Operating and Assembly Instructions
Electronic overspeed switch EGS 2
Straightforward monitoring of overspeed or zero speed detection

Read the Operating and Assembly Instructions prior to assembly, starting installation and handling!
Keep for future reference!
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1 General

1.1 Information about the Operating and Assembly Instructions
These Operating and Assembly Instructions provide important instructions for working with the device. They must be carefully read prior to starting all tasks, and the instructions contained herein must be followed.

In addition, applicable local regulations for the prevention of industrial accidents and general safety regulations must be complied with.

1.2 Scope of delivery
Electronic overspeed switch EGS 2, Operating and Assembly Instructions.

1.3 Explanation of symbols
Warnings are indicated by symbols in these Operating and Assembly Instructions. The warnings are introduced by signal words that express the scope of the hazard. The warnings must be strictly heeded; you must act prudently to prevent accidents, personal injury, and property damage.

- **WARNING!** Indicates a possibly dangerous situation that can result in death or serious injury if it is not avoided.

- **CAUTION!** Indicates a possibly dangerous situation that can result in minor injury if it is not avoided.

- **CAUTION!** Indicates a possibly dangerous situation that can result in material damage if it is not avoided.

- **NOTES!** Indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

- **NOTES!** Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

- **DANGER!** Life-threatening danger due to electric shock! Indicates a life-threatening situation due to electric shock. If the safety instructions are not complied with there is danger of serious injury or death. The work that must be executed should only be performed by a qualified electrician.
1.4 Disclaimer
All information and instructions in these Operating and Assembly Instructions have been provided under due consideration of applicable guidelines, as well as our many years of experience. The manufacturer assumes no liability for damages due to:

- Failure to follow the instructions in the Operating and Assembly Instructions
- Non-intended use
- Deployment of untrained personnel
- Opening of the device or conversions of the device

In all other aspects the obligations agreed in the delivery contract as well as the delivery conditions of the manufacturer apply.

1.5 Copyright

NOTES!
Content information, text, drawings, graphics, and other representations are protected by copyright and are subject to commercial property rights.
It is strictly forbidden to make copies of any kind or by any means for any purpose other than in conjunction with using the device without the prior written agreement of the manufacturer. Any copyright infringements will be prosecuted.

1.6 Guarantee terms
The guarantee terms are provided in the manufacturer’s terms and conditions.

1.7 Customer service
For technical information personnel is available that can be contacted by telephone, fax or email. See manufacturer’s address on page 2.

2 Safety

DANGER!
This section provides an overview of all the important safety aspects that ensure protection of personnel, as well as safe and trouble-free device operation.
If these safety instructions are not complied with significant hazard can occur.

2.1 Responsibility of the owner
The device is used in commercial applications. Consequently the owner of the device is subject to the legal occupational safety obligations and subject to the safety, accident prevention and environmental protection regulations that are applicable for the device’s area of implementation.

2.2 Personnel
Installation and commissioning as well as disassembly routines must be carried out by skilled technical staff only.
2.3 Intended use
The device has been designed and constructed exclusively for the intended use described here. Series EGS 2 electronic overspeed switches are used for speed monitoring, for instance of electrical and mechanical drives, hoisting gear, and conveying machines. The electronic overspeed switch EGS 2 is a overspeed switch, which generates a switching signal for a superior control system. This is realized with opening of a switch contact. As an alternative to this function, the device can also be used for zero speed detection. Not in addition. Claims of any type due to damage arising from non-intended use are excluded; the owner bears sole responsibility for non-intended use.

2.4 Improper use
Do not use the device in potentially explosive areas. The device must not be subjected to mechanical loads in addition to its own weight and unavoidable vibration and shock loads that arise during normal operations. Examples for non-permitted mechanical loads (incomplete list):

- Fastening transport or lifting tackle to the device, for example a crane hook to lift a motor.
- Fastening packaging components to the device, for example ratchet straps, tarpaulins etc.
- Using the device as a step, for example by people to climb onto a motor.

