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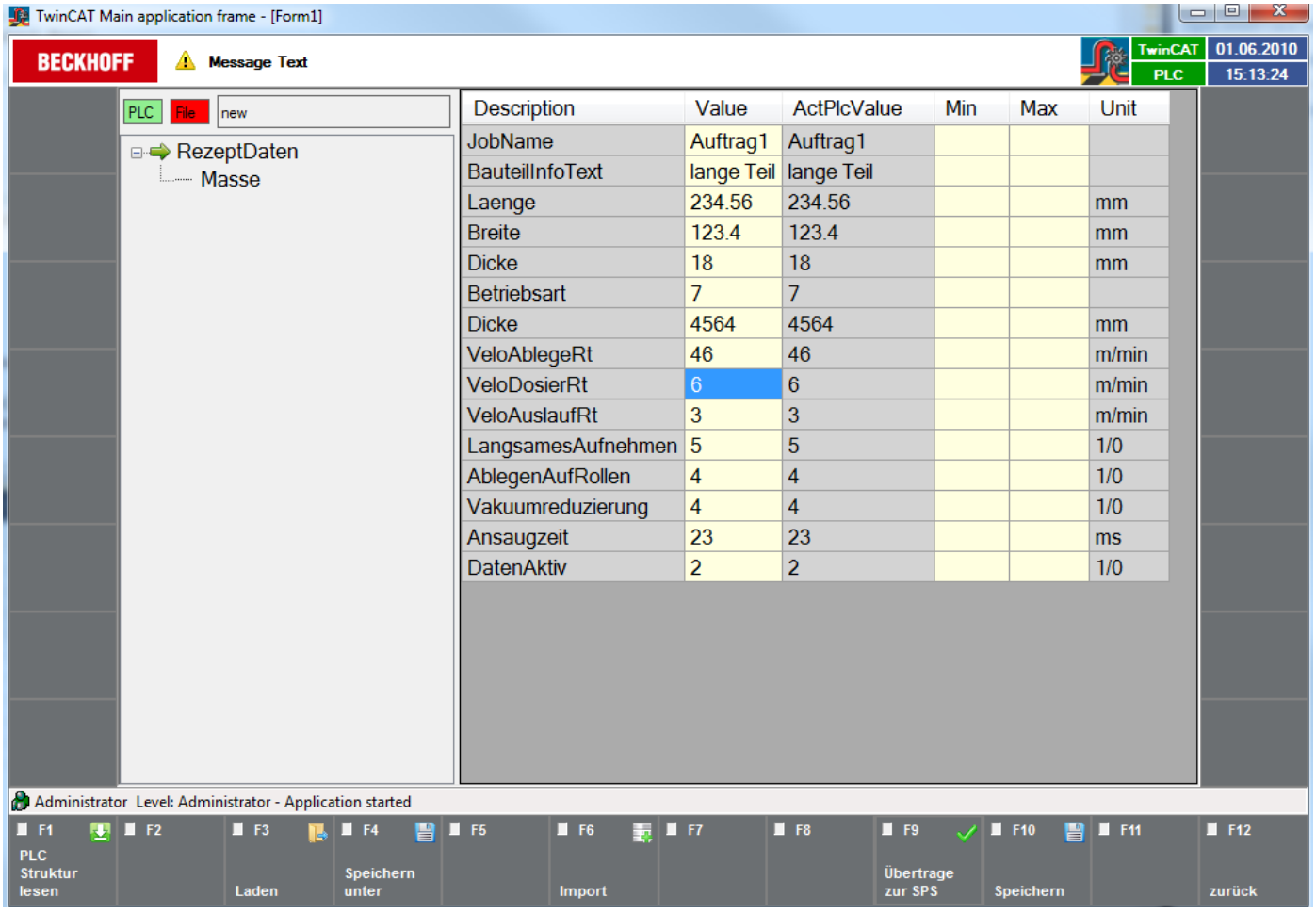
Last Modified: 26.03.2014

Reading and writing PLC structures via the HMI (Machine data, aggregate data, etc.)



- The screen for managing PLC structures can be found in the module „Beckhoff.App.PlcStructure.dll“ in the folder “Plugins” of the HMI application. It may be integrated (even more than once) into the HMI via the menu manager (see documentation “Menu Manager”).

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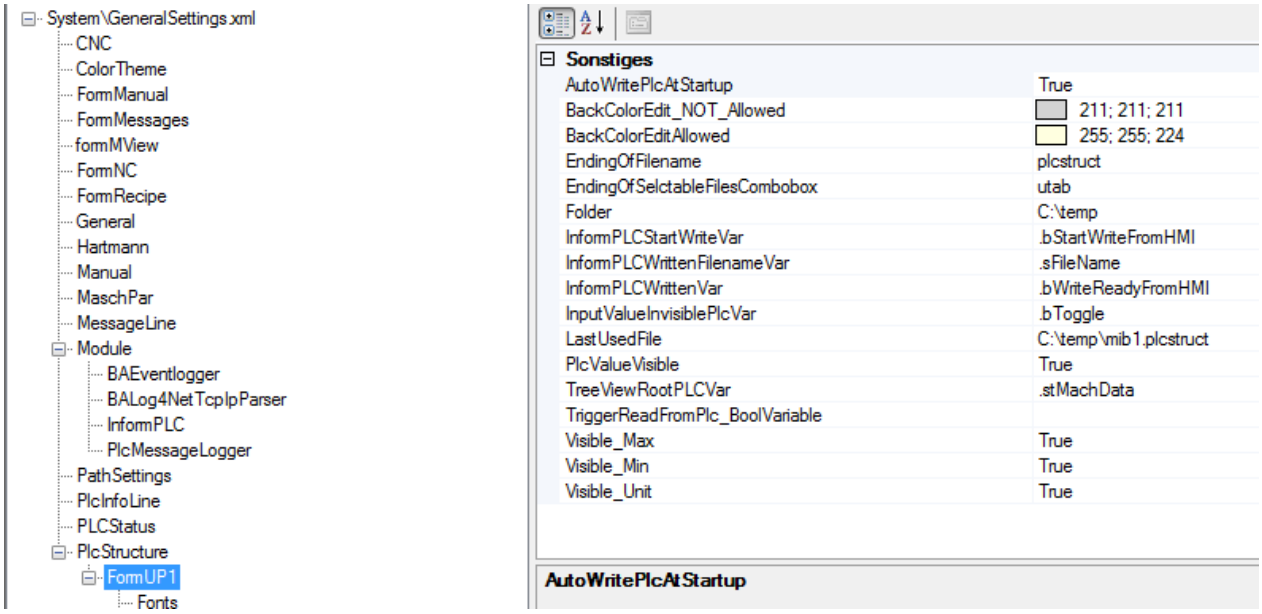
- The necessary settings will be added to the settings screen automatically. They can be found there in the tree view underneath the node “PlcStructure”. There is one child node for each instance of the PLC structure screen.



- **AutoWriteOnVariableChange**:
  True = Whenever you change an entry, it is immediately transferred to the PLC
- **AutoWritePlcAtStartup**:
  True = the content of whole structure will be written to the PLC either on each creation of the PLC structure screen or on each restart of the PLC.
  False = the content of whole structure will be written to the PLC only by means of an explicit trigger.
- **BackColor**… Color settings of the data grid showing the PLC structure data
- **EndingOfFilename**: Specifies the file extension
- **EndingOfSelectableFilesCombobox**: Specifies the file extension for selectable files.
- **Folder**: Specifies the folder in which the PLC structure data is going to be saved.
- **InformPlcStartWriteVar**: Name of a PLC variable (type BOOL) which is set TRUE before the structure data is written to the plc.
- **InformPlcWrittenVar**: Name of a PLC variable (type BOOL) which is set TRUE immediately after the structure data has been written to the plc.
- **InformPlcWrittenFilenameVar**: Name of a PLC variable (type STRING) which holds the name of the data set which was written the last time.
- **PLCValueVisible**: True = The current values will be shown in an additional column called „ActPlcValue“.

