



**Short Form Operations Manual**

**Set-up-Software Work Bench v5  
for SC-610-Series Servo Controllers**

No. 900113 01/2003

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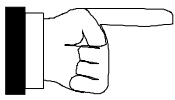

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## 1 About this Manual

This manual gives a brief overview of the major functions of the front-end tool named *Work Bench v5*! The given information should enable the user to set-up and run typical applications like Velocity Control and Position Control Mode. Further more basic tuning guidelines and Help-functions are given as well as recommendations for data backup. More detailed information and advices can be found in the help-file (press F1) of the Work Bench in parallel to this short form manual!

If the application requires further specific support please contact your local distributor or Harmonic Drive directly! It is recommended to inquire for support during commissioning the drive system in case you are not familiar with this drive system or if your expertise in terms of the software handling might be limited. Harmonic Drive is prepared to offer this support on special request.

### Legend:

	<p>This is an <b>INFORMATION</b> sign.</p> <p>By observing this information whilst installing the drive future-operating problems may be avoided.</p>
	<p>This sign means <b>ATTENTION</b>.</p> <p>Information in an ATTENTION box must always be observed otherwise dangerous situations for equipment and personnel may result.</p>

## 2 Introduction of Work Bench

The front-end tool *Work Bench v5* is a software package designed for setting up SC-610-series servo controllers. These servo controllers are prepared to drive the Harmonic Drive AC-servo actuators (ex. FHA-C-series). The software as well as the documentation is supplied on CD-ROM or via the Internet.

[www.harmonicdrive.de](http://www.harmonicdrive.de) -> for product information

[www.supportme.net/harmonicdrive](http://www.supportme.net/harmonicdrive) -> for downloading the Work Bench and Firmware

Major functions are:

- Drive set-up with the help of the commissioning wizard
- Auto-tune and fine-tune functions
- PLC-programming
- Programming of 16 or up to 256 pre-set positions
- JOG-Mode
- Data-Recording
- Parameter-Backup
- Extensive Help functions incl. Supportme.txt for Email
- ActiveX library available for interfacing to PC-programming environment

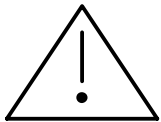
### 3 System Requirements

**Hardware requirements (minimum):**

Processor: Intel Pentium / 133 MHz  
RAM: 32MByte  
Hard Disk Space: 40Mbyte  
Screen: 800 x 600 (min.)  
Recommended: Intel Pentium III, 64 MB RAM, 200 MHz, and 60MB hard disk space free

**Software requirements:**

Recommended: Windows 98, Windows ME,  
Windows NT (Service Pack 6), Windows 2000 or Windows XP



**The Internet Explorer 4SP2 or higher must be installed! Explorer 5.5 and Service Pack 6 are recommended to avoid problems with NT4.0!**

### 4 Installation Guidelines

Please contact your administrator prior to installation in order to check your privileges for executing a new software installation.

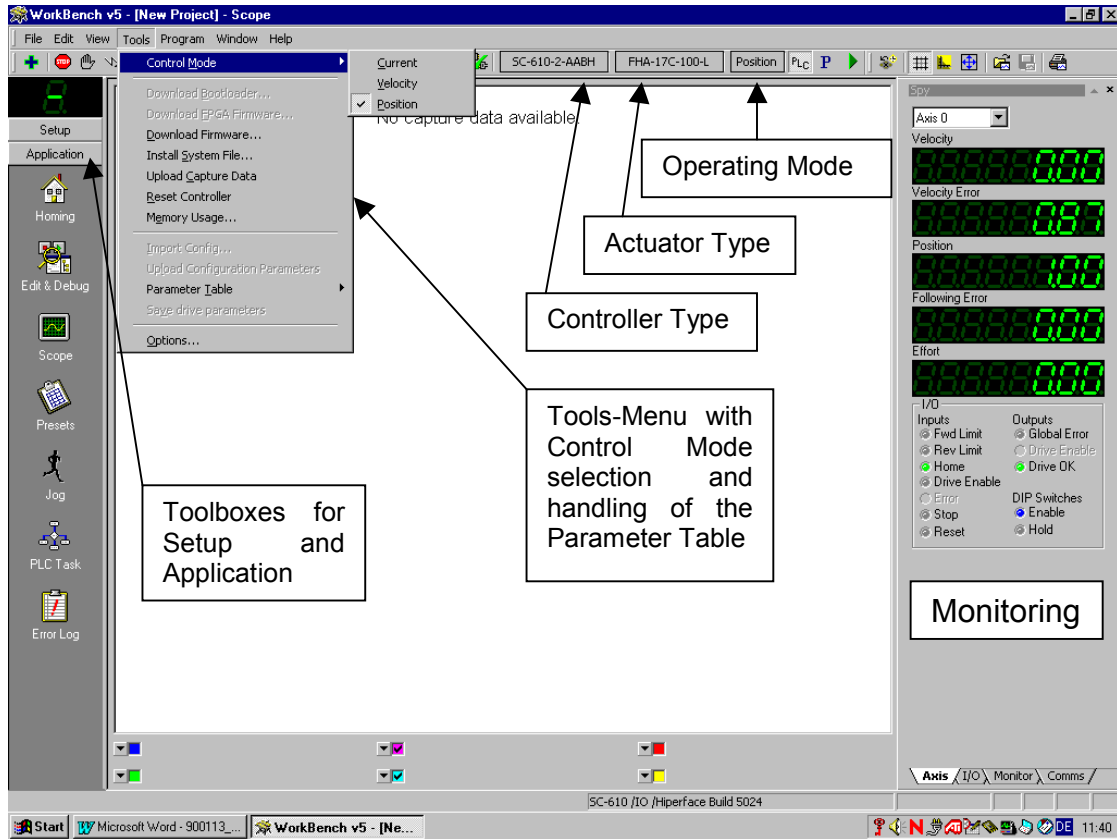
To install the Work Bench software on your computer's hard disk, please follow the sequence described below:

- 1.) Start Windows. Make sure, that no other programs are running, while Installation of Work Bench is done.
- 2.) Place Installation CD ROM in your computer's CD ROM drive.
- 3.) Look for your CD ROM drive and double click on Setup\_ xxxx.exe. (xxxx: Build version)
- 4.) Please proceed according to the demands from the installation process, given by the install shield.
- 5.) Reboot your computer after successful installation

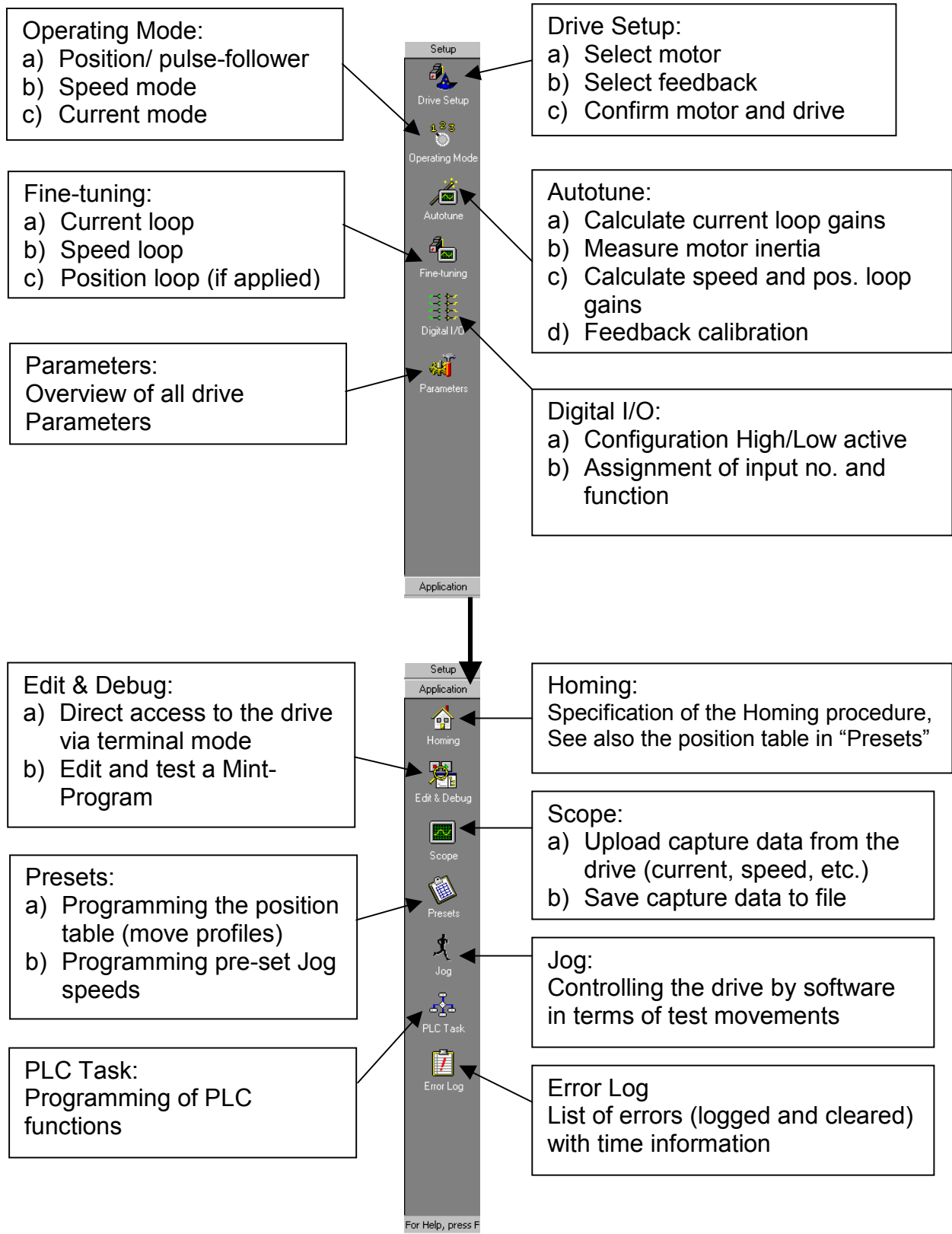
After installation process is finished, a Work Bench Icon is created on your desktop. Double clicking this icon will start the Work Bench set-up program.

## 5 Software Structure

### 5.1 Main Menus



## 5.2 Tool Boxes (Set-up and Application)



### 5.3 Monitoring

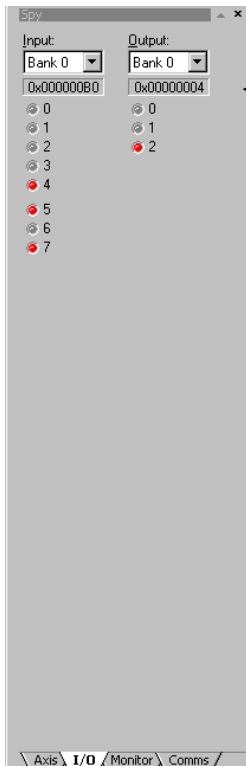
The monitor functions can be enabled by select “Scope” from the “Application” toolbox!

#### Axis-Tab



Fixed configuration for indication of major axis condition in ex.: Velocity, Position, Inputs, Outputs and Dip-switches

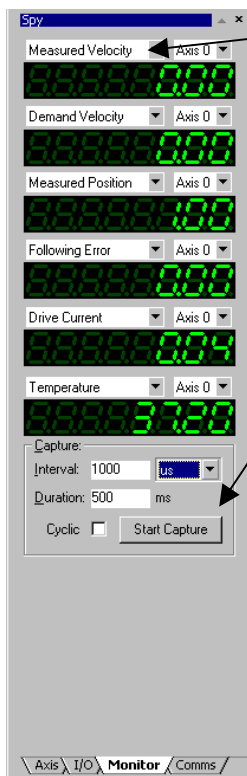
#### I/O-Tab



Fixed configuration showing each input and output condition for diagnostic purposes. Please refer to “Digital I/O” in the tool box “Application” for programming the digital I/Os!



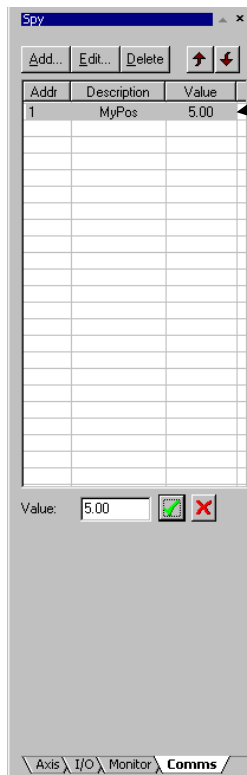
Monitor Tab



Flexible configuration can be done depending on the users request. Max. 6 parameters can be indicated simultaneously.

All above selected parameters can be captured and saved on file by "Start Capture". The time range must be specified before capturing.

