



**Smart Grippers™**  
**Assembly Guide and Users' Manual**  
**for**  
**SG0050**  
**SG0150**

**Manual 95564 Rev 00**

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## Revision

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# 1 System Description—Servo Gripper SG0050 and SG 0150

## A. INSTALLATION DECLARATION

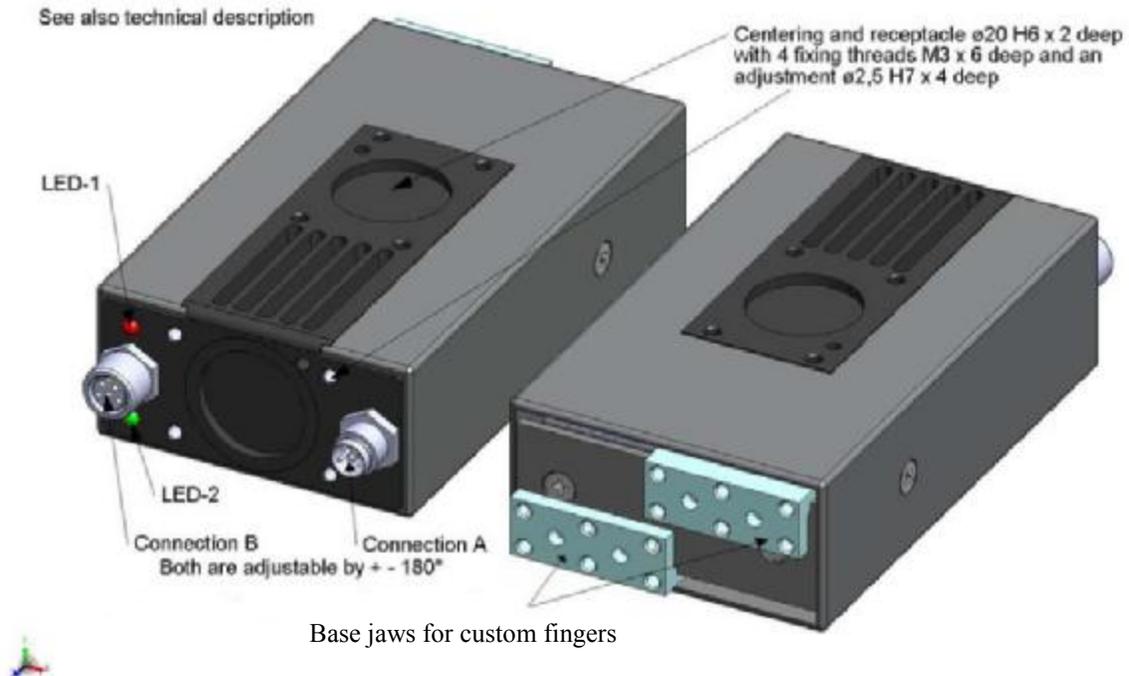
Our products are basically developed and manufactured according to applicable specifications and standards. They are based on updated knowledge and are subject to changes as well as improvements. Possible extensions or changes to the EU Guidelines are considered herein. The original installation declaration, as specified by the Directive 2006/42/EG for Machines, Appendix II Part 1 Section B, is enclosed with this product.

Before operational commissioning, the respective country-specific specifications are to be considered.

Application according to specification is considered as the utilization of our servo-gripper components for the interception of solid materials with a max. weight of 5 kg, considering the max. admissible moments and the attainable clamping forces.

In case of faults in the energy supply, the clamping force is reduced and falls to zero N. Only as a result of the intrinsic friction and the gear toothing does there still remain a retention force and self-retention of approx. 5 N. Reference is made here especially to the possibility of falling down or sliding out objects (Appendix I -1.3.3).

## B. INSTALLATION INSTRUCTION



**WARNING:** Under no circumstances should you reach between the base and gripper jaws during a drive or grip command. Severe injuries can result.

- Do not use the device either in spray water or if it is subject to other types of moisture.
- Clean the device with a moist cloth or an antistatic cloth only.  
The accident-prevention specifications of the responsible Trades Social Insurance against Occupational Accidents are to be considered.
- Utilization according to specification includes that you read these operating instructions before operational commissioning, and employ the device only within the operating conditions as described in these operating instructions.

## 2 Safety / Standards

### 2.1 Safety Notices



**READ MANUAL**—Do not start, operate or service machine until you read and understand User's Manual. Failure to do so could result in serious injury.