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- **ShowSpecialControlForEditValues**: Upon entering an editable field a special, tailored to the type of field, control is loaded for editing. This is useful for control panels that have no keyboard and can only be operated with touch.
- **TreeAutoExpand:** The first time you view the Treeview, it is shown completely unfolded.
- **LastUsedFile**: The name of the data file which was written to the PLC the last time can be found here.
- **OpenCloseSpecialDialogs**: TRUE: There are special dialogs for loading and storing files that cannot be edited (delete, Rename, etc)
- **TreeViewRootPLCVar**: Root name of the PLC structure which should be written or read by the specific screen.
- **TriggerReadFromPlc_BoolVariable**: Name of a PLC variable (type BOOL) which triggers (rising trigger) a complete upload of the specified PLC structure to the HMI. Old data may be overwritten and saved in a file with the name specified in "InformPlcWrittenFilenameVar". Finally this variable is going to be reset by the HMI.
- **TriggerWriteToPlc_BoolVariable**: If the entry is not equal to an empty string, then on rising edge all of the data from the currently loaded structure is transferred to the PLC.
  If in the variable **"InformPlcWrittenFilenameVar"** the file name of a existing file is entered, then the contents of this structure is transferred to the PLC and not the currently loaded structure.
- **InputValueInvisibePlcVar**:
  Name of a PLC variable (type BOOL) which can be used to shield the input column. This variable is monitored constantly so that it can be used to reveal or conceal the input column.
- **Visible_(Max, Min, Unit)**:
  Sets the visibility state of the corresponding columns
- **BitMaskElement:** If set to 0 all elements of the structure marked with @1 are considered when reading. In the entry <> 0, the value is "bitwise" compared with the entry @11 of each element. Only elements for which a value <> 0 are read and replaced. This method can be used so that only certain parts of a Machine Data Structure are used.

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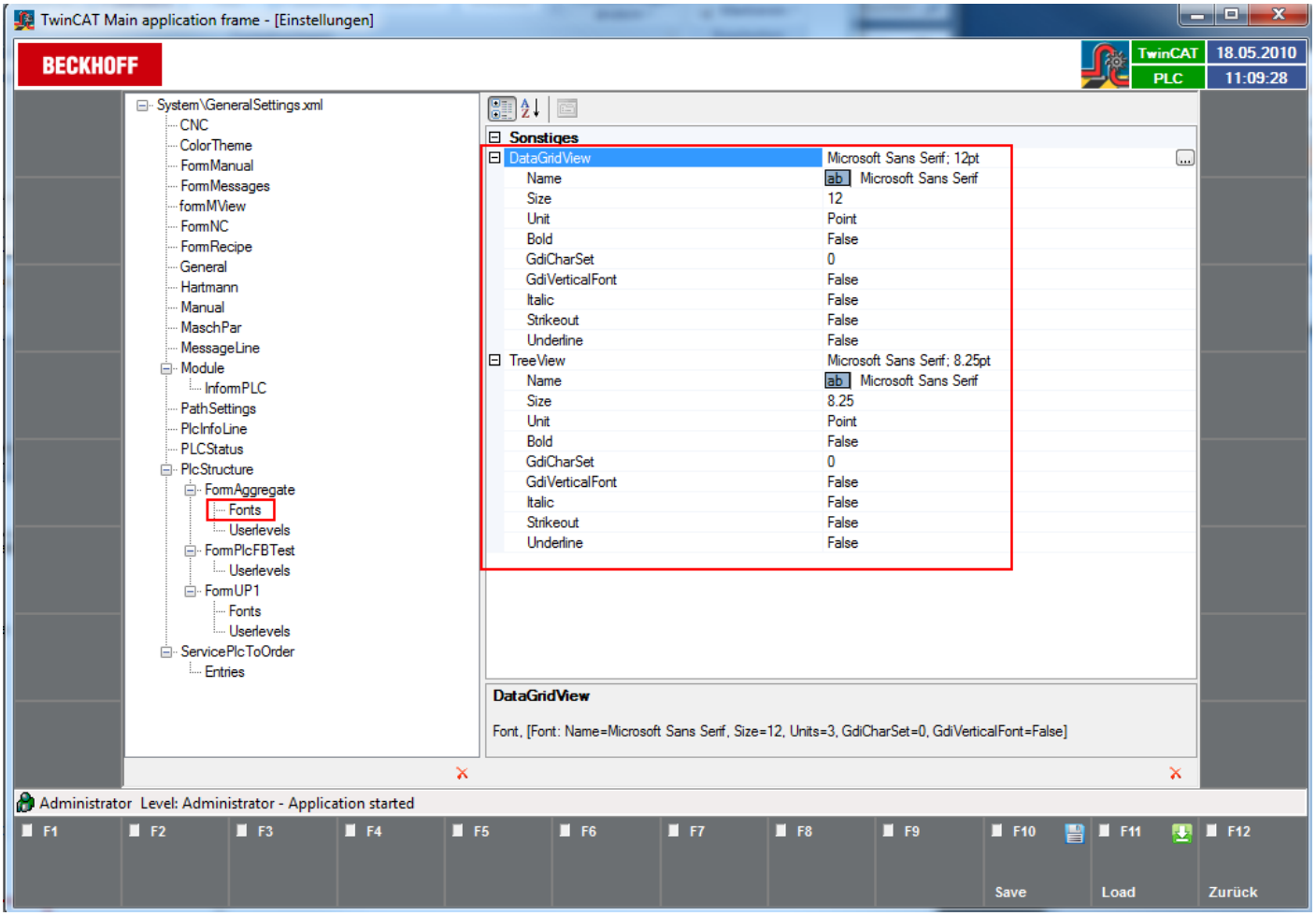
- The typeface of the tree view as well as of the data grid can be adjusted by means of the sub item „Fonts“:



- The required user level for editing PLC structure data is set via the item “Userlevel”. The correlation is as follows:

  - 0 = Administrator
  - 1 = Supervisor
  - 2 = Superuser
  - 3 = Standarduser
  - 4 = User
  - 5 = None

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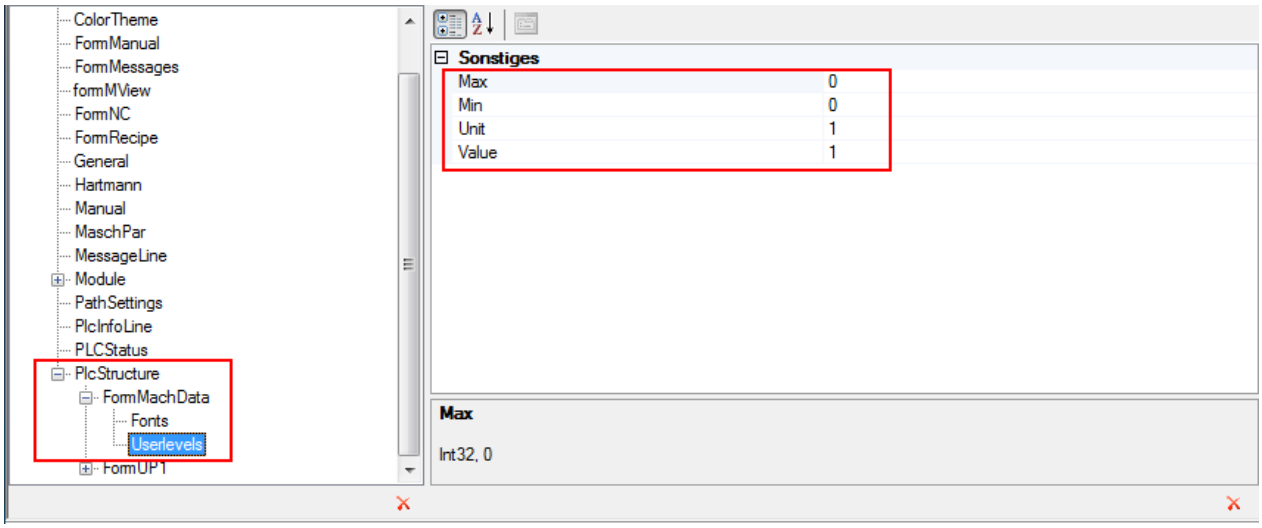

- In the example above a user with level administrator is allowed to change maximum, minimum, value and unit of a structure element.
- A user with level supervisor is allowed to edit values and units but no maximums or minimums.
- A user with level < supervisor is limited to read only access

