Introduction

Maintenance IRB 2000 3HAB 0005-2

Mechanical repair IRB 2000 3HAB 0010-2

Spare part list IRB 2000 3HAB 0006-1

Circuit Diagram IRB 2000 3HAB 0004-1

Other **(option)**

Article number: 3HAB 0009-2
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ABB Robotics Products AB
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SERVICE MANUAL IRB 2000

Mechanical unit

INTRODUCTION

The service documentation for ABB Industrial Robot system IRB 2000 is divided into two separate manuals, covering the mechanical unit and the control system respectively.

This service manual is intended to give a trained service engineer the inform necessary to carry out preventive maintenance, fault finding and repair work on the mechanical robot IRB 2000.

The manual presumes a reasonable knowledge of general mechanics, as well as of electrical system and service aids.

ABB Robotics offers a number of courses intended for training personnel, responsible for service and maintenance on ABB robot system.

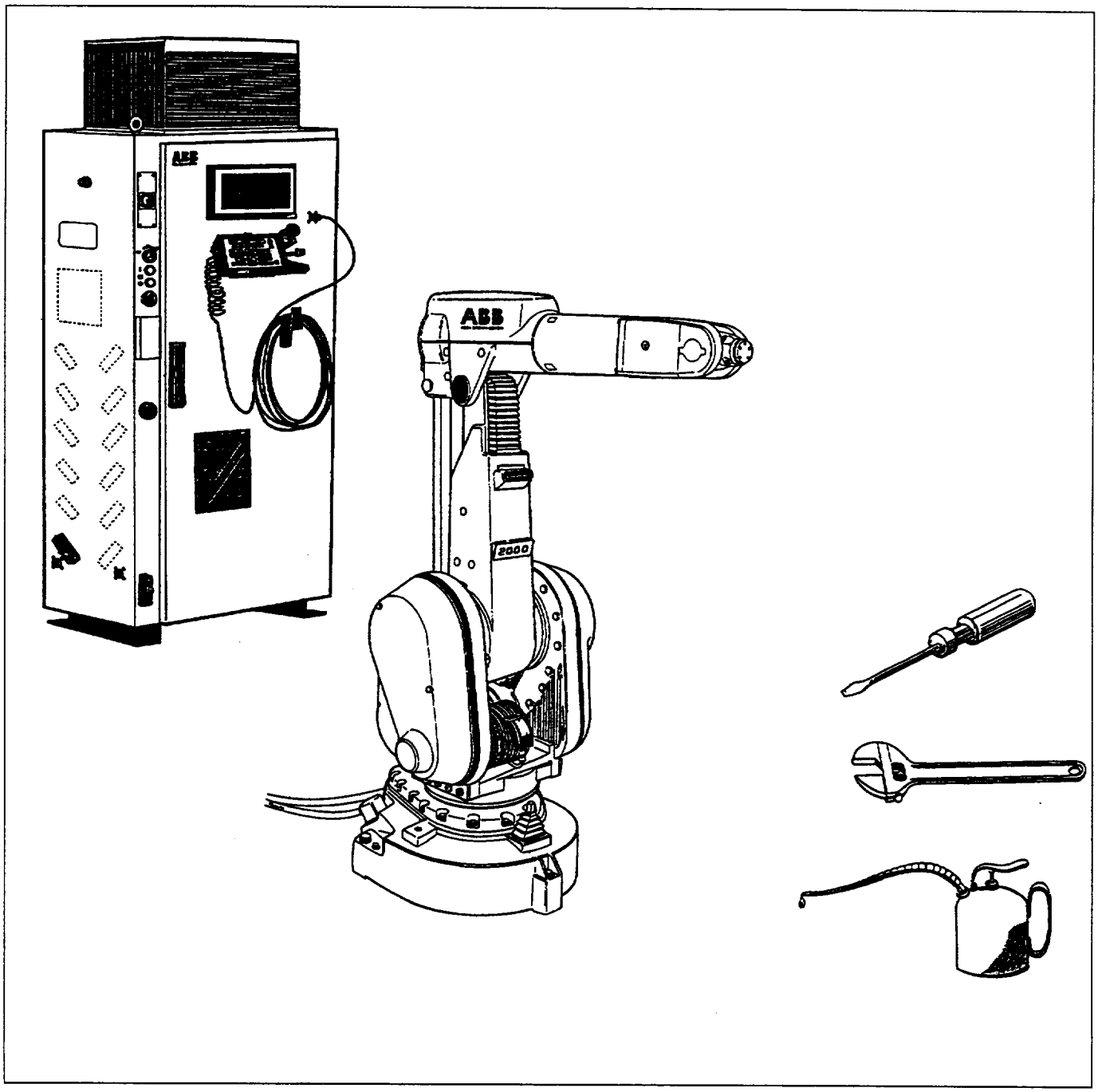
The manual includes the following documents:

• Maintenance	art.no. 3HAB 0005-2
• Mechanical repair	art.no. 3HAB 0010-2
• Spare part list	art.no. 3HAB 0006-1
• Circuit diagram	art.no. 3HAB 0004-1

NOTE!
during all work on the robot system, the safety regulations given in chapter SAFETY in Product Manual 3HAB 0007-2 must be followed carefully.

Maintenance
IRB 2000

3HAB 0005-2
January 1993/M93



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CONTENTS

1 INTRODUCTION

The industrial robot system is designed to work under severe conditions, requiring only a minimum of maintenance. Certain routine checks and actions must however be carried out at regular intervals.

In cases where disassembly is required, please refer to the instructions given in the Service Manuals of the robot and control cabinet. During all work on the robot system, the safety regulations given in the chapter SAFETY must be followed carefully.

2
MANIPULATOR

2.1
General instructions

Check regularly:
- if there are any oil leaks. If a major oil leak is discovered, call for service personnel.
- if there is excessive play in the gears. If this develops, call for service personnel.
- that the cabling between control cabinet and robot is not damaged.

Cleaning:
- Clean the robot exterior with a cloth when necessary. Do not use aggressive solvents which may damage paint or cabling.

2.2
Check of liquid grease and oil level

Axes 1-3

These gear boxes are lubricated for life with liquid grease and no check of the level is necessary.

Check of oil level in gear 4.

- Run the upper arm to hanging vertical position.
- Remove the magnetic plug and check the oil level, it shall be approx 11 mm from the rim of the refill hole after refilling, see figure 1.
- Clean the magenetic plug.

Check of oil level in axes 5 and 6.

The cover must not be dismonted.If so is the adjustment of the wrist´s gear is spoiled.

- Take the upper arm to horizontal position and axis 4 to calibration position.
- Turn **axis 4** 90^0.
- Remove the plug who is placed in the highest position on gear 5 or 6.
- The oil level shall be to the highest located hole.
- Clean the plug.
- Turn axis 4 in position so the other plug on gear 5 or 6 and tilt house plug can be dismounted and be cleaned.

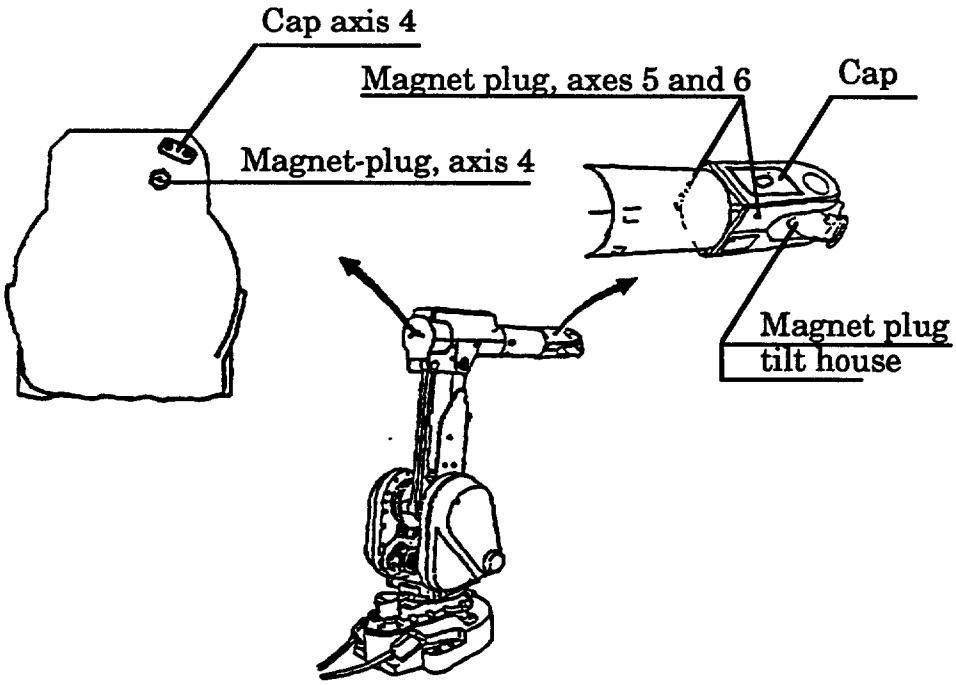

Fig 2.1 Locations for oil filling

2.3 Liquid grease and oil change

Axes 1-3

The gear boxes are filled with liquid grease ABB 1171 4016-611 and it never need to be changed.

The amount of grease is:

Axis 1:	4.6 kg/axis (5.3 litre/axis)
Axis 2:	4.6 kg/axis (5.3 litre/axis)
Axis 3:	4.6 kg/axis (5.3 litre/axis)

Axis 4

The first oil change is to be changed is to be perfomed after one year of operation or max 2000 hrs. After this the oil is changed every five years.

- Take axis 3 backwards so the upper arm point upwards.
- Open the magnetic plug, drain the oil and clean the plug.
- Remove the cap so that all the oil flow out.
- Take axis 2 and 3 forwards so that the upper arm are in vertical position.
- Fill up the oil to 11 mm under the edge of the oil plug (0.65 litre).
- Mount the plug and the cap.

Changing of oil in gear 5 or 6.

The cap must not be dismounted. If this is done the adjustment of the wrist´s gear is spoiled.

- Take upper arm to horizontel position and axes 4 and 5 to calibration position so the tilt-house magnetic plug and gear 6 magnetic plug is in direction down.
- Remove all three magnetic plugs, empty the oil and clean the plugs.
- Turn axis 4 180^0 and empty the oil who can be left in axis 5.
- Mount the plug back in to the tilthouse.
- Press the oil in the lowest hole. Oil level shall go up to the upper hole.
  As an alternativ the plug in the lovest position can be mounted and the oil filled in the upper hole.
- Mount back the plugs.

2.4 Liquid grease and oil types

ABB liquid grease article no.1171 4016-611 corresponds to:

BP:	Energrease LS- EP00

ABB oil article no. 1171 2016-603 corresponds to:

ARAL:	BMB 320

ABB oil article no. 1171 2016-604 corresponds to:

BP:	Energol GR-XP 320
Castrol:	Alpha SP 320
Esso:	Spartan EP 320
Klüber:	Lamora 320
Optimol:	Optigear 5180
Shell:	Omala Oil 320
Texaco:	Meropa 320

3.
Battery on manipulator

The robot accumulator unit is to be replaced after 5 years.

When replacing the accumulator unit, the system may be put in the STANDBY mode. In such a case, no coarse calibration is required after replacing the accumulator unit.

The unit is mounted under the axis 2 gearbox cover and is replaced by disconnecting the connector on the gearbox 2 side of the robot and then cutting the straps holding the accumulator unit.

4.
Maintenance table

	Prescribed maintenance	Check 1 times/ year	Maintenance interval	
			2000 hrs or 1 year	5 year
MANIPULATOR	Mechanical stop	X[1]		
	Cables	X[2]		
	Axes 1- 3		Maintenance-free	
	Oil level in gears for 4, 5 and 6.Possible leakage	X[3]		
	Changing of oil Gear 4, 5 and 6		X[4]	X
	Measurement system Replacing battery			X
CONTROL SYSTEM	Heat exchanger	X	X	
	Filter air kondition	X	X[5]	
	Memory back-up Replacing battery			X

1. Check so the "stop-pin" not is bent.
2. Check of all visible cabels. Change damaged cables.
3. Call service if leakage.
4. The first oil change shall be performed after one year or 2000 hrs.
5. The change interval forr exchange of the filter depents on the workshop environment. The delivery include extra dustfilter.

Mechanical repair
IRB 2000

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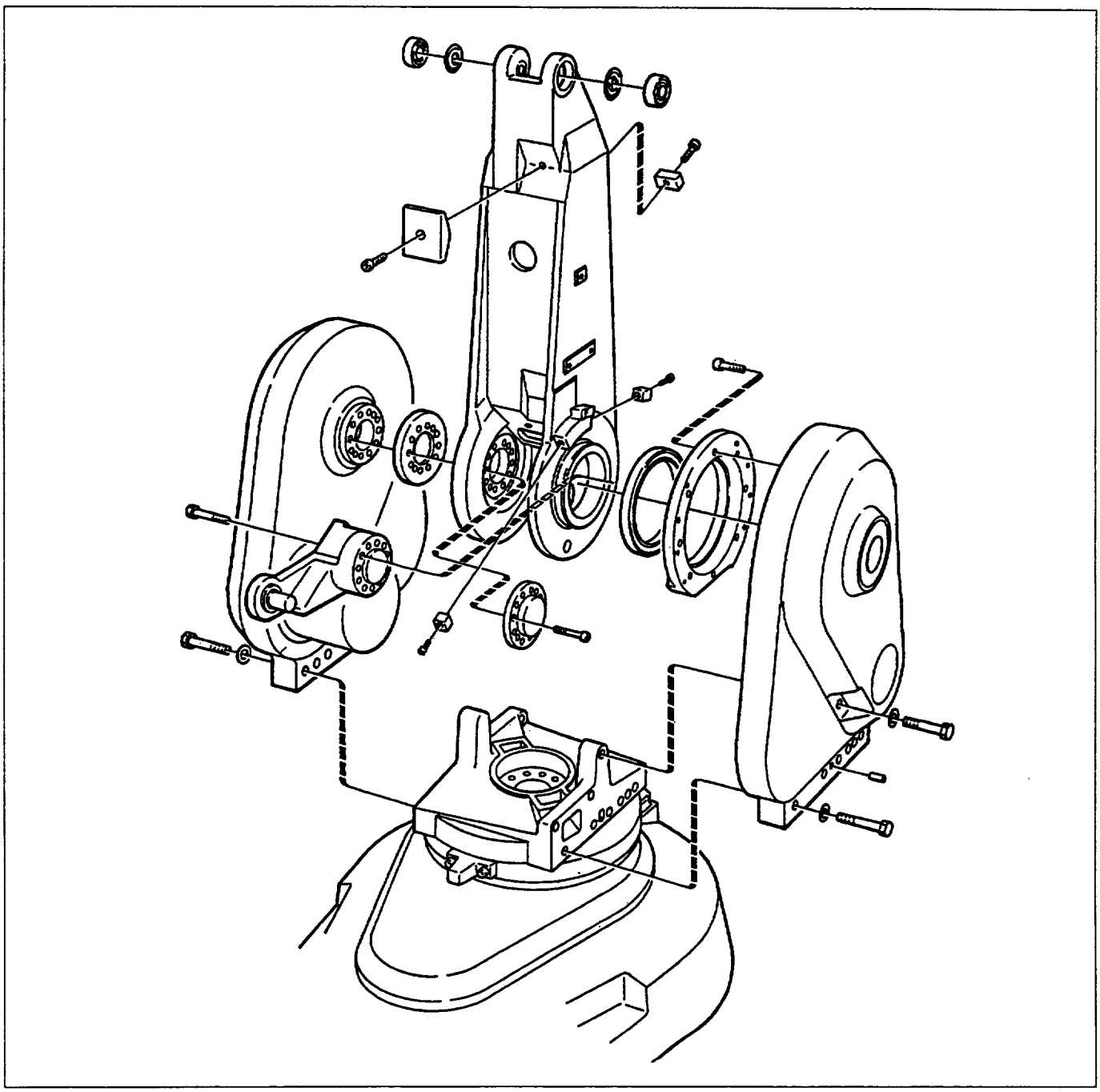

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MECHANICAL REPAIRS IRB 2000

1. INTRODUCTION

1.1 General Description

The industrial robot system IRB 2000 comprises two separate units; the control cabinet and the mechanical unit. The service of the mechanical unit is described in this document.

The mechanical unit is with regard to service divided into the following main parts:

- Electrical System
- Motor Units
- Mechanical System

The **Electrical System** is routed through the entire robot and consists of two major systems; power cabling and signal cabling. The power cabling feeds the robot axes' motor units. The signal cabling feeds the various controlling parameters like axis positions, motor revs, etc.

The AC type Motor Units provide the motive power for the various robot axes via gears. Mechanical brakes, electrically released, lock the motor units when the robot is inoperative more than 10 seconds at automatic operation, or after 5 minutes at manual operation.

The **Mechanical System** has 6 axes enabling the flexible robot motions.

Axis No 1 rotates the robot via an *intermediate plate*. The intermediate plate transfers the rotary motion to the robot's lower part, where *Axis No 2* provides the *Lower Arm's* reciprocating motion. The Lower Arm forms together with the *Parallel Arm* and the *Parallel Bracket* a parallelogram against the *Upper Arm*. The Parallel Bracket is mounted in bearings in the Parallel Arm and in the Upper Arm.

Axis No 3 provides elevation of the robot's upper arm.

Axis No 4, located in the Upper Arm, provides a rotary motion of the Upper Arm. The *Wrist* is bolted to the Upper Arm's forward end and contains the axes Nos 5 and 6. The latter axes form a cross.

Axis No 5 provides a tilting motion and *Axis No 6* a turning motion. A connection is arranged for various Customer tools at the wrist's forward end in the *Turn Disc*. The tool (or Manipulator) can be provided with pneumatic control via an external air supply (option). The signals to/from the the tool can be supplied via internal Customer connections (option).

The Control Cabinet shall be switched off at all service work on the robot! Before performing any work on the robot measurement system (measurement board, cabling, resolver unit) the accumulator power supply must always be disconnected.

A Brake Release Unit will be connected in accordance with chapter 4, Pushbutton Unit, to enable movements of the axes.

Special caution must be paid when the brakes are manually operated. Also, when the robot is taken into operation, the safety directions as described in the Programming Manual shall be followed.

1.2 Document Guidance

The subsequent chapters describe the type of service work possible to carry out by the Customer´s own service staff on location. Some service wors requiring special experience or special aids are not described in this manual. The latter work requires replacement of the failed module or component on location. The failed component is then transported to ABB ROBOTICS for service.

Commutation. A re-commutation has to be carried if a motor has been separated from its feed back unit. The procedure is detailly described in **Chapter 8, Commutation.**

Calibration. A new calibration of the robot has to be carried out after replacing mechanical unit parts or when the motor and feedback unit have been separated, a resolver error has occurred or when the power supply between measurement board and resolver has been interrupted. The procedure is described in detail in **Chapter 9, Calibration.**

Any work on the robot signal cabling may result in the robot moving to incorrect positions.

After performing such work, the robot calibration position must be checked according to chapter 9, "Calibration"..

Tools. Two types of tools are required for the various service works, on one hand conventional tools like sockets and ratchet spanners, etc. On the other hand *special tools* may be necessary to use, depending on what type of service being carried out. The conventional tools are not dealt with in this manual, based on the assumption that the service personnel has sufficient technical basic competence. Service works requiring use of special tools are described in this manual.

Foldouts. The manual's Spare Part chapter is provided with a number of foldouts illustrating the robot's details to facilitate a quick identification of both the type of service required, both the composition of the various details and components. The details are position numbered on the foldouts. Those numbers are referred to in the Manual text within "arrow heads" (< >). Where reference is made to other foldouts than specified in the paragraph title, the foldout's number is included in the position number reference, for example <5/19> or <10:2/5>, the digit(s) before the stroke referring to the foldout number.

The foldouts also include information such as article number, designation and corresponding data.

N.B. This manual is not to be considered as a substitute for a proper training course. This document shall be used* after *the course has been completed.

1.3 Cautions

1. The mechanical unit contains several parts which are too heavy to lift manually. Since, in process of repair, these parts must be moved with precision, it is important to have a suitable lifting device available.

2. The robot should **always** be switched to MOTOR OFF before anyone goes inside its working area.

1.4 Mounting Instructions for Bearings and Seals

1.4.1 Bearings

1. Let a new bearing remain in its wrapping until the mounting work shall take place to avoid contamination of the bearing.

2. Ensure that all parts comprising the bearing fitting are free from burrs, grindings and other contaminations. Cast details must be free from foundry sand.

3. Bearing rings, races and roller elements must under no circumstances be subjected to direct impacts. Also, the roller elements must not be exposed to any forces developed during the assembly work.

Tapered Bearings

4. The tensioning of the bearing shall be gradually applied until the recommended pretension is achieved.

5. It is important to note that the roller elements must be rotated a specified number of turns before the pretensioning is carried out and also rotated during the pretensioning sequence.

6. The above procedure must be carried out to enable the roller elements to adjust into correct position against the racer's flange.

7. Also, it is important that the positioning of the bearing is properly carried out as this directly will affect the lifespan of the bearing.

Greasing of Bearings

8. The bearing shall be greased after mounting. The main reason for this is the requirement for cleanliness. Lubricating grease of a good quality shall be used, for example 1171 4012-201.

9. Groove ball bearings shall be filled with grease from both sides.

10. Tapered roller bearings and axial needle bearings shall be greased in split condition.

11. The bearings shall not be completely filled with grease. If space is available besides the bearing fitting, the bearing may be totally filled with grease when mounted, as surplus grease will be thrown out from the bearing at starting up.

12. The bearing shall during operation be filled to 70-80 % of the available volume.

13. Ensure that the grease is handled and kept properly to avoid contamination.

1.4.2 Sealings

1. The usual cause of leakage is an incorrect mounting.

Rotating Sealings

2. The sealing surfaces shall be protected during transport and mounting.

3. The sealings shall remain in the original wrappings or be kept well protected.

4. Sealling surfaces shall be inspected before mounting. Should scratches or damages be found, that may result in future leakage, the seal shall be replaced.

5. Also the sealing shall be checked before mounting to ensure that:

   - there´s no damage to the sealing edge (feel with a finger nail)
   - the sealing is of correct type (provided with cut-off edge)
   - there´s no other damages.

6. Grease the sealing just before the mounting shall take place, not too early as there´s a risk for adhesion of dirt and foreign particles to the sealing. The space between dust tongue and sealing lip shall be filled to 2/3 with grease of quality 1171 4012-201. Also the rubber coated external diameter shall be greased.

7. Mounting of sealings and gears has to be carried out on clean work benches.

8. Mount the sealing correctly, if mounted misaligned, there´s a risk for leakage due to the pumping effect.

9. Always mount the sealing with a mounting tool. Never hammer directly on the sealing, as this will result in leakage.

10. Use protective sleeve for the sealing edge during the mounting, when sliding over threads, key-ways etc.

Flange Sealings and Static Sealings

11. Check the flange surfaces. The surfaces must be even and free from pores. The check of the plainness is easily carried out with a gauge on the fastened joint (without sealing compound).

12. Differences in level or presence of burrs, due to incorrect machining, is not allowed of the surfaces. Should the flange surfaces be defect, the parts are not to be used, as a mounting of defect surfaces will result in a leakage.

13. The surfaces shall be properly cleaned in accordance with ABB ROBOTICS´ recommendations.

14. Distribute the sealing compound evenly over the surface, preferrably with a brush.

15. Tighten the screws evenly when fastening the flange joint.

16. Ensure that the joint is not subjected to loads before the sealing compound has hardened in accordance with the material specification.

O-rings

17. Check the O-ring grooves. The grooves shall be geometrically correct and free from pores and contaminations.

18. Check the O-ring with regard to surface defects, burrs, accuracy to shape etc.

19. Ensure that the correct O-ring size is used.

20. Tighten the screws evenly during the mounting.

21. Defective O-rings and O-ring grooves shall not be used.

22. Mounting of defect details will result in leakage. Grease the O-ring with 1171 4012-201 before mounting.

1.5 Instructions for Tightening of Screw Joints

General

It is of greatest importance that all screw joint are tightened with the correct torque.

Application

The following tightening torques shall be used for all screw joints in metallic materials if not otherwise specified in the text.

The instructions do not apply to screw joints comprising soft or brittle materials.

For screws with higher property class than 8.8, the data for 8.8 shall be used unless otherwise specified.

5.14.3 Assembly

Screw thread dimension M8 or bigger shall preferrably be lubricated with oil. Lubrication with molybdenum disulphide grease shall only be used when specified in the text.

Screws with dimension M8 or bigger shall be tightened with torque-key if possible.

Screws with dimension M6 or less may be tightened to the correct torque with tools without torque indication, by personnel having the adequate mechanical training and instruction.

Tightening Torques

Screw with slotted or cross recessed head, property class 4.8

Dimension	Tightening Torque - Nm
	without oil
M2.5	0.25
M3	0.5
M4	1.2
M5	2.5
M6	5.0

Screw with hexagon socket head, property class 8.8

Dimension	Tightening Torque - Nm	
	without oil	with oil
M3	1	1
M4	2	2
M5	5,5	4
M6	10	9
M8	24	22
M10	48	45
M12	83	78
M16	200	190
M20	410	400
M24	750	740

2 CONTENTS

1 Axis 1

1.1 Exchange of Motor

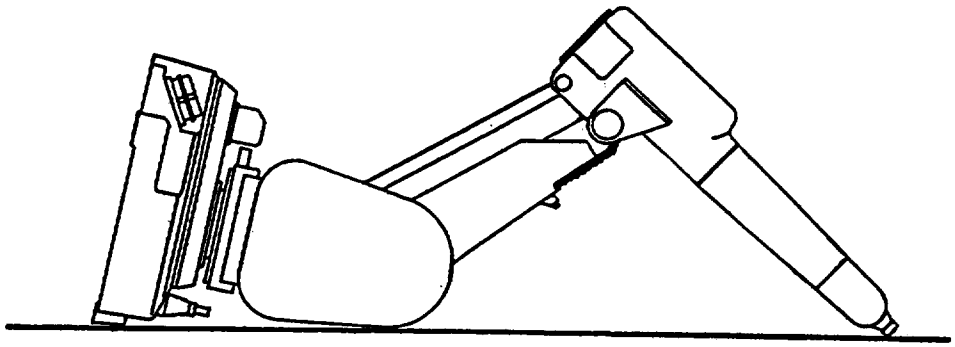
The electric motor is dismounted from the underside of the base.

Reference is made to foldout no. 2 in the spare parts section.

Dismounting:

1. Dismount the feed back unit in accordance with chapter 7, Exchange of feed back units 1-6.

2. Put the robot down as per fig. below.



3. The weight of the robot is 350 kg, and the lifting device must be dimensioned accordingly.

WARNING!
Be careful while inverting the robot to avoid personal injury!
Secure axis 1 so it cant move when the motor/brake is dismounted.

4. Remove cover <1:1/30>.

   Because of position of the robot , the liquid grease will flow to the lower part of the gear box, therefor it´s not necessary to drian it.

5. Disconnect cable contacts for motor.

6. Remove adapter <6> for feed back unit.

7. Unscrew motor flange and lift away the motor.

Mounting:

8. Ensure that assembly surfaces are clean and without scratches.

9. Fit and adjust the motor according to chapter 7, Setting of play in motor gear.

10. Erase the scribed line on adapter plate <6> for feed back unit and replace the sealings <46> and <47>.

11. Mount the adapter <6> and align it with tool no 6896 0011-MH before tightening of the screws.

12. Make a new scribed line using the pointer 6896 0011-NS, see chapter 8, Setting procedure, in accordance with erection instructions 6362 056-KM:

    - Release the brake of axis 1 and turn the brake disc to align its scribed line with that of the motor.
    - Fit the scribe pointer to the motor spindle where the feedback unit will later be fitted. The protruding tooth of the pointer is to be turned towards the adapter plate and the flat surface of the spindle is aligned with the scriber hole. The roundish part of the spindle will then be positioned against the movable part of the scribe pointer.
    - Make a 0.2 mm wide scribed line on the adapter plate along the tooth of the scribe pointer.
    - Remove the scribe pointer.

13. Remount the feed back unit in accordance with chapter 7, Exchange of feed back units axes 1-6.

14. Connect the cabling.

15. Mount the bottom cover <1:1/30>.

16. Recommutate and recalibrate the robot according to chapter 8 and 9.

Tightening torque:

Screws for motor, pos 5: 28 Nm

1.2 Cabling Unit 1

Dismounting:

Reference is made to fold out no. 3 in the spare parts section.

1. Dismount the covers on gear boxes 2 and 3.
2. Unscrew screws <1:3/54> for the cover on the intermediate plate <2:1/2>, and loosen the covers on the lower arm cabling.
3. Disconnect cable contact X4 from axis 1.
4. Disconnect contacts X6 - X8 from gear box 3.

5a. When removing av refitting the measurement board, it is of vital importance that the standards regarding ESD protection is followed.

5b. Remove the measurement board and its bracket. Disconnect X15.

5c. Disconnect contacts X5/X13, X14, X28 and X50 and shieldings from gear box 2.

6. Disconnect groundings at axes 2 and 3.
7. Mount lifting tools, lift and turn the robot according to chapter 1, Exchange motor.
8. Dismount the cover <1:1/30> from the base <1>, and contacts RX1, RX2 and X3.
9. Disconnect grounding and shielding connections for cabling unit 1.
10. Cut the cable ties.
11. Unfasten the screws holding attachment plate for cabling unit 1.
12. Pull out the unit downwards and feed the cabling through the cabling channel in the intermediate plate at the same time.

