How to edit and administrate the interpolation point tables of the FB 488 "MC_MovePath" via HMI Interface?

Technology CPU

FAQ • May 2012

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Question

How can the interpolation point tables of the technology function FB 488 "MC_MovePath" be edited and administrated in the technology CPU via HMI Interface?

Answer

The instructions and notes listed in this document provide a detailed answer to this question.

Table of Contents

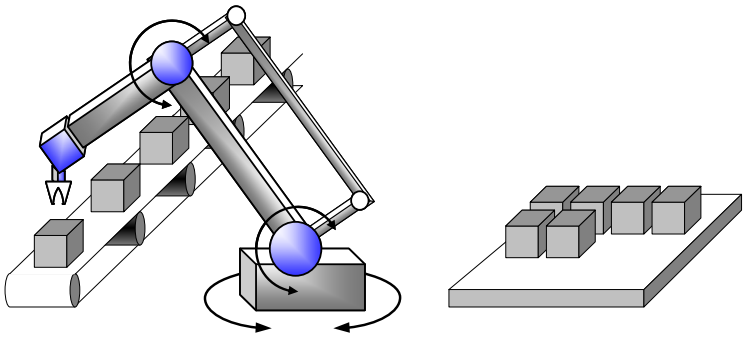
1 Introduction

1.1 Automation Task

The technology function FB 488 "MC_MovePath" can be used to easily realize a palletizing process in the technology CPU. Motion control via the technology function FB 488 "MC_MovePath" is determined by means of interpolation point tables which are stored in data blocks.

If you wish to keep the motion control flexible, it is necessary to edit the interpolation point tables during runtime of the program. Preferably, an HMI Interface should be used, which allows the user to view and edit the interpolation point tables.

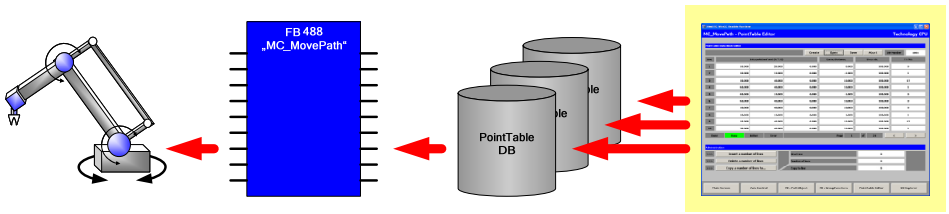
Figure 1-1 Simple palletizing process with FB 488 "MC_MovePath"



1.2 Automation solution

This FAQ provides you with an HMI Interface for administrating and editing the interpolation point table of the FB 488 "MC_MovePath", which can be quickly and easily integrated into your own projects.

Figure 1-2 Automation solution



For this process, the HMI Interface provides the following functions:

- Creating new data blocks for integration an interpolation of a point table in the technology CPU.
- Comfortably editing the interpolation point tables that already exist in the technology CPU, including the possibility to insert, delete and copy lines within the interpolation point table.

- DB-Explorer to display the data blocks existing in the technology CPU, which contain an interpolation point table.
  The decision, whether an existing data block is an interpolation point table for the technology function FB 488 "MC_MovePath" is made according to the size of the data block (5280 Bytes).
- Deleting interpolation point tables that already exist in the technology CPU; for security reasons, this function is also limited to a data block size of 5280 bytes.

Note

The functionality of the HMI Interface presented in this document is limited to administration and editing the interpolation point table for the technology function FB 488 "MC_MovePath", which is stored in a data block.

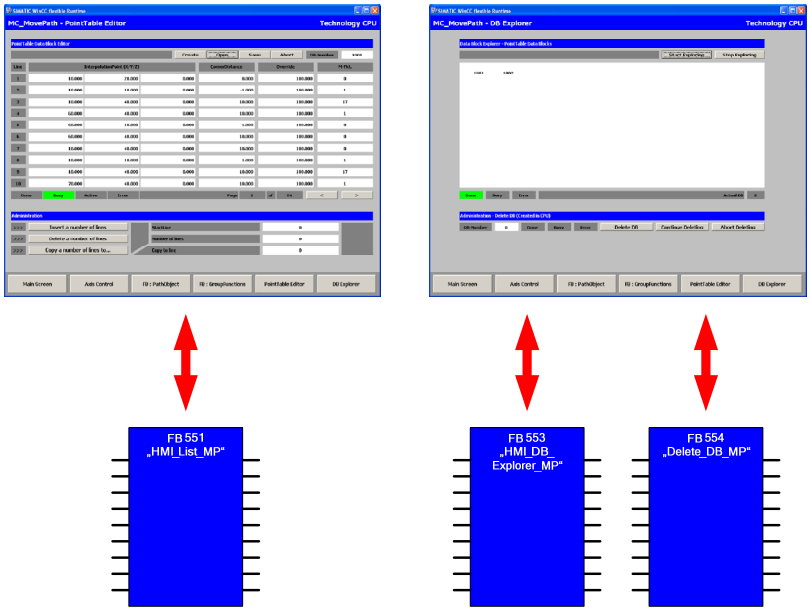
The functionality for preparing the interpolation table via FB 489 "MC_PathSelect", which is required for the process, as well as the functionality for traversing the interpolation points via"MC_MovePath" are not part of the interface, but form part of the sample program presented in chapter 4.

2 Principle of the Program

2.1 Basic information

The HMI Interface presented in this document is closely linked to three data blocks, which provide the actual function for administration and editing the interpolation point tables. Additionally, the operator screens of the HMI Interface are also directly connected to the function blocks.

Figure 2-1 HMI Interface link to the function blocks



Note

Array accesses and administration processes within the function blocks are quite complex. Therefore, the function blocks stated here are realized in the SCL creation language.

2.2 Editing an interpolation point table

Interpolation point tables are edited via the function block FB 551 "HMI_List_MP" or via "MC_MovePath – PointTable Editor" of the HMI Interface.

2.2.1 Function block FB 551 "HMI_List_MP"

The function block FB 551 "HMI_List_MP" provides the following functions for editing and manipulation of an interpolation point table stored in a data block:

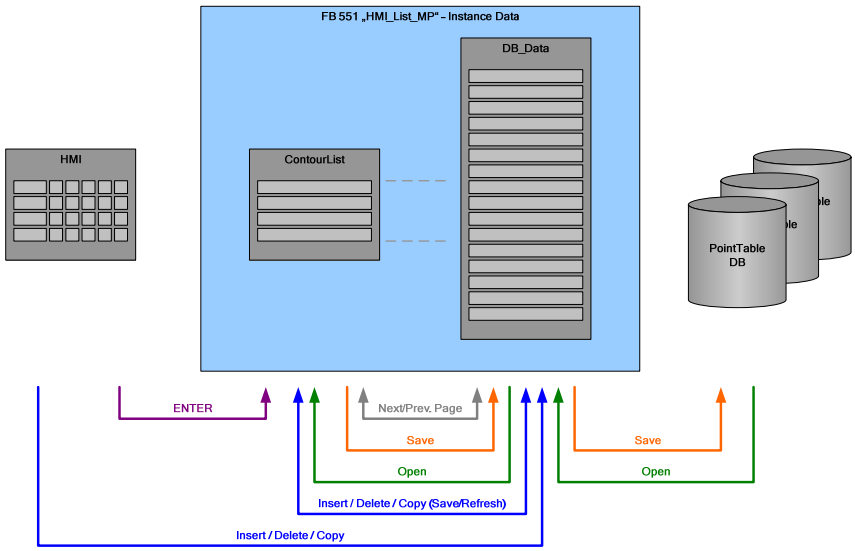
- **Creating a new interpolation point table**
  By using the system function block SFC 22 "CREAT_DB", a new interpolation point table can be created as data block in the technology CPU. Moreover, the interpolation point table will be opened for further editing right after creating the data block.

