MAINTENANCE AND REPAIR

EMCO PC MACHINES

innovative machine tools

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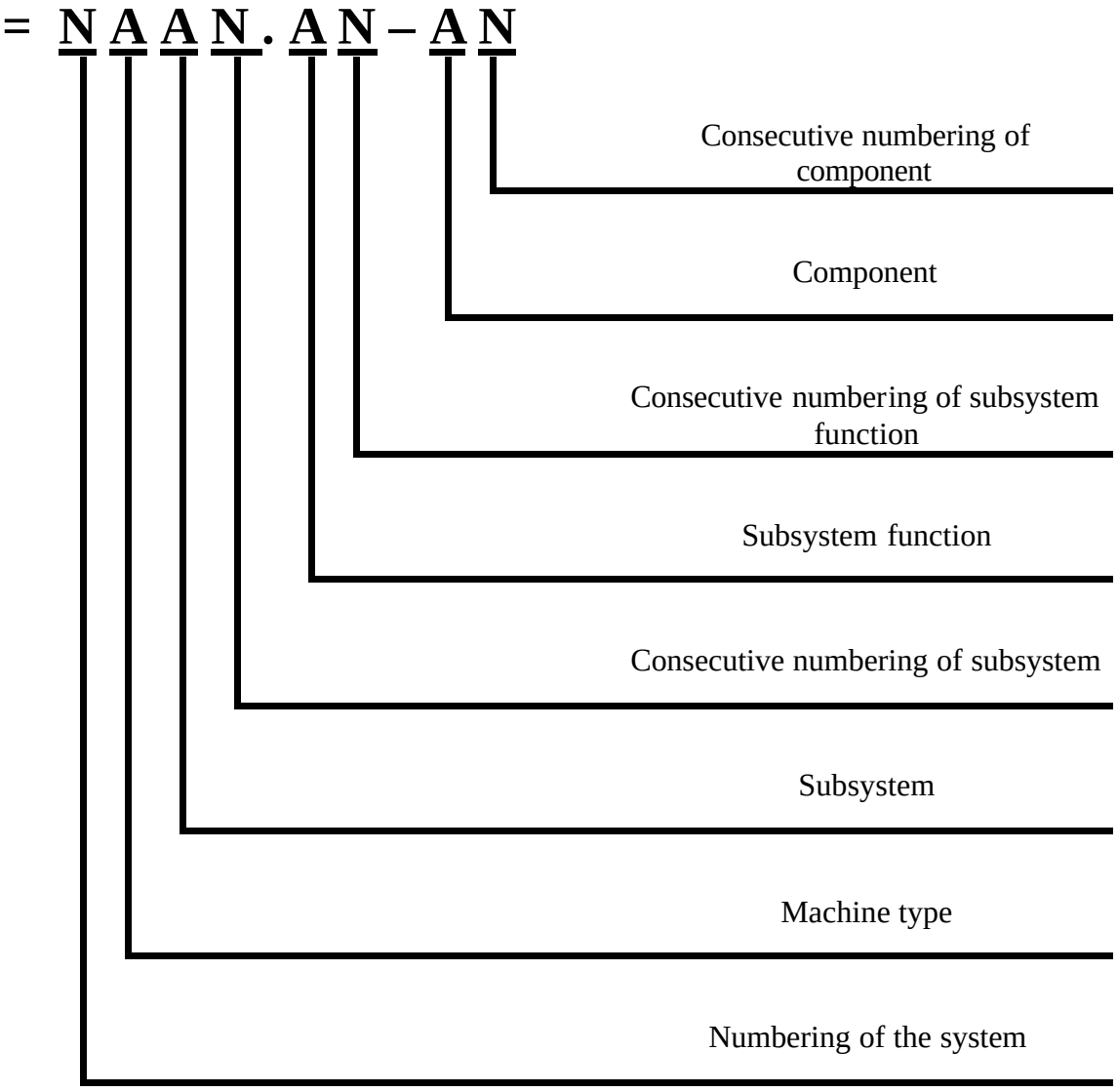
1.) Description of the Electrical Documentation:

1.1) Function Identification:

General Identification:

(Information: A ... alphanumeric sign, N ... numerc sign)



Machine Type:

= NAAN.AN-AN

D	Lathe
F	milling machine
M	automatic loading system (independent of a machine)

Subsystem, Lathe and Milling Machine:

= NAAN.AN-AN

A	General (Electrical cabinet, keyboard, etc.)
B	Maindrive with spindle
C	Axis drives with limit switches
D	Toolturret
E	Hydraulic
F	Oil extractor
G	Coolant pump
H	Central lubrication
L	Chip conveyor
M	Parts catcher
N	Warning lamp
P	Pneumatic accessories (i.e. automatic door)
R	Clamping device
S	Tailstock
T	Gaging station
V	Parts magazine, turn around station, indexing head, etc.
W	Driven tools
X	Barfeeder
Y	Loading systems (i.e. Emco Grip)
Z	Laser

Function of Subsystem:

= NAAN.AN-AN

A	Mechanical layout of electrical components
B	Electrical layouts
C	Incoming line
D	380V AC-Load (3-Phase)
E	220V AC-Load (Single Phase)
F	115V AC-Load (External Voltage)
G	AC drives, stop motors
H	DC drives
M	Control
R	Emergency off circuit
U	Regulation
V	Regulation and control
W	Monitoring

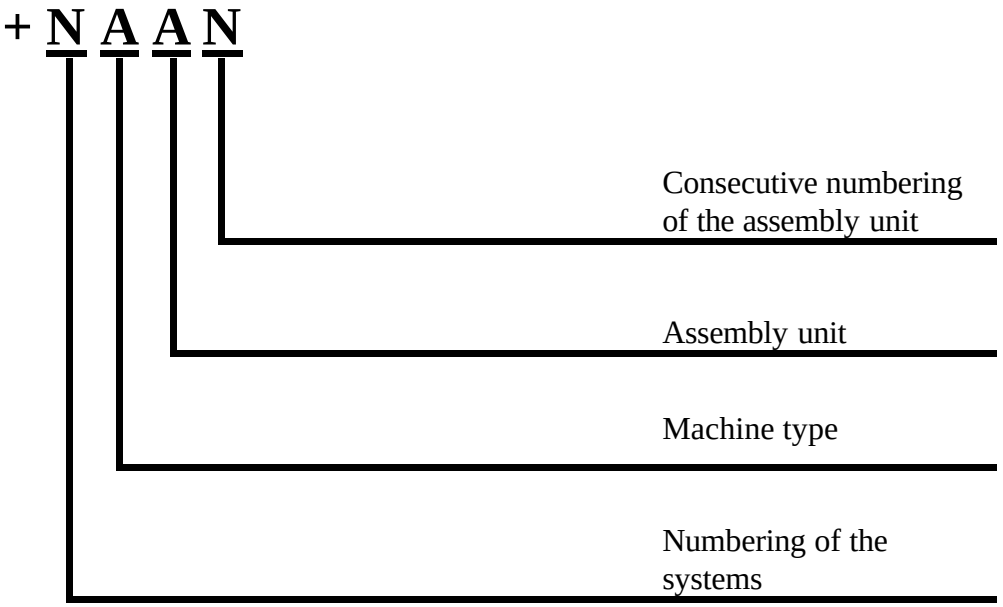
Component:

= NAAN.AN-AN

A	Assembly groups, sub-assembly groups
B	Converter of non-electrical to electrical units or reverse (encoder, tacho, pressure detector, etc.)
C	Capacitors
D	Binary elements, time delayed devices, memory devices
E	Miscellaneous (lamp, fan, etc.)
F	Protective devises (fuses, terminal overload protector, etc.)
G	Generator, current supply
H	Indication devices
K	Relay, Contactor
L	Inductors
M	Motors
N	Amplifiers, regulator
P	Gaging equipment, test equipment
Q	Power current – switching devices (motor overload, protectors, fuse brakers, etc.)
R	Resistors
S	Switch, selector (control switches, push button, limit switch)
T	Transformer
U	Modulator, converter of electrical in other electrical units
V	Electrical tubes, semiconductor (diods, transistors)
W	Transmitter, antennas
X	Terminals, plugs, sockets
Y	Electrical operated mechanical devices (brakes, valves, etc.)
Z	Filter

1.2) Location Identification:

General Identification



Machine Type see System Identification:

+ NAAN

Location Identification:

L	Electrical Cabinet
P	Control Panel
U	Electrical components mounted on the machine
V	Loading Systems (i.e. Emco Grip)
W	Raw and finish part magazine
X	Conveyor devices

2.) Control (PC):

The control of the machine is a regular PC that needs to consist of the appropriate Hardware and Software which is described in the following.

3.) Hardware:

The basics for running a PC-controled machine is a PC with an empty ISA-slot, which is needed for the PCCOM-card, a card made by EMCO. On the PCturn155 the card is already integrated in the machine.

PC

Videocard

USB

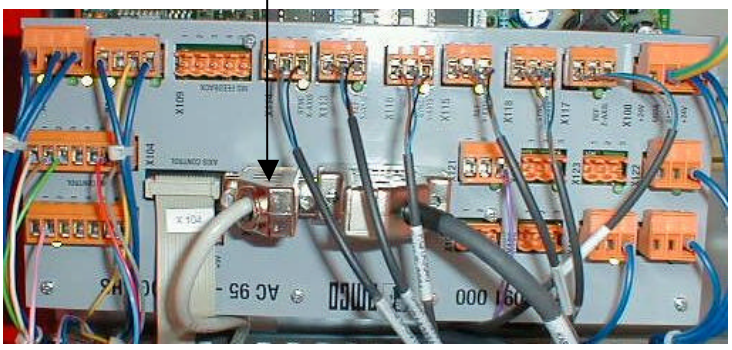
Machine Keyboard

PCCOM Card

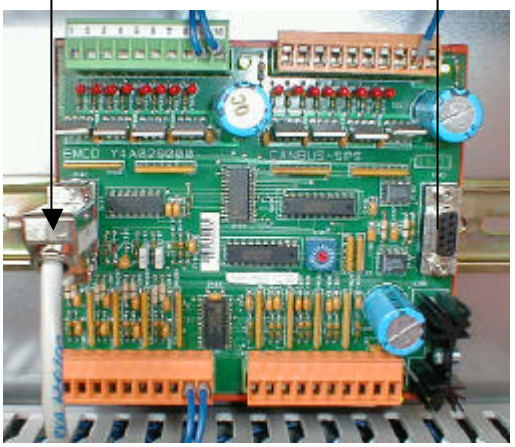
RS422

CAN BUS

CAN BUS



Axiscontroler (AC95)



Input/Output (I/O) -Boards

3.1) PCCOM-Karte:

The PCCOM-card is an interface between the PC and the machine. This card converts the digital signals of the PC into analog signals to send them to the machine.

