TN021

AKKON CNC SYSTEM

Technical note
Construction and setup of AKKON Handwheel

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1.2	10.10.2009	Update of some pictures

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1 Introduction

This document outlines how to assemble and setup the AKKON Handwheel. The document relates to all hardware variants of the AKKON Handwheel. It starts with a description of the construction steps including PCB assembling, creation of mechanics and keyboard layout as well as simple hardware tests. In a further part software configuration and firmware updates will be shown. Finally the function test using the AKKON Handwheel test and configuration application will be shown. The figure below shows the AKKON Handwheel.

Figure 1: AKKON Handwheel

2 Required tools and documentation

2.1 Installation package

In the following sections, different tools that can be used for programming, configuration and test are shown. For an easier use, an installation package including all related documents and software tools for setup and construction is available for download on www.burger-web.com.

The installation package mainly includes following tools and documents:

Software tools

- Boot loader project and modified boot loader hex file for AKKON Handwheel
- RS232 Terminal program
- USB configuration utility
- AKKON Handwheel test and configuration utility

Documentation:

- This document (AKKON Handwheel setup and construction guide)
- Part list
- CAM-file for case processing including G-Code
- Keyboard layout

2.2 Tools

Assembling the AKKON Handwheel controller board does not require special tools. At a minimum, a small soldering iron, soldering wire, alcohol and a pen for cleaning the PCB, a knife or a cable stripper, wire cutter, a crimping plier, small screw drivers, some claws, a tweezers and a digital multi meter (see figure 1) are required.

Most of the plugs used for the AKKON Handwheel are made with crimping techniques. Although it is not absolutely necessary to uses plugs and sockets and directly soldering in the wires, it is recommended to create cables with plugs because they are more convenient for setup and construction as well as for failure search. A simple crimping claw, as shown below, costs about 20 €.

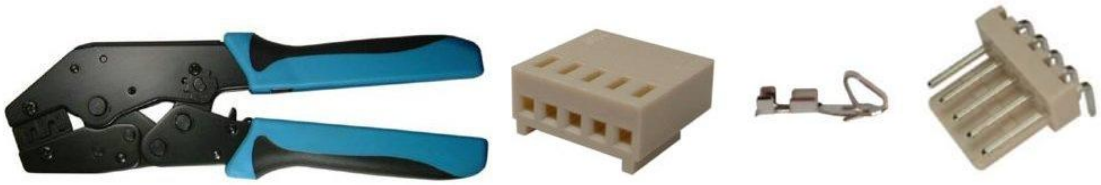

Figure 2: Crimping tool for MOLEX plugs

3 Construction

3.1 Create AKKON Handwheel cable

In a first step of the construction, the AKKON Handwheel cable should be created. The cable is used for tests during construction of the AKKON Handwheel controller board and later use of the AKKON Handwheel. The AKKON Handwheel is connected to a CNC controller and personal computer by a control cable (AKKON Handwheel control cable with D-Sub male plug) and an USB cable (AKKON Handwheel USB cable). Both cables are mechanically protected inside a sealing braid.

USB is sensitive to noise. Depending on the environment, noise can cause malfunction of the AKKON Handwheel. By that way only cables with interference suppression should be used.

Figure 3: AKKON Handwheel cable

On all cable ends 2,54 mm MOLEX plugs are uses. The cables can easily be created using crimping techniques. An alternative would be to directly soldering in the wires to the PCB.

3.1.1 Pin assignment of AKKON Handwheel control cable:

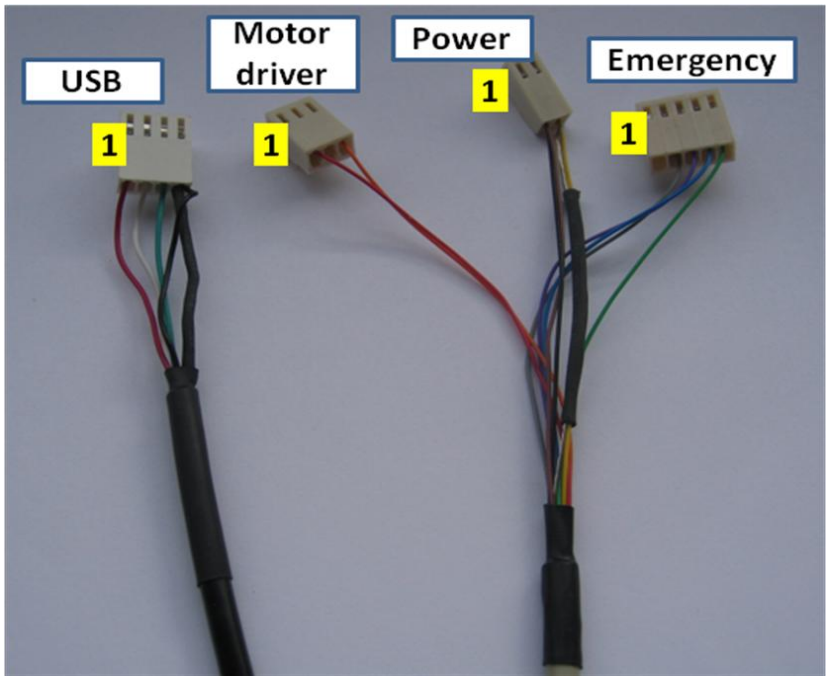

Figure 4: Controller side plugs for AKKON Handwheel controller cable

The colors of the cables can vary on the manufacturer but pin assignment on the male D-sub is as shown in the following picture:

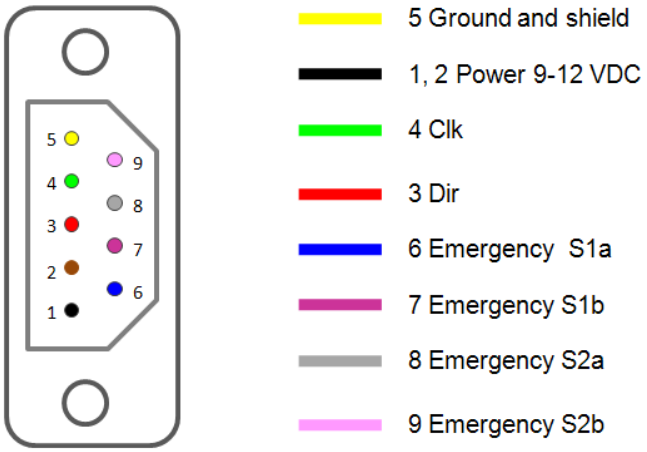

Figure 5: Pin assignment on AKKON Handwheel controller cable (Control system side)

3.1.2 Pin assignment of AKKON Handwheel USB cable:

The colors of USB cables are standardized and should normally be the same on all USB cables. According to the USB-specification the colors for the wires of an USB-cable are as follow:

Red wire: Power, 5 V

Black wire: Ground and shield

Green wire: D+

White wire D-

Following figure shows the pin assignment of the USB-cable:

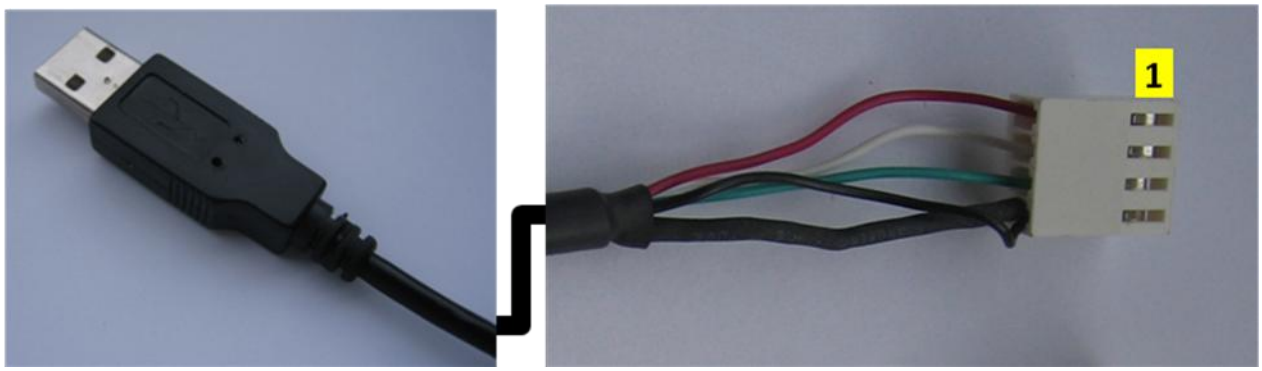

Figure 6: Controller side plugs for AKKON Handwheel controller cable

At the end of the cable (Pin 4) the ground wire and the shield are crimped together.

3.2 Create AKKON Handwheel controller board

This section outlines how to assemble and perform initial hardware tests with the AKKON Handwheel controller board and cables. Figure 1 shows the AKKON Handwheel controller board.

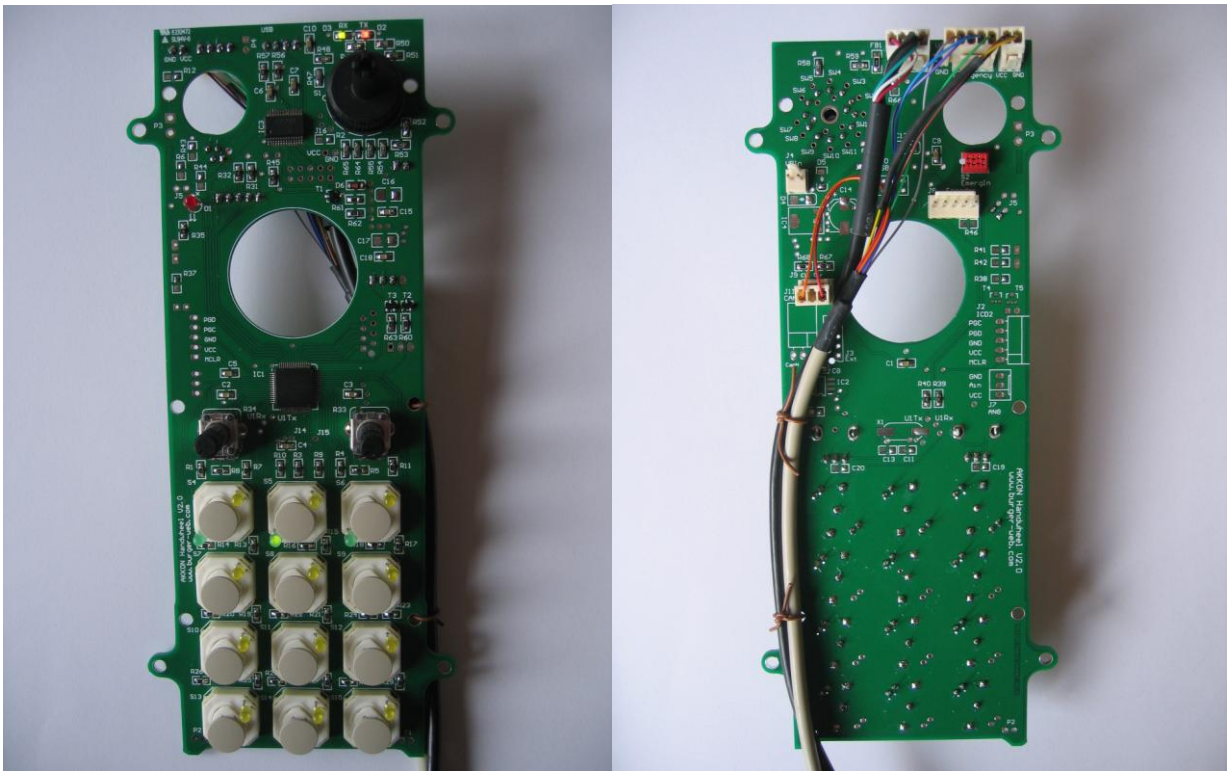

Figure 7: Front and top side of fully equipped AKKON Handwheel controller board

3.2.1 Step 1: Build power supply

Solder IC2, D5, J4, C16, C15, IC4, D4, C17, C14 and C18

Test:

- Plug in AKKON Handwheel controller cable
- Test power supply with digital multi meter. VCC should be 5V +- 0.1 V

3.2.2 Step 2: Build communication block

- Solder in IC3, FT232RL, USB driver
- Solder in J13, FB1, R56, R57, R58, R59, C6, C7, C9, C10, C12, IC3, D2, D3

Test:

- Plug in USB cable on PC and power up AKKON Handwheel. MS Windows should detect a new device and an additional serial port should be available.

3.2.3 Step 3: Build Controller block

- Solder in IC1, dsPIC30F5015, micro controller
- Solder in capacitors C1, C2, C3, C4 and C5

3.2.4 Step 4: Create connection between controller and USB interface

- Solder in R39, R40, D6, R35, R45, R61, R62, T1, D1, J2

Test 1:

- Plug in USB cable on PC and power up AKKON Handwheel. MS Windows should detect a new device and an additional serial port should be available.
- Plug in USB cable, check with terminal program if RTS is on.
- Run a RS232 terminal program. In the example below the free terminal program from BRAY is used. Establish a connection to AKKON Handwheel and enable respectively disable RTS line. This will release the controller from RESET. The signal can be checked using a digital multi meter and check power between RESET (=MCLR-pin) and Ground (GND-pin) on plug J2. The power should be around RTS = 1 => 5 V and RTS = 0 => 0 V.

