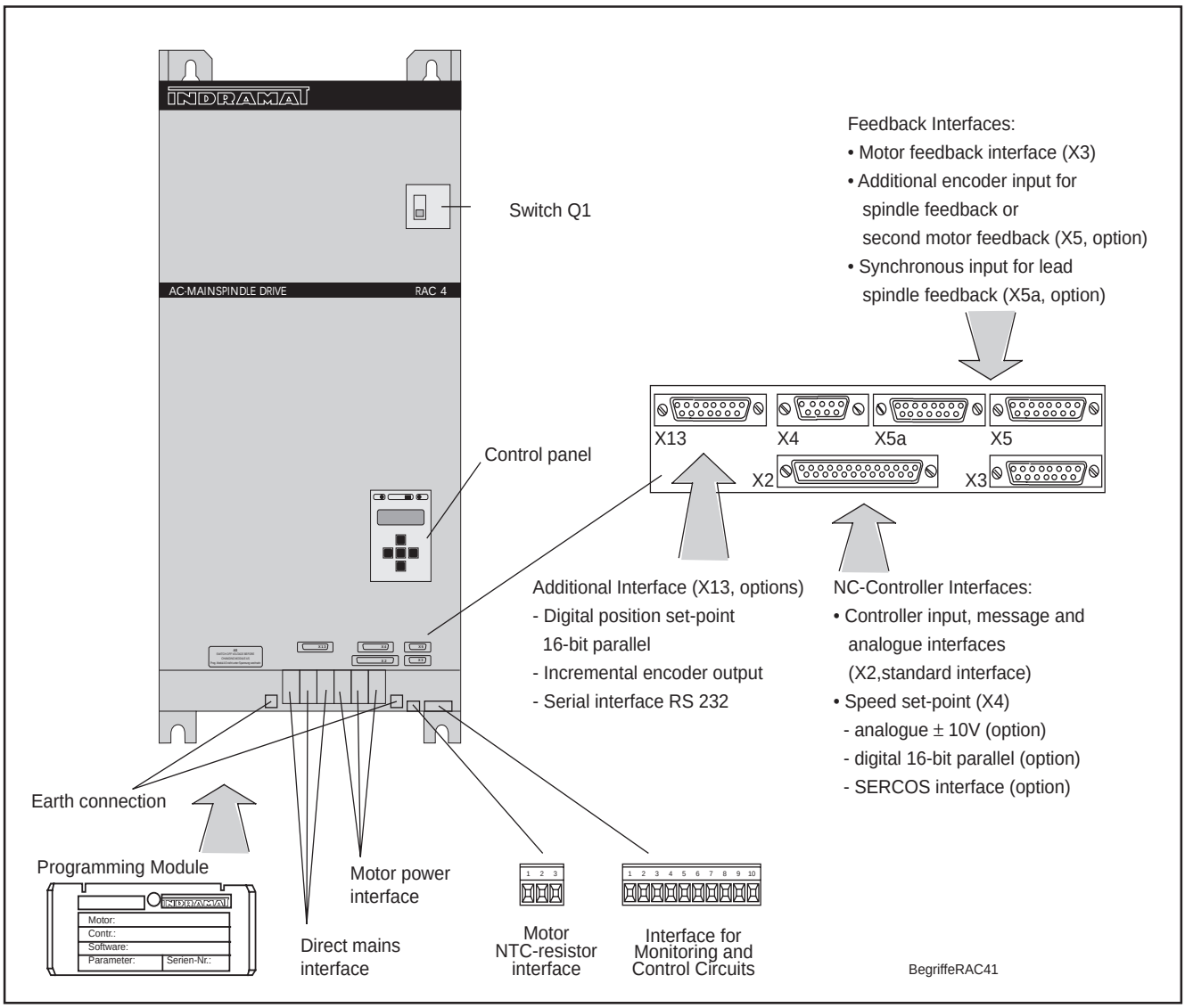


Figure 5: Allocation of Terms on the RAC 4.1

Programming Module

The individual parameters, which installation and application require, are programmed by means of a keypad on the control panel on site at the time when the unit is commissioned. These parameter values are stored together with the motor adaptation parameter values on the plugged-in programming module.

In the event that servicing becomes necessary, then only the controller needs to be exchanged. The same program module is used in the new control gears. The drive features are stored on the programming module and are immediately available for use.

Interface Options

Speed Set-Point

The controller can be delivered with different interfaces for the speed set-point:

– Analogue speed set-point
  +/- 10V for connection on conventional NC's

– Digital speed set-point
  16 bit parallel to be connected to PLC's, good for long distances and low speed set-point values.

– SERCOS Interface
  Serial real time communication with NC control for speed, position and torque set-points and actual values including the parameter handling.

Additional encoder synchronization input

For the adaptation of a spindle feedback for position controlling in the controller, an additional encoder input is available. For the synchronization of the spindle, an additional encoder input and a synchronization input (connection of the master spindle feedback) are available.

Additional Interface

The RAC 4.1 drive controller offers, above and beyond that, an optional additional interface which can be delivered in the form of

– an incremental encoder output
  for position control through numeric control in C-axis mode or for screwing, tapping

– a serial interface
  for storing and loading parameters with a PC

– Digital position set-point input
  parallel 16-bit for 3600 positions which can be selected through PLC.

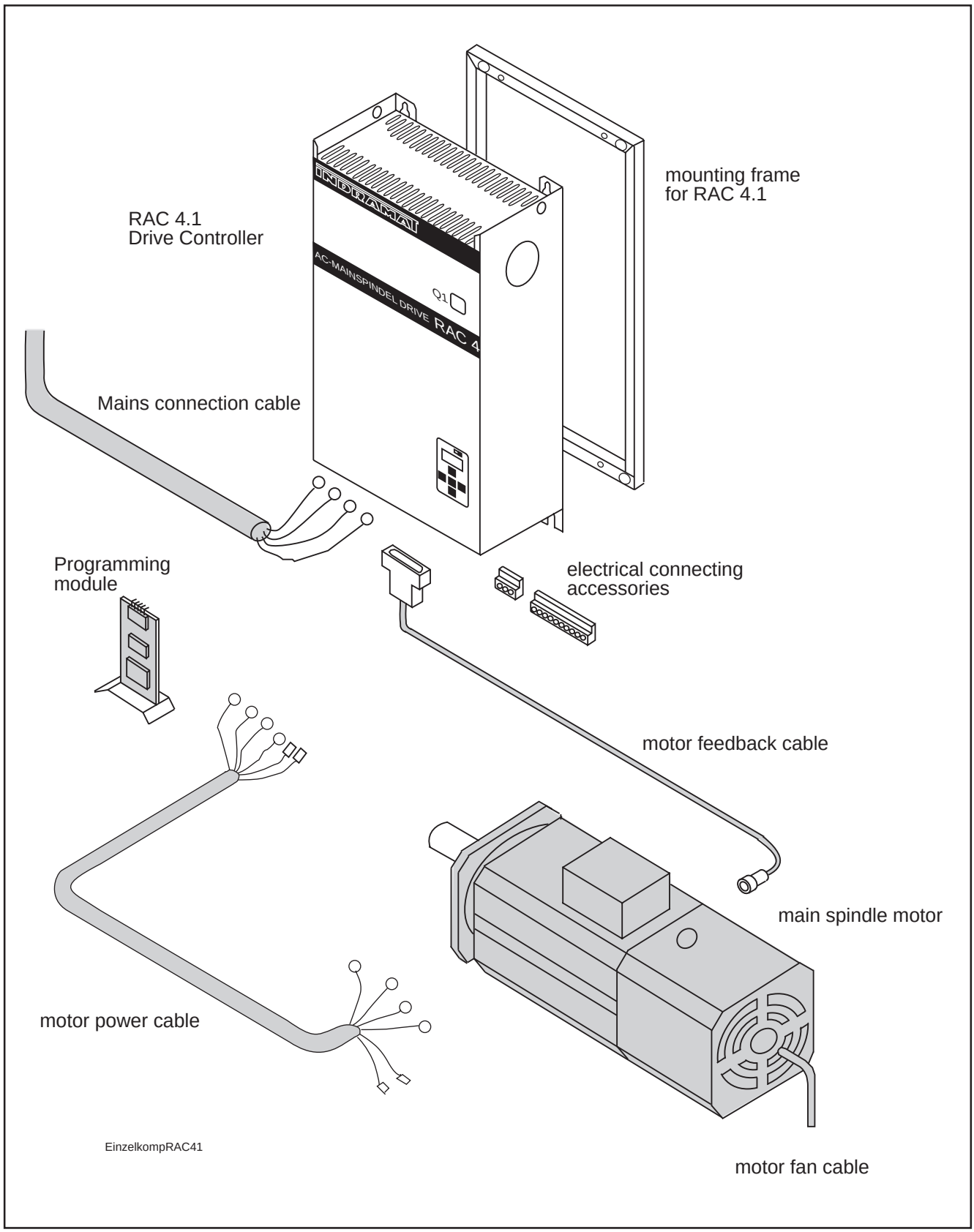


Figure 6: Individual components of a main spindle drive with allocation of terms.

2. Planning the Control Cabinet

The information for structurally integrating the main spindle drive controller RAC 4.1 is broken down into

– operating conditions

– mechanical data

– thermal data

– electrical data

– technical data/type code

2.1. Operating Conditions

Ambient Temperature

The values listed in the selection data of the main spindle drives are valid without restriction if the controller is being operated within an ambient temperature range of +5 up to +45°C. Maximum permissible ambient temperature is +55°C. The graph in Figure 7 depicts the corresponding reduction in values.

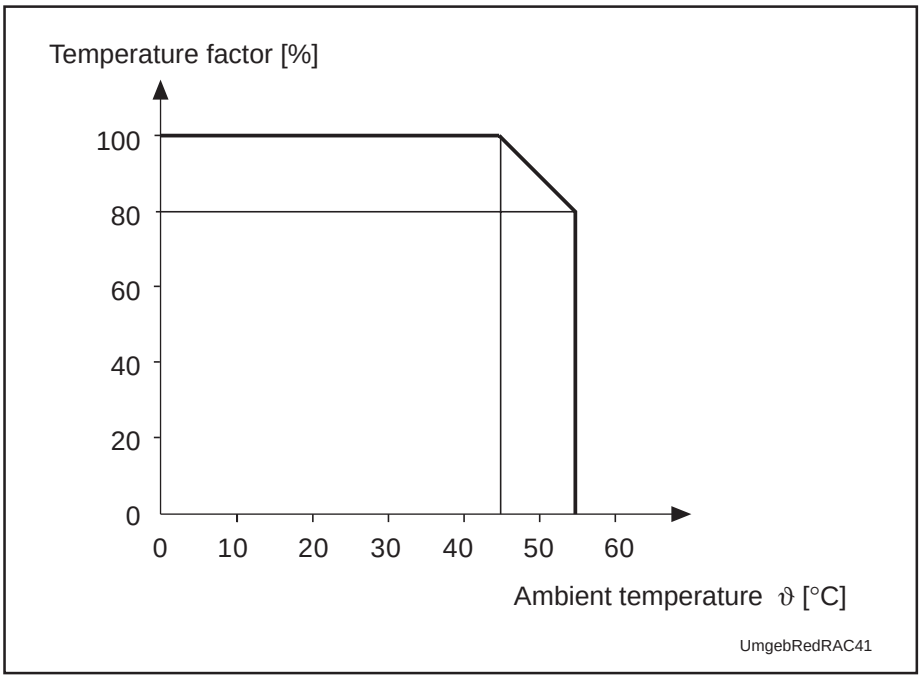


Figure 7: Ambient temperature-dependent reductions in drive data.

Mounting Altitude

Maximum mounting altitude is 1000m above sea level. The values for rated torque or respectively rated power as listed in the selection data for main spindle drives are reduced with greater altitude. The graph in Figure 8 depicts this reduction.

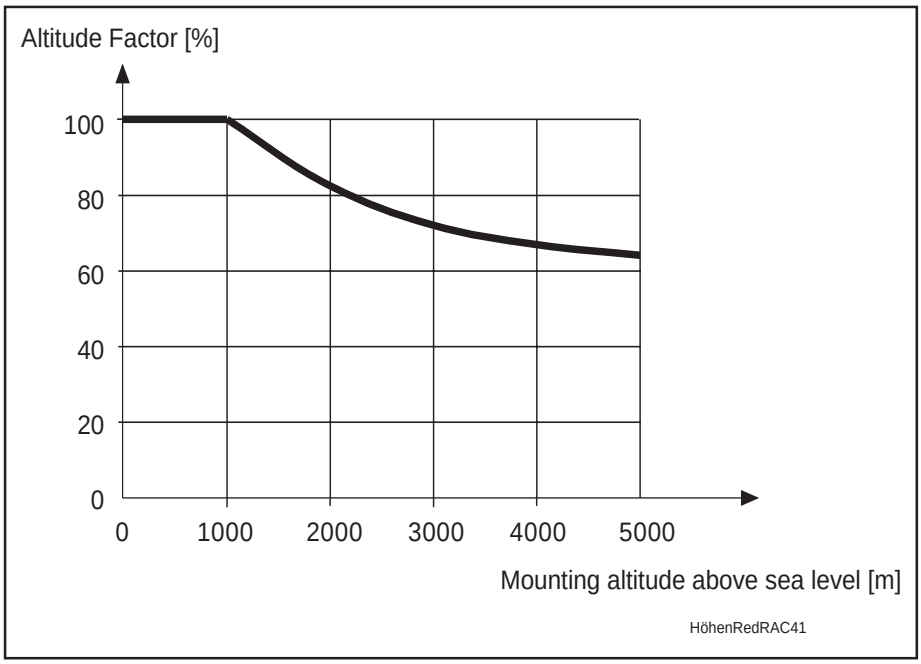


Figure 8: Altitude-dependent reduction of the drive data.

Ambient Permissible Humidity

Maximum permissible humidity corresponds to humidity class F, according to DIN 40 040. This means that the controller can be operated in humidity-endangered rooms such as workshops, as well as in cold, moderate and dry-warm climactic regions. Mean relative humidity cannot exceed 70% in the most humid month of the year! Beware of condensation water!

Type of Protection for RAC Controllers

IP 10 is the type of protection. This is in accordance with EN 60 529 (DIN VDE 0470). This means that the controller is protected against penetration by foreign objects greater than 50 mm in diameter.

The controller is not protected against:

– water and

– deliberate penetration, e.g., by a hand, but it does keep larger body surfaces out.

The RAC 4.1 has been manufactured, in accordance with DIN VDE 0160, Para. 5.5.1 and 6.5.1.3, for installation into a control cabinet or closed housing. Sufficient protection against contact must be implemented by engineering for the respective control cabinet design in accordance with the safety guidelines for the specific application. (For industrial equipment, e.g., EN 60204 / DIN VDE 0113, Section 1.)

