

# Modification instruction

Version 1.0.2

## BF46 /BF 30 Vario CNC



Fig.0-1: BF 46 Vario with CNC modification

**Keep for future reference!**

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# 1 Safety warnings (warning notes)

## 1.1 Classification of hazards

We classify the safety warnings into various levels. The table below gives an overview of the classification of symbols (pictograms) and warnings for the specific danger and its (possible) consequences.

Pictogram	Alarm expression	Definition/Consequences
	<b>DANGER!</b>	Imminent danger that will cause serious injury or death to personnel.
	<b>WARNING!</b>	Risk: A danger that might cause serious injury or death to personnel.
	<b>CAUTION!</b>	Danger of unsafe procedure that might cause injury to personnel or damage to property.
	<b>ATTENTION!</b>	Situation that could cause damage to the machine and product and other types of damage. No risk of injury to personnel.
	<b>INFORMATION</b>	Application tips and other important or useful information and notes. No dangerous or harmful consequences for personnel or objects.

In the case of specific dangers, we replace the pictogram by



### 1.1.1 Glossary of symbols

	gives additional advices
	enumerations

## 1.2 Proper use



### WARNING!

In the event of improper use of the add-on pieces, it

- will endanger the user,
- will endanger the machine and other material property of the operator or user,
- may affect proper operation of the machine.

The add-on pieces as conversion kit are provided for motor-driven milling operations of your machine.

Improper use!

The milling machine with the adapter kit must only be placed and operated in dry and ventilated rooms.

The handwheels of the driven axes need to be disassembled.

If the adapter kit is used in any way other than described above or modified without approval of the company Optimum Maschinen Germany GmbH the adapter kit is no longer properly used.

We do not take any liability for damages caused by improper use.

We would like to stress that any modifications to the construction, or technical or technological modifications that have not been authorized by Optimum Maschinen GmbH will also render the guarantee null and void.



We are pleased that you have decided to buy a CNC milling machine made by Optimum Maschinen Germany GmbH.

The illustrations of the machines may vary in a few details from the illustrations of this instruction manual, but this will have no effect on the operation of the machine.

Any changes in the construction, equipment and accessory are reserved for the advancement. Therefore, you cannot derive any claims from the indications and descriptions. Errors are reserved!

## 1.3 Required auxiliary material

- Means of shaft lock-down device "Loctite 648, join the shaft".
- The designation of the parts in the assembly description corresponds to the numbering on the packing list.
- In order to degrease the shaft, a cleaner for brakes or a corresponding cleaning agent is required.

Required tools:

- Hand drill, caliper gauge,
- Twist drill 6.8mm, screw tap M8, countersink
- Allen key, fork wrench, socket wrench 24mm
- Screw driver, tongs
- Wire cutter, trimming knife
- Hot-air drier, shrink hose, sleeves
- Blow-back proof plastic tip hammer
- Lubricating oil for thread cutting

## 2 Packing list BF 30 Vario

<b>Bezeichnung</b> <i>Designation</i>	<b>CNC - Anbausatz MK F30DP</b> BF 30 CNC
<b>Artikelnummer Anbausatz</b> <i>Item no. mounting set</i>	<b>3570030</b>
<b>Netto Gewicht</b> <i>Net Weight</i>	6.3 kg
<b>Brutto Gewicht</b> <i>Cross Weight</i>	7 kg
<b>Abmessung (Lx B x H)</b> <i>Dimension (L x W x H)</i>	320 mm x 285 mm x 80 mm

<b>Nr.</b> <i>No</i>	<b>Bezeichnung</b> <i>Description</i>	<b>Artikelnummer</b> <i>Article no.</i>	<b>Teile Nr.</b> <i>Part no.</i>	<b>Grösse</b> <i>Size</i>	<b>Abbildung</b> <i>Picture</i>	<b>Stck.</b> <i>Qty.</i>
1	<b>Gehäuse für X-, Y- und Z-Achse</b> <i>Drive housing for X-, Y- and Z-axis</i>	0 3570046 01	BFCNC-01			3
2	<b>Gehäusedeckel für X-, Y- und Z-Achse</b> <i>Housingcover for X-, Y- and Z-axis</i>	0 3570046 02	BFCNC-02			3
3	<b>Zahnriemenscheibe für Motor an X-, Y- und Z-Achse</b> <i>Toothed belt disk for motor on the X-, Y- and Z-axis</i>	0 3570046 03	BFCNC-03	22 teeth HTD-22-5M-15-AS		3
4	<b>Zahnriemenscheibe für Welle an Y- und Z-Achse</b> <i>Toothed belt disk for the shaft on the Y- and Z-axis</i>	0 3570030 04	BF3CNC-04	32 teeth HTD-32-5M-15-AS		2
5	<b>Mutter für Y- und Z-Achse</b> <i>Nut for Y- and Z-axis</i>	0 3570030 07	BF3CNC-05			2
6	<b>Distanzring X-Achse</b> <i>Distance ring for the X-axis</i>	0 3570030 10	BF3CNC-06			1
7	<b>Zahnriemenscheibe für Welle X-Achse</b> <i>Toothed belt disk for shaft at X-axis</i>	0 3570030 11	BF3CNC-07	32 teeth HTD-32-5M-15-AS		1
8	<b>Hülse für Handrad X- und Y-Achse</b> <i>Bushing for the handwheel on the X- and Y-axis</i>	0 3570030 08	BF3CNC-08			2

Nr. No	Bezeichnung Description	Artikelnummer Article no.	Teile Nr. Part no.	Grösse Size	Abbildung Picture	Stck. Qty.
9	<b>Schrittmotor für X-, Y- und Z-Achse</b> <i>Step motor for X-, Y- and Z-axis</i>	3590012		34 H2120-0.1A 8 Nm		3
10	<b>Zahnriemen für X-, Y- und Z-Achse</b> <i>Toothed belt for X-, Y- and Z-axis</i>	0 3570046 14	BFCNC-14	HTD-360-5M-15		3
11	<b>Schraube</b> <i>Screw</i>	"DIN 4762"		M8x15		6
12	<b>Madenschraube</b> <i>Screw</i>	DIN 914		M4x4		3
13	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x20		14
14	<b>Schraube</b> <i>Screw</i>	DIN 4762		M6x25		1
15	<b>Schraube</b> <i>Screw</i>	DIN 4762		M3x10		11
16	<b>Schraube</b> <i>Screw</i>	DIN 4762		M8x15		2
17	<b>Schraube</b> <i>Screw</i>	DIN 4762		M8x40		2
18	<b>Kabel</b> <i>Wire cord</i>	-		4 x 0,75mm <sup>2</sup>		15m

<b>Prüfer:</b> <i>Verified by:</i>		<b>Datum:</b> <i>Date:</i>	
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### 3 Packliste BF 46 Vario

<b>Bezeichnung</b> <i>Designation</i>	<b>CNC - Anbausatz MK F46DP</b> BF 46 CNC
<b>Artikelnummer Anbausatz</b> <i>Item no. mounting set</i>	<b>3570046</b>
<b>Netto Gewicht</b> <i>Net Weight</i>	6,3 kg
<b>Brutto Gewicht</b> <i>Cross Weight</i>	7 kg
<b>Abmessung (Lx B x H)</b> <i>Dimension (L x W x H)</i>	320 mm x 285 mm x 80 mm

<b>Nr.</b> <i>No</i>	<b>Bezeichnung</b> <i>Description</i>	<b>Artikelnummer</b> <i>Article no.</i>	<b>Teile Nr.</b> <i>Part no.</i>	<b>Grösse</b> <i>Size</i>	<b>Abbildung</b> <i>Picture</i>	<b>Stck.</b> <i>Qty.</i>
1	<b>Gehäuse für X-, Y- und Z-Achse</b> <i>Driver house for X,Y and Z-axis</i>	0 3570046 01	BFCNC-01			3
2	<b>Gehäusedeckel für X-, Y- und Z-Achse</b> <i>Housingcover for X,Y and Z axis</i>	0 3570046 02	BFCNC-02			3
3	<b>Zahnriemenscheibe für Motor an X-, Y- und Z-Achse</b> <i>Toothed belt disk for Motor X-,Y- and Z-axis</i>	0 3570046 03	BFCNC-03	22 Zähne HTD-22-5M-15-AS		3
4	<b>Zahnriemenscheibe für Welle an Y- und Z-Achse</b> <i>Toothed belt disk for Shaft Y- and Z-axis</i>	0 3570046 04	BFCNC-04	32 Zähne HTD-32-5M-15-AS		2
5	<b>Mutter für Y- und Z-Achse</b> <i>Nut for Y- and Z-axis</i>	0 3570046 07	BFCNC-07			2
6	<b>Distanzring X-Achse</b> <i>Distanzring for X-axis</i>	0 3570046 10	BFCNC-10			1
7	<b>Zahnriemenscheibe für Welle X-Achse</b> <i>Toothed belt disk for shaft X-axis</i>	0 3570046 11	BFCNC-11	32 Zähne HTD-32-5M-15-AS		1
8	<b>Hülse für Handrad an X- und Y-Achse</b> <i>Distanz for Handwheel x and y Axis</i>	0 3570046 12	BFCNC-12			2

Nr. No	Bezeichnung Description	Artikelnummer Article no.	Teile Nr. Part no.	Grösse Size	Abbildung Picture	Stck. Qty.
9	<b>Schrittmotor für X-, Y- und Z-Achse</b> <i>Step motor for X-, Y- and Z-axis</i>	357 3314		34 H2160-02IP 12 Nm		3
10	<b>Zahnriemen für X-, Y-, und Z-Achse</b> <i>Toothed belt for X-, Y- and Z-axis</i>	0 3570046 14	BFCNC-14	HTD-360-5M-15		3
11	<b>Schraube</b> <i>Screw</i>	"DIN 4762"		M8x15		6
12	<b>Madenschraube</b> <i>Screw</i>	DIN 914		M4x4		3
13	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x20		14
14	<b>Schraube</b> <i>Screw</i>	DIN 4762		M3x10		11
15	<b>Schraube</b> <i>Screw</i>	DIN 4762		M8x15		2
16	<b>Schraube</b> <i>Screw</i>	DIN 4762		M8x40		2
17	<b>Mutter</b> <i>Nut</i>	DIN 985		M16		3
18	<b>Unterlegscheibe</b> <i>Washer</i>	DIN 125-2 B		17		3
19	<b>Kabel</b> <i>Wire cord</i>	-		4 x 0,75mm <sup>2</sup>		15m

<b>Prüfer:</b> <i>Verified by:</i>		<b>Datum:</b> <i>Date:</i>	
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## 4 Assembly CNC kit

### CNC conversion kit

#### 4.1 Assembly X-axis

4.1.1 Disassemble the self-locking nut and the shim of the left handwheel of the X-axis.

4.1.2 Remove the handwheel with a blow-back proof plastic tip hammer with smooth knocks. Turn the handwheel at the same time.

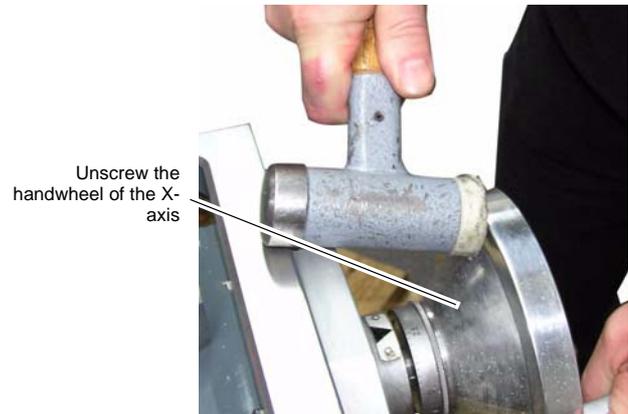


Fig.4-1: Handwheel on the left

4.1.3 Remove the dimension arrow head of the X-axis with tongs.

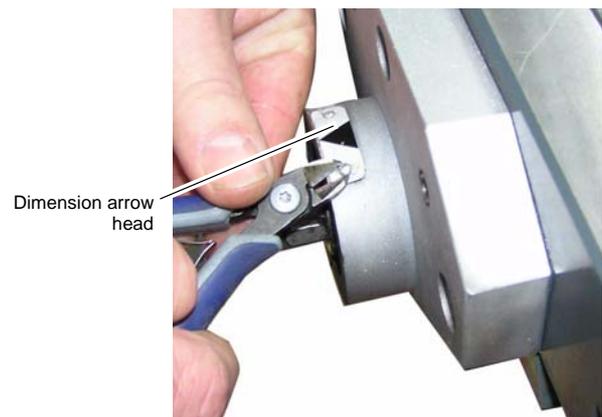


Fig.4-2: Remove the dimension arrow head

4.1.4 Unscrew the three fixing screws of the plate on the X-axis.

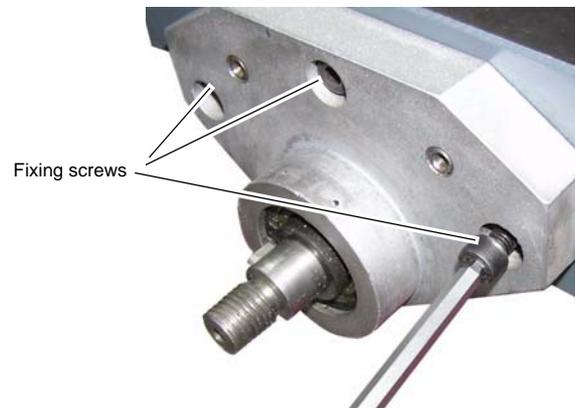


Fig.4-3: Unscrew screws

- 4.1.5 Fix the distance ring (No 6) on the plate of the X-axis.



Fig.4-4: Screw the distance ring

- 4.1.6 Screw the housing (Nr. 1) on the distance ring.

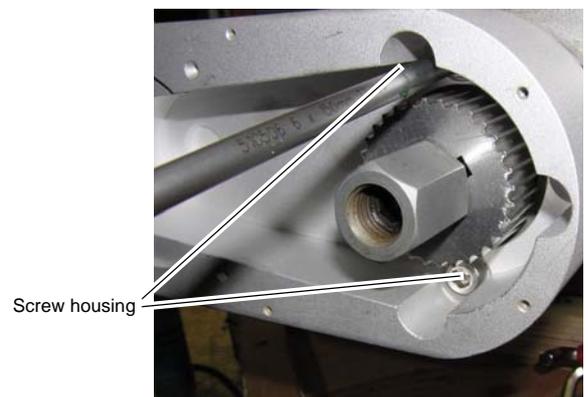


Fig.4-5: Screw housing

- 4.1.7 Slide the pulley (No 7) on the shaft of the X-axis.

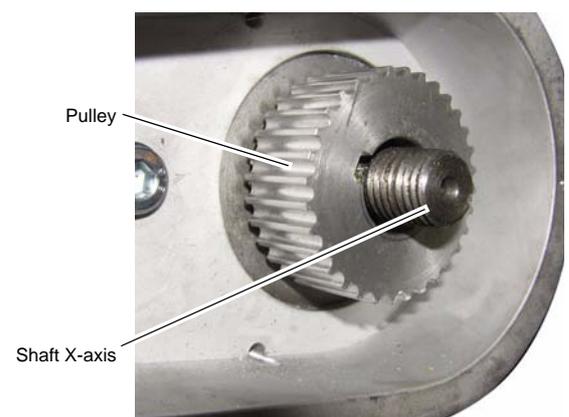


Fig.4-6: Assemble the pulley

- 4.1.8 Screw the nut on the shaft (beforehand apply some Loctite). Slightly hold on the handwheel at the right side and slightly tighten the hexagon nut using a fork wrench.

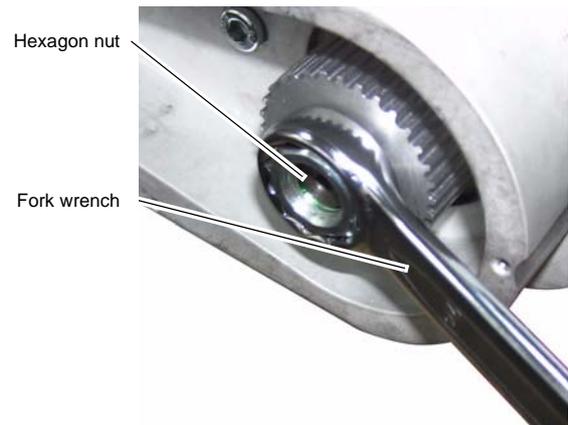


Fig.4-7: Screw the nut

- 4.1.9 Put the toothed belt (No 10) on the pulley. Determine the distance between the top edge of the housing and the top of the pulley using a caliper gauge (about 6 mm to 8 mm).

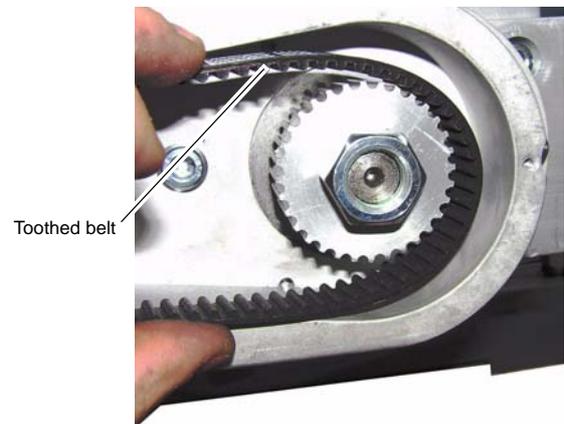


Fig.4-8: Attach the toothed belt

- 4.1.10 Mount the pulley (No 3) on the stepping motor (beforehand apply some Loctite to the motor shaft). Mount the pulley in a way that the end is aligned with the shaft of the motor. Then tighten the pulley using a head-less screw.

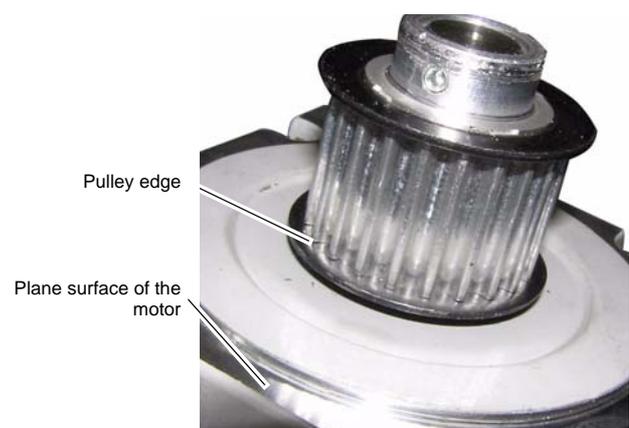


Fig.4-9: Mount the pulley of the motor

4.1.11 Attach the motor on the housing.



Fig.4-10: Attach the motor

4.1.12 Fix the motor on the housing using the four screws. It is recommended to screw the motor in a way that the outlet of the cables shows to the rear.

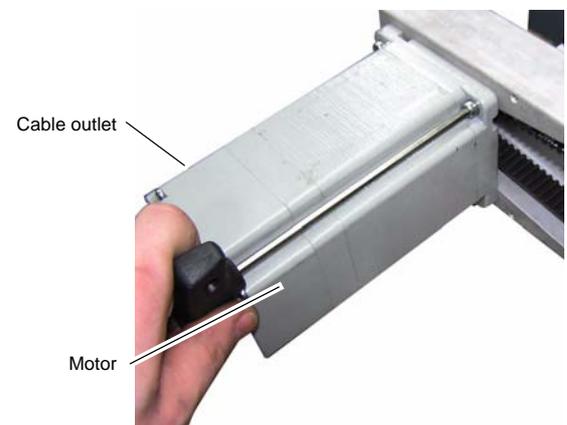


Fig.4-11: Screw the motor

4.1.13 Fix the cover (No 2) to the housing by using the four screws.

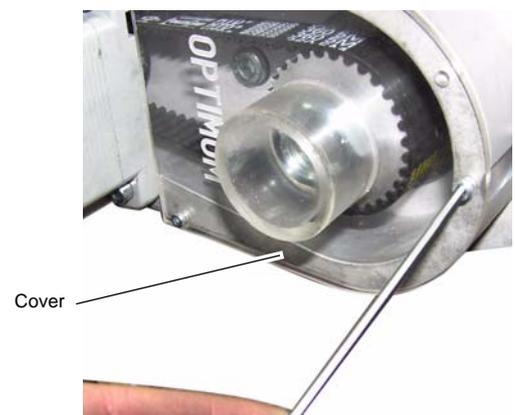


Fig.4-12: Screw the cover

- 4.1.14 Detach the right handwheel of the X-axis and plug the bushing (No 8) on the X-axis.

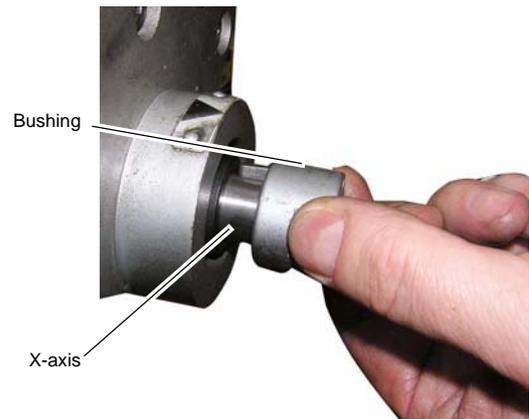


Fig.4-13: Mount the bushing

- 4.1.15 Mount the bushing (No 9) on the shaft of the X-axis and then screw the nut. In doing so, adjust the spindle clearance at the same time. To do so, you need to hold the bushing tight with the spanner flat. Fasten the nut until you determine that the spindle nut is properly closed to the flanks of the spindle thread. By minimum varying of the position of the nut, you can adjust the pretension and the thread clearance.

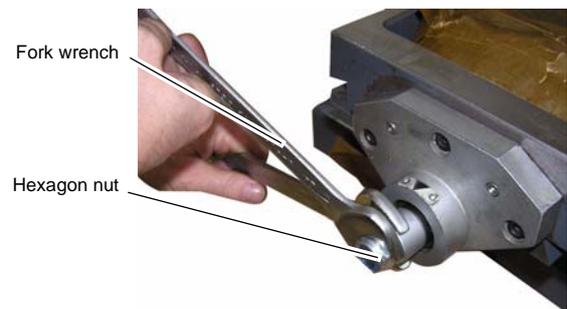


Fig.4-14: Mount the bushing

## 4.2 Assembly Y-axis

- 4.2.1 Hold the hexagon nut of the Y-axis tight with the fork wrench and detach the hexagon socket screw. Unscrew the hexagon bolt.
- 4.2.2 Remove the handwheel using a blow-back proof plastic tip hammer with slight strokes. In doing so, turn the handwheel.



Fig.4-15: Loosen the handwheel

- 4.2.3 Disassemble the cover at the rear side of the Y-axis.

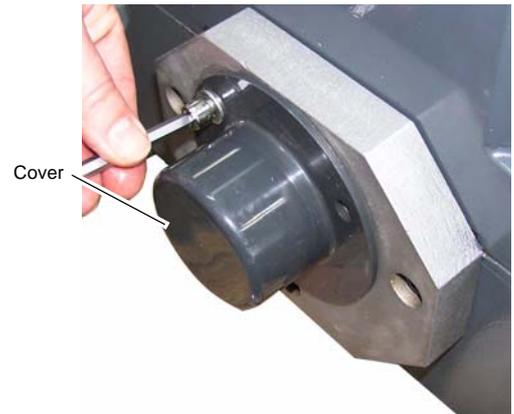


Fig.4-16: Disassemble the cover

- 4.2.4 Unscrew the three screws from the plate. Pull off the plate.

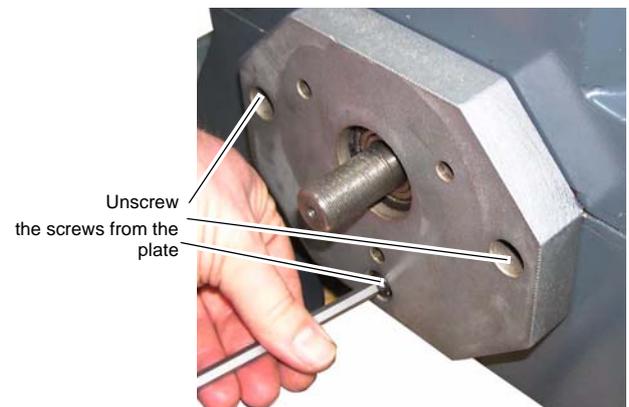


Fig.4-17: Disassemble the screws

- 4.2.5 If the fixing holes are not available, please perform the working steps described under the items 4.2.5 and 4.2.6. Put the housing of the X-axis No 1 on the plate and align it. Mark out the holes using a felt pen. Remove the housing and punch-mark the hole using a center punch.

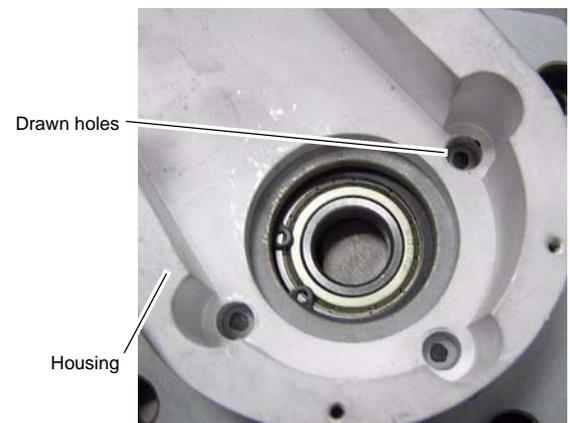


Fig.4-18: Mark out the holes

- 4.2.6 Drill the three core holes for M8 at the marked positions in the plate using an appropriate drill. Then deburr the drills using a countersink. Finally cut the thread M8 and screw the plate onto the machine.

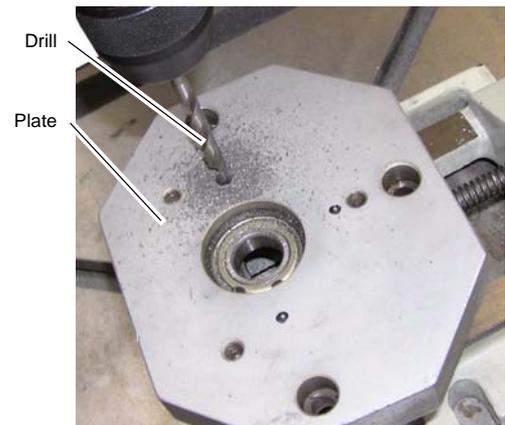


Fig.4-19: Drilling

- 4.2.7 Screw the nut (No 5) on the shaft of the Y-axis (beforehand degrease the shaft using a cleaning agent). Screw and tighten the pulley (No 4) onto the Y-axis using a shaft-securing mean.

