

PacDrive™

Robotics

Manual Gripper – Zimmer GmbH

ReadMe

March 2026

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1 Foreword

This manual can be used to integrate a gripper from Zimmer Group into a Schneider Electric system. Further information can be found in the operating manuals of the grippers. The documents are available for download on the website www.zimmer-group.com Comprehensive summary providing an overview of all validation results

2 Hardware

2.1 Supported Hardware

- PacDrive Lexium Motion Controller
- Communication module (TM5NS31)
- Power distribution module(TM5SPS3)
- Interface Module IO-Link (TM5SE4IOL)
- Gripper Zimmer Group

2.2 Software requirements

- EcoStruxure Machine Expert V2.3 or higher

2.3 Wiring Hardware

The gripper as well as all used TM5-Modules are to be wired as shown in the diagram. A line topology or ring topology can be used in the sercos system.

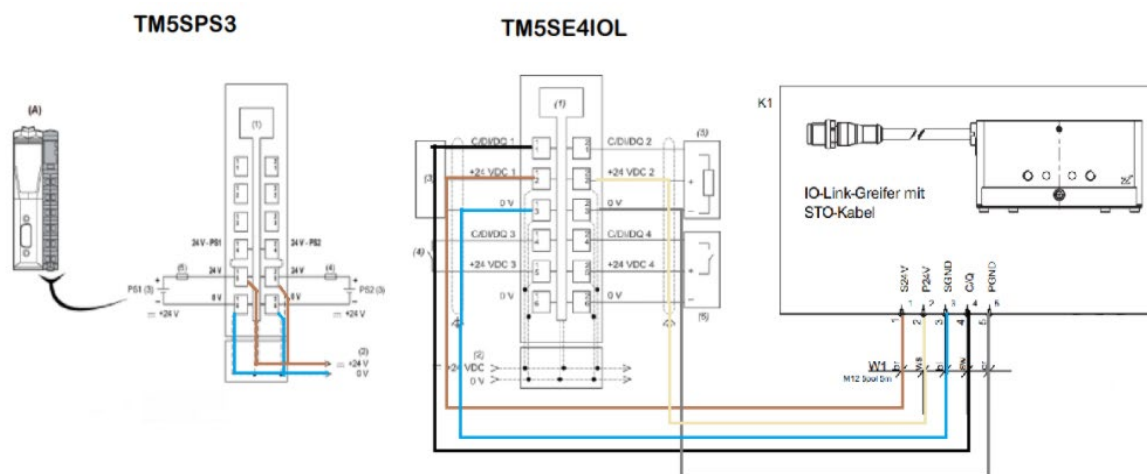


Figure 1: Wiring diagram

3 Integrating the function block

Open the project "Gripper_Interface_Basic" or "Gripper_Interface_Zimmer_Advanced" (depending on the type of gripper used) and copy the folder "Zimmer_Gripper" into your project. Additionally, the Communication module (TM5NS31), Power distribution module (TM5SPS3) and Interface Module IO-Link (TM5SE4IOL) needs to be added. This structure can also be copied from the project or taken individually.

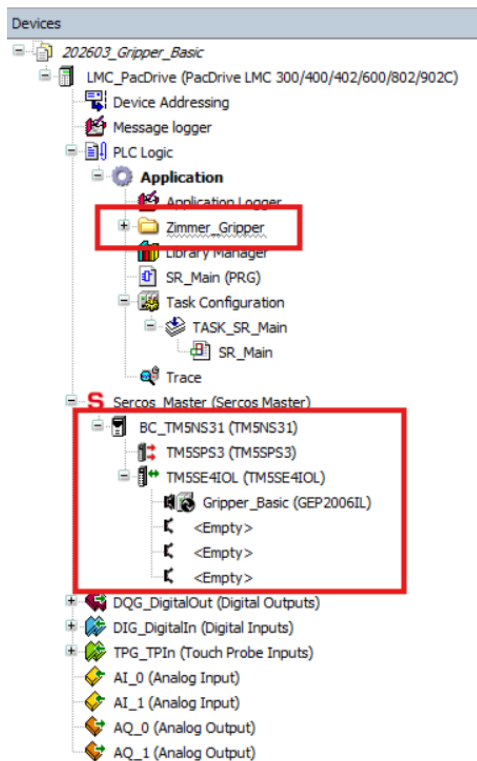


Figure 2: Required components

3.1 Device Repository

In order to properly load the grippers into the project, it is necessary to insert the respective XML file of the gripper into the project. For this, the "Device Repository" must be opened via the "Tools" menu item and the XML file must be installed.

