

WSG Series
Fieldbus Interface Manual

Firmware Version 4.0
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www.weiss-robotics.com

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1 Introduction

The WSG family of grippers provides interfaces to PROFIBUS DP V0 and/or PROFINET, depending on the device type. PROFIBUS is a widely spread field bus protocol for industrial automation. It supports both single and multiple Master modes. PROFINET is a new generation fieldbus interface designed to provide real-time communication via a standard Ethernet interface.

Every device is represented by an I/O register space that is periodically synchronized with the PROFIBUS Master or PROFINET Controller (e. g. PLC).

The following manual assumes that you are familiar with the PROFIBUS and/or PROFINET technology and the Siemens SIMATIC software.

-  **PROFINET is an optional feature for the WSG gripping modules. License keys can be obtained separately. Please contact your local sales representative.**
-  **You will find a simple PROFIBUS demo program for Siemens SIMATIC S7-1200 in the download section of the Weiss Robotics web site¹. Please refer to the link given in the “Documentation” section of the WSG’s web interface. Further information is given in chapter Appendix D.**

¹ <http://www.weiss-robotics.com>

2 PROFIBUS Interface

Each PROFIBUS slave has an I/O register space that is periodically updated and read by the PROFIBUS Master. The I/O-Space of the WSG is pre-configured at master-side by using the device profile that can be found on the Product CD or downloaded from the WSG's web interface. The I/O register space layout is described in detail in chapters 5 and 5.

2.1 Installing the GSD file in Siemens STEP7 v11.0 (TIA) and newer

The GSD file is provided as a ZIP-compressed package that contains the following files:

- WEIS5555.gsd (device description file)
- WSG_D.bmp (visualization file)
- WSG_R.bmp (visualization file)
- WSG_S.bmp (visualization file)
- install.txt (installation notes)

Follow these steps to install the GSD file in Siemens STEP7 11.0:

- Unzip the package and store the files above to your disk
- In the Siemens TIA, open the project view.
- Select "Options -> Install general station description file (GSD)"
- Point to the location where you stored the unzipped package on your disk.
- You will now find the WSG in the Device Catalog under
"Other field devices -> PROFIBUS-DP -> Drives -> Weiss Robotics GmbH & Co. KG"

2.2 Configuration

To use the WSG's PROFIBUS interface, it must first be enabled via the device's web interface. The WSG's PROFIBUS station address is predefined to 7. The station address can be changed via the web interface, too. Please refer to the User's Manual for further information.

3 PROFINET Interface

The PROFINET interface uses the same I/O register space layout that is used for PROFIBUS. Like with PROFIBUS, the I/O space is periodically updated and uses a pre-defined profile to be installed at controller side that can be found on the Product CD or downloaded from the WSG's web interface. The I/O register space is described in detail in chapters 5 and 5.

3.1 Installing the GSDML file in Siemens STEP7 v11.0 (TIA) and newer

The GSDML file is provided as a ZIP-compressed package that contains the following files:


- GSDML-V2.31-Weiss Robotics-WSG-20140401.gsdml (device description file)
- GSDML-02A2-0001-WSG.bmp (visualization file)

Follow these steps to install the GSD file in Siemens STEP7 11.0:

- Unzip the package and store the files above to your disk
- In the Siemens TIA, open the project view.
- Select "Options -> Install general station description file (GSD) "
- Point to the location where you stored the unzipped package on your disk.
- You will now find the WSG in the Device Catalog under "Other field devices -> PROFINET IO -> I/O -> Weiss Robotics GmbH & Co. KG"

3.2 Configuration

To use the WSG's PROFINET interface, it must first be enabled via the device's web interface. Further configuration options can be set either directly on the WSG using its web interface to change IP address or PROFINET device name. However, PROFINET also allows various configuration options to be set remotely using an engineering tool like e.g. Siemens STEP7. Please refer to the documentation of your engineering tool.

 **When changing the WSG's IP address settings remotely using an engineering tool, the device's web interface might become inaccessible if the PROFINET connection gets lost. It is strongly recommended to change these settings only via the WSG's web interface.**

4 Interface Description

4.1 Interface Description

The WSG's fieldbus interface is implemented as an 8-Byte output and a 12-Byte input register space as described in the following paragraphs.

4.1.1 Output Registers (PLC to WSG)


The output registers are transferred from the PROFIBUS Master or PROFINET Controller (e.g. PLC) to the WSG. They consist of command flags, user flags and three parameters and are used to control the gripper. Due to the register-space-oriented nature of PROFIBUS and PROFINET, only a subset of the WSG's command set is available via this interface. The register arrangement is given in Table 1.

Byte Number	Register Name	Description																											
0	CMDFLAGS	<p><i>Command Flags</i></p> <p>A command is issued when changing the corresponding bit from 0 to 1 (raising edge). Please see the following chapters for a detailed description.</p> <table border="1"> <thead> <tr> <th>Bit Index:</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Bit 0:</td> <td>MOVE</td> <td>Initiate a pre-position movement</td> </tr> <tr> <td>Bit 1:</td> <td>GRIP</td> <td>Grip a part</td> </tr> <tr> <td>Bit 2:</td> <td>RELEASE</td> <td>Release a part</td> </tr> <tr> <td>Bit 3:</td> <td>HOMING</td> <td>Home the gripper</td> </tr> <tr> <td>Bit 4:</td> <td>STOP/ACK</td> <td>Stop, but do not turn off the motor / Acknowledge a FAST STOP</td> </tr> <tr> <td>Bit 5:</td> <td>FASTSTOP</td> <td>Stop and turn off the motor.</td> </tr> <tr> <td>Bit 6:</td> <td>JOG+</td> <td>Jog-Mode in positive direction</td> </tr> <tr> <td>Bit 7:</td> <td>JOG-</td> <td>Jog-Mode in negative direction</td> </tr> </tbody> </table> <p>Please note: If the FASTSTOP or STOP/ACK bit is set to '1', the motion commands are disabled.</p>	Bit Index:	Name	Description	Bit 0:	MOVE	Initiate a pre-position movement	Bit 1:	GRIP	Grip a part	Bit 2:	RELEASE	Release a part	Bit 3:	HOMING	Home the gripper	Bit 4:	STOP/ACK	Stop, but do not turn off the motor / Acknowledge a FAST STOP	Bit 5:	FASTSTOP	Stop and turn off the motor.	Bit 6:	JOG+	Jog-Mode in positive direction	Bit 7:	JOG-	Jog-Mode in negative direction
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1	IF	<p><i>User Flags (input)</i></p> <p>Free programmable flags that can be used in conjunction with the Script Interpreter.</p> <table border="1"> <thead> <tr> <th>Bit Index:</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> </tbody> </table>	Bit Index:	Name	Description																								
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2..3	WIDTH	<i>Command parameter "Width"</i> New finger opening width in 1/100 millimeters (i.e. a value of 1220 means 12.20 mm). Encoded as INT (signed).
4..5	SPEED	<i>Command parameter "Speed"</i> Current movement speed in 1/100 millimeters per second (i.e. a value of 3005 means 30.05 mm/s), given as finger speed relative to each other. Encoded as WORD (unsigned). <i>Please note:</i> Setting this parameter to a value beyond the system limits and triggering a motion-related function using it raises a FAST STOP.
6..7	FORCELIMIT	<i>Command parameter "Force Limit"</i> New gripping force limit in 1/100 Newton (i.e. a value of 1050 means 10.50 N). Exception: Due to the higher force range for the WSG 70 the value is in 1/10 Newton (i.e. a value of 3050 means 305.0 N). The gripping force is twice the nominal force that is applied to the part to be gripped. Encoded as INT (signed), only positive values are allowed. <i>Please note:</i> Setting this parameter to a value beyond the system limits and triggering a motion-related function using it raises a FAST STOP.