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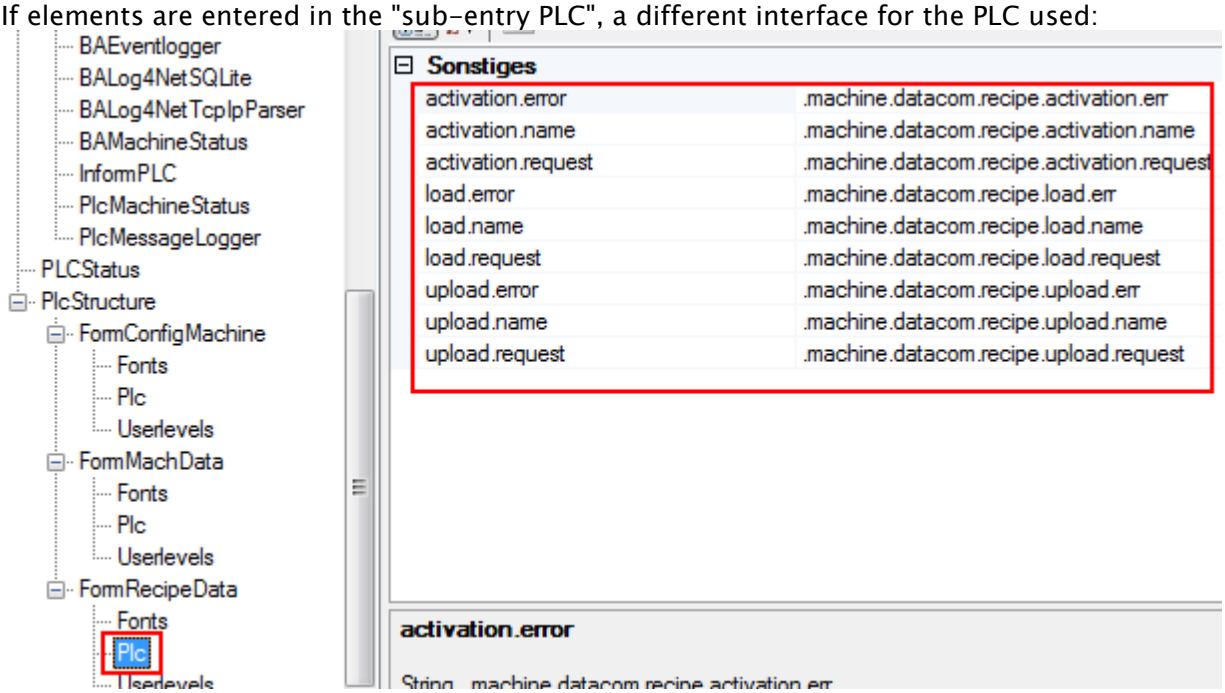
- If elements are entered in the "sub-entry PLC", a different interface for the PLC used:



- Here the HMI never writes unsolicited data to the PLC but instead writes a TRUE in the Variable "activation.request". The HMI then waits for the PLC to request the DATA by writing TRUE to "load.request". Finally, the HMI transmits the data and then sets "load.reuqest" FALSE when it is finished.
- The variable * .name is required to specify data. The HMI adds the name then automatically concatenates with the ending and sends it to the PLC. An "activation.request" should be done with a name, if different data sets are required.
- In the structure "* err" error messages are stored. Should be of the following type:

```
FUNCTION_BLOCK FB_ERRORHDL
VAR_INPUT
        flag: BOOL;
        id: DINT;
        state: DINT;
        text: STRING(256);
        fnc: STRING(64);
END_VAR
VAR_OUTPUT
END_VAR
VAR
END_VAR
```

- Within the PLC variables to be handled by the HMI get decorated with a specific comment.

```
VAR
        HMILineMas                  : ST_HMIMaschine; (*@1: Maschine *)
END_VAR
```

- There are the following tags to be evaluated:

  - **@1:Text**
    User friendly name of the structure in the HMI. An element is read by the HMI only if this tag exists. Apart from that, sub elements are only evaluated if this tag exists.

  - **@11:Byte**
    Bit mask with which the elements can be filtered out. In the Settings (about BitMaskElement) can be set, which elements should be loaded depending on the bit mask when importing the structure.

  - **@2:Text**
    Unit of the element as STRING

  - **@3:Wert**
    Default minimum of the element. Can be edited in the HMI

  - **@4:Wert**
    Default maximum of the element. Can be edited in the HMI

  - **@5:1**
    This is to specify that the current element represents a file selection which is presented in the HMI by a combo box.

  - **@51:**
    Drive for the directory of the file selection Example: @ 51: C

  - **@52:**
    Path for the directory of the file selection Example: @ 52: \ temp

  - **@6:1**
    This is to specify that the below structure represents a manual function.

- The functions „read PLC structure“, „load“, „save“ and „import“ are available after a PLC structure screen has been instantiated.

  - **Read PLC structure:**
    Evaluates the PLC structure according to its comment tags and displays it in the

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HMI as a tree. Old values may be overwritten but can be reloaded from a saved file via “Import”.

- **Load:**
  Loads a saved PLC structure with its content from disk.
- **Save:**
  Saves a PLC structure with its content to disk

- **Import:**
  Merges all elements (if possible) from a saved PLC structure into the current structure.

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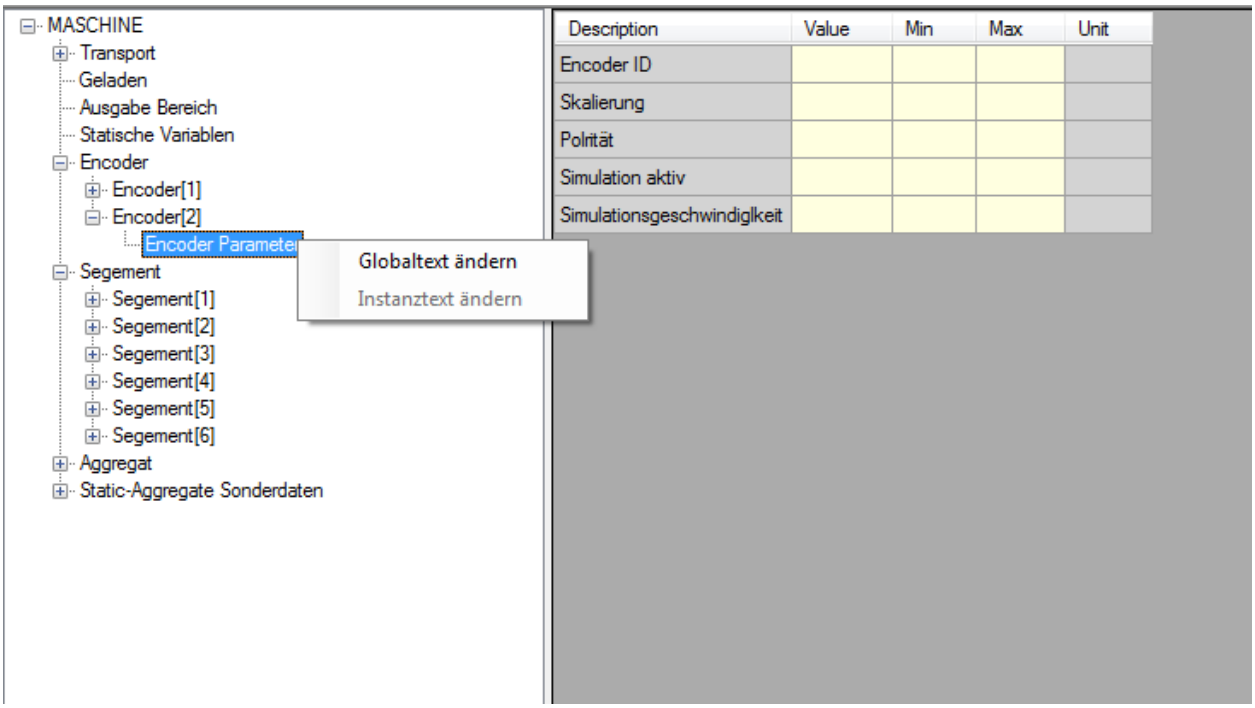
- If the current user level is administrator a right click on a tree item or on a description in the data grid shows a context menu. This is for editing the displayed names in the current language.

  - **Globaltext ändern (Change the Global Text):**
    All appearances of the selected text is going to be translated by this function.

  - **Instanztext ändern (Change the Instance Text):**
    This is for editing the selected text only.