The PCCOM-card is an ISA-card. Therefor a ISA-slot is needed for this card.

The PCCOM-card is not a plug and play (PNP) compatible card. Windows does not necessarily recognize this card automatically.
An unused hardware interrupt (IRQ) is needed and the necessary address needs to be adjusted which can be set on the PCCOM-card by jumpers.

The IRQ can be set in the configuration of the computer. Therefore the following input sequences need to be executed:

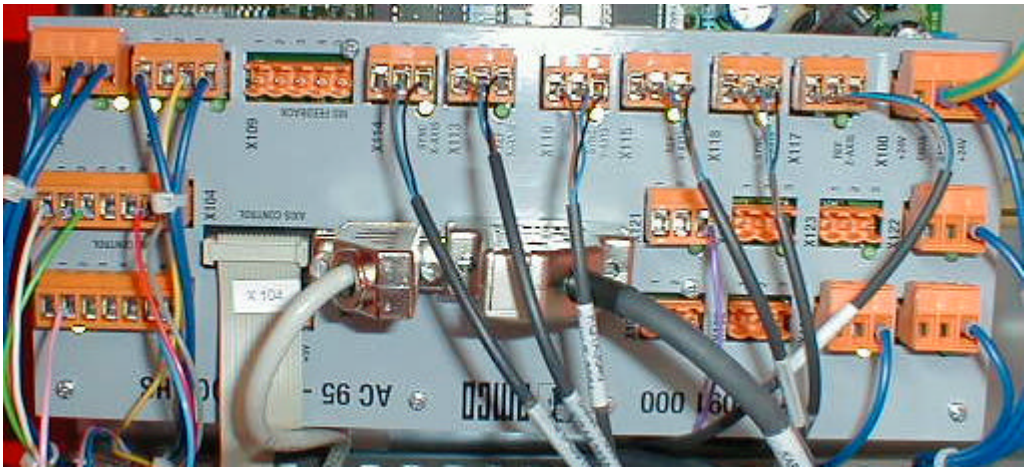
My Computer	(click right)
Properties	(click left)
Device Manager	(click left)
Computer	(click right)
Properties	(click left)

Here you can see which interrupt is not being used. This must be set in the configuration file of the WINNC. This is done the following way:

Start WinConfig (Start – EMCO-WinConfig)
Click the „key-symbol“ and enter the password „Service“.
Click on the „gear-symbol“

Click on general MSD and adjust the interrupt accordingly.

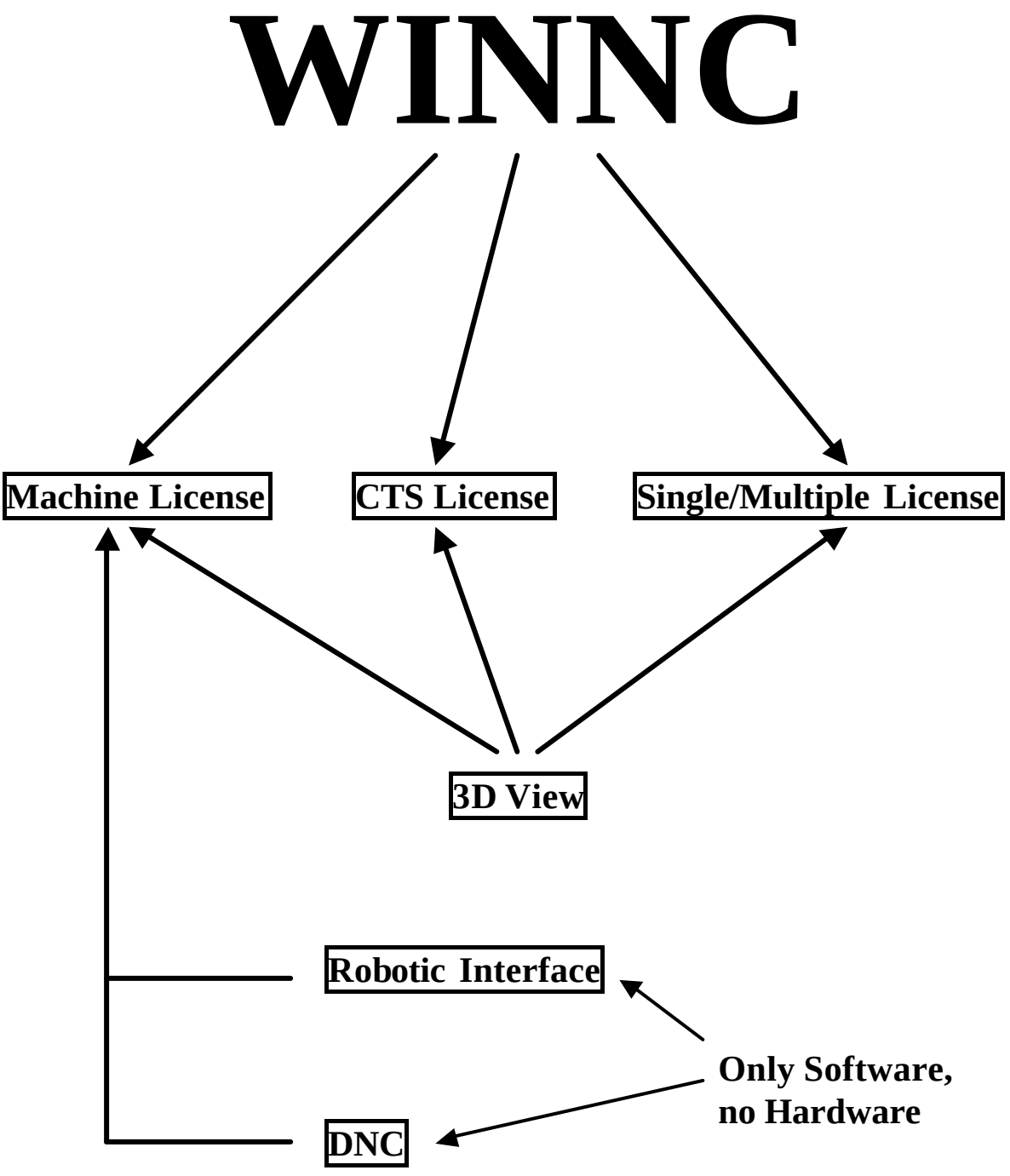
3.2) Axiscontroler (AC95):



The Axiscontroler receives the drives signal from the PCCOM-card and converts them into the respective signals needed for the drives. All set values to the axis- drives and the main spindle drive are output from this card. At the same time the Axiscontroler receives the feedback signals from the drives (encoder spindle, referencepoint switch and synchronisation switch axis). The AC95 can control a maximum of three axis and one spindle. If the machine uses more than three axis a second AC95 is needed (e.g. C-axis).

4.) Software:

To control a machine or for program training a software written by EMCO is used. The software is called WINNC and is available as different licences.



4.1) Machinelicense:

This license enables a machine to be operated e.g. PCturn155.

Operating system: Only WIN 9X
Does not work with WIN2000, WINNT, or WINXP

This license uses a real time module which was developed by Texas Instruments. After the operating system WIN98 the real time module was never used. This is the reason why the machine license cannot be used with an operating system higher than WIN98.

The machine license includes a software adaption for an automation interface. This interface is called “Robotics Interface“.

4.2) Single License:

With this license type the WINNC software can be operated on a PC that is not hooked up to a machine or that is not intended to operate a machine.

Operating system: works with every operating system up to WINXP without problems.

4.3) Multiple License:

This license is the same like a single license but allows the owner to install it on more than just one PC. (e.g. schools, classrooms)

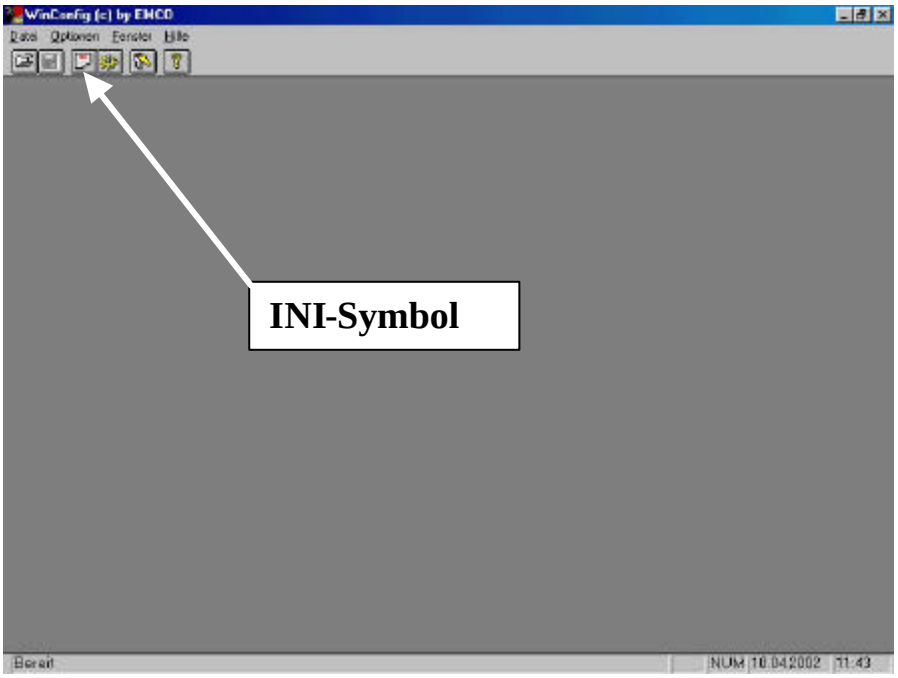
All licenses are available for the respective control system – control surface - (Fanuc, Siemens und EMCOtronic) erhältlich.

