

ARTROMOT - K4



Service Manual starting with s/n 3000 - 9999

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1 History

Revision	Date	Name	Change
1	21.09.2001	M. Nunnenmacher	Initial Release
2	15.10.2001	M. Nunnenmacher	Pos. 2.27 additional, 1.9, 1.15, 1.16,
3	06.11.2001	M. Nunnenmacher	Update Reference run
4	15.01.2002	M. Nunnenmacher	Update Pos. 3.13, 3.45,, 4.3, 4.5, Safetytest
5	06.02.2002	M. Nunnenmacher	Update Pos. 3.13, 7.1, 7.2
6	27.03.2002	M. Nunnenmacher	Update Pos. 1.1
7	27.10.2002	S. Herr	Update for all electronic parts, explosion drawing and reference run
8	02.06.2003	S. Herr	Update Pos. 6.0, 7.0, 2.10, explosion drawing
9	05.04.2004	S. Herr	Update Pos 1.6, function test
10	01.08.2006	S. Herr	Update chapter 4,8,9 Pos. 1,25 -1.28, Pos. 4,20 – 4.26
11	31.01.2008	S. Herr	Update front page
12	04.04.2013	S. Rietsche	New design, Update Chapter 9

2 Purpose

The purpose of this Service Manual is to help you to make simple repairs on the device. Only authorized staff may perform repairs and maintenance as the manufacturer's warranty and liability would otherwise be invalidated.

Only original parts may be used for servicing in accordance with the attached bill of materials for service parts.

3 General

3.1 **Electronics, connection cables**

No plugs may be connected or disconnected while the unit is switched on. Always switch the ARTROMOT®-K4 off before connecting or disconnecting any plug.

When you assembling with electronic parts make sure to use ESD (electro static discharge) equipment.

Make sure that the characteristic values of your power supply correspond to the voltage and frequency data indicated on the power adapter

3.2 **Error messages of the hand held programming unit**

Following error messages will be shown on the display:

DEVICE NEEDS REFERENCE RUN

The reference run was interrupted or the electronics were replaced

- Perform a reference run (see chapter 8.4)

POTENTIOMETER

Potentiometer shows incorrect value

- Check plug connection
- replace potentiometer if persistent

POTENTIOM.CABLE

Spiral cable for knee case defective

- Replace spiral cable for knee case (Pos.5.9)
- Check plug connection

MOTOR DRIVER

Motor electronics defective

- Replace motor electronics (see chapter 8.3) if persistent

OVER CURRENT

Motor power to high

- Replace motor electronics (see chapter 8.3) if persistent

UNWANTED BUSY

Motor control unit is not answering

- Hand-held programming unit or motor electronics are defective
- Spiral cable of the hand-held programming unit is defective

CPM MEMORY RAM

Memory fault in the motor control unit

- Replace motor electronics (see chapter 8.3) if persistent

CPM MEMORY ROM

Memory fault in the motor control unit

- Replace motor electronics (see chapter 8.3) if persistent

COMMUNICATION

Communication problem between hand-held programming unit and the motor control

- Change hand-held programming unit
- Replace motor electronics
- Change spiral cable of the hand-held programming unit

CPM-DEVICE ERROR

General mistake in the motor control unit

- Replace motor electronics (see chapter 8.3) if persistent

MOT. EN. TIMEOUT

Motor can not be activated

- Check motor electronics and plug connection for motor.
- Replace motor electronics (see chapter 8.3)
- Replace spiral cable of the hand-held programming unit if persistent

INVALID PARAMET.

Motor control unit received a wrong parameter

- Change the Hand-held programming unit
- Replace the motor electronics
- Replace the spiral cable of the hand-held programming unit

STOP RELEASE ERR

Stop line can not be released

- Change hand-held programming
- Replace spiral cable (see chapter 8.2) if persistent

UNEXP.MOT.STOP

Motor stopped unexpectedly

- Motor electronics or connecting line to motor defective

MOTOR DISABLED

Motor is disconnected

- Motor electronics or connecting line to motor defective

MOTO RERROR

Motor is not turning

- Check motor cable and motor
- Replace motor electronics (see chapter 8.3) if persistent

RTC INIT ERROR

Hand-held programming unit defective

- Replace hand-held programming unit (see chapter 8.2) if persistent

RTC COM ERROR

Communication problem with hand-held programming unit

- Replace hand-held programming unit (see chapter 8.2) if persistent

RTC ERROR

Hand-held programming unit defective

- Replace hand-held programming unit (see chapter 8.2) if persistent

RANG EEXCEEDED

Potentiometer shows a value out of range

- Replace Potentiometer and
- Change spiral cable of the Potentiometer

UNKNOWN CPM ERR.

