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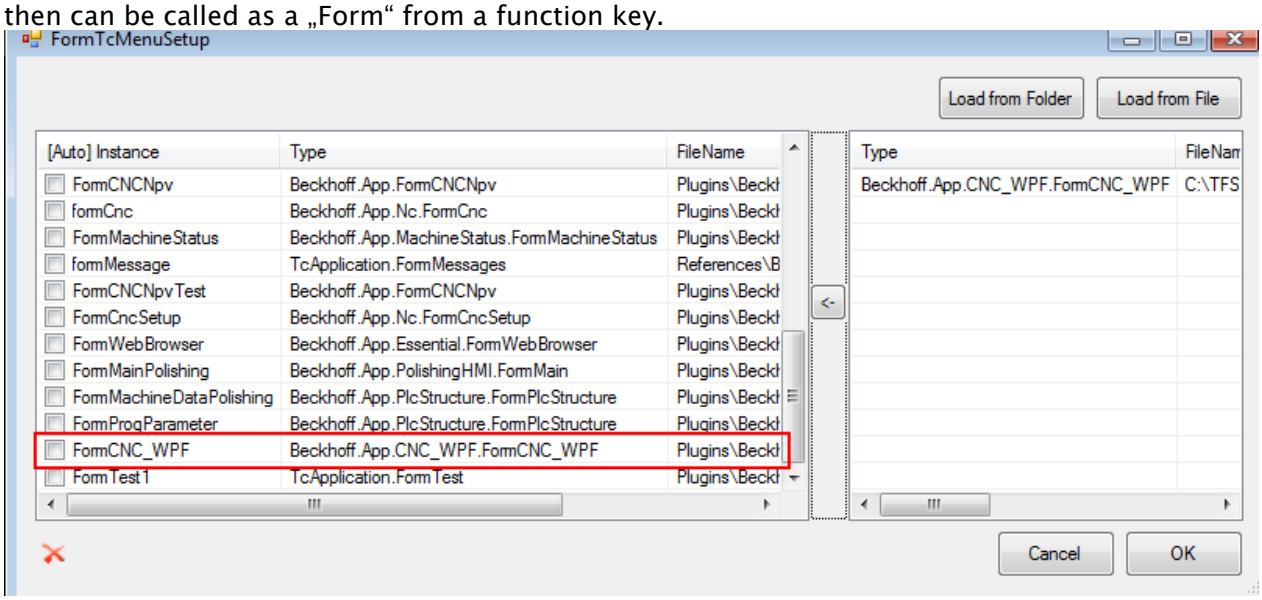
changed: 18.12.2020

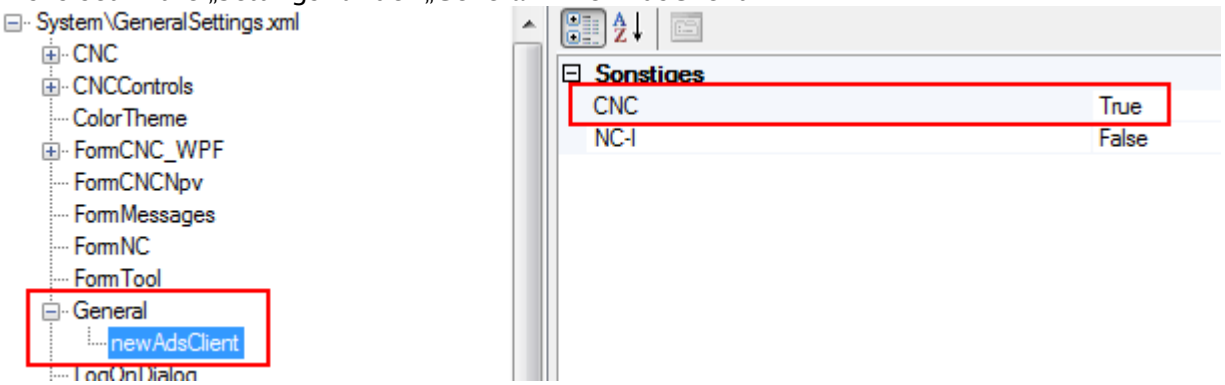
FormCNC

Installation

The FormCNC-WPF is in the Plugins Folder in the file „Beckhoff.App.CNC-WPF.dll“. With the help of the Menu Manger an instance of „Beckhoff.App.CNC_WPF.FormCNC_WPF“ can be added and then can be called as a „Form“ from a function key.



As a prerequisite of using the new CNC_WPF form the newAdsClient->CNC must be enabled. This is set in the „Settings” under „General->newAdsClient“:



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Features of FormCNC_WPF:

- Access to the CNC and PLC is accomplished via the new ADS client. Visualization of both the CNC and NC-I is possible.
- Components in the right pane are configurable. For example, there can be multiple spindle overrides or even none.
- Components in the left pane can be hidden and replace with „UserControls“
- The display area can be expanded as required.
- The values displayed for each Axis is freely adjustable. Two possibly different configurations can be switched between.
- The AxisDisplay is freely configurable with the help of a self-made XAML DataTemplate.
- The left and right pane sizes can be adjusted via a „Splitter“ to give each more or less room.
- There is the addition of the „All Axes“ selection which will show all axes including Channel-Independent axes (such as Spindle, Gantry Slaves, etc.)
- In the program display the current program is displayed with „Syntax Highlighting“.

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CallMethod‘s (possible assignments of the function keys)

- **SelectChannel(channelNr)**: The display is switched to the channel selected with „channelNr“. With channelNr=0, the display of all axes is activated.
- **ToggleMCS_WCS**: Switch between the machine coordinate system and workpiece coordinate system.
- **ToggleDisplay**: Switches back and forth between the two axis display configurations.
- **SetOpMode(mode)**:The operating mode of the CNC is switched.
  mode:
  - 2 : Automatic
  - 3 : MDI
  - 4: Manual
  - 5: Reference (Homing)
- **CncStart, CncStop, CncReset**: Commands that are sent from the PLC to the CNC.
- **OpmodeSelector(LeftPos):** a control for mode selection appears on the position defined in “LeftPos”. The “LeftPos” parameter specifies the left position of the control on the Form. This is an alternative to “SetOpMode”.

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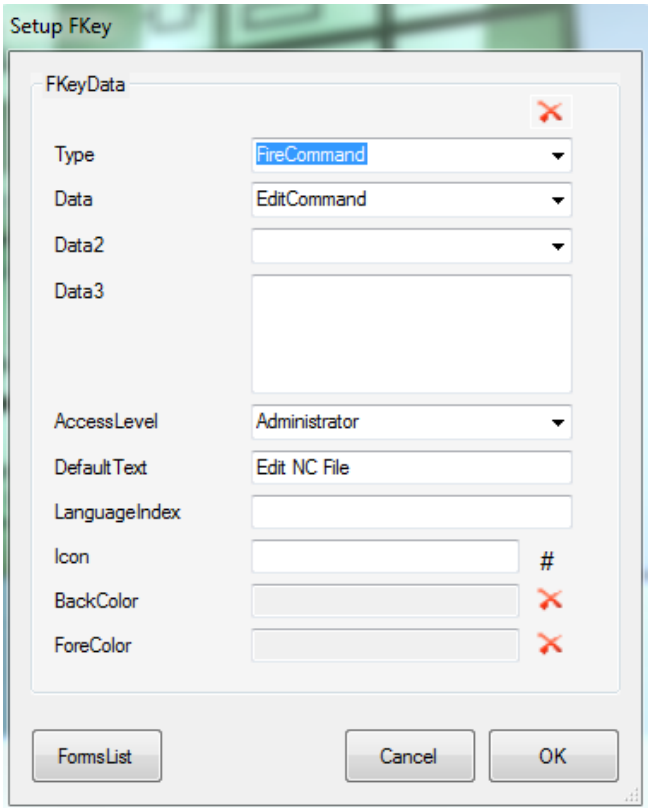
Command‘s („FireCommand“ FKeys)

In the “Menu Manager” it is possible to use „FireCommand“ to issue one of the following commands independently of the actual shown form.
To use this function, the form has to be shown once or it has to be marked as “Autoload”.

- **StartCncCommand**: PLC gets a “START” command from the HMI
- **StopCncCommand**: PLC gets a “STOP” command from the HMI
- **ResetCncCommand**: PLC gets a “RESET” command from the HMI
  SelectFileCommand: A file selection dialog to select a file is shown and the CNC program can be selected.
- **EditCommand**: The actual CNC program can be edited.



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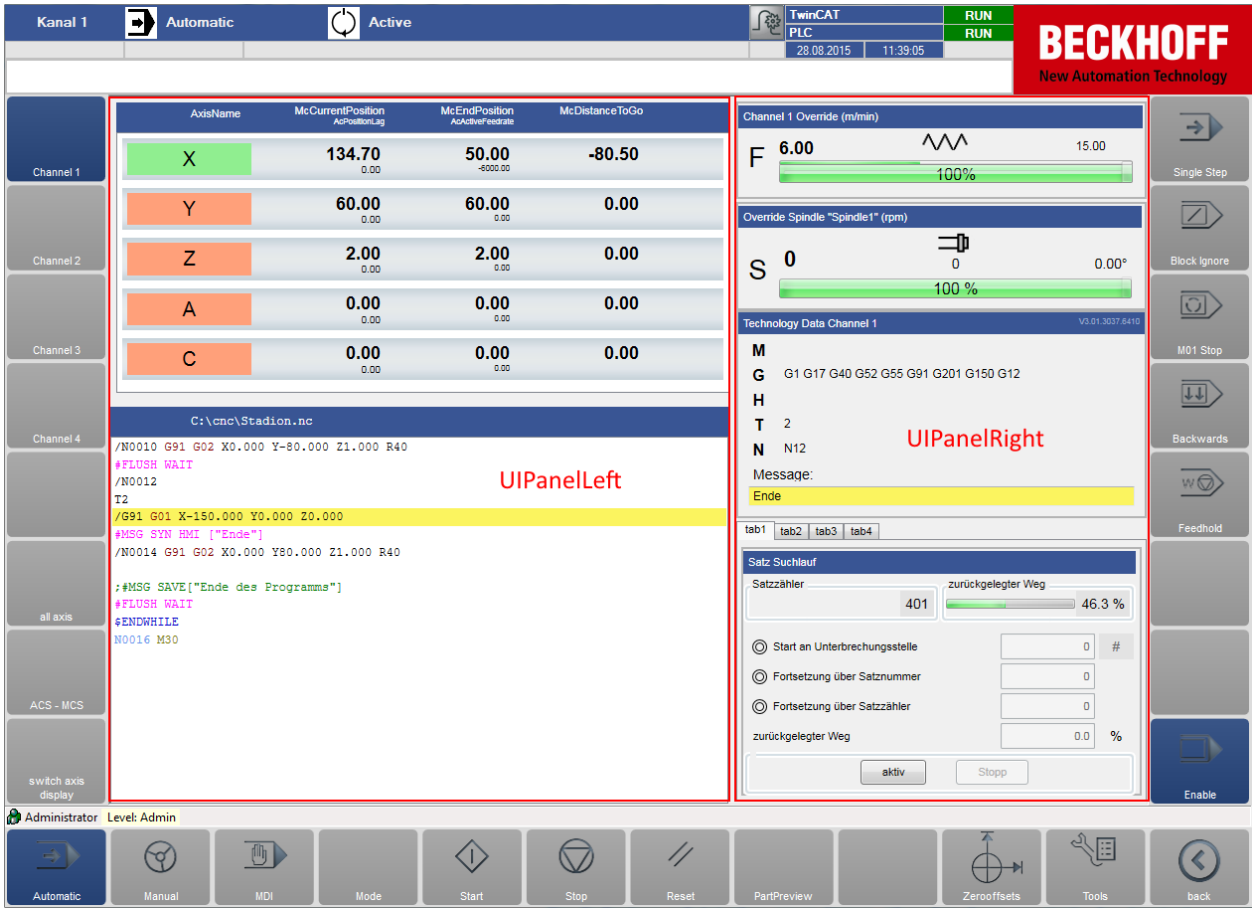
- **UI Element Definitions**



The UI elements to be displayed in the UIPanelLeft and UIPanelRight (marked in red) are defined in the settings (under FormCNC_WPF.UIPanelLeft or UIPanelRight).

In the “UIPanelLeft” area predefined elements are displayed. These are the “Axis View” in the upper area and the views for “Automatic”, ”Manual”, and “MDI” in the lower area.

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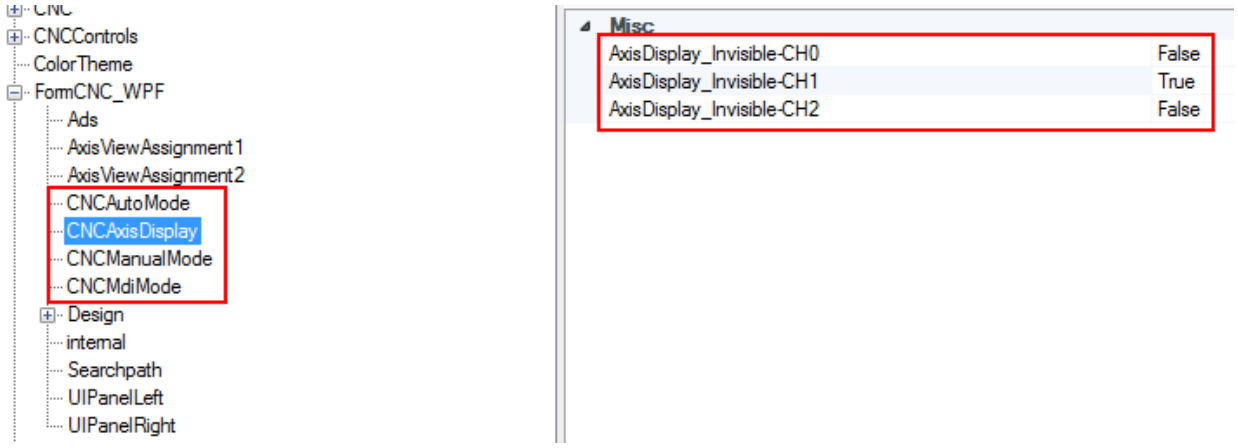
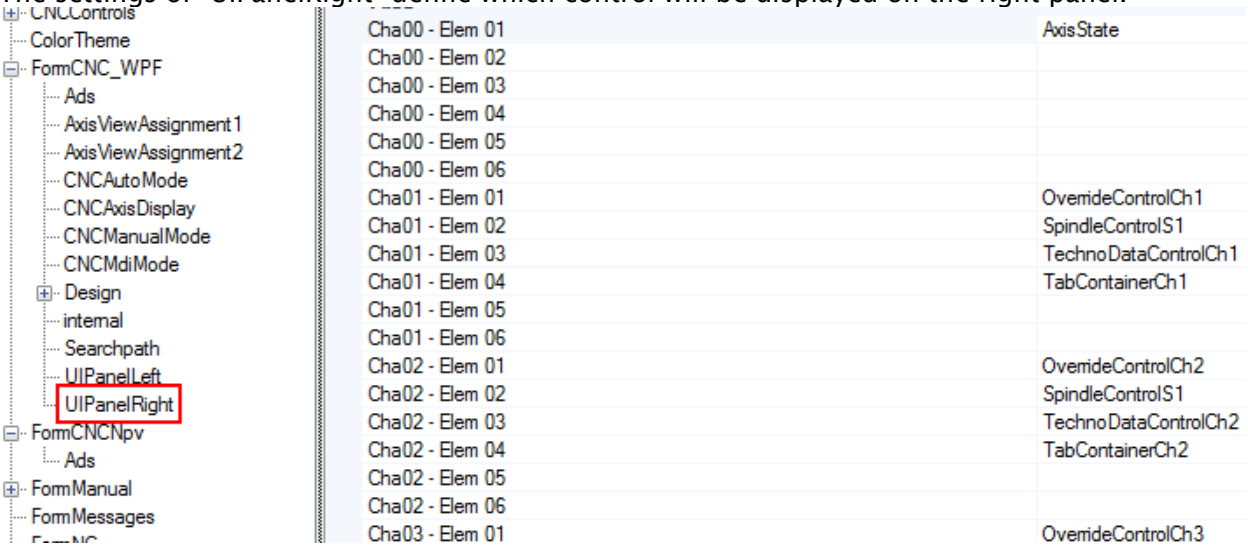


In the "CNCAutoMode", "CNCAxisDisplay", "CNCManualMode" and "CNCMdiMode" settings, it is possible to specify for each channel whether the display of the corresponding control is to be visable.
In the example above the AxisDisplay for Channel 1 is invisible.
This may be used to replace the default controls with self-defined user specific controls, which could be done in the settings for “UIPanelLeft”.