4.4) Diagnose Function (Debugger):

The Debugger is included in the WinNC Software and offers a possibility to monitor input- and output signals on the screen. The Debugger is called up in the WinConfig File.

To do so click “Start” in Windows

Click “Programs“ and select “EMCO“. Then click “WinConfig” to open the file.



Click the “INI-symbol“ and select “Test Options“.

Here you can find the PLC-Debugger. To activate it you need to click the box beside the name “PLC-Debugger” and a checkmark should appear.

Close the WinConfig File and save the changes.

When the control surface is started the Debugger window will appearin front of the control surface. In this window you can call up the signals you want to take a look at. The Debugger is only available in German. All the functions of the debugger will be described in the following section.

Click „Definieren“ (which means define)
Under „Step7 Variablen“ the type of signal to be loocked at can be defined (Input/Output)
“Anzeige“ selects the format (Decimal, Hexadecimal, Binary).
“Größe“ defines the size of the signal to be displayed (Bit, BYTE, WORD, DWORD).
“Adresse“ allows you to select the signal (e.g. A6.3 for Output 6.3).

5.) Main Spindle Drive:

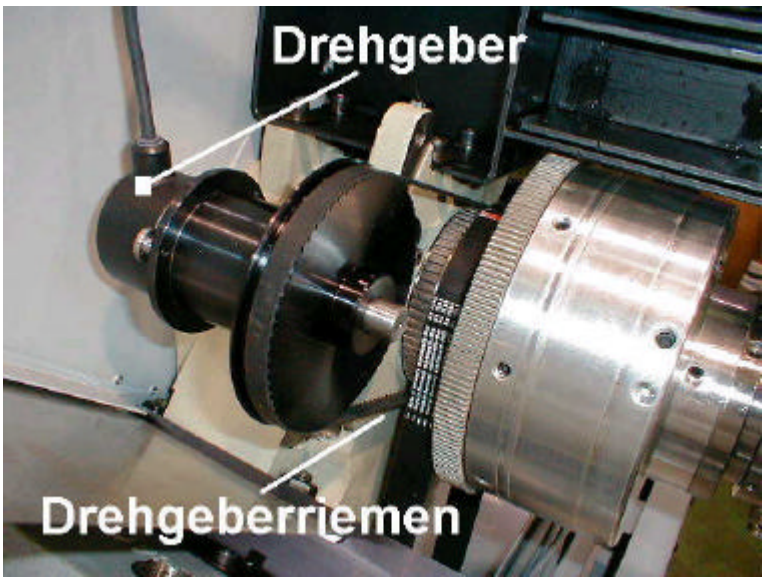
5.1) Frequency Converter:

Since the speed on an AC-Motor cannot be controled by changing armature or field voltage like on a DC-motor a different way to control speed is used. Basically an AC-motor`s speed can be regulated by changing the frequency of the motor voltage. The relationship between frequency and speed is: higher frequency – higher speed. Since the supply voltage to the machine is a fix frequency (Europe 50Hz, America 60 Hz) a AC motor cannot be controlled without any steps in between. These steps are the conversion of the supply voltage to a

frequency independent voltage – DC-voltage – and changing it back to a voltage of variable frequency to control the motor speed. When the DC-voltage is inverted the frequency can be selected individually and the speed can be controled. The control of the main motor regulation is done by a LENZE frequency converter which is supplied by a voltage of 3x400V. The control signals are sent to the frequency converter by the axiscontroler. When the motor decellerates it acts as an alternator. The energy that is produced during decelleration is burnt via a bleeder resistant.

5.2) Mainmotor:

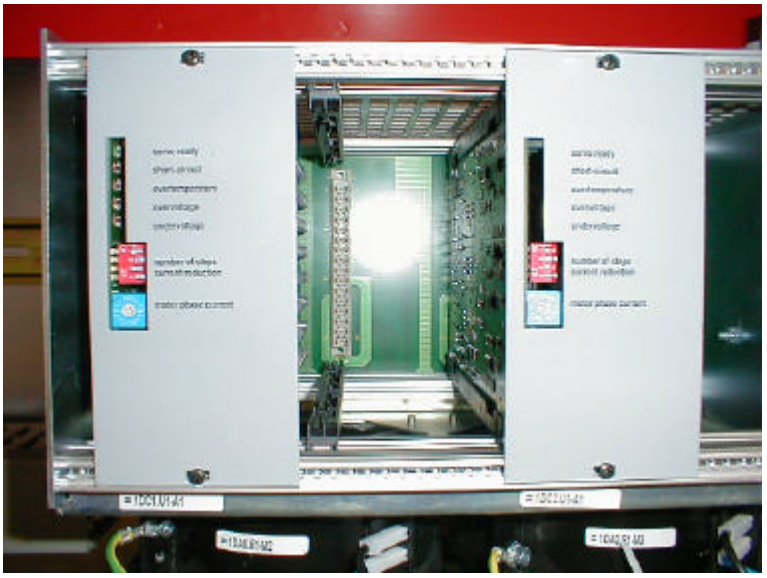
The motor is a regular 3 phase motor. There is no tacho or position encoder built in the motor.



The speed is monitored by a spindle encoder. It is driven by a toothed belt. Directly from the spindle. The signals are led to the axiscontroler which makes it a closed loop system. The encoder with its synchronisation signal is also responsible for the synchronisation of the axis and spindle during thread cutting and other speed dependent axis moves.

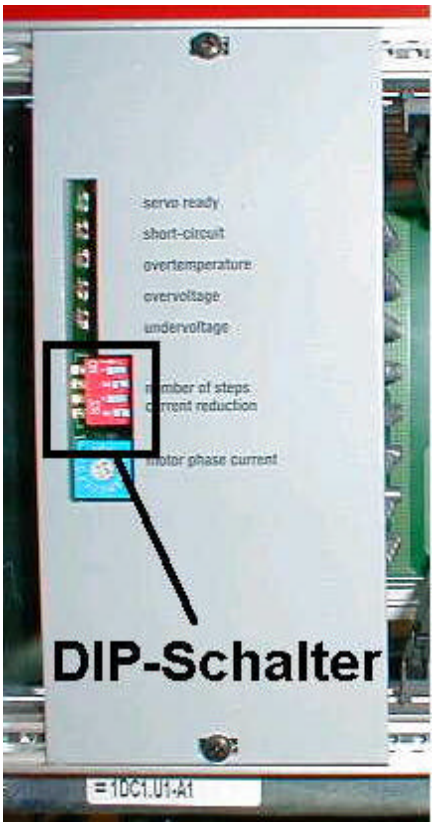
6.) Axis Drive:

6.1) Stepmotorboard:



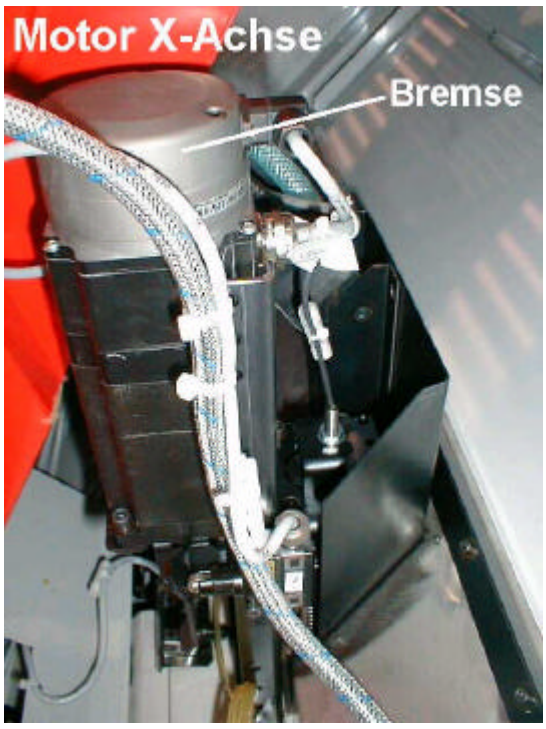
To be able to control the stepmotors correctly stepmotor cards are used which control the power and therefore the speed of the stepmotors. This stepmotorboards uses the signals from the axiscontroler to create the proper speed of the stepmotors. The voltage level of the

stepmotorboards is 130V DC. When a stepmotorboard is exchanged the proper DIP-switch setting must be observed. On the board itself LEDs indicate the condition of the board. One green LED indicates a ready condition and 4 red LEDs mark fault conditions like short-circuit, overtemperatur, overvoltage and undervoltage.



6.2) Stepmotor:

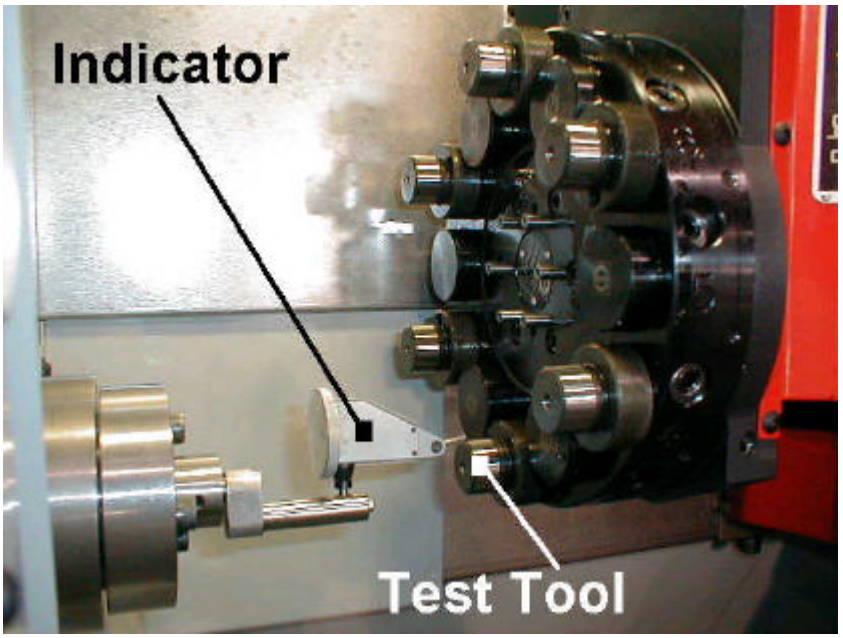
The axis are driven by stepmotors. The motors are built with three windings. Depending on which winding is powered up the motor will move step by step (name!). The resistant of the windings is a important indicator for faults in the motor. If the resistor in the winding is 0Ω a short circuit may be the reason. If the winding doesn't show a resitant at all it may be an open circuit maybe caused by a burnt winding. In both case the motor must not be hooked up to a stepmotorboard since it may cause the board to get damaged. The motor needs to be changed first.