2.5 Personal protective equipment
For tasks such as assembly, disassembly or commissioning the use of personal protective equipment such as safety footwear and protective work clothing is required. The regulations specified by the owner and that are locally specified apply.
2.6 Special dangers
Residual risks that have been determined based on a risk assessment are cited below.

2.6.1 Electrical current

**DANGER!**

**Life-threatening danger due to electrical shock!**
There is an imminent life-threatening hazard if live parts are touched. Damage to insulation or to specific components can pose a life-threatening hazard.

**Therefore:**
Immediately switch off the device and have it repaired if there is damage to the insulation of the power supply.
De-energize the electrical equipment and ensure that all components are connected for all tasks on the electrical equipment.
Keep moisture away from live parts. Moisture can cause short circuits.

2.6.2 Rotating shafts / hot surfaces

**WARNING!**

**Danger of injury due to rotating shafts and hot surfaces!**
Touching rotating shafts can cause serious injuries.

**Therefore:**
Do not reach into moving parts/shafts or handle moving parts/shafts during operation.
Close to protect from injury all access openings in flanges with the corresponding plug screw, and provided you exposed rotating components with protective covers.
Do not open covers during operation. Prior to opening the covers ensure that all parts have come to a zero speed.
The encoder can become hot during prolonged use.
In case of contact risk of burns is existing.

2.6.3 Safeguarding against restart

**DANGER!**

**Life-threatening danger if restarted without authorization!**
When correcting faults there is danger of the power supply being switched on without authorization.
This poses a life-threatening hazard for persons in the danger zone.

**Therefore:**
Prior to starting work, switch off the system and safeguard it from being switched on again.
3 Technical Data

3.1 Type plate

Type plate example:

<table>
<thead>
<tr>
<th>Englisch</th>
<th>Deutsch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer, address</td>
<td>Hersteller, Anschrift</td>
</tr>
<tr>
<td>Type: Overspeed switch</td>
<td>Typ: Grenzdrehzahlschalter</td>
</tr>
<tr>
<td>Year of manufacture</td>
<td>Baujahr</td>
</tr>
<tr>
<td>CE mark</td>
<td>CE-Kennzeichnung</td>
</tr>
<tr>
<td>Serial number (S/N)</td>
<td>Seriennummer (S/N)</td>
</tr>
<tr>
<td>Item (ID)</td>
<td>Artikel (ID)</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>Schutzart</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>Versorgungsspannung</td>
</tr>
<tr>
<td>Max. speed</td>
<td>Max. Drehzahl</td>
</tr>
<tr>
<td>Switching speed</td>
<td>Schaltdrehzahl</td>
</tr>
<tr>
<td>Switching voltage / switching current</td>
<td>Schaltspannung / Schaltstrom</td>
</tr>
</tbody>
</table>

The type plate is located on the outside of the housing and contains the following information:
## 3.2 Type code

Electronic overspeed switch

<table>
<thead>
<tr>
<th>Series</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGS2</td>
<td>AK</td>
</tr>
</tbody>
</table>

AK = Axial terminal box

## 3.3 Electrical and mechanical data

### Connection data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply voltage</strong></td>
<td>12 V ... 30 V DC</td>
</tr>
<tr>
<td><strong>No load-current</strong></td>
<td>approx. 50 mA at 24 V</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Spring-cage terminal strip type Phoenix ZFKDS 1,5-W-5,08 (0,25 mm² - 1,5 mm²)</td>
</tr>
<tr>
<td><strong>Gerätetemperaturbereich</strong></td>
<td>-25°C ... + 85°C</td>
</tr>
</tbody>
</table>