- **Opening an already existing interpolation point table for editing**
  An interpolation point table that already exists in the technology CPU is opened for further editing or manipulation.
  Within the open interpolation point table, the following administrative functions are available:
  - **Inserting blank lines within the interpolation point table**
    Within the interpolation point table, a definable number of lines can be inserted. For this purpose, the subsequent interpolation points are shifted downwards within the table.
  - **Deleting lines from the interpolation point table**
    Within the interpolation point table, a definable number of lines can be deleted. For this purpose, the subsequent interpolation points are shifted upwards accordingly within the table.
  - **Copying lines within the interpolation point table**
    Within the interpolation point table, a definable number of interpolation points can be copied. Interpolation points, which possibly exist in the target range of the copying process, will be overwritten by this function.
- **Saving the performed changes in the interpolation point table**
  Two different functions are available for saving an open interpolation point table:
  - **Save**
    If this function is used, the data of the interpolation point table are written back into the same data block in the technology CPU.
  - **Save as…**
    If a new data block number is stated before using the function, the data are written back into the data block defined by the modified number.
    If this data block should not yet exist in the technology CPU, a new data block with the defined data block number will be created in the technology CPU and the data are written into this newly created data block.
- **Reject performed changes**
  If the data changes shall not be written back into the data block of the interpolation point table, the performed changes can be rejected by using this function.

To edit or manipulate the data of the interpolation point table, there are always two data ranges available in the FB 551 "HMI_List_MP".

- **DB_Data:**
  When opening the interpolation point table (Open), all data records of the data block are stored for editing in this data range. After editing, the manipulated data records – as far as they shall not be rejected (Abort) – are copied back from this data range into the data block of the interpolation point table (Save).
- **ContourList:**
  This data range contains a section of the block "DB_Data" and represents the interpolation points, which are currently displayed in the HMI Interface for editing. By performing a page jump (Next/Prev. Page) the data range can be filled with the respective new data from the block"DB_Data".

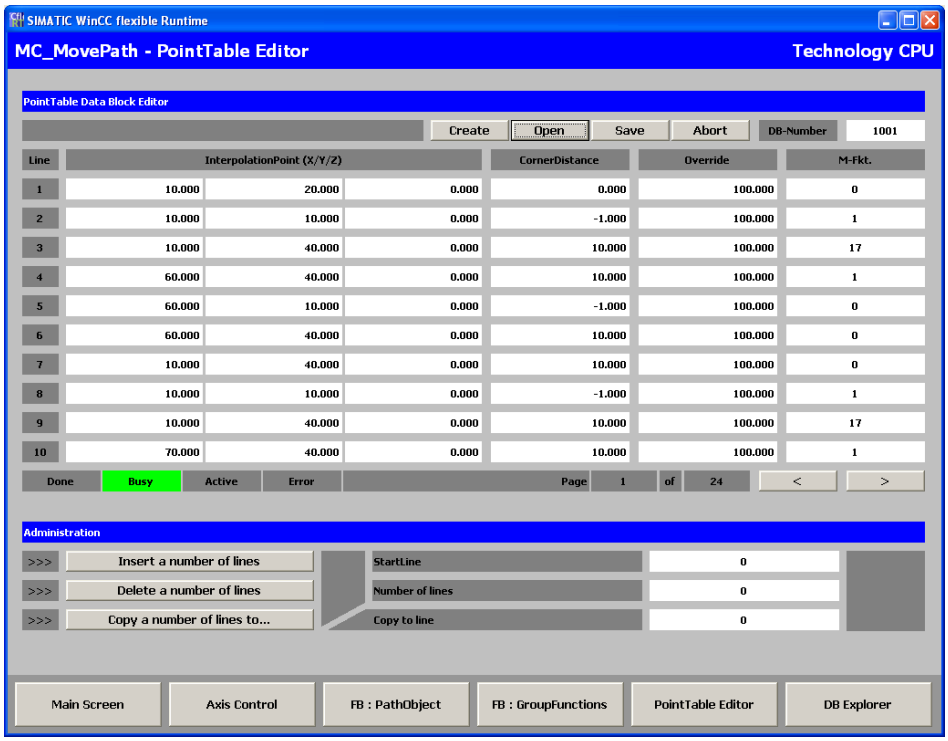
Figure 2-2 Data flow during manipulation of an interpolation point table



2.2.2 HMI "MC_MovePath – PointTable Editor"

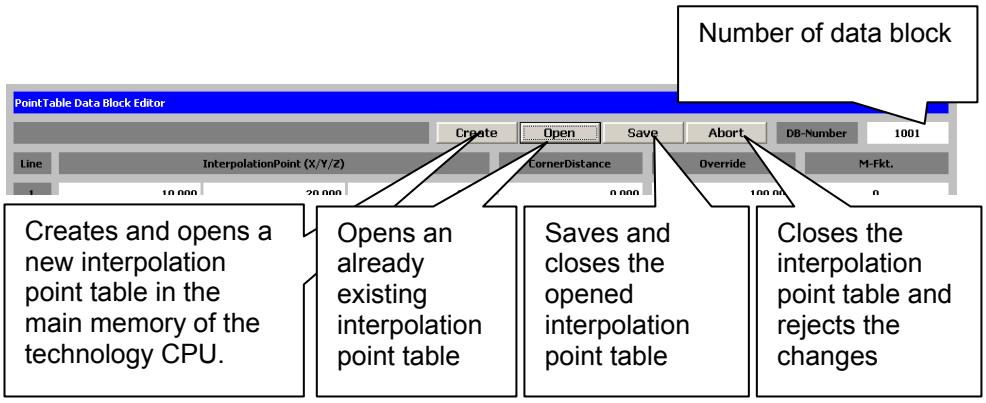
All functions of the FB 551 "HMI_List_MP" can be operated via the page "MC_MovePath – PointTable Editor" of the HMI Interface:

Figure 2-3 HMI "MC_MovePath – PointTable Editor"



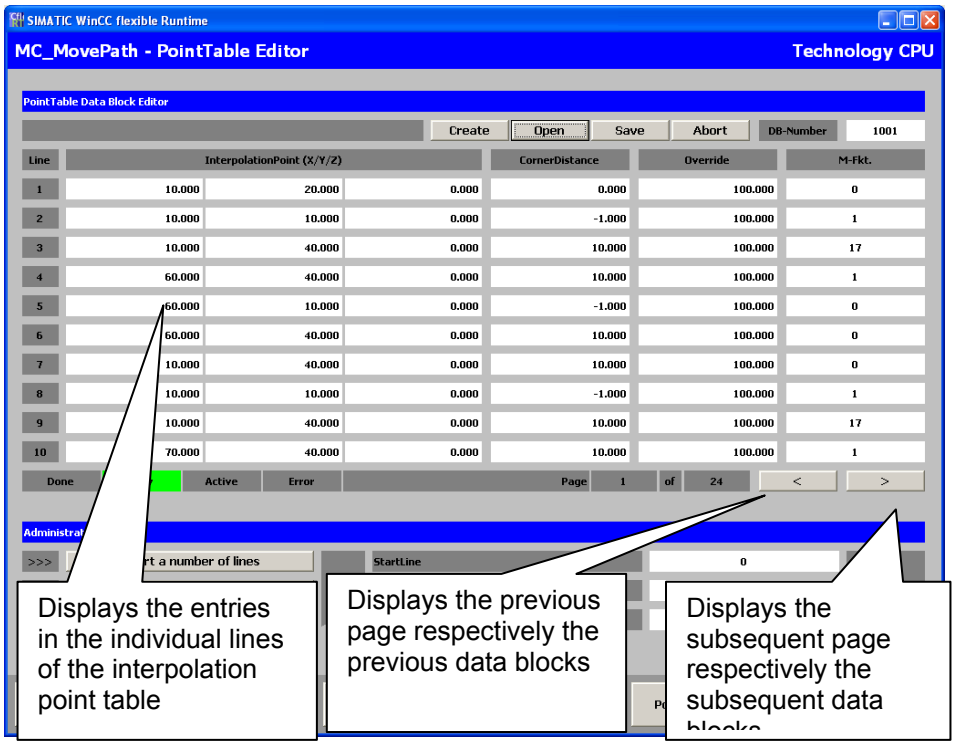
Selection of the desired function in the "PointTable Editor" is effected via the buttons above the display area of the interpolation point table.