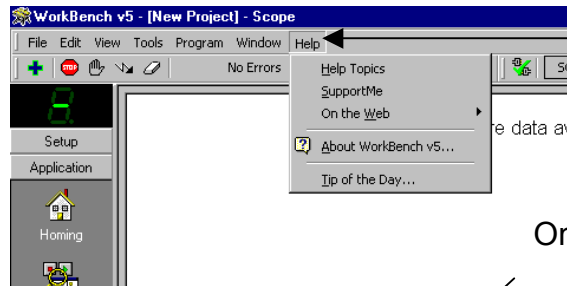
Comms-Tab



Allows specifying variables inside the comms-array, which can be accessed via the serial interface at single axis applications or by multi-drop wiring between each connected drive. Please refer to Online-Help Index "Comms" or "Comms Protocol"!

## 5.4 Help-Functions

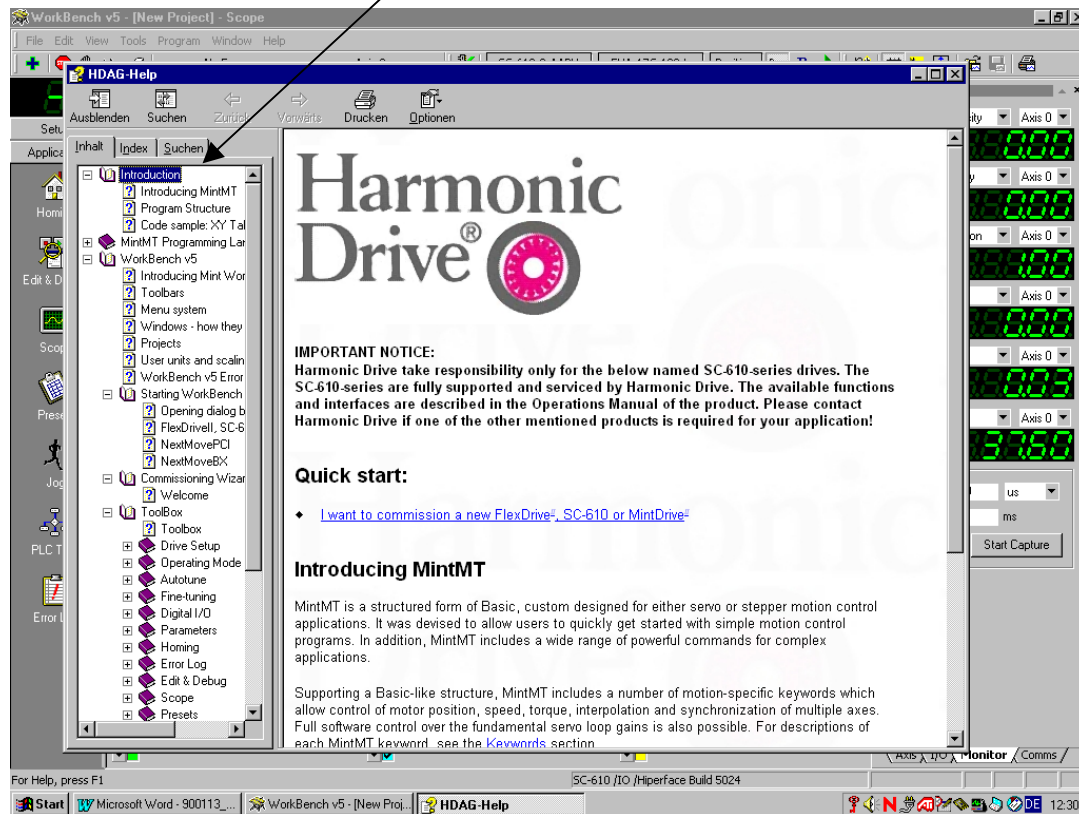
### 5.4.1 Online-Help



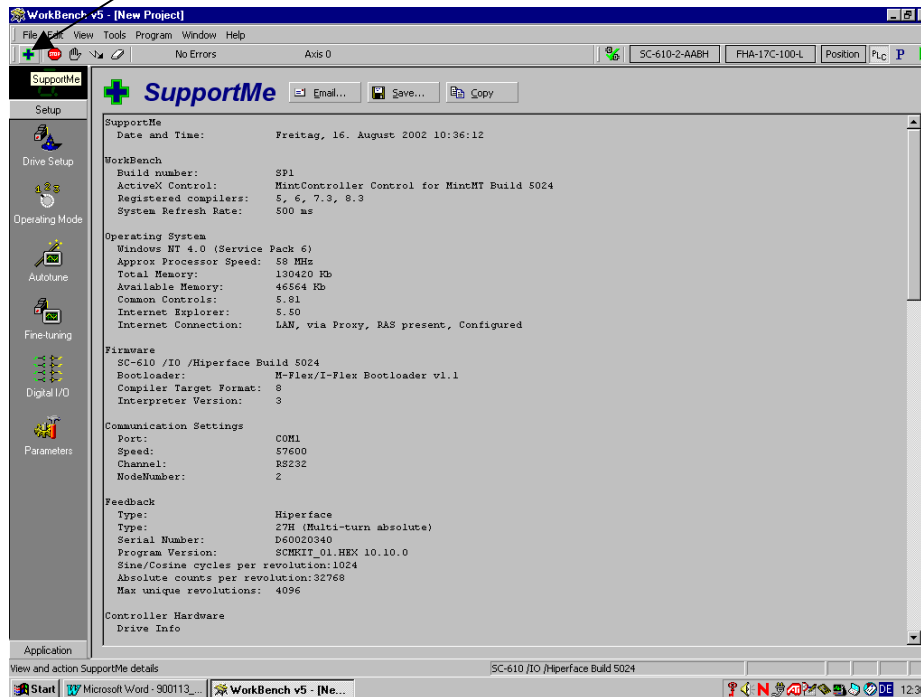
Press F1 or select „Help“ and „Help-Topics“ to open the Online-Help

Online-Help-Functions:

- a) Navigator/ Contents
- b) Index
- c) Search



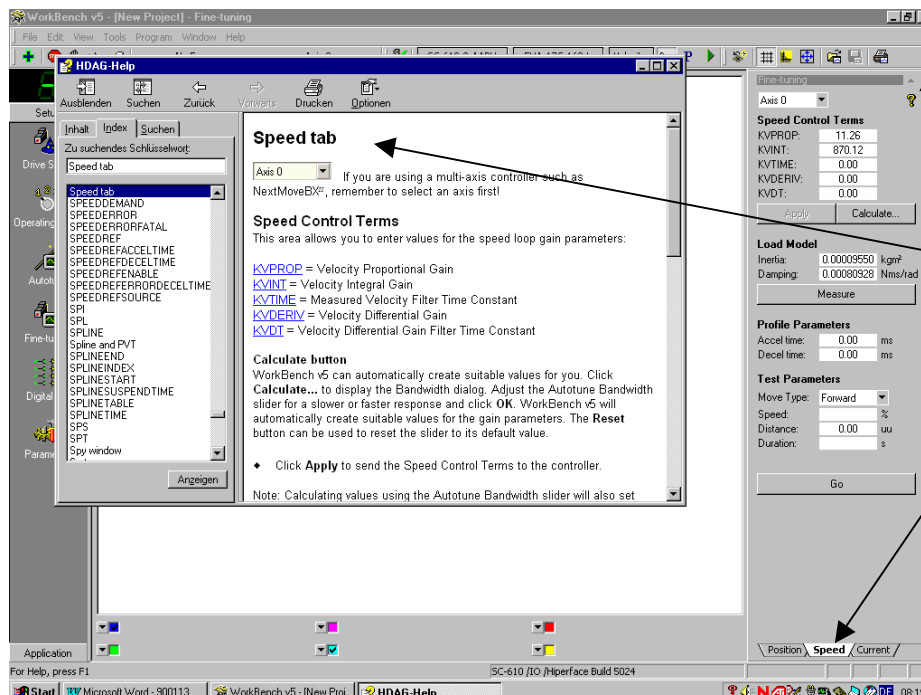
### 5.4.2 SupportMe



The function “SupportMe” saves the complete configuration data into a file, which can be sent (by email) to the supplier for technical support. This file contains important info like:

- Date and time
- Work Bench version
- Operating system
- Firmware version
- Feedback type
- Drive production data
- I/O programming
- Error log

### 5.4.3 Online-Help for Fine Tuning



Press „?” for further information about the tuning procedure

The Online-help will show the relevant information according to the selected tuning tab below!

## 6 Drive Set-up I (Example Procedure for Velocity Control Mode)

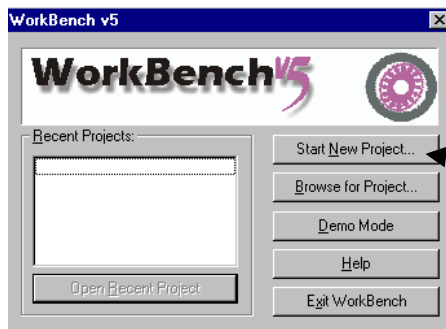
### Important Notice:

- This procedure is typically not required since the basic drive set-up is prepared ex factory Harmonic Drive
- This set-up procedure is only recommended in case major changes concerning motor type or operating mode are required or the drive has been set to the initial "factory defaults"!

- a) Start Software by double click on icon „Work Bench v5“ at the desktop

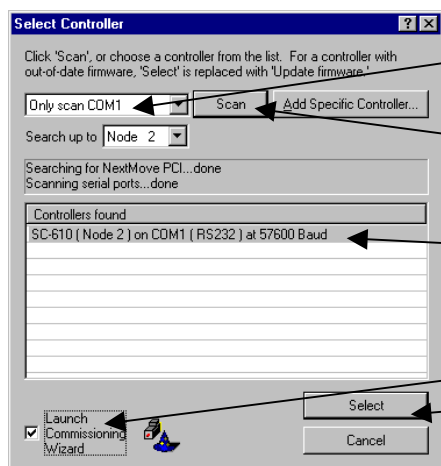


- b) Start Menu Work Bench



Click on „Start New Project“

- c) Select Controller



„Only scan COM1“ in case COM1 on the PC is in use

Click on „Scan“ and establish communication with the drive

Wait until SC-610 is indicated

Activate „Launch Commissioning Wizard“ and click on „Select“

**Attention:** In case communication can not established please check:

- Is the correct cable applied and properly wired?
- Is the PC-interface working correctly?
- Is the drive powered up? (230V or 24V at units with connector terminal for X1.9 u. 10)

d) Commissioning Wizard - Welcome

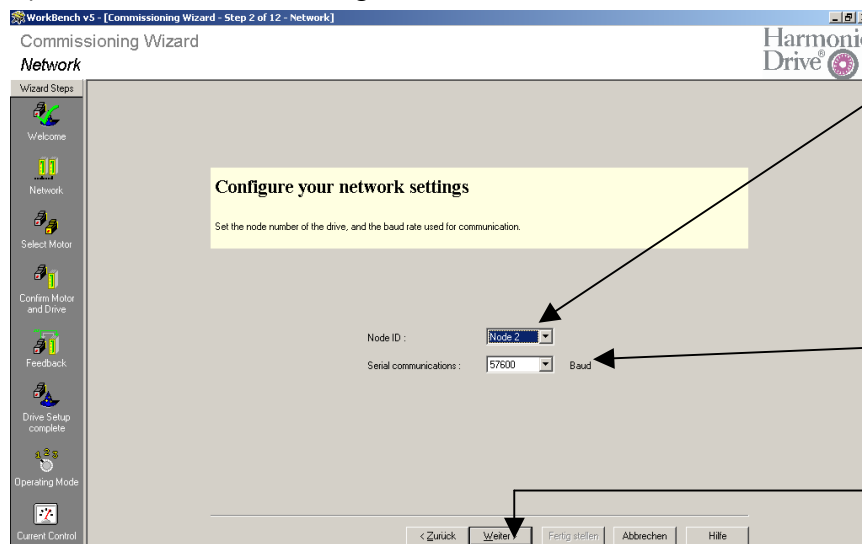


„Factory Defaults“ should not be used in normal case. All data will be lost otherwise!



Continue with „Next“

e) Commissioning Wizard - Network



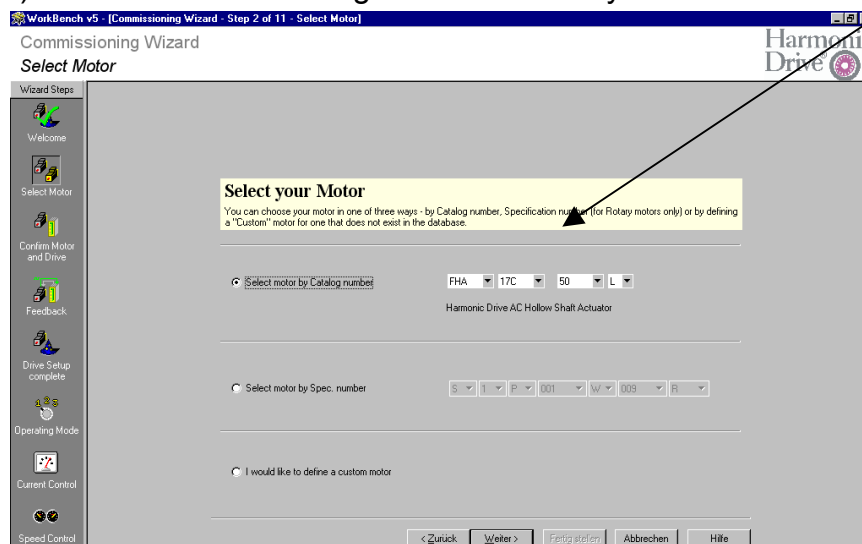
Set the Node Id to: 2 at single axis applications; 2 or higher at multi axis applications.

