SFU-Terminal Manual

Content

# 1. Start and Main Window

After launching SFU-Terminal, a connected frequency converter will be detected automatically.
In this case the Firmware Version is displayed besides the Go-window.

After initiating **Go**, the main window of SFU-Terminal will be displayed and the parameters of the frequency converter were read out.
The main window of SFU-Terminal is the center to access all functions.
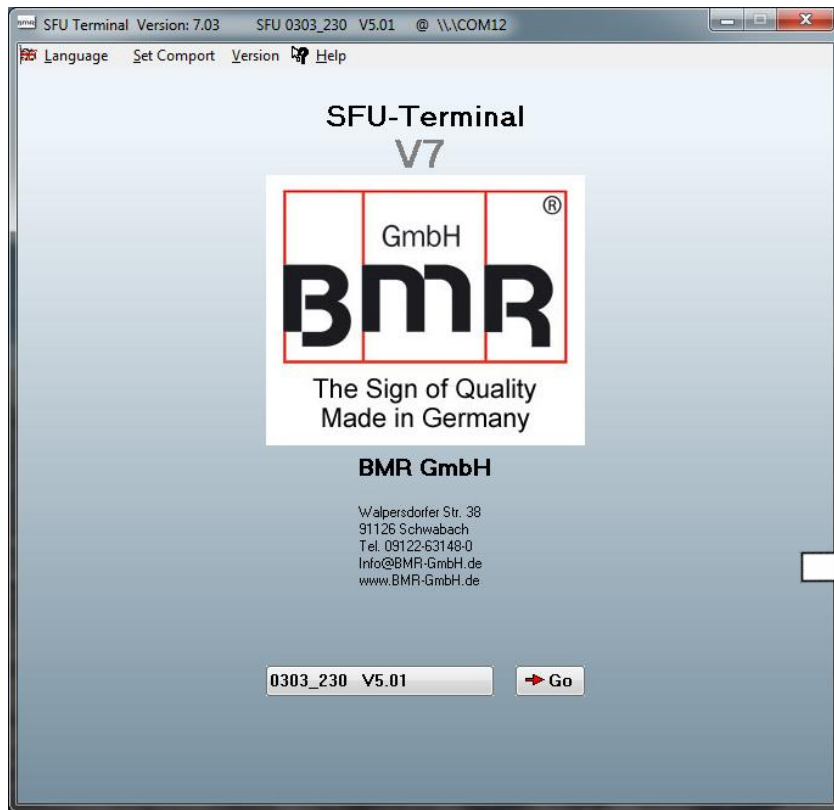
Start Window   **Main Window**
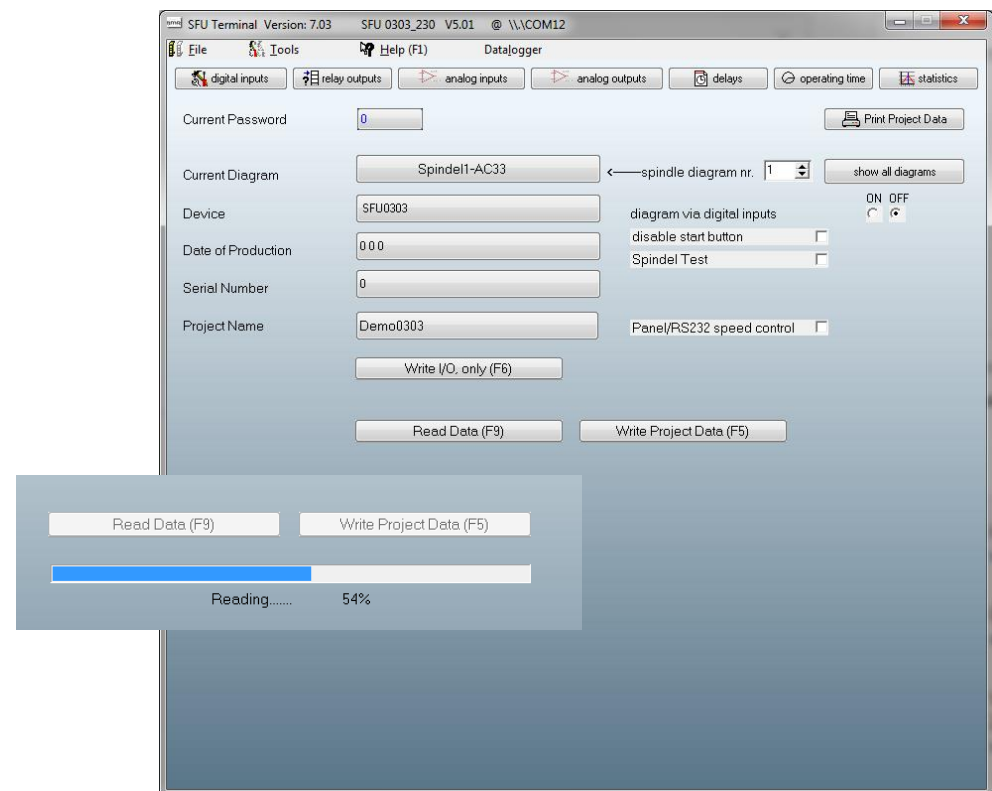
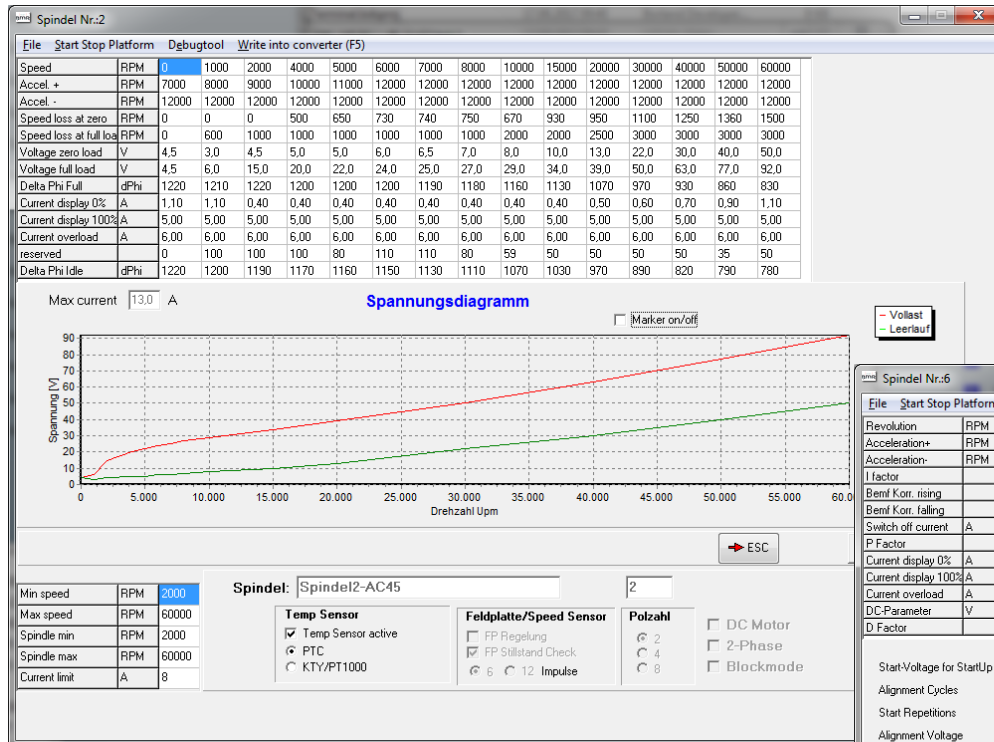## 2. Spindle Setup with Spindle Characteristic Files:

Due to the key function in today's applications, very high demands are placed on the spindles used and their running performance. So, especially high speed applications, require very sensitive balanced control concerning heat generation and speed control.

Due to these requirements, the inverter has a very important role to play. A large number of parameters are required for sensitive and powerful spindle control. Basing on these parameters, it is possible to adjust the spindle either as cool as possible or very precisely in speed and everything in between.

These data are essential and stored in spindle parameter files also called spindle characteristics with the extension *.skl.

- It contains a table with 15 setpoints which can be distributed freely over the whole speed range. At every setpoint several parameters can be defined. By this it is possible, to make a very free adjustment over the whole range of speed

- This table contains data such as spindle voltage and currents, speed settings and acceleration ramps, and many more

- A setup of the limits of Min and Max speed

- A setup for AC asynchronous or BLDC synchronous spindle can be made

- It is possible to setup the use of temperature sensor in type and threshold value.