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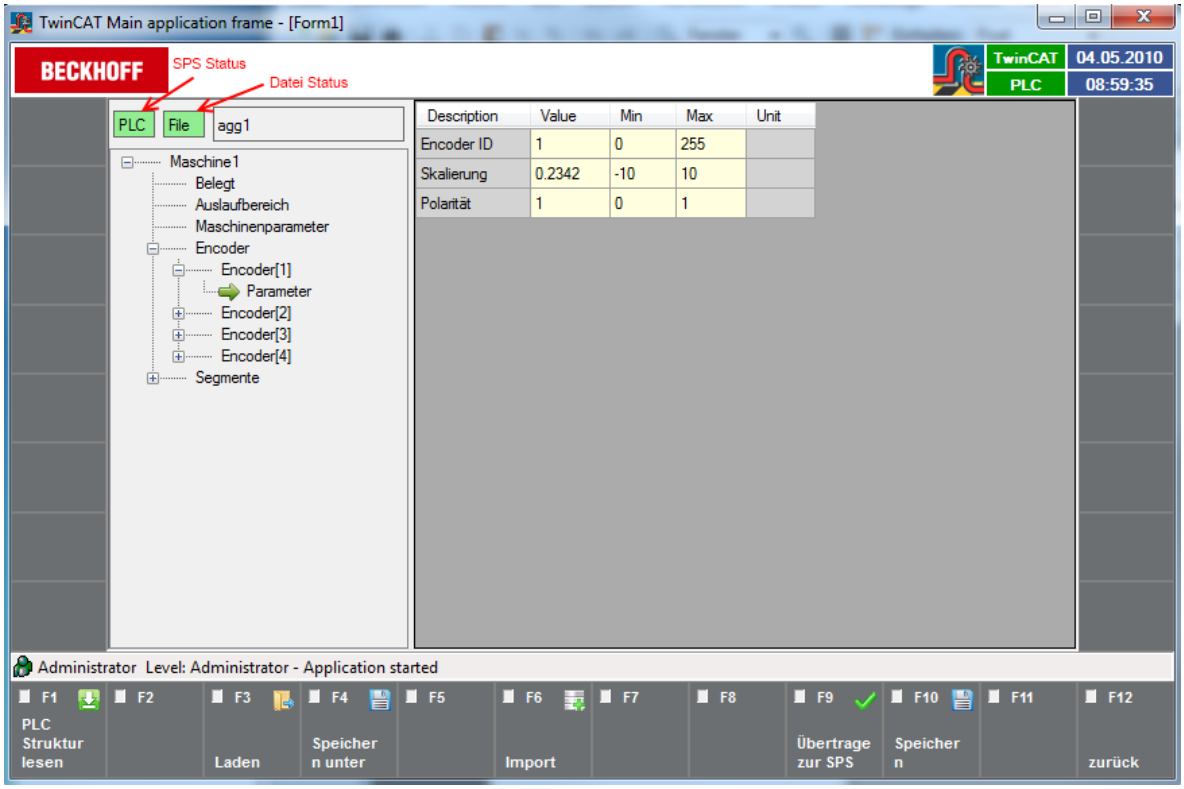
Status „PLC“ and „File“:



- The status view shows the current data file, the PLC state and the file state
- The first part of the currently loaded file is displayed.
- The „PLC Status“ box displays the correlation between the displayed data and the correspondent structure in the PLC:
  - **Red:**
    Displayed data and PLC structure are not in synch.
  - **Green:**
    Displayed data is equal to the values in the correspondent PLC structure.
- The „File Status“ box shows the correlation between the displayed data and the file content.
  - **Red:**
    Displayed data differ from file content
  - **Green:**
    Displayed data and file content are equal.
- By a click on the particular box one can synchronize data between PLC and HMI or between HMI and file. Only changed items are synchronized. The methods “WriteToPlc” and “Save” represent these functionality and may be assigned to one of the keys with

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"CallMethod" managed by the menu manager.

- The method **"SaveToFileAndWritePLC"** first saves the file and then writes CHANGED data to the plc.
- The method "SaveToFileAndWriteAllPLC" first saves the file and then writes ALL data to the plc.
- The method „WriteAllDataToPlc" writes all data to the PLC, regardless of whether they have changed since the last write.
- The method „ExportXML" exports the whole tree and all current data to a XML file.
- With the method "ImportXML" the entire tree can be imported from a previously exported XML file. Here, only the values (Value) and no other elements are imported (min, max, ...).
- The callable method to call methods "ReadStructureFromPlcAndConvertDefaultDirectory" and "ReadStructureFromPlcAndConvertDirectory" the structure of the PLC is read and then all the files in the appropriate directory are converted using the Import Function. Watch out! Here, the original files will be overwritten.
- The default key mapping can be loaded by pressing <Ctrl><Shift> and left click

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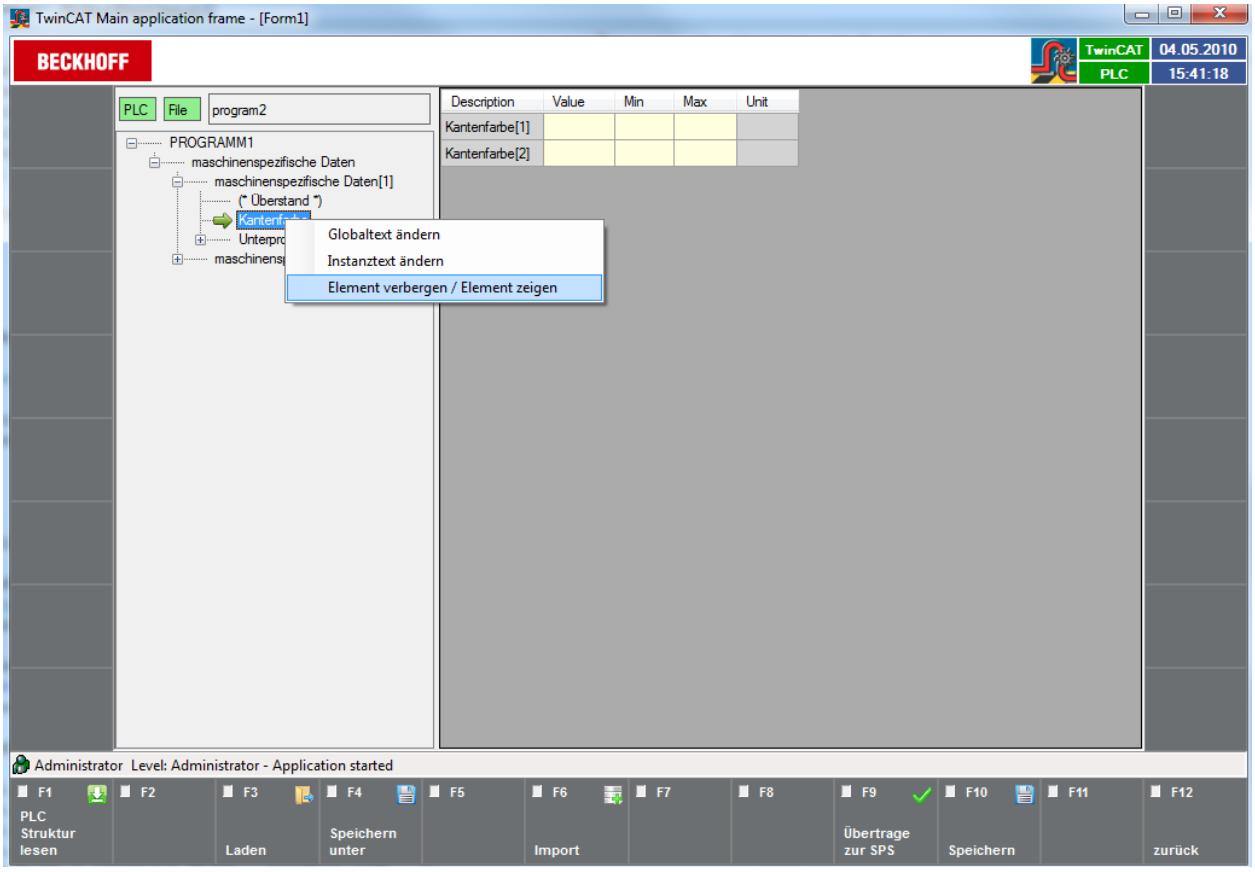
Hiding tree view items



- All users with level “Administrator” are capable of hiding single tree view items. The hide/show state is adjusted by the context menu item “Element verbergen/Element zeigen” (Hide item / show element). Within the data grid view this can be displayed by right clicking on the description.
- Hidden items are displayed in comment brackets („(**)“). Only visible for administrators! Users with a level lower than administrator don´t see these items and their children anymore.
- The context menu is available for “Administrators” only
- NOTE: Hiding and revealing items does not reduce the amount of data that is stored. Hidden elements are not written to plc.