Type of Protection for the Control Cabinet

The type of protection needed for the control cabinet is not influenced where the RAC drive controller is cooled with air inside the control cabinet.

The type of protection needed for the control cabinet is influenced when the RAC drive controller is cooled with outside air, as the air current is guided through the control cabinet through cut-outs in the backwall.

An assembly according to guidelines, (Chapter 7), means that the interior of the control cabinet is protected with IP 54. IP 24 is the type of protection used for the fan (see Figure 3).

2.2. Mechanical Data

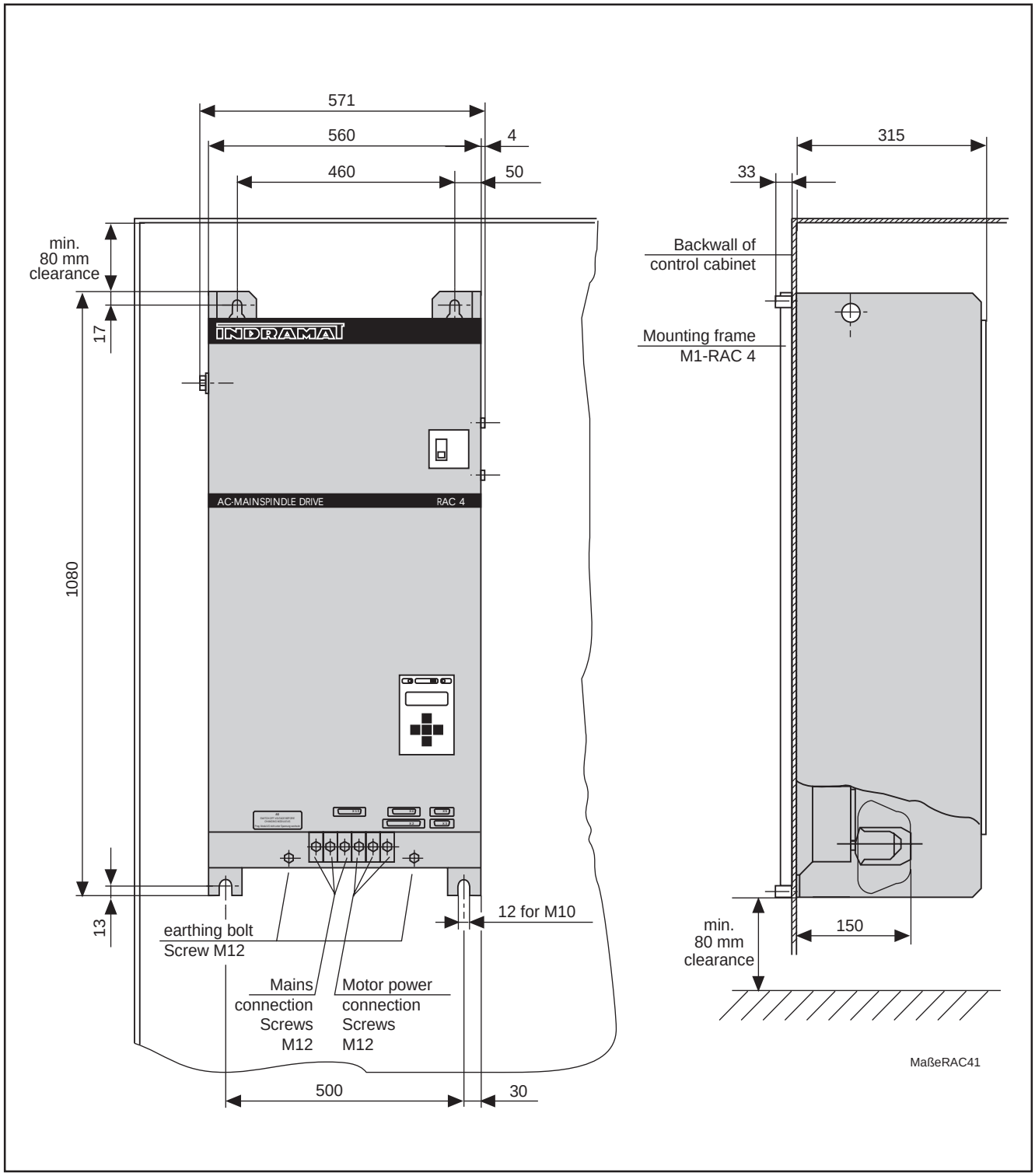


Figure 9: Dimensional data for RAC 4.1 main spindle drive controller.

The controller should only be operated in the position depicted!

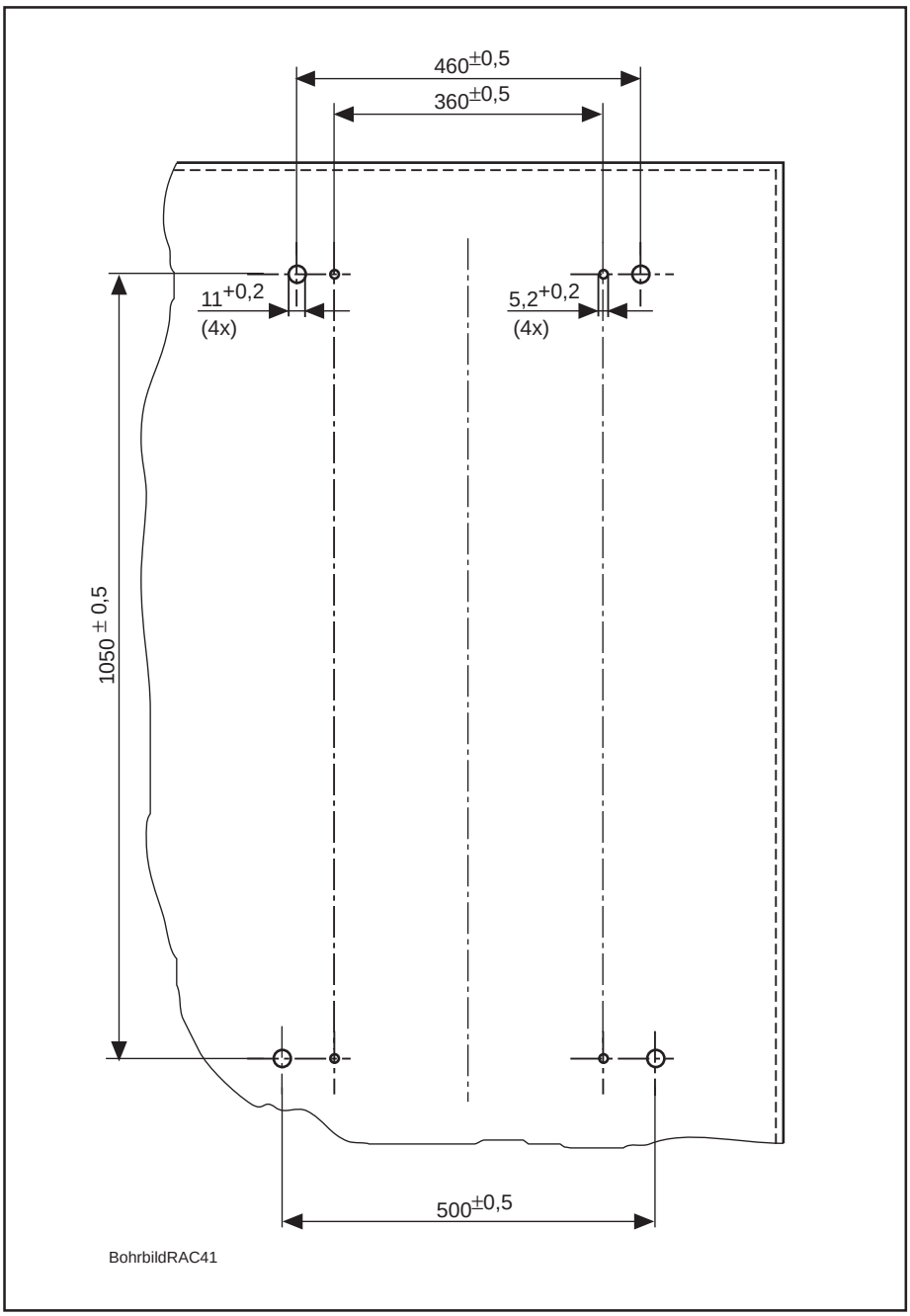


Figure 10: Drill diagram for backwall of control cabinet

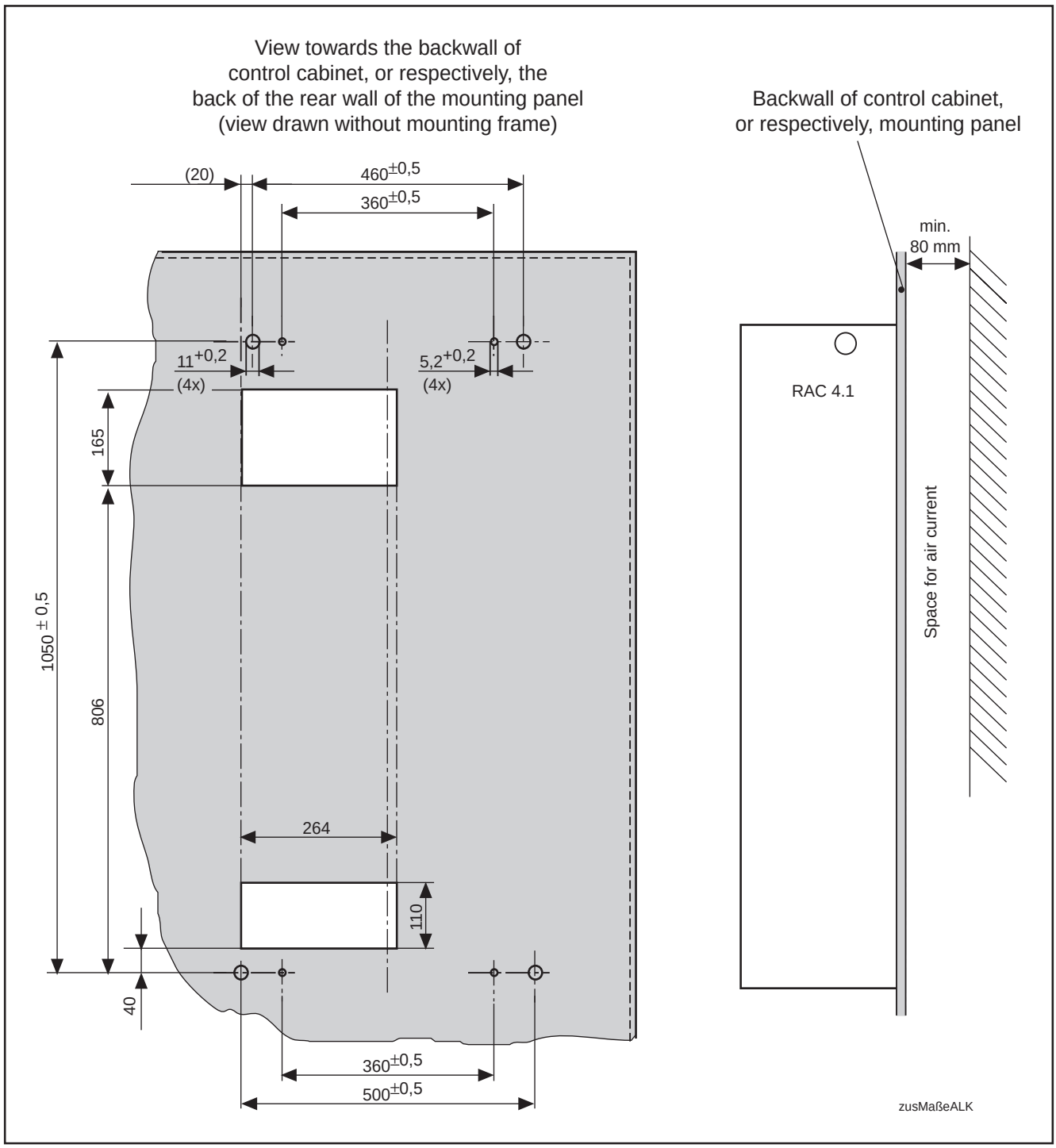


Figure 11: Additional dimensions for control cabinet cooling with outside air.