Figure 2-4 Function selection via the "PointTable Editor"



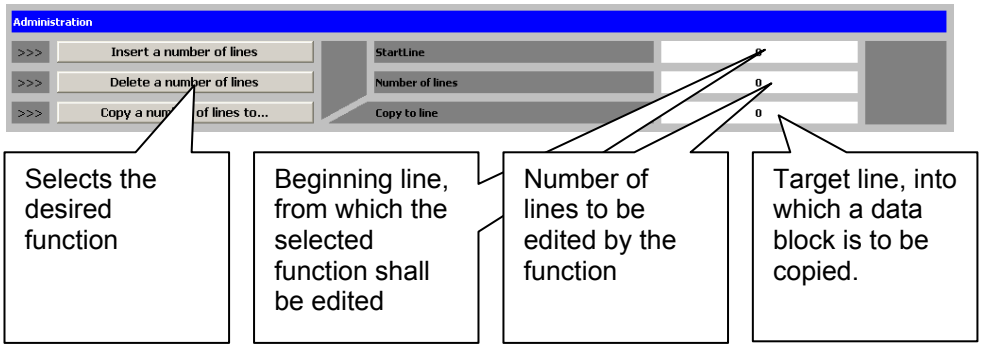
If an interpolation point table is opened, the individual lines of the table can be comfortably edited. During this process, the HMI Interface always displays 10 lines of the table. The buttons in the lower right corner are used for switching between the "individual pages" of the display of the interpolation point table. This way, all 240 lines of the interpolation point table can be displayed on the HMI Interface.

Figure 2-5 Editing the interpolation point table within a data block



If the interpolation point table is opened, there also exists the possibility to perform administrative functions within the table, such as inserting and deleting lines or copying lines within the data block of the interpolation point table.

Figure 2-6 Administrative functions within the interpolation point table



2.3 Administration of the interpolation point tables

Interpolation point tables that already exist in the technology CPU are administrated by using the function blocks FB 553 "HMI_DB_Explorer_MP" and FB 554 "Delete_DB_MP" or via the page "MC_MovePath – DB Explorer" of the HMI Interface.

2.3.1 Function block FB 553 "HMI_DB_Explorer_MP"

The function block FB 553 "HMI_DB_Explorer_MP" allows browsing the main memory of the technology CPU for data blocks, in which interpolation point tables for the FB 488 "MC_MovePath" are stored.

To identify a data block as interpolation point table, the size of 5280 bytes of the data block is decisive. The DB Explorer does not recognize other data blocks.

The FB 553 "HMI_DB_Explorer_MP" uses the SFC 24 "TEST_DB" to recognize interpolation point tables or to determine data sizes by applying this system function to all data block numbers from DB 1 to DB 2047.

Note A maximum of 100 data blocks can be captured via the function block FB 553 "HMI_DB_Explorer_MP" in the RAM of the CPU.

Note The searching process can result in an increased cycle load within the CPU. For this reason, it might be better to avoid using the DB Explorer during time-critical processes.

2.3.2 Function block FB 554 "Delete_DB_MP"

Data blocks can be deleted from the main memory of the technology CPU by using the function block FB 554 "Delete_DB_MP". The function block uses the system function SFC 23 "DEL_DB" to delete the data blocks.

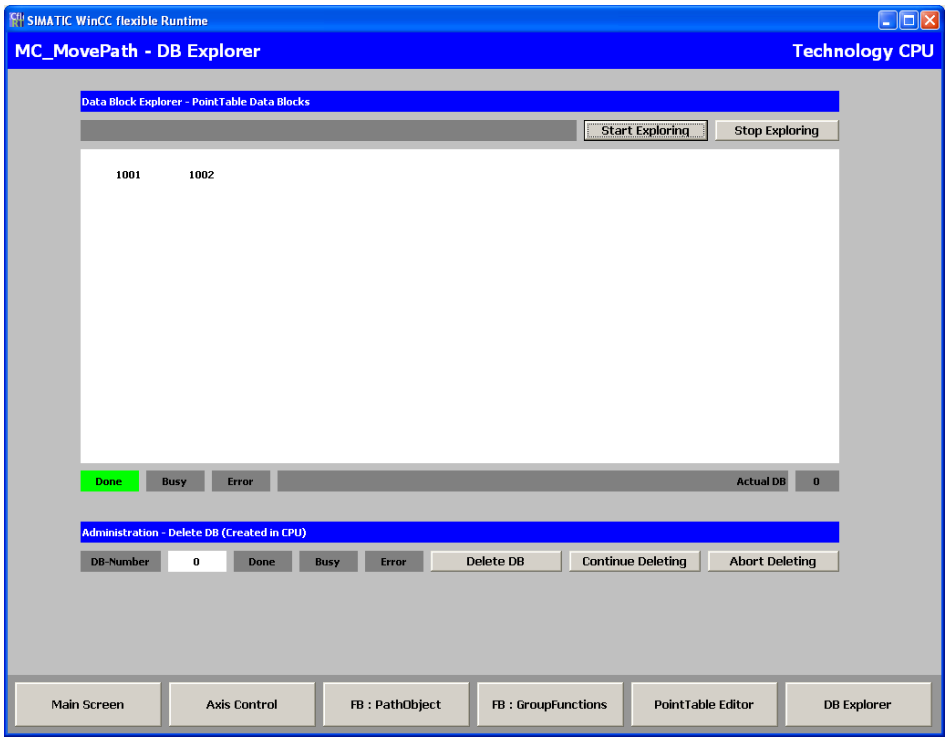
Due to safety reasons, it is, however, only possible to delete data blocks with a size of 5280 Byte from the main memory of the technology CPU. The system function SFC 24 "TEST_DB" is used for determining the data block size.

Thus, no longer required interpolation point tables can be removed from the main memory of the technology CPU in order to provide space for new interpolation point tables which are to be created.

2.3.3 HMI "MC_MovePath – DB Explorer"

All functions of the function blocks 553 "HMI_DB_Explorer_MP" and FB 554 "Delete_DB_MP" can be operated via the page "MC_MovePath – DB Explorer" of the HMI Interface:

Figure 2-7 HMI "MC_MovePath – DB Explorer"



The DB-Explorer checks the presence of the respective data block in the CPU main memory for the data block numbers DB 1 to DB 2047 and displays the number on the HMI Interface if the building block features a size of 5280 byte and is therefore identified as interpolation point table.

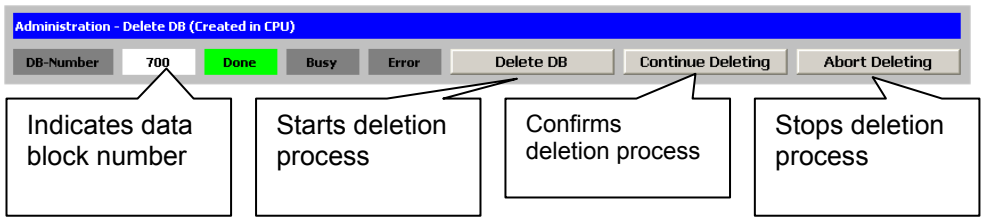
The search can be started and stopped via the buttons "Start Exploring" and "Stop Exploring". The data blocks found until the search process is stopped are listed in the display range of the operator screen. The process is automatically stopped when the whole range of the data block numbers has been searched through.

Note A maximum of 100 data blocks can be captured via the function block FB 553 "HMI_DB_Explorer_MP" in the RAM of the CPU.

Note The searching process can result in an increased cycle load within the CPU. For this reason, it might be better to avoid using the DB Explorer during time-critical processes.

Within in the administrative area of the HMI Interface, data blocks can be deleted from the main memory of the technology CPU. The deleting process can be started by indicating the data block number and confirmed by pressing the button "Delete DB". If you wish to finally delete the data block, the deletion process needs to be confirmed via the button "Continue Deleting". You can stop the deletion process by pressing the button "Abort Deleting". Consequently, the selected data block will not be deleted from the main memory of the technology CPU.

