APS

ANALOG POSITION SENSOR

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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.

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Document last updated: 25.02.2011

Reg. No. 3496-01

Reg.-No. DE-3496-01

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1 Safety

1.1 Appropriate Use

The complete APS-M1 system is intended for stroke measurement systems, e.g. for mounting on grippers for measuring and checking purposes, for installation in measuring stands and measuring appliances, and for checking and gaging workpieces in a clean environment. It is not a calibrated system. For applications of this nature, the user must calibrate the system at regular intervals.

Using the system with disregard to even a minor specification will be deemed improper use .

To ensure safe operation, the measuring system must only be used in accordance with the Operating Manual. All necessary legal provisions and safety instructions for each particular application must be observed during use. This also applies to the use of accessories and mounting kits.
The measuring system does not constitute a safety element in the sense of appropriate use. In order to operate this measuring system safely and without problem, appropriate transport, expert storage, installation and assembly and careful operation and maintenance are essential.

1.2 General Risks on Non-compliance with Safety Instructions

The measuring system conforms to the state of the art and is operationally safe.
The measuring system may be the cause of derived risks if it is improperly used and operated by untrained personnel .

All persons entrusted with the installation, commissioning, maintenance or repair of a measuring system must have read and understood the Assembly and Operating Manual, particularly the safety instructions.

1.3 Derived risks

The supplied equipment and its scope of use only covers some of the applications of stroke measuring technology. The system planner, fitter and plant operator must plan, implement and assume responsibility for technical safety issues relating to stroke measuring systems in such a way as to minimize derived risks to the greatest possible extent. Compliance with the applicable regulations is essential. Employees must be made aware of possible derived risks in connection with the stroke measuring system.

1.4 Symbol Key

You will find this symbol wherever **hazards for persons** or **damage to the product** are possible.

This symbol indicates **important information** on the product or its handling.

1.5 Conversions and Modifications

The design or technical safety aspects of the complete measuring system must not be modified without our express consent. Any modifications will exempt the manufacturer from liability for resulting damage.

1.6 Qualified Personnel

This measuring system may only be employed by qualified personnel, solely in accordance with the technical data and in compliance with the safety conditions and regulations described below. All necessary legal provisions and safety instructions for each particular application must be observed during use. This also applies to the use of accessories.

Qualified personnel are persons who are familiar with the installation, assembly, commissioning and operation of the product and who possess the necessary qualifications for such activities.

1.7 Operation at the Site of Installation

The sensor and the electronic processor must be protected from humidity, dirt and the effects of the weather (e.g. rain, snow, etc.).

1.8 Accident Prevention

Compliance with the applicable Accident Prevention Regulations from the employers' liability insurance associations is essential.

2 Warranty

The warranty period is 24 months after delivery date from the factory, assuming use in single-shift operation and that the recommended maintenance and lubrication intervals are respected. Components that come into contact with workpieces and wearing parts are never included in the warranty. In this context, please also see our General Terms and Conditions .

3 Scope of Delivery

The scope of delivery of the APS-M1 consists of:

- Position encoder APS-M1S with approx. 3m non-detachable cable
- Electronic processor APS-M1E
- Operating Manual

Please note that components can also be ordered individually. They will also be supplied with this Operating Manual.

3.1 Accessories

Extension cable for extending the 3m-long cable between the sensor and the electronic processor

ID No.	Type	Description
302066	APS-K2	Extension cable, 2m, with socket and supplied plug
302068	APS-K7	Extension cable, 7m, with socket and supplied plug

When using extension cables, please note the permitted cable lengths as specified in section 7 Electrical Connection.

3.2 Mounting Kits

In addition to the electronic processor and the APS-M1S sensor, a mounting kit for the specific gripper is required. The standard signals shown in the table can be achieved with gripper-specific mounting kits. Minor deviations are possible, however, due to manufacturing tolerances.