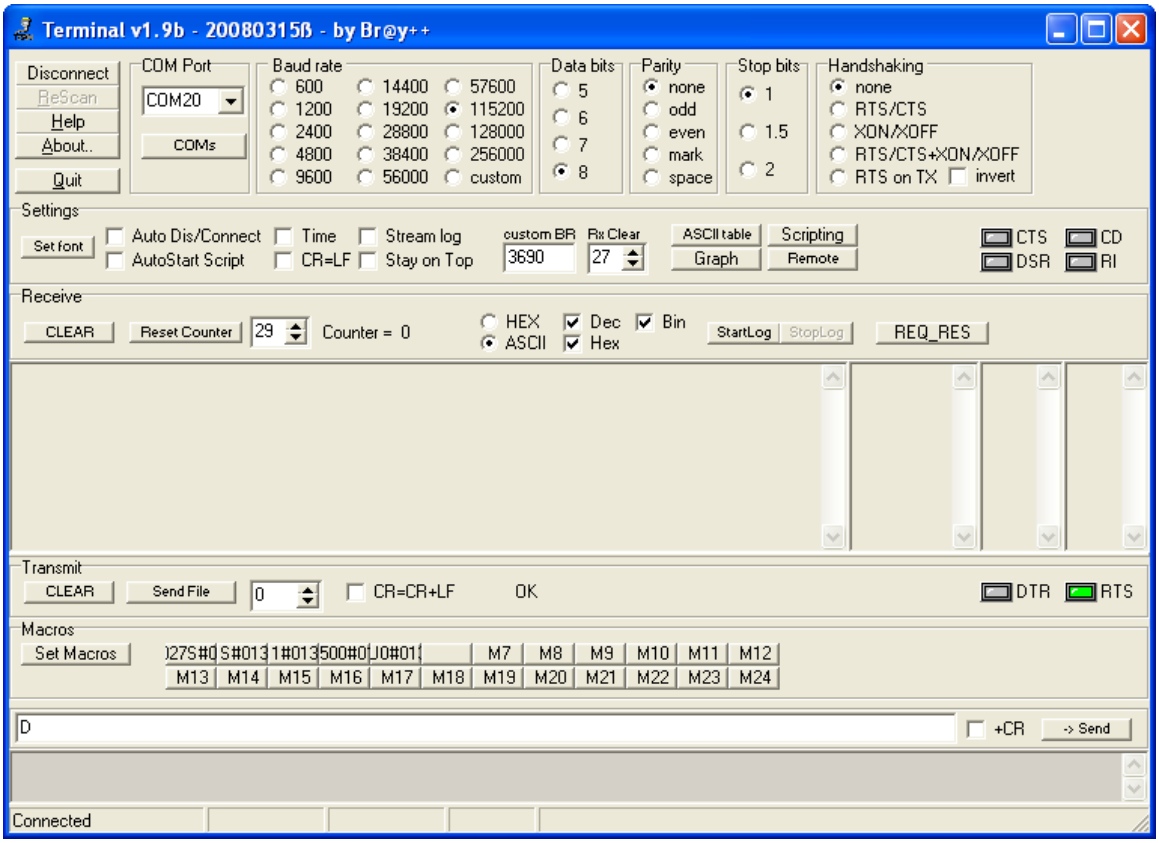

Figure 8: RS232 terminal with manual RTS signal switching

Test 2: Program boot loader and run small test application

- Program boot loader to the dsPIC controller (see section 3, Software setup for AKKON Handwheel)
- Run AKKON Test program (AHW_Led_Test.hex). Led D2 should blink with1Hz

Test 2 is not absolutely necessary but can simplify failure search in assembling state.

3.2.5 Step 5: Finalize PCB

- Solder in the other SMD-parts
- Solder in switches. Take care that the knobs on the bottom of the switches fit to the surface of the PCB.

- Solder in leds. Take care that the right pole of the leds for + and -. The long wire of an LED is the plus pole. Let all leds look around 12 mm outside of the PCB

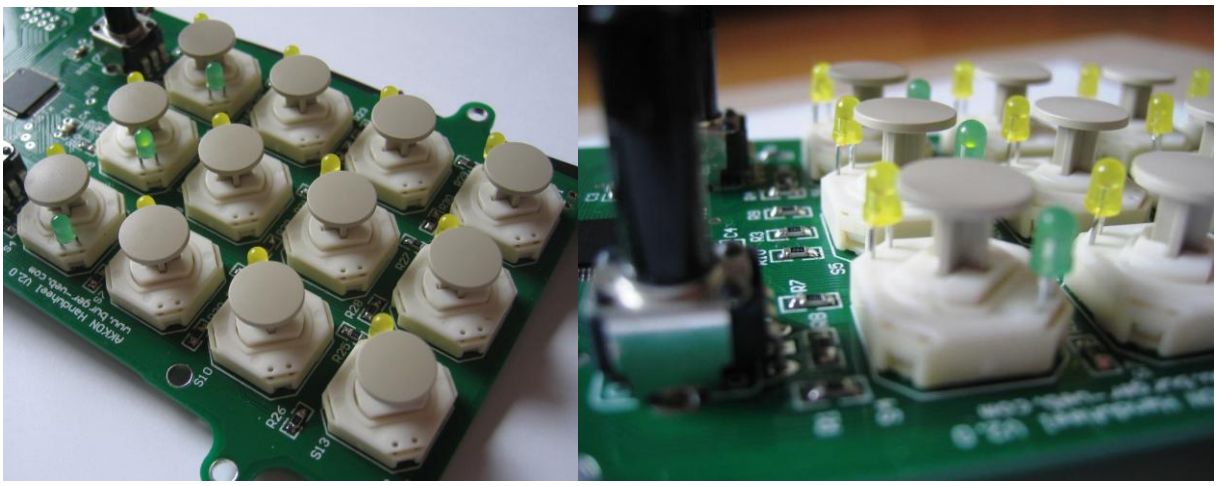

Figure 9: Mounted switches with plungers and leds

- Put power supply on board, measure current. Maximum power consumption should not exceed more than 150 mA
- Solder in R33, R34 and S1. Take care that the parts laid out on PCB so that they are soldered in vertical

Test

- Program firmware for AKKON Handwheel to board
- Plug in USB cable
- Run AKKON test program, connect to controller board and toggle RTS line

3.3 Create mechanics and keyboard layout

3.3.1 Creating case

AKKON Handwheel is mounted in a case from BOPLA (www.bopla.de). The case is made from ABS plastics that can be machined resp. processed e.g. with a milling machine, a drilling machine or rasps. G-Code for machining of the top of the case is available in the installation package for download. In addition a dxf-file for modification is available.