Motor X-Achse
Bremse


Motor
Z-Achse

7A.) Reference Points PC Turn:

7A.1) X-Axis:



Mount the test tool on the tool turret and a indicator on the spindle

Move the axis in JOG mode respectively in INC mode until the test tool is in line with the centerline of the spindle. (When turning the spindle the indicator doesn't show a deviation in any direction)

Now the reference point value needs to be calculated.

To correct the values use the following procedures:

	Displayed value	(= value shown on the screen)
(-)	Actual value	(= value the axis is positioned in relationship to machine zero)
	Correction value	(= value by which the machine data needs to be changed)

Now **always subtract** the correction value from the value in the machine data. This will be your new reference point machine data value.

Example:

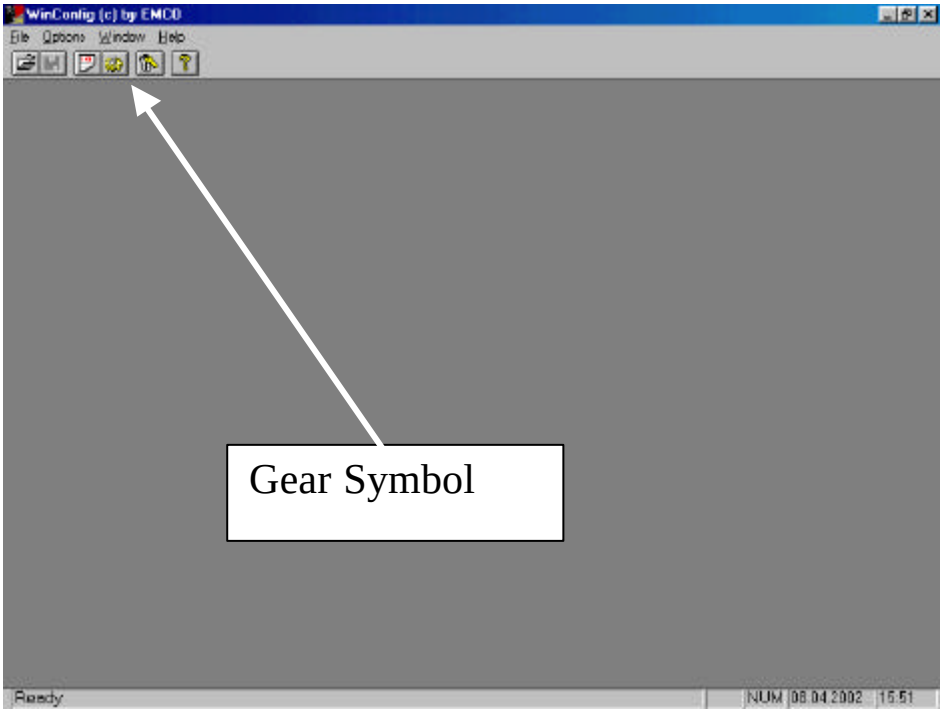
- 1,370	(Displayed value)	3,150
- 0,000	(Actual value)	- 0,000
- 1,370	(Correction value)	3,150

Since the test tool is in line with the spindle center line the „actual value“ is 0mm.

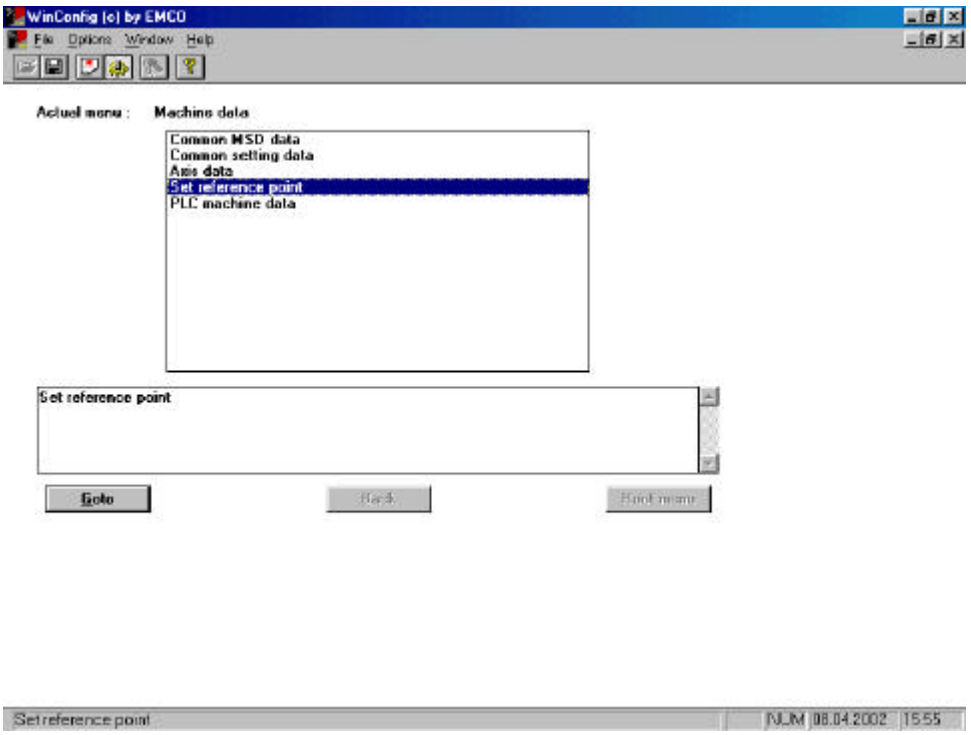
The displayed value is half (radius) of the value that is shown on the screen (diameter) when the axis is in line with the spindle center line.

To find the momentary active reference point value and to be able to change the value the WinConfig file needs to be called up.
“Start”, “Programs”, and “EMCO”

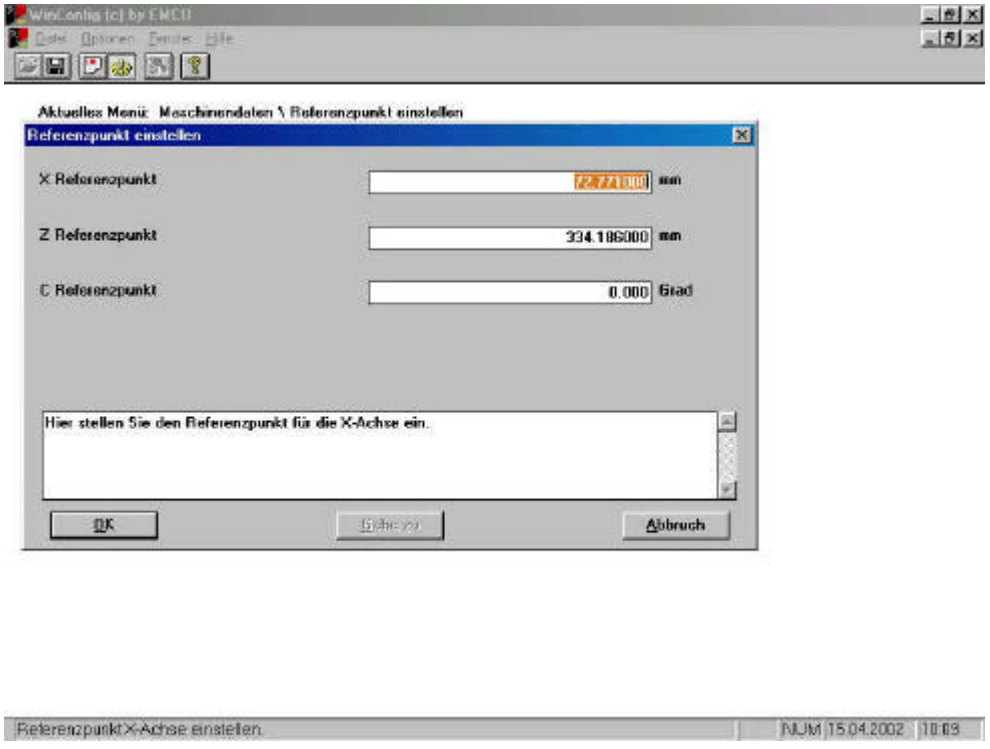
Win Config Main screen



Click the “Gear Symbol” for the reference point menu.



Click “Set reference point”



This screen shows the momentary set reference points (machine data value)

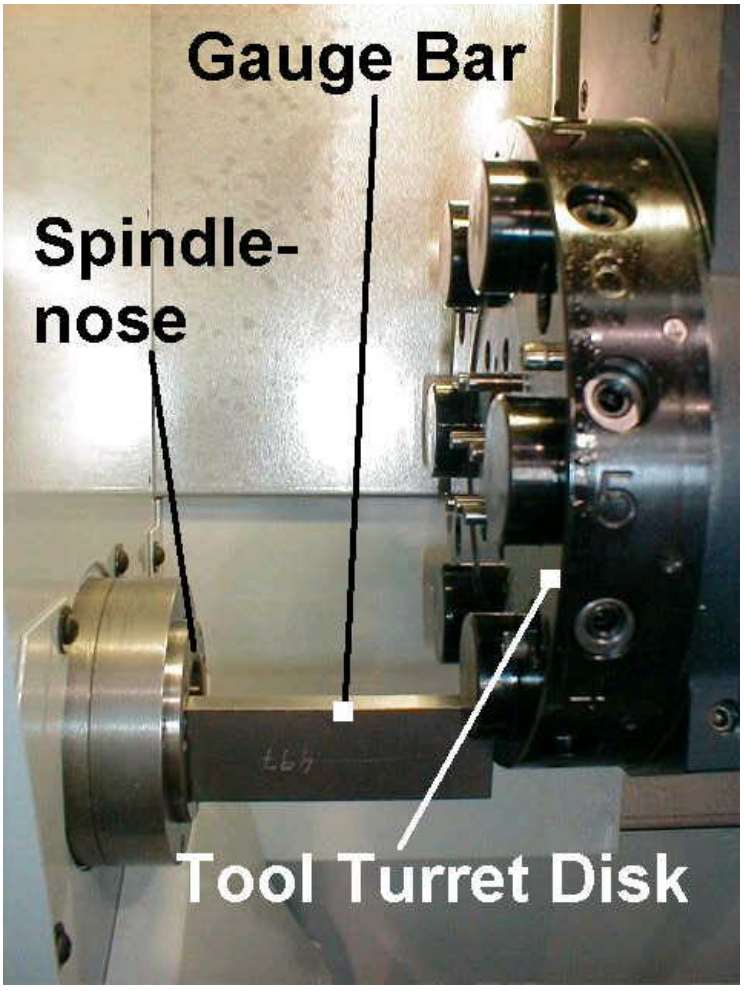
Calculation for the correct machine data value:

72,771	(Machine data value)	72,771
-(-)1,370	(Correction value)	- 3,150
74,141	(New Machine Data Value)	69,621

A value minus a negative value makes an addition.
A value minus a positive value is a subtraction.