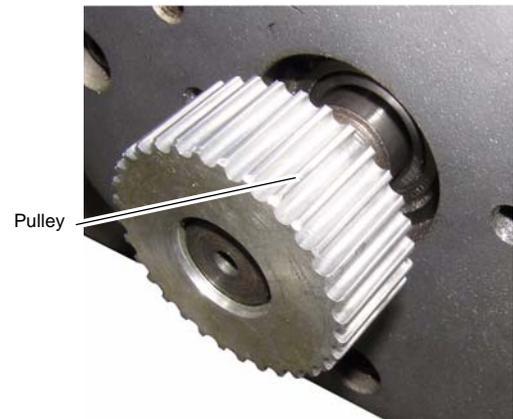


Fig.4-20: Tighten the drive pinion

- 4.2.8 Screw the housing (No 1) using the three hexagon socket screws. Determine the clearance between the housing edge and the pulley top side using a caliper gauge (about 6 mm to 8 mm).

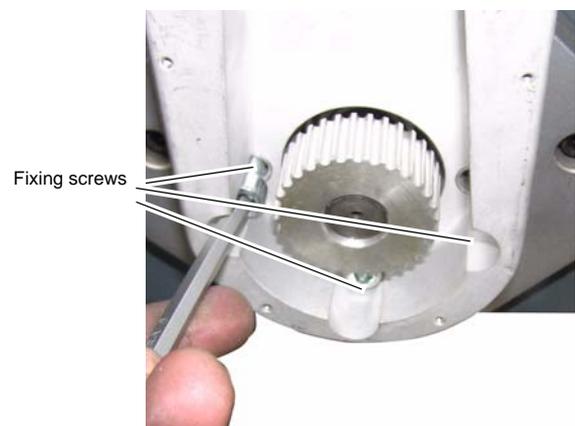


Fig.4-21: Mount the housing

- 4.2.9 Put the pulley (No 3) on the motor shaft (beforehand apply some Loctite on the motor shaft). Mount the pulley shaft aligned with the shaft end of the motor. After setting the pulley, tighten it using the headless screws.

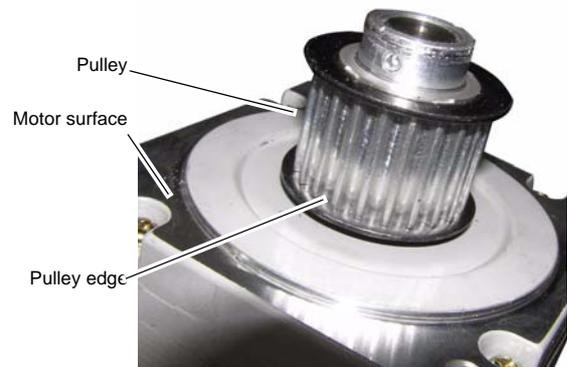


Fig.4-22: Mount the pulley

- 4.2.10 Attach the toothed belt on the toothed belt disk in the housing (as illustrated).

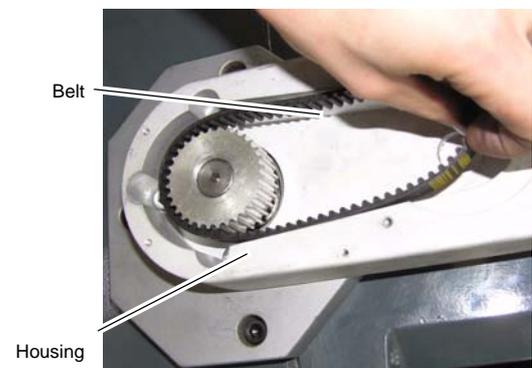


Fig.4-23: Mount the belt

- 4.2.11 Insert the motor (No 9) into the housing.

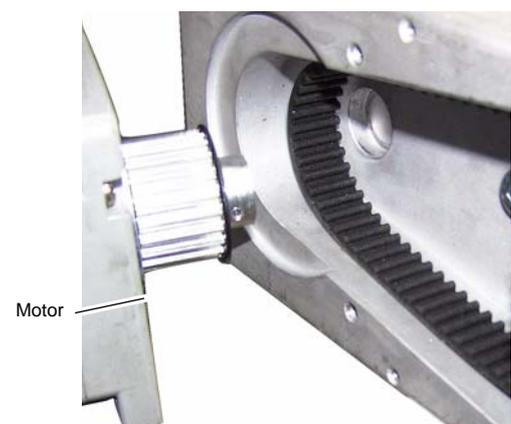


Fig.4-24: Attach the motor

- 4.2.12 Screw the step motor to the housing using the four hexagon socket screws.

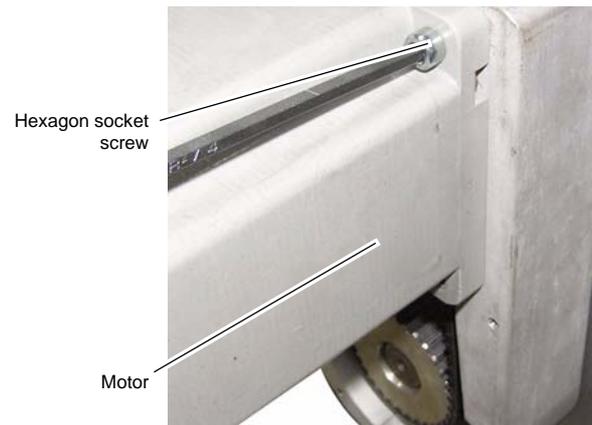


Fig.4-25: Screw the motor

- 4.2.13 Screw the lid of the housing (No 2) to the housing using the hexagon socket screws.

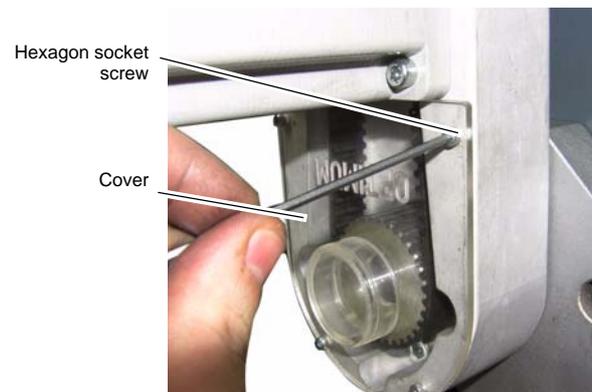


Fig.4-26: Screw the cover of the housing

- 4.2.14 Mount the bushing (No 9) on the shaft of the Y-axis and then screw the nut. In doing so, you simultaneously adjust the spindle clearance. To do so, you need to hold the bushing tight with the spanner flat. Fasten the nut until you determine if the spindle nut is properly closed to the flanks of the spindle thread. By minimum varying of the position of the nut, you can adjust the pretension and the thread clearance.

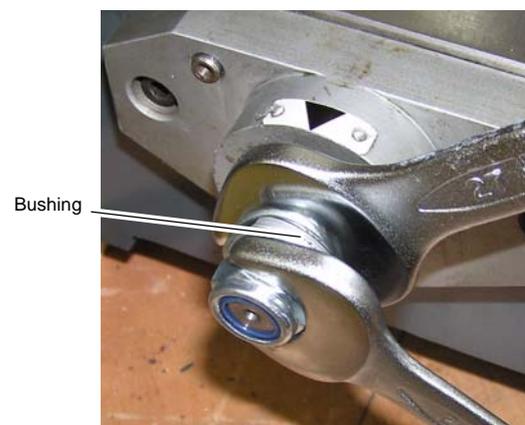


Fig.4-27: Mount the bushing.

## 4.3 Assembly Z-axis

- 4.3.1 Remove the three screws of the spindle cover of the Z-axis and take off the cover.

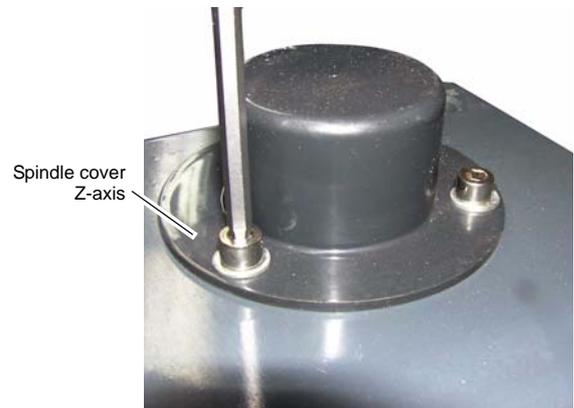


Fig.4-28: Remove spindle cover

- 4.3.2 If the holes are not yet available, please perform the working steps described under the items 3.3.2 and 3.3.3. Put the housing (No 1) on the plate of the Z-axis and mark out the holes in the same way as for the Y-axis. Remove the four hexagon socket screws of the plate and remove the plate.

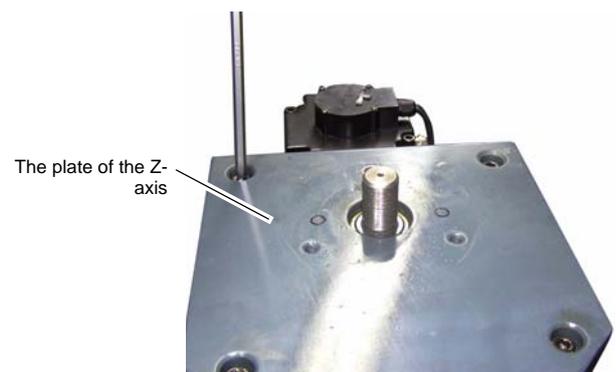


Fig.4-29: Remove the plate

- 4.3.3 Drill the three core holes for M8 into the plate at the marked out positions using an appropriate drill. Then deburr the drills using a countersink. Finally cut the thread M8 and remount the plate of the Z-axis.

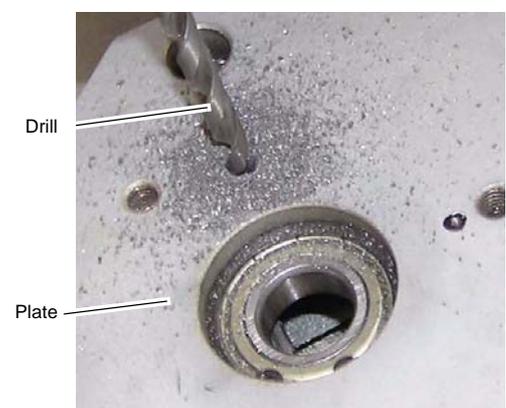


Fig.4-30: Drilling

- 4.3.4 Mount the pulley (No 4) on the shaft of the Z-axis (beforehand apply some Loctite on the motor shaft) and lock it with the nut (No 5). Determine the clearance between the edge of the housing and the top edge of the pulley using a caliper gauge (about 6 mm to 8 mm).

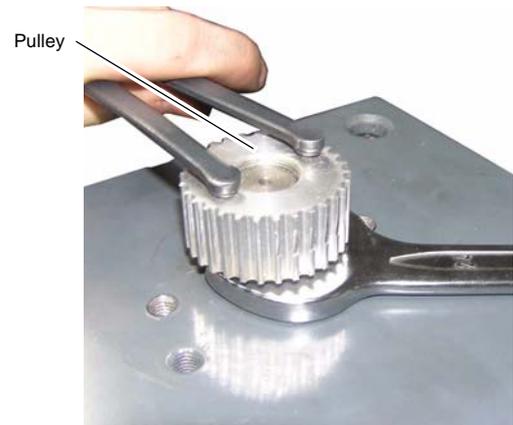


Fig.4-31: Mount shaft of the pulley

- 4.3.5 Mount the housing (No 1) using the three screws M8.

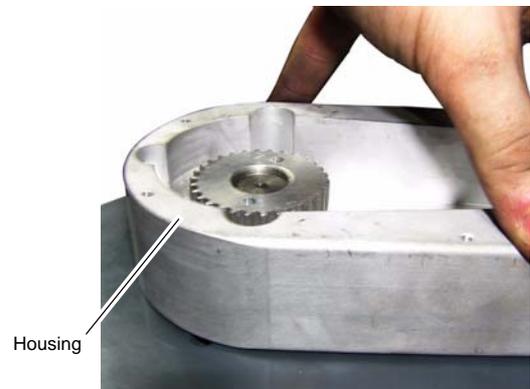


Fig.4-32: Mount the housing

- 4.3.6 Put the pulley (No 3) on the motor shaft (beforehand apply some Loctite on the motor shaft). Mount the pulley shaft aligned with the shaft end of the motor. After setting the pulley disk, tighten the headless screws.

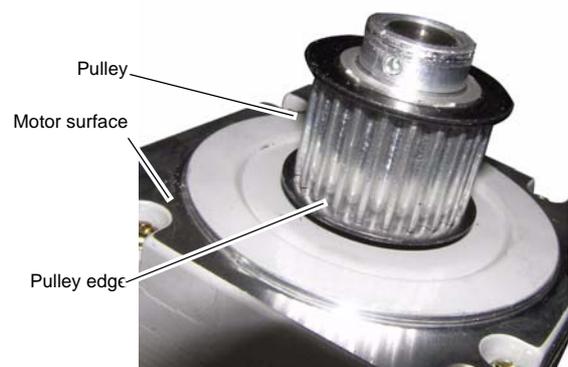


Fig.4-33: Mount the pulley

- 4.3.7 Put the belt on the pulley in the housing.

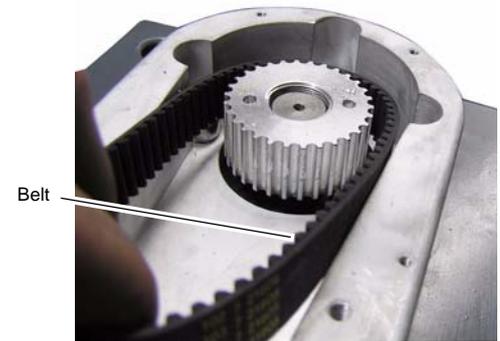


Fig.4-34: Attach the belt

- 4.3.8 Attach the motor (No 9) to the housing.

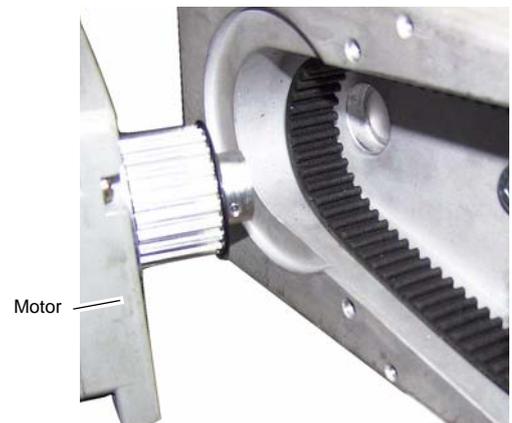


Fig.4-35: Attach the motor

- 4.3.9 Fix the motor on the housing using the four hexagon socket screws.



Fig.4-36: Screw the motor

- 4.3.10 Tighten the lid (No 2) on the housing using the four hexagon socket screws.



Fig.4-37: Mount the lid of the Z-axis

- 4.3.11 Unscrew the complete handwheel of the Z-axis and take it off .



Fig. 4-38: Remove the handwheel

- 4.3.12 There is the following option to cover the column:

You need to drill three thread holes M6 into the column in order to mount the spindle cover of the Z-axis to the column.

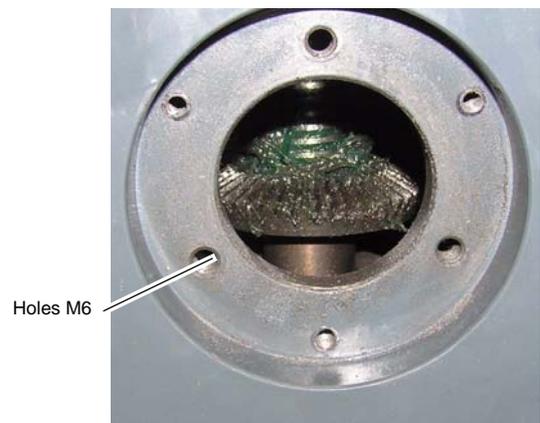


Fig.4-39: New drilling template

- 4.3.13 Dress the spindle cover of the Z-axis to the appropriate diameter and screw it to the column.

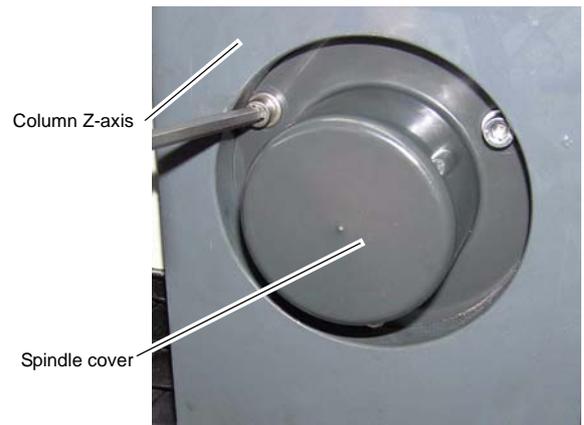


Fig.4-40: Screw on the cover

## 5 Assembly notes

### 5.1 Assembly and disassembly of ball bearing spindles



**ATTENTION!**

Please observe the following assembly and maintenance instructions. If such instructions are not obeyed, the warranty for those components will become null and void.

#### Einbau und Wartung Kugelgewindetriebe

Ball screws have to be mounted in this way that there are no radial or eccentric forces on the nut or the spindle. Ball screws are only usable for the transmission of axial forces. On the machine there have to be limit switches and stops to avoid an overtravelling of the height of lift and a damage of the unit. By mounting the nut should not be turned over the shaft ends without using a sleeve. The mounting has to be made without force. Especially heavy ball screws may not be put down on the nut. The return caps you can see on the outside should not be damaged. A disassembly of the return systems has only to be made in our company. When mounting you have to use much care that the ballscrew doesn't get dirty. With petroleum, thin oil or gasoline used for cleaning purposes you can clean chips and other dirt. Please don't use lacquer solvent - this will damage the nut. Ball screws have to be mounted exactly in this way that they run parallel to the guide way.



Generally our ball screws are delivered with a mounted nut. If a disassembling is necessary please do it as follows:

To mount the nut you need a sleeve. The outside diameter is about 0,1 – 0,2 mm smaller than the minor thread diameter. It is a bit longer than the nut. The sleeve is hold to the beginning of the thread and the nut is turned on it according to the direction of the thread. The sleeve prevents the falling out of the balls. Now the nut can be drawn from the spindle with the sleeve.

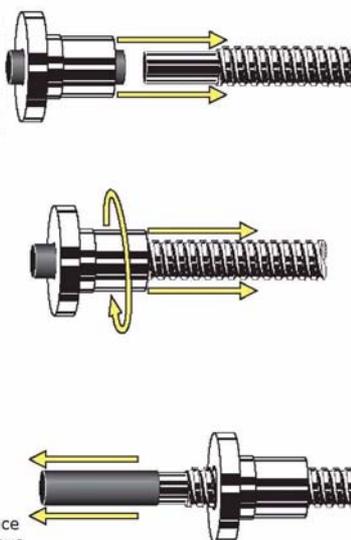
The mounting has to be made the other way round. This has to be made without force otherwise the nut will be damaged inside. The nut has to be completely on the thread before taking away the sleeve.

Damaged ball screws have to be repaired in our company.

**ATTENTION!**

- Never disassemble return systems.
- If there are balls missing – don't replace them by new balls. In this case you have to fill each middle circuit incomplete.

#### MONTAGE EINER KUGELGEWINDEMUTTER MOUNTING OF A NUT



Kugelgewindetriebe müssen so eingebaut werden, daß keine radialen oder exzentrischen Kräfte auf die Mutter oder die Spindel wirken. Kugelgewindetriebe sind nur zur Übertragung von axialen Kräften geeignet. An der Maschine sind Endschalter und Anschläge vorzusehen, um ein Überfahren des Hubweges und damit eine Beschädigung der Einheit zu vermeiden. Die Mutter darf auch bei der Montage nicht ohne Hilfsmittel (Montagehülse) über das Spindelende hinausgedreht werden. Die Montage muß kraftfrei erfolgen. Insbesondere schwere Kugelgewindetriebe dürfen nicht auf der Mutter abgelegt werden. Die von außen sichtbaren Umlenkeinheiten dürfen nicht beschädigt werden. Eine Demontage der Umlenkeinheiten darf nur im Werk erfolgen. Beim Einbau sind Verschmutzungen des Kugelgewindetriebes zu vermeiden. Späne und andere Verunreinigungen können mit Petroleum, dünnem Öl oder Waschbenzin entfernt werden. Lacklösemittel oder Kaltreiniger führen zur Beschädigung der Kugelgewindetriebe und dürfen daher nicht verwendet werden. Kugelgewindetriebe müssen zur Führung exakt fluchtend ausgerichtet werden.

Unsere Kugelgewindetriebe werden im allgemeinen mit montierter Mutter geliefert. Sollte eine Demontage dennoch erforderlich werden, bitte folgendermaßen vorgehen:

Zur Aufnahme der Mutter wird eine Montagehülse benötigt. Der Außendurchmesser der Montagehülse ist 0,1 – 0,2 mm kleiner als der Kerndurchmesser des Gewindes. Sie ist etwas länger als die Mutter. Die Montagehülse wird an den Gewindeanfang gehalten und die Mutter entsprechend der Gewinderichtung auf ihn gedreht. Die Montagehülse verhindert, daß die Kugeln aus der Mutter herausfallen. Die Mutter kann nun mit der Montagehülse von der Spindel abgezogen werden.

Die Montage erfolgt in umgekehrter Reihenfolge. Diese muß ohne Kraftaufwand erfolgen, da sonst in der Mutter Beschädigungen entstehen. Die Mutter muß sich vollständig auf dem Gewinde befinden, bevor die Montagehülse entfernt wird.

Beschädigte Kugelgewindetriebe sollten in unserem Werk repariert werden.

**ACHTUNG!**

- Umlenkungen niemals demontieren.
- Fehlende Kugeln nicht durch neue Kugeln ersetzen. Fehlen einzelne Kugeln, so ist der jeweils mittlere Gang einer Mutter unvollständig zu füllen.

## 5.2 Maintenance instruction ball bearing spindle

### Einbau und Wartung Kugelgewindetriebe

Kugelgewindetriebe sind empfindlich gegen Beschädigung und Verschmutzung. Sie müssen trocken gelagert werden. Die Spindel ist dabei so zu unterstützen, daß eine Durchbiegung nicht möglich ist. Besonders bei schweren Kugelgewindetrieben ist darauf zu achten, daß diese nicht auf der Mutter abgelegt werden.

Zur Erhaltung der Funktionsfähigkeit der Kugelgewindetriebe müssen diese ausreichend geschmiert werden. Es kommen die gleichen Schmierstoffe zum Einsatz, wie sie für Wälzlager verwendet werden. Schmierstoffe, die MoS<sub>2</sub> oder Graphit enthalten, dürfen nicht verwendet werden. Die Wahl des Schmierstoffs und die Art der Zufuhr kann in der Regel an die Schmierung der übrigen Maschinenkomponenten angepaßt werden. Eine einmalige Lebensdauerschmierung der Kugelgewindetriebe ist erfahrungsgemäß nicht ausreichend, da die Spindel ständig kleine Mengen Schmierstoff aus der Mutter austrägt.

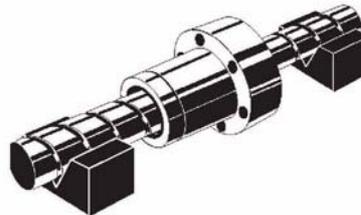
#### Fettschmierung

Wir empfehlen Fette auf Mineralölbasis in der Qualität K2K, DIN 51825. Liegen die Belastungen über 10% der dynamischen Tragzahl, sind Fette mit EP-Zusätzen (KP2K, DIN 51825) zu verwenden. Bei hohen Drehzahlen (Drehzahlkennwert  $n \cdot d > 50000$ ) ist die Qualität K1K bzw. KP1K zu wählen. Drehzahlkennwerte unter 2000 erfordern ein Fett der Konsistenzklasse 3 (K3K bzw. KP3K, DIN 51825). Die erforderliche Nachschmierfrist richtet sich nach den Umgebungsbedingungen. Im allgemeinen muß alle 200 – 600 Betriebsstunden nachgeschmiert werden. Als Richtwert für die Nachschmiermenge gilt: pro cm Spindeldurchmesser 1cm<sup>3</sup> Fett je Mutter. Es darf nur mit Fetten gleicher Verseifungsbasis nachgeschmiert werden.

#### Ölschmierung

Für die Ölschmierung eignen sich Schmieröle der Klasse CL nach DIN 51517 Teil 2. Bei der Betriebstemperatur sollte das Öl eine Viskosität von 68 bis 100 mm<sup>2</sup>/s aufweisen. Bei hohen Drehzahlen (Drehzahlkennwert  $n \cdot d > 50000$ ) sind Öle der Viskositätsklasse ISO VG 46 – 22 vorzusehen. Für Drehzahlkennwerte unter 2000 sind die Viskositäten ISO VG 150 – 460 zu verwenden. Liegt die Belastung über 10% der dynamischen Tragzahl werden Öle mit Zusätzen zur Erhöhung der Belastbarkeit (Klasse CLP, DIN 51517 Teil 3) empfohlen. Bei einer Ölbadschmierung sollte die Spindel 0,5 bis 1 mm über dem Ölspiegel liegen. Die Ölzufuhr bei einer Umlaufschmierung sollte 3 bis 8 cm<sup>3</sup>/h pro Kugelumlauf betragen.

#### LAGERHALTUNG STORAGE



Ballscrews are sensitive to dirt and damage. They have to be stored dry. You have to take care that the spindle doesn't sag. Especially by the heavy ballscrews it is important that they are not put down on the nut.

#### SCHMIERUNG LUBRICATION



In view of the life and efficiency ballscrews require adequate lubrication. You can take the same lubricants as for ball bearings. Please don't use lubricants including MoS<sub>2</sub> or graphite. Normally you can use lubricants according to the other machine components. A one-life-lubrication of ballscrews is not sufficient because there are always small quantities of lubricant put out of the nut.