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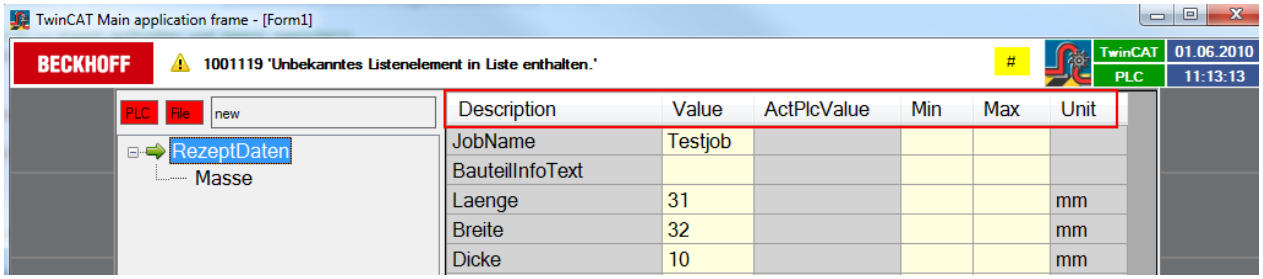
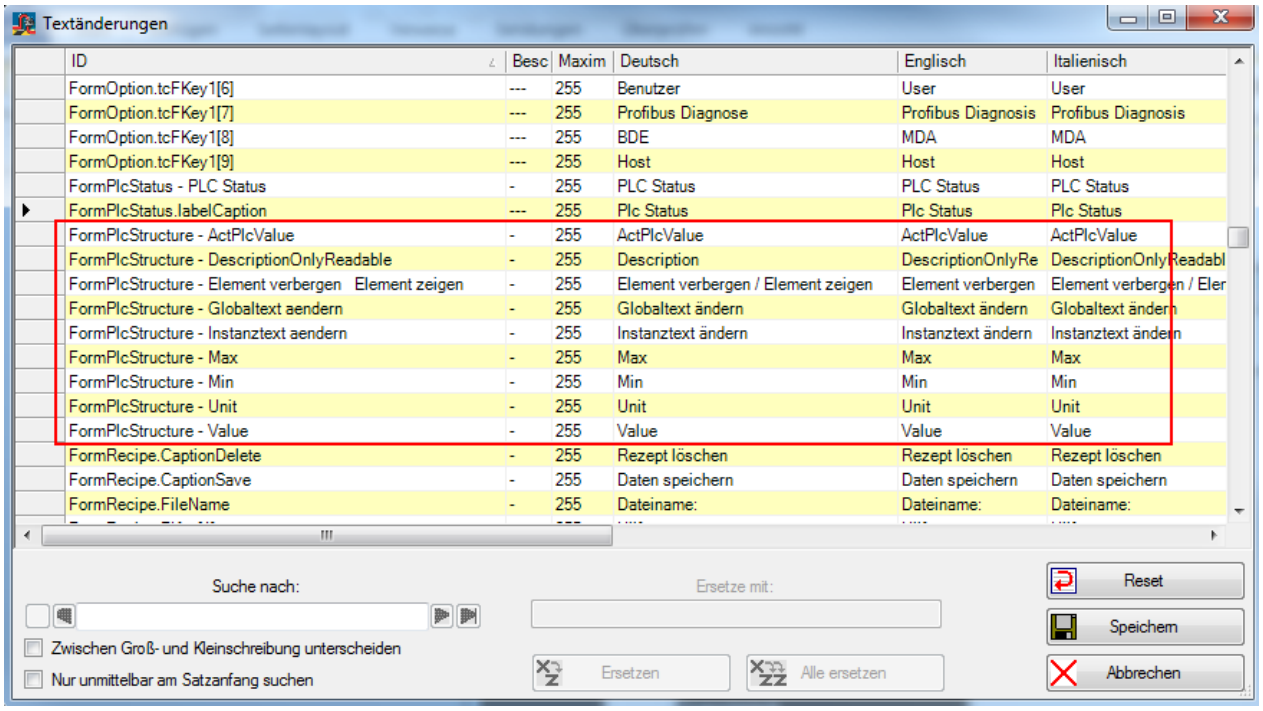
Switching column header languages

- Language switching for column headers as well as for context menu items is adjusted by the language manager. The relevant indices are called "FormPlcStructure-[ColumnName]".





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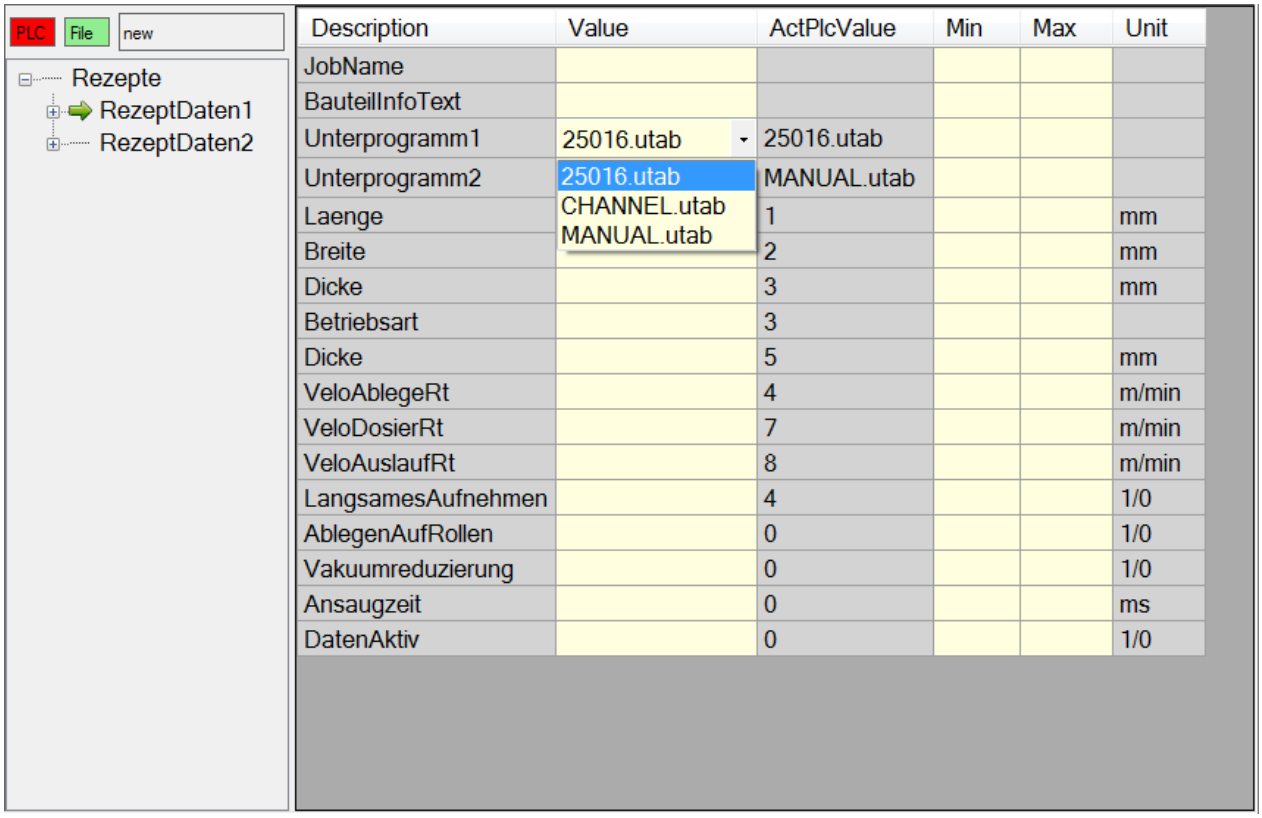
File selection by meany of a combo box (@5:1)

- Any variable in the PLC declared with a “@5:1” offers a file selection and is displayed in the HMI as a combo box.
- By right clicking on such an item one can adjust the file path
- The default location for the files shown in the combo box is established with the help of the entry "FolderComboboxItems" in the Settings.
- The file extension used are adjusted in the settings screen via the parameter **EndingOfSelectableFilesCombobox** .
- The PLC should provide a proper string variable for the file name.



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Manual functions (@6:1)

- Manual functions are specified by the parent element by using the tag @6:1. The description is adjusted by tag @1. For example.

  manualFunction: ST_HMI_Manual; (*@1:Manual function @6:1 *)

- The definition of a manual functions requires two variables. Each of type BYTE. The first one is for the manual command, whereas the second provides state information.
  In case of a manual function the @-tags have the following meaning:

  - Example:
    blowing: BYTE; (* @1:abblasen @2:on:1 @3:Position 1*)
  - @1:
    General description of the manual function (e.g. “Valve Y1”)
  - @2 to @9:
    Text for the keys 1 to 8. The suffix 0 or 1 is used to specify the switching behavior (e.g. “@2:On:0 @3:On:1…”)
  - The keys 1 to 8 are mapped to the correspondent bits of the specific byte.
  - The status display of the keys is realized as a byte variable whose name is extended with the string "Status". A change of the bits in this variable leads a color change in the HMI.
    Example:
    blowingStatus: BYTE;

  - The button labels can be change by the PLC at runtime by using an array of type String, whose name was added to the string "text". This can, for example, bring to the display the current process states. The content of the string is monitored for change (OnChange). Only string content not equal to a blank string is considered.
    Example:
    blowingText: ARRAY [0..7] OF STRING
    The declaration of this STRING variable is optional, which means there is no error, if it is not defined. The displayed texts are **not** translated using the language switching.