Mounting:

Reference is made to fold out no. 3 in the spare parts section.

13. Insert the cabling through the base plate´s center hole.

    N.B. It is important to gather the cables in correct order when they are inserted through the cable channels to avoid unintentional wear to the cables. Also, axis 1 shall be in calibration position 0.

14. Fit the rotator and fasten it from the under side with the screws.
15. Fasten the cabling unit to the base from the under side.
16. Refit X15 and the bracket and fasten the ribbon cable shield connection. Connect X5/X13, X14, X28 and X50. Refit the measurement board.
17. Connect contact X4.
18. Connect the cable contacts for signal and power cabling, X3, X6-X7, X8, X12-X15, RX1, RX2 and grounding and shielding connectors on gear boxes 1, 2 and 3.

19. Fasten the cables with new cable ties.

20. Ensure that all mounting points are thoroughly tightened and that the cabling is properly fed via the rotator.

21. Mount back all covers.

1.3 Exchange of gear box

Reference is made to foldout no 3 in the spare parts section.

The gearbox for axis 1 is of conventional tooth gear type, manufactured with very high accuracy. The gearbox is integrated with the housing for axis 1, thus forming the base.

Service or adjustments of the gearbox are normally not carried out. In the event of failure the gearbox is exchanged as a complete unit.

Dismounting:

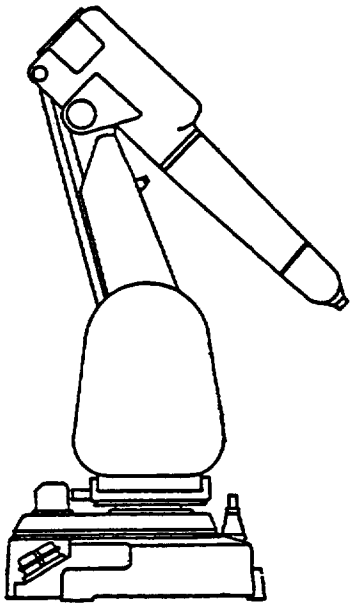
1. Disconnect and remove cabling unit according to chapter 1, Cabling axis 1 and disconnect the signal cable connectors X11 and X12.

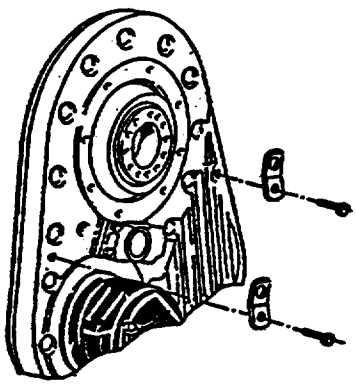
2. Separate the gear boxes 2 and 3 and arm system from intermediate plate in accordance with the following section.

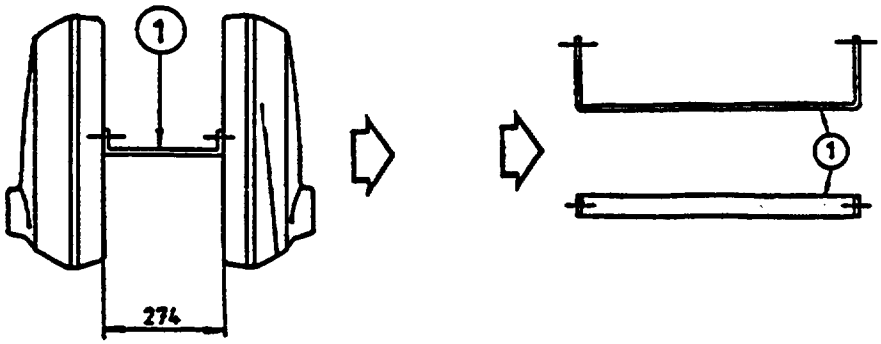
Lifting and separate robot against axis 1

3. Position lower and upper arm as per fig. below.

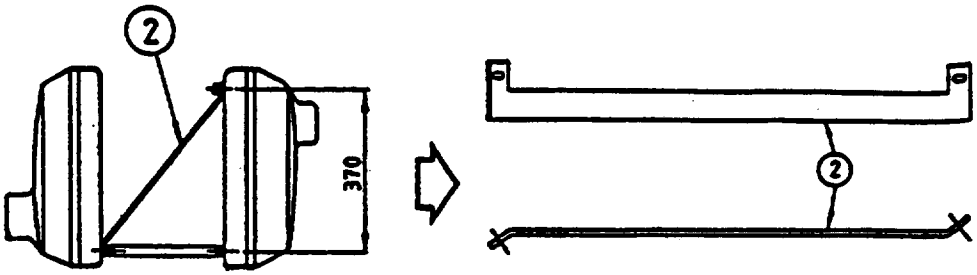
4. Fasten lifting clamps and lifting eyes as per fig. below. Attach lifting straps to the lifting eyes. The clamps shown in figure on next page, can easily be manufactured. Using these clamps is not compulsory, but in some cases they simplify the handling.





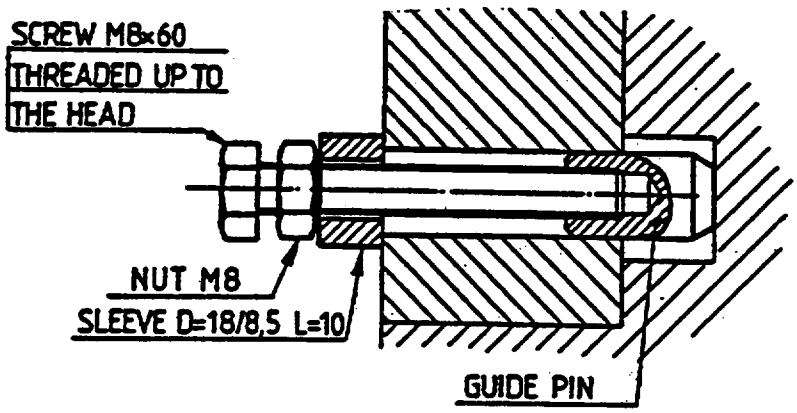


Screws: M12 x 22



5. Unscrew screw joint for gear boxes 2 and 3, screws <24, 25>.

6. Remove the guide pins <23> from both gear boxes using a tool according to the figure below:



7. Lift away the arm system inclusive gearboxes 2 and 3.

The weight being lifted is 275 kg, and the lifting device must be dimensioned accordingly.

For dismounting and mounting of intermediate plate see chapter 1.

Mounting:

Reference is made to foldout 3 in the spare parts section.

8. Lift the robot´s upper parts in place on intermediate plate and adjust the position carefully before driving in guiding pins <23>.

9. Attach washers <26>, grease screws <24, 25> slightly with molybdenun disulphide grease and tighten with torque, 98 Nm.

10. Mount cabling unit 1 according to chapter 1, Cabling axis 1 and the signal cable connectors X11 and X12.

11. Check that all cables are correctly connected.

12. Put covers in place on gearboxes 2 and 3.

Tightening torque:

Screw joint gearboxes 2 and 3/intermediate plate, pos 24, 25: 98 Nm

1.4 Dismounting of intermediate Plate

Dismounting:

Reference is made to foldout 2:1 in the spare parts section.

1. Dismount and lift away the robot parts in accordance with chapter 1.

2. Remove the stop <17>.

3. Dismount ring <18> from intermediate plate <2>.

4. Fasten two eyebolts diametrically in M12-threaded holes in intermediate plate. Use a lifting device.

Be carefull, using the lifting device!

5. Remove the intermediate plate.

6. Remove lower ring <19>.

Mounting:

7. Ensure that assembly surfaces on gearbox and intermediate plate are clean and free from scratches.

8. Put lower ring <19> in place on secondary shaft end of gearbox 1.

   N.B. Observe the roll pin!

9. Lower intermediate plate down on gearbox 1.

   N.B. Observe the roll pin!

10. Put upper ring <18> inplace on top of intermediate plate.

11. Tighten screw joint<26> intermediate plate/gearbox 1 with torque, 110 Nm.

12. Refit the stop <17> and the sync plates <21,22> (only if the intermediate plate has been exchanged).

13. Lift the robot's upper parts in place on intermediate plate.

Tightening torque:

Screw joint Intermediate plate/gearbox 1, pos 26:	110Nm
Screw joint gearboxes 2 and 3/ intermediate plate, pos 24, 25:	98 Nm

2 Axis 2

2.1 Exchange of motor

The electric motors are dismounted from the inner sides of gear boxes.

Reference is made to foldouts no 6 in the spare parts section.

Dismounting:

1. Dismount feed back unit in accordance with chapter 7, Exchange of feed back units.
2. Disconnect electrical motor cable contact from motor.
3. Drain the grease through the lower plug. A pressure of 0.2 bar in the upper hole makes the emtying easier. Warm liquid grease are more fluently.

WARNING!
The robot may carry out unintentional motions when the motor is removed. The arms must be secured in an end position or with an overhead crane.

4. Unscrew the screws for the motor and it lift away.
5. Remove adapter plate<3>.

Mounting:

6. Ensure that assembly surfaces are clean and without scratches.
7. Fit and adjust the electric motor in accordance with chapter 7, Setting of play in motor gear axes 1-3.
8. Replace the sealings in adapter plate <3>.
9. Mount the adapter plate and align it with tool no 6896 0011-MH before tightening the screws.
10. Mount the feed back unit in accordance with chapter 7, Exchange of feed back units.
11. Connect motor cabling.
12. Fill with the earlier drained grease, 4,6 kg. See the Maintenance Manual.
13. Re-commutate and re-calibrate the robot in accordance with chapter 8 and 9.

Tightening torque:

Screws for motor, pos 13: 28 Nm

2.2 Lower arm cabling, measurement board

Replacement of measurement board

When replacing the measurement board it is of vital importantance that the ESD-safety standards are followed.
- Disconnect the cable contacts X5, X13, X14, X28 and X50
- Dismount the screws that keeps the mounting plate on to the measurement board.
Assemble in reversed order.

Cabling

Reference is made to foldouts no 1:2 in the spare parts section.

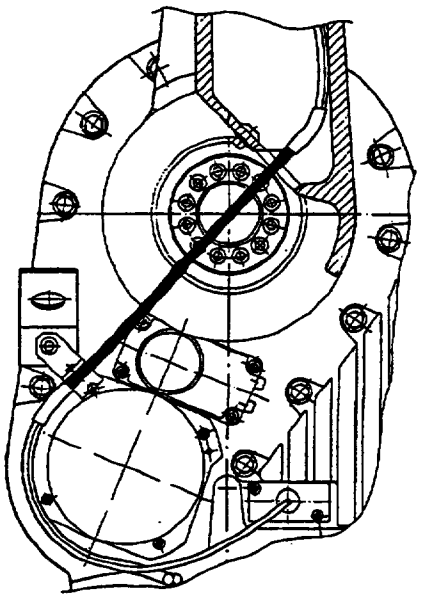
Dismounting:

1. Disconnect contacts for signal and power, outside gear box 2 and 3.
2. Remove plate <50>.
3. Unscrew screw <44>, on both sides and feed the cables through the gear box.
4. Loosen the cabling from bracket <73>.
5. Remove screw <29>.
6. Dismount the bracket in the upper arm. The bracket is also fasten round the screw that goes through the lower - and upper arm.
7. Disconnect contacts for axes 4, 5 and 6. Feed the cables down from the upper arm.
8. Pull out the cables through the lower arm.

Mounting:

9. Mount in reversed order.

NOTE!
Make sure that the cables goes over the centre of gear box 2. See figure.



2.3 Exchange of gearbox

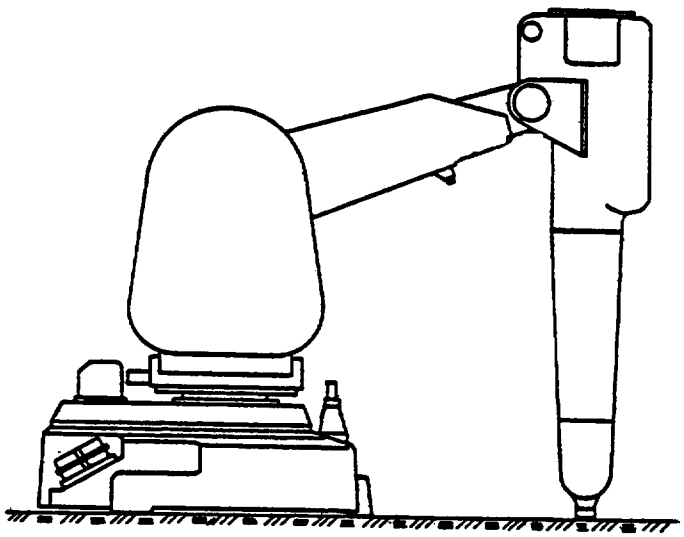
Reference is made to foldout no. 3 in the spare parts section.

The gearbox for axis no 2 is of conventional tooth gear type, manufactured with very high accuracy.

Service or adjustments of the gearbox are normally not carried out. In the event of failure the gearbox is exchanged as a complete unit.

Dismounting:

1. Position the robot's upper and lower arms in accordance with fig. below.

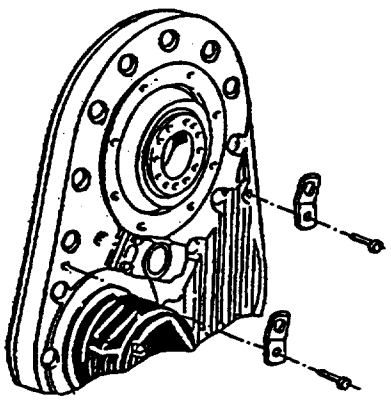


2. Dismount lower arm cabling according to section 2.2.

NOTE! It is important that the armsystem of the robot is fixed before the gearbox is removed.

3. Dismount cover <6> from lower arm.

4. Attach lifting eyes on gearbox 2 in accordance with fig.



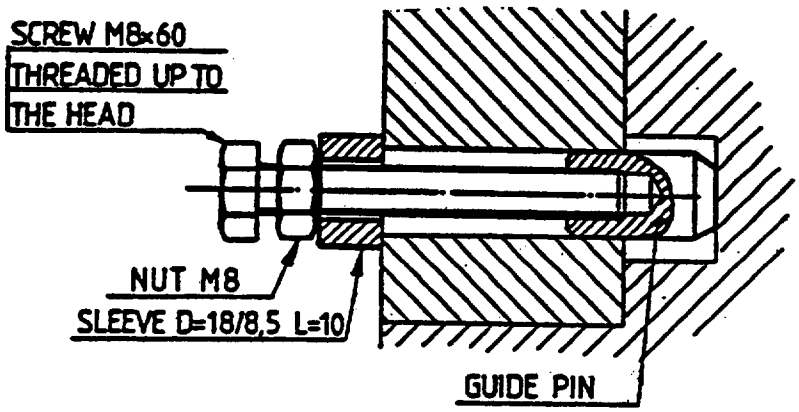
5. Remove the sign <6/25>

6. Dismount motor according to chapter 2, Exchange of motor.

7. Couple lifting straps to lifting eyes and tighten up.

8. Unscrew M12-screws <24, 25>.

9. Retract guide pin <23> with a tool as per fig.



10. Push gearbox 2 sidewards, while suspended by the lifting straps, until the gearbox is free from the lower arm.

11. Lift away gearbox 2.

12. Remove ring <5> from gearbox.

Mounting:

Reference is made to foldout 3 in the spare parts section.

13. Mount lifting eyes on the new gearbox .

14. Mount ring <5> to the shaft on the gear box.

15. Press guide pin <23> into the gearbox. The thread shall be turned outwards from the intermediate plate.

16. Couple lifting straps and lift the gearbox in place on intermediate plate.

17. Push the gearbox towards the lower arm, until the guide pin enters the intermediate plate.

18. Attach washers <26> and grease the screws <24, 25> slightly with molybdenum disulphide grease and tighten with torque , 98 Nm.

19. Put ring <6> in place in lower arm and tighten with M12-screws <8>. Tighten with torque, 98 Nm.

20. Mount the motor according to chapter 2, Exchange of motor.

21. Mount lower arm cabling according to section 2.2.

22. Mount sign <6/25>.

Tightening torque:

Screw joint gearbox/intermediate plate, pos 24, 25:	98 Nm
Screw joint lower arm/ gearbox, pos 8:	98 Nm

2.4 Lower Arm

Exchange of lower arm

Dismounting:

Reference is made to foldout no. 3 in the spare parts section.

1. Dismount parallel bracket <4/2> in accordance with chapter 3, Exchange of parallel bracket.
2. Dismount upper arm in accordance with chapter 3, Dismounting of upper arm, complete.
3. Dismount gearbox no 3 in accordance with chapter 3, Exchange of gearbox.
4. Couple lifting strap to the lower arm.

Observe great caution when disconnecting the lower arm!

5. Unscrew ring <8>.
6. Push lower arm sidewards from gearbox no 2 and lift away.
7. Press out bearing <10> and flange <11> as a unit from lower arm.

Mounting:

Reference is made to foldout 3 in the spare parts section.

8. Mount bearing <10> and flange <11> as a unit in a new lower arm.
9. Lift the lower arm in place towards gearbox no 2.*N.B. Observe the roll pin!*
10. Grease screws <8> slightly with molybdenum disulphide grease and mount ring <6>. Tighten with torque , 98 Nm.
11. Mount gearbox 3 <2/3> according to chapter 3, Exchange of gearbox.
12. Mount parallel arm <13> in accordance with chapter 3, Dismounting parallel arm.
13. Mount upper arm in accordance with chapter 3, Dismounting upper arm.
14. Mount parallel bracket <2> in accordance with chapter 3, Exchange of parallel bracket.

15. Mount lower arm cabling according to section 2.2.

16. Re-calibrate the robot in accordance with chapter 9.

Tightening torque:

Screw joint lower arm/gearbox 2, pos 8: 98 Nm

2.5 Exchange of Bearings, lower arm

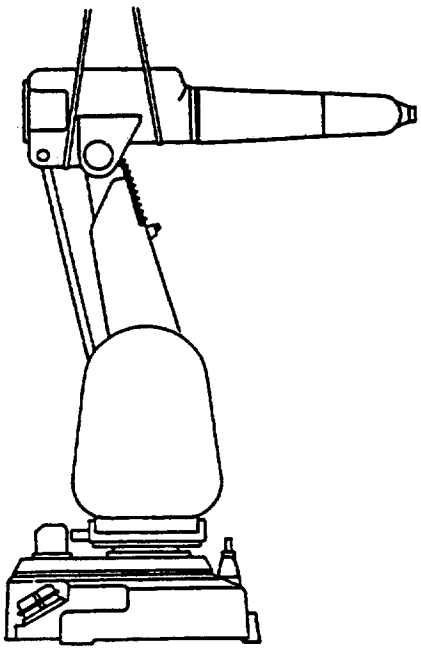
Dismounting:

Reference is made to foldout no 3 in the spare parts section.

1. Dismount lower arm cabling according to section 2.2.

2. Couple and relieve the arm system´s weight as shown in fig. below.

Observe great caution when disconnecting the upper arm!



3. Dismount parallel bracket´s lower bearing <4/2> in accordance with chapter 3, Exchange of parallel bracket or bearings.

4. Dismount screw joint for parallel arm <13> and remove arm.

5. Dismount gearbox no 3 in accordance with chapter 3, Exchange of gearbox.

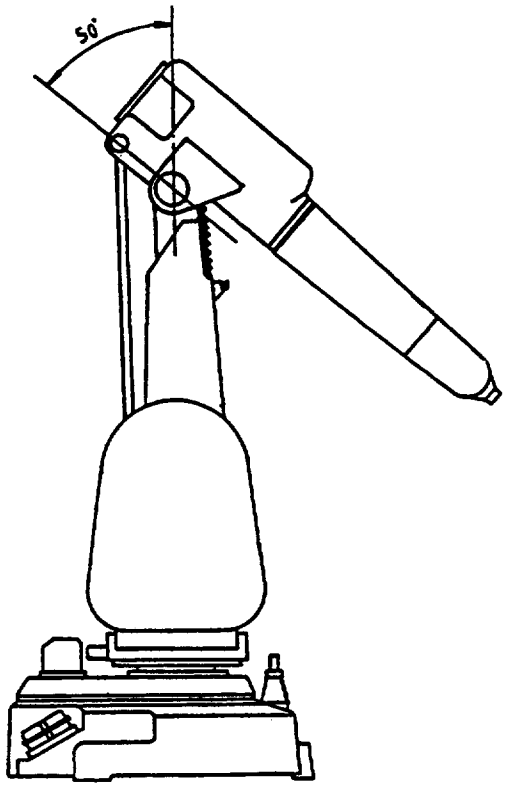
6. Remove flange <11> from lower arm.

7. Dismount bearing <10>.

Mounting:

Reference is made to foldout no 3 in the spare parts section.

8. Mount a new bearing <10> on flange <11>.
9. Mount flange with bearing into lower arm.
10. Mount gearbox no 3 in accordance with chapter 3, Exchange of gearbox.
11. Mount parallel arm <13> in accordance with chapter 3, Dismounting parallel arm.
12. Mount parallel bracket's lower bearing <4/2> in accordance with chapter 3.
13. Position the robot as shown in fig.



14. Mount lower arm cabling according to section 2.2.
15. Connect cable contacts on gearbox 3 and on the motors.
16. Put protective covers in place.

Tightening torque:

Screw joint gearbox 3/intermediate plate, pos 24, 25:	98	Nm
Screw joint parallel arm, pos 14:	100	Nm

3 Axis 3

3.1 Exchange of motor

The electric motors are dismounted from the inner sides of gear boxes.

Reference is made to foldouts no 5 in the spare parts section.

Dismounting:

1. Dismount feed back unit in accordance with chapter 7, Exchange of feed back units.
2. Disconnect electrical motor cable contact from motor.
3. Drain the grease through the lower plug. A pressure of 0.2 bar in the upper hole makes the emtying easier. Warm liquid grease are more fluently.

WARNING!
The robot may carry out unintentional motions when the motor is removed.The arms must be secured in an end position or with an overhead crane.

4. Unscrew motor flange and lift away the motor.
5. Remove adapter plate<3>.

Mounting:

6. Ensure that assembly surfaces are clean and without scratches.
7. Fit and adjust the electric motor in accordance with chapter 7, Setting of play in motor gear.
8. Replace the sealings in adapter plate <3>.
9. Mount the adapter plate and align it with tool no 6896 0011-MH before tightening the screws.
10. Mount the feed back unit in accordance with chapter 7, Exchange of feed back units.
11. Connect motor cabling.
12. Fill with the earlier drained grease, 4,6 kg. See the Maintenance Manual.
13. Re-commutate and re-calibrate the robot in accordance with chapter 8 and 9.

Tightening torque:

Screws for motor,pos 16: 28 Nm

3.2 Cables Axis 3

Power cables

Dismounting:

Reference is made to fold out no. 4 in the spare parts section.

1. Dismount protective cover on gear box 3.
2. Disconnect contacts X10 and X6 on gear box.
3. Disconnect contact X16 from motor 2 and contact X17 from motor 3.
4. Dismount cover <7>, included with the cable, on the inside of gear box 3.
5. Pull out the cabling through the hole in gear box 3.

Mounting:

6. Assemble in reversed order.

Signal Cable Axis 3

Dismounting:

1. Dismount cover for gear box 2 and 3.
2. Dismount cove <15> for intermediate plate <3/2>.
3. Disconnect contact X11 on gearbox 3.
4. Disconnect contact X12 and X28 on gearbox 2.
5. Feed the signal cable carefully through the cable channel in the intermediate plate.

Mounting:

6. Assemble in reversed order.

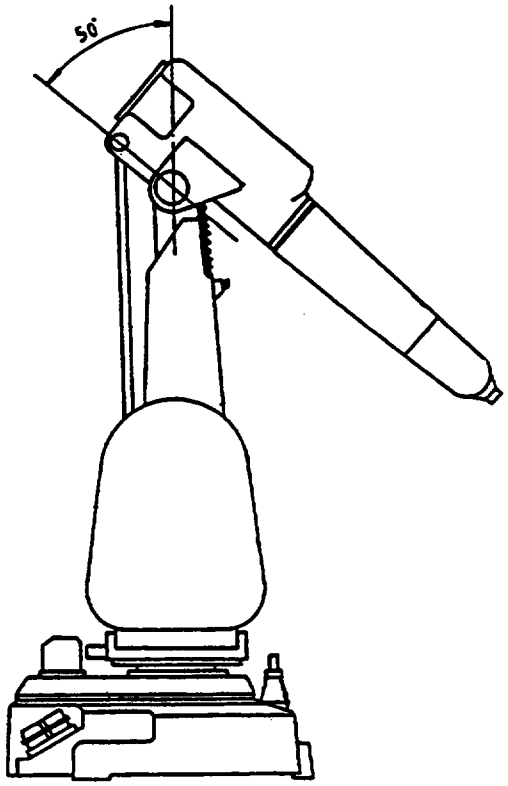
3.3 Exchange gearbox

Reference is made to foldout no 3 in the spare parts section.

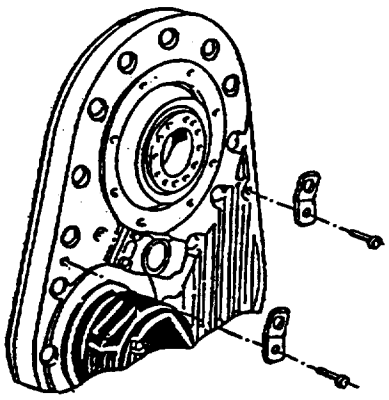
The gearbox for axis no 3 is of same type as gearbox no. 2.

Dismounting:

1. Position the robot's upper and lower arms in accordance with fig. below.



2. Dismount lower arm cabling according to chapter 2.
3. Dismount parallel arm <13> in accordance with chapter 3, Dismounting parallel arm.
4. Unscrew flange <11>.
5. Attach lifting eyes on gearbox 3 in accordance with fig.



6. Disconnect cable contact on motor.

7. Pull out cables through the gearbox.

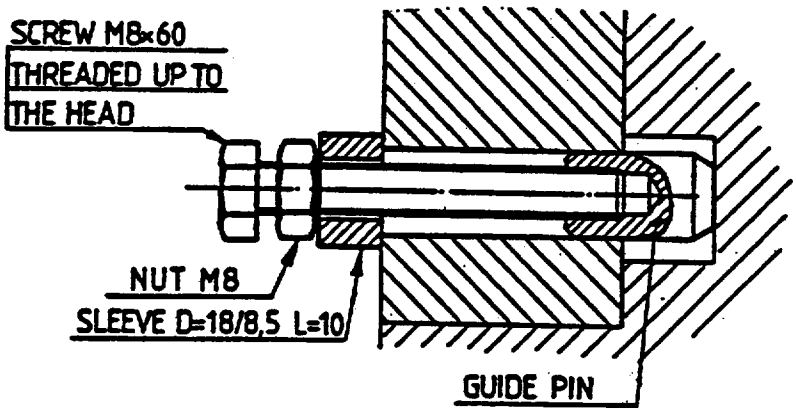
8. Couple lifting straps to lifting eyes and tighten up.

Observe great caution when removing the gearbox!

9. Dismount motor according to chapter 3.

10. Unscrew M12-screws <24, 25>.

11. Retract guide pin <23> with a tool as per fig.



12. Push gearbox 3 sidewards, while suspended by the lifting straps, until the gearbox is free from the lower arm bearing support.

13. Lift away gearbox 3 and dismount cables, bracket and pushbutton unit from the gearbox.

Mounting:

Reference is made to foldout no 3 in the spare parts section.

14. Attach lifting eyes on the new gearbox .

15. Ensure that assembly surfaces are clean and free from scratches.

16. Press guide pin <23> into the gearbox. The thread shall be turned outwards from the intermediate plate.

17. Couple lifting straps and lift the gearbox in position.

Observe caution when lifting the gear box!

18. Push the gearbox towards the lower arm, until the guide pin enters the intermediate plate.

19. Attach washers <26> and grease the screws<24, 25> slightly with molybdenum disulphide grease and tighten with torque, 98 Nm.

20. Tighten screws for flange <11> towards gearbox 3 with torque, 28 Nm.
21. Mount the motor according to chapter 3, Exchange of motor.
22. Connect cable contacts.
23. Mount parallel arm <13> in accordance with chapter 3, Dismounting parallel arm.
24. Mount bracket <5/6>, pushbutton unit, cable fasteners and contacts X8-X10.
25. Put protective cover in place.
26. Re-calibrate the robot in accordance with chapter 9.

Tightening torque:

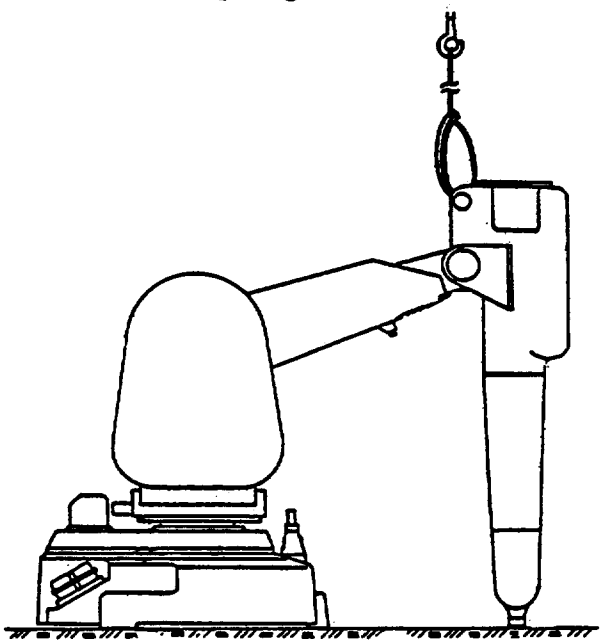
Screw joint gearbox/intermediate plate, pos 24, 25:	98 Nm
Screw joint flange/gearbox 3, pos 12:	28 Nm

3.4 Dismounting parallel arm

Dismounting:

Reference is made to foldout no 3 in the spare parts section.