Figure 2-8 Deleting data blocks



Note For safety reasons, you can only delete data blocks with a size of 5280 bytes, i.e. if it can be assumed that these data blocks are interpolation point tables.

2.4 Data block of an interpolation point table

2.4.1 Data block structure

The data block structure of an interpolation point table is determined via one of the following user-defined data types:

- **UDT 121 "PathData"**
- **UDT 120 "PathPoint"**

Note When using the UDT 121 "PathData" to define the interpolation point table, the UDT 120 "PathPoint" must be available in the program as well!

UDT 121 "PathData"

This data type defines length and structure of the interpolation point table.

By means of this UDT, the interpolation point table can be defined for a path motion in a data block.

The UDT, and thus the data block, feature the following structure:

Figure 2-9 UDT 121 "PathData"

Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	Point	ARRAY[1..240]		Collection of points defining a segment
*22.0		"PathPoint"		
=5280.0		END_STRUCT		

UDT 120 "PathPoint"

This data type defines the individual interpolation points of the interpolation point table.

The UDT features the following structure:

Figure 2-10 UDT 120 "PathPoint"

Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	X	REAL	0.000000e+000	X-Coordinate
+4.0	Y	REAL	0.000000e+000	Y-Coordinate
+8.0	Z	REAL	0.000000e+000	Z-Coordinate
+12.0	CornerDistance	REAL	0.000000e+000	Corner distance for transition start.
+16.0	Override	REAL	1.000000e+002	Velocity override for path velocity.
+20.0	M_Function	INT	0	Spezial function code for path point.
=22.0		END_STRUCT		

The individual elements of the interpolation points have the following meaning or function, which can also be selected via the HMI Interface when editing the interpolation point table:

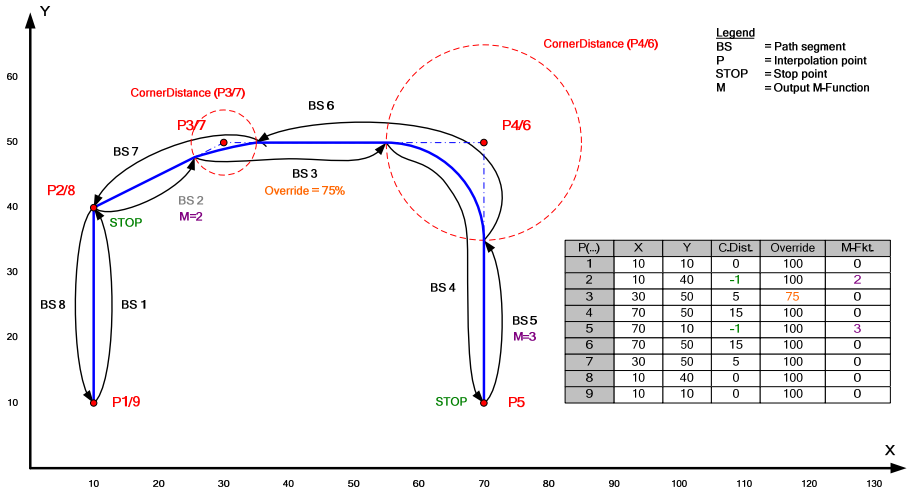
Table 2-1 Description of parameters

Parameter	Description
X / Y / Z	Description of the coordinates of the respective interpolation point. For two-dimensional kinematics, the coordinate not in use (coordinate outside the processing level) does not have to be defined.
CornerDistance	Corner distance (ball-shaped around the defined interpolation point) within which the transition between the two straight lines of the motion path takes place. **Stop point** If a negative corner distance is entered, the path motion is stopped at this interpolation point. The motion can then be continued via the technology function FB 483 "MC_GroupContinue". If the job at FB 483 "MC_GroupContinue" is started directly before reaching the stop point, the interruption of the path motion can be skipped until the next stop point, i.e. there is no interruption of the motion.

Parameter	Description
Override	Through the override parameter, the travel speed of the respective path segment following the interpolation point can be influenced. If the table is traversed from the first to the last interpolation point, each override will have an effect on the path segment following the interpolation point. If the table is followed in reverse direction (last till first interpolation point), the corresponding override setting of the previous interpolation point will have an effect on the path segment.
M_Function	User-definable interpolation point detection. As soon as the interpolation point was passed by the motion, the value defined at the output code of FB 488 "MC_MovePath" is output until reaching the next interpolation point. Via this parameter, additional functions (e.g. open/close grippers) can be selected, which are to be carried out at certain path positions.

The following figure serves as an example for the definition of a path motion via individual interpolation points.

Figure 2-11 Example for the definition of a path motion via individual interpolation points



P(...)	X	Y	C.Dist.	Override	M-Fkt.
1	10	10	0	100	0
2	10	40	-1	100	2
3	30	50	5	75	0
4	70	50	15	100	0
5	70	10	-1	100	3
6	70	50	15	100	0
7	30	50	5	100	0
8	10	40	0	100	0
9	10	10	0	100	0

3 Installation

3.1 Basic proceeding

To integrate the HMI Interface for administration and processing of the interpolation point table of the FB 488 "MC_MovePath" into your own application, you need to proceed as follows:

Table 3-1 Basic proceeding for the installation of the functionality

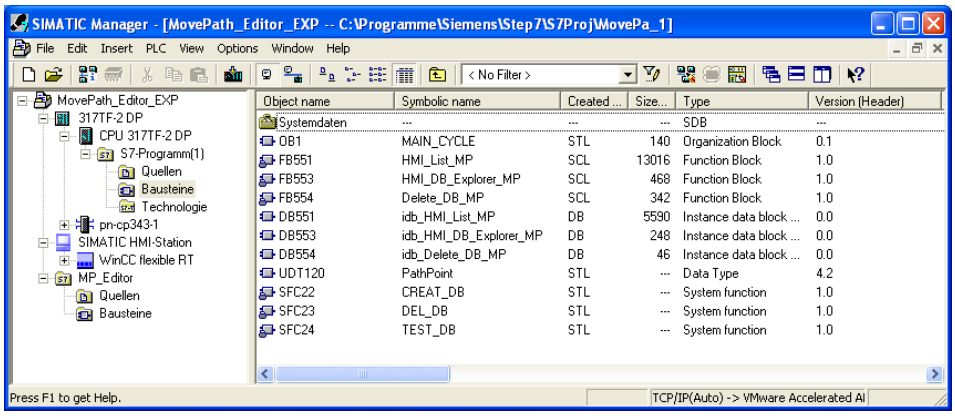
Step	Process / Action	Required Software / Tools
1.	Copy the required function blocks into the target application. Dont' forget to copy also the corresponding SCL sources together with the function blocks into the target application, otherwise you might be facing problems during compiling of the whole project.	SIMATIC Manager STEP 7
2.	Enter the function block calls in OB 1 of the target program.	
3.	Load the modified user program or the modified STEP 7 blocks into the SIMATIC CPU.	
4.	Prepare the project texts in WinCC flexible for the transfer from the source project to the target project.	WinCC flexible
5.	Copy the required pages of the HMI Interface into the HMI Interface of the target application or target project.	
6.	Adjust the picture names if necessary, so that they match the target project.	
7.	Delete the additional connections resulting from copying the pages of the HMI Interface.	
8.	Allocate the variables of the HMI Interface pages to the still existing connection (entries in variable table highlighted in orange).	
9.	Reconnect the variables of the HMI Interface pages by means of the address and data type without changing the names of the variables.	
10.	Integrate the page call into the operating structure of the HMI Interface of the target project.	
11.	Save the changes in the HMI project and recreate the HMI Interface.	