**HAND CRUSH NOTICE**—Indicates the possibility for a crush force between components during coupling of the Robot and Tool adaptors.



**DANGER NOTICE** — Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.



**WARNING NOTICE** — Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.



**CAUTION NOTICE** — Indicates a potentially hazardous situation which, if not avoided, will or could result in minor or moderate injury; also used where the risk applies only to property damage.

**IGNORING INFORMATION ABOUT POTENTIAL HAZARDS CAN LEAD TO SERIOUS HARM TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT, AND MAY RESULT IN THE**

### 3. General

A power supply of 24 Volts DC is required to operate the servo gripper. As soon as power is applied, the yellow LED-2 at the rear panel will illuminate. After designation of the interface to be used (to be set with the command SIF) and successful referencing of the gripper (to be initiated with the command REF), the yellow LED will extinguish and the green LED will illuminate. A maximum current of 0.45 Amps will be drawn at the max. grip force of 50 N. In case the voltage supply is not within the tolerance limits an error bit will be set and the red LED at the rear panel of the servo gripper will illuminate, respectively the Open-Collector-Output "Error" will be set. In order to provide a highly reproducible grip force the supply voltage should be close to the nominal input voltage of 24 Volts DC.

In case of a power loss the gripper will store the information if a part has been gripped last. Upon power up again, the gripper will built-up the last commanded grip force over a max. position travel of 5mm in the direction of motion stored.

general there are 2 basic operating commands:

In

- a. **Positioning:** With the "POS" command the servo gripper travels (LED-1+2 illuminate yellow) to the commanded target position (0...50 re. 100mm) with the programmed speed. Upon reaching the target position a "READY" bit feedback will be provided and the green LED at the rear panel of the servo gripper will illuminate, as well as the Open-Collector-Output "READY" for the digital I/O lines will be set. Also at a status request a "READY" bit will be provided. In case of a reaching of the target position is prevented, the command will be terminated and an „ERROR“ feedback will be provided. (LED-1 illuminates red and LED-2 yellow)

**b. Gripping:** With the "GRI" command the servo gripper travels (LED-1+2 illuminate yellow) with the programmed speed from the current position towards the newly set end position. When a resistance is preventing a further travel (e.g. by the object to be gripped), the grip force will be increased up to the commanded value (3...50N) and a "READY" will be provided (LED-2 illuminates green). In case the set position value will be reached, an „ERROR“ feedback will be provided (LED-1 illuminates red and LED-2 yellow ), since the object to be gripped was obviously not reached.

Thus follows: In case an object is to be gripped from an outside position, first a "POS" command is set with a position setting (target position) slightly larger than the width of the object to be gripped. When this position is reached, a "GRI" command is following in order to grip the object. It is important with the "GRI" command to set the position setting some e.g. 2-3 mm smaller than the actual size of the object. Accordingly is proceeded in case an object is to be gripped from an inside position outwards. With the "POS" command, a slightly narrower position than the inside dimension of the object is set. With a following "GRI" command position setting slightly larger than the inner object width, together with the grip force setting a secure grip of the object is ensured.

### 4. Control

The servo gripper may either be controlled via a serial link RS232 (optional RS485), or via digital In/Output lines. The interface RS232/RS485 as well as the digital I/O lines are galvanically isolated from the system ground and a common (ISO-GND) reference potential is provided. With a control via the serial RS232/RS485 link a permanent status request of the servo gripper may be requested. With a control via the digital I/O lines two open collector outputs "ERROR" (red LED) and "READY" (green LED) are provided.

Which control link is utilised must be selected once with the first initialisation with the command SIF (Set Inter Face). This setting will remain until changed again.

In case the servo gripper is controlled via the serial interface only, the digital I/O connection may be utilised for connecting external devices used in conjunction with the gripper. Such a device could be for example status evaluation of a photoelectric relay.

## 5. Control and Parameter Setting via serial link RS232/RS485

The RS232/RS485 serial link provides the following features:

Baudrate: 9600

Stopbit: 1

Parity: Even parity

Protocol: command send, return receive:

It is recommended to send only one command at a time and wait for the return completed. Latest after 0.5 seconds a timeout may be programmed, since the return cycles are within 10..20ms.

Input buffer size: 32 Byte.

The RS485 interface is operated in the half duplex transfer mode.

