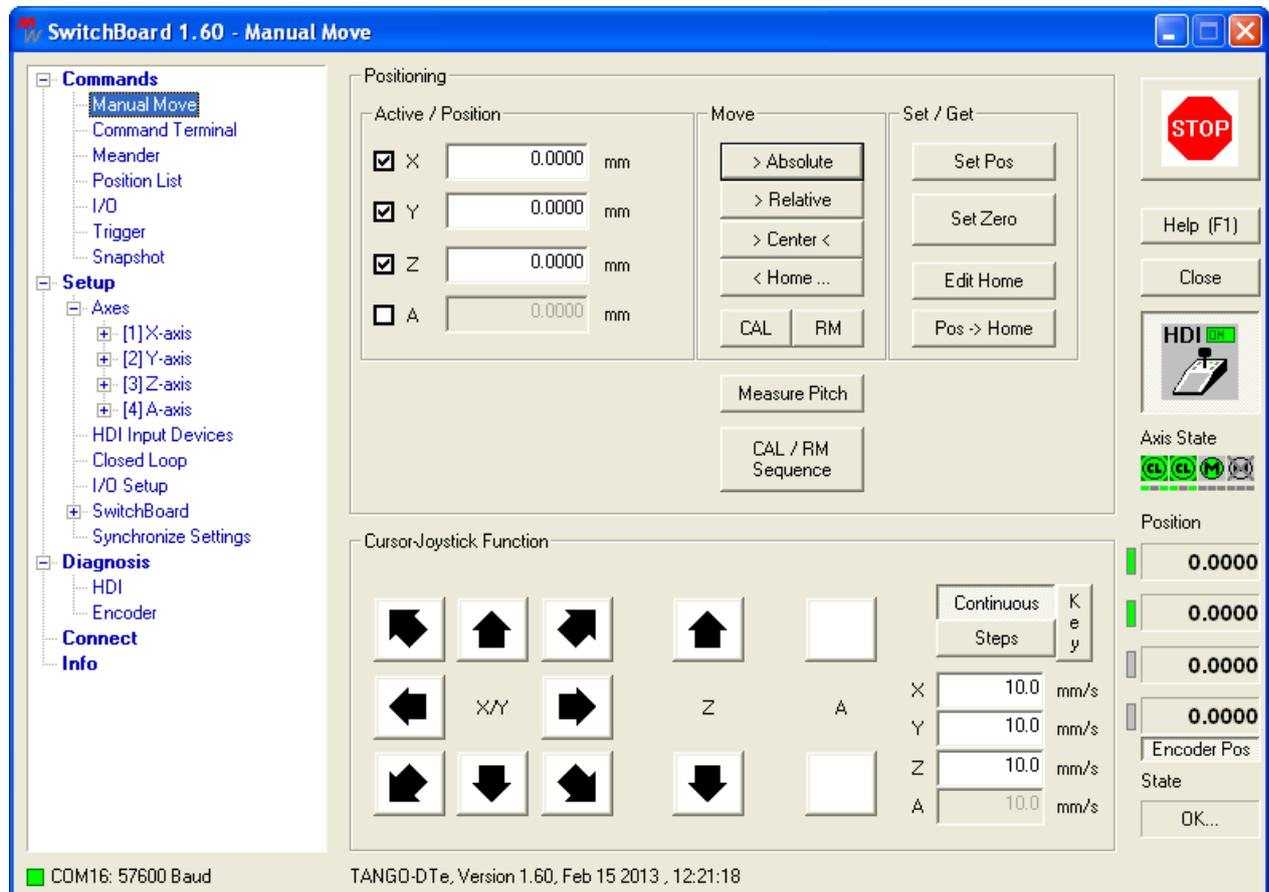


# Operating Manual

## SwitchBoard

User Interface for TANGO Motion Controller

Version 1.60



## Index

1	The SwitchBoard Software.....	3
2	Description of the individual Dialog Windows .....	5
2.1	Dialog „Connect“ – Connecting the TANGO Controller.....	5
2.2	Dialog „Manual Move“ .....	7
2.3	Dialog „Command Terminal“ .....	10
2.4	Dialog „Meander“ .....	12
2.5	Dialog „Position List“ .....	14
2.6	Dialog „I/O“ – Access to the Input / Output functionality .....	16
2.7	Dialog „Trigger“ – Optional Trigger Output.....	18
2.8	Dialog „Snapshot“ – Optional Trigger Input.....	21
2.9	Dialog „Setup → Axis“ .....	22
2.10	Dialog „Setup → Axis → Limit Switches“ .....	25
2.11	Dialog „HDI Input Devices“ – Configuration of the input device .....	28
2.12	Dialog „Closed Loop“ – Measuring System and Closed Loop .....	30
2.13	Dialog „Program Settings“ for SwitchBoard.....	33
2.14	Dialog „PC Function Keys“ – Assigning PC Function Keys to SwitchBoard .....	34
2.15	Dialog „Synchronize Settings“ – Manage TANGO and SwitchBoard Config .....	36
2.16	Dialog „Info“ .....	38
3	Document Revision History .....	40

# 1 The SwitchBoard Software

## Terms of use

The SwitchBoard Software is designed to be used with Maerzhaeuser Wetzlar TANGO Stepper Motor Controllers. SwitchBoard only supports the TANGO Instruction Set. This software serves as a tool to demonstrate the features of the TANGO controller. It is provided as is without any warranty of any kind, either expressed or implied. In no event shall we be liable for any damages including, but not limited to, direct, indirect, special, incidental or consequential damages or other losses arising out of the use of or inability to use this software. This software is designed to run under Windows 2k / XP / Vista / 7 / 8, 32 and 64 bit.

## Abstract

The SwitchBoard functions are accessed by navigating through the menu tree, which is located on the leftmost side of the program window.

The menu tree is divided into sections

- Commands (Move and I/O commands)
- Setup (Motor current, pitch etc.)
- Diagnosis (Encoder signals, HDI/Joystick)
- Connect (Connect to the TANGO controller / select COM port)
- Info (Information about SwitchBoard and the connected TANGO)

with further sub menus, depending on the TANGO controller, type and firmware version.

Language: After installing the SwitchBoard program language is set to the Windows operating system language - English, German or French. In case of other Windows languages, English will be set as the SwitchBoard default.

The SwitchBoard language can be changed in the sub menu [Setup\SwitchBoard\Program Settings]. The new setting then remains.

**Program Help** is available via F1 of the PC keyboard. It offers information about the currently displayed program dialog.

Remarks: Windows 7 does not support the help functionality by default. A Microsoft patch must be installed. It can be found on the TANGO CD, for 32 and 64 bit Win7 OS.

The remaining function keys F2...F12 can be assigned to SwitchBoard functions, like switching to different program dialogs [Setup\SwitchBoard\PC Function Keys].

Die STOP button function (red button on the upper right corner in SwitchBoard) can also be triggered by pressing [ESC] of the PC keyboard.

**Position display:** The position display is located in the lower right area of the SwitchBoard window. If axes are equipped with an encoder / measuring system, the displayed position can be either set to the (theoretical) motor position or the currently measured encoder position. If encoder positions are available, a button [Encoder Pos] is displayed. Also the LEDs aside each position display then appear green (dark green indicates that encoder position is available, light green indicates that the encoder position is currently displayed). The position display is not available in all program dialogs and not all permanently update the position.

## Connecting the TANGO controller

SwitchBoard must be connected with the TANGO controller. First the Serial Port to which the TANGO is connected must be selected, and also the Baudrate (usually 57600 Baud). Then the [Connect] button can be pressed. In case of a true serial (RS232) connection with unknown Baudrate, the [Baud Auto Detect] button can be pressed instead. SwitchBoard shows available COM ports in the range of COM1 to COM16.

## TANGO controller Setup

The sub menus of [Setup] provide access to all the parameter and options of the currently connected hardware. Velocities, pitch, limit switches, encoder and I/O functionality can be configured.

Remarks:

Changes made in the setup are not passed through to the TANGO automatically. In order to take effect, the setup must be sent to the TANGO. It can be done in two ways:

- a) Send to the TANGO (volatile, only remains until power off or reset)
- b) Send and save to the TANGO (remains permanently in the TANGO controller)

The setup can be saved to an INI file, making it possible to restore individual settings or apply the same settings to multiple TANGO controllers. INI file handling, read out and storing of the TANGO setup can be done in the menu [Setup\Synchronize Settings]. SwitchBoard also supports Drag&Drop of INI files e.g. from the Windows Explorer.

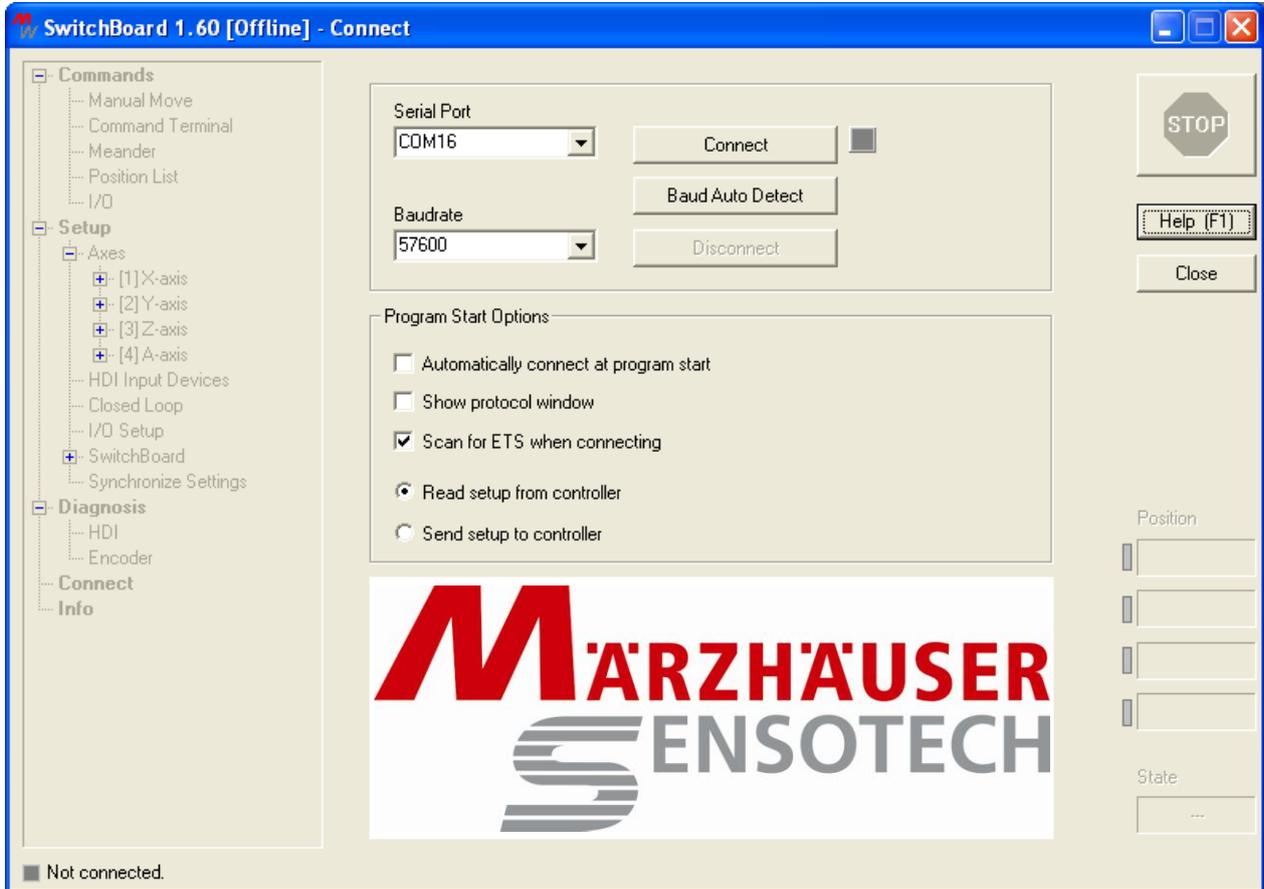
## Service Print

Service Print generates a parameter list of the most important TANGO states and settings.

The function is available in the [Commands\Command Terminal] dialog. By pressing the [Service Print] button, a list is generated and can be exported to a text file by [Save]. Providing a convenient way to send information via email, e.g. in case of technical inquiries.

## 2 Description of the individual Dialog Windows

### 2.1 Dialog “Connect” – Connecting the TANGO Controller



#### Procedure

- Select serial port
- Select baudrate
- Press [Connect] button  
or alternatively: If the baud rate is unknown press the [Baud Auto Detect] button.

**Remarks:** Check the [Automatically connect at program start] check box. Beginning from the next start, SwitchBoard will connect to the last used serial port automatically.

**Remarks:** COM ports higher than COM16 are not detected by SwitchBoard. In order to access higher COM port numbers, e.g. COM25, the number can be entered in the [Serial Port] selection manually.

If connected successfully, the program directly opens the recent program dialog or the [Manual Move] dialog.

If connecting fails, the menu tree remains disabled (greyed) and the [Connect] dialog is visible. The Connect dialog is accessible all time, e.g. to reconnect or change connection to another TANGO controller (here: [Disconnect] + [Connect]).

The status of the connection is displayed in the lower left corner of the program window.