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- The following type definition…

```
TYPE ST_HMI_Manual :
STRUCT
    (* @1:Beschreibung @2: 1.Spalte Beschreibung:0=tastend, 1 =rastend @3 2.Spalte
    Beschreibung:0=tastend, 1 =rastend ...*)
    (* Milling *)
    milling         : BYTE;   (* @1:Motor @2:Ein:1 @3:Rückwärts:1 @4:Arbeitspos:0 *)
    millingStatus   : BYTE;
    millingText     : ARRAY[0..7] OF STRING;

    (* Blowing *)
    blowing         : BYTE;    (* @1:abblasen @2:on:1 @3:Position 1 *)
    blowingStatus   : BYTE;
    blowingText     : ARRAY[0..7] OF STRING;

    (* Axis *)
    axisY           : BYTE;   (* @1:Y-Axis @2:Forward:0 @3:Backward:0*)
    axisYStatus     : BYTE;
    axisZ           : BYTE;   (* @1:Z-Axis @2:Forward:0 @3:Backward:0*)
    axisZStatus     : BYTE;
    axisC           : BYTE;   (* @1:C-Axis @2:Forward:0 @3:Backward:0*)
    axisCStatus     : BYTE;
    axisU           : BYTE;   (* @1:U-Axis @2:Forward:0 @3:Backward:0 @5:Grundpos*)
    axisUStatus     : BYTE;
END_STRUCT
END_TYPE
```

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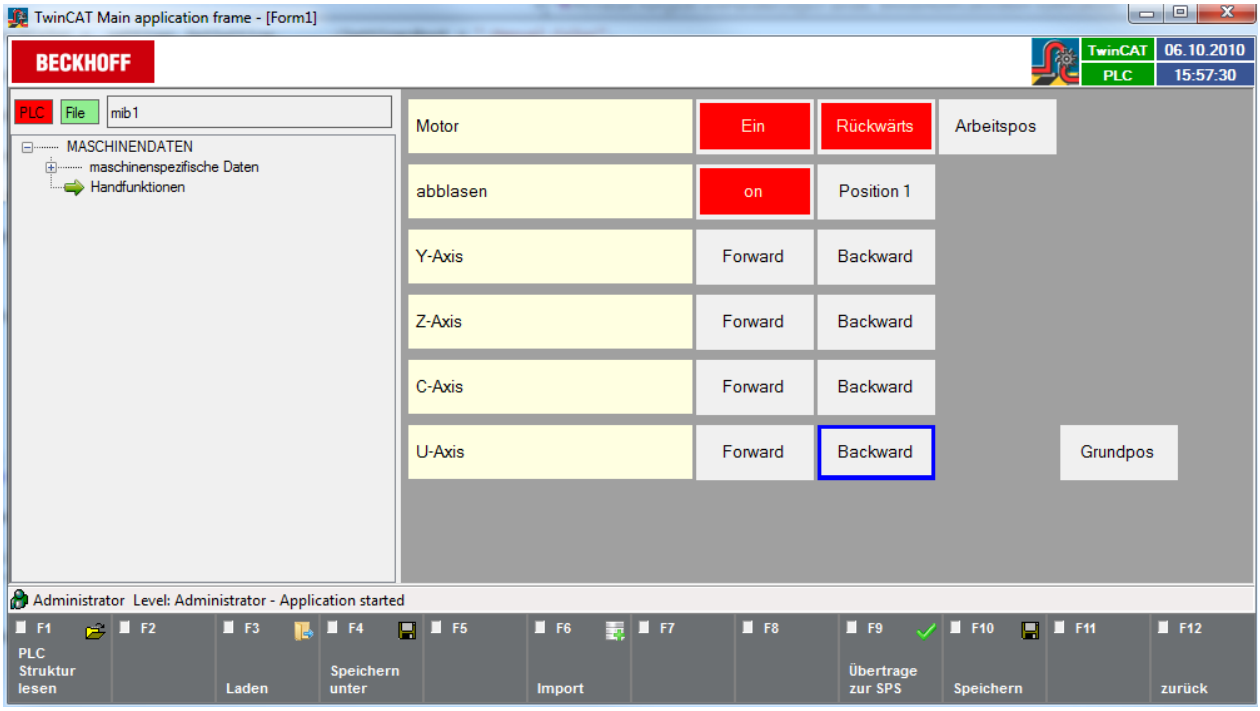
- …will lead to the following display:



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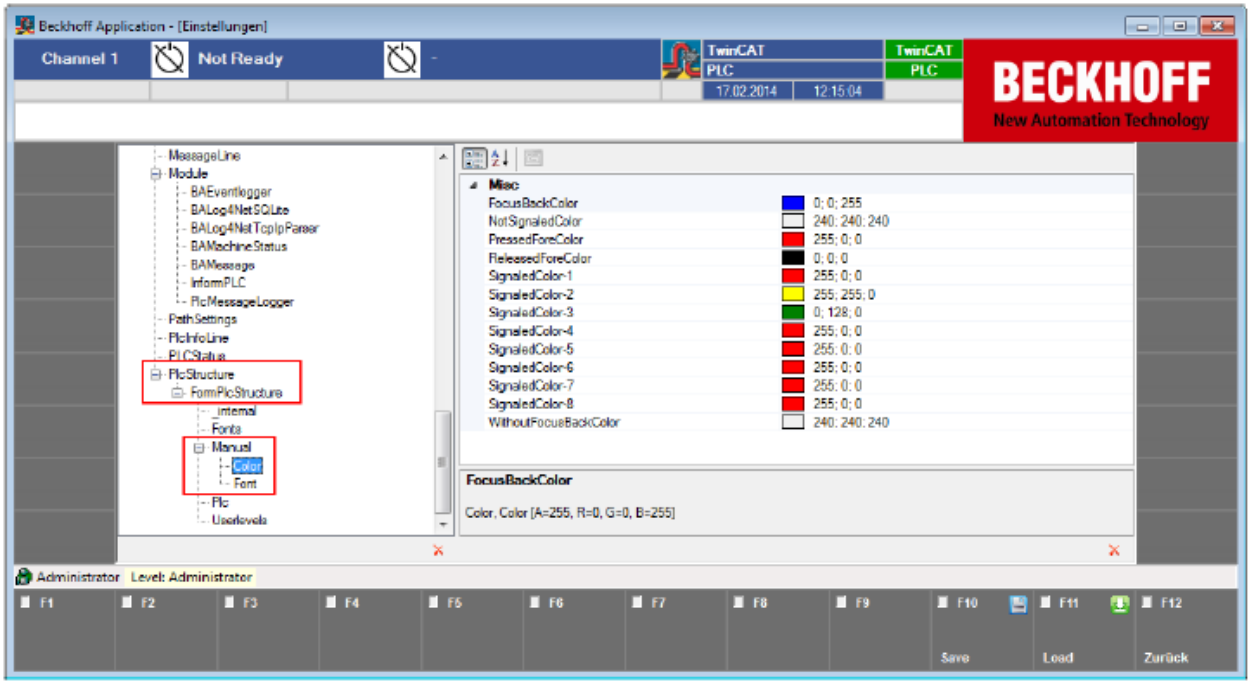
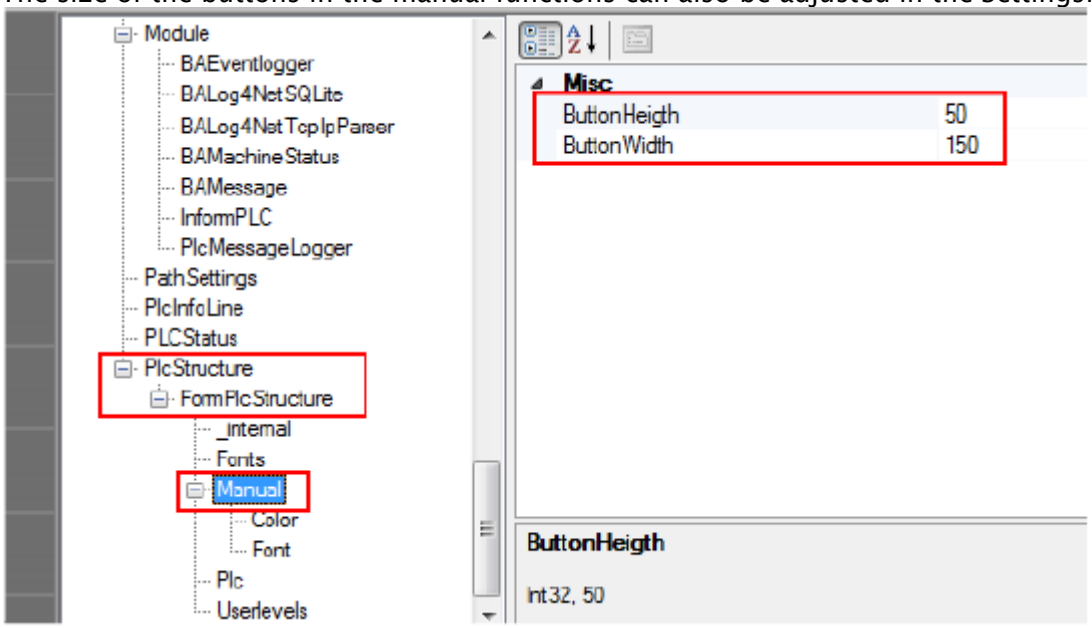
Settings in the Settings for manual functions

- In the Settings, the colors and fonts for each instance can be adjusted.
- The color of a status display can be set. The default value of "red" is entered.