1. Position the robot as per fig.



2. Dismount lower fitting for parallel bracket <4/2> in accordance with chapter 3.
3. Dismount screw joint for parallel arm <13> and remove the arm.

Observe great caution when disconnecting the parallel arms!

Mounting:

Reference is made to foldout no 3 in the spare parts section.

4. Ensure that assembly surfaces on gearbox no 3 and parallel arm are clean and free from scratches
5. Mount the new parallel arm <13> through lower arm towards gearbox no 3.
6. Tighten screw joint with torque, 110 Nm.
7. Mount lower fitting for parallel bracket in accordance with chapter 3.
8. Re-calibrate the robot in accordance with chapter 9.

Tightening torque:

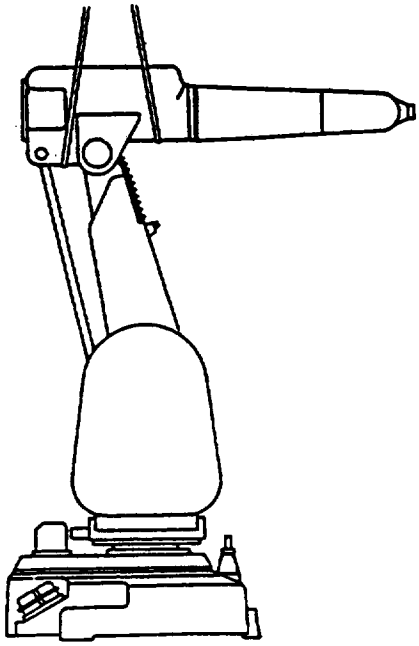
Screw joint parallel arm/ gearbox, pos 14: 110 Nm

3.5 Exchange of Parallel Bracket or Bearings

Reference are made to foldout no 4 in the spare parts section

Dismounting:

1. Couple lifting strap and relieve the arm systems weight as depicted below.



2. Remove clamping sleeve <12>.
3. Unscrew upper KM-nut <8> until the nut is just about to release from the tapered adapter sleeve <8>.
4. Carefully hammer on the spanner until the bearing <5> will release from the sleeve.
5. Knock out shaft <13>.
6. Dismount the lower part, same as the upper.
7. Lift the parallel bracket away.
8. Dismount bearings <5>.

Mounting:

Reference is made to foldout no 4 in the spare parts section.

9. Mount bearing <5>, sleeve <8>, ring <6> in the new parallel bracket´s <2> upper bearing fitting.
10. Continue mounting of lower bearing as per above procedure.
11. Lift parallel bracket <2> in position.
12. Mount lower bearing end on the parallel arm´s <3/13> shaft.

13. Secure lower bearing with sealing ring <9> and KM-nut <8>.
14. Tighten the lower KM-nut 28 Nm.

    N.B. Do not overtighten the KM-nut!

16. Put the bracket´s upper end in position.
17. Mount shaft <13>.
18. Tighten upper KM-nut <8> until the bearing just starts to be pretensioned.
19. Tighten another 90° with the spanner.

    N.B. Do not overtighten the KM-nut!

20. Mount clamping sleeve <12>.
21. Put protective covers in place.
22. Re-calibrate the robot in accorandce with chapter 9.

3.6 Dismounting Upper Arm Complete

Dismounting:

Reference is made to foldout no 4 in the spare parts section.

1. Attatch a hoist to the upper arm.
2. Disconnect the cables to the upper arm.
3. Dismount parallel bracket´s upper bearing.
4. Unscrew nut <20> and hexagon head bolt <19>.
5. Unscrew main screws <17> in axis <16>.
6. Mount a stroke hammer with M10-screw in shaft <16> and knock it out.
7. Remove the axis including the inner race of the cone roller bearing <14>.
8. Mount a stroke hammer in shaft with M8-screw <18> and knock it out.
11. Lift and remove upper arm.

Observe great caution when lifting the upper arm!

Mounting:

Reference is made to foldout no 4 in the spare parts section.

12. Lift the upper arm in position over the lower arm.
13. Mount axis <18> inclusive the inner race of roller bearing <14> in the fitting in the upper arm housing´s fitting.
14. Mount axis <16> inclusive the inner race of roller bearing <14> in the fitting.
15. Fit in and tighten the hexagon head bolt <19> to set the cone roller bearings to a recommended pretension.
16. Mount parallel bracket´s <2> upper bearing in accordance with chapter 3, Exchange of parallel bracket.
17. Mount the cables.
18. Re-calibrate the robot according to chapter 9.

Tightening torque:

KM-nut on parallel-arm and parallel- bracket´s 28 Nm.

4 Pushbutton unit for release of brakes

4.1 Pushbutton Unit for release of brakes

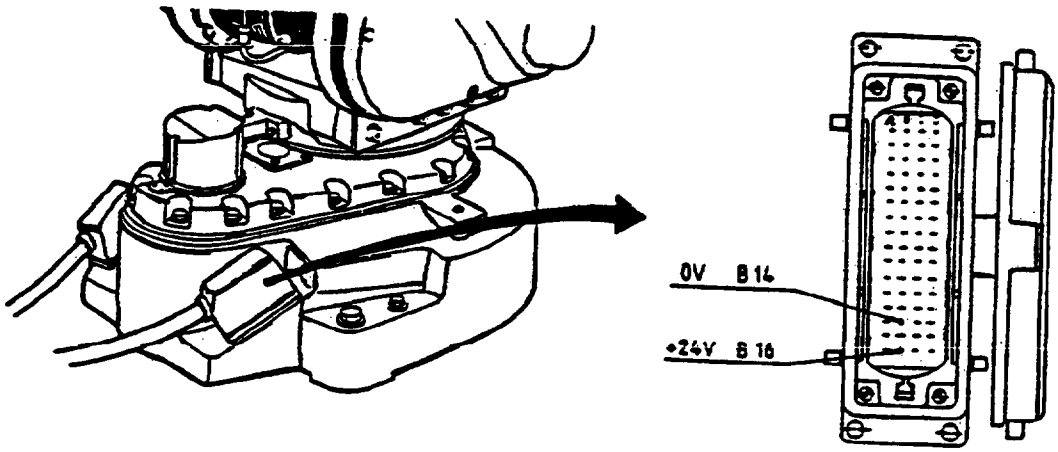
Reference is made to foldout no 3 in the spare parts section.

The pushbutton unit <36>, located outside on gearbox 3, facilitates a quick and safe manual release of the axes' brakes during various work of or around the robot. A possibility is accordingly also provided to move the robot arms manually if necessary.

Should the control cabinet and perhaps also some of the robot's cabling be disconnected, it is possible to release the brakes by the use of an external 24 V DC power source. The connection is carried out according to three alternatives as follows:

1. Contact R. X1 on the robot's base:

   +24 V connects to R.X1. pin B16
   0 V connects to R.X1. pin B14



WARNING! An incorrect connection may result in a release of all brakes!

2. Contact X8 on the pushbutton unit:

   +24 V connects to X8 pin 5
   0 V connects to X8 pin 4

3. Directly to respectively brake's cable.

   Connection is carried out as per circuit diagram for the mechanical robot.

WARNING!
The brake will be released at connection directly to the brake's cables as soon as the power is switched on. This may result in unintentional motions by the robot!

The pushbutton unit is provided with 6 pushbuttons for operation of the axes' brakes. The pushbuttons are labelled with corresponding axis number. The brakes, of mechanical type, equipped with electromagnets, are released at live voltage. A pushbutton must accordingly be kept pushed down to enable release of the brake in question. When the button is released, the brake will again be engaged.

4.2
Exchange of Pushbutton Unit

Reference is made to foldout no 3 in the spare parts section.

When exchanging the pushbutton unit <36> is completely dismounted as follows:

1. Move the lower arm to an end position. Also lower the upper arm to an end position.

WARNING!
The robot must not be in MOTOR OFF mode! This procedure shall take place at all cabling work. Observe great caution when the voltage is reapplied, since the robot may carry out unexpected movements.

2. Switch off power to the control cabinet.
3. Remove cover for gear box 3.
4. Disconnect contacts for cabling to pushbutton unit <36>.
5. Dismount pushbutton unit by removing fastening screws (4 pcs).
6. Mount a new pushbutton unit in reversed order.

5 Axis 4

5.1 Exchange of motor

Reference is made to foldout no 7 in the spare parts section.

Dismounting:

1. Remove cover on upper arm housing.
2. Disconnect the cable connectors from the electric motor.
3. Drain the oil by moving axes 2 and 3 backwards so that the plug <35> comes lowest. Then remove plug.
4. Remove the electric motor by loosening screws <24>.
5. Pull the gear off using the puller tool 6896 0011-TE. Remove the feed back unit acc. to chapter 7, Exchange of feed back units.

Mounting:

6. Fit the gear to the new electric motor.

   Note that a sleeve6896 0011-MX must be pressed onto the spindle against the inner ring of the rear bearing to fix the spindle and to prevent it from getting bent.

7. Replace the O-ring<22> of the motor.
8. Fit the motor flange with its screws without tightening the screws, however. Adjust the play between gears in the intermediate gear with tool no. 3HAA 7601-AMB, by displacing the motor sideways.
9. Check by turning the shaft with a small spanner to be sure that the gears don`t bind, instead it should be a very small play.
10. Tighten the motor. Mount feed back unit acc. to chapter 7, conntacts and cable ties.
11. Refill oil and check the oil level according to the Maintenance Manual.
12. Fit the protective cover on the upper arm.
13. Re- commutate and recalibrate the robot as per chapters 8 and 9.

5.2 Rotator 4

Dismounting:

Reference is made to fold out no. 1:4, 8 in the spare parts section.

1. Put the robot in a suitable position.
2. Dismount covers <1:4/64> and <1:4/58> from the upper arm housing.
3. Disconnect contacts X23, X27, air hose, contacts X25 and X29 if there are any, and cut the cable ties.

4. Unscrew the rotator from the bracket <8/69> and from the cover.
5. Put the contacts together with some tape.
6. Loosen screws <1:4/67>, the screw joint for the wrist.
7. Pull out axes 5 and 6, with the rotator 4.

   N.B! Observe the position of the rotator in relation to the bracket.
8. Place the wrist and rotator on a suitable support.
9. Loosen contacts X33, X35, X38 and X39.
10. Unscrew scews <71> and remove the rotator.

Mounting:

11. Mount a new rotator 4 to axes 5 and 6 with screws <71>.
12. Connect the contacts.
13. Insert the rotator including axes 5 and 6 carefully in the upper arm tubular shaft.

    Observe the position of the rotator in relation to the bracket.
14. Tighten screws <1:4/67> joint wrist/tube shaft. Fasten evenly with torque, 24 Nm.
15. Mount the rotator to the bracket, <8/62> and <8/63>.
16. Connect contacts X23, X27 and X25, X29 and air hose if there are any. Fix cabling with cable ties <1:4/47>.
18. Mount covers <58>, <64> on the upper arm housing.

Tigthening torque:
Screw joint wrist/upper arm tubular, pos 1:4/67: 24 Nm

5.3 Exchange og gear on motor shaft

Gearbox no 4 comprises the following main parts:

- driving gear <25>
- intermediate gear <21>
- final gear <6>

Dismounting:

Reference is made to foldout no 7 in the spare parts section.

1. Remove cover on housing axis 4.
2. Drain the oil by moving axes 2 and 3 backwards so that the plug <35> comes lowest. Then remove plug.
3. Dismount feed back unit and motor in accordance with chapter 7 and 5.
4. Pull off driving gear with puller no. 6896 0011-TE.

   N.B. Driving gear and transfer gear on intermediate gear ar worn-in together. Accordingly, a damaged driving gear may result in the need for exchange of intermediate gear as well!

Mounting:

5. Mount the new driving gear.

   N.B. A sleeve must be attached towards the inner ring of the rear bearing to fix the motor shaft and prevent bending.

6. Mount feed back unit and motor in accordance with chapter 7 and 5.

5.4 Exchange of Intermediate Gear

Dismounting:

Reference is made to foldout no 7 in the spare parts section.

1. Remove covers on housing axis 4.
2. Drain the oil by moving axes 2 and 3 backwards so that the plug <35> comes lowest. Then remove plug.
3. Dismount motor unit in accordance with section 5.1, Exchange motor.
4. Loosen contacts X23, X27 and X25, X29 and air hose if there are any.
5. Loosen the bracket from the rotator and the cover.
6. Remove the cover <31>.
7. Remove sealring <11> from <31>.
8. Unscrew screws <17> that holds the intermediate gear.
9. Dismount final gear <6> from tubular shaft <29> by attaching two threaded bolts in the gear's threaded holes and pulling out the gear.
10. Dismount stop heads <20>.
11. Lift out the intermediate gear.

Mounting:

Reference is made to foldout no 7 in the spare parts section and figure no 5.6 above.

12. Mount a new intermediate gear without the screws <17>.
13. Mount the stop heads <20>.
14. Replace the O-ring <22>.
15. Mount gear <6>, tighten with torque 10 Nm.
16. Tighten the intermediate gear with screws <17>, don't tighten the screws.
17. Replace the O-ring <22> on the motor.
18. Mount motor according to section 5.1.
19. Adjust the play between the final gear - intermediate gear and intermediate gear - motor pinion, with tool no 3HAA 7601-AMB until the final gear and the pinion has a very small play against the intermediate gear. A play shall be recognized when moving a spanner gently back and forth.

    N.B. The upper arm shall be positioned horizontally when adjusting the play and the wrist shall be in place.

20. Tighten screws <17>, torque 33 Nm.

21. Mount a new sealring <11>.

22. Mount a new cork gasket <16> under the cover.

23. Mount rotator 4 according to section 5.2.

24. Check the oil level in accordance with the maintenance manual.

25. Mount back the protective covers again.

Tightening torque:

Screw joint final gear, pos. <37>:	10 Nm
Screw joint intermediate gear, pos. <17>:	33 Nm

5.5 Exchange of final gear

Dismounting:

Reference is made to foldout no 7 in the spare parts section.

1. Remove cover on upper arm housing.
2. Dismount rotator 4 in accordance with section 5.2, Rotator 4.
3. Drain the oil by moving axes 2 and 3 backwards so that the plug <35> comes lowest. Then remove plug.
4. Dismount cover plate axis 4 <31>.
5. Remove sealing ring <11> from <31>.
6. Unscrew screws <17> for the intermediate gear.
7. Dismount final gear <6> from tubular shaft <29> by attaching two threaded bolts in the gear´s threaded holes and pulling out the gear.

Mounting:

8. Carefully clean assembling surfaces for final gear as well as screw threads.
9. Replace o-ring <15>.
10. The required thickness of shims <8-10> is determined by measuring of the depth gauge in final gear center comparing with corresponding protrusion of the tubular shaft <29> from the aft bearing <2>.
11. Compare the difference of measures and compensate with shims <8-10>.

    N.B. The shim´s thickness shall be = 0.02-0.06 mm ***lager*** *than measured value. That gives a pretension of the bearings. No play is allowed.*

12. Mount final gear with torque, 10 Nm.
13. Mount screws <17> for intermediate gear, don´t tighten.
14. Adjust the play between the final gear <6> and intermediate gear <21> with tool no 3HAA 7601-AMB until the pinion has a very small play against the gear.
15. Tighten screws <17>, torque 33 Nm.
16. Mount a new sealing ring <11>.
17. Mount a new cork gasket<16> before mounting the end plate axis 4.
18. Mount rotator 4 in accordance with section 5.2, Rotator 4.
19. Check the oil level in accordance with the maintenance manual.
20. Put protective covers in place on housing axis 4.

Tightening torque:

Screw joint final gear, pos 37:	10 Nm
Screw joint intermediate gear, pos. 17:	33 Nm

5.6 Dismounting of Upper Arm Tubular

Dismounting:

Reference is made to foldout no 7 in the spare parts section.

1. Remove covers on upper arm housing.
2. Dismount rotator 4 <10:6> in accordance with section 5.2, Rotator 4.
3. Drain the oil by moving axes 2 and 3 backwards so that the plug <35> comes lowest. Then remove plug.
4. Dismount final gear as per section 5.5, Exchange of final gear.
5. Remove washers <4> 5 pieces and the stop heads <20> 2 pieces that locks the bearing in position.
6. Attach tool no 6869 011-RT center spindle to sleeve <1>. Pull out the sleeve with the bearing.
7. Attach the tool in the holes for the washers <4> and stop heads <20>.
8. Push the shaft free of the forward bearing and sleeve with the tool.

Mounting:

9. Mount a new bearing <27> and the gasket <28> on the tubular shaft.
10. Mount sleeve <1> with bearing <2>.
11. Insert the tubular shaft in the upper arm.
12. Attach the tool center spindle with long screws through the holes in sleeve <1> and into the tubular shaft. When the tubular shaft comes futher in, switch too shorter screws.
13. Pull tubular shaft through forward bearing <27>and sleeve <1> with tool no 2171 205-160

    NOTE! Be ware so that the shaft not get stuckt, so that the threads in the tubular shaft is damage.
14. Attach the washers for bearing lock<4> and the stop heads <20> and tighten.
15. Mount final gear in accordance with section 5.5, Exchange final gear.
16. Mount rotator 4 in accordance with section 5.2, Rotator 4.
17. Check the oil level in accordance with the maintenance manual.
18. Re-calibrate the robot according to chapter 9.

5.7 Upper Arm Tubular - Exchange of Seals and Bearings

Dismounting:

Reference is made to foldout no 7 in the spare parts section.

1. Dismount upper arm tubular in accordance with previous section.
2. Remove inner sealing <11> and O-ring <15>.
3. Dismount forward sealing <28>.

Mounting:

4. Mount a new forward sealing <28>.
5. Mount a new rear sealing <11> in upper arm housing <26>.
6. Attach a new O-ring <15> in groove on sleeve <1>.
7. Mount the upper arm tubular <29> in accordance with previous section.

6 Wrist, axes 5 and 6

The wrist includes axes 5 and 6 and forms a complete unit, comprising motor units and gears of which the design is such that no service work of the wrist is advisable on the Customer's location during normal maintenance of the robot. The wrist shall accordingly be dismounted as a unit and transported to ABB ROBOTICS for service.

The only maintenance or repair work that should be carried out by the Customer's service personnel is:

- Exchange of a brake as per chapter 7, Exchange brakes axes 1-6.
- Exchange of a feed back unit as per chapter 7, Exchange of feed back units axes 1-6.
- Oil change according with the maintenance manual.

6.1 Dismounting of wrist

Dismounting and mounting of the wrist is carried out in accordance with chapter 5, Cabling axis 4, exchange of the rotator 4.

7. MOTOR UNITS

General

Each robot axis is provided with a motor unit consisting of:

- A synchronous AC motor with gear
- A brake

Totally, 6 motor units are mounted on the robot.

From the robot's cabling unit contacts, power and signal cables are routed to the respective electric motor. The cables are connected by contacts to the motor.

The motor's drive shaft is directly connected to the robot axis gearbox. On the motor shaft´s rear end a mechanical brake is mounted, on the shaft´s drive end a pinion. The brake is electromagnetically released at live voltage to the coil.

Each motor unit is provided with a feed back unit.

The robots are delivered with alternative motor types. The type in question should be entered as a parameter in the system, see Installation manual S3.

Motor and brake cover always belongs together. The brake 2284 261-V instead, can always be used as a spare part on axes 1-3 irrespectivly of motor type, brake 2284 261-R is valid for axes 4-6.

After carrying out service including separation of the motor and feed back unit, the robot will have to be commutated and calibrated according to chapters 8 and 9.

7.1 Setting of Play in Motor Gear Axes 1-3

1. Ensure that the O-ring is properly placed in the motor flange before mounting. Lubricate the screws with molybdenum disulphide grease and fasten the motor unit including washers with the screws.

   The screws shall only be tightened to compress the O-ring until the motor flange is in contact with the assembly surface (corresponds to a torque of about 0.4 Nm).

2. Fit play adjustment tool no 6896 0011-NZ (without measurement arm) where the feed back unit is normally fitted.

   Turn the locking sleeve clockwise until its gear totally fits in the intermediate gear wheel. Secure the sleeve in this position with the locking nut on the link screw.

   Mount measuring lever on motor shaft and dial indicator on measuring tool. Release the brake .

Observe great caution when releasing the brakes, since this may result in uncontrollable robot motions!

3. The play between motor gear and intermediate gear is measured by turning the motor shaft with its measuring lever attached and observing the dial's indication. To adjust the play, see the instructions given below:
   - Loosen the motor fixing screws.
   - Displace the motor, by e.g gently tapping the motor flange, to either increase or decrease the play in the gear.

   The play adjustment shall be carried out with the gear turned to a position with the smallest play. This position is determined by measuring and comparing the play in four different points on the intermediate gear's circumference. The angle between the points shall be 90 degrees, which is accomplished by turning the brake disc two turns. The play at the first point shall be adjusted to an indicated value on the dial between 0.20 and 0.25 mm.

4. Turn the intermediate gear shaft to that one of the four points having the smallest play. Measure the surface temperature of the gearbox on the machined surface where the play adjustment tool is attached. Use contact thermometer. Then adjust the play in accordance with table overleaf.

5. When the correct play has been achieved, the motor's fastening screws are tightened with torque to 28 Nm.

   Recheck the play to ensure that no change has occured after the torque tightening.

6. Remove the play adjustment tool.

Tightening torque:

Screws for motor fastening: 28 Nm

TABLE

Play Adjustment Values in Relation to Surface Temperatures

Temp (^{0}C)	Dial Indication (mm)
5-7	0.06 -0.10
7-9	0-08-0.12
9-11	0.10-0.14
11-13	0.12-0.16
13-15	0.14-0.18
15-17	0.16-0.20
17-19	0.18-0.22
19-21	0.20-0.24
21-23	0.22-0.26
23-25	0.24-0.28
25-27	0.26-0.30
27-29	0.28-0.32
29-31	0.30-0.34
31-33	0.32-0.36
33-35	0.34-0.38

7.2 Exchange of brakes axes 1-6

Reference is made to foldout no 2:1 in the spare parts section.

Dismounting of brakes axes 1-3:

1. Lift and invert the robot in accordance with chapter 1, Exchange of motor.(**Only valid for axis 1).**

Observe great caution when turning the robot!

2. Remove cover <1:1/56>. **(Only valid for axis 1).**

3. Disconnect contact from the motor and unscrew the connector on the motor terminal. Remove pins in position "L" and "M". Use extractor no 6893 153-4.

4. Apply 24 V DC to the pins.

WARNING! The robot is now free to move. Be careful and have possible moving parts secured.

5. Turn the brake disc until the two holes, D=10 mm, in it will allow two socket head screws, M5 x 10, to be mounted in the magnet housing. Tighten the screws until the anchor plate is pressed against the magnet housing.

6. Disconnect the voltage.

7. Remove the locking nut from the motor shaft.

8. Fasten tool no 6896 0011-NR to the brake disc and pull off the disc.

9. Unscrew the magnet housing and pull gently out the cables from the motor.

Mounting brakes on axes 1-3:

10. Lead the brake cables through the motor terminal and attach the brake magnet housing to the motor. If the motor has an extra cover on the terminal box can tha t be removed to make the mounting easier. Grease the screws slightly with molybdenum disulphide grease and tighten with torque 7 Nm.

11. Check that the transport locking screws press the anchor plate against the magnet housing.

12. Mount the brake disc on motor shaft by using tool no. 6896 0011-VM. Ensure that the holes in the brake disc correspong to the screw heads on the anchor plate.

13. Adjust the play between anchor plate and lining on brake disc to 0.25-0.30 mm by tightening the nut on the motor shaft. When correct play is achieved secure the nut with lockning screw in the nearest thread in the brake disc.

14. Unscrew transportation screws from the anchor plate.

15. Apply voltage and operate the brake a couple of times. Check the play and adjust if necessary.

16. Connect brake cables to position "L" and "M" in connector and remount to motor.

17. Connect motor contact.

18. Mount cover <1:1/59>. **(Only valid for axis 1).**

19. Lift and turn the robot according to chapter 1. **(Only valid for axis 1).**

Tightening torque:

Screws for the brake: 7 Nm

Dismounting brake axis 4

Reference is made to foldout no 6 in the spare parts section.

Dismounting:

1. Remove cover on upper arm housing.

2. Dismount feed back unit in accordance with chapter 7, Exchange feed back unit.

3. Diconnect contact. Apply 24 V DC to the pins.

4. Turn the brake disc until the two holes in it will allow two socket head screws to be mounted in the magnet housing. Tighten the screws until the anchor plate is pressed against the magnet housing.

5. Disconnect the voltage.

6. Remove the locking nut from the motor shaft.

7. Fasten tool no 6896 0011-NR to the brake disc and pull off the disc.

8. Unscrew the magnet housing.

Mounting:

9. Mount new brake, grease the screws slightly with molybdenum disulphide grease and tighten with torque 7 Nm.

10. Check that the transport locking screws press the anchor plate against the magnet housing.

11. Mount the brake disc on motor shaft by gently hammering on the hub. Ensure that the holes in the brake disc correspong to the screw heads on the anchor plate.

12. Adjust the play between anchor plate and lining on brake disc to 0.30-0.35 mm by tightening the nut on the motor shaft. When correct play is achieved secure the nut with lockning screw in the nearest thread in the brake disc.

13. Unscrew transportation screws from the anchor plate.

14. Apply voltage and operate the brake a couple of times. Check the play and adjust if necessary.

15 Re-commutate and re-calibrate the robot according to chapter 8 and 9.

Note! The small size of the brake permits mounting with help of a sleeve and cautious use of a hamer.

Tightening torque:

Screws for brake: 7 Nm

Dismounting brakes axes 5 and 6

Reference is made to foldout no 7 in the spare parts section. With the wrist unit seen from the turning disc, the right motor unit is the axis 5 motor unit and the left motor unit is the axis 6 motor unit.

Dismounting:

1. Dismount rotator 4 in accordance with chapter 5, Cabling axis 4.
2. Dismount then in the same way as for brake on axis 4.

Mounting:

3. Mount new brake in the same way as for axis 4.
4. Mount wrist and rotator 4 in accordance with chapter 5, Cabling axis 4.
5. Re-commutate and re-calibrate the robot according to chapters 8 and 9.

Tightening torque:

Screws for brake: 7 Nm

7.3 Exchange of Feed Back Unit axes 1-6

General

Each electric motor is provided with a feed back unit.
The feed back units are exchanged as complete units. The units for axes 1-3 are accessible outside on the gearboxes 1-3 and the unit for axis 4 on the electric motor. At exchange of a feed back unit for a wrist motor, the wrist has to be dismounted in accordance with chapter 6, Dismounting of wrist.

The feed back unit is provided with a coupling equipped with 2 M3-threaded set screws, located 90° from each other. One of the screws shall be tightened against the flat on the motor shaft as depicted in figure on next page.

After each work which includes separation of feedback unit and motor, the robot must be commutated and calibrated according to chapters 8 and 9. Replacement of parts in the arm system must be followed by a calibration according to chapter 9.

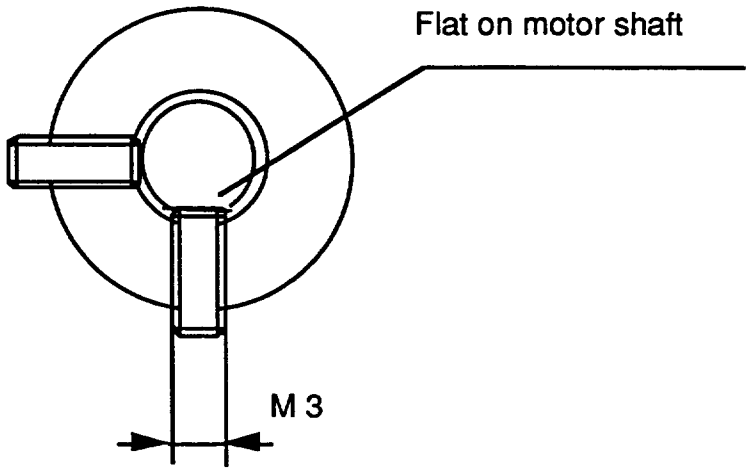
Dismounting of Feed Back Unit

Reference is made to foldouts nos 1:1 and 1:2 in the spare parts section.

1. Disconnect contact.
2. Release the brake with brake release unit.
3. Unscrew stop screws for the feed back unit coupling.
4. Remove feed back unit.
5. Mount the new feed back unit in reversed order.

   N.B. Do not apply any pressure on the coupling during mounting.

   Regarding axis 1, the motor spindle might need rotating to the scribed line before fitting of the feedback unit. See chapter 8.
6. Re-commutate and re-calibrate the robot as per chapter 8 and 9.



8 Commutation

8.1 General

The permanently magnetized synchronous motor provides a torque proportional to the current. The stator current vector must have a 90° phase shift to the rotor magnetic flux vector to achieve this torque. The rotor position is continuously calculated using the resolver as position sensor.

If work has been performed, such as separation of motor and feed back units, a new input of resolver offset values must be made.