Unknown error in the motor control unit

- Replace motor electronics (see chapter 8.3) if persistent

UNDEFINED ERROR

Undefined error

- Change hand-held programming unit
- Replace motor electronics
- Replace spiral cable of the hand-held programming unit

CPM 24V SUPPLY

24 V supply in motor control out of range

- Check power supply
- Replace motor electronics (see chapter 8.3) if persistent

CPM 3.3V SUPPLY

3.3V supply in motor control out of range

- Replace motor electronics (see chapter 8.3) if persistent

HS 24V SUPPLY

24 V supply in hand-held programming out of range

- Replace hand-held programming unit
- Change spiral cable if persistent

HS 5V SUPPLY

5V supply in hand-held programming unit out of range

- Replace hand-held programming unit if persistent

HS 3.3V SUPPLY

3.3V supply in hand-held programming unit out of range

- Replace hand-held programming unit if persistent

3.3 Mechanics

The Threaded spindle is not interchangeable with ARTROMOT®-K4 serial number < 3000.

The moveable screws should not be completely unscrewed when adjustments are being made.

Make sure that the moveable screws are tightened for operation and transport.

The frame is unstable: Possible cause bolt and screws are missing or loose. Tighten the screws and bolts.

3.4 Other

Do not clean the housing or the support with grease or oil.

No solvents may be used when cleaning the device.

3.5 Assembly and disassembly

Preparations for transport the ARTROMOT®-K4 has to be done.

The first step is to move the device in a maximum position of EXTENSION = 5 degrees.

Switch off the device.

Remove the power adapter and put it into the specified cutouts of the styro foam.

Loosen the 2 knurled handles (Pos. 6.2), pull out the ankle joint (Pos. 4.x).

For transportation, use the original packaging.

Loose the knurled handle (Pos. 6.9) and turn the femur Extension around 90 degrees.

Press the pushbutton (Pos. 7.4) and remove the square tube (Pos. 7.3).

Put the femur extension assembly into the specified cutout of the styro foam.

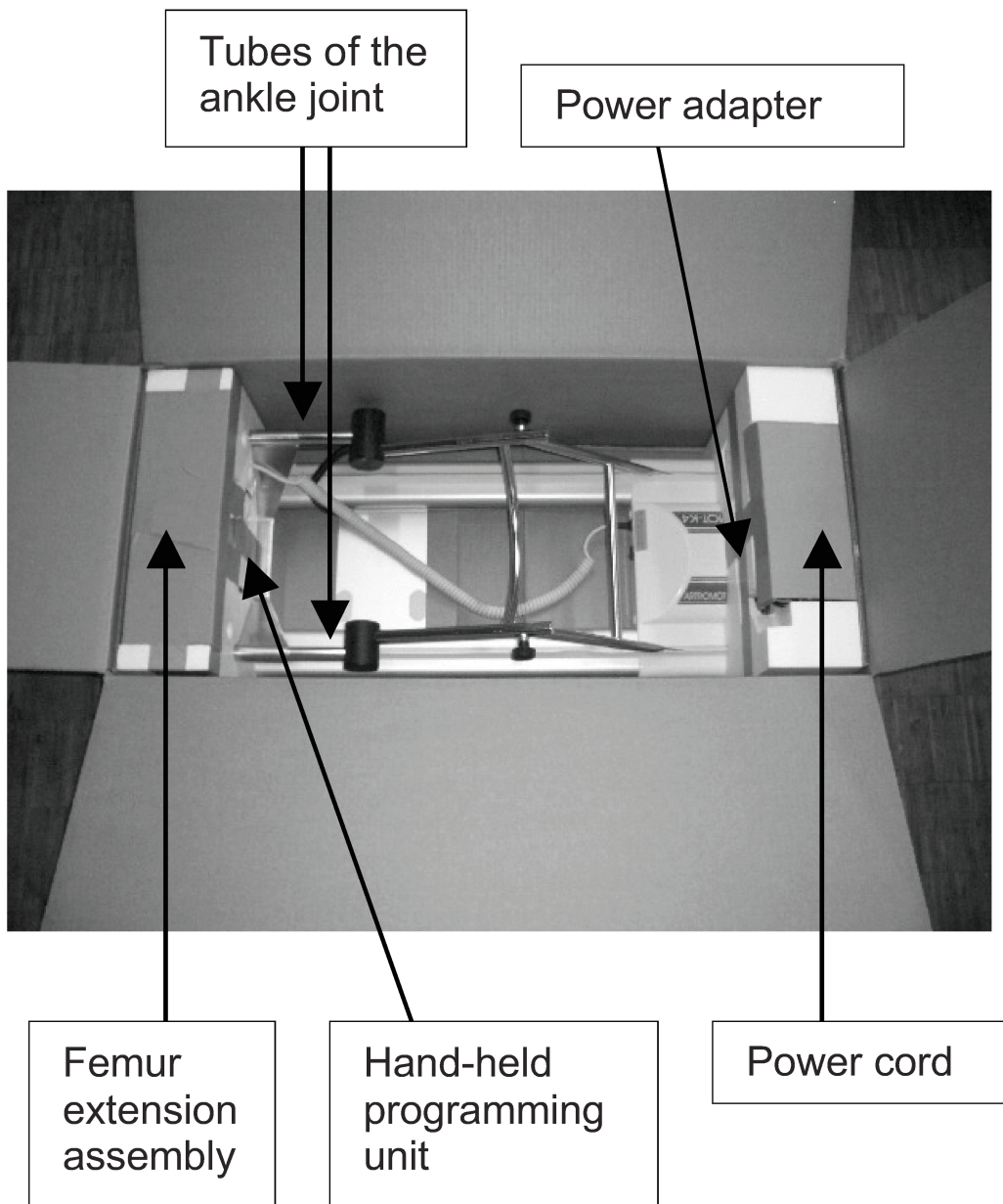
Move the two styro foam parts on the device.