Confirm this selection with the DIP-switch AS1-1~4! Node 2 = 1~4 OFF

Select the baud rate: 9600; 19200; 38400; 57600 Default is 57600!

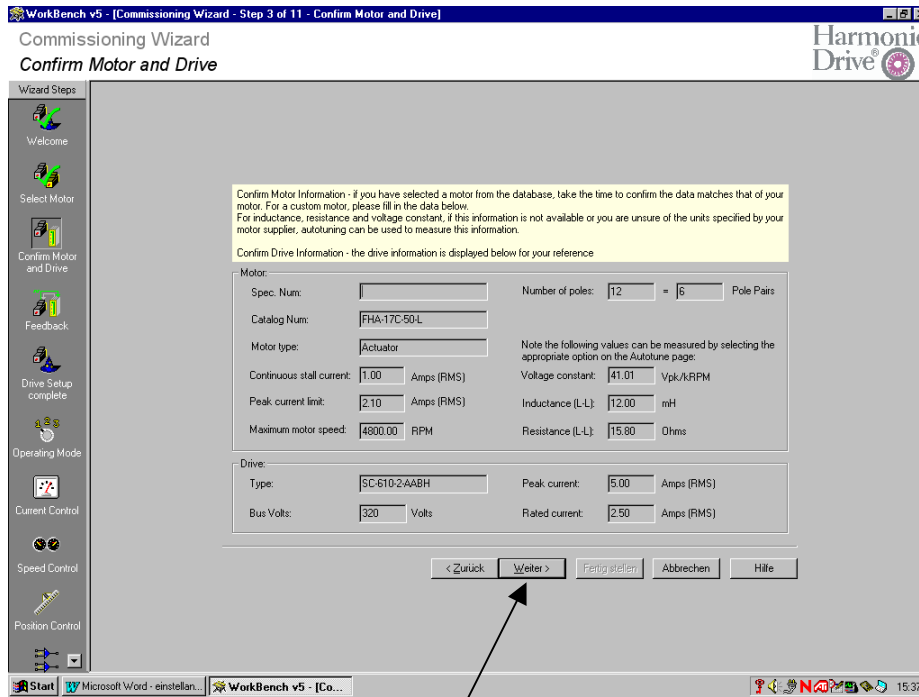
Continue with „Next“

f) Commissioning Wizard - Select your Motor



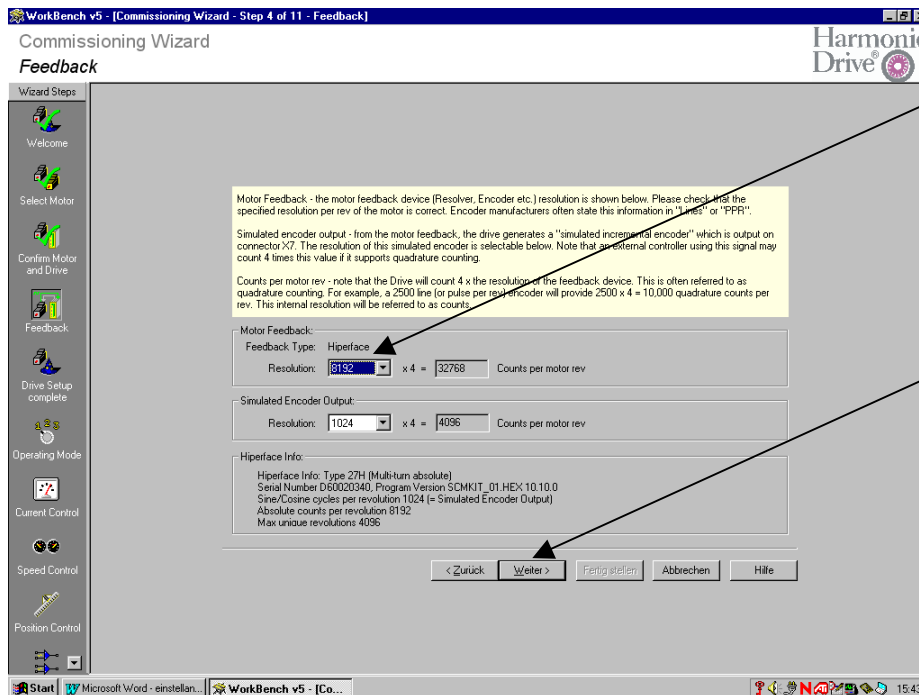
Select motor type, size and gear ratio

g) Commissioning Wizard - Confirm Motor and Drive



Confirm the system configuration by means of motor and drive data and continue with „Next“

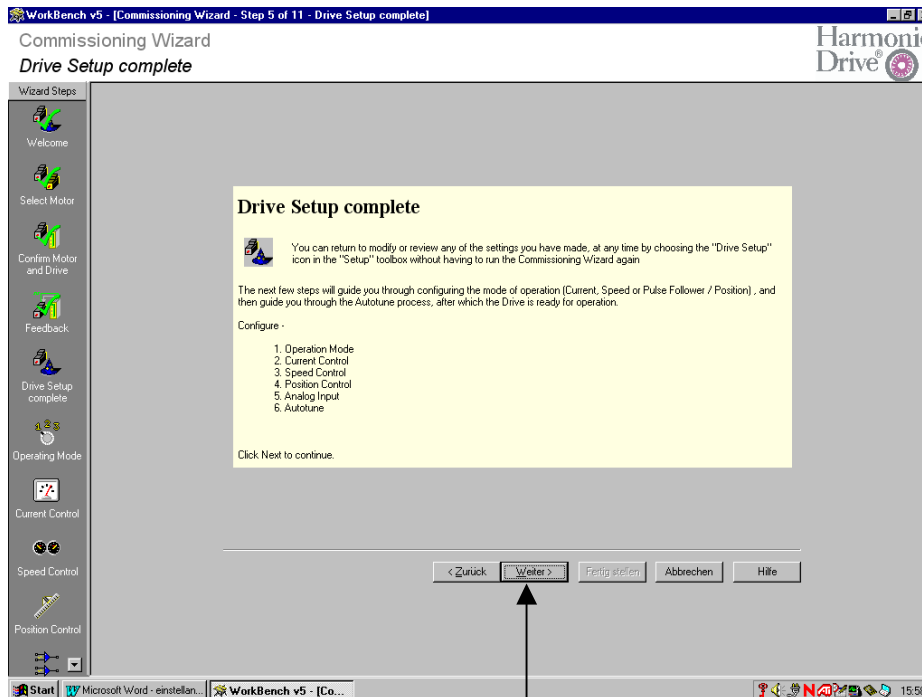
h) Commissioning Wizard - Feedback



Set „Hiperface-Resolution“ to 8192

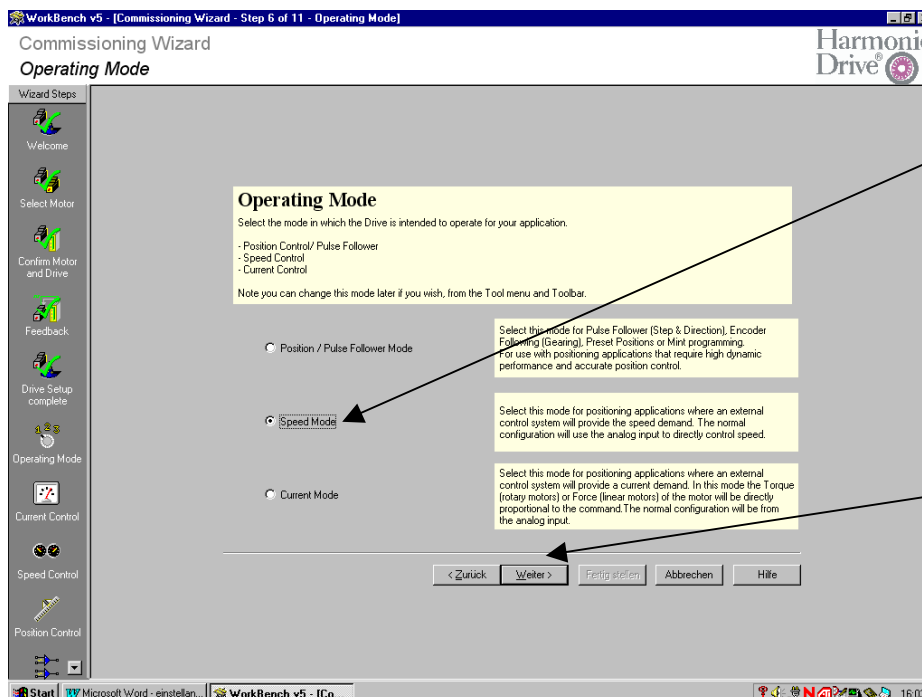
Continue with „Next“

i) Commissioning Wizard - Drive Setup Complete



Confirm the Drive Set-up with „Next“

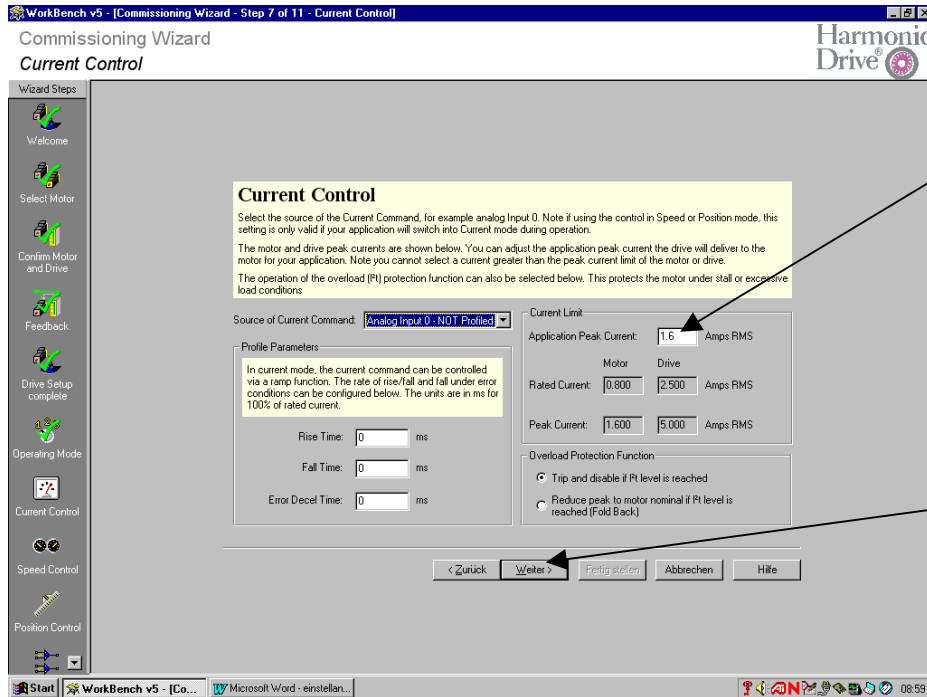
j) Commissioning Wizard - Operating Mode



Select your desired Operating Mode:  
Ex. „Speed Mode“ or  
“Position/Pulse.. “  
(See also chapter 6.3)

Continue  
with „Next“

k) Commissioning Wizard - Current Control

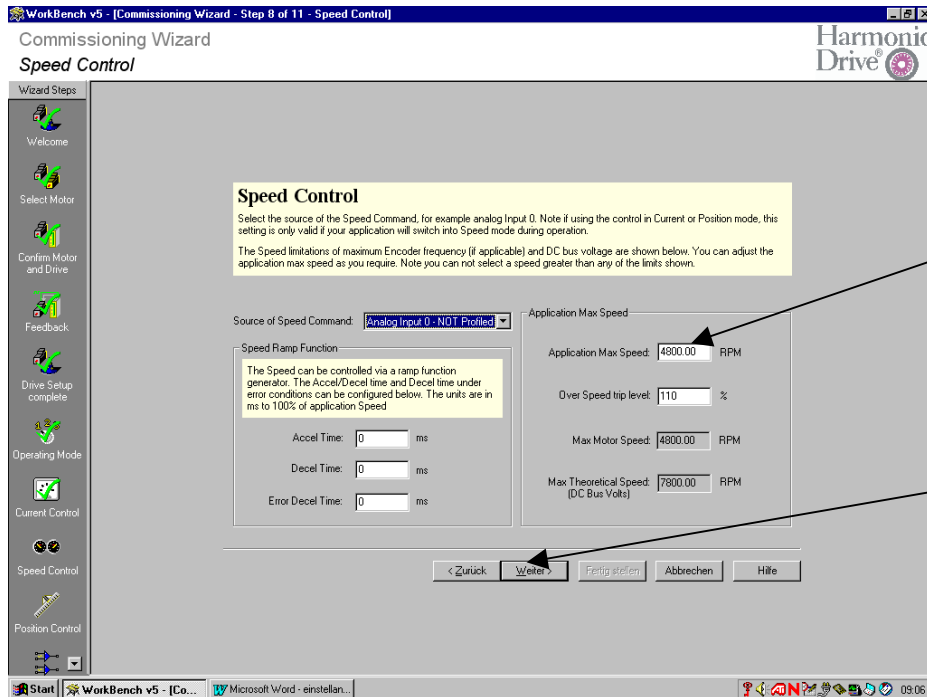


Confirm the application max. current in respect to the actuators max. current!