### Degree of protection acc. DIN EN 60529

<table>
<thead>
<tr>
<th>Degree of protection</th>
<th>Sealing</th>
<th>Rotor moment of inertia</th>
<th>Breakaway torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP 66</td>
<td>with radial shaft seal</td>
<td>approx. 100 g cm²</td>
<td>approx. 3 N cm</td>
</tr>
</tbody>
</table>

### Vibration resistance

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN 60068-2-6 / IEC 68-2-6</td>
<td>20 g (=200 m/s²)</td>
</tr>
<tr>
<td>(10 ... 2000 Hz)</td>
<td></td>
</tr>
</tbody>
</table>

### Shock resistance

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN EN 60068-2-27 / IEC 68-2-27</td>
<td>200 g (=2000 m/s²)</td>
</tr>
<tr>
<td>(6 ms)</td>
<td></td>
</tr>
</tbody>
</table>

### Max. encoder shaft load

<table>
<thead>
<tr>
<th>F ax, max. (axial)</th>
<th>100 N</th>
</tr>
</thead>
<tbody>
<tr>
<td>F r, max. (radial)</td>
<td>120 N</td>
</tr>
</tbody>
</table>

### Max. speed: AK solid shaft

<table>
<thead>
<tr>
<th></th>
<th>7000 rpm</th>
</tr>
</thead>
</table>

### Shaft dimensions

<table>
<thead>
<tr>
<th></th>
<th>11j6 x 30 mm</th>
</tr>
</thead>
</table>

### Weight

<table>
<thead>
<tr>
<th></th>
<th>approx. 2 kg</th>
</tr>
</thead>
</table>
4 Overspeed monitoring
The electronic overspeed switch EGS 2 has a galvanically insulated switching output. The switching function is realized with a semiconductor, the switching speed is set in our factory (switching hysteresis 10%). Possible values for switching speed is any whole number between 1 and 5400 rpm. If the set switching speed is exceeded, the switch opens.
It is recommended to save the switch circuit against an overcurrent with a fuse (0,5A).

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching speed range, factory-set</td>
<td>AK with solid shaft max. 6300 rpm AK with hollow shaft max. 5400 rpm</td>
</tr>
<tr>
<td>Deviation from switch:</td>
<td>Accuracy of measurement: 2%</td>
</tr>
<tr>
<td>Switch data</td>
<td>Switching time $T_{Sw} &lt; 3$ms</td>
</tr>
<tr>
<td></td>
<td>0...30V DC/max 500mA</td>
</tr>
<tr>
<td></td>
<td>Max. voltage drop at closed switch: 0,7V</td>
</tr>
</tbody>
</table>

5 Zero speed monitoring
The zero speed monitoring is a function for the control of rotary movements. This function is available as an alternative to overspeed monitoring, not in addition. The galvanically isolated switching contact changes the state as soon as the shaft leaves the zero speed.
Functionality:
At a speed of less than 0.25 rpm the zero speed monitoring is activated and the switching contacting contact is closed. When the zero speed monitoring is activated, the current position value is stored and monitored for possible changes in the angle of rotation. As a result, very slow or creeping wave movements can also be detected. In the speed range from 0 to 0.25 rpm, the switching contact opens for approx. 200 - 400 milliseconds after a change in the angular position of ± 5°. The possible switching contact states are shown in the following table.
The switching contact is closed at zero speed ($n = 0$ rpm).
For rotary movement ($n \geq 0.25$ rpm), the switching contact is open.
At a creep motion ($0 < n < 0.25$ rpm), the switching contact opens as soon as a change in the angle of rotation of more than ± 5°. After 200 to 400 ms, the switching contact is closed again as long as the speed is less than 0.25 rpm.