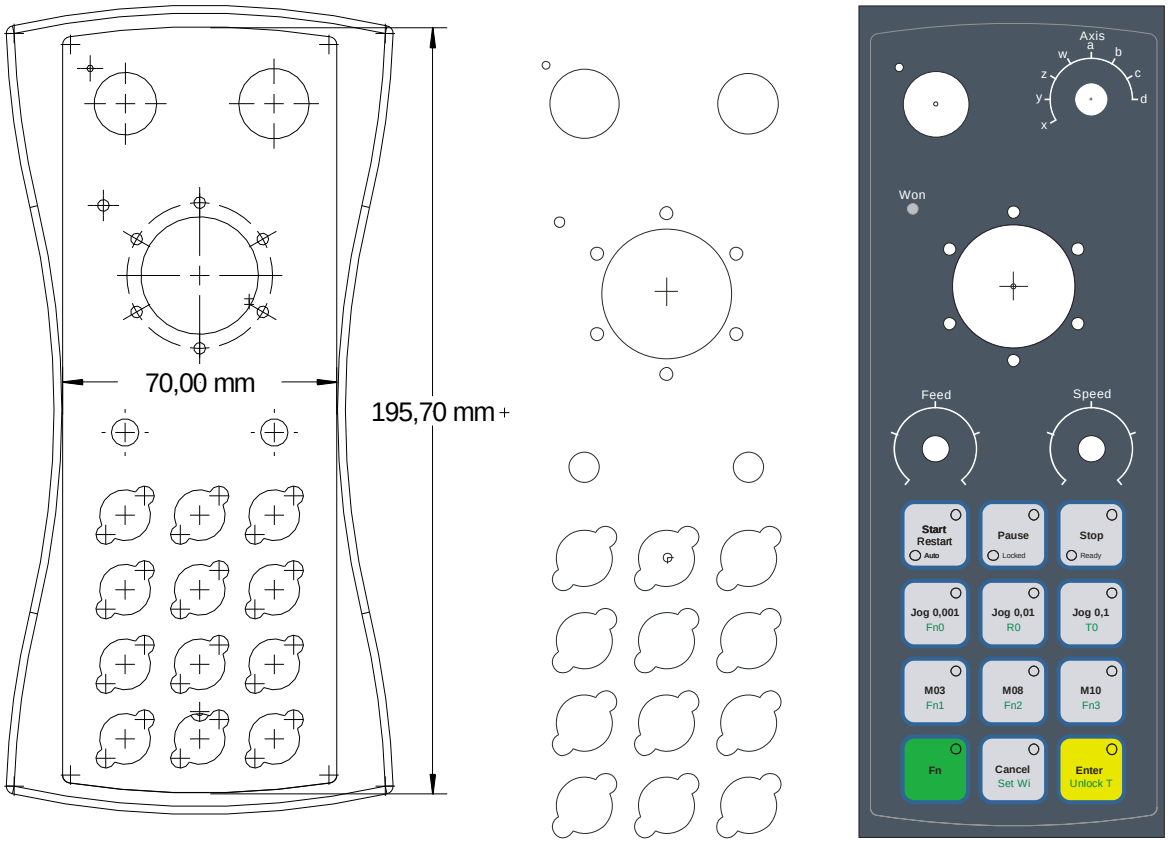

Figure 10: Mechanical drawing, milling contour for case (middle) and example keyboard layout

Depending on the application, the keyboard layout can be designed by the user. A standard design for a Handwheel used with AKKON CNC, shown in the figure above (right picture), is also included in the installation package. A further hole for the cord grip with a diameter of 16 mm on bottom of the case is necessary to feed through the cables.

3.3.2 Creating keyboard layout

There are different techniques for creation of keyboard layouts. An inexpensive way is to create keyboard with self-sealing foils. These foils can be printed with inkjet or laser printers. Protection of the layout can additionally be established by putting a further transparent foil to the top of the surface. Reducing abrasion on the buttons a thin plate made of felt can be put between the plungers of the buttons and the foil.

3.4 Assembling of components

Having created all components as described above, assembling of the AKKON Handwheel can be done. There are no special considerations necessary.

4 Software setup for AKKON Handwheel

This section describes how to test and setup AKKON Handwheel for future use. In a first part the USB interface hardware will be configured. In the second part the procedure for firmware updates will be shown.

4.1 Configuration of USB interface

AKKON Handwheel uses self powered option for the USB device. This option has to be configured using FTDI EEPROM configuration software. On the FTDI web site there is a tool called Multi Device EEPROM Programmer available (also included in the installation package). Run MProg.exe on the PC

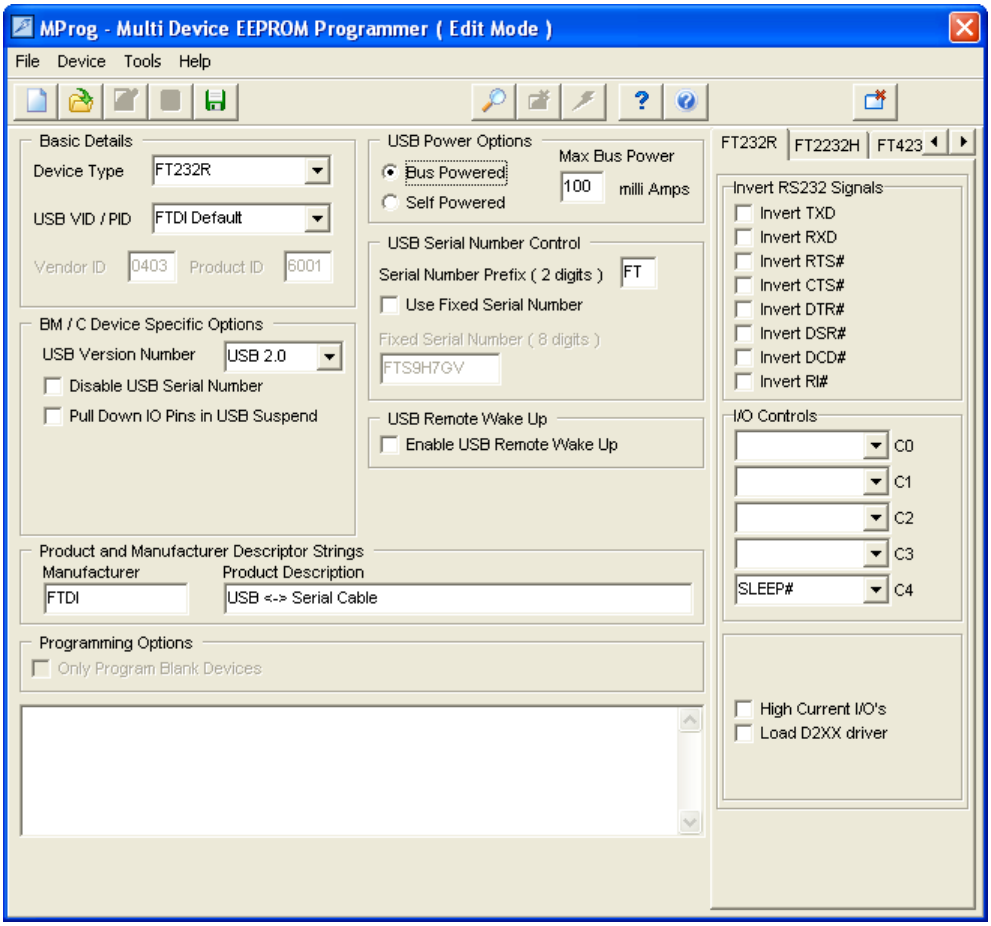

Figure 11: Multi Device EEPROM Programmer and test tool release by FTDI

Press Menu => Device => “Scan”. After successful scan, at least on device should be found by the software.

Press Menu => Tools => “Read and Parse”. After successful operation, the parameters of the FT232R-device are displayed.

NOTE: These settings depend on used boot loader. Depending on the boot loader the default settings work.