Servo grippers with RS232 interface are not BUS compatible, therefore each servo gripper requires its own control. Servo gripper with RS485 interface however are BUS compatible and up to 32 servo grippers may be operated on a BUS. With longer BUS cables it might be required to terminate the BUS line with a 150 Ohm resistor.

To distinguish the individual servo grippers in a BUS system, each servo gripper may be designated with an address from 1..32 (with the command SAD): The address 0 has a special significance, since at the address 0 every servo gripper on the BUS will react independently of the individually advised address. Therefore the address 0 may not be utilised in a BUS system and should be used only for test purposes, respectively for the initial programming of an address.

The commands are in principle consisting of the following pattern:

Command code ; Address; Parameter 1; Parameter 2;...;Parameter N; <LF><CR>

The command code consists of 3 capital letters, the parameters of the digits 0..9. The permissible parameter values are either determined through a range (1..8) or a listing (1,2). Following parameters are divided by semicolons.

The servo gripper answers on a command according to the following pattern:

**"A"** Address: **"OK"**, **"Error"** ; **"Error Par"** error number; <LF><CR>

**OK:** The command was accepted and executed.

**Error:** The command cannot be executed.

In principle commands are divided in Parameter- / Monitoring- and Direct Control Commands.

Parameter commands are used to initially configure the servo gripper to the intended task. As an example may serve the command "STO", storing object and gripper parameters permanently at the designated storage location.

Direct control commands are used for direct control of the servo gripper through the higher level control electronics (e.g. robot controller). Direct control commands are only available, when the command **"SIF;1"** was provided, meaning the control via **RS232/RS485** was chosen. Once defined this command is permanently stored until changed again.

Example: **GRI(P)** command to the servo gripper with the address **5**, grip position **20**mm, grip force **10**N

The controller sends: **GRI;5;200;10<LF><CR>**

The servo gripper returns: **A5:OK<LF><CR>**

**<LF><CR>** : Linefeed, Carriage return: **0x0A, 0x0D;**

The following table provides a list of all parameter- and request commands:

<b>Command / Return</b>	<b>Address</b>	<b>Parameter 1</b>	<b>Param. 2</b>	<b>Param. 3</b>	<b>Par. 4</b>
<b>STO</b> Stores object- and gripper-parameters permanently at the designated storage	<b>0, 1..32</b>	<b>1..8</b> Storage location	<b>0..MaxPos</b> Gripper position [1/10mm]	<b>0..MaxPos</b> Position setting [1/10mm]	<b>3..50</b> Grip force [N]
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. [1,2,3,4]]</b>			
<b>RCL</b> Reads object- and grip-parameters from the gripper.	<b>0, 1..32</b>	<b>1..8</b> Storage location			
<b>A</b>	<b>0..32:</b>	<b>1..8</b> Storage location	<b>0..MaxPos</b> Gripper position [1/10mm]	<b>0..MaxPos</b> Position setting [1/10mm]	<b>3..50</b> Grip force [N]
<b>Error Param. 1</b>					

<b>RES</b> Erases the data at the designated storage location	<b>0, 1..32</b>	<b>1..8</b> Storage location		
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>		
<b>SAD</b> Sets a new address	<b>0, 1..32</b>	<b>1..32</b> New address		
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>		
<b>SDO</b> Sets the digital I/Os	<b>0, 1..32</b>	<b>0..3</b> 0: No output set 1: Error output set 2: Ready output set 3: Both outputs set		
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b> <b>[Error]</b> In case not in Direct Control Mode		
<b>SIF</b> Sets the control interface	<b>0, 1..32</b>	<b>0, 1</b> 0: Control via digital I/O lines 1: Control via RS232/RS485		
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>		
<b>SMS</b> Sets the travel speed in the GRIP and POSITION mode and stores this value non volatile if applicable (depending from Parameter 3 setting)	<b>0, 1..32</b>	<b>10..150</b> travel speed at GRIP command [mm/s]	<b>10..150</b> travel speed at POSITION command [mm/s]	<b>0, 1</b> 0: travel speed setting will not be stored 1: travel speed setting will be stored non volatile