Enter the new value into the line for Z reference point and save the changes when closing Win Config.

7A.2) Z-Axis:



A gauge block is used (e.g. 100mm). Move the axis to the position of the length of the gauge bar, 100 mm, and check the position with the gauge block. Move in JOG mode respectively in INC mode, until the gauge bar fits exactly between spindle nose and tool turret disk. It must be possible to move the gauge block without forcing it between the spindle nose and the tool turret disk. The gauge bar should hold on its own.

Now the new reference point value needs to be calculated.

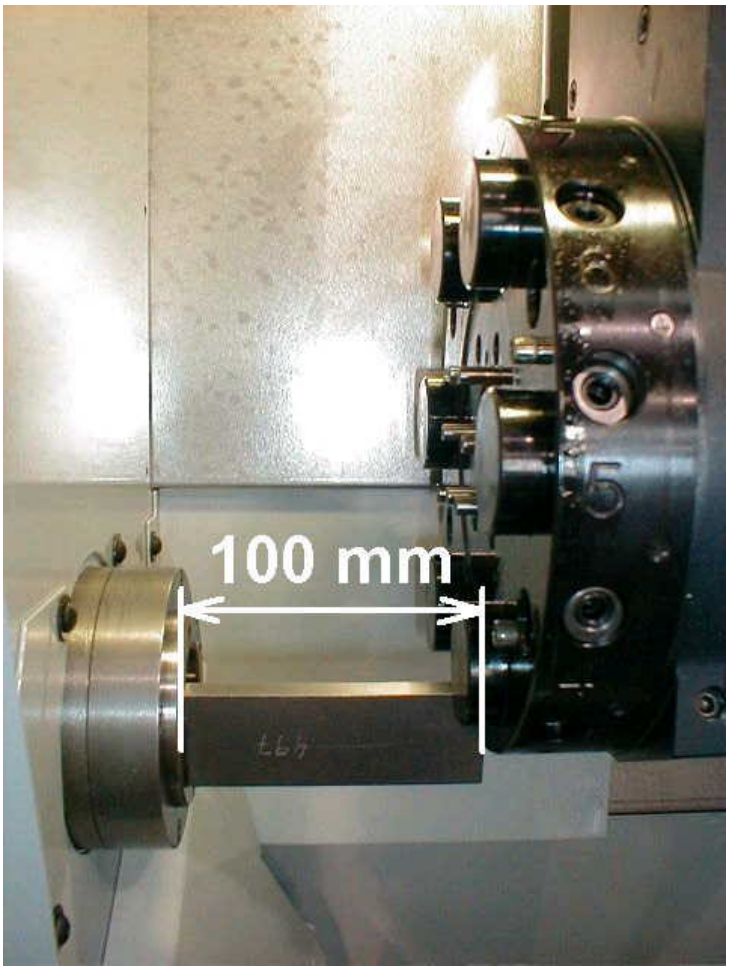
To correct the values use the following procedures:

	Displayed value	(= value shown on the screen)
(-)	Actual value	(= value the axis is positioned in relationship to machine zero)
	Correction value	(= value by which the machine data needs to be changed)

Now **always subtract** the correction value from the value in the machine data. This will be your new reference point machine data value.

Example:

98,456	(Displayed value)	102,724
- 100,000	(Actual value)	- 100,000
- 1,170	(Correction value)	2,132



Since the gauge bar is 100mm long the „actual value“ is 100mm.

The displayed value is the value shown on the screen when the gauge bar fits exactly between spindle nose and tool turret disk.

Now calculate the new machine data value:

To find the momentary active reference point value and to be able to change the value the WinConfig file needs to be called up.
“Start”, “Programs”, and “EMCO” (see Chapter Z-axis)

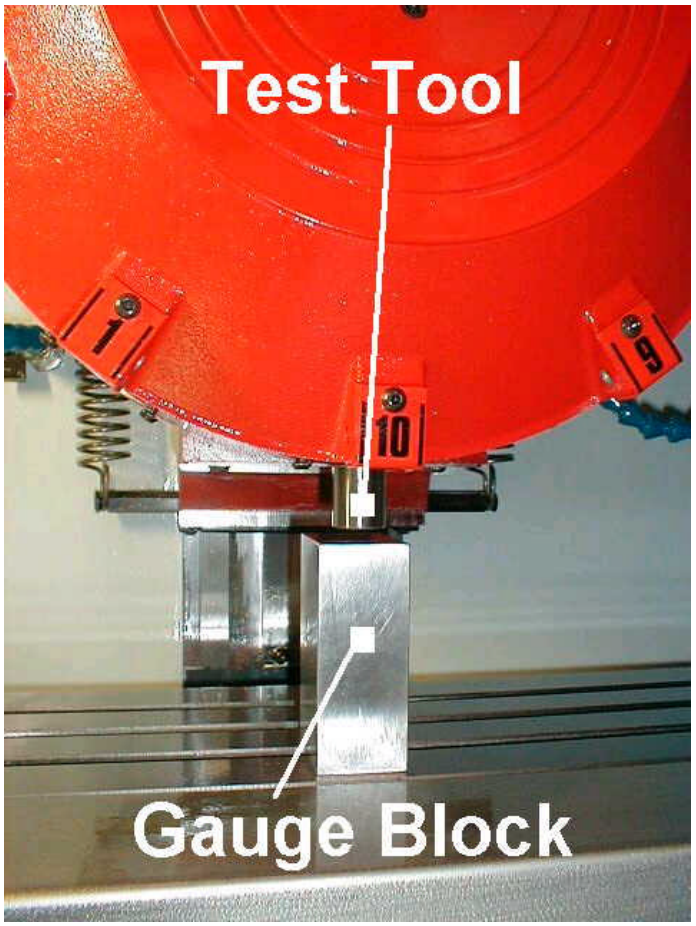
Calculation of the correct machine data value:

334,186	(Machine data value)	334,186
-(-)1,170	(Correction value)	- 2,132
110,733	(New Machine Data Value)	107,431

A value minus a negative value makes an addition.
A value minus a positive value is a subtraction.

Enter the new value into the line for Y reference point and save the changes when closing Win Config.

7B.) Reference Points PC Mill:



Put the test tool in the spindle (test tool diameter=25mm)

Use gauge block (e.g. 70mm X 100mm)

7B.1.) Z-Axis:

Place the gauge block on the table and move the Z-axis towards the gauge block (for smaller steps use the “Increment Mode”.

When the test tool hits the gauge block make sure that the block still can be removed and moved again under the test tool without any problems.

Now the new reference point value needs to be calculated.

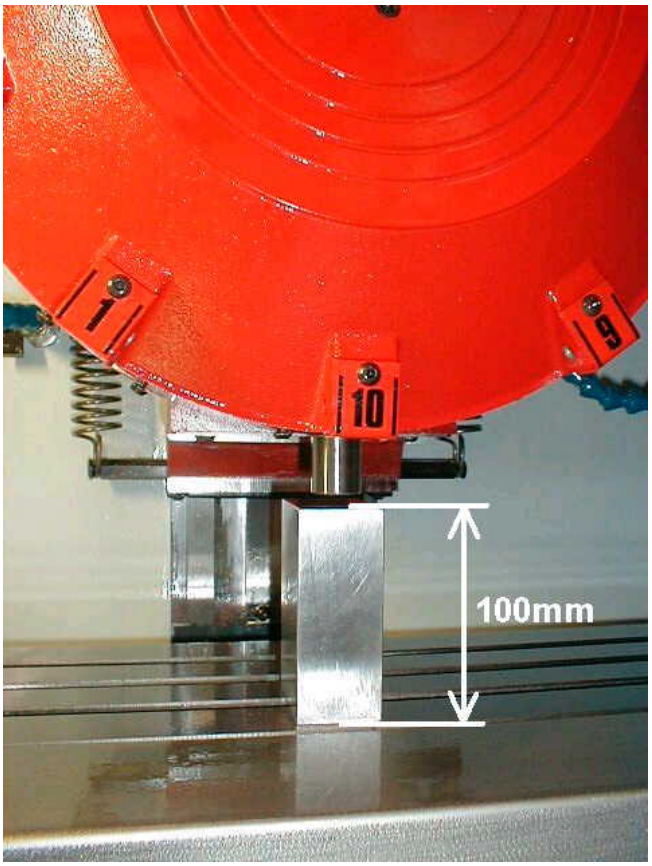
To correct the values use the following procedures:

	Displayed value	(= value shown on the screen)
(-)	Actual value	(= value the axis is positioned in relationship to machine zero)
	Correction value	(= value by which the machine data needs to be changed)

Now **always subtract** the correction value from the value in the machine data. This will be your new reference point machine data value.