3.2 Working within the SIMATIC Manager

3.2.1 Unzipping process and content of the STEP 7 source project

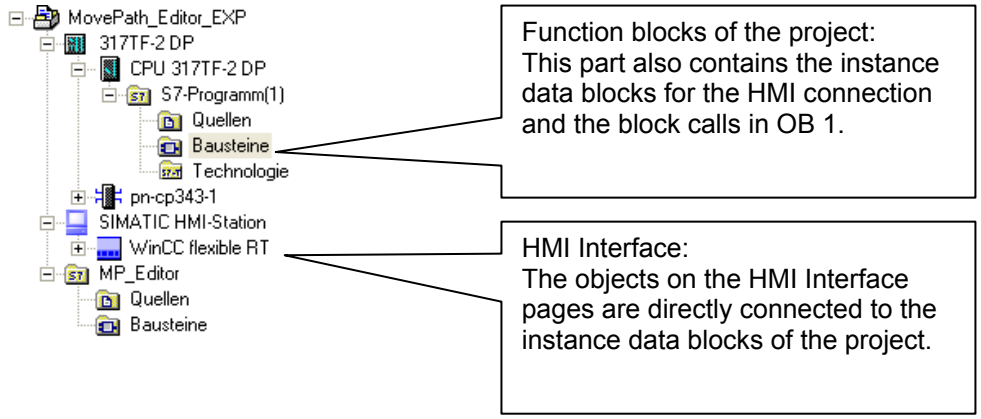
Unzip the STEP 7 archive of the source project, in which the STEP 7 blocks required for the functionality and the HMI Interface are contained.

Figure 3-1 Content of the STEP 7 source project



The individual folders of the STEP 7 source project have the following meaning:

Figure 3-2 Project tree of the STEP 7 source project



3.2.2 Transfer of the function blocks to the target project

To transfer the function blocks from the STEP 7 source project to the target project, copy all function blocks (FB), instance data blocks (DB), user-defined data tyes (UDT) and system functions (SFC) into the target project.

Subsequently, reconnect the function blocks (FB) to the instance data blocks (DB) by calling the function blocks in OB 1, or a cyclically called function block (FB), or a function (FC). Instead of individually calling the function blocks, you can also transfer Network 1, which is contained in OB 1 of the source project, to the target project.

Note

Do not change the numbers of the function blocks and the instance data blocks when transferring the blocks from the source project to the target project. Otherwise you might be facing problems when connecting the HMI Interface.

Figure 3-3 Network 1 from OB 1 of the source project

```
OB1 :  "Main Program Sweep (Cycle)"
Comment:

Network 1: Additional Tools
Comment:

      CALL  "HMI_List_MP" , "idb_HMI_List_MP"                FB551 / DB551
       DB_Number      :=
       Generate_DB    :=
       Open_DB        :=
       Close_DB       :=
       Abort_DB       :=
       Prev_Block     :=
       Next_Block     :=
       InsertLines    :=
       DeleteLines    :=
       CopyLines      :=
       StartLine      :=
       Quantity       :=
       DestinationLine:=
       Done           :=
       Busy           :=
       Active         :=
       Error          :=
       ActPage        :=
       MaxPage        :=

      CALL  "HMI_DB_Explorer_MP" , "idb_HMI_DB_Explorer_MP"  FB553 / DB553
       StartExplore:=
       StopExplore :=
       Done        :=
       Busy        :=
       Error       :=
       Act_DB      :=

      CALL  "Delete_DB_MP" , "idb_Delete_DB_MP"              FB554 / DB554
       DB_Number   :=
       Delete_DB   :=
       Del_Continue:=
       Del_Abort   :=
       Done        :=
       Busy        :=
       Error       :=
```

3.3 Working within WinCC flexible

3.3.1 Preparation of the project texts

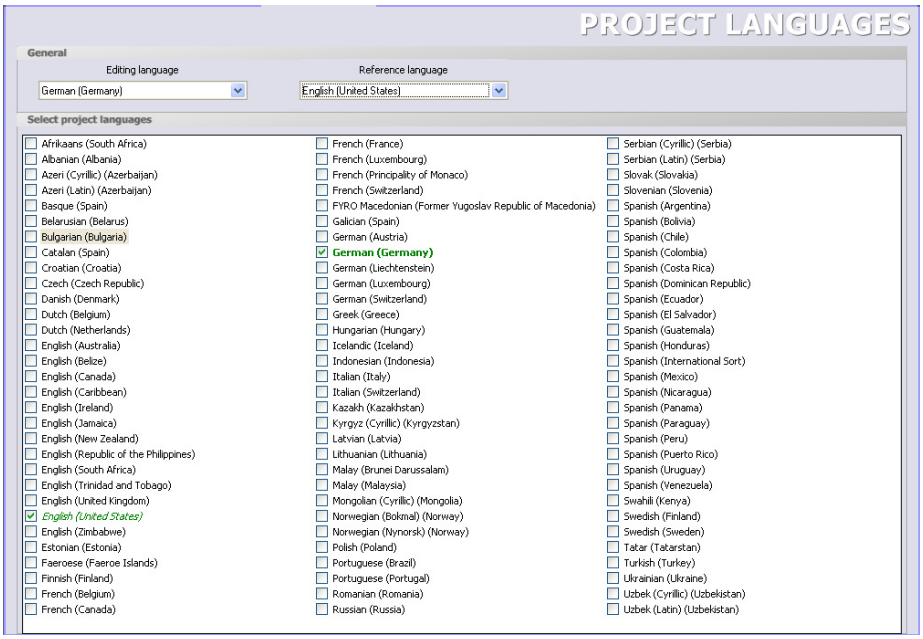
In order to be able to completely and successfully copy the HMI Interface pages, all project texts need to be prepared accordingly.

Basic requirements:
There must be at least one match in the project languages of both projects.

If there is no language in the project texts, which exists in both, the source project and the target project, we recommend the following proceeding:

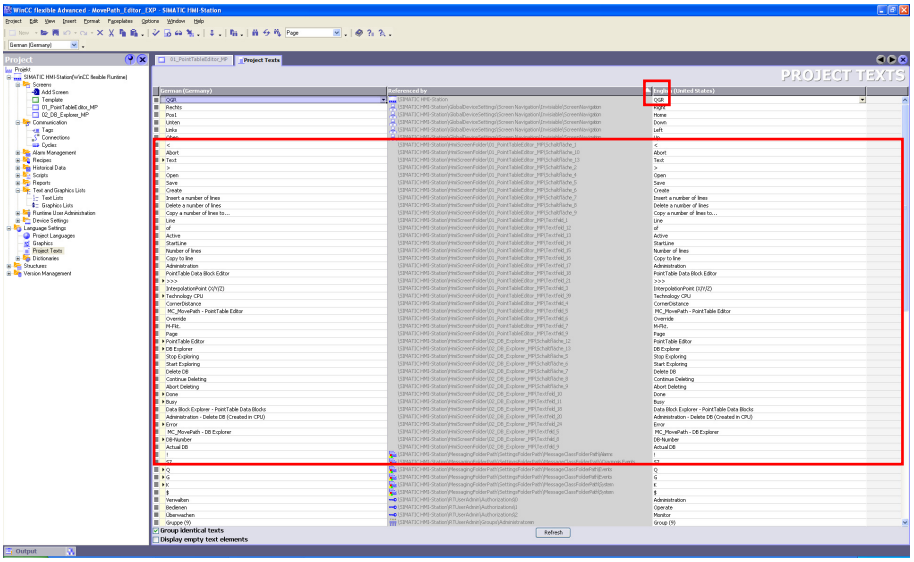
1. Create a language in the project texts of the source project, which also exists in the target project.

Figure 3-4 Languages available in the WinCC flexible project



2. Copy the labels of the HMI pages, which are to be copied, into the newly created language from one of the languages of your source project, e.g. the creation language.

Figure 3-5 Copying the labels of the HMI pages



To do this, proceed as follows:

- Sort the project text list in ascending or descending order according to the references.
- Mark all entries belonging to the HMI pages, which are to be copied, in the already existing language and select the function "Copy" from the context menu.

- Mark the same entries in the list of the newly added language and select the function "Paste" from the context menu.

Thus, the project texts belonging to the HMI pages are available in a language which also exists in the target project and can now be copied, together with the HMI pages, into the target project without any problems.