- It is possible to setup a speed sensor support, with or without and the number of pulses per rotation
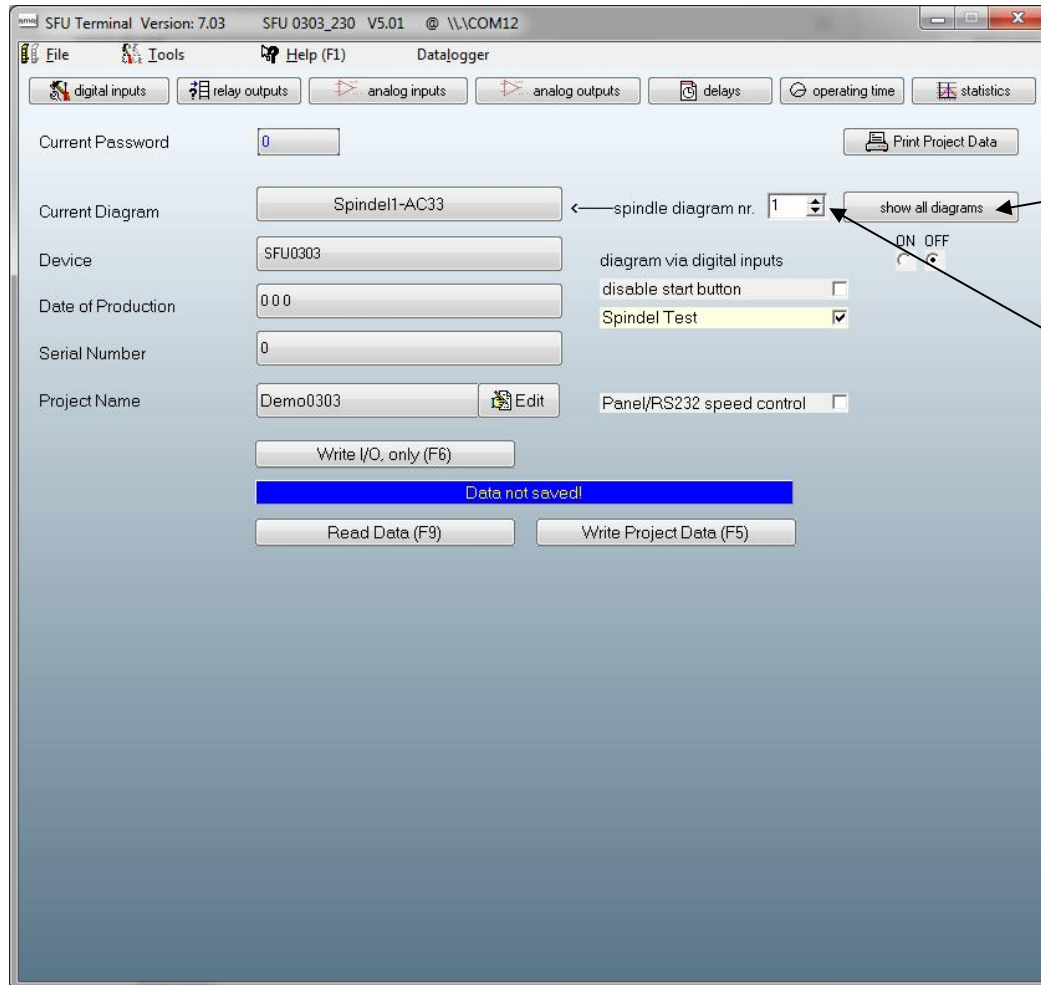
Spindle Characteristic Files

Typical spindle characteristic for an AC asynchronous spindle

Typical spindle characteristic for an BLDC synchronous spindle
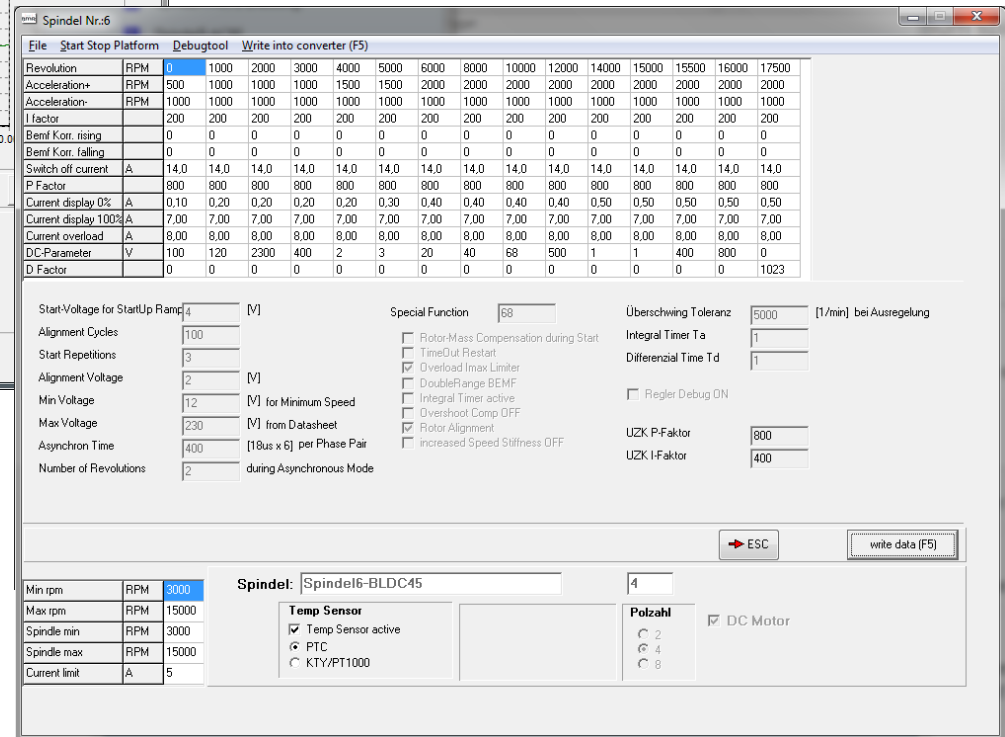
3. Spindle Characteristics

To drive a spindle properly, the converter needs all data about the relevant spindle parameter. These data are essential and stored in spindle parameter files also called spindle characteristics with the extension *.skl. They contain all relevant data such as spindle voltage, current, speed information, and many more.

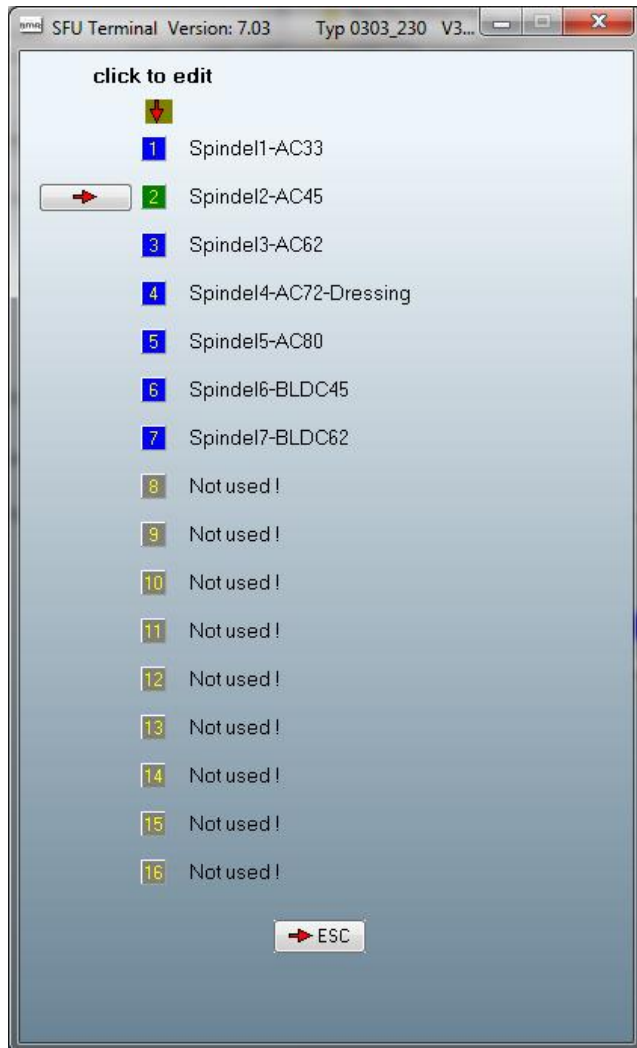There are two possibilities to select a certain spindle parameter file:

- With Click on **show all diagrams** in the main window all spindle characteristics which are currently available in the converter are displayed in a list.
  Click on the desired spindle
  Now the spindle table opens and dialog window will open and ask if the new file has to be activated →click on **Ja/Yes**

- It is possible, to select a spindle characteristic by it's number in the **spindle diagram nr** field with **up** and **down** arrow keys. The relating spindle name is displayed in the spindle window

  Finally this setting has to be activated in the frequency converter with **Write I/O only**

With the SFU0303 there is an additional possibility to remote control the spindle characteristic selection by digital inputs of the spindle interface

- To activate this, the option button **diagram via digital inputs** has to be set to **ON**

  In this case the 4 bit interface on connector X4 can address all 16 spindle characteristics. In case all inputs are open unwired, spindle nr1 is the default selection

With Click on **show all diagrams** in the main window all spindle characteristics which are currently available in the converter are displayed in a list.