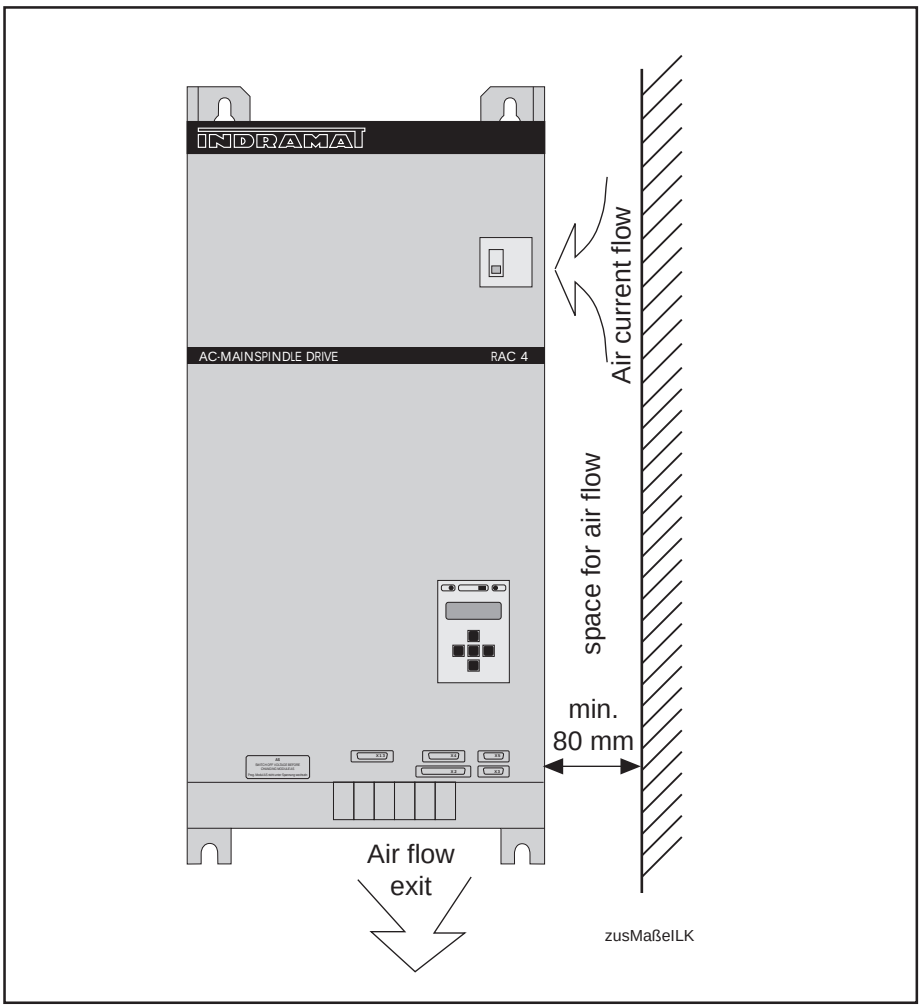
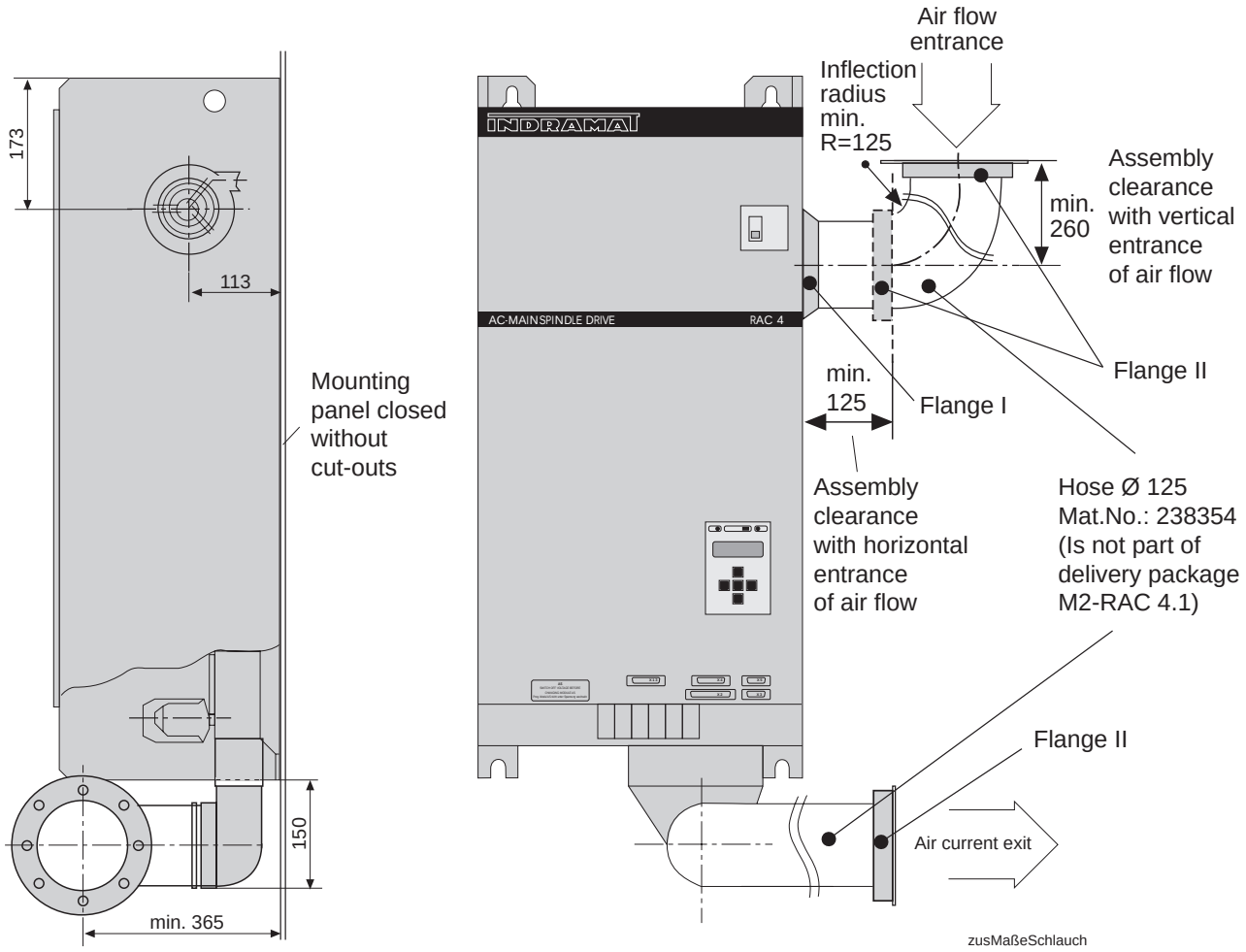


Figure 12: Additional dimensions for control cabinet cooling with inside air.



All parts needed for mounting, including screws and gaskets, are part of the mechanical package M2-RAC 4.1 automatically delivered.
INDRAMAT can supply the hose upon request.

Figure 13: Additional dimensions for cooling with hose.

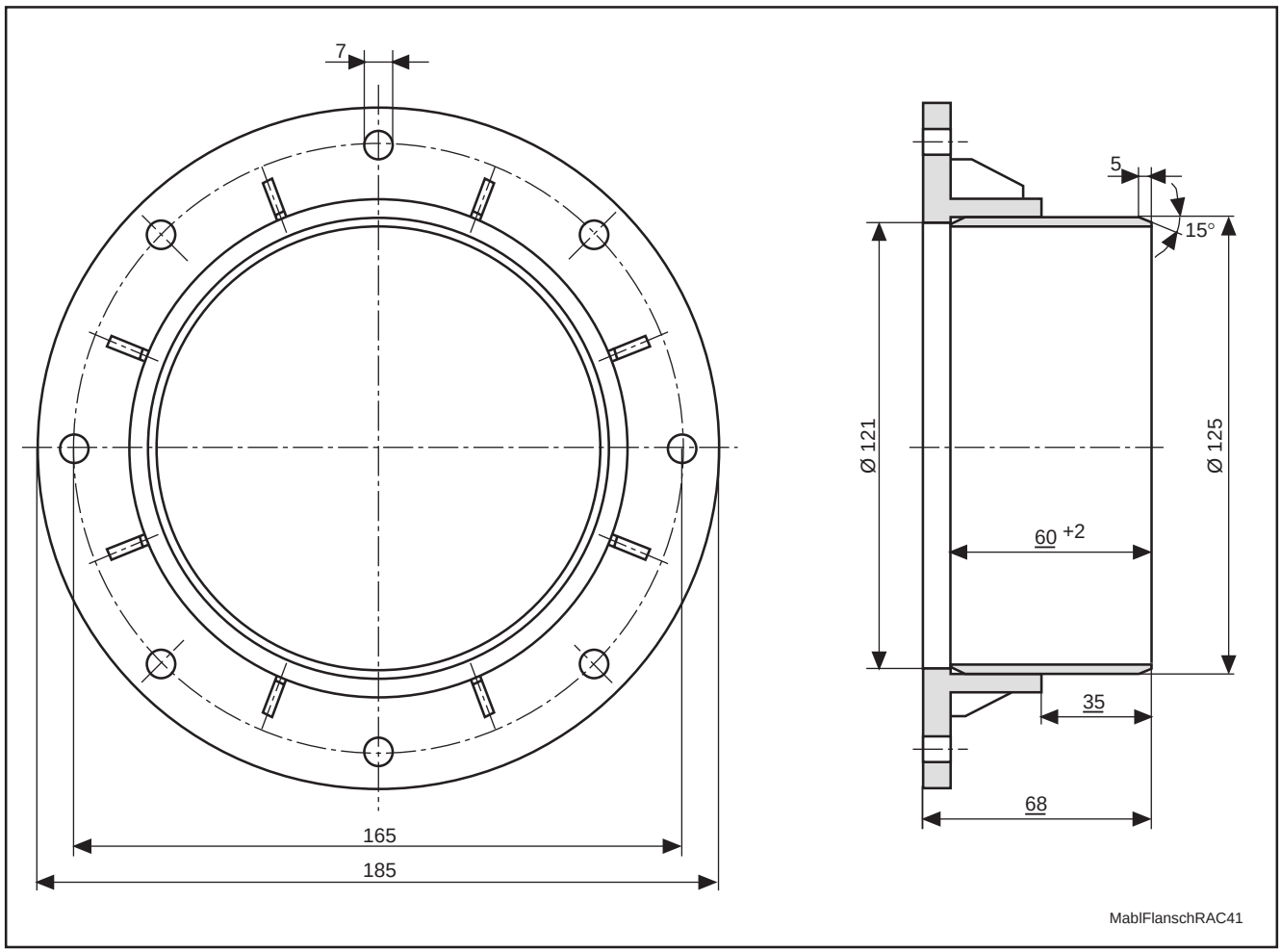


Figure 14: Flange II Dimensions Sheet for Cooling with a Hose.

2.3. Thermal Data

Power Dissipation

Drive controller RAC 4.1 emits heat during operation via the air slits at the top and the heat sink built into the unit.

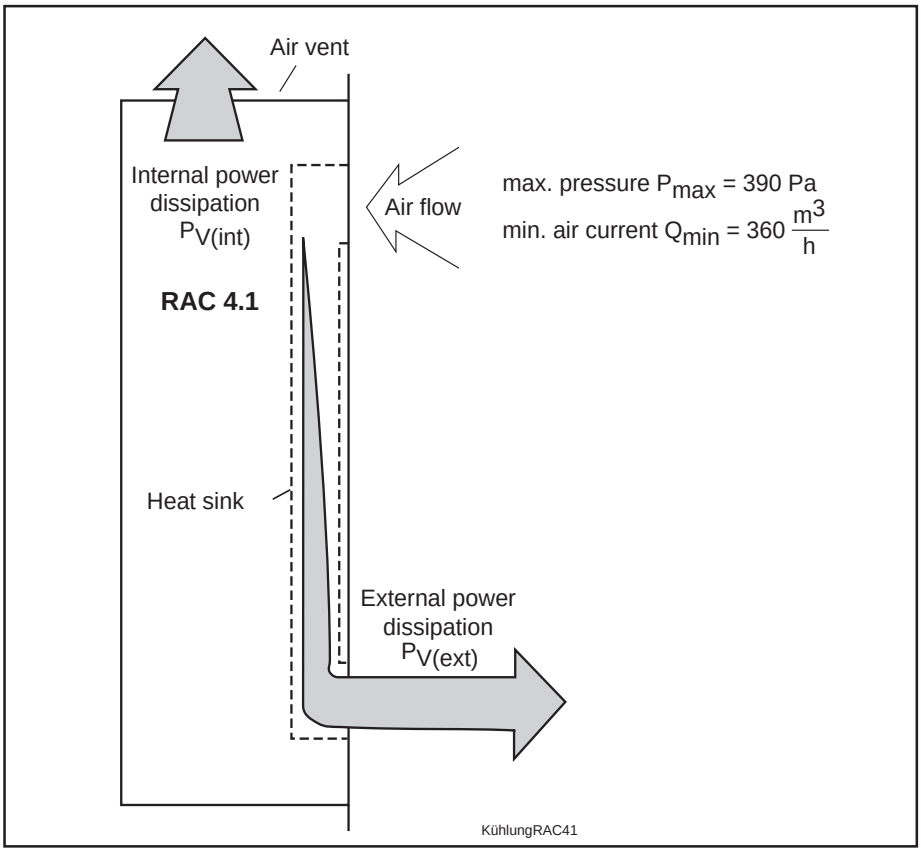


Figure 15: Cooling the RAC 4.1 Drive Controller

The external and internal power dissipation produced by controller RAC 4.1 is workload-dependent. For the dimensioning of either the control cabinet, or respectively, ventilation, it is sufficient to calculate power dissipation dependent upon rated power of the main spindle motor used.

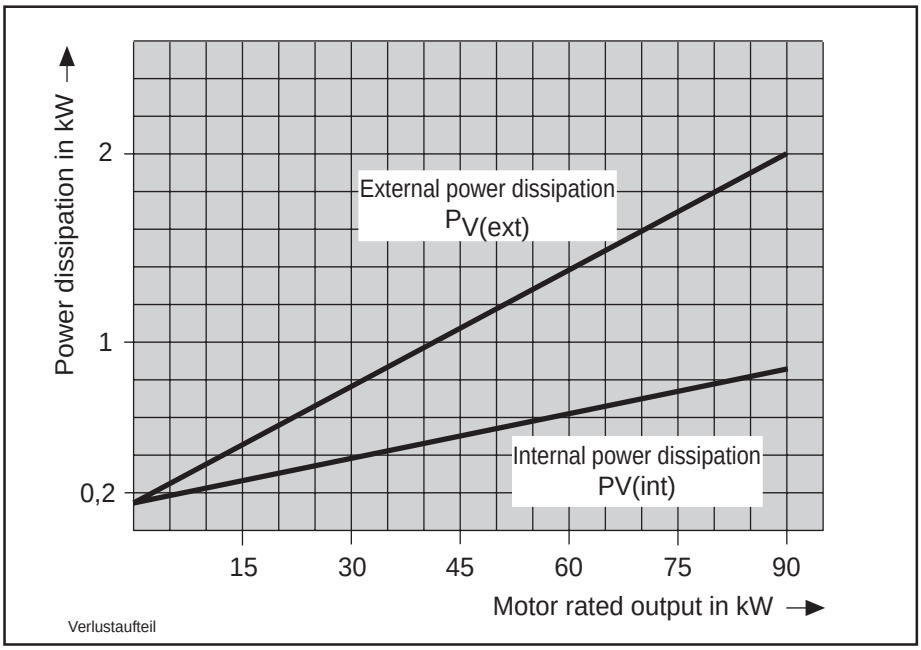


Figure 16: Division of power dissipation internal - external

The unit can be cooled using the air from either inside or outside the control cabinet. The ventilating air for the heat sink remains, dependent upon mounting type, within the control cabinet or it is sucked in from outside and then blown out (the principle of the heat exchanger).

The unit is automatically delivered with outside air cooling. Should either inside air cooling or hose cooling be used, then the unit must be structurally altered (see Chapter 7).

The dimensions of the air shaft must be taken into consideration if air is to be drawn in and out over an air shaft (required cooling air flow).

If hose cooling is used, then the hoses should be kept as short as possible with inflections no greater than 90° per hose.

As a safety measure, the values for cooling air flow Q and the maximum permissible excess pressure Pmax should be controlled.

To avoid the danger of overheating, protect the air shafts and heat sinks against dirt!

2.3.1. Guidelines on the Use of Cooling Devices on Control Cabinets

Controller RAC 4.1 can only be operated with an ambient temperature of up to 45°C without reduction in drive data. In order to be able to maintain these ambient conditions within the control cabinet, it may be necessary to cool the interior air of the control cabinet.

Humidity and condensation water endanger the installed controller if the cooling devices used are not properly installed!

Danger from Dew

Humid air enters the control cabinet and condenses on the controller as it cools down!

Danger from Condensation

The condensed water, continuously produced in cooling devices, can drip into the controller or be sprayed into the cooling air current, if the cooling device has not been installed properly.

