<Operationmanual_Advanced Gripping_TC2_V2(EN).docx>
topic: <FB Advanced Gripping>

version: <2.0>

History

Author	Reason for change/changes made	Release	Date
Armbruster	Creation	1.01	
Lindner	Completion header and extensioning DataTransfer	1.1	26.03.2019
Nock	Displaying parameter change with output bit Bugfix: holding pressure current at mode 63, 73, 85, 95 Automatic reset of the direction flags	1.21	31.03.2020
Nock	Selection of Homing-DeviceMode Compatibility with GEP2000IL-03-B Optimization of drive command routines Optimization of the MotorON routine Bugfix: "DataTransferError"	2.0	01.08.2021

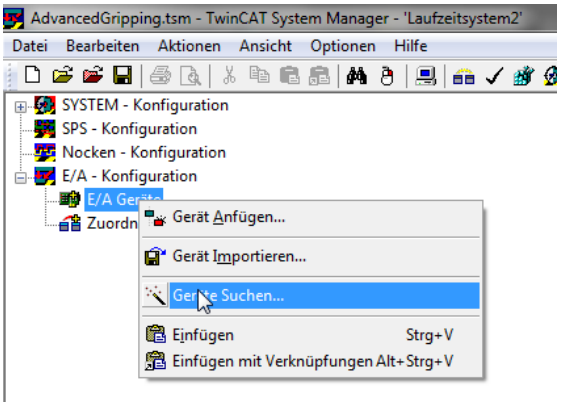
Content

1 Foreword

For using the example program at first a correct hardware configuration must be done. In this example a Beckhoff CX9020 with a Beckhoff IO Link master are used. After the hardware settings the example project can be implemented. Please pass the following steps for that.

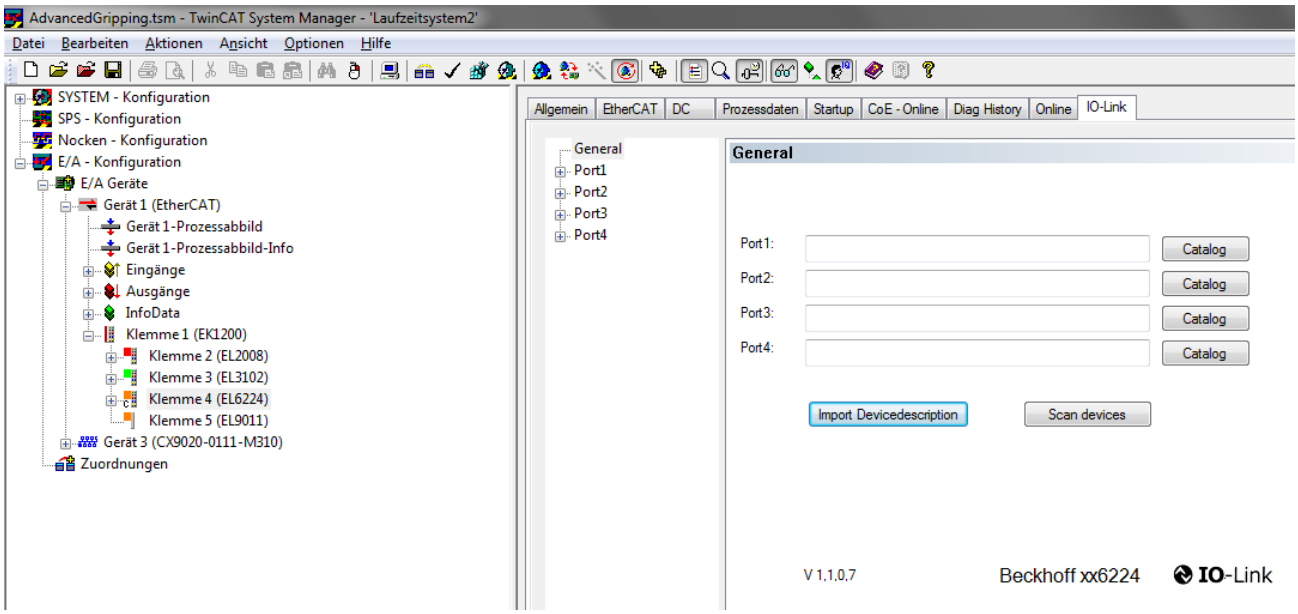
2 Creating of a system configuration with the system manager

When the connected PLC is turned to the ConfigMode, you can look for devices.