Now the following options are possible:

- to select a certain spindle
Click on the desired spindle
Now the spindle table opens and dialog window will open and ask if the new file has to be activated →click on **Ja/Yes**

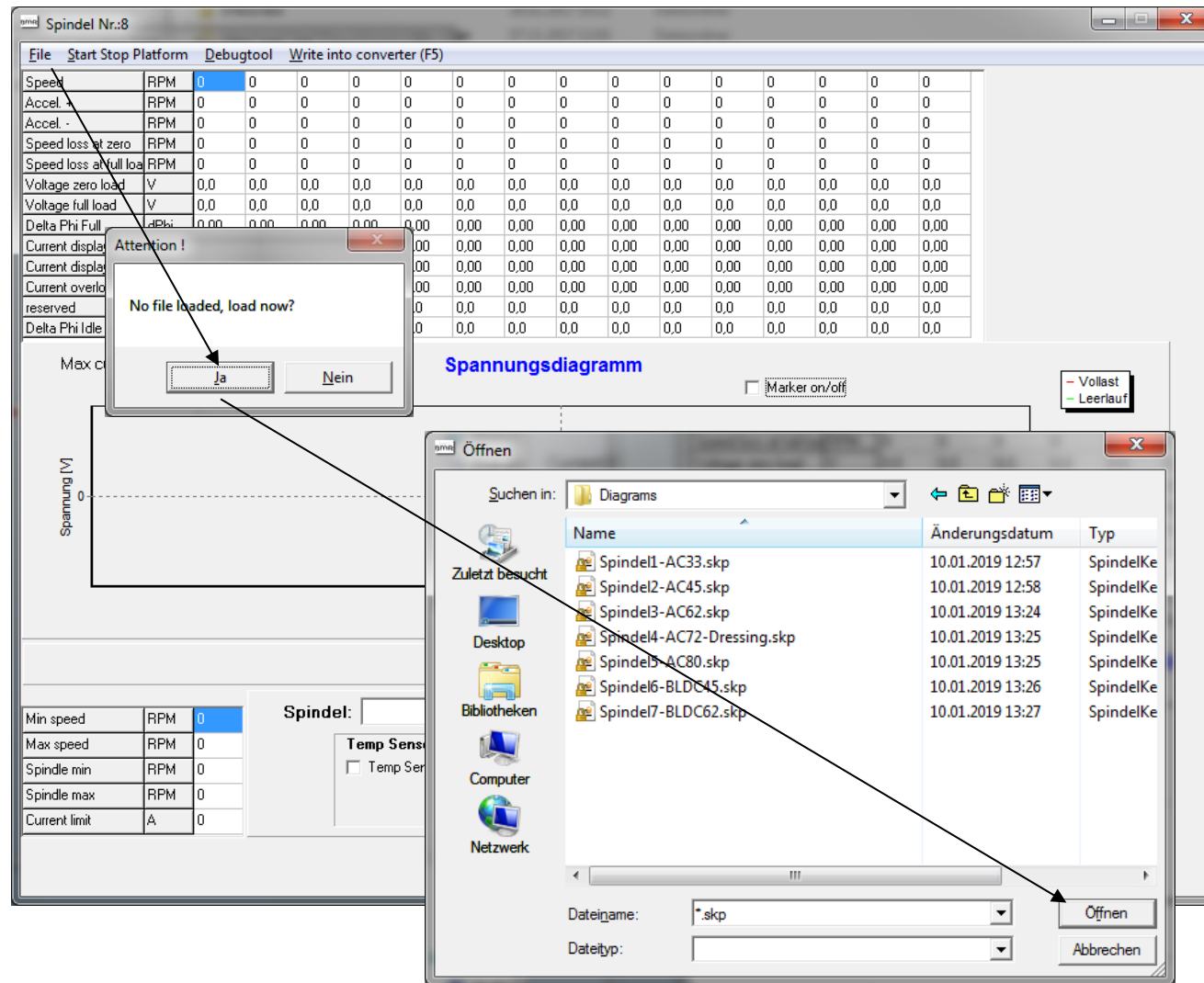- to add another one.
Click on an unused place.

A dialog window will open and ask if a new file (characteristic) should be loaded

- To replace an existing one
Click on the desired spindle
Now the spindle table opens and it has to be transferred it to the converter with button **write data**

3.1 Adding, Replacing or Saving a Spindle Characteristic

- For **adding a spindle** click on an unsused place in the spindle list.
Now a dialog box opens which has to be confirmed with *Ja/Yes.*
Select the required spindle in the file dialog box and click on *Öffnen/Open*

- For **replacing a spindle** click on an select a certain spindle in the spindle list.
Now the spindle window shows the current spindle parameters.
At the menu point *File – open diagram* a new spindle characteristic can be loaded.
Select the required spindle in the file dialog box and click on *Öffnen/Open*

- For **saving an existing spindle** characteristic to the PC, proceed vice versa with the menu point *File – save diagram* will do so

Speed	RPM	0	1000	2000	4000	5000	6000	7000	8000	10000	15000	20000	30000	40000	50000	60000
Accel. +	RPM	7000	8000	9000	10000	11000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Accel. -	RPM	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Speed loss at zero	RPM	0	0	0	500	650	730	740	750	670	930	950	1100	1250	1360	1500
Speed loss at full loa	RPM	0	600	1000	1000	1000	1000	1000	1000	2000	2000	2500	3000	3000	3000	3000
Voltage zero load	V	4,5	3,0	4,5	5,0	5,0	6,0	6,5	7,0	8,0	10,0	13,0	22,0	30,0	40,0	50,0
Voltage full load	V	4,5	6,0	15,0	20,0	22,0	24,0	25,0	27,0	29,0	34,0	39,0	50,0	63,0	77,0	92,0
Delta Phi Full	dPhi	1220	1210	1220	1200	1200	1200	1190	1180	1160	1130	1070	970	930	860	830
Current display 0%	A	1,10	1,10	0,40	0,40	0,40	0,40	0,40	0,40	0,40	0,40	0,50	0,60	0,70	0,90	1,10
Current display 100%	A	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Current overload	A	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00	6,00
reserved		0	100	100	100	80	110	110	80	59	50	50	50	50	35	50
Delta Phi Idle	dPhi	1220	1200	1190	1170	1160	1150	1130	1110	1070	1030	970	890	820	790	780

Now the table will be filled with the new relevant spindle data.

Finally, this characteristic has to be transferred into the converter with *Write Data*

After finished transfer the dialogbox has to be confirmed with **OK**

Finally a new dialog box appears asking if this characteristic should be activated.
In case of yes, click on **Ja**

Now the new spindle characteristic is available in the converter and can be used

3.2 Modifying a Spindle Characteristic
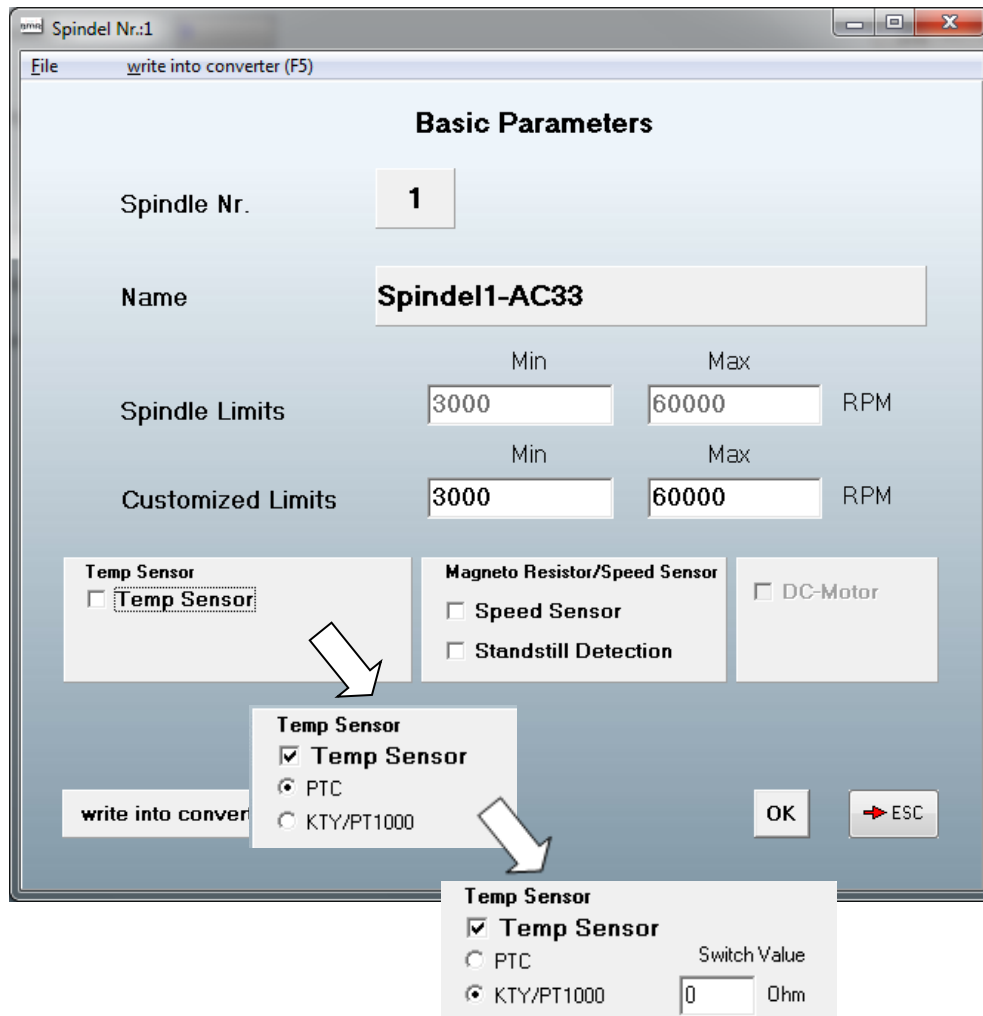
Speed Setting
There are 4 speed values, where 2 of them are fixed due to limitations of the capabilities of the spindle. Within these limits the 2 *Customized Limits* may be modified according to the requirements:

These values have to be regarded when configuring the scaling of the speed reference analog input.

A special case is, to setup Min and Max value to the same value, so there is only one speed possible and cannot be varied.

Temperature Sensors with 3 possibilities:
- No Temp Sensor
- Temp Sensor PTC
- Temp Sensor KTY or PT1000 with free definable switch value
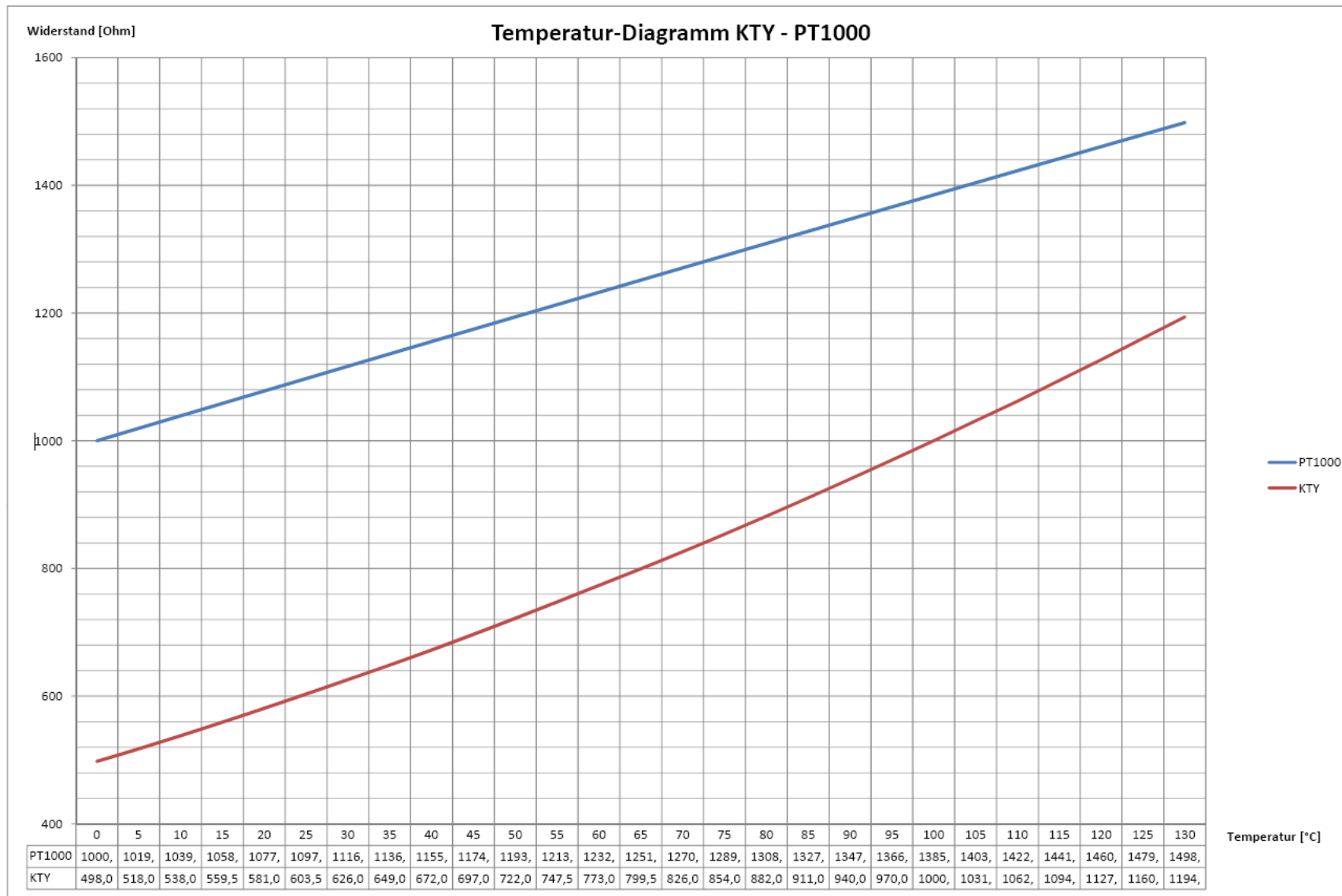 For setup, please have a look into the KTY-PT1000 diagram (3.3)

Speed Sensors with 3 possibilities
- No Speed Sensor: Realizes optimum performance and minimal spindle temperature, but with slight deviations in spindle speed due to slipping
- Operation without Speed Sensor support, but with Standstill detection.
- Operation with Speed Sensor support: will generate a bit more heat in the spindle due to a more stronger action of the converter regulation, but precise speed value

Finally, this setup has to be transferred into the converter with **Write Project Data**

The last two options need a wiring of the speed sensor with converter inputs

3.3 KTY-PT1000 Diagram

Temperatur-Diagramm KTY - PT1000

Temperatur [°C]	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130
PT1000	1000,	1019,	1039,	1058,	1077,	1097,	1116,	1136,	1155,	1174,	1193,	1213,	1232,	1251,	1270,	1289,	1308,	1327,	1347,	1366,	1385,	1403,	1422,	1441,	1460,	1479,	1498,
KTY	498,0	518,0	538,0	559,5	581,0	603,5	626,0	649,0	672,0	697,0	722,0	747,5	773,0	799,5	826,0	854,0	882,0	911,0	940,0	970,0	1000,	1031,	1062,	1094,	1127,	1160,	1194,

4. Project Files

A project file is the key element of a frequency converter. All data of the frequency converter can be saved into and loaded from so called project files. These files with the extension *.ps5 contain informations and all parameters, which define the setting of the frequency converter, such as all spindle characteristics and the setup of inputs and outputs and much more.

After connecting a frequency converter and initiating **Go** , the project file is uploaded from the frequency converter into SFU-Terminal. Now all parameters can be inspected and saved on the PC for documentation with **save project**

In case of loading project from the PC with **open project** or modifying the formerly uploaded one, the project has to be transferred to the frequency converter with **Write Project Data** .
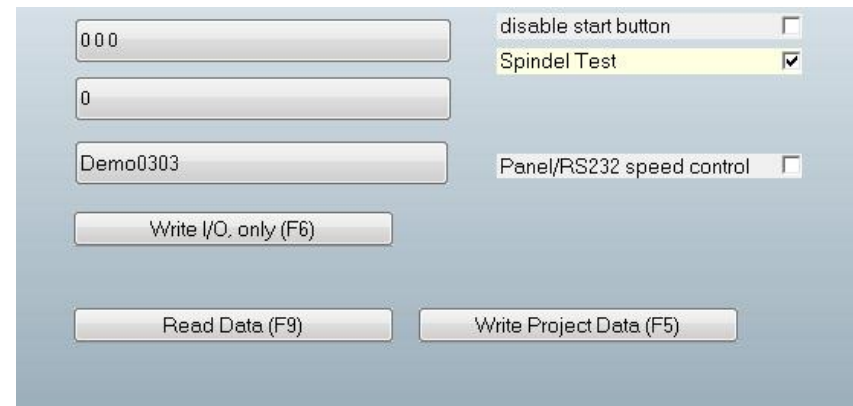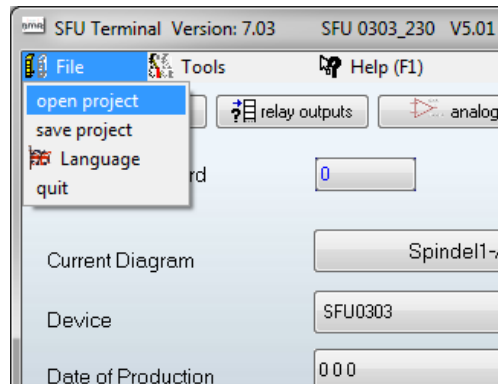
Furthermore, it is possible to initiate a read out of the parameters from the frequency converter with **Read Data**.

