# ELECTRIC VARIABLE GRIPPER

# EVG 55

Dear Customer,

Congratulations on choosing a SCHUNK product. By choosing SCHUNK, you have opted for the highest precision, top quality and best service.

**You are going to increase the process reliability of your production and achieve best machining results – to the customer's complete satisfaction.**

**SCHUNK products are inspiring.**
Our detailed assembly and operation manual will support you.

Do you have further questions? You may contact us at any time – even after purchase. You can reach us directly at the mentioned addresses in the last chapter of these instructions.

Kindest Regards,

Your SCHUNK GmbH & Co. KG
Precision Workholding Systems
Bahnhofstr. 106 - 134
D-74348 Lauffen/ Neckar

Tel. +49-7133-103-2503
Fax +49-7133-103-2189
automation@de.schunk.com
www.schunk.com

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# Contents

# 1. Safety

## 1.1. Explanation of symbols

⚠ This symbol is displayed wherever there is a possibility of **danger to life and limb**.

☝ This symbol is displayed wherever there is a possibility of **damage to the unit** exists.

💡 This symbol denotes **important information** about the product and its handling.

## 1.2. Intended use

The gripper unit is designed for gripping and temporary secure holding of workpieces or other objects.

The unit is intended for installation / mounting in machines and equipment. The requirements of the applicable directives must be observed and complied with.

The unit may be used only within the range of its technical data. Any other use is deemed improper and unintended use. The manufacturer will not be liable for any damages resulting from improper use.

To use this unit as intended, it is also essential to comply with the manufacturer's specifications regarding commissioning, assembly, operation, maintenance and the ambient conditions. Any other use or use exceeding that specified is an infringement of use for intended purpose. The manufacturer shall not be liable for any damages arising from use other than the intended use.

## 1.3. Unintended use

If the unit is used directly as a guide or bracket for tools such as lasers, drills, milling machines, etc., this is deemed misuse. Likewise, the gripper is not a pressing tool.

This means that all actions that deviate from the functions of gripping, holding and releasing of a gripped object are deemed misuse.

## 1.4. Environmental and operating conditions

- Use the unit only within the application parameters defined in the Technical Catalog. The most recent version applies (according to Chapter 2.3 of the General Terms and Conditions).
- Clean ambient conditions at room temperature are required. If these conditions are not ensured, the maintenance interval will be shorter, depending on the actual utilization.
- The environment must be free of splashing water and vapors, and also of abrasive dust and process dust. This does not apply to units designed especially for unclean environments.

## 1.5. Safety information

1. There are potential risks associated with the unit, for example if:
   - the gripper is improperly used, installed or serviced.
   - the gripper is used other than for the intended purpose.
   - the EC Machine Directive, the accident prevention regulations, the VDE guidelines or the safety and installation instructions are not observed.

2. All personnel who are responsible for installation, commissioning and servicing must have read and understood the entire operating manual, in particular the chapter on »Safety«. It is recommended to have this confirmed in writing.

3. Installation and dismantling, mounting of the proximity switches, connections and commissioning may be carried out only by authorized personnel.

4. Dangers exist due to units automatically starting up!
   - Do not reach into the open mechanical parts and the area between the gripper fingers.
   - Do not move any parts by hand when the unit is connected to the power supply.
   - Remove the power supply cables for assembly, modification, maintenance and adjustment of the unit.

5. During connection, adjusting, commissioning and testing, measures must be taken to prevent the risk of inadvertent activation of the unit by the fitter / installer or other persons.

6. There is a danger due to falling or ejected objects!
   - Take preventive measures to prevent the falling or ejection of potentially dangerous objects (machined workpieces, tools, chips, debris, waste, etc.).

7. During operation dangers can be caused by the gripper due to:
   - moving or rotating parts
   - or hot surfaces – up to 110°C!

   Therefore, suitable protective measures such as protective covers must be provided in accordance with the EC Machine Directive.

8. **The electric gripper is not suitable for use in potentially explosive areas.**
   If the gripper is to be used in special applications (e.g. potentially explosive areas), always comply with the required standards and regulations (e.g. EN 50014 and EN 50018).
   The approval for such special areas of application must always be obtained from Schunk in writing.

9. The correct operation of the unit can be disrupted by contamination or running dry!
   - Observe the maintenance and cleaning intervals.

10. Ensure compliance with EMC directives when connecting the motor and the controller.

11. ⚠ The gripper is equipped with an electric drive.
Serious injuries and major damages can be prevented by:
- Assignment of only qualified personnel for all work on/with the unit! (Personnel who are familiar with electric drive systems and with the installation, assembly, commissioning and operation of electric drives.)
- Compliance with the applicable national accident prevention regulations etc. Cp. IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC-Report 664 or VDE 0110 and national accident prevention regulations or VBG 4.)
- During transport and handling, make sure that no components are bent and that no insulation clearances are changed. (Electric grippers contain electrostatically sensitive components.)
- Establish all electrical connections in accordance with the information in this documentation and the relevant regulations (e.g. wire size, fuses, protective conductors).

12. ☞ Repairs in and on the electric gripper may be carried out only by the manufacturer or an authorized repair center.
Unauthorized opening and improper handling can result in bodily injury and material damage.

13. ⚠ Electronic devices are not fail-safe. The user is personally responsible for ensuring that the drive is in a safe state in the event of a failure.

14. Additional bore holes, threads or attachments not offered by SCHUNK as accessories may be mounted only after obtaining the approval of SCHUNK.

15. In addition, the applicable safety regulations and accident prevention regulations must be observed.

16. ⚠ Danger of personal injury or material damage.
Faulty position parameters can lead to crushing, jamming or breakage of the attachments.
- Always adjust parameter specifications to the unit's operating environment.
- Only specialist personnel or specially trained staff should carry out settings and enter parameters.

17. ⚠ Attachments can fall if the fittings or alterations to the machine or system are faulty.
Serious bodily harm possible (e.g. laceration of the head) with fatal consequences.
- Check for compliance with EC Machine Directive item 1.4 for the safety requirements.
(Check need for barriers etc.)
- Only allow specialist personnel or specially trained staff to handle the machine / system.
- Follow the assembly instructions.
- Wear appropriate protective clothing (e.g. helmet).

18. ⚠ Contamination or dry-running can lead to malfunctions.
Fatal head injuries can be caused by workpieces falling or being flung off.
- Comply with the maintenance and cleaning intervals.
- Restrict access to the module's operating area.
- Wear appropriate protective equipment (e.g. helmet).

**Note**
The CD-ROM for older versions of the unit includes a different configuration tool (PowerConfig).
If you wish to use the older version, please contact your SCHUNK contact person.

## 2. Warranty

The warranty period is 24 months from the date of delivery when utilized as intended in single-shift operations and in compliance with the specified maintenance and lubrication intervals. Parts that come into contact with the workpiece and wearing parts are not covered by the warranty. See also our General Terms and Conditions in this regard.

The unit is considered defective when the basic gripping function is inoperable.

## 3. Scope of delivery

The scope of delivery includes:
- **Electric Variable Gripper EVG** (without top jaws) in the ordered model.
- Assembly and Operating Manual EVG
- DVD (Included only in the delivery of the optional external Controller MCS-12)
- USBtoRS232- Converter incl. Driver-CD

**Note**

For optimum use of your SCHUNK gripper, the SCHUNK controller MCS-06 is recommended. The controller can be ordered separately.

Other accessories for the unit are available in the SCHUNK catalog, at www.schunk.com or from your SCHUNK contact person.

# 4. Technical Data

## 4.1. Basic data

The noise level emitted by the unit is ≤ 70dB(A)

**Note**
Additional technical data can be found in our catalog. The most recent version applies. (according to Terms and Conditions in Chapter 2.3)

The technical dimensions of the gripper can be found in the catalog data.

| Designation | EVG 55 stroke 40 | EVG 55 stroke 100 |
|---|---|---|
| Stroke per finger | 20 mm | 50 mm |
| Max. gripping force bei I=8 Aeff * / 80% ED | 24 N | 57 N |
| Min. gripping force | 5 N | 3 N |
| Workpiece weight ** | 0,12 kg | 0,28 kg |
| Öpening time | 0,6s | 1,5s |
| Closing time | 0,6s | 1,5s |
| Deadweight | 0,79 kg | 1,1 kg |
| Mass moment of inertia Iy | 8,98 kg cm² | 18,7 kg cm² |
| Repeat accuracy *** | ± 0,05 mm | ± 0,05 mm |
| Max. finger length | 125 mm | 125 mm |
| Power supply for MCS-06 | 24 VDC | 24 VDC |
| Rated current | 3,6 Aeff | 3,7 Aeff |
| Max. current | 8 Aeff | 8 Aeff |
| Max. speed | 300 mm/s | 400 mm/s |
| Max. acceleration | 10000 mm/s² | 10000 mm/s² |
| Gear reduction | 2,37 | 2,37 |
| Impulse encoder per revolution | 2000 | 2000 |

**Table 1: Basic data**

* The gripping force is the arithmetic sum of the individual forces acting on the gripper jaws at a distance of P=50 mm where I=8 Aeff =80% duty ratio and 6 mm pre-positioning and max. speed, Mmax < 3 seconds
** Values for friction coefficient μ = 0.1 and safety factor v = 2. The values can be increased in the case of form-fitting.
*** Distribution of the end positions with 100 successive strokes.

