

Mounting and Operating Manual

Electrical Compact Gripper WSG 32

Firmware Version: 4.0

Hardware Version: 3

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www.weiss-robotics.com

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1 Introduction

The WSG 32 is an electrical 2-Finger Compact Gripper. It has an integrated control unit supporting the Interfaces: Ethernet TCP/IP, CAN-Bus (optional), PROFINET (optional) and Modbus/TCP (optional). Figure 1 shows the components and connectors of the module. The configuration of the module is done via a Web-Interface supporting almost every common web browser. Furthermore, the WSG 32 comes standard with a sensor port in the base jaws. Here gripper fingers can be connected with integrated sensors, which are evaluated directly from the gripper control. Weiss Robotics and authorized distributors provide standardized finger as accessories, which work directly with the gripper control. For more information, please contact Weiss Robotics.

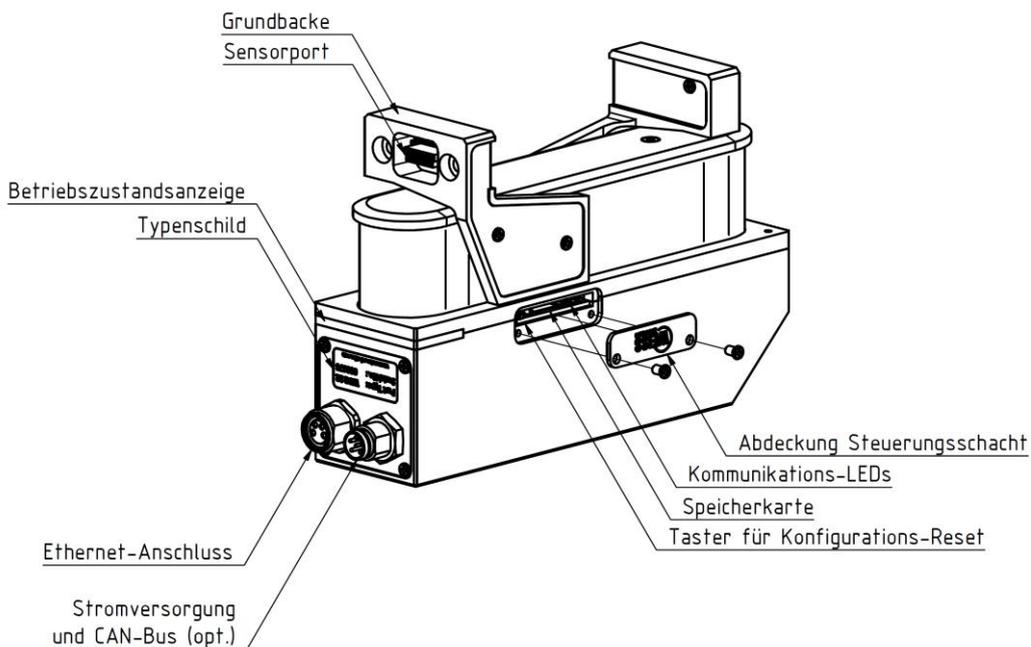


Figure 1: Components and connectors of the WSG 32

2 About this manual

This instruction is an integral part of the product and contains important information for a safe and proper assembly, commissioning, operation, maintenance and helps for an easier trouble shooting.

Before using the product, read and note the instruction, especially chapter 3 "Basic safety notes". This manual is exclusively valid for the gripper type WSG 32.

2.1 Applicable documents

For more detailed information about the operation of this module, please see the following documents which are available in PDF format on both the accompanying CD as well as via the WSG web interface:

- **WSG Command Set Reference Manual** - Description of the binary command protocol (TCP/IP, CAN-Bus)
- **WSG GCL Reference Manual** – Description of the text based command protocol (TCP/IP)
- **WSG Fieldbus Interface Manual** - Description of the fieldbus interface (PROFINET, Modbus/TCP)
- **WSG Scripting Reference Manual** - Description of the optional script interpreter for the gripper control system

Please find additional information about the warranty in our general terms and conditions, available online at www.weiss-robotics.com.

2.2 Target audience

Target audience for these instructions are plant manufacturers and operators who keep this and other documents supplied to the personnel at all times and also ask to read and observe particularly the safety instructions and warnings.

In addition, it is aimed at professionals and technicians who read this manual, while they should particularly observe the safety and warning notes at all times.

2.3 Notation and symbols

For better clarity, the following symbols are used in this manual:

	Functional or safety-related information. Failure to comply may jeopardize the safety of personnel and equipment, damage the device or impair the function of the device.
	Additional information for a better understanding of the facts described.



Reference to further information.

3 Basic safety notes

3.1 Intended use

- The module was designed to grip and to temporarily and securely hold work pieces and objects.
- The module is intended for installation in a machine/system. The requirements of the applicable guidelines must be observed and complied with.
- The module may be used only in the context of its defined application parameters.
To use this unit as intended, it is also essential to observe the technical data and installation and operation notes in this manual and to comply with the maintenance intervals.

3.2 Environmental and operating conditions

- The module may only be used within its defined application parameters.
- It must be ensured that the module and the top jaws are sufficiently dimensioned according to the use case.
- It must be ensured that the environment is clean and the ambient temperature corresponds to the specifications catalogue. Please observe the maintenance instructions (see chapter 10).
- It must be ensured that the environment is free from splash and vapours as well as from abrasion or process dust. Excepted are modules that are specifically designed for dirty environments.

3.3 Product safety

Dangers arise from the module, if e.g.:

- The module is not used in accordance with its intended purpose.
- The module is not installed or maintained properly.
- The safety and installation notes are not observed.

Avoid any manner of working that may interfere with the function and operational safety of the module.
Wear protective equipment.

3.3.1 Protective equipment



Provide protective equipment per EC Machine Directive

3.3.2 Constructional changes, attachments, or modifications

Additional drill holes, threads, or attachments that are not offered as accessories by Weiss Robotics may be attached only with permission of Weiss Robotics.

3.3.3 Special standards

The following standards are met:

- Fast transients on supply and I/O lines (burst) to IEC / EN 61000-4-4
- FH power supply to IEC/EN 61000-4-6
- HF radiation according to IEC/EN 61000-4-3
- Emissions according to EN 55011:2009 Class A (corresponds to EN 61000-6-4:2007)
- Power frequency magnetic field according to EN 61000-4-8

3.4 Personnel qualification

The assembly, initial commissioning, maintenance, and repair of the module may be performed only by trained specialist personnel. Every person called upon by the operator to work on the module must have read and understood the complete assembly and operating manual especially the chapter 3 "Basic safety notes". This applies particularly to personnel only used occasionally, such as maintenance personnel.

3.5 Safety Considerations

-  **Avoid any operation that affects the function and reliability of the module.**
-  **Observe applicable on site safety and accident prevention regulations.**

3.6 Notes on particular risks

Generally valid:

Risk of injury from objects falling and being ejected

-  **The danger zone must be surrounded by a safety fence during operation.**

Risk of injury due to squeezing and bumping during movement of the gripper jaws and breaking or loosening of the gripper fingers

-  **While disassembling uncontrollable moves of parts of the gripper possible!**
-  **Do not move parts by hand when the energy supply is connected.**
-  **Do not reach into the open mechanism or the movement area of the module.**
-  **Remove the energy supplies before installation, modification, maintenance, or adjustment work.**

-  **Make sure, that no residual energy remains in the system.**
-  **Perform maintenance, modifications, and additions outside the danger zone.**
-  **For all work, secure the unit against accidental operation.**
-  **Take a precautionary approach by maintenance and disassembly.**
-  **Only special trained staff should disassemble the module.**

4 Warranty

The warranty is valid for 24 months from the delivery date to the production facility under the following conditions:

- Intended use in 1-shift operation
- Observe the mandatory maintenance and lubrication intervals.
- Observe the environmental and operating conditions.

Parts touching the work piece and wearing parts are not part of the warranty.

The module is considered defective if its basic function “gripping” is no longer given.

5 Scope of delivery

The scope of delivery includes:

- WSG 32-068 servo-electric 2-finger parallel gripper
- Operating manual
- CD with documentation and firmware

6 Accessories

The following accessories that are required for the module must be ordered separately:

- Ethernet data cable, length 5 m, 4-pole M8 to RJ-45, for WSG gripper modules and KMS 40, Part No. AL-ETH-4P-5M (straight) and AL-ETH-4PW-5M (right angle)
- Power supply cable, length 5 m, 6-pole M8 connector to free wire ends, shielded, Part No. AL-M8-6P-5M (straight) and AL-M8-6PW-5M(right angle)
- Centering sleeves, 06.0x5.35, outer diameter 6h6, item no. ZH-6.0-5.35
- PROFINET RT (software license), OPT-WSG-PN
- Universal Finger WSG-F
- Force Measurement Finger WSG-FMF
- Tactile Sensing Finger WSG-DSA



Please order accessories separately. More accessories can be found on our web site www.weiss-robotics.com.

7 Technical Data

7.1 Outer dimensions

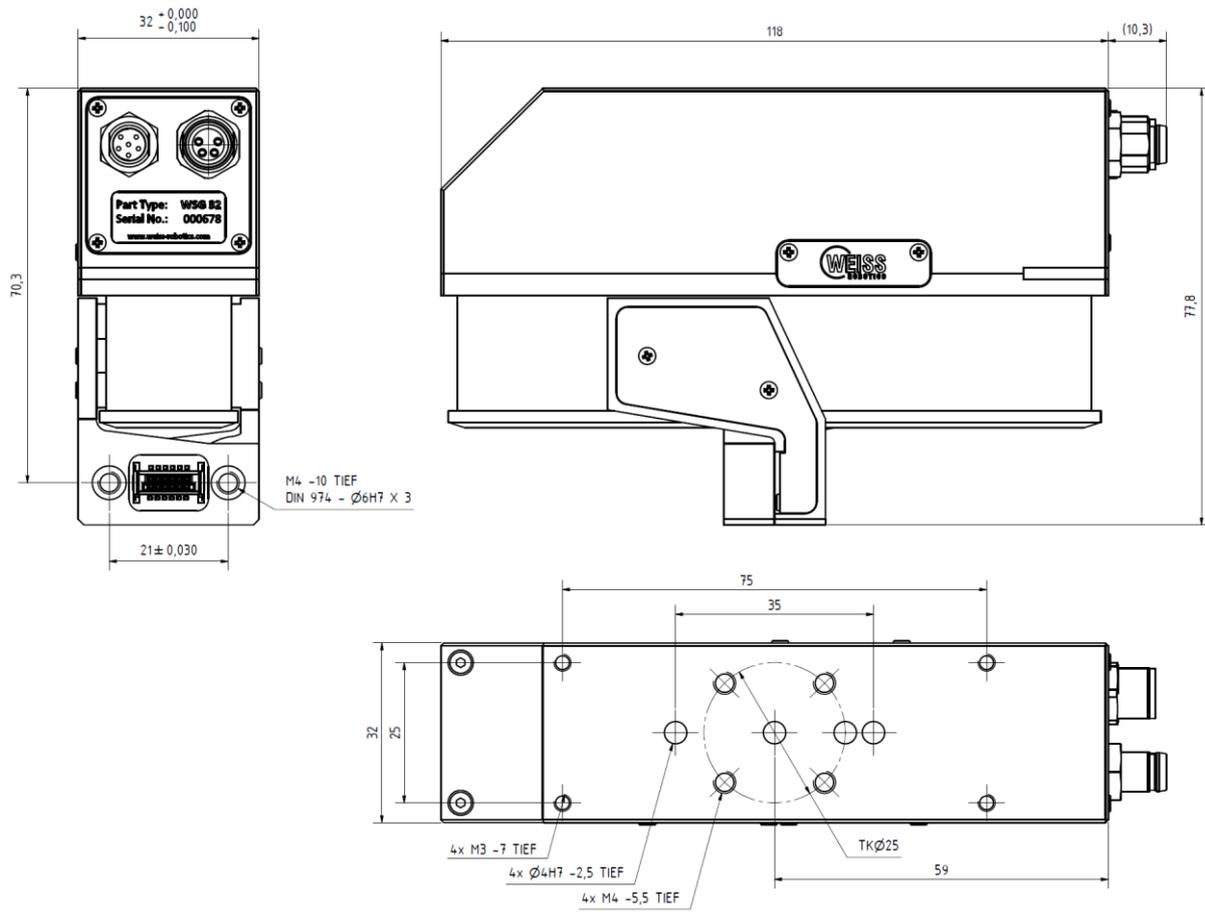


Figure 2: Outer dimensions

7.2 Nominal mechanical data

⚠ Exceeding the specified nominal data can damage the module. If in doubt, please discuss your application with our technical sales department.