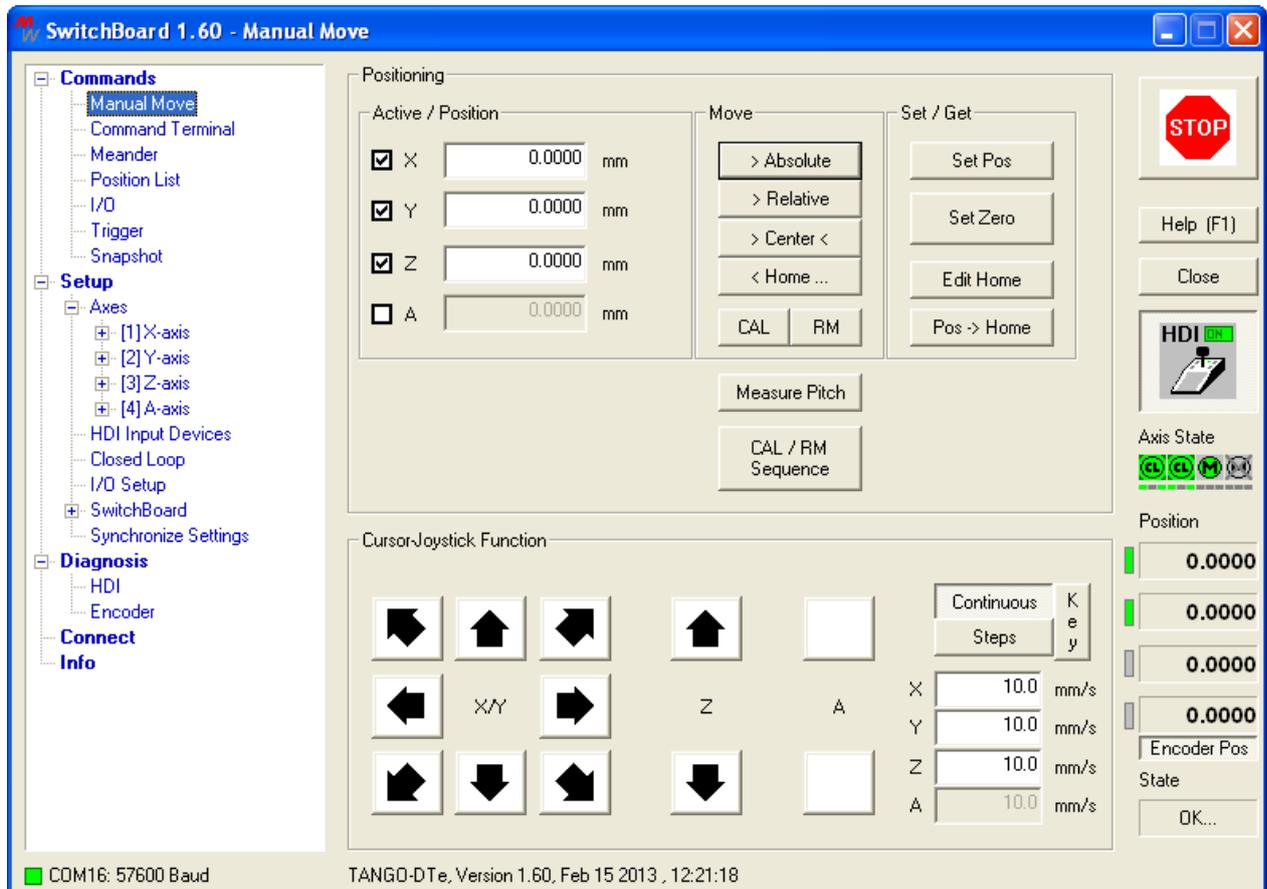
**Option: Offline Mode**

The menu tree can be enabled in offline mode (when no controller is connected) by a left click on the grey connect status LED aside the [Connect] button. Then all program options are accessible.

**Description**

<b>Serial Port:</b>	COM port to which the TANGO controller is connected Select by drop-down or enter COM number manually
<b>Baudrate:</b>	COM port data rate (typ. 57600 baud, PCI: don't care)
<b>[Connect]</b>	SwitchBoard connects to the controller at the selected COM port.
<b>[Baud Auto Detect]</b>	SwitchBoard connects to the controller at the selected COM port and detects the correct Baudrate automatically.
<b>Automatically connect at program start:</b>	When SwitchBoard is started, it automatically connects to the recent COM port and baud rate.
<b>Show protocol window:</b>	Opens an additional window which shows the communication between SwitchBoard and the TANGO controller. Saving the recorded data to a text file is also possible. The window can be opened and closed any time, even if the controller is connected.
<b>Scan for ETS when connecting:</b>	When connecting, the TANGO re-scans the ETS data bus. This ensures that the correct ETS states and parameters are available.
<b>Read setup from controller:</b>	When connecting, SwitchBoard reads the current setup from the TANGO controller (default, recommended).
<b>Send setup to controller:</b>	When connecting, SwitchBoard transmits its current SwitchBoard setup to the controller. The TANGO internal parameters are overwritten, but not stored permanently.

## 2.2 Dialog “Manual Move”



### Abstract

Provides move functionality. Emergency stop is possible via STOP button or PC ESC key.

A joystick button is displayed on the right side of the window. Checking/unchecking this button enables/disables the HDI device (Joystick) temporarily. Remarks: When reading or writing to the controller, the [Joystick Mode] parameter can be affected by changing the state of this button.

PC Keyboard F-Key commands can be executed in this window. Further information is available in [PC Function Keys](#) description.

**Axis State** display: Active motor amplifiers are shown in green, disabled amplifiers are shown greyed. An error state is indicated by red symbols. Arrangement: [X][Y][Z][A].

- Motor amplifier is enabled, Closed Loop is on and active
- Motor amplifier is enabled, Closed Loop is on, but momentary not active
- Motor amplifier is enabled
- Motor amplifier is disabled
- Motor amplifier is switched off (dead)
- Error, motor amplifier off
- Axis is not available
  
- Calibration state: No CAL or RM (no hardware limits, no zero position set)
- Calibration state: CAL completed
- Calibration state: CAL completed and position correction active
- Calibration state: RM completed
- Calibration state: CAL and RM completed
- Calibration state: CAL and RM completed and position correction active

**Position** display on the lower left: A grey LED to the left of the position display indicates that no encoder position is available and the motor position is displayed, a dark green LED signals that encoder position is available but not shown, a green LED signals that the encoder position is displayed. If the LED is red, it indicates an encoder error. The button [Encoder Pos] appears when at least one encoder is present. The button then enables switching between motor- or encoder-position displays (dark green/green LED).

**Active checkboxes [X,Y,Z,A]:** Individually enable / disable axes for SwitchBoard. Disabling of axes here is independent of the TANGO internal settings.

**Position:** Target positions for [Absolute] move, or distances for [Relative] move, or position for [Set Pos].

**Move:** Commands only affect the [Active] checked axes.

- **Absolute:** Move to absolute positions entered on the left.

- **Relative:** Move relative distances entered on the left.

- **Center:** Axes X & Y move to the stage center position (CAL+RM necessary!).

- **Home:** Move to the home positions (0, editable by [Home Pos] button).

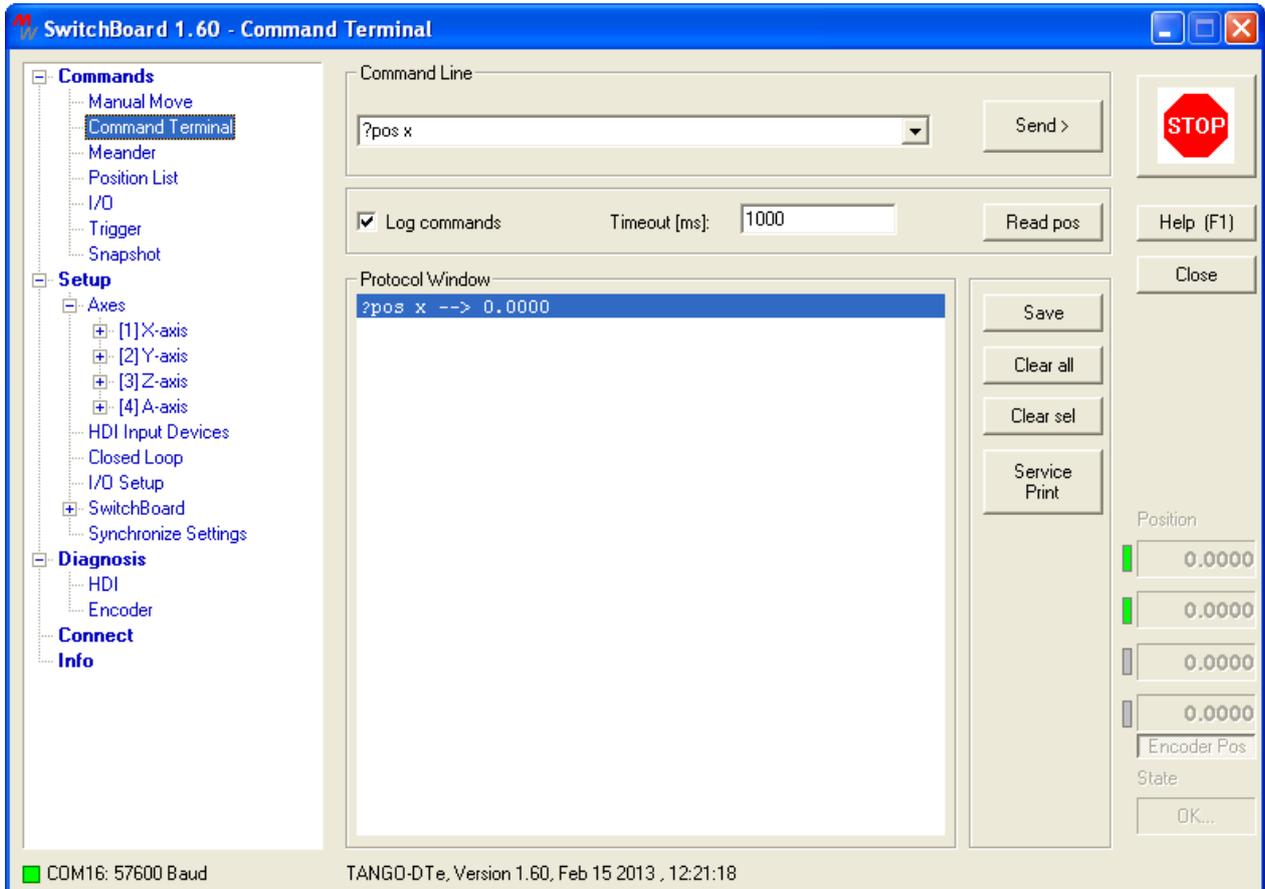
- **CAL:** Starts a calibration move to the lower (origin) limit switches. Can be aborted by again pressing the [CAL] button or [STOP]. The CAL sequence can be selected with the [CAL/RM Sequence] button function.

- **RM:** Starts a calibration move to the upper (end) limit switches. Can be aborted by again pressing the [RM] button or [STOP]. The RM sequence can be selected with the [CAL/RM Sequence] button function.

- **CAL/RM Sequence:** Configure the sequence that is started by pressing [CAL] or [RM]. A sequence can consist of up to 4 steps: simultaneous, multiple or consecutive limit switch moves possible. The velocity and acceleration used by SwitchBoard for CAL&RM can also be specified.

- Set / Get:** (Depending on the Active Checkboxes X,Y,Z,A):
- **Set Pos:** Set the axis positions to the values entered in the Position fields.
  - **Set Zero:** Set axis positions to zero.
  - **Edit Home:** Edit the home position used by the [< Home] button (a dialog appears).
  - **Pos -> Home:** Set Home Position to the current controller position. (Affects only the axes which are enabled by the [Active] checkboxes, as described above.)
- Cursor-Joystick Function:** The arrows can be pressed by either the mouse or the PC keyboard (cursor block & NUM block). It is possible to move continuously or in single steps. Continuous velocity or step width may be edited below.
- [Key]** Enable the keyboard (cursor- and NUM block) for Joystick functions. Caution: Do not enter numbers via the NUM block. This will lead to moving axes (XYZ).
- [Continuous]** Move with constant velocity, as long as arrow or cursor key is pressed.
- [Steps]** Move one step per keystroke.
- INI-File Option 'AnyKey'** The SwitchBoard.ini entry AnyKey in [DLG\1] can be modified by a text editor:
- AnyKey=0 --> AnyKey function off / normal cursor function  
AnyKey=1 --> Any Keyboard key moves X positive (as cursor right)  
AnyKey=-1 --> Any Keyboard key moves X negative (as cursor left)  
AnyKey=2 --> Any Keyboard key moves Y positive (as cursor up)  
AnyKey=-2 --> Any Keyboard key moves Y negative (cursor down)
- The function is active when the Key Button is pressed. The AnyKey active warning will then be displayed in the Joystick headline.
- If any key (a-z, 0-9, ... except the special functions e.g. shift, tab, F, cursor, ...) of the PC Keyboard is pressed, it will cause the same behavior as the desired cursor key.
- SwitchBoard.ini entry:
- ```
[DLG\1]
CurJoyKeys=0
CurJoyType=1
AnyKey=0
```