## 4.2. Factory settings of all modules

| DEFAULT values | |
|---|---|
| Communication | RS232 |
| Data rate | 9,600 Baud |
| Module address | 12 |

## 4.3. Gripping force diagrams



Gripping force EVG55 Stroke 40 v=30mm/s
- EVG 55 Stroke 100 / I=2,5A / 100%ED
- EVG 55 Stroke 100 / I=5A / 100%ED
- EVG 55 Stroke 100 / I=8A / 80%ED

Gripping force EVG55 Stroke 40 v=300mm/s
- EVG 55 Stroke 100 / I=2,5A / 100%ED
- EVG 55 Stroke 100 / I=5A / 100%ED
- EVG 55 Stroke 100 / I=8A / 80%ED

Gripping force EVG55 Stroke 100 v=40mm/s
- EVG 55 Stroke 100 / I=2,5A / 100%ED
- EVG 55 Stroke 100 / I=5A / 100%ED
- EVG 55 Stroke 100 / I=8A / 80%ED

Greifkraft EVG55 Hub 100 v=400mm/s
- EVG 55 Hub 100 / I=2,5A / 100%ED
- EVG 55 Hub 100 / I=5A / 100%ED
- EVG 55 Hub 100 / I=8A / 80%ED

# 5. Description of the module

## 5.1. Design of the module

The gripper base jaws are designed so that many different types of fingers for parallel grippers can be mounted. The gripper is provided with power via a controller. The gripper only has to be connected to the controller.

The module is equipped with a brushless direct current servo motor with bevel gears and toothed belt.
The gripper can also use a magnetic brake that catches immediately in the event of a loss of current.

The unit is designed to grip, hold and release workpieces.
The servo-electric gripper has a software safety system for monitoring the end positions, voltage, current and temperature, with a function for switching off the unit if any of the permitted values are exceeded.

All the parameters, such as speed, stroke, position or motor current, are transferred to an external controller via the corresponding interface (RS 232, CAN Bus, Profibus).

## 5.2. Operating principle

> For optimum use of your SCHUNK gripper, the SCHUNK controller MCS-06 is recommended. The controller can be ordered separately..

The **actuator** (the brushless DC servo motor with resolver) is controlled by the **external** (logic) **controller**. This controller receives the required parameters from the master controller.

The motion sequences of the gripper are linear. The **gripper jaws** execute a mechanical motion. Their position is monitored constantly. The required data is transmitted by **sensors** back to the external logic controller.

The gripper is controlled via the **user interface**, where the required data is transmitted via the external logic controller. You can define the following parameters, for example:
- Current i;
- Gripper jaw position (=distance between base jaws);
- Speed v;
- Acceleration a.
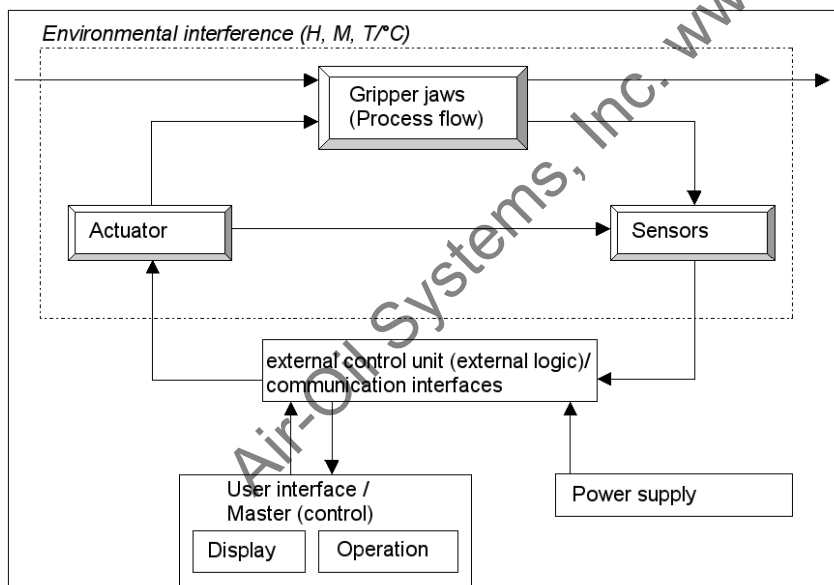
## 5.3. Information on Controller MCS-06

### 5.3.1. DVD

The DVD is included in the delivery of the MCS-12.

Content of DVD:
- MC Demo (configuration tool and commissioning tool)
- Operating manual in PDF format
- Software manual SCHUNK MotionControl in PDF format

### 5.3.2. Technical data for MCS-06

**A controller is needed to operate the gripper.**
**We recommend the MCS-06.**

| Designation | Value / characteristics |
|---|---|
| **MCS-06 Id number** | **0 306 030** |
| Interfaces = communication type (data rate) | Profibus DP (auto-detect), RS232 (9.600 Baud) |
| | CAN |
| Output power supply | 24 V DC |
| Rated current | 6 A |
| Mass | 0,45 kg |
| Control types | Current regulation |
| | Speed regulation |
| | Position regulation |

**Table 2: Controller MCS-06 Data**

### 5.3.3. Layout of the MCS-06 controller
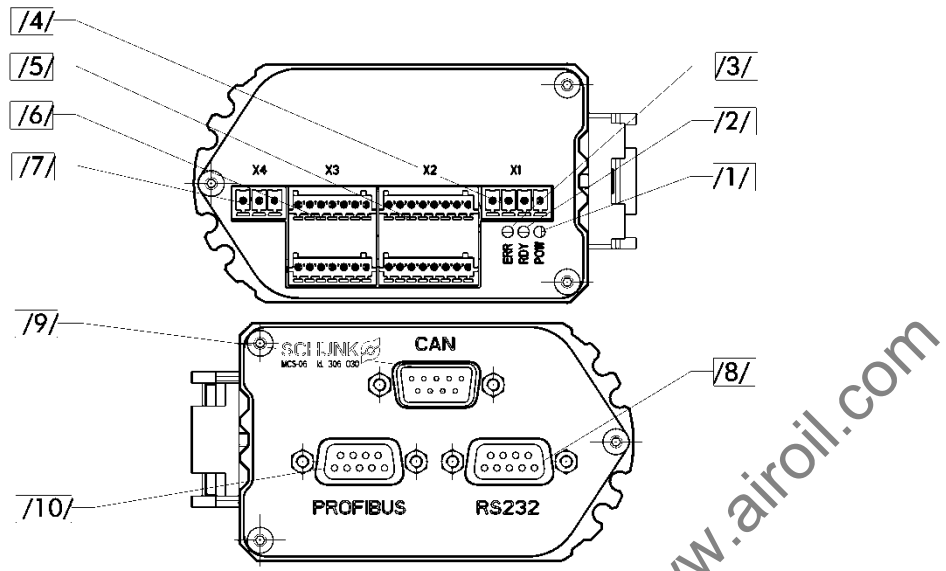


**Figure 1: Layout of the MCS-06 controller**

|  | | Type MCS-06 |
|---|---|---|
| /1/ | Display LED for POW (displays available output power supply) | |
| /2/ | Display LED for RDY (displays communication readiness) | |
| /3/ | Display LED for ERR (displays occurring errors) | |
| /4/ | Terminal strip X1 for motor phases | |
| /5/ | Terminal strip X2 for encoder, Hall-effect sensors, resolver, power supply +5 VDC for encoder, resolver and Hall-effect sensors | |
| /6/ | Terminal strip X3 for digital inputs and outputs, encoder, power supply +24 VDC for logic | |
| /7/ | Terminal strip X4 for power supply +24 VDC for output | |
| /8/ | RS232 connection | |
| /9/ | CAN connection | |
| /10/ | Profibus connection | |

**Table 3: Controller MCS-06 terminals and display elements**

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# 6. Assembly

## 6.1. Mechanical Connection

⚠ **Danger!**
Falling parts as a result of incorrect modifications and attachments to the machine or system! Fatal head injuries (e.g. lacerations) or server bodily injuries (e.g. contusions) are possible!
- Leave power switched off until all mounting work has been completed.
- Have mounting work carried out only by qualified or specially trained personnel.
- Wear proper protective gear (e.g. safety helmet).

Also observe the safety information on page 4.

Mount the unit so that:
- The connection cable does not present a hazard to personnel or the machine.
  (e.g.: prevent malfunctions by winding up the cable!)
- Personnel and the machine are not exposed to hazards.
  (e.g.: prevent crushing between machine parts;
  prevent collisions of machine parts!)

**Requirements for levelness of the bolting surface**
(in relation to the entire bolting surface for the gripper)
< 0.02 mm for an edge length up to 100 mm
< 0.05 mm for an edge length of 100 mm or more

## 6.2. Assembly
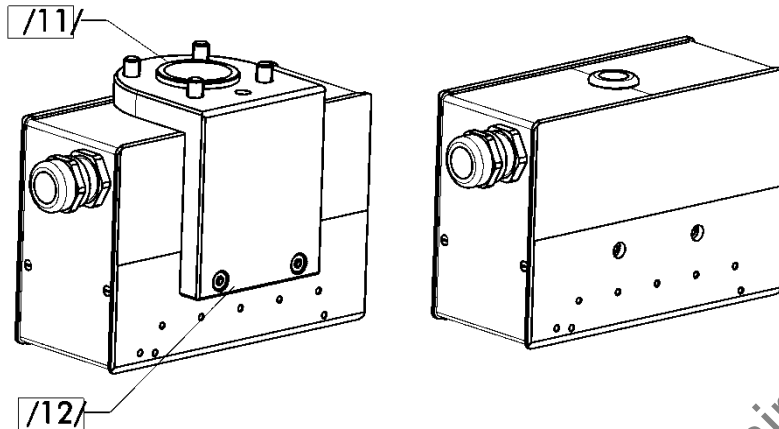


**Figure 2: Mechanical connection**

The gripper can be fastened and mounted using the threads at the sides (including centering) available for that purpose. A further option is an adaptation via an L-shaped adapter plate with ISO 9409-1-A50 flange.

| | Type EVG 55 |
|---|---|
| /11/ | L-shaped adapter plate with flange as per ISO 9409-1-A50 |
| /12/ | DIN EN ISO 4762 M4 mounting screws and centering sleeve ∅6x5.35 |