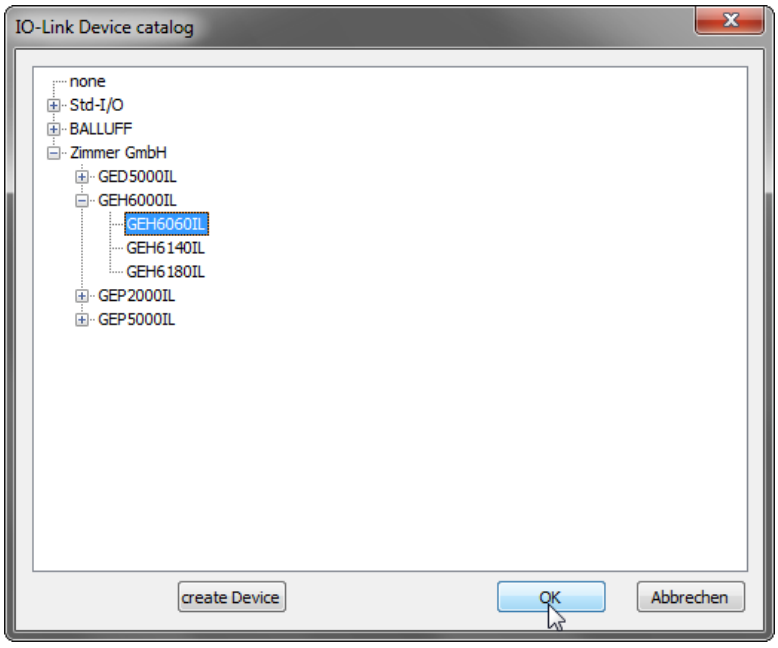
Now the connected devices should be found and listed. In our example the IO Link master (conductor 4 / EL6224) is located on the first module under the conductor 1.

The IO Link master offers the function to identify the gripper. For that you must click on „Scan devices“ in the equestrian “IO Link” in the menu of the IO Link master. After that a further window is opened which shows a list on which port which gripper is connected.



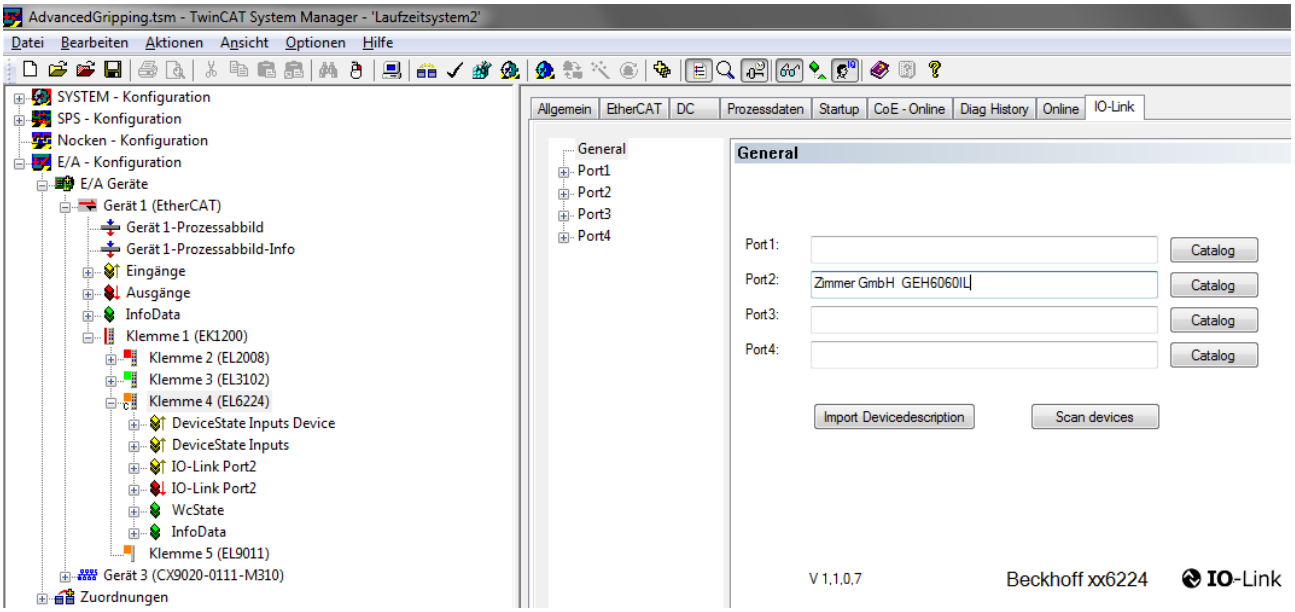
If not the correct gripper was identified or you would like to do the system configuration without the connected gripper, the gripper also can be inserted manually. For that please click on the button „Catalog“ next to the requiered port.