<table>
<thead>
<tr>
<th>Rotation speed $n$ [rpm]</th>
<th>State</th>
<th>Switching contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = 0$</td>
<td>On</td>
<td></td>
</tr>
<tr>
<td>(zero speed)</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>$n \geq 0.25$</td>
<td>On</td>
<td></td>
</tr>
<tr>
<td>(rotary motion)</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>$0 &lt; n &lt; 0.25$</td>
<td>On</td>
<td></td>
</tr>
<tr>
<td>(creep motion)</td>
<td>Off</td>
<td></td>
</tr>
</tbody>
</table>

Switching contact opens for approx. 200 - 400 milliseconds after a change in the angular position of ± 5°.
6 Transport, packaging and storage

6.1 Safety instructions for transport

CAUTION!
Material damage caused by improper transport!
Observe the symbols and information on the packaging:
- Do not throw - risk of breakage
- Keep dry
- Do not expose to heat above 40 °C or direct sunlight.

6.2 Goods inward inspection
Check the delivery immediately upon receipt for transit damage or short delivery. Inform the carrier immediately on receipt if you determine that damage has occurred during transit (take photos as proof).

6.3 Packaging / disposal
The packaging is not taken back and must be disposed of in accordance with the respective statutory regulations and local guidelines.

6.4 Storage of packages (devices)

Keep dry
Keep packages dry and free from dust; protect from moisture.

Protect against heat
Protect packages from heat above 40 °C and direct sunlight.

If you intend to store the device for a longer period of time (> 6 months) we recommend you use protective packaging (with desiccant).

NOTES!
Turn the shaft of the device every 6 month to prevent the bearing grease solidifying!
7 Installation and commissioning

7.1 Safety instructions

Personnel
Installation and commissioning must be carried out by skilled technical staff only.

WARNING!
Observe the safety instructions contained in Chapter 2 when dismantling the device!

7.2 Technical information

NOTES!
Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

Ambient temperature
The max. permissible ambient temperature depends on the speed and degree of protection of the device, the signal frequency, the length of the signal cable and the place of installation (please refer to Chapter 3.3).

Degree of protection
To fulfil degree of protection requirements the diameter of the connection cable must correspond to that of the cable gland (please refer to Chapter 13 Dimension drawings).

Deep groove ball bearings
EGS 2 overspeed switches are fitted with maintenance-free, greased "for-life" deep groove bearings. Bearings must be changed by the manufacturer only. Opening the encoder renders the guarantee null and void.

Screw retention
We recommend using Loctite® 243 threadlocker (medium strength) on all fastening screws to prevent loosening.

7.3 Required tools

- Spanners: 10 mm, 22 mm
- Allen keys: 2 mm, 3 mm
- Flat-blade screwdrivers:
- Assembly grease
- Loctite® 243 (medium strength threadlocker)
7.4 Mounting preparations

1. Ensure all accessories are available (please refer to Chapter 13 Dimension drawings).

   **NOTES!**
   Fastening screws and earth cable are not included in the range of supply.

2. Preparing the place of attachment: Clean the (motor) shaft, centering, bolting surfaces and fastening threads; check for damage. Repair any damage!

7.5 Mounting the encoder

   **NOTES!**
   For a mounting example please refer to dimension drawing HM 17 M 111276 Chapter 13
1. Lightly grease the (motor) shaft (1) an Centerin (9).

2. Fit coupling (2) onto (motor) shaft.

   **NOTES!**
   You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary! We recommend our zero-backlash, torsion-resistant **HK 5 coupling** to attach the overspeed switch. Please refer to the catalogue **Torsion Resistant Couplings** for encoders.

3. Secure the coupling hub on the (motor) shaft with a grub screw or cheese head screw (10) (depending on the coupling type).

4. Fasten the intermediate flange (3) to the motor using the fastening screws (12).

   **NOTES!**
   If possible, fit the intermediate flange in a manner that ensures the screwed sealing plug (14) points downwards!

5. Lightly grease the encoder shaft (5) and centering (4).

6. Fit the encoder (8) into both the centering (4) and coupling hub at the same time.

   **NOTES!**
   You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary!

   **NOTES!**
   If possible, fit the device in a manner that ensures the cable gland (7) points downwards.

7. Secure the encoder with 6 screws (6).

8. Remove the sealing plug (14) from the access bore (13) to the coupling.

9. Secure the coupling hub on the encoder shaft with a grub screw or cheese head screw (11) (depending on the coupling type).