3.2 Global Variables

Variables for the input and output data of the gripper with the correct data type are already created in the variable table.

The global variables are assigned to the physical quantities under the IO-Link object "Gripper_Basic" or "Gripper_Advanced"

3.3 Using the function block

To enable the function block to access the address ranges of the IO-Link data, the variables "i_stGripperDataIn" and "q_stGripperDataOut" must be linked to the variables created in point 4. The gripper can be parameterized by writing to the input variables on the module.

Furthermore, it must be noted that in the bus coupler, the parameter "OutputsActiveSet" is set to "ON".

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
i_tMotionTimeout	T#15s
i_etDeviceMode	63
i_etDeviceModeHoming	10
i_etWorkpieceNumber	0
i_lPositionTolerance	1
i_lGripForce	90
i_lDriveVelocity	100
i_lBasePosition	1
i_lShiftPosition	20
i_lTeachPositon	38
i_lWorkPosition	40

Table 1 : Standard input values Advanced

Variable	Value
i_etDeviceMode	100
i_etWorkpieceNumber	0
i_lPositionTolerance	1
i_lGripForce	1
i_lTeachPositon	10

Table 2 : Standard input values Basic

4 Function block FB_Advanced_Gripper

4.1 Enable the FB with "i_xEnable"

The input variable `i_xEnable` is meant to enable the function block.

It should be ensured that an "OutputsActiveSet" has been set in the Sercos III bus interface module.

4.2 Input data "i_stGripperDataIn"

The input data of the gripper is passed to the function block via the input "i_stGripperDataIn". Input data includes: Statusword, Diagnosis and the actual position of the Gripper.

4.3 Resetting the step sequence „i_xStepReset“

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

4.4 Switching on motor „i_xMotorOn“

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 "q_xMotorOn" signal is "FALSE". If the signal edge is positive, the motor is switched on and the "q_xMotorON" signal is set to "TRUE". The input is edge-triggered. The function block converts this signal into "Device-Mode" 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 "q_xMotorON" bit changes from "FALSE" to "TRUE". The motor is now switched on. The function block does this automatically.

4.5 Switching off motor "i_xMotorOff"

To switch off the gripper motor, a positive signal edge must be set at the "i_xMotorOff" 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.

4.6 Referencing the gripper „i_xStartHoming“

The gripper must be referenced so that it can always output the correct position. The "q_xHomingPositionOK" 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 "i_xStartHoming" 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.

4.7 Transferring data with handshake „i_xDataTransfer“

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 "q_xDataTransferRequired" 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 "i_xDataTransfer" input. The variable "q_xDataTransferRequired" 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 "Control-Word" 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.

4.8 Saving workpiece recipes „i_xWritePDU“

With a positive signal edge, the currently set process parameters at the function block input are stored in the currently set "WorkpieceNumber". This procedure can take up to 30 seconds. The parameters are stored in the internal recipe locations and can be reloaded by specifying the "WorkpieceNumber". Up to 32 recipes can be stored in the gripper.

4.9 Resetting the direction flags „i_xResetDirectionFlag“

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.

4.10 Drive to BasePosition „i_xMoveToBase“

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "BasePosition".

4.11 Drive to WorkPosition „i_xMoveToWork“

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "WorkPosition".

4.12 Jog in direction WorkPosition „i_xJogToWork“

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.

4.13 Jog in direction BasePosition „i_xJogToBase“

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.