Now the „IO-Link Device catalog“ is opened where the several grippers are listed.



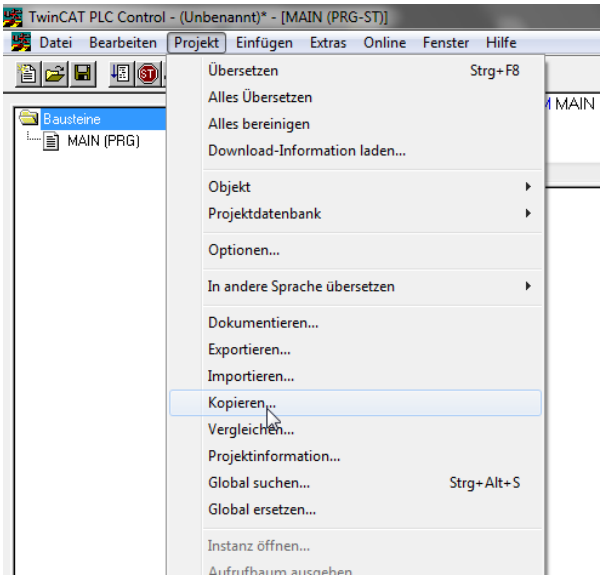
If the required gripper is not in the list, it can be inserted with a click on the button „Import Devicedescription“. All IODD data for our grippers can be downloaded from our hompage.

When the required gripper was inserted on the correct port, the gripper type is shown at the configurated port.



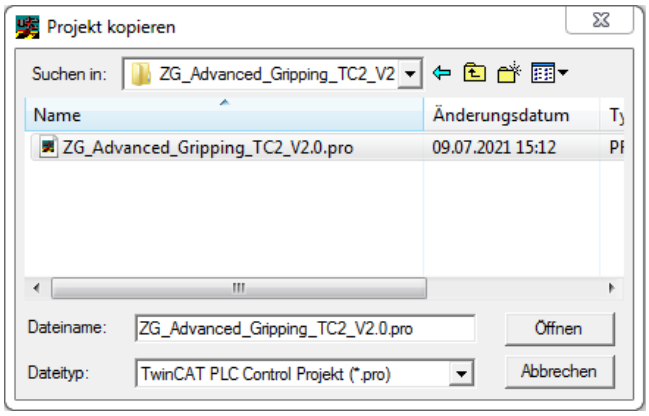
In the parameter tree the inputs and outputs can be shown. After the integration of a PLC configuration they can be linked with the variables of the program.