The control values for resolver offset and type of motor are noted on a marking plate located on gearbox 2, see figure below. The values are used for example, at exchange of the control cabinet. The values have to be corrected if a motor or feed back unit has been exchanged.

Setting and control is carried out with the control cabinet switch in position MOTOR OFF.

RESOLVER OFFSET					WRITE IN PENCIL / SKRIV MED BLYERTS	
MOTOR COMMUTATION						
CALIBRATION POSITION						
MOTOR TYPE						
AXIS	1	2	3	4	5	6

8.2 Setting Procedure

A scribed marking is made on the respective electric motor housing. A corresponding marking is made on the brake disc.

The setting is carried out as follows:

1. Turn the motor shaft by release of the brake until the brake disc´s marking is positioned opposite to the marking on the motor.

   An alternative method may be used for axis 1 if the cover <1:1/59> is not dismounted:

   - Turn the motor shaft so that one screw in the coupling can tightened against the flat on the shaft. Turn the shaft and tightened the other screw.
   - Press the TEST button a few seconds and at the same time the INIT on the robot coumputer board. Release the buttons when the FAULT lamp twinkels.
   - Choose on the programming unit: BORADS
DSQC 236 axis 1
   - Press the enabeling device, axis 1 brake release push button and NEXT three times at the same time.

   N.B. The motor´s shaft must not be turned!

2. The motor will now be in the commutation position. The brake shall be in locked condition.

   N.B. The scribed mark adjustment of axes 5 and 6 is carried out with the wrist dismounted from the upper arm. During the mounting sequence the motor shafts must not be turned until readings of resolver offsets have been carried out.

3. Read and store the commutation position by using the following commands on the programming unit:

   MAN
SCAN
PARAM
RESOLV
COMMOFF
AXIS NO = (current axis is selected)
ENTER
UPDATE

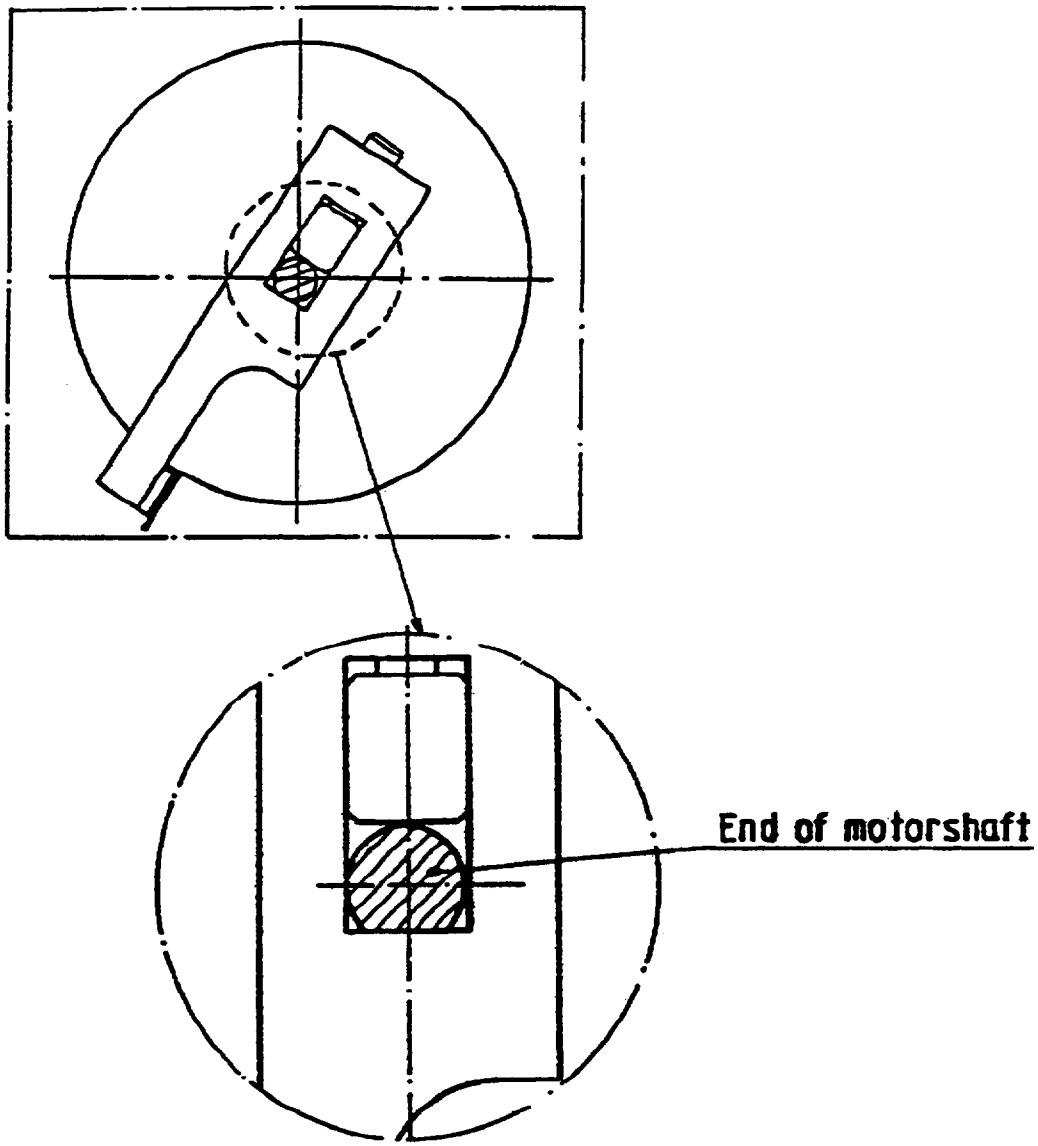
4. Enter the new resolver values on the marking plate on gearbox 2.

5. To restart the system, the following commands are to be carried out on the programming unit:

   BREAK
ACTIVE

6. Store a back up copy of the parameters by carrying out the following commands on the programming unit:

   MAN
SCAN
PARAM
TO DISK


End of motorshaft

9 Calibration

9.1 General

The robot measurement system consists of one feedback unit for each axis and a measurement board keeping track on the present robot position. The measurement board memory has a battery back up.

The measurement system needs to be carefully calibrated (acc. to section 9.2) if any of the resolver values is changed. This happens if:

- parts affecting the calibration position has been replaced on the robot.
- the feedback unit and the axis motor have been separated. It is however not necessary if the robot has been run to the calibration position using the system disk 5736 052-C before separating the feedback unit and the motor. After refitting, the resolver value is to be read back into the memory according to section 9.2.

The system needs to be coarsely calibrated (acc. to section 9.2) if the contents of the revolution counter memory is lost. This may happen if:

- the battery is dischaged.
- an resolver error occurs.
- the signal between resolver and measurement board is interrupted.

The robot has to be commutated correctly (acc. to ch. 8) before it is calibrated!

9.2 Calibration Procedure

The axes are to be adjusted in increasing sequence, i.e. 1 - 2 - 3 - 4 - 5 - 6.

1. Position the robot approximately in calibration position 0 according to section 9.4.

2. Select STANDBY mode.

Axis 1

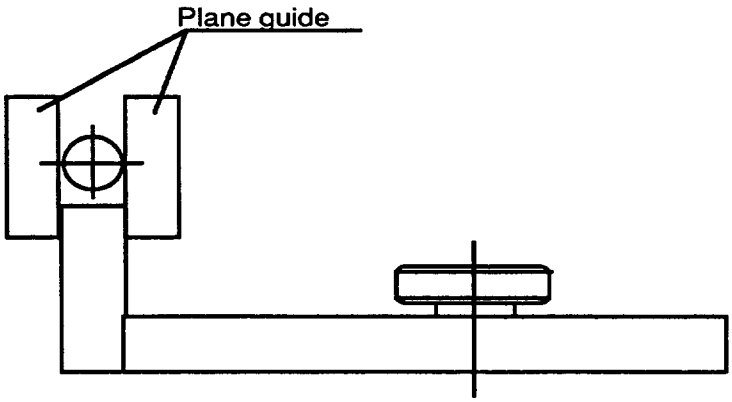
3. Remove plate <1:1/27> on gearbox 1.

4. Attach synchronization fixture 6808 0011-GN to the planned surface and insert corresponding measuring rod 6808 134-GR in hole in the intermediate plate.

5. Put the operation mode selector in the TEACH mode and switch the system to RUN mode. Operate the robot manually with the joystick until the measuring rod is positioned within the planned surface on the calibration fixture's elbow.

Observe caution. Risk of injures!

6. Check with a plane guide. Reference is made to the figure below.



Axes 2 - 6

7. Select STANDBY mode.
   Remove plate <1:1/28>.

8. Mount sensor fixture 6808 0011-GM on the base's reference plane.

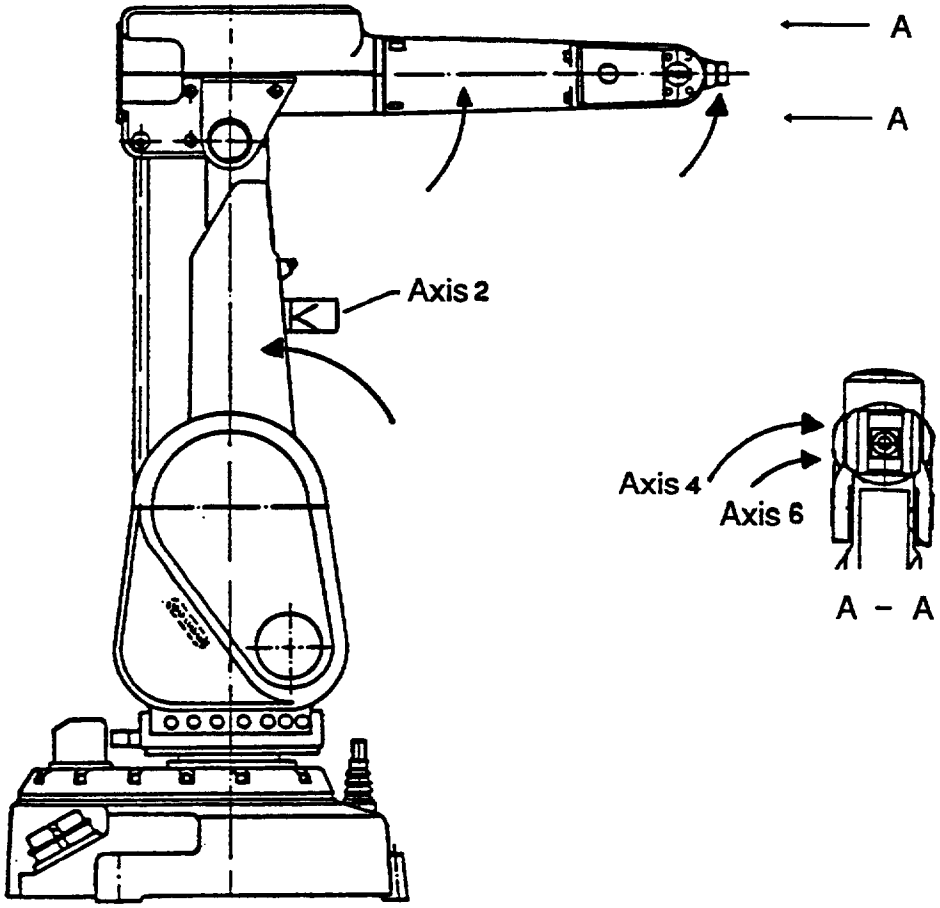
9. Mount elbow fixture 6808 0011-LP on the lower arm's calibration plane.

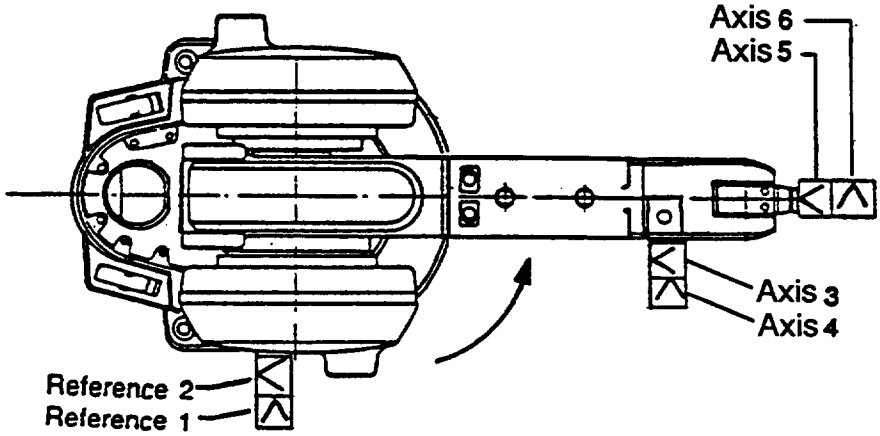
10. Mount sensor fixture 6808 0011-GM on the wrist's calibration plane turned upwards.

11. Mount elbow fixture 6808 0011-GU on the turn disc. Note that the elbow fixture's position is adjusted with a guide pin.

12. Mount inclination instrument 6807 081-D. One sensor shall be mounted on the reference plane and the other on the elbow fixture for axis 2. Both sensors shall be positioned in the same direction. Also, see the figure on the next page.

    Note that the sensor unit always shall be mounted on top of the fixture .


A
A
Axis 2
Axis 4
Axis 6
A - A


Axis 6
Axis 5
Axis 3
Axis 4
Reference 2
Reference 1

13. Select RUN mode and operate joystick manually in the direction pointed out in the figure on previous page until the digital levelling gauge indicates zero. The gauge shall read 0 ±12 increments. (0.3 mm/m).

    The reson for that always adjust, the calibration position, in directions shown in figure, are that the friction - and gravity forces then co-operates against the direction of the movement. There by is the adjustment simplified.

14. Turn the reference sensor, move the other sensor and continue the calibration procedure for the other axes.

15. When all axes have been adjusted, the resolver values are stored by executing the following commands on the programming unit. If the robot is provided with an absolute measuring system, also the commands presented within brackets shall be executed:

    MAN
    SCAN
    PARAM
    RESOLV
    SYNCOFF
    AXIS NO =1
    ENTER
    UPDATE

    The revolution counter is now calibrated. The value does not have to be recorded.

16. The resolver value for axis 1 has now been updated. Write the value on the ID-card located outside on gearbox 2.

    NEXT
    UPDATE

17. To store the resolver value for axis 2, press:

    NEXT
    UPDATE
    NEXT
    UPDATE

18. Continue the procedure in the same way for remaining axes.

19. To restart the system, the following commands are to be carried out on the programming unit:

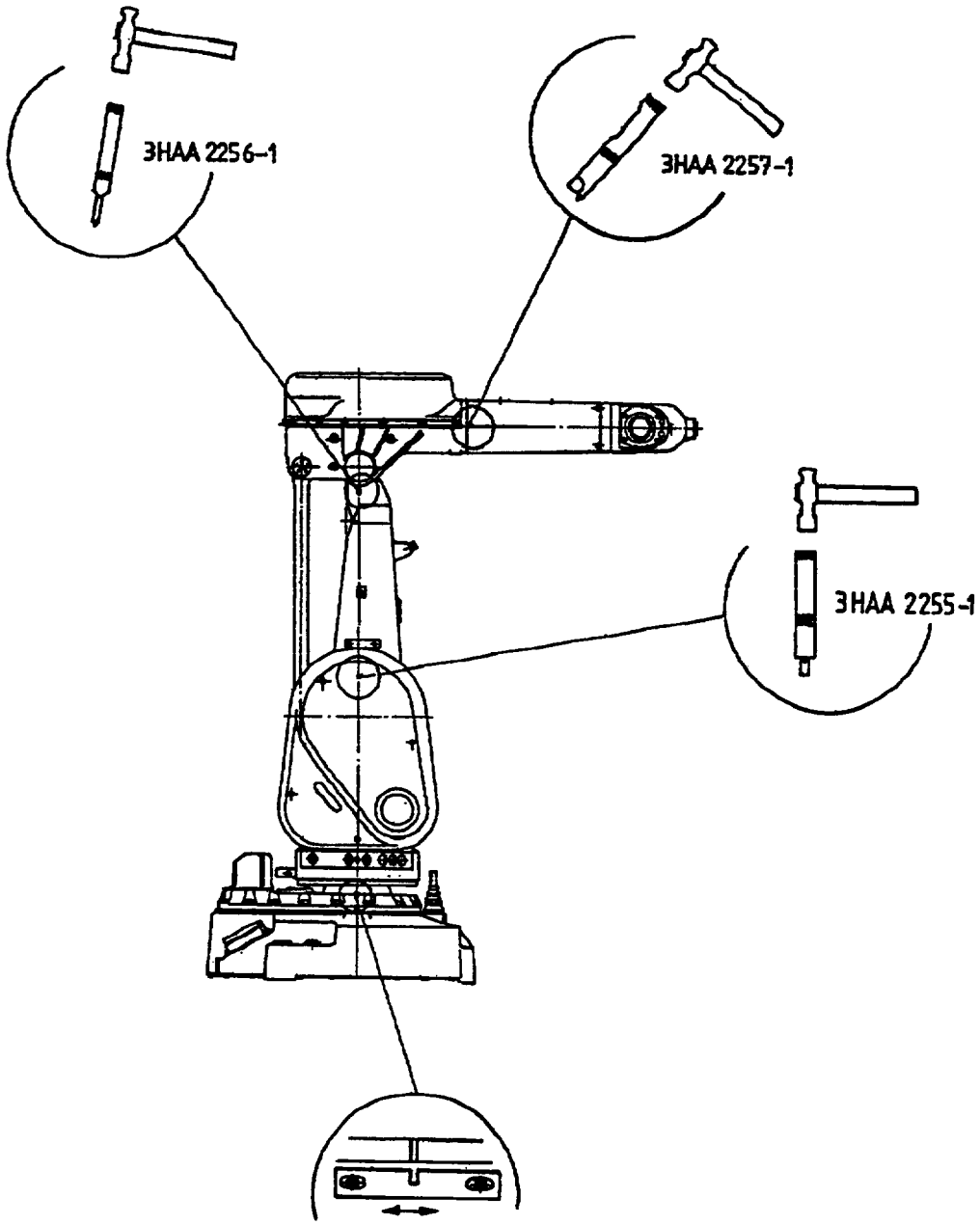
    BREAK
    ACTIVE

    Store a back up copy of the parameters by carrying out the following commands on the programming unit:

    MAN
    SCAN
    PARAM
    TO DISK

Calibration Plate and Calibration Marks

20. Adjust the calibration plate for axes 1, in present cases the other positions are to be marked with a punch mark.
See figure.



21. Check the calibration position according to chapter "9.5, Check of calibration position".

9.3
Coarse calibration using the robot calibration marks

If error message 509 SYNC.ERROR XXXX or ROBOT NOT SYNCHRONIZED, the robot must be calibrated against the calibration mark of each axis on the robot. See figure on the next page.

Examples when the revolution counter is to be calibrated:
- when the battery unit is discharged
- after a resolver fault
- the signal between resolver and serial measurement board is interrupted
- some robot axes have been manually moved with disconnected control system

After approx. 18 hrs of operation, the accumulator unit is fully recharged.

If calibration of the resolvers must be performed, see Service Manual IRB 2000, Mechanical repair, chapter 9.

Observe caution when inside he robot working range!

Put the system in the MOTOR ON mode and run the robot manually, using the joystick, to a position where the calibration marks are within the tolerance zone, as shown in the figure on the next page.The axes are to be adjusted in increasing sequence, i.e. 1 - 2 - 3 - 4 - 5 - 6.

Axes 5 or 6 must not be manually moved before the robot is calibrated, to avoid that the resolver of axis 6 is calibrated on the wrong resolver revolution.
When calibration is performed as below, avoid to move axis 6 when axis 5 is moved to it´s calibration position.

When all axes have been set according to the above, the revolution counter values are to be stored by giving the following commands on the programming unit:

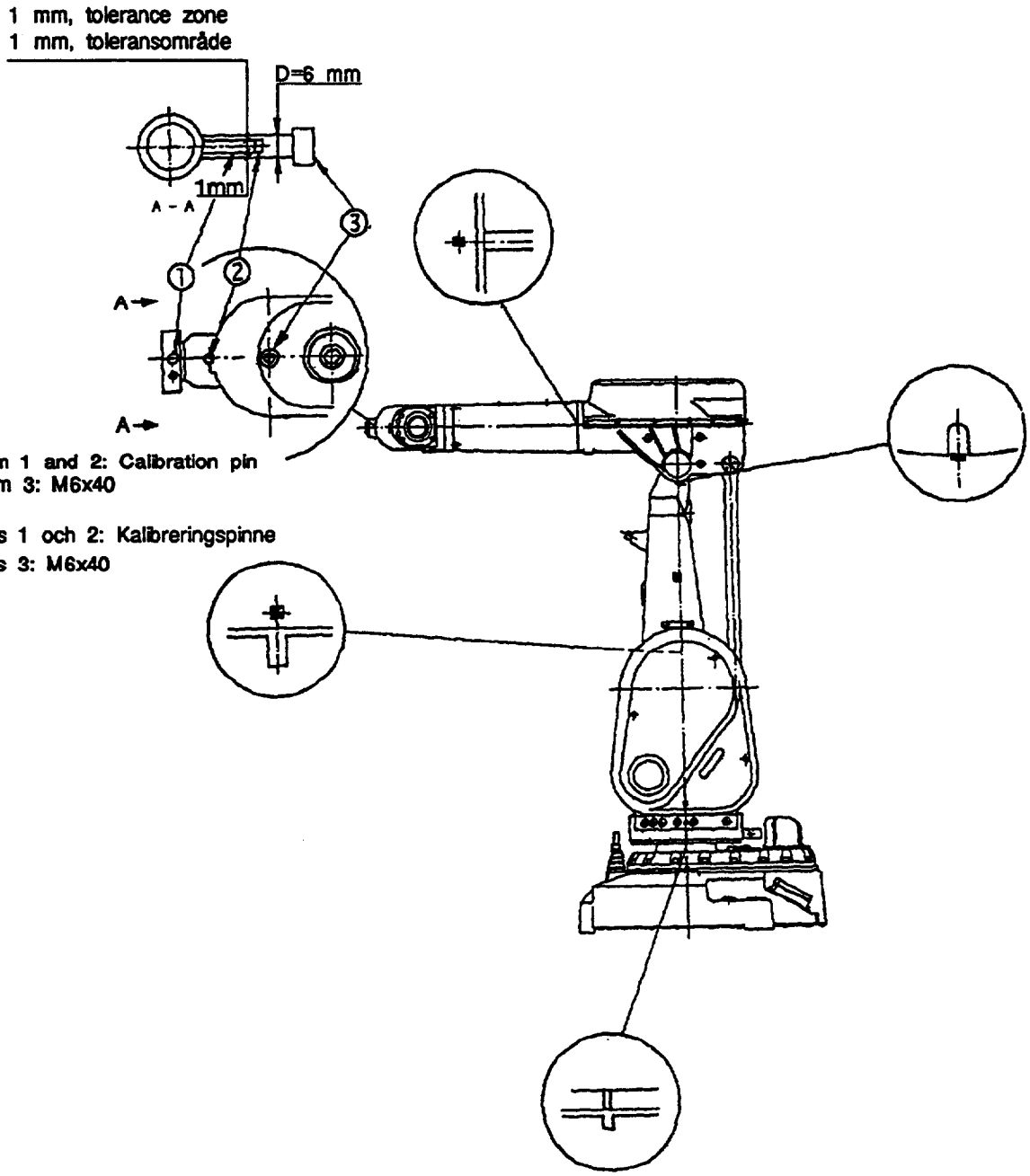
- Note. Don´t uppdate the SYNCPAR value.

MAN
SCAN
PARAM
RESOLV
COUNTER
UPDATE ALL COUNTERS? YES

Make a back up copy of the parameters on a diskette or similar by performing the following sequence:

MAN
SCAN
PARAM
TO DISK

After uppdate of the revolution counter check every time calibration position and drive a sutable calibration program.



Item 1 and 2: Calibration pin
Item 3: M6x40

Pos 1 och 2: Kalibreringspinne
Pos 3: M6x40

9.4
Alternative calibration positions

The robot must be calibrated at calibration position 0 before it can be calibrated in any of the alternative positions.
Use system disk 3HAA 3923-A to set the alternative calibration positions according to the following:

IRB 2000:

program	2000	calibration position	0
program	2001	calibration position	1
program	2002	calibration position	2
program	2003	calibration position	3
program	2004	calibration position	4
program	2005	calibration position	5

Note that if the final installation prevents that calibration position 0 can be reached, must the setting of alternative calibration positions be carried out before installation.

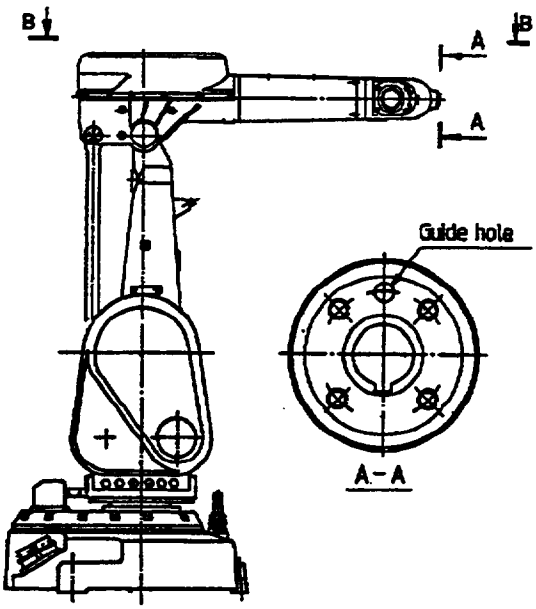
The different alternative calibration positions are described in the Installation Manual of Control System S3. After setting any of the above alternative calibration positions, the revolution counter value is to be stored by giving the following commands on the programming unit:

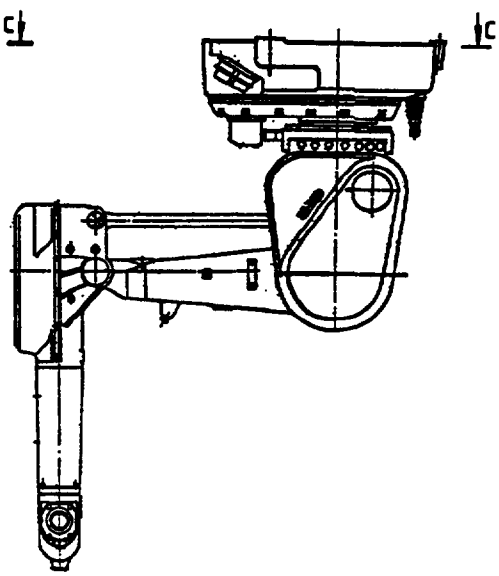
MAN
SCAN
PARAM
RESOLV
SYNCOFF
Select axis
UPDATE (write down on calibration label)
NEXT
UPDATE (counter)
NEXT
.
.
.
BREAK
ACTIVE

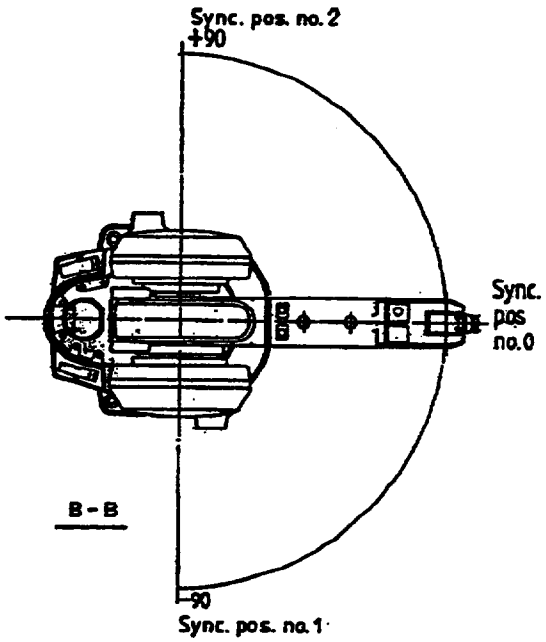
Make a back up copy of the parameters on a diskett or similar by perforing the following sequence:

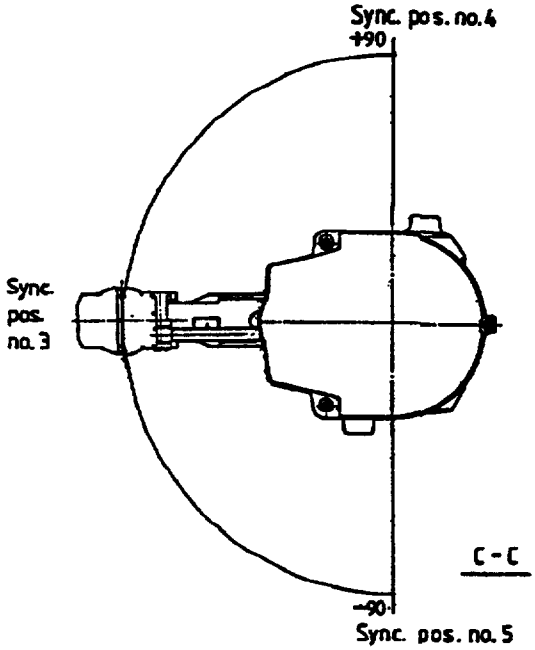
MAN
SCAN
PARAM
TO DISK

Axis	Calibration position (see figure below)					
	0	1	2	3	4	5
1	0°	-90°	+90°	0°	-90°	+90°
2	0°	0°	0°	-90°	-90°	-90°
3	0°	0°	0°	(-90°	-90°	-90°)









9.5
Check of calibration positions

Use system disk 3HAA 3923-A to check the calibration positions. Select calibration program according to section 9.4. Start the program and switch the robot to the STANDBY mode when it has been calibrated. Check that the calibration marks align with each other.
At check, with the electrical inclination instrument, should the result be within 0.5 mm/m, using the system disk.