4.1 Modifying Configuration of Digital Inputs (shown on the example of a SFU0303)
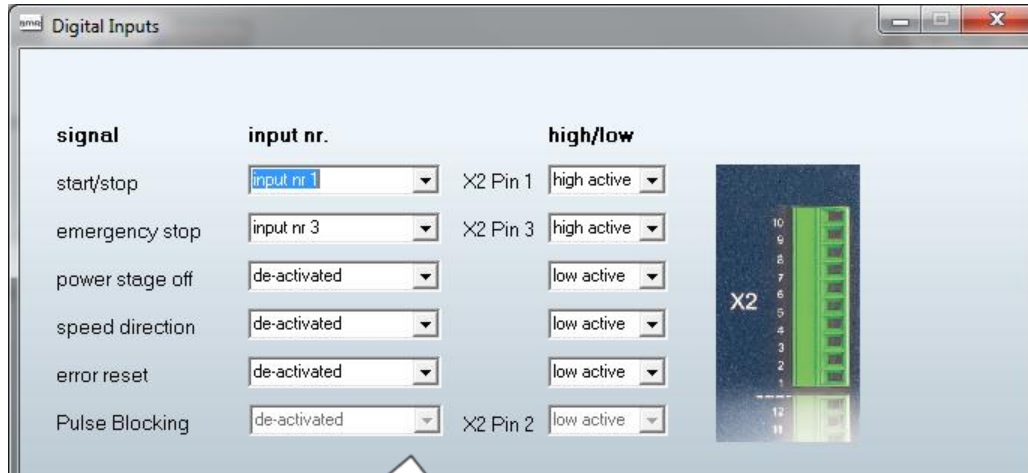
Setting

In the column "signal" are listed the available actions, which can be assigned to a certain input number or can be activated and deactivated permanently.

The desired input or operation can be selected in a list box and assigned to a function
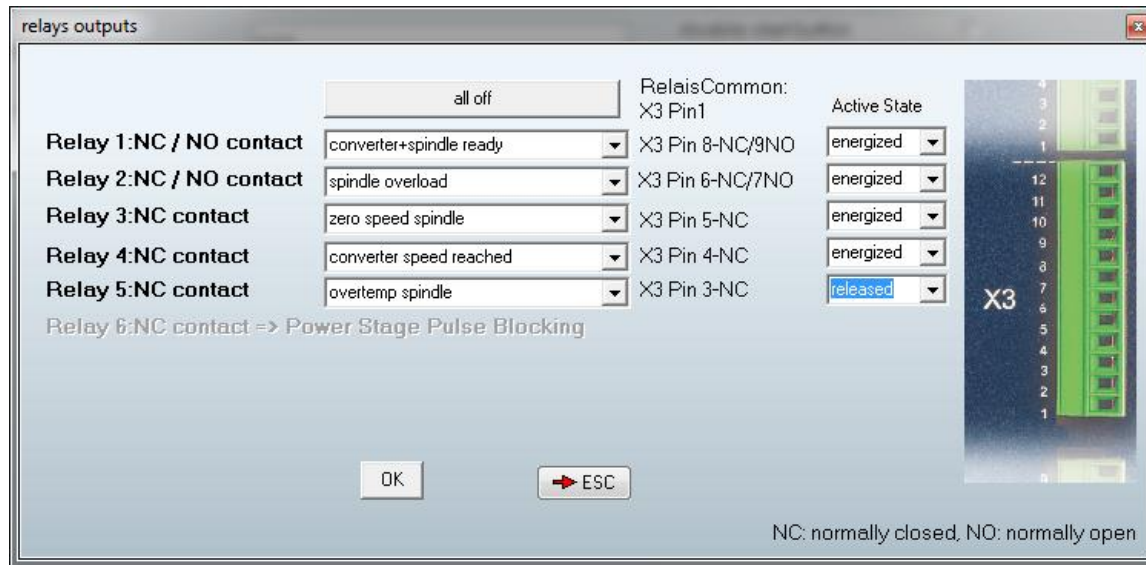
Moreover the polarity can be defined, whether it is an active low or active high function.

High Active means, the function will be initiated with a positive signal at the input

Finally, this setup has to be transferred into the converter with **Write I/O only** or with **Write Project Data** after closing this window and returning to the main window.
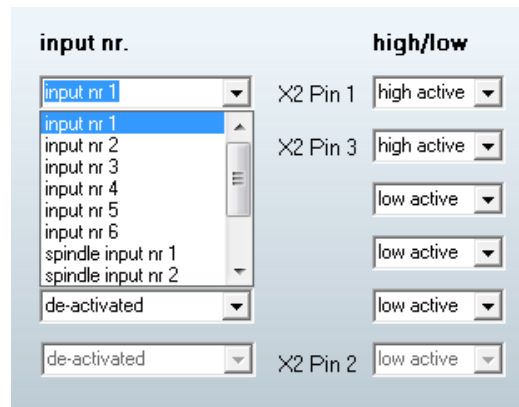
4.2 Modifying Configuration of Digital Outputs

Setting
Each relay can be assigned to a specific message from a list box

Moreover the also the polarity can be defined, whether the relay is energized or deenergized in the activated state.

- As an example, with relay 3:
In Power OFF state or as long as the spindle is at standstill, the contact is closed.
But as soon as the spindle shaft is at rotation, the relay will be activated, which means, the contact is opened.

- As an example, with relay 5:
As soon as the converter is powered ON and as long as the spindle temperature is OK, the contact is open. During Power OFF or as soon as the temperature is beyond the limit, the contact is closed.

The Digital Output function is realized with Relays or open collector outputs, depending on the SFU-model.
Even so the number of available outputs is depending on the SFU-model
In the example shown, it is a SFU0303 with 6 relays where relay 6 is reserved for the power stage locking function.

Moreover, there are relays with normally open contacts, normally closed contacts or with both options on two output channels.

Normally Open (NO) means, that the contact of this relay is open in case the relay is not energized or engaged. As soon as it is energized, it will close the contact. Equally with **Normally Closed (NC)** contacts.

Finally, this setup has to be transferred into the converter with **Write I/O only** or with **Write Project Data** after closing this window and returning to the main window.

4.3 Modifying Configuration of Analog Inputs and Vario Load
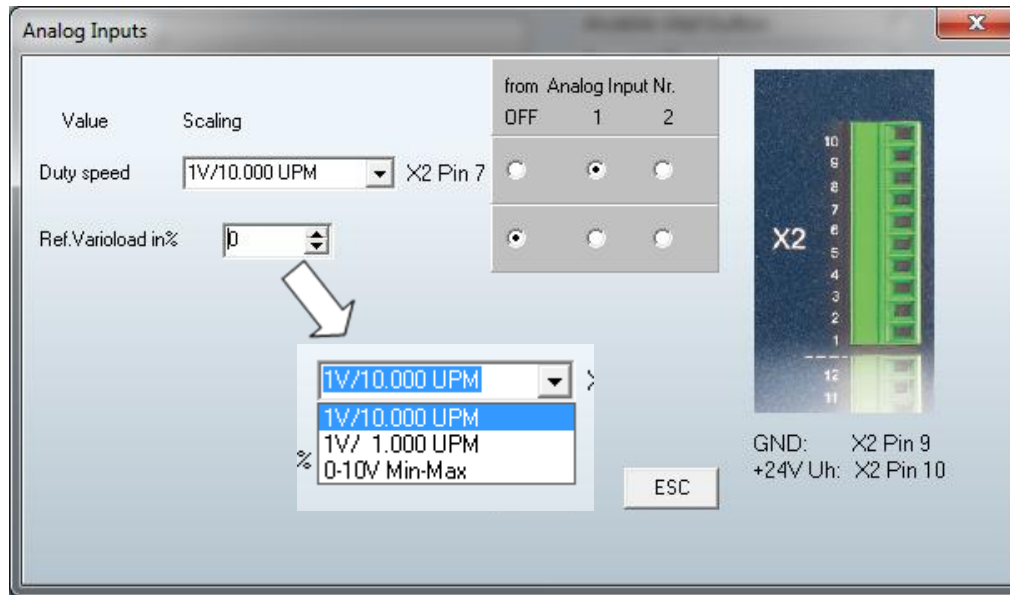
Setting

It is possible, to assign the remote value of the duty speed or the threshold value of the varioload to 2 different analog inputs. Additionally, the remote function can be switched off, also

Moreover the scaling can be selected, too:

- 1V/10.000UPM: standard setting with direct relation of voltage to speed: for a desired speed of the spindle of 50.000rpm, the input should be 5V.