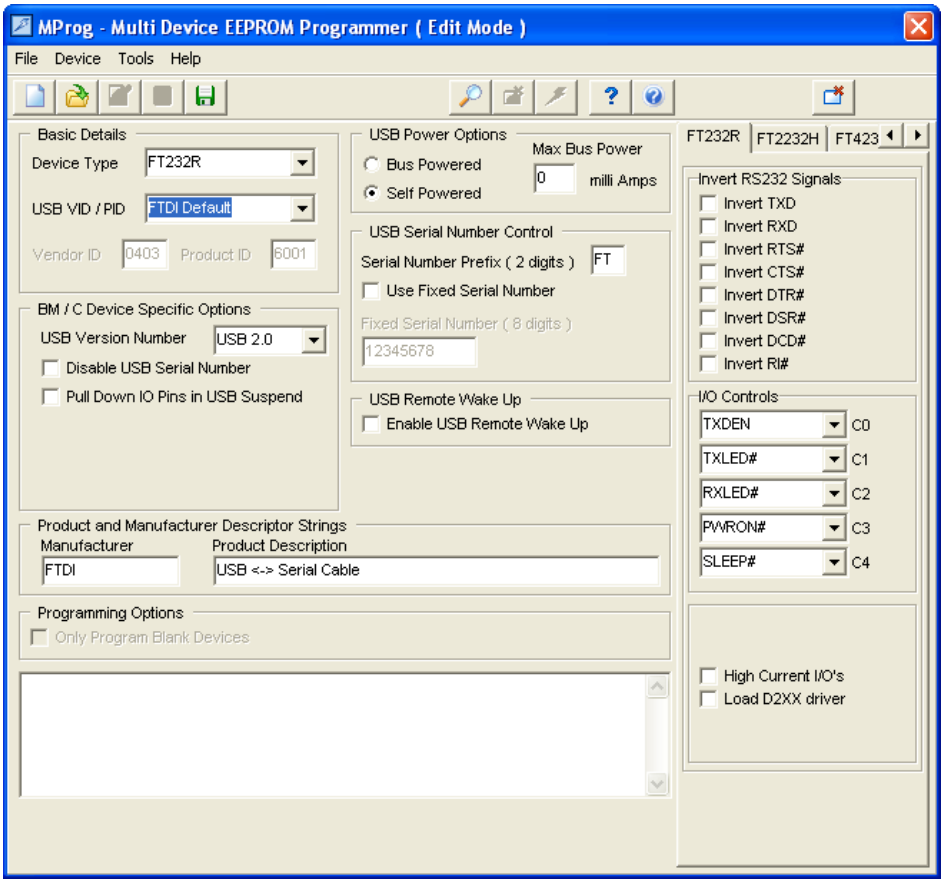

Figure 12: Multi Device EEPROM Programmer and test tool release by FTDI

In a next step a new configuration profile for FT232RL device has to be created. On this device USB Power Options have to be set to “Self Powerd”. A template is included in the installation package. Load the template file and press program to burn the EEPROM of the USB interface. The AKKON Handwheel can now be tested for future use.

4.2 Firmware updates

The AKKON Handwheel can be programmed and debugged using In Circuit Programmer. This option is mainly used for firmware development. A more convenient approach is to initially program a small program – called boot loader – on the micro controller. The boot loader is able to create a connection to serial interface and write the application (firmware) to the micro controller. There are different commercial and free boot loaders available.

Firmware updates using Tiny boot loader

The following description outlines how to perform firmware updates using the free TINY boot loader (http://www.etc.ugal.ro/cchiculita/software/picbootload.htm). The Tiny boot loader takes around 100 word of program space. It is assumed that the Tiny boot loader has already been programmed to the AKKON Handwheel controller board using a dsPIC **I**n **C**ircuit **S**erial **P**rogrammer. A modified boot loader the AKKON Handwheel is included in the Installation package.

Run Tiny boot loader application. The screen should look like as shown in figure 5.

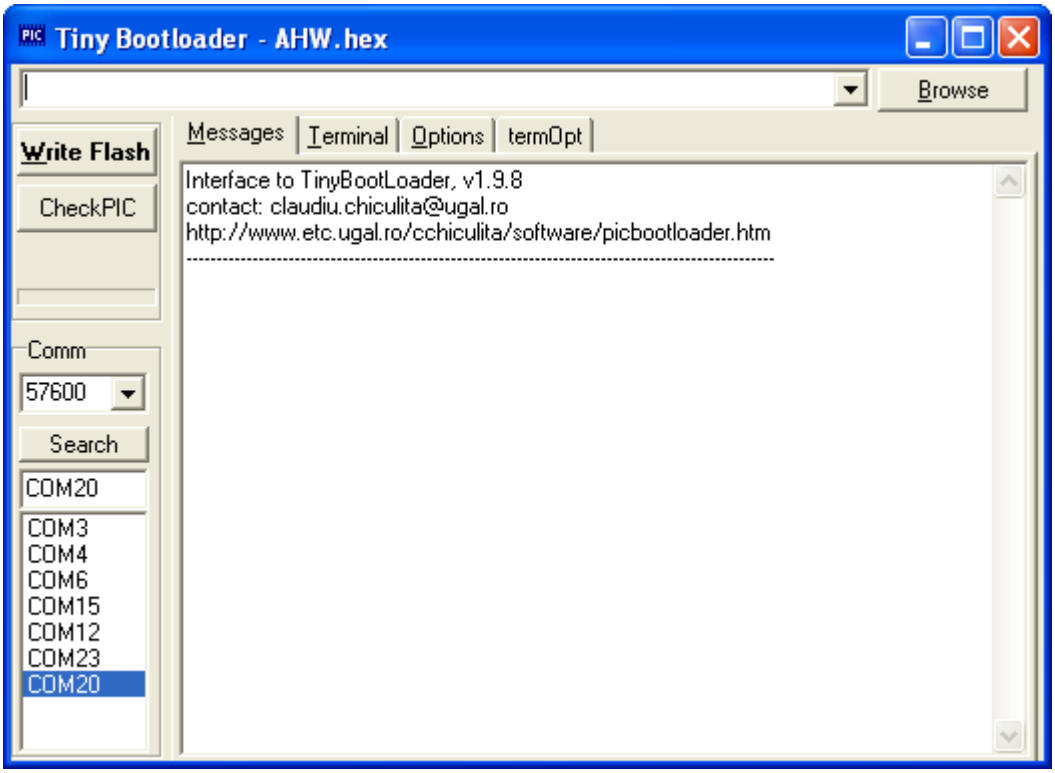

Figure 13: Initial screen after starting up Tiny boot loader

In a next step setup options for the boot loader.