Mechanical Data	Unit	Min.	Typ.	Max.	Remark
Stroke per finger	mm		34		
Nominal gripping force	N		50		
Minimum gripping force	N			5	Gripping speed 5 mm/s, finger length 55 mm, steel on steel
Maximum gripping force	N	50			Gripping speed 50 mm/s, finger length 55 mm, steel on steel
Weight	kg		0.55		
Workpiece weight	kg		0.5	0.5	
Finger length	mm			120	at nominal force, see Figure 3
Mass per finger	kg			0.1	
Tightness	IP		40		DIN EN 60529
Ambient temperature	°C	0		50	
Air humidity	%	0		90	Non condensing
Repeatability	mm		±0.005		3σ-deviation
Gripping speed	mm/s	5		400	
Finger acceleration	mm/s ²	100		5000	

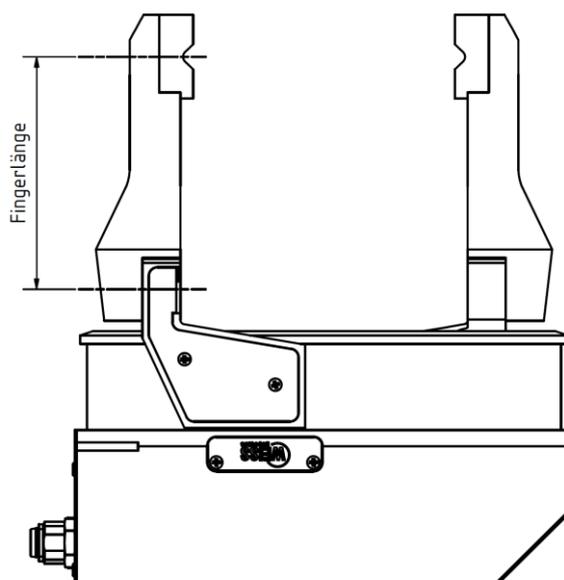


Figure 3: Determining the clamping height

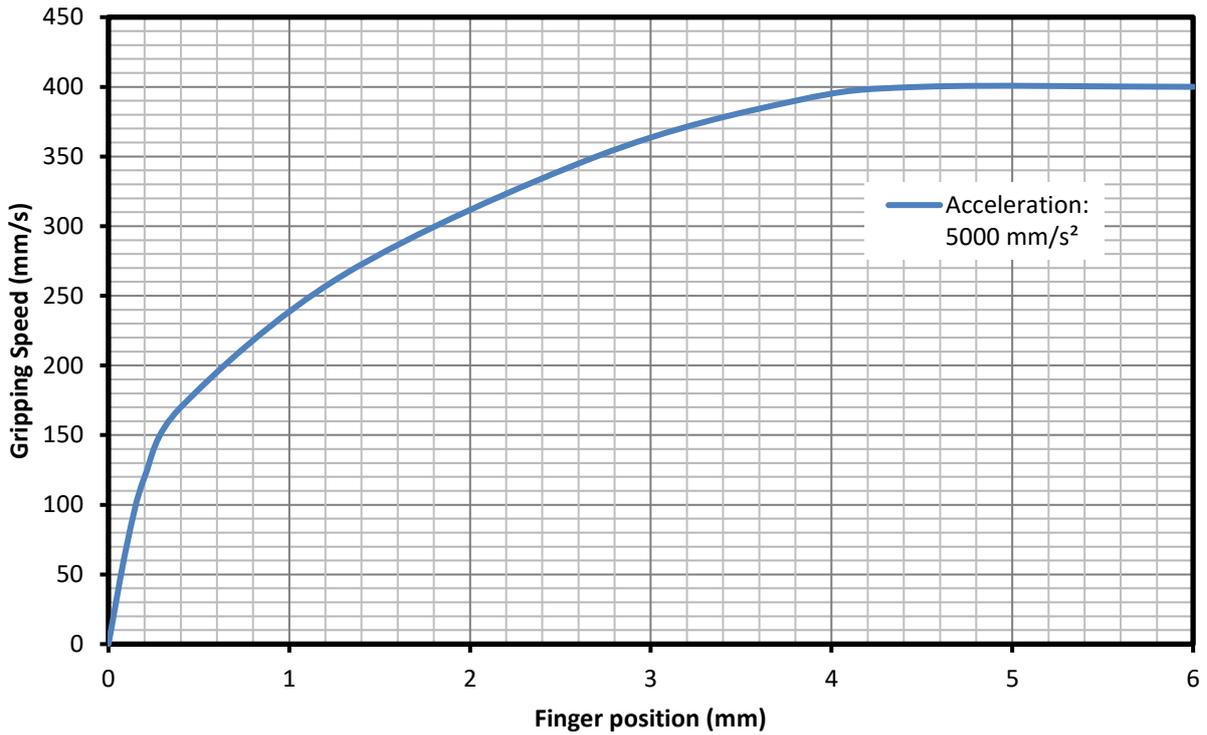


Figure 4: Typical finger acceleration, gripping force: 50 N, finger mass: 2x 0.1 kg

7.2.1 Mechanical Finger Load

The following table shows the maximum load of the finger. The specified load may be applied simultaneously and in addition to the gripping force.

Mechanical Load	Unit	Min.	Typ.	Max.	Remark
F_z	N			50	
M_x	Nm			1.6	
M_y	Nm			1.6	
M_z	Nm			1	

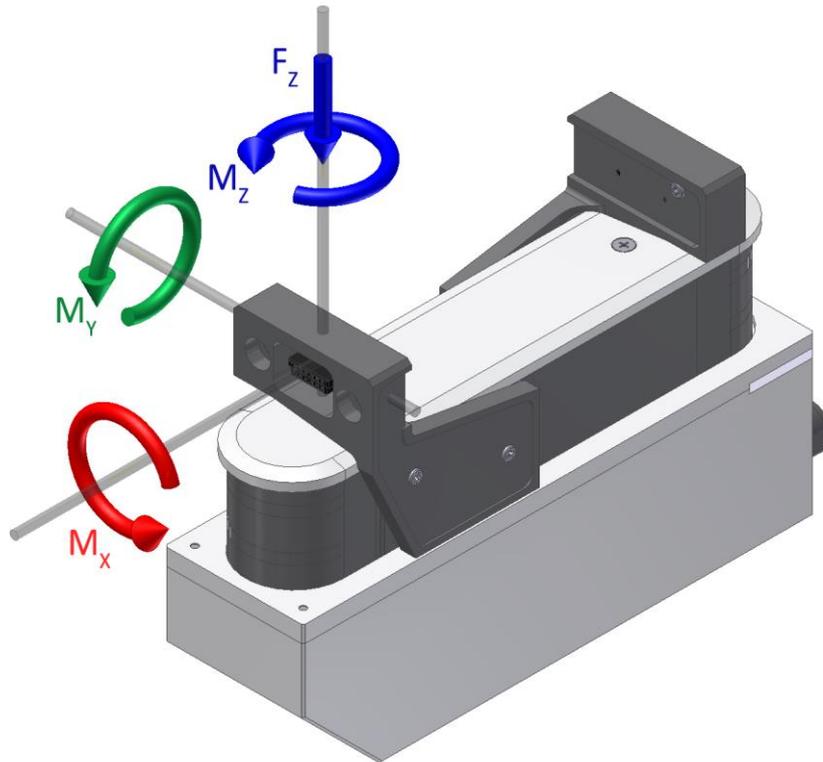


Figure 5: Mechanical finger load

7.2.2 Gripping force

The gripping force is defined as the effective force acting between the fingers multiplied by the number of fingers in contact with the part to be grasped. To operate the gripping module without force measurement fingers, the gripping force is calibrated during the manufacturing process. The actual gripping force depends on gripping speed, finger length and temperature. Figure 6 shows the recommended gripping speed according to the desired gripping force. The typical influence of the finger to the effective gripping force is shown in Figure 7.



For a precise control of the gripping force use the Force Measurement Finger WSG-FMF (available as an accessory)

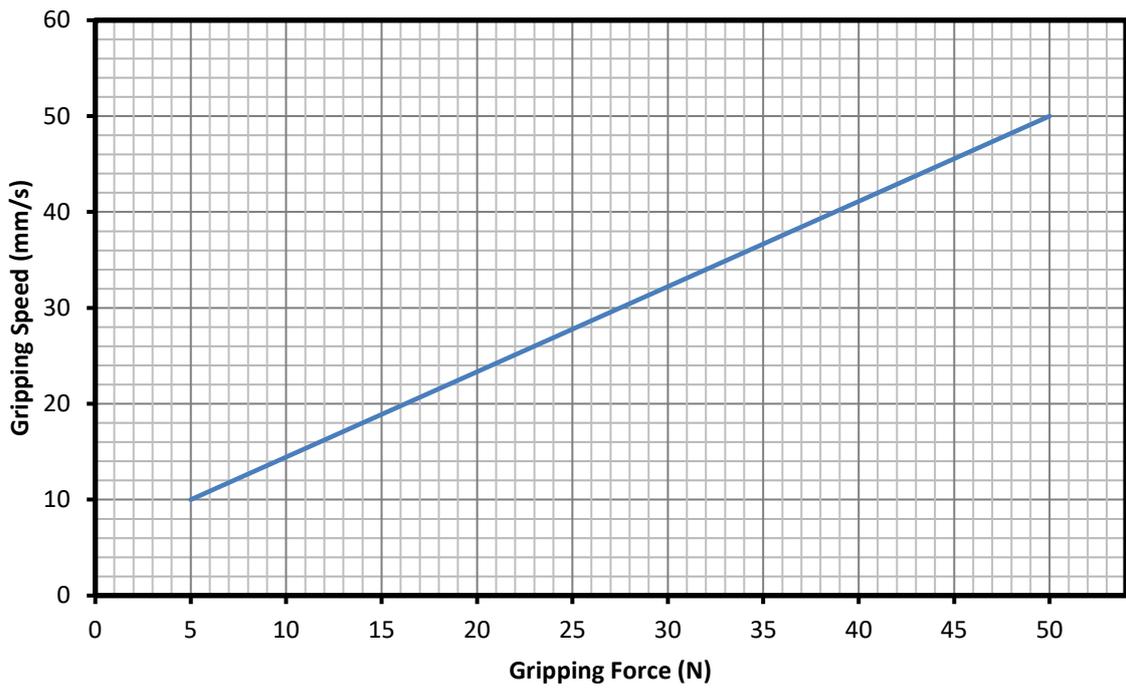


Figure 6: Recommended gripping speed (steel on steel, finger length 40 mm)

△ The diagram above is considered as a recommendation. If in doubt, please try out and measure the actual force for your application.

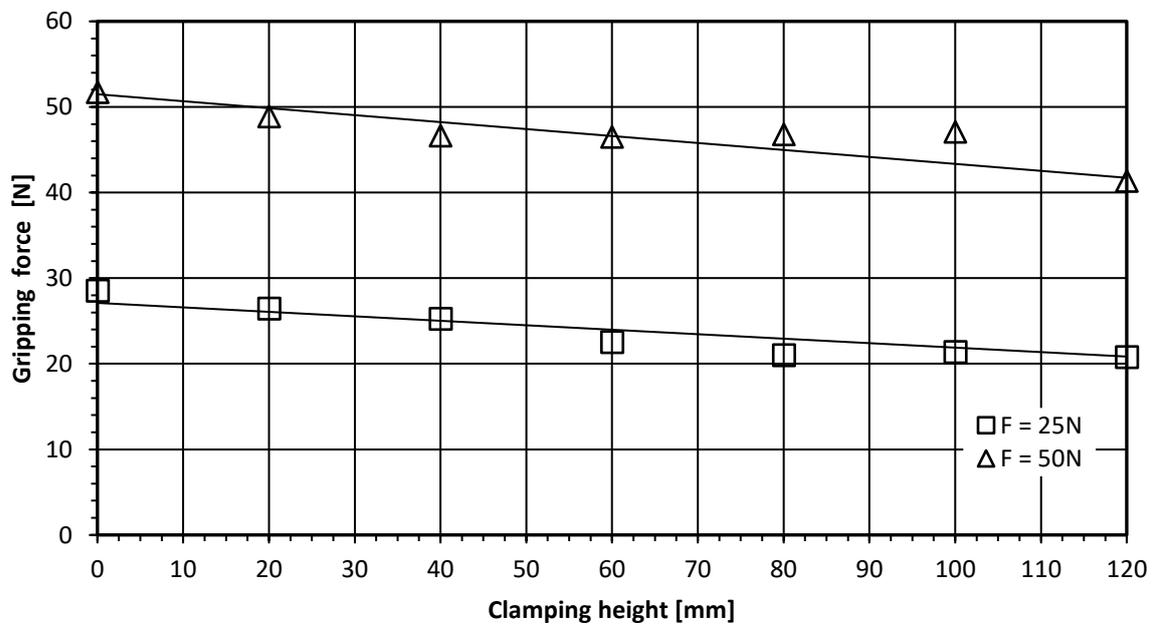


Figure 7: Gripping force over clamping height diagram

Definition of the nominal gripping force

To determine the nominal gripping force, the module is non-positively mounted to an aluminum plate, see Figure 8. The plate itself is thermally insulated from the underlying surface. With an ambient temperature of 22° C the module can hold with the nominal gripping force for at least 5 hours.