3 PLC Control

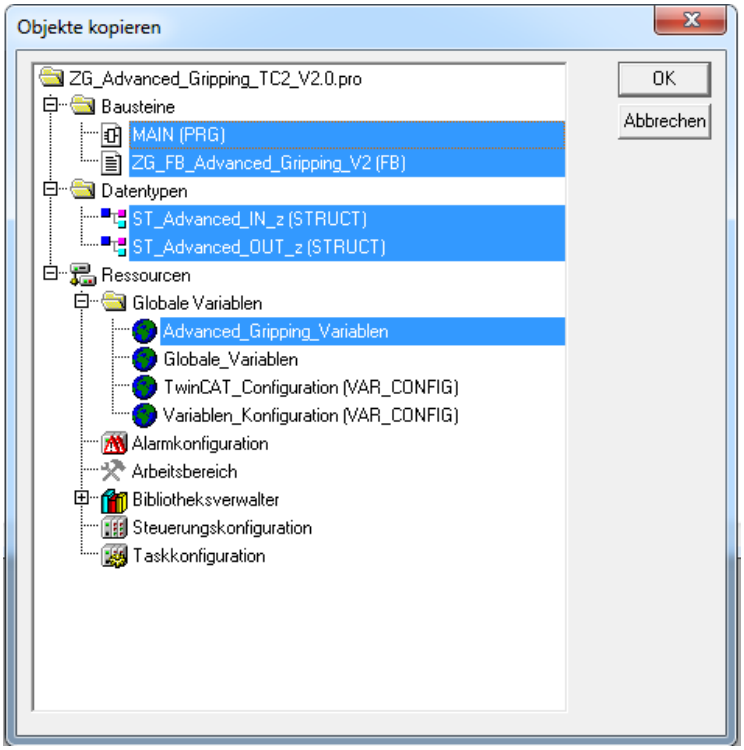


We created an example program to make the controlling of a gripper easier. In this example project is shown how a gripper can be controlled and how the several signals must be handled.

You have to copy the required blocks from our example project for using them in your application. For that you must select in your project the command „Copy …“ in the menu „Project“.



In the opened window you must select now our example project.



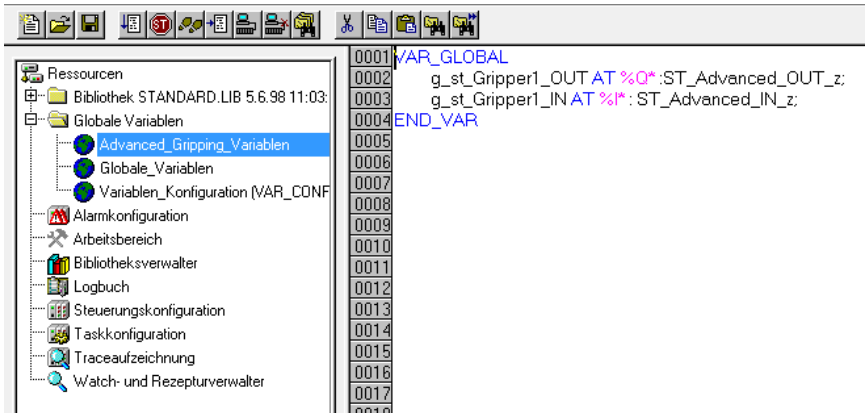
The desired components of the project can be copied in the "Copy objects" window. The function block "ZG_FB_Advanced_Gripping_V2" contains the program flow to control the gripper correctly. So that the module can work correctly, the data types "ST_Advanced_IN_z" and "ST_Advanced_OUT_z" and the global variable file "Advanced_Gripping_Variablen" are needed. You can now select all of these and insert them into your existing program by clicking the "OK" button. If you have created a new empty project, you can also copy the "MAIN" block into your project. This module contains the program call for the module "ZG_FB_Advanced_Gripping_V2".

```
ST_Advanced_OUT_z
0001 TYPE ST_Advanced_OUT_z :
0002 STRUCT
0003     i16_ControlWord : WORD;
0004     i8_DeviceMode : BYTE;
0005     i8_WorkpieceNo : BYTE;
0006     i8_Reserve : BYTE;
0007     i8_PositionTolerance : BYTE;
0008     i8_GripForce : BYTE;
0009     i8_DriveVelocity : BYTE;
0010     i16_BasePosition : WORD;
0011     i16_ShiftPosition : WORD;
0012     i16_TeachPosition : WORD;
0013     i16_WorkPosition : WORD;
0014 END_STRUCT
0015 END_TYPE
0016
```

The definitions of the data types "ST_Advanced_OUT_z" and "ST_Advanced_IN_z" are an exact image of the input and output variables of the gripper that you want to control. The order and the data size must be identical to the default from the assembly instructions of the gripper.