- 1V/1.000UPM: for low speed operations below 10.000rpm. for a desired speed of the spindle of 6.000rpm, the input should be 6V.

- 0-10V Min-Max: the total speed range of the spindle is assigned to a range from 0-10V.

$$\text{Uin} = \frac{10V \ast \text{ desired speed}}{\text{speed range}}$$

If the speed range is 60.000rpm, and the desired speed of the spindle should be 50.000rpm, the input should be 8,33V

Finally, this setup has to be transferred into the converter with **Write I/O only** or with **Write Project Data** after closing this window and returning to the main window.

Configuring Varioload

Setting

Varioload is a freely definable threshold of the spindle current. As soon as it is reached, several actions can take place. The definition of the threshold value is done in this menu. This can be done either direct in % of the spindle current or as analog voltage at an input.

As an example:
- In case the 100% value is 7A and the varioloid value is defined at 30% defined, the corresponding flag in the Status Register is set, if the current is beyond 2,1A

- If the analog input is used, the range is 10V

$$\text{U Threshold} = \frac{10V * \text{desired switch value}}{100\% \text{ value}}$$

Finally, this setup has to be transferred into the converter with **Write I/O only** or with **Write Project Data** after closing this window and returning to the main window.

4.4 Modifying Configuration of Analog Outputs
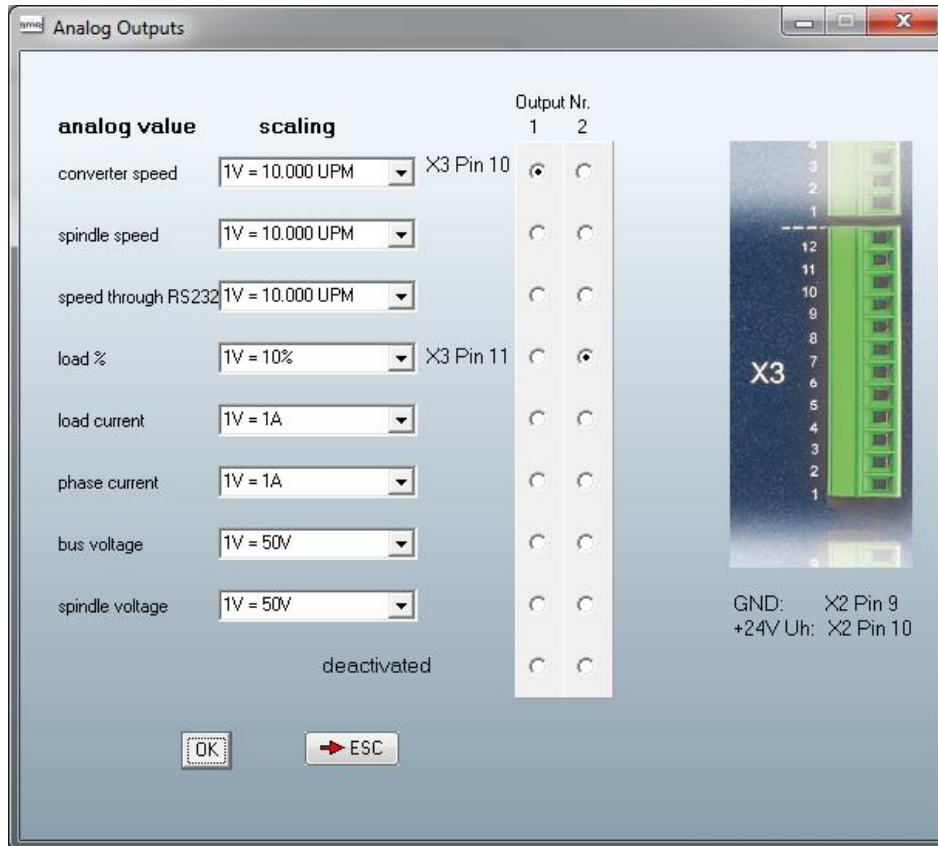
Setting
Several analog parameters can be assigned to 2 analog outputs
With several different scaling options depending on the function:

All speed values with scaling
- 1V/10.000UPM: standard setting with direct relation of voltage to speed:

- 1V/1.000UPM: for low speed operations below 10.000rpm.

- 0-10V Min-Max: the total speed range of the spindle is assigned to a range from 0-10V.

$$Uout = \frac{10V * actual\ speed}{speed\ range}$$

All currents with
- 1V / 1A, 1V / 2A, 1V / 5A

All voltages with
- 1V / 50V, 1V / 100V

Finally, this setup has to be transferred into the converter with **Write I/O only** or with **Write Project Data** after closing this window and returning to the main window.

4.5 Delay Times
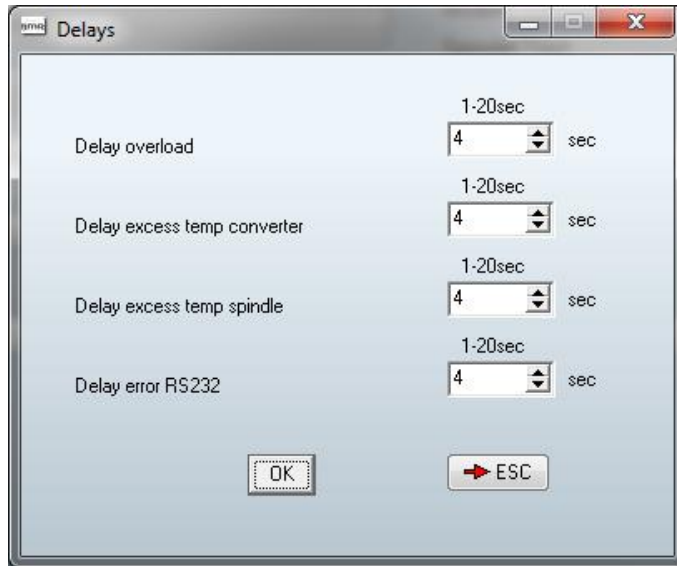
In connection with the digital outputs, several parameters can also be provided with a response delay.

This means, if a limit value has been reached or an input has switched, it is not reacted to immediately, but after an adjustable period of time.

These time delays can be defined in the Delay menu.

4.6 Printing Project Data

For documentation and archiving purposes there is the possibility, to print out all setups and data of the project using the button *Print Project Data*.

These pages contain all relevant data of the project including the current operating times and collection of errors up to now.
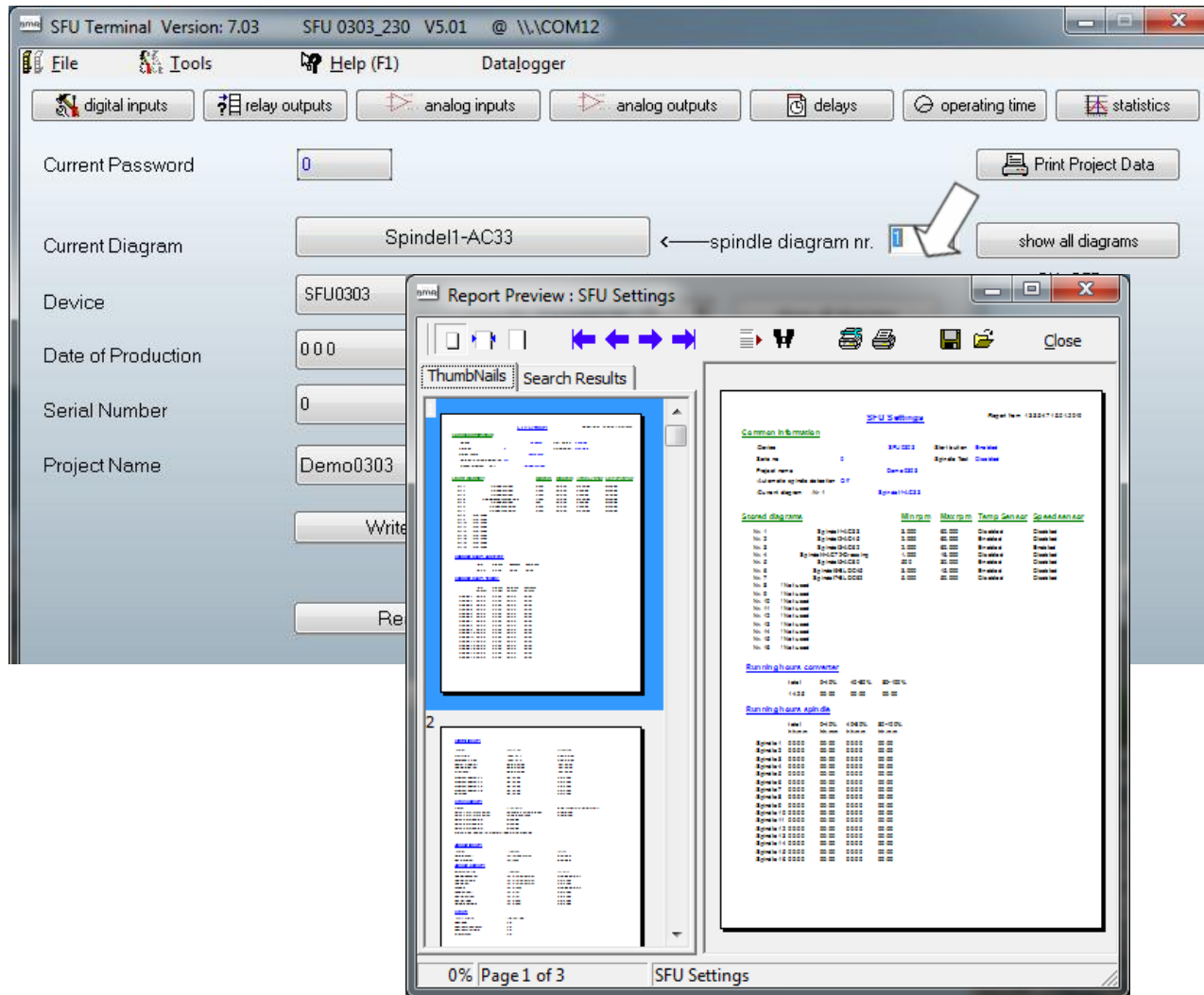
5. Debug Tool