ID No.	Type	Gripper type	Standard signal
302075	AS-APS-M1	PGN+/PZN+64/1	0-10V / 4-20mA
302076	AS-APS-M1	PGN+/PZN+64/2	0-5V / 4-12mA
302077	AS-APS-M1	PGN+/PZN+80/1	0-10V / 4-20mA
302078	AS-APS-M1	PGN+/PZN+80/2	0-6.5V / 4-15mA
302079	AS-APS-M1	PGN+/PZN+100/1	0-10V / 4-20mA
302080	AS-APS-M1	PGN+/PZN+100/2	0-8V / 4-18mA
302081	AS-APS-M1	PGN+/PZN+125/1	0-10V / 4-20mA
302082	AS-APS-M1	PGN+/PZN+125/2	0-10V / 4-20mA
302083	AS-APS-M1	PGN+/PZN+160/1, PGN+/PZN+240/2	0-10V / 4-20mA
302084	AS-APS-M1	PGN+/PZN+160/2	0-10V / 4-20mA
302085	AS-APS-M1	PGN+/PZN+200/1, PGN+/PZN+380/2	0-10V / 4-20mA
302086	AS-APS-M1	PGN+/PZN+200/2	0-10V / 4-20mA
302087	AS-APS-M1	PGN+/PZN+240/1	0-10V / 4-20mA
302088	AS-APS-M1	PGN+/PZN+300/1	0-10V / 4-20mA
302089	AS-APS-M1	PGN+/PZN+300/2	0-10V / 4-20mA
302090	AS-APS-M1	PGN+/PZN+380/1	0-10V / 4-20mA

Further mounting kits for other grippers are available on request.

⚠ **When using grippers with a stroke of less than approx. 6.5 mm per jaw, in most cases the full output signal of 0-10V or 4-20mA cannot be achieved**. This is due to the fact that the full sensor stroke of 2 mm cannot be traveled because the required inclined plane may be tilted by max. 17° to the direction of motion of the jaw.

4 Introduction

An increasing degree of automation of tasks means that industrial products have to be evaluated during the handling process. The APS-M1 has a measuring system developed for this purpose. The APS-M1E electronic processor is designed for installation in control cabinets, while the probe can be mounted directly to a gripper to evaluate the workpieces directly during the gripping process.

The standard signal – which is proportionate to the gripper stroke – can then be evaluated with a programmable controller, e.g. an SPC, enabling the handled workpieces to be assessed as well.

Here are some examples of possible areas of application:

- Gaging of workpieces
- Classifications
- Detection of skewed grippers
- etc.

5 Design and Method of Operation

The sensors comprise a ferromagnetic core and a coiled tube bearing two measuring coils one behind the other, which together form an inductive half-bridge.

The ferromagnetic core is mounted on a non-magnetic core rod, and is situated in the center of the coil system. Axial shifts in the core lead to a converse change in the impedance of the measuring coil.
A ferritic casing tube surrounds the coil system and simultaneously acts as the magnetic shield. Under a plastic casting are resistors that adjust the sensitivity of the pickups and make the half-bridge into a four-arm bridge.

The electronic processor energizes the four-arm sensor bridge by means of a sinusoidal voltage. The phase angle and amplitude are evaluated and a standard signal generated on this basis. The electronic processor provides two standard signal outputs, with which the zero point and gain can be adjusted separately in line with the respective gripper stroke.

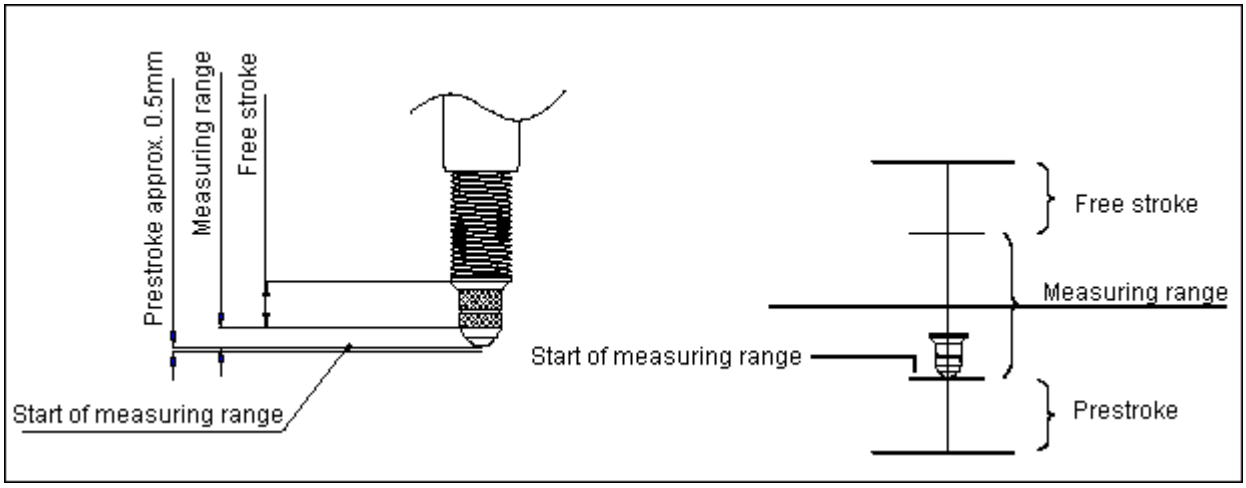
The inclined plane of the mounting kit causes the gripper stroke to be converted into a movement that, to the sensor, is axial. The stroke of each gripper jaw corresponds to the entire travel range of the sensor.