**Table 4: EVG mounting**

### 6.3. Special connection dimensions

The EVG gripper can be screwed on using the lateral M4 mounting threads. Two M3 mounting threads for the top jaws are available on each base jaw.
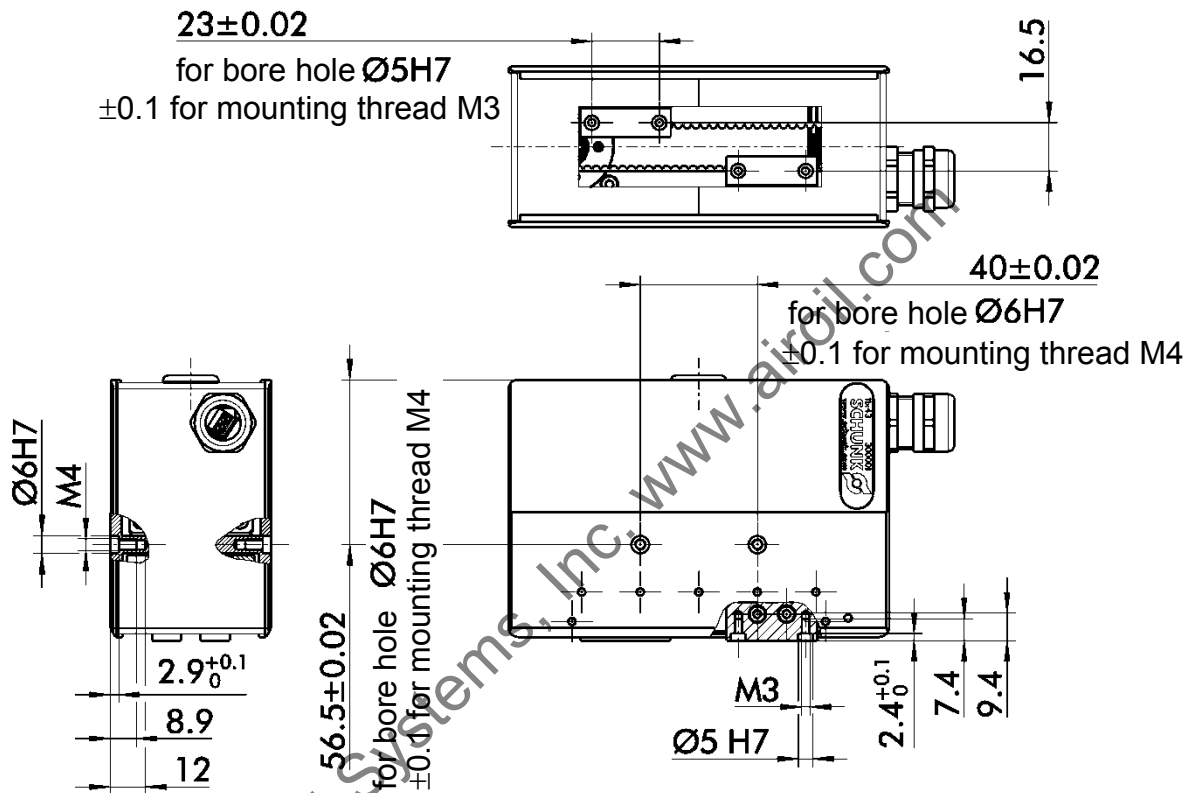


**Figure 3: Connection dimensions**

## 6.4. MCS-06 electrical connection

### 6.4.1. Notes

Observe the safety information in the standard "Electrical Equipment for Machines"
(DIN EN 60204).

Commissioning is permitted only on the condition of compliance with ECM guidelines
(89/336/EEC). For the Low-Voltage Directive 73/23/EEC, the harmonized standards of
the series prEN 50178/DIN VDE 0160 apply for the grippers in combination with
EN 60439-1/DIN VDE 0660 Part 500 and EN 60146/DIN VDE 0558.

### 6.4.2. Connection principle

The gripper is supplied with power via the controller. The gripper has to be connected to the
controller.

| ⚠ | **Danger of short circuit!** The printed circuit board of the gripper or of the MCS-12 controller could be destroyed! Due to incorrect connection of the power supply. Note layout of the terminals. |
|---|---|
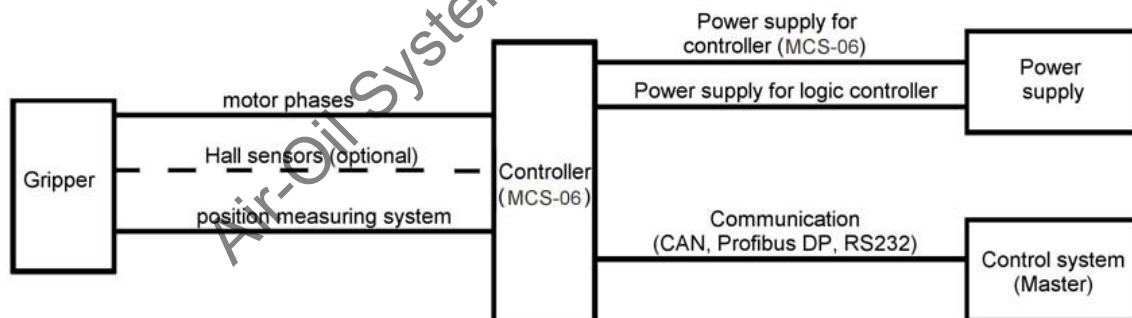


### 6.4.1. Power supply requirements

| Power supply (MCS-06) | 24 V DC |
|---|---|
| Power supply for logic controller | 24 V DC (bis 36 V DC) |
| Motor power supply (module) | 24 V (+ 10% / - 4%) |
| Connected load | Number of modules x module nominal current x 1.2 |
| Voltage ripple at output | Residual ripple less than 150 mVSS; Switching peaks less than 240 mVSS |

**Table 5: Power supply requirements**

### 6.4.2. EMV fitting for the connection cable on the gripper

The EVG gripper has a connection board to which the signal lines and output lines for the MCS-06 controller can be connected. To remove the cover, loosen the countersunk screws. The connection cable is pulled through the EMV fitting.
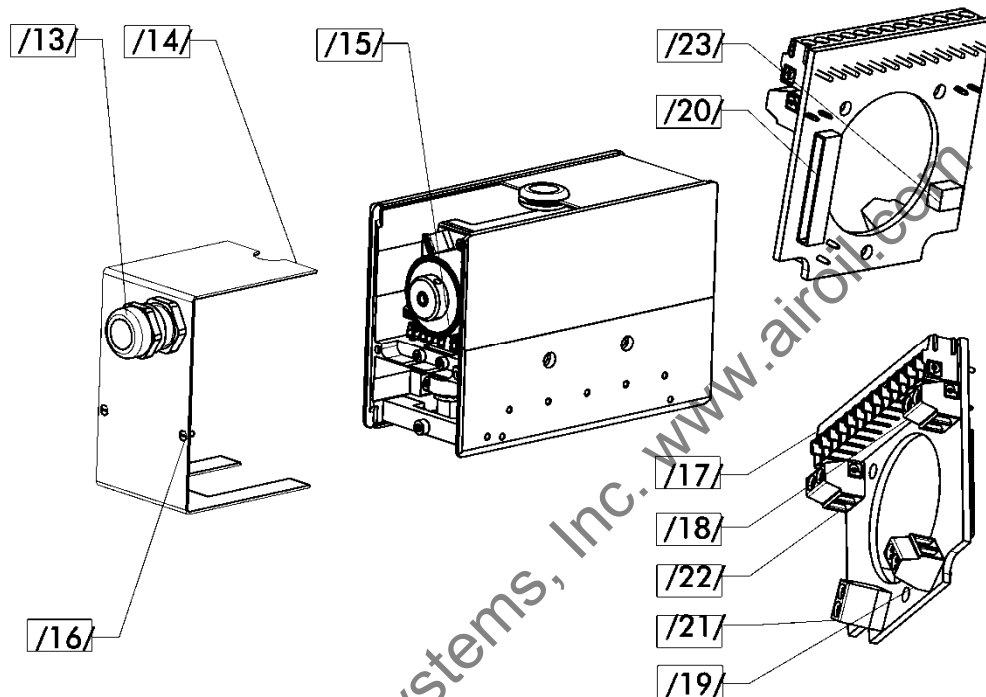
**Figure 4: Connection board with terminals on the EVG**
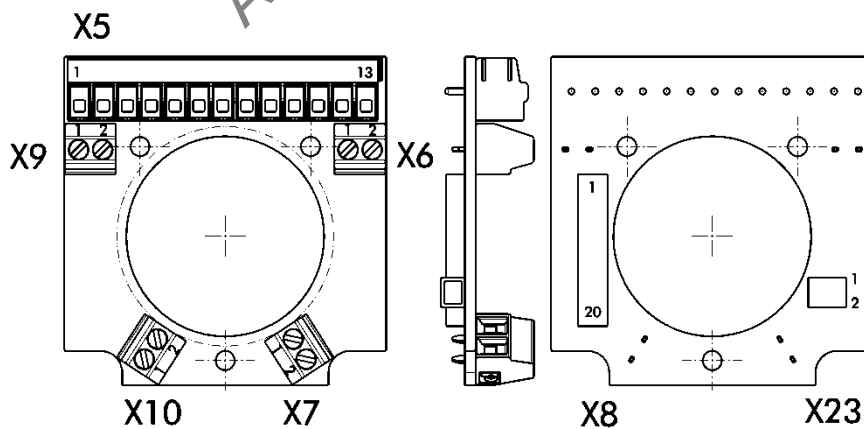
**Figure 5: Terminal pin assignment on the EVG**

| | Type EVG 55 | Pin -assign-ment | Function | Cable color (for Schunk cables) |
|---|---|---|---|---|
| /13/ | EMV fitting | - | - | |
| /14/ | Cover | - | | |
| /15/ | Board with terminals | - | | |
| /16/ | Countersunk screws | - | | |
| /17/ | X5 terminal strip | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13 | Brake -<br>Brake +<br>Hall sensor 1<br>Hall sensor 2<br>Hall sensor 3<br>Encoder track A<br>Encoder track B<br>Encoder track C<br>Encoder track A\<br>Encoder track B\<br>Encoder track C\<br>GND<br>+5V | Brown (0.34 mm²)<br>White (0.34 mm²)<br>Yellow<br>Pink<br>Gray<br>Black<br>White<br>Copper<br>Purple<br>Brown<br>Orange<br>Blue<br>Red |
| /18/ | X6 terminal strip | 1<br>2 | Shielding<br>Motor phase W | Gray<br>Black |
| /19/ | X7 terminal strip | 1<br>2 | Shielding<br>Motor phase W | Gray<br>Black |
| /20/ | X8 connector | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17<br>18<br>19<br>20 | -<br>-<br>Encoder track C\<br>Encoder track B\<br>Encoder track A\<br>Encoder track C<br>Encoder track B<br>Encoder track A<br>GND<br>+5V<br>Hall sensor 3<br>Hall sensor 2<br>Hall sensor 1<br>GND<br>+5V<br>-<br>-<br>-<br>-<br>- | |
| /21/ | X9 terminal strip | 1<br>2 | Motor phase U<br>Motor phase V | Red<br>White |
| /22/ | X10 terminal strip | 1<br>2 | Motor phase U<br>Motor phase V | Red<br>White |
| /23/ | X23 connector | 1<br>2 | Brake +<br>Brake - | |