9.6
Calibration equipment

Calibration set	
Calibration equipment	no YB 111 056-Z
Inclination instrument	no 6807 081-D
Kit of punches for making the calibration marks, acc. to fig. on page 9:5	no 3HAA 2351-8

10 Special Tool List and Service Card

Motor Units

• Play measuring tool	no 6896 0011-NZ
• Dial indicator	
• Aligning tool	no 6896 0011-MH
• Extractor	no 6893 153-4
• Puller	no 6896 0011-NR
• Commutation arm	no 6896 0011-NS
• Calibration equipment	no YB 111 056-Z
• Inclination instrument	no 6807 081-D
• Play adjustment, axis 4	no 3HAA 7601-AMB

Mechanics

Frame

• Lifting tool	no YB 111 056-V
• Hook spanner	no 6896 0011-MY
• Hook spanner	no 6893 0011-NE
• Hook spanner	no 6896 0011-MZ
• Puller	no 6896 0011-NV
• Mounting tool	no 6896 0011-NU

Arm System

• Upper arm tool	no 6896 0011-RT	
• Hook spanner	no 6896 0011-MY	
• Hook spanner	no 6896 0011-NE	
• Hook spanner	no 6896 0011-MZ	
• Puller	no 6896 0011-NV	
• Mounting tool	no 6896 0011-NU	
• Mounting tool	no 6896 0011-NL	
• Sleeve	no 6896 0011-ML	
• Sleeve	no 6896 0011-MM	
• Washer	no 6896 0011-MN	
• Tool	no 6896 0011-NG	
• Puller	no 6896 0011-TE	
• Tool	no 6896 0011-NG	
• Shim	no 2159 167-25 (2 pcs)	t=0.3
• Shim	no 2159 167-27	t=0.1
• Shim	no 2159 167-28	t=0.05
• Puller	no 6896 0011-NR	

Others

• TCP-kit	no 3HAA 2246-1

Service Card

Date	Service (activity)	Repl by/Exch of (spare part etc)	Adjustm of (torque, play)	Oil Change (type, lit)	Served by (sign.)

Spare Part List/
Reservdelslista
IRB 2000

3HAB0006-1
Januari 1993/M93

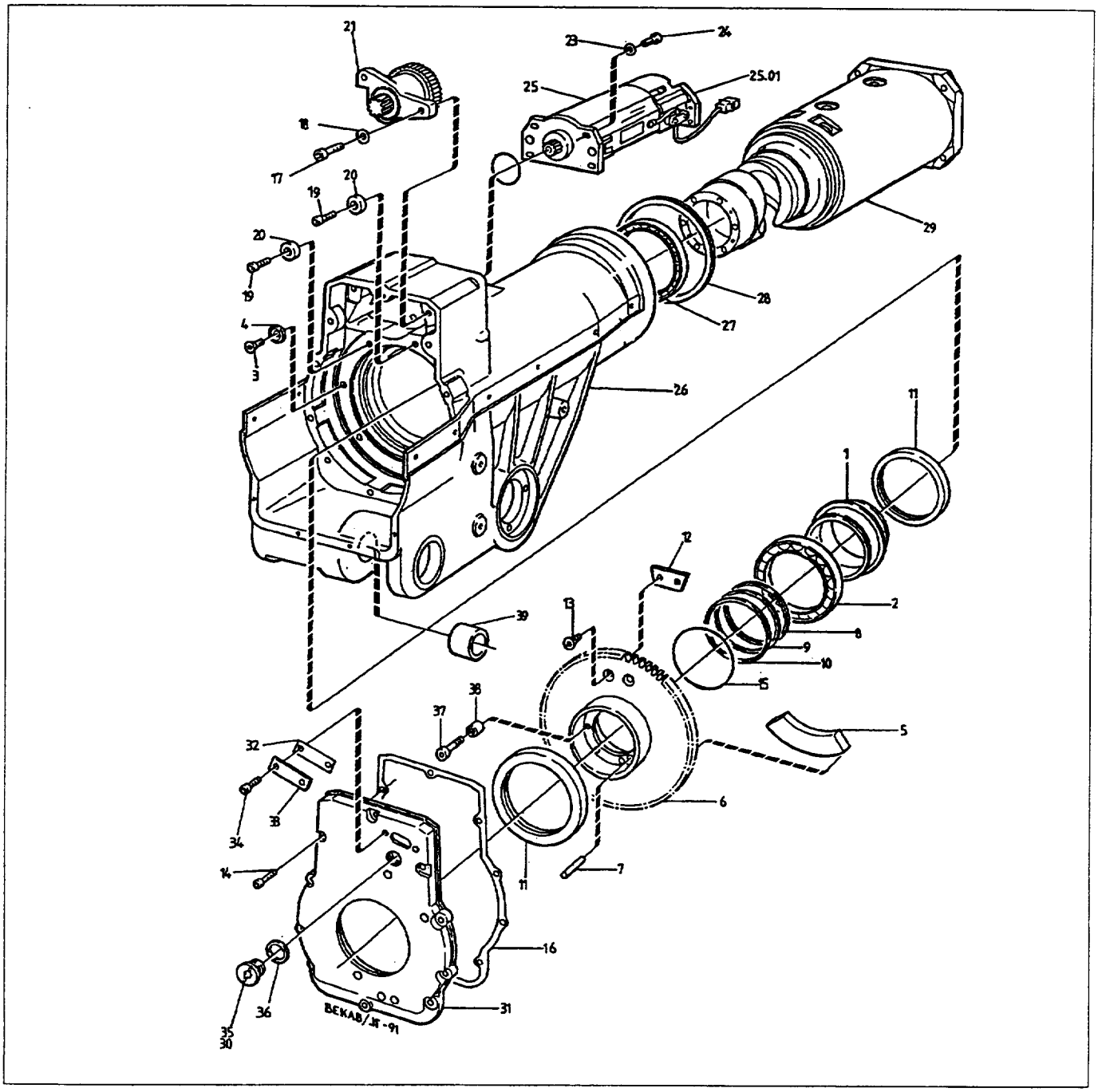


ABB Robotics Products

ABB
ASEA BROWN BOVERI

Spare parts
Reservdelar

Content / Innehåll — Page/sid

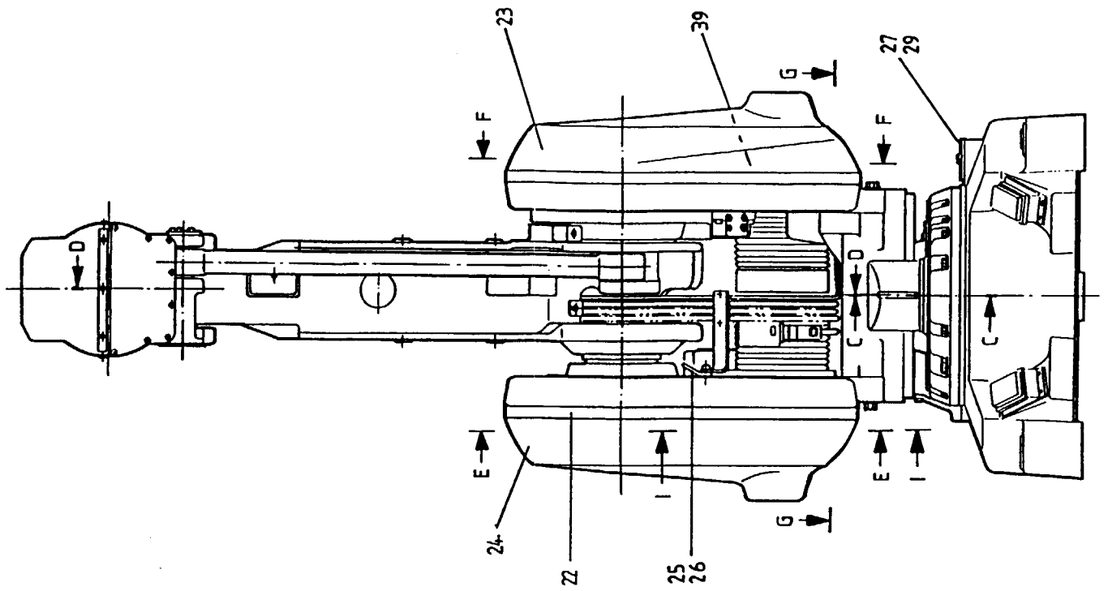
Robot, complete unit part 1
Robot, komplett enhet del 1

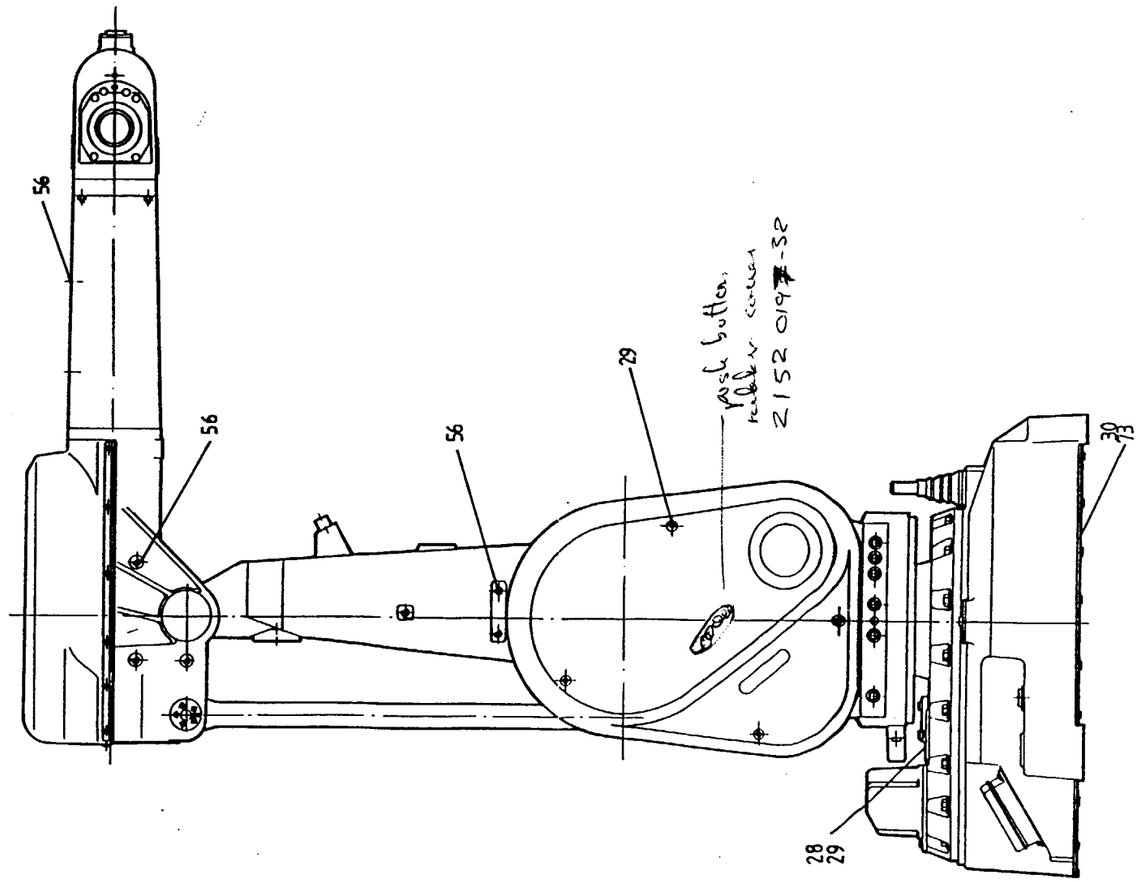
(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
3	1	3HAA 2231-2	Axis 4/Axel 4	
4	1	6362 056-YE	Axes 5/6 / Axel 5/6	
22	2	2152 0197-50	Sealing stripTätningslist	
23	1	2158 0132-85	Gearhousing/Växelkåpa Steel axis 2.	
24	1	2158 0143-BZ	Gearhousing axis 2/Växelkåpa axel 2	
25	2	2179 090-25	Lifting eye/Lyftögla	
26•	2	2121 2519-536	Screw/Skruv	MC6S, M12x30
27	1	2155 187-11	Protecting plate/Skyddsplåt	
28	1	2155 187-15	Protecting plate/Skyddsplåt	
29•	15	2121 0596-31	Screw/Skruv	MK6S, M8x12
30	1	2161 357-26	Cover/Bottenplåt	
31•	12	2121 2411-329	Screw/Skruv	M5x16
32	1	2152 0197-98	Gasket/Packning	130/150 t=1
33	1	2158 0132-156	Hub/Huv	
34•	24	2121 2519-291	Screw/Skruv	MC6S, M4x12
35	6	5692 435-R	Feedback/Återföringsdon	
36	1	2166 1910-1	Flate cable bracket/Flatkabelfäste	
37•	1	2166 1912-1	Straps/Buntband	L=200
39	1	2152 0197-32	Pushbutton guard/Tryckknappsskydd	
41	1	3HAA 2115-1	Consol/Konsol	
44	2	2152 0197-49	Gasket/Gummipackning	
46	2	2166 1911-1	Bracket/Fäste	
47•	5	2166 2055-6	Straps(outdoors)/Buntband(utomhus)	TY-27 MX B=7,6 L=368mm
48	1	4944 026-4	Battery/Batteri	
50	1	3HAA 3563-ACA	Seriel measurement board DSQC234/ Seriemätkort DSQC 234	
51	1	3HAA 2194-2	Adaptercabling/Adapterkablage	
52	2	5217 520-27	Locking screw/Låsskruv	
54•	4	2121 2519-366	Screw/skruv	MC6S, M6x12
55•	5	2151 2062-165	Washer/Bricka	BRB, 8,4x16x1,6
56•	14	2216 264-14	Plug/Täckplugg	
57	1	3HAA 2322-2	Power cable ax. 2,3/Kraftkabel ax. 2,3	
58	1	3HAA 2280-1	Cover/Lock	
59	1	3HAA 2281-1	Sealing strip/Tätningslist	
60	1	3HAA 2130-1	Bearing/Lager	
61	1	3HAA 2279-1	Strip/List	
62•	3	2126 2011-114	Hexagon nut/Sexkantsmutter	M5
63•	8	2151 2062-146	Washer/Bricka	
64	1	~~3HAA 2258-2~~	Housing/Kåpa 2158 0206-31 (Earoid Type Lock 1990 back)	
65	1	1856 1915-2	Sealing strip/Tätningslist	L=200
67•	4	2121 0601-7	Screw/Skruv	m8x50 10.9
68	1	1854 1909-2	Sealing strip/Tätningslist	L=1200
69	1	3HAA 2126-1	Bracket/Fäste	
70	2	3HAA 2324-1	Strip/List	

Items marked with a dot (•) are not kept in stock and may therefore have longer delivery times / Artiklar markerade med en punkt (•) lagerhålls ej och kan därför ha längre leveranstider.
* Quantity will be according to the equipment of the robot / Kvantiteten är beroende av robotens utrustning.

71•	4	2121 2519-325	Screw/Skruv	SKRC, M5x10 FZB
72•	4	2125 2052-194	Screw/Skruv	M5x140
73•	33	2121 2411-325	Screw/Skruv	M5x10
74	1	2175 0034-194	Bracket/Fäste	
75•	10	2121 2172-227	Screw/Skruv	Steel 8.8, M5x10
76	3	2166 0494-180	Clamp/Överfall	
77•	2	2166 2055-1	Straps/Buntband	L=101 mm
78	1	2641 666-2	Flat-pin/Flatstift	
79•	4	5217 520-27	Locking screw/Låsskruv	
302	1	3HAA 2121-2	Rotator axis 4 /Rotator axel 4	





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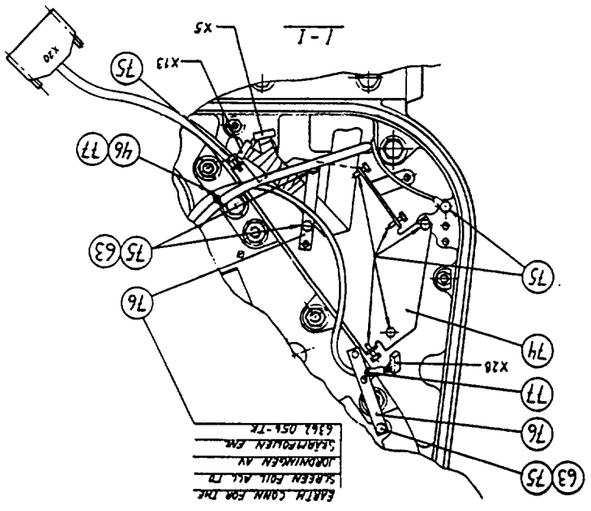
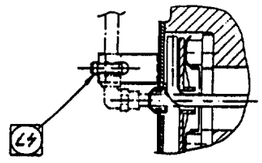
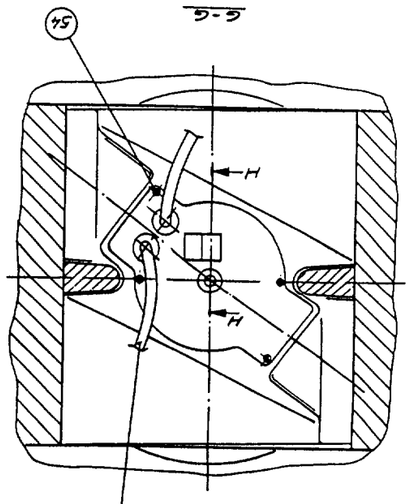
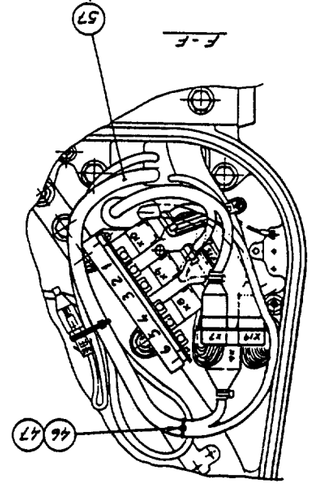
FOLDOUT 1:3


J-J
X5
X13
X20
75
76
77
63
74
X26
EARTH CONN FOR THE
SCREEN FOIL ALL IN
JORDNINGEN AV
SKÄRMFOLIEN ENE
6361 056-TE


H-H
47


G-G
54
H
H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57
44
47

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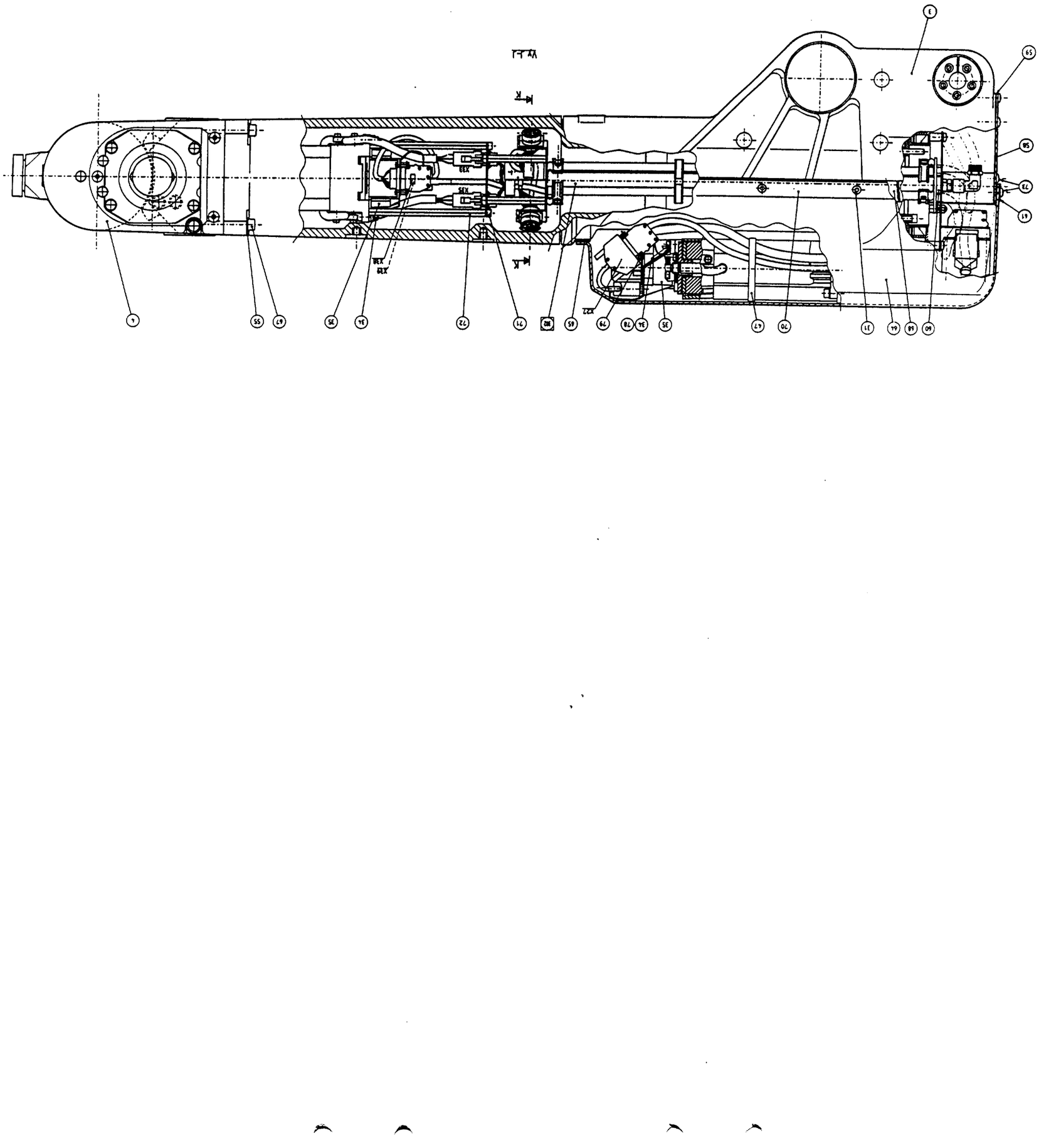
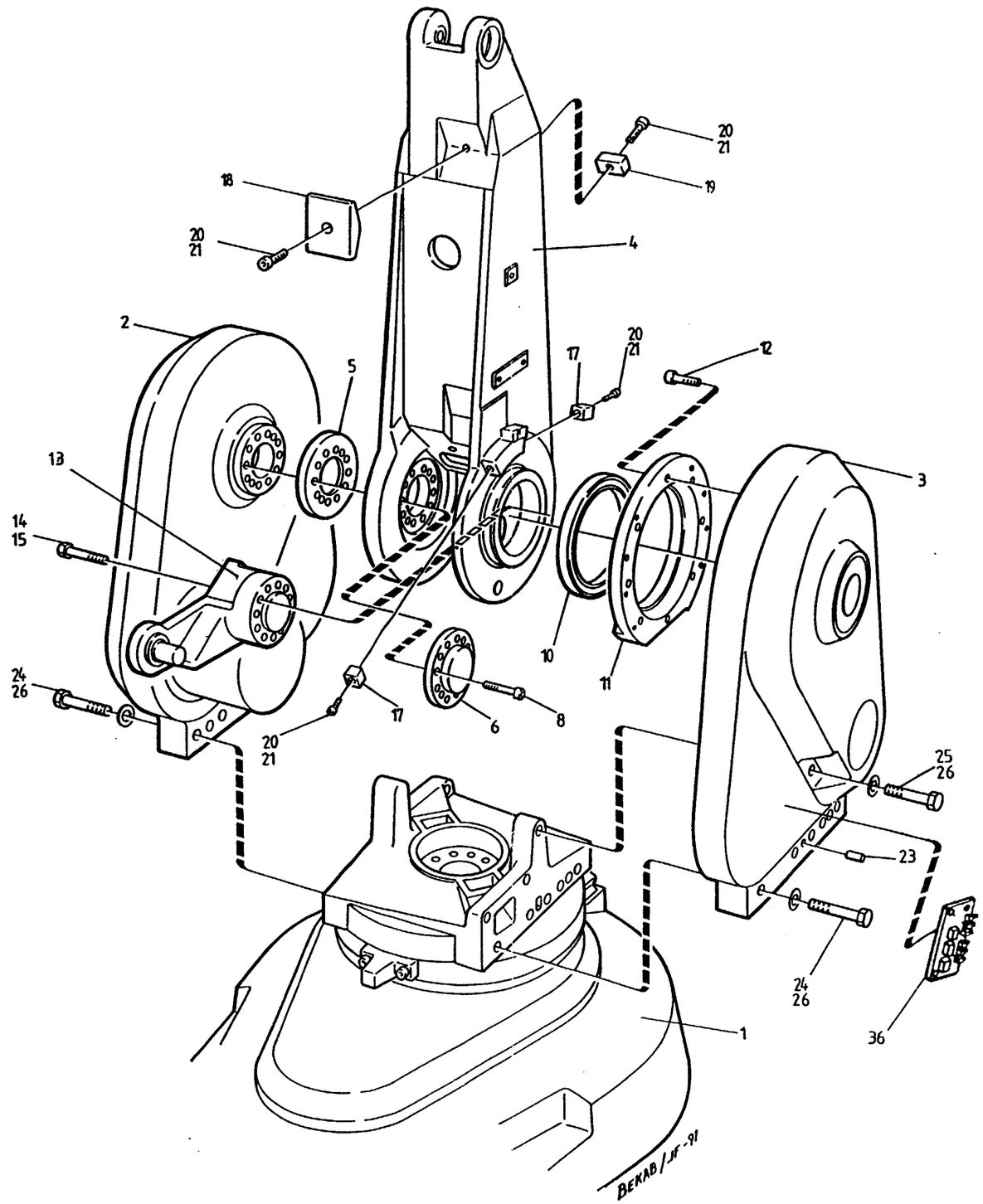


Axis 1, 2, 3
Axel 1, 2, 3

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	3HAA 2234-2	Axes 1/Axel 1	
2	1	3HAA 2236-2	Axes 2/Axel 2	
3	1	3HAA 2237-2	Axes 3/Axel 3	
4	1	3HAA 2022-1	Lower arm/Under arm	
5	1	2151 0024-225	Ring/Ring axel	
6	1	3HAA 2106-1	Cover/Lock	
8•	12	2121 0601-11	Screw/Skruv	M12x55 10,9
10	1	3HAA 2325-11	Ball bearing/Kullager	61828-2RZ
11	1	3HAA 2023-1	Stop ring/Stopp ring	
12	8	2121 0601-1	Hexagon cap screw/Sexkanthålskruv	M8x25 10.9
13	1	3HAA 2024-1	Parallel arm/Parallellarm	
14•	8	2121 2518-552	Hexagon cap screw/Sexkanthålskruv	M12x100 12.9
15•	2	2121 2518-540	Hexagon cap screw/Sexkanthålskruv	M12x40 12.9
17	2	3HAA 2110-1	Buffer/Buffert	
18	1	3HAA 2111-1	Buffer/Buffert	
19	1	2196 065-30	Buffer/Buffert	
20•	4	2121 2519-331	Screw/Skruv	MC6S, M5x20
21•	8	2151 2062-146	Washer/Bricka	BRB 5,3x10x1
23•	2	2111 0292-31	Guide pin/Styrpinne	
24•	16	2121 0602-1	Hexagon cap screw/Sexkanthålskruv	M12x75, 10.9
25•	2	2121 0602-2	Hexagon cap screw/Sexkanthålskruv	M12x100, 10.9
26•	18	2151 0024-200	Washer/Bricka	
36	1	5376 247-A	Pushbutton unit/Tryckknappsenhet	