   **NOTES!**
   To carry out this task, it may be necessary to turn the (motor) shaft to the correct position.

10. Replace the sealing plug (14) to seal the access bore to the coupling.
Mounting tolerances for our zero-backlash, torsion-resistant couplings HK 5 and HKD 5:

<table>
<thead>
<tr>
<th>Coupling</th>
<th>Axial offset $a$</th>
<th>Angular error $\alpha$</th>
<th>Parallel offset $e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HK 5</td>
<td>± 1 mm</td>
<td>0.5°</td>
<td>-</td>
</tr>
<tr>
<td>HKD 5</td>
<td>± 1.5 mm</td>
<td>0.5°</td>
<td>0.5 mm</td>
</tr>
</tbody>
</table>
7.7 Electrical connection and start up

NOTES!
You must observe applicable EMC guidelines when routing cables!

7.7.1 Preparing cables

1. Strip cable insulation. The cable for the signal and supply line is shielded, the cable for the option S and the cable for LWL will not be shielded.

2. Crimp wire-end ferrules.

7.7.2 Electrical connection

1. Open the terminal box cover (15, Fig.1).

CAUTION!
Do not allow moisture to enter the terminal box when the cover is open!

2. Remove the cap of the cable glands (17, Fig.1).

3. Feed the cable into the terminal box trough the cable glands.

NOTES!
The signal cable shielding has to be connected directly to the housing via the EMC cable gland.

To achieve an effective shielding the cable shield must also be connected in the electrical cabinet.

4. Tighten the cable gland using a spanner.

NOTES!
Prior to delivery cable glands and blanking plugs are tightened finger tight only. To ensure that the terminal box is reliably sealed tighten all cable glands and blanking plugs before starting up for the first time.

5. Use a spanner to tighten the cable gland until the cables are securely clamped and properly sealed.

NOTES!
Prevent lateral pulling forces acting on the cable so as not to impair the degree of protection of the cable gland.
6. Connect the supply voltage, the signal cable and possibly option S (please refer to the connection diagrams, Chapter 14).

7. Close the terminal box cover.

<table>
<thead>
<tr>
<th>NOTES!</th>
<th>Before closing the terminal box cover check and if necessary clean both seal surfaces and the gasket.</th>
</tr>
</thead>
</table>

| CAUTION! | Ensure when closing the terminal box cover that no cable becomes jammed. |

8 Dismantling

8.1 Safety instructions

Personnel
Dismantling must be carried out by skilled technical staff only.

<table>
<thead>
<tr>
<th>WARNING!</th>
<th>Observe the safety instructions contained in Chapter 2 when dismantling the device!</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NOTES!</th>
<th>Do not use a hammer or similar tool when dismantling the device due to the risk of damage occurring to the bearings or coupling!</th>
</tr>
</thead>
</table>

8.2 Dismantling the encoder
Dismantling must be carried out by skilled technical staff only.

To dismantling the encoder follow the instructions given in Chapter 7.5 in the reverse order.
## 9 Faults

### 9.1 Faults table

<table>
<thead>
<tr>
<th>Faults</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch does not close</td>
<td>No supply voltage&lt;br&gt;Control: LED in the terminal box does not shine</td>
<td>Check connection cable and supply voltage</td>
</tr>
<tr>
<td></td>
<td>Error LED does not shine: Rotation speed above the switching speed</td>
<td>Adjust the suitable rotation speed</td>
</tr>
<tr>
<td></td>
<td>Error LED is shining: Evaluation of rotation speed is faulty.</td>
<td>Disconnect power supply and switch on again</td>
</tr>
<tr>
<td>Moisture in the terminal box</td>
<td>Soiled terminal box gasket or seal surfaces</td>
<td>Clean terminal box gasket and seal surfaces</td>
</tr>
<tr>
<td></td>
<td>Damaged terminal box gasket</td>
<td>Replace terminal box gasket</td>
</tr>
<tr>
<td></td>
<td>Cable gland/blanking plug not tightened</td>
<td>Tighten cable gland/blanking plug</td>
</tr>
<tr>
<td></td>
<td>Unsuitable cable for cable gland</td>
<td>Use suitable cable and cable glands</td>
</tr>
</tbody>
</table>