The Debug Tool is one of the most helpful and powerful tools in SFU-Terminal. It makes possible to inspect all parameters of the frequency converter. The Status and Error word are decoded and displayed in bit format, so an allocation of the current state and to identify errors becomes very easy. Moreover, the state of the input and outputs is displayed clearly by state and value and with the according message. This all during standstill and as well while spindle operation.
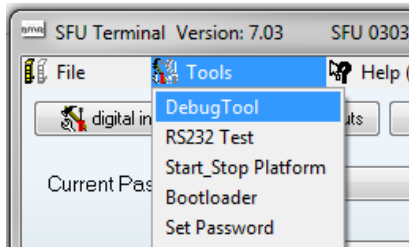
Another possibility is, to be able to control the converter from this window. Start/Stop and rotational speed can be setup

6. Changing the Direction of Rotation

This function is connected with an input, to be found in the menu "digital inputs" at function "speed direction"
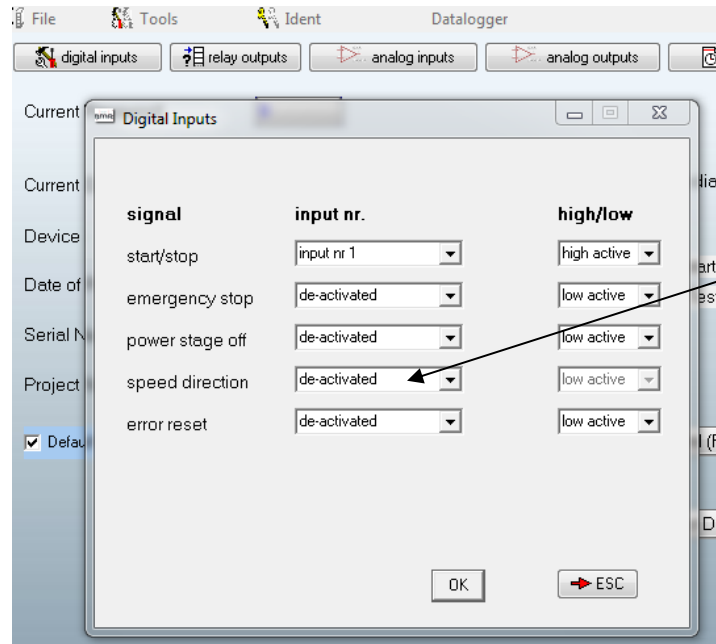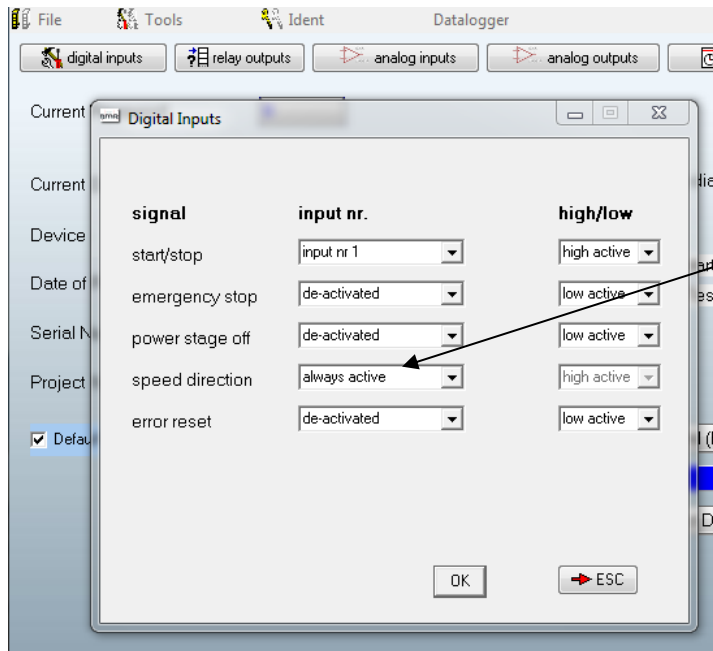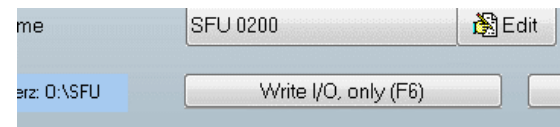

Moreover, this can be monitored in the "debug-tool"

To change this, the function can be altered to "always active" and has to be confirmed with "OK"
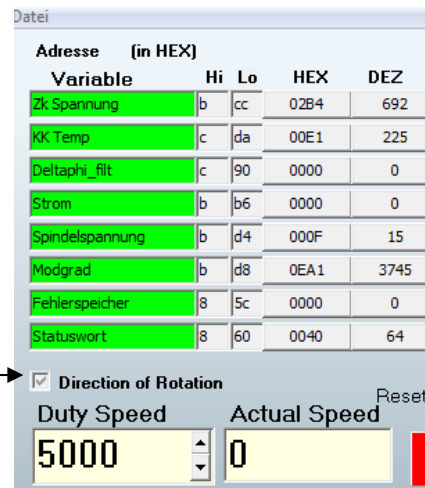
Moreover, this can be monitored in the "debug-tool"

To make this effictive in the converter, this setting has to be transferred to the converter with "Write I/O, only"
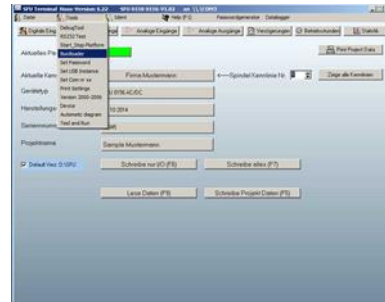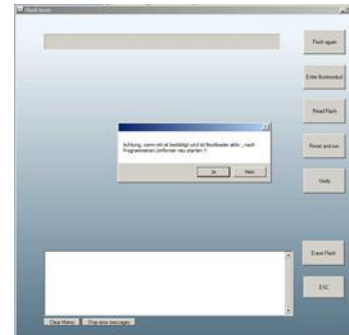
7. Firmware Update / Bootloader

Sometimes it is necessary, to update the converter firmware. This is done with the bootloader function
The required procedure is displayed in steps below.

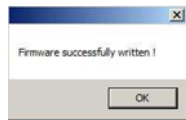Connecting the converter
and uploading parameter

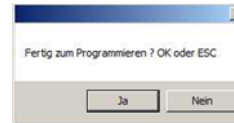Main Window: Select
Tools → Bootloader

Bootloader Menu
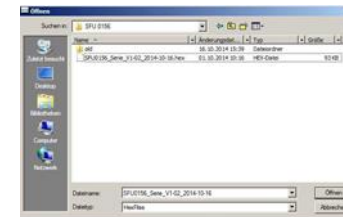
SFU is successfully
switched to
Bootloader Mode

Ready

Flashing and bootloading
is in progress

If ready click on **Yes**

Select Firmware
*.hex file

8. Spindle Autotuning

t.b.d.

9. Datalogger

Record Window

Resolution:

The resolution of the time-axis is around 4ms.

Controls:

After activating the **Start Record** Button you were asked to specify the recordname without extension.
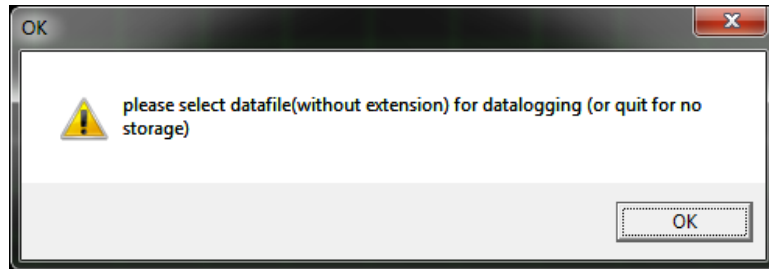
After confirmation, the record- or datalog-file will be completed with date- and time-stamp and the extension *.dtl automatically.

example: filename_25-07-2018_13-38-52.dtl

During recording this button serves as the **Stop Record** button.