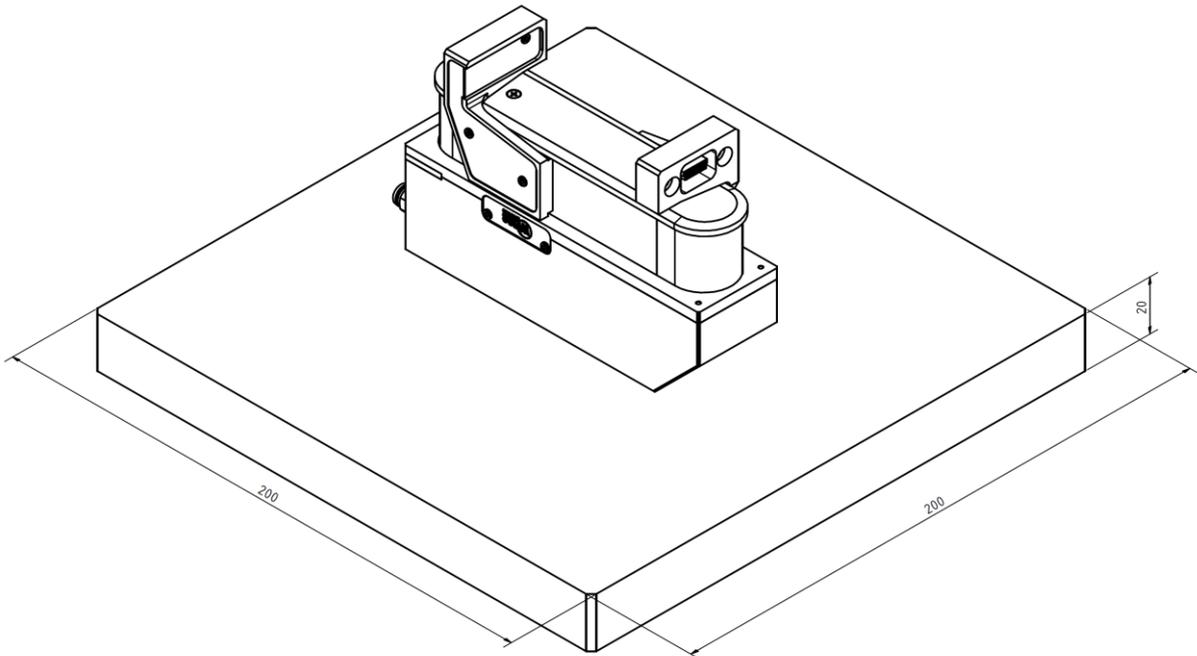


Figure 8: Arrangement for ascertaining the nominal gripping force

⚠ For high gripping forces or long holding cycles, make sure that heat is well dissipated via the screw contact surface. Damage to the module is possible!

7.3 Nominal electrical data

⚠ Exceeding the specified nominal data can damage the module. If in doubt, please discuss your application with our technical sales department.

Parameter	Unit	Min.	Typical	Max.	Remark
Clamping voltage	V DC	22	24	28	
Current drawn when idle	A		0.05		
Current drawn when holding	A		0.75		Gripping force = 50N
Positioning resolution	µm		1.3		
Controller		Integrated			
Field bus interface		Ethernet / CAN-Bus (optional) / PROFINET (optional)			
Configuration interface		web based			

7.3.1 Fuse

The module has an integrated fuse to protect against short circuits and incorrect polarity.

 **To have the fuse changed, please contact an authorized sales partner.**

7.3.2 Power supply and CAN-Bus (optional)

Power is supplied via a 6-way M8 connector on the modules housing, which also carries the optional CAN-Bus interface. CAN-Bus can be used for commands as well as for configuration and diagnosis via the web server (cf. chapter 7). The CAN-Bus interface is not electrically isolated and uses the module's GND pin as reference potential. Figure 9 shows the pin assignments.

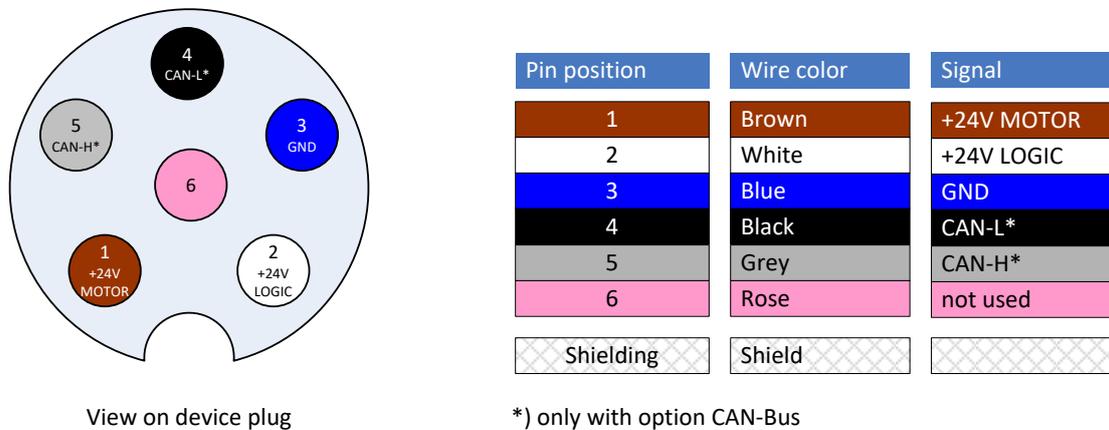


Figure 9: Terminal assignment of the power supply and CAN-Bus connector

Requirement for the power supply:

- Power supply: 24 V DC $\pm 10\%$
- Ripple < 150mV_{PP}
- Available output current: at least 3 A

7.3.3 Ethernet

The Ethernet interface can be used both for commands as well as for configuration via the integrated web server. It is presented via a 4-way M8 connector (socket). Figure 10 shows the pin assignments.

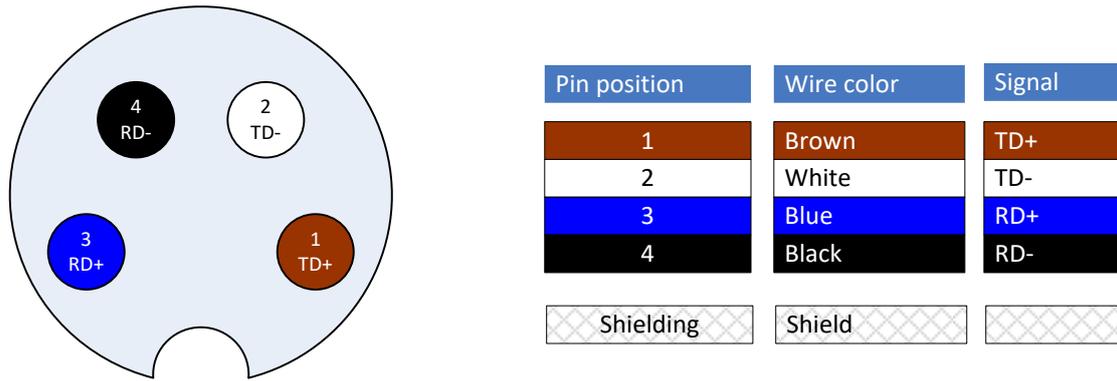


Figure 10: Pin assignment of the Ethernet connector (view on the socket).

The following cables from Weiss Robotics are suitable to connect the Ethernet interface:

- Type: AL-ETH-4P-3M (M8 straight to RJ-45, cable length: 3 m)
- Type: AL-ETH-4P-5M (M8 straight to RJ-45, cable length: 5 m)

Commands are sent to the module via TCP/IP connections, using the TCP or UDP protocol. For further information, please see the "WSG Command Set Reference Manual" (on the accompanying CD or can be called up via the web interface). The module currently also supports the following network services: DHCP (dynamic IP addresses), SNTP (network time), HTTP (web user interface), Multicast DNS (decentralized resolution of host names).

Interface specification:

Parameter	Unit	Min.	Typical	Max.	Remark
Transmission standard		IEEE 802.3			
Communication standard		TCP/IP (IPv4)			
Transmission speed	MBit/s	10; 100			Auto-negotiated
Transmission type		Half duplex			
Auto-MDIX		yes			

7.3.4 CAN-Bus (optional)

The module is available with an optional CAN-Bus interface. It is connected using the M8 connector of the power supply, cf. Figure 9.

Interface specification CAN-Bus (option):

Parameter	Unit	Min.	Typical	Max.	Remark
Bus Standard		CAN 2.0A, CAN 2.0B			
Supported bit rates	kBit/s	10; 20; 50; 100; 125; 250; 500; 1000			
Voltage CAN-L and CAN-H	V	-7		12	relative to GND

Input resistance CAN-L and CAN-H	kΩ	20		50	
Differential input resistance	kΩ	40		100	

Connecting the module to CAN-Bus

CAN networks must have a defined termination at the first and last participant of the bus. The module comes with a factory-set optional termination, see ordering information in chapter 6.

 **There is no electrical isolation on the CAN-Bus!**

7.3.5 Base jaw with sensor port

The module has an integrated sensor port in each of the base jaws which makes it easy to connect intelligent gripper fingers. The sensor port makes the following interfaces available:

- UART (LVTTTL levels)
- SPI (LVTTTL levels)
- Digital I/O pin (LVTTTL levels)

The sensor port supports the automatic configuration of the connected fingers. To use this function, a configuration memory must be integrated into the fingers. All of the intelligent fingers offered by Weiss Robotics for this gripper (e.g. force measurement finger WSG-FMF) already have this memory integrated and are completely configured, so that you just have to fit this finger to the module. The fingers will then be automatically detected the next time the system starts.

The sensor port supplies an operating voltage of 5 V ±10% at max. 200 mA. The supply voltage is protected against short circuits and can be switched on and off from the gripper control system. A short circuit in the supply voltage will trigger an error state which must be acknowledged.

 **The power supply from the sensor port is not suitable to supply actuators.**

 **The gripper control system may be destroyed by excess voltage on the sensor port pins.**

The digital pins on the sensor port are protected against electrostatic discharge. However, we still recommend that you should not directly touch the pins on the connector with your fingers, to avoid damage from electrostatic discharge. The SPI and UART digital interfaces share transmit and receive pins. The configuration memory determines which function is active.

 **Should you require detailed specifications of the sensor port to implement your own fingers, please contact Weiss Robotics.**

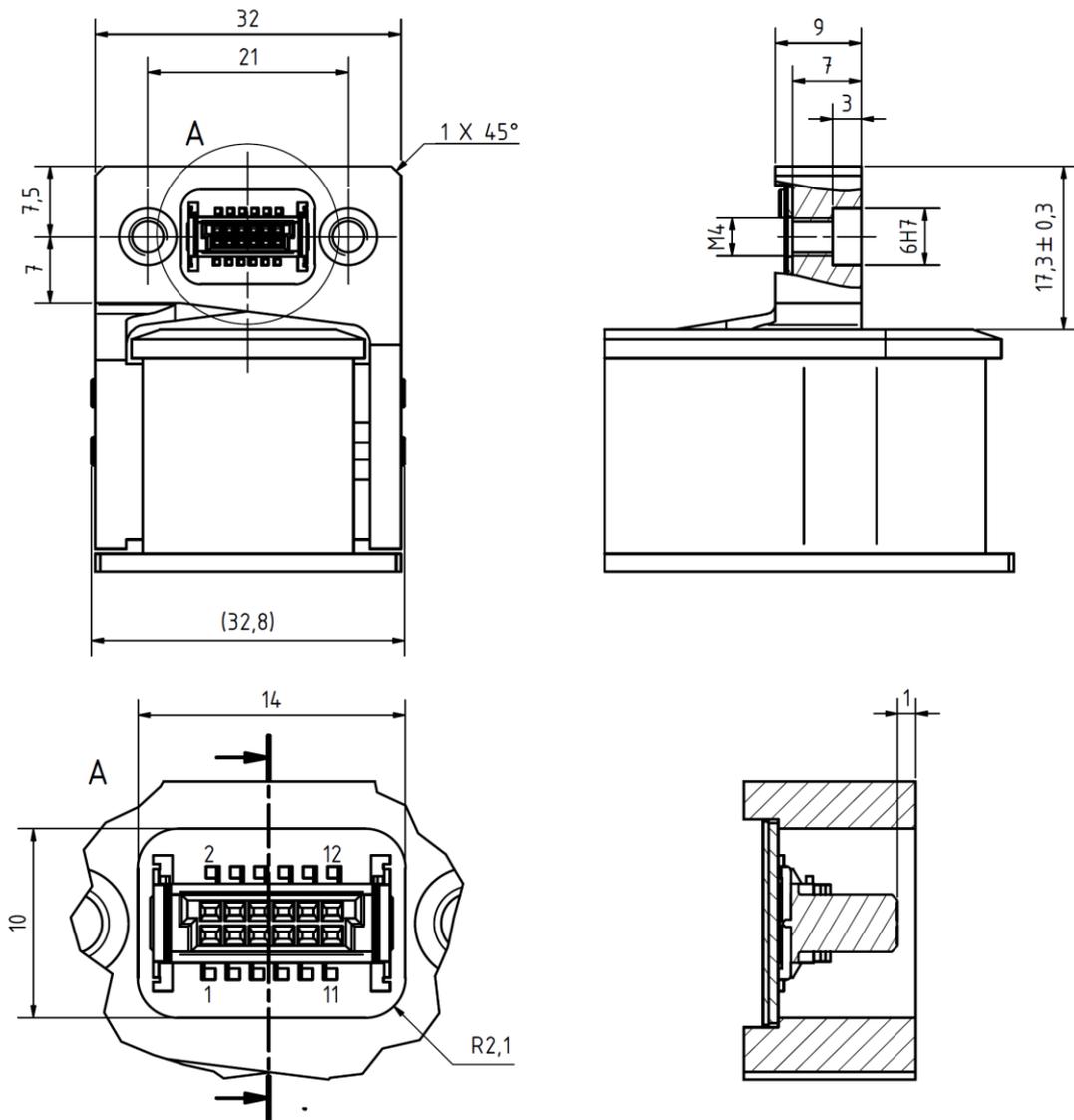


Figure 11: Sensor port

Matching centering sleeves

Matching centering sleeves are supplied with the fingers. For your own designs or as a spare part, please use the centering sleeves which are available as accessories under item no. ZH-6.0-5.35, described as: centering sleeve 06.0 x 5.35 (outer diameter: 6h6).