The settings of “UIPanelRight” define which control will be displayed on the right panel.



There is a maximum of 6 UI elements which can be defined for each channel (up to 12 channels), that are to be displayed in the area.
Channel 0 corresponds to the "all axes" view in which no channel is defined.
Different elements can be displayed in each channel!

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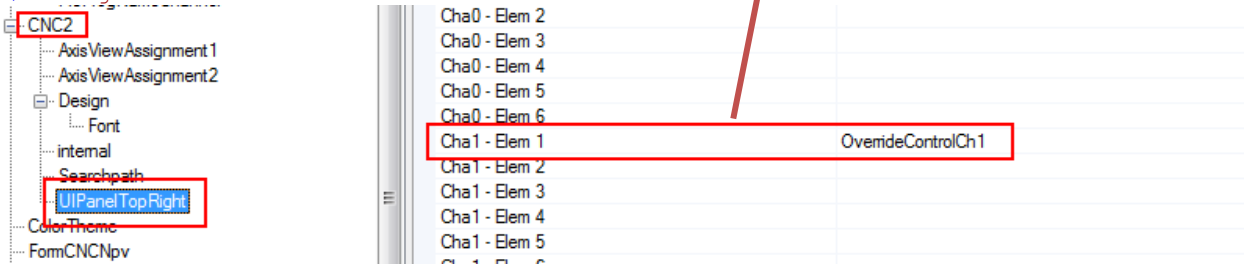
The definition is made via a string, which is then used to create the control via Unity. The definition points to a name in the Unity configuration located in “Systen\IocConfig”.
Example Unity configuration file „CNCOverride.config.xml“:

```
<?xml version="1.0"?>
<configuration>
  <configSections>
    <section name="unity" type="Microsoft.Practices.Unity.Configuration.Unity
ConfigurationSection, Microsoft.Practices.Unity.Configuration" />
  </configSections>

<unity>
 <alias alias="string" type="System.String, mscorlib" />
 <alias alias="Object" type="System.Object, mscorlib" />
<alias alias="singleton" type="Microsoft.Practices.Unity.ContainerControlledL
ifetimeManager, Microsoft.Practices.Unity" />
        <alias alias="external" type="Microsoft.Practices.Unity.ExternallyCon
trolledLifetimeManager, Microsoft.Practices.Unity" />
<container>
<register type="Object" mapTo="Beckhoff.App.CNC_WPF.WPFOverride.WPFOverrideCn
c, Beckhoff.App.CNC-WPF" name="OverrideControlCh1">
        <property name="DataContext" >
                <dependency type="Object" name="OverrideVmCh1" />
        </property>
</register>

<register type="Object" mapTo="Beckhoff.App.CNC_WPF.OverrideVM, Beckhoff.App.
CNC-WPF" name="OverrideVmCh1">
      <lifetime type="singleton" />
      <constructor>
        <param name="iocContainer" />
        <param name="channelNo" >
                <value value="1"/>
        </param>
        <param name="instanceName" >
                <value value="OverrideVmCh1"/>
        </param>
       </constructor>
</register>
</container>
</unity>
</configuration>
```



The string "OverrideControlCh1" is used to create the reference to the class WPFOverrideCnc and with the help of Unity the instance is generated at run time.

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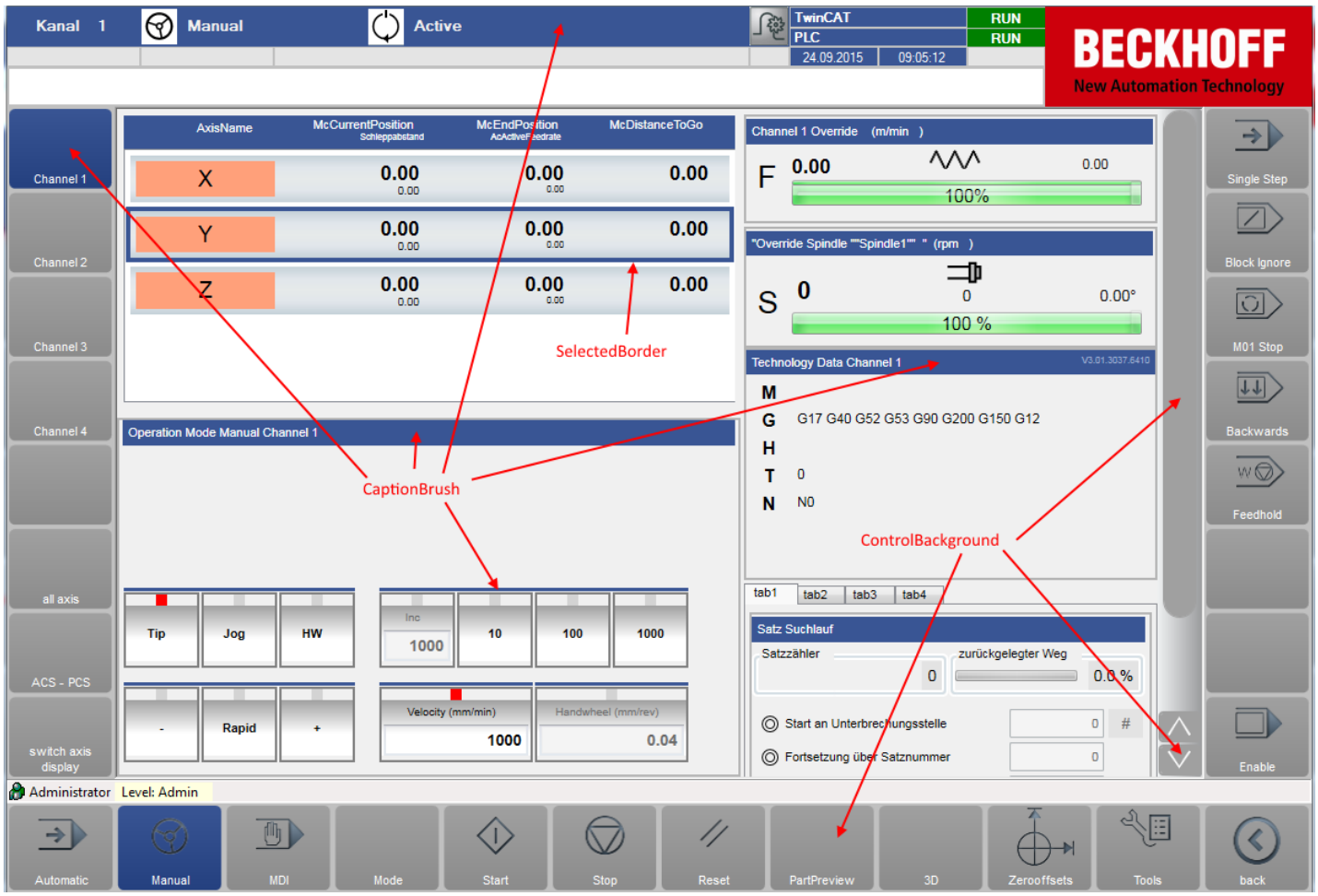
Color Settings

The displayed color can be edited in the resource file “System\GeneralResources.xaml“ in XAML Syntax.

Following elements can be used:

- CaptionBrush
- ControlBackground
- SelectedBorder



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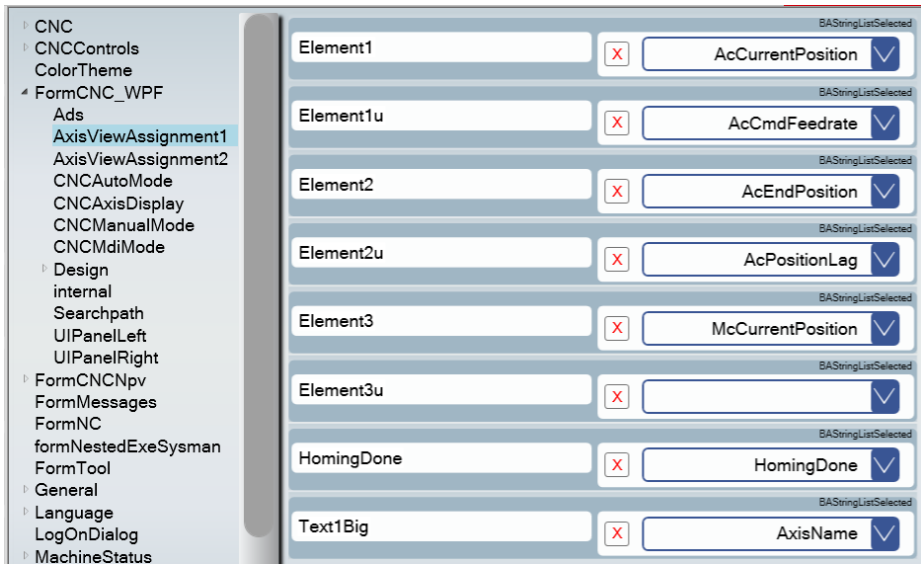
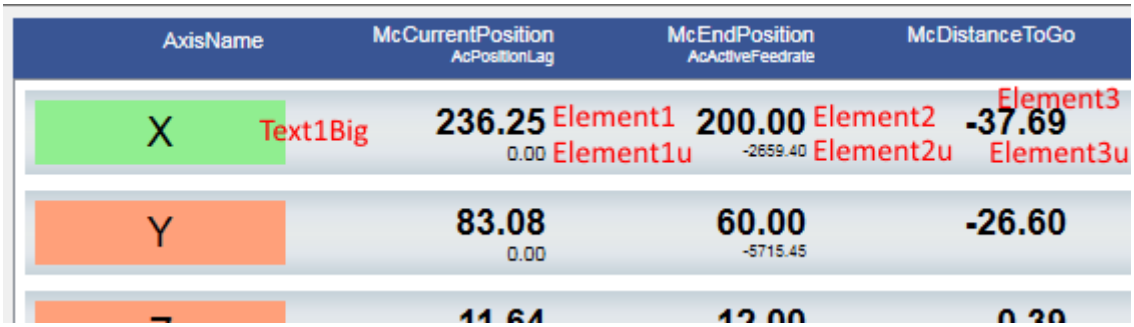
Axis View:





There are two configurations available to set for the axis view. The view can be toggled back and forth by via „callMethod“ in FormCNCWPF (method „ToggleAxisDisplayAssignemt“).

The headings of the columns starting with the element name is entered in the language switching "CNC2.AxisView -" and can then be translated there.
Example: "CNC2.AxisView - McActivePosition"

The method „ToggleMCS_WCS“ (called via callMethod) switches between the axis coordinate system and workpiece coordinate. This will toggle the AxisView assignments of the following:

- McActivePosition <-> AcActivePosition
- McCurrentPosition <-> AcCurrentPosition
- McEndPosition <-> AcEndPosition

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If the representation of the axis list elements is to be adapted to your needs, you can define an XAML DataTemplate with the name "AxisElementTemplate" in the resources file ("System \ GlobalResouces.xaml").
If a DataTemplate definition is found, this replaces the default representation.

Standard data template for axis list elements:

```
<DataTemplate x:Key="AxisElementTemplate">
  <StackPanel Orientation="Horizontal"
              Name="AxisMainList"
              Background="{StaticResource NormalBackgroundBrush}"
              HorizontalAlignment="Stretch"
              Margin="2,2"
              RenderTransformOrigin="0.5,0.5">
        <StackPanel Orientation="Horizontal" Margin="3" Background="{Binding Path=StateColor}">
              <TextBlock Text="{Binding Path=Text1Big}"
                     FontSize="{Binding Path=FontSizeText1Big}"
                     Width="125"
                     TextAlignment="Center"
                     VerticalAlignment="Center"
                     Margin="0"
                     Background="{Binding Path=StateColor}"
                    RenderTransformOrigin="0.5,0.5" />
        </StackPanel>
        <StackPanel Orientation="Vertical" Width="120">
               <TextBlock Text="{Binding Path=Element1}" TextAlignment="Right"
                          FontSize="{Binding Path=FontSizeElement1}"
                          FontWeight="Bold" />
               <TextBlock Text="{Binding Path=Element1u}" TextAlignment="Right"
                          FontSize="{Binding Path=FontSizeElement1u}" />
        </StackPanel>
        <StackPanel Orientation="Vertical" Width="120">
                <TextBlock Text="{Binding Path=Element2}" TextAlignment="Right"
                           FontSize="{Binding Path=FontSizeElement2}" FontWeight="Bold" />
                <TextBlock Text="{Binding Path=Element2u}" TextAlignment="Right"
                           FontSize="{Binding Path=FontSizeElement2u}" />
        </StackPanel>
        <StackPanel Orientation="Vertical" Width="120">
                <TextBlock Text="{Binding Path=Element3}" TextAlignment="Right"
                           FontSize="{Binding Path=FontSizeElement3}" FontWeight="Bold" />
                <TextBlock Text="{Binding Path=Element3u}" TextAlignment="Right"
                           FontSize="{Binding Path=FontSizeElement3u}" />
        </StackPanel>
  </StackPanel>
</DataTemplate>
```

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List of possible elements to be displayed in AxisView:

```
The active axis feedrate mm/min.
double AcActiveFeedrate

Set value (Sollwert) of the physical axis.
double AcActivePosition

The commanded axis feedrate mm/min.
double AcCmdFeedrate

Actual value (Istwert) of the physical axis.
double AcCurrentPosition

Destination value (Zielposition) of the physical axis.
double AcEndPosition

the max feedrate of the axis in mm/min
public double AcMaxFeedrate

Lag distance of the axis (Schleppabstand).
double AcPositionLag

Active feedrate of the spindle (Soll) °/min.
double AcSpindleActiveFeedrate

Current feedrate of the spindle (Ist). °/min.
public double AcSpindleCurrentFeedrate

The axis id.
public uint AxisId

Programmable axis name.
string AxisName

Real axis name.
string AxisNameReal

The axis nr in system manager order
int AxisNo

The axis state.
string AxisState


The type of the axis/0x01=linear/0x02=rotat./0x04=spindle.
int AxisType
```

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```
        Drive type of axis
        1 konevntioneller Antrieb (+-10V), nicht verwendet
        2 SERCOS
        3 Profidrive
        4 Antriebsimulation
        5 Lightbus
        6 Terminalachse (+.10V) über Bus
        7 Echtzeit Ethernet
        8 CANopen Antrieb
        16 Virtueller Antrieb
        32 CAN-Antrieb (Option)
        int DriveType