**Table 6: Terminal pin assignment**

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**Caution**

Incorrect wire insulation can lead to a short-circuit in the board.
Can lead to malfunctions or destruction of the board.
- All electrical connection work to be carried out by appropriate specialist personnel only.
- Do no remove too much insulation from the wire strands.
- Do not connect the wires incorrectly.

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**Caution**

Overtightening the fastening screws can lead to the board breaking.
Can lead to malfunctions or destruction of the board.
- Tighten the screws only slightly – the board is merely fixed in place.

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- Lead the connection cable through the EMV fitting.
- Insulate approx. 90 mm of the MCS-06's connecting cable outer cover. Insulate approx. 5 mm of the individual wires in a manner suitable for the spring clamp connectors.
- The external cable shielding is connected to the EMV fitting. To do this, pull back the external shielding over the cable's outer cover.
- Fix the shielding in position using suitable shrink tubing, so that the shielding remains visible at the end of the cover.

Connecting cable

EMC fitting

Outer shield

Stranded wires

Heat-shrinkable sleeve
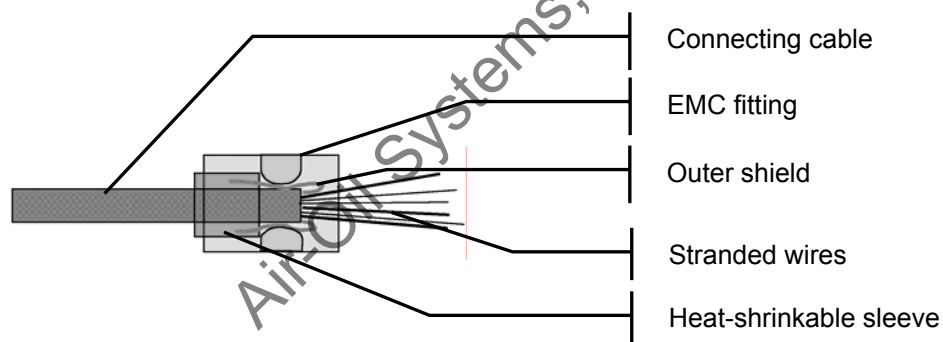
**Figure 6 EMC fitting**

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### 6.4.3. **Connection assignment at X1 terminal**

**Note**
The cable color refers to the pre-installed SCHUNK connection cable.
You require the strands with a diameter of 1,0 mm$^2$ here.
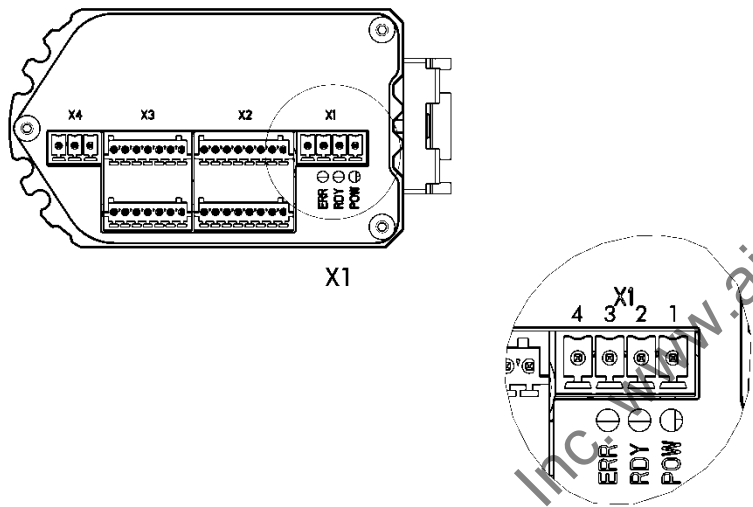
**Figure 7: X1 terminal**

| Pin | Function | Cable color |
|-----|----------|-------------|
| 1 | Motor phase U | Red |
| 2 | Motor phase V | White |
| 3 | Motor phase W | Black |
| 4 | Shielding | |

**Table 7: X1 terminal pin assignment**

### 6.4.4. **Connection assignment at X2 terminal**

**Note**
The cable color refers to the pre-installed SCHUNK connection cable.
You require the strands with a diameter of 0.15 mm² here.
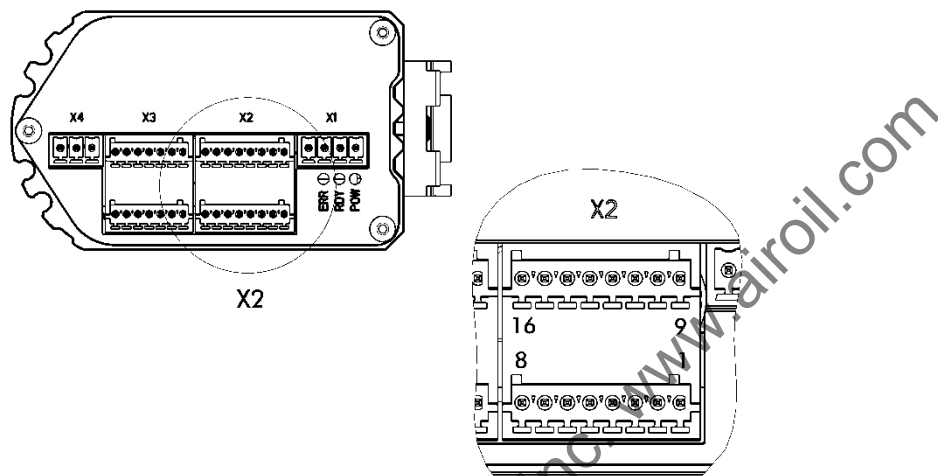
**Figure 8: X2 terminal**

| Pin | Function | Cable color (diff. encoder) |
|-----|----------|------------------------------|
| 1 | Resolver signal reference + | - |
| 2 | Resolver signal COSINE+ | - |
| 3 | Resolver signal COSINE- | - |
| 4 | Resolver signal SINE+ | - |
| 5 | Resolver signal SINE- | - |
| 6 | Encoder track A (or Adiff) | Black |
| 7 | Encoder track B (or Bdiff) | White |
| 8 | Encoder track C (or Adiff\) | Purple |
| 9 | +5V for encoder and Hall sensors | Red |
| 10 | GND for encoder and Hall sensors | Blue |
| 11 | Hall sensor 1 | Yellow |
| 12 | Hall sensor 2 | Pink |
| 13 | Hall sensor 3 | Gray |
| 14 | Brake - | Brown (0.34 mm²) |
| 15 | Brake + | White (0.34 mm²) |
| 16 | Resolver signal reference - | - |

**Table 8: X2 terminal pin assignment**

### 6.4.5. Connection assignment at X3 terminal

**Note**
The cable color refers to the pre-installed SCHUNK connection cable.
You require the strands with a diameter of 0.15 mm$^2$ here.
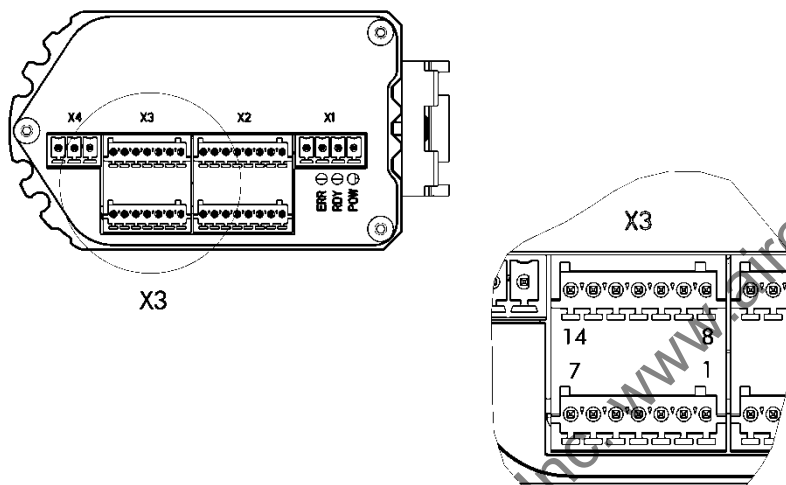


**Figure 9: X3 terminal**

| Pin | Function | Cable color (diff. encoder) |
|-----|----------|-----------------------------|
| 1 | Encoder track Bdiff\ | Brown |
| 2 | Encoder track Cdiff | Copper |
| 3 | Encoder track Cdiff\ | Orange |
| 4 | Digital output 1 | - |
| 5 | Digital output 2 | - |
| 6 | Digital output 3 | - |
| 7 | Digital output 4 | - |
| 8 | +24V logic supply | - |
| 9 | GND logic supply | - |
| 10 | Digital input 4 | - |
| 11 | Digital input 3 | - |
| 12 | Digital input 2 | - |
| 13 | Digital input 1 | - |
| 14 | Default | - |