Contact Hubner-Service (page 2) if none of the remedies listed above provides a solution!
10 Inspections

10.1 Safety instructions

**WARNING!**
Skilled technical staff only are permitted to inspect the device and its installation. Observe the safety instructions contained in Chapter 2 when inspecting or working on the device!

10.2 Maintenance information
The device is maintenance-free. However, to guarantee optimum fault-free operations we recommend that you carry out the following inspections.

10.3 Inspection schedule

<table>
<thead>
<tr>
<th>Interval</th>
<th>Inspections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly</td>
<td>Inspect the coupling for damage and ensure it is free of play</td>
</tr>
<tr>
<td></td>
<td>Ensure the fastening screws are properly tightened</td>
</tr>
<tr>
<td></td>
<td>Ensure cable connections and connection terminals are securely seated</td>
</tr>
<tr>
<td>Following approx 16 000 – 20 000 hours of operation / higher levels of continuous load</td>
<td>Check deep groove ball bearings are running smoothly and listen for running noises</td>
</tr>
</tbody>
</table>

11 Disposal

11.1 Disposal procedure
The manufacturer is not obliged to take back the device.
The device is classed as electronic equipment; observe local country-specific laws when disposing of the device.
For information on environmentally sound disposal please contact your local authority or a specialist disposal company.

12 Replacement parts
The replacement parts listed below can be obtained via the service address on page 2.

<table>
<thead>
<tr>
<th>Replacement parts</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC cable gland</td>
<td>M 20 x 1.5, cable Ø 5…14 mm</td>
</tr>
<tr>
<td>Terminal box cover</td>
<td>Including O-Ring and screws</td>
</tr>
<tr>
<td>Screw plug</td>
<td>For closing the access to the coupling</td>
</tr>
</tbody>
</table>
13 Dimension drawings

- **Dimension drawings**

  - **Electronic overspeed switch EGS 2**

  - **Klemmkeildeckel** (spring-loaded terminal block cover) with O-Ring seal and retaining nut ZVa-Schraube M6 with seal.

  - **Kabelverschraubung für Kabel** (cable gland for cable) with screw M5

  - **Transport und Lagerstelle** (transport and storage)

  - **Waage aus nichtrostendem Stahl** (shaft of stainless steel)

- **EGS 2 K**

  - **Bauform / construction type** B5

  - **Zeichnung / drawing** HM 17 M 11 12 75
Electronic overspeed switch EGS 2
14 Connection diagrams

14.1 Terminal box

NOTES!
The connection diagrams are displayed in each terminal box cover!

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>0V</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>+U</td>
<td>Power supply</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Switching output</td>
</tr>
<tr>
<td>13</td>
<td></td>
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</table>

Connection diagram PN166-480a

14.2 Connection cable

NOTES!
The connection diagrams are attached to each cable!

<table>
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<tr>
<th>WH</th>
<th>0,5</th>
<th>0V</th>
<th>GND</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>0,5</td>
<td>+U</td>
<td>Power supply</td>
</tr>
<tr>
<td>GN</td>
<td>0,5</td>
<td></td>
<td>Switching output</td>
</tr>
<tr>
<td>YE</td>
<td>0,5</td>
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</tbody>
</table>

Connection cable: IGUS chainflex® CF9.UL.05.04 control cable TPR 4x0,5

Connection diagram PN166-481a