The standard signals can be evaluated in relation to the overall gripper stroke by means of a programmable controller.

6 Assembly

During sensor assembly, please follow this procedure:

- Open the gripper pneumatically, ensuring that the base jaws are fully in contact with the mechanical stop
- Use glue on the upper side and side surfaces of the mounting kit, so the mounting kit will be glued to the base jaw additionaly to being screwed to. Please take care, that there is absolutely **no glue on that surface the head of the sensor will get in contact with**.
- Replace one of the standard control cams with the mounting kit (see mounting kits table) with inclined plane
- Insert the sensor in the bracket until a prestroke of approx. 0.5mm is reached. The prestroke is the distance between the sensor's rest position (push rod not actuated) up to the start of the sensor's measuring range.



- Slightly tighten the screws in the bracket
- Align the sensor vertically to the gripper
- Tighten the screws fully
- Check the installation position of the sensor once again

7 Electrical Connection

If the sensor cable length of approx. 3m is sufficient, you can fit connector sleeves to the ends of the cable and connect them directly to the terminals of the electronic processor.

If, on the other hand, the sensor cable is not long enough, the connector that is supplied with every sensor extension must be soldered to the exposed cable ends (see Cable Extensions).

Here, take care to ensure that the sensor extension is as long as necessary but as short as possible.

It is important that the maximum cable length is not exceeded.

⚠ **The max. permitted cable length between the sensor and the electronic processor is 10 m.**
Longer distances impair the resolution and restrict the max. span of the output signal. Excessively long cables may also lead to further problems.