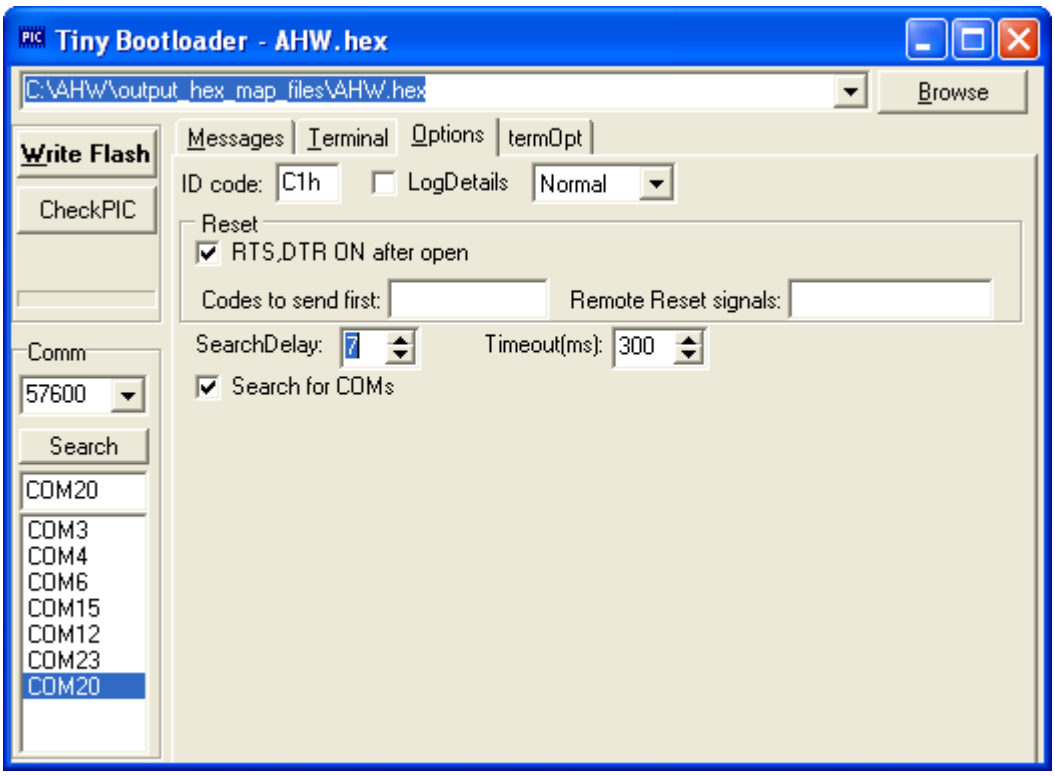

Figure 14: Configuration of Tiny Boot loader

Press button “CheckPIC” and if Tiny boot loader found successful a message as shown below should be output by the Tiny boot loader.

NOTE: If programming does not work, please try to set timeout value to 100 ms.

NOTE2: Depending on setup of FTDI-chip resp serial interface Tiny bootloader can be setup to change reset signals by placing commands in input field “Remot Reset signals”.

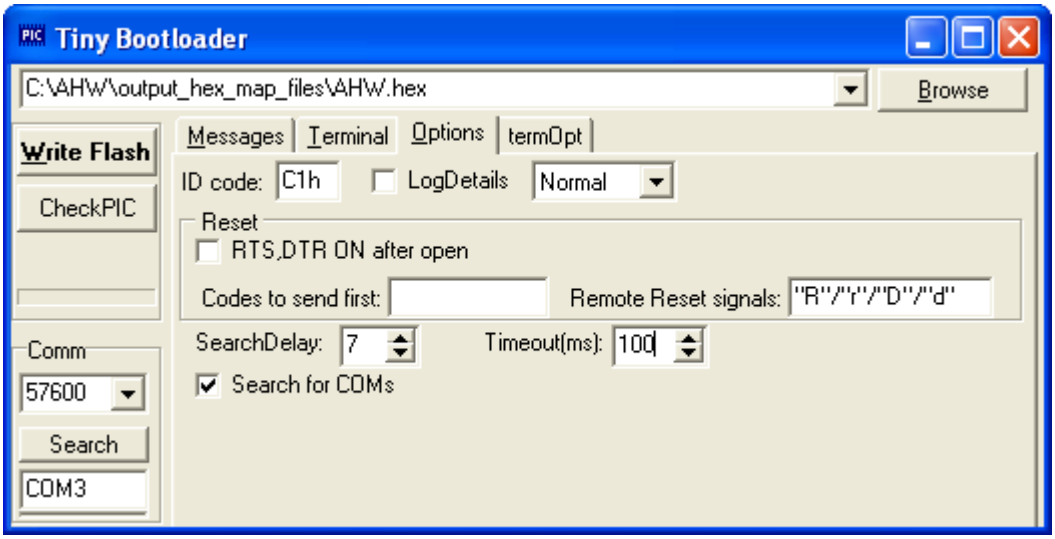

Figure 15: Configuration of remote signals for Reset

Lower characters disable the signal, upper characters enables it.

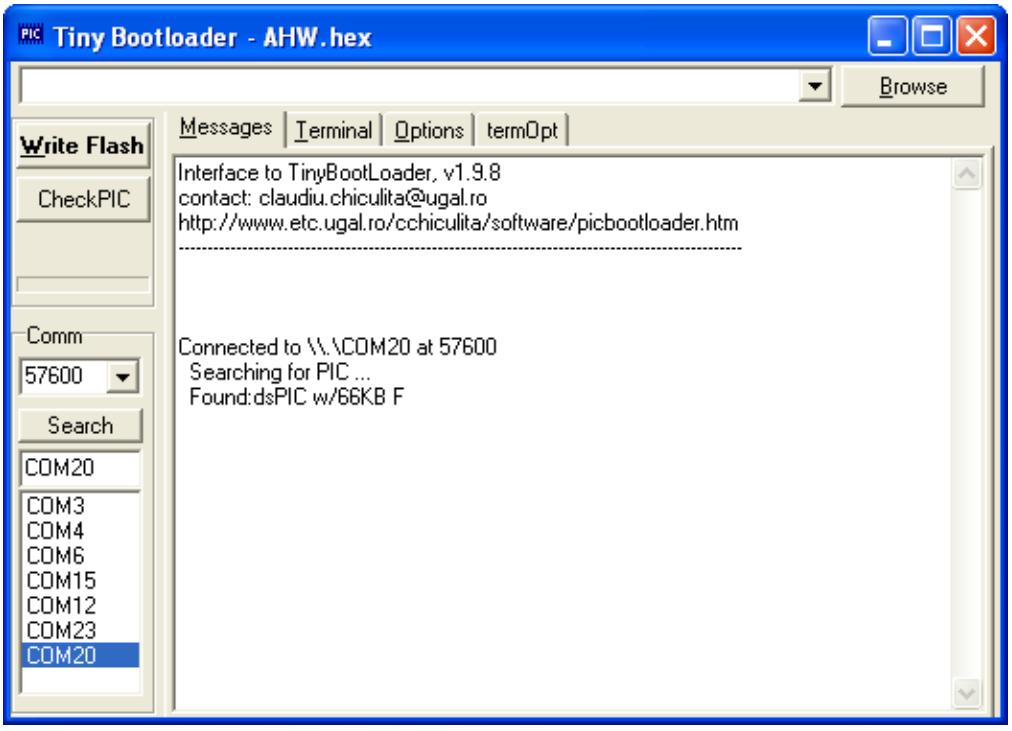

Figure 16: Screen dump of Tiny boot loader after successful board identification

Select firmware of AKKON Handwheel and press button “Write Flash”