#### Greasing

We recommend grease based on mineral oil with the quality K2K, DIN 51825. If the load is 10% higher than the dynamic load capacity you have to use greases with extrem pressure supplements (KP2K, DIN 51825). For high speed ( $n \cdot d > 50000$ ) we recommend the quality K1K or KP1K. A  $n \cdot d$  value under 2000 needs a grease of the consistency class 3 (K3K or KP3K, DIN 51825). The necessary time of another lubrication depends on the ambient conditions. Generally it is necessary to lubricate all 200 – 600 running hours. The determining factor for relubrication is: per each centimeter of spindle diameter 1cm<sup>3</sup> grease each nut. You may not use greases of different saponifications.

#### Oiling

For the oiling lubricating oils of class CL according to DIN 51517 part 2 are suitable. At the operating temperature the oil should have a viscosity of 68 to 100 mm<sup>2</sup>/s. For high speed ( $n \cdot d > 50000$ ) we recommend oils of the viscosity class ISO VG 46 – 22. For  $n \cdot d$  value under 2000 you have to use the viscosities ISO VG 150 – 460. If the load is more than 10% higher than the dynamic load capacity we recommend oils with supplements for increasing the loading capacity (class CLP, DIN 51517 part 3). When making an oil bath lubrication the spindle should be hold 0.5 to 1 mm over the oil level. The oil feed for a circulation system lubrication should be 3 to 8 cm<sup>3</sup>/h each ball turn.

## 6 Assembly ball bearing spindles

### Ball bearing spindles

#### 6.1 Disassembly of all axes

6.1.1 Disassemble the chuck protection and the handle at the head.

6.1.2 Lift the head from the head carrier using an appropriate lifting gear.

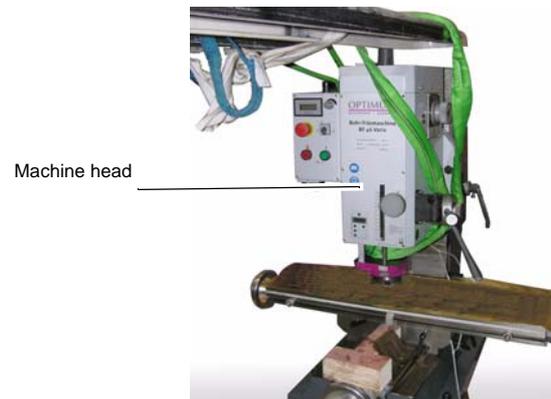


Fig.6-1: BF46

6.1.3 Disassemble the crank of the Z-axis.

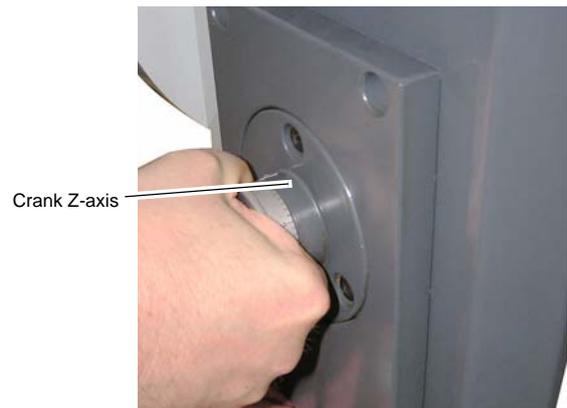


Fig.6-2: Remove the crank

6.1.4 Disassemble clamping levers of the three carriages. Please keep the brass inserts which you remove from the holes at a safe place.



Fig.6-3: Unscrew the clamping lever

6.1.5 Disassemble the cover of the Z-axis.

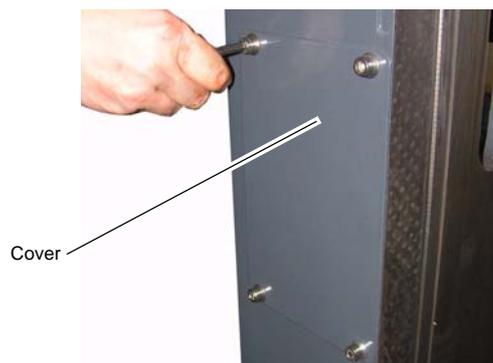


Fig.6-4: Unscrew the lid

6.1.6 Unscrew the fixing screws of the spindle block at the head carrier.

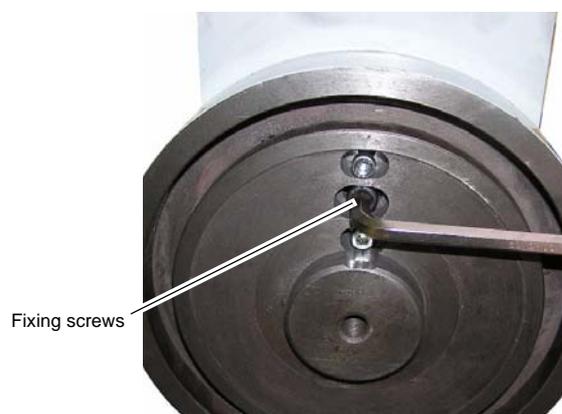


Fig.6-5: Head carrier

6.1.7 Unscrew and screw out the two groove nuts of the Z-axis bearing. Then unscrew the bearing plate of the Z-spindle and finally pull out the spindle from the column.

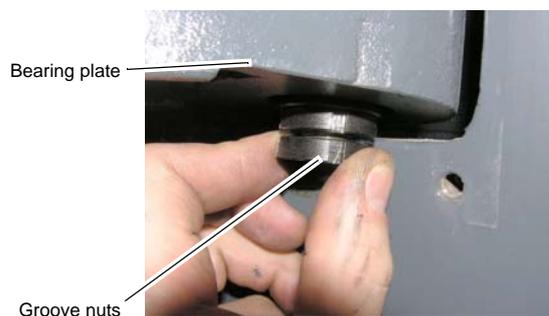


Fig.6-6: Unscrew the groove nuts

- 6.1.8 Unscrew the cover of the Z-column.  
Then remove the V-ledge of the Z-axis.



Fig.6-7: Loosen the cover

- 6.1.9 Shift the head carrier from the column to the top and take it off.

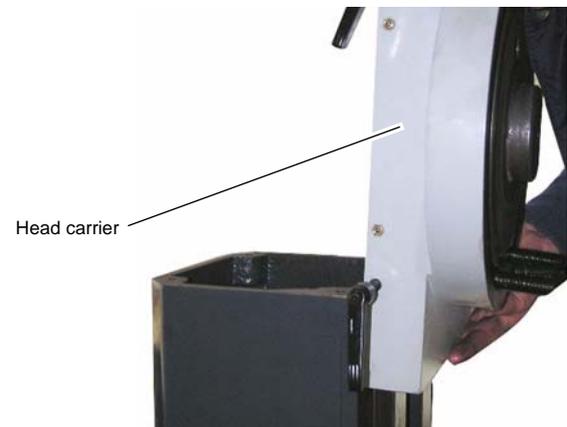


Fig.6-8: Remove the head carrier

- 6.1.10 Disassemble rubber cover on the Y-axis.



Fig.6-9: Disassemble the rubber cover

- 6.1.11 Unscrew the stopper in the center and at the left and right ruler stopper on the table.



Fig.6-10: Disassemble stopper

- 6.1.12 Remove the handwheels of the X- or Y-axis handwheel.

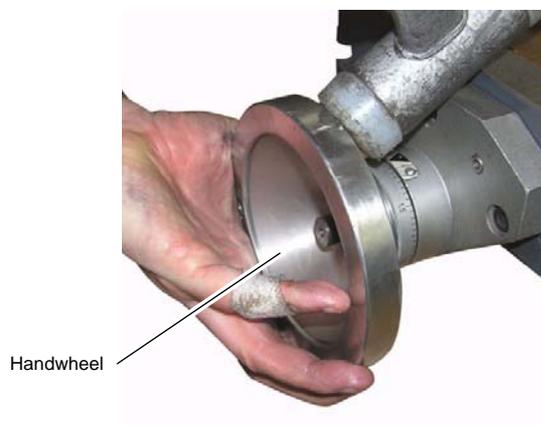


Fig.6-11: Remove the handwheel

- 6.1.13 Remove the feather key from the shaft and store the distance rings together with the corresponding axes at a safe place.

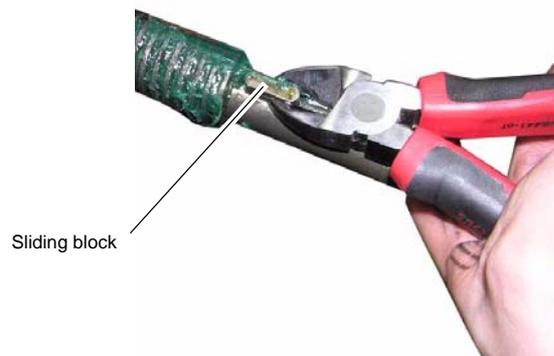


Fig.6-12: Feather key

- 6.1.14 Disassemble the bearing lid of the X- and Z-axis. Also remove the V-ledges of the X- and Y-axis.



Fig.6-13: Take off the bearing lid

- 6.1.15 Take off the table of the X-axis from the Y-carriage.

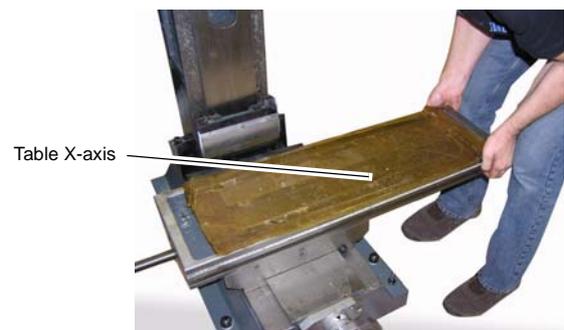


Fig.6-14: Take off the table

- 6.1.16 Disassemble the spindle of the X-axis with the bearing block.



Fig.6-15: Remove the spindle

6.1.17 Loosen the nut holder of the Y-axis.

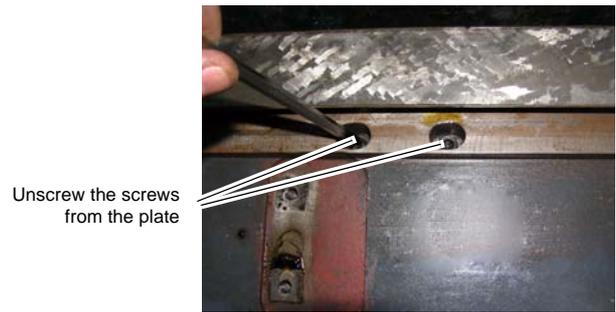


Fig.6-16: Remove the screws for the holder

6.1.18 Take off the carriage of the Y-axis.



Fig.6-17: Take off the carriage

6.1.19 Unscrew the spindle of the Y-axis from the nut holder.

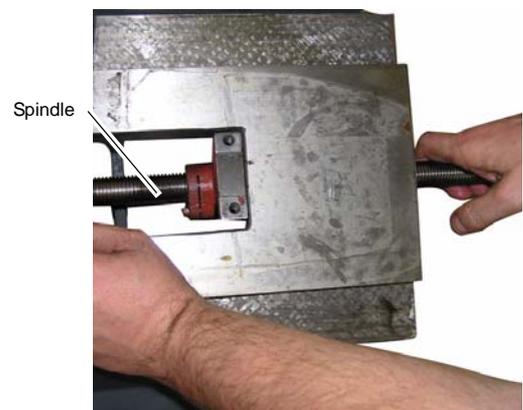


Fig.6-18: Take off the spindle

6.1.20 Completely clean the machine.

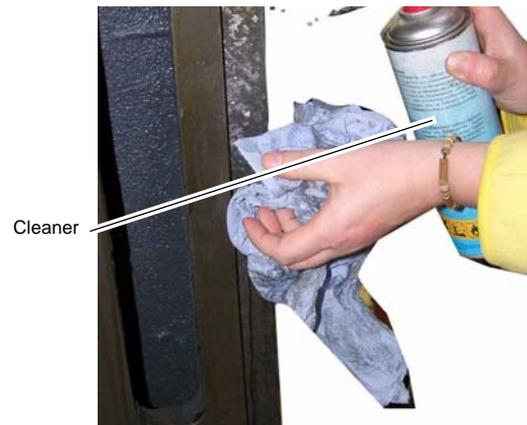


Fig.6-19: Clean the machine

## 6.2 Assembly on the X- and Y-axis

6.2.1 Disassemble the nut of the Y-axis.



Fig.6-20: Disassemble the nut

6.2.2 Assemble the spindle on the Y-axis. Please make sure that you always generate a counterpressure on the assembly bushing. In case of improper handling, the spindle nut might get damaged.

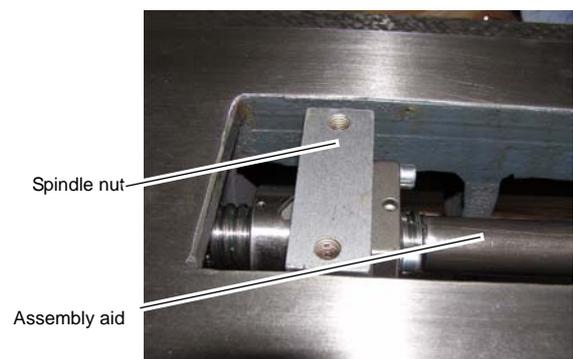


Fig.6-21: Assemble the nut

- 6.2.3 Check the assembly surface at the bottom of the Y-axis carriage. The surface has to be free from color remnants.

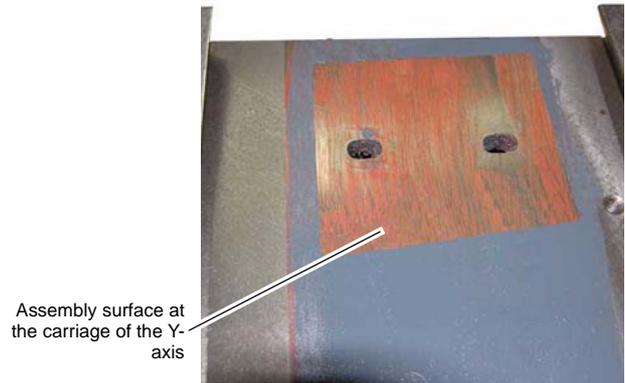


Fig.6-22: Remove color

- 6.2.4 Slide the carriage of the Y-axis on the guide rail. Then assemble the V-ledge and adjust it.



Fig.6-23: Assemble the carriage

- 6.2.5 Slightly turn in the two fixing screws of the Y-axis nut block, but do not yet tighten them.

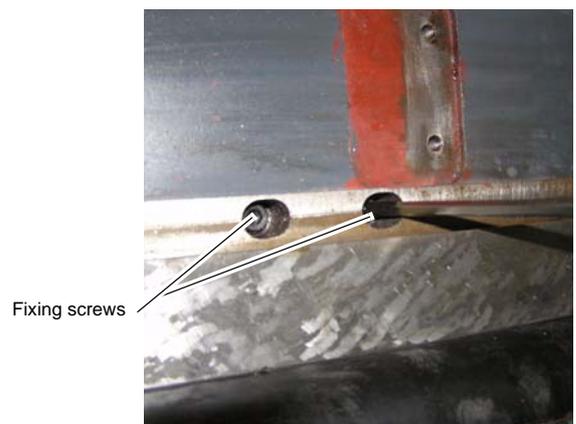


Fig.6-24: Turn in the screws

- 6.2.6 Assemble the bearing plate of the Y-axis.



Fig.6-25: Screw on the bearing plate

- 6.2.7 Assemble the distance ring and the feather key of the Y-axis. Then drive the carriage as far as possible in direction of the column and then completely tighten the nut holder for the spindle.

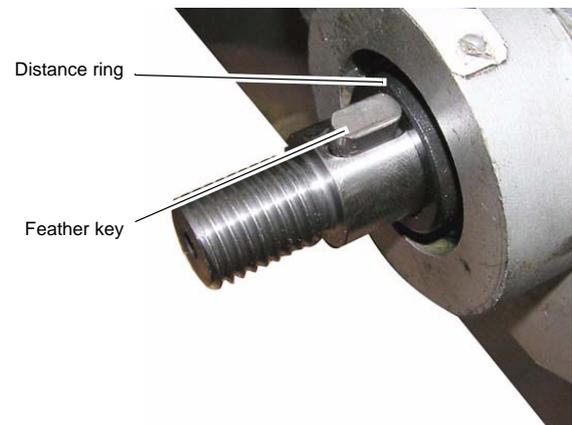


Fig.6-26: Insert the feather key

- 6.2.8 Assemble the bearing plate of the Y-axis. Please check, if the holes which you need to fasten the CNC housing are drilled in the lid. If necessary, drill the holes before performing the installation.

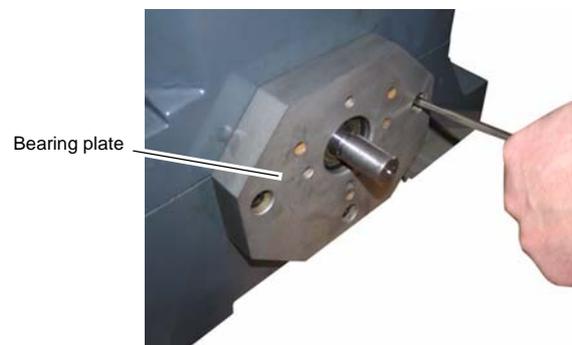


Fig.6-27: Tighten the bearing plate

- 6.2.9 Assemble the distance bushings on the spindle and adjust the bearing clearance using the nut.

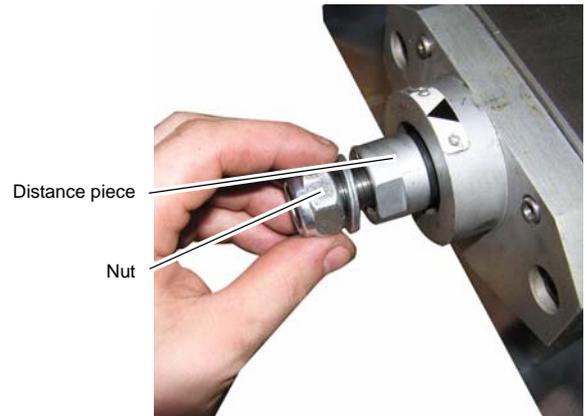


Fig.6-28: Adjust the clearance of the bearing

- 6.2.10 Assemble the nut holder of the X-axis. In doing so, do not yet completely tighten the screws, so that you can still move the spindle a little. Please make sure that you correctly build in the spindle. The shaft carrier is located at the right side of the shaft when you are positioned in front of the machine.

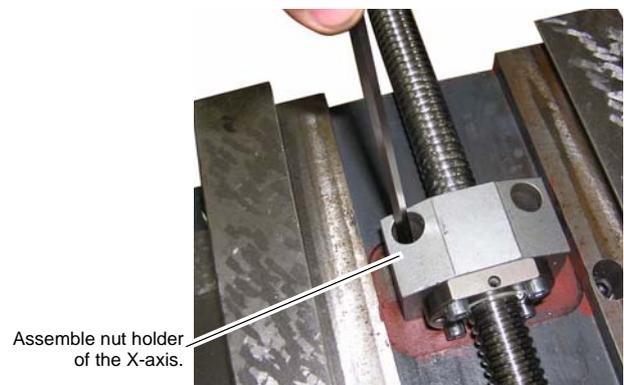


Fig.6-29: Assemble the spindle

- 6.2.11 Shift the table of the X-axis on the guide rails and insert the V-ledge. In doing so, first put on the bearing block and align the spindle in its correct orientation in this way. Then drag the table once again laterally and completely tighten the nut holder.

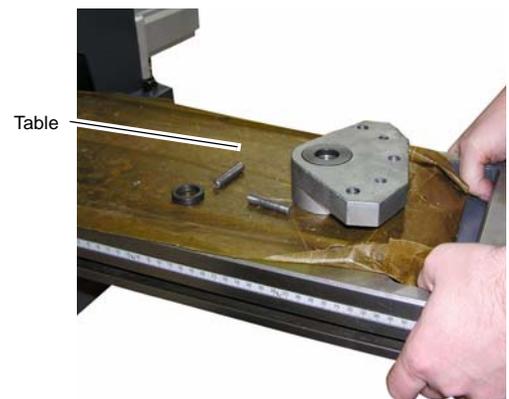


Fig.6-30: Mount the table

- 6.2.12 Assemble the two bearing plates of the X-axis and readjust the V-ledge once again.

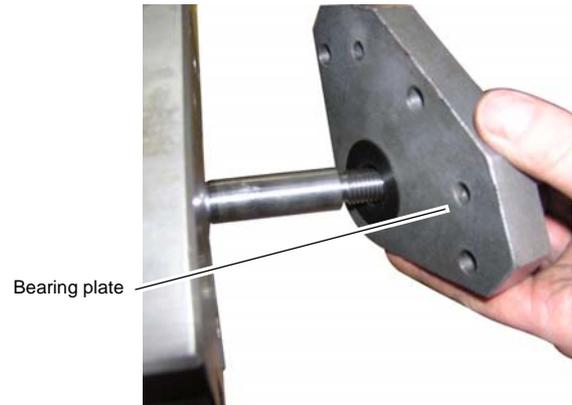


Fig.6-31: Put on the bearing plate

- 6.2.13 Mount the distance ring on the right side of the X-axis using the feather key and the distance bushings and adjust the clearance by turning the nut.

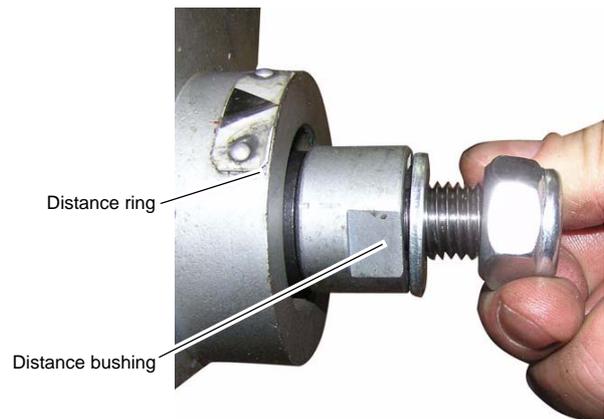


Fig.6-32: Adjust the spindle

### 6.3 Assembly on the Z-axis

- 6.3.1 Mount the spindle holder for the Z-spindle. In doing so, drill the holes to fix the nut, if necessary. The nut has to be assembled in a way that the collar is at the bottom side when it is built in.

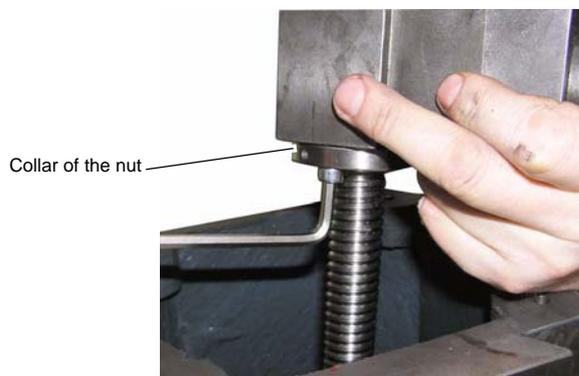


Fig.6-33: Mount the nut

- 6.3.2 Disassemble the miter wheel and the feather key from the original spindle and mount it onto the new spindle.



Fig.6-34: Mount the miter wheel

- 6.3.3 Put the distance ring into the holder of the Z-axis.

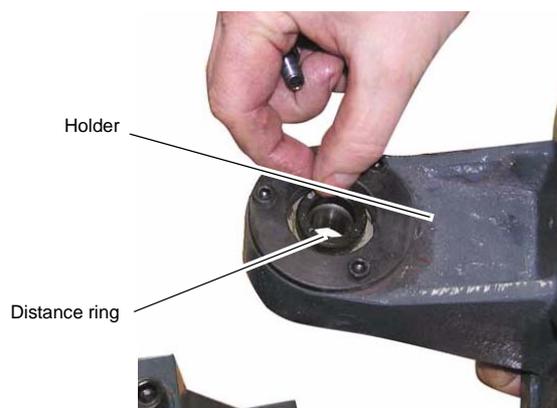


Fig.6-35: Put in the distance ring

- 6.3.4 Insert the spindle with the holder into the column from the top. Then put the spindle into the column.

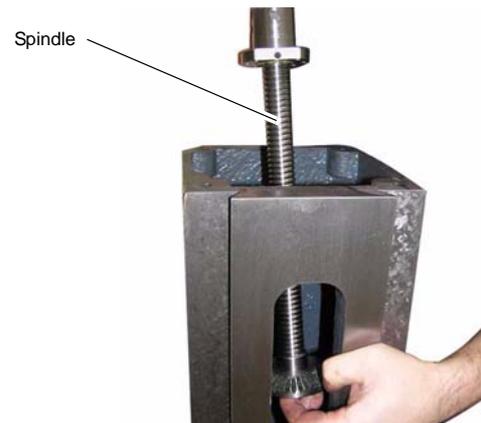


Fig.6-36: Insert the spindle

- 6.3.5 Mount the head carrier, build in the V-ledges and clamp the carrier to the Z-axis using the clamping lever.



Fig.6-37: Mount the housing

- 6.3.6 Insert the spindle into the bearing plate and fix them using the two groove nuts. Insert the Z-axis holder into the head carrier. As soon as you have performed those tasks, screw the bearing plate onto the column.

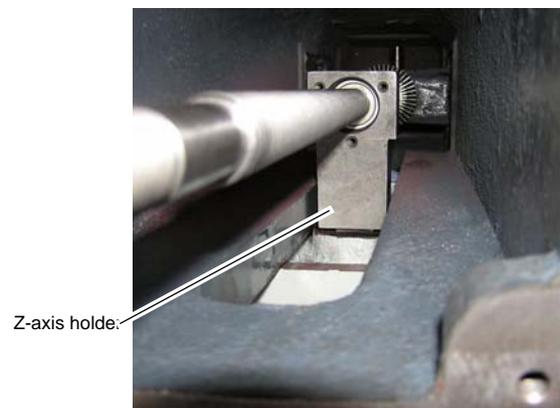


Fig.6-38: Mount holder

- 6.3.7 Screw the head carrier to the Z-axes holder.