Table 1: WSG Output Register

To initiate a command, the command parameters have to be set up and the respective command flag has to be changed from 0 to 1 (i.e. a raising transition). Jog Mode flags are level-sensitive. A detailed description of the specific commands can be found in chapter 4.1.2.

 If more than one command flag was changed simultaneously, only the command with the lowest bit number is executed (i.e. setting both MOVE and GRIP flags from 0 to 1 will result in a MOVE command).

 Changing parameters while fingers are moving (i.e. MOVING in the system flags is 1) will result in a FAST STOP.

4.1.2 Input Registers (WSG to PLC)

The input register space (see Table 2) is transferred from the WSG to the PROFIBUS Master or PROFINET Controller each cycle. It contains the current gripper parameters, its operating state, the gripper state, user defined flags as well as a status code representing the result of the last command.

Byte Number	Register Name	Description																											
0	GSTATE	<p><i>Gripping State</i></p> <p>These flags encode the current gripper state as below and are intended to control and monitor the gripping process:</p> <table border="1"> <thead> <tr> <th>Bit Index:</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Bit 0:</td> <td>IDLE</td> <td>Waiting for new command</td> </tr> <tr> <td>Bit 1:</td> <td>GRIPPING</td> <td>Fingers moving towards the part</td> </tr> <tr> <td>Bit 2:</td> <td>NO_PART</td> <td>No part found</td> </tr> <tr> <td>Bit 3:</td> <td>PART_LOST</td> <td>Part was gripped but then lost</td> </tr> <tr> <td>Bit 4:</td> <td>HOLDING</td> <td>Holding a part</td> </tr> <tr> <td>Bit 5:</td> <td>RELEASING</td> <td>Fingers moving away from the part</td> </tr> <tr> <td>Bit 6:</td> <td>POSITIONING</td> <td>Fingers moving due to a pre-position command (MOVE)</td> </tr> <tr> <td>Bit 7:</td> <td>ERROR</td> <td>An error occurred</td> </tr> </tbody> </table>	Bit Index:	Name	Description	Bit 0:	IDLE	Waiting for new command	Bit 1:	GRIPPING	Fingers moving towards the part	Bit 2:	NO_PART	No part found	Bit 3:	PART_LOST	Part was gripped but then lost	Bit 4:	HOLDING	Holding a part	Bit 5:	RELEASING	Fingers moving away from the part	Bit 6:	POSITIONING	Fingers moving due to a pre-position command (MOVE)	Bit 7:	ERROR	An error occurred
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1	OF	<p><i>User Flags (output)</i></p> <p>Freely programmable flags that can be used to interact between the PLC code and a running WSG Script.</p> <table border="1"> <thead> <tr> <th>Bit Index:</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Bit 0:</td> <td>OF1</td> <td>Output User Flag 1</td> </tr> <tr> <td>Bit 1:</td> <td>OF2</td> <td>Output User Flag 2</td> </tr> <tr> <td>Bit 2:</td> <td>OF3</td> <td>Output User Flag 3</td> </tr> <tr> <td>Bit 3:</td> <td>OF4</td> <td>Output User Flag 4</td> </tr> <tr> <td>Bit 4:</td> <td>OF5</td> <td>Output User Flag 5</td> </tr> <tr> <td>Bit 5:</td> <td>OF6</td> <td>Output User Flag 6</td> </tr> <tr> <td>Bit 6:</td> <td>OF7</td> <td>Output User Flag 7</td> </tr> </tbody> </table>	Bit Index:	Name	Description	Bit 0:	OF1	Output User Flag 1	Bit 1:	OF2	Output User Flag 2	Bit 2:	OF3	Output User Flag 3	Bit 3:	OF4	Output User Flag 4	Bit 4:	OF5	Output User Flag 5	Bit 5:	OF6	Output User Flag 6	Bit 6:	OF7	Output User Flag 7			
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2..5	SYSSTATE	<p><i>System State</i></p> <p>Current system state of the gripper encoded as a bit vector. Please see Appendix B for a description of the single bits. This register is updated every bus cycle with the system state flags regardless of the currently processed command. Please note that the system state flags should not be used to control the gripping process. Use the gripper state instead.</p> <table border="1"> <thead> <tr> <th>Bit Index:</th> <th>Name</th> </tr> </thead> <tbody> <tr><td>Bit 0</td><td>REFERENCED</td></tr> <tr><td>Bit 1</td><td>MOVING</td></tr> <tr><td>Bit 2</td><td>BLOCKED_MINUS</td></tr> <tr><td>Bit 3</td><td>BLOCKED_PLUS</td></tr> <tr><td>Bit 4</td><td>SOFT_LIMIT_MINUS</td></tr> <tr><td>Bit 5</td><td>SOFT_LIMIT_PLUS</td></tr> <tr><td>Bit 6</td><td>AXIS_STOPPED</td></tr> <tr><td>Bit 7</td><td>TARGET_POS_REACHED</td></tr> <tr><td>Bit 8</td><td>OVERDRIVE_MODE²</td></tr> <tr><td>Bit 9</td><td>FORCECNTL_MODE</td></tr> <tr><td>Bit 10</td><td>reserved</td></tr> <tr><td>Bit 11</td><td>reserved</td></tr> <tr><td>Bit 12</td><td>FAST_STOP</td></tr> <tr><td>Bit 13</td><td>TEMP_WARNING</td></tr> <tr><td>Bit 14</td><td>TEMP_FAULT</td></tr> <tr><td>Bit 15</td><td>POWER_FAULT</td></tr> <tr><td>Bit 16</td><td>CURR_FAULT</td></tr> <tr><td>Bit 17</td><td>FINGER_FAULT</td></tr> <tr><td>Bit 18</td><td>CMD_FAILURE</td></tr> <tr><td>Bit 19</td><td>SCRIPT_RUNNING</td></tr> <tr><td>Bit 20</td><td>SCRIPT_FAILURE</td></tr> <tr><td>Bit 21</td><td>reserved</td></tr> <tr><td>Bit 22</td><td>reserved</td></tr> <tr><td>Bit 23</td><td>reserved</td></tr> <tr><td>Bit 24</td><td>reserved</td></tr> <tr><td>Bit 25</td><td>reserved</td></tr> <tr><td>Bit 26</td><td>reserved</td></tr> </tbody> </table>	Bit Index:	Name	Bit 0	REFERENCED	Bit 1	MOVING	Bit 2	BLOCKED_MINUS	Bit 3	BLOCKED_PLUS	Bit 4	SOFT_LIMIT_MINUS	Bit 5	SOFT_LIMIT_PLUS	Bit 6	AXIS_STOPPED	Bit 7	TARGET_POS_REACHED	Bit 8	OVERDRIVE_MODE ²	Bit 9	FORCECNTL_MODE	Bit 10	reserved	Bit 11	reserved	Bit 12	FAST_STOP	Bit 13	TEMP_WARNING	Bit 14	TEMP_FAULT	Bit 15	POWER_FAULT	Bit 16	CURR_FAULT	Bit 17	FINGER_FAULT	Bit 18	CMD_FAILURE	Bit 19	SCRIPT_RUNNING	Bit 20	SCRIPT_FAILURE	Bit 21	reserved	Bit 22	reserved	Bit 23	reserved	Bit 24	reserved	Bit 25	reserved	Bit 26	reserved
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² Overdrive mode is not supported by all WSG grippers.