Put the hand-held programming unit into the specified cut out of the styro foam.

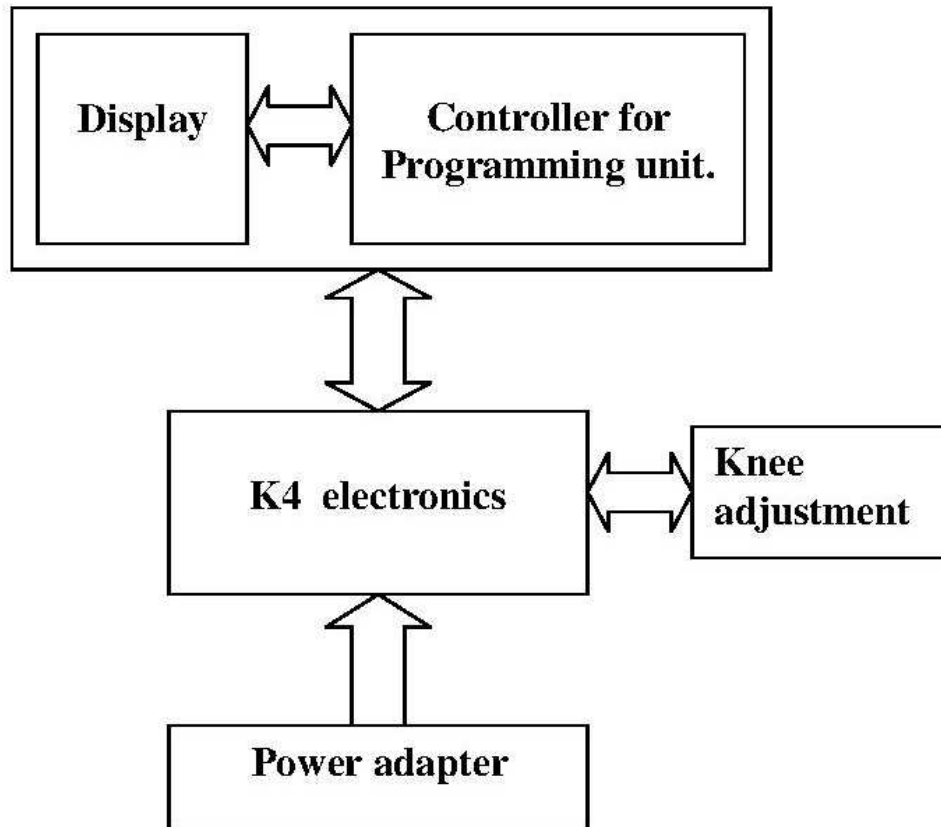
Put the device with the styro foam parts in the carton.