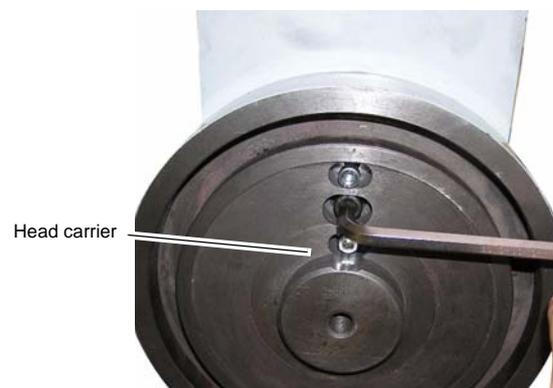


Fig. 6-39: Mount head carrier

- 6.3.8 Put the bearing plate on the column and tighten the screws.

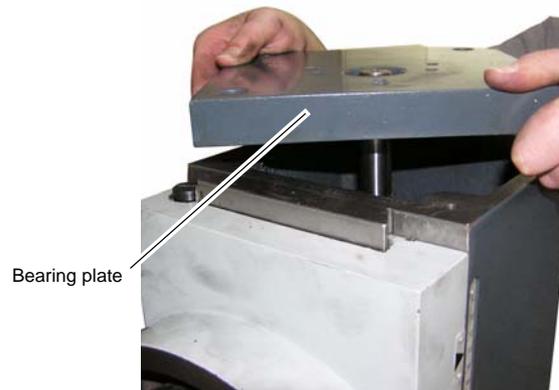


Fig. 6-40: Mount the bearing plate

## 7 Installation of step motors

### 7.1 Wiring X-, Y- and Z-axis

7.1.1 Open the lid of the step motor using a crosstip screwdriver.

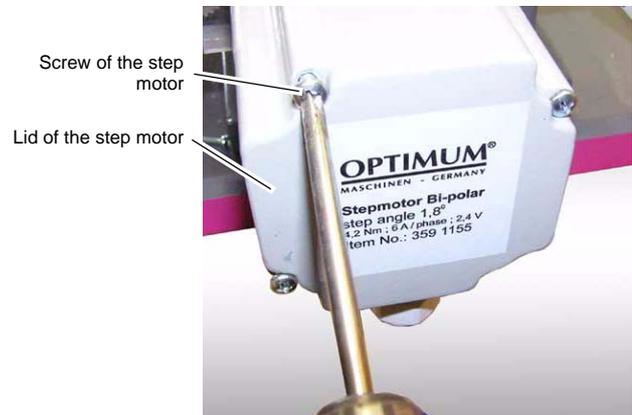


Fig.7-1: Open the lid of the step motor

7.1.2 Remove the outer isolation of the cable and make sure that you do not damage the lower isolation of the single conductor.

7.1.3 The stripped part should have a length of about 6 cm.

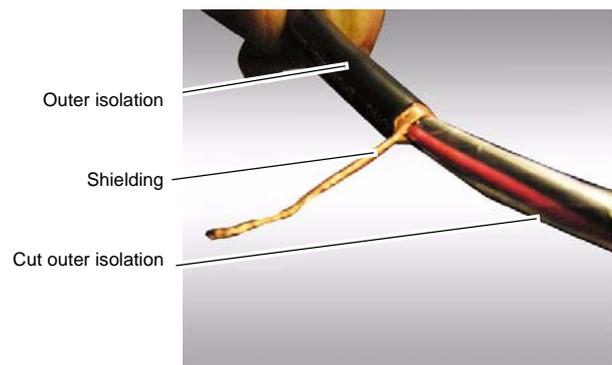


Fig.7-2: Remove the outer isolation



#### INFORMATION!

The shielding is connected on both sides to the strip terminal of the motor and to the controller.

- 7.1.4 Peel off the cables at a length of about 5 mm using insulation stripping tongs.
- 7.1.5 Plug and press wire terminations on the ends of the cables.
- 7.1.6 Plug the strain relief over the cable.
- 7.1.7 Insert the cable through the opening of the cover plate of the step motor.
- 7.1.8 Connect the cable to the motor and tighten the strain relief.
- 7.1.9 The twisted shielding goes with the clamping "GND".

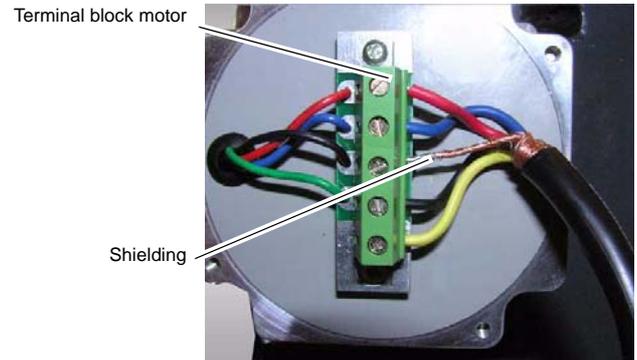


Fig.7-3: Terminal block of the motor

- 7.1.10 Fasten the lid of the step motor using a crosstip screwdriver.
- 7.1.11 Then cut the cable to the length which is required in order to connect it to the CNC controller.



Fig.7-4: Screw the lid

- 7.1.12 Connect the cable on the plug according to the following configuration plan.

Motor		Plug
A-	to	A-
A+	to	A+
B-	to	B-
B+	to	B+
GND	to	GND

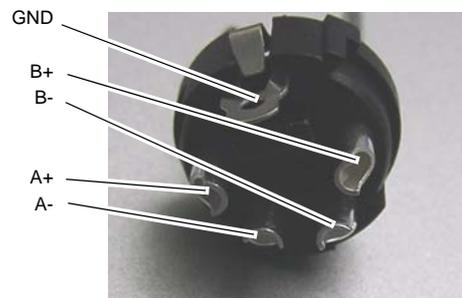


Fig.7-5: Terminal block plug

## 7.2 Plug assembly for X-, Y- and Z-axis

7.2.1 Remove about 3cm of the isolation at the other end of the motor cable. Twist the shielding to a connectable conductor bunch.

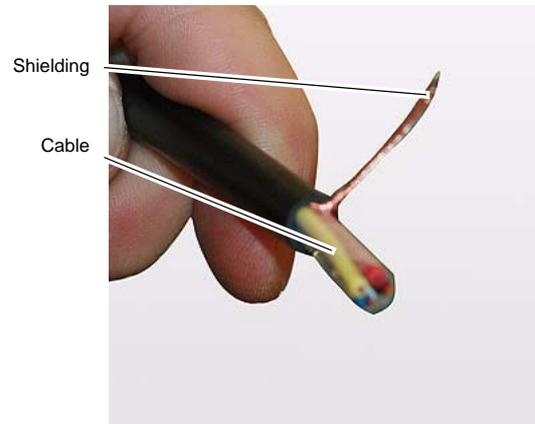


Fig.7-6: Open the lif of the step motor

7.2.2 Remove about 5mm of the isolation from the lead tips and tin the cables using a soldering iron. Slide the black screwing together with the black cable fixing over the cable.

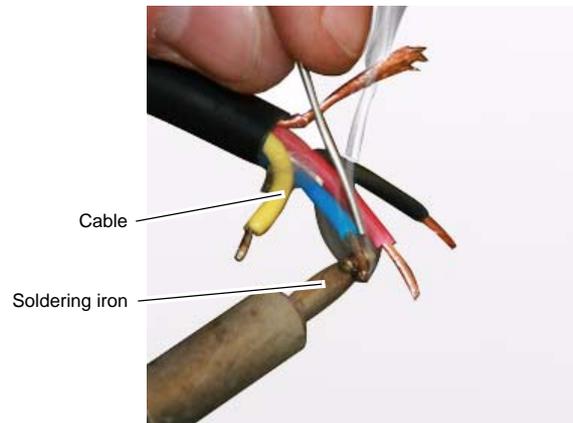


Fig.7-7: Remove outer isolation

7.2.3 Solder the cables on the plug according to the illustration shown under item 1.1.12.

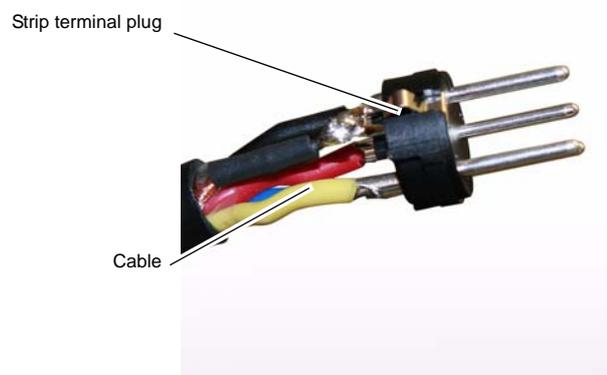


Fig.7-8: Strip terminal step motor

- 7.2.4 Slide the plug together with the table clamping from the rear into the housing. Beforehand slide the color marking over the cable.



Fig.7-9: Unscrew the lid

- 7.2.5 Connect the plug housing with the screwing.

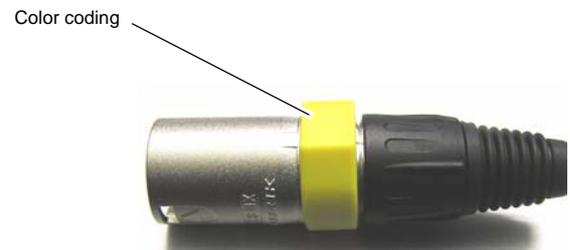
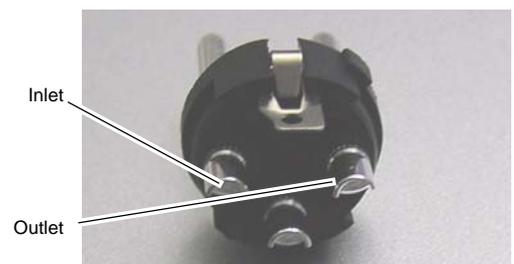


Fig.7-10: Unscrew the lid

- 7.2.6 The three-pole plug serves as an emergency-stop connector. If necessary, you can connect the emergency-stop switch using this plug. Otherwise you need to build a bridge into the plug in order to be able to operate the controller without using the emergency-stop.



## 8 Appendix

### 8.1 Copyright

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The company reserves the right to make technical alternations without prior notice.

### 8.2 Terminology/Glossary

Term	Explanation
Adapter kit	Components
Blow-back proof plastic tip hammer	A plastic tip hammer which is filled with sand which does prevent a spring-back when knocking.
Disassembly	Remove, relieve

### 8.3 Liability claims for defects / warranty

Beside the legal liability claims for defects of the customer towards the seller the manufacturer of the product, OPTIMUM GmbH, Robert-Pfleger-Straße 26, D-96103 Hallstadt, does not grant any further warranties unless they are listed below or had been promised in the frame of a single contractual agreement.

- The processing of the liability claims or of the warranty is performed as chosen by OPTIMUM GmbH either directly or through one of its dealers. Any defective products or components of such products will either be repaired or replaced by components which are free from defects. The property of replaced products or components passes on to OPTIMUM GmbH.
- The automatically generated original proof of purchase which shows the date of purchase, the type of machine and the serial number, if applicable, is the precondition in order to assert liability or warranty claims. If the original proof of purchase is not presented, we are not able to perform any services.
- Defects resulting of the following circumstances are excluded from liability and warranty claims:
  - Using the product beyond the technical options and proper use, in particular due to overstraining of the machine
  - Any defects arising by one's own fault due to faulty operations or if the operating manual is disregarded
  - Inattentive or incorrect handling and use of improper equipment
  - Non-authorized modifications and repairs
  - Insufficient installation and safeguarding of the machine
  - Disregarding the installation requirements and conditions of use
  - Atmospheric discharges, overvoltage and lightning strokes as well as chemical influences
- The following items are as well not subject to the liability or warranty claims:
  - Wearing parts and components which are subject to a standard wear as intended such as e.g. V-belts, ball bearings, illuminants, filters, sealings, etc.
  - Non reproducible software errors
- Any services which OPTIMUM GmbH or one of its agents performs in order to fulfill in the frame of an additional guarantee are neither an acceptance of the defects nor an acceptance of its obligation to compensate. Such services do neither delay nor interrupt the warranty period.
- Place of jurisdiction among traders is Bamberg.
- If one of the above mentioned agreements is totally or partially inefficient and/or null, it is considered as agreed what is closest to the will of the warrantor and which remains in the framework of the limits of liability and warranty which are predefined by this contract.

### 8.4 Disposal



Disposal of used electric and electronic machines

(Applicable in the countries of the European Union and other European countries with a separate collecting system for those devices).

The sign on the product or on its packing indicates that the product must not be handled as common household waste, but that it needs to be delivered to a central collection point for recycling. Your contribution to the correct disposal of this product will protect the environment and the health of your fellow men. The environment and the health are endangered by incorrect disposal. Recycling of material will help to reduce the consumption of raw materials. Your District Office, the municipal waste collection station or the shop where you have bought the product will inform you about the recycling of this product.



# Mounting examples

Version 1.0

## Universal reference switch kit



## 1 Packing list

<b>Bezeichnung</b> <i>Designation</i>	<b>CNC reference switch with universal mounting parts</b>
<b>Artikelnummer Anbausatz</b> <i>Item no. mounting set</i>	357 1980
<b>Netto Gewicht</b> <i>Net Weight</i>	0,7 kg
<b>Brutto Gewicht</b> <i>Gross Weight</i>	0,6 kg
<b>Abmessung (L x B x H)</b> <i>Dimension (L x W x H)</i>	320 x 285 x 80 mm

<b>Nr.</b> <i>No</i>	<b>Bezeichnung</b> <i>Description</i>	<b>Artikelnummer</b> <i>Article no.</i>	<b>Teile Nr.</b> <i>Part no.</i>	<b>Grösse</b> <i>Size</i>	<b>Abbildung</b> <i>Picture</i>	<b>Stck.</b> <i>Qty.</i>
1	<b>Sensorhalter X-Achse</b> <i>Sensor Holder X-Axis</i>	0 357 1980 01	Ref-01			1
2	<b>Sensorhalter Y und Z-Achse</b> <i>Sensor Holder Y and Z axis</i>	0 357 1980 02	Ref-02			3
3	<b>Unterlegteil Z-Achse</b> <i>Distance part Z axis</i>	0 357 1980 03	Ref-03			3
4	<b>Klotz für Z-Achse</b> <i>Part for Z axis</i>	0 357 1980 04	Ref-04			3
5	<b>Referenzschalter</b> <i>Ref. Switch</i>	0 357 1980 05	Ref-05			1

<b>Prüfer:</b> <i>Verified by:</i>		<b>Datum:</b> <i>Date:</i>	
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## 2 Mounting examples reference switch BF30 Vario/ BF46 Vario



Y-axis



X-axis



Z-axis



## START-UP MANUAL FOR SOFTWARE NCdrive AT USE OF OPTIMUM CNC-CONTROLLER III / VI / IV

### 0.1 Software installation

The CNC-control-software NCdrive can be used for running e.g. of BF 20 Vario milling machine, either as stand-alone solution or as sub-instance of the CAD/CAM-software MegaNC.

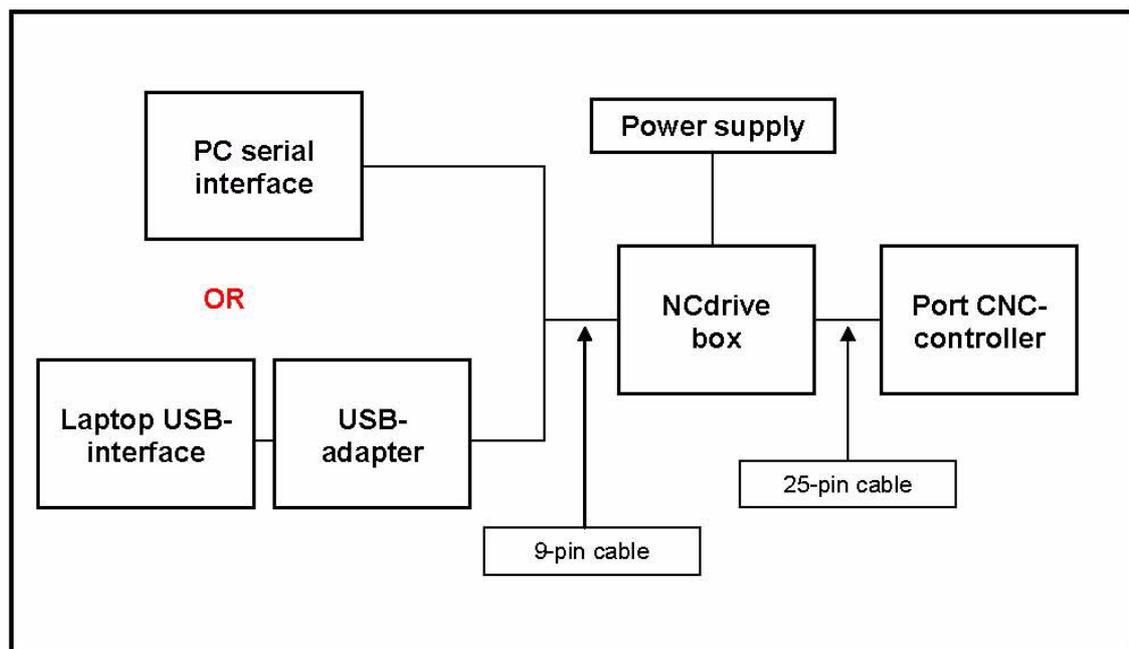
Our NCdrive package (art.-no. 358 2110) contains of the core program NCdrive, the additional simulation software NClyzer light as well as the NCdrive hardware box incl. power supply unit and connection cable. The software NCdrive requires no separate licensing procedure because for running the machine the included hardware box is necessary imperatively.

Please use the form included in delivery for licensing of the additional simulation software NClyzer only. If you do not licence it, this software part will expire after a period of thirty days.

As operating system for both variants are recommended Windows 2000 or Windows XP. NCdrive in current version is not tested for Windows Vista.

For the installation of software please obey the corresponding advices of the installation routines at the software installation CD-ROM.

### 0.2 Connection of hardware



## Description of hardware components:



Input port

CNC-Controller III



Input port

Reference switch connector

CNC-Controller VI



Input port

Reference switch connector

CNC-Controller IV



NCdrive box



Power supply unit



USB-adaptor



Cable 9 / 25-pin

For connection of the PC with the CNC-Controller please note the connection scheme shown above at page 1. At right side of scheme is shown the 25-pin cable which is included in delivery of the CNC-Controller. This is interlinked between the input port of the CNC-Controller and the 25-pin connector at the NCdrive box front side. At rear side of NCdrive box is connected the power supply unit as well as at the 9-pin connector the included serial connection cable.

The 9-pin connection cable will be interlinked directly with the serial interface of the PC (if available). Modern computers, especially laptops, are often not equipped with a serial interface anymore. In this case has to be used an USB-adapter additionally, as shown at lower left area of connection scheme.

**ATTENTION:**

**We highly recommend to use in this case the USB-Adapter RS232 (art.-no. 357 1969) originally offered from Optimum. This adapter guarantees a continuous data transfer flow. A lot of different adapter types are sending data in bundled packages. This can result in malfunctions at running of the machine.**

### 0.3 Configuration of PC interface

If NCdrive is connected directly to the serial interface of PC please start the sub-menu with the extended settings of the interfaces at the Windows system setting menu. According to motherboard version at some computers can be changed the setting of the "Latency Timer" in this menu. Please check this in section "Advanced Settings". The timer should be set to 1 msec as shown at following example (Picture 1).

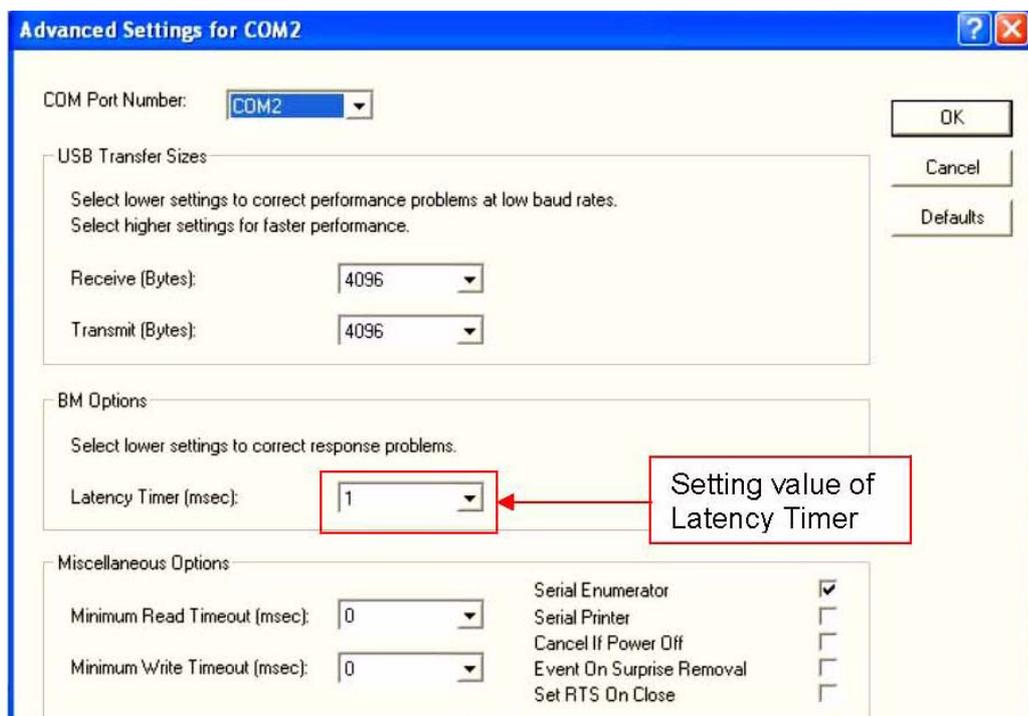


Abb.0-1: Konfiguration der Anschlüsse

If NCdrive is connected to an USB port of PC by use of the USB-adapter, Windows will request the installation of a corresponding driver file for the USB-adapter. It is highly recommended that you do not use the driver included in delivery of the adapter at this case. Please install instead only the optimised driver file which is included in your NCdrive installation folder, sub-folder "USB-driver". After re-start of the computer the interface which is connected with NCdrive box should be assigned as shown in following picture (Picture 2). The number of interface (COMx) can be variable at different computers.

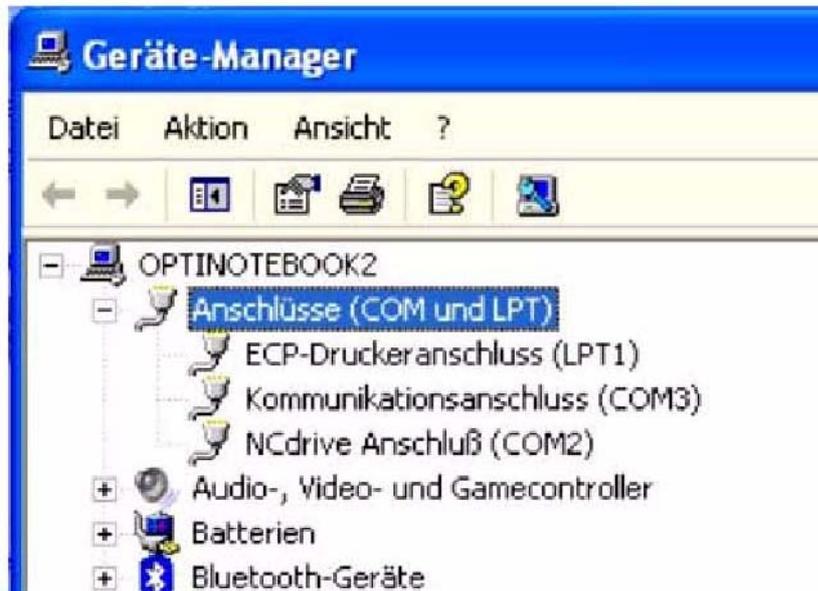


Abb.0-2: Devicemanager

Please check again the setting of "Latency Timer" (as described above) after installation of the USB-driver.

Finally you can check the firmware of the NCdrive box. Please obey for this the routine described at chapter 9 of NCdrive manual. The corresponding firmware is named "NCdrive.bin".

## 0.4 Configuration of machine parameters

Please start the program NCdrive either directly through Windows or out of software MegaNC. After start-up the screen looks as follows (Picture 3).

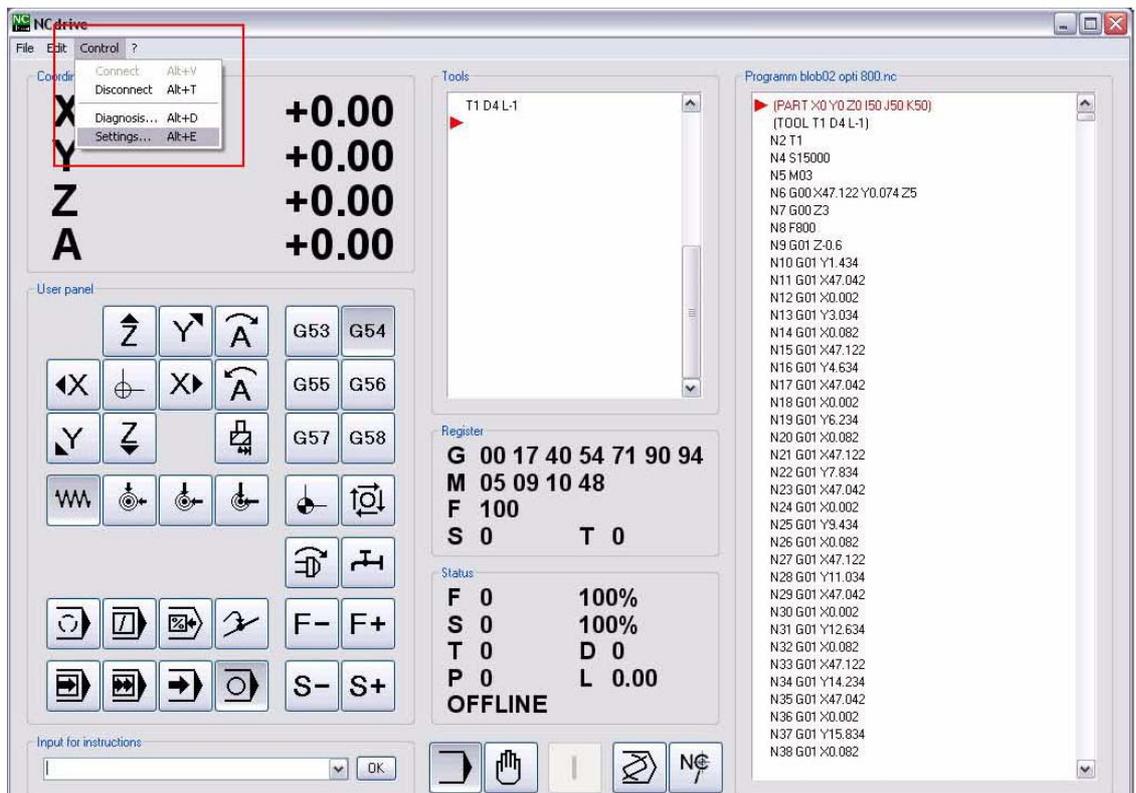


Abb.0-3: Configuration of machine parameters

The necessary adjustments for the start-up of the milling machine can be done in the menu "Control", sub-menu "Settings" (please note marking in Picture 3).