Byte Number	Register Name	Description
		Bit 27 reserved Bit 28 reserved Bit 29 reserved Bit 30 reserved Bit 31 reserved
6..7	WIDTH	<i>Current Opening Width</i> Current opening width of the fingers in 1/100 millimeters (i.e. a value of 1220 means 12.2 mm). Encoded as INT. This register is updated every bus cycle with the current opening width regardless of the currently processed command.
8..9	Gripping Force	<i>Current Gripping Force</i> Current gripping force in 1/100 Newton (i.e. a value of 405 means a gripping force of 40.5 N). Exception: Due to the higher force range for the WSG 70 the value is in 1/10 Newton (i.e. a value of 3050 means 305.0 N). This is twice the nominal force that is currently applied to a part. Encoded as INT. This register is updated every bus cycle with the current gripping force regardless of the currently processed command.  If no force measurement finger is installed on the WSG, this value is approximated using the motor current.
10..11	Status Code	<i>Result of the last Command</i> This field holds its state, until a new command is issued. Please see Appendix A for a description of possible status codes.

Table 2: WSG Input Register

4.2 PROFIBUS Diagnosis Messages

The WSG will send diagnosis messages containing the current system state flags as the first double word to the PROFIBUS Master (PLC) if at least one of the following error-related flags of its system state was raised (i.e. changes from 0 to 1):

- SF_SOFT_LIMIT_MINUS
- SF_SOFT_LIMIT_PLUS
- SF_FAST_STOP
- SF_TEMP_FAULT
- SF_POWER_FAULT
- SF_CURR_FAULT

- SF_FINGER_FAULT
- SF_CMD_FAILURE
- SF_SCRIPT_FAILURE

Please see Appendix B for a more detailed description of these flags.

The format of the diagnosis message is as follows:

Byte Number	Description
0..3	<i>Standard Diagnostic Data</i> Diagnostic Data as defined by the PROFIBUS Specification
4..5	<i>Slave Ident-No.</i> Slave Identification Number. This is 0x5555 for the WSG.
6	<i>Length of Diagnostic Message</i> Diagnosis messages of the WSG are always 10 Bytes = 0x0A.
7..10	<i>System State</i> Current system state of the gripper encoded as a bit vector. Same coding as SYSSTATE in Table 2.
10..15	<i>reserved</i> This area is reserved for future use.

Table 3: WSG Diagnosis Messages

5 Commands

5.1 Move the fingers in positioning mode (MOVE)

This command can be used to position the gripper fingers to a defined width before issuing a grip command. The command is intended to speed up gripping of sensitive parts when the gripper fingers have to travel a larger distance due to process constraints.

MOVE can only be issued if the gripper is idle, i.e. gripper state is IDLE.

Command Flag Position:

Bit 0

Parameters used:

WIDTH, SPEED, FORCELIMIT

Status Code

The status code register is set to E_CMD_PENDING upon start of the movement and set to the command's result when it has finished.

Gripper State

The gripper state changes to POSITIONING when starting to move and back to IDLE when finished. In case of an error, the gripper state is set to ERROR.

System State

Various transitions will occur. You should use the gripper state to evaluate the current state of the gripping process, unless you have very special requirements.

5.2 Grip a part (GRIP)

Grip a part using its nominal width, the speed and the force limit at which the part should be gripped. When the command is issued, the gripper moves its fingers to the nominal part width and tries to clamp the expected part with the previously set gripping force. If the gripper can establish the desired gripping force within the defined clamping travel, a part is gripped. If the fingers fall through the clamping travel without establishing the gripping force, no part was found and the gripper state is updated accordingly. The clamping travel can be set using the WSG's web interface. The gripper state is updated with the result of this operation (either HOLDING or NO_PART) as well as the gripping statistics.