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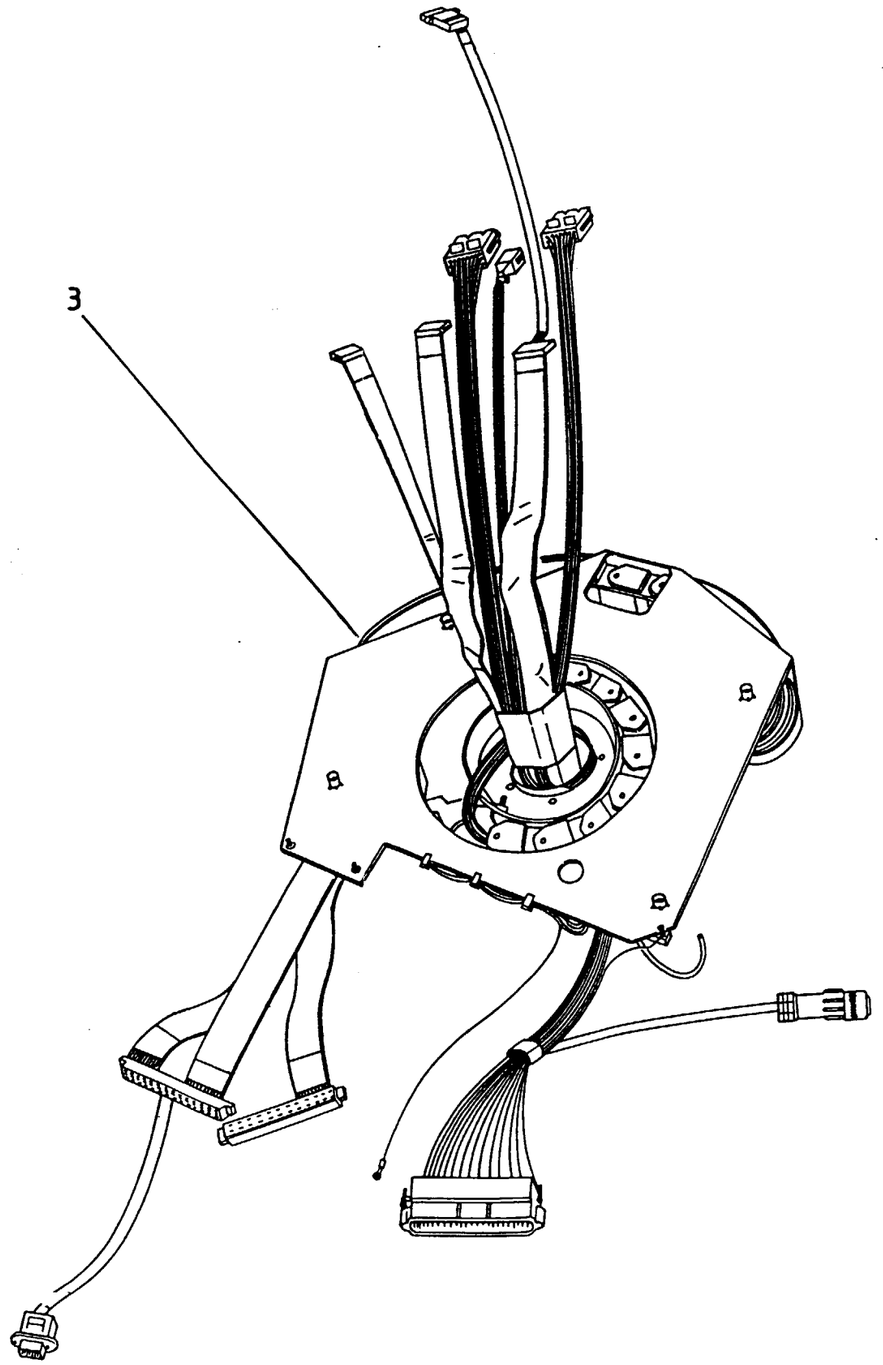
3

Axis 1
Axel 1

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	2399 058-AA	Foot with gearbox/fot med växellåda	
2	1	3HAA 2105-1	Intermediate plate/Mellanplatta	
3	1	3HAA 2235-2	Cable unit 1/Kabelenhet 1	
4	1	4429 584-CE	Motor unit/Motor enhet	
4.01	1	2152 0431-11	O-ring/O-ring	
4.02	1	2284 261V	Brake/Broms	
5•	4	2121 0601-1	Hexagon cap screw/Sexkanthålskruv	SKRC, M8x25 10,9
6	1	2173 195-118	Adapter/Adapter	
13	1	2196 065-27	Stpo bar/Stoppstång	
15	1	2173 195-117	Holder upper/Beslag övre	
16	1	2516 024-7	Bellow/Bälg	
17	1	2196 065-28	Stop/Stoppklack	
18	1	2151 0024-120	Ring/Ring	
19	1	2151 0024-225	Ring/Ring	
23	1	2948 3216-20	Synkplate/Synkskylt	
24	1	2163 125-129	Bracket/Fäste	
25	2	5217 687-22	Plug socket/Kontaktdon	
26•	12	2121 0639-1	Hexagon cap screw/Sexkanthålsskruv	SKRC,M14x85 FZB
27•	2	2121 2519-536	Hexagon cap screw/Sexkanthålsskruv	SKRC,M12x30 FZB
28•	2	2121 2519-451	Hexagon cap screw/Sexkanthålsskruv	SKRC,M8x20 FZB
32•	8	2121 2172-230	Thread form screw/Gängf.sexkantskruv	M6SF,M5x16 FZB
35•	8	2121 2172-202	Thread form screw/Gängf.sexkantskruv	M6SF,M4x12 FZB
37•	8	2151 2062-165	Washer/Underläggsbricka	8,4x16x1,5 FZB
41•	2	2151 2062-124	Washer/Underläggsbricka	3,2x6x0,5 FZB
42•	1	2111 2021-458	Parallel pin/Cyl. pinne	PINC 10x30
43•	1	2111 2835-258	Roll pin/Fjädrande rörpinne	4x24
44•	1	2111 2835-345	Roll pin/Fjädrande rörpinne	PINF 6x32
45•	2	2124 2011-221	Cross tapping screw/Kryss g.pr.skruv	ST 2,9x6,5
46	1	2152 2012-416	O-ring/O-ring	49,5x3,0
47	1	2216 261-14	Sealing ring/Tätningsring	22x35x7
49•	1	2522 2101-11	Protective hood/Skyddspropp	TYPE188(R3/8)14x16,1
57	1	1171 4016-611	Semi fluid grease/Flytfett	5,3 lit.=4,6 kg
61•	2	2126 2011-116	Nut/ Mutter	M6
65	2	5217 687-27	Guide socket/Styrhylsa	
66	2	5217 687-28	Guide pin/Styrpinne	
73	1	2171 205-176	Bracket/ Fäste	
75	1	2158 0132-142	Protecting cover/Skyddskåpa	

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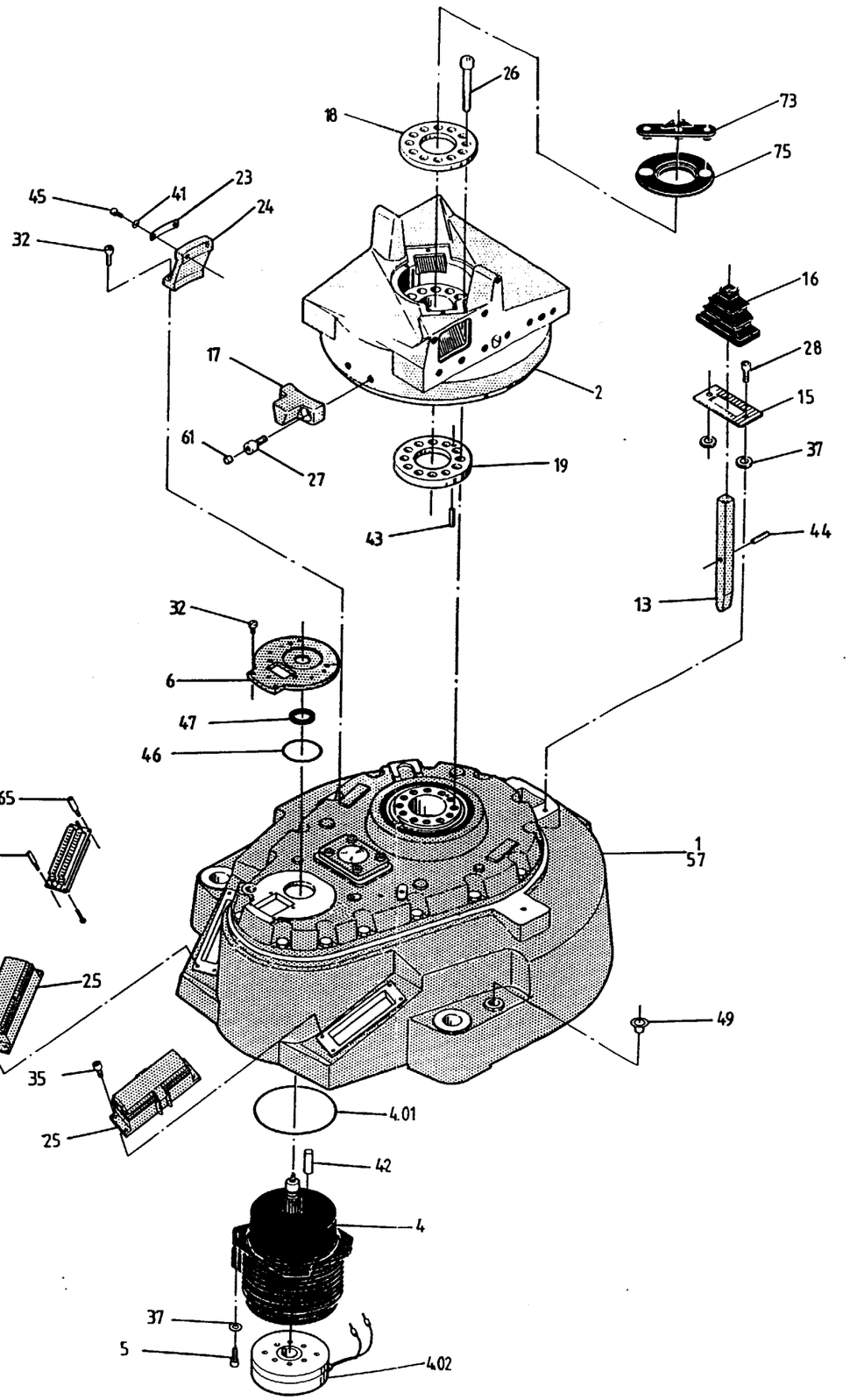

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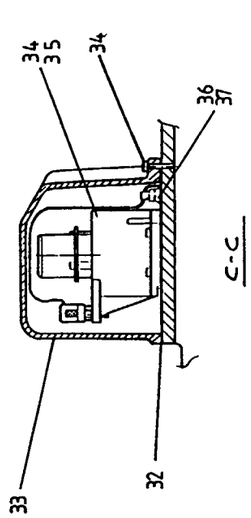
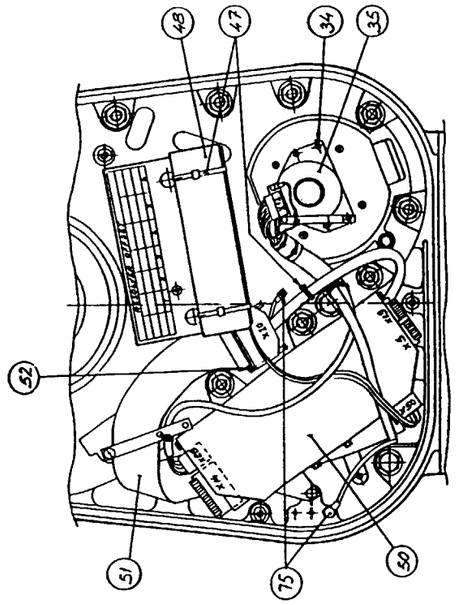
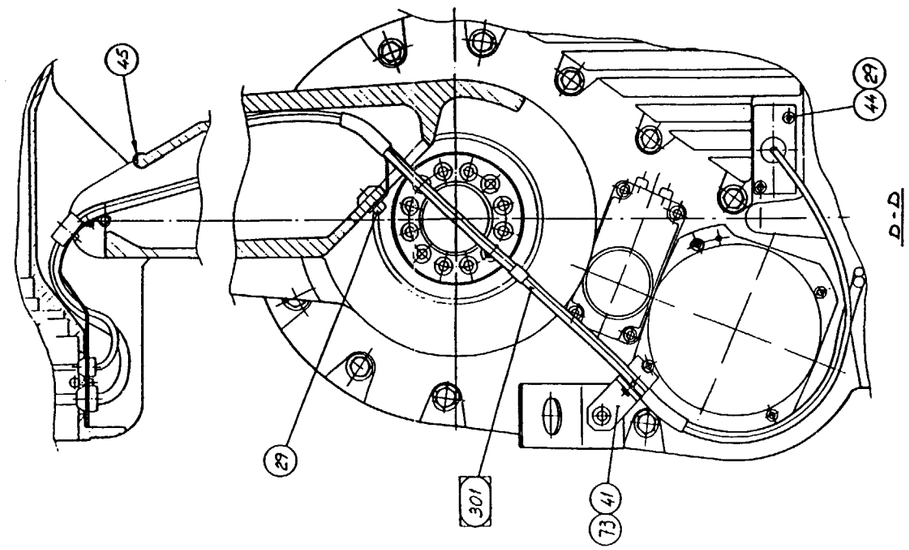


C-C



E-E

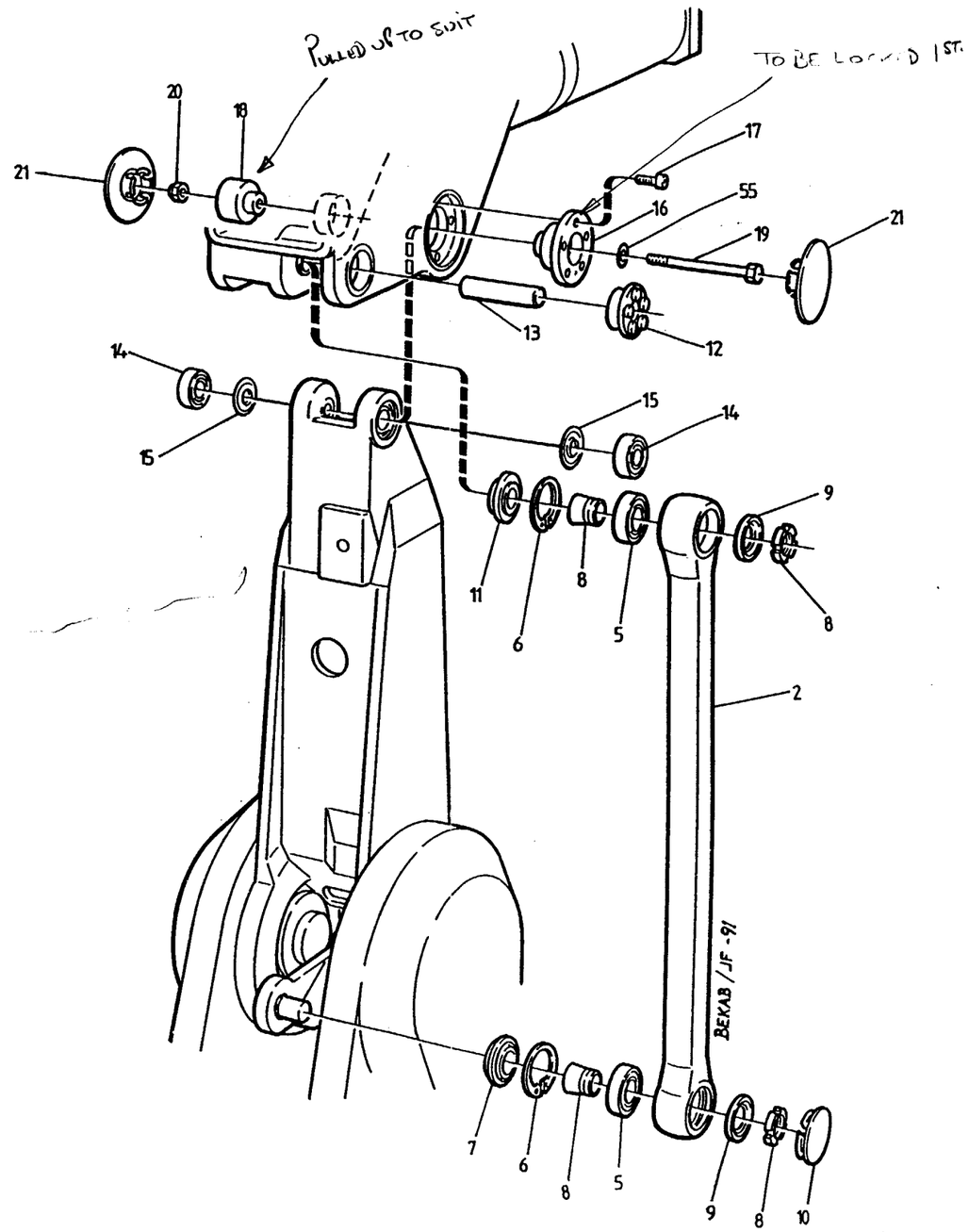


D-D

Lower arm (robot complete)
Under armen (robot komplett)

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
2	1	3HAA 2025-1	Parallel bracket/Parallellstag	
5	2	2213 1905-1	Bearing/Lager	FAG 20205K.C3
6	2	2154 2527-143	Retaining ring/Spårring	Sgh 56.2
7	1	3HAA 2109-1	Space collar/Distanshylsa	
8	2	2219 238-36	Clamping sleeve/Klämhylsa	FAG H205
9	2	2216 263-9	Sealing ring/Lagertätning	NILOS 6205AV
10	1	2216 264-6	Cover/Lock	
11	1	3HAA 2108-1	Space collar/Distansring	
12	1	3HAA 2107-11	Sleave/Klämmbussning	TAPERLOCK20x47
13	1	3HAA 2388-11	Parallel pin/Cyl. pinne	CP 20x100
14	2	2213 3000-204	Roller bearing/Kon. rullager	SKF 30204
15	2	3HAA 2092-11	Sealing ring/Lagertätning	NILOS 30204 JV
16	1	3HAA 2053-1	Shaft/Axel	
17	4	2121 2416-370	Hexagon cap screw/Sexkanthålskruv	M6x20
18	1	2239 056-23	Shaft/Axel	
19•	1	2121 0435-38	Hexagon cap screw/Sexkanthålskruv	SKR6, M8x140 FZB
20•	1	2126 2293-5	Prevailing torque nut/Låsmutter	M8
21	2	2216 264-4	Cover/Lock	
55•	5	2151 2062-165	Washer/Bricka	BRB, 8,4x16x1,6



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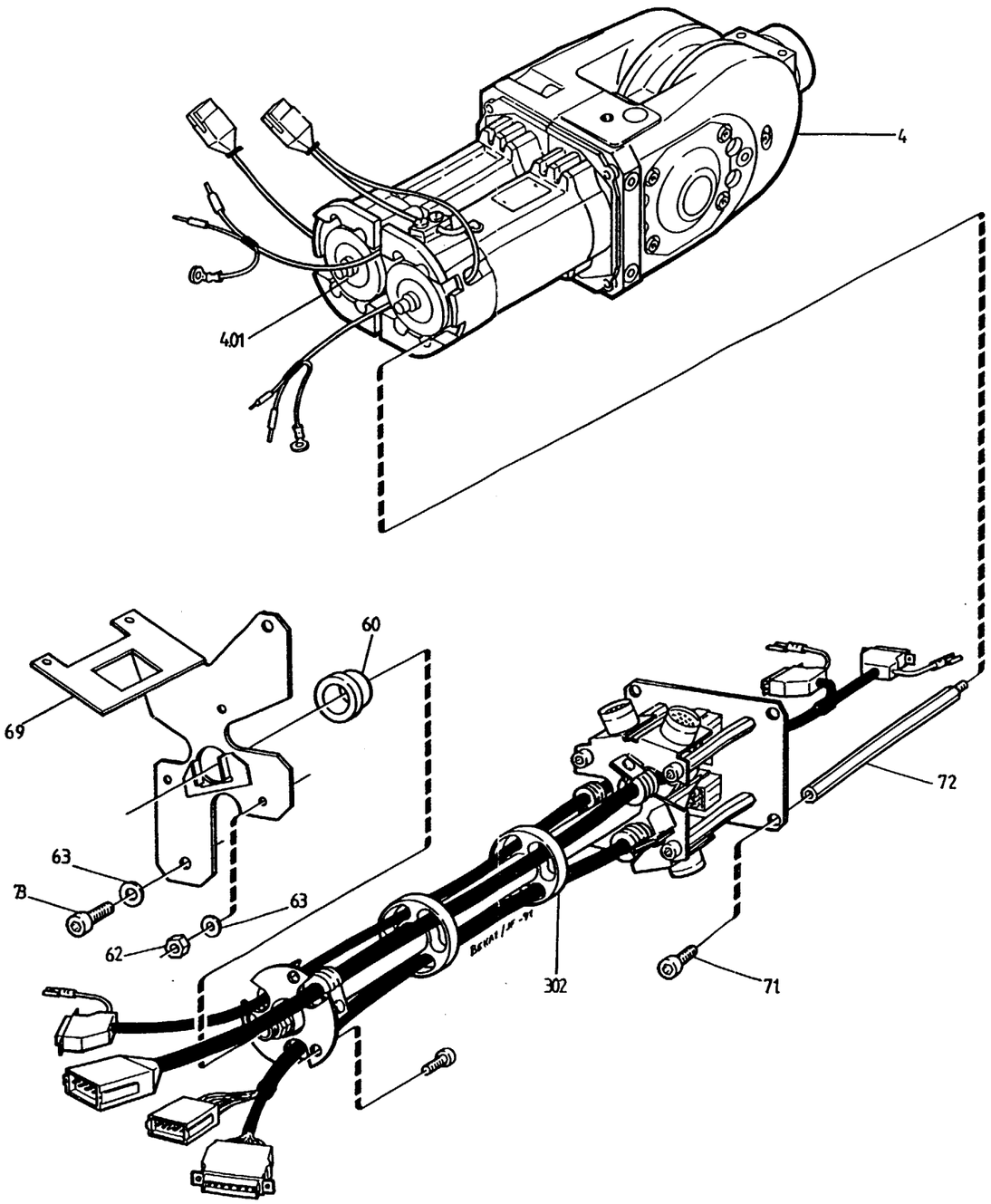
Axis 5 - 6, complete unit 3HAA 2379-2
Axel 5 - 6, komplett enhet 3HAA 2379-2

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
4	1	6362 056-YE	Axes 5/6 / Axel 5/6	
4.01	2	2284 261-R	Brake / Broms	
60	1	3HAA 2130-1	Bearing / Lager	
62•	3	2126 2011-114	Hexagon nut /Sexkantmutter	M5
63•	8	2151 2062-146	Washer /Bricka	BRB 5,3x10x1
69	1	3HAA 2126-1	Holder / Fäste	
71•	4	2121 2519-325	Hexagon cap screw / Sexkanthålskruv	SKRC M5x10 FZB
72	4	2125 2052-194	Distance bolt / Distansskruv	M5x140
73•	33	2121 2411-325	Screw / Skruv	M5x10
302	1	3HAA 2121-2	Rotator axis 4 / Rotator axel 4	



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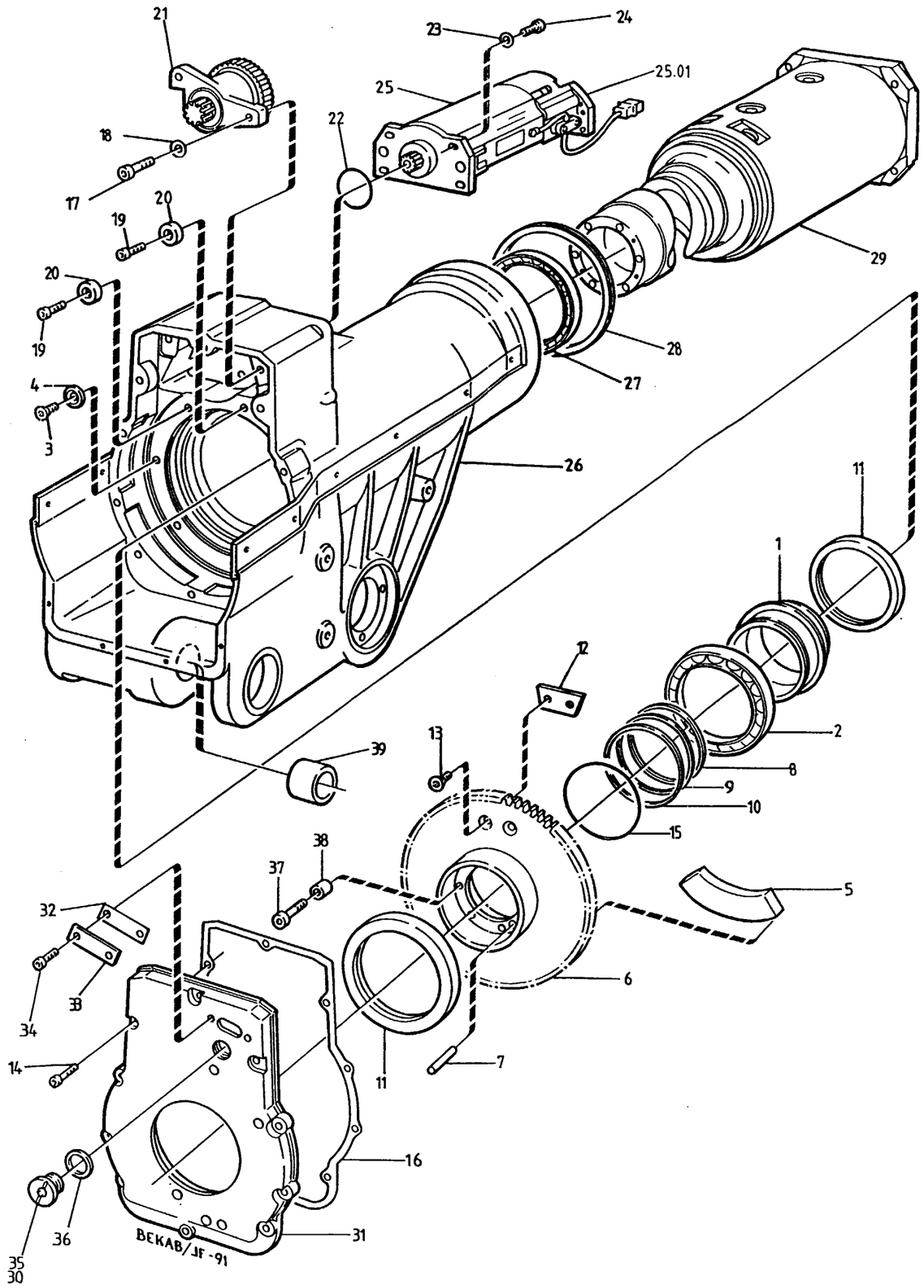
Axis 4, complete unit 3HAA 2231-2
Axel 4, komplett enhet 3HAA 2231-2

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	3HAA 2039-1	Sleeve / Hylsa	
2	1	2213 259-3	Ball bearing / Kullager	fpxd 400/cl
3	5	2121 2851-368	Screw / Skruv	M6x16 10.9
4	5	2151 0024-222	Washer / Bricka	
5	1	3HAA 2164-1	Segment / Segment	
6	1	2321 0885-21	Gear / Kugghjul	
7	1	2111 2021-361	Parallel pin / Cylindrisk pinne	
8	1	2159 167-26	Shims / Shims	
9	1	2159 167-27	Shims / Shims	
10	1	2159 167-28	Shims / Shims	
11	2	2216 261-6	Ring / Tätningsring	
12	1	2295 213-50	Segment / Segment	
13	2	2121 2852-325	Screw / Skruv	SKRC M5x10
14•	10	2121 2519-333	Hexagon cap screw / Sexkanthålskruv	M5x25
15	1	2152 2012-431	O-ring / O-ring	
16	1	2152 0197-93	Gasket / Packning	
17	2	2121 2518-459	Hexagon cap screw / Sexkanthålskruv	M8x40 12.9
18•	2	2151 2062-165	Washer / Bricka	BRIR 8,4x16x1,5
19•	2	2121 2519-368	Hexagon cap screw / Sexkanthålskruv	M6x16 8.8
20	2	3HAA 2163-1	Stop / Stoppklack	
21	1	3HAA 2294-2	Intermediate gear / Mellanväxel	
22	1	2152 2012-416	O-ring / O-ring	D=49,5x3
23•	4	2151 2062-153	Plain washer / Rundbricka	BRIR 6,4x12x1,6
24•	4	2121 2519-368	Hexagon bolt / Sexkantsskruv	M6x16 STEEL 8.8
25	1	4429 584-CJ	Motor unit / Motor enhet	
25.01	1	2284 261-R	Brake / Broms	
26	1	3HAA 2026-1	Housing ax.4 / Armhus ax. 4	
27	1	3HAA 2099-12	Groove ball bearing / Spårkullager	61820
28	1	2216 264-10	V-ring / V-ring	
29	1	3HAA 2087-1	Tubular shaft / Röraxel	
30	1	1171 2016-604	Lubricant oil / Smörjolja	7 1201-604 650 ml
31	1	5237 397-95	End plate axis 4 / Gavel axel 4	
32	1	2152 0197-36	Gasket / Packning	
33	1	2152 0197-35	Cover / Lock	
34	2	2121 2531-327	Screw / Skruv	
35	1	2522 122-1	Magnetic plug / Magnetplugg	mtcem 1/4"
36	1	2152 2031-6	Washer / Tätningsbricka	13,7x20,6
37	6	2121 2519-374	Hexagon cap screw / Sexkanthålskruv	M6x30 FE/ZN 8C
38	6	3HAA 2350-11	Spacer / Distansbricka	6,1x10x10
39	1	2171 205-94	Sleeve / Hylsa	

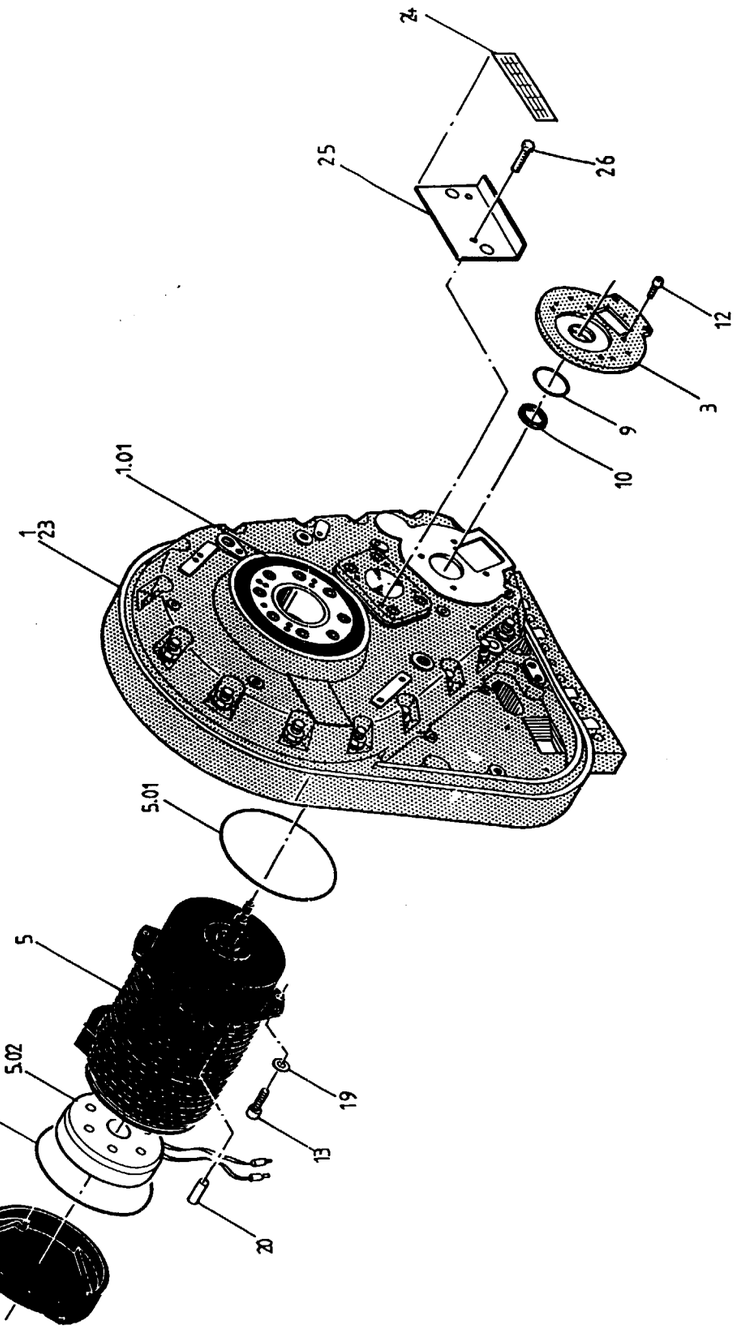


Items marked with a dot (•) are not kept in stock and may therefore have longer delivery times / Artiklar markerade med en punkt (•) lagerhålls ej och kan därför ha längre leveranstider.
* Quantity will be according to the equipment of the robot / Kvantiteten är beroende av robotens utrustning.