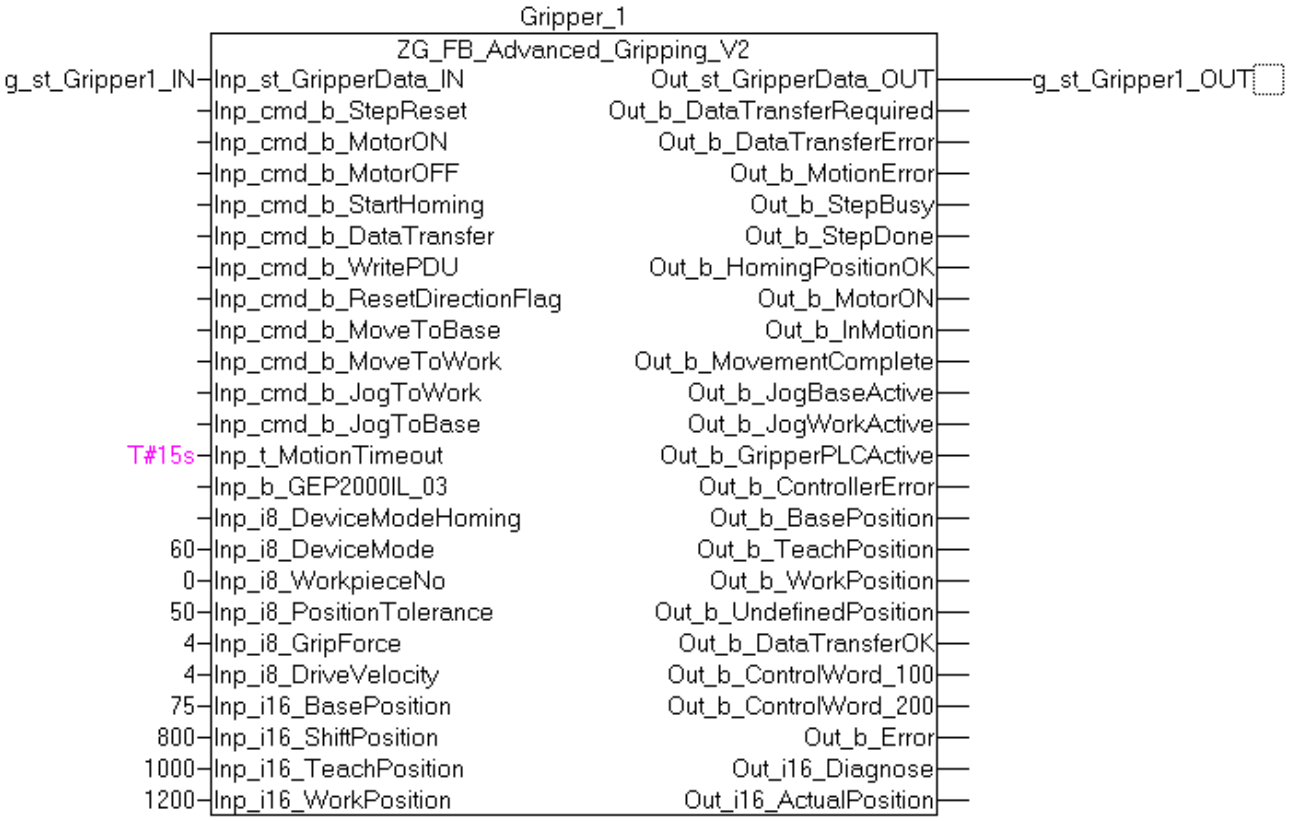
If this should change, the data areas would no longer be synchronous and the gripper could not process the data correctly. Proper control of the gripper would therefore no longer be possible.

```
ST_Advanced_IN_z
0001 TYPE ST_Advanced_IN_z:
0002 STRUCT
0003     i16_StatusWord : WORD;
0004     i16_Diagnose: WORD;
0005     i16_ActualPosition: WORD;
0006 END_STRUCT
0007 END_TYPE
0008
```



In the enclosed variable table the variable "g_st_Gripper1_OUT" is declaired with the data type "ST_Advanced_OUT_z" and the variable "g_st_Gripper1_IN" with the data type "ST_Advanced_IN_z". These variables must be added to the block later.

For the simpler legibilty of the function block it was inserted in the programming language FUP.



Nomenclature:

Prefix	**Meaning**
Inp	Input variable
Out	Output variable
cmd	Command input
b	Binary signal (BOOL)
i8	Variable in byte size (BYTE)
i16	Variable in word size (WORD)
st	Data structure (STRUCT)
t	Time (TIME)
g	Global variable

4 Using the function block

To enable the function block to access the address ranges of the IO-Link data, the variables "Inp_st_GripperData_IN" and "Out_st_GripperData_OUT" must be linked to the variables created in point 3. The gripper can be parameterized by writing to the input variables on the module.