Sensorport connector type

Manufacturer: ERNI, type: SMC-B-12 (terminal strip), part number: 154805

Counterpiece: SMC-Q-12 (male, low-profile connector), part number: 154818

Sensor port connector pin assignments

Pin number	Name	Direction	Function
1	MOSI/TXD	OUT	SPI/UART: Transmit data from the manual controller
2	nSSEL	OUT	Only SPI: A low signal selects the slave

3	DIO	I/O	Digital I/O pin
4	SCLK	OUT	Only SPI: Clock for transmit and receive data
5	CFG-SDA	I/O	Configuration bus – data line
6	MISO/RXD	IN	SPI/UART: Received data
7	CFG-SCL	OUT	Configuration bus – clock line
8	NC	-	not connected
9	+5V	OUT	Operating voltage output 5V/200mA max.
10	+5V		
11	GND	OUT	Mass
12	GND		

7.4 Name plate

The name plate is on the narrow side of the module above the connector.

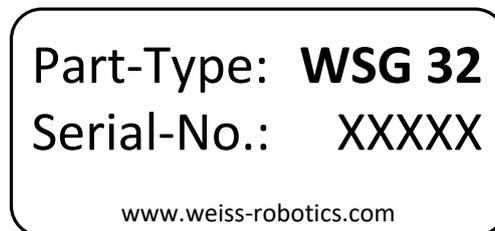


Figure 12: Name plate

8 Installation

8.1 Installation instructions

-  **Risk of injury because of electrical energy!**
-  **Warning: Risk of injury when the machine/system moves unexpectedly!**
-  **Remove energy supplies during all maintenance work and adjustments.**

8.2 Mechanical connection

The threads that can be used to mount the module and the centering holes are shown in Figure 13. The module has both M3 and M4 threads for fixing on the rear of its housing, as well as 6 mm centering holes. The M4 threads together with the centering holes form part of the 50 mm ISO standard flange for industrial robots.

When in holding mode, the module constantly adjusts the gripping force, to ensure a constant gripping force. The surfaces which are screwed together must be capable of dissipating the resulting heat.

-  **Risk of burns from hot surfaces!**
 -  **Please ensure that the thermal coupling is good, especially if the module is to apply high gripping forces over longer periods of time. There is a risk of overheating!**
 -  **Prevent exposure to external sources of heat, such as from your robot's pan-tilt unit, as this can reduce the module's performance. Poor dissipation of heat or exposure to additional heat will require the gripping force to be reduced.**
-  **To ensure fault-free operation and to minimize the radiation of electromagnetic interference (EMC) the module's housing must be properly earthed.**

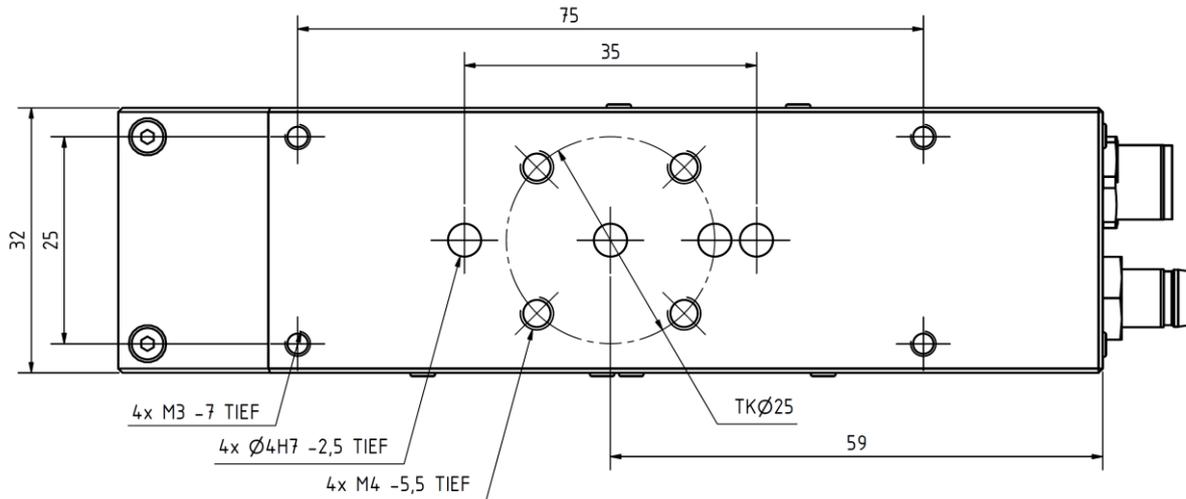


Figure 13: Mechanical connection

⚠ Do not exceed maximum torque: M3 threads = 1.0 Nm MAX, M4 threads = 2.0 Nm MAX

8.3 Electrical connection

As supplied, the module is configured so that the M8 connector carries both the power as well as the logic parts for the integrated gripper control system. If your application requires the power and logic parts to be separated, for instance if you would like to use an external relay to ensure that the gripping force is safely switched off (cf. "safe torque off", STO), then the power and logic parts can be supplied separately. The equivalent circuit for the power supply is shown in Figure 14. The power and logic supply are not electrically isolated so they must use the same power supply unit. The common supply of load and logic is shown in Figure 15. If the supply to the load is to be switchable in operation, then the connection can be arranged as shown in Figure 16.

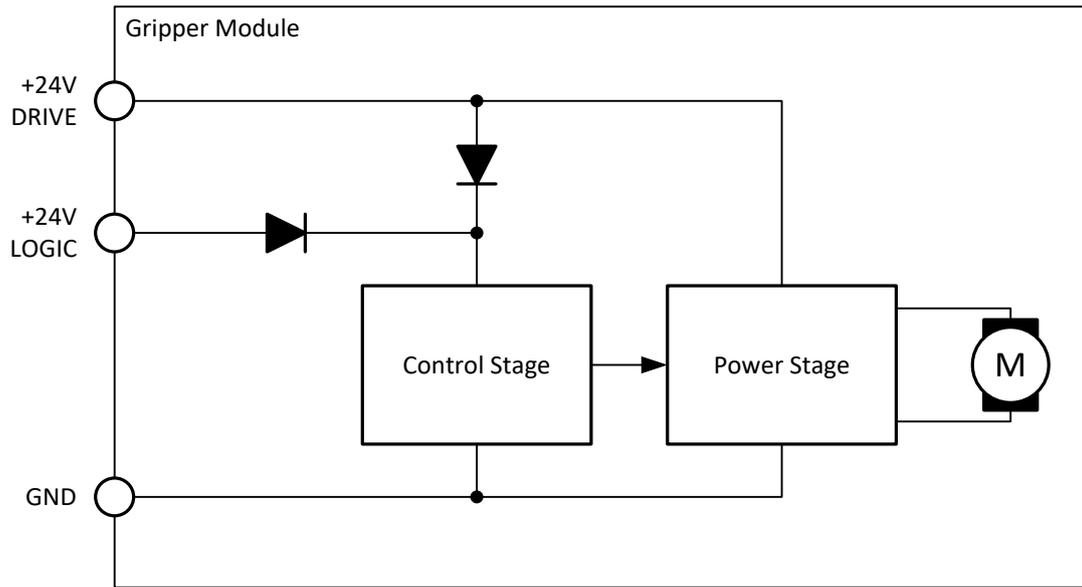


Figure 14: Equivalent circuit for the power supply

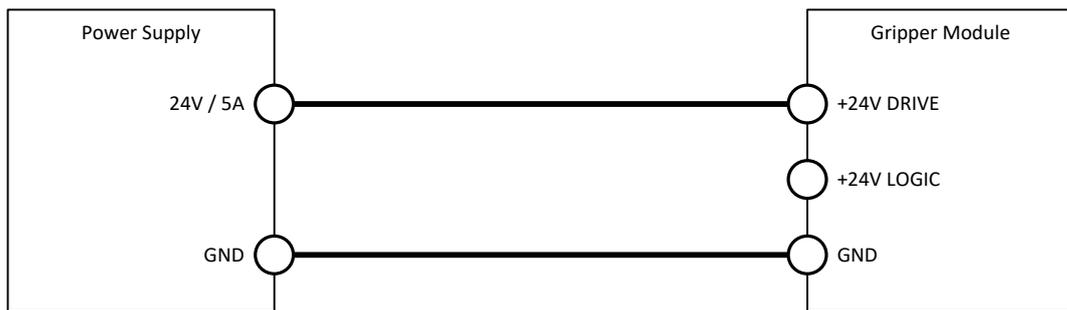


Figure 15: Connection type common supply to load and logic

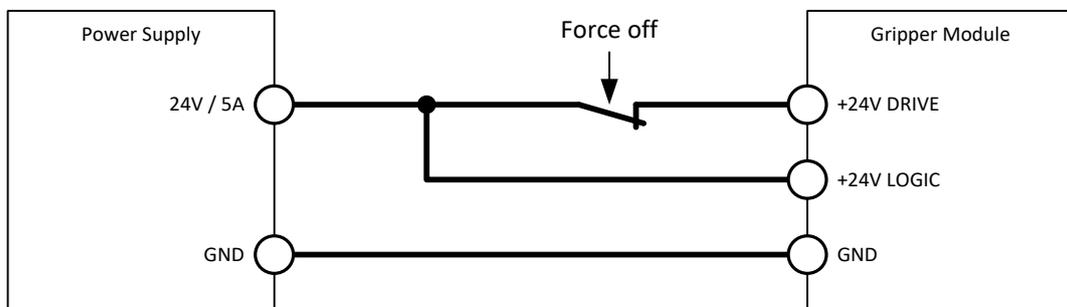


Figure 16: Connection type: Supply to load separate from supply to logic

△ If load and logic are operated separately, always use the same power supply.

8.4 Installation of the fingers

To install the standard fingers, please use the fixing material supplied with the fingers. The centering sleeves supplied with the fingers must be used during the installation. This is particularly necessary if the finger has an electrical interface to the sensor port as otherwise the sensor port's connector can be damaged.

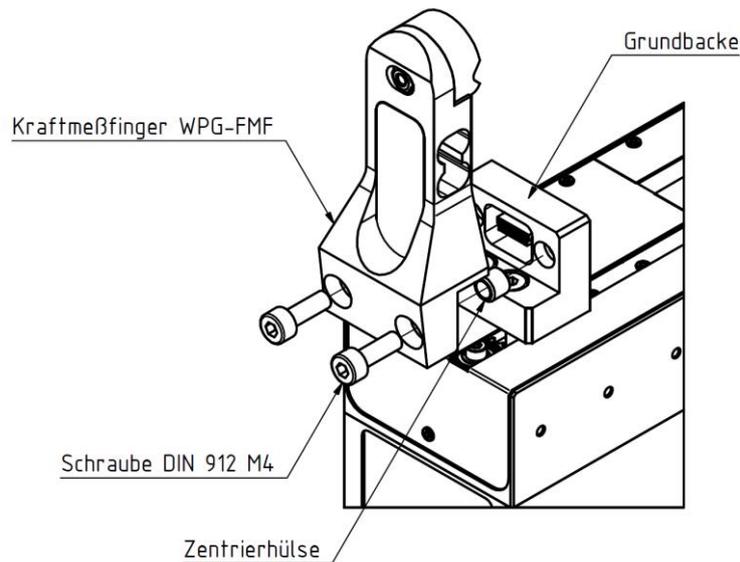


Figure 17: Installation of the fingers

△ Do not exceed maximum torque: M4 threads = 2.5 Nm MAX

8.5 Initial startup

When first commissioning the module, please follow this sequence of steps:

1. Using the Ethernet cable supplied, connect the module to the existing Ethernet network or alternatively to the network card in your PC or laptop.

△ The module's IP address is factory-set to a static value of 192.168.1.20. Should you wish to operate several modules in the same network and/or if this address is already in use, then you will have to change the module's IP address accordingly (e.g. set the 2nd module's IP address to 192.168.1.21). To do that, first connect the module directly to your computer's network connection, to avoid address conflicts in the network. For more information about changing the IP address, please see chapter 8.6.

⚠ To directly operate the module on your computer's network connection, you may have to alter your computer's network configuration. If in doubt, contact your system administrator.

2. Connect your module with the power supply (24 V, 3 A).
3. The module will now start up. The indicator for the operating state will light up blue and after about 5 seconds it will start flashing quickly blue. This signals that the module is booting. After about 15 seconds the indicator will slowly flash white. The module is ready for use.
4. On your computer, open its web browser and enter the address **http://192.168.1.20**.
5. You will be presented with the module's configuration interface (Figure 18)
6. From the menu, select the „Motion“ → “Manual Control“ option and click on the „Home“ button (Figure 19). The module will now zero itself.