Continue with „Next“

l) Commissioning Wizard - Speed Control



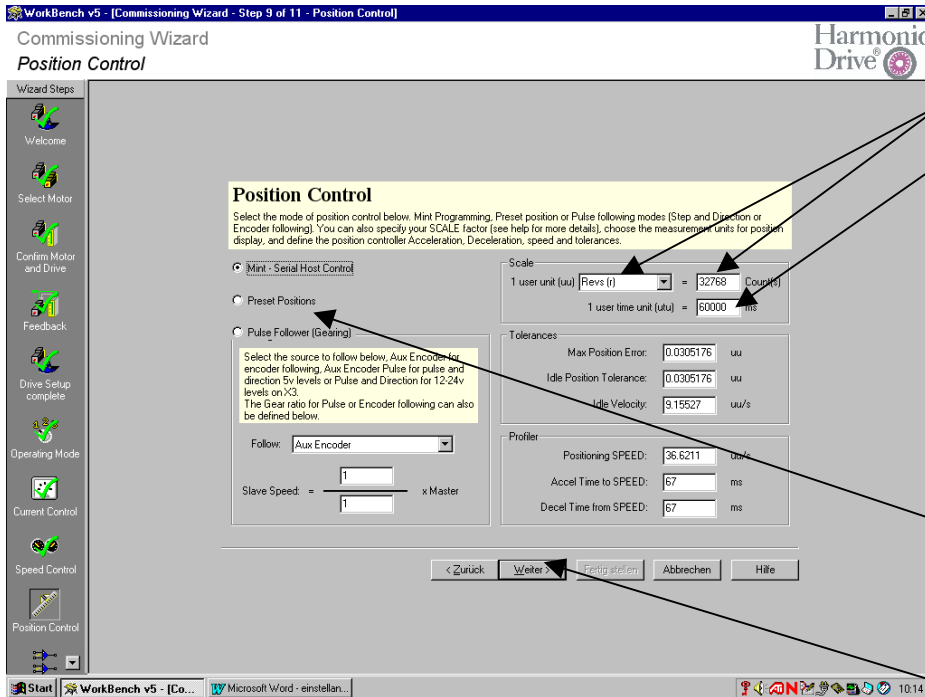
Confirm the application max. speed in respect to the actuators max. speed!



Continue with „Next“



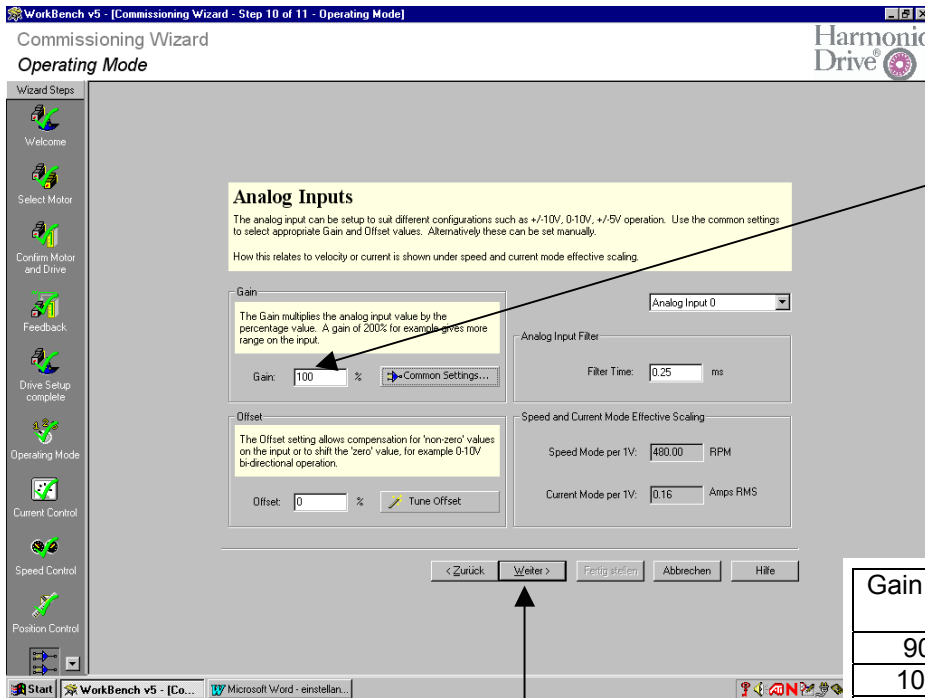
m) Commissioning Wizard - Position Control



Scaling:  
 a) User unit: Revs(r)  
 = 32768 counts  
 b) User time unit = 60000 ms  
 Result:  
 Programming and indication of position in revs and speed in rpm in the monitor of the Work Bench

Select „Preset Pos...“ for using the position table as shown in chapter 6.3  
 ↓  
 Continue with „Next“

n) Commissioning Wizard - Operating Mode/ Analogue Inputs

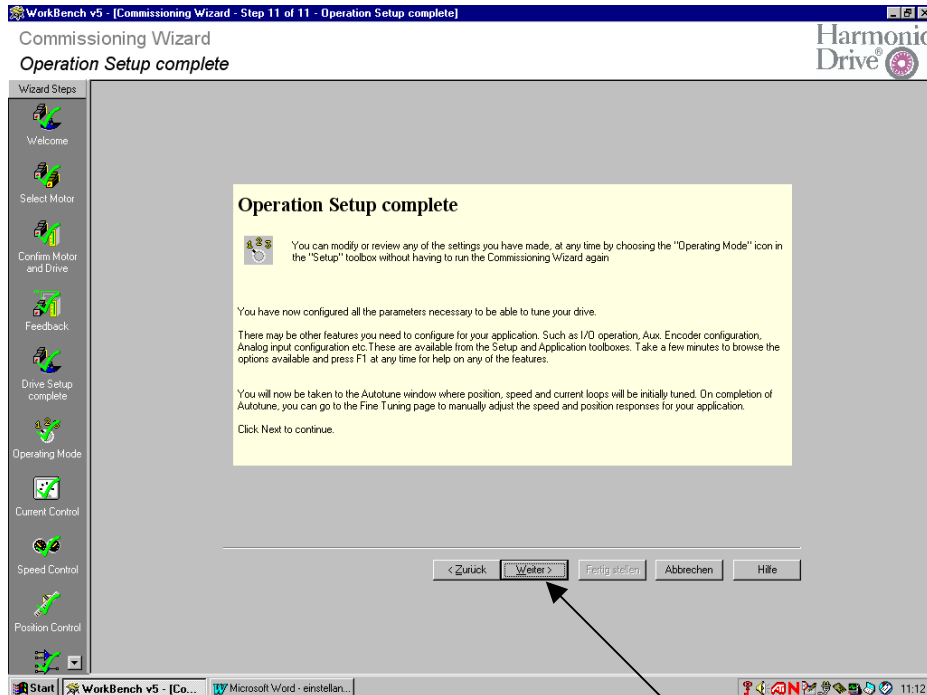


Gain factor allows adaptation of the reference between demand voltage and motor speed. See below an example for FHA-17C:

Gain [%]	Speed [1V]	Speed [9V]	Speed [10V]
90	432	3888	4320
100	480	4320	4800
110	728	4752	5280

Confirm Analogue Inputs with „Next“

o) Commissioning Wizard – Operation Set-up Complete



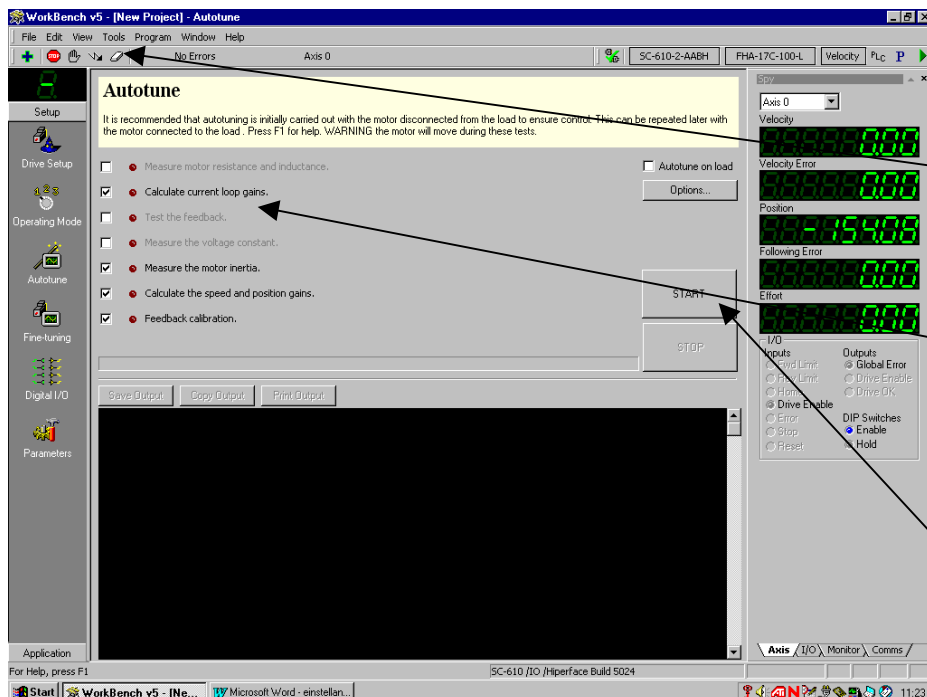
Confirm Operation Setup Complete with „Next“

p) Autotune



**Warning:**

- a) The drive must be enabled by hardware!
- b) The actuator will move during the auto tune procedure!



Set Enable On

Press „Cleaner“ to disable the active Operating Mode 1)

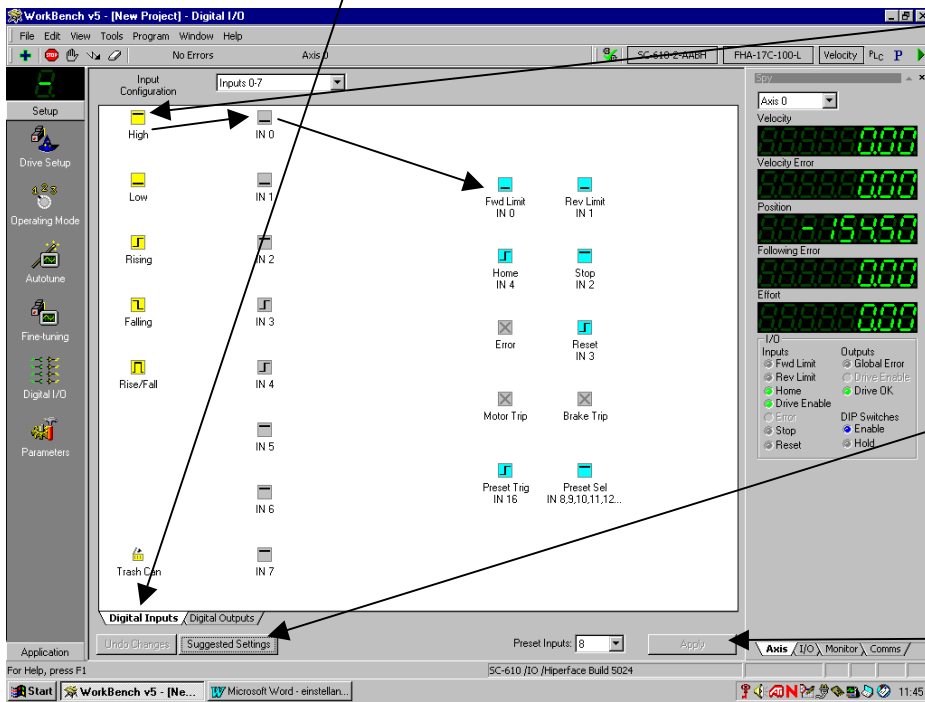
Execute the recommended procedures or select them depending on request or application!

Start Autotune!