**Table 9: X3 terminal pin assignment**

### 6.4.6. Connection assignment at X4 terminal
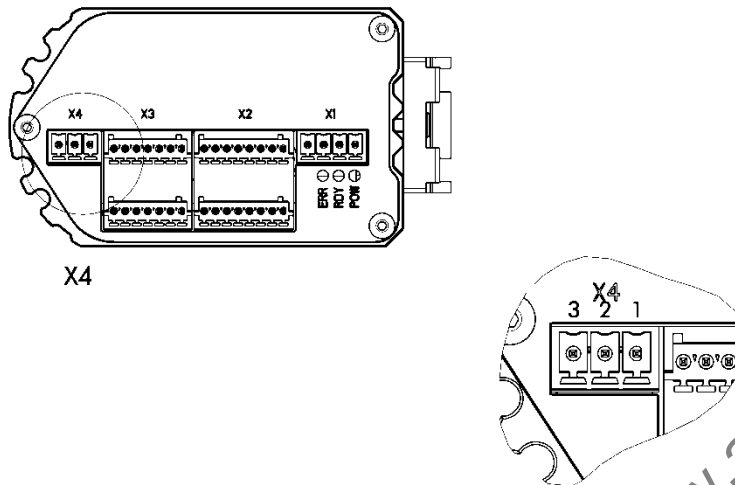
**Figure 10: X4 terminal**

| Pin | Function |
|-----|----------|
| 1 | +24V output supply |
| 2 | GND output supply |
| 3 | PE protective conductor |

**Table 10: X4 terminal pin assignment**

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## 6.5. Connection assignment of the interfaces

### 6.5.1. CAN connection assignment
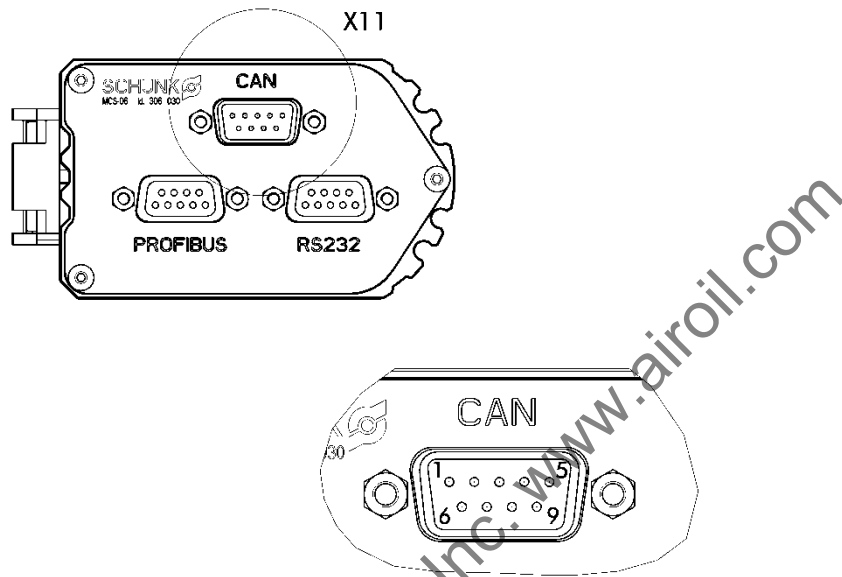


**Figure 11: CAN interface**

| Pin | Function | Description |
|---|---|---|
| 1 | - | - |
| 2 | CAN_L | CAN BUS signal (dominant low) |
| 3 | | - |
| 4 | - | - |
| 5 | CAN_SHLD | Optional shielding |
| 6 | - | - |
| 7 | CAN_H | CAN BUS signal (dominant high) |
| 8 | - | - |
| 9 | - | - |

**Table 11: CAN interface pin assignment**

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### 6.5.2.  PROFIBUS connection assignment
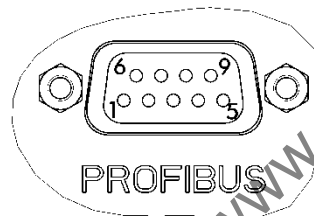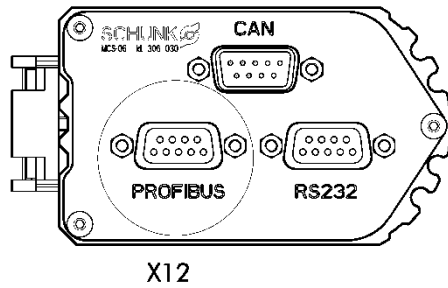


**Figure 12: PROFIBUS interface**

| Pin | Function | Description |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | RxD/TxD-P | Received/transmitted data plus line (B line) |
| 4 | | |
| 5 | GND | Reference potential for 5V supply voltage |
| 6 | +5 V | Supply voltage +5 V DC |
| 7 | | |
| 8 | RxD/TxD-N | Received/transmitted data N line (A line) |
| 9 | | |

**Table 12: PROFIBUS interface pin assignment**

### 6.5.3. RS232 connection assignment
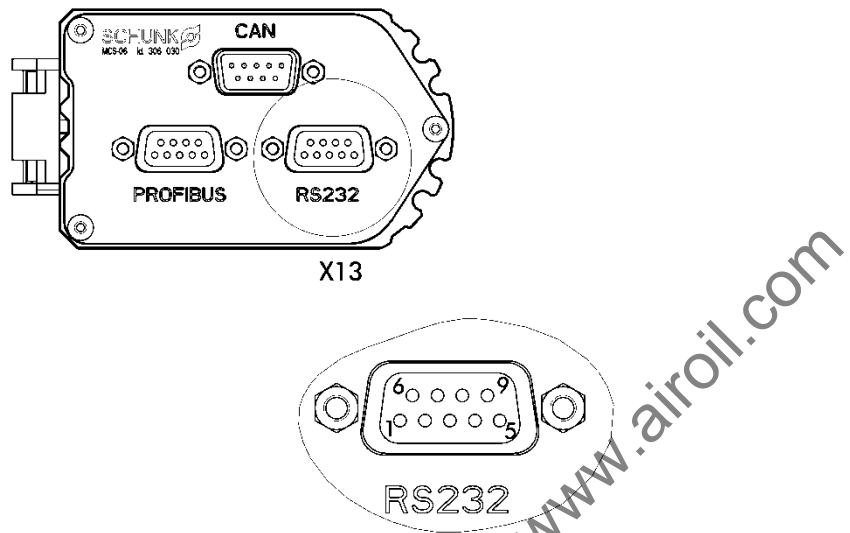


**Figure 13: RS232 interface**

| Pin | Function | Description |
|-----|----------|-------------|
| 1 | | |
| 2 | TxD | Transmitted data |
| 3 | RxD | Received data |
| 4 | | |
| 5 | GND | Reference potential for data lines |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |

**Table 13: RS232 interface pin assignment**

# 7. Function and handling

---

☝ **Important!**

Gripper base jaws can become blocked by accumulations on the toothed belt.
Sustained short stroke travel can damage the gripper.
- Travel the entire stroke every 1000 cycles (or at least once a day).

---

☝ **Attention!**

After every start up, the Controller MCS06 has to search his commutation-offset.
Therefore the gripper has to move an entire stroke.

---

The servo axis of the gripper normally moves as if hitting a mechanical stop. Therefore, the following points must be observed when handling the unit:
- The maximum gripper force refers to the load on the guides.
  Therefore, this force must not be built up until shortly before the workpiece.
- When the gripper travels in current mode the fingers accelerate. If gripping takes place at this point the fingers will be subject to the following forces:
  a) increased gripping force proportional to the current
  b) increased pulse proportional to the speed on impact; the impact speed should be kept as low as possible. This can be achieved by pre-positioning.
- If the gripper moves to the stop (even when gripping!) in positioning mode it will cause mechanical overload. This will reduce the gripper's service life.
- Use the magnetic brake (if installed) only when the fingers are idle.
- Check the lubrication of the guides at regular intervals; especially constant, very small strokes can lead to dry-running.

---

💡 **Note**

If the gripper travels in live mode, the gripper fingers accelerate.
The gripping forces acts on the gripper fingers when the gripping procedure starts.
This force is proportional to the current. In other words, the larger the current, the larger the gripping force.
The maximum permissible gripping force is achieved with the maximum permissible current (see technical data, page 9)

## 7.1. Pre-positioning

When gripping the workpiece, it is important to ensure that pre-positioning is carried out first up to approx. 1 to 5 mm before making contact with the workpiece. After this has been done (and not before), switch to live mode and build up force to grip the workpiece.
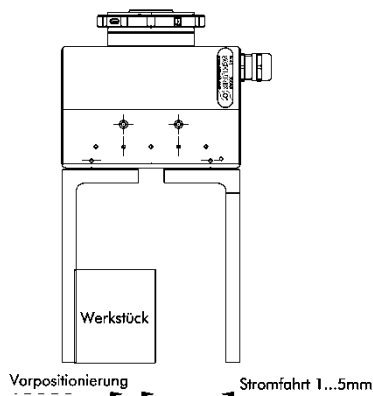