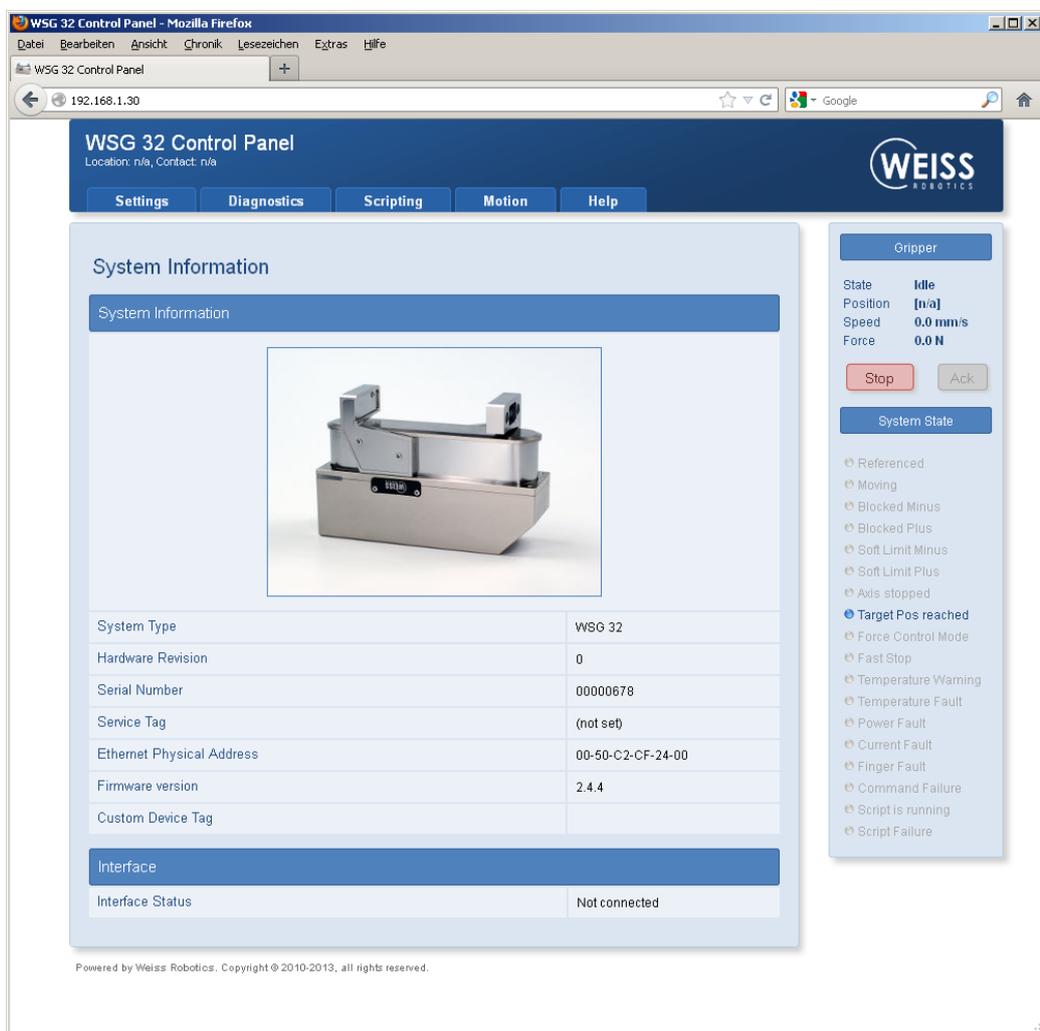


Figure 18: The starting page of the web-based interface

7. Once the movements associated with zeroing have finished, for test purposes, you can move the module via the web interface. For this, select the movement parameters about the adjuster and then click on the "Move" button.

Important: The module must be zeroed to be able to execute movement commands.

8. Other steps which you should take during the commissioning:

- Call up the "Diagnostics" → "System State" page, to check the module's supply voltage
- On the „Settings" → "Command Interface" page, select the interface on which your module is to be operated.
- If necessary, on the „Settings" → "Motion Configuration" page enable automatic zeroing during startup („Homing on Startup").
- On the „Settings" → "System" page, create a user with corresponding rights and activate the web interface's security function to prevent changes to your setting by unauthorized persons.

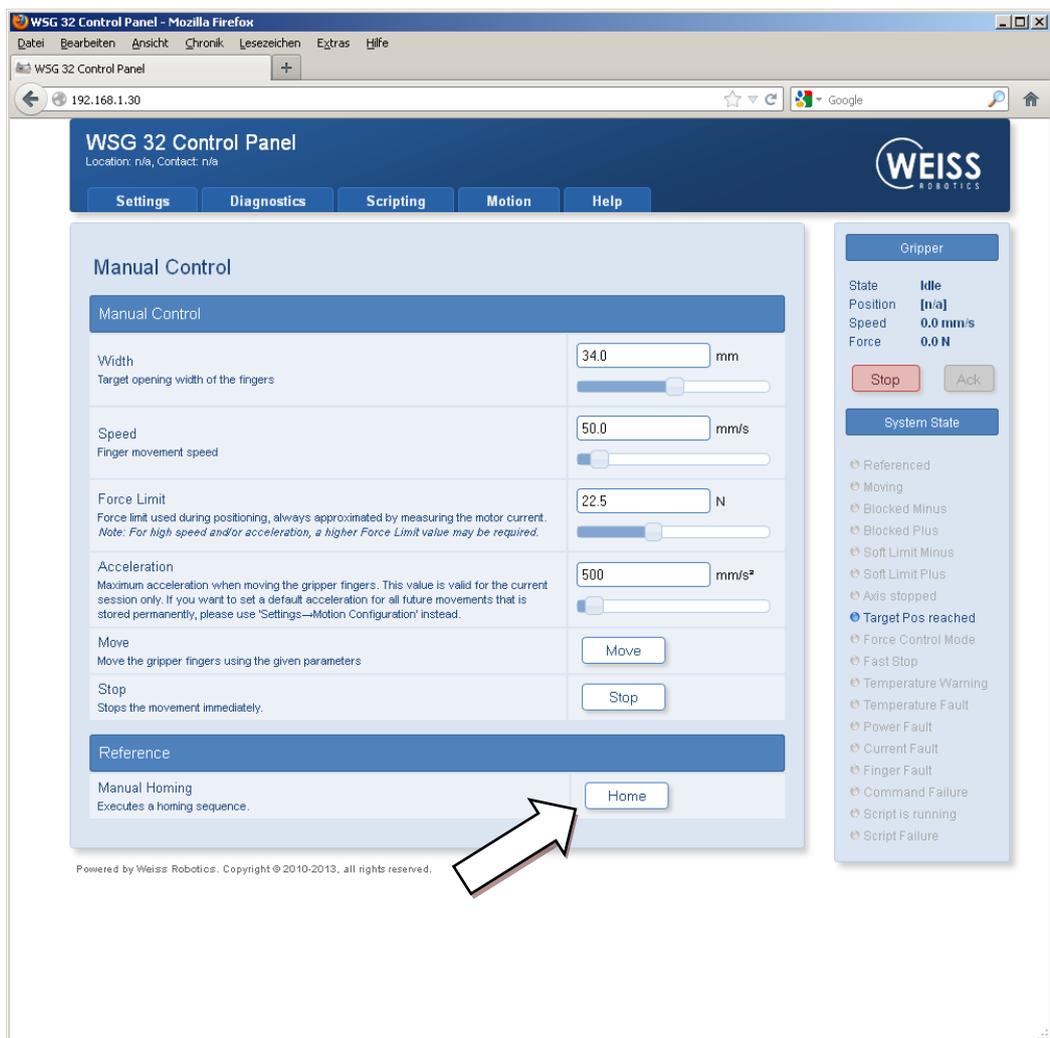


Figure 19: „Manual Control“ configuration page

8.6 Changing the IP address and using DHCP

To change the module's IP address, in the web interface, select the "Settings" → "Network" menu option. Adjust the IP address, subnet masks and any gateway or DNS server addresses for your local network and confirm the changes by clicking on the "Apply" button.

 **After changing the network configuration you will have to restart the module.**

To use addresses dynamically assigned via DHCP, check the corresponding box. In this case the module will automatically take its network configuration from a DHCP server..

 **Please note that if you use DHCP to dynamically allocate IP addresses, there is no integrated way of finding out what IP address has been allocated. This is why the DHCP server should be configured so that the module is issued with an IP address which is known in advance.**

 **Please contact your network administrator for more information.**

9 Operation

The module disposes a powerful integrated control unit. The control unit is accessible by removing the cover plate with the Weiss Robotics Logo (cf. Figure 20).

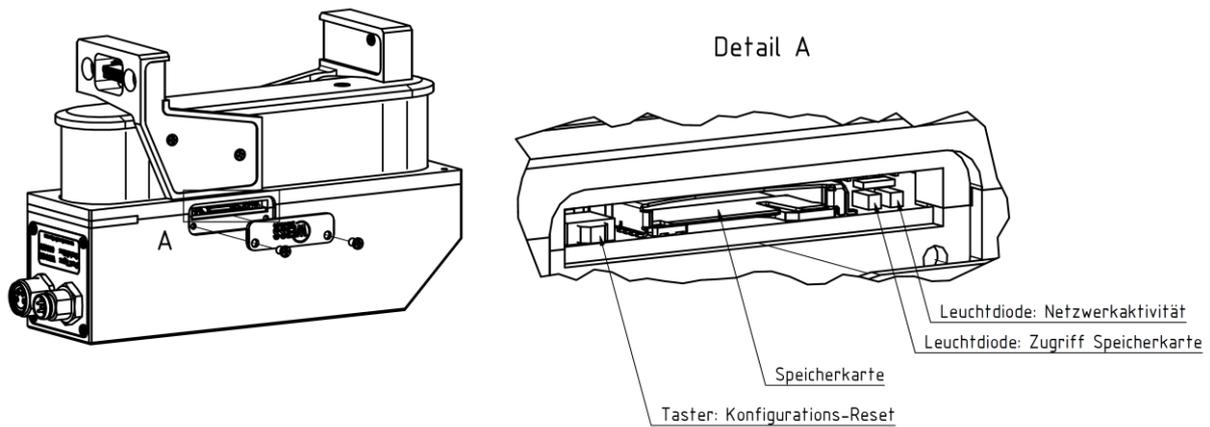


Figure 20: Tray to access the control unit

Via this tray, additional control LEDs and the memory card can be accessed.

⚠ Danger of damaging the control unit. Only use the supplied screws to mount the plate!

9.1 Operating software

The software needed to operate the module is already installed in the unit.

⚠ To guarantee proper operation, the latest version of the firmware should always be installed in the module.

👉 The latest firmware can be downloaded free of charge from www.weiss-robotics.de. The module has to be registered before download.

9.2 Memory card

The module's control unit is equipped with a tray for Micro SD memory cards. Although all popular types (SD and SDHC) are supported, the use of the following memory card type is recommended:

Micro SD card:

Manufacturer: SANDISK, Type: SDSAQM-002G-B35, Capacity: 2 GB

The memory card contains the following data:

- the software needed to operate the module
- configuration data
- documentation and software tools (to be downloaded from the web interface)
- scripts and other user-specific data in the /user directory

The factory-installed card has a capacity of 2 GB. The required software to operate the module is already installed. User-specific data and scripts can be saved in the subdirectory “user”. Please do not change any files outside of this subdirectory, as this may influence the operation of the module and a proper operation cannot be guaranteed any more.



The memory card and the installed software are necessary to operate the module. If you are considering to change the SD card, please copy the contents of the original card to the new card with an appropriate card reader.

9.3 Boot process

The module has a boot loader, which loads and runs the unit’s software from the memory card when the unit is powered up. The indicator for the operating state will light up blue during this. If there is an error, the indicator will light up red for 5 seconds. After this the boot loader will automatically be restarted. This will continue until the firmware can be loaded correctly.

9.4 Display of operating state

On the side, the module has a multi-colored indicator for the operating state (Figure 21). The current operating state is shown by both the color of the indicator as well as by the flash rate.