Move the tubes of the ankle joint upside down into the specified cutouts of the styro foam.

Put separate pads around the foot plate and frame to protect the device against vibration and damage.



4 Block diagramm of the electronic parts



5 Bill of materials for service parts

Position	Description	Ordernumber
1.0	Electronics	
1.1	Power adapter 115V	0.0031.107W
	Power cord USA – version to 0.0031.107W	0.0032.011
	Power cord EU – version to 0.0031.107W	0.0032.012
1.2	Hand-held programming unit	0.0031.113
1.4	Rubber mat	2.0031.195
1.5	Sheet metal cover	2.0032.136
1.6	Motor electronics	2.0031.900RevB
1.7	Fantype lock washer	DIN6798AD3,2vz
1.8	Screw thread slab	962.903
1.9	Screw	LIKOM4x8A2
1.11	Hexagonal nut	DIN934M3vz
1.13	Cloth white	0.0010.144
1.14	Sticker	2.0013.362
1.15	Phillips screw	9B2.013
1.16	Cover top black	9B2.013
1.17	Spiral cable	2.0032.137
	Holding clip	0.0031.004
1.19	Countersunk screw	DIN7991M3x10sw
1.20	Flat connector	0.0013.125
1.21	Washer	DIN125D3,2vz
1.22	Wire-Set Motor	2.0032.139
1.23	Pan head screw	DIN912M3x6A2
1.24	Washer	2.0013.317
1.25 - 1.28	Holder set motor plate (Pos. 1.25 – 1.28)	0.0032.010
2.0	Exterior under frame	
2.1	Right profile	2.0031.107
2.2	Left profile	2.0031.106
2.3	Right rubber mat	2.0031.185
2.4	Right rubber mat	2.0031.187
2.5	Lip	2.0031.193
2.6	Interior slit	2.0031.167
2.7	Interior slit	2.0031.196
2.8	Right cover	2.0031.111
2.9	Left cover	2.0031.110
2.10	Shaft bearing	2.0031.112
2.11	DU collar	0.0031.110
2.12	Interior slit	2.0031.197
2.14	Exterior slit	2.0031.168
2.15	Exterior slit	2.0031.168
2.16	Connection plate	2.0031.174
2.17	Tread plate	962.901
2.18	Pan head screw	DIN912M6x8A2
2.19	Left rubber mat	2.0031.169
2.20	Left rubber mat	2.0031.186
2.21	Countersunk screw	2.0031.166
2.22	Countersunk screw	DIN7991M4x8A2
2.23	Spring wire	0.0031.300
2.24	Band white	2.0020.163
2.25	Implementation spout	0.0031.145
2.27	Locking pin / Spannstift	DIN1481D3x12

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Position	Description	Ordernumber
3.0	Drive technology	
3.1	Motor including transmission	0.0031.100
3.2	Right slide	2.0031.108
3.3	Left slide	2.0031.109
3.4	Threaded spindle	2.0031.212
3.5	Rubber ring	2.0031.176
3.7	Rubber plate	2.0028.170
3.8	Motor plate	2.0031.156
3.9	Spline shaft drive	2.0031.181
3.10	Toothed belt	0.0031.130
3.11	Toothed lock washer drive	2.0031.180
3.12	Labeled casing	2.0031.032
3.13	Bearing plate left	2.0031.165
3.14	Rubber plate	2.0031.102
3.15	Sheet metal	2.0031.115
3.17	Ball bearing	910.008
3.18	Rubber ring	2.0031.105
3.19	Rubber disk	2.0031.104
3.20	Joint plate	2.0031.113
3.22	Covering plate	0.0028.105
3.23	Ring	0.0028.106
3.24	Split rivet	0.0031.136
3.25	Wire-set power supply	2.0032.140
3.26	Retaining ring	DIN471A8x0,8
3.27	Rubber buffer	0.0031.109
3.28	Spacer sleeve	0.0031.104
3.29	Pin	2.0031.188
3.30	Countersunk screw	DIN7991M5x20vz
3.31	Screw thread pin	DIN916M4x4sw
3.32	Screw thread pin	DIN914M4x4sw
3.33	Countersunk screw	DIN7991M4x10vz
3.34	Hexagonal nut	DIN934M5vz
3.35	Pan head screw	DIN912M5x6vz
3.36	Countersunk screw	DIN7991M5x25A2
3.37	Countersunk screw	DIN7991M5x55vz
3.38	Countersunk screw	DIN7991M5x16vz
3.39	Bearing plate right	2.0031.103
3.50	Countersunk screw	DIN7991M4x16vz
3.51	Pan head screw	DIN912M4x12vz
3.53	Spindle nut	2.0032.141
4.0	Ankle joint	
4.1	Ankle joint bowl	2.0031.120
4.2	Base plate	2.0031.170
4.3	Knurled handle	GN534-40-M6-10sw
4.4	Washer	DIN9021D6,4vz
4.5	Washer	0.0031.111
4.6	Washer	0.0031.142
4.7	Screw rosette	0.0031.137
4.8	Spacer sleeve	0.0013.104
4.9	Sleeve nut	2.0031.178
4.10	Fastening band	0.0031.144
4.11	Rigid pipe	2.0031.117
4.12	Knurled handle	2.0031.031
4.13	Washer	DIN7349D6,4vz