Figure 3-6 Project texts: Mark and copy source

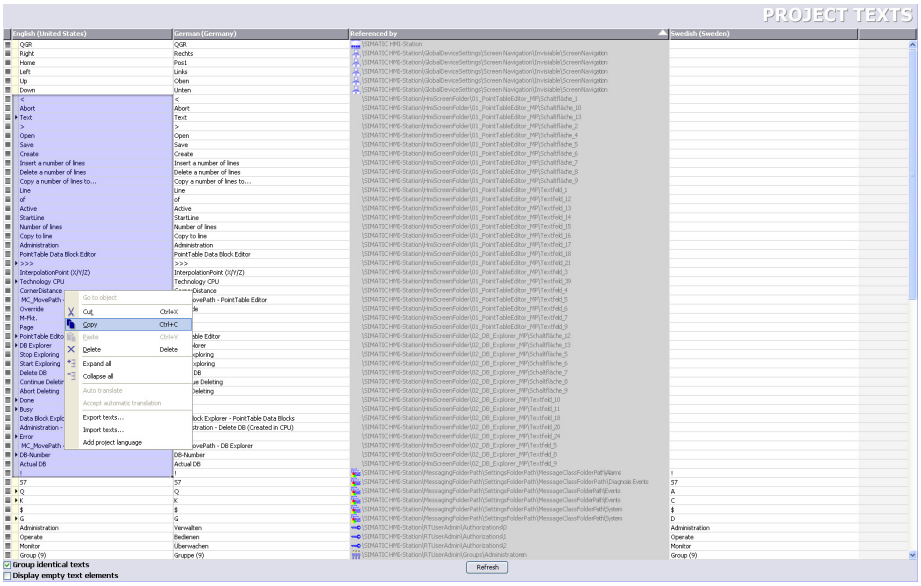
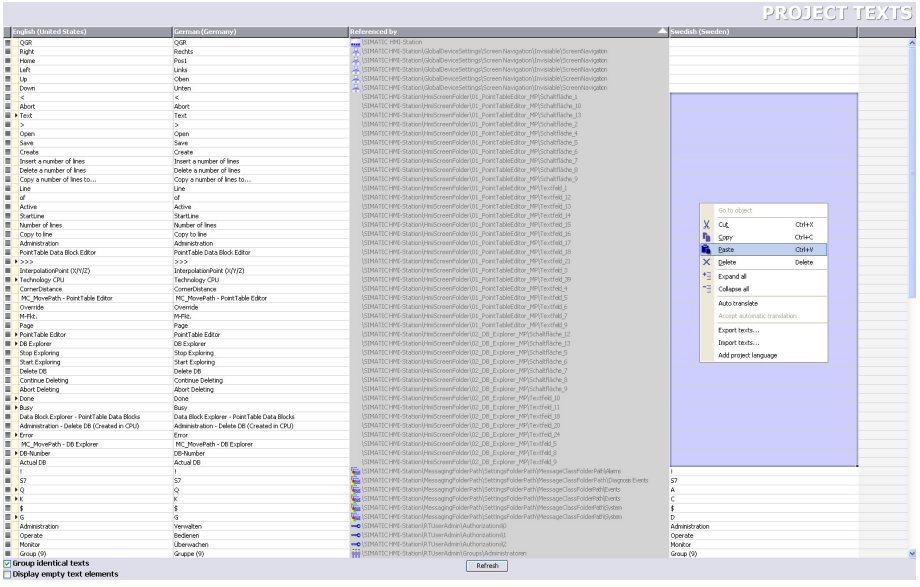


Figure 3-7 Project texts: Mark and insert target



Note

The list of project texts and the settings for the project languages are located in the WinCC flexible project tree under the following entry:

SIMATIC HMI-STATION (WinCC flexible Runtime) > Language Settings >…

3.3.2 Copying HMI pages into the target project

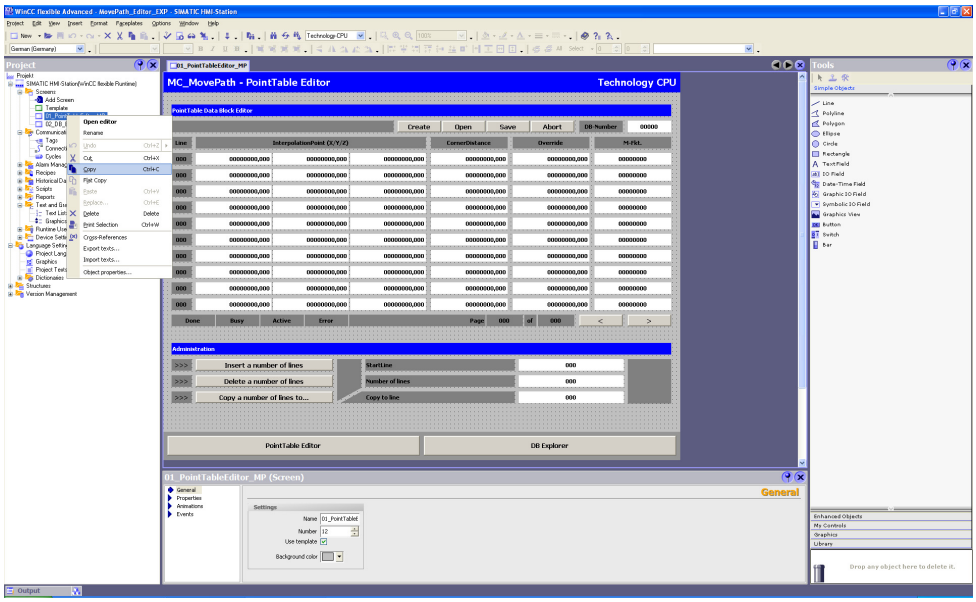
Open the source project and target project of the HMI Interface each in a seperate instance of WinCC flexible.

Select the page to be copied of the HMI Interface in the project tree under the section "Screens" and copy the respective page into the target project by means of the context menu (right mouse click) using the function "Copy".

Note

The pages of the HMI Interface have to be copied one by one from the source project into the target project. It is not possible to collectively copy all pages.

Figure 3-8 Copying the HMI pages



Note

To copy the pages from the HMI user interface, always select the function "Copy" from the context menu. Only by using this function, the page will be completely transferred into the target project.

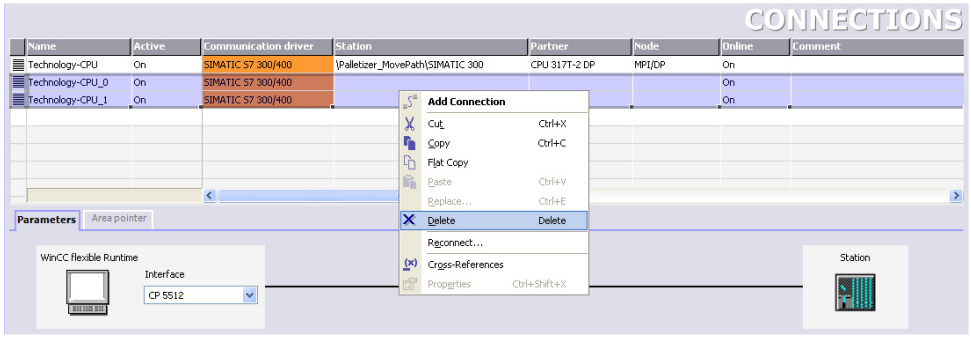
If you use the function "Flat Copy" (simple copying process) the relations of the variables to the individual objects would get lost and have to be reconnected afterwards.

3.3.3 Adjusting the connections in the HMI project

When copying each HMI page separately, a new connection is established in the WinCC flexible project for this page. The communication in the target project should, however, be effected for all HMI pages of the user interface via one single connection.

For this reason, the newly created connections can be deleted from the WinCC flexible project again. To do so, mark the newly created connections and select the function "Delete" from the context menu.