4.14 Limiting of the motion time „i_tMotionTimeout“ and „q_xMotionError“

The "i_tMotionTimeout" 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 "q_xMotionError" output is set to "TRUE". The Error can only be acknowledged by the input "i_xStepReset".

4.15 Setting homing mode "i_etDeviceModeHoming"

The desired referencing mode (e.g. "14" for DeviceMode 14) can be set at this input. When not connected, DeviceMode 10 is set as default. Homing is started with the "i_xStartHoming" input.

Further information can be found in the datasheet of the gripper.

etDeviceModeHoming	Description
10	Homing outside - to the internal limit switch of the product
14	Homing inside - to the internal limit switch of the product
16	"Special" homing outside - on external stop
17	"Special" homing inside - on external stop

Table 3 : etDeviceModeHoming

4.16 Output data "q_stGripperDataOut"

The output data of the function block to the gripper is transmitted through the output "q_stGripperDataOut".

Output data includes: ControlWord, DeviceMode, WorkPieceNo, PositionTolerance, GripForce, DriveVelocity, BasePosition, ShiftPosition, TeachPosition and WorkPosition.

4.17 Data transfer is required „q_xDataTransferRequired“

The variable "q_xDataTransferRequired" 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 "i_xDataTransfer" input variable. The "q_xDataTransferRequired" variable then changes to "FALSE" and the gripper uses the currently set parameters.

4.18 Error in DataTransfer "q_xDataTransferError"

The "q_xDataTransferError" 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. This error can be acknowledged by setting the "i_xStepReset" input.

4.19 Function block is busy "q_xStepBusy"

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.

4.20 Ready for commands "q_xStepDone"

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.

4.21 "q_xHomingPositionOk" (Bit 0 of the StatusWord)

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.

4.22 "q_xMotorOn" (Bit 1 of the StatusWord)

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

4.23 "q_xInMotion" (Bit 2 of StatusWord)

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

4.24 "q_xMovementComplete" (Bit 3 of StatusWord)

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

4.25 "q_xJogBaseActive" (Bit 4 of StatusWord)

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

4.26 "q_xJogWorkActive" (Bit 5 of StatusWord)

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

4.27 „q_xGripperPLCActive“ (Bit 6 of the StatusWord)

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".

4.28 „q_xControllerError“ (Bit 7 of the StatusWord)

Error in the internal controller of the gripper.

4.29 „q_xBasePosition“ (Bit 8 of the StatusWord)

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".

4.30 „q_xTeachPosition“ (Bit 9 of the StatusWord)

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".

4.31 „q_xWorkPosition“ (Bit 10 of the StatusWord)

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".

4.32 „q_xUndefinedPosition“ (Bit 11 of the StatusWord)

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

4.33 „q_xDataTransferOK“ (Bit 12 of the StatusWord)

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

4.34 „q_xDirectionFlagBasePos“ (Bit 13 of the StatusWord)

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 6.7).

4.35 „q_xDirectionFlagWorkPos (Bit 14 of the StatusWord)

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 "i_xResetDirectionFlag" (see 6.7).

4.36 „q_xError“ (Bit 15 of the StatusWord) and „q_etResult“ / “q_sResultMsg”

If the diagnostic value of the gripper is not 0 or the function block has an error, this bit is set. The error code is output in the data word "q_etResult" and the message "q_sResultMsg".

4.37 Actual position "q_uiActualPosition"

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

5 Function block FB_Basic_Gripper

5.1 Enable the FB with "i_xEnable"

The input variable i_xEnable is meant to enable the function block.

It should be ensured that an "OutputsActiveSet" has been set in the Sercos III bus interface module.

5.2 Input data "i_stGripperDataIn"

The input data of the gripper is passed to the function block via the input "i_stGripperDataIn". Input data includes: Statusword, Diagnosis and the actual position of the Gripper.

5.3 Resetting the step sequence „i_xStepReset“

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

5.4 Transferring data with handshake „i_xDataTransfer“

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 "q_xDataTransferRequired" 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 "i_xDataTransfer" input. The variable "q_xDataTransferRequired" then changes to "FALSE". Thereby the "ControlWord" is set to value 1 and waits for bit 12 of the "StatusWord". 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.