Proper Implementation of Cooling Devices

Avoiding Condensation

– Only well-sealed control cabinets should be used in conjunction with cooling devices. This helps avoid condensation caused by hot, humid outside air which could otherwise enter the cabinet!
– If a control cabinet is operated while a door is open (commissioning, servicing, etc.), then it must be warranted that the controller, at no point in time after closing the doors, is cooler than the air inside the control cabinet, as otherwise condensation could form. For this reason, the cooling device should continue to run even when the unit has been shutdown until the temperature of the control cabinet air and the installed equipment remain at the same level.
– The cooling device should be set at a temperature of 40°C., no lower!
– Cooling devices with follow-up temperatures should be set in such a way that the temperature of the air inside the control cabinet is less than 2°C. below the temperature of the outside air. Set temperature limit at 40°C.

Avoiding Moisture from Dripping or Spraying

– Cooling devices should always be so arranged that any condensed water produced cannot drip onto installed controllers. Cooling devices located on the top of control cabinets require a special control cabinet design, (see Figure 17)!
– The cooling device should always be arranged in such a way that the blower of the cooling device cannot spray the condenser water, that collects after a shutdown, onto the controller (see Chapter 18)!

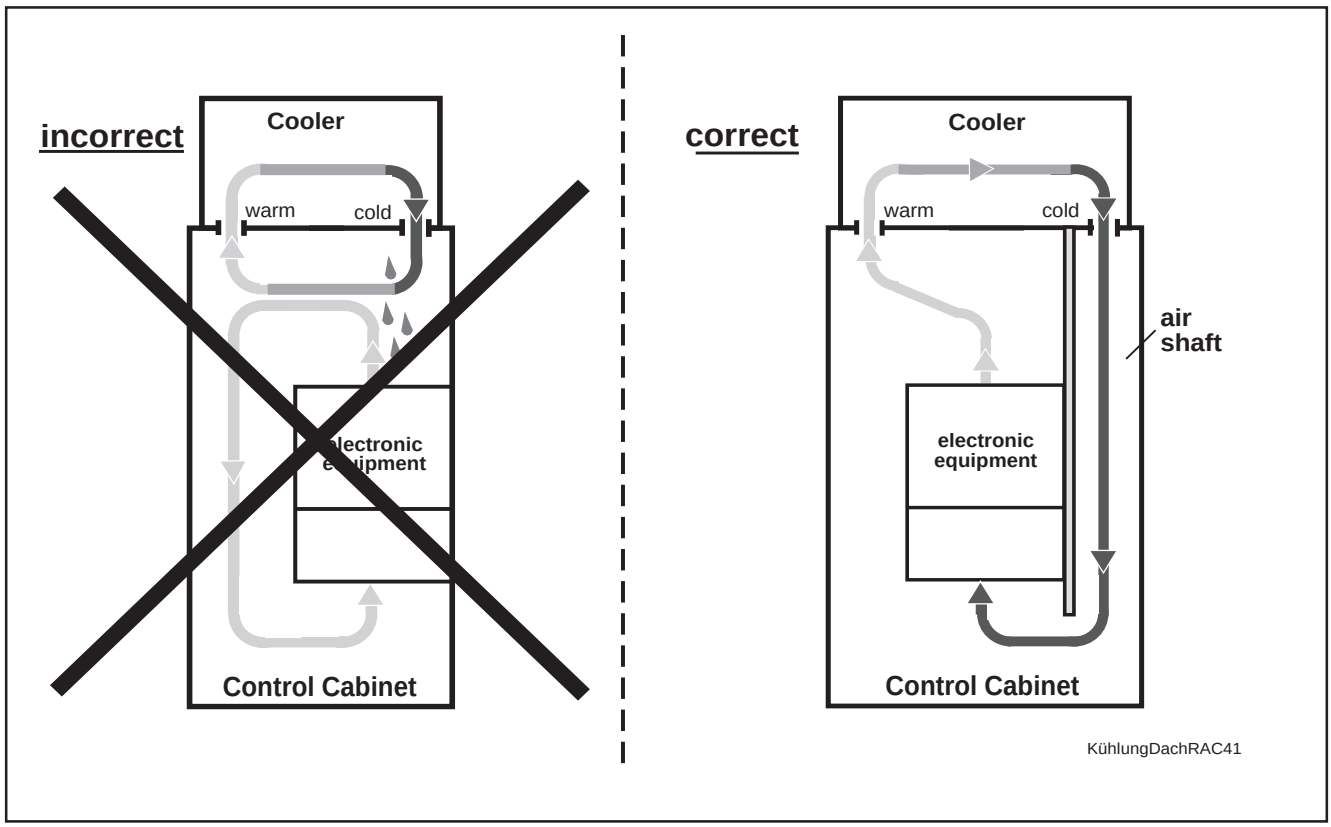


Figure 17: Cooler mounted on top of the control cabinet

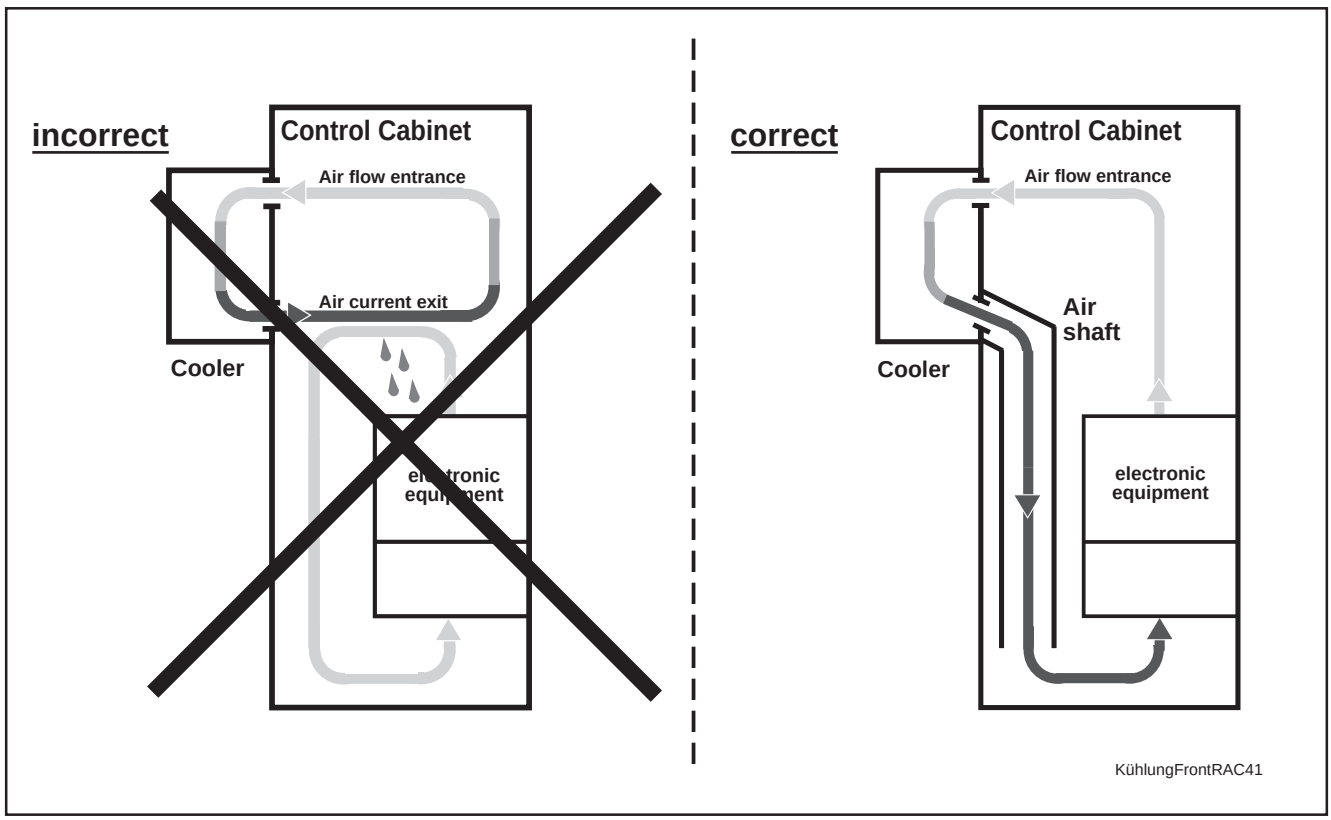


Figure 18: Cooler mounted to the front of the control cabinet.

The cooler must not be permitted to drip condensation water onto the installed controller!
Attention must be paid to correct cooler temperature!

2.4. Electrical Data

Connection Diagram (schematic)

The connection diagram depicted in Fig. 19 is schematic in nature. It is the checklist for all electrical connections needed to operate a main spindle drive.

The electrical connections of INDRAMAT's main spindle drives are standardized to keep the range of cables offered limited.

There are three categories of electrical connections for all of INDRAMAT's main spindle drives:

– feedback and NC connections

– power connections

– controller-dependent connections

Connection Diagrams for Feedback, NC and Power Connections

The feedback and NC connections and the power connections (mains connection, motor power connection) have, independent of the main spindle controller, identical plug and terminal assignments. A summary of these connection diagrams can be found in document „Electrical Connections of the Main Spindle Drive; Planning and Design“ (Document No. 209.0042.4111). These documents are an absolute necessity when laying-out the unit's connection diagrams!

Connecting the control-dependent circuits

In addition to the already mentioned electrical connections, mains contactor controls and monitors, as well as an evaluation of the ready-to-operate contact are also required so that the RAC 4.1 drive controller can be tied into the control circuit of the control cabinet. These connections are specific to all RAC controllers. They are connected via terminal strip X15 (also see Figure 23).