<b>A</b>	<b>0..32:</b>	<b>[OK, Store OK, Error Param. [1,2,3]]</b>
<b>SSO</b> Sets the STA command option Standard, Extended. This setting will be stored permanently and is required only once	<b>0, 1..32</b>	<b>0, 1</b> 0: Standard STA command with the parameters: Status; Position 1: Extended STA command with the parameters Status; Position; Digital Inputs
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>
<b>STA</b> Status request calling.	<b>0, 1..32</b>	
<b>A</b>	<b>0..32:</b>	<b>Status[0..255]; Pos[0..MaxPos]; [Digital-Input [0..15]]</b> Status: Definition of the status bits see section 9 Position: Actual position in 1/10mm Digital-Input: Optional Parameter returns the current state of the digital inputs.
<b>VER</b> Reads the current gripper firmware version.	<b>0, 1..32:</b>	
<b>A</b>	<b>0..32:</b>	<b>[SG0050,SG0150]</b> <b>&lt;Space&gt;MMM&lt;Space&gt;TT&lt;Space&gt;JJJJ</b> <b>MMM:</b> Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec <b>TT:</b> 01..31 <b>JJJJ:</b> 2008 .. 20xx

<b>POS</b> Positions the servo gripper to the set position	<b>0, 1..32</b>	<b>0..MaxPos</b> Position [1/10mm]	
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>	
<b>GRI</b> The object will be gripped starting from the current position setting. The new position setting will determine if the object will be gripped from the outside or inside.	<b>0, 1..32</b>	<b>0..MaxPos</b> Grip position [1/10mm]	<b>3..50</b> Grip force [N]
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. [1,2]]</b>	
<b>REF</b> The servo gripper travels to its Minimum- and Maximum reference for a travel calibration. This command MUST BE SENT each time after power up, since none of the other commands POS, GRI and TST will be accepted before that. After successful reference travel the green LED will illuminate and the Bit 6 ( <i>referenced</i> ) in the status will switch to 1.	<b>0, 1..32</b>		
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>	
<b>TST</b> Test operation: The servo gripper travels to 2 positions alternating between Position 1 and Position 2. This command is looped. Abortion through sending any other command.	<b>0, 1..32</b>	<b>0..MaxPos</b> Position 1 [1/10mm]	<b>0..MaxP</b> Position 2 [1/10mm]
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. [1,2]]</b>	
<b>CMP</b> The gripper performs a friction compensation test of the mechanical drive at the stated position.	<b>0, 1..32</b>	<b>0..MaxPos</b> Position for the friction compensation [1/10mm]	
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>	
<b>REL</b> Emergency position command, gripper operates with min. speed and low grip force without prior referencing.	<b>0, 1..32</b>	<b>- MaxPos..MaxPos</b> Relative position [1/10mm]	
<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>	

<b>A</b>	<b>0..32:</b>	<b>[OK, Error Param. 1]</b>
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MaxPos is a placeholder for the maximum position that may be used in the according commands. With the servo gripper SG0050 (50mm stroke) the MaxPos is 500, with the servo gripper SG0150 (100mm stroke) the MaxPos may be replaced by 1000.

Direct control commands are only accepted after definition of the interface selection RS232/RS485 ("SIF"command).

## 6. Control via the Digital Input lines

Instead of utilizing the serial RS232/RS485 link the servo gripper may alternatively controlled via the digital input lines. For using the digital interface, it is required to once send the command "**SIF;Adr;0**". This will activate the control via the digital input lines and will be stored until superseded with a next SIF command. Control is done by choosing the inputs DIN\_0, DIN\_1, DIN\_2 calling one of the previously stored parameter settings. The input DIN\_3 switches between positioning and gripping (see tables). A logic 1 corresponds to a voltage of 24 Volts DC, a logic 0 corresponds a 0 Volt or an open input. The storage position 8 designates a special task. It is used for referencing resp. for friction compensation of the servo gripper. Before the gripper will position resp. perform a grip command, also at the digital inputs a reference travel must be initiated. A reference travel will be performed when DIN\_2, DIN\_1, DIN\_0 = 1 with DIN\_3 = 0. In case DIN\_3 = 1 a friction compensation at the designated position will be performed.

This reference travel **MUST** be performed first since no other command is accepted. After successful reference calibration the green LED will illuminate respectively the Open-Collector output DOUT\_Ready will be switched.