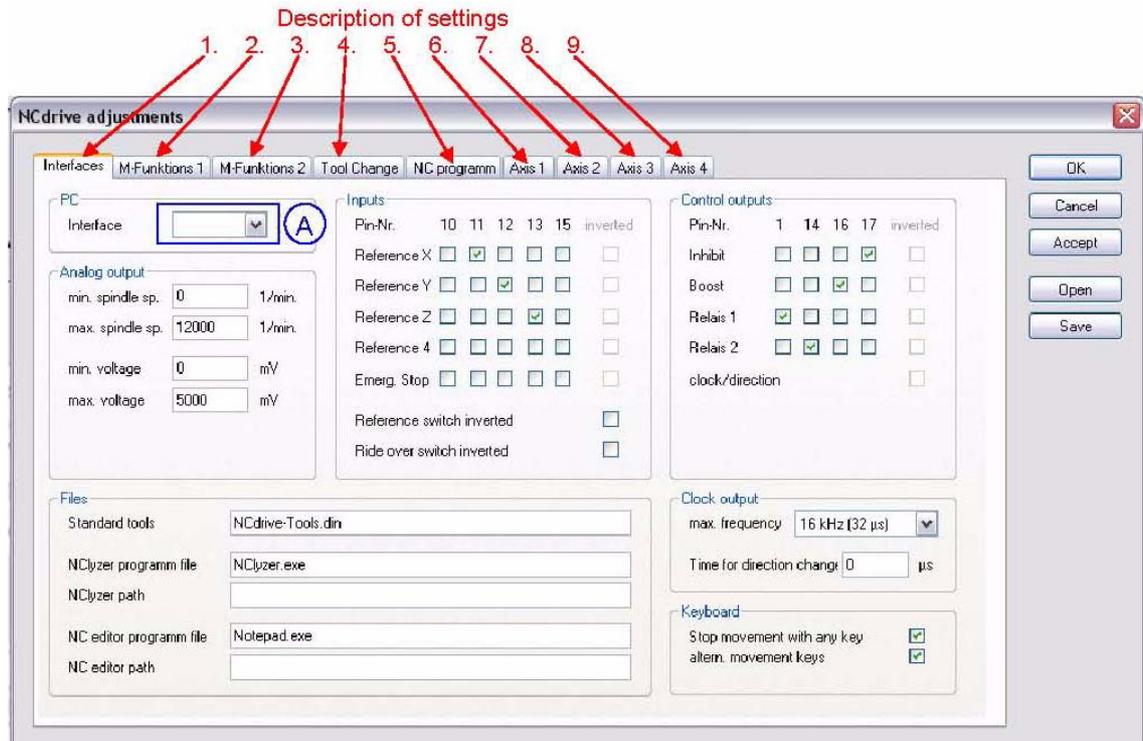


Abb.0-4: Description of setting

This menu (Picture 4) contains several sub-menu-cards in which the settings have to be inserted.

1. As shown in picture above, the first sub-menu-card is named "Interfaces". In this card you have to select in section "PC" (detail "A" in Picture 4) the COM-interface with the NCdrive-connection. If (as shown in picture) no interface is marked and selected, NCdrive is set to "stand-by". All further pre-set adjustments of this sub-menu-card can remain unchanged for the moment. The section in the middle called "Inputs" is described in chapter 5.2 separately. This is important for use of the optional reference switches.

2. + 3. The next two sub-menu-cards "M-Funktionen 1" and "M-Funktionen 2" provide possibilities for experienced users of NCdrive. These settings are described at the manual of NCdrive. In order to simplify the first start-up routine you should delete all settings on these two sub-menu-cards (see Picture 5).

Please note also chapter 5.3 of this manual for settings of the sub-menu-card "M-Funktionen 1".

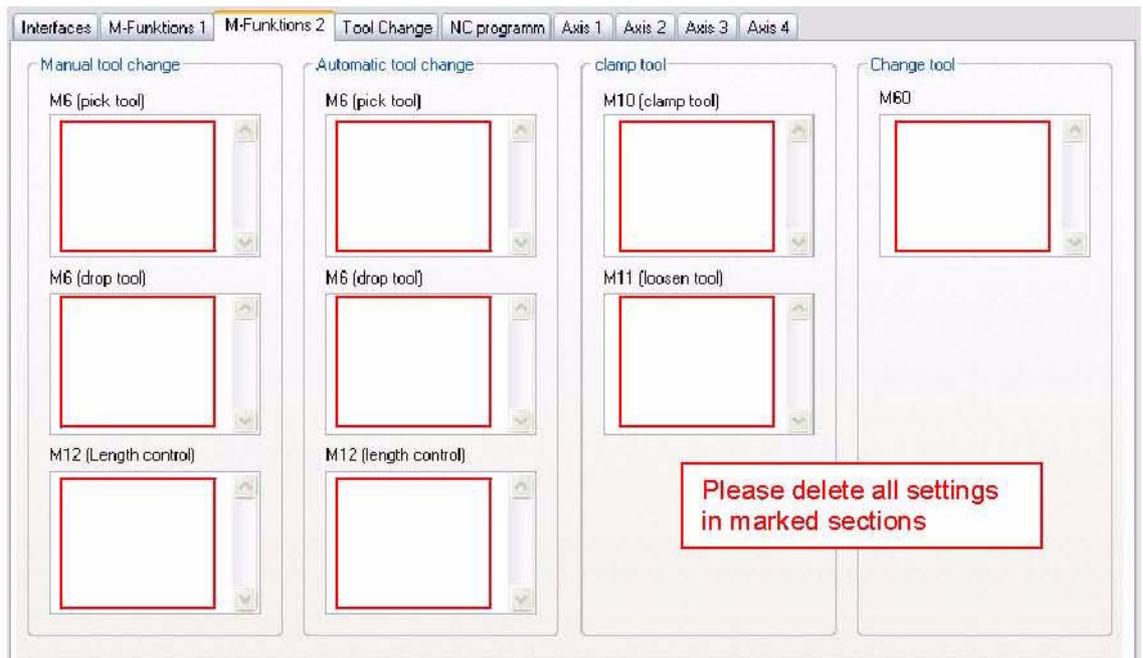


Abb.0-5: Description of setting

4. The fourth sub-menu-card "Tool change" is not relevant for the use of the milling machine BF 20 Vario.

5. In following sub-menu-card "NC programm" (Picture 6) are fitting settings for the running of a BF 20 Vario inserted already. Please double-check the settings with the following picture and correct values if necessary:

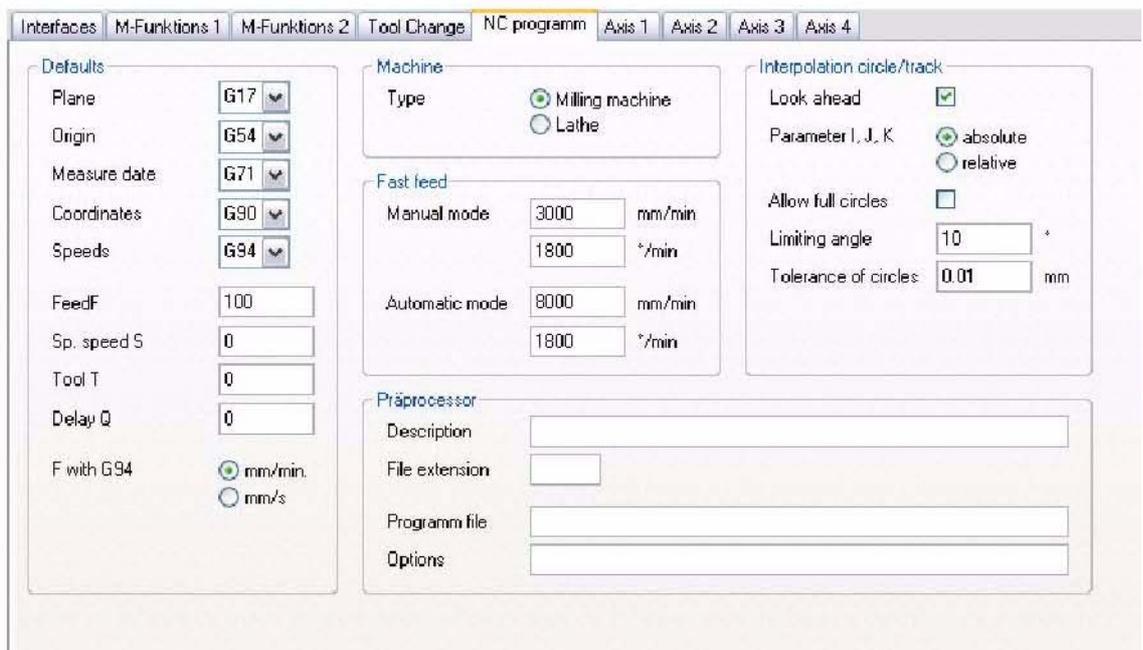


Abb.0-6: Description of setting

6. - 9. The sub-menu-cards "Axis 1" up to "Axis 4" are containing the parameters for control of the single axis-step-motors by NCdrive. Depending on the current configuration of the machine (e.g. type of the built-in spindles) different settings are necessary at this card. Suitable parameters for our Optimum machine types are delivered together with the software NCdrive.

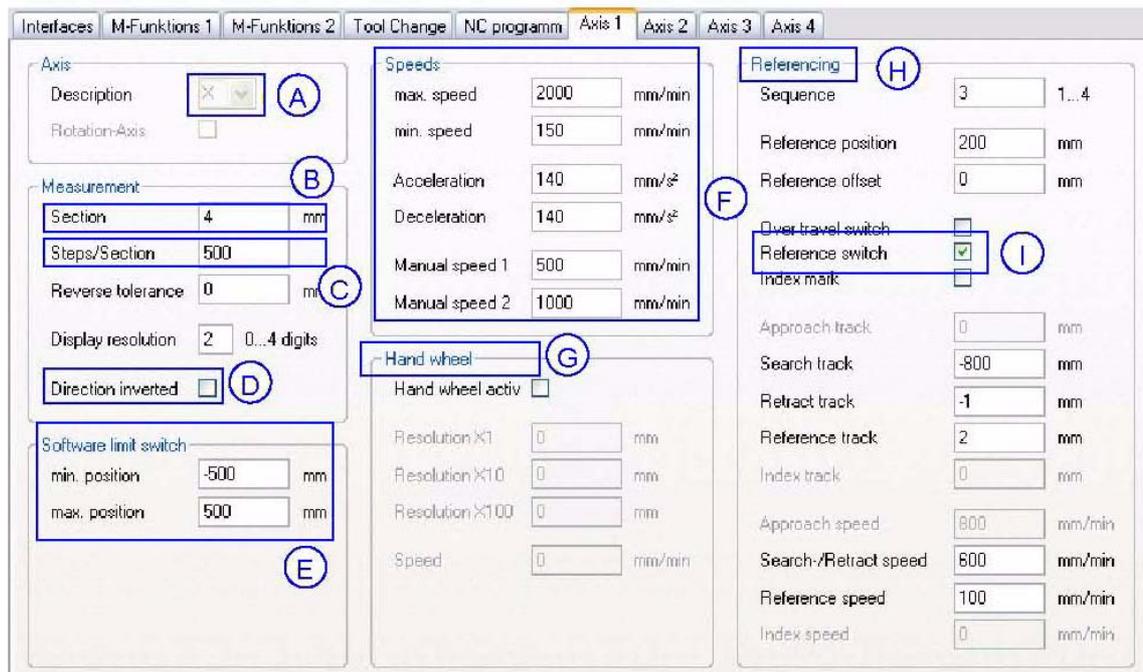


Abb.0-7: Description of setting

In Picture 7 are shown example settings for the X-axis of the BF 20 Vario. Due to the fact that at all milling machines the names of the three main axes are standardized it is not possible to insert different names to the section "Axis" (Detail "A" in Picture 7).

In the section "Measurement" the mounted spindle drive for the axis is described. At "Section" (Detail "B" in Picture 7) has to be inserted the thread pitch of the used axis spindle.

The value for "Steps/Section" (Detail "C" in Picture 7) results of the numbers of motor steps per revolution (e.g. 400 half-steps) combined with the gear reduction of the axis belt drive.

Helpful is also the function "Direction inverted" (Detail "D" in Picture 7). With this function the moving direction of the axis can be changed without manipulating the wiring of the axis step motor.

In section "Software limit switch" (Detail "E" in Picture 7) the moving of the axis can be limited easily by surveillance of the movement range. In order to provide the full movement range during the first start-up of machine, we recommend to insert here quite high values for the moment (as shown above).

In picture above are inserted values to section "Speeds" (Detail "F" in Picture 7) which can vary from single machine to machine. At use of the trapeze thread spindles at Optimum machines the initial value to be inserted for maximum speed should be 840 mm/min. At use of the optional ball screw spindles the initial value is 1500 mm/min.

If the inserted values are too high, loss of steps can appear at running of the axes. Loss of steps will cause defects of the milling course. Also new position referencing will be necessary due to the lost steps. The loss of steps can be recognised by uneven running noise too.

The specific optimised maximum values of each single machine can be verified by practical running tests with the machine.

For this NCdrive provides the functions of menu "Control" - "Diagnosis" (Picture 8).

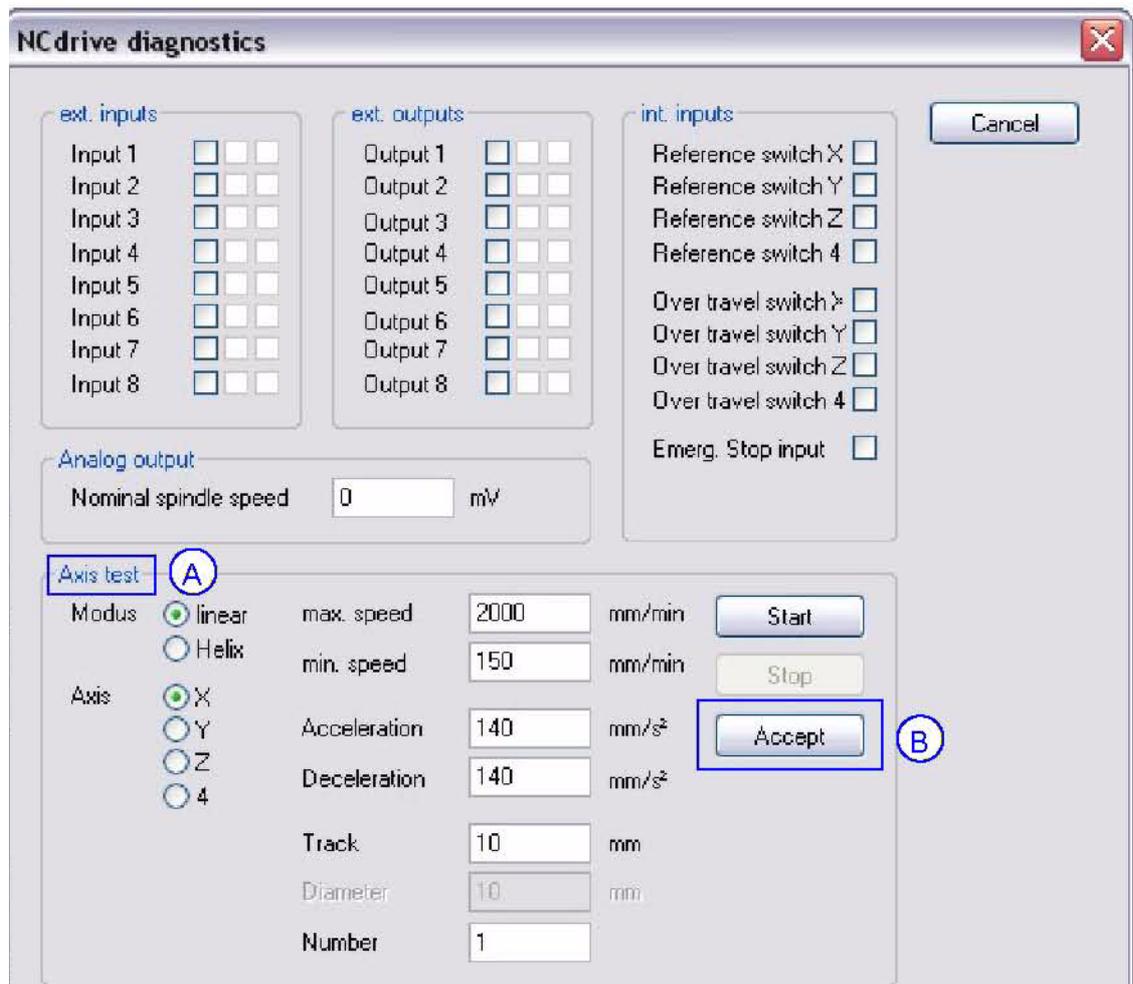


Abb.0-8: NCdrive diagnostics

Here can be selected e.g. the X-axis in section "Axis test" (Detail "A" in Picture 8). Then the axis can be moved back and forth with manually pre-set speeds and accelerations. By permanent increasing of the inserted values you can approach to the optimised setting for your machine. By clicking the "Accept"-button (Detail "B" in Picture 8) this setting will be transferred directly and automatically to the according section "Speeds" in sub-menu-card "Axis 1". Please proceed in the same way for the other axes of the machine.

6. Back in sub-menu-card "Axis 1" you find also the section "Hand wheel" (Detail "G" in Picture 7), in which nothing has to be inserted. The section "Referencing" (Detail "H" in Picture 7) is meant for adjusting the functions of the optional reference switches.

If no such switches are used at your machine, this section should be made inactive by deleting the hook at line "Reference switch" (Detail "I" in Picture 7). The necessary settings for use of the optional reference switches are described in chapter 5.2 separately.

7. The sub-menu-card "Axis 2" (Y-axis) should be filled with identical values as the card of the X-axis. This is because both axes are controlled by similar motors and also are driven by comparable spindles. A subsequently adjustment of values is only necessary at highly divergent running performance.

8. In the sub-menu-card "Axis 3" (Z-axis) have to be inserted different values. In most cases the thread pitch of the Z-axis spindle is different from the X- and Y-spindle. At use of the trapeze thread spindles of Optimum machines the initial value to be inserted for maximum speed should be 840 mm/min. At use of the optional ball screw spindles the initial value is 1440 mm/min. Please use again the above described "Diagnosis" function for optimising the regarding values.

## 0.5 Configuration of optional accessories

### 0.5.1 Circular dividing table (4th axis)

If a circular dividing table (e.g. RT 100 or RT 150 of OPTIMUM) is connected to the CNC-Controller by use of our add-on kit CNC MK RT1 (art.-no. 357 0510), this can be controlled as fourth axis by the NCdrive software.

Please note in this case that a simultaneous running of all four axes (e.g. for milling of helices on shafts) is not possible with the actual release of NCdrive. The 4th axis can only work out rotational positioning tasks.

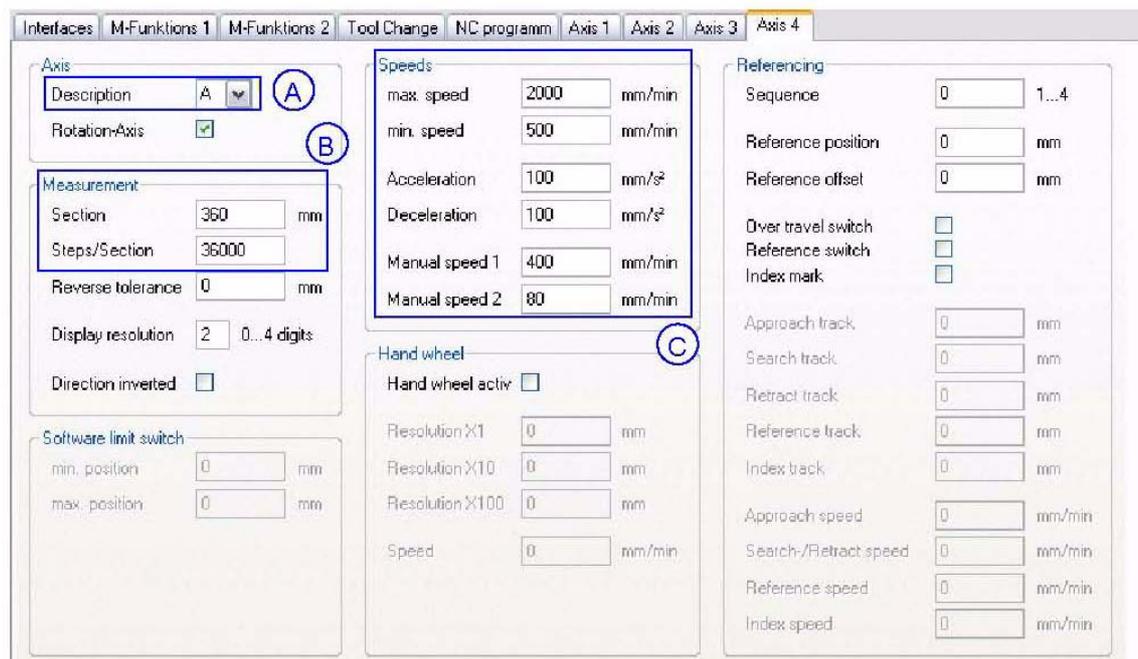


Abb.0-9: Circular dividing table

In section "Axis" (Detail "A" in Picture 9) you can select the name of the fourth axis out of a choice of usual descriptions. If no circulating dividing table is at use this section should remain empty. So the NCdrive software is handling the 4th axis as inactive.

Please insert to section "Measurement" (Detail "B" in Picture 9) for "Section" the value "360" (means 360 degrees per table rotation) and for "Steps/Section" the value "36000". This is the product of the number of steps done by step motor (400 half-steps) and the gear ratio of the circular dividing table (1:90).

For verification of the values for section "Speeds" (Detail "C" in Picture 9) please use again the "Diagnosis" function as described above. All other sections should remain inactive because for a circular dividing table no software limit switches, hand wheel or reference switches are used under regular circumstances.

### 0.5.2 Reference switches

By use of the software NCdrive reference switches can be controlled. We highly recommend for this the use of our reference switch set art.-no. 357 1980. Due to the fact that this switch set is completely fixed arranged to a 9-pin connector, it provides a default connection pattern. This has to be inserted also with the according hooks to the sub-menu-card "Interfaces" as shown in Picture 10.

Pin-Nr.	10	11	12	13	15	inverted
Reference X	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reference Y	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reference Z	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reference 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emerg. Stop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reference switch inverted						<input type="checkbox"/>
Ride over switch inverted						<input type="checkbox"/>

Abb.0-10: Inputs

Additionally you have to do several settings for each axis (which has got a switch) at section "Referencing" (Picture 11).

Referencing			
Sequence	3	1...4	<b>A</b>
Reference position	200	mm	
Reference offset	0	mm	
Over travel switch	<input type="checkbox"/>		
Reference switch	<input checked="" type="checkbox"/>		<b>B</b>
Index mark	<input type="checkbox"/>		
Approach track	0	mm	
Search track	-800	mm	<b>C</b>
Retract track	-1	mm	<b>D</b>
Reference track	2	mm	<b>E</b>
Index track	0	mm	
Approach speed	800	mm/min	
Search-/Retract speed	600	mm/min	<b>F</b>
Reference speed	100	mm/min	
Index speed	0	mm/min	

Abb.0-11: Referencing

First you have to assign the sequence of axis movements at reference point run of the machine (Detail "A" in Picture 11). The milling head of machine has to be driven free in first instance in order to avoid collisions. So the Z-axis (sub-menu-card "Axis 3") has to be set to "1" in the sequence. For X- and Y-axis you can insert either "2" or "3" as sequence number.

Reference position and reference offset can be set free according to local circumstances.

Very important is the hook at section "Reference switch" (Detail "B" in Picture 11). NCdrive is using this hook to activate the sensor!

The inserted value at section "Search track" (Detail "C" in Picture 11) describes the movement range of the axis at which the reference switch will be recognised. Therefore for this has to be selected a value which is according to the hardware movement range of the axis. Important is

the correct algebraic sign so that the switch can be surely reached. Consequently you have to insert a positive value for the Z-axis because the sensor usually is mounted to the upper area of the column.

At Y-axis the reference switch is mounted at front side in most of the cases. Therefore the machine must move in negative direction (e.g. -300) in order to reach the switch. Please insert the algebraic sign for the X-axis value according to the mounting position of reference switch at your machine.

For "Retract track" (Detail "D" in Picture 11) please insert at all axes "1 mm". The algebraic sign has to be identical to the value of "Search track" of the axis. "Reference track (Detail "E" in Picture 11) is "2 mm" in all cases. The algebraic sign has to be opposite to the value of "Search track" of the axis.

The pre-set values for speeds of reference movement (Detail "F" in Picture 11) can remain unchanged under normal circumstances.

Following two example pictures for mounting of the reference switches (Picture 12 showing X- and Y-axis as well as Picture 13 showing Z-axis):



Abb.0-12: X- and Y-axis



Abb.0-13: Z-axis

### 0.5.3 Actuating of main drive spindle

The software NCdrive is able to actuate relays at the CNC-Controller. With these relays can be switched the main drive spindle of the milling machine as well as other devices (e.g. cooling unit pump or an exhausting unit). Please obey for this also the manual of the CNC-Controller, chapter 6.