5.5 Reset the jaw end positions "i_xAdjust"

Setting this bit will reset the jaw end positions, provided no other bit in the control word is set.

5.6 Saving workpiece recipes „i_xWritePDU“

With a positive signal edge, the currently set process parameters at the function block input are stored in the currently set "WorkpieceNumber". This procedure can take up to 30 seconds. The parameters are stored in the internal recipe locations and can be reloaded by specifying the "WorkpieceNumber". Up to 32 recipes can be stored in the gripper.

5.7 Resetting the direction flags „i_xResetDirectionFlag“

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.

5.8 Drive to BasePosition „i_xMoveToBase“

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "BasePosition".

5.9 Drive to WorkPosition „i_xMoveToWork“

With a positive signal edge, the gripper jaws move with the set travel profile in the direction of the set "WorkPosition".

5.10 Output data “q_stGripperDataOut”

The output data of the function block to the gripper is transmitted through the output “q_stGripperDataOut”.

Output data includes: ControlWord, DeviceMode, WorkPieceNo, PositionTolerance, GripForce, DriveVelocity, BasePosition, ShiftPosition, TeachPosition and WorkPosition.

5.11 Data transfer is required „q_xDataTransferRequired“

The variable “q_xDataTransferRequired” 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 “i_xDataTransfer” input variable. The “q_xDataTransferRequired” variable then changes to “FALSE” and the gripper uses the currently set parameters.

5.12 Error in DataTransfer “q_xDataTransferError”

The “q_xDataTransferError” 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. This error can be acknowledged by setting the “i_xStepReset” input.

5.13 Function block is busy “q_xStepBusy”

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.

5.14 Ready for commands “q_xStepDone”

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.

5.15 „q_xGripperPLCActive“ (Bit 6 of the StatusWord)

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”.

5.16 „q_xBasePosition“ (Bit 8 of the StatusWord)

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”.

5.17 „q_xTeachPosition“ (Bit 9 of the StatusWord)

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”.

5.18 „q_xWorkPosition“ (Bit 10 of the StatusWord)

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”.

5.19 „q_xUndefinedPosition“ (Bit 11 of the StatusWord)

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

5.20 „q_xDataTransferOK“ (Bit 12 of the StatusWord)

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

5.21 „q_xDirectionFlagBasePos“ (Bit 13 of the StatusWord)

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 6.7).

5.22 „q_xDirectionFlagWorkPos (Bit 14 of the StatusWord)

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 "i_xResetDirectionFlag" (see 6.7).

5.23 „q_xError“ (Bit 15 of the StatusWord) and „q_etResult“ / “q_sResultMsg”

If the diagnostic value of the gripper is not 0 or the function block has an error, this bit is set. The error code is output in the data word "q_etResult" and the message "q_sResultMsg".

5.24 Actual position "q_uiActualPosition"

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

6 Appendices

6.1 Advanced Gripper

Channel Name	Bit	Name
Gripper Control (Controlword)	0	DataTransfer
	1	WritePDU
	2	ResetDirectionFlag
	3	Teach
	4	Reserve
	5	Reserve
	6	Reserve
	7	Reserve
	8	MoveToBase
	9	MoveToWork
	10	JogToWork
	11	JogToBase
	12	Reserve
	13	Reserve
	14	Reserve
	15	Reserve
DeviceMode	0-7	Set Basic Operations and Movement
WorkPieceNo	0-7	SetWorkPieceNo
Reserve	0-7	
PositionTolerance	0-7	SetPositionTolerance
GripForce	0-7	SetGripForce
DriveVelocity	0-7	SetDriveVelocity
BasePosition	0-15	SetBasePosition
ShiftPosition	0-15	SetShiftPosition
TeachPosition	0-15	SetTeachPosition
WorkPosition	0-15	SetWorkPosition