DIN_2	DIN_1	DIN_0	Function
0	0	0	Utilize parameter in storage location 1
0	0	1	Utilize parameter in storage location 2
0	1	0	Utilize parameter in storage location 3
0	1	1	Utilize parameter in storage location 4
1	0	0	Utilize parameter in storage location 5
1	0	1	Utilize parameter in storage location 6
1	1	0	Utilize parameter in storage location 7
1	1	1	Perform reference calibration /friction compensation

DIN_3	Function
0	Travel to position setting / perform reference travel
1	Grip in direction of set position with designated grip force / perform friction compensation

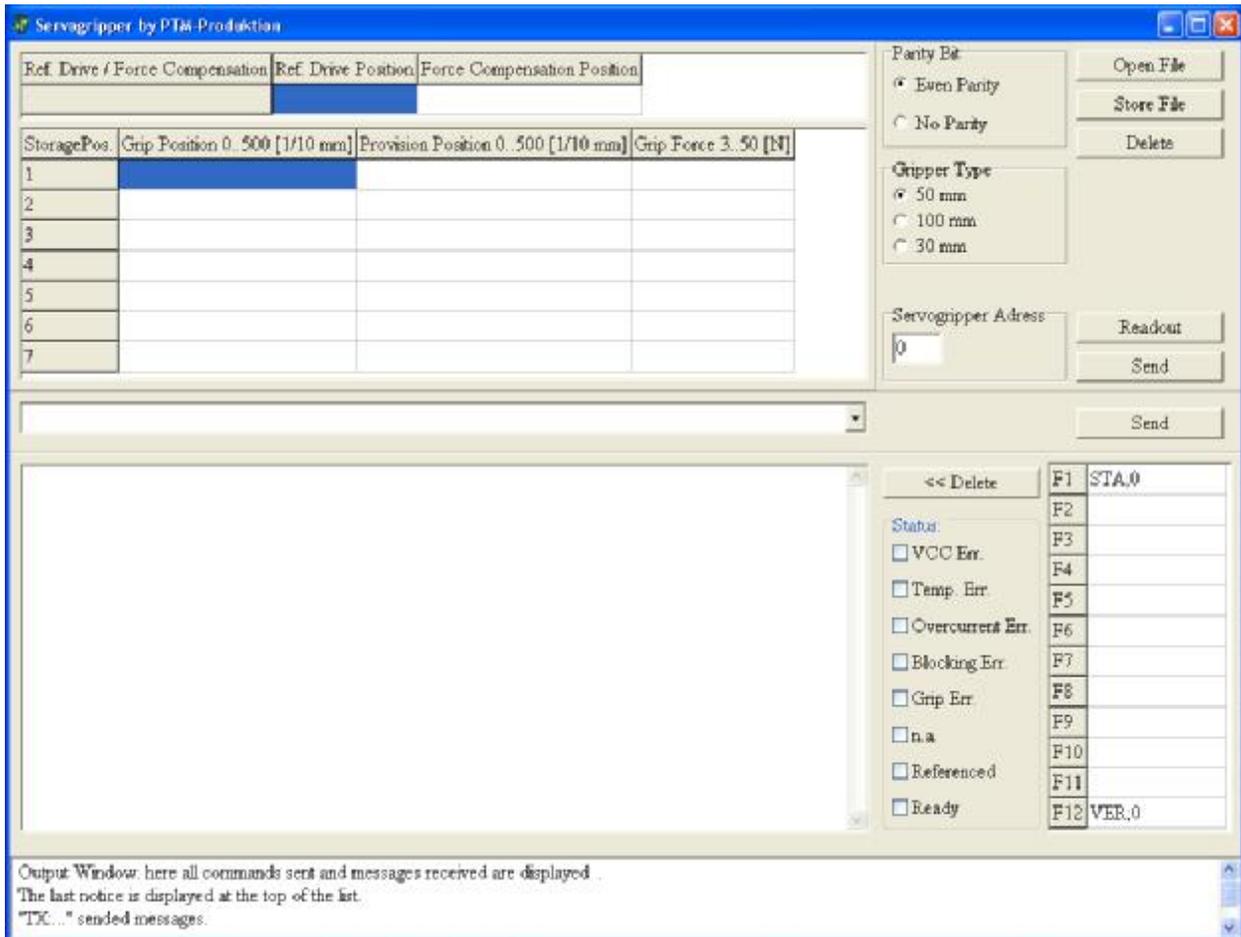
## 7. Status reports by the Digital Outputs

The two status outputs „Ready“ and „Error“ correspond to the green respectively red LED at the rear panel of the servo gripper. This is provided through galvanically isolated Open-Collector outputs with an ISO-GND reference potential. For addressing the control lines an auxiliary supply voltage (e.g. 24V) and a Pull-Up resistor (4k7 @24V) must be utilized.