Confirm ready message with „Ok“

1) This is only required in case the drive has been configured to any Operating Mode (ex: display “S” or “P”) The cleaner will then lead to display “8”!

q) Digital I/O - Inputs

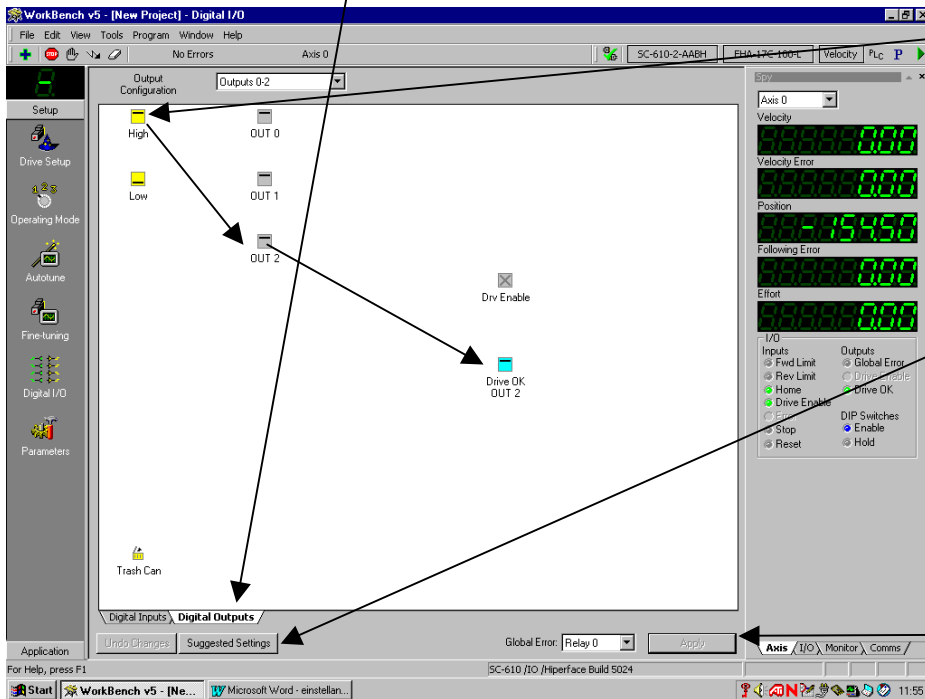


Drag and drop the input configuration according to your desired function From the "left" to the "right"!

Or execute „Suggested Settings" to achieve compliance to the recommended hardware wiring!

Press „Apply" for downloading the changes

r) Digital I/O - Outputs

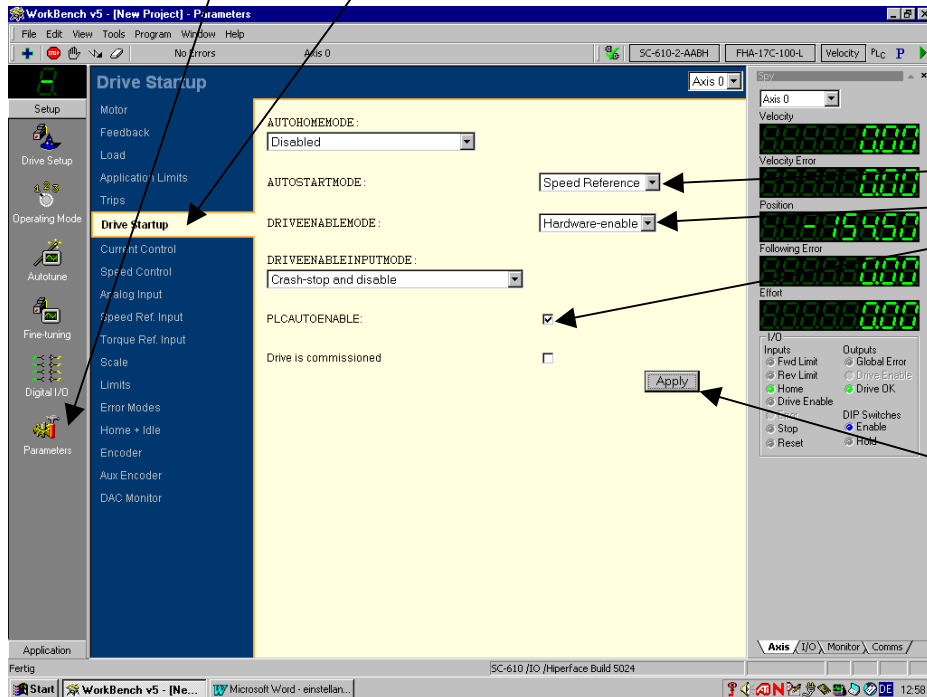


Drag and drop the output configuration according to your desired function From the "left" to the "right"!

Or execute „Suggested Settings" to achieve compliance to the recommended hardware wiring!

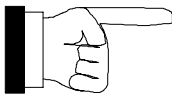
Press „Apply" for downloading the changes

s) Parameters - Drive Start-up



Set desired start-up conditions in ex:  
 a) Speed Reference  
 or Pre-Set Positions  
 b) Hardware Enable  
 c) PLC-AutoEnable

Confirm the settings with „Apply“



Please note that the “Apply” button must be used after every change! The modified data will be lost if “Apply” has not been executed before leaving this menu!

**The basic first step of the commissioning is finished at this point!**

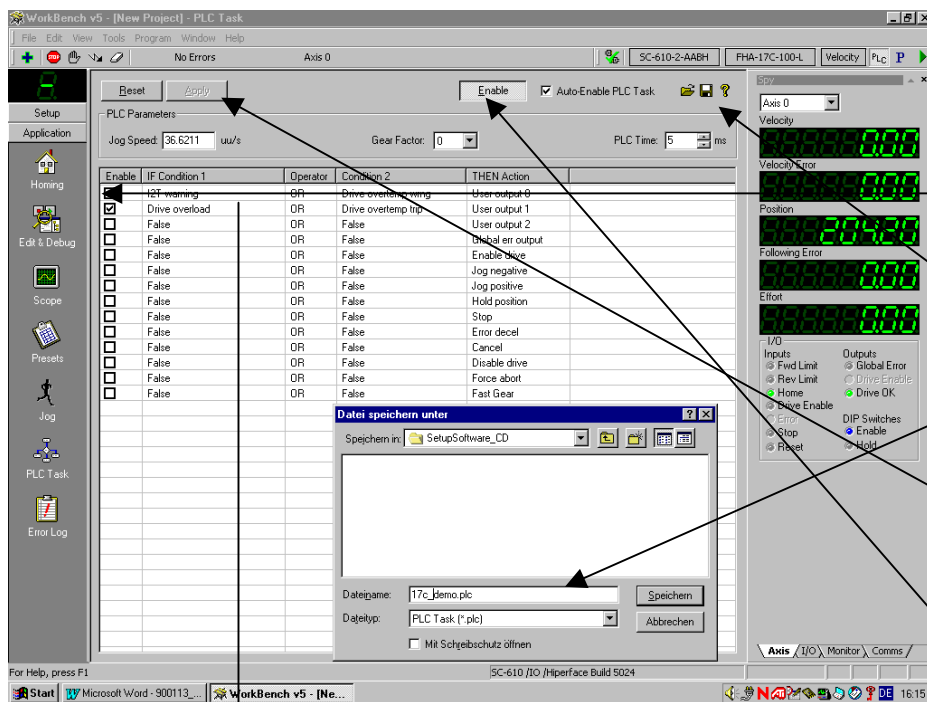
**Please continue with chapter 7 for further application specific set-up advices!**

## 7 Drive Set-up II (PLC and Position-Table)

The following procedures are required to be done by the user in order to adapt the drive to the desired application for example:

- Configuration of the PLC-function in case certain drive condition should be watched by the above control system or
- The drive is used as a position controller and position table must be programmed.

### 7.1 PLC-Set-up for Velocity Control



Program the desired functions as shown in example below!

Enable each PLC-line

Save the PLC-configuration if requested: name.plc

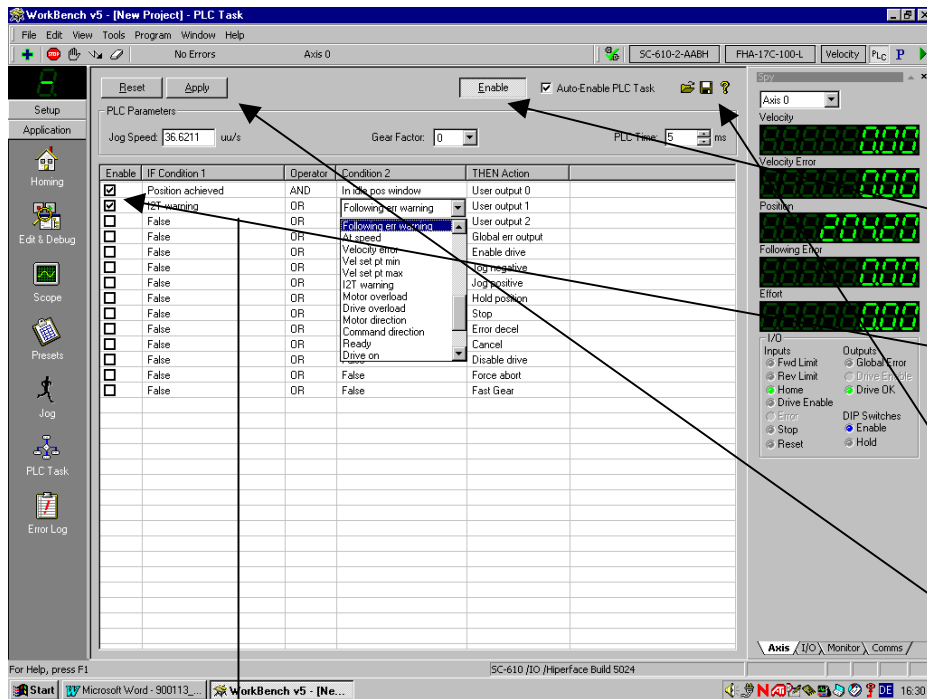
Press "Apply" for downloading the PLC-data!

Enable the PLC-functions in general!

Functions programmed for example are:

- If "I²t-Warning" or "Drive Overtemp. Warning" occurs, then User Output no. 0 (X3.18) will be active! (Warning for motor current and drive temperature warning limit!)
- If "Drive Overload" or "Drive Overtemp Trip" occurs, then User Output no. 1 (X3.19) will be active! (Error regarding drive current and drive temperature alarm limit!)

## 7.2 PLC-Set-up for Position Control



Program the desired functions as shown in example below!

Enable the PLC-functions in general!

Enable each PLC-line

Save the PLC-configuration if requested: name.plc

Press "Apply" for downloading the PLC-data!

Functions programmed for example are:

- a) If "Position Achieved" and "In Idle Pos Window" are true, then User Output no. 0 (X3.18) will be active! (Move is finished and desired target window is reached!)
- b) If "I2t-Warning" or "Following Err Warning" occurs, then User Output no. 1 (X3.19) will be active! (Motor effective current exceeded or following error exceeded!)

### 7.3 Programming the pre-set position table

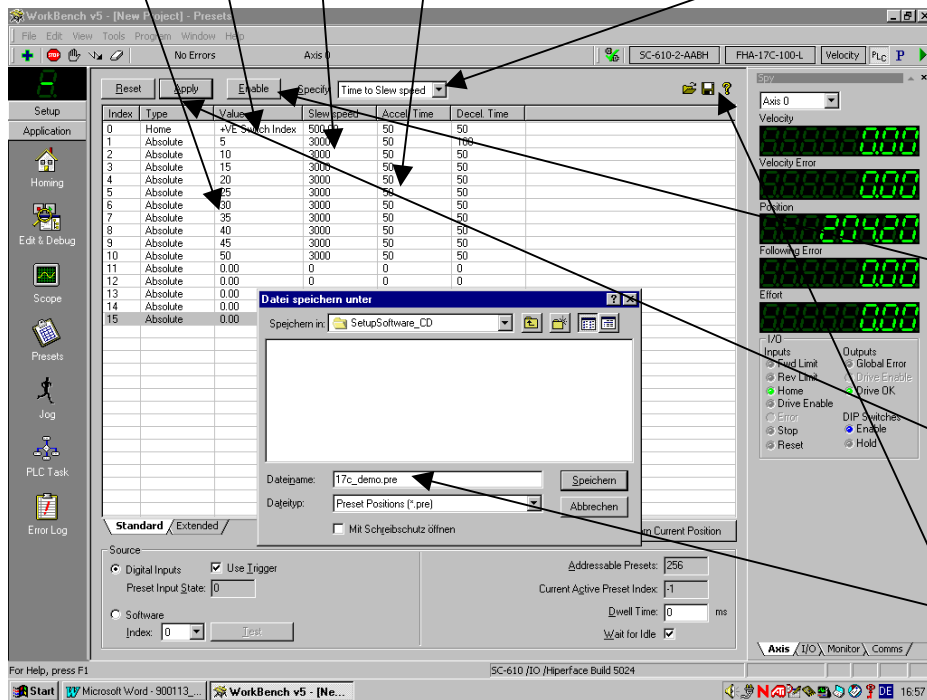
#### 7.3.1 Example for SC-610-AAH with max. 16 Position Lines

Actuator type: FHA-17C-50-L-S1024  
 Gear ratio: 50  
 Hiperface Resolution: 32768 (4 x 8192)  
 Position scaling: 1 Rev = 32768 counts -> programming in Motor revolutions  
 Speed scaling: 60.000ms -> programming in rpm

Application example: 10 absolute position steps at gear output, each 36°  
 Step angle in Mot. Revs.:  $36^\circ/360^\circ * 50 = 5$  Revs. on the motor side  
 Homing using proximity switch plus encoder index pulse (Hiperface Pos. 0)

Slew Speed: 3000 rpm  
 Accel; Decel. time: 50 ms

Select Time to Slew speed



Enable the Pre-Sets in general!

Press "Apply" for downloading the position table!