After successfully gripping a part, the integrated part monitoring is enabled which supervises the gripping force. If a part is removed from the gripper before issuing the release command, the gripper detects it and changes the gripper state to PART_LOST.



You may reduce the gripping speed with sensitive parts to limit the impact due to the mass of the gripper fingers and the internal mechanics.

 The gripper state reflects the current state of the gripping process. It should be checked after each command to control if the gripping process works as intended.

Command Flag Position:

Bit 1

Parameters used:

WIDTH, SPEED, FORCELIMIT

Status Code

The status code register is set to E_CMD_PENDING upon start of the movement and set to the command's result when it has finished. If no part was found, the status code is set to E_CMD_FAILED.

Gripper state

During finger movement, the gripper state is set to GRIPPING. If a part was found, it changes to HOLDING. If no part was found, the Gripper state is set to NO_PART. If a part was removed after it was clamped, the gripper state is set to PART_LOST. In case of an error, the gripper state is set to ERROR.

System State

Various transitions will occur. You should use the gripper state to evaluate the current state of the gripping process, unless you have very special requirements.

5.3 Release a part (RELEASE)

Release a part by opening the fingers with a given speed and width. The RELEASE command does not pinch the part. This is ensured by successively increasing the internal force limit only when moving away from it.

The part monitoring is disabled before releasing it. The gripper's nominal force is used for release.

Command Flag Position:

Bit 3

Parameters used:

WIDTH, SPEED

Status Code

The status code register is set to E_CMD_PENDING upon start of the movement and set to the command's result when it has finished.

Gripper state

During finger movement, the gripper state is set to RELEASING. When the end position is reached, the gripper state is set to IDLE. In case of an error, the gripper state is set to ERROR.

System State

Various transitions will occur. You should use the gripper state to evaluate the current state of the gripping process, unless you have very special requirements.

5.4 Referencing the gripper (HOMING)

This command references the gripper by executing a homing sequence. During homing, the fingers will move to the mechanical end stop. The homing sequence has to be configured on the “*Settings -> Motion Configuration*” page of the WSG’s web interface.

You can set the direction of homing (inbound or outbound) as well as enable automatic homing on startup.



Homing is required prior to any motion-related command. The best positioning performance will be achieved if homing is done into the direction in which the better positioning accuracy is required.



During homing, soft limits are disabled. Obstacles in the movement range of the fingers and collisions with these during homing may result in a wrong reference point for the finger position!

Command Flag Position:

Bit 3

Parameters used:

none

Status Code

The status code register is immediately set to E_CMD_PENDING and to the command’s result when it has finished.

Gripper state

During homing, the gripper state is IDLE.

System State

During movement, the MOVING flag is set to 1. If the gripper is referenced, the REFERENCED flag is set to 1.

5.5 Stop movement or acknowledge a FAST STOP (STOP/ACK)

Stop any pending movement immediately without disabling the drive. When stopping during holding (i.e. the gripper state is HOLDING), the part monitor will be disabled and the gripping force will not be applied anymore.

Acknowledging a FAST STOP condition:

If the WSG is in FAST STOP mode, a transition from 0 to 1 is required on this flag to acknowledge and to return in normal operating mode. You have to reset the FASTSTOP flag before acknowledging it!

Command Flag Position:

Bit 4

Parameters used:

none

Status Code

Set to E_SUCCESS.

Gripper state

The gripper state is set to IDLE.

System State

The AXIS_STOPPED flag is set to 1. If acknowledging a FAST STOP, the FASTSTOP flag is cleared.

5.6 Raise a Fast Stop (FAST STOP)

This function is similar to an “Emergency Stop”. It immediately stops any movement the fastest way, disables the drive and prevents further motion-related commands from being executed. The FAST STOP state can only be left by issuing a FAST STOP Acknowledge (see chapter 5.5). All motion-related commands are prohibited during FAST STOP and will produce an E_ACCESS_DENIED error.

The FAST STOP state is indicated in the system flags and logged in the system’s log file, so this command should in general be used to react on certain error conditions.



To simply stop the current movement, you may want to use the STOP command instead.



In addition to the STOP/ACK flag, the FAST STOP can be cleared interactively using the web interface, too. This will enable the drive again; however, it is required to reset the FAST STOP flag on the PROFIBUS interface to enable motion-related commands again.

Command Flag Position:

Bit 5

Parameters used:

none

Status Code

Set to E_SUCCESS.

Gripper state

The gripper state is set to IDLE.

System State

The FASTSTOP flag is set to 1.


5.7 Jog Mode (JOG+ and JOG-)

To set up a process, it may be required to move the fingers of the WSG manually. This can be done using the Jog Mode Flags. These flags are evaluated level-sensitive and allow a constant speed drive of the fingers using two switches on the PLC. The flags are decoded as given in the following table:

JOG+	JOG-	Movement direction
0	0	Jog Mode is disabled*
1	0	positive with SPEED
0	1	negative with SPEED
1	1	Stop

*) If the Jog flags change to both 0, the Jog mode is left and the drive is stopped.

The force limit (current controlled only) as well as the speed can be passed as parameters. You may consider using a hand wheel to control them. Please be aware that high movement speed may interfere with a low force limit setting.

 **In contrast to other motion-related commands, the SPEED Parameter can be set to 0 resulting in an internal clamping of the value to the minimum gripper speed.**

 **The Jog Mode is intended only to set up a process. Do not use the Jog Mode in normal operation of the gripper!**

Command Flag Position:

Bit 6 and 7

Parameters used:

SPEED, FORCELIMIT

Status Code

The status code register is set to E_CMD_PENDING upon start of the movement and set to the command's result when it has finished.

Gripper state

During finger movement, the gripper state is set to RELEASING. When the end position is reached (or in case of an error), the gripper state is set to IDLE.

System State

Various transitions will occur. You should use the gripper state to evaluate the current state of the gripping process, unless you have very special requirements.

6 WSG Fieldbus Monitor

The WSG has a built-in Fieldbus Monitor that can be accessed via the web interface (select “*Diagnosis -> Fieldbus Monitor*” from the menu). The monitor displays the current content of the input and output registers belonging to the WSG and gives some basic information about the bus state, thus making it easy to embed it in a PROFIBUS or PROFINET based industrial environment.