**Figure 14: Pre-positioning**

## 7.2. Example of an optimized gripping procedure

Position the gripper fingers slightly in front of the workpiece to be gripped. (See figure "Handling the unit" below.)
Switch to live mode and slowly increase the supply of current until you reach the desired gripping force. Once the current has reached the desired level, retaining it at that level will hold the workpiece.
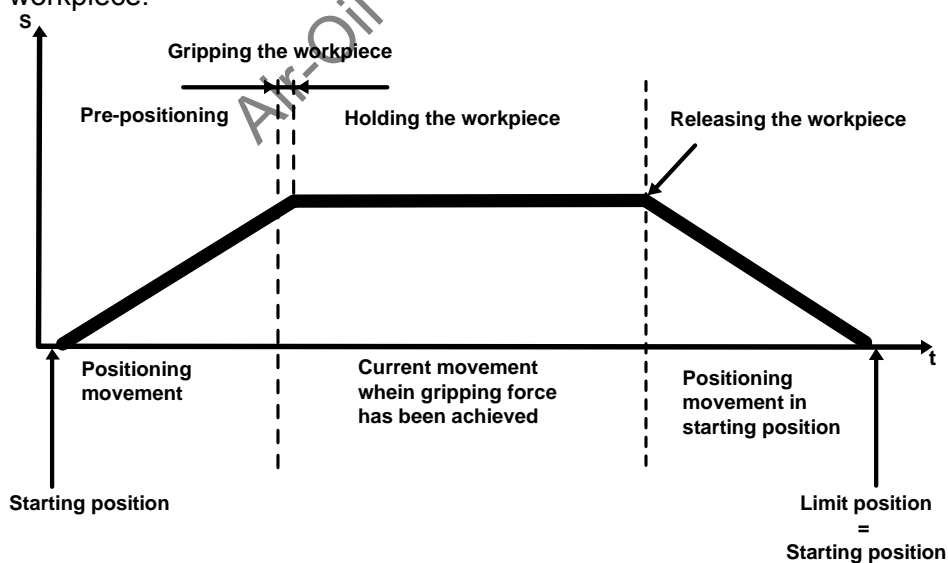


**Figure 15: Handling the unit**

# 8. System integration of the Unit

## 8.1. Notes

⚠ **Danger!**
Personal injury and material damage possible!
Incorrect position parameters can result in crushing, pinching, or breakage of attachments.
- Always adapt parameters to the impact environment of the module.
- Have adjustments and parameter input carried out only by qualified or specially trained personnel.

⚠ **Danger!**
Severe head injuries can result from falling or flying workpieces!
Caused by incorrect programming.
- Have programming carried out only by qualified personnel.
- Persons within the sphere of action of the unit must wear suitable protective gear (e.g. safety helmet).

## 8.2. System structure
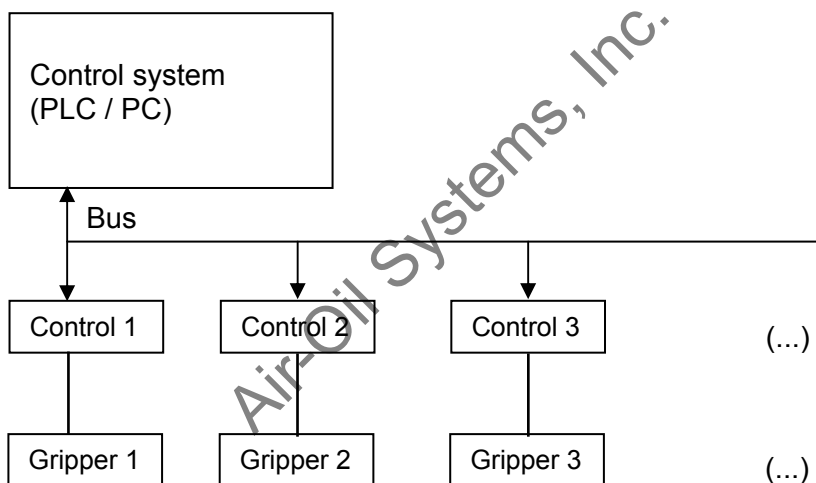


**Figure 16 Representation oft he system structure**

💡
- The number of connected modules depends on the bus that is used.
- You can assign up to 255 IDs.

## Data format

The data is transmitted in INTEL format (Little Endian Format).

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## 8.3. SCHUNK Motion-Protocol

**Note**
There is a separate, very detailed operating manual and a corresponding configuration and demonstration software (MC Demo) for the SCHUNK Motion Protocol. The following description is intended only for the initial commissioning with basic standard applications.

The SCHUNK Motion Protocol defines the format of the data to be exchanged between a SCHUNK module (gripper, rotary unit, etc.) and the higher-level controller (PC, PLC). The data exchange itself can take place by means of various bus systems. Currently, RS-232, Profibus-DP and CAN-Bus are supported

The actual payload data of a message in the Motion Protocol is not dependent on the specific bus system used. To send a message in the Motion Protocol, it must be "packed" in a message of the respective bus system. Accordingly, when a message is received from the bus system, the module message contained in the message has to be "unpacked".

The data frame of the Motion Protocol always includes the following elements:
- **D-Len** (1 byte; specified the number of following bytes)
- **Cmd** (1 byte; command code)
- **Data** (required data or parameters; length depends on command)
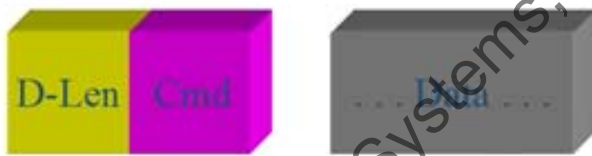


**Figure 12: Data frame fo the Motion-Protocol**

The details for each of the individual bus types can be found in the document "„MotionControl" (see DVD).

## 8.4. Overview of selected commands and messages

### 8.4.1.   Commands for the module

> Further information can be found in the document "MotionControl".

> All values are given here in hexadecimal form.

Each of these commands is confirmed by a response from the module.

| Designation | Command | Explanation |
|---|---|---|
| CMD_STOP | 0x91 | Command for stopping the module |
| CMD_REFERENCE | 0x92 | Conduct reference run |
| GET_STATE | 0x95 | State query to module (Chapter 8.4.2 see page 34) |
| MOVE_POS | 0xB0 | Conduct position run |
| MOVE_CUR | 0xB3 | Conduct current run |
| MOVE_VEL | 0xB5 | Conduct speed run |

**Table 14 Commands**

> For the move command MOVE_POS, there is an optional parameter:
> -    Current intensity (CUR)
>
> If you do not specify this parameter, it will be taken from the last parameter used or the last movement command.

**Special commands:**

| Designation | Command | Explanation |
|---|---|---|
| CMD_ACK | 0x8B | Acknowledgment of error message |
| CMD_EMERGENCY_STOP | 0x90 | "FAST STOP" |

**Table 15 Special commands**

### 8.4.2. GET_STATE

The following parameters can be set for the command GET_STATE:
- [mode]
- [PollTime]

This command can be used to get the parameters for position, speed and current, in addition to the status byte. The PollTime parameter is used to define how often, in [ms] the current status should be transmitted from the module.

> **Applies only to Profibus:**
> The status byte is always sent with each response.

**Sample values for the query of the parameter [mode]:**

| Value | Query after ... |
|-------|-----------------|
| 0x01 | ... Position |
| 0x02 | ... Speed |
| 0x04 | ... Current |
| 0x07 | ... Position, speed an current |

### 8.4.3. Responses (Acknowledge) or spontaneous essage from module

The module can automatically send a so called spontaneous message.
- For example, after a position run from the module to the master, the following can be sent:
  "Position XY reached" (CMD_POS_REACHED).

This also applies to error messages from the module to the master that do not directly follow a command.
- For example, a response of 1 (= no spontaneous message) follows a command to positively confirm it. A response of 2 (= spontaneous message) can follow, in which the module reports that it has not yet been referenced.
  (CMD_INFO with the parameter INFO_NOT_REFERENCED)

These will be sent by the module only if the respective bus allows it.

| Designation | Command | Explanation |
|-------------|---------|-------------|
| CMD_POS_REACHED | 0x94 | Module confirms: "Position reached" |
| CMD_INFO | 0x8A | Module reports an event and remains active. |

**Table 16 Acknowledge from module**

### 8.4.4. Error messages from the module

| Designation | Command | Explanation |
|-------------|---------|-------------|
| CMD_ERROR | 0x88 | Error message |
| CMD_WARNING | 0x89 | Warning message |

**Table 17 Possible error messages**

> Further information can be found in the document "MotionControl".

# 9. Examples for data exchange between master controller and gripper

## 9.1. Application example for RS232

The SCHUNK Protocol is explained briefly on page 32.

|  |  |
|---|---|
| ☼ | **Notes**<br>- The examples refer to a module with **module address 1**.<br>- Some time can pass between response 1 and response 2. Response 2 does not always have to appear. This depends on the command.<br><br>Further information can be found in the document "MotionControl". |

|  |  |
|---|---|
| ☼ | **Note**<br>If the included USBtoRS232-Converter is used, a driver has to be installed. The driver and a installation manual can be found on the enclosed Driver-CD. |

### 9.1.1. Referece run

**Command from master to module**

("Conduct reference run")

| ID | | D-Len | Cmd | Data | | CRC16 | |
|---|---|---|---|---|---|---|---|
| 0x05 | 0x01 | 0x01 | 0x92 | | | 0xD1 | 0x31 |

**Response 1 from module to master**

("Reference run - command received." - Module is moving.)

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x03 | 0x92 | 0x4F 0x4B | 0xE9 | 0xD9 |

**Time-delayed-response 2 from module to master**

("Stoped at position position 5.792[mm].")

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x05 | 0x94 | 0x21 0x56 0xB9 0x40 | 0x4D | 0x22 |

### 9.1.2. Position run

**Command from master to module**

(„Move to position 10[mm]")

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x05 | 0x01 | 0x05 | 0xB0 | 0x00 0x00 0x20 0x41 | 0x48 | 0x80 |

**Response 1 from module to master**

(„Will reach position in 3.358[s]." - Movement being started.)

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x05 | 0xB0 | 0xEE 0xEE 0x56 0x40 | 0x7B | 0xE4 |

**Time delayes response 2 from module to master**

(„Have reached position 9,9969.")