To move the gripper, the position and travel data must be transferred. The values listed in the following table can be used as standard values. Other values may prove to be more suitable. Please refer to the installation and operating instructions. You can enter these parameters as constants on the module, as in this example, or you can use variables of the appropriate length, so that the circuitry is flexible. When not connected, the variables are pre-initialized with the default values.

Variable	**Value**
Inp_t_MotionTimeout	T#15s
Inp_i8_DeviceMode	60
Inp_i8_WorkpieceNo	0
Inp_i8_PositionTolerance	50
Inp_i8_GripForce	4
Inp_i8_DriveVelocity	4
Inp_i16_BasePosition	75
Inp_i16_ShiftPosition	800
Inp_i16_TeachPositon	1000
Inp_i16_WorkPosition	1200

The "Inp_i8_DeviceMode" variable corresponds to the travel profile of the gripper. These travel profiles can be found in the installation and operating instructions for the gripper. In this example, the De-viceMode 60 was selected, which corresponds to the travel profile "Force profile external gripping".

The finished module should now correspond to the above figure. Finally, the settings must be transferred to the PLC. To do this, go through the steps required by Beckhoff:

- Translate
- Log in

5 Functions of the function block

Depending on the input wiring of the function block, the corresponding functions are executed. Further information can also be found in the comments in the block header.

5.1 Resetting the step sequence „Inp_cmd_b_StepReset“ (BOOL)

The input variable "Inp_cmd_b_StepReset" resets the step chain within this block. This happens regardless of which step the block is currently in. If the block issues the error "Out_b_DataTransferError" or "Out_b_MotionError", it can only be acknowledged by this input.

5.2 Switching on motor „Inp_cmd_b_MotorON“ (BOOL)

The gripper can only move when the motor is switched on. The gripper represents its states in the "Status-Word". If the gripper is switched off, the "Out_b_MotorON" signal is "FALSE". If the signal edge is positive, the motor is switched on and the "Out_b_MotorON" signal is set to "TRUE". The function block converts this signal into "DeviceMode" 3 and sends it to the gripper. In order for the gripper to use this "DeviceMode", a data transmission with handshake must be carried out. After successful transfer of the data, the "b_MotorON" bit changes from "FALSE" to "TRUE". The motor is now switched on. The function block does this automatically.

5.3 Switching off motor „Inp_cmd_b_MotorOFF“ (BOOL)

To switch off the gripper motor, a positive signal edge must be set at the "Inp_cmd_b_MotorOFF" input. The "DeviceMode" is automatically set to the value 5 and a data transfer is performed. The motor can be switched off at any time (except during a reference run) and is independent of which command the gripper has previously received.

5.4 Referencing the gripper „Inp_cmd_b_StartHoming“ (BOOL)

The gripper must be referenced so that it can always output the correct position. The "Out_b_HomingPositionOK" signal indicates the current status of the referencing. If this signal is set to "FALSE", the gripper does not know in which position the gripper jaws are and process-safe operation would therefore not be guaranteed. The gripper can be referenced again with the "Inp_cmd_b_StartHoming" signal. There are different referencing modes that can be set with the "Inp_i8_DeviceModeHoming" input. With a positive signal edge, the gripper starts a new homing run with the set referencing mode. A reference run must not take place in the gripped state. Make sure in advance that the gripper is free to move.

5.5 Transfering data with handshake „Inp_cmd_b_DataTransfer“ (BOOL)

After each change of a process parameter (except "ControlWord") or at a cold start of the gripper, the parameters must be taken over with a data transfer. If the "Out_b_DataTransferRequired" output variable is "TRUE", the gripper is not yet operating with the currently set parameters. In this case, the process parameters must be transferred with a positive signal edge at the "Inp_cmd_b_DataTransfer" input. The variable "Out_b_DataTransferRequired" then changes to "FALSE". Thereby the "ControlWord" is set to value 1 and waits for bit 12 of the "Status-Word". Bit 12 becomes "TRUE" as soon as the data transfer is completed. Then the "ControlWord" is set to 0 again and waited until bit 12 becomes "FALSE". This procedure is a handshake and should be used for error-free data transfer.

5.6 Saving workpiece recipes „Inp_cmd_b_WritePDU“ (BOOL)

With a positive signal edge, the currently set process parameters at the function block input are stored in the currently set "WorkpieceNo". The "ControlWord" is set to value 2 and bit 12 of the "StatusWord" is waited for. This procedure can take up to 30 seconds. The parameters are stored in the internal recipe locations and can be reloaded by specifying the "WorkpieceNo". Up to 32 recipes can be stored in the gripper.