Save the Position table if requested: name.pre

#### Important Notice:

- For setting the drive into position mode and for executing the programmed position lines please execute steps j), m) and s) from the commissioning wizard in chapter 6!
- 6j will set the drive into "Position Mode"!
- 6m will activate the "Preset" position table as programmed above!
- 6s will activate the "Preset Mode" at drive start-up!

### 7.3.2 Example for SC-610-AABH with max. 256 Position Lines

Actuator type: FHA-17C-50-L-S1024  
 Gear ratio: 50  
 Hiperface Resolution: 32768 (4 x 8192)  
 Position scaling: 1 Rev = 32768 counts -> programming in Motor revolutions  
 Speed scaling: 60.000ms -> programming in rpm

Application example: 20 absolute position steps at gear output, each 18°  
 Step angle in Mot. Revs.:  $18^\circ/360^\circ * 50 = 2.5$  Revs. on the motor side  
 Homing using proximity switch plus encoder index pulse (Hiperface Pos. 0)  
 Slew Speed: 3000 rpm  
 Accel; Decel. time: 50 ms

Select Time to Slew speed

Index	Type	Value	Slew speed	Accel. Time	Decel. Time
0	Home	+VE Switch Index	500	50.00	50.00
1	Absolute	2.50	3000.00	4112.00	8224.00
2	Absolute	5	3000.00	50.00	67.00
3	Absolute	7.5	3000.00	50.00	67.00
4	Absolute	10	3000.00	50.00	67.00
5	Absolute	12.5	3000.00	50.00	67.00
6	Absolute	15	3000.00	50.00	67.00
7	Absolute	17.5	3000.00	50.00	67.00
8	Absolute	20	3000.00	50.00	67.00
9	Absolute	22.5	3000.00	50.00	67.00
10	Absolute	25	3000.00	50.00	67.00
11	Absolute	27.5	3000.00	50.00	67.00
12	Absolute	30	3000.00	50.00	67.00
13	Absolute	32.5	3000.00	50.00	67.00
14	Absolute	35	3000.00	50.00	67.00
15	Absolute	37.5	3000.00	50.00	67.00

Step A: Programming first 16 standard position lines!

Enable the Pre-Sets in general!

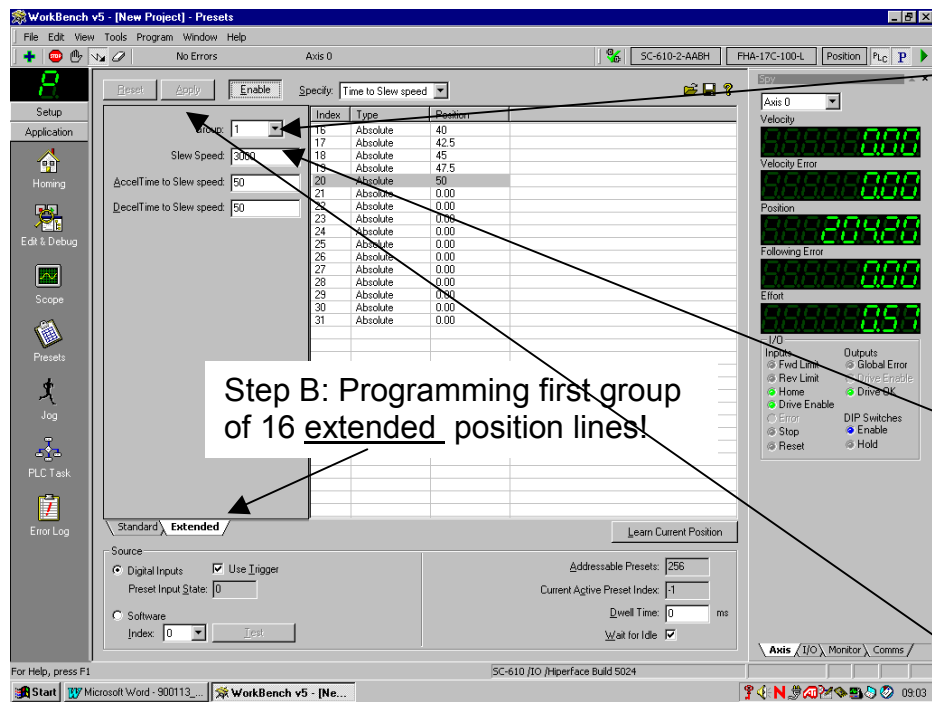
Press "Apply" for downloading the position table!

#### Important Notice:

- For setting the drive into position mode and for executing the programmed position lines please execute steps j), m) and s) from the commissioning wizard in chapter 6!
- 6j will set the drive into "Position Mode"!
- 6m will activate the "Preset" position table as programmed above!
- 6s will activate the "Preset Mode" at drive start-up!

For step B (programming the next 5 position lines) please refer to the following page!





Select group no. 1 of extended position lines!



Each group use common profile for the position lines!

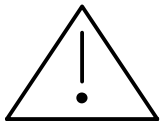


Press "Apply" for downloading the position table!

## 8 Tuning Guidelines

Tuning philosophy:

- Executing Auto-tune under no load condition as a final step of drive commissioning
- Executing Fine-tune at load condition after having checked the system wiring and mechanical assembly



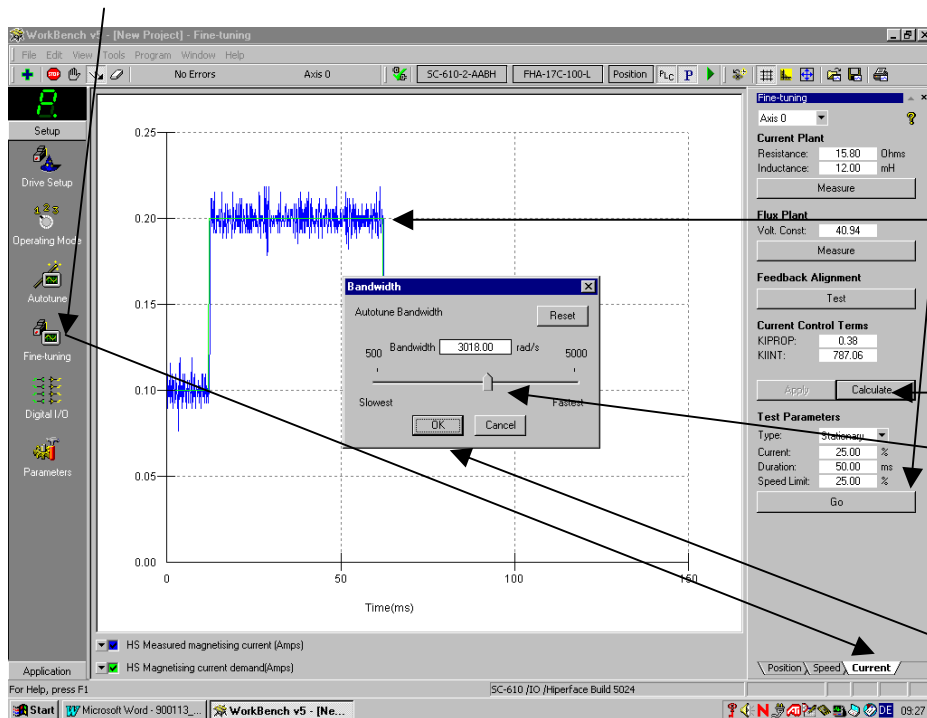
**Warning:**

- a) The drive must be enabled by hardware!
- b) The actuator will move during the auto tune procedure!

Tuning rule:

- First: tune the current loop
- Second: tune the velocity loop
- Third: tune the position loop (only if position mode is applied)

### Fine Tuning the Current Loop



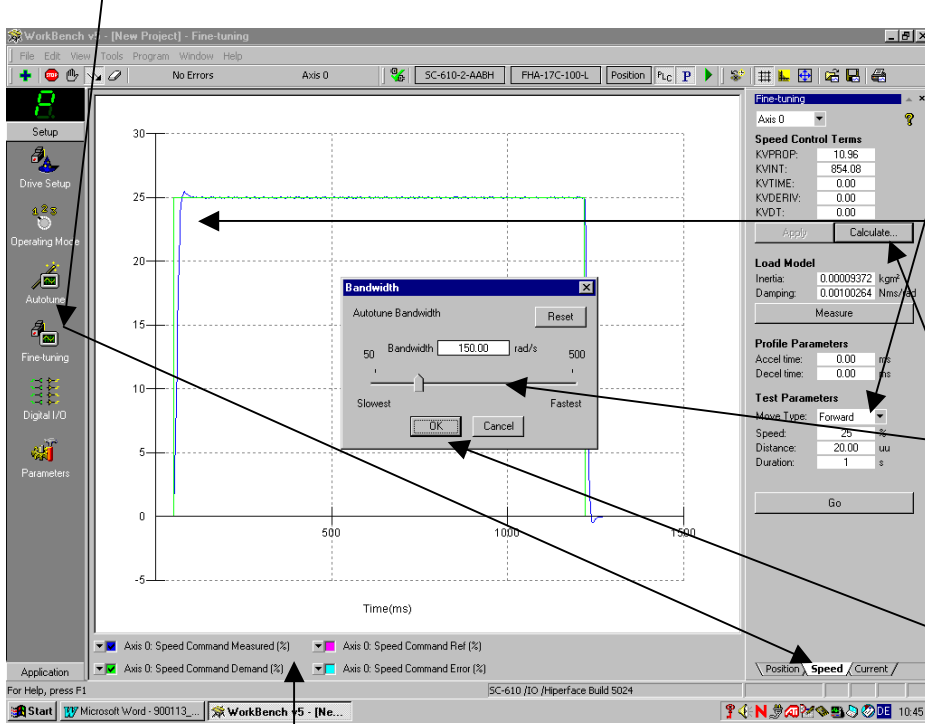
Execute the step response by „Go“!

Judge whether indicated response is acceptable, if not ...

Press “Calculate” and modify the Bandwidth with the slider towards right for higher dynamic or left for more damping.

Press “Ok” and “Go” for repeating the step response!

### Fine Tuning the Speed Loop



Specify the test parameters and execute the step response by „Go“!

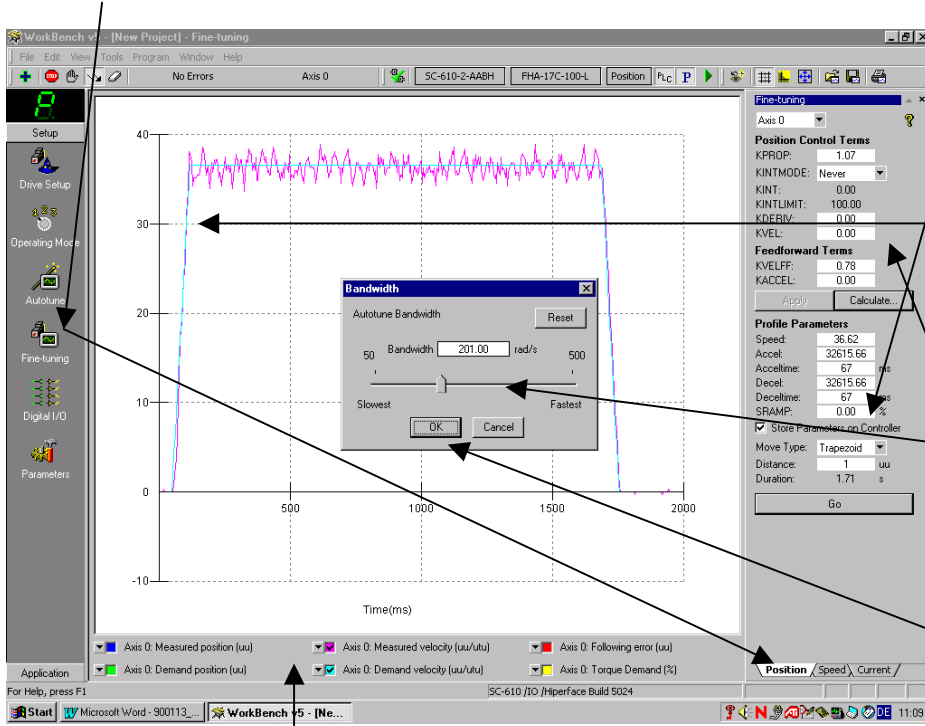
Judge whether indicated response is acceptable, if not ...

Press “Calculate” and modify the Bandwidth with the slider towards right for higher dynamic or left for more damping.

Press “Ok” and “Go” for repeating the step response!

Select the parameters to be indicated after uploading from the drive!

### Fine Tuning the Position Loop (only if applied)



Specify the test parameters and execute the step response by „Go“!

Judge whether indicated response is acceptable, if not ...

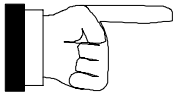
Press “Calculate” and modify the Bandwidth with the slider towards right for higher dynamic or left for more damping.

Press “Ok” and “Go” for repeating the step response!

Select the parameters to be indicated after uploading from the drive!