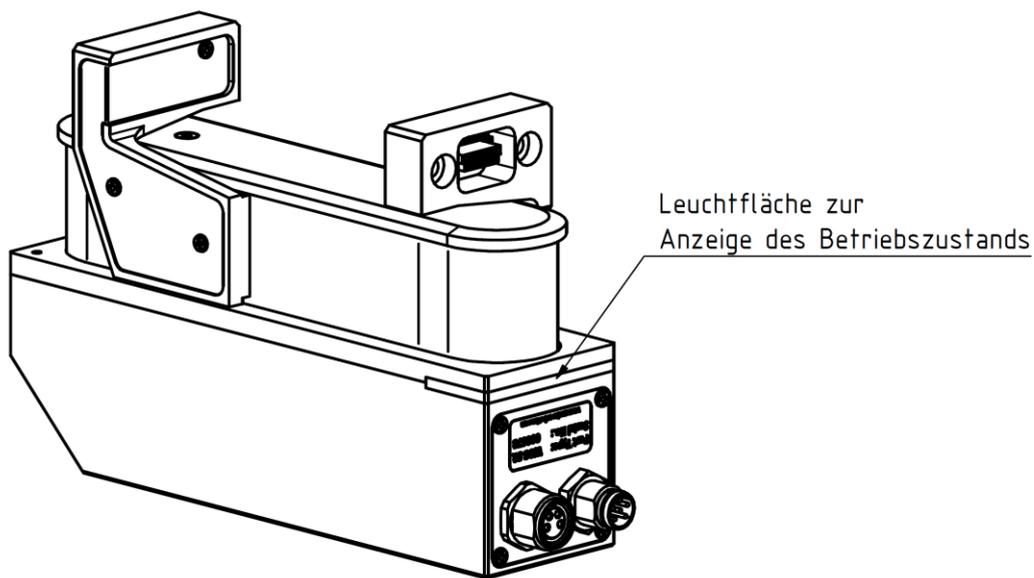


Figure 21: Display of operating state

The following operating states are indicated:

State	Display
Loading the operating software The module loads the firmware and gets ready to start	Blue, constantly on
There was an error loading the operating software The boot process will automatically be restarted	Red for about 5 seconds, then blue again
The boot process for the operating software The operating software will be started and the control system will be configured.	Blue, flashing
Wait state The module is ready for operation and is waiting for a command.	White, slowly pulsating
Busy The module is in the initialization phase or is currently executing a command	White, quickly pulsating
Executing a script A script is being executed by the control system.	Green, quickly pulsating
Warning One or more parameters have reached warning limits. Please check the system's status via its web interface.	Yellow, quickly pulsating
Command received with no errors The module has received an error-free command	Green, pulses once
Error carrying out a command An error has occurred while receiving or executing a command.	Red, pulses once
Loading the operating software The module loads the firmware and gets ready to start	Blue, constantly on
Critical fault An error has occurred (e.g. excess temperature, loss of communications, etc.). This error must be acknowledged before the module can process new commands to move.	Red, pulses quickly
Critical software fault	Red, flash code 2x short, long pause

A serious error has occurred and the execution of the software in the unit has been stopped. The module will restart after a short time.	
--	--

More LEDs indicating SD card and communication activity can be found next to the SD card slot under the cover plate with the Weiss Robotics logo (cf. Figure 20). A constant lightning of the respective LED indicates that the interface is active. The LEDs flash in the rhythm of the interface activity or data traffic.

9.5 Status word and gripper state

The module's current state can be called up at any time via the status word and the gripper state.

9.5.1 Status word

The current state of the gripper is summarized in the so-called status word. The status word can be read via the command interface (command „Get System State“, 40h), via the web interface or by a script (command „Read System State Flags“, gripper.state()). Figure 22 shows the display of the status word via the side bar in the web interface. The status word includes both pure status messages (e.g. zeroed, execution of script, etc.) as well as warnings and errors (e.g. temperature warning, power failure, etc.).



You will find the documentation for the status word in the “WSG Command Set Reference Manual”.

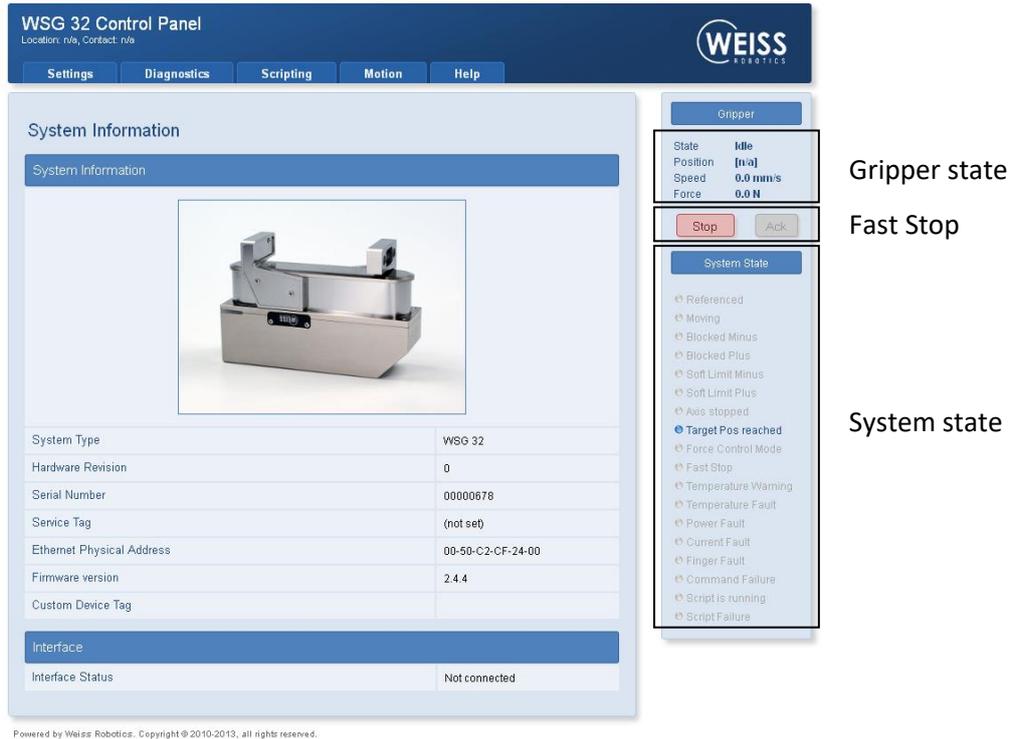


Figure 22: Web Interface side bar with system state

9.5.2 Gripper state

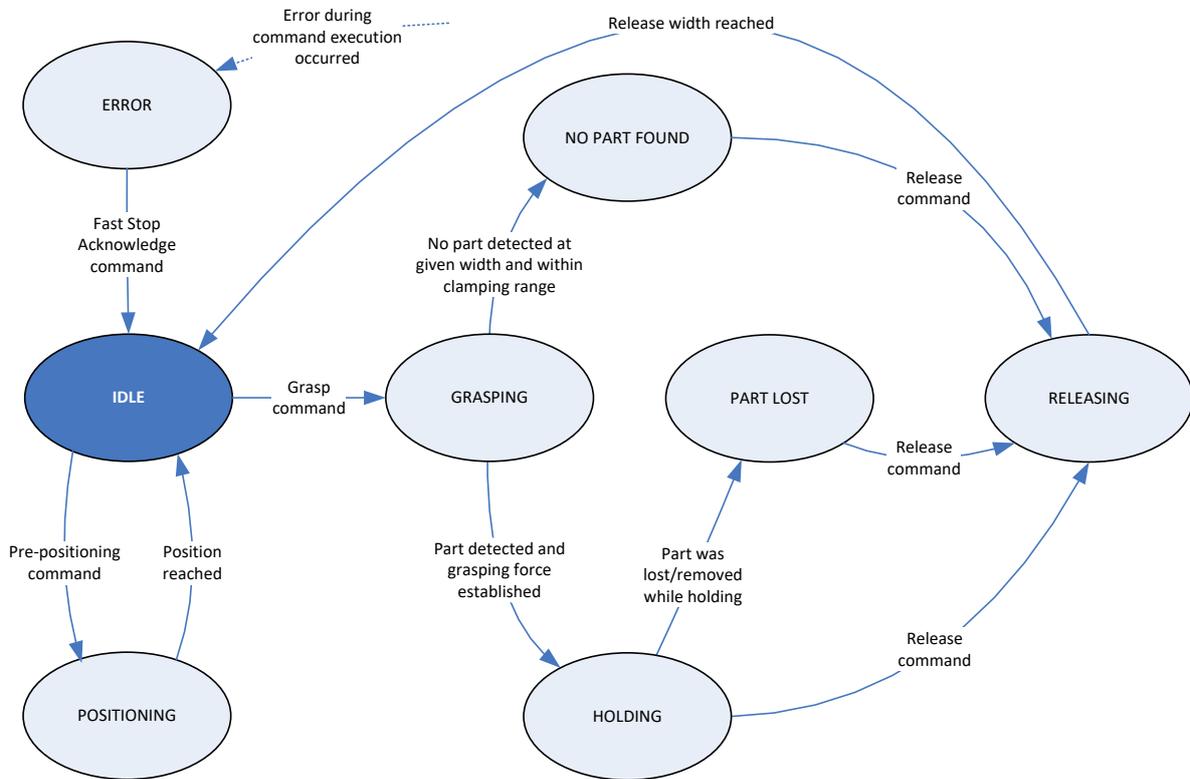
The gripper state reflects the current state of the gripper and is used to control the process of gripping. It can take the following states:

State	Description
IDLE	The gripper is in its idle state No gripping process is currently in progress
GRASPING	The gripper is closing A part is being gripped, the fingers are moving towards the part. The detection of gripped items is active.
HOLDING	A part is being held A part is being held with the configured force. The monitor of the gripped part has been activated.
PART LOST	A part has been lost The pre-configured gripping force can no longer be applied, presumably because the part to be gripped has been lost.
NO PART FOUND	No part has been found When closing the gripper at the configured position, no part was found to be gripped.

RELEASING	The gripper is opening The gripped part is being released, the fingers are moving.
POSITIONING	Pre-positioning The grippers are being pre-positioned and the fingers are moving.
ERROR	Error An error occurred carrying out the last command. For errors which require acknowledgment, the SF_FAST_STOP flag is also set in the system status word. After any acknowledgment required, the movement can be restarted.

i The gripper state does not indicate whether the gripper is referenced or not. Instead, the system state flags (SF_REFERENCED) must be read to check this.

The state of the gripper is shown like the status word in the side bar of the web interface, see Figure 22. The diagram in Figure 23 shows the possible transitions between the module's states.



Stop command: Issuing a Stop command in any state (except ERROR) will abort the current action and immediately return to IDLE state.

Figure 23: Transitions between the grasping states

9.6 Homing the module

To detect the module's position, it is equipped with a measuring system which can detect the finger's spatial location at a high resolution. Due to the incremental method of position detection, the module has to be homed before motion commands can be executed. The module has a special command for homing which can be issued via the command interface, by a script or via the web interface. It then moves its fingers to the inner or outer physical limit and saves the measured position as a reference value.

To offer maximum flexibility, the module can be referenced to the inner as well as to the outer limit. For outer homing, a factory-calibrated value is used to shift the reference position, so that both variants end up with the same direction and the same origin for the axis coordinates.

 **Make sure that the fingers can actually move freely in the reference drive direction up to the module's mechanical limit.**

 **Due to the integrated damping elements at the outer limit, the WSG 32's position accuracy is better when homing to the inside.**

 **To automatically execute a homing sequence on start up, activate the "Homing on Start up" option via the web interface ("Settings" → "Motion Configuration")**

9.7 Gripping, part detection and grip monitoring

The module is equipped with an integrated detector for parts to be gripped and a grip monitor, which allows reliable handling even for difficult parts without the use of external sensors. To configure these functions, the following parameters are available on the web interface ("Settings" → "Motion Configuration"):

Parameter	Description
Part Width Tolerance	The tolerance of the specified nominal gripper width which is sent to the module with the grasp command. This is measured as the relative gap between two fingers moving towards one another.
Clamping travel	If a part to be gripped has been detected, the module will attempt to apply the required gripping force by moving the fingers within this range. This is measured as the relative gap between two fingers moving towards one another.

The table above clarifies the function of these two parameters. A grip is only valid (which means it doesn't create an error) if the detected width of the part lies within the hatched area consisting of the part width tolerance and the clamping travel. If no part is detected, then the gripper state will change to "NO PART FOUND". If a contact is detected outside of the defined range, this will be detected as an axis block and the gripper's state will change to "ERROR".

 **The detector of parts to be gripped and the grip monitor are not running in pre-position mode ("Pre-position" command).**

⚠ Damage to the gripper is possible due to insufficient lubrication (dry-running) if the gripper constantly goes through short movements. → every 1000 movements (or at least once per day) the gripper should be moved through its full range of travel.

i For soft parts to be gripped, it may be necessary to increase the clamping travel.

i Setting the part width tolerance to the full range of movement of the module (maximum settings) will deactivate the detection of axis blocking when gripping.