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x05 | 0x94 | 0xB6 0xF3 0x1F 0x41 | 0x7E | 0xD5 |

### 9.1.3. Acknowledgment of an error message

**Error messages from module to master**

("Power supply to motor switched off." - Switch power supply back on.) This message is sent every 15[s] until error is eliminated.

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x02 | 0x88 | 0x74 | 0x82 | 0x1B |

**Command from master to module**

("Acknowledge error message" - CMD ACK)

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x05 | 0x01 | 0x01 | 0x8B | | 0x10 | 0xFB |

**Response 1 from module to master**

("Command acknowledge error message received.")

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x03 | 0x8B | 0x4F 0x4B | 0x38 | 0x1E |

**Response 2 info message from module to master**

("No further errors exist.")

| ID | | D-Len | Cmd | Data | CRC16 | |
|---|---|---|---|---|---|---|
| 0x07 | 0x01 | 0x03 | 0x8A | 0x08 0x00 | 0x1A | 0x19 |

Now a command has to be sent from the master to the module requesting the latter to move in the opposite direction.

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## 9.2. Application example for CAN

The SCHUNK Protocol is explained briefly on page 32.

| | **Note** |
|---|---|
| | - The examples refer to a module with **module address 1**. |
| | - Some time can pass between response 1 and response 2. Response 2 does not always have to appear. This depends on the command. |

Further information can be found in the document "MotionControl".

### 9.2.1. Reference run

**Command from master to module**

("Conduct reference run")

| ID | DLC | D-Len | Cmd | Data |
|---|---|---|---|---|
| 0x501 | 0x02 | 0x01 | 0x92 | |

**Response 1 from module to master**

("Reference run - command received." Module is moving.)

| ID | DLC | D-Len | Cmd | Data |
|---|---|---|---|---|
| 0x701 | 0x04 | 0x03 | 0x92 | 0x4F 0x4B |

**Time-delayed response 2 from module to master**

(after a while: "Stopped at position 5.792[mm].")

| ID | DLC | D-Len | Cmd | Data |
|---|---|---|---|---|
| 0x701 | 0x06 | 0x05 | 0x93 | 0x21 0x56 0xB9 0x40 |

### 9.2.2. Position run

**Command from master to module**

("Moving to position 10[mm].")

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x501 | 0x06 | 0x05 | 0xB0 | 0x00 0x00 0x20 0x41 |

**Response 1 from module to master**

("Will reach position in 3.358[s]." Movement being started.)

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x701 | 0x06 | 0x05 | 0xB0 | 0xEE 0xEE 0x56 0x40 |

**Time-delayed response 2 from module to master**

("Have reached position 9.9969")

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x701 | 0x06 | 0x05 | 0x94 | 0xB6 |

### 9.2.3. Acknowledgment of an error message

**Error message from module to master**

("Power supply to motor switched off." - Switch power supply back on.) This message is sent every 15[s] until error is eliminated.

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x301 | 0x03 | 0x02 | 0x88 | 0x74 |

**Command from master to module**

("Acknowledge error message" - CMD ACK)

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x501 | 0x02 | 0x01 | 0x8B | |

**Response 1 from module to master**

("Command acknowledge error message received.")

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x701 | 0x04 | 0x03 | 0x8B | 0x4F 0x4B |

**Response 2 info message from module to master**

("No further errors exist.")

| ID | DLC | D-Len | Cmd | Data |
|----|-----|-------|-----|------|
| 0x701 | 0x04 | 0x03 | 0x8A | 0x08 0x00 |

Now a command has to be sent from the master to the module requesting the latter to move in the opposite direction.

## 9.3. Application example for Profibus DP

💡 **Notes**

- Some time can pass between response 1 and response 2.
  Response 2 does not necessarily have to appear, since the message is a spontaneous message.
  - The SCHUNK Motion Protocol is explained briefly on page page 32.
  - 0x?? represents any data.

💡 Further information can be found in the document "MotionControl".

### 9.3.1. Reference run

**Command from master to module**

("Conduct reference run")

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x01 | 0x92 | 0x?? 0x?? 0x?? 0x?? 0x?? | | |

**Response 1 from module to master**

("Reference run - command received." Module is moving.)

The "MsgCount" is being increased by one.

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x03 | 0x92 | 0x4F 0x4B 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x00 | 0x01 |

**Time-delayed response 2 from module to master**

(after a while: "Stopped at position 5.792[mm].")

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x05 | 0x93 | 0x21 0x56 0xB9 0x40 | 0x61 | 0x01 |

💡 The byte **MsgCount** is increased consecutively by 1 for each response to a previous command, except for "spontaneous messages" - in this case, the MsgCount is taken from the previous response.

### 9.3.2. Position run

**Command from master to module**

("Moving to position 10[mm].")

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x05 | 0xB0 | 0x00 0x00 0x20 0x41 0x?? 0x?? | | |

**Response 1 from module to master**

("Will reach position in 3.358[s]." Movement being started.)

The "MsgCount" is being increased by one.

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x05 | 0xB0 | 0xEE 0xEE 0x56 0x40 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x01 | 0x02 |

**Time-delayed response 2 from module to master**

("Have reached position 9.9969")

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x05 | 0x94 | 0xB6 0xF3 0x1F 0x41 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x61 | 0x02 |

### 9.3.3. Acknowledgment of an error message

**Error message from module to master**

("Power supply to motor switched off."

- Switch power supply back on.) Extended diagnosis is supported.

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x02 | 0x88 | 0x74 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x30 | 0x02 |

**Command from master to module**

("Acknowledge error message" - CMD ACK)

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x01 | 0x8B | 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | | |

**Response 1 from module to master**

("Command acknowledge error message received.") The "MsgCount" is being increased by one.

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x03 | 0x8B | 0x4F 0x4B 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x20 | 0x03 |

**Response 2 info message from module to master**

("No further errors exist.")

| | D-Len | Cmd | Data | State (Byte 14) | MsgCount (Byte 15) |
|---|---|---|---|---|---|
| | 0x03 | 0x8A | 0X08 0x00 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? 0x?? | 0x20 | 0x03 |

Now a command has to be sent from the master to the module requesting the latter to move in the opposite direction.

The byte **MsgCount** is increased consecutively by 1 for each response to a previous command, except for "spontaneous messages" - in this case, the MsgCount is taken from the previous response.

# 10. Troubleshooting

| Event | Possible cause | Possible solution |
|---|---|---|
| **No LED lights up on controller** | (a) There is no voltage<br><br>(b) Master (controller) at bus is not active | (a) Check power supply and logic voltage supply at controller<br>(b) Check master, activate |
| **"POW" LED (green) on controller does not light up** | There is no voltage | Check power supply at controller |
| **"RDY" LED (green) on controller does not blink** | (a) Faulty connection<br><br>(b) No voltage at logic | (a) Check connection (starting with Chapter 6.4 page 18)<br>(b) Check power supply of logic at controller |
| **"ERR" LED (red) at controller blinks or lights up continuously** | (a) Undervoltage at "POW"<br>(b) There is an error = Module reports CMD_ERROR | (a) Check power supply at controller<br>(b) See software manual "MotionControl.pdf". |
| **Module does not respond / does not move** | (a) Encoder is connected incorrectly<br>(b) Motor is connected incorrectly | (a) Check connection at gripper and at controller (starting with Chapter 6.4 page 18)<br>(b) Check connection of motor at controller |
| **Module stops abruptly** (This can be reported by the module with the parameter **ERROR_CABLE_BREAK**, if the GSD file included in the delivery has been integrated.) | Malfunctions at the bus cable (connection to module was interrupted) | - Check bus cable for signs of damage, replace the cable if necessary.<br>- See software manual "MotionControl.pdf". |
| **Motor does not turn** | Defective motor lines | Check the armature resistance:<br>- Motor lines to each other: R = 0,4 ... 2,0 Ohm (depending on the cable length) |
| **The gripper does not execute the full stroke** | - Dirt between the cover plate<br>- Dirt between the base jaws and the guide | Clean gripper and re-lubricate, if necessary. |
| **The gripping force drops** | (a) Accumulations of dirt | (a) Clean gripper<br>(b) Re-lubricate gripper |
| **The gripper opens or closes abruptly** | (a) Accumulations of dirt | (a) Clean gripper<br>(b) Re-lubricate gripper |

# 11. Replacement of the module

| | **Hot surface!**<br>The surfaces of the modules could become hot under normal operating conditions. Touching these surfaces may result in burns!<br>    -   Let the module cool down before replacing it. |
|---|---|

(1)  Stop the relevant machine(s).
(2)  Switch off the power supply completely.
(3)  After the system has become idle, unscrew the countersunk screws on the cover plate on the EMV fitting side.
(4)  Carefully remove the cover plate.
(5)  Remove the wire strands from the terminals.
(6)  Completely remove the cover plate together with the cable.
(7)  Remove the unit from the machine or system.
(8)  Now remove the cover plate on the EMV fitting side on the new unit.
(9)  Take the new unit and mount it in the machine or system.
(10) Reconnect the wire strands to the terminals.
(11) Place the old cover plate together with the cable on the new unit.
(12) Reattach the countersunk screws for the old cover plate.
(13) Package the old unit together with the new cover plate (with a fault log, if appropriate).
(14) Store the unit in a dry place.

# 12. Completely removing a unit from the machine

| | **Hot surface!**<br>The surfaces of the modules could become hot under normal operating conditions.<br>    -   Touching these surfaces may result in burns! Let the module cool down before replacing it. |
|---|---|

(1)  Stop the relevant machine(s).
(2)  Switch off the power supply completely.
(3)  After the system has become idle, unscrew the countersunk screws on the cover plate on the EMV fitting side.
(4)  Carefully remove the cover plate.
(5)  Remove the wire strands from the terminals.
(6)  Completely remove the cover plate together with the cable.
(7)  Remove the unit from the machine or system.
(8)  Package the unit (with a fault log, if appropriate).
(9)  Store the unit in a dry place.