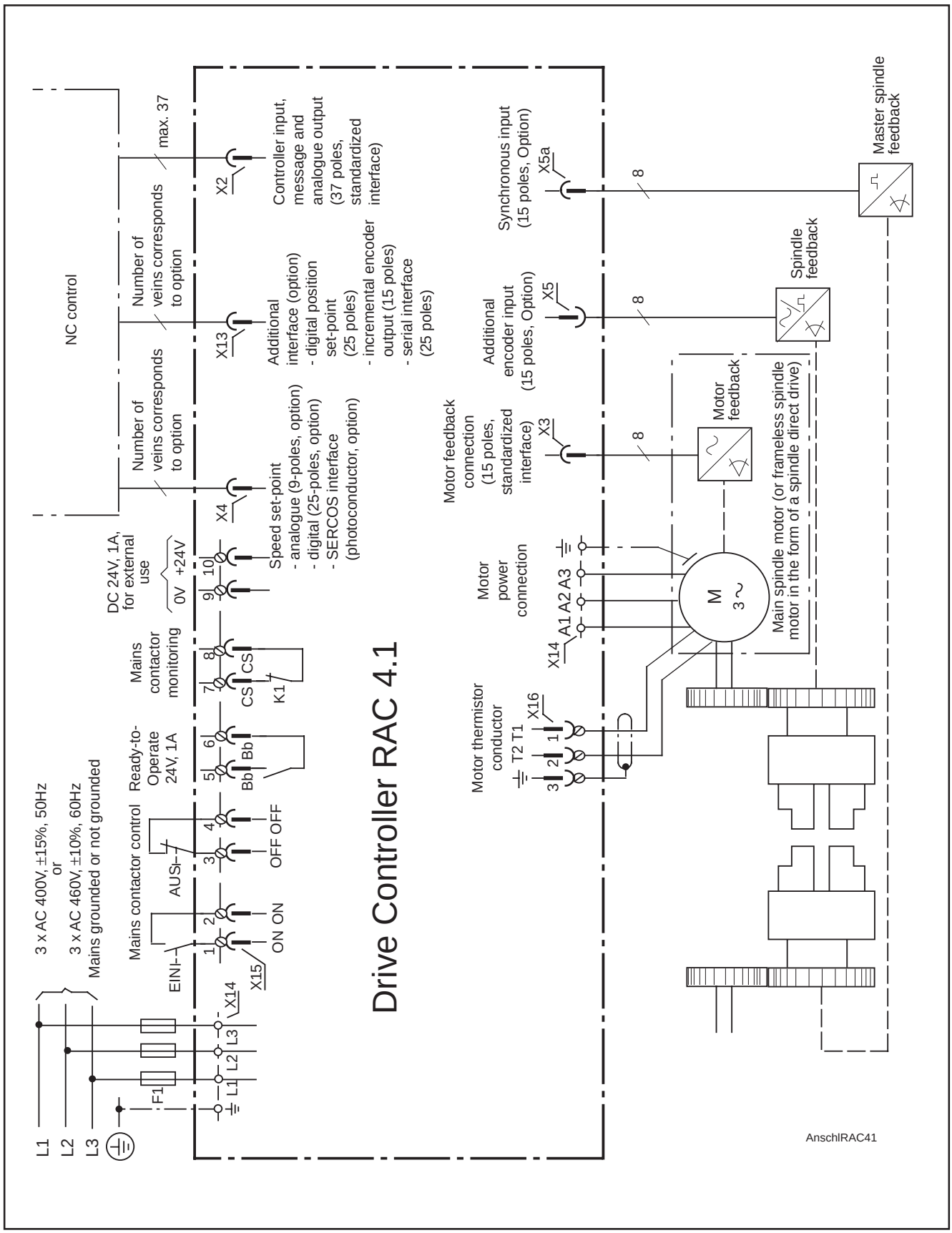


Figure 19: Schematic Connection Plan for the RAC 4.1

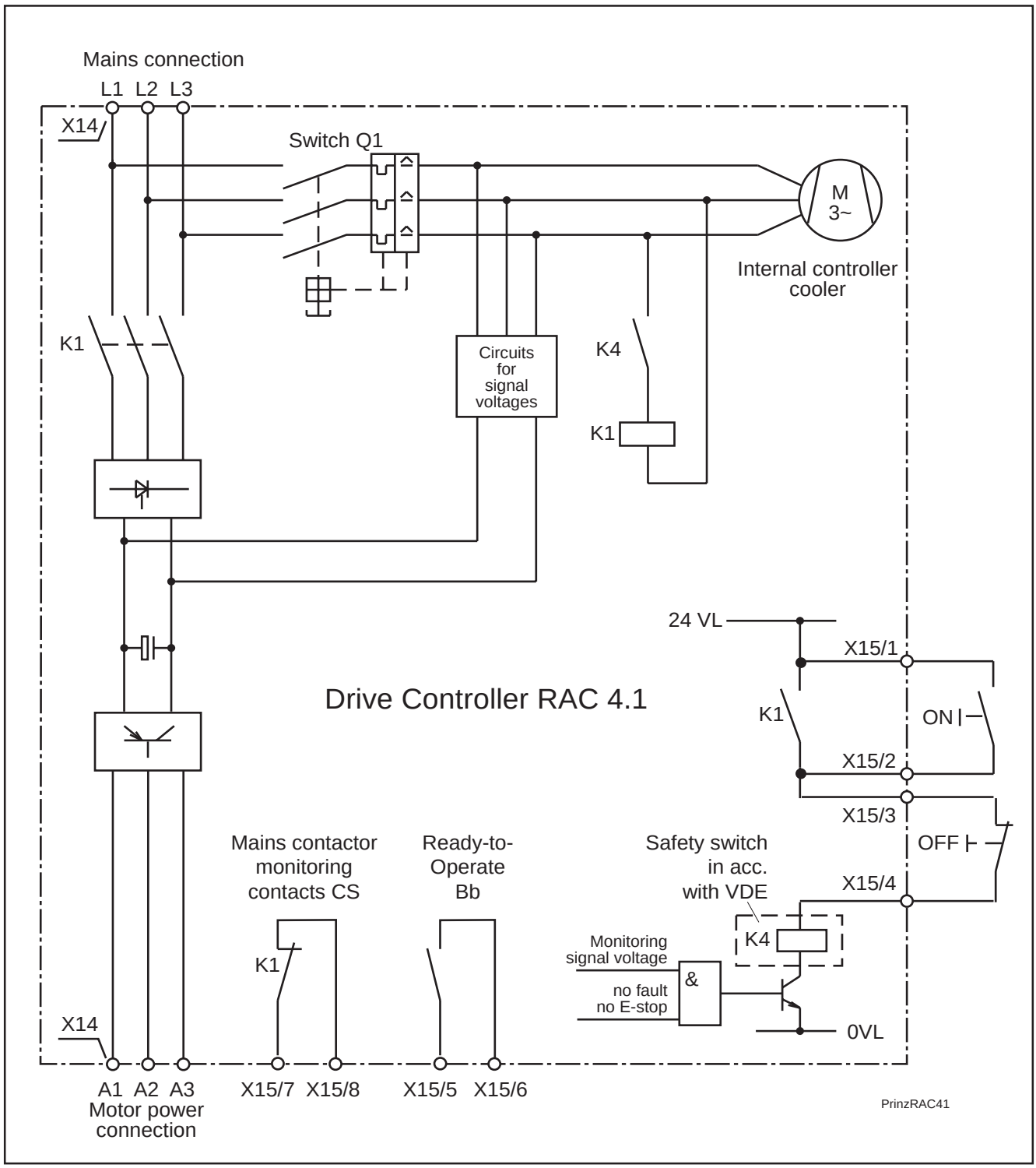


Figure 20: The RAC 4.1's Principle Circuit Diagram of the Control Circuit and the Power Section

Conditions for Bb ready-to-operate, see documents
„AC-Main Spindle Drive with Controlled Synchronous Motor or Frameless Spindle Motor - Description of Application", doc. no. 209-0041-4109.

The safety circuit, in accordance with VDE, is a relay combination of two auxiliary relays with forcibly actuated contacts which have been designed in such a way that if one of the relays should become faulty, the shutting down of mains contactor K1 is guaranteed, and it becomes impossible to turn it back on. As a result, an additional mains contactor is not required for a safe mains separation in the mains lead of the controller!

Feedback and NC Connections

The interfaces of all feedback and NC connections are, independent of the main spindle controller, identical in terminal assignment and designation. They can be found not only in the document entitled „Electrical Connections of the Main Spindle Drive“ (Doc. no. 209.0042.4111), but also in the document entitled „AC Main Spindle Drives with Controlled Asynchronous Motor or Frameless Spindle Motor; Description of Application“ (doc. no. 209-0041-4109).

The functions and the signal levels linked to these interfaces are also identical independent of the main spindle controller. These can be found in the latter document.

The required electrical connections are dependent upon

– the functional options of the controller selected.

Figure 21 depicts how the interfaces of each main spindle controller (standard interfaces) are assigned by means of a text string to the respective connection plan. Figure 22 depicts the assigning of the functional options of the controllers to the respective connection plan with the use of a text string.

The connection plans for feedback and NC connections can be easily located in the document „Electrical Connections of the Main Spindle Drive; Projection“ by using the text string (last column of Figs. 21 and 22). The index of this document lists this text string.

Designation of Type: RAC 4.1- • • • - • • • - • • • - • • • - • •

See document "Elec. Conn. of the Main Spindle Drives"

Standard Interfaces	Designation	Connections terminals	Text string
NC Interface	Controller input, message and analogue output	X2, 37-pole	IKS 610
Feedback Interface	Motor feedback connection	X3, 15-pole	IKS 315

Figure 21: Allocation of the Standard Interfaces in the Electrical Circuit Diagram of the Feedback and NC Connections

Designation of Type: RAC 4.1- • • • - • • • - □□□ - • •

Functional Options

Functional Codes	Code	Designation	Connecting terminals	Circuit Diagram See doc. "Elec. Conn. of the Main Spindle Drives" Text string
□□□ Speed set-point input (type key field 6)	A	analog	X4, 9-pole	IKS 613
	D	digital 16 bit-parallel	X4, 25-pole	IKS 612
	L	SERCOS-interface	X4, fiber optic cables	IKO
□□□ additional encoder input (Type key field 7)	O	without additional encoder input		
	P / Y	with additional encoder input	with high-resolution INDRAMAT encoder (~) X5	IKS 312
			15-poles with incremental encoder (⎍)	IKS 327
		Synchronous input	X5a, 15-poles (⎍)	master spindle feedback
□□□ Additional interfaces (type code field 8)	O	none		
	D	digital position set-point	X13, 25-pole	IKS 612
	I	incremental encoder output	X13, 15-pole	IKS 323
	S	serial interface RS 232-C	X13, 25-pole	IKS 016

Figure 22: Allocation of functional options of the controller to the electrical connections in the unit and the circuit diagram of the feedback and NC connections.

Controller-Specific Connections

There are special plug-and-socket connections for tieing the controller into the control circuit of the control cabinet and for connecting the motor's thermistor conductor. They are included in electrical connecting accessories E1-RAC.

The electrical connecting accessories consist of the following parts:

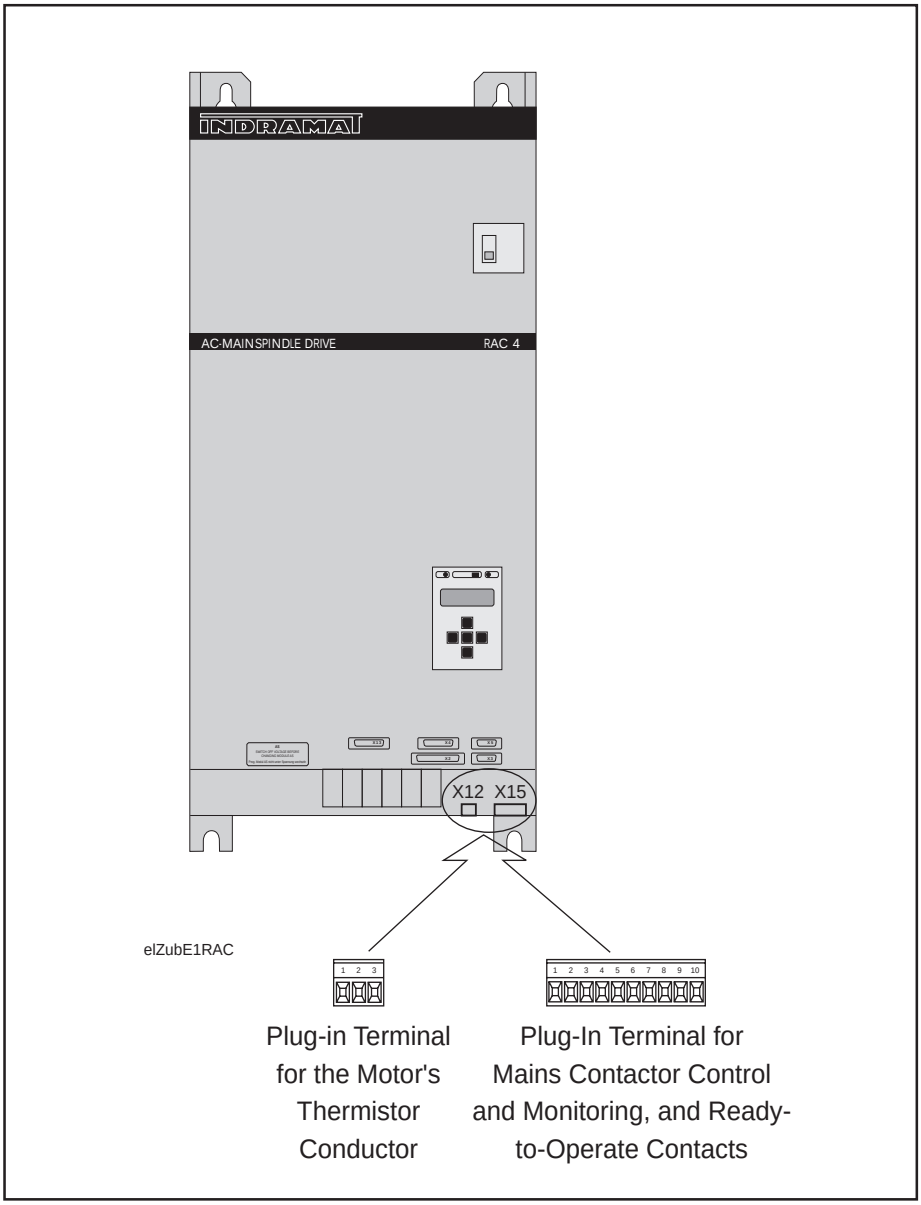


Figure 23: Electrical Connecting Accessories E1-RAC

Power Connections to the Motor

Connection plans and the conductor cross sections can be easily located using the text string (last colum of Figure 24) listed in the document entitled „Electrical Connections of the Main Spindle Drives; Planning and Design“. The key word index of this document lists this text string.

The conductor cross sections are dependent upon the motor’s rated current using drives which permit motor overload over short periods of the duty cycles.

Drive combination: RAC 4.1- • • • - • • • - • • • - • • • with ...	
...main spindle motor	Circuit plan see Doc. "Elec. Conn. of the Main Spindle Drive" text string
2AD 180 C 2AD 180 D 2AD 200 C 2AD 225 C	Connection 2AD 180
1MB 375 D	Connection 1MB to RAC

Figure 24: Allocation of the Main Spindle Motors in the Power Connections Plan

The smaller values can be used for proportioning in the case of those motor controller combinations where the continuous output of the controller is smaller than that of the motor.

For controller continuous output with different types of current see Figure 25, „Technical Data RAC 4.1“.

Three-Phase Alternating Current Network Power Connections

If the mains voltage and the rated connection voltage of the RAC agree, then the controllers can be connected to either grounded or ungrounded three-phase current networks.

The mains connection plans for the different types of mains are the same for all controllers RAC (RAC2, RAC3, RAC 4). They can, therefore, be found in all documents applicable to main spindle drives entitled „Electrical Connections for Main Spindle Drives; Planning and Design“ (doc. no. 209-0042-4111). This document contains the data for conductor cross sections, rated fuse currents and any power transformers which might be required.

2.5. Summary of Technical Data

Designation	Symbol	Unit	RAC 4.1-300-460-••••-••	RAC 4.1-400-460-••••-••
Cooling			by means of built-in ventilator	
Nominal connection voltage	$U_{(AC)}$	V	3 x AC 400 V, 50 Hz, ± 15% 3 x AC 460 V, 60 Hz, ± 10%	
Controller continuous output (as relates to motor output shaft)	$P_{(cont)}$	kW	93	93
Controller peak output (as relates to motor output shaft)	$P_{(max)}$	kW	93	120
Feedback continous output (as relates to motor output shaft)	$P_{(back)}$	kW	60	60
Feedback peak output (max. 5 s) (as relates to motor output shaft)	$P_{(backmax)}$	kW	93	120
Weights				
Weight of controllers	m	kg	150	
Weight Assembly Frame M1-RAC4	m	kg	4	
Weight Accessories M2-RAC (Hose cooling)	m	kg	1,7	
Operating Conditions				
Permissible ambient temperature range with rated data		°Celsius	+5 … +45	
Max. perm. ambient temperature range with rated data reduced to 80 %		°Celsius	+55	
Storage and transport temperature		°Celsius	-30 … +85	
Assembly altitudes without reduction of rated data		m above sea level	max. 1000	
Permissible humidity in accordance with humidity category			F in acc. with DIN 40 040	
Type of Protection			IP 10 acc. to EN 60 529 (DIN VDE 0470)	

Figure 25: Technical Data RAC 4.1

2.6. Type Code

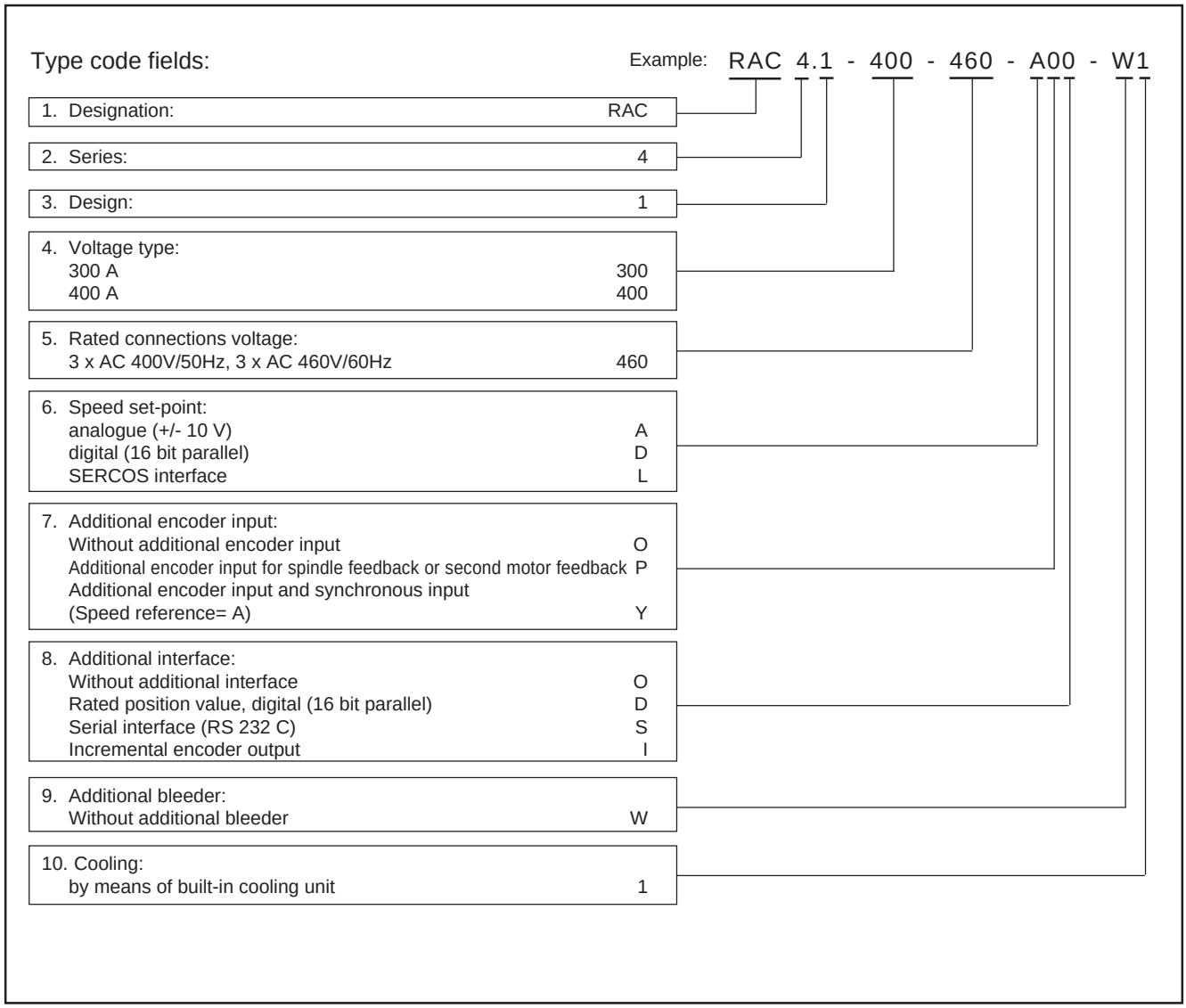


Figure 26: Type Code for RAC 4.1

3. AS Programming Module

Programming Module AS, which is plugged into the controller, adapts the controller to the main spindle motor, and realizes the characteristic curve of the main spindle drive.