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Position	Description	Ordernumber
4.14	Hinge box	2.0031.119
4.15	Washer	2.0031.118
4.16	Countersunk screw	DIN7991M5x8A2
4.17	Cylinder pin	DIN7D4x20A2
4.18	Nut	0.0031.108
4.19	Nut	0.0031.105
	New Ankle joint complete	2.0037.022K3K4
4.20	Supporting disk	2.0031.213
4.21	Ankle joint bow	2.0037.163
4.22	Base plate	2.0037.168
4.23	Countersunk screw	DIN7991M5x12A2
4.24	Ankle joint nut	2.0037.165
4.25	Distance disk	0.0037.27
4.26	Wing screw	GN531-32-M6-10sw
4.28	Pin	DIN6325D4x12
5.0	Knee case	
5.1	Cover knee case	2.0031.160
5.2	Retaining ring	DIN471A10x1
5.3	Bearing shell	2.0031.146
5.4	Right knee case	2.0031.152
5.5	Left knee case	2.0031.149
5.6	Shim	DIN988D10x16x0,3
5.7	Catch	2.0031.150
5.8	Shaft	2.0031.147
5.9	Left knee case	2.0031.148
5.10	Cover knee case left	2.0031.189
5.11	Knee electronics	0.0031.121
5.12	Spiral cable for knee case	0.0031.122
5.13	Tapping screw countersunk	DIN7982D3,9x13A2
5.14	Cylinder pin	DIN6325D5x40
5.15	Screw thread pin	DIN913M6x10A2
5.16	Shim	DIN988D10x16x0,1
6.0	Femur bow	
6.0	Femur bow + Femur extension assembly (6.4- 6.22 + 7.1 - 7.8)	2.0031.003
6.1	Frame (shank)	2.0031.027
6.2	Knurled handle	GN534-32-M6-10
6.3	Frame (thigh)	2.0031.028
6.4	Tube end plug	2.0031.023
6.5	Retaining ring	DIN472I20x1
6.6	CB-Disc spring	0.0028.109
6.7	Compression spring	2.0031.179
6.8	Bolt	2.0031.127
6.9	Knurled handle	2.0031.135
6.10	Rigid pipe	2.0031.145
6.11	Cover	2.0031.153
6.12	Case	2.0031.162
6.13	Sliding disk	2.0031.173
6.14	Joint pipe	2.0031.026
6.15	Cover	2.0031.154
6.16	Screw	DIN923M5x3vz
6.17	Flat head screw	DIN921M3x5A2
6.18	Screw thread in	DIN914M5x6A2
6.19	Edge-protection profile	2.0031.202
6.20	Sticker (lock insert)	0.0031.153