Variables to be recorded:

This is specified by the variable file *.van which was loaded in the record window.

After clicking on **collect data** in the main menu, the variable file will be setup automatically to the default value:

For AC-spindles this is "default+converter name.van" or for BLDC-spindles this is "default+converter name. ven". (ex. default0103.van)

The values may be changed in name, address scaling and unit and can be saved and reloaded as required.

Additionally the variables may be deselected prior or after record by check boxes. Deselection after a record will delete this variable permanently from the current display and cannot be restored. Nevertheless it is kept within the record-file. So, it can be observed by reloading the file.

Finishing the record

The record is finished with clicking on the **Stop Record** button.

On default the file is saved in the directory "debug" under the SFU-Terminal installation path.

With leaving this window the question is raised, if the record should be continued (*Yes / Ja*) in the background or stopped.(*No /Nein*)
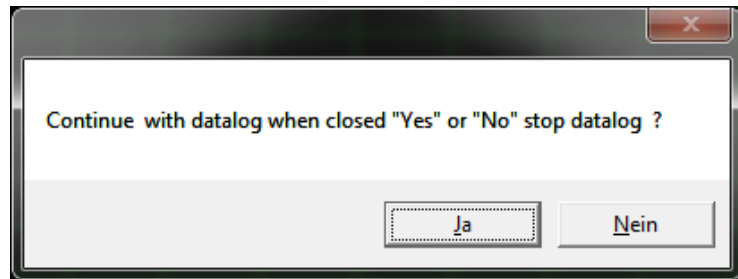
Typically "No" has to be selected

Replay Window

Wrench-Symbol = Tools-menu

Variables Window: These variables are controlled by the variable-file
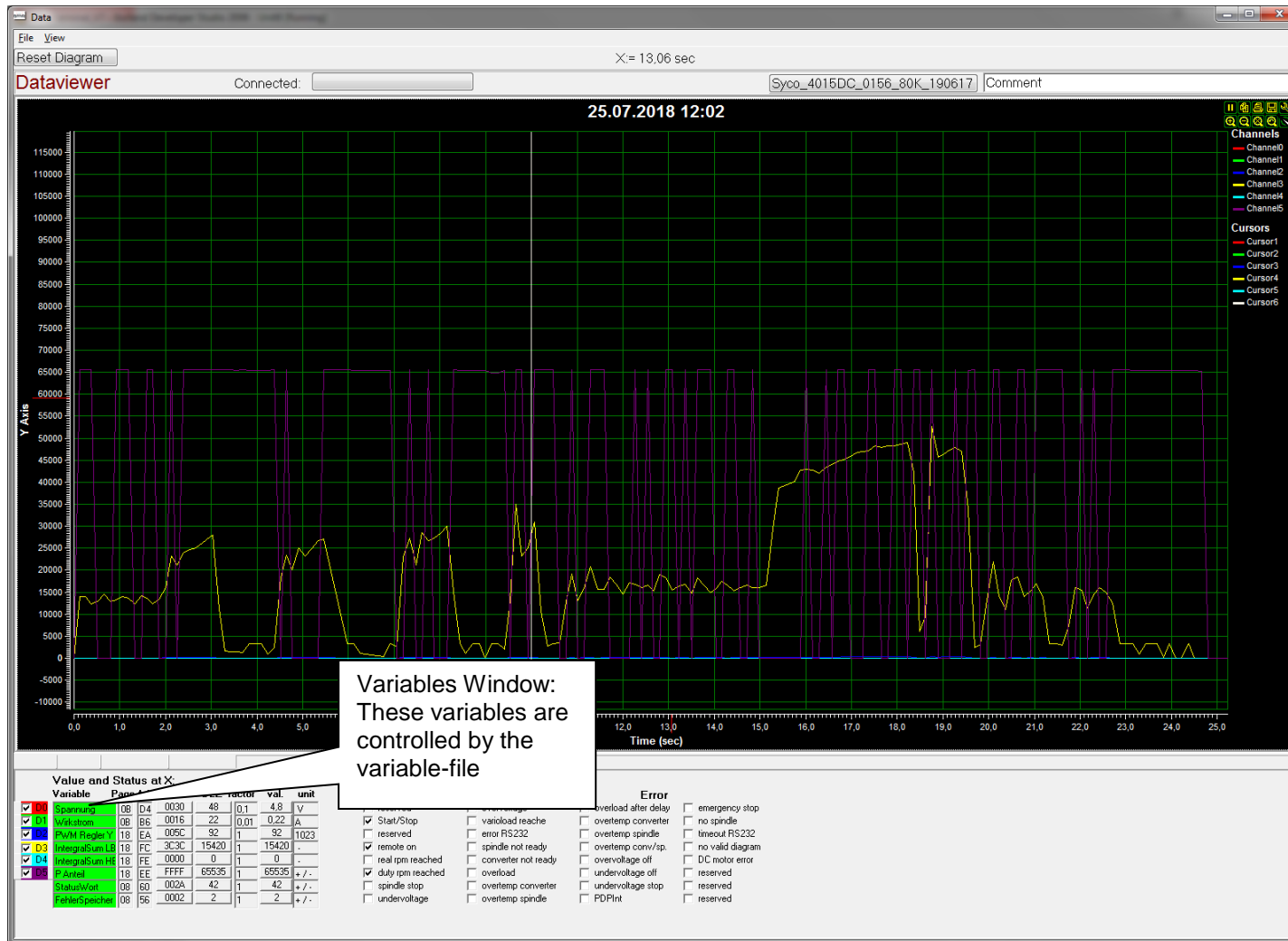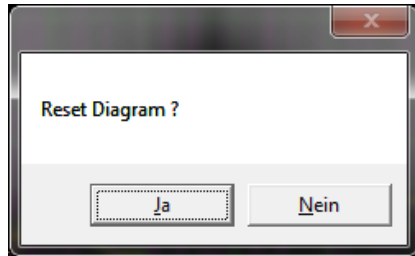
Loading and reloading a record:

Loading or reloading a record can be achieved with *file/load file* additionally the current diagram has to be reset or not.

If "*No /Nein*" is selected, the new file is overlayed with the current one.

In general ***Yes / Ja*** has to be selected.

On default the file is saved in the directory "debug" under the SFU-Terminal installation path.

Controls:

Resetting the diagram manually

Scaling of the axis:

If the mouse-pointer is placed left of the Y-axis or below the time-axis, it can be zoomed with the mouse wheel or the + / - Buttons. Additionally the axis can be moved by pressing and holding the left mouse button and shifting the axis into the desired direction.

Specific attention has to be kept with the Y-axis. All values are recorded with their true value, which means, that some values will be very high and some are very low and will seem to melt with the 0-line. If these values are of specific interest, the mouse-pointer has to be placed on the 0 point of the Y-axis and zoomed with the mouse wheel, until the desired resolution.

Additionally the variables may be deselected prior or after record by check boxes. Deselection after a record will delete this variable permanently from the current display and cannot be restored. Nevertheless it is kept within the record-file. So, it can be observed by reloading.

Specific variable and curve inspection:

For closer inspection of a certain area of the record, the mouse pointer can be positioned directly on the curve and it will be displayed the certain time and value of this specific record-point. For additional information the current position of this point is displayed with a red line on time- and Y-axis and all other variables are displayed in the variables window with it's current values.

Cursors:

For additional help there are 8 cursors available, which can be placed horizontal or vertical individually. They can be configured freely in orientation and colour. It might be helpful for measuring signal thresholds or as time markers for repetitive actions. In case, that they are not needed, it is possible to switch them off by unchecking the corresponding checkbox. If all cursors are deactivated, it is possible to reactivate them in the tools-menu under the wrench symbol.
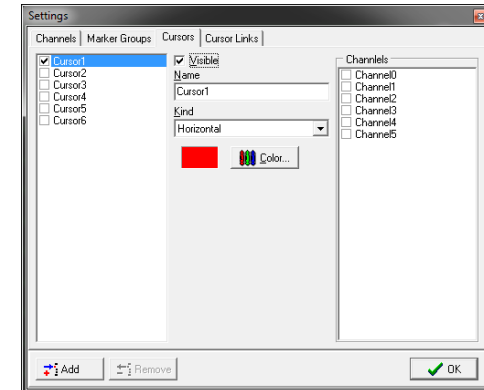
Version 1.0   15. 01. 2019
Version 1.1   09. 04. 2019   kleine Änderungen

Subject to technical alterations.
August 2019