Axis 2, complete unit 3HAA 2236-2
Axel 2, komplett enhet 3HAA 2236-2

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	2399 058-AB	Gearbox / Växellåda	
1.01	2	2216 264-27	Sealing ring / Tätningsring	
3	1	2173 195-118	Adapter / Adapter	
4	1	2158 0132-174	Brake cover/ Bromskåpa	
5	1	4429 584-CF, alt.	Motor unit/ Motorenhet	Type/ Typ 2
		4429 584-BN	Motor unit/ Motorenhet	Type/ Typ 3
5.01	1	2152 0431-11	O-ring/ O-ring	149 x 4
5.02	1	2284 261-V	Brake/ Broms	
9	1	2152 2012-416	O-ring / O-ring	49,5 x 3,0
10	1	2216 261-14	Sealing ring / Tätningsring	35 x 22 x 7
12•	4	2121 2172-230	Thread forming screw / Gängf. skruv	M5 x 16
13•	4	2121 0601-1	Screw/ Skruv	M8x25 10.9
16	1	2152 2012-438	O-ring/ O-ring	129.5 x 3
19•	4	2151 2062-165	Washer / Underläggsbricka	8,4 x 16 x 1,5
20•	1	2111 2021-458	Parallel pin / Cyl. pinne	10 x 30
23	1	1171 4016-611	Semi fluid grease/Flytfett	5,3 lit. = 4,6 kg
24	1	2943 2266-4	Plate/Skylt	
25	1	2174 0022-160	Mounting plate/Fästplåt	
26•	2	2121 2452-289	Hex. cap screw/Förs. sexkanth.skruv	M4 x 10



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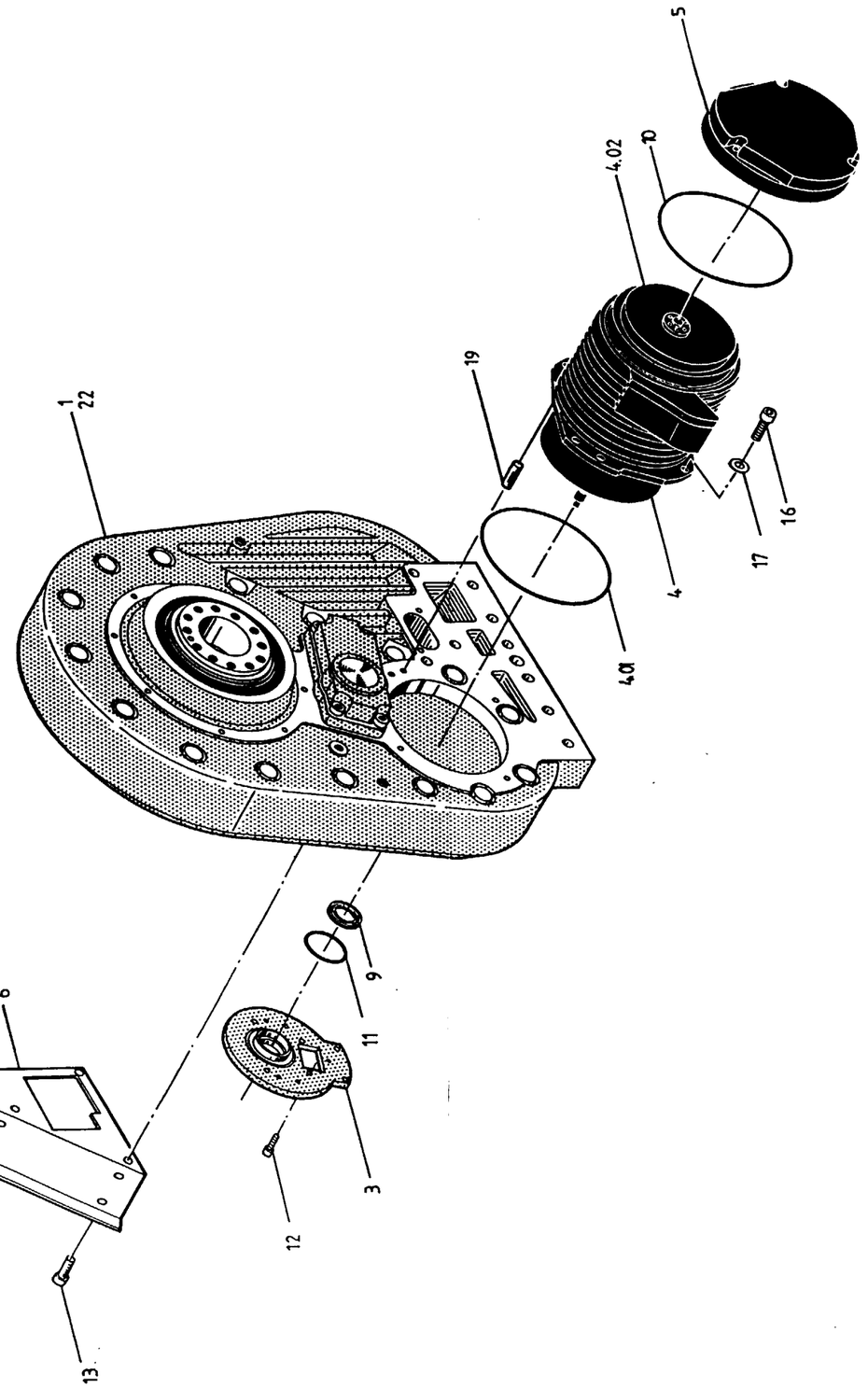
Axis 3, complete unit 3HAA 2237-2
Axel 3, komplett enhet 3HAA 2237-2

(cable details, see separate list)
(kablagedetaljer återfinns på separat lista)

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	2399 058-AB	Gearbox / Växellåda	
3	1	2173 195-118	Adapter / Adapter	
4	1	4429 584-CE, alt.	Motor unit/ Motorenhet	Type/ Typ 1
		4429 584-BN	Motor unit/ Motorenhet	Type/ Typ 3
4.01	1	2152 0431-11	O-ring / O-ring	
4.02	1	2284 261-V	Brake/ Broms	
5	1	2158 0132-174	Brake cover/ Bromskåpa	
6	1	3HAA 2238-1	Contact plate / Kontaktplatta	
9	1	2216 261-14	Sealing ring / Tätningsring	35 x 22 x 7
10	1	2152 2012-438	O-ring/ O-ring	129.5 x 3
11	1	2152 2012-416	O-ring / O-ring	49,5 x 3
12•	4	2121 2172-230	Thread forming screw / Gängf skruv	M5 x 16
13•	4	2121 2172-227	Screw/ Skruv	M5x10
16	4	2121 0601-1	Screw / Skruv	M8 x 25 10.9
17•	4	2151 2062-165	Washer / Bricka	8,4 x 16 x 1,5
19•	1	2111 2021-458	Parallel pin / Cylindrisk pinne	10 x 30
22	1	1171 4016-611	Semi fluid grease / Flytfett	5,3 lit. = 4,6 kg



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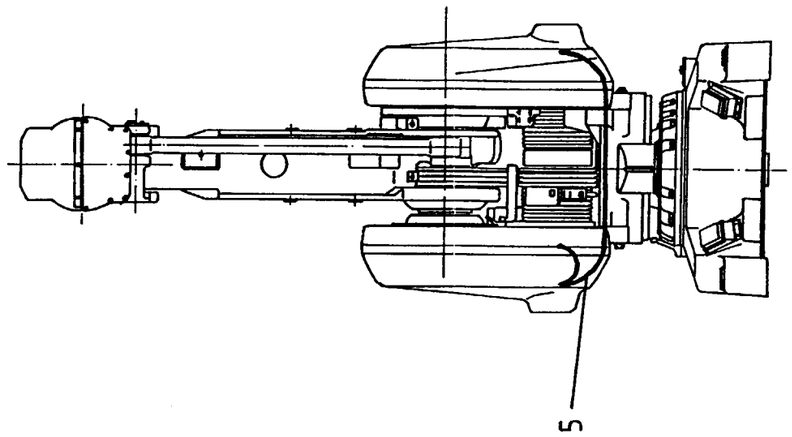
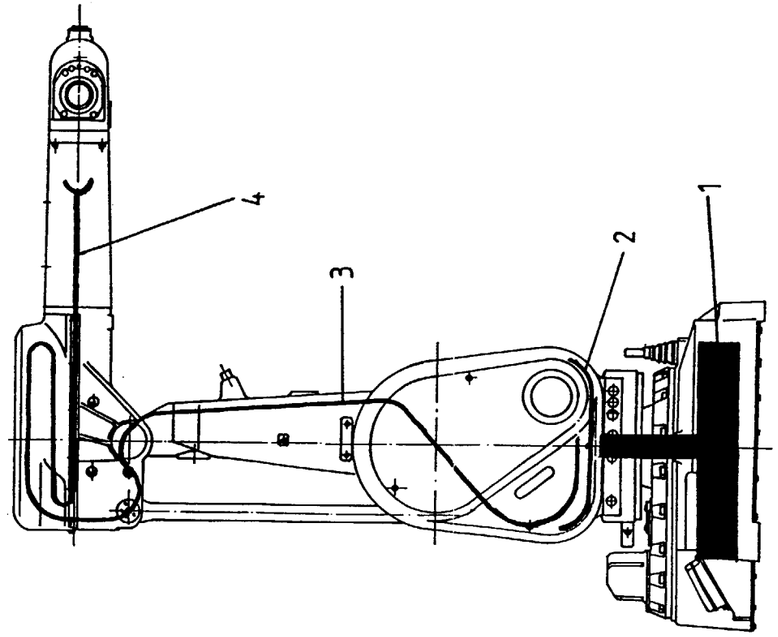
Cables, IRB 2000 / Kablage, IRB 2000

Itm Pos	Qty Ant	Article no Artikel nr	Name Benämning	Data, rem Data, anm
1	1	3HAA 2235-2	Lower cable / Nedre kablage S/S BY 3HAA 2596-2	
2	1	3HAA 2322-2	Power cable / Kraft kabel	
3	1	3HAA 2207-2	Cable lower arm / Underarmskablage	No customer connection/ Inga kundanslutningar
	1	3HAA 2207-3	Cable lower arm/Underarmskablage	With customer connections/ Med kundanslutningar
4	1	3HAA 2121-2	Cable upper arm / Överarmskablage	With customer connection/ Med kundanslutningar
	1	3HAA 2121-3	Cable upper arm/Överarmskablage	No customer connections/ Inga kundanslutningar
5	1	2639 0351-NN	Control cable / Signal kabel	





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Artiklar markerade med en punkt (•) lagerhålls ej och kan därför ha längre leveranstider.
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Kretsschema/
Circuit Diagram
IRB 2000

3HAB 0004-1
Januari 1993/M93

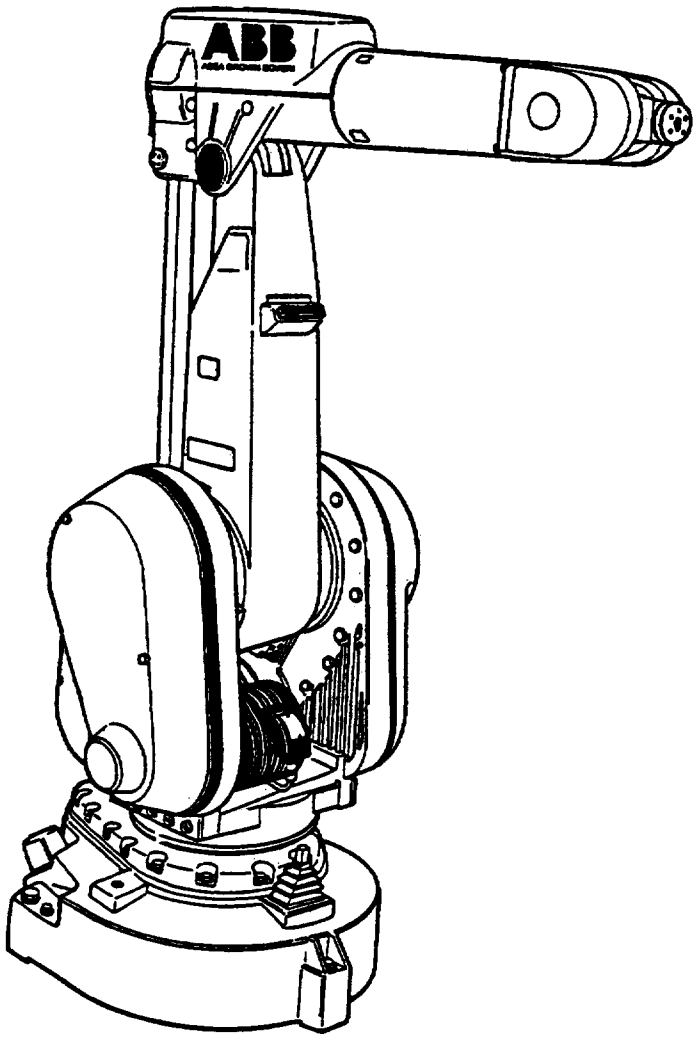

ABB Robotics Products

ASEA BROWN BOVERI

SHEET BLAD	CONTENT INNEHÅLL
1	LIST OF CONTENTS INNEHÅLLSFÖRTECKNING
2	CONNECTION POINT LOCATIONS ÖVERSIKT ÖVER DELNINGSPUNKTER
3	LEGEND SYMBOLER
4	BRAKE RELEASE UNIT, SERIAL MEASURING BOARD BROMSLOSSNINGSENHET, SERIEMÄTKORT
5	AXIS 1 AXEL 1
6	AXIS 2 AXEL 2
7	AXIS 3 AXEL 3
8	AXIS 4 AXEL 4
9	AXIS 5 AXEL 5
10	AXIS 6 AXIS 6
11	CUSTOMER POWER CONNECTIONS KUNDKABLAGE KRAFT
12	CUSTOMER SIGNAL CONNECTIONS, FRONT KUNDKABLAGE SIGNAL, FRAM

PRIMARY PART IN ARCADE

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INNEHÅLLSFÖRTECKNING

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CIRCUIT DIAGRAM
IRB 2000 M92

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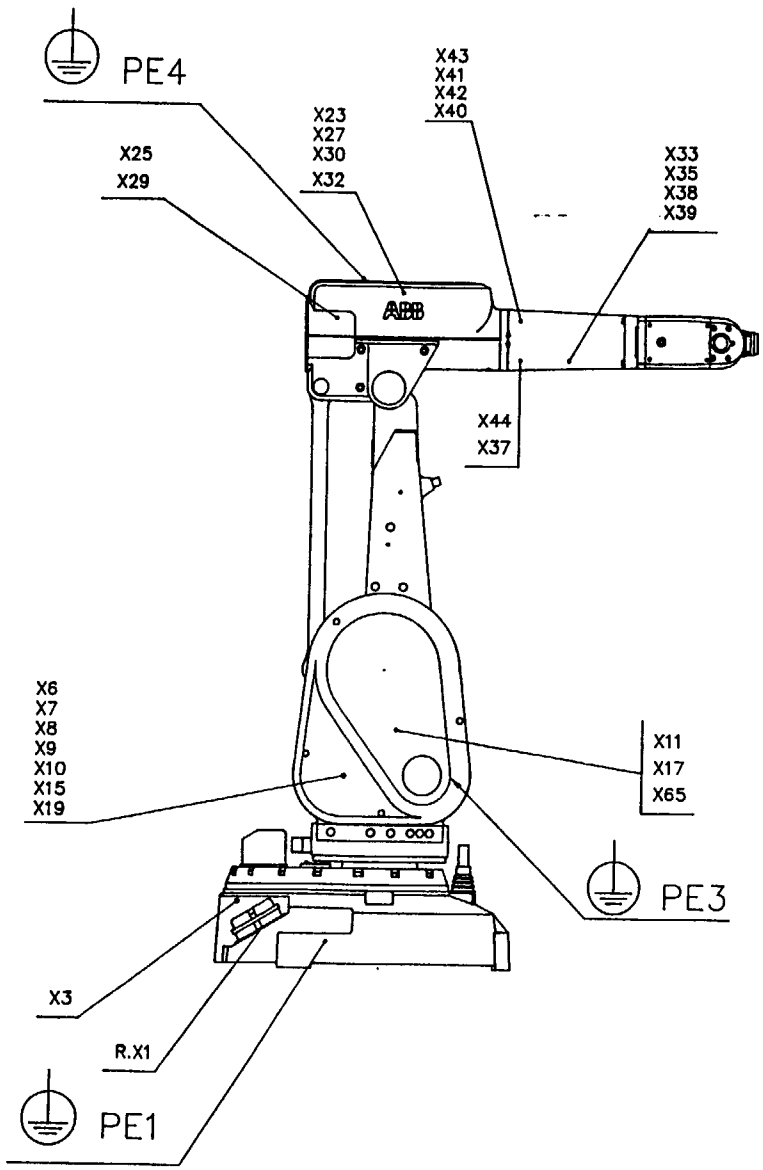

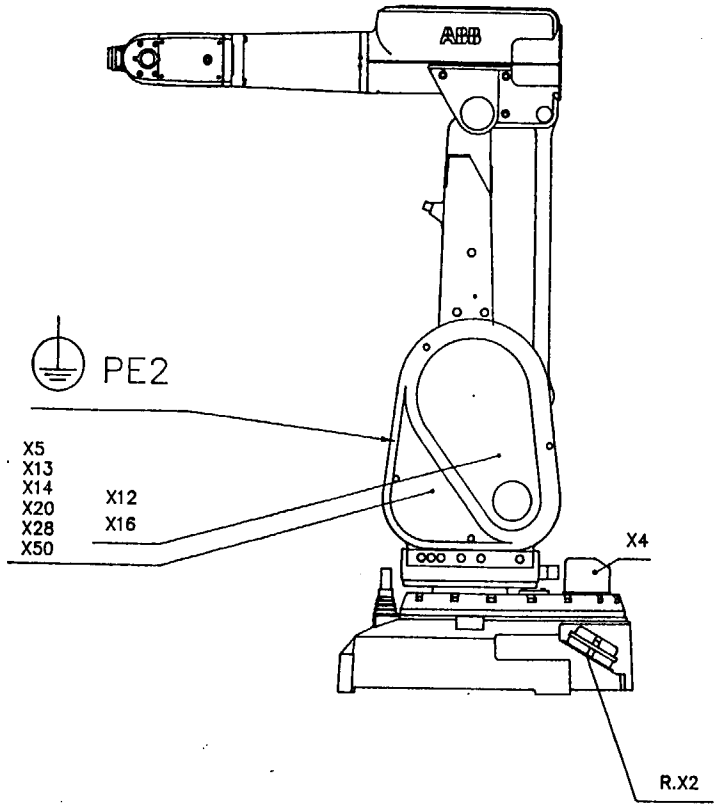

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CONN POINT LOCATION
ÖVERSIKT DELN.PUNKTER

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IRB 2000 M92

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ABB

M	MOTOR MOTOR
B	BRAKE BROMS
PTC	TEMP SENSOR TEMP GIVARE
R	RESOLVER RESOLVER
BU	BRAKE RELEASE UNIT BROMSLOSSNINGSENHET
FB	FEED-BACK UNIT ÅTERFÖRINGSDON
SMB	SERIAL MEASURING BOARD SERIEMÄTKORT
⏚	PROTECTIVE EARTH SKYDDSJORD
⫽	TWISTED CABLES TVINNADE LEDARE
⫽	SCREENED CABLES SKÄRMADE LEDARE
⫽○	OPTIONAL FUNCTIONS TILLVALSFUNKTIONER
KEY PIN/STIFT	LOCATION PIN TO AVOID MISMATCH OF CONNECTOR NYCKELSTIFT FÖR ATT FÖRHINDRA FELANSLUTNING

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LEGEND
SYMBOLER

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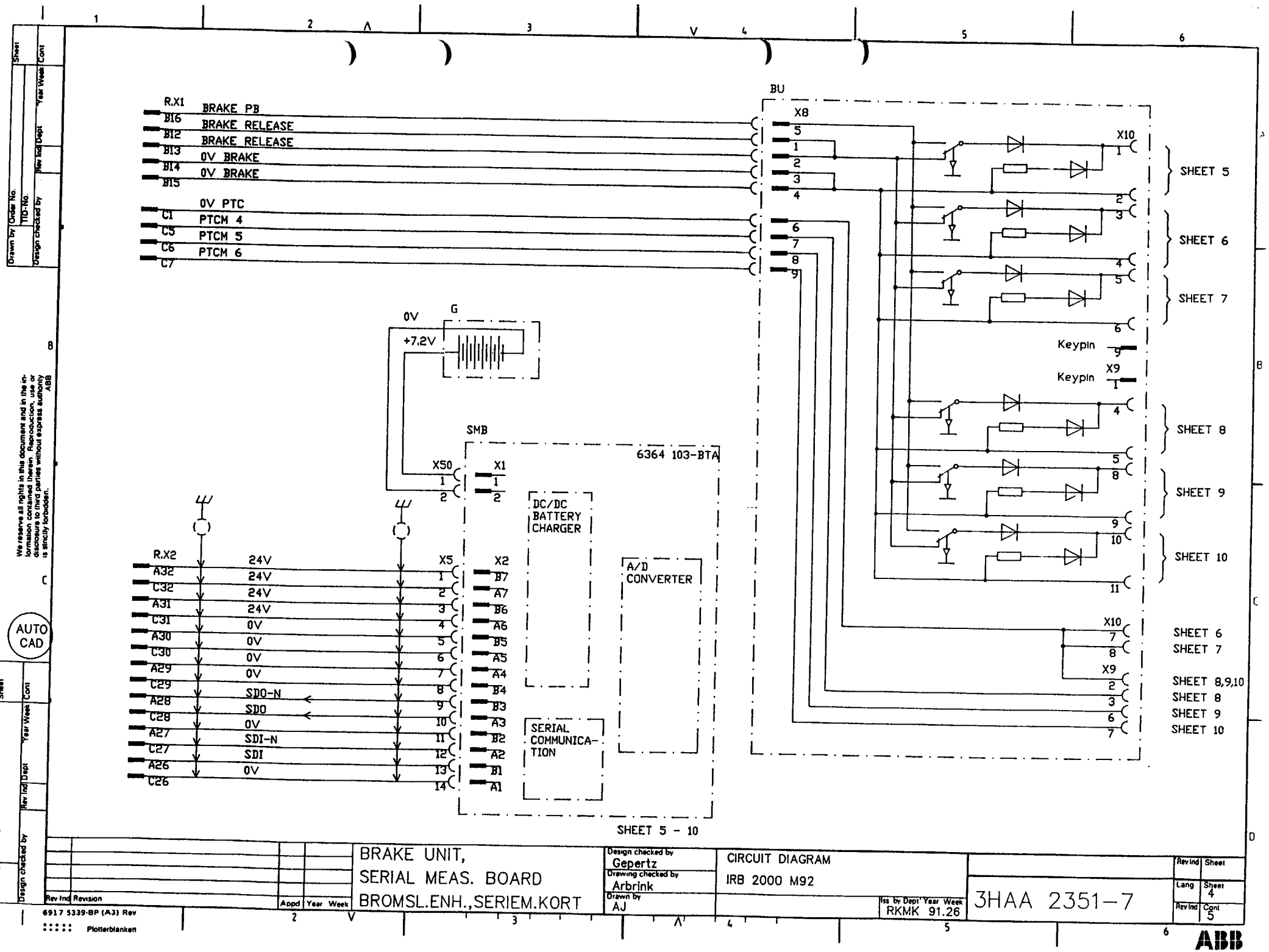
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BI6 BRAKE PB
BI2 BRAKE RELEASE
BI3 BRAKE RELEASE
BI4 0V BRAKE
BI5 0V BRAKE
C1 0V PTC
C5 PTCM 4
C6 PTCM 5
C7 PTCM 6
BU
X8
X10
SHEET 5
SHEET 6
SHEET 7
Keypin
Keypin
X9
SHEET 8
SHEET 9
SHEET 10
0V
+7.2V
G
SMB
6364 103-BTA
XS0
X1
DC/DC BATTERY CHARGER
A/D CONVERTER
SERIAL COMMUNICA-TION
R.X2
A32 24V
C32 24V
A31 24V
C31 0V
A30 0V
C30 0V
A29 0V
C29 SDO-N
A28 SDO
C28 0V
A27 SDI-N
C27 SDI
A26 0V
C26
X5
X2
SHEET 5 - 10
SHEET 6
SHEET 7
SHEET 8,9,10
SHEET 8
SHEET 9
SHEET 10
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ABB
BRAKE UNIT,
SERIAL MEAS. BOARD
BROMSL.ENH.,SERIEM.KORT
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Drawn by AJ
CIRCUIT DIAGRAM
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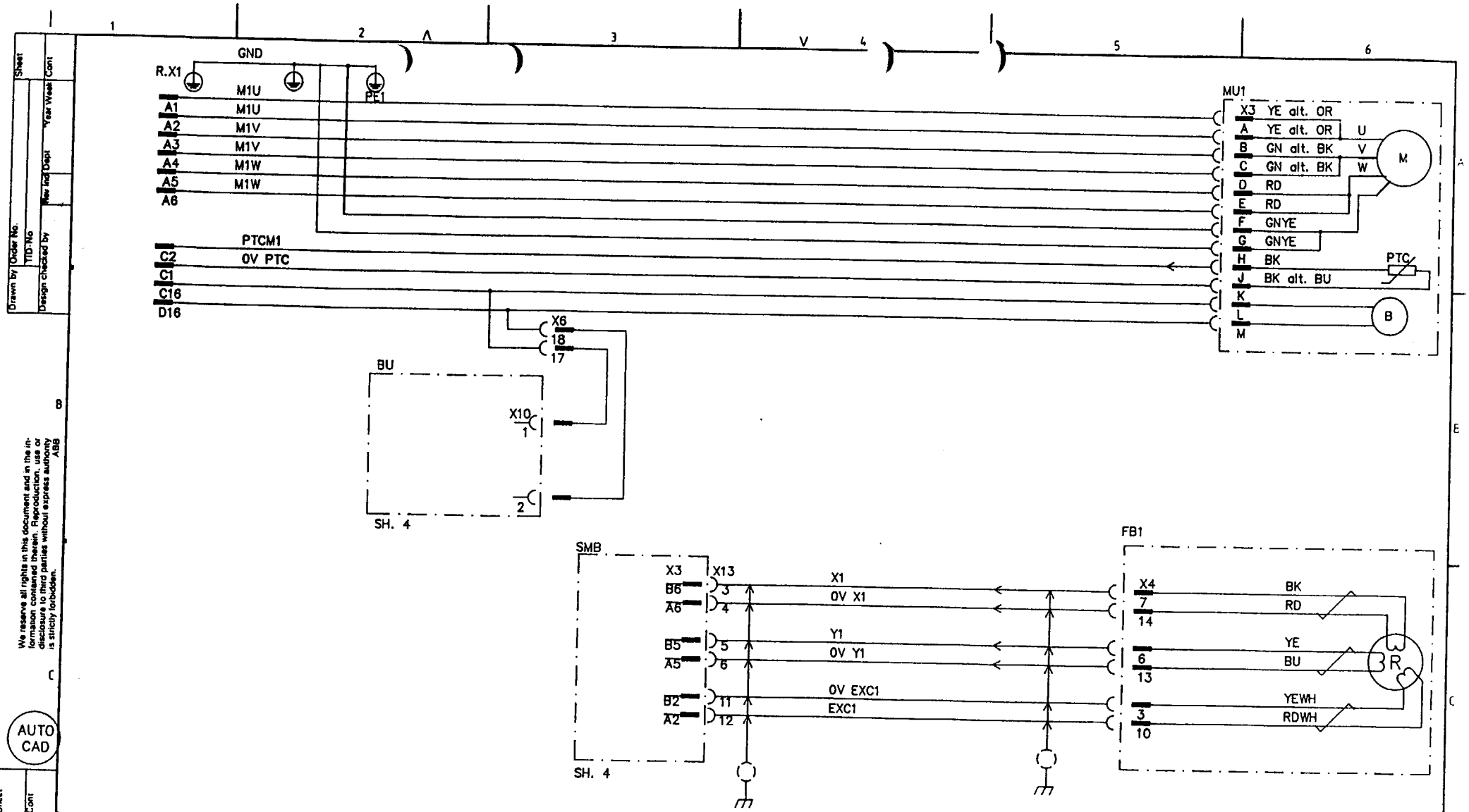