- The size of the buttons in the manual functions can also be adjusted in the Settings:



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Texts to choose from (@ 7: SPSVariablenArray)

Here a PLC variable is in "SPSVariablenArray" stated that contains an ARRAY OF STRING. These entries can then be displayed as choices in the HMI. From the HMI then the number of selected entries is transferred to the variable. The variable in the PLC must be of type INT.

Example:

```
texts: ARRAY[0..6] OF STRING(20) :=
'DISABLE', (* 0 *)
'ENABLE', (* 1 *)
'Mode2', (* 2 *)
'SuperFastMode', (* 3 *)
'SlowMotion', (* 4 *)
'FastMotion', (* 5 *)
'Maintenance'; (* 6 *)
```

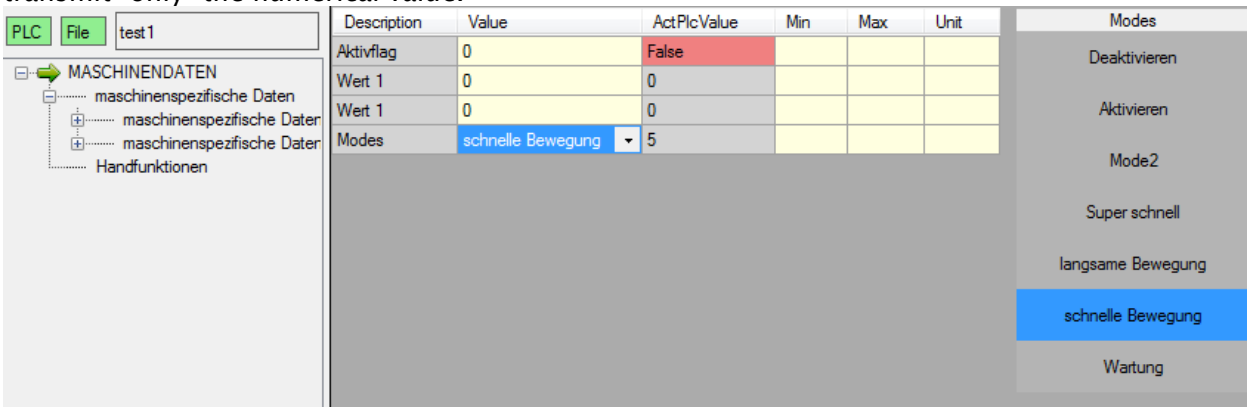
In the Structure:

```
modes: INT; (*@1: Modes @7:.texts *)
```

These texts can be translated using the language database. You use the index "Instance name of PlcStructure" + "- arr-" + original:

PlcStructure.FormPlcStructure - arr-DISABLE	-	255	Deaktivieren	DISABLE	DISA
PlcStructure.FormPlcStructure - arr-ENABLE	-	255	Aktivieren	ENABLE	ENAB
PlcStructure.FormPlcStructure - arr-FastMotion	-	255	schnelle Bewegung	FastMotion	FastM
PlcStructure.FormPlcStructure - arr-Maintenance	-	255	Wartung	Maintenance	Maint
PlcStructure.FormPlcStructure - arr-Mode2	-	255	Mode2	Mode2	Mode
PlcStructure.FormPlcStructure - arr-SlowMotion	-	255	langsame Bewegung	SlowMotion	SlowM

The HMI translates the entries displayed in the combo box and the PLC continues to transmit "only" the numerical value.



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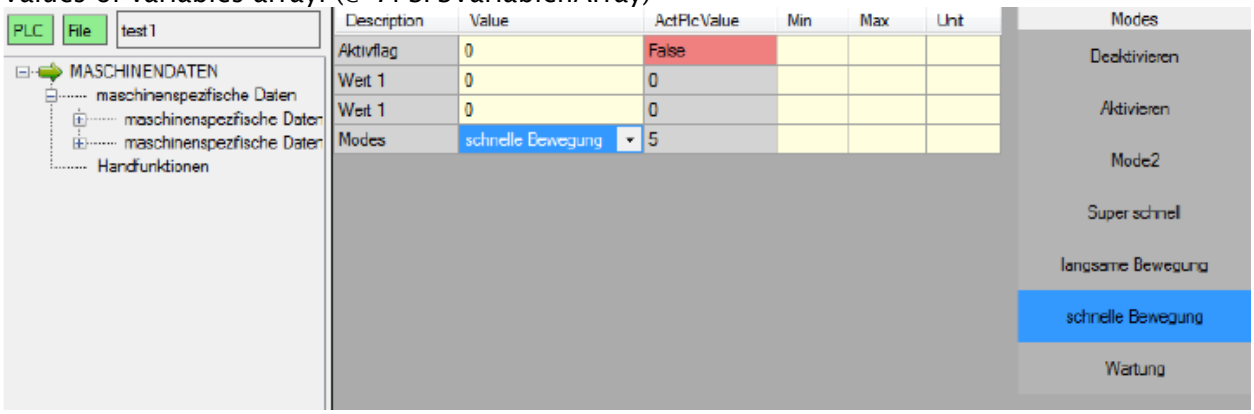
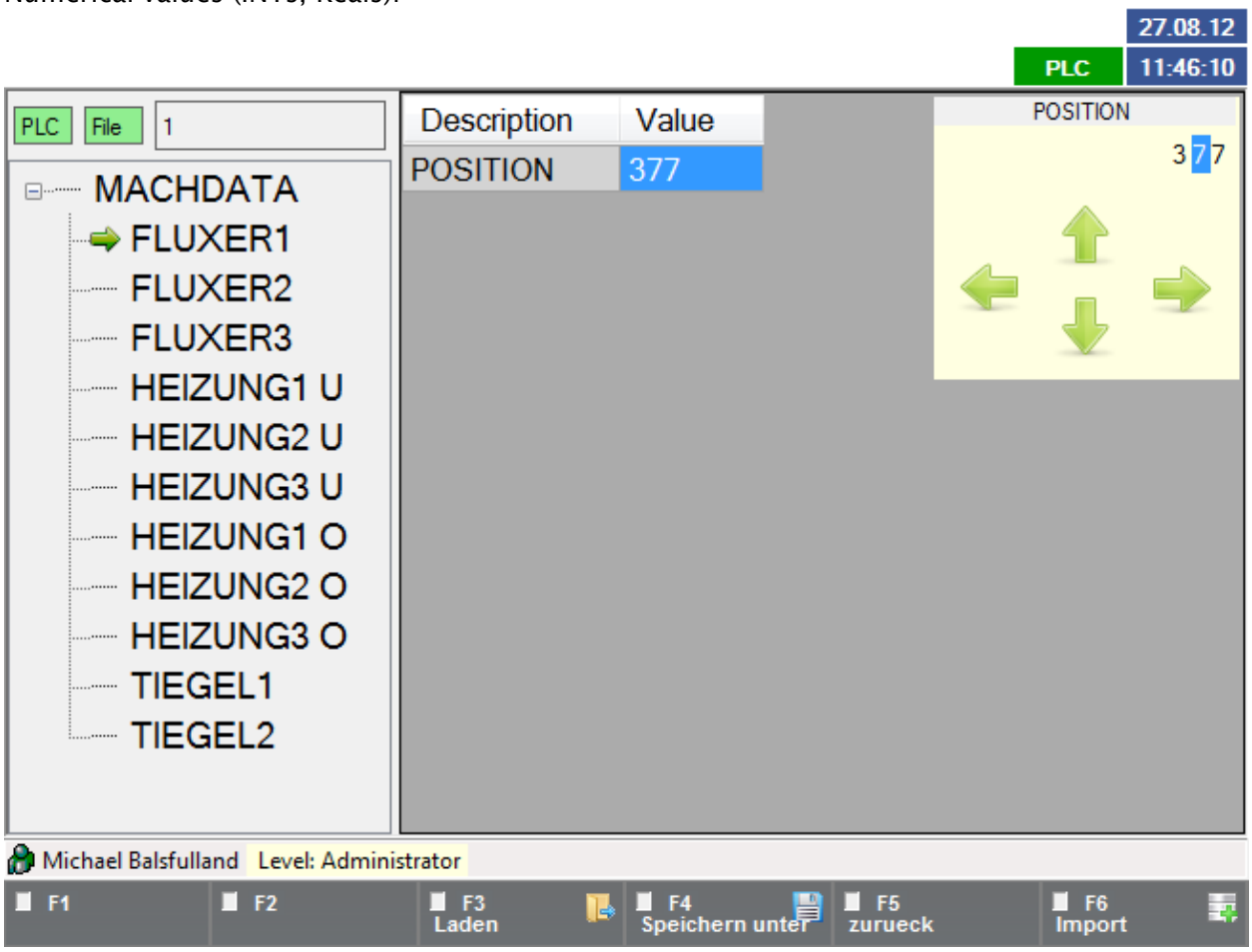
Special Controls for input (ShowSpecialControlForEditValues = TRUE)