## 2.3 Dialog „Command Terminal“



### Abstract

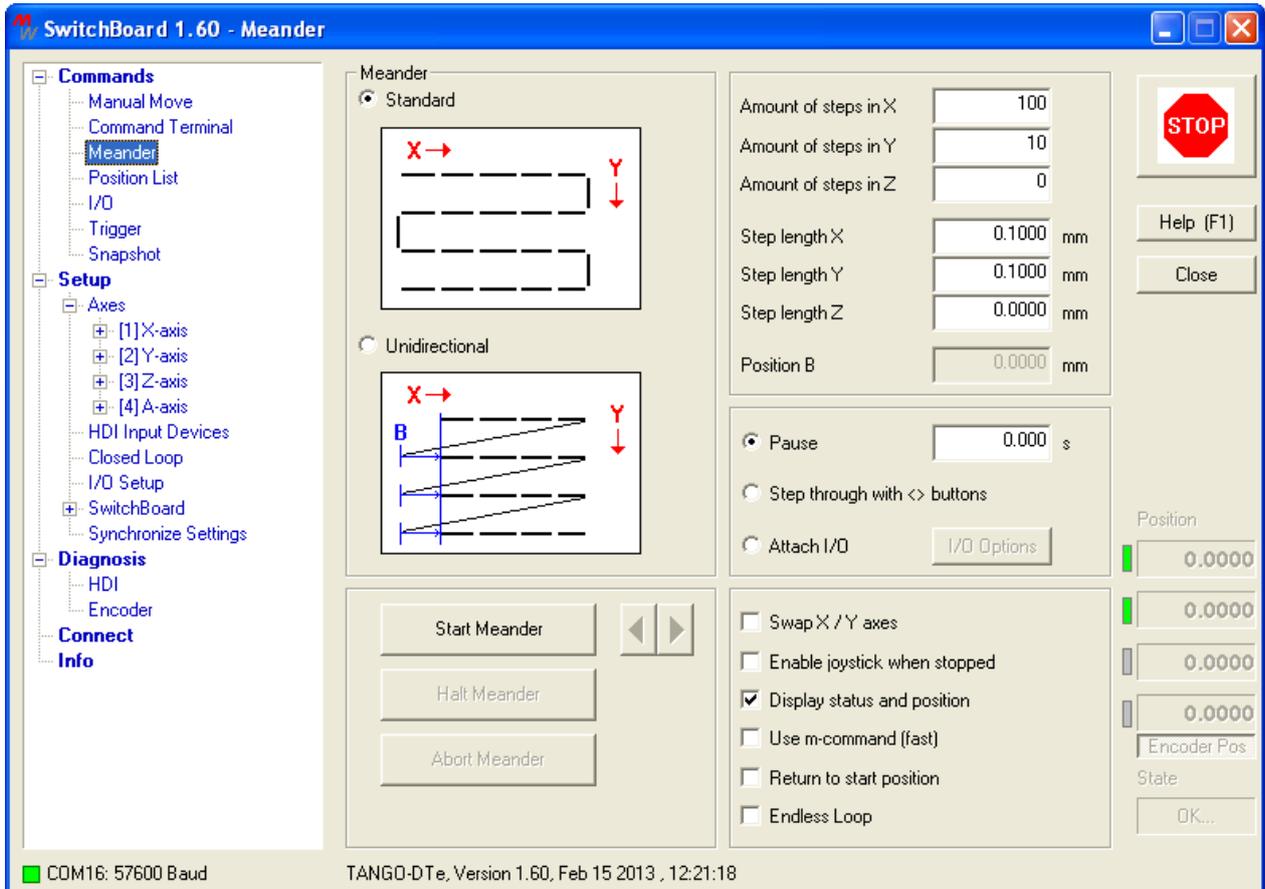
This Dialog provides a direct command line interface to the controller.

For available commands please refer to the TANGO Instruction Set Description.  
The most recently sent commands are available in the command line dropdown list.  
The position display is not updated automatically.

- Command Line:** For entering TANGO commands. The command is sent after pressing the keyboard enter key or the [Send >] button.
- Log commands:** Write the sent command to the Protocol Window.  
If unchecked, only the TANGO replies are listed.
- Timeout [ms]:** Maximum waiting time for a controller response.  
Move commands like *moa*, *mor*, *cal*, *rm* response when the target position is reached, which can take longer than the default 1 second.  
If required, a longer waiting time can be specified for the reply.
- [Read pos]** Manually update the SwitchBoard position display (on the lower right)
- [Save]** Save the Protocol Window content to a file.
- [Clear all]** Delete entire protocol.

- [Clear sel]** Delete the selected protocol line.
- [Service Print]** Executes the TANGO *service* instruction. Generates a listing of the most important controller states and settings.
- Protocol Window:** Shows the controller response and optional the sent command also.

## 2.4 Dialog „Meander“



### Abstract

Processing of meander moves.

**Axis State** display: Active motor amplifiers are shown in green, disabled amplifiers are shown greyed. An error state is indicated by red pictographs.

**Position** display: Updated only when the option [Display status and position] is selected.

**Standard/Unidirectional:** The standard meander processes the steps in both X directions, the unidirectional meander moves back to the beginning of the next line and processes the meander in one direction only. Also, a start position B can be specified to start each meander line before the first meander position.

**Pause:** After each position the axis is halted for the specified time.

**Step through:** The arrow button [>] right of [Start Meander] becomes enabled. The meander can be processed forward, step by step, manually.

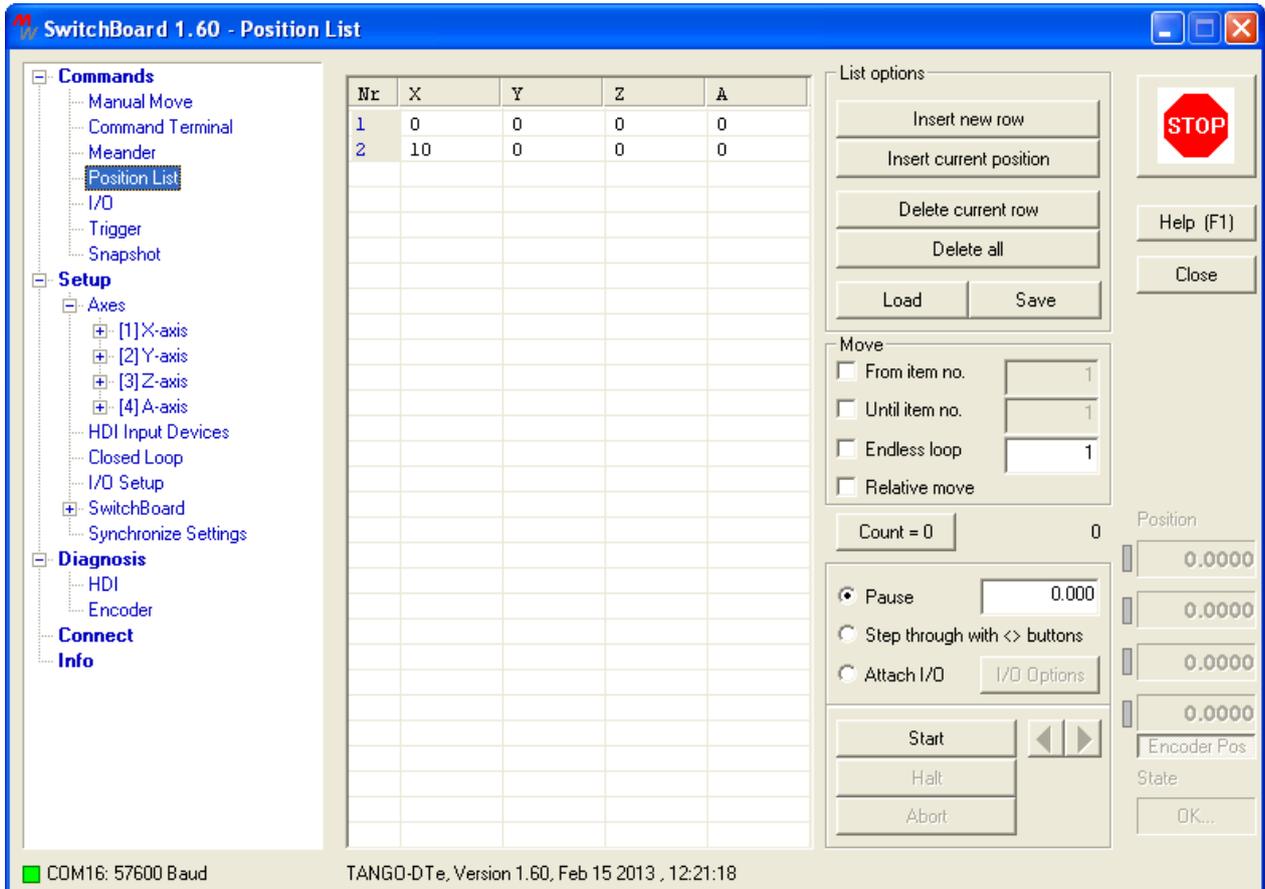
**Attach I/O:** Executing meander steps can be triggered by an external event. E.g. by pressing a joystick key or by edge and level of I/O signals. Also the trigger output can be set when reaching a step position.

**Swap X / Y axes:** The meander is processed in a 90 degrees angle.

- Enable Joystick:** The Joystick (HDI device) should be disabled during the meander. When the m-command is used, having the Joystick/HDI enabled may cause an increasing position deviation each step.
- Display status and pos:** Position and state display is updated after each step. This can be deactivated in order to increase performance, mainly with true RS232 communication at low data rates.
- Use m-command (fast):** Can be activated in order to increase performance, mainly with true RS232 communication at low data rates. If the performance impact is not noticeable it is recommended not to use the m-command.
- Return to start pos:** Returns to start position after processing the meander.
- Endless Loop:** Endless repetition of the meander until stopped or aborted.
- [Start Meander]** Button pressed: Start meander, button remains pressed  
Uncheck button: Currently running move will be completed, then ends the meander.
- [Halt Meander]** Currently running move will be completed, then the meander is halted until the halt button is unchecked.
- [Abort Meander]** Immediately aborts move and ends the meander
- Z Stacks:** It is possible to execute meanders in several Z layers. Therefore the amount of steps in Z must be set to  $> 0$ . After completion of each X,Y meander and returning to the X,Y start position, the next Z position is set and the X,Y meander is executed again. The step length in Z is the relative position change for the next layer. (If set to 0 this will lead to executing a X,Y meander in the same Z layer for n times.)

Remarks: It is recommended to disable the Joystick (HDI device) during the meander ([Enable Joystick] must be left unchecked), at least when using the m-command option. Else it can cause slight position deviation.

## 2.5 Dialog „Position List”



### Abstract

Managing of position lists. Position lists can be created, edited, loaded, saved and executed.

#### Creating a new list:

A new list can be created by first adding the desired amount of rows. Which then can be edited.

**Extra functionality for Snapshot:** If the Snapshot functionality of the TANGO is enabled, a menu for transferring the position list to and from the TANGO Snapshot array can be displayed by pressing the right mouse button.

**Axis State display:** Active motor amplifiers are shown in green, disabled amplifiers are shown greyed. An error state is indicated by red pictographs. Only displayed while executing a list.

**Position display:** Updated only after reaching a position.

**[Insert new row]** Inserts a new row underneath the currently marked row in the list.

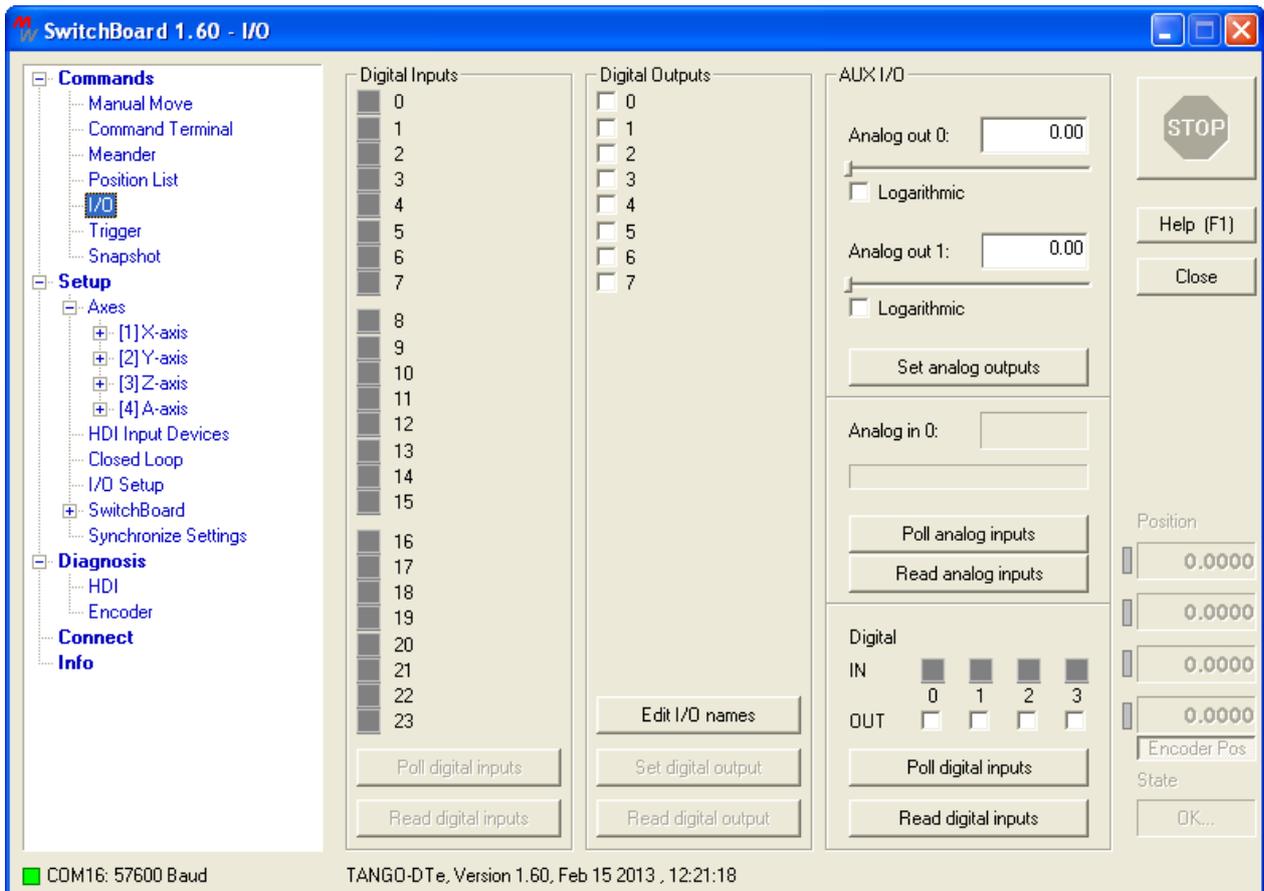
**[Insert current position]** Inserts a new row with the controller positions underneath the currently marked list row.