Example:

98,630	(Displayed value)	103,150
- 100,000	(Actual value)	- 100,000
- 1,370	(Correction value)	3,150

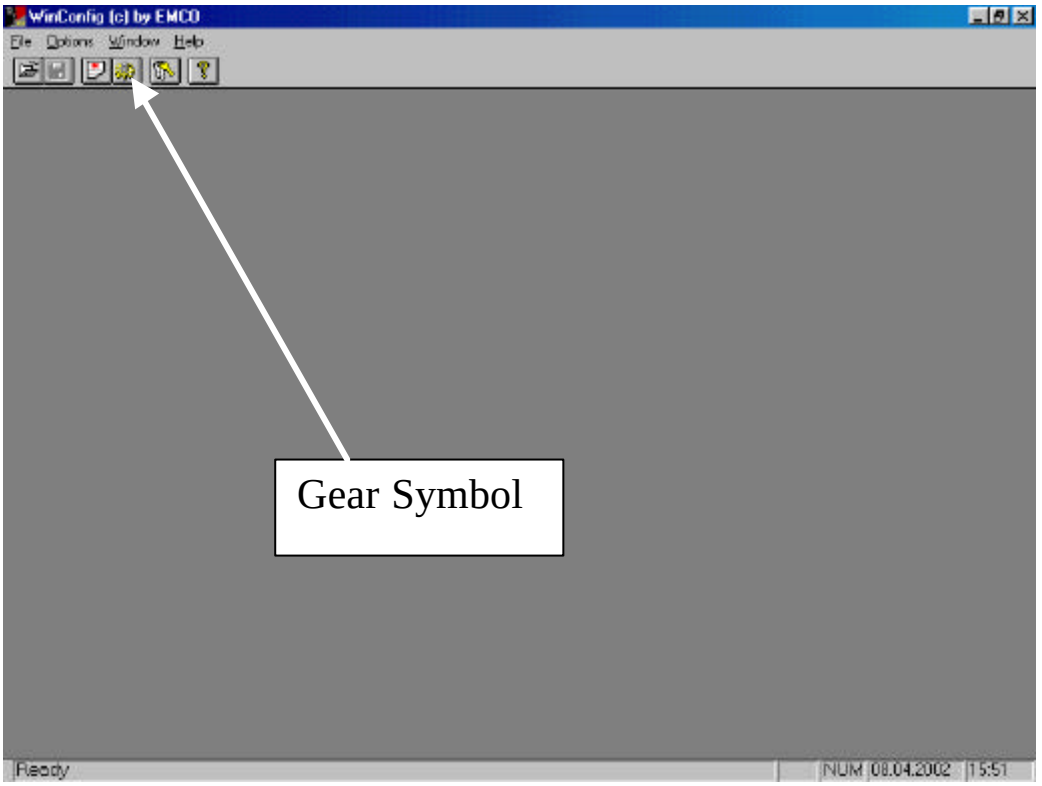


Since a gauge bar with 100mm is being used the “Actual value” is 100mm.
The “Displayed value” is the value the machine shows on the screen when the test tool hits the gauge bar.

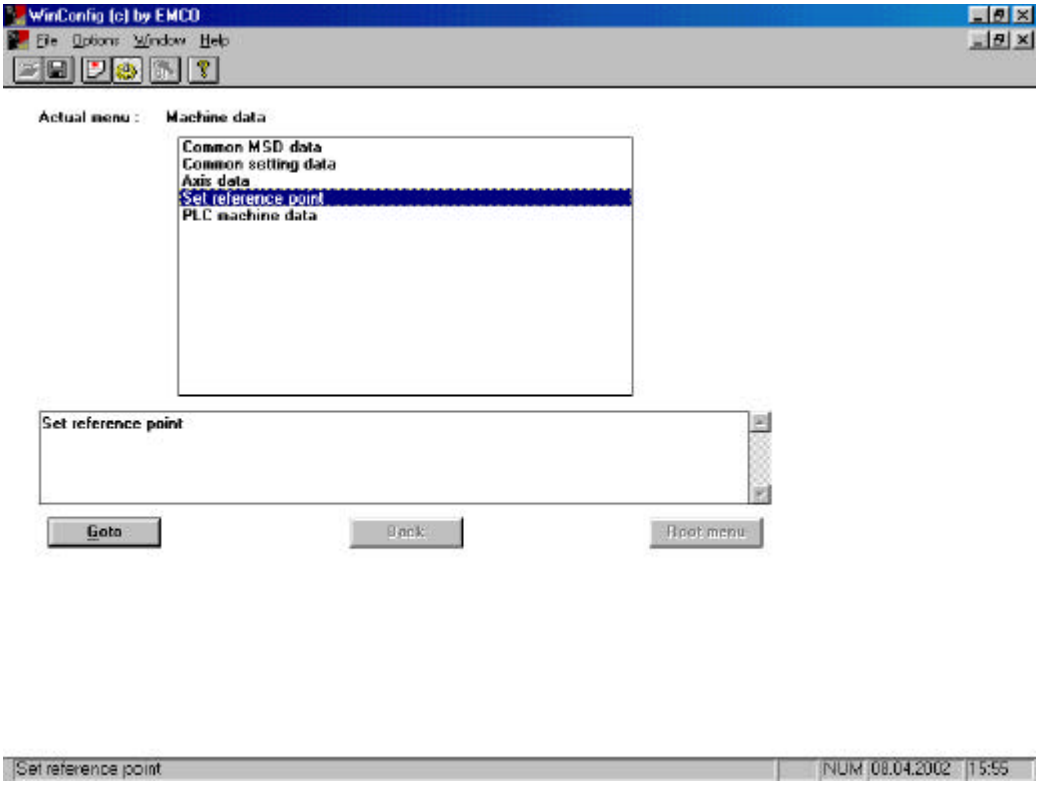
Now calculate the new machine data value:

To find the momentary active reference point value and to be able to change the value the WinConfig file needs to be called up.
“Start”, “Programs”, and “EMCO”

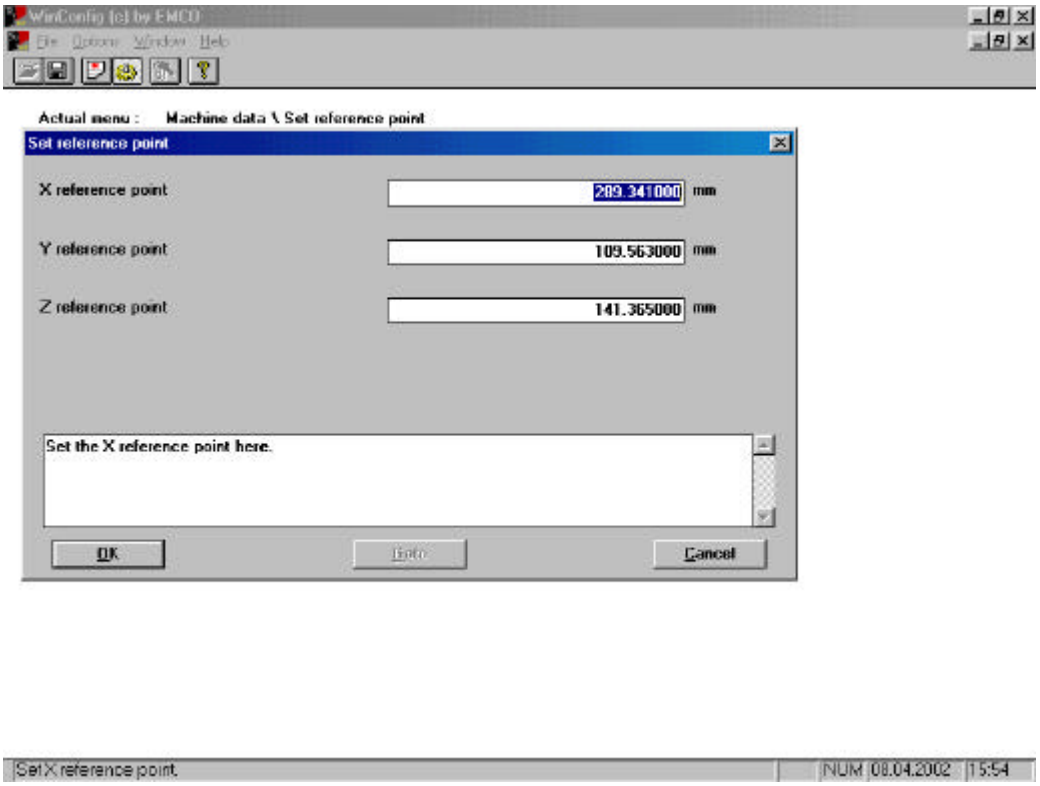
Win Config Main screen:



Click the “Gear Symbol” for the reference point menu.



Click “Set reference point”



This screen shows the momentary set reference points (machine data value)

Calculation for the correct machine data value:

141,365	(Machine data value)	141,365
-(-)1,370	(Correction value)	- 3,150
142,735	(New Machine Data Value)	138,215

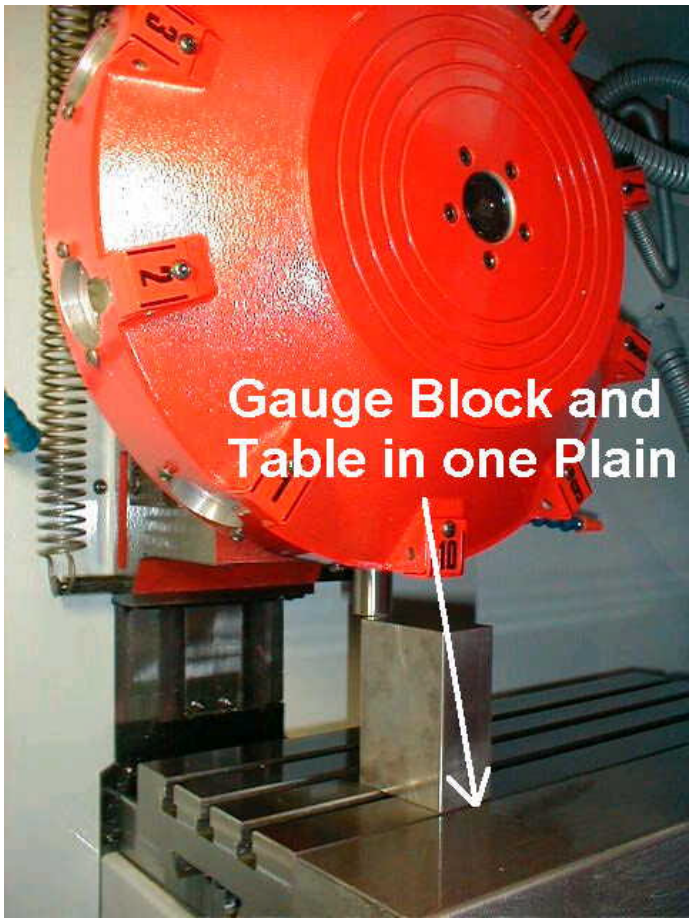
A value minus a negative value makes an addition.
A value minus a positive value is a subtraction.