Figure 3-9 Deleting additionally created connections

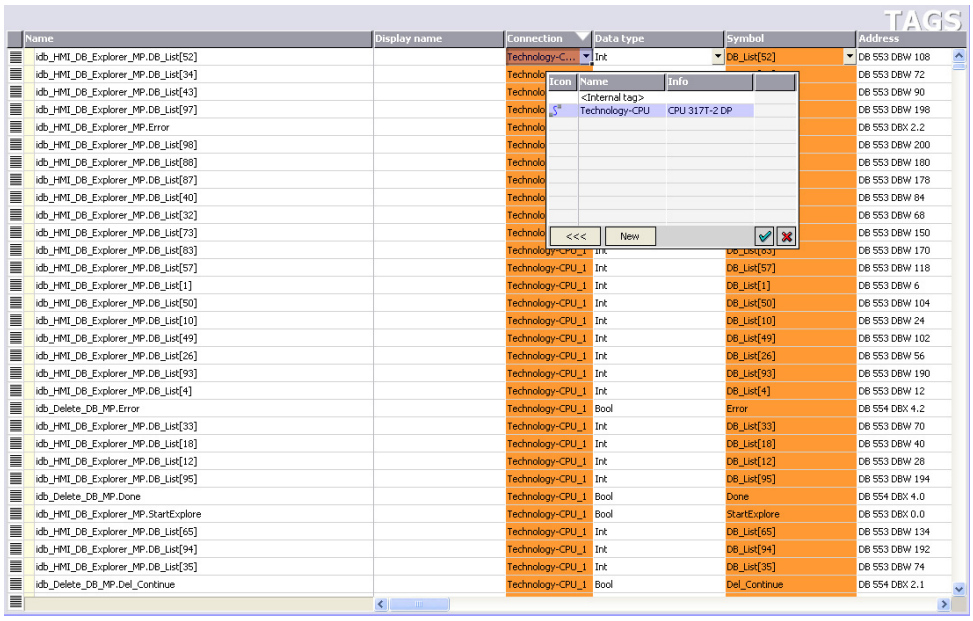


3.3.4 Adjusting the connection of the variables in the HMI project

When deleting the connections created during copying, the connections of the HMI variables to the technology CPU are lost. These have to be recreated now.

For this purpose, select an entry highlighted in orange from the variables table for the connection and subsequently mark the desired new connection in the drop-down list.

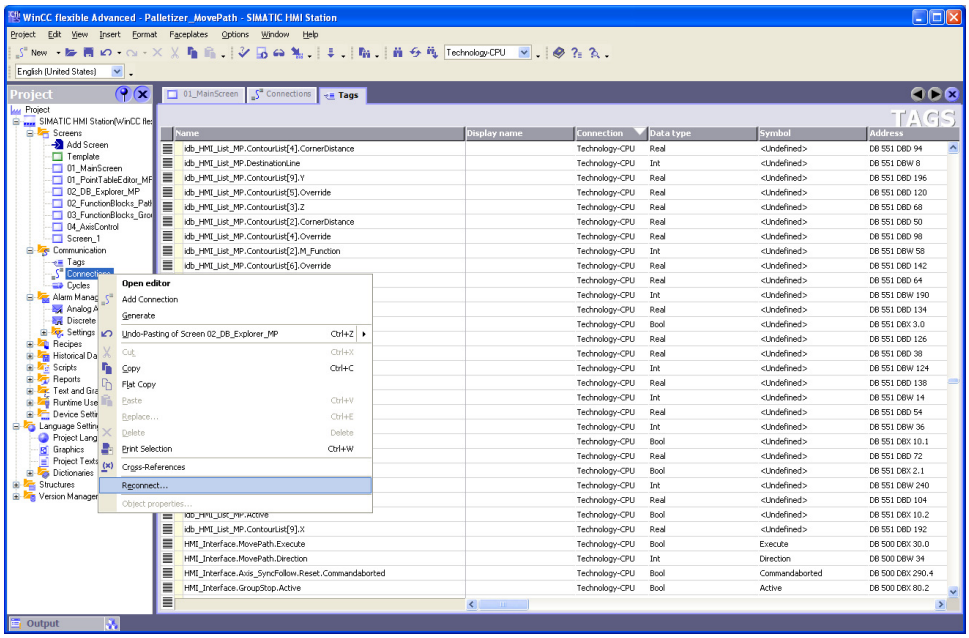
Figure 3-10 Selecting a new connection



Once you have marked the newly selected connection, you can transfer the setting made to all other entries highlighted in orange by dragging the small square at the lower right corner of the marking.

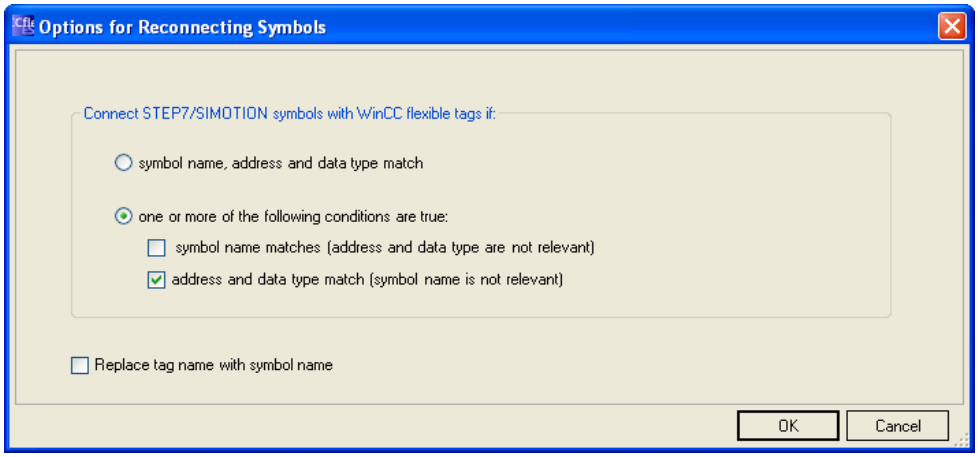
Then you need to reconnect the variable provided with a new connection to the data source in the technology CPU. For this purpose, select the entry "Connections" from the context menu and the function "Reconnect" from the menu tree.

Figure 3-11 Reconnecting variables



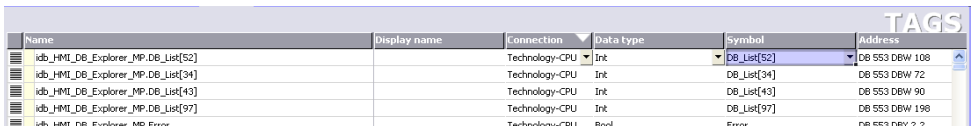
Select the settings for the connection of the variables as shown in the following figure. However, do not forget to uncheck the setting "Replace tag name with symbol name", otherwise the names of the variables will also be readjusted.

Figure 3-12 Settings for the function "Reconnect Variables"



Once the connections of the variables have been recreated successfully, the symbol names of the variables from the data blocks will reappear in the variables list.

Figure 3-13 Reconnected variables



3.3.5 Transfer of the HMI pages to the operatering structure

Now the operator screens have to be transferred to the operator structure of the HMI user interface of the target project.

The operator screens can, for example, be activated via the menu buttons at the bottom of the HMI Interface. For this purpose, insert the appropriate buttons into the HMI user interface, add the property "ActivateScreen" to these buttons and select the respective HMI page as picture name.