**[Delete current row]** Delete the marked row.

**[Delete all]** Delete the entire list.

|                                                      |                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[Load]</b>                                        | Open a TANGO Position List file (.tpl).<br>Can also be done by drag&drop.                                                                                                                                                                                                                                                                                                |
| <b>[Save]</b>                                        | Save current list as TANGO Position List file (.tpl).                                                                                                                                                                                                                                                                                                                    |
| <b>From item no.:</b>                                | Execution starts at this row. Rows above are ignored.                                                                                                                                                                                                                                                                                                                    |
| <b>To item no.:</b>                                  | Execution ends at this row. Rows below are ignored.                                                                                                                                                                                                                                                                                                                      |
| <b>Endless Loop:</b>                                 | If Endless loop is checked, the list will be executed until the Abort button is pressed.<br>If Endless loop is not checked, the list execution will be executed by the amount entered in the edit field on the right (1 --> list is executed once, 2--> list is executed 2 times, etc.).                                                                                 |
| <b>Relative move:</b>                                | If checked, the position values are executed as relative move positions. Else they are regarded as absolute positions (default).                                                                                                                                                                                                                                         |
| <b>Number displayed underneath the input fields:</b> | Loop counter, counting how many times the list has been executed. The counter is resetted when starting the SwitchBoard software, by loading a list file or pressing the [Count=0] button.                                                                                                                                                                               |
| <b>[Count = 0]</b>                                   | Reset loop counter to zero.                                                                                                                                                                                                                                                                                                                                              |
| <b>Pause:</b>                                        | This wait time in seconds is inserted after execution of each line.                                                                                                                                                                                                                                                                                                      |
| <b>Step through:</b>                                 | An arrow button appears with which the list can be executed row by row.                                                                                                                                                                                                                                                                                                  |
| <b>Attach I/O:</b>                                   | Executing position steps can be triggered by an external event. E.g. by pressing a joystick key or by edge and level of I/O signals. Also the trigger output can be set when reaching a step position.                                                                                                                                                                   |
| <b>[Start]</b>                                       | Button pressed: Start executing the list, button remains pressed, The list gets executed by the amount entered in the Loop field (default=1: only once, no repeat). If Endless loop is checked, the list will be repeatedly executed until the Abort button is pressed.<br>Uncheck button: Complete the currently running move and then end executing the position list. |
| <b>[Halt]</b>                                        | Currently running move will be completed, then the list execution is halted until the halt button is unchecked.                                                                                                                                                                                                                                                          |
| <b>[Abort]</b>                                       | Immediately aborts a running move and ends the list execution.                                                                                                                                                                                                                                                                                                           |

## 2.6 Dialog „I/O” – Access to the Input / Output functionality



### Abstract

Provides access to the TANGO input/output functionality of the optional AUX-I/O connector. The dialog also offers access to in- and outputs of the optional I/O1 and Multi I/O ports.

**Digital Inputs:** Optional I/O1 or Multi I/O Port: Read input state.

**[Poll digital inputs]** Continuously read input state.

**[Read digital inputs]** Read input state now.

**Digital Outputs:** Optional IO1 or IO2 extension: Set output state.

**Relay:** Optional IO1 or IO2 extension: Switch optional relay

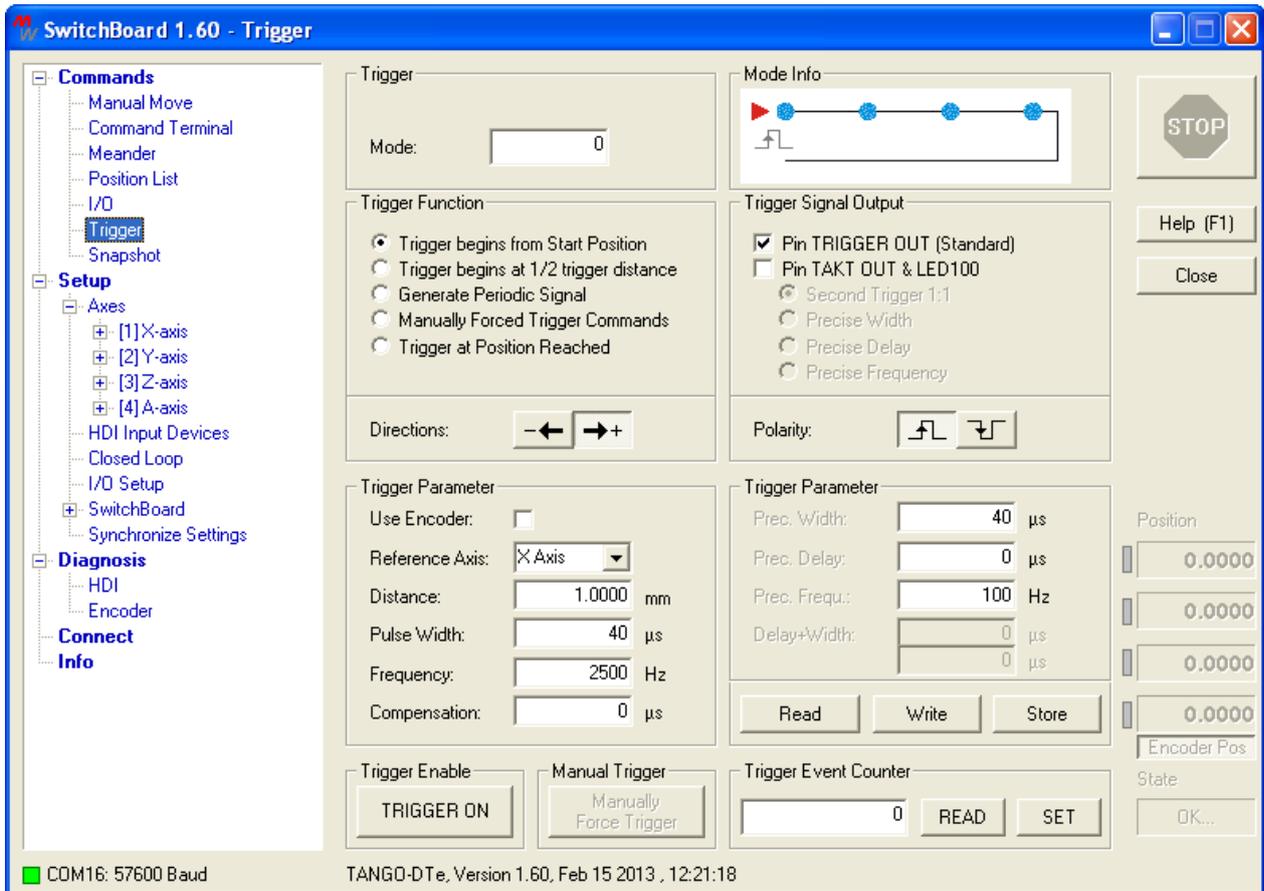
**[Set digital output]** Set outputs to the selected I/O bit pattern. Remark: The I/O output state is also updated each time an output bit is changed (checked / unchecked). So pressing this button usually is not necessary.

**[Read digital output]** Read back the output states from the TANGO I/O.

**[Edit I/O names]** Assign custom names to the digital I/O labels.

|                             |                                                                                                                                                                                                                                                                                                |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Analog Out:</b>          | Both analog outputs of the AUX I/O connector can be set either by the slider or entered as a value of 0~100 percent. Dragging the slider updates the analog outputs automatically. When typing in a percent value, the outputs have to be updated by pressing the [Set analog outputs] button. |
| <b>Logarithmic:</b>         | The analog out sliders can be set to logarithmic sensitivity. This increases the resolution of smaller values and may be used when e.g. controlling a light source like LED100.                                                                                                                |
| <b>Analog In:</b>           | Analog input of the optional AUX I/O connector.                                                                                                                                                                                                                                                |
| <b>[Poll analog inputs]</b> | Continuously update the displayed analog input value.                                                                                                                                                                                                                                          |
| <b>[Read analog inputs]</b> | Read the analog input value once.                                                                                                                                                                                                                                                              |
| <b>Digital IN:</b>          | Digital inputs of the optional AUX I/O connector:<br>0 = Pin 1 TAKT_IN (not available)<br>1 = Pin 2 V/R IN<br>2 = Pin 3 STOP<br>3 = Pin 4 SNAP_SHOT2                                                                                                                                           |
| <b>Digital OUT:</b>         | Digital outputs of the optional AUX I/O connector:<br>0 = Pin 5 TAKT_OUT (& LED100, may be occupied by trigger)<br>1 = Pin 6 VR_OUT<br>2 = Pin 7 SHUTTER_OUT<br>3 = Pin 8 TRIGGER_OUT (may be occupied by trigger functionality)                                                               |

## 2.7 Dialog „Trigger” – Optional Trigger Output



### Abstract

Setup and test of the trigger functionality.

The trigger mode can be set by entering the trigger mode number, as described in the TANGO Instruction Set or optional by selecting the required polarity, direction and function checkboxes. In this case SwitchBoard sets the corresponding trigger mode number automatically. Otherwise SwitchBoard updates the corresponding checkboxes if a mode number is entered.

If the entered operating mode is valid, a pictograph on the upper right will be displayed.

Make sure that the selected trigger mode is supported by the TANGO (refer to Instruction Set).

The trigger output must be set separately. It is not contained in the trigger mode. Depending on the hardware up to two trigger outputs are available.

The settings must be applied to the TANGO by pressing the [Set] or [Save] button.

In addition to the trigger function setup, the dialog also offers testing of the selected mode and parameters. Therefore the Trigger can be enabled, a manual trigger signal can be forced (in manual trigger mode) and the trigger event counter can be read or set.

**Trigger Mode:** Trigger Mode (number), as listed in the TANGO Instruction Set

**Or set mode optional by**

**- Signal Polarity:** Trigger Signal output active high / active low.

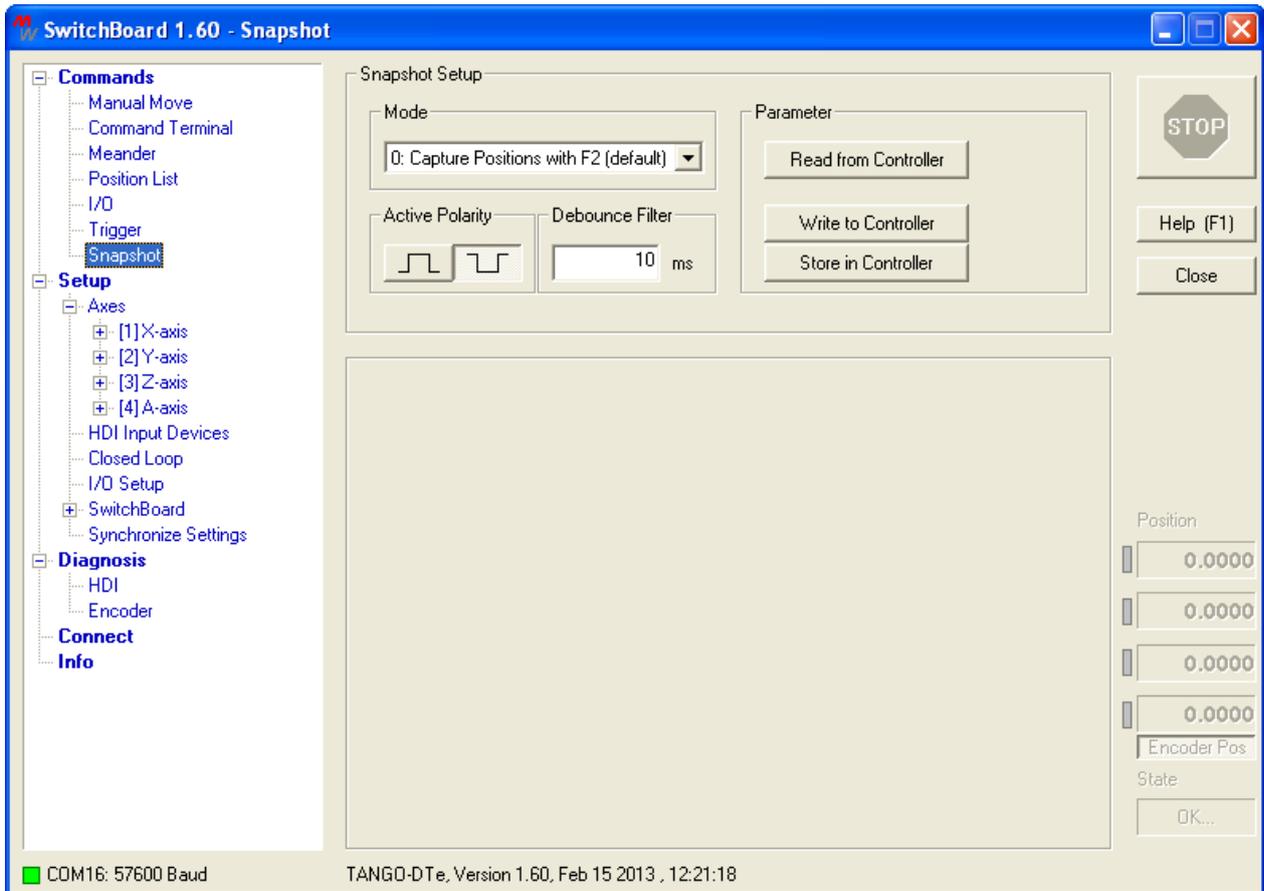
- **Trigger Direction:** Trigger when traveling forward and/or backward
- **Trigger Function:**
  - 1) Trigger output from start position in fixed distances
  - 2) Trigger output from half distance in fixed distances
  - 3) Permanent output of fixed frequency
  - 4) Manually forced trigger by TANGO instruction
  - 5) Generate trigger when axis position is reached
- **Pin TRIGGER\_OUT:** Enable the standard trigger output
- **Pin TAKT\_OUT & LED100** Enable secondary trigger output which provides several options:  
**Second Trigger 1:1** = second trigger does same as TRIGGER\_OUT  
**Precise Width** = high precision+resolution signal width *trigbwidth*  
**Precise Delay** = high precision+resolution edge delay *trigbdelay*  
**Precise Frequency** = high precision+resolution frequency *trigbf*

### Trigger Parameter

- **Use Encoder:** Position dependent trigger is derived from encoder signal (Closed Loop of the trigger axis must be active).
  - **Reference Axis:** Axis the position dependent trigger is related to.
  - **Distance:** Distance of trigger pulses (position difference).
  - **Pulse Width:** Pulse width of the trigger signal in microseconds. TANGO supports signal widths in 40µs steps (0,40,80,120,...)
  - **Frequency:** Frequency of the trigger signal in Generate Periodic Signal Function.
  - **Compensation:** Time delay compensation for the trigger signal chain. Compensation activates the trigger signal before reaching the position (look-ahead). Can be used to reduce or eliminate effects of bidirectional scanning applications.
  - **Prec. Width:** HiRes Pulse width of second trigger output (TAKT\_OUT & LED100)
  - **Prec. Delay:** HiRes Edge delay of second trigger output (TAKT\_OUT & LED100)
  - **Prec. Frequ.:** HiRes Frequency of second trigger output (TAKT\_OUT & LED100)
  - **Delay+Width:** PCI-E based TANGOs: In Second Trigger 1:1 mode, the second trigger can be delayed and/or have a different signal width than the first trigger. The parameters cannot be saved in the controller.
- [Read]** Read Trigger Setup from Controller (except write only Delay+Width)  
**[Write]** Send Trigger Setup to the Controller  
**[Store]** Send Trigger Setup to the Controller and store them permanently
- [Trigger Enable]** Globally enable the trigger functionality (ON).
- [Manually Force Trigger]** Manually force the trigger signal (in the corresponding manual trigger mode, the trigger event counter display is also updated).