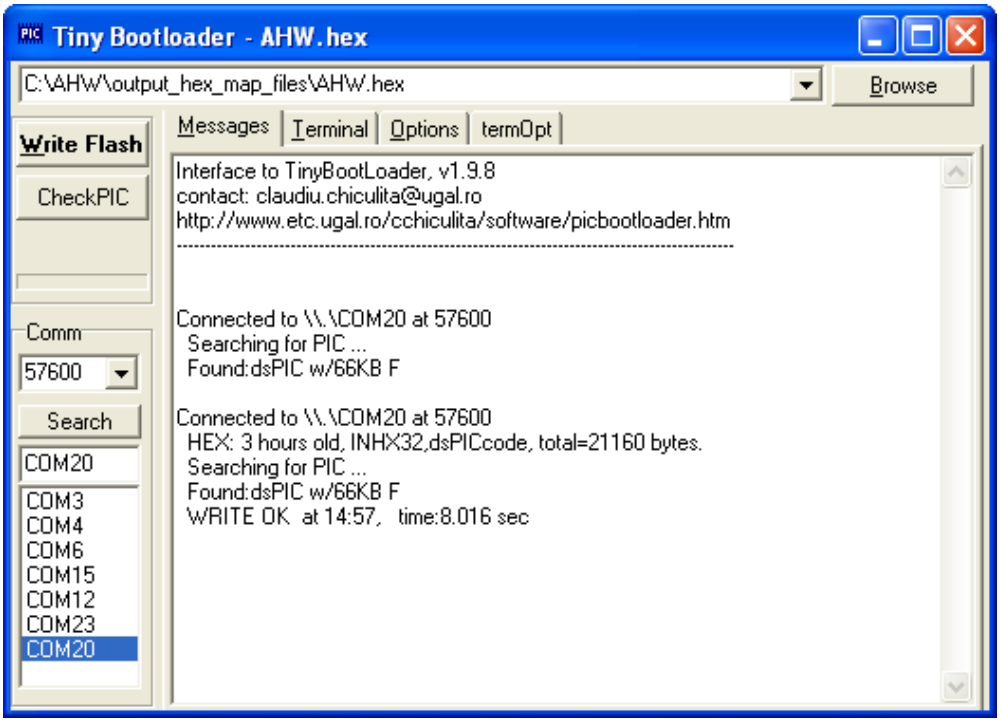

Figure 17: Screen dump of Tiny boot loader after successful firmware update

4.3 USB Device driver configuration on windows XP

Before running the AKKON test application the settings of the "**R**eady **T**o **S**end" (RTS)-signal of the RS232 port has to be checked. If resistor R62 is soldered on board the behavior of the RTS-signal after closing the serial port has to be changed. The modifications require administrator privileges on the PC.

Move to Windows Device Manager.

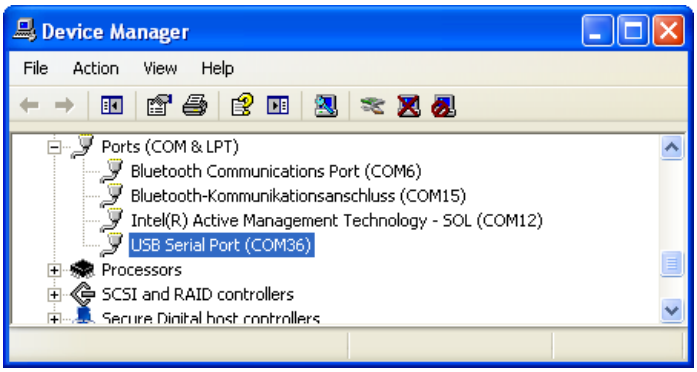

Figure 18: Serial port of AKKON Handwheel in the windows device manager

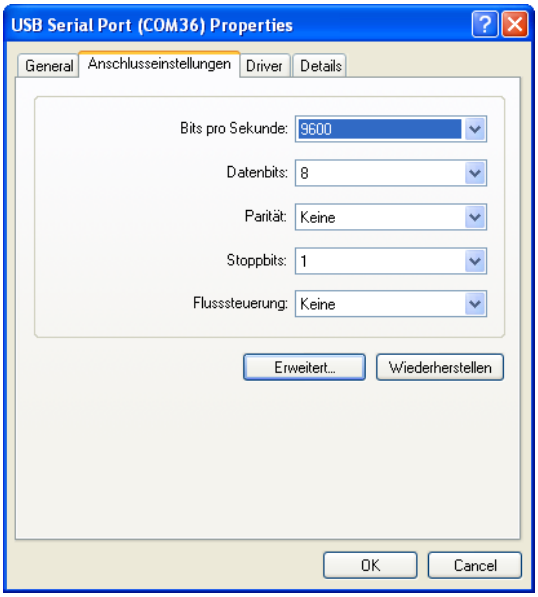

Figure 19: Screen shot of USB driver properties

Click “Erweitert” button.

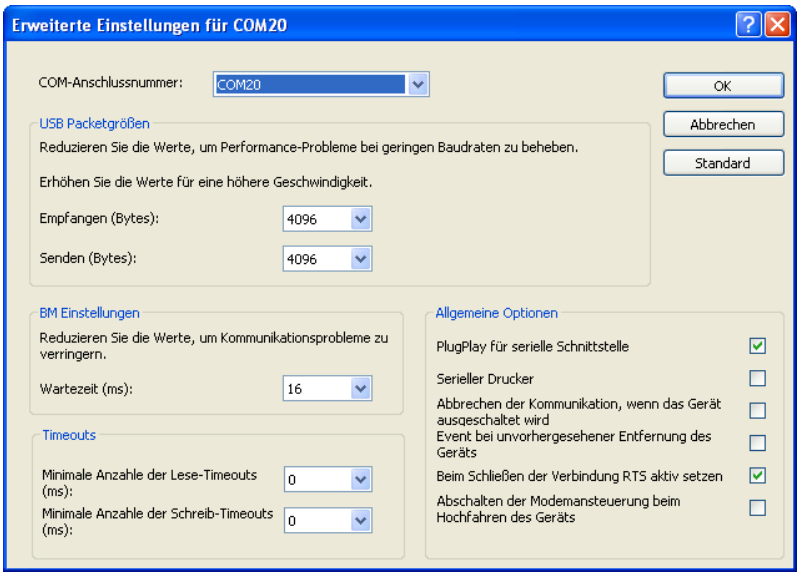

Figure 20: Windows device manager

If checkbox “Beim Schliessen der Verbindung RTS aktiv setzen” is eabled then disable it.