Figure 3-14 Calling the HMI pages via buttons

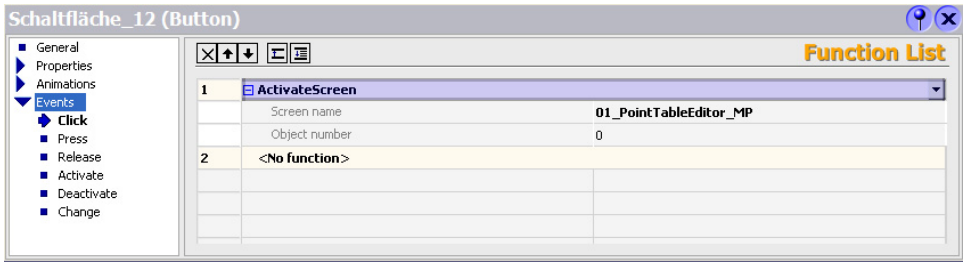
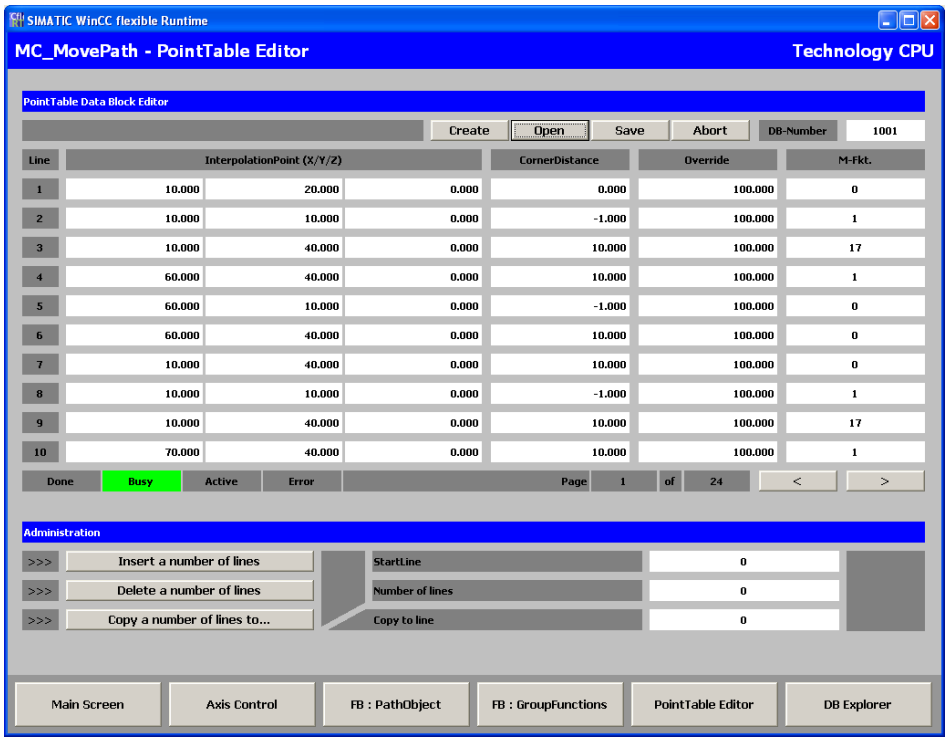


Figure 3-15 Menu buttons at the bottom of the HMI Interface



4 Sample Program

4.1 Basis

The STEP 7 Program offered as download in the following FAQ serves as basis for the sample program:

FAQ	How can a simple palletizer be realized with a technology CPU and the FB 488 "MC_MovePath"? Link: http://support.automation.siemens.com/WW/view/en/48206063

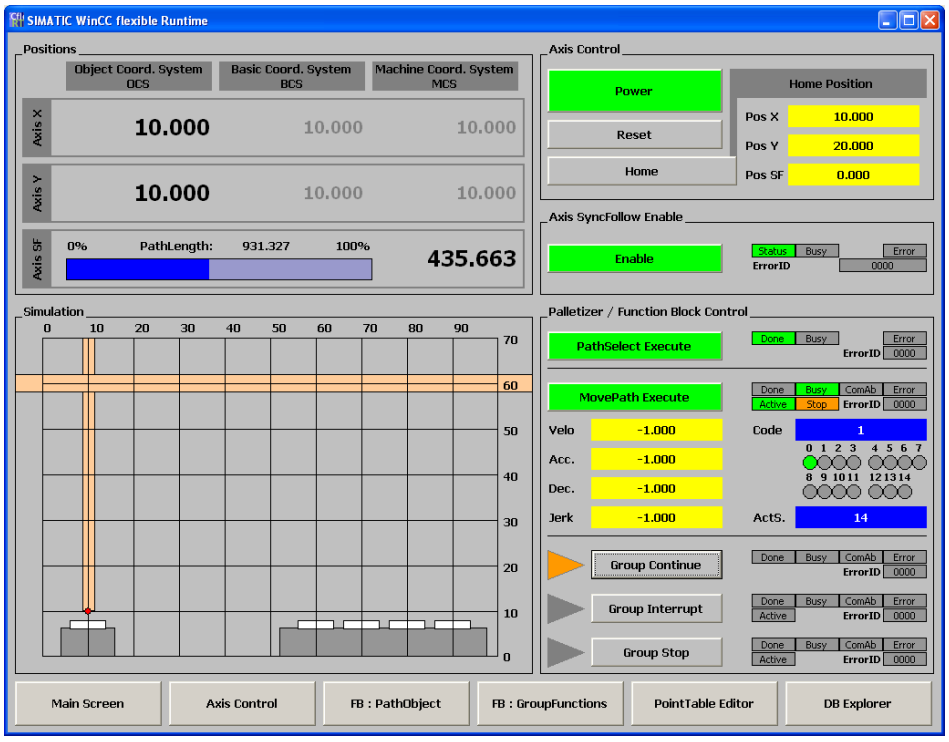
Please refer to the documentation of the above mentioned FAQ for a detailled description of the sample program operation.

4.2 Restrictions within the interpolation point tables

The following restrictions apply for the creation of interpolation point tables via the PointTable Editor in the sample program:

- On the HMI user interface, motions can only be shown two-dimensionally (2D); for this reason, the interpolation points in the interpolation point table should only be entered with X and Y coordinates. Motions in Z direction are not displayed.
- To represent the interpolation point positions on the HMI Interface, the following value ranges are to be kept:
  - X coordinates: 0 ≤ X ≤ 100
  - Y coordinates: 0 ≤ X ≤ 70

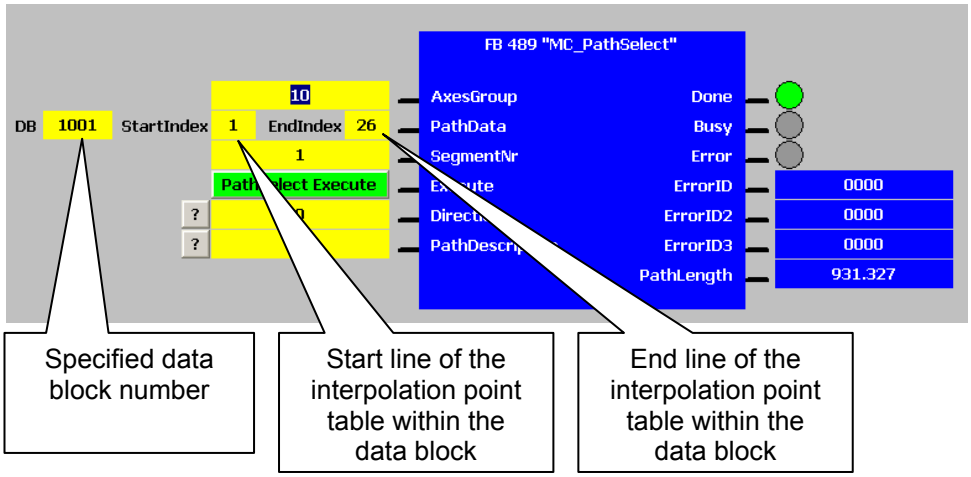
Figure 4-1 Sample program



4.3 Selection of the interpolation point tables

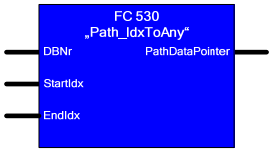
Within the sample program, the interpolation point table is selected via the operating range "FB: PathObject". If a new interpolation point table has been created in the technology CPU via the PointTable Editor, it has to be entered here for processing.

Figure 4-2 Selecting the interpolation point table via the operating range "FB: PathObject"



The FC 530 "Path_IdxToAny" is used for creating the ANY pointer at the input of the technology function FB 489 "MC_PathSelect", via which the data block number and the StartIndex or EndIndex can be entered directly.

Figure 4-3 Block FC 530 "Path_IdxToAny"



Note

By defining StartIndex and EndIndex of the interpolation point table, or start line and end line respectively, it is also possible to store more than one interpolation point table within one data block.