DOUT_Ready	Function
Open-Collector Transistor resistance high (green LED extinguished)	A current command is executed.
	The last command is successfully completed.

DOUT_Error	Function
Open-Collector Transistor resistance high (red LED extinguished)	No error detected.
Open-Collector Transistor switched (red LED illuminated)	Error detected. (one of the bits 0.4 of the status byte of command STA is set)

## 8. The Test- and Parameter Program ServoGreifer.EXE



**ServoGreifer.exe** can be operated on all MS Windows® computers with the operating systems Windows NT to Windows XP. The computer must provide a serial link connector RS232/RS485 to connect to the servo gripper. The link parameters are set by the program, only the COM port must initially be selected to send the first command. **ServoGreifer** needs not to be installed. The program may be started with the Explorer from floppy disk, CD, hard disk, USB-stick etc. directly. Provided files are **Servogreifer.exe** as well as **Servogreifer.DE**.

**Servogreifer** will detect the PC selected language setting and will automatically initiate in German for all German language settings. In case of a different language setting the program will automatically switch to English.

In the upper part of the program an entry mask for the reference travel / friction compensation as well as 7 storage places is provided. These entries can be stored in the servo gripper and may be called via the Digital Input lines.

The position parameter for the reference travel / friction compensation are optional. In case of no entry, the middle position (25 re. 50mm) will be chosen. The individual storage places however can only be utilized if a complete input is provided.

**“Open File”**: Opens a previously stored parameter table and loads this to the grid.

**“Store File”**: Reads the grid and stores this to a file.

**“Delete”**: Deletes the data entered in the grid.

**“Readout”**: Reads the 8 parameter blocks from the connected servo gripper and enters these to the grid.

**“Send”**: Reads the 8 parameter blocks from the grid and sends these to the connected servo gripper. Previous parameters will be overwritten.

In the field "Servo gripper Address" a specific servo gripper can be called via the addresses 1..32, provided several grippers are connected to the RS485 Bus. The Address 0 is a universal address that calls servo grippers independent of their individual address setting and should therefore be used only when a single servo gripper is connected.

In the center part there is a ComboBox in which all available commands are listed as examples with explanation of the parameter. Also new commands may be entered, which are then sorted alphabetically and can be called until program termination. With the Soft Button "Send" the command will be sent to the servo gripper. Instead of a fixed address, the wild-card "#ADR" may be entered. This will then send dynamically the address entered in the field "Servo gripper Address".

Below there is an entry field in which all going (Prefix "Tx:") and all received (Prefix "->Rx:") data are protocolled. With the Soft Button "Delete" the data in the output field are deleted.

In the lower part there is a text field, in which an explanation is displayed for the most important operation elements.

## 9. Connector Wiring - see supplement -

**ConConnector A:** 6 pin male connector at the servo gripper, 6 pin plug female at the cable (shielded)

Pin	Color	Function
1	Brown	ISO-RS232_RxD/ RS485_Negative
2	White	Not used
3	Blue	Supply voltage 0V, Common
4	Black	ISO-GND, isolated reference potential RS232/RS485 and Digital-I/O
5	Grey	ISO-RS232_TxD/ RS485_Positive
6	Rose	Supply voltage 24V, 1A/0,5A

**Connector B:** 6 pin female connector at the servo gripper, 6 pin plug male at the cable

1	Brown	ISO-DIN_2
2	White	ISO-DOUT_Ready (Open Collector)
3	Blue	ISO-DIN_0
4	Black	ISO-DIN_3
5	Grey	ISO-DOUT_Error (Open Collector)
6	Rose	ISO-DIN_1

(shielded)

## 10. LED Status Indication

LED - 1	LED - 1	LED - 2	LED - 2	Message
			yellow	Supply voltage present
green		green		Ready command executed
	yellow		yellow	Command is executed
red			yellow	Malfunction during command execution
red			yellow	Malfunction over or under voltage
red			yellow	Malfunction cannot reach designated position
red			yellow	Malfunction—no object to grip
red		green		Malfunction—over or under voltage

## **11. Definition of Status Bits:**

The STA Command not only provides the Status-Bits, but also the current position of the gripper in 1/10mm in a second parameter.

### **Bit 0: VCC Error**

This bit will be set when the nominal voltage value of the power supply is exceeded approximately by +/- 10%. It will be reset automatically when the nominal voltage value is restored.