        The unit of the axis. (Only available at NCI)
        string AxisUnit


        The channel number within the axis is placed.
        int ChannelNr

        Gets or sets the error no.
        uint ErrorNo

        Shoes axis homing done.
        bool HomingDone

        The axis nr from the look of the channel. (logical axis id)
        int LogConfAxisNo


        Set value (Sollwert) within the programmable (machine) coordinate system.
        double McActivePosition

        Actual value (Istwert) within the programmable (machine) coordinate system.
        double McCurrentPosition


      Distance to go(Restfahrweg) within the programmable(machine) coordinate system
      double McDistanceToGo

      Destination value (Zielposition) within the programmable (machine) coordinate s
ystem.
        double McEndPosition

        The op mode.
        BAAdsNc.Opmodes OpMode

        Gets or sets the state code.
        uint StateCode
```

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If the active position of an axis equals a software limit, a bar in beside the axis name shows this. The negative limit shows a bar on the left side and the positive limit shows a bar on the right side.
Example: (X is located on the negative software limit position and Y on the positive limit position):

AxisName	ActivePosition (PCS) ActivePosition (PCS)	EndPosition (PCS) ActiveFeedrate	ActivePosition (ACS) ActivePosition (ACS)
X mm	**-150.00** -150.00	**-150.00** 0.00	**-150.00** -150.00
Y mm	**1900.00** 1900.00	**1900.00** 0.00	**1900.00** 1900.00
Z mm	**2.53** 2.53	**2.53** 0.00	**2.53** 2.53
A °	**19.33** 19.33	**19.33** 0.00	**19.33** 19.33
Y2 mm	**0.00** 0.00	**0.00** 0.00	**0.00** 0.00

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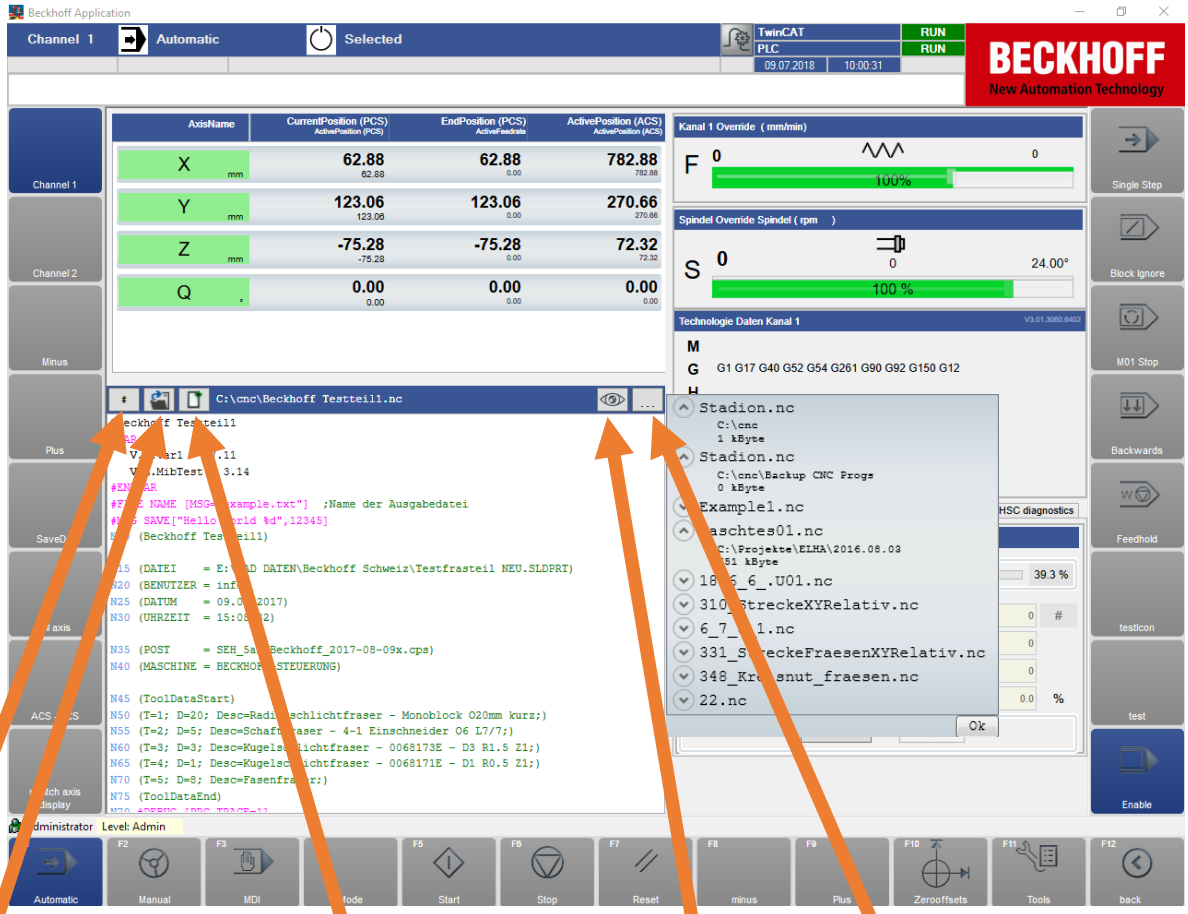
Automatic Mode



Select nc program

Create new nc program

Select from last 10 used programs

Edit nc program

If there is an image file named like the NC program and has a suffix .png, .jpg or .bmp instead of the ending .nc, this graphic will be displayed with the button

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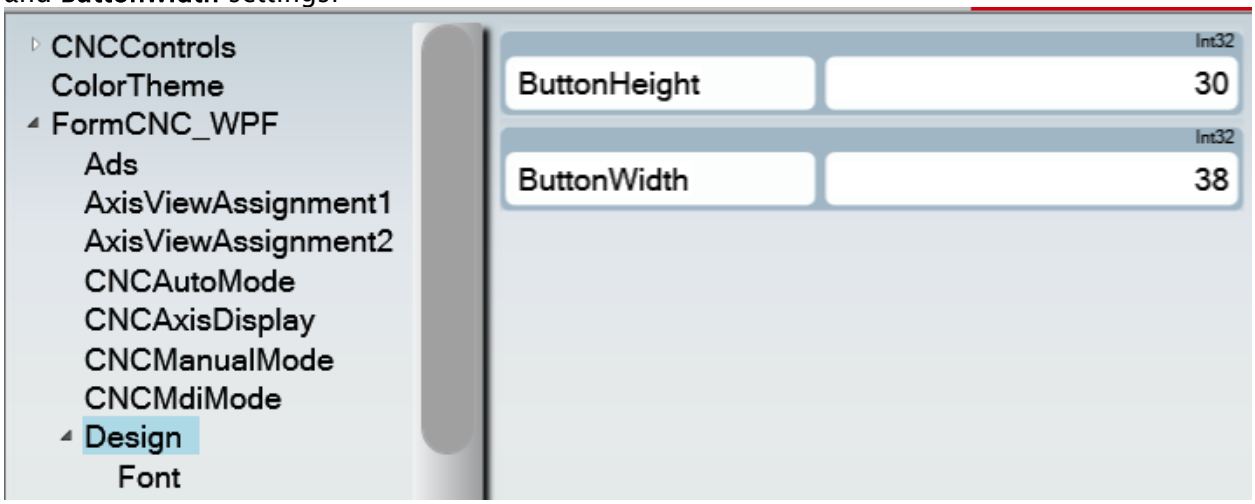
The size of the buttons can be changed in the settings under "Design" using the **ButtonHeight** and **ButtonWidth** settings:



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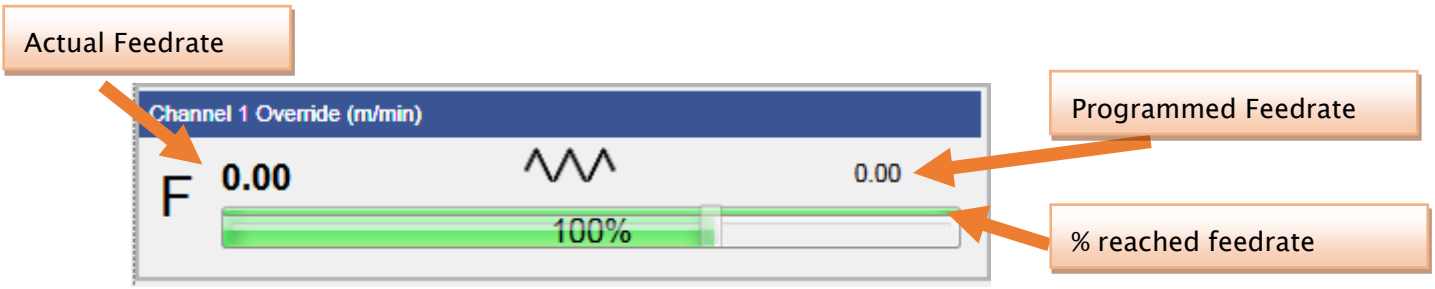
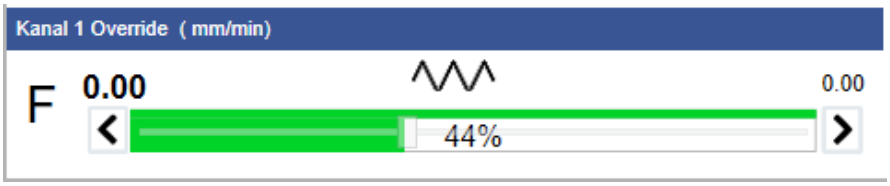
CNC – Controls

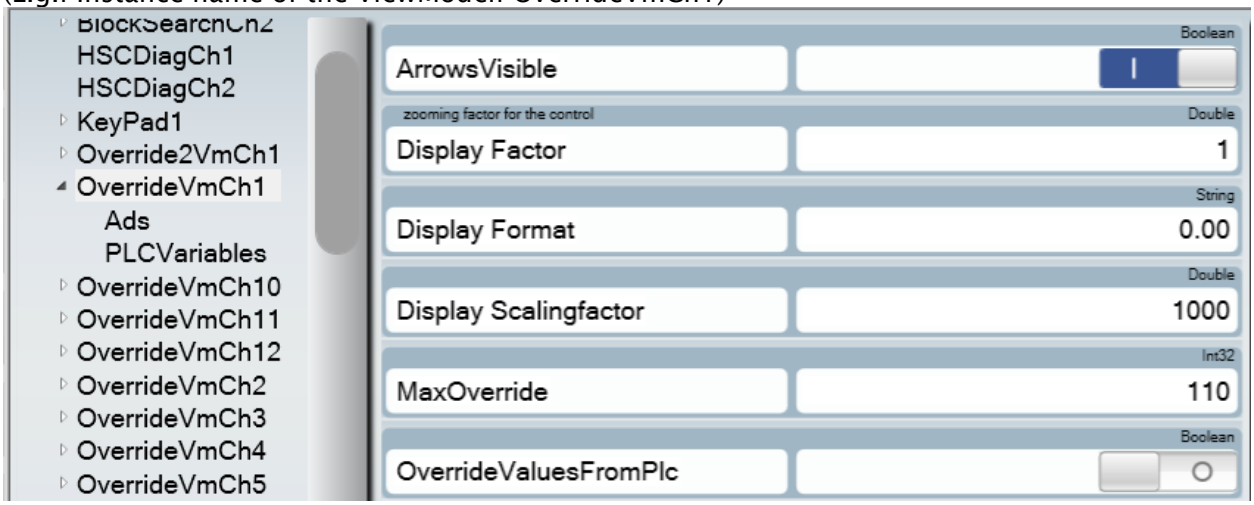
Channel Feed (Beckhoff.App.CNC_WPF.WPFOverride.WPFOverrideCnc)



The values displayed come directly from the CNC via ADS.
Use the mouse to change the override value. This change is transmitted to a PLC variable that is defined in the settings.
"RightClick" on the override slider sets it to 100%.
The setting „ArrowsVisible" allows to enable arrows for each control. If the arrows are visible, a click leads to change of 1% and a click besides the actual value leads to a change of 10%:



The override control settings are made in the „Settings".
There is a separate settings for each instance.
(E.g.: Instance name of the ViewModel: OverrideVmCh1)



Meaning of the Parameters:

- ArrowsVisible: arrows on the left and right allow to change in 1% steps

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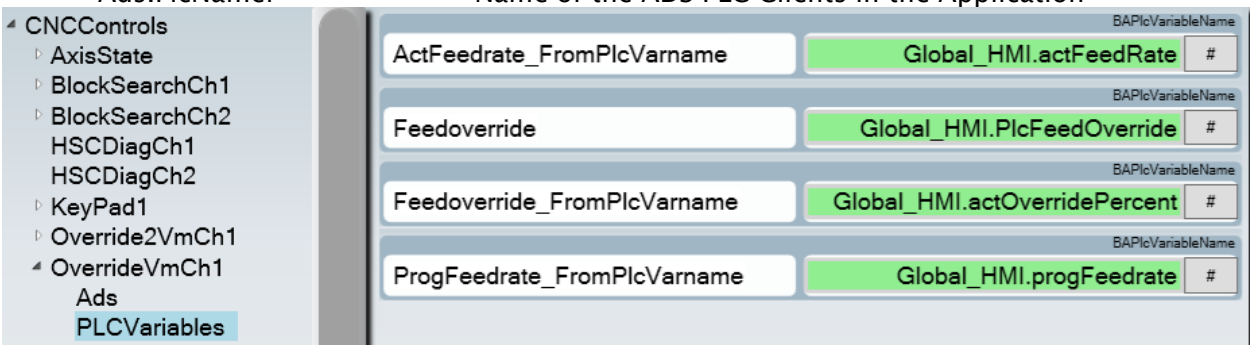
- MaxOverride: maximum override in %
- DisplayFormat: format of the displayed value
- Display Scalingfactor scaling factor for the display (for example to calculate mm to inch)
- Display Factor: Zooming factor for the display of the element.
- OverrideValuesFromPlc: TRUE: The actual value of the override comes from the PLC
- Ads.CNCName: Name of the ADS CNC Client in the Application
- Ads.PlcName: Name of the ADS PLC Clients in the Application



- ActFeedrate_FromPlcVarname:
  PLC variable from which the current feedrate is read,
  if "OverideValuesFromPlc" is set to "True".
- Feedoverride: PLC variable to which the override value is transferred
- Feedoverride_FromPLcVarname:
- PLC variable from which the current override in percent is read,
  if "OverideValuesFromPlc" is set to "True".
- ProgFeedrate_FromPlcVarname:
  PLC variable from which the programmed feedrate is read,
  if "OverideValuesFromPlc" is set to "True".

Example of writing the "Feedrate" LREAL variables with data from the first CNC channel from the PLC using the HLI interface:

```
progFeedRate := DINT_TO_LREAL(gpCh[0]^.bahn_state.command_feed_r) * 60.0 / 1000.0 / 1000.0;

actFeedRate := DINT_TO_LREAL(gpCh[0]^.bahn_state.active_feed_r) * 60.0 / 1000.0 / 1000.0;
```

The configuration of the control (Channel Number, Instance Name) is an XML file that contains Unity (http://msdn.microsoft.com/en-us/library/hh917317.aspx) configuration.
File name: „System\IoCConfig\CNCOverride.config.xml".

The entries of the translatable texts can be found in the language database under "CncControls." Instance name "…" (Ex: CNCControls.OverrideVmCh1…).

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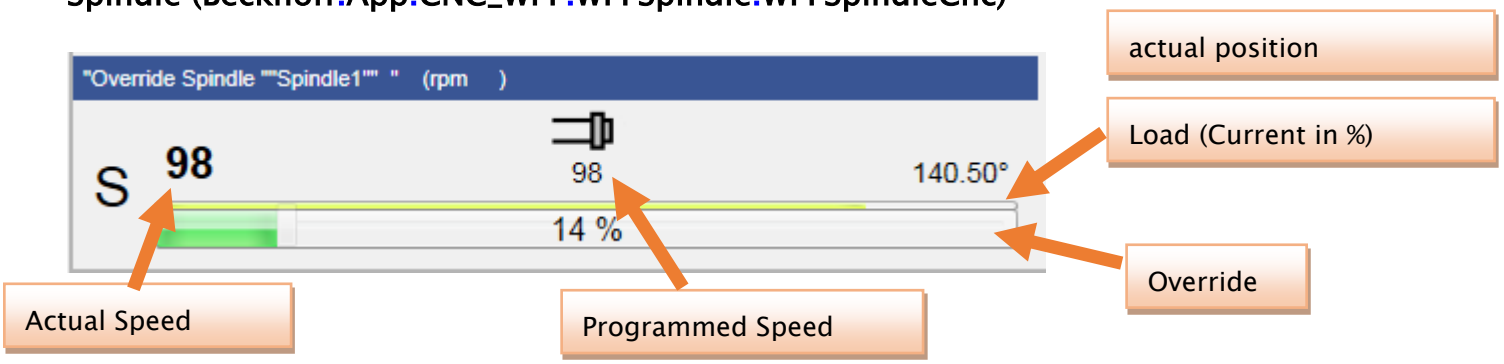
Spindle (Beckhoff.App.CNC_WPF.WPFSpindle.WPFSpindleCnc)



The display speed and position values are read directly from the CNC via ADS. The current position is no longer displayed at a speed > 100 RPM. The value of the override is written to the PLC (using the mouse to change) and also read from this PLC variables. This PLC variable is defined in the settings.

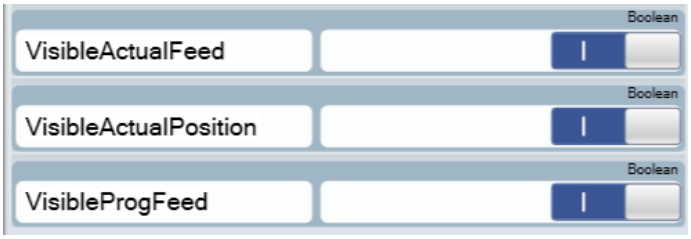
“RightClick” on the override slider sets it to 100%.

The settings for the Spindle Control are made under the "CNCControls" section and correspond to the settings for the Channel Feed (override).

As with the Channel Feed, the control is configured via a Unity configuration file in the "System\IoCConfig" folder.
File name: CNCSpindle.config.xml.

The bar display for the spindle load is only visible if a corresponding LREAL PLC variable exists whose name is entered in the settings. The contents of this variable should reflect the current spindle load in the range 0% to 100%. (CNCControls.Spindel ... PlcVariables.SpindleLoad).
The entries for the colors of the bars are in the area CNCContols.Spindel ...
This is where the green bar (<= SpindleLoadColorGreen) or yellow (<= SpindleLoadColorYellow) or Red (> SpindleLoadColorYellow) is displayed.

The visibility of „actual speed (VisibleActualFeed)“, „programmed speed (VisibleProgFeed)“ and „actual position (VisibleActualPosition)“ can be parametrized in settings:



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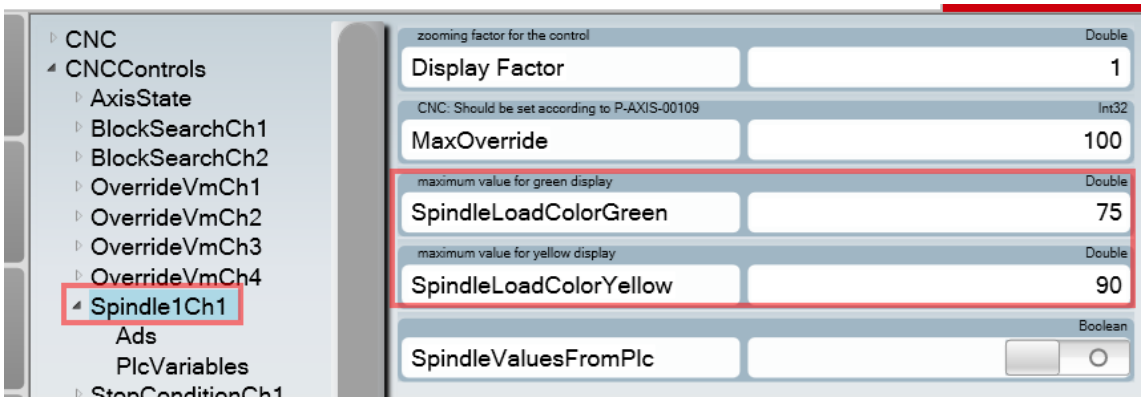
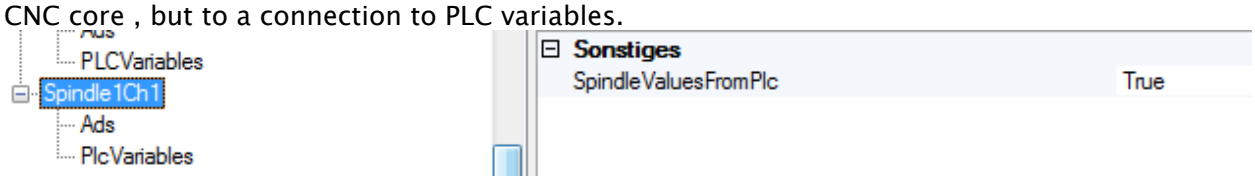
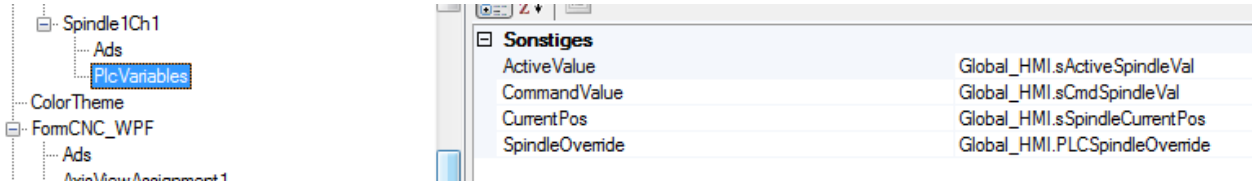


The setting “SpindleValuesFromPlc” causes the displayed values not to be sent directly from the CNC core , but to a connection to PLC variables.



The variable names can be set in the "PlcVariables" area:



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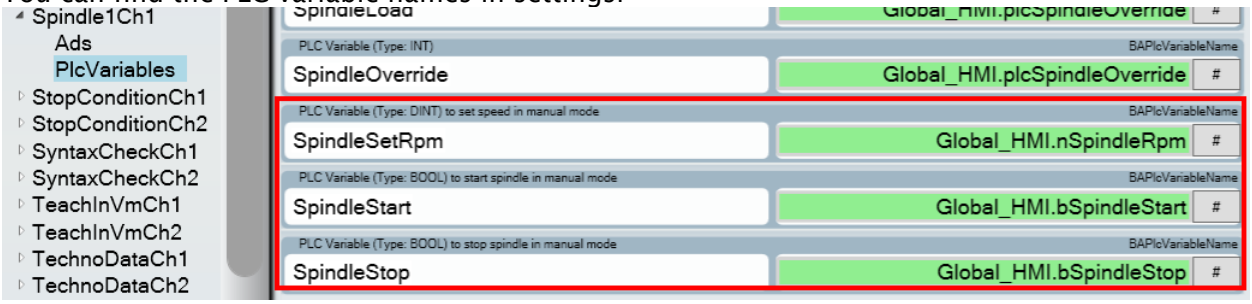
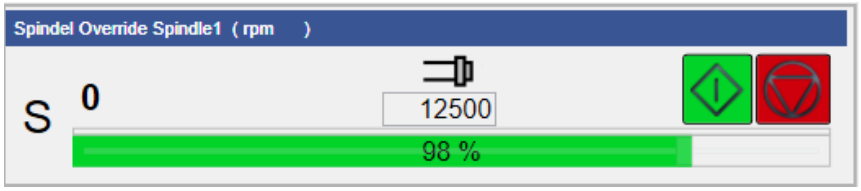
ManualMode for Spindle

The spindle can be controlled in manual mode, if the variables for „SpindleRpm", "SpindleStart" and "SpindleStop" exists in PLC.
It is possible to insert the velocity (rpm) and command a start or stop with the correspinding buttons.
The PLC may use this information to command a spindle.

You can find the PLC variable names in settings:



In manualmode the CNC control for Spindle looks like this:



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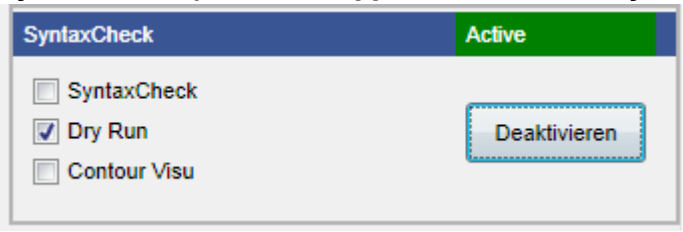
Technology Data (Beckhoff.App.CNC_WPF.WPFTechnoData.WPFTechnoDataCnc)

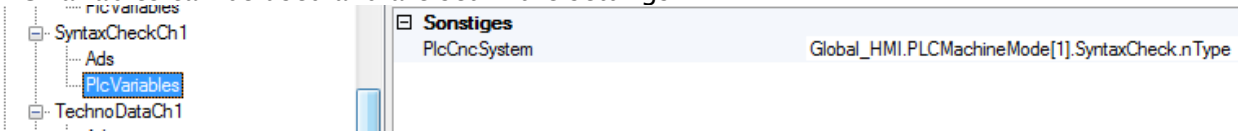
This control shows current technology data and other important information. The fields “Kin.Trafo” and “Cart.Trafo” are only visible if the corresponding transformation is active. The last message programmed in the CNC program is displayed in the “Message” area.

This control is configured via a Unity configuration file in the "System\IoCConfig" folder.
File name: CNCTechnoData.config.xml.

SyntaxCheck (Beckhoff.App.CNC_WPF.WPFSyntaxCheck)



With this control different simulation modes of the CNC core can be activated. With the press of the button the selected operating mode is activated/deactivated.
This control is configured via a Unity configuration file in the "System\IoCConfig" folder.
File name: CNCSyntaxCheck.config.xml.
PLC variables can be used and are set in the settings:



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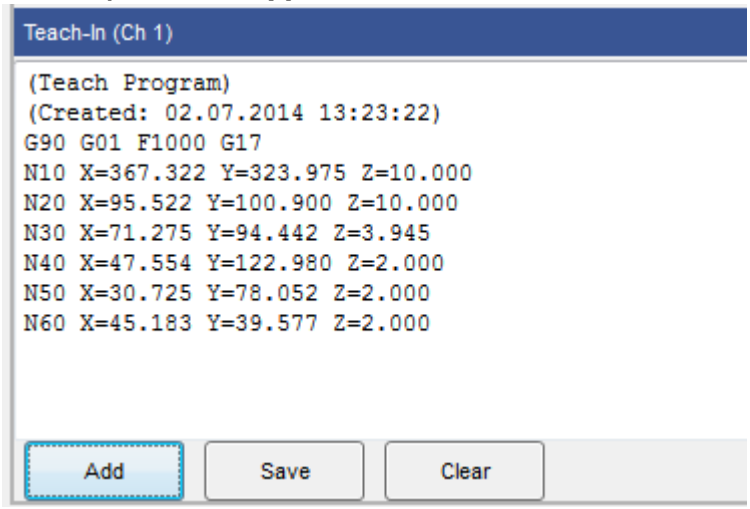
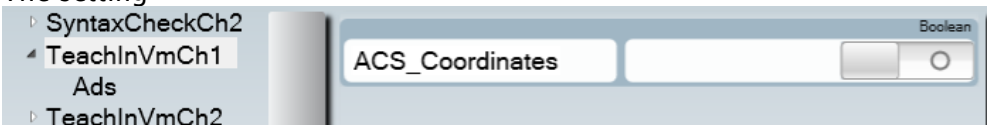
TechIn (Beckhoff.App.CNC_WPF.WPF_TechIn.WPFTeachInCnc)



With this control a simple "TeachIn" procedure was implemented. Each time the "Add" button is pressed, the current positions of all axes configured in the channel are entered into the program. The subroutine generated in this way can be saved with the "Save" button. "Clear" deletes all data from the display area.

This control is configured via a Unity configuration file in the "System\IoCConfig" folder.
File name: CNCTeachIn.config.xml
The channel number of the instance name of the control is set in this file.
The setting



defines , if ACS ccordinates ord PCS coordinates are used.
If „ACSCoordinates“ is turned to off, the actual information regarding G53-G59 and #TRAFO are written to the generated line.

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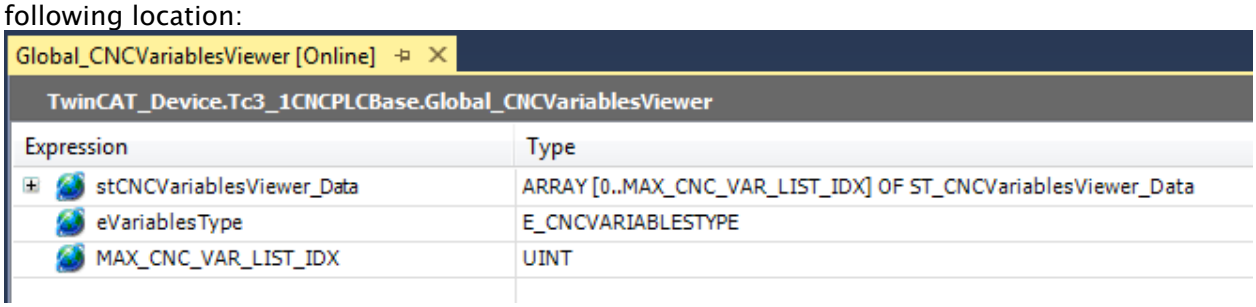
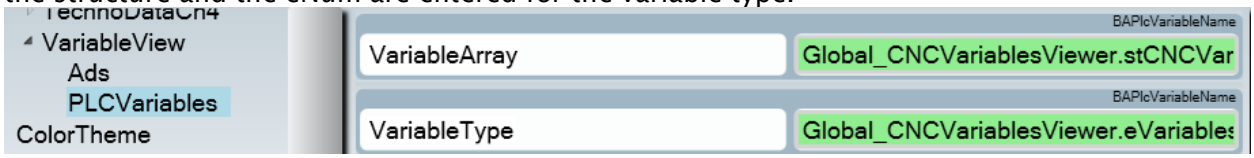
Variable View (Beckhoff.App.CNC_WPF.WPFVariableView)

With this control internal variables of the CNC can be displayed.
It requires a PLC structure, which provides the desired information.
This PLC structure is located in the example PLC project as of version 3.1.3025.24 at the following location:



The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File name: CNCVariableView.config.xml
The instance name of the control is set here.
In the settings (settings) of the control (CNCControls.PlcVariables), the PLC variable names of the structure and the eNum are entered for the variable type.



The content of the PLC structure is only updated as long as the control is visible.
As soon as it becomes invisible, it automatically switches the variable "eVariablesType" to "none", so that no further ADS traffic is generated in the PLC.