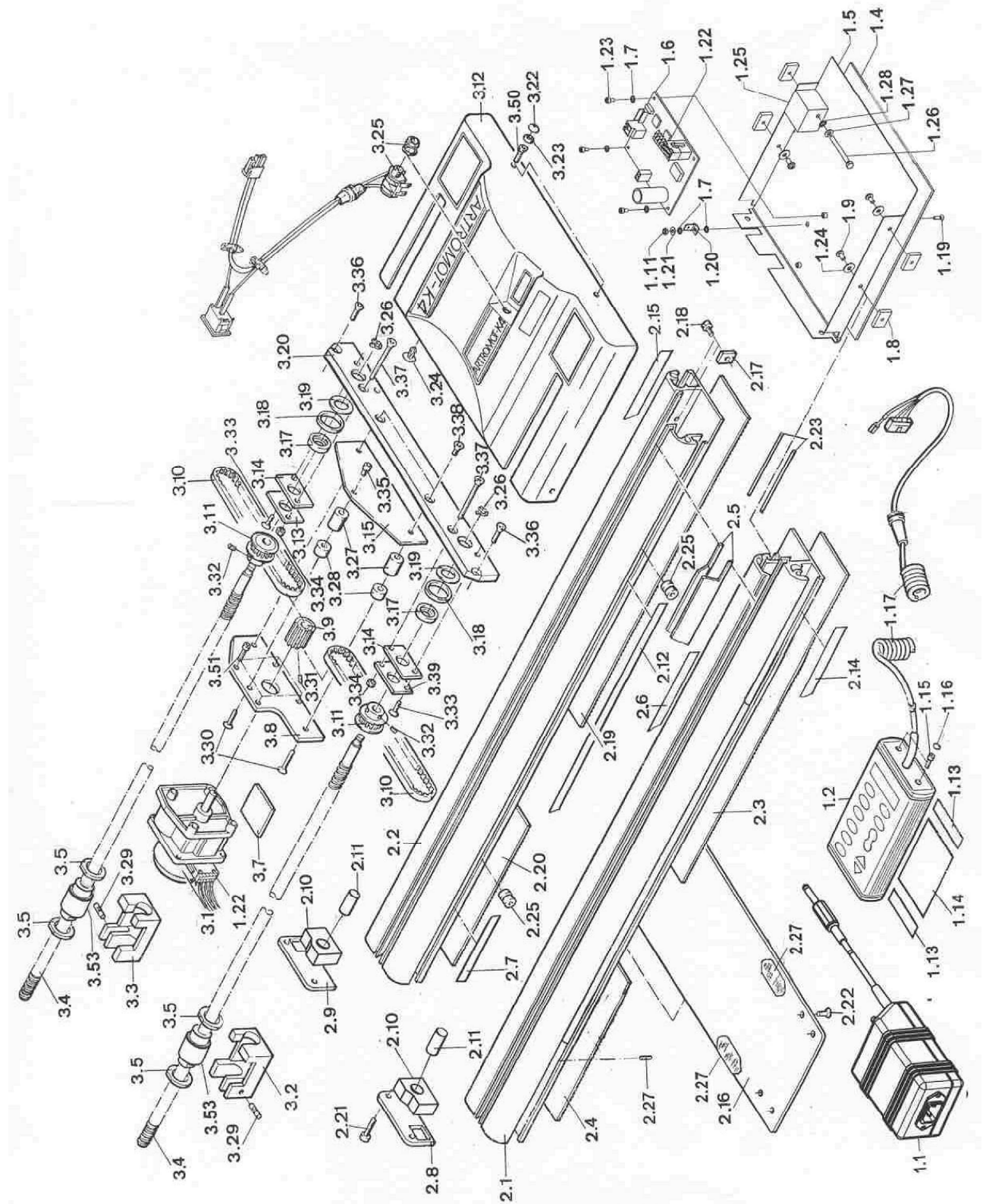
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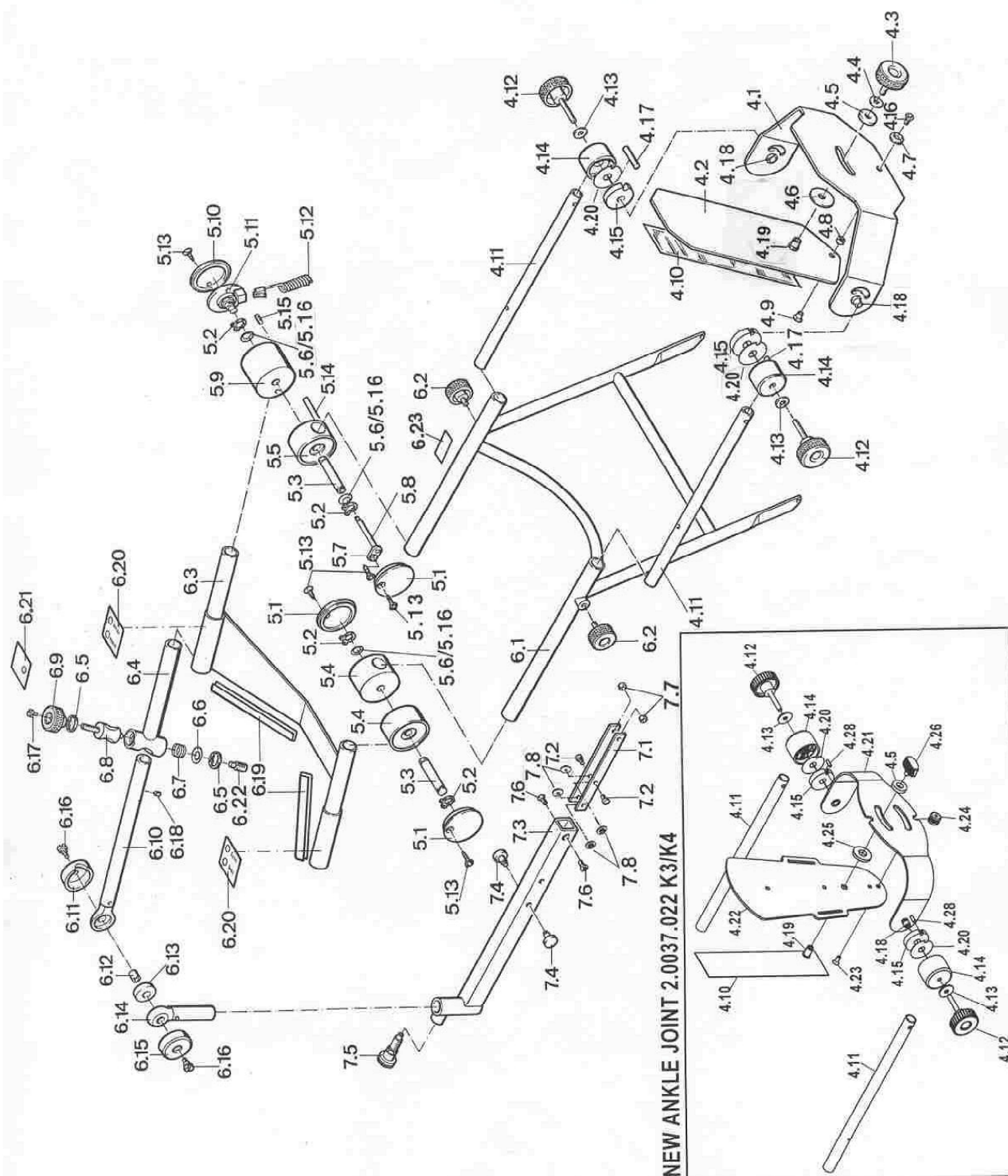
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Position	Description	Ordernumber
6.21	Sticker (insert)	0.0031.152
6.22	Screw thread pin	DIN915M5x10A2
6.23	Sticker (PRECAUTION)	0.0031.146
7.0	Femur extension	
7.0	Femur extension assembly (7.1 – 7.8)	2.0031.051
7.1	Leaf spring	2.0031.143
7.2	Stud bolt	2.0031.142
7.3	Square tube	2.0031.025
7.4	Push-button	2.0031.141
7.5	Dwell bolt	GN617-5-A-NI
7.6	Countersunk screw	DIN7991M4x8A2
7.7	Hexagonal nut	DIN985M4vz
7.8	Nut	0.0031.106
Patient kits		
No illustration	Patient kit fleece	2.0032.155
No illustration	Patient kit cool-quilt	2.0032.155B
No illustration	Foot rest reconstruction K3 + K4	2.0032.012
No illustration	Leg supports reconstruction kit K3 + K4	2.0032.013
No illustration	Stereo jack connector	0.0032.200