**Trigger Event Counter:** Read the number of trigger events or set the counter to any number, e.g. zero.

## 2.8 Dialog „Snapshot” – Optional Trigger Input



### Abstract

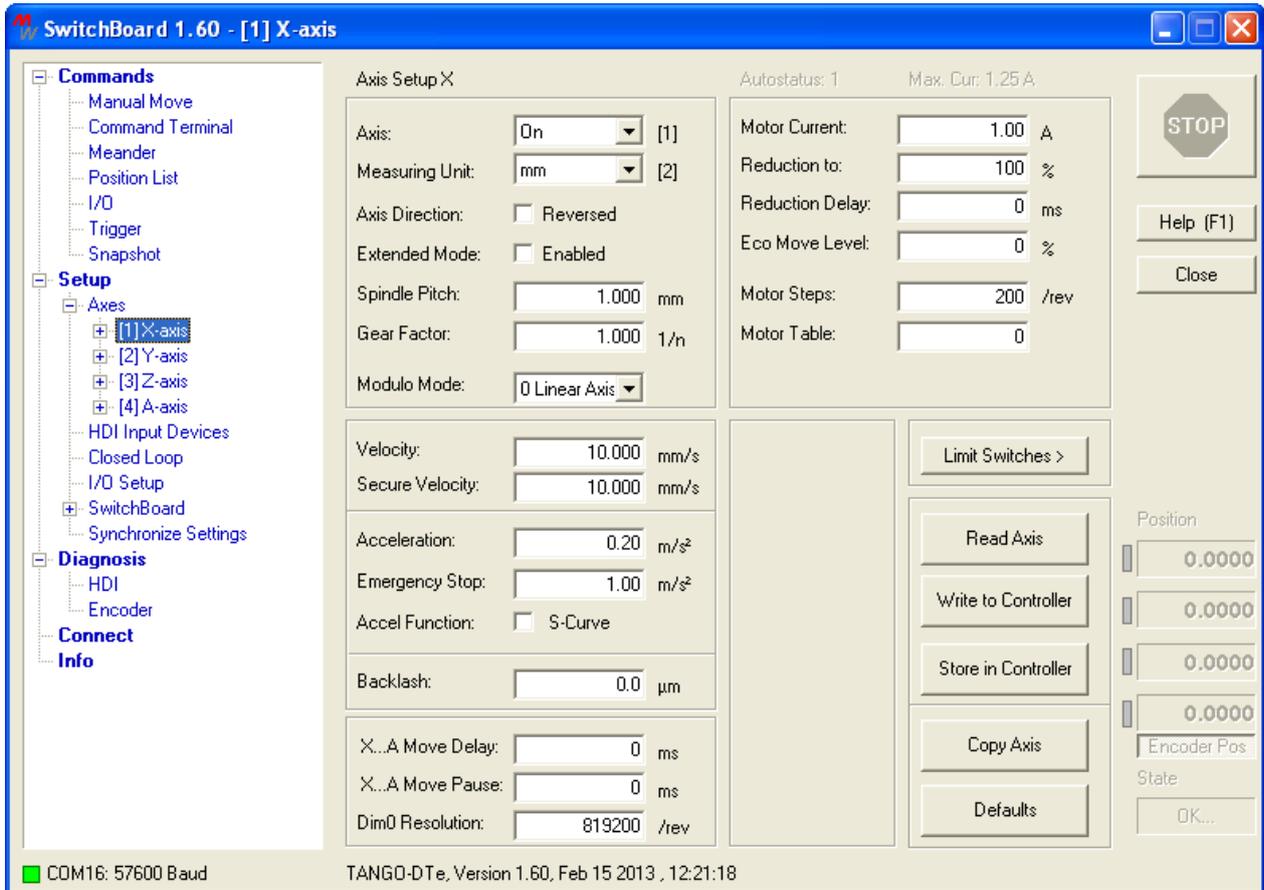
Setup of the Snapshot functionality.

|                               |                                                                                                                                                                         |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mode</b>                   | Snapshot Mode                                                                                                                                                           |
| <b>Active Polarity</b>        | Signal polarity: Active high or active low                                                                                                                              |
| <b>Debounce Filter</b>        | Signal debounce time in milliseconds (typically 10)<br>When using digitally generated input signals via I/O, this parameter can be set to 0 for faster signal response. |
| <b>[Read from Controller]</b> | Read Snapshot settings from the TANGO controller                                                                                                                        |
| <b>[Write to Controller]</b>  | Send Snapshot settings to the TANGO controller                                                                                                                          |
| <b>[Store in Controller]</b>  | Send Snapshot settings to the TANGO controller and store them permanently                                                                                               |

### Remarks:

The snapshot position array can be accessed via the [Position List] Dialog.

## 2.9 Dialog „Setup → Axis“



### Abstract

Set the axis related parameters of the TANGO controller.

The entered parameters are not sent to the controller automatically. In order to update the TANGO controller with the new parameters they must be transmitted by [Transmit Parameters] or [Store Parameters], which also stores them permanently in the TANGO.

The parameters are displayed as one axis per dialog. Some parameters are the same for all axes, they can only be changed in the X axis dialog and remain greyed in the other axes.

To open or save parameters from an INI file, please refer to the dialog [Synchronize Settings]. Loading INI files is also possible via drag&drop of the file into the SwitchBoard window.

- Axis:** Select if motor should be on, disabled or switched off
- Measuring Unit:** Dim of the axis (mm, µm etc.)
- Axis Direction:** Reverse direction (limit switches are re-assigned automatically)
- Extended Mode:** Extended and improved Instruction Set (please read about changes in behavior in the instruction set documentation. E.g. it offers and requires to set joystick or cal, rm velocities independent of the axis velocity)
- Spindle Pitch:** Axial feed per spindle revolution in mm

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Gear Factor:</b>          | Factor for motors with gearbox or transmission                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Modulo Mode:</b>          | Modes for rotational axes                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Accel Function:</b>       | Acceleration ramp executed as s-curve/sin <sup>2</sup> (for <i>mor</i> , <i>moa</i> , <i>moc</i> , <i>m</i> ) when AccelFunc = 1<br>or standard linear acceleration ramps when AccelFunc = 0.                                                                                                                                                                                                                                   |
| <b>Motor Current:</b>        | Electrical motor current in Ampere                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Reduction:</b>            | Motor current reduction when not moving, as percent of selected motor current (100% = no reduction). Can be used to avoid dissipation of heat.                                                                                                                                                                                                                                                                                  |
| <b>Reduction Delay:</b>      | Delay time after move before the selected current reduction is applied                                                                                                                                                                                                                                                                                                                                                          |
| <b>EcoMove Level:</b>        | Can be used to avoid dissipation of heat of the running motor, the higher the level the higher the power saving (0%=disabled, 70%=max. saving).<br>Available from TANGO firmware 1.57. Using EcoMove reduces force when motor is running at constant speed (not during acceleration / deceleration). Please make sure that the axis will work under these conditions. EcoMove is disabled during Calibration and Range Measure. |
| <b>Motor Steps:</b>          | Electrical step resolution of the motor (e.g. 200 for a 1.8° motor)                                                                                                                                                                                                                                                                                                                                                             |
| <b>Motor Table:</b>          | Apply a motor compensation table that fits to the used stepper motor, in order to improve smoothness. It is set by factory according to the motor and motor wiring.                                                                                                                                                                                                                                                             |
| <b>Backlash:</b>             | Mechanical backlash compensation of the axis.                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>X...A Move Delay:</b>     | Delay for positioning instructions. A move instruction will start delayed by the specified time.<br>One parameter applies to all axes.                                                                                                                                                                                                                                                                                          |
| <b>X...A Move Pause:</b>     | Pause for positioning instructions. The @@@ autostatus reply after a move will be delayed by the specified time.<br>One parameter applies to all axes.                                                                                                                                                                                                                                                                          |
| <b>Dim0 Resolution:</b>      | Desired resolution in micro steps per revolution <b>for Axis unit dim=0</b> .<br>Used for compatibility with existing software that expects e.g. a motor revolution to be 40000 or 54000 when positioning in micro steps.<br>One parameter applies to all axes which are in dim mode 0.                                                                                                                                         |
| <b>BUTTON FUNCTIONS:</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>[Limit Switches &gt;]</b> | Show the Limit Switch window (instead of browsing to it by tree navigation on the left side).                                                                                                                                                                                                                                                                                                                                   |
| <b>[Read Axis]</b>           | Read parameters of the current axis from the controller.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>[Write to Controller]</b> | Send the parameters to the controller (all axes). Parameters are volatile and will be lost when switching off the controller. *                                                                                                                                                                                                                                                                                                 |

**[ReadfromController]** Send the parameters to the controller (all axes) and store them permanently. \*

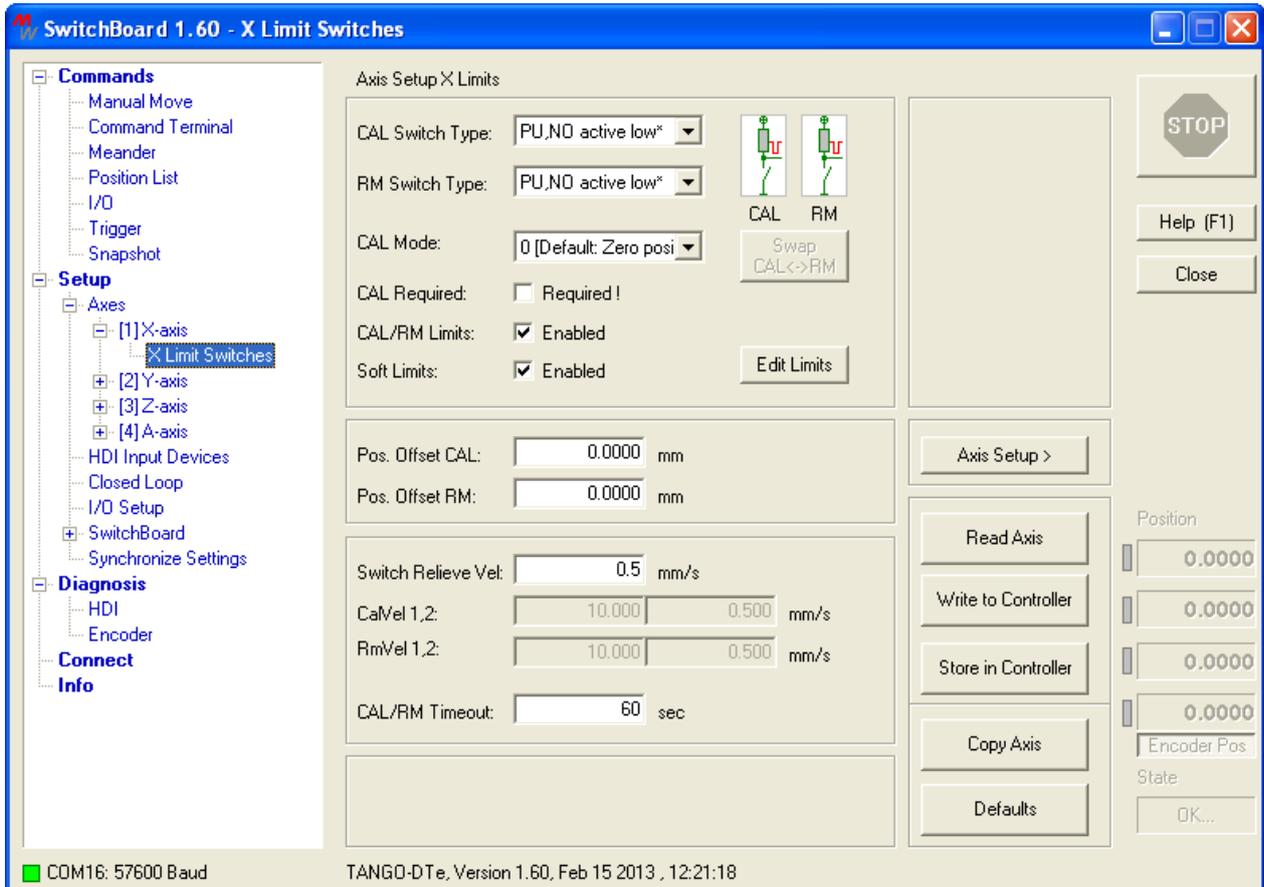
**\*Remarks:** From SwitchBoard version 1.31 and following, the Soft Limits are not transmitted to the controller. As this could lead to problems e.g. unwanted limitation of travel range. If needed, the Soft Limits can be sent from within the Soft Limits dialog.