5 Running AKKON Handwheel test and configuration application

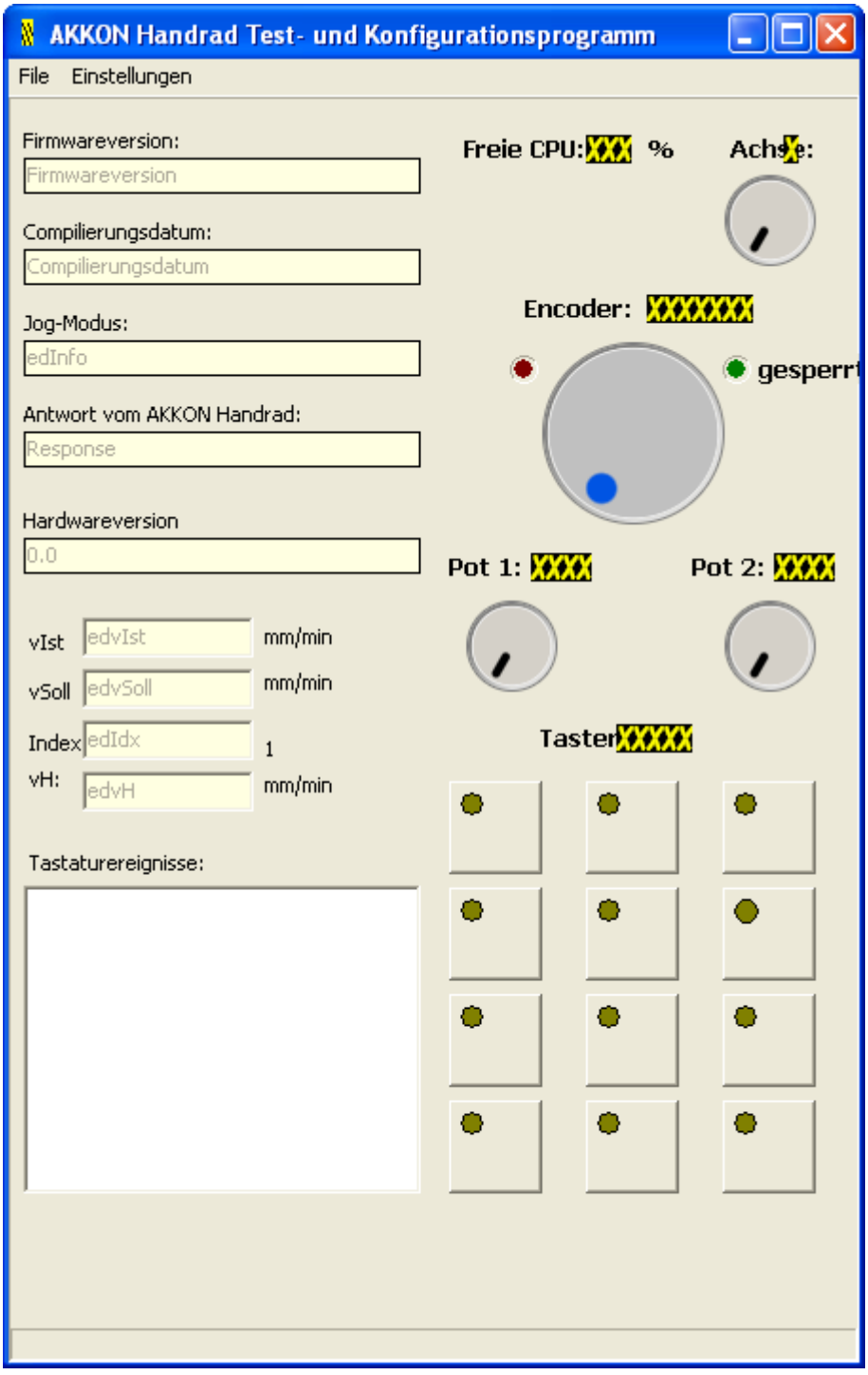

Figure 21: AKKON Handwheel test application

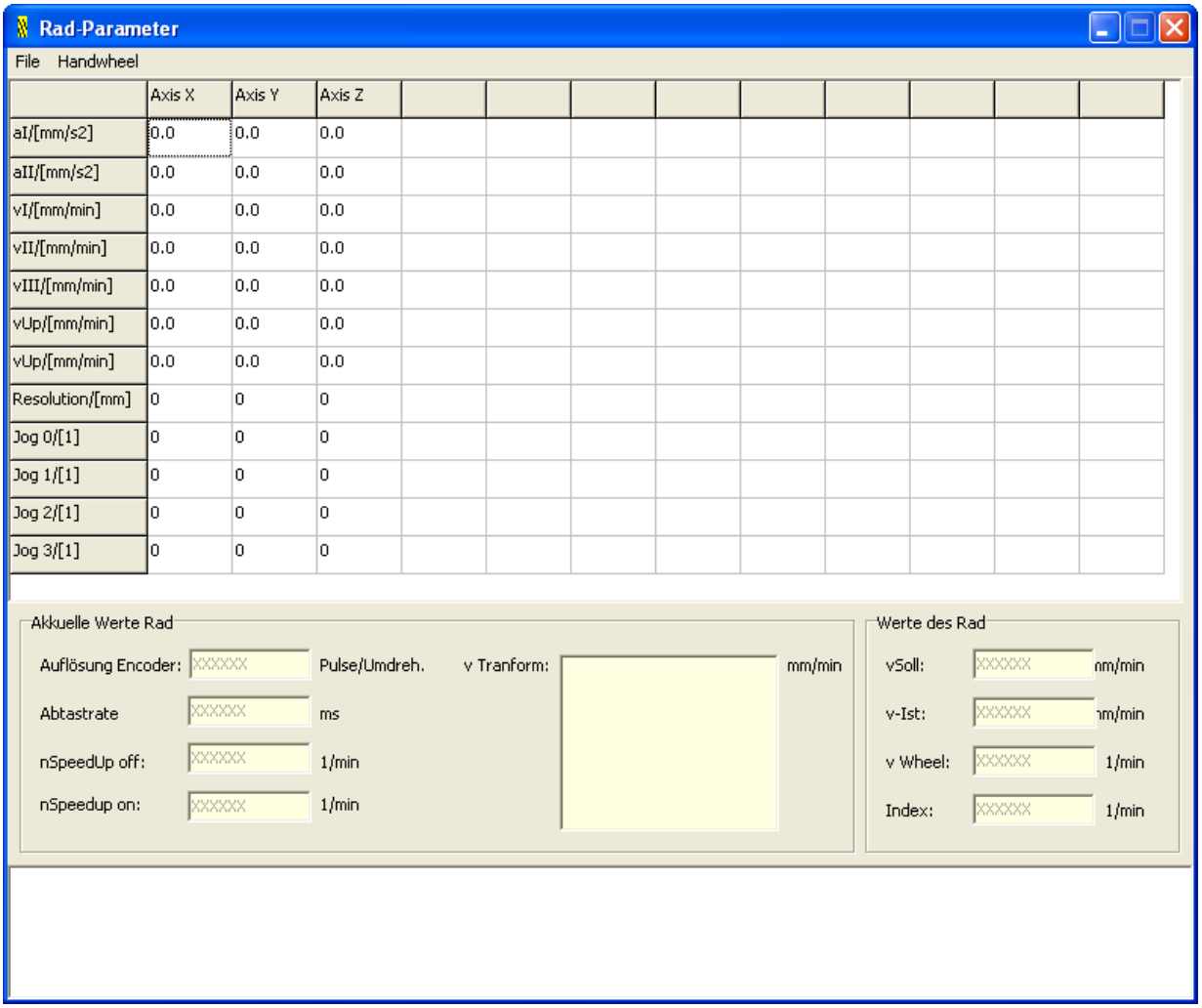

Figure 22: AKKON Handwheel parameterization

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