6 Figure for bill of materials part 1



7 Figure for bill of materials part 2



8 How to perform repairs

8.1 Housing cover (Pos. 3.12)

Move the ARTROMOT®-K4 in a position of approximately 120 degrees.

Turn the Power OFF at the ARTROMOT®-K4 and remove the power adapter.

Hit the 4 pins of the split rivet (Pos. 3.24) inwards.

Remove the 2 covering plates (Pos. 3.22).

Loosen the 2 countersunk screws (Pos. 3.50) and remove the casing.

Remove the 4 pins of the split rivet, which are inside the casing.

If you have exchanged any of the printed circuit boards including the knee electronics and the hand held programming unit or any parts of the drive technology (Pos. 3.x), you have to perform a reference run (see chapter 8.4).

Finally, a function- and safety test has to be performed.

8.2 Exchange the hand-held programming unit (Pos. 1.2)

ATTENTION!

When you assembling with electronic parts make sure to use ESD (electro static discharge) equipment.

Remove the casing (see chapter 8.1).

Pull out the connector of the hand held programming unit.

Put in the connector of the new hand held programming unit.

Rebuild the casing.

Perform a reference run (see chapter 8.4).

Finally, a function- and safety test has to be performed.

8.3 Exchange the motor electronics (Pos. 1.3 and 1.6)

ATTENTION!

When you assembling with electronic parts make sure to use ESD (electro static discharge) equipment.

Remove the casing (see chapter 8.1).

Pull out the required cables at the printed circuit board (Pos. 1.6).

Exchange the defect printed circuit board.

Put in the cables at the same position (Pay attention to the code).



Rebuild the casing.
Perform a reference run (see chapter 8.4).
Finally, a function- and safetytest has to be performed.

8.4 How to perform a reference run

Adjust a maximum femur length, a minimum lower leg length, hip axis in smallest position and the middle position of the foot rotation.

Under special functions select the operation REFERENCE RUN by using "+" and "-".

Press "SET" for five seconds.

The display shows: REFERENCE RUN (flashing for 5 sec.)
FOR SERVICE ONLY

Then the display shows: REFERENCE RUN
ENTER KEY

To start the reference run press "+" and "-" at the same time.

While the reference run is in progress the display
shows: PERFORMING R-RUN
PLEASE WAIT

The reference run starts automatically and will take up to 10 minutes.

The ARTROMOT®-K4 will reach both points of the mechanical stud (first minimum at EXTENSION afterwards maximum at FLEXION). Now the ARTROMOT®- K4 moves between -5 to 125 degrees or parts of this range with different speed and will stop at a position of 0 degrees. After the ARTROMOT®- K4 stops the display will show : REFERENCE RUN
SUCCESSFUL

The ARTROMOT®- K4 is now ready for operation.

Finally, a function- and safety test has to be performed.

Attention:

If the reference run was interrupted the display shows:

REFERENCE RUN
INTERRUPTED (The ARTROMOT®- K4 stops)

If you try to start the ARTROMOT®- K4 the display will show :
DEVICE NEEDS
REFERENCE RUN (The ARTROMOT®- K4 is inoperable)

Perform a reference run.

9 Checklist of safety and function test

Safety test	Measured value	Date/ Signature
Enclosure Leakage current IEC62353/ VDE 0751-1 $\leq 100 \mu\text{A}$	μA	
or		
Enclosure Leakage current as in UL 2601 $\leq 100 \mu\text{A}$	μA	

Function test	OK	Error
Switch on the ARTROMOT®-K4. Press "Set". Display: Software version K4 V40 161002		
The maximum range of motion for Extension/ Flexion is –10 to 125 degrees. Check the angle in a position - 5 degrees. Tolerance +/- 5 degrees. Check the angle in a position 60 degrees. Tolerance +/- 5 degrees. Check the angle in a position 100 degrees. Tolerance +/- 5 degrees.		
Check the emergency-off function. Switch the ARTROMOT®-K4 on in continuous operation. Press any key, the ARTROMOT®-K4 will stop immediately.		
Perform the following settings. Extension -> -10 degrees Flexion -> 125 degrees Pause Ex. -> 5 sec. Pause Flex. -> 10 sec. Force -> 45 kp Speed -> 100 % Adjust a maximum femur length.		
First press "STOP" and afterwards press "START". ➤ The ARTROMOT®-K4 should then reach both points of changing direction within 80 to 95 seconds.		
Change the speed to 50% and repeat last test ➤ The ARTROMOT®-K4 should then reach both points of changing direction within 125 to 145 seconds.		
Verify the settings for "Pause Ex." and "Pause Flex." ➤ The tolerance for both is +/- 3 seconds		