WSG 50 Control Panel
Location: n/a, Contact: n/a

Settings | Diagnostics | Scripting | Motion | Help

Profibus

Bus State

Station Address	7
Bitrate	1.5 MB/s
Interface state	Online

I/O Register View

Output Register (Profibus Master to WSG)

Byte Index	Data	Description	Value
0	20h	Command Flags	<input type="checkbox"/> MOVE <input type="checkbox"/> GRASP <input type="checkbox"/> RELEASE <input type="checkbox"/> HOMING <input type="checkbox"/> STOP/ACK <input checked="" type="checkbox"/> FASTSTOP <input type="checkbox"/> JOG+ <input type="checkbox"/> JOG-
1	C0h	User Flags	<input type="checkbox"/> IF1 <input type="checkbox"/> IF2 <input type="checkbox"/> IF3 <input type="checkbox"/> IF4 <input type="checkbox"/> IF5 <input type="checkbox"/> IF6 <input checked="" type="checkbox"/> IF7 <input type="checkbox"/> IF8
2	00h	Width	0.00 mm
3	00h		
4	00h	Speed	0.00 mm/s
5	00h		
6	00h	Force Limit	0.00 N
7	00h		

Input Register (WSG to Profibus Master)

Byte Index	Data	Description	Value
0	01h	Grasping State	<input checked="" type="checkbox"/> IDLE <input type="checkbox"/> GRASPING <input type="checkbox"/> NO_PART <input type="checkbox"/> PART_LOST <input type="checkbox"/> HOLDING <input type="checkbox"/> RELEASING <input type="checkbox"/> POSITIONING <input type="checkbox"/> ---
1	00h	User Flags	<input type="checkbox"/> OF1 <input type="checkbox"/> OF2 <input type="checkbox"/> OF3 <input type="checkbox"/> OF4 <input type="checkbox"/> OF5 <input type="checkbox"/> OF6 <input type="checkbox"/> OF7 <input type="checkbox"/> OF8
2	00h		
3	00h		
4	00h	System State	00000000h
5	00h		
6	00h	Current Opening Width	0.00 mm
7	00h		
8	00h	Grasping Force	0.00 N
9	00h		
10	00h	Error Code	E_SUCCESS
11	00h		

Gripper

State: idle
Position: [n/a]
Speed: 0.0 mm/s
Force: 0.0 N

Stop | Ack

- Referenced
- Moving
- Blocked Minus
- Blocked Plus
- Soft Limit Minus
- Soft Limit Plus
- Axis stopped
- Target Pos reached
- Overdrive Mode
- Force Control Mode
- Fast Stop
- Temperature Warning
- Temperature Fault
- Power Fault
- Current Fault
- Finger Fault
- Command Failure
- Script is running
- Script Failure

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Figure 1: Screenshot of the WSG Fieldbus Monitor

Appendix A. Status Codes

Status Code	Symbol name	Description
0	E_SUCCESS	No error occurred, operation was successful
1	E_NOT_AVAILABLE	Function or data is not available
2	E_NO_SENSOR	No measurement converter is connected
3	E_NOT_INITIALIZED	Device was not initialized
4	E_ALREADY_RUNNING	The data acquisition is already running
5	E_FEATURE_NOT_SUPPORTED	The requested feature is currently not available
6	E_INCONSISTENT_DATA	One or more parameters are inconsistent
7	E_TIMEOUT	Timeout error
8	E_READ_ERROR	Error while reading data
9	E_WRITE_ERROR	Error while writing data
10	E_INSUFFICIENT_RESOURCES	No more memory available
11	E_CHECKSUM_ERROR	Checksum error
12	E_NO_PARAM_EXPECTED	A Parameter was given, but none expected
13	E_NOT_ENOUGH_PARAMS	Not enough parameters for executing the command
14	E_CMD_UNKNOWN	Unknown command
15	E_CMD_FORMAT_ERROR	Command format error
16	E_ACCESS_DENIED	Access denied
17	E_ALREADY_OPEN	Interface is already open
18	E_CMD_FAILED	Error while executing a command
19	E_CMD_ABORTED	Command execution was aborted by the user
20	E_INVALID_HANDLE	Invalid handle
21	E_NOT_FOUND	Device or file not found
22	E_NOT_OPEN	Device or file not open

23	E_IO_ERROR	Input/Output Error
24	E_INVALID_PARAMETER	Wrong parameter
25	E_INDEX_OUT_OF_BOUNDS	Index out of bounds
26	E_CMD_PENDING	No error, but the command was not completed, yet. Another return message will follow including a status code, if the function has completed.
27	E_OVERRUN	Data overrun
28	E_RANGE_ERROR	Range error
29	E_AXIS_BLOCKED	Axis blocked
30	E_FILE_EXISTS	File already exists

Appendix B. System State Flags

The system state flags are arranged as a 32-bit wide integer value that is provided via the PROFIBUS Input Registers. Each bit has a special meaning listed below.

Bit No.	Flag Name	Description
D31..21	reserved	These bits are currently unused but may be used in a future release of the WSG firmware.
D20	SF_SCRIPT_FAILURE	Script Error. An error occurred while executing a script and the script has been aborted. The flag is reset whenever a script is started.
D19	SF_SCRIPT_RUNNING	A script is currently running. The flag is reset if the script either terminated normally, a script error occurred or the script has been terminated manually by the user.
D18	SF_CMD_FAILURE	Command Error. The last command returned an error.
D17	SF_FINGER_FAULT	Finger Fault. The status of at least one finger is different from “operating” and “not connected”. Please check the finger flags for a more detailed error description.
D16	SF_CURR_FAULT	Engine Current Error. The engine has reached its maximum thermal power consumption. The flag will be reset automatically as soon as the engine has recovered. Then the corresponding Fast Stop can be committed.
D15	SF_POWER_FAULT	Power Error. The power supply is outside the valid range.
D14	SF_TEMP_FAULT	Temperature Error. The gripper hardware has reached a critical temperature level. All motion-related commands are disabled until the temperature falls below the critical level.