To ensure the parameters were set correctly, use [Read Axis] to read back the parameters from the controller and check them again. Also, [Parameter Checking] can be selected in the [Synchronize Settings] dialog.

**[Defaults]** Set the parameters of the current axis dialog to the SwitchBoard program defaults. Parameters are not transmitted to the controller.

**[Copy Axis]** Opens a dialog in which copying the current axis parameters to another or all axes is possible.  
Caution: If the [Joystick Function] [On] is copied to the 4<sup>th</sup> axis (A) this axis will move when deflecting the Joystick Z axis! (Z and A combined).  
If the controller provides 4 axes and this is not the desired behavior, please set the A axis [Joystick Function] back to [Off] before transmitting.

## 2.10 Dialog „Setup → Axis → Limit Switches”



### Abstract

Edit the limit switch related controller settings.

The entered parameters are not sent to the controller automatically. In order to update the TANGO controller with the new parameters they must to be transmitted by [Transmit Parameters] or [Store Parameters], which also stores them permanently in the TANGO.

The parameters are displayed as one axis per dialog. Some parameters are the same for all axes, they can only be changed in the X axis dialog and remain greyed in the other axes.

To open or save parameters from an INI file, please refer to the dialog [Synchronize Settings]. Loading INI files is also possible via drag&drop of the file into the SwitchBoard window.

**CAL Switch Type:** Select the switch characteristic of the lower hardware limit switch. The default setting is marked by a \*. Switching to supply or ground, normally open or closed can be selected.

**RM Switch Type:** Select the switch characteristic of the upper hardware limit switch. The default setting is marked by a \*. Switching to supply or ground, normally open or closed can be selected.

**Swap CAL<->RM:** Set by equipment manufacturer only! The upper/lower limit switch assignment can be swapped. This necessity only depends on the axis hardware and wiring. Once set correctly by manufacturer, this setting must never be changed. Else it will lead to damage of the axis due to not recognized limits!

Even if the axis direction is changed by software (*axisdir*) it is NOT necessary to change the CAL<->RM assignment, as in this case it is done by the TANGO controller automatically.

**CAL Mode:** Axis zero position and Closed Loop activation mode, if encoders are available.

0: Axis zero position is set at the lower hardware limit switch, CAL and Closed Loop is activated

1: Axis zero position is set at power on, Closed Loop is activated instantly from power-on

2: Zero position like mode 0, but Closed Loop is activated instantly from power-on

**CAL Required:** From TANGO firmware version 1.53 the axes can be disabled for any move until they are calibrated. No move is possible before executing the CAL instruction.

**CAL/RM Limits:** If enabled, CAL and RM will set the lower and upper Soft Limits to the limit switch positions (default setting). If CAL, RM must not manipulate the Soft Limits, this function can be disabled. (TANGO *!nosetlimit 1* instruction.)

**Soft Limits:** By clicking the Button [Edit Limits] or a left click on the Label [Soft Limits:] a dialog can be displayed which offers editing and sending of the soft limits. Soft limits can not be saved in the TANGO controller and will be set to default (e.g. +-2600mm) after power-on or reset.

**Switch Relieve Vel.:** This velocity is used by the calibration routine for exactly finding the origin and limit positions when moving slowly out of a limit switch. This parameter should be set to a slow value in order to achieve high accuracy. The unit is in user dimensions, but finally sent to the controller as an integer value in 1/100rev/s (by the calbspeed command).

**CalVel, RmVel:** TANGO firmware versions from 1.32 and above offer an Extended Mode. Here the calvel1,2 / rmvel1,2 parameters are used instead of the axis vel and calbspeed. (Refer to TANGO Instruction Set Description for additional differences to normal mode!)

**CAL/RM Timeout:** Individual timeouts for Calibration (CAL) and Range Measure (RM) instructions. Depending on axis length and travel velocity it might become necessary to adapt the timeout. To make sure no error is generated when traveling the full range to an end switch.

**[Axis Setup>]** Show the Axis Setup window (instead of browsing to it by tree navigation on the left side).

**[Read Axis]** Read parameters of the current axis from the controller.

**[Write to Controller]** Send the parameters to the controller (all axes). Parameters are volatile and will be lost when switching off the controller. \*

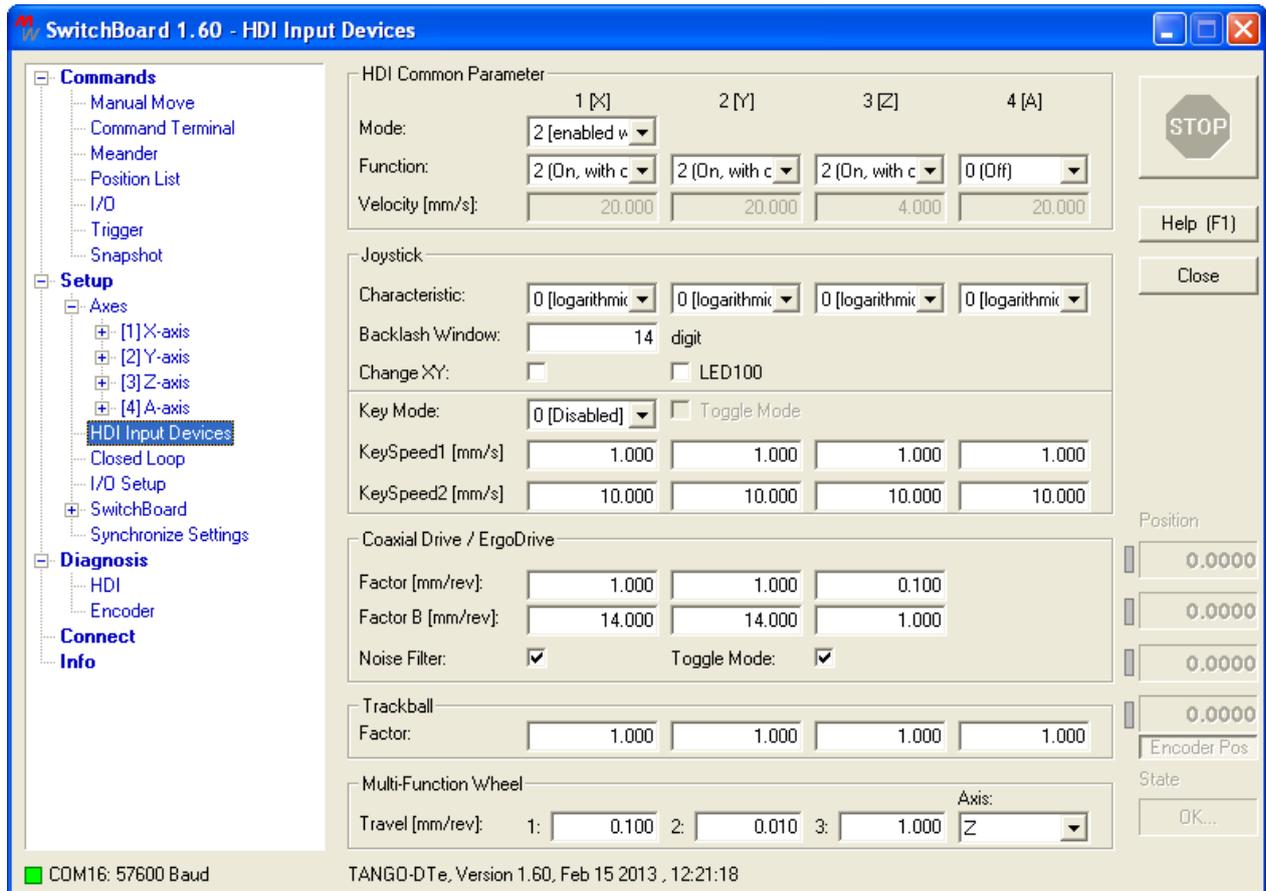
**[Store in Controller]** Send the parameters to the controller (all axes) and store them permanently. \*

**\*Remarks:** From SwitchBoard version 1.31 and following, the Soft Limits are not transmitted to the controller. As this could lead to problems e.g. unwanted limitation of travel range. If needed, the Soft Limits can be sent from within the Soft Limits dialog.

To ensure the parameters were set correctly, use [Read Axis] to read back the parameters from the controller and check them again. Also, [Parameter Checking] can be selected in the [Synchronize Settings] dialog.

- [Defaults]** Set the parameters of the current axis dialog to the SwitchBoard program defaults. Parameters are not transmitted to the controller.
- [Copy Axis]** Opens a dialog in which copying the current axis parameters to another or all axes is possible.  
Caution: If the [Joystick Function] [On] is copied to the 4<sup>th</sup> axis (A) this axis will move when deflecting the Joystick Z axis! (Z and A combined).  
If the controller provides 4 axes and this is not the desired behavior, please set the A axis [Joystick Function] back to [Off] before transmitting.

## 2.11 Dialog „HDI Input Devices” – Configuration of the input device



### Abstract

Setup for the HDI devices – Joystick, Trackball, ErgoDrive and Multi-Function Wheel.

All available TANGO HDI devices are supported. The dialog is divided into functional groups:

- General setup of common parameters
- Joystick and its optional functionality, e.g. LED100 brightness control
- Coaxial Drive and ErgoDrive
- Trackball
- Multi-Function Wheel (which can be part of the Joystick or ErgoDrive)

**HDI Common:**

|                  |                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mode:</b>     | ON (2) / OFF (0)                                                                                                                                                                                                |
| <b>Function:</b> | Additional per axis enable/disable and direction (2, 0, -2)                                                                                                                                                     |
| <b>Velocity:</b> | In Extended Mode – refer to [Setup\Axis] – the Joystick velocity must be specified here. It also limits the maximum travel velocity that can be achieved by turning the Trackball or Coaxial Drive / ErgoDrive. |

**Joystick:**

|                         |                                                                    |
|-------------------------|--------------------------------------------------------------------|
| <b>Characteristic:</b>  | Logarithmic (default, recommended), Linear or Quadratic            |
| <b>Backlash Window:</b> | Joystick center backlash (14 = +/- 7 digit), should not be changed |

- Change XY:** Swap Joystick X and Y axes, turns Joystick coordinate system by 90 degrees
- LED100:** Manually control LED100 brightness via  
 - F2 and multi-function wheel  
 or in case of Joystick without wheel:  
 - F3 and Joystick Y deflection  
 Pressing F3+F4 saves the brightness as default setting
- Key Mode:** Mode, in which two Joystick velocities can be alternated, KeySpeed 1 and 2. The different velocities are applied by pressing the Joystick function keys. Depending if Toggle Mode is enabled or not, the KeySpeeds are selected by:  
 F1: Select X,Y KeySpeed2  
 F4: Select X,Y KeySpeed1  
 F2: Select Z KeySpeed2  
 F3: Select Z KeySpeed1  
 For Toggle Mode key assignment refer to Toggle Mode.
- Toggle Mode:** If Key Mode is enabled, the KeySpeeds are toggled (fast, slow, fast, ...) by the  
 F1 Key for X and Y axis and by  
 F4 to toggle Z speed separately (firmware  $\geq 1.56$  required)
- KeySpeed:** Joystick velocities when using KeyMode.

**Coaxial Drive /  
ErgoDrive:**

- Factor:** Travel distance per knob revolution
- FactorB:** Alternate travel distance per knob revolution.  
 Used by ErgoDrive HDI device while pressing [XY] or [Z]  
 key, or permanently in Toggle Mode.  
 The Pilot microscope stage also uses both factors.

HDI devices with multi-function wheel, e.g. ErgoDrive, also use the Multi-Function Wheel Travel factor (here: Factor 1, and factor 3 for the alternate parameter). It can be entered either in the Z-Axis Factor and Factor B or in the Multi-Function Wheel settings 1 and 3. The values are kept identical by SwitchBoard.

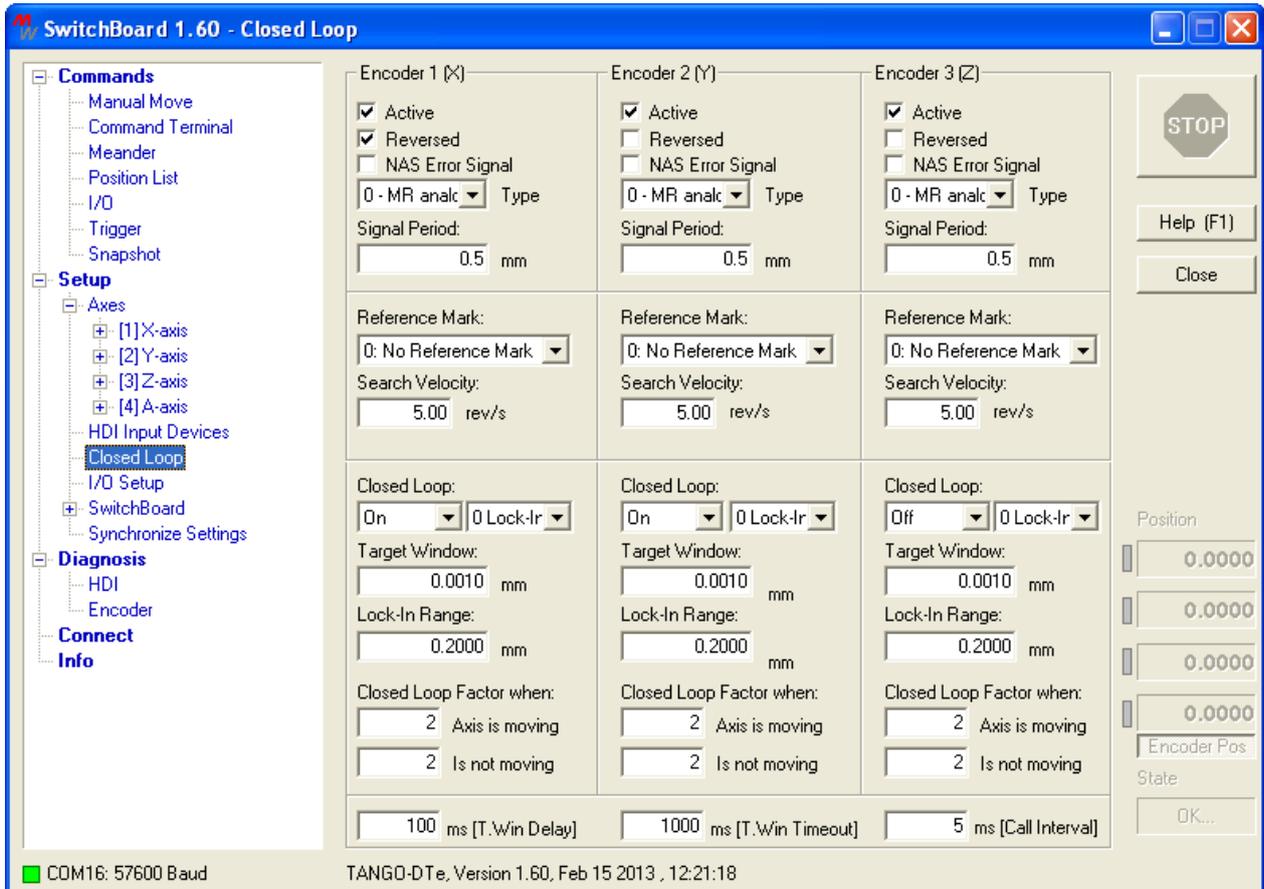
- Noise Filter:** Recommended. Eliminates position jitter of the X and Y wheels when not used. Only uncheck this if a very sensitive behavior is required.
- Toggle Mode:** ErgoDrive key behavior: Alternate velocity only while key pressed or in a latched toggle mode.