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AXIS 1
AXEL 1

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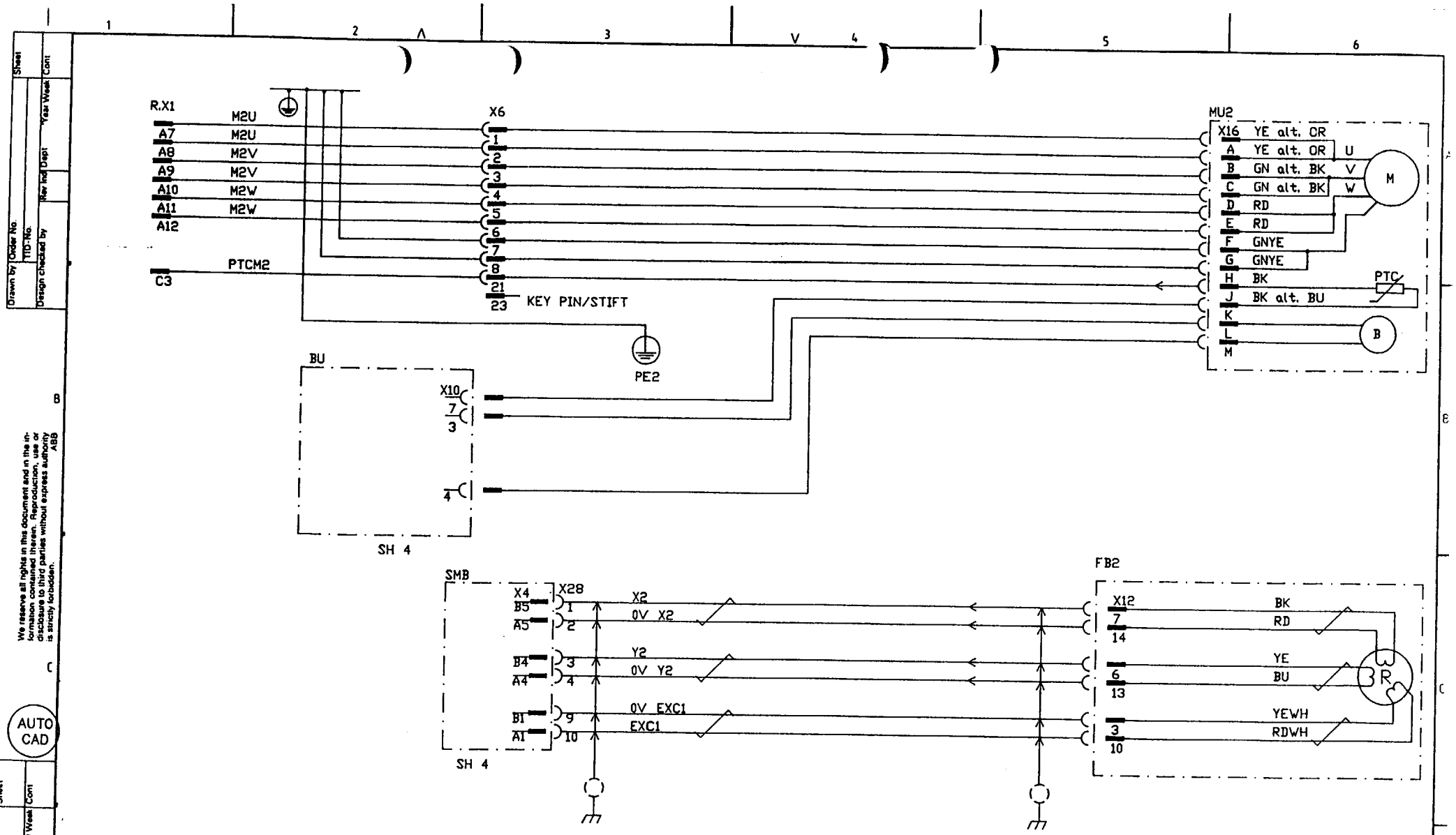

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AXIS 2
AXEL 2

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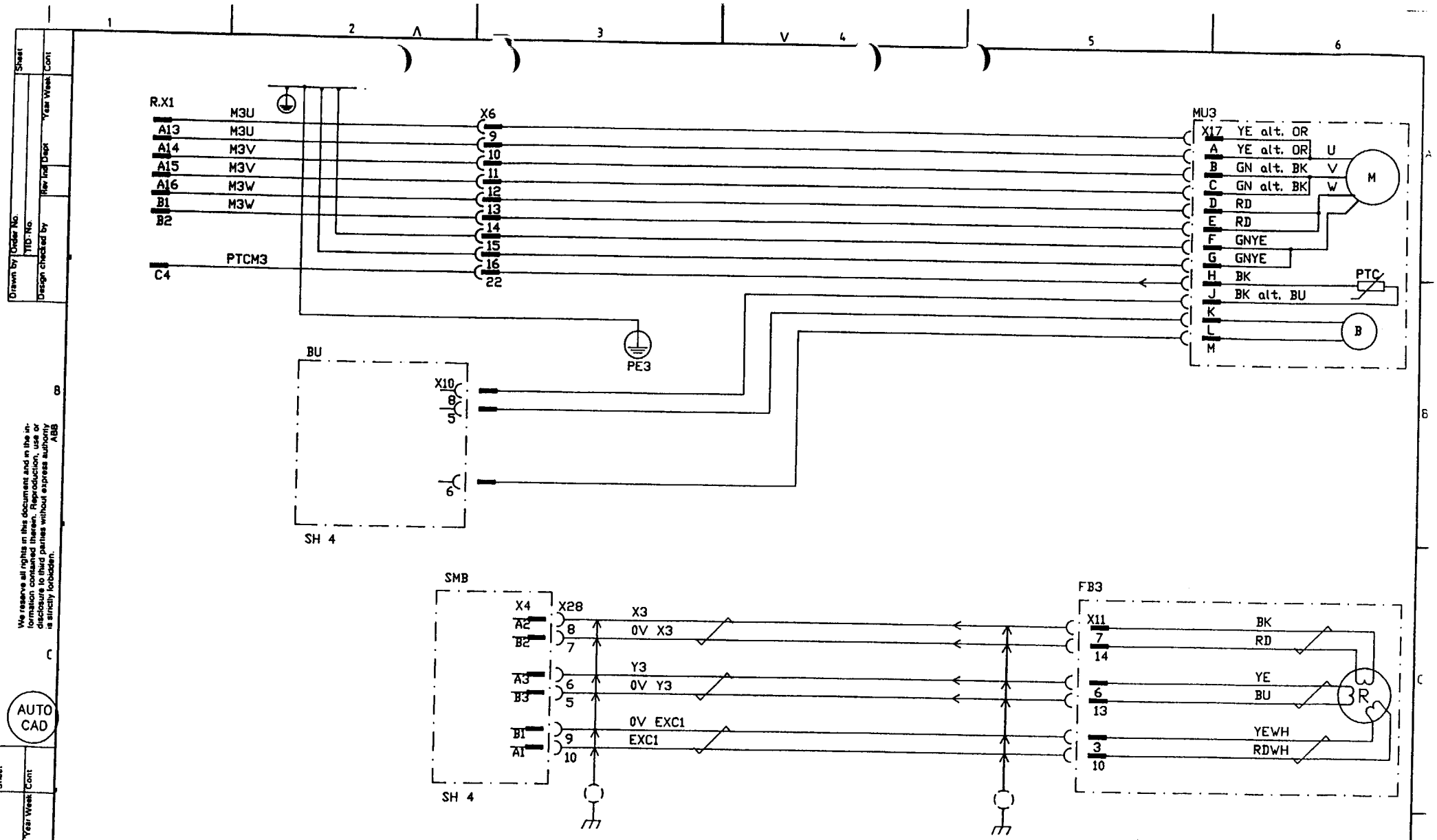

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AXIS 3
AXEL 3

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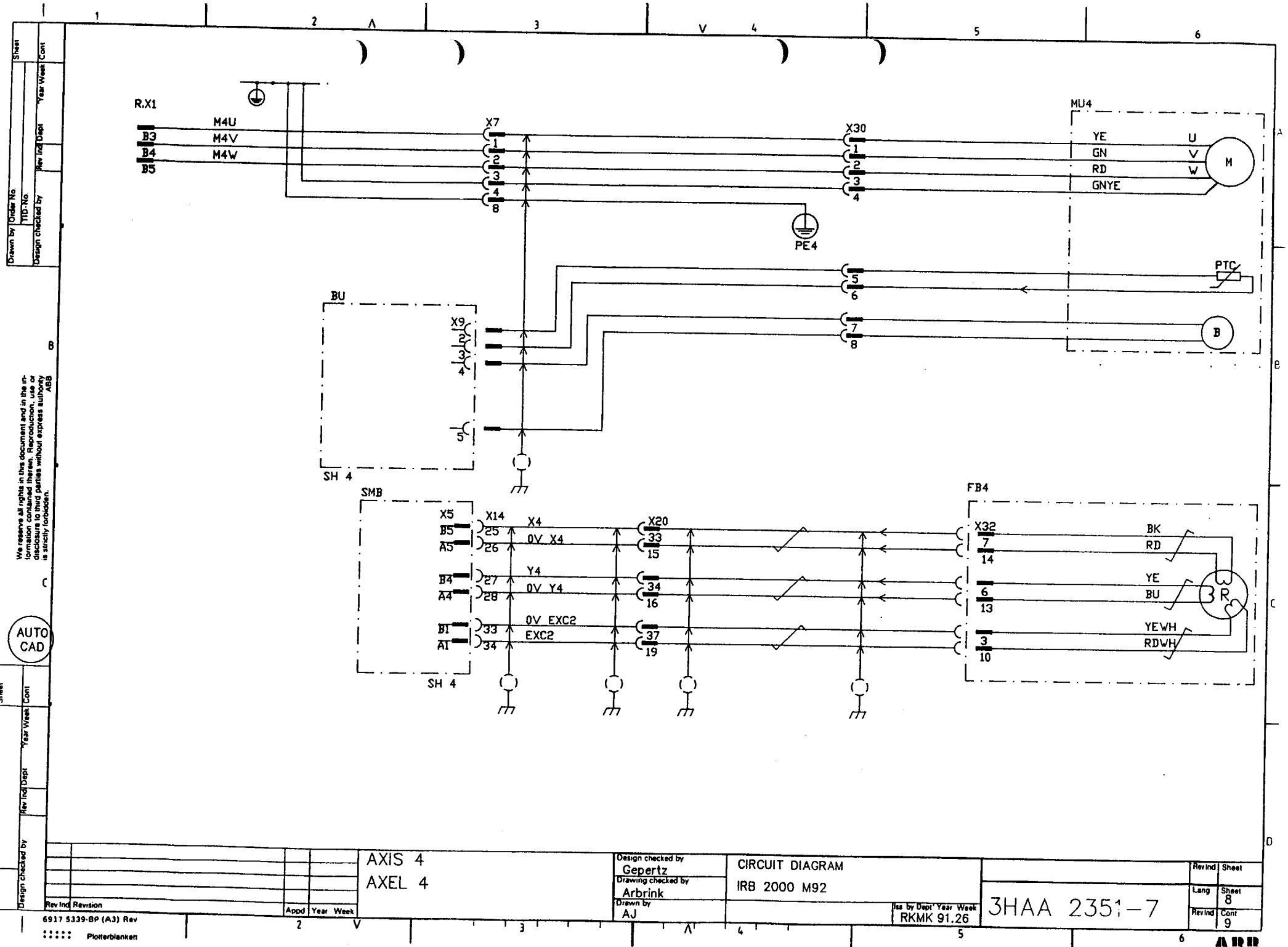
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M4U
M4V
M4W
B3
B4
B5
X7
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2
3
4
8
X30
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3
4
MU4
YE
GN
RD
GNYE
U
V
W
M
PE4
PTC
5
6
7
8
B
BU
X9
2
3
4
5
SH 4
SMB
X5
B5
A5
B4
A4
B1
A1
X14
25
26
27
28
33
34
X4
0V X4
Y4
0V Y4
0V EXC2
EXC2
X20
33
15
34
16
37
19
SH 4
FB4
X32
7
14
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13
3
10
BK
RD
YE
BU
YEWH
RDWH
R
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AXIS 4
AXEL 4
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AJ
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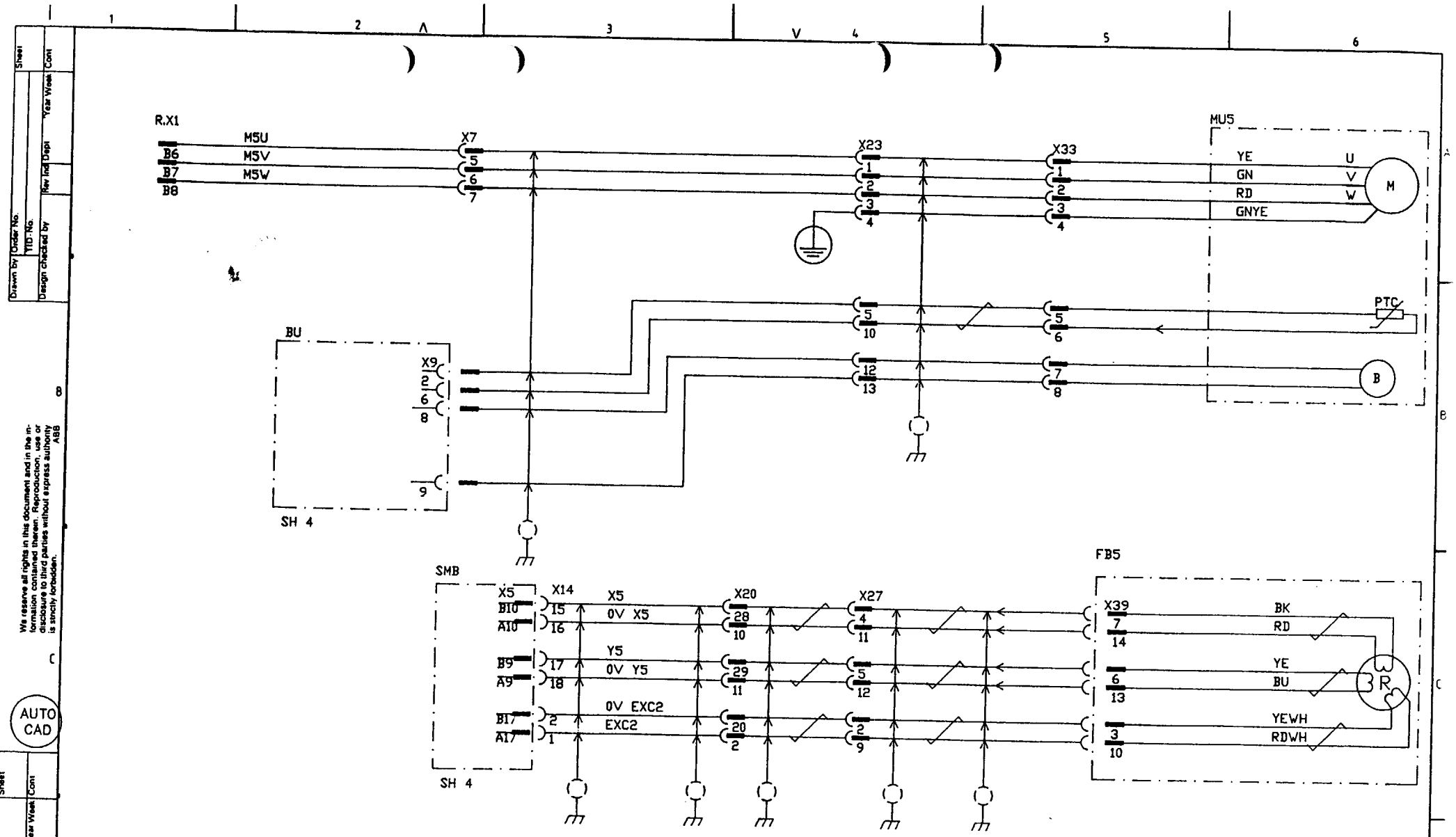

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AXIS 5
AXEL 5

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IRB 2000 M92

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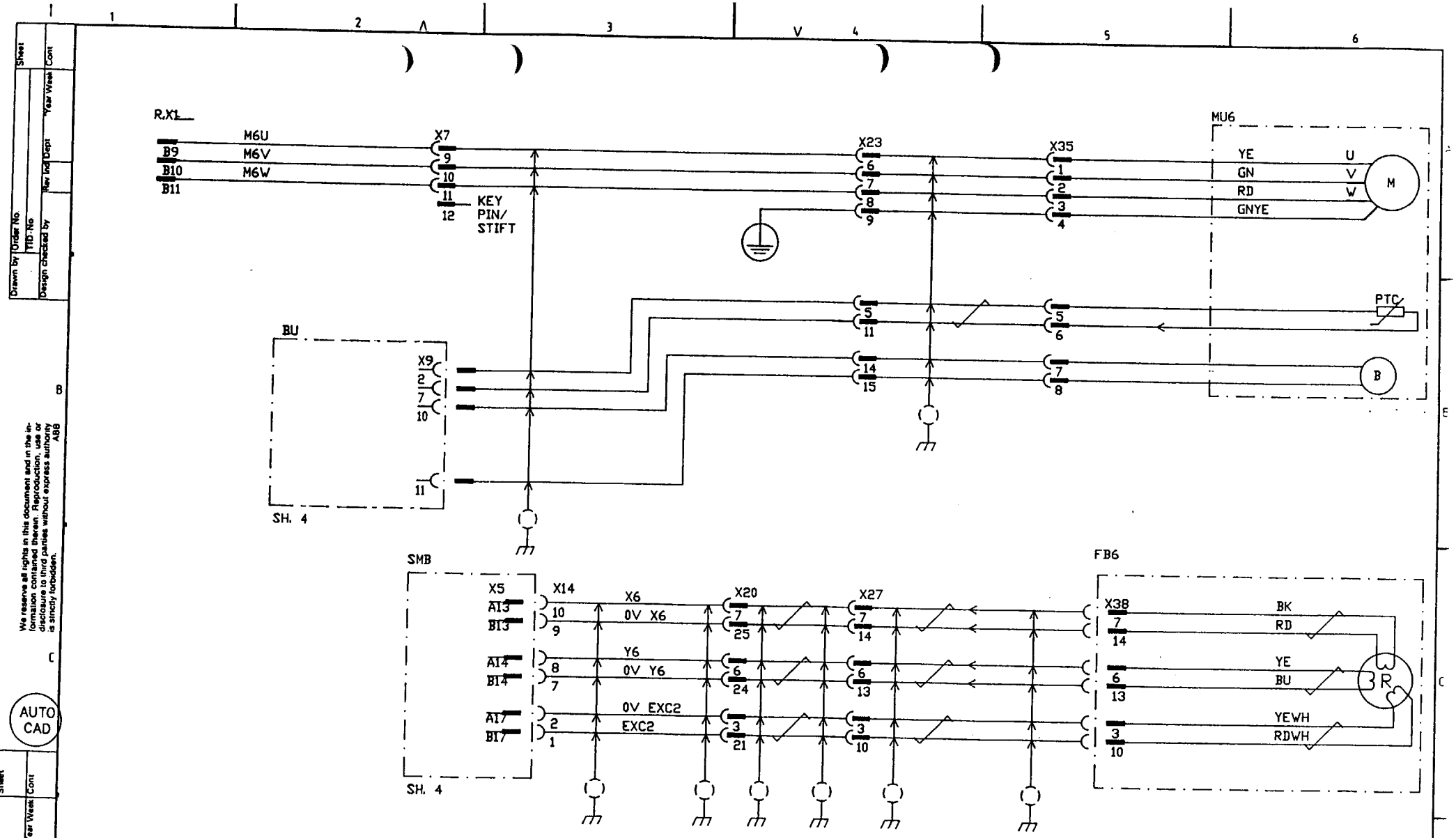

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AXIS 6
AXEL 6

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Drawing checked by: Arbrink
Drawn by: AJ

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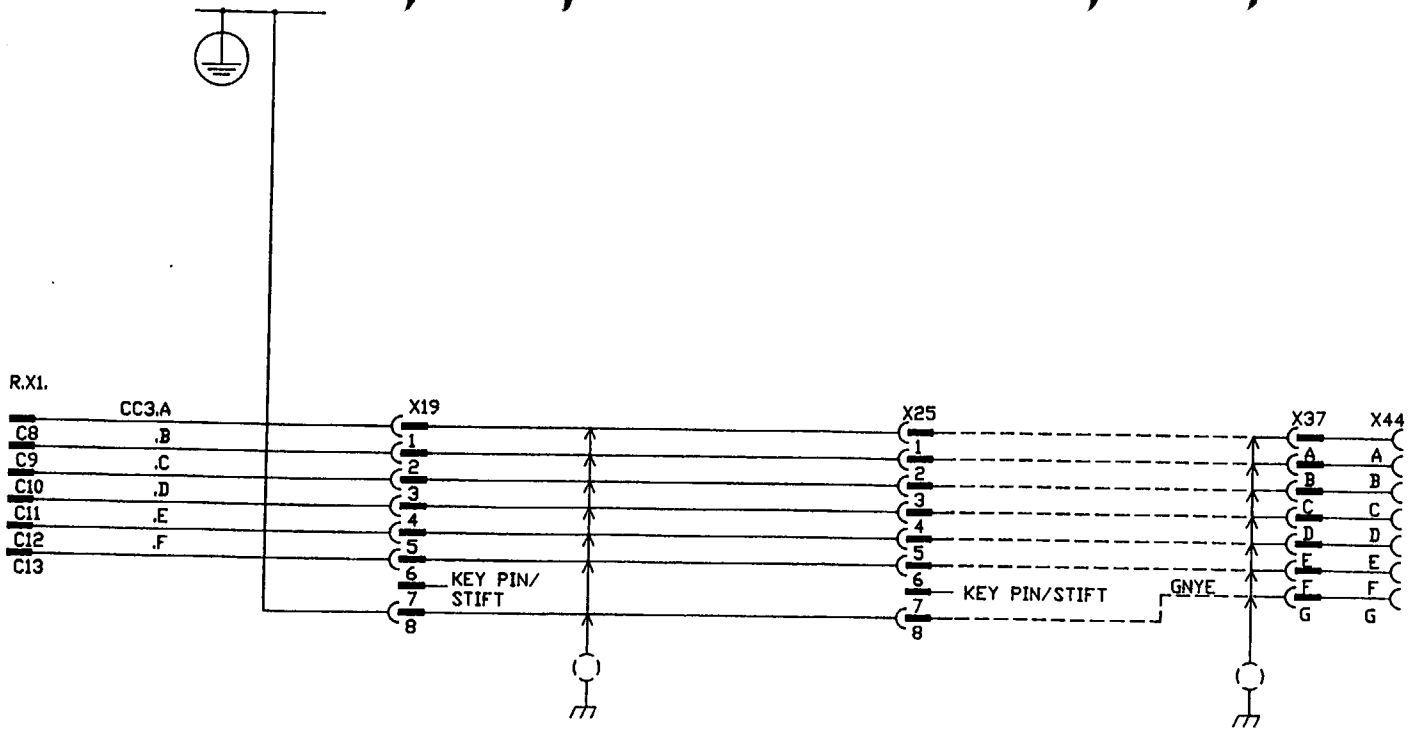

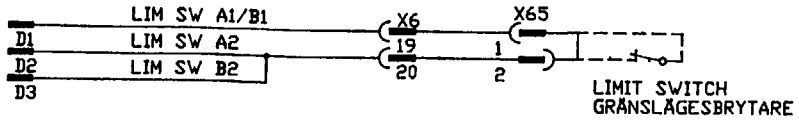

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CUSTOMER POWER CONNECTIONS
KUNDKABLAGE, KRAFT

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Drawing checked by: Arbrink
Drawn by: AJ

CIRCUIT DIAGRAM
IRB 2000 M92

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3HAA 2351-7

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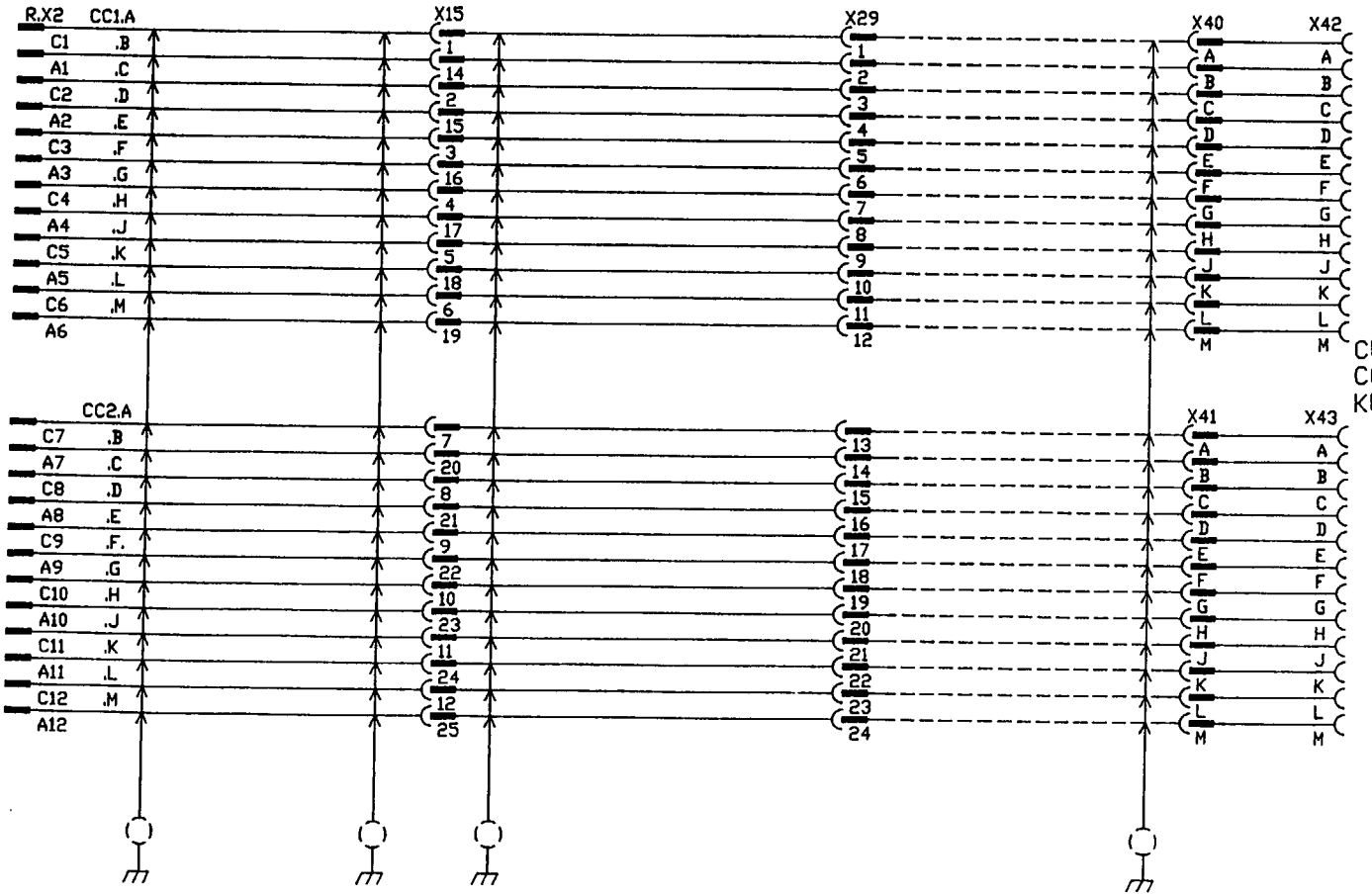

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Rev Ind	Revision	Appd	Year Week

6917 5339-BP (A3) Rev

Plotterblankett

CUSTOMER SIGNAL
CONNECTIONS, FRONT
KUNDKABLAGE SIGN. FRAM

Design checked by	Gepertz
Drawing checked by	Arbrink
Drawn by	AJ

CIRCUIT DIAGRAM
IRB 2000 M92

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3HAA 2351-7

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