In following picture (Picture 14) is shown a connected relay at Port 1 of the CNC-Controller, in this case for the main drive spindle.

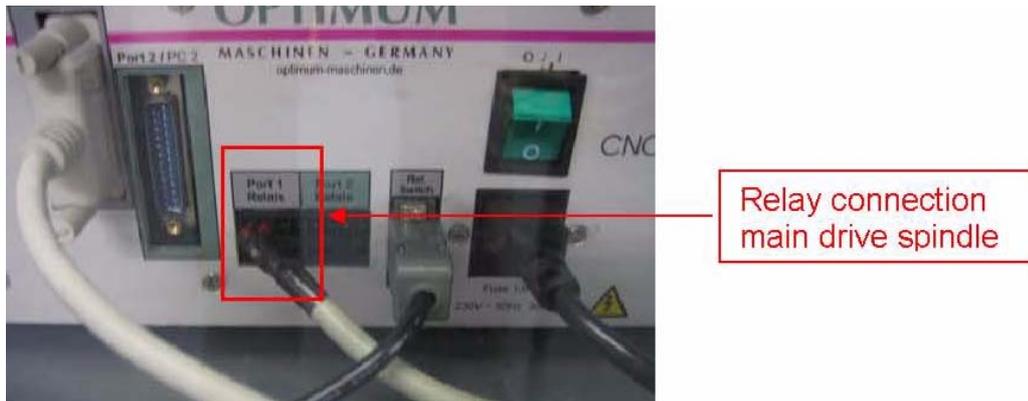


Abb.0-14: Relay connection main drive spindle

At the circuit board of the BF 20 Vario the relay will be connected to the contact pins 9 and 10, please note for this Picture 15.

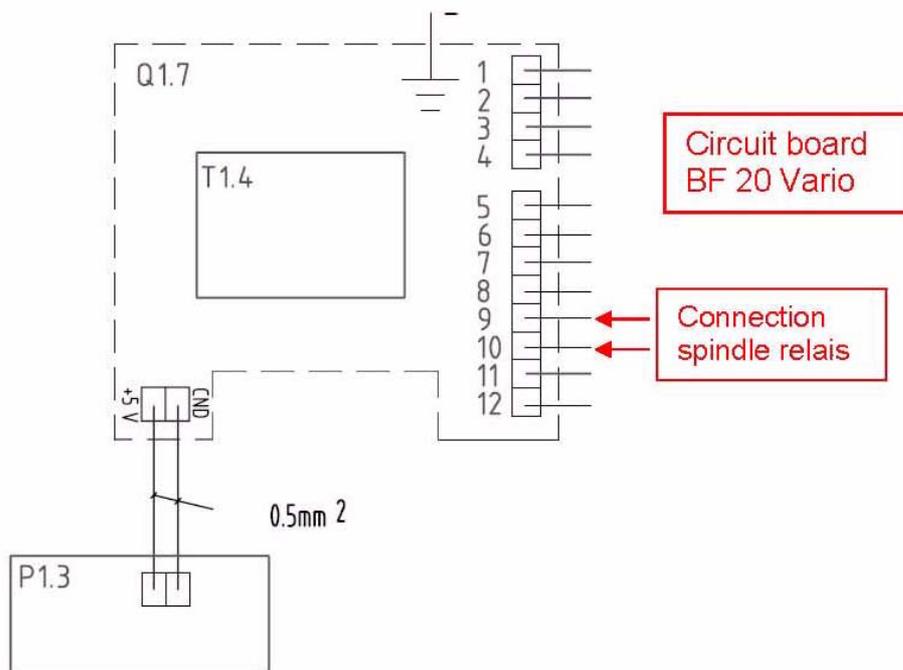


Abb.0-15: Connection spindle relais

In the software have to be done following settings for the control of the relays:

At the sub-menu-card "Interfaces" you have to insert hooks in section "Control outputs" as shown for relay 1 and 2 to pin 1 and 14 (Detail "A" in Picture 16).

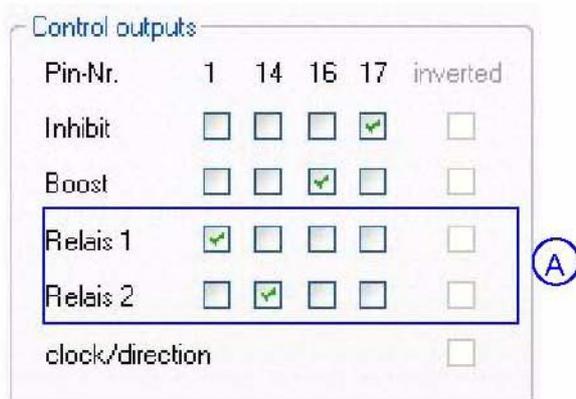


Abb.0-16: Steuerausgänge

Please insert also the following code to the sub-menu-card "M-Funktionen 1" (Picture 17).

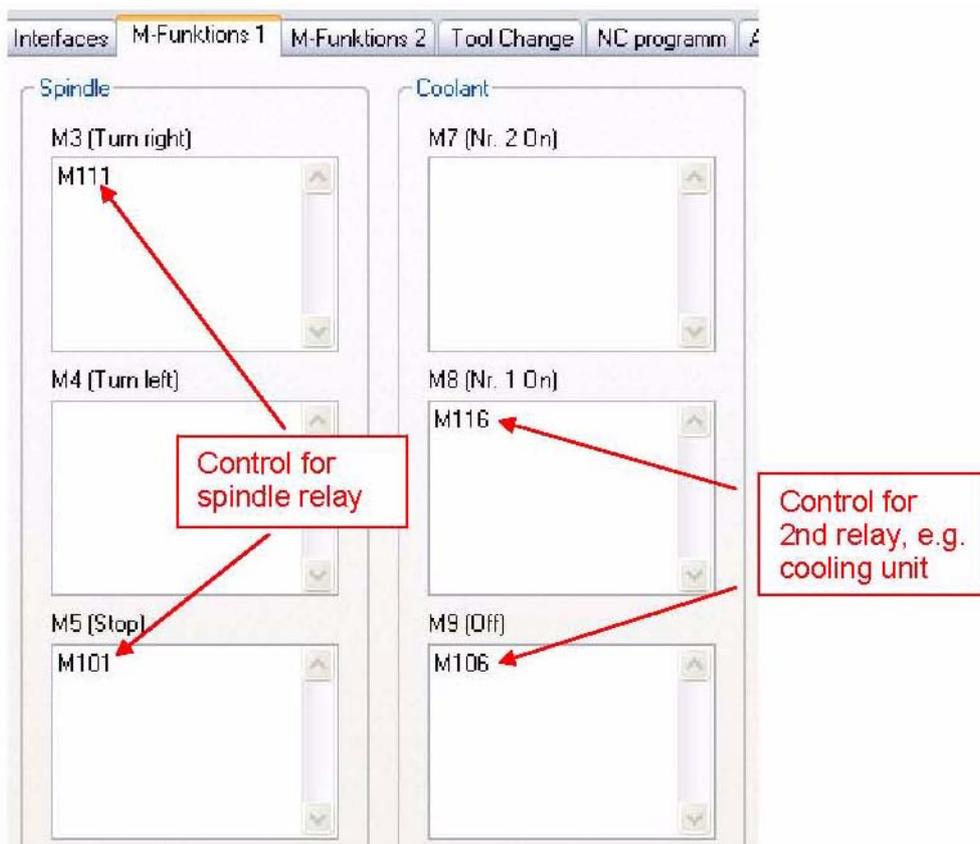


Abb.0-17: M-Funktion 1

With this setting spindle and cooling unit can be actuated respectively with according buttons at the NCdrive working screen (Picture 18) or directly out of a NC-program.



Abb.0-18: Buttons

## 0.6 First machine movements

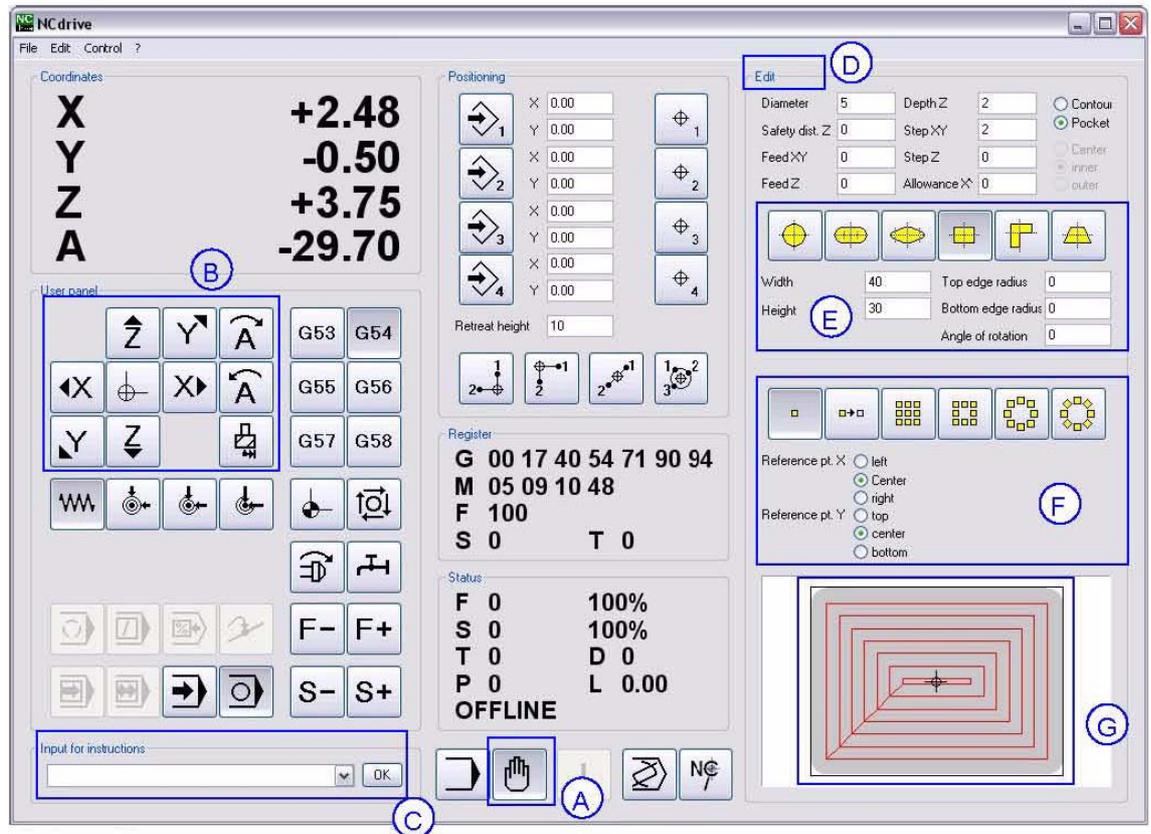


Abb.0-19: First machine movements

When you have done all the above described connections and adjustments, you can already run the milling machine BF 20 Vario in manual operation mode by NCdrive. The manual operation mode will be activated by clicking the icon "Mode: Manual" (Detail "A" in Picture 19).

Please check before starting the work with NCdrive if the CNC-Controller is switched on and the green "Ready"-LED at the NCdrive box is shining. When necessary please activate the linkage to the CNC-Controller with the menu "Control" - "Connect". By mouse-clicks you can now actuate the axis movement icons (Detail "B" in Picture 19) for running of the respective axis.

Please get used to the different manual movement functions by testing the icons in the left screen area.

Testing of the functions is possible without risk because in each running mode you can stop all machine movement immediately by pressing of any key of the computer keyboard.

At section "Input for instructions" (Detail "C" in Picture 19) you can insert a single NC-command line according to standard DIN 66025. This command will be exercised by pressing the "OK"-button. This function is quite similar to the MDA-function of bigger CNC milling machines.

The three sections at the middle screen area are not relevant for the start-up of NCdrive. Please note for this also the respective descriptions mentioned in the NCdrive manual.

With the functions of the section "Edit" (Detail "D" in Picture 19) at right screen area you can create simple contours and pockets without any knowledge of NC-programming. For this first you simply choose the requested geometrical shape by selecting the respective icon (Detail "E" in Picture 19). Then you can insert the required dimensions of contour / pocket according to the geometrical shape. Below are placed some icons (Detail "F" in Picture 19) with which you can multiply the contour / pocket geometrically .

According to the inserted setting you will get a graphical preview of the contour / pocket as well as the resulting milling tracks (Detail "G" in Picture 19).

## 0.7 Automatic mode and NC-programs

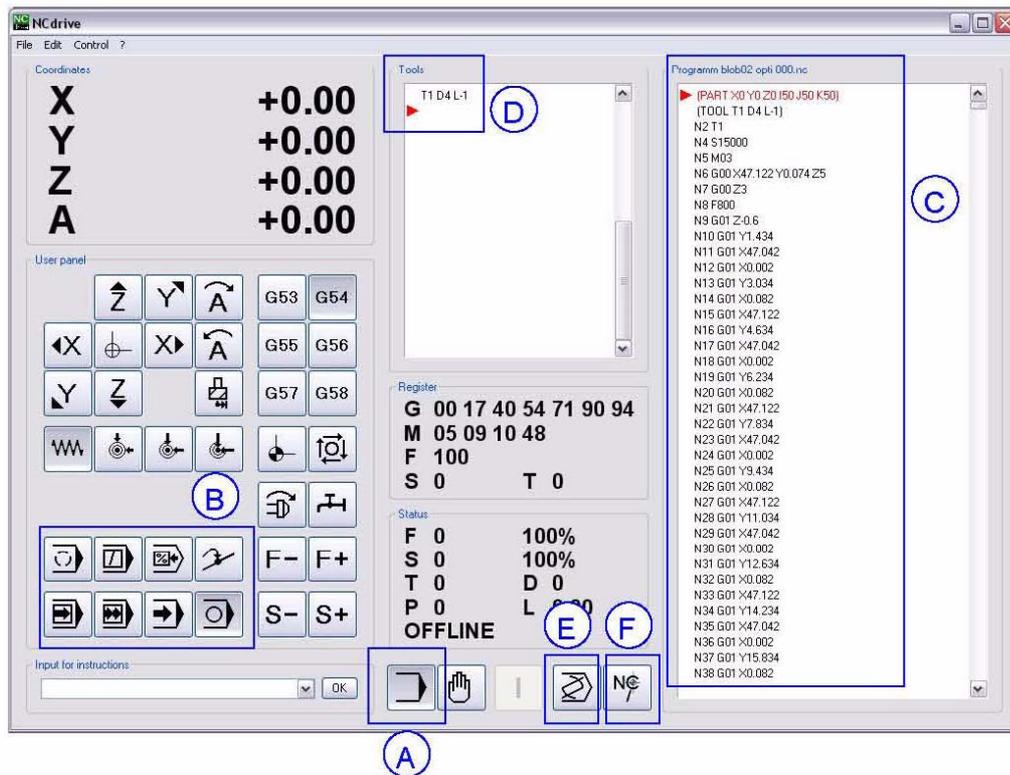


Abb.0-20: Automatic mode and NC-programs

NC-drive is designed for reading and executing NC-programs which are created according to standard DIN 66025. You can activate the automatic running mode with the icon "Mode: Automatic" (Detail "A" in Picture 20).

As you can see the left screen area remains nearly unchanged. Only the necessary icons for the automatic mode (Detail "B" in Picture 20) are now active and can be actuated.

These icons are designed according to the usual standards of CNC machine keyboards.

There are three different possibilities for inserting NC-programs:

- The NC-program has been generated by the recommended CAD/CAM software MegaNC: After starting NCdrive directly out of MegaNC, the NC-program is available for execution automatically. It is displayed at the right screen area (Detail "C" in Picture 20). Also a list of the tools has been generated automatically. This is displayed at middle screen area (Detail "D" in Picture 20).
- By use of the menu "File" - "NC-programm open" an already existing NC-program can be read in: Please note for this that the NC-program has to be created according to the DIN 66025-standardisation.
- By clicking the icon "Edit programm" (Detail "E" in Picture 20) you can start an editor for NC-programs: The Windows Text Editor is here pre-set as a standard. With the editor you can either write manually a simple NC-program or you can do changes to the valid NC-program which is displayed at the right screen area.

## 0.8 Simulation of the program run

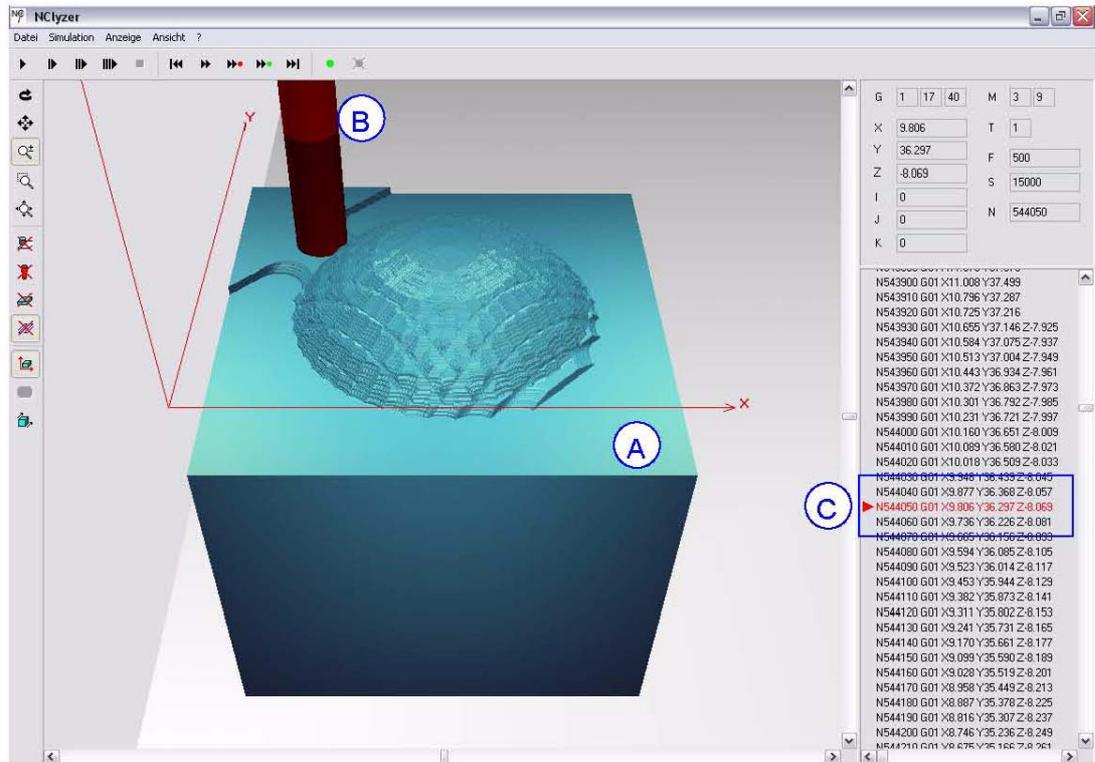


Abb.0-21: Simulation of the program run

Before a NC-program is running at the milling machine the first time, you should check it by a simulation in all cases. With this wrong program lines and orders can be recognised without that damage on work piece, tool or machine can appear.

For such simulations NCdrive provides the simulation software "NClzyer". This sub-program can be started by clicking the respective button (Detail "F" in Picture 20).

Picture 21 shows a screenshot of a typical simulation of a 3D-NC-program. You can clearly recognise the milling tracks of the tool (Detail "B" in Picture 21) on the work piece (Detail "A" in Picture 21). At the right screen area the NC-program is displayed continuously parallel to the graphical simulation. In this program listing is marked with red colour (Detail "C" in Picture 21) the program line which is valid at the moment.

## 0.9 Data back-up of the settings

We highly recommend that you do a data back-up of the parameter settings after you have made all settings and first test run. For this you have to do a back-up copy of the file "NCdrive.ini" in the installation folder of the software.

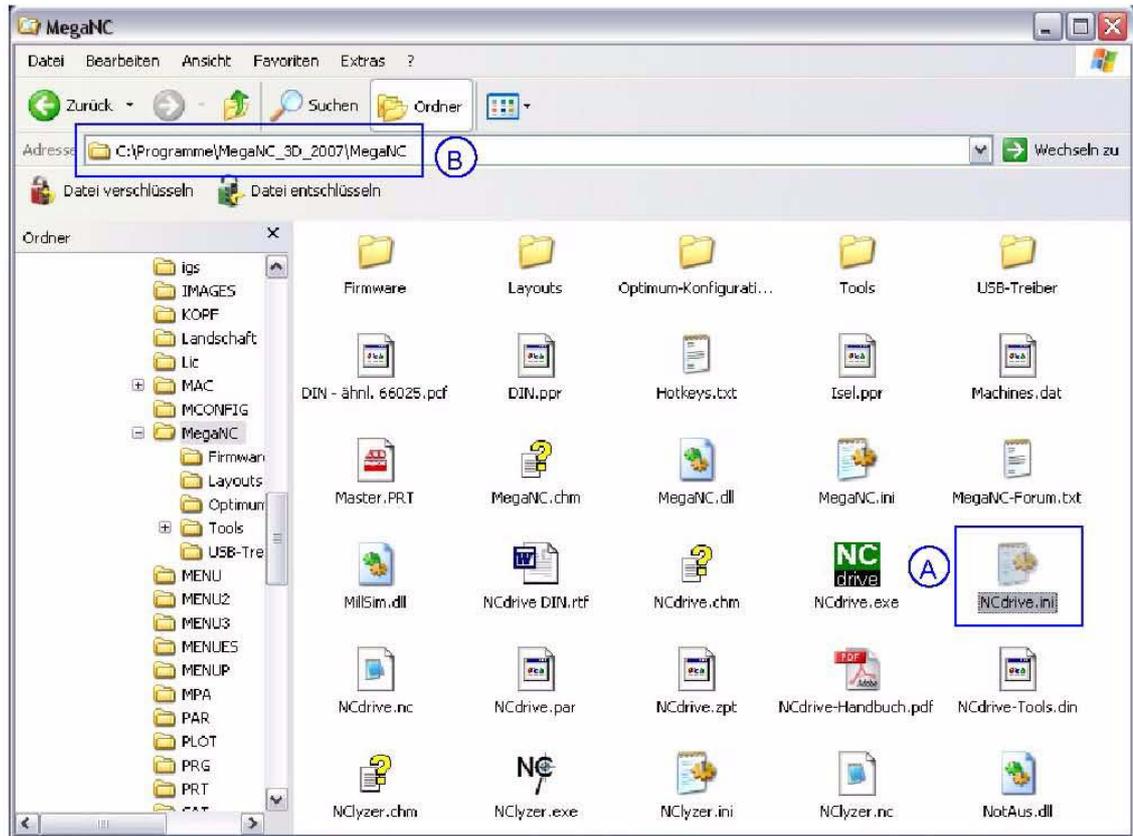


Abb.0-22: Data back-up of the settings

So after a loss of data you can place all correct and running parameters at the disposal again. For this please restore the back-up file "NCdrive.ini" (Detail "A" in Picture 22) into the installation folder (Detail "B" in Picture 22).

# Operating manual

Version 1.0.1

## Step motor control

Half-step operation

## CNC Controller IV



Keep for future reference!

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## 1 General warning notes

### Glossary of symbols

	gives additional indications
	calls on you to act
	enumerations

This part of the operation manual

- explains the meaning and use of the warning references contained in the operation manual,
- explains how to use the CNC Controller properly,
- highlights the dangers that might arise for you or others if these instructions are not obeyed,
- tells you how to avoid dangers.

In addition to this operating manual please observe,

- applicable laws and regulations,
- legal regulations for accident prevention,
- the warning notes on the CNC Controller.

**ALWAYS KEEP THIS DOCUMENTATION CLOSE TO THE CNC CONTROLLER.**

### 1.1 Proper use

The CNC Controller is designed and built to be used in dry and non-explosive environments. It is provided to control step motors up to a maximum power of 6A at 40 V.

It is also part of proper use that

- the maximum values for the CNC Controller are to be complied with,
- the operating manual needs to be observed.



#### **WARNING!**

**It is forbidden to make any modifications or alterations to the values of the CNC Controller!**

**These could endanger the staff and cause damages to the CNC Controller and the connected devices.**



#### **WARNING!**

- **Always disconnect the CNC Controller when exchanging the control board.**
- **Wait at least 3 minutes until you open the housing of the CNC Controller.**
- **Switch off the CNC Controller with the main switch, if the CNC Controller is not in use.**

## 2 Assembly and function

The step motor control is working in half-step operation. The supply of the step motors amounts to maximum 40 volts DC. The operation control boards are protected against any kind of short circuit. Any malfunctions are displayed by flashing up of the red LED. After correcting the malfunction, it is sufficient to switch off the controller and to switch it on again.

### 2.1 Capacity and general data

The following information give the dimensions and weight of the CNC Controller IV and is the manufacturer's authorized machine data.

<b>Power supply</b>	CNC Controller IV
Connection	230V ~ 50 Hz 300VA
Fusing	1,6 A slow-blow fuse
<b>General data</b>	
Potential-free relay output	4 pcs. max. 10 A per relay
Dimensions: Length x Width x Height [ mm ]	540 x 275 x 125
<b>Environmental conditions</b>	
Temperature	5 - 35 °C
Humidity	25 - 80 %

### 2.2 Unpacking and connection



#### INFORMATION

When the CNC controller is delivered, check immediately that the machine is not been damaged during transport and that all components are included. Also check that no fastening screws have come loose.

### 2.3 Delivery volume

- CNC Controller without control boards
- LPT port adapter plug
- LPT connection cable
- IEC power connector
- operating manual

### 2.4 Commissioning

#### 2.4.1 Safety

Use the CNC Controller only under the following conditions:

- the CNC Controller is in proper working order.
- the CNC Controller is used as prescribed.
- the operating manual is observed.



All anomalies should be eliminated immediately. Stop the CNC controller immediately in the event of any abnormality in operation and make sure it cannot be started-up unintentionally or without authorization.