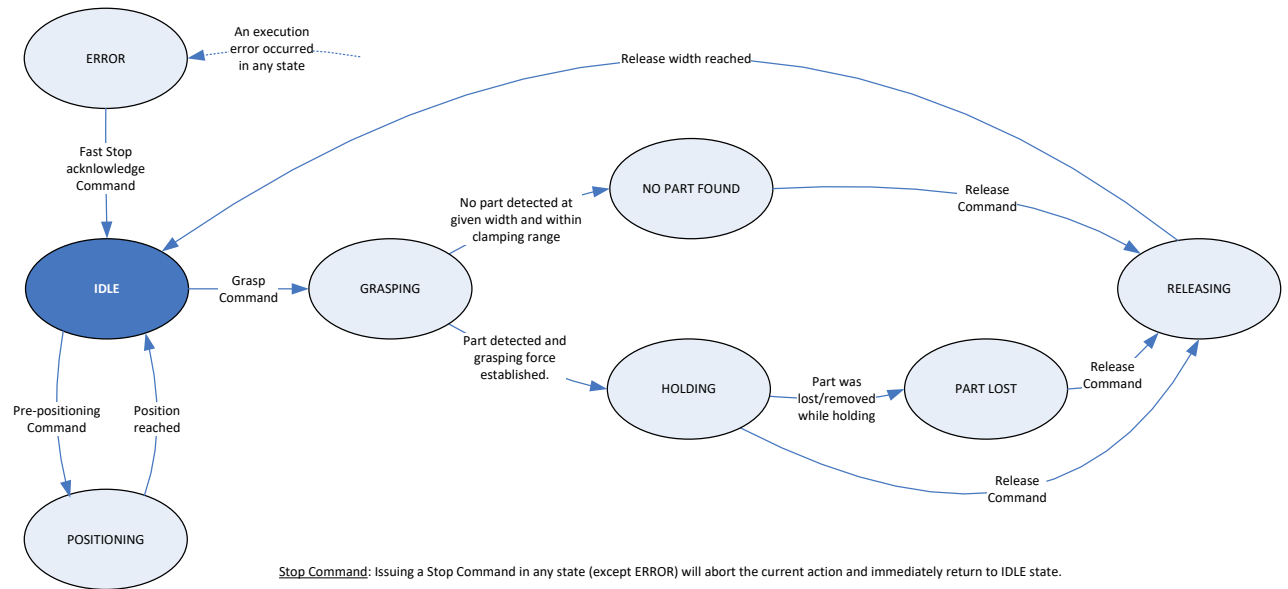
D13	SF_TEMP_WARNING	<p>Temperature Warning.</p> <p>The gripper hardware will soon reach a critical temperature level.</p>
D12	SF_FAST_STOP	<p>Fast Stop.</p> <p>The gripper has been stopped due to an error condition. You have to acknowledge the error in order to reset this flag and to re-enable motion-related commands.</p>
D11..10	reserved	<p>These bits are currently unused but may be used in a future release of the WSG firmware.</p>
D9	SF_FORCECNTL_MODE	<p>Force Control Mode.</p> <p>True force control is currently enabled by using the installed force measurement finger (WSG-FMF). If this flag is not set, the gripping force is controlled by approximation based on the motor current.</p>
D8	SF_OVERDRIVE_MODE	<p>Overdrive Mode³.</p> <p>Gripper is in overdrive mode and the gripping force can be set to a value up to the overdrive force limit. If this bit is not set, the gripping force cannot be higher than the gripper's nominal gripping force value.</p>
D7	SF_TARGET_POS_REACHED	<p>Target position reached.</p> <p>Set if the target position was reached. This flag is not synchronized with SF_MOVING, so it is possible that there is a delay between SF_MOVING being reset and SF_TARGET_POS becoming active.</p>
D6	SF_AXIS_STOPPED	<p>Axis stopped.</p> <p>A previous motion command has been aborted using the stop command. This flag is reset on the next motion command.</p>

³ Overdrive mode is not supported by all WSG grippers. Please refer to the User's Manual for further information.

D5	SF_SOFT_LIMIT_PLUS	<p>Positive direction soft limit reached.</p> <p>The fingers reached the defined soft limit in positive moving direction. A further movement into this direction is not allowed any more. This flag is cleared if the fingers are moved away from the soft limit position.</p>
D4	SF_SOFT_LIMIT_MINUS	<p>Negative direction soft limit reached.</p> <p>The fingers reached the defined soft limit in negative moving direction. A further movement into this direction is not allowed any more. This flag is cleared if the fingers are moved away from the soft limit position.</p>
D3	SF_BLOCKED_PLUS	<p>Axis is blocked in positive moving direction.</p> <p>Set if the axis is blocked in positive moving direction. The flag is reset if either the blocking condition is resolved or a stop command is issued.</p>
D2	SF_BLOCKED_MINUS	<p>Axis is blocked in negative moving direction.</p> <p>Set if the axis is blocked in negative moving direction. The flag will be reset if either the blocking condition is resolved or a stop command is issued.</p>
D1	SF_MOVING	<p>The Fingers are currently moving.</p> <p>This flag is set whenever a movement is started (e.g. MOVE command) and reset automatically as soon as the movement stops.</p>
D0	SF_REFERENCED	<p>Fingers Referenced.</p> <p>If set, the gripper is referenced and accepts motion-related commands.</p>

Appendix C. Gripper states

The following diagram illustrates the gripper states and transitions as intended to be used in normal operation.



Appendix D. PLC Demo Program

The WSG is provided with several simple demo projects for Siemens SIMATIC S7-1200 controls and STEP 7 TIA v12. The projects can be downloaded from the Weiss Robotics web site⁴. A download link is given in the “Documentation” section of the WSG’s web interface.

The projects have been implemented and tested on a CPU of type 1212C with the PROFIBUS module CM1243-5 using the Siemens STEP7 Basic v12.0 (TIA Portal) project environment. They will execute an endless loop of a simple gripping cycle, consisting of pre-positioning the gripper jaws, gripping a part, releasing and returning to the start position. If a part is detected, the gripper will hold it for a short moment.

In case of an error, the gripper will execute a homing sequence and restart from the beginning. Please note that the WSG must be referenced before running the program.

The PLC is configured in the project to use IP address 192.168.1.250 and PROFIBUS address 2. The WSG is expected to use PROFIBUS address 7 (default). These settings may be changed according to your requirements.