INDRAMAT supplies a matching AS programming module (standard delivery according to selection list) for every main spindle drive offered.

INDRAMAT main spindle drives are microprocessor controlled.

The Drive is Quickly Commissioned

A matching AS programming module makes it possible to take the main spindle drive into operation right with the first run without any adjustment work. Precision connection work (see Chapter 2.4) and competent commissioning are prerequisites (see Chapter 9).

INDRAMAT main spindle motors can be adapted to the unit's installation conditions and the functional demands of the application.

The Advantages of Being Able to Exchange the Entire Controller

An AS programming module contains both software and parameters. In the event that a unit needs to be exchanged, then the controller requires no additional re-adjusting, as it is immediately adapted to both motor and facility by simply plugging the programming module which has thus far been used and is, therefore, already adapted into it.

Duplication

Already adapted programming modules can easily be duplicated for additional and similar machines. This is done either with the parameter duplicating adaptor or by means of serial interfaces and a storage device (PC or something similar).

Parameters

The software contains two groups of parameters:

– drive-related and

– application-related parameters.

The drive-related parameters influence the characteristic operating curve of the drive. The appropriate INDRAMAT parameter values are defined and fixed in order to implement the characteristic operating curve of the drives offered.

The application-related parameters activate or influence, according to application, the functions of the main spindle drive, and the drive is adapted to the reality of the facility.

Input and Change in Parameter Values

Input and change in parameter values is the same in all INDRAMAT main spindle controllers. The task is performed using the keypad on the control panel.

For further information, please see the Chapter on „Using the Controller“ in document „AC Main Spindle Drives with Controlled Asynchronous Motor or Kit Spindle Motor; Description of Application“ (doc. no. 209-0041-4109).

3.1. Type of Programming Module AS

AS programming modules contain the application-related parameter values defined by INDRAMAT.

Standards

The applications-related parameters are set to standard values. The facility or the applications-dependent parameter values are input on site.

The customer is responsible for documentation and administration of these facility and applications-dependent parameter values.

Customer-Specific Values (for larger series)

If a program module, once facility- and applications-dependent parameter values have been input, is also to be documented, administered and delivered by INDRAMAT in this condition, then it becomes necessary to define a customer-specific programming module. This can be done upon request in agreement with INDRAMAT for an additional fee.

3.2. Compatibility of the AS Programming Modules

A state-of-the-art (updating Program Module AS) programming module for the operation of the drive is automatically part of the delivery without any change in the order specifications becoming necessary (type designation). Updated programming modules are compatible with programming modules already delivered.

Updating AS Programming Modules

It is not necessary to make any changes in an order as there should be no doubt that the drive being operated is state-of-the-art.

This means:

– software fault-correction

– expansion of the range of functions without impairing existing functions

– improved parameter values for motor-controller combination.

3.3. Type Plate Info

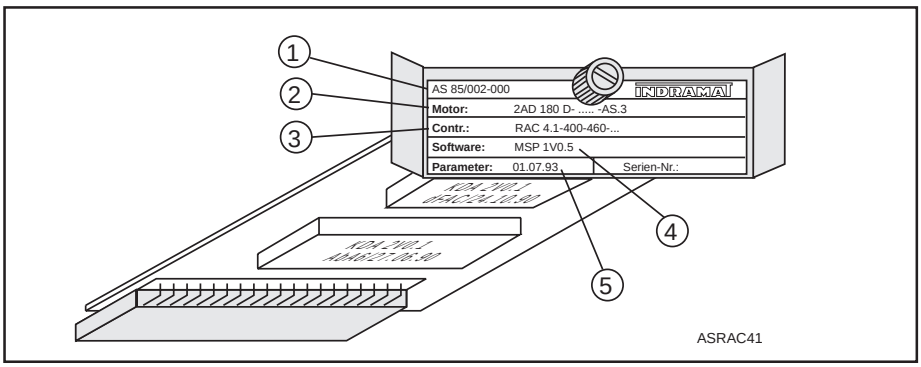


Figure 27: Programming Module AS with Identification Plate Specifications

① Type Designation

The final digits of a standard design programming modules are -000. The final digits of customer-specific programming modules are the customer-specific digits assigned by INDRAMAT.

② Rated Plate Data of Motor

③ Rated Plate Data of Controller

The data on type of motor and controller contained in the programming module must agree with motor and controller installed, as otherwise there is the risk damage!

④ Software Designation

The letter-digit-combination, including the letter „V“, indicate the type of software with version. The digits that follow are the counter digits of the software update.

⑤ Date Parameters Determined

INDRAMAT herewith records the date the parameters of the technical status were determined including parameter values.

3.4. Type Code

Type Code Fields: Example: AS 83/004-001

1.	Designation:	AS
2.	Main Spindle Controller	
	KDA 3.2	3
	RAC 2.2	5
	RAC 3.1	6
	TDA 1.1	7
	RAC 4.1	8
3.	Software Code Digit	
	Main Spindle Drive (standard)	
	(all combinations not listed below)	1
	Servo-drive (always includes incremental encoder output)	2
	Main spindle drive with incremental encoder output	3
	Main spindle drive with SERCOS interface	4
	Main spindle drive with additional functions	5
4.	Motor feedback	
	High-resolution motorfeedback	0
5.	Code Digit for Motor-Controller Combination	
	Defined and documented by INDRAMAT	e.g., 04
6.	Design	
	Standard	000
	Customer-specific, e.g.,: 003	003

Quellverweis: INN 07.20

Figure 28: Type code of the AS programming module

4. Condition Upon Delivery

The RAC 4.1, with all its accessories, is packed into one carton (transport container) for delivery. Accessories have been screwed onto the unit (M1-RAc 4) or packed into plastic bags loosely placed in the cartons (possibly M2-RAC 4 and E1-RAC).

An envelope containing two delivery slips is attached to the outside of the transport container. There are no additional accompanying documents unless otherwise specified.

By splitting the glue strips open, it is possible unpack without causing damage.

The cooling mode of controller RAC 4.1 as generally delivered is of the control cabinet outside air type (see Chapter 1). Current and insulation have also been tested in accordance with VDE 0160.

5. Identication of Hardware

A delivery slip with duplicate is attached to the transport container. The listed contents of the delivery can be distribued over several cartons (transport containers). This is also noted either on the delivery slip or the bill of lading.

The delivery slip lists the merchandise by designation and order designation.

In the case of mixed orders, individually packed controllers and accessories are packed into the transport containers. With multiple-orders of the same units, the accessories might be found in a separate transport container.

Main Spindle Controller RAC 4.1

A barcode sticker can be found on the the RAC 4.1 packaging. It identifies contents in terms of design and order handling.

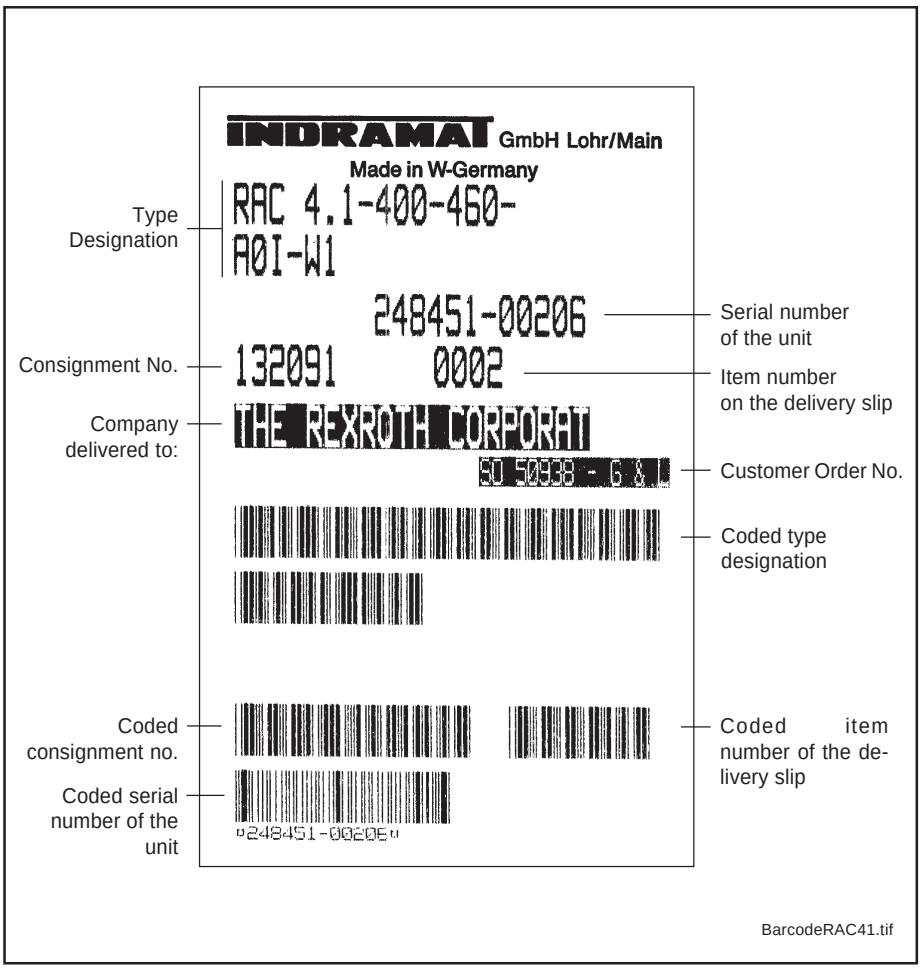


Figure 29: Barcode sticker on the RAC packaging (example)

A sticker is located on the side of the RAC 4.1 itself. It contains all necessary information in the event that servicing should be needed. It corresponds to the barcode sticker and contains all delivery data (see Figure 30).

The identification plate (see Figure 31) is located on the lower left side of the inside of the housing of the RAC 4.1.

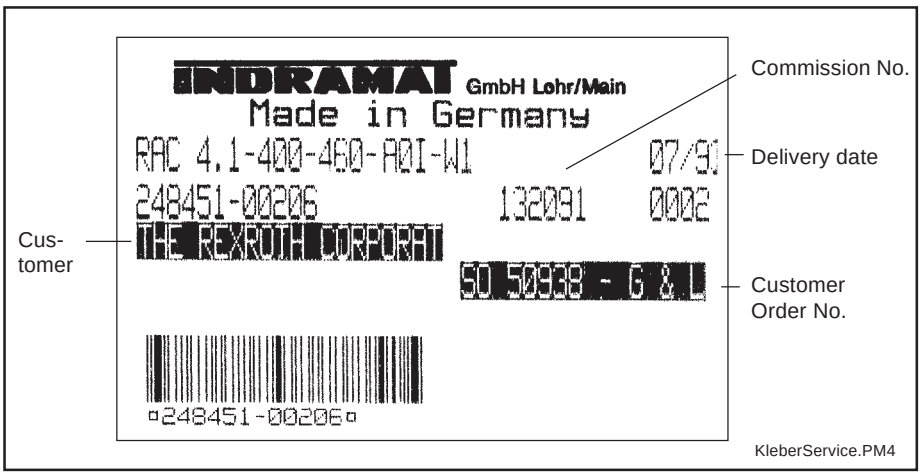


Figure 30: Servicing sticker (on the side of the unit, example)

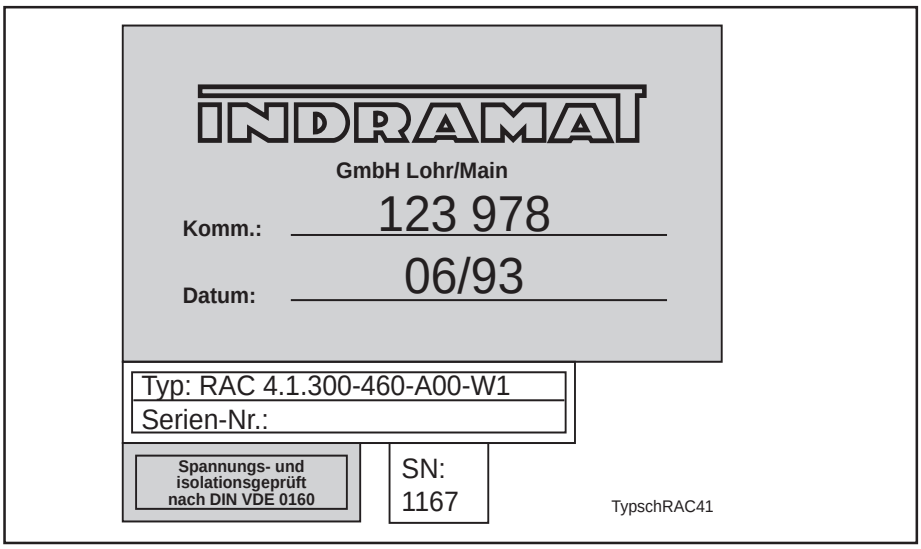


Figure 31: Identification Plate of the RAC 4.1 (on inside left side wall)

AS Programming Module

Programming modules are always packed individually in plastic bags and then, additionally, in a carton.

There is a barcode sticker on the side of the carton on which the individual data is additionally printed in text (Figure 32).

The plastic bag protects the AS programming module against static loads.

Touching the printed circuit board can cause damage!

The parameter list is included with the programming module in the plastic bag. It contains all data about the programming module and documents the parameter values set at delivery.

If parameter values should be lost, for example, when operation is started up, then it is possible to input the original values by hand taking them from the parameter list. The parameter list should be included in the machine file!