5.7 Resetting the direction flags „Inp_cmd_b_ResetDirectionFlag“ (BOOL)

If a gripper is moved in the direction of "WorkPosition", for example, bit 14 of the "Status word" is set in the gripper. This signal remains until a movement in the other direction or a cold start of the gripper. If a gripper is to be moved several times in succession in the same direction, e.g. by changing positions, then this bit must first be reset. This can be done by a positive signal edge at the input "Inp_cmd_b_ResetDirectionFlag". Thereby the "ControlWord" is set to the value 4 and waits until bit 13 and bit 14 of the "StatusWord" change to "FALSE". After this, a new movement in the same direction can take place. From function block version V1.21 onwards, this procedure is carried out automatically before the gripper is moved, if necessary.

5.8 Drive to BasePosition „Inp_cmd_b_MoveToBase“ (BOOL)

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "BasePosition". The "ControlWord" is set to the value 256.

5.9 Drive to WorkPosition „Inp_cmd_b_MoveToWork“ (BOOL)

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "WorkPosition". The "ControlWord" is set to the value 512.

5.10 Jog in direction WorkPosition „Inp_cmd_b_JogToWork“ (BOOL)

The gripper moves in inching mode. No software limit switches are active in this mode. When this input is set to "TRUE", the "DeviceMode" is automatically set to the value 11, a handshake is performed and the corresponding bit of the "ControlWord" is set. The gripper jaws move at low speed in the direction of the "WorkPosition". When the input is set to "FALSE", the gripper stops again.

5.11 Jog in direction BasePosition „Inp_cmd_b_JogToBase“ (BOOL)

The gripper moves in inching mode. No software limit switches are active in this mode. When this input is set to "TRUE", the "DeviceMode" is automatically set to the value 11, a handshake is performed and the corresponding bit of the "ControlWord" is set. The gripper jaws move at low speed in the direction of the "BasePosition". When the input is set to "FALSE", the gripper stops again.

5.12 Limitting of the motion time „Inp_t_MotionTimeout“ (TIME) and „Out_b_MotionError“ (BOOL)

The "Inp_t_MotionTimeout" time can be used to define the maximum time the gripper may take to move until it reaches its target position. This depends on the parameterization of the gripper and must be adapted project-specifically. If the gripper does not reach its target position within the set time, the "MotionError" error is activated. The "Out_b_MotionError" output is set to "TRUE".

5.13 Switchover to use of a GEP2000IL-03-B "Inp_b_GEP2000_03" (BOOL)

In addition to the GEH6000IL, this function block is also compatible with the GEP2000IL-03 gripper series. Setting the input to "TRUE" signals to the function block that it is operated with a GEP2000IL-03-B. The functions that a GEP2000IL-03-B does not have compared to a GEH6000IL are thus deactivated.

5.14 Setting homing mode "Inp_i8_DeviceModeHoming" (BYTE)

The desired referencing mode (e.g. "14" for DeviceMode 14) can be set at this input. The modes can be taken from the installation and operating instructions. When not connected, DeviceMode 10 is set as default. It is not allowed to connect the input with the value "0". Homing is started with the "Inp_b_cmd_StartHoming" input (see 5.4).

5.15 Data transfer is required „Out_b_DataTransferRequired“ (BOOL)

The variable "Out_b_DataTransferRequired" is automatically activated if at least one process parameter was changed at the inputs. As long as this variable is active, the gripper has not yet transferred the changed values. For data transfer, a positive signal edge must be set at the "Inp_cmd_b_DataTransfer" input variable.

The "Out_b_DataTransferRequired" variable then changes to "FALSE" and the gripper uses the currently set parameters.

5.16 Error in the DataTransfer „Out_b_DataTransferError“ (BOOL)

The "Out_b_DataTransferError" output is set to "TRUE" if the data transfer could not be carried out successfully and the feedback of the gripper was not sent within one second. This can occur, among other things, if the set process parameters are not plausible. The error code can be taken from the variable "Out_i16_Diagnose". The error codes are described in more detail in the installation and operating instructions. This error can be acknowledged by setting the "Inp_cmd_b_StepReset" input.