 **It might be useful to open the Fieldbus Monitor (see chapter 6) on the WSG’s web interface when running the program to get more information on possible problems.**

 **The demo project is intended for testing purposes only. Do not use it in any production environment.**

⁴ <http://www.weiss-robotics.com/>

SCL Source Code Listing for the gripping cycle used in the demo projects

```
1  ////////////////////////////////////////////////////////////////////
2  // Receive data type           //
3  ////////////////////////////////////////////////////////////////////
4
5  TYPE "WSG_RECEIVE"
6  VERSION : 0.1
7      STRUCT
8          STW1 : Struct
9              IDLE : Bool;
10             GRASPING : Bool;
11             NO_PART : Bool;
12             PART_LOST : Bool;
13             HOLDING : Bool;
14             RELEASING : Bool;
15             POSITIONING : Bool;
16             ERROR : Bool;
17             OF1 : Bool;
18             OF2 : Bool;
19             OF3 : Bool;
20             OF4 : Bool;
21             OF5 : Bool;
22             OF6 : Bool;
23             OF7 : Bool;
24             OF8 : Bool;
25     END_STRUCT;
26     SYSSTATE : Struct
27         REFERENCED : Bool;
28         MOVING : Bool;
29         BLOCKED_MINUS : Bool;
30         BLOCKED_PLUS : Bool;
31         SOFT_LIMIT_MINUS : Bool;
32         SOFT_LIMIT_PLUS : Bool;
33         AXIS_STOPPED : Bool;
34         TARGET_POS_REACHED : Bool;
35         OVERDRIVE_MODE : Bool;
36         FORCECNTL_MODE : Bool;
37         RES10 : Bool;
38         RES11 : Bool;
39         FAST_STOP : Bool;
40         TEMP_WARNING : Bool;
41         TEMP_FAULT : Bool;
42         POWER_FAULT : Bool;
43         CURR_FAULT : Bool;
44         FINGER_FAULT : Bool;
45         CMD_FAILURE : Bool;
46         SCRIPT_RUN : Bool;
47         SCRIPT_FAILURE : Bool;
48         RES21 : Bool;
49         RES22 : Bool;
50         RES23 : Bool;
51         RES24 : Bool;
52         RES25 : Bool;
53         RES26 : Bool;
54         RES27 : Bool;
55         RES28 : Bool;
```

```

56         RES29 : Bool;
57         RES30 : Bool;
58         RES31 : Bool;
59     END_STRUCT;
60     WIDTH : Int;
61     FORCE : UInt;
62     ERROR_CODE : UInt;
63     END_STRUCT;
64
65 END_TYPE
66
67
68 ////////////////////////////////////////////////////
69 // Send data type //
70 ////////////////////////////////////////////////////
71
72 TYPE "WSG_SEND"
73 VERSION : 0.1
74     STRUCT
75         STW1 : Struct
76             MOVE : Bool;
77             GRASP : Bool;
78             RELEASE : Bool;
79             HOMING : Bool;
80             STOP_ACK : Bool;
81             FASTSTOP : Bool;
82             JOG_PLUS : Bool;
83             JOG_MINUS : Bool;
84             IF1 : Bool;
85             IF2 : Bool;
86             IF3 : Bool;
87             IF4 : Bool;
88             IF5 : Bool;
89             IF6 : Bool;
90             IF7 : Bool;
91             IF8 : Bool;
92         END_STRUCT;
93         WIDTH : Int;
94         SPEED : UInt;
95         FORCELIMIT : UInt;
96     END_STRUCT;
97
98 END_TYPE
99
100
101 ////////////////////////////////////////////////////
102 // Gripping Cycle FB //
103 ////////////////////////////////////////////////////
104
105 FUNCTION_BLOCK "GrippingCycle"
106 { S7_Optimized_Access := 'TRUE' }
107 VERSION : 0.1
108     VAR DB_SPECIFIC
109         dp_data_in { S7_HMI_Visible := 'False' } : Array [1..12] of Byte;
110         receive { S7_HMI_Accessible := 'False'; S7_HMI_Visible := 'False' } AT
111 dp_data_in : "WSG_RECEIVE";
112         dp_data_out { S7_HMI_Visible := 'False' } : Array [1..8] of Byte;

```

```

113     send  {  S7_HMI_Accessible  :=  'False';  S7_HMI_Visible  :=  'False'}  AT
114 dp_data_out : "WSG_SEND";
115     END_VAR
116     VAR
117         holding_active : Bool;
118         state : Int := -2;
119         timer_expired : Bool;
120         CycleConfig : Struct
121             PreposWidth : Int := 3000;
122             PreposSpeed : UInt := 40000;
123             PreposForce : UInt := 8000;
124             GraspWidth : Int := 2200;
125             GraspSpeed : UInt := 40000;
126             GraspForce : UInt := 5000;
127             HoldingTime : Time := T#1000ms;
128             ReleaseWidth : Int := 3000;
129             ReleaseSpeed : UInt := 40000;
130             ReleaseForce : UInt := 8000;
131             StartWidth : Int := 6000;
132             StartSpeed : UInt := 40000;
133             StartForce : UInt := 8000;
134             CycleFinished : Bool := true;
135             ErrorCount : UInt := 0;
136             TimerExpired : Bool;
137         END_STRUCT;
138     END_VAR
139
140     VAR_TEMP
141         ret_val : Int;
142         do_next_step : Bool;
143     END_VAR
144
145
146 BEGIN
147     // Implementation of state machine
148
149     // Call receive function block
150     // Note: The address parameter comes from the Profibus module.
151     // Check default tag table, system constants tab, Profibus interface and
152     // convert the decimal address listed there to hex and enter it here.
153     #ret_val := DPRD_DAT( LADDR := W#16#113, RECORD => #dp_data_in );
154
155     // Initial values
156     #do_next_step := false;
157
158     // State transitions
159     CASE #state OF
160
161         // NOTE: All states <= 0 belong to ERROR HANDLING!
162
163         // Step -1 (error state)
164         -1:
165             // Reset all control flags TO get a defined #state
166             #CycleConfig.ErrorCount := #CycleConfig.ErrorCount + 1;
167             #send.STW1.FASTSTOP := false;
168             #send.STW1.GRASP := false;
169             #send.STW1.HOMING := false;