### **Bit 1: Temperature Error**

This bit will be set when the temperature of the gripper housing will exceed 85°C degree. It will be reset automatically when the temperature restores below the critical value.

### **Bit 2: Over Current Error**

This bit will be set when an over current situation occurs. It will be reset with a new position or grip command.

### **Bit 3: Blocking Error**

This bit will be set when the gripper is mechanically blocked when a position command is performed. It will be reset with a new position or grip command.

### **Bit 4: Grip Error**

This bit will be set when the gripper reaches the commanded position of a grip command. It will be reset with a new position or grip command.

### **Bit 5: Free**

Currently not used

### **Bit 6: Reference Flag**

This bit will be set when reference travel of the gripper was successfully performed. It is a prerequisite for any consequent position or grip command.

### **Bit 7: Ready Flag**

This bit will be set after a successful execution of position or grip command. It will be reset with a new position or grip command.

## **12. FAQs**

- [After Power On is there a reference travel mandatory to calibrate the servo gripper?](#)

Before any motion command is accepted (POS, GRI, TST) a reference travel for calibration is required.

- [When must the "REF" command be sent?](#)

The only accepted command after Power-Up is the „REF“ command. No other motion commands are possible.

- [How are a successful execution or error of the POS and GRI commands reported, directly as feedback on the command or must the status of the gripper be actively and continuously be called with the command STA ?](#)

The feedback OK only states, that the gripper has accepted and is executing the command. The current status of the action may be polled with the command STA (Status request). The Bit Nr. 7 in the Status byte is providing the Ready state. In case a command is sent, the Ready-Bit is 0, in case the command is successfully finished, the Ready-Bit changes to 1. In case the current command shall be aborted, a new command may be sent without waiting the last command to be completed.

- [I noticed that the speed of the gripper changes depending on the force you give it. Lower forces have slower gripping speeds while higher forces grip faster. Why isn't the grip speed always the same, regardless of the force.](#)

It was designed this way. We thought, that when you enter a lower grip force, the object to be gripped is (most likely) of a more delicate nature (e.g. a glass vial). Since one cannot expect a repeated exact position of an object to be gripped, we wanted to prevent, that a faster impact of force may cause a damage. Vice versa, the higher the grip force the more sturdy the object, and thus faster an encounter of force could be. Thus we slowed down the movement at lower grip forces.

- [Can the yaw travelling speed be varied upon positioning and gripping?](#)

Starting with Firmware version „Oct 26th. 2010“ (see also the VER command) the speed upon positioning and gripping may be set with the SMS command. The setting can vary between a range of 10 .. 150 mm/s. This however can lead to a higher short initial impact pulse on the object than the actual yaw gripping force setting . The probability is especially higher at higher speed settings with low gripping force settings.

- [The normal orientation of the "A" and "B" connector\(s\) notch is vertical in direction to the gripper top side. Is there a possibility to change the orientation of the connector\(s\)in the field.](#)

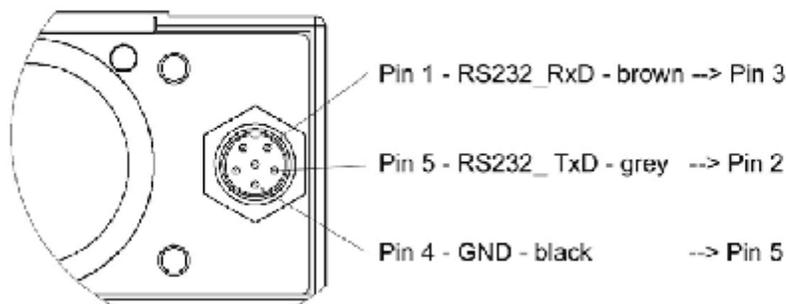
The direction may be changed by +/- 180 degree clockwise or counter clockwise by slightly loosening the counter locking nut of the connector(s) from the gripper housing and reorientation of the connector(s) to the required direction. Then the connector(s) must be locked again by tightening the counter looking nut.

### 13. Supplement:

In compliance with the standard for RS232, the cable is terminated with a female plug, the RS232 connector at the PC is a male pin connector.  
female connector insert  
view from pin side

RS232  
Servo-Gripper SG0050 / SG0150

PC/Steering etc.  
standard 9pol.



connection A

**RS485**

Servo-Gripper SG0050 / SG0150

PC/Steering etc.  
alternative names

Gripper Nr. 1