Enter the new value into the line for Z reference point and save the changes when closing Win Config.

7B.2.) Y-Axis:

Place the gauge block on the table and move the Y-Axis towards the gauge block (for smaller steps use the “Increment Mode”.

Position the Y-Axis so that the gauge block and the table are in one plain.



Now the new reference point value needs to be calculated.

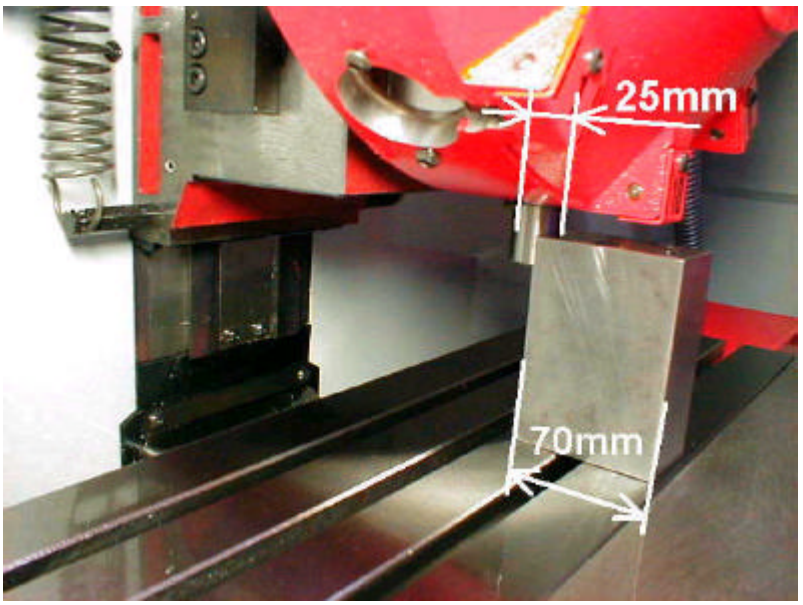
To correct the values use the following procedures:

	Displayed value	(= value shown on the screen)
(-)	Actual value	(= value the axis is positioned in relationship to machine zero)
	Correction value	(= value by which the machine data needs to be changed)

Now **always subtract** the correction value from the value in the machine data. This will be your new reference point machine data value.

Example:

81,330	(Displayed value)	84,632
- 82,500	(Actual value)	- 82,500
- 1,170	(Correction value)	2,132



Since the test tool has a diameter of 25mm the radius of 12,5mm has to be considered when evaluating the reference point value. Therefore the actual value is 82,5mm (test tool radius plus gauge block).

The “Displayed value” is the value the machine shows on the screen when the test tool hits the gauge bar.

Now calculate the new machine data value:

To find the momentary active reference point value and to be able to change the value the WinConfig file needs to be called up.
“Start”, “Programs”, and “EMCO” (see Chapter Z-axis)

Calculation for the correct machine data value:

109,563	(Machine data value)	109,563
-(-)1,170	(Correction value)	- 2,132
110,733	(New Machine Data Value)	107,431

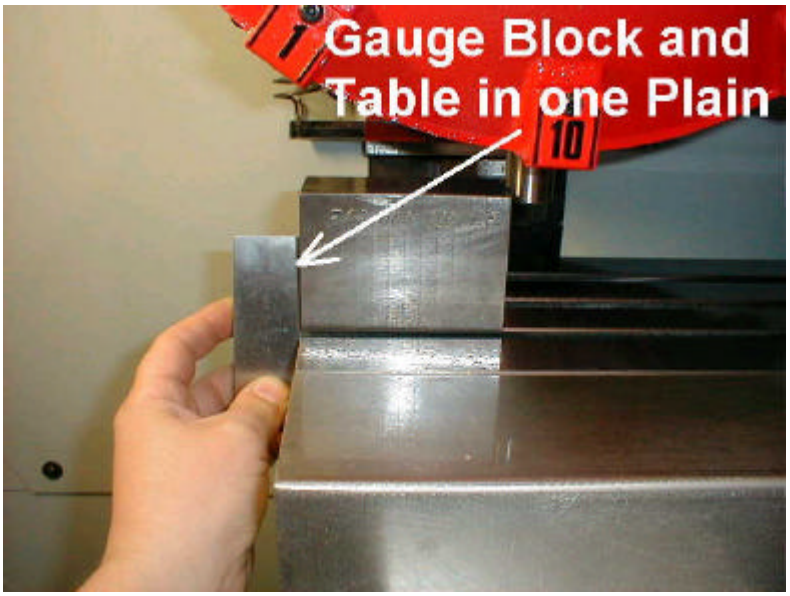
A value minus a negative value makes an addition.
A value minus a positive value is a subtraction.

Enter the new value into the line for Y reference point and save the changes when closing Win Config.

7B.3.) X-Axis:

Place the gauge block on the table and move the X-Axis towards the gauge block (for smaller steps use the “Increment Mode”.

Position the X-Axis so that the gauge block and the table are in one plain.



Now the new reference point value needs to be calculated.

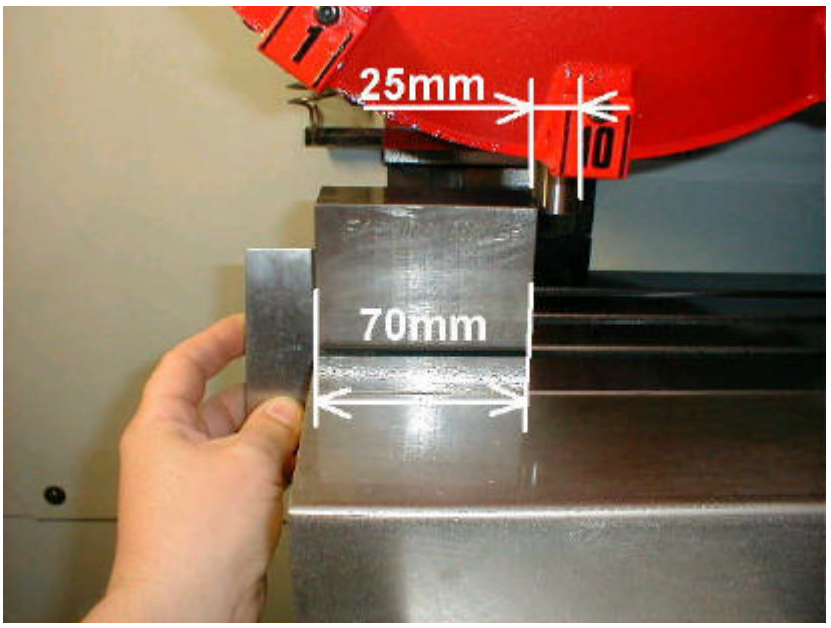
To correct the values use the following procedures:

	Displayed value	(= value shown on the screen)
(-)	Actual value	(= value the axis is positioned in relationship to machine zero)
	Correction value	(= value by which the machine data needs to be changed)

Now **always subtract** the correction value from the value in the machine data. This will be your new reference point machine data value.

Example:

81,330	(Displayed value)	84,632
- 82,500	(Actual value)	- 82,500
- 1,170	(Correction value)	2,132



Since the test tool has a diameter of 25mm the radius of 12,5mm has to be considered when evaluating the reference point value. Therefore the actual value is 82,5mm (test tool radius plus gauge block).

The “Displayed value” is the value the machine shows on the screen when the test tool hits the gauge bar.

Now calculate the new machine data value:

To find the momentary active reference point value and to be able to change the value the WinConfig file needs to be called up.
“Start”, “Programs”, and “EMCO” (see Chapter Z-axis)

Calculation for the correct machine data value:

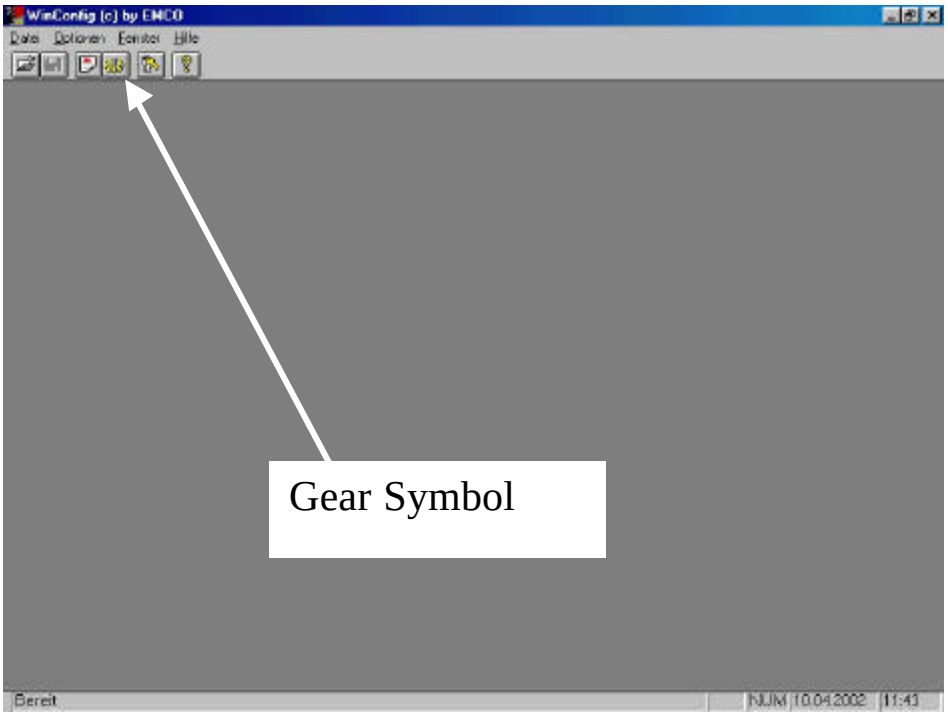
209,341	(Machine data value)	209,341
-(-)1,170	(Correction value)	- 2,132
210,511	(New Machine Data Value)	207,209

A value minus a negative value makes an addition.
A value minus a positive value is a subtraction.