**Trackball:** **Factor:** Transmission ratio for Trackball

**Multi-Function Wheel:** Travel distance per revolution of the multi-function wheel (available with Joystick and ErgoDrive).

**Axis:** Assign the multi-function wheel to any axis, default setting is Z.

## 2.12 Dialog „Closed Loop“ – Measuring System and Closed Loop



### Abstract

Configuration of the measuring systems and the closed loop for up to 3 axes. Only available with controllers that provide a measuring system interface.

Remarks: The activation mode for Closed Loop (after power-on or after calibration) is selected via the CalMode parameter in the [Setup\Limit Switches] dialog.

The setup can be written to the TANGO controller by either using the [Synchronize Settings] dialog or by pressing the right mouse key, which opens a menu.

The default and recommended operation of the Closed Loop is permanently on\* mode 2 (On). Independent of the specified Targeted Window, Closed Loop then always tries to keep the position deviation at zero. The Target Window, in conjunction with the TW Delay, only specifies the position reached criteria for the axis.

\* Remark: If the axis is not traveling and the optional motor current reduction is selected below 30% (in dialog [Setup\Axes]), the closed loop becomes inactive for as long as the applied motor current is below 30%.

**Active:** Generally enable usage of the measuring system. The activation for closed loop then is done by the TANGO controller after calibration (CAL) or power up, depending on the CalMode setting in [Setup\Limit Switches].

- Reversed:** Counting direction of the measuring system. The direction is set automatically by the TANGO controller. It is not necessary to change this setting and also not allowed during operation of the Closed Loop.
- NAS Error Signal:** For measuring systems that provide an error output signal (often called NAS signal). If activated, an error signaled by NAS is also used by the TANGO controller to generate an internal error condition.
- Type:** Specify the connected incremental encoder type. Depending on the TANGO version and configuration, several options are available.
- 0: Analog encoder, either 1Vpp/MR depending on interface hardware or MR in case of Universal Interface**  
 Controllers with hard-wired interface select this option 0 in order to activate analog SIN/COS interpolation. Which is necessary for 1Vpp and MR encoders. If the Controller provides an Universal Interface, this option 0 assigns MR interpolation behavior.
- 1: TTL / RS422**  
 Enables to use digital incremental encoders with the encoder interface. (RS422 A/B-TTL). Interpolation is disabled. When using digital encoders, this option must be enabled to prevent erroneous behavior.
- 2: 1Vss with Universal Interface**  
 Controllers with hard-wired encoder interface (fixed to 1Vpp or MR) do not provide this option. In case of Universal Interface, option 2 selects 1Vpp behavior.
- REMARKS: If the analog interpolation is not configured by factory, the interface only provides TTL/RS422 functionality. In this case (blue text is displayed: [TTL Config=0]) the interface behaves like option 1, independent of which behavior is set.
- Signal Period:** Signal period of the measuring system (in case of TTL: 4x the resolution)
- Reference Mark:**
- 0 = Measuring system has no reference mark, or do not use
  - 1 = Measuring system has one reference mark, to which the axis will be traveling after calibration (CAL)
  - 2 = Measuring system has no reference mark, but the limit switch position is taught in by factory and calibration (CAL) travels to the precise teach-in position.
- Search Velocity:** Velocity at which the axis travels towards the reference mark
- Closed Loop:** Closed Loop ON (2) or OFF (0) and behavior outside the Lock-In Range. The behavior outside the Lock-In Range can be set to different modes for e.g. safety and damage protection (collision detection) or avoidance of stalling the stepper motor by selecting slow behavior.
- Target Window:** Position range (twi), in which the Closed Loop in Closed Loop mode 1 (Until Target) turns off closed loop, or in Closed Loop mode 2 (On) generates the status reply (@@@) when reaching the target position

**Lock-In Range:** Lock-in range of the Closed Loop. If the position deviation exceeds this value, the behavior assigned Closed Loop is applied (ctrsm). Please refer to the Closed Loop description.

**Closed Loop Factor when:**

Two parameters are available for the integral gain of the Closed Loop.

One that is applied when the axis is moving and one that is applied when the axis is not moving (idle). I can be used to optimize performance.

**Axis is moving:** Closed Loop integral gain when axis is moving.

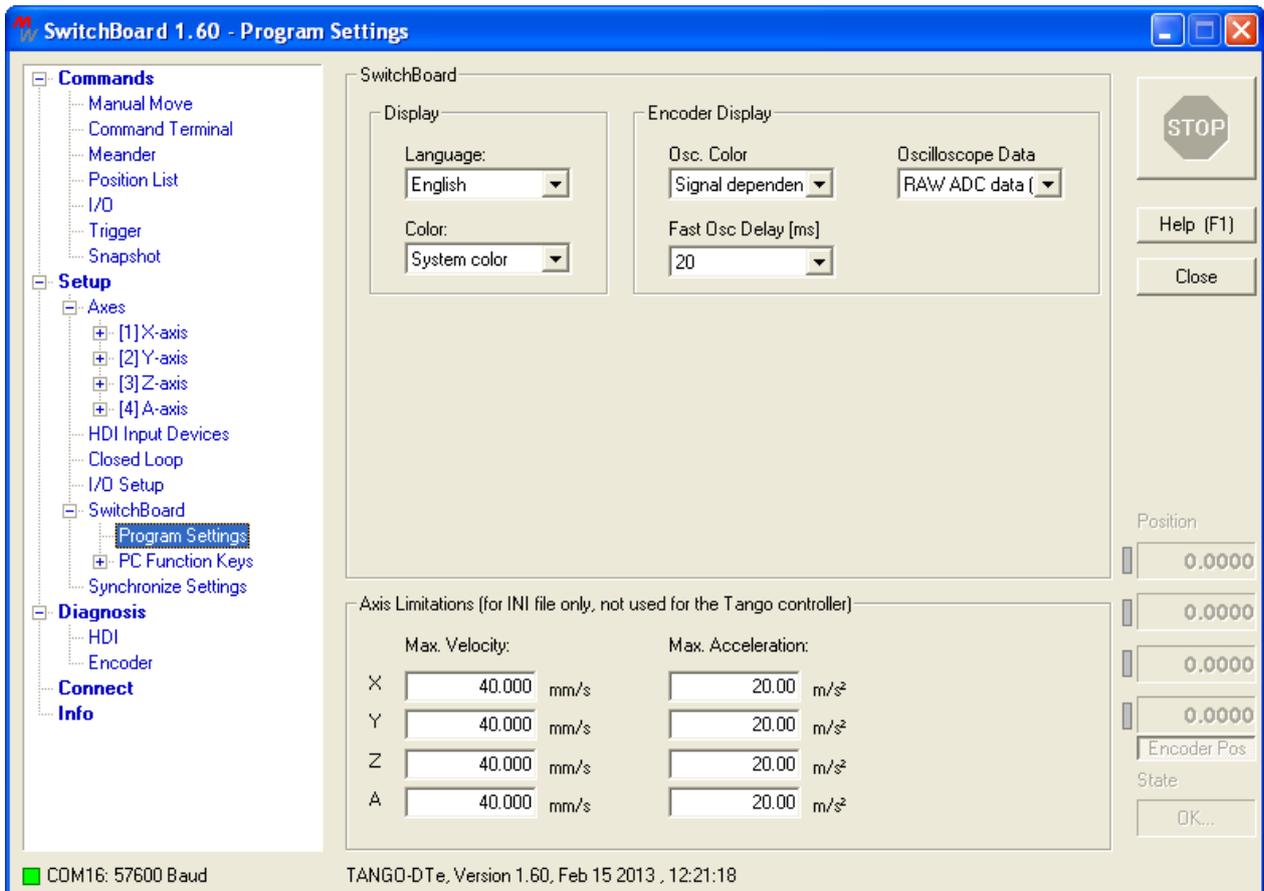
**Is not moving:** Closed Loop integral gain when axis is stopped.

**T.Win Delay:** Condition for the Closed Loop state *target position reached* (in conjunction with the target window). The axis must remain within the target window for the here specified time (ctrd). Typical settings are 100 to 250 milliseconds.

**T.Win Timeout:** If the target window can't be reached or the axis can't remain in the target window for the specified TW Delay time (twi, ctrd), a maximum time can be specified after which the axis generates the position reached reply.

**Call Interval:** Calling interval of the Closed Loop. Typically 5 milliseconds, in case of TANGO mini based controllers also 3 milliseconds. This default setting should not be changed. It is not recommended to choose intervals shorter than 3 milliseconds.

## 2.13 Dialog „Program Settings“ for SwitchBoard



### Abstract

Access to SwitchBoard related parameters.

**Language:** SwitchBoard language (English / German / French)

**Color:** SwitchBoard window color (white or system color)

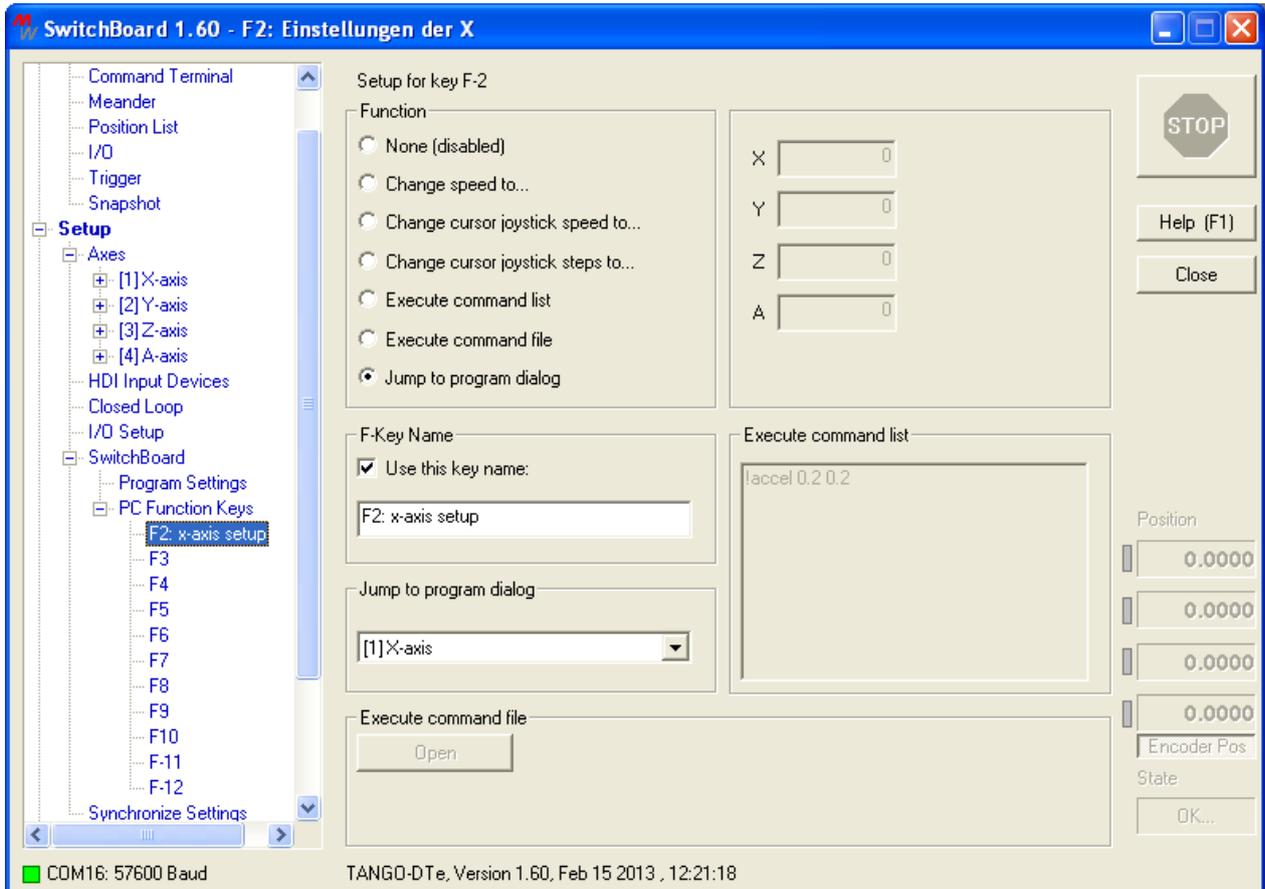
**Osc. Color:** The encoder signal in the [Diagnosis\Encoder] Dialog can be set to a signal strength dependent color mode (green/yellow/red).