# 13.  Maintenance and care

The maintenance and lubrication intervals must be adapted to the ambient conditions
and operating conditions. The following factors must be taken into account:
- Extreme operating temperatures
- Effects of condensation and humidity
- High vibrational stress
- Use in a vacuum
- Highly dynamic operation
- Constant, small stroke movements
- Effects of foreign substances (e.g. vapors, acids, etc.)

To keep the gripper functioning correctly, please observe the following instructions:
- Unless otherwise specified, tighten all screws and nuts to the DIN tightening torque
  and secure with Loctite No. 243.
- Do not expose the gripper to drilling emulsions.
- The gripper may be operated only at an ambient temperature between +5°C (+40 °F)
  and +55°C (+130 °F).
- When laying the cable, the bending radius must be observed.
  Torsional movements are not permissible.
- Since the system is a servo system, the motor can temporarily create forces far above
  the nominal values. These forces can overload the gripper and destroy it mechani-
  cally. Operate the gripper only within the range of the nominal data. Any overload re-
  duces the service life of the system.
- Repeat accuracy of the gripping force is: ± 15 %
  The breakaway force can vary greatly from gripper to gripper!
  If an automatic gripper change is to be enabled, the breakaway force has to
  be determined in the higher-level controller for each initialization!
- For programming instructions, please refer to the manual for your controller.

## 13.1.  Cleaning

### 13.1.1.  Gripper

The gripper corresponds to the protection class IP 40.

Clean the gripper when dry at regular intervals in order to remove all impurities and chips.
These materials generally accumulate in the hollow spaces, on the linear guides of the gripper
base jaws or on the edges of the gripper housing.

### 13.1.1.  Controller

The MCS-06 controller complies with protection class IP 30.

Clean the controller without water as needed to remove all contamination.

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### 13.2. Lubrication

The profiled rail guides dry out faster during sustained travel with short strokes than during brief periods of travel with long strokes.
You should therefore travel a complete gripper stroke at least every 1000 cycles in order to avoid dry-running on the profiled rail guides.

After each day of production (or at least once a day), check that there is sufficient lubrication on the profiled rail guides for the gripper base jaws.
The quantity of lubricant and the lubrication intervals depend on the stroke lengths and stroke cycles.
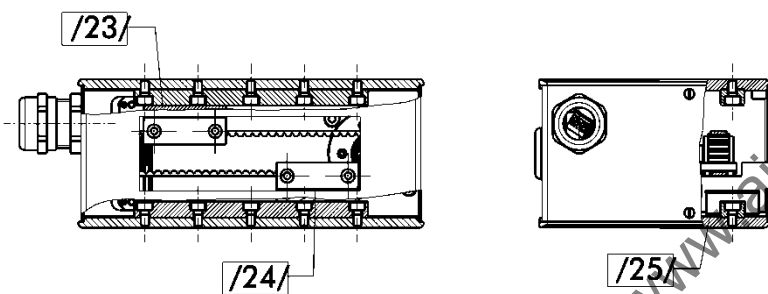


**Figure 17: Grease areas**

|       | Type EVG 55       |
|-------|-------------------|
| /23/  | Profiled rail     |
| /24/  | Gripper base jaw  |
| /24/  | Profile carriage  |

**Table 18: Grease areas**

## 14. Disassembly of the module

**The module may disassembled and repaired only by SCHUNK, otherwise the warrantys expires!**

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## 15. Contact

**GERMANY – HEAD OFFICE**
SCHUNK GmbH & Co. KG
Spann - und Greiftechnik
Bahnhofstrasse 106 – 134
D – Lauffen / Neckar
Tel. +49-7133-103-0
Fax +49-7133-103-2399
info@de.schunk.com
www.schunk.com

**AUSTRIA**
SCHUNK Intec GmbH
Holzbauernstr. 20
4050 Traun
Tel. +43-7229-65770-0
Fax +43-7229-65770-14
info@at.schunk.com
www.at.schunk.com

**BELGIUM, LUXEMBOURG**
SCHUNK Intec N.V./S.A.
Bedrijvencentrum Regio Aalst
Industrielaan 4, Zuid III
9320 Aalst-Erembodegem
Tel. +32-53-853504
Fax +32-53-836022
info@be.schunk.com
www.be.schunk.com
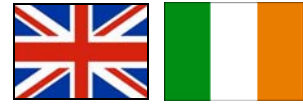
**GREAT BRITAIN, IRELAND**
SCHUNK Intec Ltd.
Cromwell Business Centre
10 Howard Way,
Interchange Park
Newport Pagnell MK16 9QS
Tel. +44-1908-611127
Fax +44-1908-615525
info@gb.schunk.com
www.gb.schunk.com

**CHINA**
SCHUNK Precision Machinery
(Hangzhou) Co.,Ltd.
6, 24th Street, HEDA
Hangzhou 310018
Tel. +86-571-8672-1000
Fax +86-571-8672-8800
info@cn.schunk.com
www.cn.schunk.com

SCHUNK GmbH & Co.KG
Shanghai
Representative Office
777 Zhao Jia Bang Road
Pine City Hotel, Room 923
Xuhui District
Shanghai 200032
Tel. +86-21-64433177
Fax +86-21-64431922
info@cn.schunk.com
www.cn.schunk.com

**DENMARK**
SCHUNK Intec A/S
Storhaven 7
7100 Vejle
Tel. +45-43601339
Fax +45-43601492
info@dk.schunk.com
www.dk.schunk.com

**FRANCE**
SCHUNK Intec SARL
Parc d´Activités des Trois
Noyers 15, Avenue James de
Rothschild
Ferrières-en-Brie
77614 Marne-la-Vallée
Cedex 3
Tel. +33-1-64 66 38 24
Fax +33-1-64 66 38 23
info@fr.schunk.com
www.fr.schunk.com

**NETHERLANDS**
SCHUNK Intec B.V.
Speldenmakerstraat 3d
5232 BH 's-Hertogenbosch
Tel. +31-73-6441779
Fax +31-73-6448025
info@nl.schunk.com
www.nl.schunk.com

**INDIA**
SCHUNK India Branch Office
# 80 B, Yeswanthpur
Industrial Suburbs,
Bangalore 560 022
Tel. +91-80-41277361
Fax +91-80-41277363
info@in.schunk.com
www.in.schunk.com

**ITALY**
SCHUNK Intec S.r.l.
Via Caio Plinio 5
22072 Cermenate (CO)
Tel. +39-031-770185
Fax +39-031-771388
info@it.schunk.com
www.it.schunk.com

**HUNGARY**
SCHUNK Intec Kft.
Széchenyi út. 70.
3530 Miskolc
Tel. +36-46-50900-7
Fax +36-46-50900-6
info@hu.schunk.com
www.hu.schunk.com

**SCHUNK**®

**POLAND**

SCHUNK Intec Sp.z o.o.
Stara Iwiczna,
ul. Słoneczna 116 A
05-500 Piaseczno
Tel. +48-22-7262500
Fax +48-22-7262525
info@pl.schunk.com
www.pl.schunk.com

**PORTUGAL**

Sales Representative
Victor Marques
Tel. +34-937-556 020
Fax +34-937-908 692
Mobil +351-963-786 445
info@pt.schunk.com
www.pt.schunk.com

**SOUTH KOREA**

SCHUNK Intec Korea Ltd.
# 907 Joongang
Induspia 2 Bldg.,
144-5 Sangdaewon-dong
Jungwon-gu, Seongnam-si
Kyunggi-do, 462-722
Tel. +82-31-7376141
Fax +82-31-7376142
info@kr.schunk.com
www.kr.schunk.com

**SPAIN**

SCHUNK Intec S.L.
Foneria, 27
08304 Mataró (Barcelona)
Tel. +34-937 556 020
Fax +34-937 908 692
info@es.schunk.com
www.es.schunk.com

**SWEDEN**

SCHUNK Intec AB
Morabergsvägen 28
152 42 Södertälje
Tel. +46-8 554 421 00
Fax +46-8 554 421 01
info@se.schunk.com
www.se.schunk.com

**SWITZERLAND,
LIECHTENSTEIN**

SCHUNK Intec AG
Soodring 19
8134 Adliswil 2
Tel. +41-44-7102171
Fax +41-44-7102279
info@ch.schunk.com
www.ch.schunk.com

**CZECH REPUBLIC**

SCHUNK Intec s.r.o.
Ernsta Macha 1
643 00 Brno
Tel. +420-545 229 095
Fax +420-545 220 508
info@cz.schunk.com
www.cz.schunk.com

**MEXICO, VENEZUELA**

SCHUNK Intec S.A. de C.V.
Av. Luis Vega y Monroy # 332
Fracc. Plazas de Sol
Santiago de Querétaro,
Qro. 76099
Tel. +52-442-223-6525
Fax +52-442-223-7665
info@mx.schunk.com
www.mx.schunk.com

**USA**

SCHUNK Intec Inc.
211 Kitty Hawk Drive
Morrisville, NC 27560
Tel. +1-919-572-2705
Fax +1-919-572-2818
info@us.schunk.com
www.us.schunk.com

**CANADA**

SCHUNK Intec Corp.
190 Britannia Road East,
Units 23-24
Mississauga, ON L4Z 1W6
Tel. +1-905-712-2200
Fax +1-905-712-2210
info@ca.schunk.com
www.ca.schunk.com

**SLOVAKIA**

SCHUNK Intec s.r.o.
Mostná 62
919 01 Nitra
Tel. +421-37-3260610
Fax +421-37-6421906
info@sk.schunk.com
www.sk.schunk.com

**TURKEY**

SCHUNK Intec
Bağlama Sistemleri ve
Otomasyon San. ve Tic. Ltd.
Şti.
Küçükyali Iş Merkezi
Girne Mahallesi
Irmak Sodak, A Blok, No: 9
34852 Maltepe, Istanbul
Tel. +90-216-366-2111
Fax +90-216-366-2277
info@tr.schunk.com
www.tr.schunk.com