Channel Name	Bit	Name
Gripper Status (Statusword)	0	HomingPositionOk
	1	MotorOn
	2	InMotion
	3	Movement Complete
	4	JogBaseActive-
	5	JogworkActivr+
	6	GripperPLCactive
	7	Reserve
	8	BasePosition
	9	TeachPosition
	10	WorkPosition
	11	UndefinedPosition
	12	DataTransferOK
	13	ControlWord
	14	ControlWord
	15	Error
Diagnose	0-15	Error diagnosis
Actual Position	0-15	Position Feedback

Figure 3 : Advanced Gripper Register

DeviceMode	Description
5x	Positioning profiles
50	Standard
51	High clock rate
6x	Force profiles – Outside gripping
60	Without holding pressure for energy-saving gripping
61	High clock rate for energy-saving gripping
63	With holding pressure for detecting part loss
64	With stronger holding pressure for detecting part loss
65	Without holding pressure for flexible/elastic components
7x	Force profiles – Inside gripping
70	Without holding pressure for energy-saving gripping
71	High clock rate for energy-saving gripping
73	With holding pressure for detecting part loss
74	With stronger holding pressure for detecting part loss
75	Without holding pressure for flexible/elastic components
8x	Pre-positioning – Force profiles – Outside gripping
80	Without holding pressure for energy-saving gripping
81	High clock rate for energy-saving gripping
84	With stronger holding pressure for detecting part loss
85	With holding pressure for detecting part loss
9x	Pre-positioning – Force profiles – Inside gripping
90	Without holding pressure for energy-saving gripping
91	High clock rate for energy-saving gripping
94	With stronger holding pressure for detecting part loss
95	With holding pressure for detecting part loss

Figure 4 : Movement Profile Advanced Gripper

6.2 Basic Gripper

Channel Name	Bit	Name	Channel Name	Bit	Name
Gripper Control (Controlword)	0	DataTransfer	Gripper Status (Statusword)	0	Reserve
	1	WritePDU		1	Reserve
	2	ResetDirectionFlag		2	Reserve
	3	Teach		3	Reserve
	4	Reserve		4	Reserve
	5	Reserve		5	Reserve
	6	Reserve		6	GripperPLCActive
	7	Adjust		7	Reserve
	8	MoveToBase		8	BasePosition
	9	MoveToWork		9	TeachPosition
	10	Reserve		10	WorkPosition
	11	Reserve		11	UndefinedPosition
	12	Reserve		12	DataTransferOK
	13	Reserve		13	ControlWord
	14	Reserve		14	ControlWord
	15	ErrorReset		15	Error
DeviceMode	0-7	Set Basic Operations and Movement	Diagnose	0-15	Error diagnosis
WorkPieceNo	0-7	SetWorkPieceNo	Actual Position	0-15	Position Feedback
Reserve	0-7				
PositionTolerance	0-7	SetPositionTolerance			
GripForce	0-7	SetGripForce			
DriveVelocity	0-7	SetDriveVelocity			
BasePosition	0-15	SetBasePosition			
ShiftPosition	0-15	SetShiftPosition			
TeachPosition	0-15	SetTeachPosition			
WorkPosition	0-15	SetWorkPosition			

Figure 5: Basic Gripper Register

Input	Mode	Description
63	Outside gripping with subsequent current feed	Like Mode 60, but with an activated subsequent current feed for a time of 500 ms when the direction of movement is Work. To achieve the best gripping results, the gripped workpiece must be transported further during the subsequent current feed.
73	Inside gripping with subsequent current feed	Like Mode 70, but with an activated subsequent current feed for a time of 500 ms when the direction of movement is Base. To achieve the best gripping results, the gripped workpiece must be transported further during the subsequent current feed.
103	Universal operation with subsequent current feed	Like Mode 100, but with an activated subsequent current feed for a time of 500 ms in both directions. To achieve the best gripping results, the gripped workpiece must be transported further during the subsequent current feed.
60	Outside gripping	Inward with the desired gripping force and speed, outward at high speed.
70	Inside gripping	Outward with the desired gripping force and speed, inward at high speed.
100	Universal mode	Inside and outside gripping, both movements at the same speed depending on the desired gripping force.

Figure 6: Movement Profile Basic Gripper