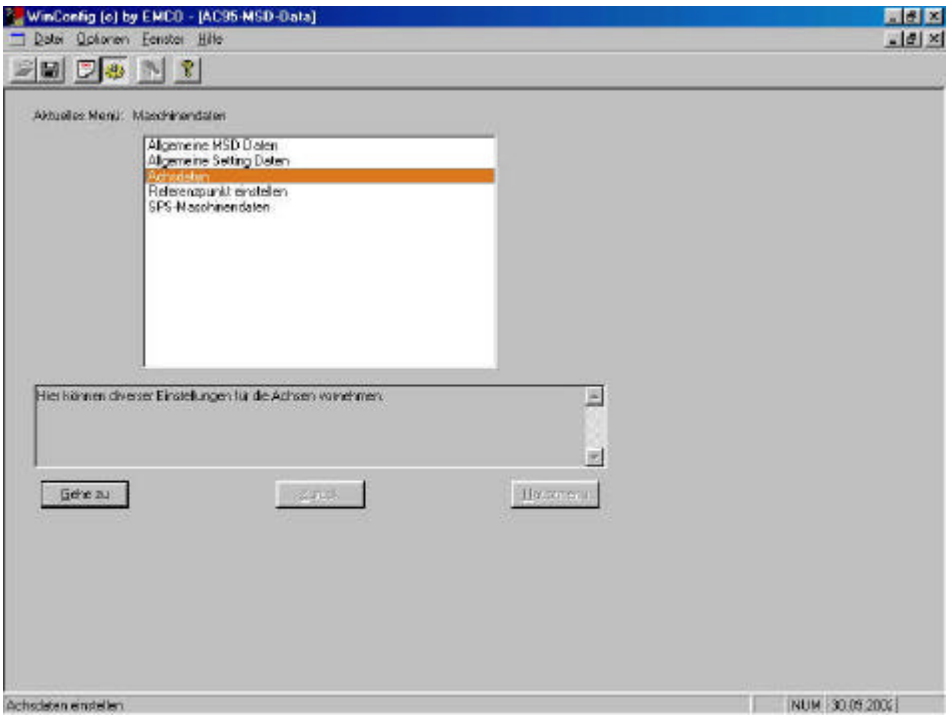
Enter the new value into the line for X reference point and save the changes when closing Win Config.

8.) Backlash:

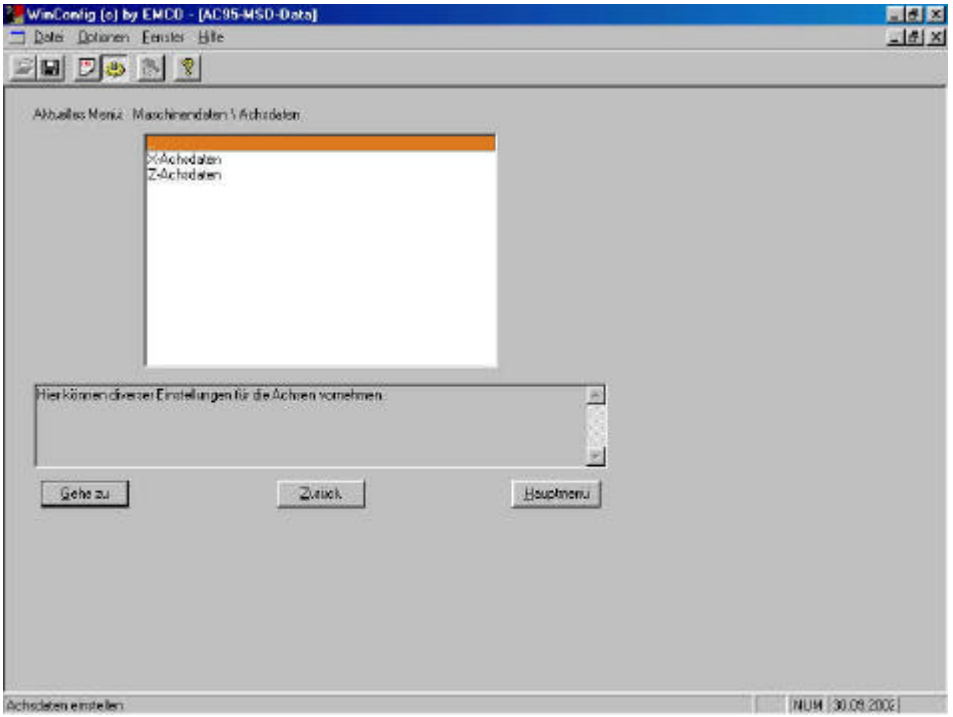
The backlash can be evaluated with an indicator. Put the indicator onto the axis to be checked and move the axis in INC100 or INC10 mode towards the indicator until it shows 0. Continue in the same direction for 5 steps and again 5 steps in the opposite direction. The difference to the =-mark on the indicator is the backlash to be compensated. To compensate the backlash use the following procedure.

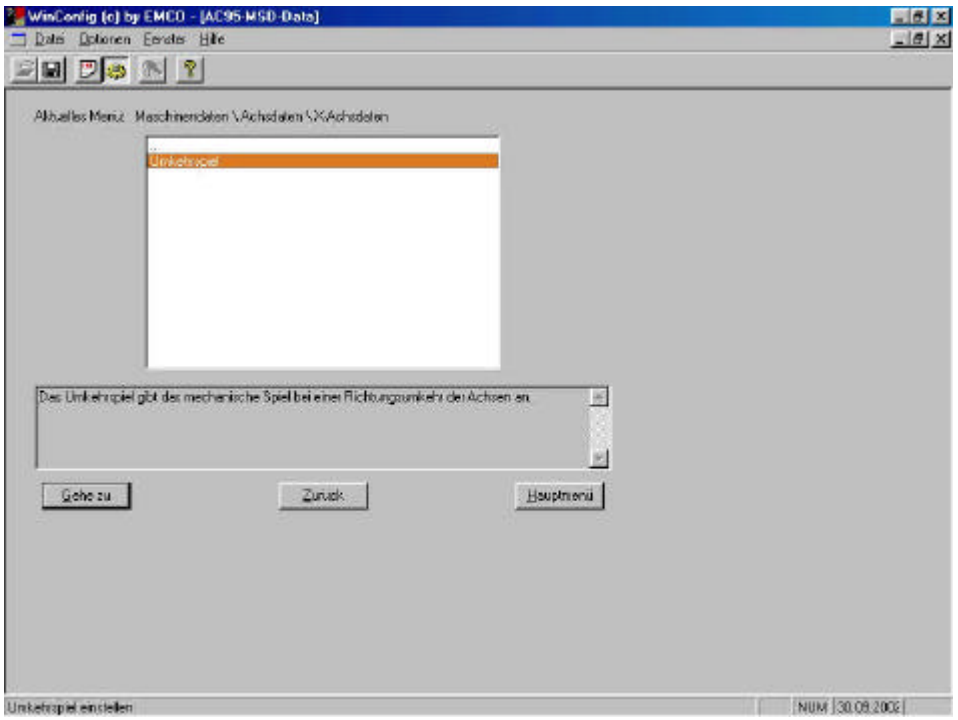


The machine data to compensate the backlash can be found in the WinConfig-file. Open the WinConfig-file by clicking , “Start“,, “Programs”, “EMCO“ and “WinConfig”. Then click on the gear symbol.

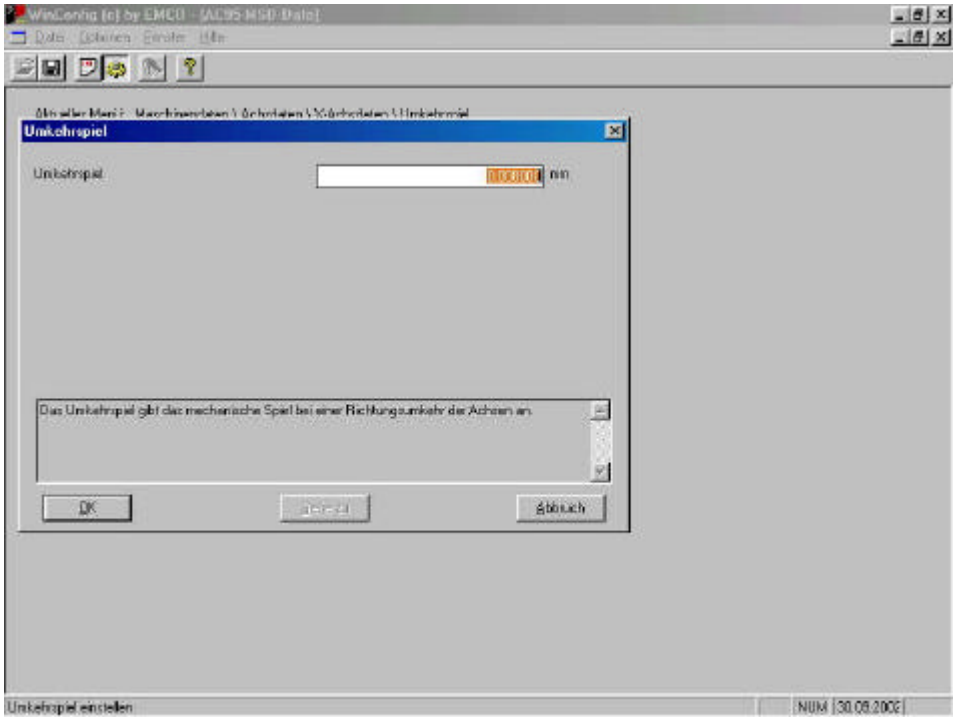


Under the menue “Axis data“ you can find the machine datas for the X- and the Z-axis.





Click “Reversing Play“ .



Now you can enter the value which was evaluated in mm. In the put the machine data diskette into the A-drive and close the file with saving the new machine datas to the disk. If the datas are not saved the correction of the machine data has not been activated. The datas are neither saved in the PC nor on the disk.