An identification plate is located on the front of the programming module (see Figure 27).

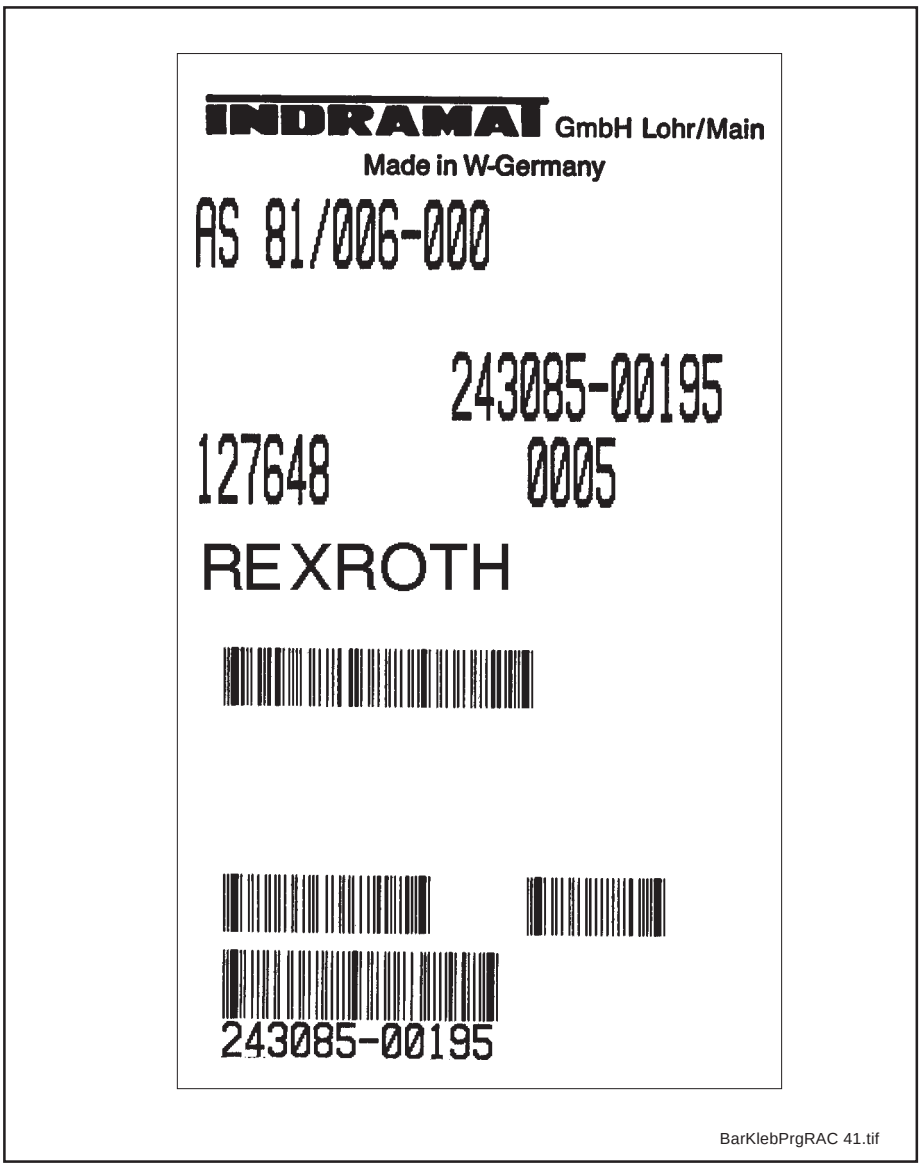


Figure 32: Barcode sticker on programming module carton

Accessories

The electrical accessories are packed in plastic bags with order information manually written on it.

Mechanical accessories M1-RAC 4 (assembly frame) are mounted on the back of the controller.

Mechanical accessories M2-RAC4 (optional hose cooling) is delivered in a separate carton. It contains four flanges (unpacked) and all the screws (in a plastic bag) which will be needed to assemble hose cooling. „M2-RAC4“ is written on the outside of the carton. The hose is not automatically a part of the delivery!

6. Storage and Transport

The controller must be kept dry, stored dust and impact-free; permissible ambient temperature range is from -30 to +85°C.

In the event of the danger of excessive vibrations, use a vibration-damping base during transport!

Transport tips on the packaging:

Figure 33: Safety Tips for Transport

7. Mounting

Condition Upon Delivery

The controller is always standardly delivered with a cooling system which uses control cabinet outside air. If this should not agree with the cooling mounted in the machine, then structural alterations become necessary. For the sake of expediency, this should be done before the controller is built into the control cabinet.

Structural Alterations to Accomodate Control Cabinet Inside Air Cooling

– Remove lid of cooling housing (1) (snap attachment)

– Detach lower skin plate of the heat sink (2) by removing the fixing bolt. The screws are easily accessible from the underside of the controller.

An assembly plate without cut-outs should be used for cooling with control cabinet inside air.

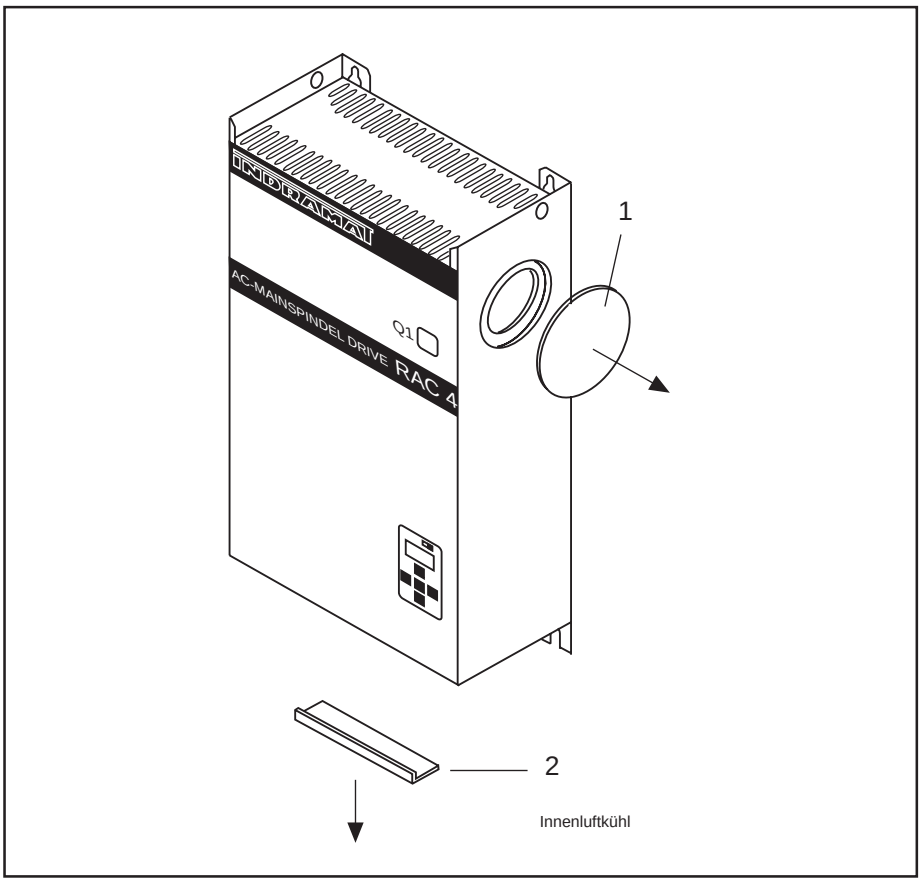


Figure 34: Structural Changes to Accomodate Hose Cooling

Structural Changes to Accomodate Hose Cooling

– Remove lid for ventilator housing (1) (snap attachment)

– Detach lower skin plate of the heat sink (2) by removing fixing bolt. The screws are easily accessible from the underside of the controller.

– Assemble the hose ventilation accessories (3) in accordance with the structural alteration plans supplied (Drawing No. 9.558.116.3-00).

Here as well, an assembly plate without cut-outs should be used for hose cooling.

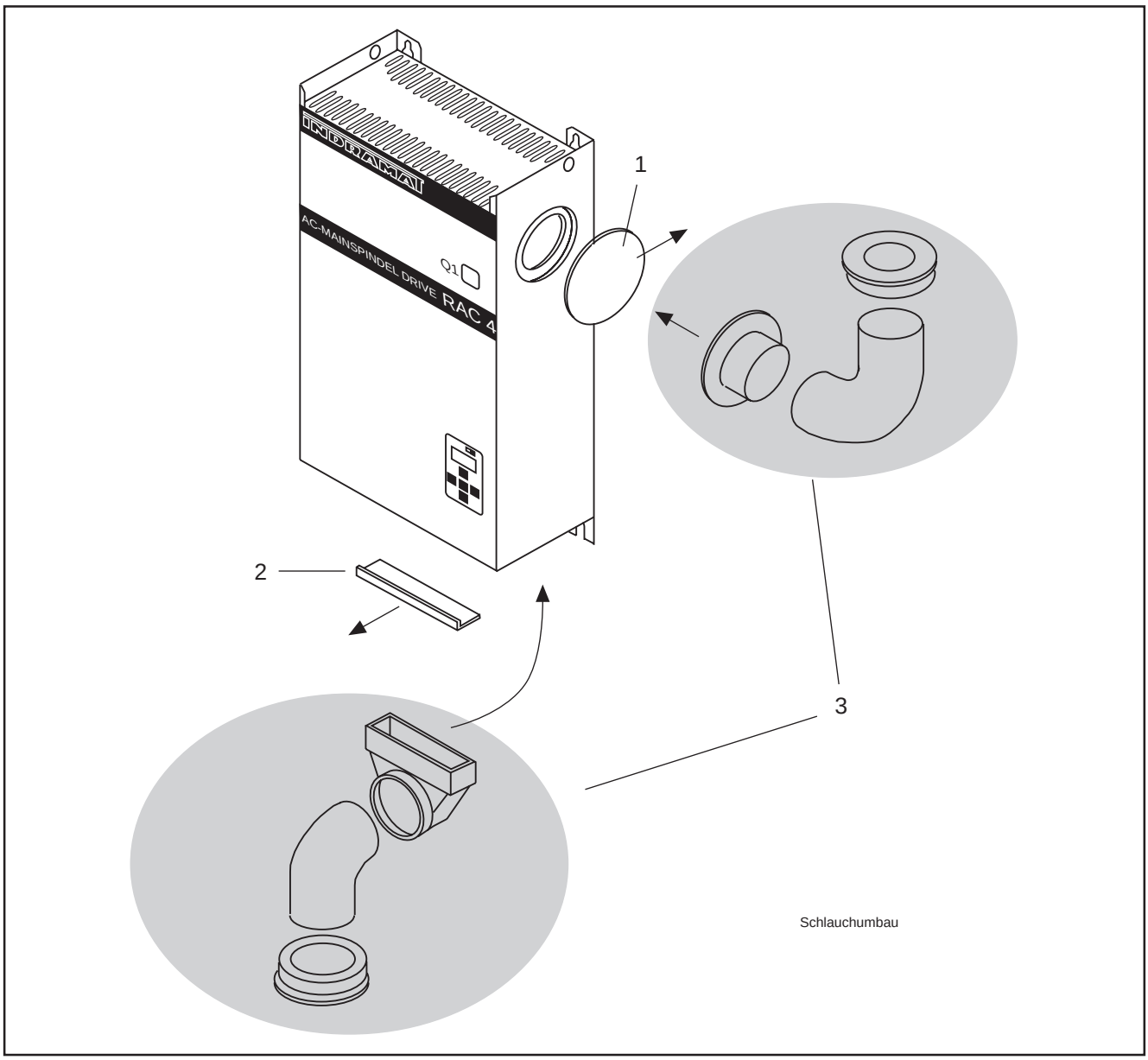


Figure 35: Structural Alterations to Accomodate Hose Cooling

7.1. Mounting the Drive Controller in the Control Cabinet

The following parts are required for mounting into the control cabinet:

– Mechanical mounting accessories M1-RAC 4

– Controller RAC 4.1

– Lifting apparatus (weight RAC 4.1 = 150 kg)

The control cabinet should accordingly be made ready for the intended cooling.

Installing the Mounting Frame for the Controller

Remove the mounting frame from the backwall of the controller. Using the screws supplied, fix it to the backwall of the control cabinet or the mounting plate. The mounting frame is located behind the control cabinet wall or the mounting plate. The screws for fixing the controller should be screwed in so far that they cannot fall out.

The mounting frame serves the purpose of reinforcing the backwall of the control cabinet or the mounting plate and thereby creates a level surface for the gasket on the controller. It carries all threads and packing rings that are needed to secure support for itself and the controller, and to guarantee the sealing of the control cabinet (see „Category of Protection“, Chapter 2.1).

Mounting the Controller

The controller should be lifted into its position in the control cabinet using a lifting device (crane or something similar), and hung onto the already mounted screws. The screws should be completely screwed in at this point.

Installing the Controller

The spot for the programming module is located in the middle at the lower edge of the front plate of the RAC 4. The programming module is pushed in and secured with a knurled screw!

The programming module should be plugged in and secured with a knurled screw prior to starting the RAC 4.1 up for operation.