## 9 Data Backup

### 9.1 Generating a Parameter File

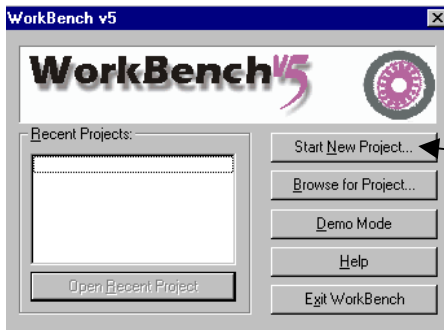


The data backup should be done after having done the basic and specific set-up including the fine-tuning!

a) Start Software by double click on icon „Work Bench v5“ at the desktop

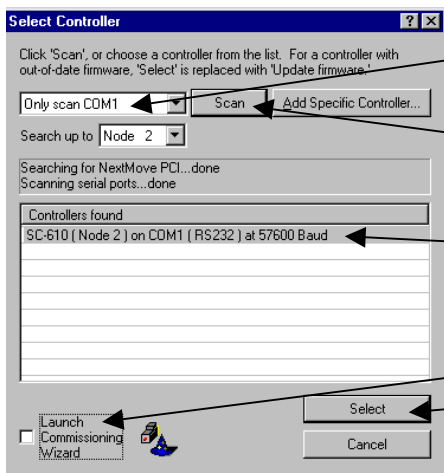


b) Start Menu Work Bench



Click on „Start New Project“

c) Select Controller



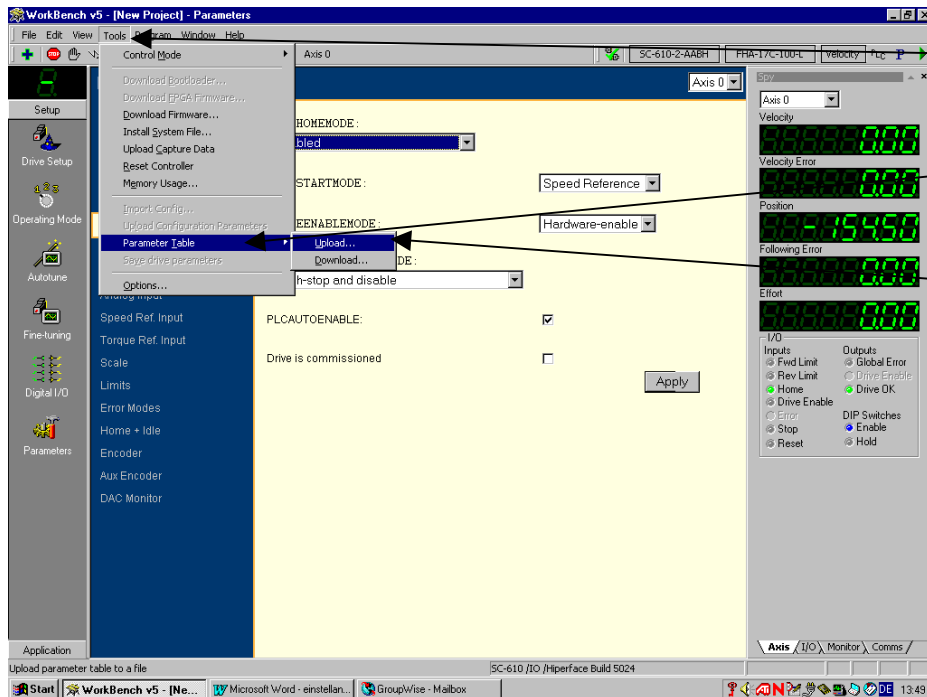
„Only scan COM1“ in case COM1 on the PC is in use

Click on „Scan“ and establish communication with the drive

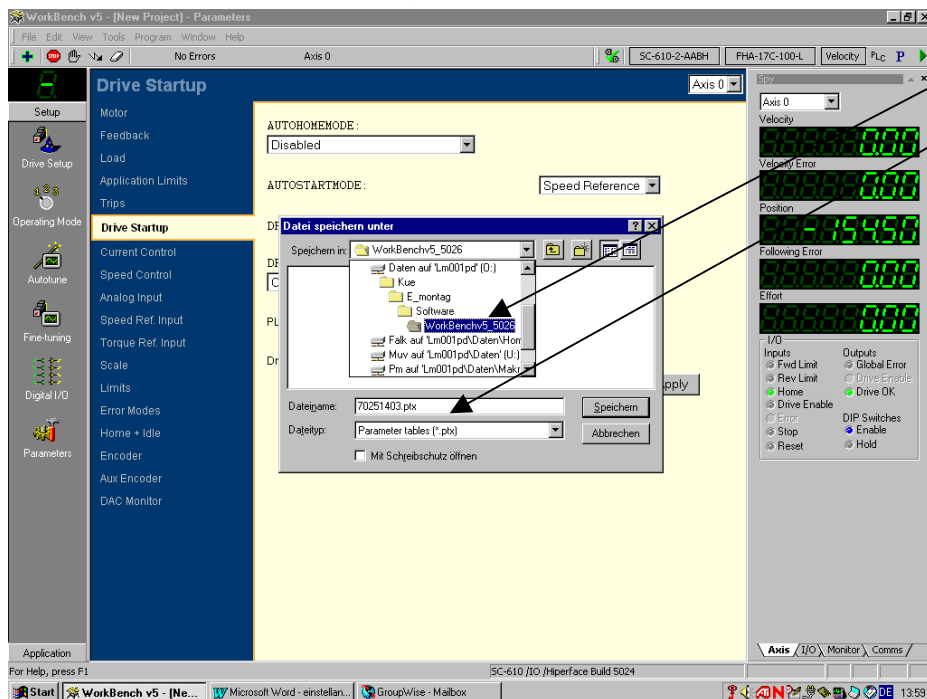
Wait until SC-610 is indicated

Do not activate „Launch Commissioning Wizard“ and click on „Select“

d) Data Backup on Hard Disk (Create Parameter File)



Tools  
↓  
Parameter Table  
↓  
Upload



Save parameter file into your desired destination folder on the hard disk as: name.ptx (name to be specified by the customer)

**The data backup procedure is finished at this point!**

**Execute a reset by “Tools-Controller-Reset” or power cycle the drive!**

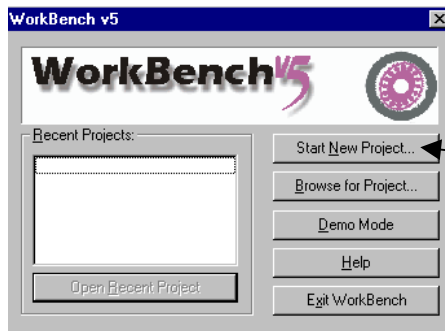
**Please see the following chapter for reloading the parameter file into the drive!**

### 9.2 Downloading a Parameter File into the Drive

a) Start Software by double click on icon „Work Bench v5“ at the desktop

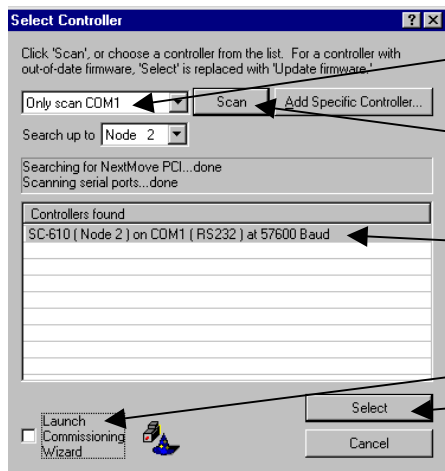


b) Start Menu Work Bench



Click on „Start New Project“

c) Select Controller



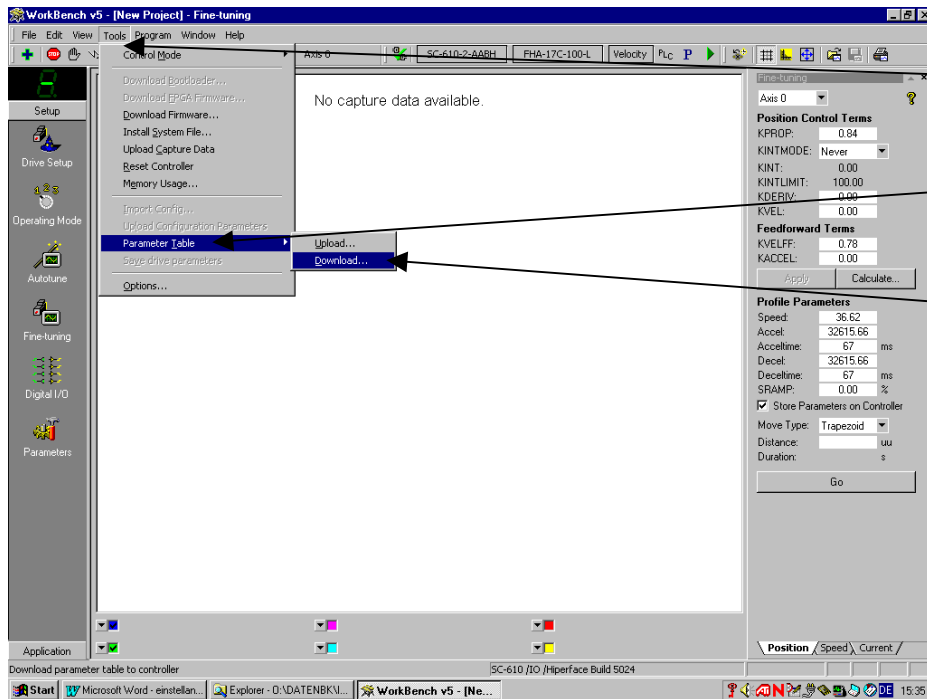
„Only scan COM1“ in case COM1 on the PC is in use

Click on „Scan“ and establish communication with the drive

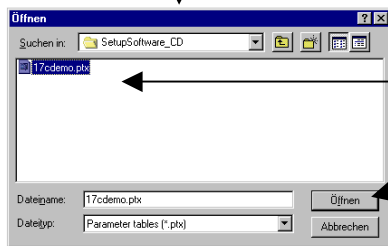
Wait until SC-610 is indicated

Do not activate „Launch Commissioning Wizard“ and click on „Select“

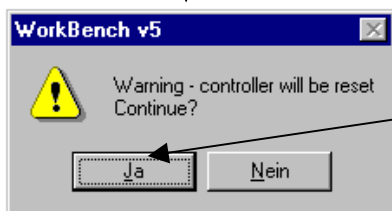
d) Loading file into the drive



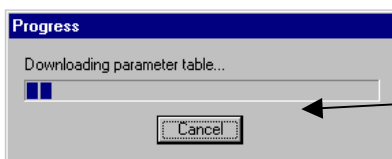
Tools  
↓  
Parameter Table  
↓  
Download



Select parameter file from your folder on the hard disk; Press "Open" for downloading into the drive!



Confirm with „Yes“ the downloading into the drive!



Wait until download is finished after approx. 3 minutes and DriveOK-Message comes back again!

**Execute a reset by "Tools-Controller-Reset" or power cycle the drive!**

## 10 Downloading a new Firmware Version

a) Start Software by double click on icon „Work Bench v5“ at the desktop

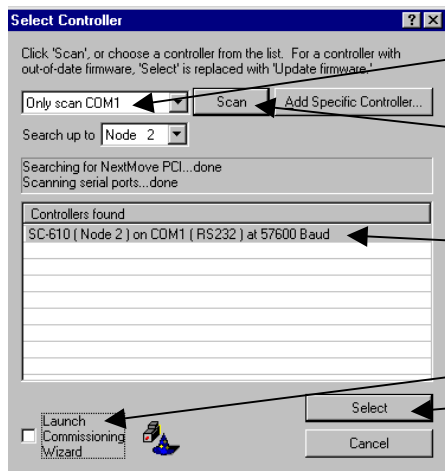


b) Start Menu Work Bench



Click on „Start New Project“

c) Select Controller



„Only scan COM1“ in case COM1 on the PC is in use

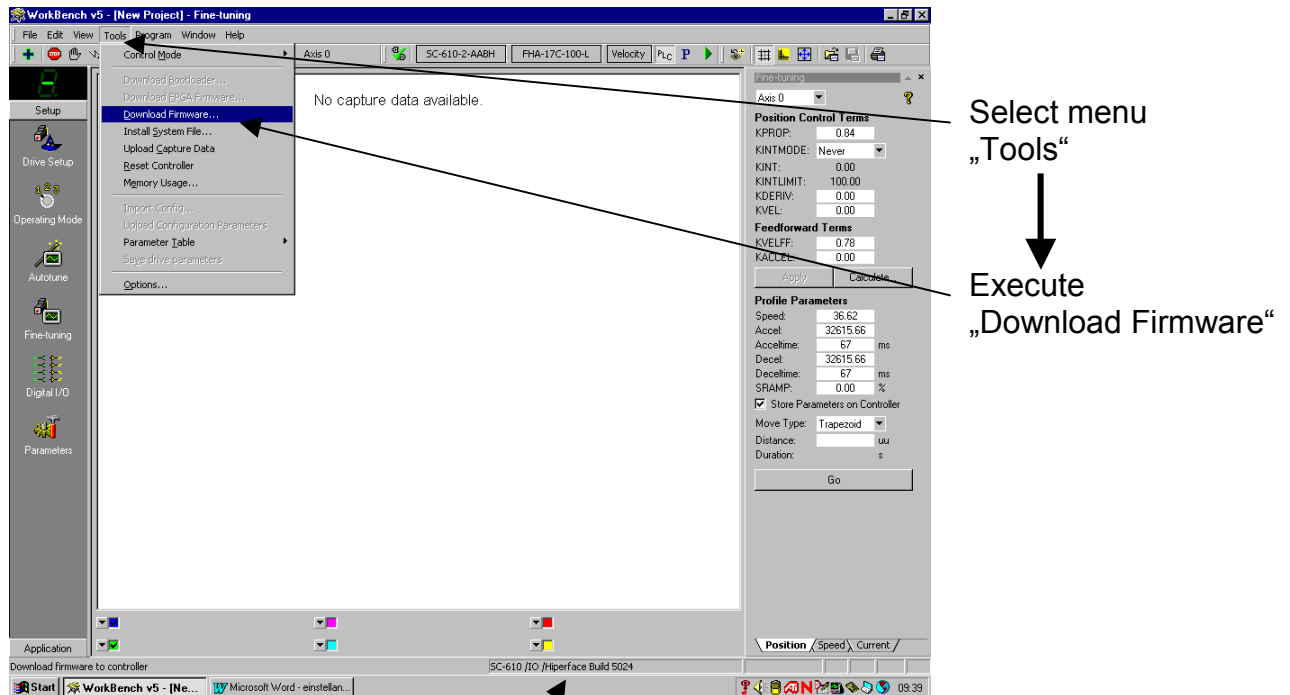
Click on „Scan“ and establish communication with the drive

