



PRODUKTION

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Certified accord. DIN EN ISO 9001:2000

USERGUIDE:

Servo – Gripper

1. General

A power supply of 24 Volts DC is required to operate the servo gripper. As soon as power is applied, the red LED 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 red 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 is outside of 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 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.

In general there are 2 basic operating commands:

a. Positioning: With the "POS" command the servo gripper travels to the commanded target position (0...50mm) with high 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 a reaching of the target position is prevented, the command will be terminated and an „ERROR“ feedback will be provided.

b. Gripping: With the "GRI" command the servo gripper travels slowly 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. In case the set position value will be reached, an „ERROR“ feedback will be provided, 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.

2. 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 separated 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 (SetInterFace). 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.

3. 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 servogripper with the address **5**, grip position **20mm**, grip force **10N**

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:

Command / Return	Address	Parameter 1	Param. 2	Param. 3	Par. 4
STO Stores object- and gripper-parameters permanently at the designated storage	0, 1..32	1..8 Storage location	0..500 Gripper position [1/10mm]	0..500 Position setting [1/10mm]	3..50 Grip force [N]
A	0..32:	[OK, Error Param. [1,2,3,4]]			
RCL Reads object- and grip-parameters from the gripper.	0, 1..32	1..8 Storage location			
A	0..32:	1..8 Storage location	0..500 Gripper position [1/10mm]	0..500 Position setting [1/10mm]	3..50 Grip force [N]
		Error Param. 1			
RES Erases the data at the designated storage location	0, 1..32	1..8 Storage location			
A	0..32:	[OK, Error Param. 1]			
SAD Sets a new address	0, 1..32	1..32 New addresse			
A	0..32:	[OK, Error Param. 1]			
SDO Sets the digital I/Os	0, 1..32	0..3 0: No output set 1: Error output set 2: Ready output set 3: Both outputs set			
A	0..32:	[OK, Error Param. 1] [Error] In case not in Direct Control Mode			
SIF Sets the control interface	0, 1..32	0, 1 0: Control via digital I/O lines 1: Control via RS232/RS485			
A	0..32:	[OK, Error Param. 1]			
SSO Sets the STA command option Standard, Extended. This setting will be stored permanently and is required only once	0, 1..32	0, 1 0: Standard STA command with the parameters: Status; Position 1: Extended STA command with the parameters Status; Position; Digital Inputs			
A	0..32:	[OK, Error Param. 1]			
STA Status request calling.	0, 1..32				
A	0..32:	Status[0..255]; Pos[0..500]; [Digital-Input[0..15]] 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.			
VER Reads the current gripper firmware version.	0, 1..32:				
A	0..32:	MMM<Space>TT<Space>JJJJ MMM: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec TT: 01..31 JJJJ: 2008 .. 20xx			

The following table provides a list of all direct commands:

Command / Return	Address	Parameter 1	Par. 2	Par 3	Par 4
POS Positions the servo gripper to the set position	0, 1..32	0..500 Position [1/10mm]			
A	0..32:	[OK, Error Param. 1]			
GRI 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.	0, 1..32	0..500 Grip position [1/10mm]	3..50 Grip force [N]		
A	0..32:	[OK, Error Param. [1,2]]			
REF The servo gripper travels to its Minimum- and Maximum reference for a travel calibration. This command MUST BE SENT after power up, since none of the other commands POS, GRI and TST will be accepted. After successful reference travel the green LED will illuminate and the Bit 6 (<i>referenced</i>) in the status will switch to 1.	0, 1..32	0..500 Position for the travel calibration [1/10mm]			
A	0..32:	[OK, Error Param. 1]			
TST 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.	0, 1..32	0..500 Position 1 [1/10mm]	0..500 Position 2 [1/10mm]		
A	0..32:	[OK, Error Param. [1,2]]			
CMP The gripper performs a friction compensation test of the mechanical drive at the stated position.	0, 1..32	0..500 Position for the friction compensation [1/10mm]			
A	0..32:	[OK, Error Param. 1]			
REL Emergency position command, gripper operates with min. speed and low grip force without prior referencing.	0, 1..32	- 500..500 Relative position [1/10mm]			
A	0..32:	[OK, Error Param. 1]			

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

4. Control via the Digital Input lines

Instead of utilising 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 superceeded 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	Utilise parameter in storage location 1
0	0	1	Utilise parameter in storage location 2
0	1	0	Utilise parameter in storage location 3
0	1	1	Utilise parameter in storage location 4
1	0	0	Utilise parameter in storage location 5
1	0	1	Utilise parameter in storage location 6
1	1	0	Utilise 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

5. Status reports by the Digital Outputs

The two status outputs „Ready“ and „Error“ correspond to the green respectifely red LED at the rear panel of the servo gripper. This is provided through galvanically separated 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 utilised.

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.)

6. The Test- and Parameter Program ServoGreifer.EXE

Ref. Drive / Force Compensation | Ref. Drive Position | Force Compensation Position

StoragePos.	Grip Position 0..500 [1/10 mm]	Provision Position 0..500 [1/10 mm]	Grip Force 3..50 [N]
1			
2			
3			
4			
5			
6			
7			

Parity Bit
 Even Parity
 No Parity

Gripper Type
 50 mm
 100 mm

Servogripper Address

Buttons: Open File, Store File, Delete, Readout, Send

STA;0

Buttons: << Delete, Send

F1	STA;0
F2	
F3	
F4	
F5	
F6	
F7	
F8	
F9	
F10	
F11	
F12	

In this grid the position and grip parameters for the 7 storage places of the servo gripper are entered respectively displayed.

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 (25mm) will be chosen. The individual storage places however can only be utilised 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 “*Servogripper 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 centre 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 “*Servogripper 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.

7. Connector Wiring

Connector 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 (shielded)

Pin	Color	Function
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

8. LED Status Indication

LED - 1	LED - 1	LED - 2	LED - 2	Meldungen
			yellow	supply voltage present
		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

9. 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.

10. FAQs

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

Before any motion command is accepted (POS, GRI, TST) a reference travel for calibration is mandatory. If you prefer to design your own gripper jaws, please make sure, that for referencing the gripper may travel the full stroke (without component) so no obstruction can prevent the gripper from reaching the utmost end position

- [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. Perhaps this is "as designed". I just thought it gripped at the same speed, 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). So we wanted to prevent, that a faster impact of force may cause a damage. Thus we slowed down the movement at lower grip forces. Vice versa, the higher the grip force the more sturdy the object, and thus faster an encounter of force could be.

- [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 counterclockwise 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 locking nut.

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