## 2.5 Connections

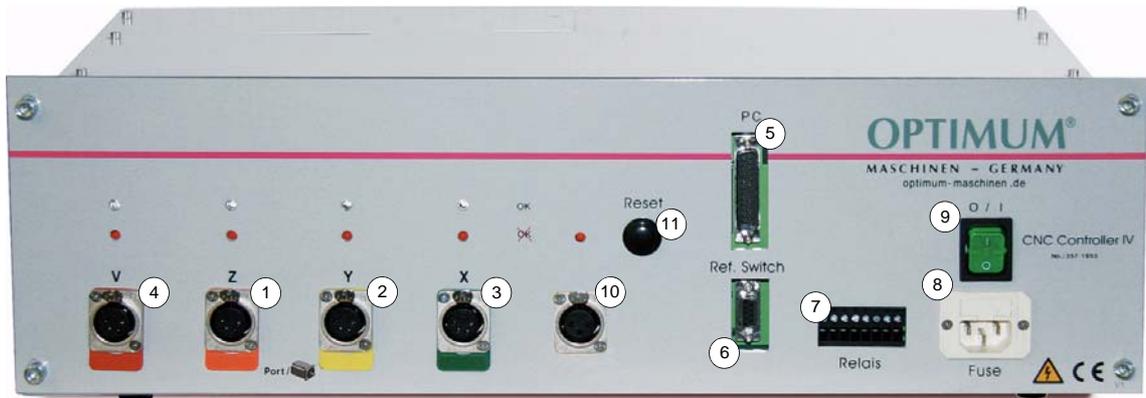


Fig.2-1: Connections to the CNC Controller IV

Description		Description	
①	Z <sub>1</sub> connection step motor Z - axis of the machine	⑥	Port 2 / PC2 parallel port, LPT connection personal computer to the control of the axis Z <sub>2</sub> , Y <sub>2</sub> , X <sub>2</sub>
②	Y <sub>1</sub> connection step motor Y - axis of the machine	⑦	Ports with relay: potential-free relay output, for user defined application in connection with Port 1 /PC1 maximum 10 A
③	X <sub>1</sub> connection step motor X - axis of the machine	⑧	Power connection with fine wire fuse 1.6 A slow-blow
④	V <sub>1</sub> connection step motor X <sub>2</sub> - axis of the machine	⑨	On-Off switch
⑤	Port 1 / PC1 parallel port, LPT connection personal computer to the control of the axis Z, Y, X	⑩	Connection for EMERGENCY STOP

## 2.6 Signal configuration on the parallel port

The CNC controller IV need to be supplied with separate direction and cycle signals. When using the HSE software such as Pcturn DOS Pcturn for Windows you have to connect the adapter plug which is included in the delivery volume on the PC port.



Fig.2-2: LPT port adapter plug

### 2.6.1 Assignment of the signals at the parallel port, CNC Controller IV (Port / PC)

The following assignment of signals is required on the parallel port.

Pin Nr.	Application	Description	DB 25 male
2	Direction X-axis	Direction signal to control the axis	
3	Cycle X	Cycle signal to control the step motor	
4	Direction Y	Direction signal to control the axis	
5	Cycle Y	Cycle signal to control the step motor	
6	Direction Z	Direction signal to control the axis	
7	Cycle Z	Cycle signal to control the step motor	
8 - 24	Free	Not assigned	
25	OV DC, earthing		

## 2.6.2 Assignment of signals at the port reference switch (Ref.switch)

The following signal configuration is used on the parallel port.

Pin Nr.	Application	Description	DB9 female
1	X1	Machine point of origin port 1 X-axis	
2	Y1	Machine point of origin port 1 Y-axis	
3	Z1	Machine point of origin port 1 Z-axis	
4	Round table	Point of origin round table port 1	
5	+12V DC		
6	X2	Machine point of origin port 2 X-axis	
7	Y2	Machine point of origin port 2 Y-axis	
8	Z2	Machine point of origin port 2 Z-axis	
9	0V DC		

## 2.6.3 Assignment of signals at the parallel port 1, CNC Controller IV (Port / PC)

The following assignment of signals is required at the parallel port.

Pin Nr.	Application	Description	DB 25 male
1	Relay 9	Switching output e.g. motor on	
2	Direction X-axis	Direction signal to control the axis	
3	Cycle X	Cycle signal to control the step motor	
4	Direction Y	Direction signal to control the axis	
5	Cycle Y	Cycle signal to control the step motor	
6	Direction Z	Direction signal to control the axis	
7	Cycle Z	Cycle signal to control the step motor	
8	Direction 4th axis	Direction signal of the optional 4th axis	
9	Cycle 4th axis	Cycle signal of the optional 4th axis	
10	Free	Not assigned	
11	Reference switch Z axis	„Assignment of the signals at the parallel port, CNC Controller IV (Port / PC)“ on page 5	
12	Reference switch Y axis		
13	Reference switch X axis		
14	Relay 10	Switching output e.g. coolant on	
15	Reference switch 4th axis		
16 - 24	Free	Not assigned	
25	OV DC, earthing		

## 3 Setting the control cards

Settings need to be performed on the control card for an intended use in three adjustable ranges. The control card disposes of several jumper positions which need to be correctly set before installing the control card into the CNC Controller, depending on the drive motor.



### ATTENTION!

**A wrong setting of the jumper may lead to malfunctions and damages of the drive motors.**

### Holding current

The holding current provides for a safe hold when the machining is being stopped and a safe hold of the non-moved axis during the machining time.

### Operating current

The operating current moves the step motor. The operating current can be set from 2 A - 8 A. The type plate of the corresponding step motor indicates the values of the required setting.

### Step motor type

The operating current moves the step motor. It is possible to change the direction of rotation via the direction signal. The operating current can be set from 2 - 8 A.

#### Hold Torque

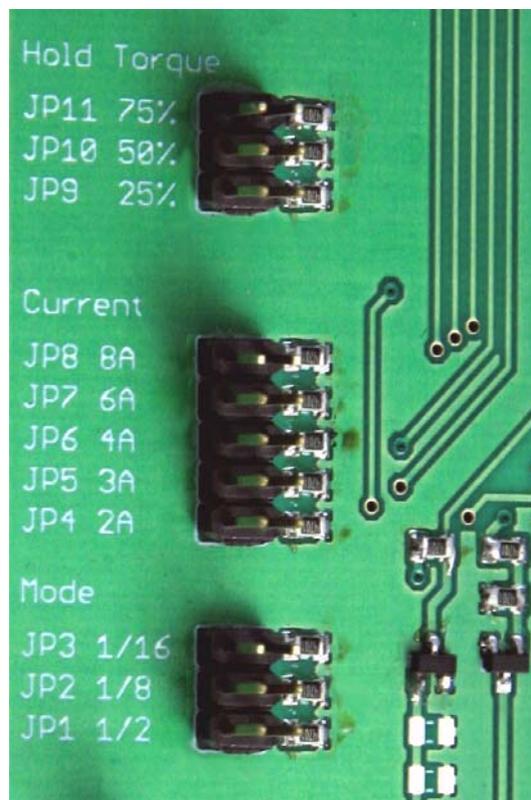
JP11	75%
JP10	50%
JP9	25%

#### Current

JP8	8 A
JP7	6 A
JP6	4 A
JP5	3 A
JP4	2 A

#### Mode

JP3	1/16
JP2	1/8
JP1	1/2



## 3.1 Setting the step motor type

### Setting at Jumper 1 - 3 :

Depending on the operational mode of the step motor the jumper is set to the corresponding position.

The step motors offered by OPTIMUM are working in the half step operation. Therefore, select the Jumper Position JP1 by default.

## 3.2 Setting the operating current

### Setting at Jumper 4 - 8 :

The current has to be set to the used step motor via the Jumper. If the current is too high it will lead to a degradation of the running properties and will not yield more performance!

When the red control light on the printed circuit board is flashing (red LED) the operating current is too high. Check if the Jumper position is correct which complies to the used step motor.

☞ „Red LED on the CNC Controller is illuminated“ on page 14

## 3.3 Setting the holding current

### Setting at Jumper 9 - 11 :

In order to find the correct setting value you should firstly start with the setting 25%.

Only if this value is not sufficient for a safe hold of the axis such as for instance for heavy vertical axis you should gradually increase the value by one position until you achieve a satisfactory drive behavior.



### ATTENTION!

**If the holding current is set too high it will lead to an unnecessary heating up and possibly to damages of the drive motor.**

## 3.4 Replacing a control board



### CAUTION!

**Unplug the mains plug and wait at least 3 minutes before opening the CNC controller. This time period is required in order to make sure that all condensers are being discharged.**

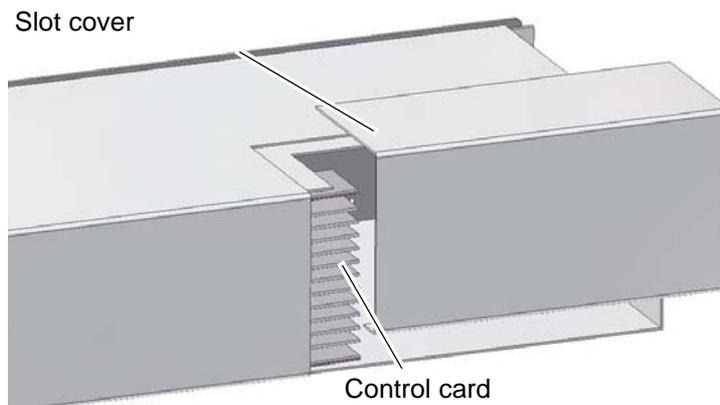


Fig.3-1: Rear side of the CNC Controller

### Proceeding

- Disconnect the mains plug and wait at least 3 minutes.
- Disconnect the plug of the step motor from the control board.
- Screw off the slot cover of the control boards.
- Pull off the control board from the slot.
- Set the correct positioning of the jumpers.
- Insert the new control board into the slot.
- Reassemble the slot covering of the control boards.
- Reconnect the plug of the step motor.

## 4 Connection of the step motors

### 4.1 Cabling X-/Y-/Z-axis

4.1.1 Open the cover of the step motor with a Philips screw driver.

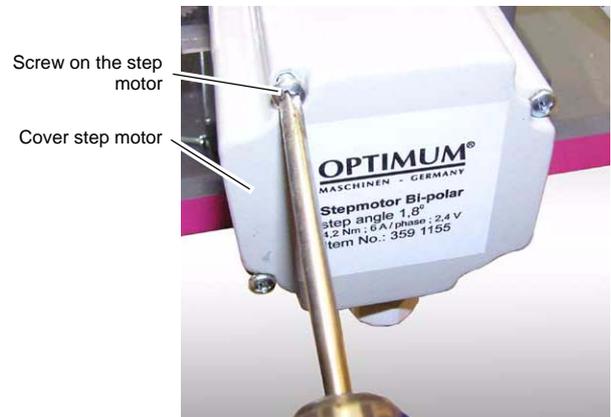


Abb.4-1: Open cover on the step motor

4.1.2 Remove the outer isolation of the cable and make sure that the isolation of the single conductor below will not be damaged.

4.1.3 The stripped part should be about 6 cm long.



#### INFORMATION!

**The shielding is connected to the marshaling panel marshaling panel of the motor and to the Controller on both sides.**

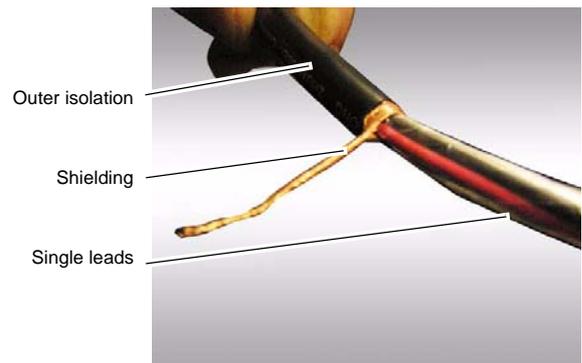


Fig.4-2: Remove outer isolation

4.1.4 The cable will be stripped at a length of about 5mm with isolation stripping tongs.

4.1.5 Plug and press the wire end sleeves on the end of the cables.

4.1.6 Plug the strain relief over the cable.

4.1.7 Push the cable through the opening on the sealing cap of the step motor.

4.1.8 Connect the cable to the motor and tighten the strain relief.

4.1.9 The twisted screening needs to be positioned at the clamping "GND" .

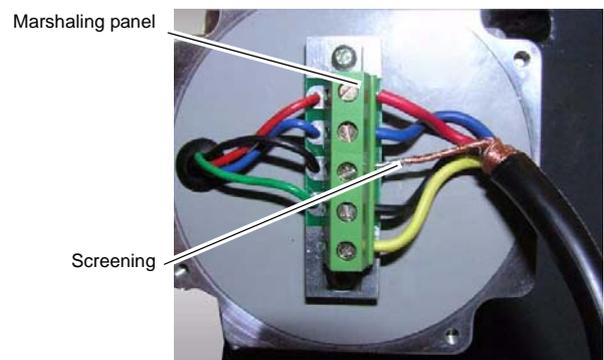


Fig.4-3: Marshaling panel

- 4.1.10 Shift the cable through the opening of the sealing cover of the step motor.
- 4.1.11 Connect the cable to the motor and tighten the strain relief.
- 4.1.12 The twisted shielding needs to be connected to the clamping "GND" .
- 4.1.13 Retighten the cover of the step motor with the Philips screw driver.
- 4.1.14 Then cut the cable to the length which is required to connect it to the CNC controller.

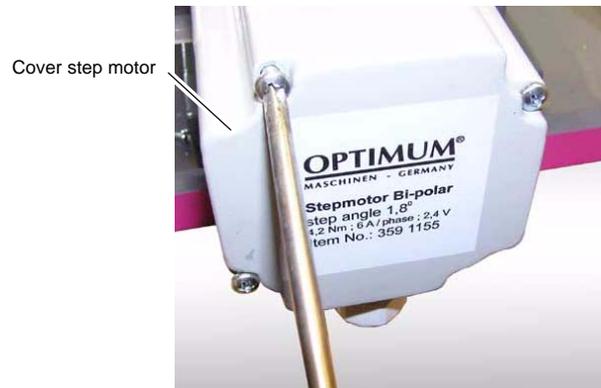


Fig.4-4: Screw cover

- 4.1.15 Connect the cable to the CNC controller as required.

Motor		Plug
A-	to	A-
A+	to	A+
B-	to	B-
B+	to	B+
GND	to	GND

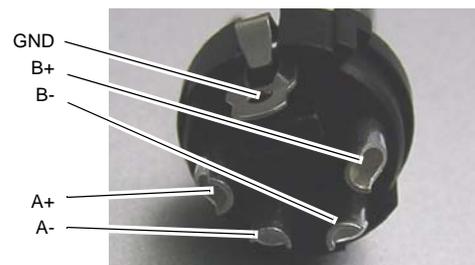


Fig.4-5: Marshaling panel plug

## 4.2 Plug assembly for X-/Y-/Z axis

- 4.2.1 Remove about 3cm of the isolation of the cable. Twist the shielding together to one cable.

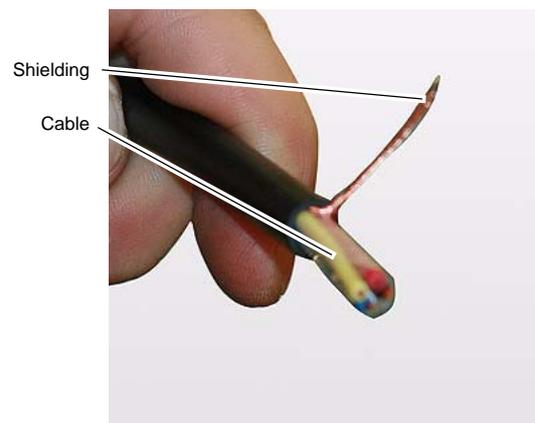


Fig.4-6: Open the cover of the step motor

- 4.2.2 Remove about 5mm of the isolation from the cable ends tin the cables with a soldering iron. Shift the black screw connection over the cable and also shift the black cable fixing over the cable.

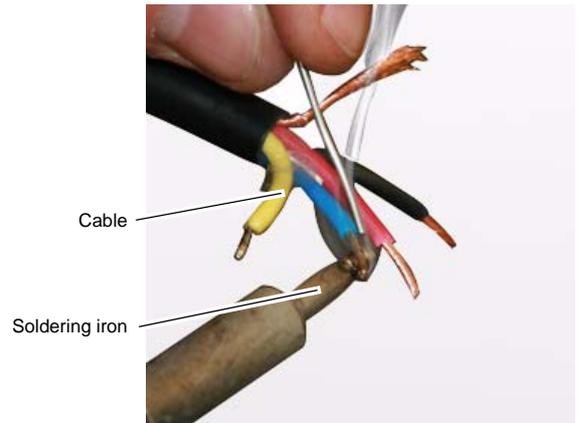


Fig.4-7: Remove outer isolation

- 4.2.3 Solder the cables onto the plug according to the above mentioned diagram under item 1.1.12.

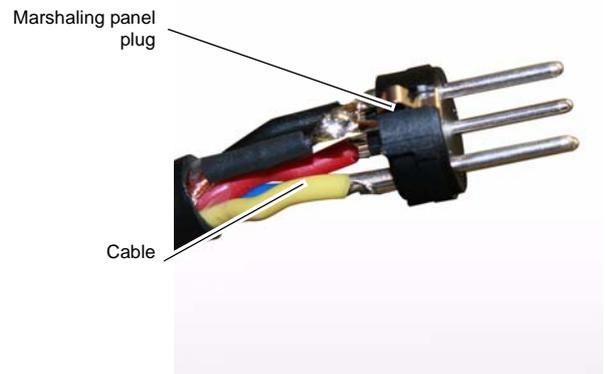


Fig.4-8: Marshaling panel step motor

- 4.2.4 Shift the plug together with the cable clamping into the housing from the rear. Before shift the color marking over the cable.

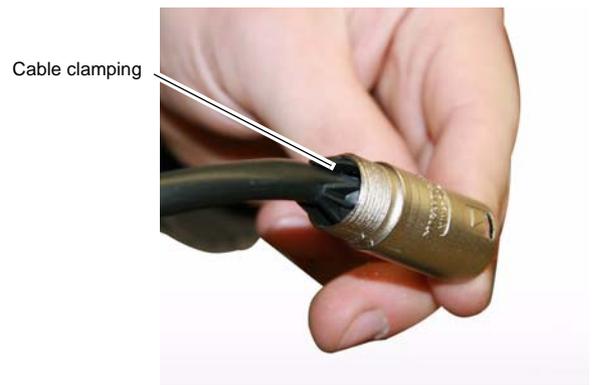


Fig.4-9: Screw cover

- 4.2.5 Screw the plug housing together using the screw connection.

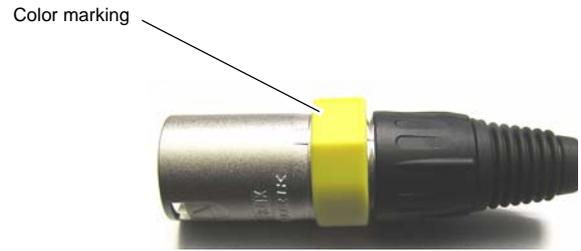
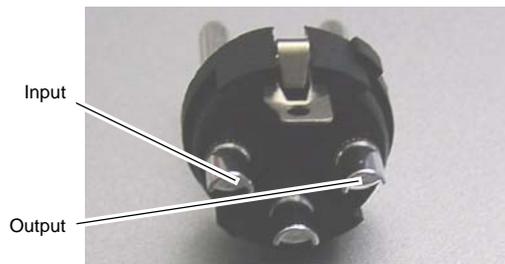


Fig.4-10: Screw cover

- 4.2.6 The three-pole plug serves as EMERGENCY STOP plug. It is either possible to insert an EMERGENCY STOP switch or built a bridge into the plug in order to be able to operate the Controller.



### 4.3 Determining the designation of the axis

Right turning rectangular coordinate systems are used for machine tools. They are used to describe the movements on the machine as relative movements between the tool and the work-piece. The machine datum is the origin of such coordinate systems. Here all axis are having the position zero. This point only serves as a reference point.

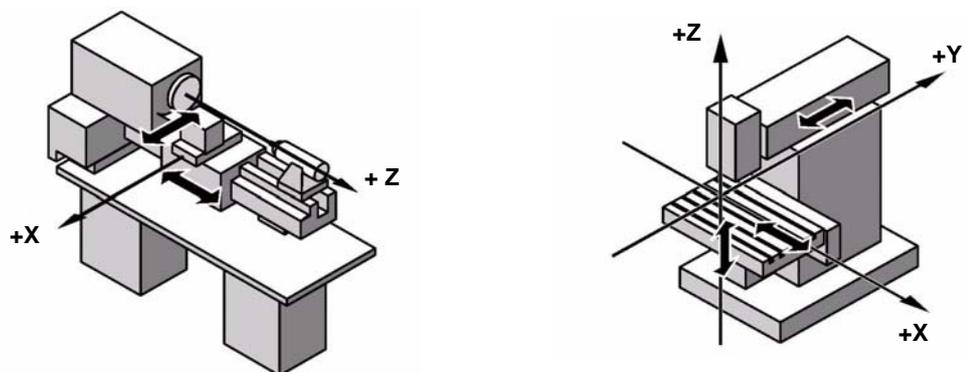


Fig.4-11: Coordinate system lathe and milling machine

## 5 Malfunctions

### 5.1 Red LED on the CNC Controller is illuminated

The operating current is set too high.

Slightly turn back the operating current on the potentiometer anti-clockwise.

The correct function is always given if the blue LED flashes when the corresponding axis is being triggered.

### 5.2 Axis are not controlled

In case of a short circuit or excess voltage or in case of a defect on the control board, all 3 axes will be switched off! This way a damage of the workpiece will be avoided as far as possible.

The red LED shows which axis is concerned. -> "Replacing a control board" on page 9

### 5.3 Step motor does not run

**Possible cause:** The CNC controller has no tension.

Remedy: Is the illumination of the main switch of the CNC controller off? Check the plug and the fine-wire fuse on the CNC Controller

**Possible cause:** The machine is not cleaned from corrosion protection agent. Therewith, the static torque is too high.

Remedy: Remove the corrosion protection agent on the machine, clean the machine and grease it again.

**Possible cause:** The marshaling panels on the machine are fastened too tight. Therewith the static torque is too high.

Remedy: Better adjusting the marshaling panels.

**Possible cause:** The transverse rate is set too high, motor current is selected too low.

Remedy: Reduce transverse rate, increase motor current a little.

## 6 Spare parts

### 6.1 Spare parts Controller IV

Bezeichnung	Designation	Artikelnummer
		Item no.
Steuerkarte	Control board	3571960
		
CNC Controller III komplett 3 Steckplätze	Complete CNC Controller III 3 slots	3571951
CNC Controller VI komplett 6 Steckplätze	Complete CNC Controller VI 6 slots	3571950
Netzteil	Power supply unit	035719501
Lüfter	Fan	035719502
Kaltgerätestecker	Inlet connector for non-heating apparatus	035719503
Ein-Aus Schalter	On - Off switch	035719504
Anschlusstecker Steuerkarte	Plug control board	035719505
Feinsicherung 1,6 A Träge	Fine-wire fuse 1.6 A slow-blow	035719506
Hauptplatine CNC Controller VI, Version 2	Mainboard CNC Controller VI , version 2	0357195027
		
Hauptplatine CNC Controller III , Version 2	Mainboard CNC Controller III , version 2	0357195028
Frontblende CNC Controller VI	Front screen (Front cover) CNC Controller VI	035719509V2
Frontblende CNC Controller III	Front screen (Front cover) CNC Controller III	0357195010V2
Gehäuse CNC Controller VI; komplett ohne Elektrik	Housing CNC Controller VI; completely without electric	0357195011
Gehäuse CNC Controller III; komplett ohne Elektrik	Housing CNC Controller III; completely without electric	0357195012
Slot - Abdeckung CNC Controller VI	Slot - cover CNC Controller VI	0357195013
Slot - Abdeckung CNC Controller III	Slot - cover CNC Controller III	0357195014
Adapterstecker Parallel Anschluss SUB D 25 polig	Adapter plug parallel port SUB D 25 pins	0357195015

### 6.2 Accessories

Bezeichnung	Designation	Artikelnummer
		Item no.
		
Set Referenzschalter D210 - D280, 3 Achsen	Set reference switches D210 - D280, 3 axis	3571966
		
Satz Referenzschalter BF20, 3 Achsen zum Anschluss an SUB D 9 polig	Set reference switches BF20, 3 axis for connection on SUB D 9 pins	3571967
		

## 7 Appendix

### 7.1 Copyright

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This document is copyright. All derived rights are also reserved, especially those of translation, re-impression, use of figures, broadcast, reproduction by photo-mechanical or similar means and recording in data processing systems, whether partial or total.

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- The processing of the liability claims or of the warranty is performed as chosen by OPTIMUM GmbH either directly or through one of its dealers. Any defective products or components of such products will either be repaired or replaced by components which are free from defects. The property of replaced products or components passes on to OPTIMUM GmbH.
- The automatically generated original proof of purchase which shows the date of purchase, the type of machine and the serial number, if applicable, is the precondition in order to assert liability or warranty claims. If the original proof of purchase is not presented, we are not able to perform any services.
- Defects resulting of the following circumstances are excluded from liability and warranty claims:
  - Using the product beyond the technical options and proper use, in particular due to overstraining of the machine
  - Any defects arising by one's own fault due to faulty operations or if the operating manual is disregarded
  - Inattentive or incorrect handling and use of improper equipment
  - Non-authorized modifications and repairs
  - Insufficient installation and safeguarding of the machine
  - Disregarding the installation requirements and conditions of use
  - Atmospheric discharges, overvoltage and lightning strokes as well as chemical influences
- The following items are as well not subject to the liability or warranty claims:
  - Wearing parts and components which are subject to a standard wear as intended such as e.g. V-belts, ball bearings, illuminants, filters, sealings, etc.
  - Non reproducible software errors
- Any services which OPTIMUM GmbH or one of its agents performs in order to fulfill in the frame of an additional guarantee are neither an acceptance of the defects nor an acceptance of its obligation to compensate. Such services do neither delay nor interrupt the warranty period.
- Place of jurisdiction among traders is Bamberg.
- If one of the above mentioned agreements is totally or partially inefficient and/or null, it is considered as agreed what is closest to the will of the warrantor and which remains in the framework of the limits of liability and warranty which are predefined by this contract.



## 7.6 EC Declaration of Conformity

**The manufacturer /  
retailer:** Optimum Maschinen Germany GmbH  
Dr.-Robert-Pfleger-Str. 26  
D-96103 Hallstadt

hereby declares that the following product,

**Machine type:** CNC Controller IV

**Relevant EU directives:**

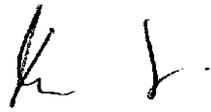
**EMV directive** 89/336/EWG

**Low Voltage Directive** 73/23/EWG

meets the provisions of the aforementioned directive, including any amendments valid at the time of this statement.