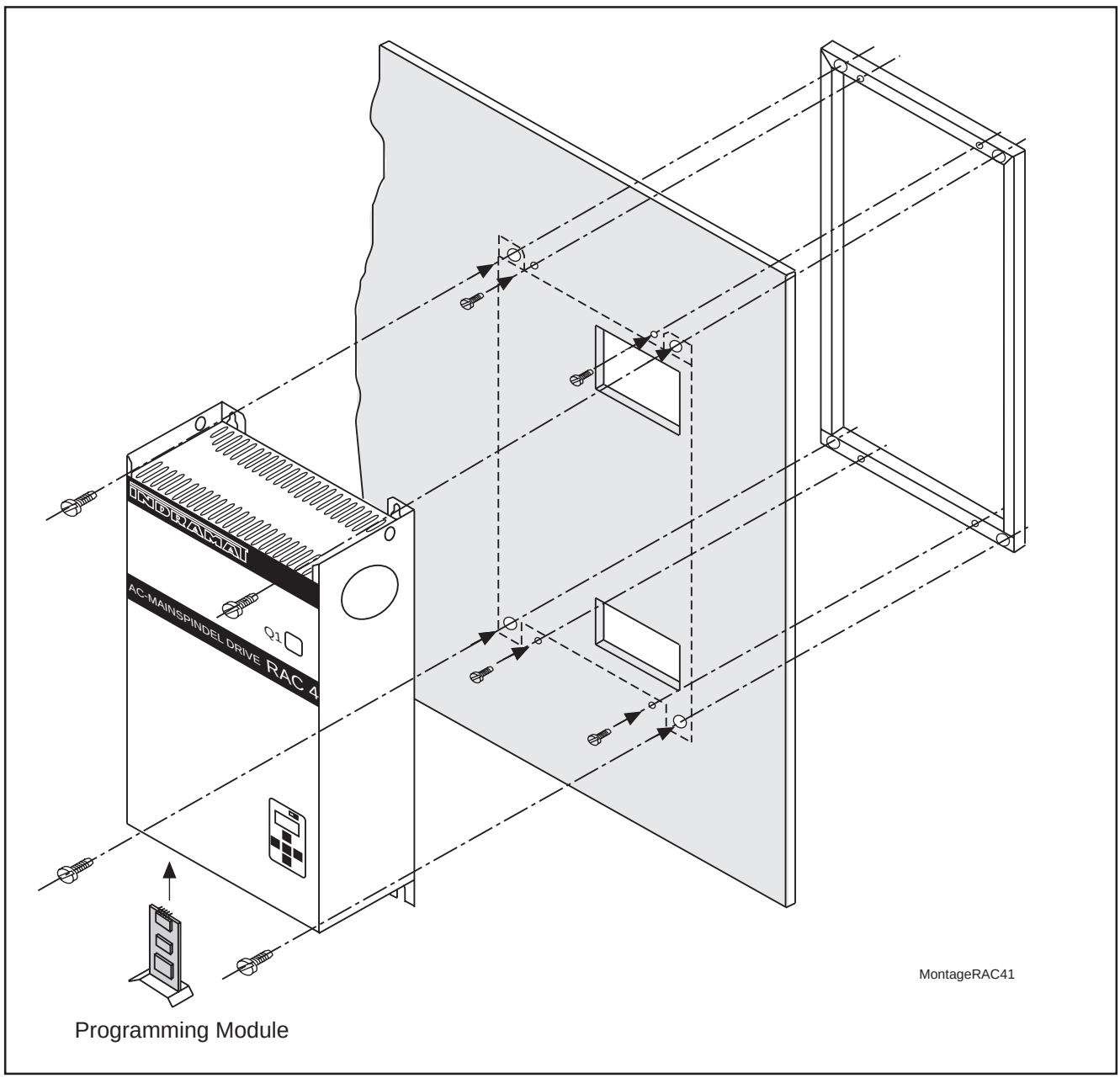


Figure 36: Installing the RAC 4.1

8. Installation Guidelines

– The wiring diagrams of the machine manufacturer must be followed when wiring the facility!

– INDRAMAT's connecting plans, see „Electrical Connections of Main Spindle Drives; Planning and Design“ (doc. no. 209-0042-4111) are to be used when developing the facility's wiring diagram.

– The power connections contact guard, located on the front side of the unit, must be mounted before the unit is turned on and operation started up!

– The D-sub-plug-and-socket-connection must be firmly screwed into place upon commissioning!

– The unit should be shut down prior to removing the AS programming module. The knurled screw must be firmly screwed into place!

– The power cable cores must be twisted!

– The motor must be grounded at the controller!

9. Commissioning Guidelines

Commissioning procedures are identical for all main spindle controllers (RAC 2, RAC 3, RAC4). For this reason, and because of the extensive range of functions, this procedure is explained only once in the INDRAMAT main spindle drives document valid for them all, namely, in the document entitled „AC Main Spindle Drives with Controlled Asynchronous Motors or Frameless Spindle Motor Description of Application“ (doc. no. 209-0041-4109).

10. Servicing Guidelines

10.1. Fault Diagnosis

The RAC 4.1 diagnosis the drive faults by means of the display located on the control panel. The drive, in the event of a fault, brakes until it has halted, at which point the RAC 4.1 then shuts power down. The fault diagnoses of the different main spindle drive controllers are the same.

The fault diagnosis and the fault recovery guidelines are, therefore, described in the document entitled „AC Main Spindle Drives with Controlled Asynchronous Motors or Frameless Spindle Motor Description of Application“, (doc. no. 209-0041-4109). It is valid for all INDRAMAT main spindle drives.

10.2. Defective Drive Controllers

As a result of the excessive weight of the controller, its exchange is only possible with the use of suitable lifting equipment (crane or something similar). In most cases, any occuring problem is repaired on location.

Should an exchange, however, become necessary, then the drive can be changed without any problem by unplugging the programming module from the defective controller and sticking it into the replacement controller. As the drive and machine-specific adaptation of the RAC 4.1 is contained in the AS programming module, the drive, with the new controller, now operates in the same manner as the original drive.

Repairs

If the controller should require any work as the result of a defect, then the following procedure must be followed:

– The master switch must be opened and secured against switching back on before any work can be performed on the electrical equipment.

– Only INDRAMAT customer service personnel or comparably trained personnel should be permitted to repair the equipment!

Controller Exchange

– All connections should be disconnected and removed before exchanging equipment. The fixing screws should be released and lifting equipment should be used to remove the RAC 4 from the control cabinet.

– Lifting equipment should also be used to lift the replacement back into the control cabinet. Remove the programming module from the defective equipment, plug it into the replacement and, using the knurled screw, secure it against falling out.

Do not remove or plug in the programming module with power on! The fixing bolt on the programming module must be tightly screwed into place when the RAC 4.1 is in operation!

– Connect the new RAC 4 in accordance with the wiring diagram and close the contact guard.

– Assume operation (see document „AC Main Spindle Drive with Controlled Asynchronous Motor or Frameless Spindle Motor Description of Application“ (doc. no. 209.0041.4109) see chapter on commissioning.

Returning A Defective Controller

– Fill out the return card for return of equipment/trouble protocol! A sample of this card is depicted in Figure 37, which can be copied and used for your convenience!

– Send the defective equipment back with the return card to the appropriate INDRAMAT servicing representative!

Repair Card

for INDRAMAT equipment and components

Completed by:	Company/Town:		Date:
When replacing single components, enter component designation		SN:	Supply job no.:
		SN:	Shipment date:
Machine manufacturer/Company:	Type:	Machine no.:	if necessary - commissioning date
Fault in axis no.	☐ horizontal ☐ vertical ☐	Operating hours:	Date fault occurred:

Fault status:

Fault _____

_____

☐ always present
☐ occurs sporadically
☐ occurs after _____ hrs
☐ occurs on impact/vibration
☐ is temperature-dependent
☐ other

* _____
* _____
* _____

Additional information:
(e.g. LED diagnosis messages in display)

_____
_____
_____
_____
_____
_____
_____
_____

Cause of fault:

☐ not known
☐ fault connection
☐ ext. short-circuit
☐ mech. damage
☐ loose cable connections
☐ other

* _____
* _____
* _____

Supplementary information

General details:

☐ no function
☐ drive running irregularly
☐ uncontrolled drive motion
☐ fault in only one direction
☐ burnt-out fuse on supply
☐ other

Related incidents:

☐ mechanical problems
☐ failure of power supply
☐ failure of controller
☐ motor failure
☐ cable break
☐ other

Controller, supply unit, amplifier, mains power:

☐ faulty control voltage
☐ mains power fuse burnt out
☐ defective fan
☐ defective bleeder resistor
☐ faulty power supply voltage
☐ connection bolt sheared off
☐ other

Control system:

☐ no function
☐ faulty display
☐ no set-point output
☐ diagnosis
☐ dimensional shift in direction
☐ E-STOP circuit broken
☐ pos. control loop does not close
☐ programme sequence fault
☐ faulty internal auxiliary function (outputs)
☐ acknowledgements not accepted (inputs)
☐ other _____

_____
_____

Motor:

☐ defective thermocouple
☐ defective brake
☐ defective fan
☐ defective feedback
☐ defective speed encoder signal
☐ defective BLC signal
☐ earthing short-circuit
☐ overheating
☐ other _____

_____
_____
_____
_____

Remarks:

_____
_____
_____
_____
_____
_____
_____
_____

Figure 37: Repair Return Card

10.3. Service Representatives

BELGIUM

G.L. Rexroth N.V./S.A.
Geschäftsbereich Indramat
Industrielaan, 8
B - 17 40 Ternat
✆ 02/582 318-0
Telex 222 10
Telefax 02/5 82 43 10

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BEC Elektronik AS
Zinkvej 6
DK - 8900 Randers
✆ 086/44 78 66
Telefax 086/44 71 60

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Telefax 02 85/65 49 91

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✆ 0/84 85 11
Telefax 0/84 63 87

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F - 92 632 Gennevilliers Cedex
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Telex 616 581
Telefax 1/47 94 69 41

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✆ 011/7 71 22 30
Telefax 011/7 71 01 90

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11. Keyword Index

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Overview of Supplementary Documentation

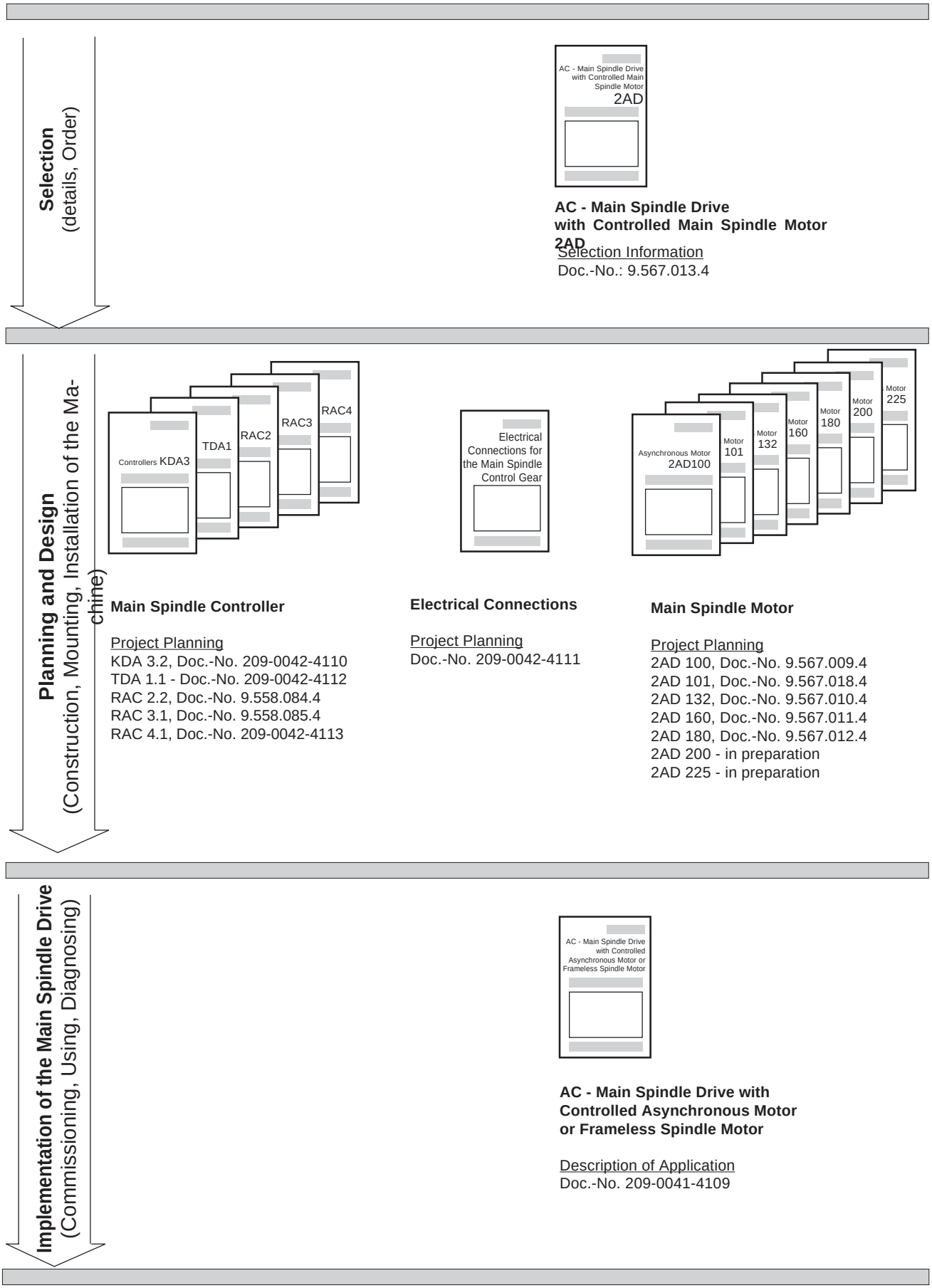
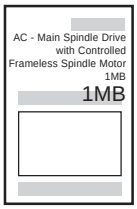
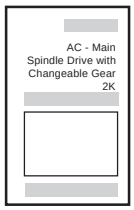


Figure 38: Overview of Supplementary Documents



AC - Main Spindle Drive with Controlled Frameless Spindle Motor 1MB

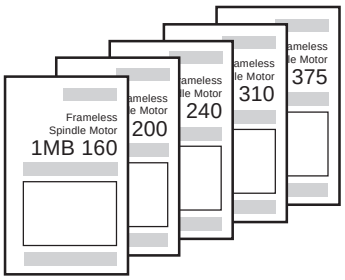
Selection Information
Doc.-No. 9.567.012.4

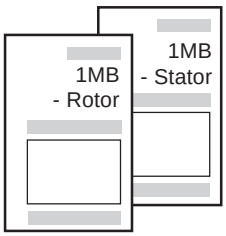


AC - Main Spindle Drive with Controlled Asynchronous Motor 2AD and Changeable Planetary Gearboxes 2K

Selection Information
Doc.-No. 9.567.022.4

Selection (details, order)

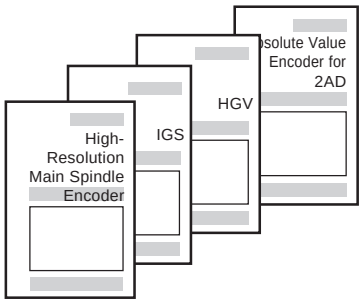




Frameless Spindle Motor

Project Planning
1MB 160, Doc.-No. 9.576.014.4
1MB 200, Doc.-No. 9.576.016.4
1MB 240/241, Doc.-No. 9.576.015.4
1MB 310/312, Doc.-No. 9.576.008.4
1MB 375, Doc.-No. 9.576.007.4

Mounting Guidelines
Stator, Doc.-No. 9.600.063.4
Rotor, Doc.-No. 9.600.062.4



Additional Documents

- High-Resolution Main Spindle Encoder
  - Description of Application
    Doc.-No. 9.552.247.4
  - Assembly Guidelines
    Doc.-No. 9.600.060.4
- Incremental Encoder Output IGS
  Doc.-No. 9.568.015.4
- High-Resolution Encoder Junction HGV
  Doc.-No. 9.568.010.4
- Attachment Absolute Value Encoder for
  2AD 132, 2AD 160, 2AD 180
  Doc.No. 9.568.020.4

Planning and Design (Construction, Mounting, Installation of the Machine)

Implementation of the Main Spindle Drive (Commissioning, Using, Diagnosing)