A mouse click on a corresponding field (none, V.E., P, V.P, V.S., V.L) describes the PLC Enum types and leads to the desired display. The corresponding field is highlighted "green".
If the connection to one of the two PLC variables is not possible, no field is displayed in color.

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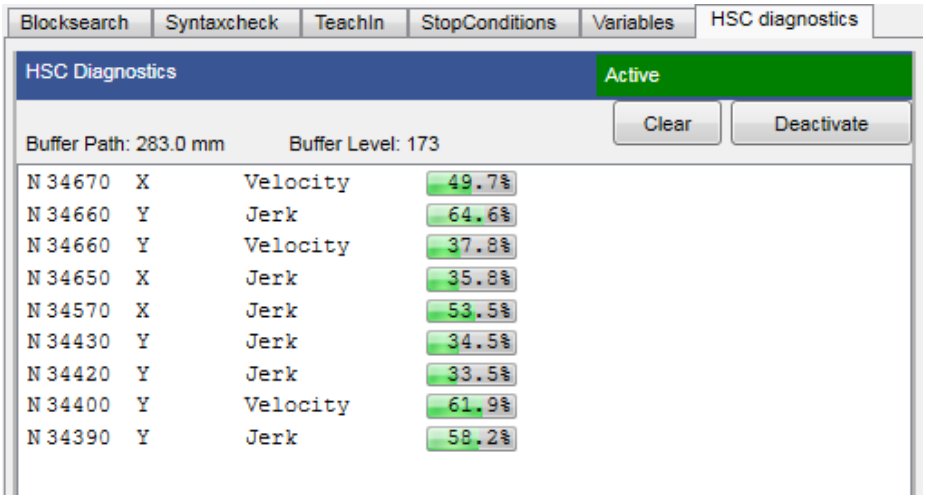
HSC Diagnose (Beckhoff.App.CNC_WPF.WPFHscDiag)



This control displays information about the diagnosis of HSC programs.
The function can be activated and deactivated by pressing the button at the top right.

The information "Buffer Path" and "Buffer Level" are displayed as the current status.

In the lower part, a list with block number (N), axis designation and reason is created during processing, which is why the programmed path speed can not be reached.

Reasons for the lack of the programmed path speed can be axis-specific limitations of the following parameters:

- Velocity (speed)
- Acceleration
- Jerk (jerk)

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The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File name: CNCHscDiag.xml

By default this control is accessed via the TAB container.

In Settings (CNCControls.HSCDiagChx) for every channel a CycleTime is paramterized.
It is used for the connect to the diagnostic data.
A value of 0 delivers extrem fast values and increases the load of the whole system. The standard value is 50ms.

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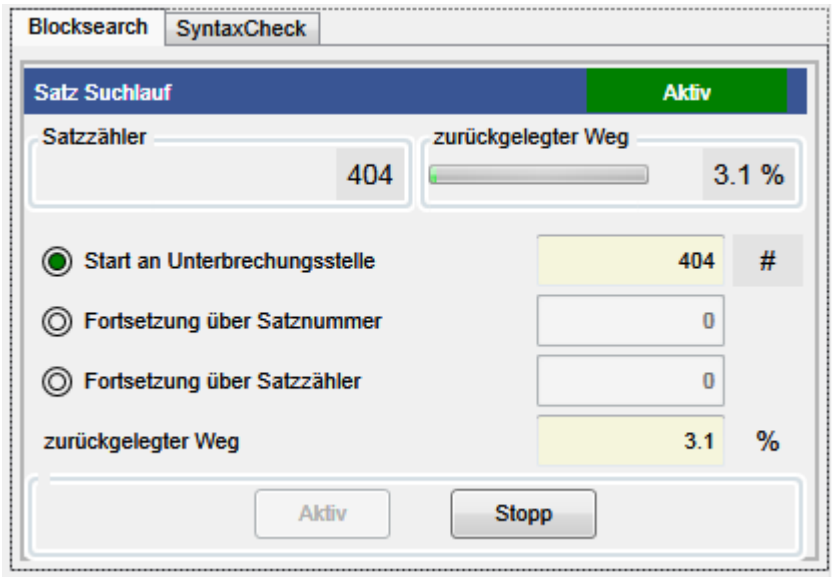
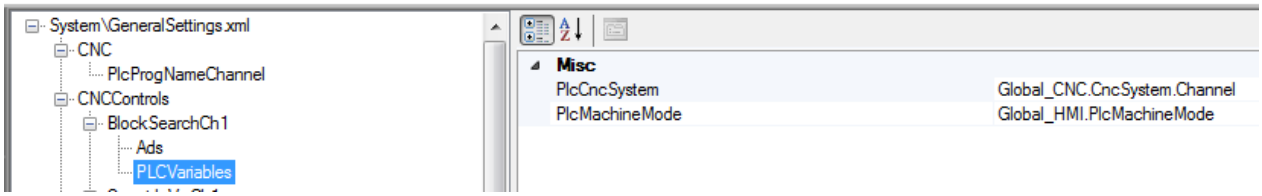
Blocksearch(Beckhoff.App.CNC_WPF.WPFBlocksearch)



With this control, the "Blocksearch" functionality can be controlled in the CNC. The different operation modes of the Blocksearch are selected using radio buttons. The desired values can then be entered in the text boxes.
The "active" header activates the "Blocksearch" with the parameters set.

The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File Name: CNCBlockSearch.config.xml
The channel number of the instance name of the control is set here.

The instance name is used in the settings to make changes for each instance: (Example: Instantname "BlockSearchCh1")



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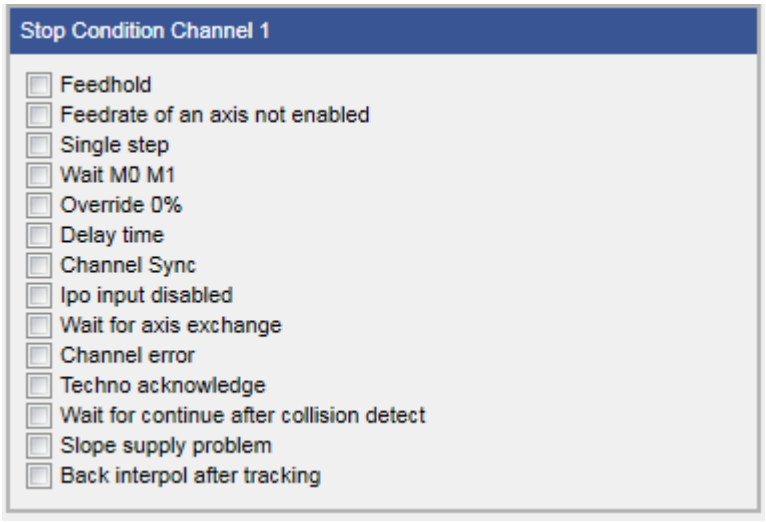
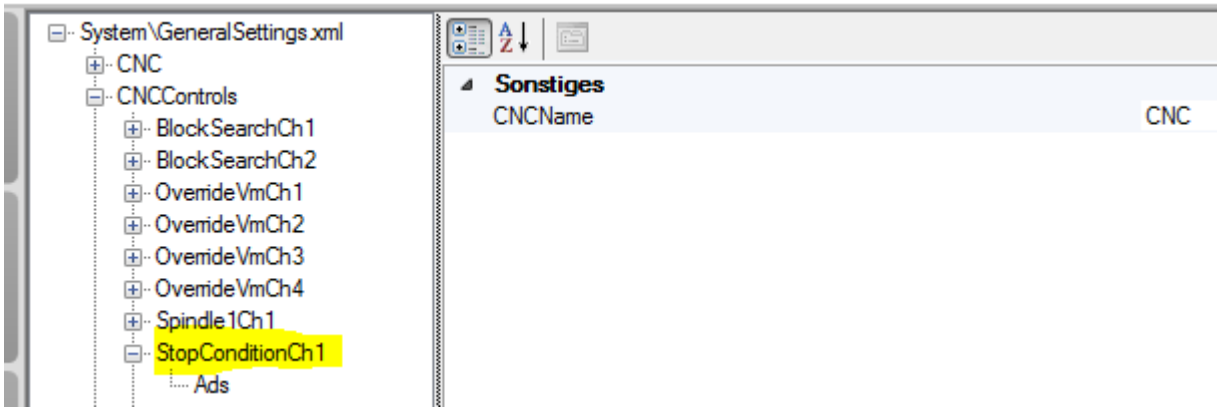
StopConditions (Beckhoff.App.CNC_WPF.WPFStopCondition)



This control shows why a channel stops or why no movement can take place.

The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File Name: CNCStopCondition.xml
The channel number of the instance name of the control is set here.

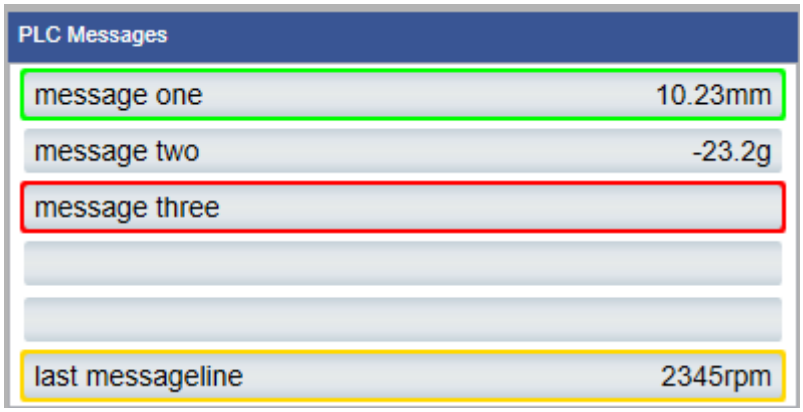
The instance name is used to make settings for each instance: (Example: Instantname "StopConditionCh1")



The texts of the control are to be found and set in the language manager under the entry "CNCStopConditions- .....".

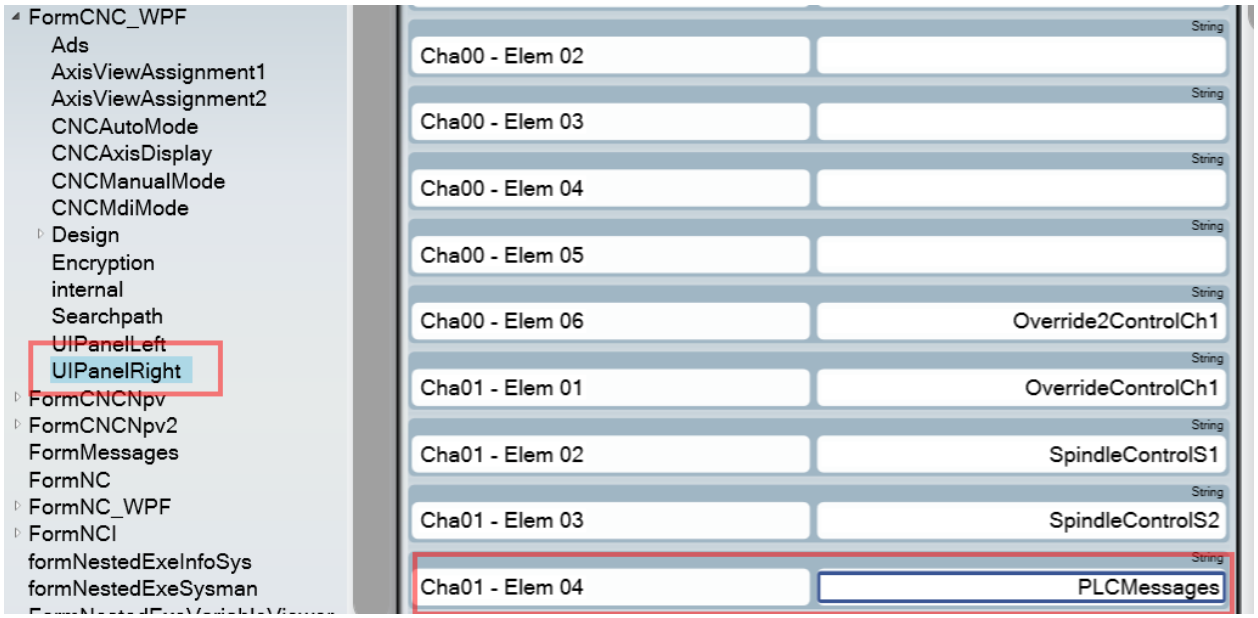
BECKHOFF

PlcMessages (Beckhoff.App.CNC_WPF.WPFPlcMessages)



With the help of this control, messages and values from PLC can be displayed and colored.
The control definition is done with “Unity” and stored in a config file in folder „System\IoCConfig“.
Filename: „CNCPlcMessages.config.xml“.

The control is named „PLCMessages“. This name is used to enable the control on any place in the cnc form:



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An „OnChange“ to an „array of string“ connection is established.
The array index must start at 0. The array dimension is read atomatically from plc when the App is started.

An additinal optional „ array of string“ contains string which are displayed in a second column.

An additional optional „array of UDINT“ contains a color for each row. The color is calculated with the following system:

16#AARRGGBB,

AA = Alpha (full color = FF)
RR = Red
GG = Green
BB = Blue

Example: full Green:
nColor = 16#FF00FF00

PLC Example:

HmiMessages	ARRAY [0..5] OF STRING	
HmiMessages[0]	STRING	'message one'
HmiMessages[1]	STRING	'message two'
HmiMessages[2]	STRING	'message three'
HmiMessages[3]	STRING	''
HmiMessages[4]	STRING	''
HmiMessages[5]	STRING	'last messageline'
HmiMessagesValues	ARRAY [0..5] OF STRING	
HmiMessagesValues[0]	STRING	'10.23mm'
HmiMessagesValues[1]	STRING	'-23.2g'
HmiMessagesValues[2]	STRING	''
HmiMessagesValues[3]	STRING	''
HmiMessagesValues[4]	STRING	''
HmiMessagesValues[5]	STRING	'2345rpm'
HmiMessagesColor	ARRAY [0..5] OF UDINT	
HmiMessagesColor[0]	UDINT	16#FF00FF00
HmiMessagesColor[1]	UDINT	16#00000000
HmiMessagesColor[2]	UDINT	16#FFFF0000
HmiMessagesColor[3]	UDINT	16#00000000
HmiMessagesColor[4]	UDINT	16#00000000
HmiMessagesColor[5]	UDINT	16#FFFFD800

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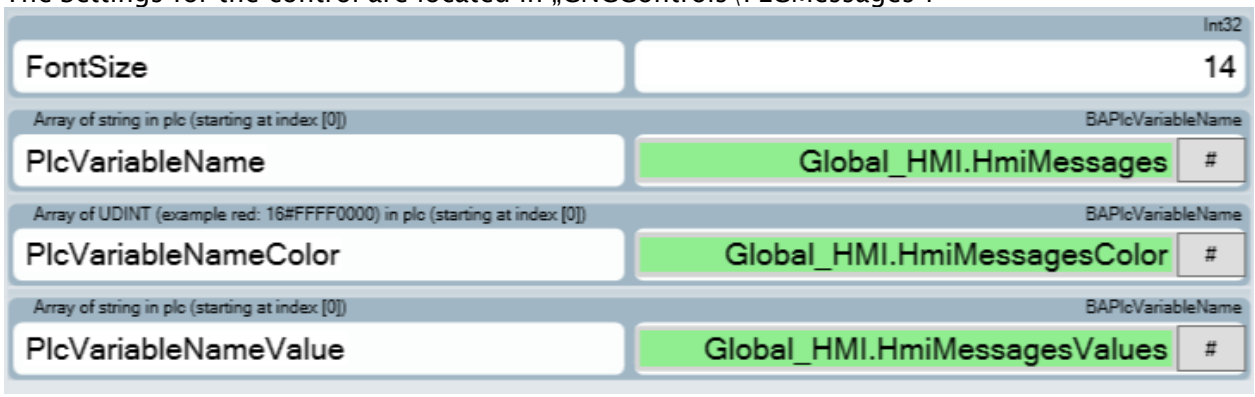
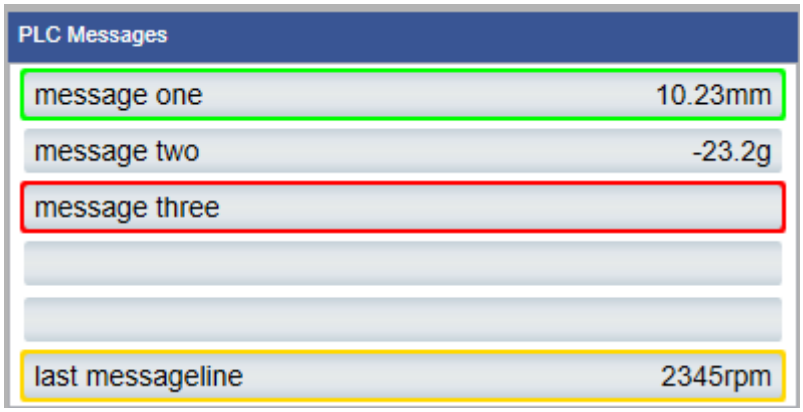
The Settings for the control are located in „CNCControls\PLCMessages“:





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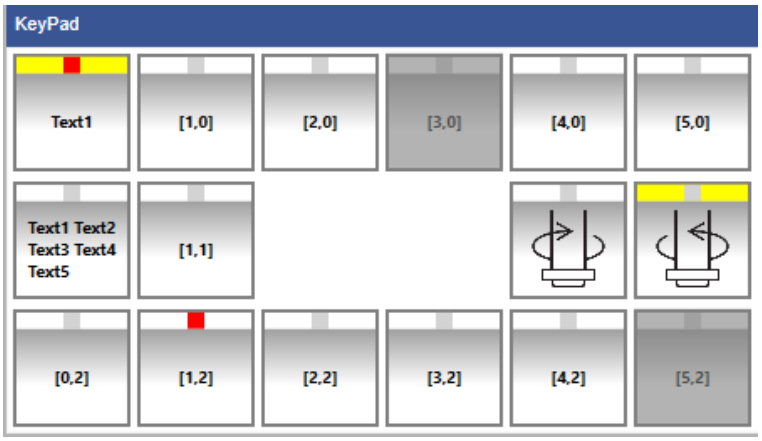
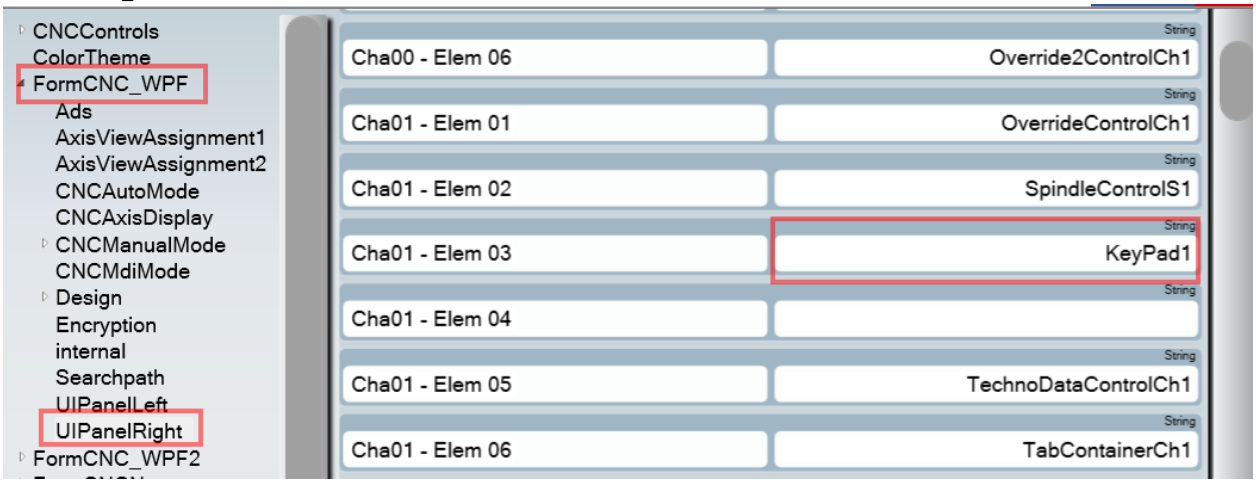
KeyPad (Beckhoff.App.CNC_WPF.WPFKeyPad)



This control shows a keypad, which is connected to the PLC.
The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File Name: „CNCKeyPad.xml“.
In default, configuration a control named “KeyPad1” is defined. It can included in settings of FormWPF_CNC:



It is possible to create multiple instances of the keypad control.

BECKHOFF

The configuration of every instance is found in settings in „CNCControls.instacename“ (default : CNCControls.KeyPad1):

Meaning of configuration entries:

- **Bitmap Directory**: directory for graphic files.
- **Font**: Font type, Font Size and Font style
- **KeyHeight**: Key Height (for all keys)
- **KeyWidth**: Key Width (for all keys)
- **Ads.PLCName:** PLC name to be connected (actually always „PLC“)
- **PlcVariables.RootPlcVariableName:** Symbol name of root element to connect.

PLC Data type

In PLC there is a variable definition, which is connected to the HMI KeyPad:

```
ARRAY[xl..xh,yl..yh] OF ST_HMIKeyPad;
```

The values of xl,xh,yl,yh can be chosen freely (xl <= xh, yl <= yh). The array dimension is read from HMI and the view is automatically generated.

Example:

```
keypad: ARRAY[0..5,0..2] OF ST_HMIKeyPad;
```

The ST_HMIKeyPad structure is defined in TC3_CNC library:

```
TYPE ST_HMIKeyPad :
STRUCT
    q:          BOOL;                   // from HMI -> true -> Key is pressed
    on:         BOOL;                   // to HMI
    on2:        BOOL;                   // to HMI
    hide:       BOOL;                   // to HMI
    disable:    BOOL;                   // to HMI
    color:      UDINT := 16#FFFFFFFF;   // to HMI Color 16#AARRGGBB
    text:       STRING[40];             // to HMI
    pic:        STRING[80];             // to HMI
END_STRUCT
END_TYPE
```

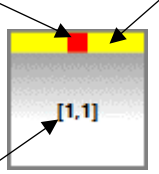
Attention: maximum number of elements is limited to 157.

BECKHOFF

The meaning of the elements:

- q: TRUE on keypress, FALSE on key release.
  If „TRUE“: A blue border is displayed:

- on on2 switches the corresponding areas on/off



- text: text on key (here „[1,1]“)
- pic: graphics filename which is shown on the key. The search directory is configured in settings.

- color: Backcolor of key with follwoing coding: Kodierung:
  16#AARRGGBB, with
  AA = Alpha (pure color = FF)
  RR = Red
  GG = Green
  BB = Blue

- hide: TRUE: hide key
- disable: TRUE: disable key and show it „gray“

All elements are connected „OnChange“ and a change will result in an immediately update of the view.

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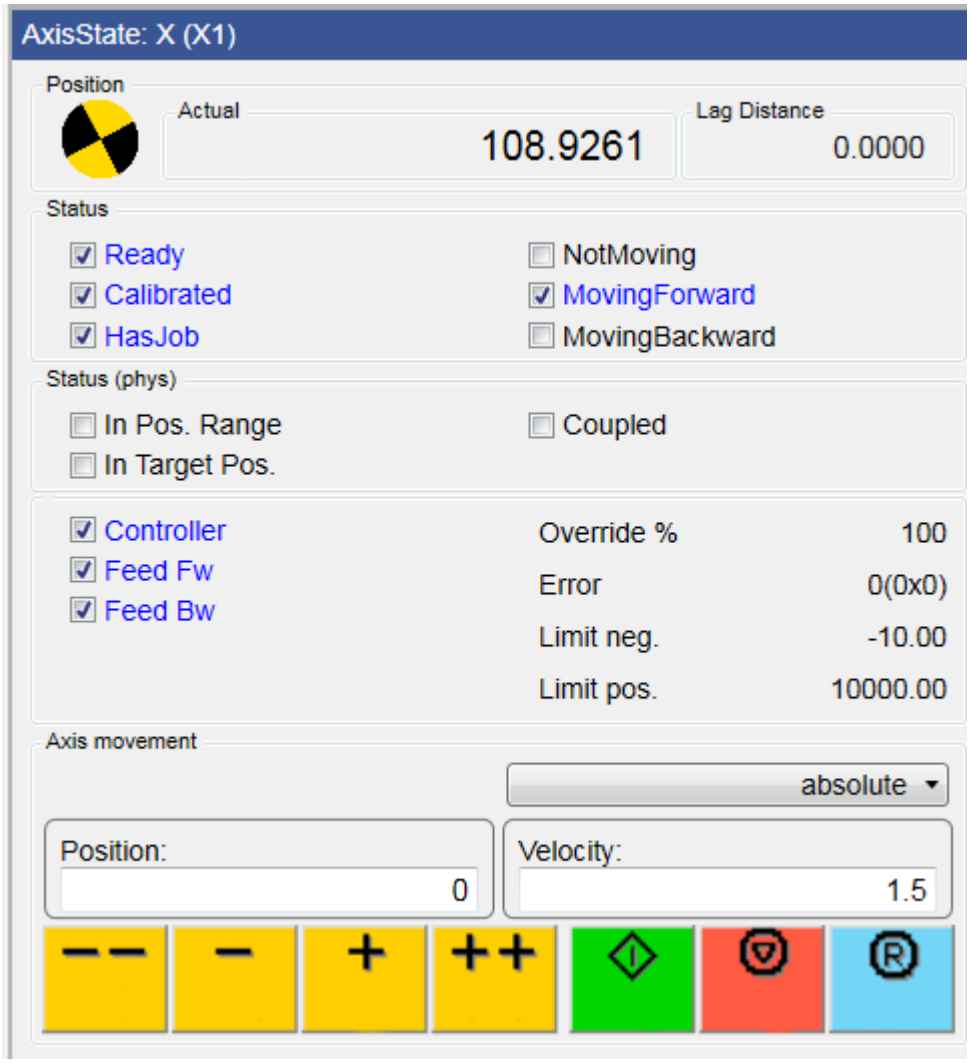
AxistState (optimized for PTP Axes) (Beckhoff.App.CNC_WPF.WPFAxisState)



This control is used to display the status of the axis currently selected in the axis window. In addition, it is possible to move the axis (analogous to the system manager). The motion commands are sent to the axis via ADS and are independent of the currently running PLC.

The control is configured using a Unity configuration file in the folder "System\IoCConfig".
File Name: CNCAxisState.xml

In the settings of the control (eg CNCControls.AxisState) the name of the CNC can be set under ADS. For PTP and NC-I axes, "NC-I" should be entered here.

The texts of the control can be found in the language database under "AxisState-".

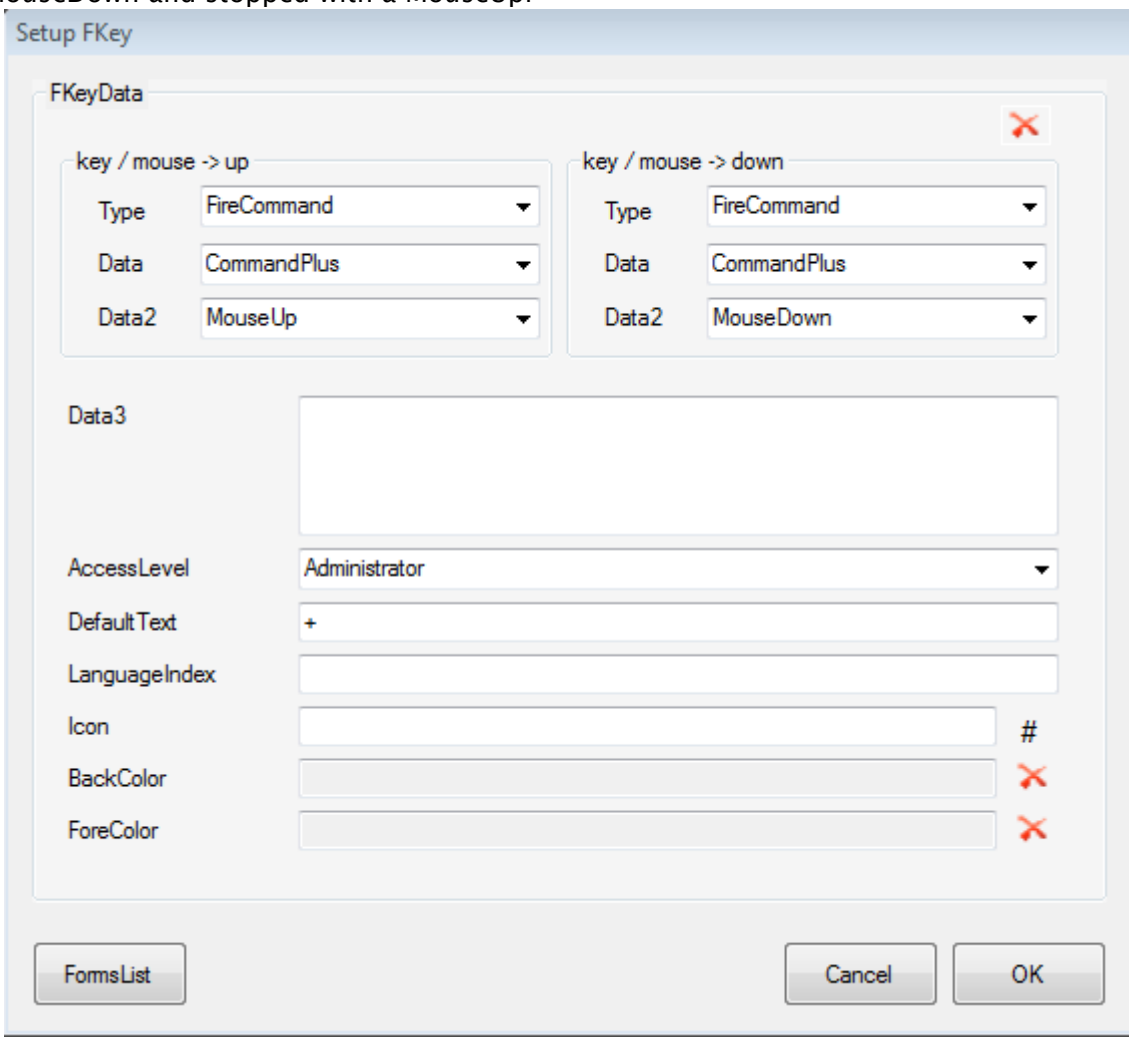
BECKHOFF

In the „AxisState“ control there are the following commands available, which can be operated by the Menu Manager via „FireCommand“:

- `CommandMinusMinus`
- `CommandMinus`
- `CommandPlus`
- `CommandPlusPlus`
- `CommandStart`
- `CommandStop`
- `CommandReset`

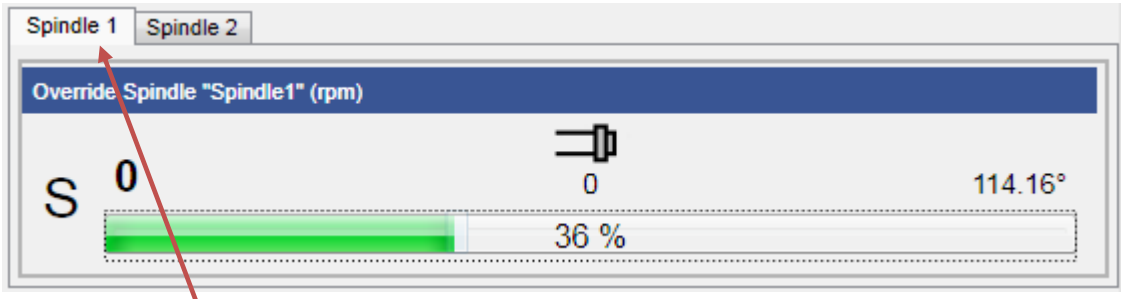
Eache command can be called via the parameter „`MouseDown`“ or „`MouseUp`“ executing the same command either way.

Example configuration in which the currently selected axis is started in the positive direction with a MouseDown and stopped with a MouseUp:



BECKHOFF

TabContainer (Beckhoff.App.CNC_WPF.WPFTabContainer)



The TabContainer can be used to combine various controls in a tab control. In the example, two Spindle controls were combined into a TabContainer. In the settings, the name of the TabContainer is to be displayed at the corresponding location (UIPanelTopRight or UIPanelBottomRight).

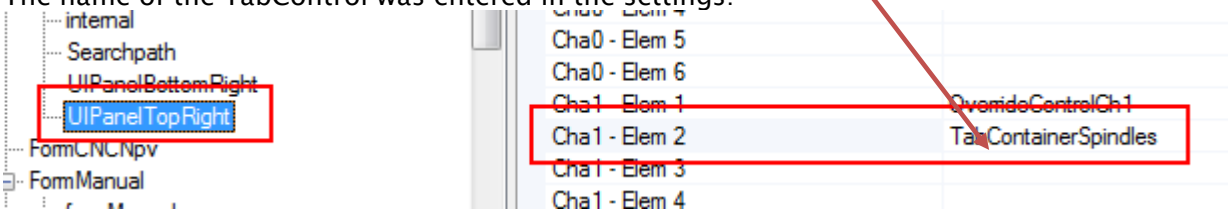
The configuration of the example is as follows:

```
<!-- Tabulator container for spindles-->
<register type="Object" mapTo="Beckhoff.App.CNC WPF.WPFTabContainer, Beckhoff.App.CNC-
WPF" name="TabContainerSpindles">

   <property name="DataContext" >
      <dependency type="Object" name="TabContainerSpindlesVM" />
   </property>
   </register>
      <register type="Object" mapTo="Beckhoff.App.CNC WPF.TabContainerVM, Beckhoff.App.CNC-
WPF" name="TabContainerSpindlesVM">
           <property name="TabText">
                <value value="Spindle"></value>
           </property>
           <property name ="ElementArray">
              <array>
                <dependency name="SpindleControlS1"/>
                <dependency name="SpindleControlS2"/>
              </array>
            </property>
   </register>
```

The entries in the field *name* = "SpindleControlS1" and "SpindleControlS2" generates the two named controls and inserts them into TabControl. Here you have the possibility to enter further names of controls, which can be resolved by Unity.

The name of the TabControl was entered in the settings:



The "TabText" property entry defines the names of the individual tabs. The tabs are automatically supplemented by a sequence number.

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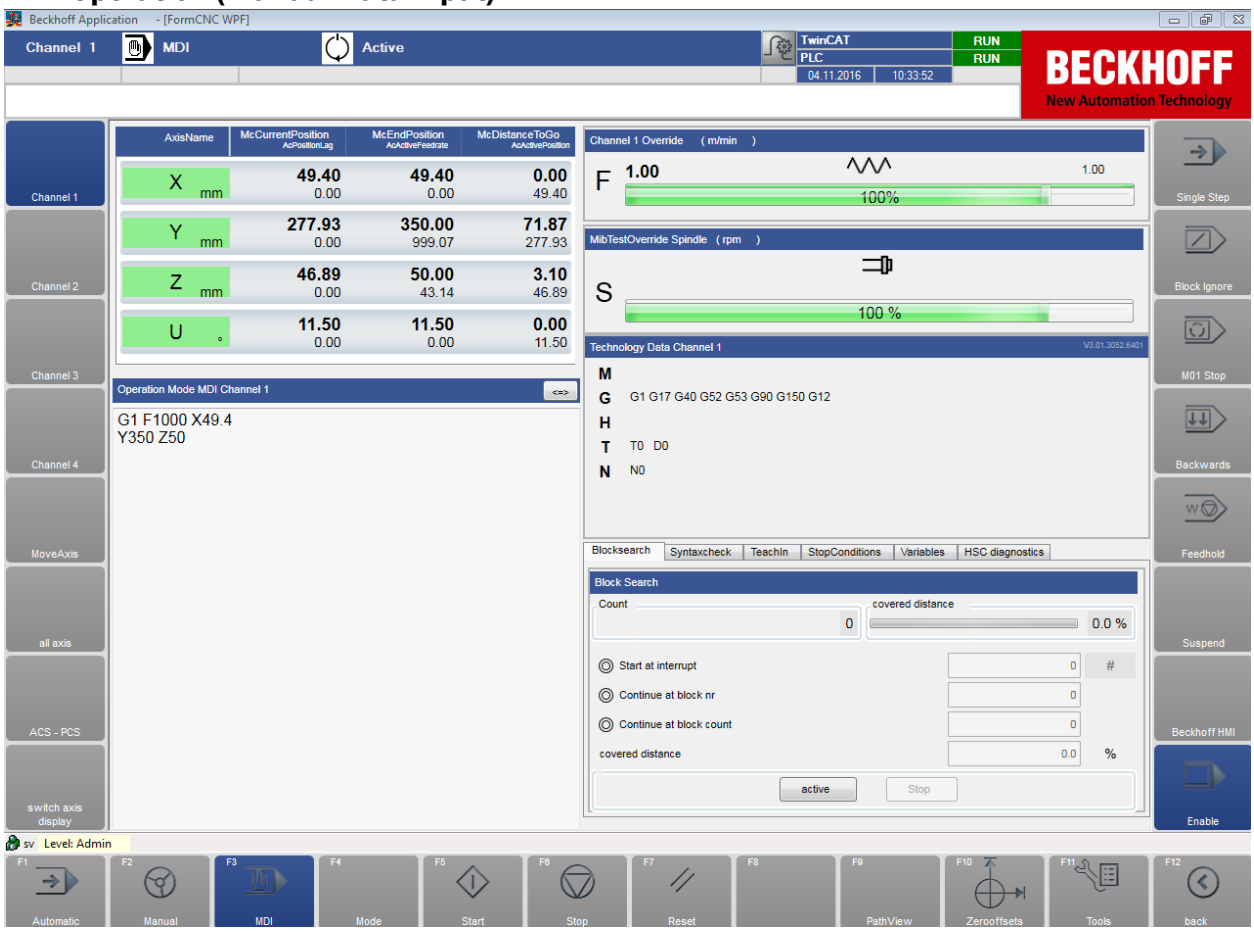
MDI-Operation (Manual Data Input)

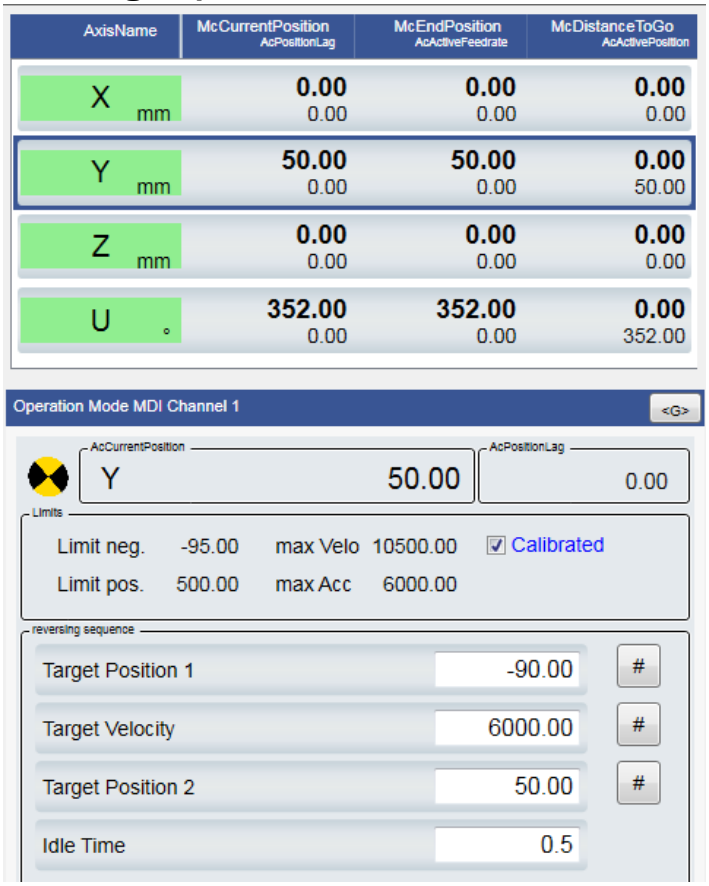


In MDI mode, NC lines can be entered manually, which are then processed via <Start>. In contrast to the Automatic Mode, no program from a file is executed. Instead the entered NC commands are transmitted as a string to the PLC and then directly to the CNC core.
The maximum input length in MDI mode is limited.
Also in contrast to Automation Mode, the current block is not highlighted.
The input area shows the current text which is stored in the PLC in the variable PlcMachineMode[x] .MDIString.

If the selected user level is "Administrator", you can use the button <=> in the upper right corner of the MDI Control to an input mask, which commands a "Reversing Sequence".
This can be used for the optimization and commissioning of axes.

BECKHOFF

Reversing Sequence im MDI



The positions and speed for a reversing sequence can be entered into the input boxes.
The axis selection is done in the upper axis display just like in manual operation.
The buttons next to the input fields have the following function:

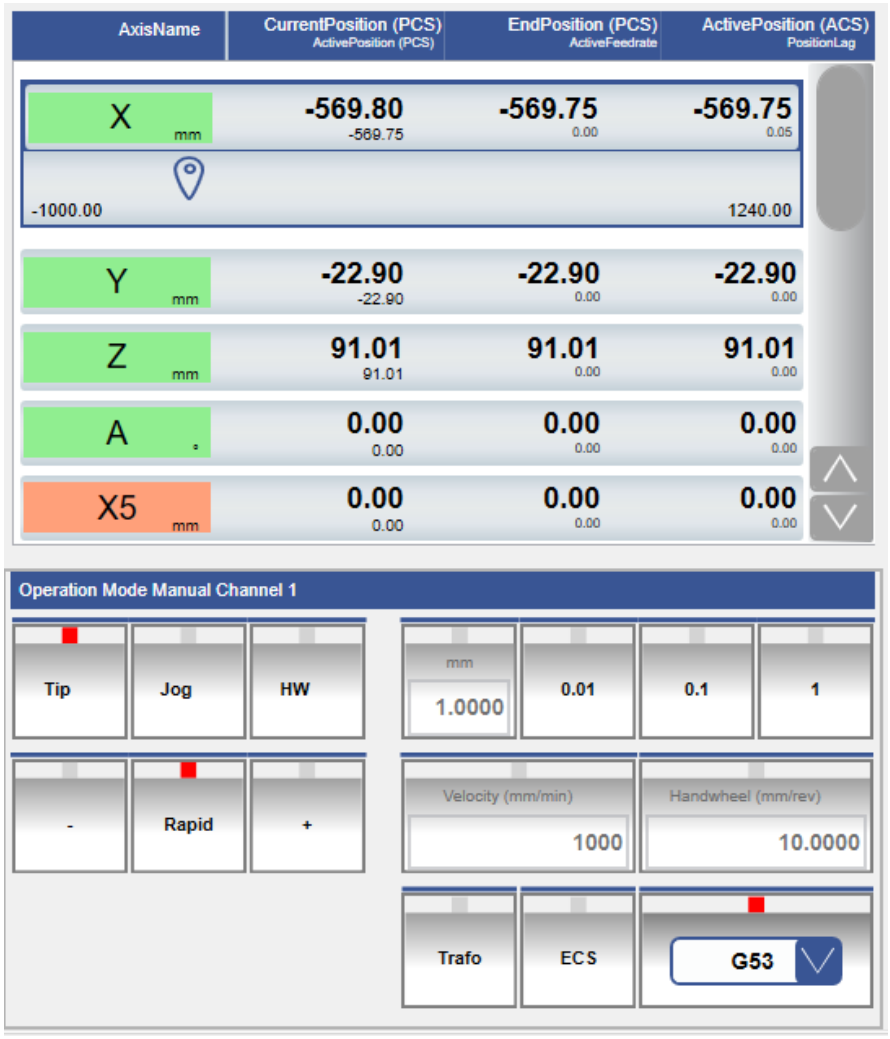
- Target Position 1: The negative software end position +5 mm is assumed as the position
- Target Position 2: The positive software end position -5 mm is assumed as the position
- Target Velocity: The maximum axis speed of the selected axis is set

After entering the desired parameters, the sequence can be operated as usual with the <Start>, <Stop>, <Reset> keys.

The button <G> in the upper right corner switches the control off and returns to the "normal" MDI display.

BECKHOFF

Manual Operations



As soon as the currently selected CNC channel is in “Manual Mode”, a control for operating this mode is displayed.
The software end positions are displayed below the selected axis

The  symbol shows the position within the travel range. This only is active, if the axis is referenced and has active software limits.

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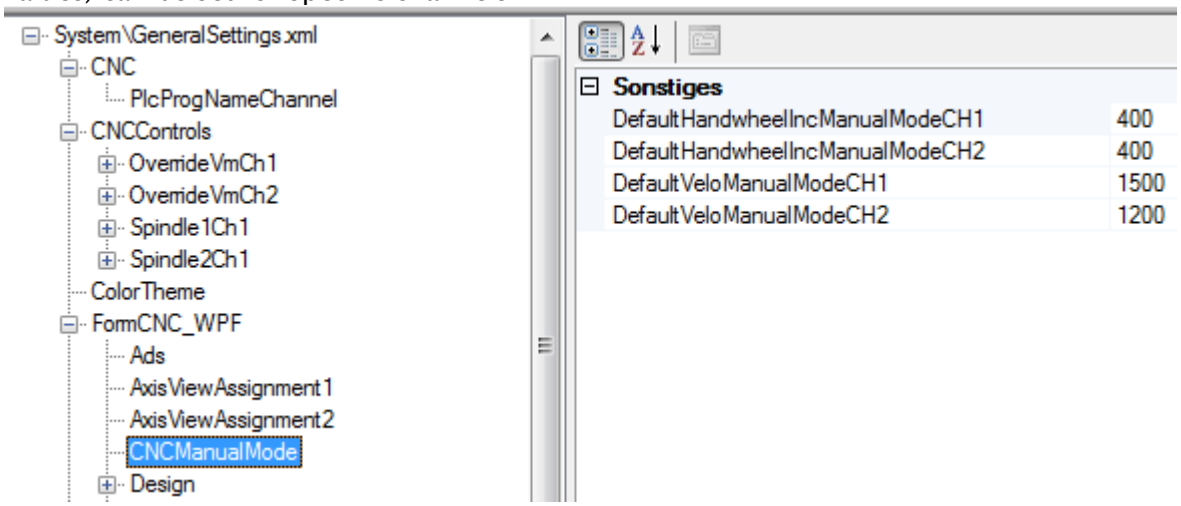
BECKHOFF

In the settings (instance name of FormCNC2\CNCManualMode) some settings (and default values) can be set for specific channels:



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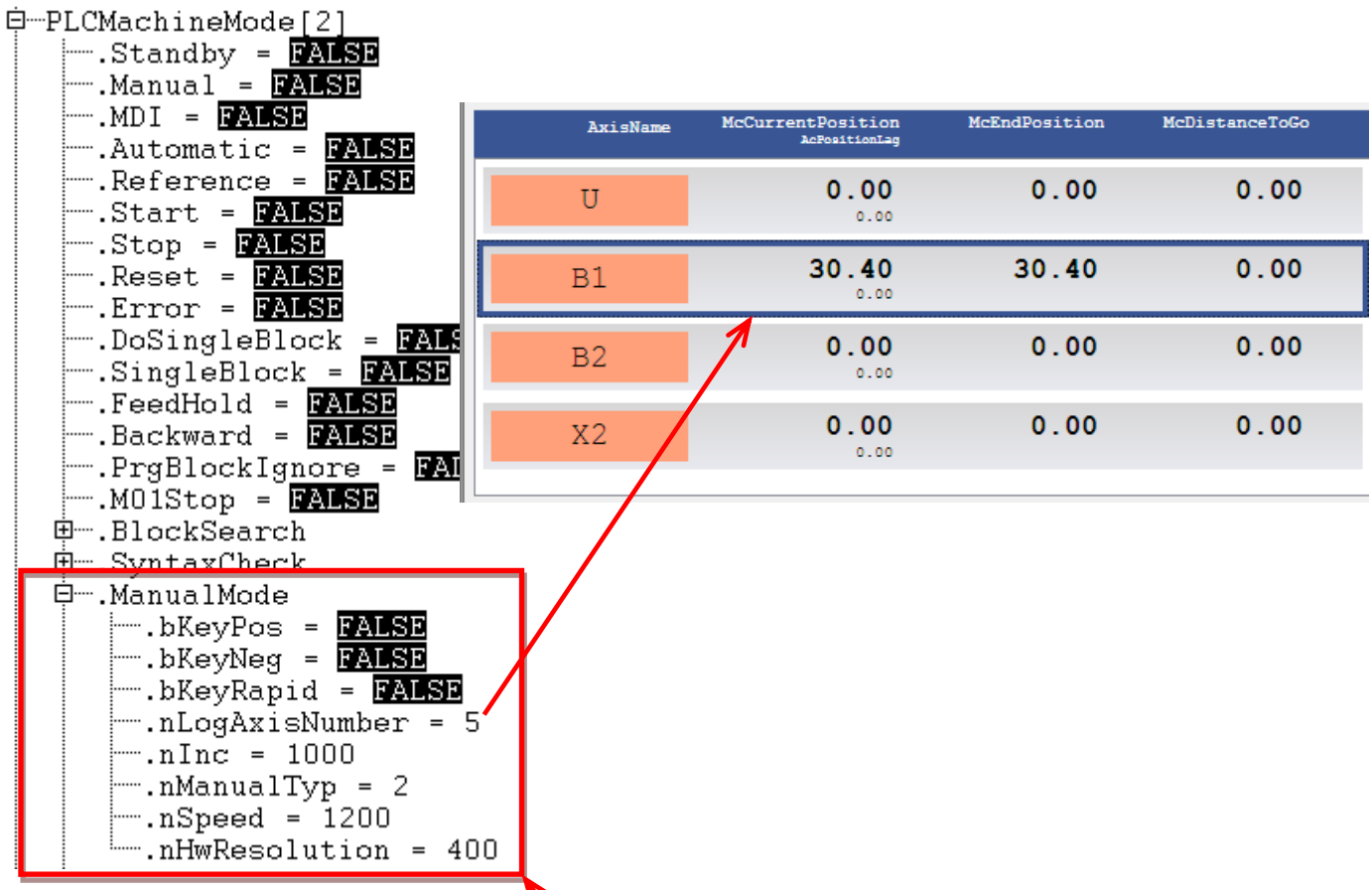
BECKHOFF

The control Manual operation is accomplished by the PLC via the HLI interface. The HMI Manual describes the structure ManulaMode, which is located within the structure PLCMachineMode[channel]:



The status of a Control Button is linked directly to the PLC variables current status.

BECKHOFF

Using the following controls, the transformation, ECS and a zero offset can be activated in manual mode.
This information is also passed to the structure PlcMachineMode[channel].
If the corresponding variables are not present in the PLC, the controls are not displayed.

BlockSearch	ST_BlockSearch	
SyntaxCheck	ST_SyntaxCheck	
ManualMode	ST_ManualMode	
bKeyPos	BOOL	FALSE
bKeyNeg	BOOL	FALSE
bKeyRapid	BOOL	FALSE
nLogAxisNumber	UINT	3
nInc	UDINT	1000
nManualTyp	UINT	2
stManualOption	ST_CNC_ManualOption	
bTrafoActive	BOOL	FALSE
bEcsActive	BOOL	FALSE
eZeroOffset	E_CNC_MANUALZEROOFFSET	G57
nSpeed	UINT	1000

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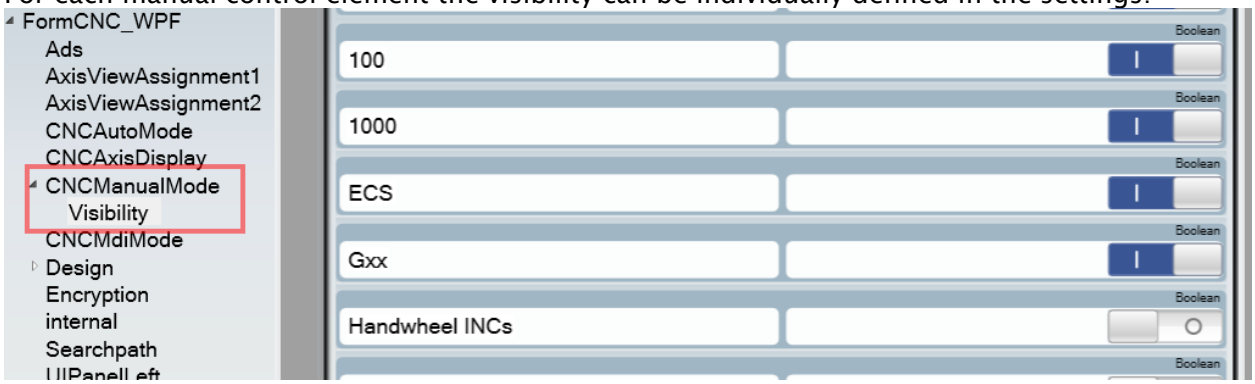
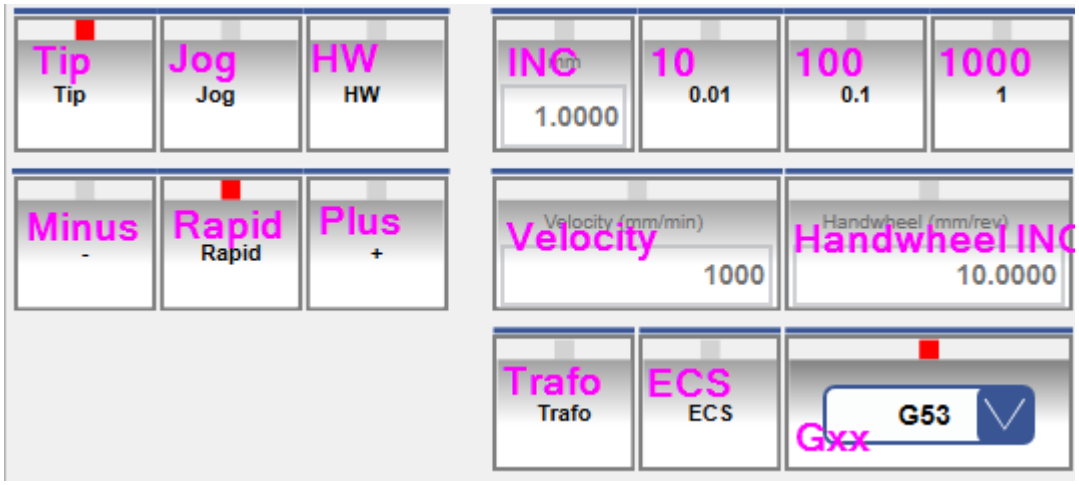
The indexes of the texts for the manual mode controls to be translated begin in the language switching database with „CNCManualMode":

CNCManualMode - Handwheel INC	-	255	Handwheel (inc/mm)	H
CNCManualMode - HW	-	255	HW	H
CNCManualMode - Inc	-	255	Inc	I
CNCManualMode - Jog	-	255	Jog	J
CNCManualMode - Tip	-	255	Tip	T
CNCManualMode - Velocity	-	255	Velocity (mm/min)	V
CNCManualMode- Operation Mode Manual	-	255	Operation Mode Manual Channel {0}	O
CNCManualMode-Handwheel INC	-	255	Handwheel INC	H
CNCManualMode-Jog increments µm	-	255	Jog increments µm	J
CNCManualMode-Manual Mode	-	255	Manual Mode	M
CNCManualMode-Movemment	-	255	Movemment	M
CNCManualMode-Velo	-	255	Velo	V

For each manual control element the visibility can be individually defined in the settings:



The elements are named as follows:



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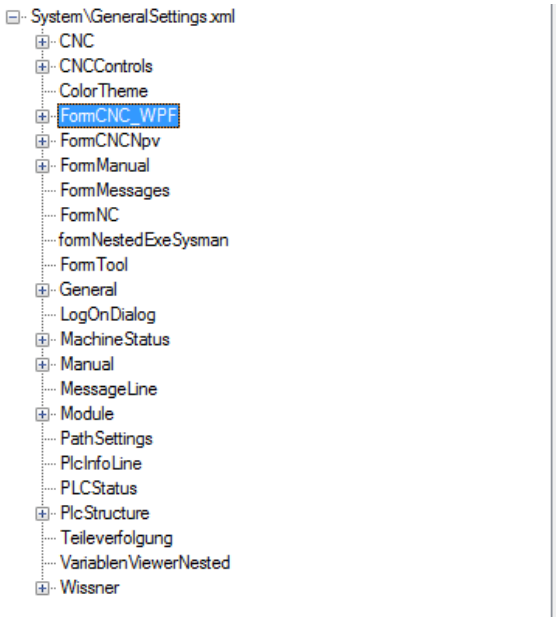
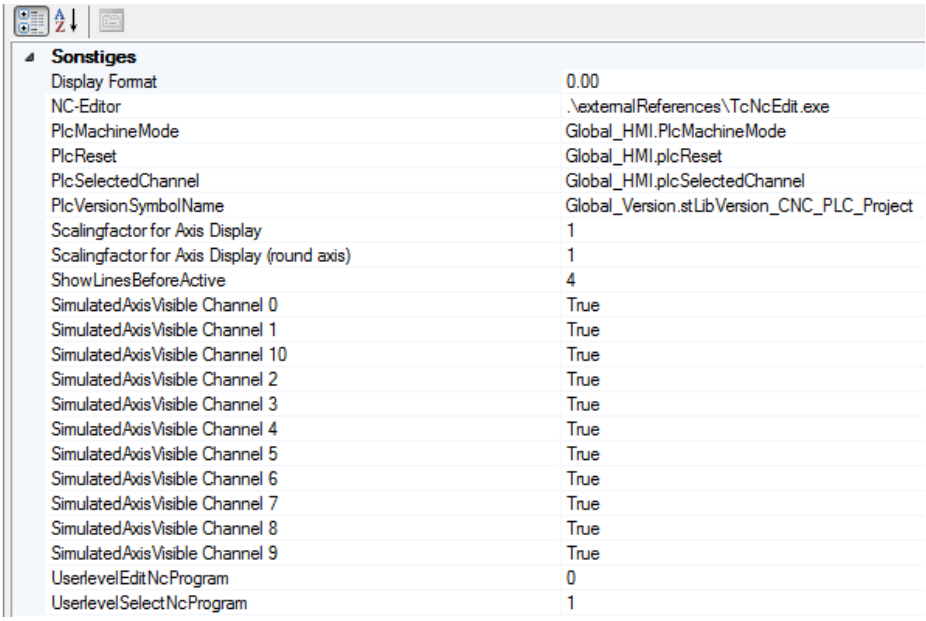
General Settings for FormCNC_WPF (Settings)





Sonstiges	
Display Format	0.00
NC-Editor	.\externalReferences\TcNcEdit.exe
PlcMachineMode	Global_HMI.PlcMachineMode
PlcReset	Global_HMI.plcReset
PlcSelectedChannel	Global_HMI.plcSelectedChannel
PlcVersionSymbolName	Global_Version.stLibVersion_CNC_PLC_Project
Scalingfactor for Axis Display	1
Scalingfactor for Axis Display (round axis)	1
ShowLinesBeforeActive	4
SimulatedAxisVisible Channel 0	True
SimulatedAxisVisible Channel 1	True
SimulatedAxisVisible Channel 10	True
SimulatedAxisVisible Channel 2	True
SimulatedAxisVisible Channel 3	True
SimulatedAxisVisible Channel 4	True
SimulatedAxisVisible Channel 5	True
SimulatedAxisVisible Channel 6	True
SimulatedAxisVisible Channel 7	True
SimulatedAxisVisible Channel 8	True
SimulatedAxisVisible Channel 9	True
UserlevelEditNcProgram	0
UserlevelSelectNcProgram	1

The display and behavior can adjusted here.

- **DisplayFormat**: Display format for axis.
- **NcEditor**: Filename of the NC Editor that should be used.
- **PlcMachineMode**: PLC variable structure for controlling the CNC or NC-
- **PLCSelectedChannel**: PLC variable for the selected channel
- **PLCVersionSymbolName**: PLC structure which holds the version number of the PLC project
- **Scalingfactor**: Scaling factor for the axis display. Can be setup up separately for linear and round axis
- **ShowAxisOfAllChannels:** Instead of a channel specific display, ALL axes of all channels are displayed in each channel. When selecting an axis by mouse click, the logical axisId of the axis is written to the structure „PlcMachineMode[0]“.
- **ShowLinesBeforeActive**: Display of the selected line in nc program
- **SimulatedAxisVisible Channel X**: for each channel it can be configured if simulated axis are displayed (DriveType 4). Channel 0 means the display for “allAxis”
- **UserlevelEditNcProgram**: minimum user level that is necessary to edit a program
- **UserlevelSelectNcProgram**: minimum user level that is necessary to select a program

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