In order to ensure conformity the following harmonized standards in particular have been applied:

DIN EN 62079:2001 Editing of instructions - structure, content and illustration  
(VDE 0039)  
IEC 62079:2001



Thomas Collrep  
(Manager)



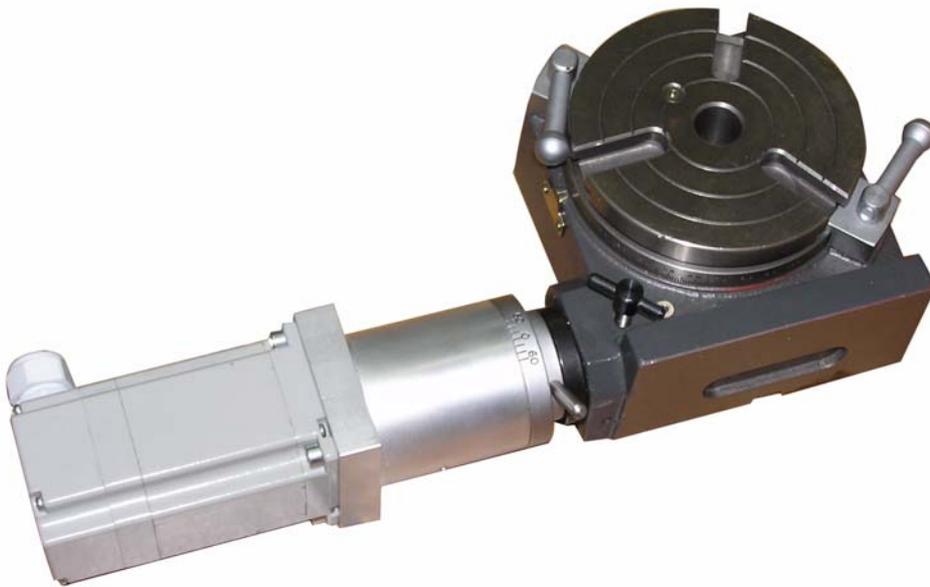
Kilian Stürmer  
(Manager)

Hallstadt, 23 / 10 / 2008

# Conversion instruction

Version 1.1.0

## Adapter kit RT 100/ 150 CNC



Illustr. 0-1: RT100

**Keep for future reference!**

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# 1 Safety warnings (warning notes)

## 1.1 Classification of hazards

We classify the safety warnings into various levels. The table below gives an overview of the classification of symbols (pictograms) and warnings for the specific danger and its (possible) consequences.

Pictogram	Alarm expression	Definition/Consequences
	<b>DANGER!</b>	Imminent danger that will cause serious injury or death to personnel.
	<b>WARNING!</b>	Risk: A danger that might cause serious injury or death to personnel.
	<b>CAUTION!</b>	Danger of unsafe procedure that might cause injury to personnel or damage to property.
	<b>ATTENTION!</b>	Situation that could cause damage to the machine and product and other types of damage. No risk of injury to personnel.
	<b>INFORMATION</b>	Application tips and other important or useful information and notes. No dangerous or harmful consequences for personnel or objects.

In the case of specific dangers, we replace the pictogram by



### 1.1.1 Glossary of symbols

	gives additional advices
	enumerations

## 1.2 Proper use



### WARNING!

In the event of improper use of the add-on pieces, it

- will endanger the user,
- will endanger the machine and other material property of the operator or user,
- may affect proper operation of the machine.

The attachment parts as conversion kit are provided for engine driven milling works of your machine.

Improper use!

The milling machine with the adapter kit must only be placed and operated in dry and ventilated rooms.

The handwheels on the driven axis need to be disassembled for safety reasons.

If the adapter kit is used in any way other than described above or modified without approval or the company Optimum Maschinen Germany GmbH, the adapter kit is no longer properly used.

We do not take liability for any damage caused by improper use.

We would like to stress that any modifications to the construction, or technical or technological modifications that have not been authorized by Optimum Maschinen GmbH will also render the guarantee null and void.

## 1.3 Required auxiliary material

- Means of shaft lock-down device "Loctite 648, join the shaft".
- The designation of the parts in the assembly description corresponds to the numbering of the packing list.
- In order to degrease the shaft, a cleaner for brakes or a corresponding cleaning agent is required.

Required tools:

- Allen key

## 2 Packing list RT 100 CNC

<b>Bezeichnung</b> <i>Designation</i>	<b>CNC - Adapter kit MK RT1 f</b> RT 100 CNC
<b>Artikelnummer Anbausatz</b> <i>Item No. assembly kit</i>	<b>3570510</b>
<b>Netto Gewicht</b> <i>Net Weight</i>	2 kg
<b>Brutto Gewicht</b> <i>Gross Weight</i>	2.5 kg
<b>Abmessung (L x B x H)</b> <i>Dimension (L x W x H)</i>	320 x 285 x 80 mm

<b>Nr.</b> <i>No</i>	<b>Bezeichnung</b> <i>Description</i>	<b>Artikelnummer</b> <i>Article No.</i>	<b>Teile Nr.</b> <i>Part No.</i>	<b>Grösse</b> <i>Size</i>	<b>Abbildung</b> <i>Picture</i>	<b>Stck.</b> <i>Qty.</i>
1	<b>Gehäuse</b> <i>Housing</i>	0 357 0510 1	RT1CNC-01			1
2	<b>Kupplung</b> <i>Clutch</i>	0 357 0510 2	RT1CNC-02			1
3	<b>Schrittmotor</b> <i>Step motor</i>	357 3304		23H280-01EA 2,2 NM 3A		1
4	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x15		4
5	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x20		3
6	<b>Kabel</b> <i>Cable wire</i>	-		4 x 0,75mm <sup>2</sup>		3m

<b>Prüfer:</b> <i>Verified by:</i>		<b>Datum:</b> <i>Date:</i>	
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## 3 Packing list RT 150 CNC

<b>Bezeichnung</b> <i>Designation</i>	<b>CNC - Adapter kit MK RT1 f</b> RT 150 CNC
<b>Artikelnummer Anbausatz</b> <i>Item No. assembly kit</i>	<b>3570510</b>
<b>Netto Gewicht</b> <i>Net Weight</i>	2 kg
<b>Brutto Gewicht</b> <i>Gross Weight</i>	2.5 kg
<b>Abmessung (L x B x H)</b> <i>Dimension (L x W x H)</i>	320 x 285 x 80 mm

<b>Nr.</b> <i>No</i>	<b>Bezeichnung</b> <i>Description</i>	<b>Artikelnummer</b> <i>Article No.</i>	<b>Teile Nr.</b> <i>Part No.</i>	<b>Grösse</b> <i>Size</i>	<b>Abbildung</b> <i>Picture</i>	<b>Stck.</b> <i>Qty.</i>
1	<b>Gehäuse</b> <i>Housing</i>	0 357 0510 1	RT1CNC-01			1
2	<b>Kupplung</b> <i>Clutch</i>	0 357 0510 2	RT1CNC-02			1
3	<b>Schrittmotor</b> <i>Step motor</i>	357 3304		23H280-01EA 2,2 NM 3A		1
4	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x15		4
5	<b>Schraube</b> <i>Screw</i>	DIN 4762		M5x20		3
6	<b>Kabel</b> <i>Cable wire</i>	-		4 x 0,75mm <sup>2</sup>		3m

<b>Prüfer:</b> <i>Verified by:</i>		<b>Datum:</b> <i>Date:</i>	
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## 4 Assembly RT 100/ 150 CNC

### 4.1 Assembly on the RT

- 4.1.1 Unfasten and unscrew the hexagon socket head screw of the handwheel with an Allen key.



Illustr.4-1: Unscrew screws

- 4.1.2 Remove the handwheel from the shaft. If you cannot pull it off easily, you can detach the handwheel by slightly knocking on it with a plastic tip hammer.



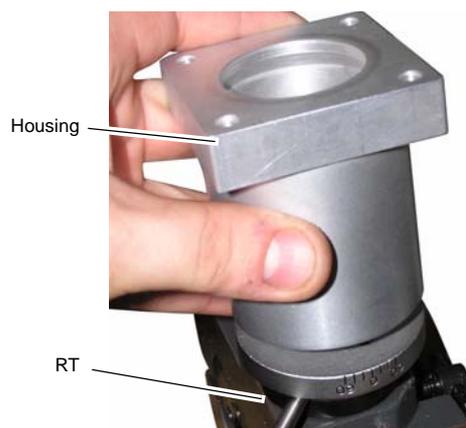
Illustr.4-2: Pull off handwheel

- 4.1.3 Take the feather key out of the shaft.



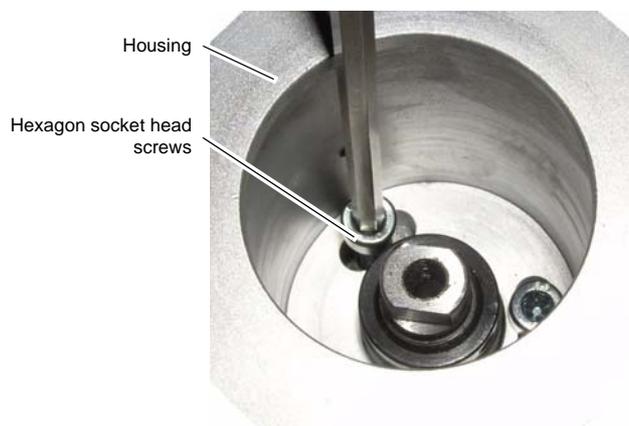
Illustr.4-3: Disassembly of feather key

4.1.4 Stick the housing on the RT, as shown.



Illustr.4-4: Mount housing

4.1.5 Fasten the housing with the three hexagon socket head screws on the RT. Please make sure that the housing is screwed on in a way that the motor is horizontally positioned on the RT.



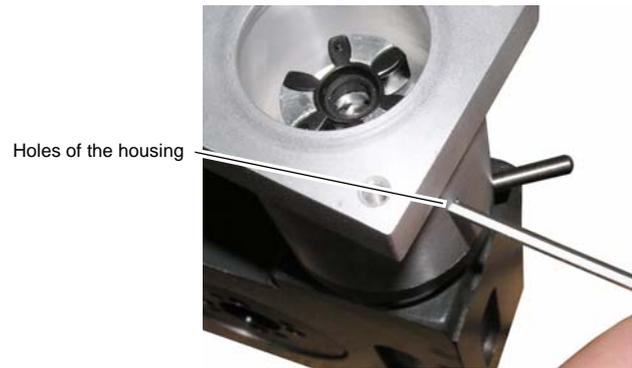
Illustr.4-5: Fasten screws

4.1.6 Shift on half of the clutch with the larger holes on the shaft of the RT, as shown.



Illustr.4-6: Fit clutch

- 4.1.7 Fasten the clutch through the holes of the housing with an Allen key.



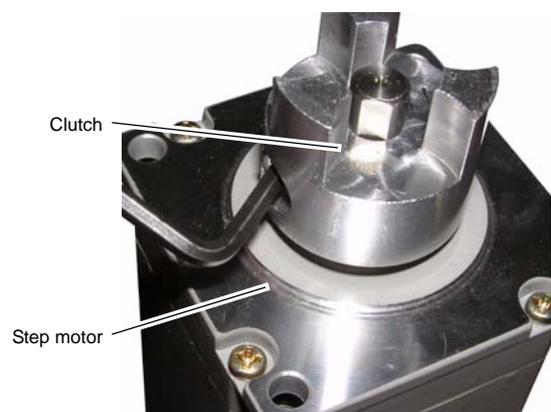
Illustr.4-7: Fasten clutch

- 4.1.8 Plug the other half of the clutch on the shaft of the step motor.



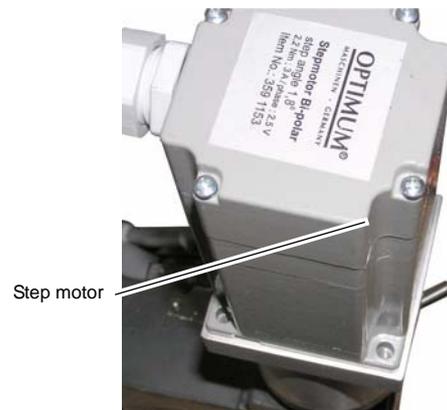
Illustr.4-8: Clutch on the motor

- 4.1.9 The clutch should be pushed on the shaft of the step motor as far as possible. Then fasten the clutch with an Allen key.



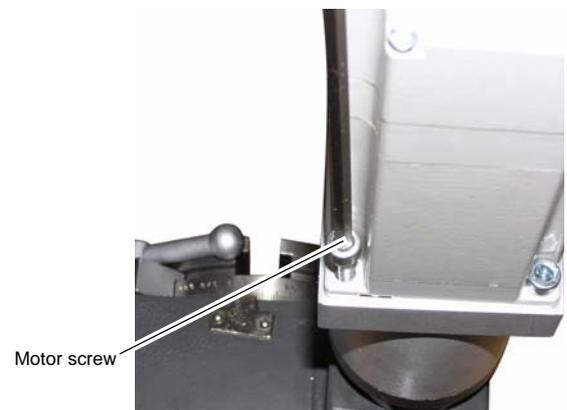
Illustr.4-9: Fasten clutch

- 4.1.10 Align the clutch of the step motor in a way that it fits with the counterpart in the housing. Then put the motor on the housing.



Illustr.4-10: Fit the step motor

- 4.1.11 Fasten the motor with the hexagon socket head screws on the housing.

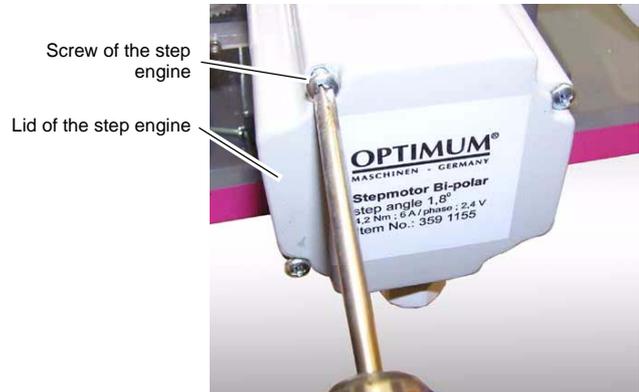


Illustr.4-11: Screw the motor

## 5 Installation of the step motors

### 5.1 Wiring

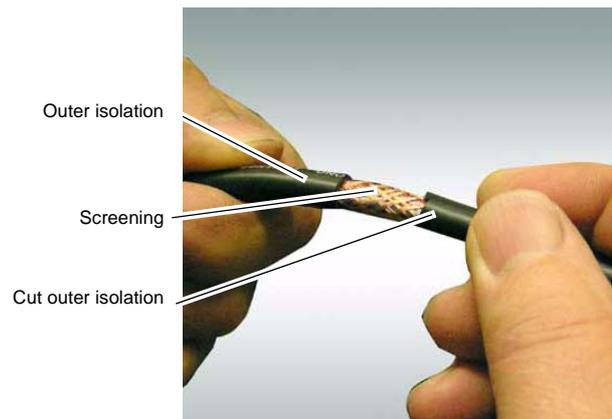
5.1.1 Open the lid of the step engine with a cross slot screwdriver.



Illustr.5-1: Open the lid of the step engine

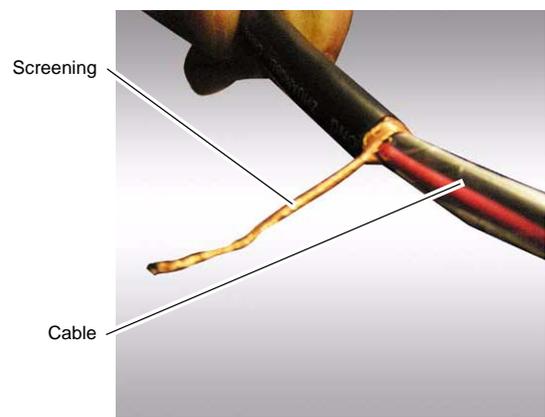
5.1.2 Remove the outer isolation of the cable and make sure that the lower isolation of the single conductor will not be damaged.

5.1.3 The dismantled part should have a length of about 6 cm.



Illustr.5-2: Remove outer isolation

5.1.4 Twist the fabric of the shielding.



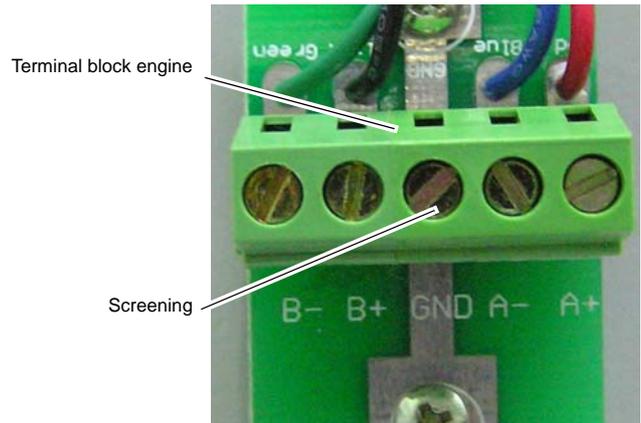
Illustr.5-3: Twist screening



### INFORMATION!

The shielding will be connected to the terminal block of the engine on one side.

- 5.1.5 The cables will be peeled off at a length of about 5 mm with insulation stripping tongs.
- 5.1.6 Plug and press wire terminations on the ends of the cable.
- 5.1.7 Plug the strain relief over the cable.
- 5.1.8 Insert the cable through the opening of the cover plate of the step engine.
- 5.1.9 Connect the cable to the engine and tighten the strain relief.
- 5.1.10 The twisted screening goes with the clamping "GND".



Illustr.5-4: Terminal block of the engine

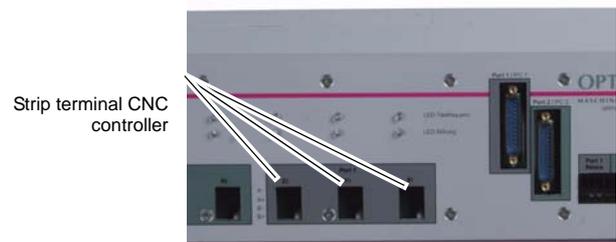
- 5.1.11 Fasten the lid of the step engine with the cross slot screwdriver.
- 5.1.12 Then cut the cable to the length which is required to connect it to the CNC controller.



Illustr.5-5: Screw the lid

- 5.1.13 Connect the cable to the CNC controller as required.

Motor		Controller
A-	to	A-
A+	to	A+
B-	to	B-
B+	to	B+
GND		



Illustr.5-6: Strip terminal CNC Controller VI



### INFORMATION!

Do not connect a screening or an earthed cable to the CNC Controller.



**INFORMATION!**

If the turning direction of one or several step motors for CNC operation via a CNC software is wrong, please exchange the respective connection on the step motor or on the CNC controller.

**Example:**

Motor		Controller
A-	to	B-
A+	to	B+
B-	to	A-
B+	to	A+
GND		

## 6 RT CNC

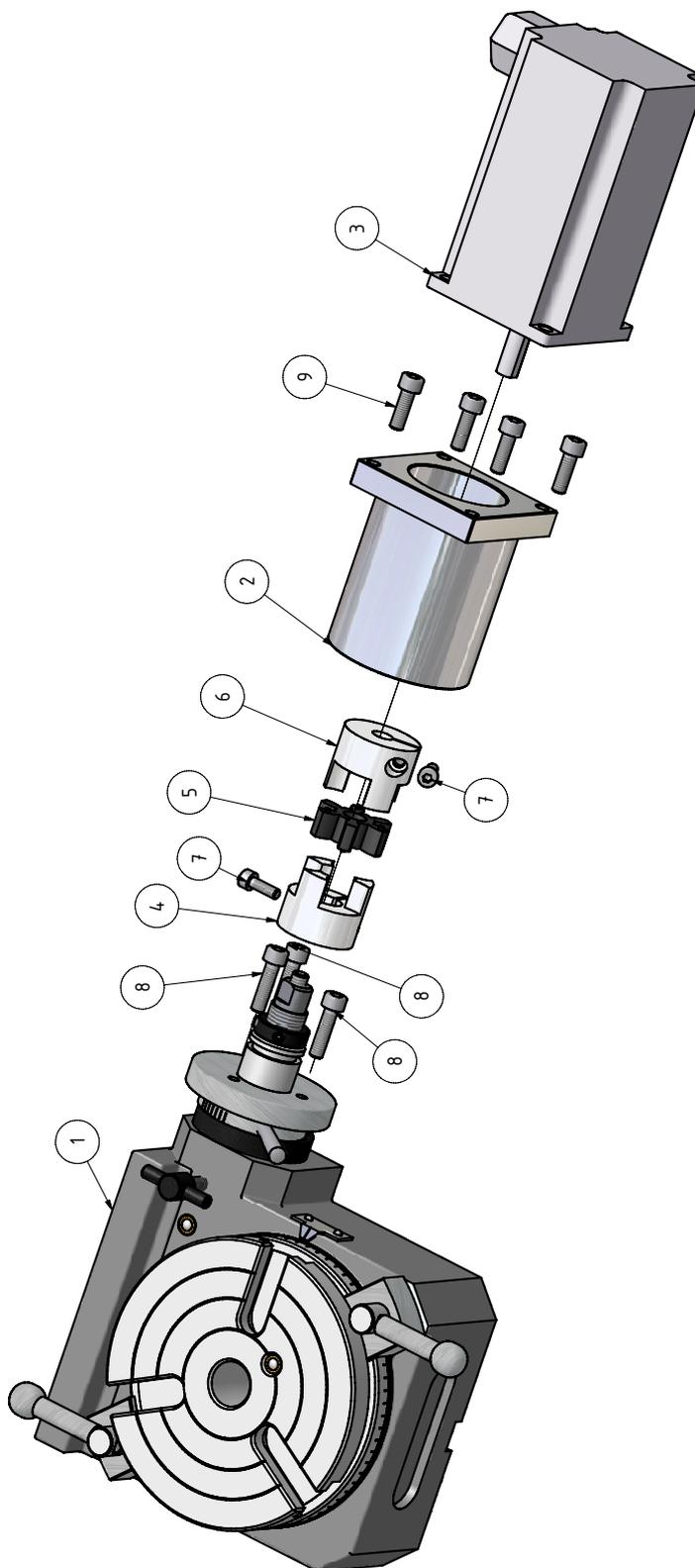


Abb.6-1: RT CNC

## 6.0.1 Ersatzteilliste - Spare part list

Pos.	Bezeichnung	Designation	Menge	Zeichnungs- nummer	Grösse	Artikel- nummer
			Qty.	Drawing no.	Size	Item no.
1	RT100/150	RT100/150	1			3356110 / 3356150
2	Gehäuse	Driver house	1			035705101
3	Schrittmotor	Stepmotor	1		23-H280-01EA	3573304
4	Kupplung1	Clutch1	1			033561104
5	Mitnehmer	Driver	1			033561105
6	Kupplung2	Clutch2	1			033561106
7	Schraube	Screw	2			033561107
8	Schraube	Screw	3		DIN 4762 M5x20	033561108
9	Schraube	Screw	4		DIN 4762 M5x15	033561109

## 7 Appendix

### 7.1 Copyright

© 2008

The documentation is copyright. All derived rights are also reserved, especially those of translation, re-printing, use of figures, broadcast, reproduction by photo-mechanical or similar means and recording in data processing systems, neither partial nor total.

The company reserves the right to make technical alternations without prior notice.

### 7.2 Terminology/Glossary

Term	Explanation
Adapter kit	Components
blow-back proof plastic tip hammer	A plastic tip hammer which is filled with sand which does prevent a spring-back when knocking.
Disassembly	Remove, relieve

### 7.3 Liability claims for defects / warranty

Beside the legal liability claims for defects of the customer towards the seller the manufacturer of the product, OPTIMUM GmbH, Robert-Pfleger-Straße 26, D-96103 Hallstadt, does not grant any further warranties unless they are listed below or had been promised in the frame of a single contractual agreement.

- The processing of the liability claims or of the warranty is performed as chosen by OPTIMUM GmbH either directly or through one of its dealers. Any defective products or components of such products will either be repaired or replaced by components which are free from defects. The property of replaced products or components passes on to OPTIMUM GmbH.
- The automatically generated original proof of purchase which shows the date of purchase, the type of machine and the serial number, if applicable, is the precondition in order to assert liability or warranty claims. If the original proof of purchase is not presented, we are not able to perform any services.
- Defects resulting of the following circumstances are excluded from liability and warranty claims:
  - Using the product beyond the technical options and proper use, in particular due to overstraining of the machine
  - Any defects arising by one's own fault due to faulty operations or if the operating manual is disregarded
  - Inattentive or incorrect handling and use of improper equipment
  - Non-authorized modifications and repairs
  - Insufficient installation and safeguarding of the machine
  - Disregarding the installation requirements and conditions of use
  - Atmospheric discharges, overvoltage and lightning strokes as well as chemical influences
- The following items are as well not subject to the liability or warranty claims:
  - Wearing parts and components which are subject to a standard wear as intended such as e.g. V-belts, ball bearings, illuminants, filters, sealings, etc.
  - Non reproducible software errors
- Any services which OPTIMUM GmbH or one of its agents performs in order to fulfill in the frame of an additional guarantee are neither an acceptance of the defects nor an acceptance of its obligation to compensate. Such services do neither delay nor interrupt the warranty period.
- Place of jurisdiction among traders is Bamberg.
- If one of the above mentioned agreements is totally or partially inefficient and/or null, it is considered as agreed what is closest to the will of the warrantor and which remains in the framework of the limits of liability and warranty which are predefined by this contract.

### 7.4 Disposal



Disposal of used electric and electronic machines

(Applicable in the countries of European Union and other European countries with a separate collecting system for those devices).

The sign on the product or on its packing indicates that the product must not be handled as common household waste, but that it needs to be delivered to a central collection point for recycling. Your contribution to the correct disposal of this product will protect the environment and the health of your fellow men. The environment and the health are endangered by incorrect disposal. Recycling of material will help to reduce the consumption of raw materials. Your District Office, the municipal waste collection station or the shop where you have bought the product will inform you about the recycling of this product.