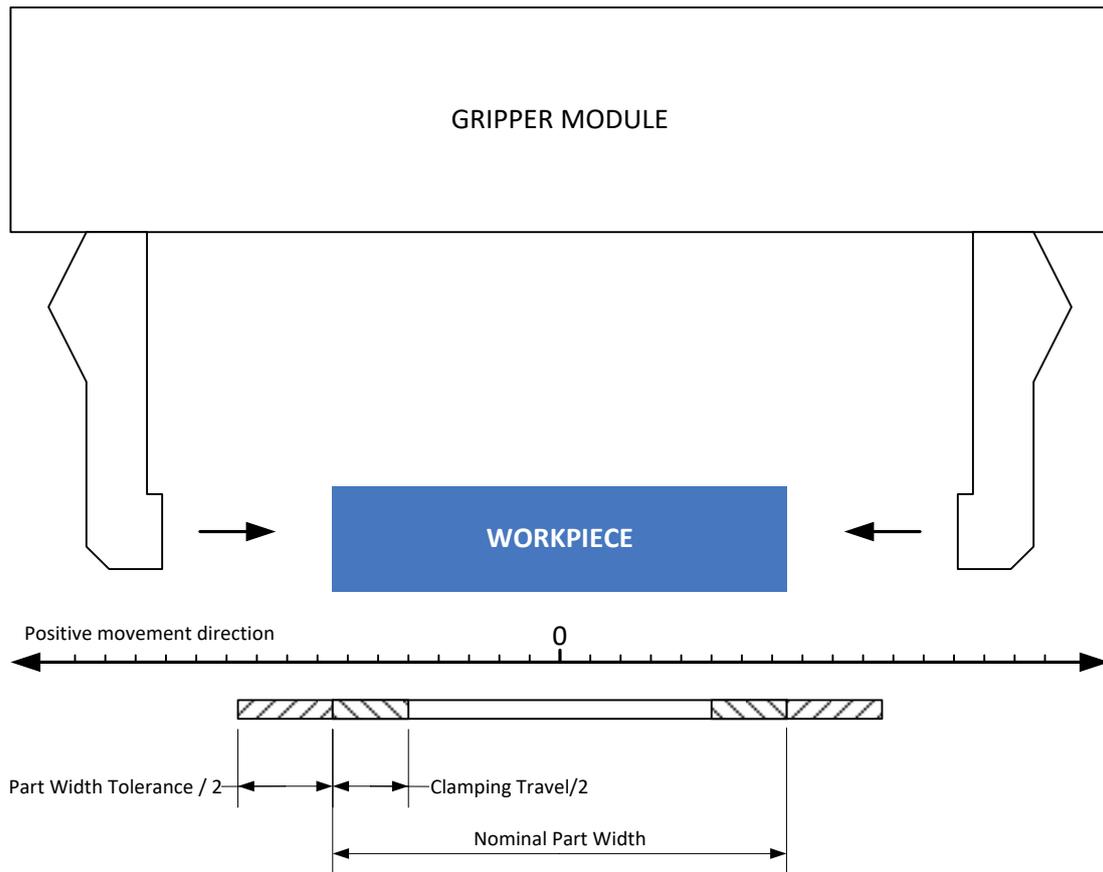


Figure 24: Parameters defining a grip

9.8 Software limit switch

The module's travel can be limited via the software limit switch, as shown in Figure 25. There is one limit switch for an inner range ("MINUS") and one for an outer range ("PLUS"). If the software limit switches have been activated, then positioning commands to move fingers into this range will get a range error response and the command will not be executed. There is also protection from crossing the edges of these ranges. The monitor will trigger a fast stop which requires acknowledgment if the fingers should be moved into these areas.

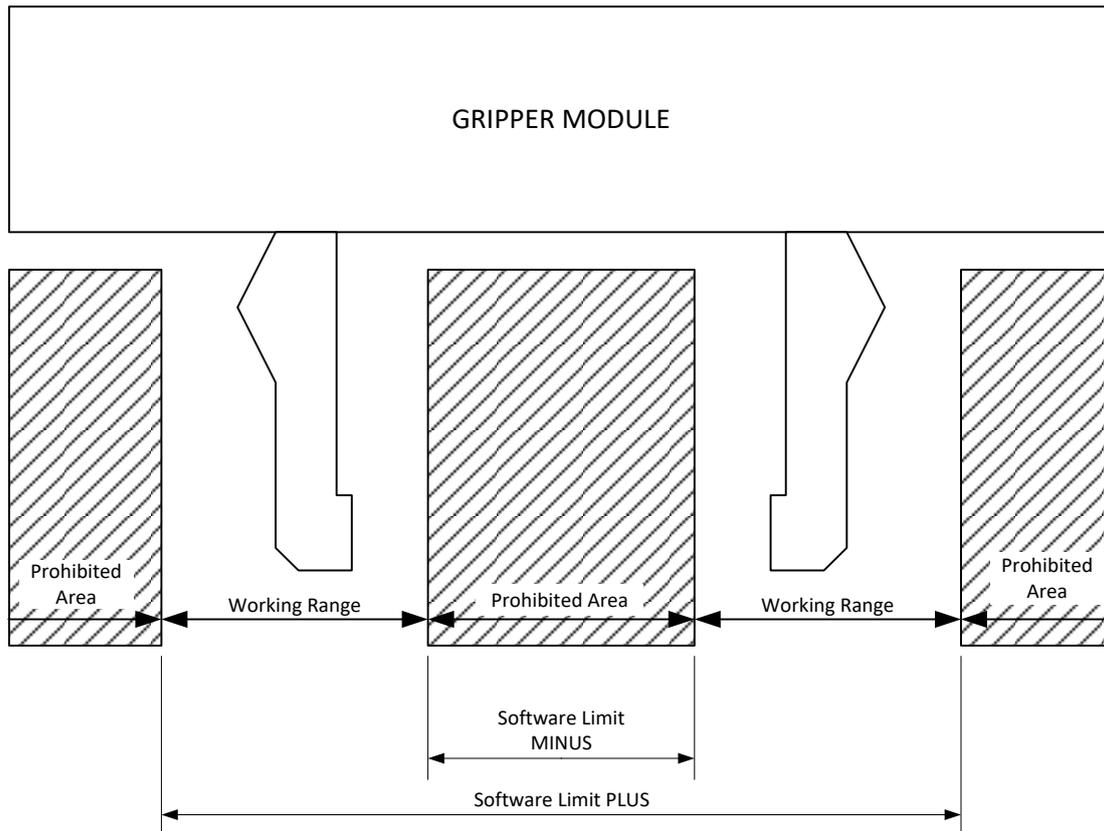


Figure 25: Software limits

The software limits can be set via the command interface, a script or the web interface (“Settings” → “Motion Configuration”).

⚠ These software limits do not represent a safety function as understood by the machine directive.

⚠ The software limit switches are always related to the reference position of the base jaws. Bodies on the base jaws or on the gripper jaws are not included!

i If the fingers are within the forbidden area when the software limit switches are activated, then only movements to leave this area will be possible.

👉 You will find more information on this subject in the "WSG Command Set Reference Manual" and the "WSG Scripting Reference Manual".

9.9 Fast Stops requiring acknowledgment

The module offers a so-called Fast Stop to put itself into a defined state in case of an error or malfunction. Fast Stops are displayed by setting the SF_FAST_STOP flag in the status word. If a fast stop is triggered, for example due to an insufficient voltage error, then all movement commands will be rejected until the error

is acknowledged and any fault condition has been cleared, with corresponding error codes being returned (access denied).

If the module is in Fast Stop state, power will be removed from the drives but the position reference will be retained.

The error can be acknowledged both via the command interface (the command is: Acknowledging a Fast Stop or fault Condition, 24h) as well as manually by clicking on the "Ack" button in the side bar of the web interface (see Figure 22). Fast stops are recorded in the module's event log (see chapter 9.10).



Loss of gripping power on fast stop!



The fast stop does not represent a safety function as understood by the machine directive.



A fast stop can also be triggered via the command interface, by a script or manually via the web interface.



For more information, please refer to the "WSG Scripting Reference Manual".

9.10 Log memory

The module has a non-volatile log memory in which important events are recorded. The events are saved with a timestamp (if no time of day is available via the network, then the time in milliseconds since the system was started will be used) and are displayed in chronological order. If the memory is full, the oldest events will be overwritten. The log memory can be read out via the web interface („Diagnostics“ → „System State“). It can also be copied to the SD card to be downloaded from the web interface via the integrated file manager:

1. Open the web interface
2. In the menu, go to “Diagnostics” → “System Information”
3. Click the button „Dump“ below the system log. A file named „logfile.txt“ is created in the user directory on the SD card.
4. Download the file with the file manager. Choose “Scripting” → “File Manager” from the menu. Select the file and start downloading by clicking the button .

9.11 Thermal monitor

To protect the module from overheating, its housing is constantly monitored during operation. The current housing temperature can be checked both via the web interface as well as the command interface.

If the temperature measured exceeds the limit of 65 °C, then a temperature warning will be issued. From a housing temperature of 70 °C the module will change into temperature error mode and will switch the power output stage off via a fast stop. This temperature error must be acknowledged via the "Fast Stop Acknowledge" command.

Temperature warnings and errors are recorded in the module's event log (see chapter 9.10).

 **Loss of gripping force on temperature error!**

 **This error can only be acknowledged if there is no longer a temperature error.**

 **The command to read out the current housing temperature and the command to acknowledge the Fast Stop via the command interface are documented in the "WSG Command Set Reference Manual".**

9.12 Monitoring the drive current

The drive current is continuously measured and monitored during operation. An integrated motor model is used to check whether the drive is being overloaded or not. In this case, the power output stage will be switched off via a fast stop and a "current fault" will be displayed. The current error must be acknowledged. This can either be done via the web interface or via the command interface using the "Fast Stop Acknowledge" command. Current errors are recorded in the module's event log (see chapter 9.10).

 **Loss of gripping force when there is a current error!**

 **This error can only be acknowledged if there is no longer a current error.**

 **For the documentation of the command to acknowledge the "Fast Stop" via the command interface, see the "WSG Command Set Reference Manual".**

9.13 Monitoring the supply voltage

To ensure the correct functioning of the module, the supply voltage to its power section is continuously monitored. If the measured voltage is outside a defined range, a warning or an error will be issued. The following limits apply:

Threshold	Consequence
Supply Voltage ≤ 20 V	Low voltage fault SF_POWER_FAULT will be set in the system's status word and the status indicator will show the error state.
Supply Voltage ≤ 22 V	Low voltage warning SF_POWER_WARNING will be set in the system's status word and the status indicator will show the warning state.
Supply Voltage ≥ 26 V	Excess voltage warning SF_POWER_WARNING will be set in the system's status word and the status indicator will show the warning state.
Supply Voltage ≥ 28 V	Excess voltage error SF_POWER_FAULT will be set in the system's status word and the indicator will show the error state.

Hysteresis is used to prevent the states chattering to and fro. If there is a voltage error, the power output stage will be switched off using a Fast Stop and a voltage error will be indicated. Acknowledging the FastStop is possible only if the operating voltage is back in its allowed range. Acknowledging can be done either via the web interface or via the command interface by using the "Fast Stop Acknowledge" command.

⚠ Loss of gripper force following an error due to the voltage being too high or too low!

ℹ The low voltage fault will also be triggered if the power supply is interrupted when switching the force off, e.g. via an emergency stop relay.

ℹ This error can only be acknowledged if there is no longer a high/low voltage error.

👉 For the documentation of the system status word and the command to acknowledge the "Fast Stop" via the command interface, see the "WSG Command Set Reference Manual".

9.14 Configuration and diagnosis via the web interface

The module has an integrated web server, with a user interface for configuration and diagnosis. To use this, the module must be connected via Ethernet. To get to the configuration user interface, open a browser and enter the module's IP address (on delivery this is 192.168.1.20) into the browser's address line:

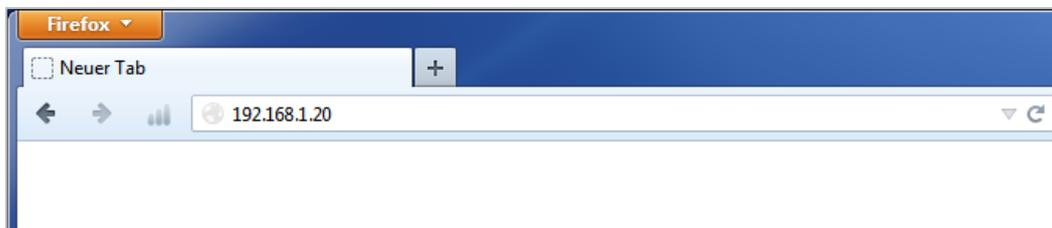


Figure 26: Entering the IP address to start web-based configuration

The following browsers have been tested and support the module's web interface:

- Mozilla Firefox 16 and above
- Google Chrome 23 and above
- Apple Safari 5 and above
- Mobile Safari (iOS 4.3 and above)
- Internet Explorer 8 and above

ℹ To display the web user interface, JavaScript must be enabled in your browser.

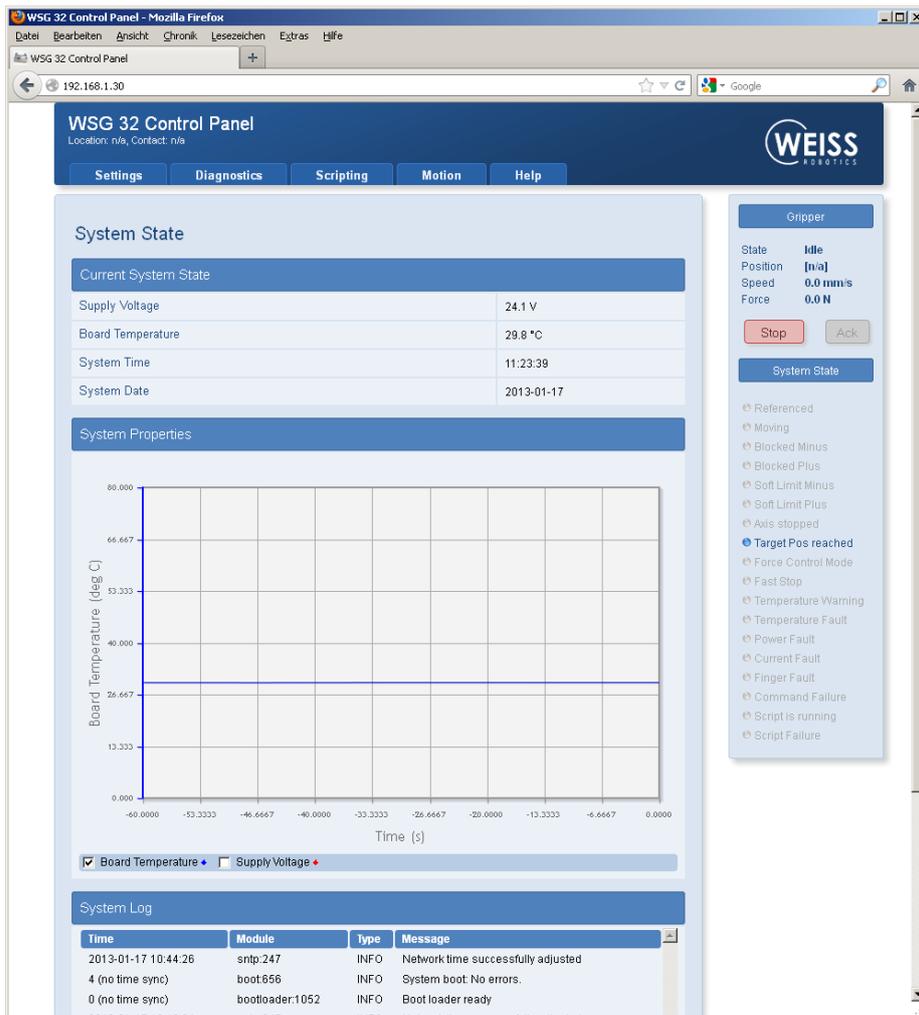


Figure 27: Web interface for configuration and diagnosis

Via integrated help texts, the module's web interface is intuitive to use. In the upper area you will find a menu bar via which the individual pages can be called up.