**Fast Osc Delay:** Select the sampling rate for the [FAST OSC] button in the Encoder Diagnosis Dialog (standard = 20ms).

**Oscilloscope Data:** Select the data to be drawn in the Encoder Diagnosis Dialog as either the RAW ADC data (default) or the TANGO compensated signals, e.g in conjunction with MR measuring system.

**Axis Limitations:** Only for compatibility when exporting WinCommander setup files: Limit for maximum travel velocity and acceleration. These parameters are not used by the TANGO controller or SwitchBoard.

## 2.14 Dialog „PC Function Keys“ – Assigning PC Function Keys to SwitchBoard



### Abstract

The PC keyboard Function Keys F2-F12 can be assigned to special SwitchBoard functions or to execute TANGO instructions when in [Manual Move] dialog.

Calling different SwitchBoard dialogs is also supported, providing easy switching between e.g. [Axis Setup] and [Manual Move].

For better comprehensibility, individual labels can be assigned to the function keys which appear in the SwitchBoard menu tree.

**Functions with a \* are only available in the [Manual Move] dialog window.**

### Function:

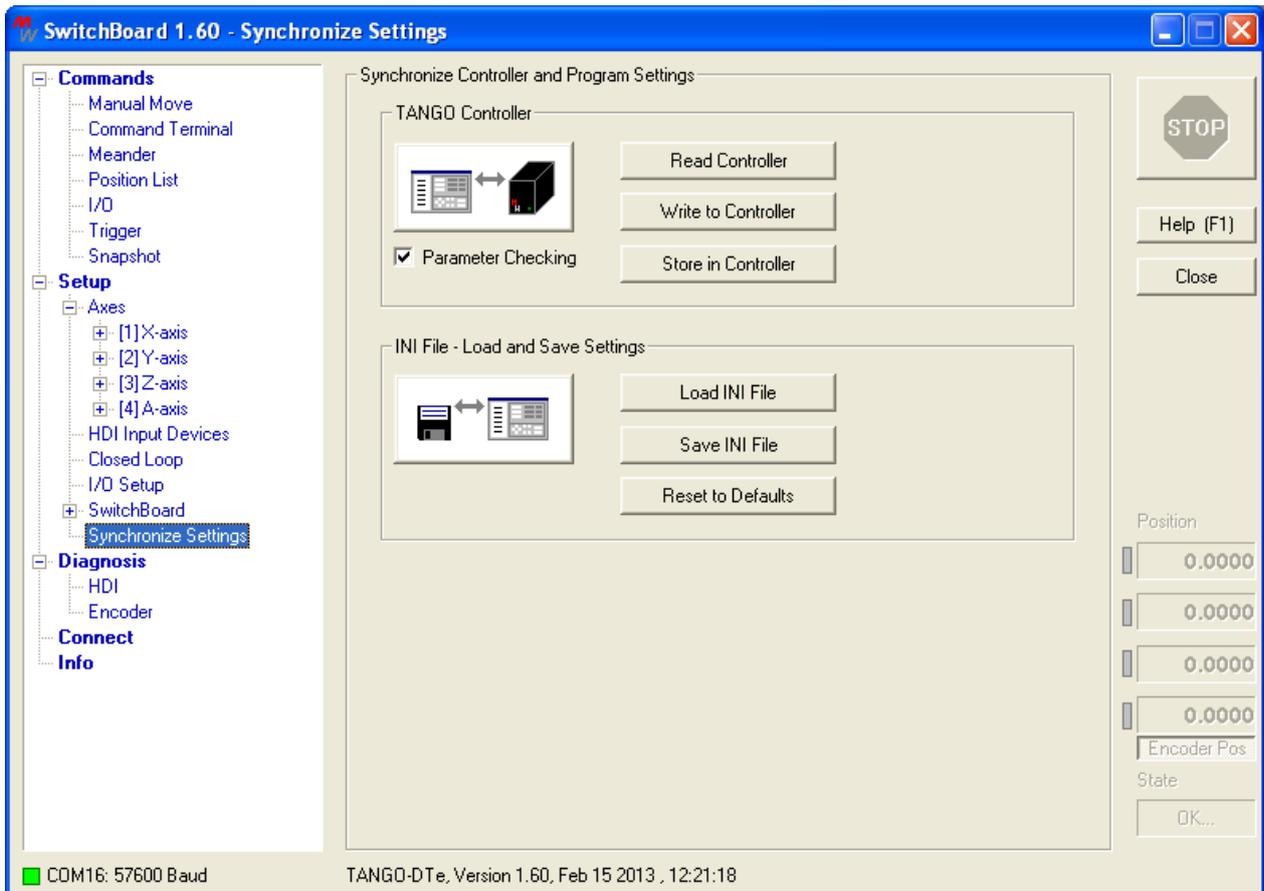
**None (disabled):** Pressing this F key does nothing in SwitchBoard.

**Change speed to...: \*** The input field on the upper right becomes enabled, providing the move velocities that are set when pressing the F key.

**Change cursor joystick speed to...: \*** The input field on the upper right becomes enabled, providing the cursor joystick velocities that are set when pressing the F key.

- Change cursor steps speed to...: \*** The input field on the upper right becomes enabled, providing the cursor joystick step sizes that are set when pressing the F key.
- Execute command list: \*** The multi-line input field for commands becomes enabled. TANGO commands can be entered according to the TANGO Instruction Set Description. Restrictions:  
One command per line. Only use commands that set parameters or start movement. Commands that cause a reply are not allowed.
- Execute command file: \*** Similar to the execute command list option, here a text file with TANGO commands can be applied to a PC function key. The Open button becomes enabled to select a .tcl or .txt file containing TANGO commands. The commands have the same restrictions as mentioned in execute command list:  
Restrictions:  
One command per line. Only use commands that set parameters or start movement. Commands that cause a reply are not allowed.
- Jump to program dialog:** Call a dialog window. Enables fast switching between SwitchBoard dialog windows by just pressing the F key (e.g. switching to a setup dialog or the [Manual Move] dialog etc.)

## 2.15 Dialog „Synchronize Settings“ – Manage TANGO and SwitchBoard Config



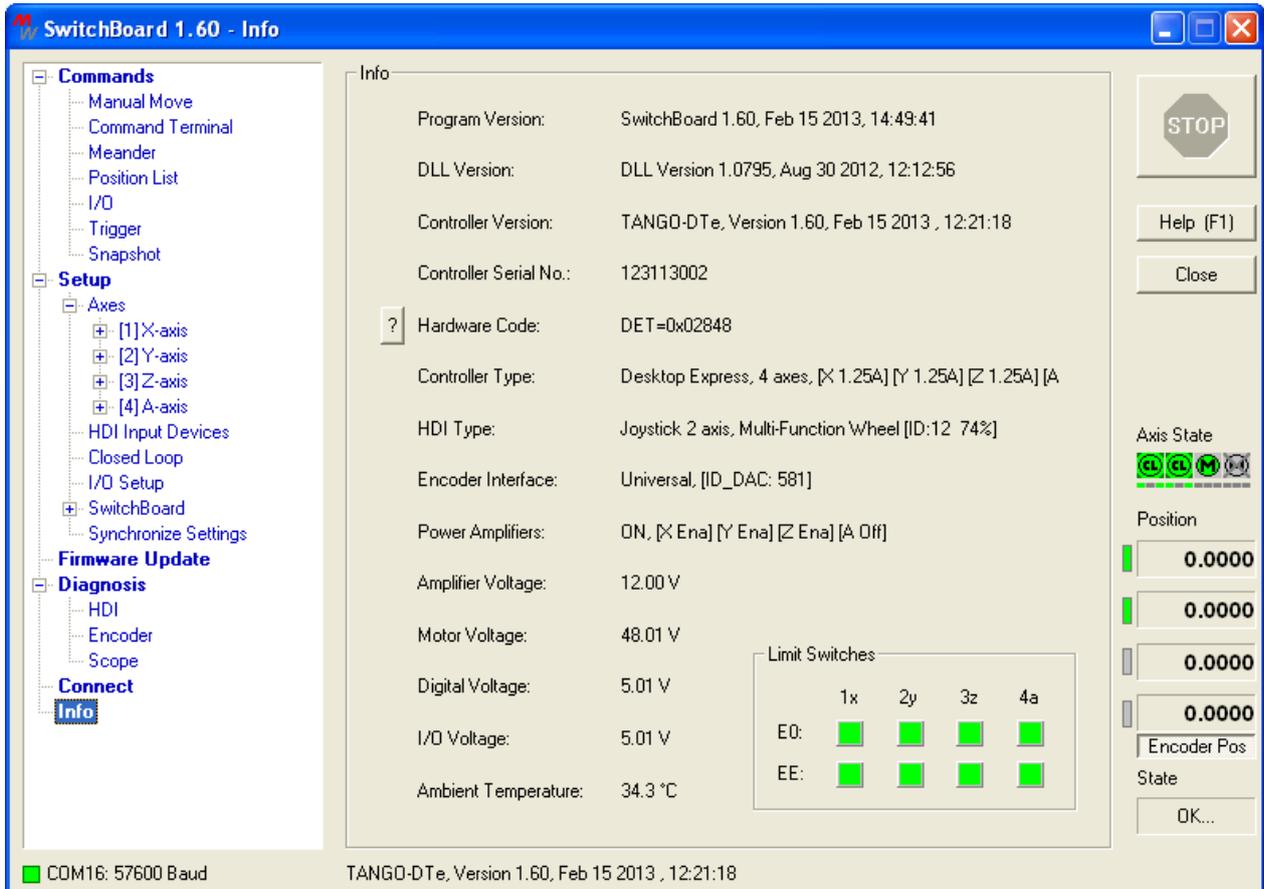
### Abstract

The TANGO and SwitchBoard setup can be synchronized with the controller or a setup file.

- Read Controller:** Read setup from the TANGO controller.
- Write to Controller:** Transmit setup to the TANGO controller. Parameters are not stored permanently.
- Store in Controller:** Transmit setup to the TANGO controller. Parameters are stored permanently (remain when switched off).
- Parameter Checking:** When activated, SwitchBoard checks if the parameter sent to the TANGO controller are accepted or not (e.g. the value entered is in an allowed range). In case of errors, a report window is displayed after sending the parameter to the controller, including the instruction and error code number which can be looked up in the TANGO Instruction Set Description.
- Load INI File:** Load INI setup files containing the TANGO parameter set and the SwitchBoard settings. The setup is loaded into SwitchBoard only, no automatic transmission to the TANGO controller. For compatibility, setup files generated by WinCommander software (.INI and .LS) are also accepted.

- Save INI File:** Save the current TANGO and SwitchBoard setup to an INI file. No transmission to the TANGO controller.
- Export LS File:** Export current setup to a WinCommander .LS format compliant file. *(Only available in Service Mode)*
- Reset to Defaults:** The setup in SwitchBoard is reset to the SwitchBoard defaults. It does not directly affect the TANGO controller.

## 2.16 Dialog „Info”



### Abstract

Information display about version numbers, controller configuration and operating state. Displayed data is updated permanently. This dialog mainly addresses troubleshooting & service.

**Axis State** display: Active motor amplifiers are shown in green, disabled amplifiers are shown greyed. An error state is indicated by red symbols. For further information please refer to the [Manual Move] dialog description.

**Program Version:** SwitchBoard program version

**DLL Version:** TangoDLL.dll version used by SwitchBoard

**Controller Version:** Version of the connected TANGO controller

**Controller Serial No.:** Serial number of the connected TANGO controller

**Hardware Code:** Bit code of the TANGO configuration. Press the [?] button for an explanation of the displayed bit code or refer to the TANGO Instruction Set Description (here: *?det* instruction).

**Controller Type:** Desktop or PCI controller, amount of axes, maximum motor currents

|                                   |                                                                                                                                                                                                                                          |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HDI Type:</b>                  | Digital identifier of the currently connected HDI device (Joystick etc.)<br>An ID of 16 indicates no device is connected, for further information please refer to the TANGO Instruction Set Description (here: <i>?hdi</i> instruction). |
| <b>Encoder:</b>                   | Shows the type of the TANGO encoder interface, e.g. 1Vpp                                                                                                                                                                                 |
| <b>Power Amplifiers:</b>          | ON = All activated amplifiers are on<br>OFF= One or more amplifiers are off<br>The axis state is displayed in [brackets]: Enabled, Disabled or Off                                                                                       |
| <b>Amplifier Voltage:</b>         | Amplifier supply voltage in Volts (typically 12 V).                                                                                                                                                                                      |
| <b>Motor Voltage:</b><br>Remarks: | Motor voltage in Volts (typically 12, 24 or 48 V).<br>If the motor voltage is significantly lower than 12 Volts, please check if the HDD power plug is connected to the PCI controller.                                                  |
| <b>Digital Voltage:</b>           | Typically 5 or 3.3 Volts.                                                                                                                                                                                                                |
| <b>I/O Voltage:</b>               | With I/O extension 5 or 12 ... 24V, depending on type.<br>Without extension or with AUX-I/O typically 5V.                                                                                                                                |
| <b>Ambient Temperature:</b>       | If the TANGO provides this option, the case or PC internal ambient temperature is displayed here in centigrade.                                                                                                                          |

### 3 Document Revision History

| No. | Revision | Date             | Changes                                                                           | Remarks                   |
|-----|----------|------------------|-----------------------------------------------------------------------------------|---------------------------|
| 01  | 2.1      | 21. August 2012  | Newly revised version                                                             | Based on SwitchBoard 1.51 |
| 02  | 2.2      | 11. October 2012 | Remarks to COM ports greater 16                                                   |                           |
| 03  | 2.3      | 18. Feb. 2013    | New SwitchBoard version 1.60                                                      | Based on SwitchBoard 1.60 |
| 04  | 2.4      | 27. May 2013     | Manual Move: Red Encoder LED<br>Changed Document Author,<br>Company and File Name |                           |
|     |          |                  |                                                                                   |                           |