Wait until SC-610 is indicated

Do not activate „Launch Commissioning Wizard“ and click on „Select“



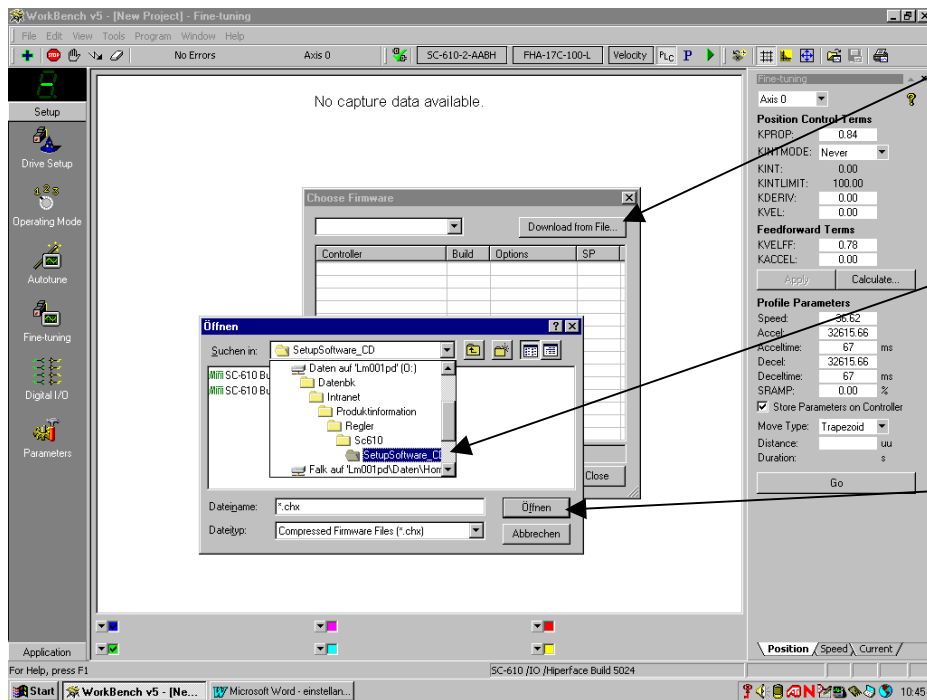
d) Proving Firmware and Download only at deviation from table below



Actual configuration as per December 2002:

Drive Type	Firmware	Connector X12	Pins on X8
SC-610-X-XXAH	SC-610/Hiperface Build 5104	No	15
SC-610-X-XXBH	SC-610/IO/Hiperface Build 5104	Yes	15
SC-610-X-XXAR	SC-610/Resolver Build 5104	No	9
SC-610-X-XXBR	SC-610/IO/Resolver Build 5104	Yes	9

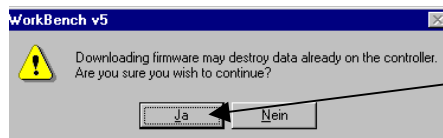
e) Select Firmware from Internet or CD-ROM and Download



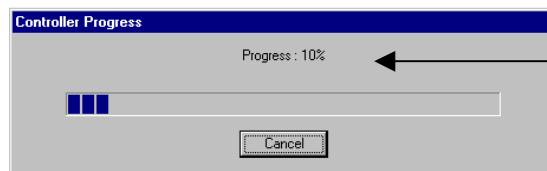
Execute  
„Download from File“

Select file from  
Internet or CD-ROM

„Open“ and  
download file into  
the drive



Confirm message  
with „Yes“



Wait until the loading  
time of approx. 90  
seconds is over.  
The display is blinking  
with 3 bars.

**Advices:**

- The Firmware-Download has executed successfully, if the display shows a static bar in the middle!
- The option „Factory Defaults“ must be activated during the following commissioning procedure! Please refer to chapter 6d!
- The download of parameter file (\*.ptx) based on a previous firmware-version is not permitted after having updated the firmware!

## 11 Programming with ActiveX-Controls

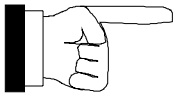
### 11.1 General description

ActiveX controls, formerly known as OLE controls or OCX controls, are components (or objects) that can be inserted into an application to reuse packaged functionality. For example, the ActiveX controls that are included with these servo controllers allow PC applications to communicate with controllers to allow complete machine control from a PC.

A key advantage of ActiveX controls is that they can be used in applications written in many programming languages, including development environments such as:

- Microsoft Visual C++
- Microsoft Visual Basic
- Borland Delphi
- National Instruments Lab View

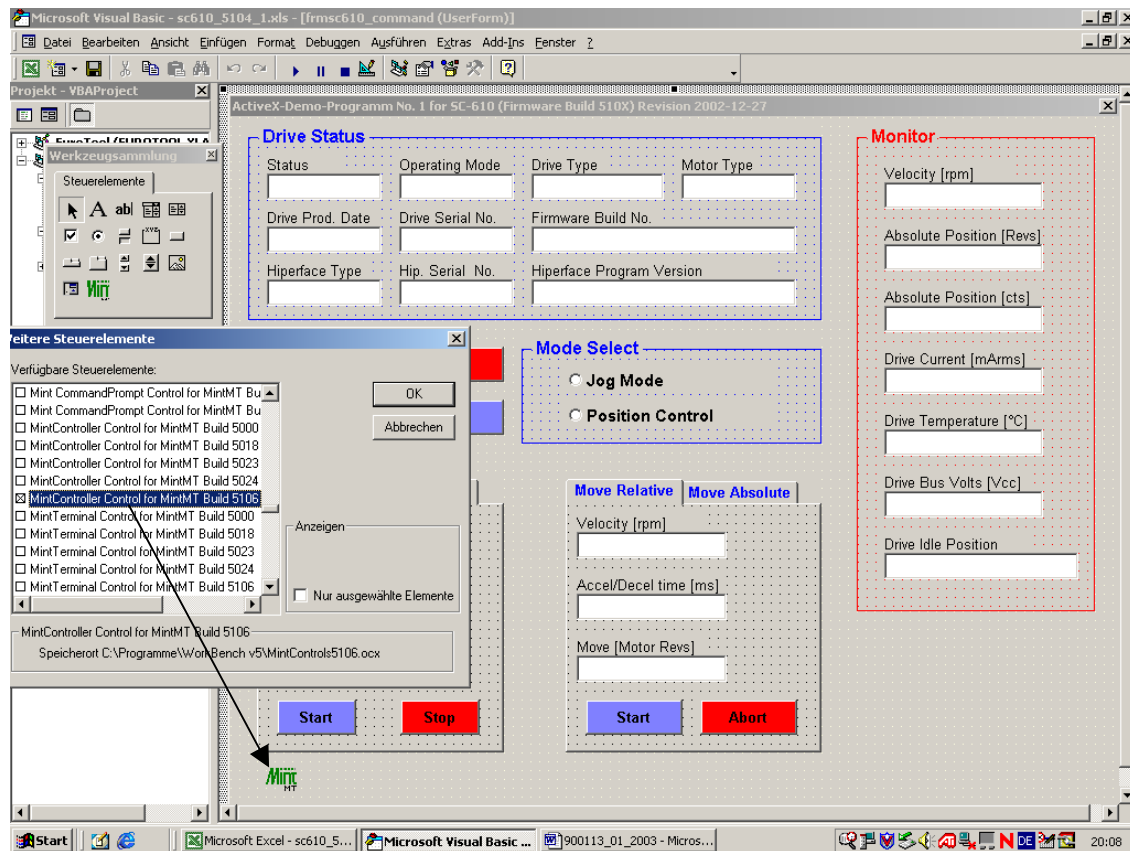
Any development environment that supports ActiveX controls can use the SC610-ActiveX-control making it a very versatile interface to the controller.



The use of ActiveX-Controls is reserved for qualified engineers who are familiar with this technology!  
It is upon the user to develop and maintain the code since Harmonic Drive does not take over any responsibility in the final operation and possible malfunctions!

## 11.2 Example for VBA

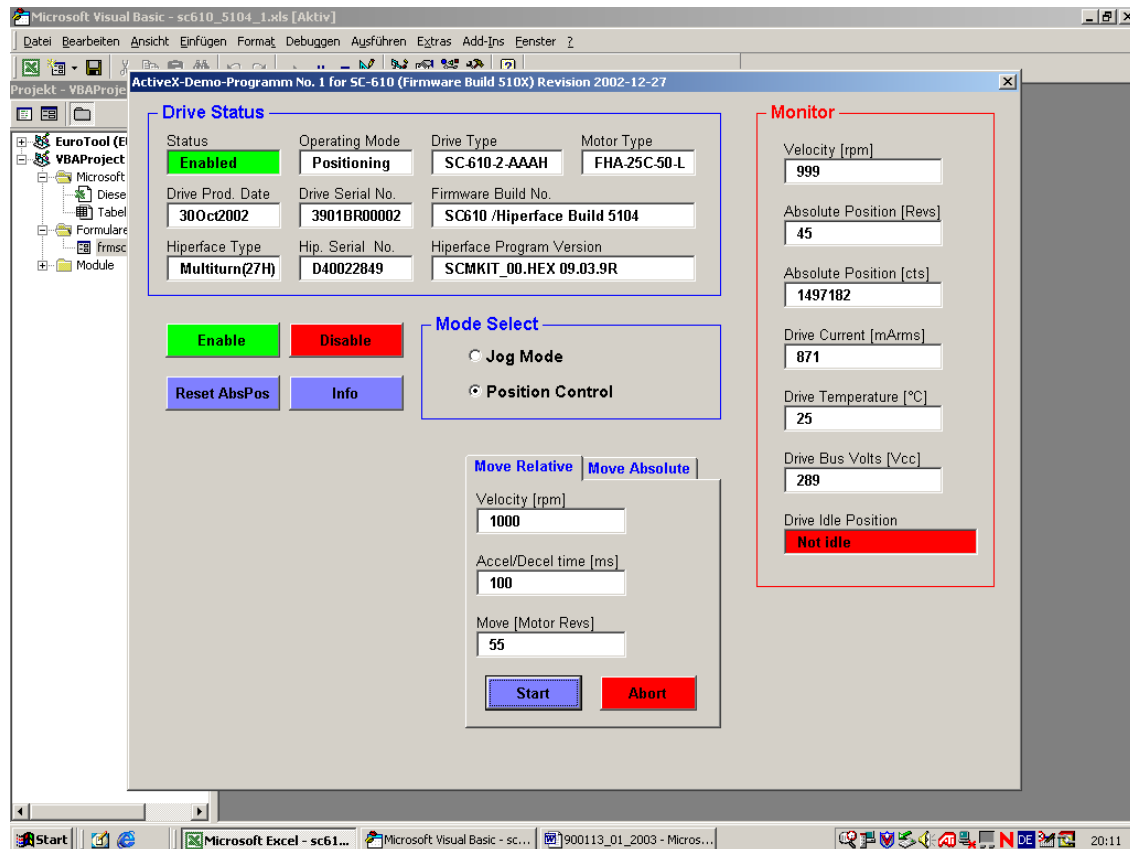
### How to get started with VBA!



#### Suggested Procedure:

- Open Visual Basic Editor and design your User Form according to your desired application
- Open Tool Box and copy additional tools (effective after Install of Work Bench on your computer) from the list into your User Form
- Rename the “name” in the property window from “Mintcontroller1” into “SC610”
- The SC610 ActiveX elements are now available for designing your program code

Example for a User Form in VBA attached to an Excel-file!



Example for a VBA-code (extract only) attached to an Excel-file!