5.17 Function block is busy „Out_b_StepBusy“ (BOOL)

If the block is processing a command and is in a step, this output is active and signals that it is blocked for further commands.

5.18 Ready for commands „Out_b_StepDone“ (BOOL)

If the block is in the initial step and ready for commands, this output is "TRUE". Querying this bit before a command for programming step chains is recommended.

5.19 Bit 0 of the StatusWord „Out_b_HomingPositionOK“ (BOOL)

The gripper has an internal distance measuring system which does not have to be referenced under normal circumstances. As long as the gripper has a valid referencing, this signal is active. As soon as this signal is set to "FALSE", the gripper must be referenced again (see 5.4).

5.20 Bit 1 of the StatusWord „Out_b_MotorON“ (BOOL)

As long as this signal is "FALSE", the gripper cannot be moved. The motor of the gripper must first be switched on (s 5.2).

5.21 Bit 2 of the StatusWord „Out_b_InMotion“ (BOOL)

This signal is active as long as the gripper jaws are moving.

5.22 Bit 3 of the StatusWord „Out_b_MovementComplete“ (BOOL)

This signal indicates that a movement has been completed and the gripper is at a standstill.

5.23 Bit 4 of the StatusWord „Out_b_JogBaseActive“ (BOOL)

This signal is active as long as the gripper is controlled in jog mode and moved in the direction of the "Base position".

5.24 Bit 5 of the StatusWord „Out_b_JogWorkActive“ (BOOL)

This signal is active as long as the gripper is controlled in jog mode and moved in the direction of the "WorkPosition".

5.25 Bit 6 of the StatusWord „Out_b_GripperPLCActive“ (BOOL)

This signal indicates the operational readiness of the control in the gripper. In the event of a cold start or restart after a power failure, the gripper can only receive data again when this signal is "TRUE".

5.26 Bit 7 of the StatusWord „Out_b_ControllerError“ (BOOL)

Error in the internal controller.

5.27 Bit 8 of the StatusWord „Out_b_BasePosition“ (BOOL)

As soon as the gripper has reached its set "BasePosition" and is at standstill, this signal is activated. The size of the range is defined by the "PositionTolerance".

5.28 Bit 9 of the StatusWord „Out_b_TeachPosition“ (BOOL)

As soon as the gripper has reached its set "TeachPosition" and is at standstill, this signal is activated. The size of the range is defined by the "PositionTolerance".

5.29 Bit 10 of the StatusWord „Out_b_WorkPosition“ (BOOL)

As soon as the gripper has reached its set "WorkPosition" and is at standstill, this signal is activated. The size of the range is defined by the "PositionTolerance".

5.30 Bit 11 of the StatusWord „Out_b_UndefinedPosition“ (BOOL)

If the gripper is stationary and is neither at "BasePosition" nor at "TeachPosition" or "WorkPosition", this signal is "TRUE".

5.31 Bit 12 of the StatusWord „Out_b_DataTransferOK“ (BOOL)

With this bit the gripper gives the feedback that a data transmission has been successfully executed. Therefore it is used in a handshake procedure.

5.32 Bit 13 of the StatusWord „Out_b_ControlWord_100“ (BOOL)

This direction flag becomes active when the gripper has received a "MoveToBase" command. The gripper cannot execute another "MoveToBase" command in this state. The flag is set to "FALSE" again when the gripper receives a "MoveToWork" command or a reset is performed manually via "Inp_cmd_b_ResetDirectionFlag" (see 5.7).

5.33 Bit 14 of the StatusWord „Out_b_ControlWord_200“ (BOOL)

This direction flag becomes active when the gripper has received a "MoveToWork" command. The gripper cannot execute another "MoveToWork" command in this state. The flag is set to "FALSE" again when the gripper receives a "MoveToBase" command or a reset is performed manually via "Inp_cmd_b_ResetDirectionFlag" (see 5.7).

5.34 Bit 15 of the StatusWord „Out_b_Error“ (BOOL) and „Out_i16_Diagnose“ (UINT)

If the diagnostic value of the gripper is not 0, this bit is set. The error code is output in the data word "Out_i16_Diagnose". The descriptions of the error codes can be taken from the assembly and operating instructions.

5.35 Actual position "Out_i16_ActualPosition" (UINT)

In this data word the actual position of the gripper jaws is output in 0.01mm.