Values of variables array: (@ 7: SPSVariablenArray)



Numerical values (INTs, Reals):



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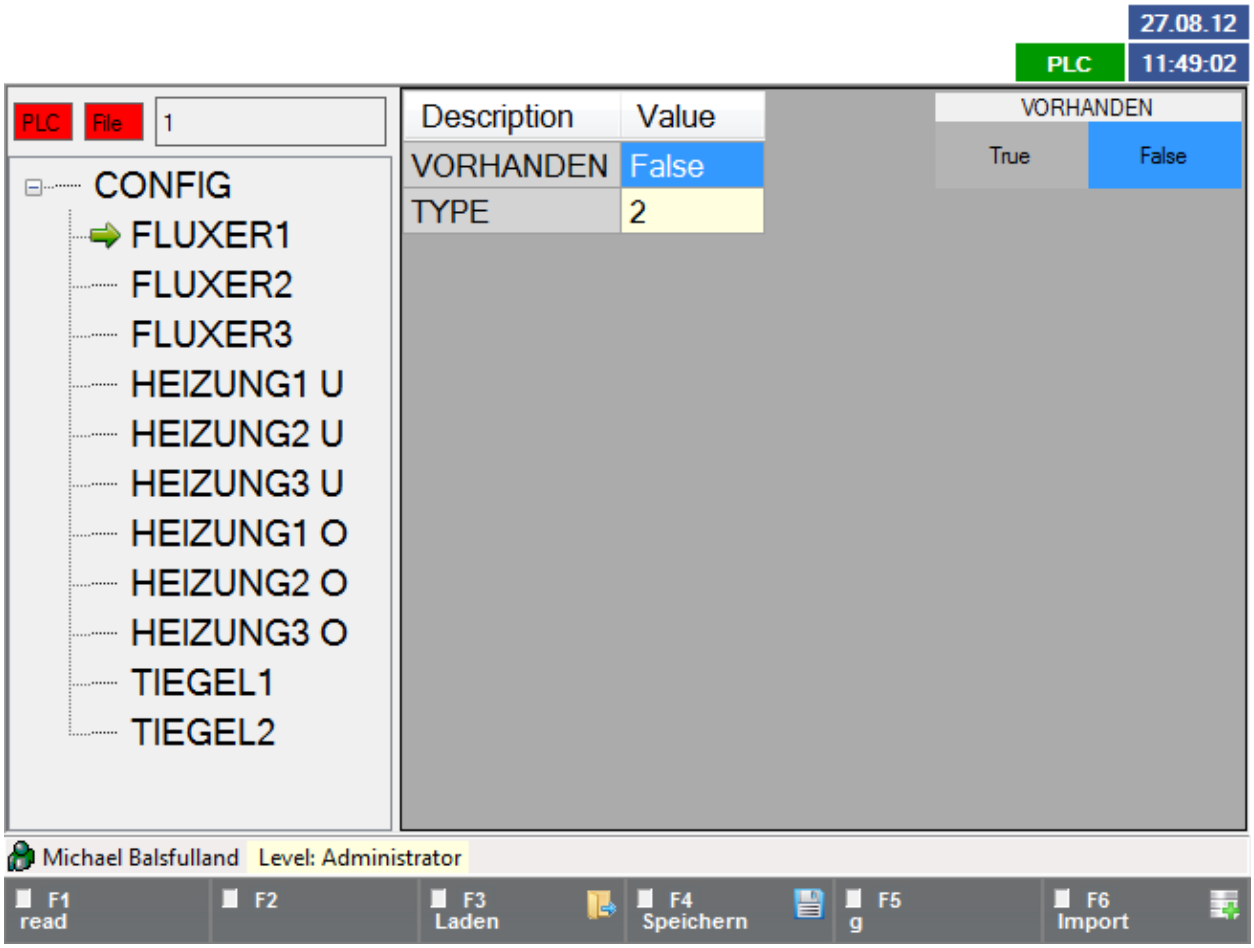
Bool Values:



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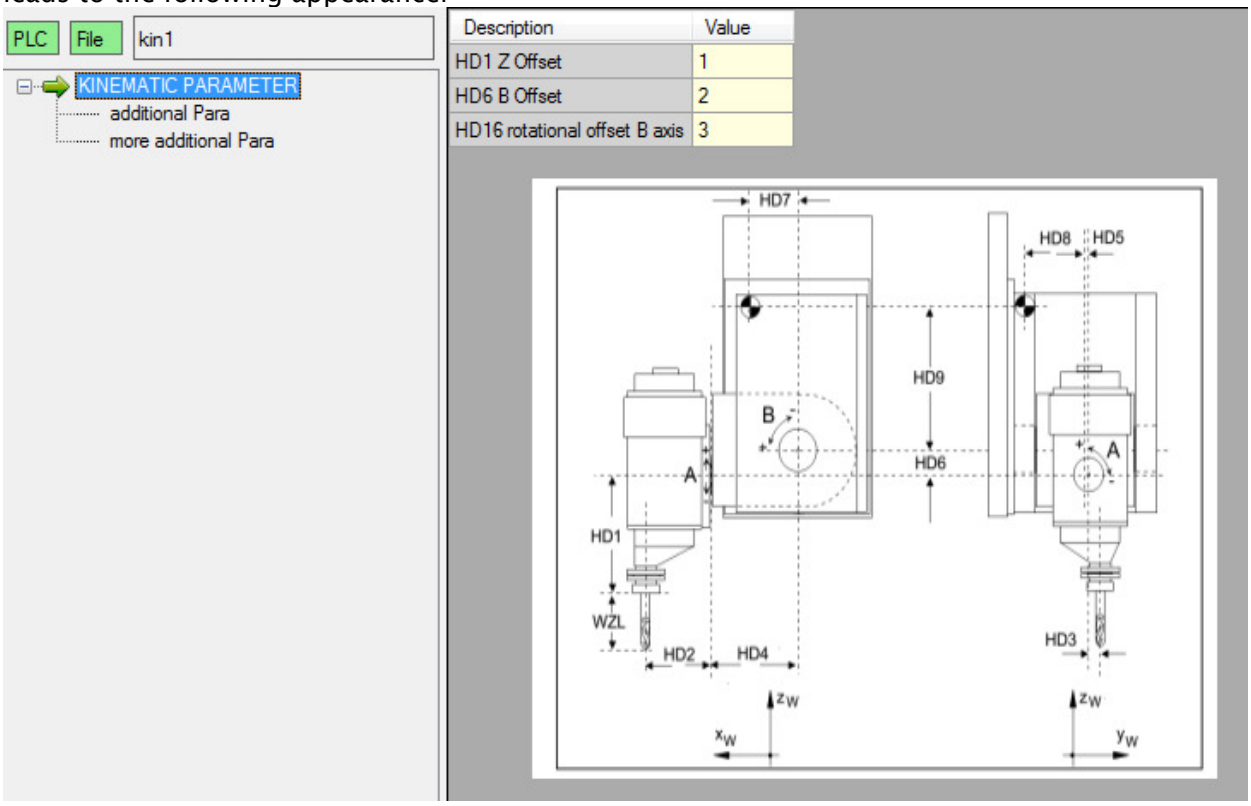
View Image (@ 8: filename; PosX; PosY, Width, Height)

Example Declaration in the PLC:

```
stKinematic: ST_KinPara; (* @1:Kinematic Parameter @8:test.jpg;50;100;400;350 *)
```

leads to the following appearance:



The search path for image files is adjusted in the settings with the entry "Folder Pictures".