```

```

170         #send.STW1.JOG_MINUS := false;
171         #send.STW1.JOG_PLUS := false;
172         #send.STW1.MOVE := false;
173         #send.STW1.RELEASE := false;
174
175         // Set STOP/ACK flag to true to resolve error condition
176         #send.STW1.STOP_ACK := true;
177
178         // Go to next step
179         #do_next_step := true;
180
181         // Step 0 (initial start): Execute homing sequence
182         0:
183         // Error handling. State *must* be IDLE at this point.
184         IF #receive.STW1.IDLE = false THEN
185             #state := -1;
186         END_IF;
187
188
189         // Reset STOP/ACK flag and set HOMING command flag
190         IF #receive.STW1.IDLE = true THEN
191             #send.STW1.STOP_ACK := false;
192             #send.STW1.HOMING := true;
193             #do_next_step := true;
194         END_IF;
195
196         // Step 1: Check if HOMING is running
197         1:
198         // Error handling
199         IF #receive.STW1.ERROR = true THEN
200             #state := -1;
201         END_IF;
202
203         // Check for gripper state set to POSITIONING
204         IF #receive.STW1.POSITIONING = true THEN
205             #send.STW1.HOMING := false;
206             #do_next_step := true;
207         END_IF;
208
209         // Step 2: Wait for gripper state to become IDLE
210         // and check if gripper is referenced
211         2:
212         IF #receive.STW1.ERROR = true THEN
213             #state := -1;
214         END_IF;
215
216         IF #receive.STW1.IDLE = true THEN
217             IF #receive.SYSSTATE.REFERENCED = false THEN
218                 #state := -1;
219             ELSE
220                 #do_next_step := true;
221             END_IF;
222         END_IF;
223
224         // Step 3: When idle, move to pre-position width
225         3:
226         // Error handling

```

```

227     IF #receive.STW1.ERROR = true THEN
228         #state := -1;
229     END_IF;
230
231     // Trigger move command to pre-position the gripper jaws
232     IF #receive.STW1.IDLE = true THEN
233         #send.WIDTH := #CycleConfig.PreposWidth;
234         #send.SPEED := #CycleConfig.PreposSpeed;
235         #send.FORCELIMIT := #CycleConfig.PreposForce;
236         #send.STW1.MOVE := true;
237         #do_next_step := true;
238     END_IF;
239
240     // Step 4: Check if gripper state is set to POSITIONING, i.e. gripper is
241 moving
242     4:
243     // Error handling
244     IF #receive.STW1.ERROR = true THEN
245         #state := -1;
246     END_IF;
247
248     // Reset move command flag
249     IF #receive.STW1.POSITIONING = true THEN
250         #send.STW1.MOVE := false;
251         #do_next_step := true;
252     END_IF;
253
254     // Step 5: When idle, start grasping
255     5:
256     IF #receive.STW1.ERROR = true THEN
257         #state := -1;
258     END_IF;
259
260     IF #receive.STW1.IDLE = true THEN
261         #send.WIDTH := #CycleConfig.GraspWidth;
262         #send.SPEED := #CycleConfig.GraspSpeed;
263         #send.FORCELIMIT := #CycleConfig.GraspForce;
264         #send.STW1.GRASP := true;
265         #do_next_step := true;
266     END_IF;
267
268     // Step 6: When grasping is active, go to next step
269     6:
270     IF #receive.STW1.ERROR = true THEN
271         #state := -1;
272     END_IF;
273
274     IF #receive.STW1.GRASPING = true THEN
275         #send.STW1.GRASP := false;
276         #do_next_step := true;
277     END_IF;
278
279     // Step 7: When holding, wait. If no part found/part lost, release immedi-
280 ately.
281     7:
282     IF #receive.STW1.ERROR = true THEN
283         #state := -1;

```

```

284         END_IF;
285
286         // Part found. Hold for some time, then go to next step.
287         IF #receive.STW1.HOLDING = true AND #holding_active = false THEN
288             #holding_active := true;
289             #ret_val := SRT_DINT( OB_NR := 20, DTIME := #CycleConfig.HoldingTime,
290 SIGN := 1 );
291         END_IF;
292
293         // No part found or part lost. Go to next step.
294         IF #timer_expired = true OR #receive.STW1.NO_PART = true OR #re-
295 ceive.STW1.PART_LOST = true THEN
296             #holding_active := false;
297             #timer_expired := false;
298             #send.WIDTH := #CycleConfig.ReleaseWidth;
299             #send.SPEED := #CycleConfig.ReleaseSpeed;
300             #send.FORCELIMIT := #CycleConfig.ReleaseForce;
301             #send.STW1.RELEASE := true;
302             #do_next_step := true;
303         END_IF;
304
305         // Step 8: When releasing is active, go to next step
306         8:
307         IF #receive.STW1.ERROR = true THEN
308             #state := -1;
309         END_IF;
310
311         IF #receive.STW1.RELEASING = true THEN
312             #send.STW1.RELEASE := false;
313             #do_next_step := true;
314         END_IF;
315
316         // Step 9: When idle, move to start position
317         9:
318         IF #receive.STW1.ERROR = true THEN
319             #state := -1;
320         END_IF;
321
322         IF #receive.STW1.IDLE = true THEN
323             #send.WIDTH := #CycleConfig.StartWidth;
324             #send.SPEED := #CycleConfig.StartSpeed;
325             #send.FORCELIMIT := #CycleConfig.StartForce;
326             #send.STW1.MOVE := true;
327             #do_next_step := true;
328         END_IF;
329
330         // Step 10: When positioning is active, go to next step
331         10:
332         IF #receive.STW1.ERROR = true THEN
333             #state := -1;
334         END_IF;
335
336         IF #receive.STW1.POSITIONING = true THEN
337             #send.STW1.MOVE := false;
338             #do_next_step := true;
339         END_IF;
340

```

```

341         // Default (state is not -1..10)
342     ELSE
343
344         // Go to error state
345         IF #receive.STW1.ERROR = true THEN
346             #state := -1;
347         END_IF;
348
349         // Start cycle from the beginning (without homing)
350         IF #receive.STW1.IDLE = true THEN
351             #state := 3;
352             #CycleConfig.CycleFinished := true;
353         END_IF;
354
355     END_CASE;
356
357     // Increment state variable
358     IF #do_next_step = true THEN
359         #state := #state + 1;
360     END_IF;
361
362     // Call send function block
363     #ret_val := DPWR_DAT( LADDR := W#16#114, RECORD := #dp_data_out );
364
365 END_FUNCTION_BLOCK

```



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