9.15 Access restrictions for the web user interface

Depending on the network configuration, the module will be visible to everyone in the entire network and the configuration can thus be altered unchecked.

To restrict access to the module's web interface, under "Settings" → "System Configuration" you can activate access restrictions for the interface and create users with differing access rights. If this is activated, each user must be identified with a login name and personal password (Figure 28). Every user is assigned to one of the following user groups:

- **User**

Standard user. Cannot adjust settings, but can only access the pages under the menu options "Diagnostics" and "Help".

- **Administrator**

Administrator. Can adjust all of the module's settings without restriction.



If access restrictions have been activated, then the module will record which user logs in and when.

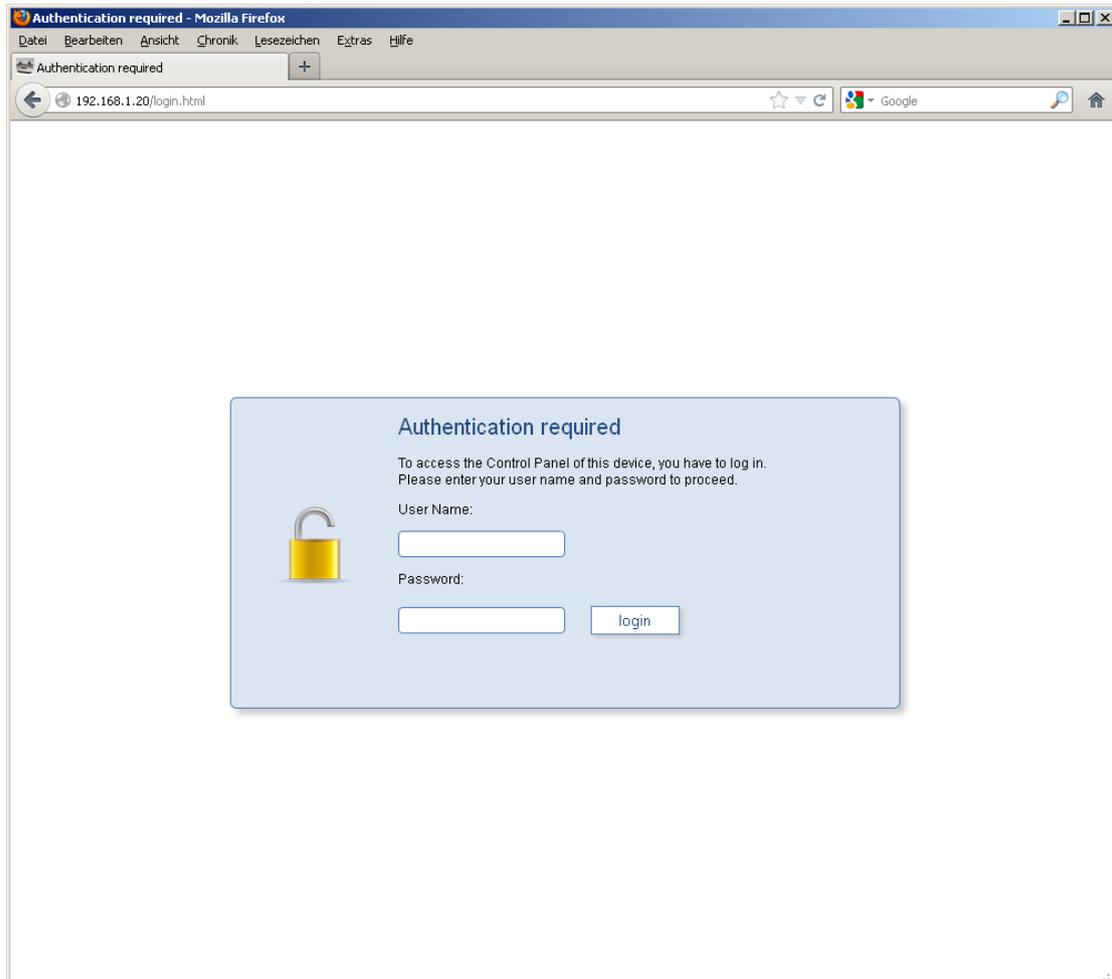


Figure 28: Login screen

9.16 Command interface

The module supports control via TCP/IP, UDP, CAN-Bus (optional), PROFINET (optional) and Modbus/TCP (optional). For TCP/IP and UDP a text-based communications protocol (GCL – Gripper Command Language) can be used, which is specified in the document "GCL Reference Manual". The CAN-Bus interface supports a binary communications protocol, which is described in detail in the document "WSG Command Set Reference Manual". This binary protocol can also be used over TCP/IP and UDP.

For the control via the fieldbuses PROFINET and Modbus/TCP a DPv0 compatible I/O register space is supplied with which the module can be controlled by setting discrete input values and reading the module's current output parameters. For further information, please refer to the "WSG Fieldbus Interface Manual".

The command interface is selected and configured via the module's web interface, via the menu option "Settings" → "Command Interface".

9.17 Scripting

The module's control unit has an integrated interpreter for the Lua programming language, via which you can adapt the module's software to your application. The programs (scripts) are saved on the integrated SD card and can be run automatically when the module starts. The interpreter is configured via the web interface. You will find the reference information for the commands as well as notes about creating and using scripts in the document "WSG Scripting Reference Manual".

9.18 Resetting the configuration

Via the "Settings" → "System" page, the module's configuration can be reset to its state on delivery. Should the configuration interface no longer be accessible, for example if the network configuration is faulty, or if you have forgotten your password, the module can also be reset using a button in the tray under the cover plate (see Figure 20). To reset the module, follow these steps:

1. Remove the cover plate from the control tray
2. Press the configuration reset button.. The SD card's access LED will start to blink. Keep the button pressed until the module restarts after about 5 seconds.
3. The configuration has been reset to factory defaults.

9.19 Implementing the gripping process

In the following section, the steps are described which are needed for a simple handling cycle (preposition - grip - release). The specified commands relate to the command interface. You will find a detailed description of the commands and their parameters in the "WSG Command Set Reference Manual".

Preparatory work:

1. **Adjust the "Clamping Travel" and "Part Width Tolerance" to the application.**
For a description see chapter 9.7.
2. **Perform a test grip.**
You can do this for example via the web interface, menu option "Motion" → "Grasping"

Executing the gripping cycle:

1. **Check whether the gripper has been zeroed (optional)**
If not, run the command "Homing (20h)" and wait until SF_REFERENCED is set in the status word.

Request the status word with the command "Get System State (40h)". On error, see section "dealing with errors" below.

2. Pre-position finger

Execute the command "Pre-Position Fingers (21h)". Parameters: Opening width and speed. The gripper state changes to "POSITIONING". Wait until the gripper state is "IDLE". Request the gripper state with the command "Get Grasping State (41h)".

3. Execute the grip

Command "Grasp Part (25h)". Parameters: Nominal gripping width, gripping speed, gripping force. The gripper state changes to "GRASPING". Wait until the gripper state is "HOLDING". Deal with errors if gripper state is "NO PART FOUND" or "ERROR".

4. Handling the part

Periodically request the gripper state and check whether it is still "HOLDING". Deal with errors for "PART LOST" or "ERROR". The periodical requests will not be required if spontaneous messages (see "WSG Command Set Reference Manual") have been activated.

5. Releasing the part

Command "Release Part (26h)". Parameters: Opening width, speed. The gripper state changes to "RELEASING". Wait until the gripper state is "IDLE". Deal with errors on "ERROR".

6. Start again at 2.

Dealing with errors

What to do in case of an error actually depends a lot on the application, but in general requires the user to do something. The following section gives some hints:

1. Does the returned status code differ from E_SUCCESS?

Evaluate the returned status code and eventually request user intervention.

2. Gripper status „ERROR“

request user intervention. Also: Test whether SF_FAST_STOP is set in the status word. If it is, then request acknowledgment.

3. Gripper status „NO PART FOUND“

Depending on the task, jump over the processing and fetch a new part.

4. Gripper status „PART LOST“

Part lost. If necessary, abort processing and fetch new part or request user intervention.



Gripper cycles can also be mapped via a script. For this purpose, please see the "WSG Scripting Reference Manual".



Damage to the gripper is possible due to insufficient lubrication (dry-running) if the gripper constantly goes through short movements. → every 1000 movements (or at least once per day) the gripper should be moved through its full range of travel.

10 Maintenance and cleaning

The maintenance and lubrication intervals must be adapted to the ambient and operating conditions. The following factors should be taken into account here:

- Extreme operating temperatures
- The effects of condensation
- High vibration loading
- Use in a vacuum
- Very dynamic operation
- The effect of foreign substances (e.g. steam, acids, etc.)

Clean the module at regular intervals with a dry cloth to remove all soiling and metal chips. These typically collect in the depressions, on the linear guides for the base jaws and on the edges of the housing.



Damage to the gripper is possible due to insufficient lubrication (dry-running) if the gripper constantly goes through short movements. → every 1000 movements (or at least once per day) the gripper should be moved through its full range of travel.

11 Troubleshooting

11.1 The gripper jaws don't move

Possible cause	Remedy
The base jaws may be jammed in the housing, for example because the surfaces to which they are screwed is not sufficiently flat.	<ul style="list-style-type: none"> • Check that the surface is flat where the jaws are to be screwed on • Loosen the module's mounting screws and actuate the module again.
A component is broken, e.g. due to overloading	<ul style="list-style-type: none"> • Replace component or send the module with a repair order to Weiss Robotics. Make sure that the module was only used within its defined application parameters.
Operating voltage is not sufficient	<ul style="list-style-type: none"> • Check the power supply. • Check the requirements on the power supply.
Communication with the module is not possible	<ul style="list-style-type: none"> • Check the connections and communications cables. • Check the interface addressing (e.g. IP address and Port settings). • Check the connection parameters.
Error message in the system (the LEDs on the module illuminate yellow or red)	<ul style="list-style-type: none"> • Check the module's operating state.

11.2 Module stops abruptly

Possible cause	Remedy
Power supply interrupted	<ul style="list-style-type: none"> • Check the power supply
Communication with the module is not possible	<ul style="list-style-type: none"> • Check connections and communication cables.
Fast stop	<ul style="list-style-type: none"> • Check the status of the gripper control system. • Determine the cause of the fast stop and remedy if necessary. • Acknowledge the fast stop (see chapter 9.9).
Error message in the system (the operating state indicators of the module illuminate yellow or red)	<ul style="list-style-type: none"> • Check the module's operating state.

11.3 No connection to the web interface

Possible cause	Remedy
Power supply interrupted	<ul style="list-style-type: none">• Check the power supply.
Communication with the module is not possible	<ul style="list-style-type: none">• Check the connections and communications cable.• Check the network settings in the module.• Check the network settings in the computer.

12 EC Declaration of Incorporation

In terms of the EC Machinery Directive 2006/42/EG, Annex II, Part B

Manufacturer Weiss Robotics GmbH & Co. KG
 Karl-Heinrich-Käferle-Str. 8
 D-71636 Ludwigsburg

Distributor Weiss Robotics GmbH & Co. KG
 Karl-Heinrich-Käferle-Str. 8
 D-71636 Ludwigsburg

We hereby declare that the following product:

Product designation: Electrical Compact Gripper WSG 32
Type: WSG 32-068
Part number: 5010003

Meets the applicable basic requirements of the **Machinery Directive (2006/42/EC)**.

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

Applied harmonized standards, especially:

EN ISO 12100-1 Safety of machines – Basic concepts, general principles for design – Part 1:
 Basic terminology, methodology

EN ISO 12100-2 Safety of machines – Basic concepts, general principles for design – Part 2:
 Technical principles

The manufacturer agrees to forward on demand the special technical documents for the incomplete machine to state offices.

The special technical documents according to Annex VII, Part B, belonging to the incomplete machine have been created.

Person responsible for documentation: Dr.-Ing. Karsten Weiss, Tel.: +49(0)7141/642062-6

Location, Date/Signature: Ludwigsburg, January 2013



Details of the signatory: Weiss Robotics GmbH & Co. KG



www.weiss-robotics.com

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