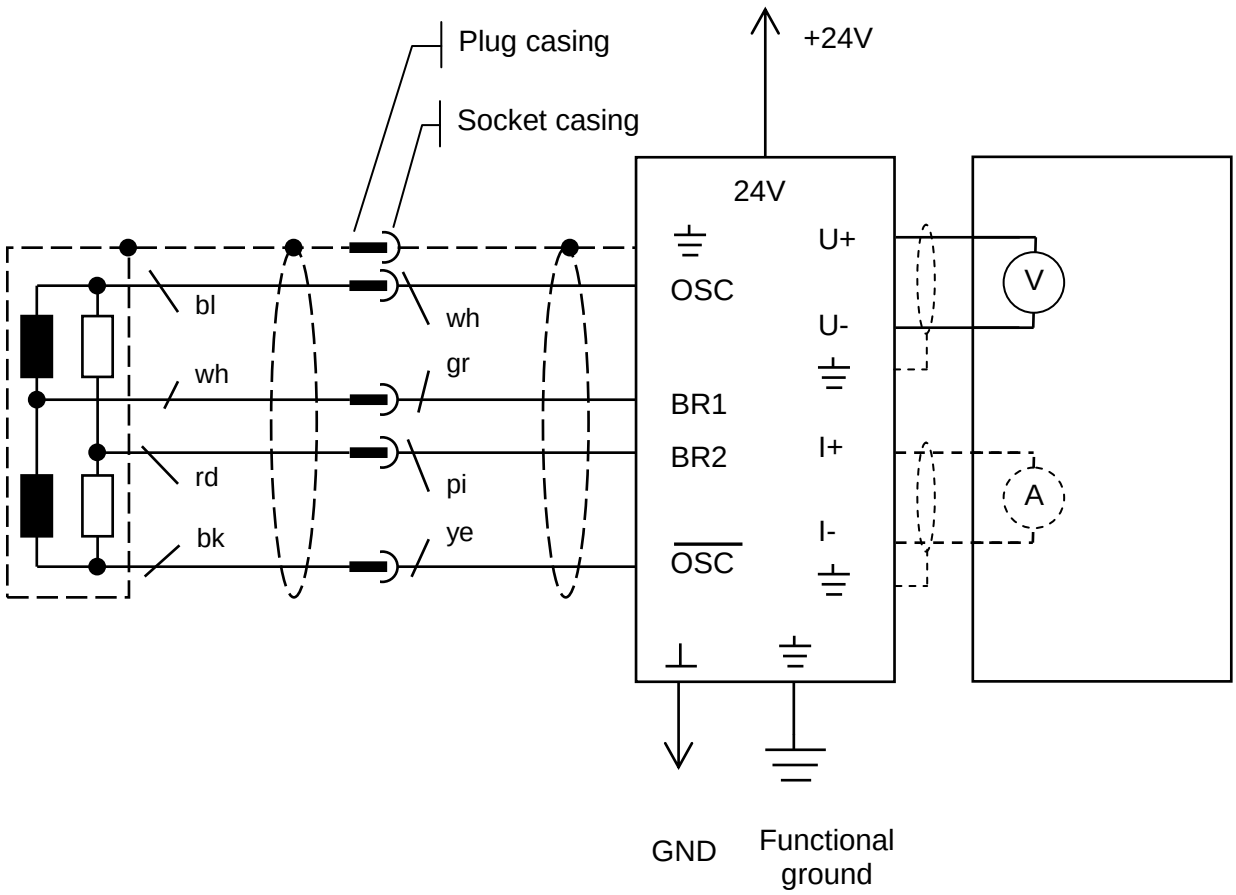
Connect the sensor and the electronic processor to one another as illustrated in the diagram below, taking care to ensure that the shield of the sensor cable is routed to a ground terminal on the electronic processor. After you have connected the sensor, connect the electronic processor to the power supply. Ensure that the functional ground is also connected, as this ensures problem-free operation of the electronic processor.

We also recommend using a shielded cable for connecting the APS-M1E to the control system. Connect one end of this cable to the functional ground of the electronic processor.

⚠ **The max. permitted cable length between the APS electronics and the control system is 1 m**.
The APS system functions correctly, as shown in EMC tests, up to a cable length of 1m.
Longer cable lengths usually function OK, because the occurring electromagnetic interference is mostly very minor. However, SCHUNK is unable to issue a general guarantee for the functionality of the unit if cables longer than 1m are used.

On initial startup of the unit, you should connect a multimeter to the standard signal output that is to be employed. You should only connect the programmable controller when the standard signal output has been calibrated in line with the gripper stroke. Precision calibration may then be required.

Inductive sensor	Cable extension	Electronic processor	Programmable controller
APS-M1S	**APS-K2** **APS-K7**	**APS-M1E**	**e.g. S7-300**

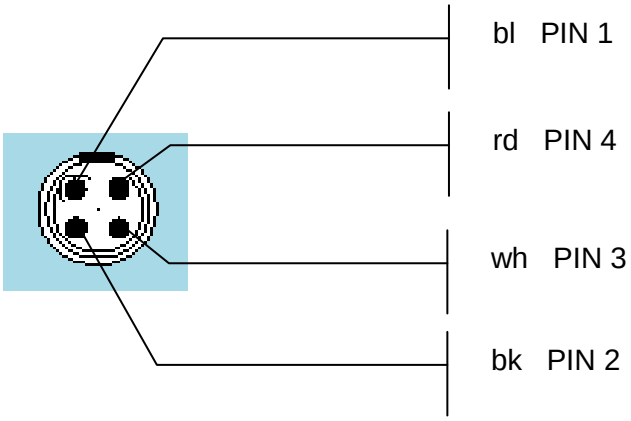


7.1 Cable Extensions

If you are using cable extensions APS-K2 and APS-K7, it is essential that the shield of the sensor cable is lying with its whole surface against the casing of the connector.

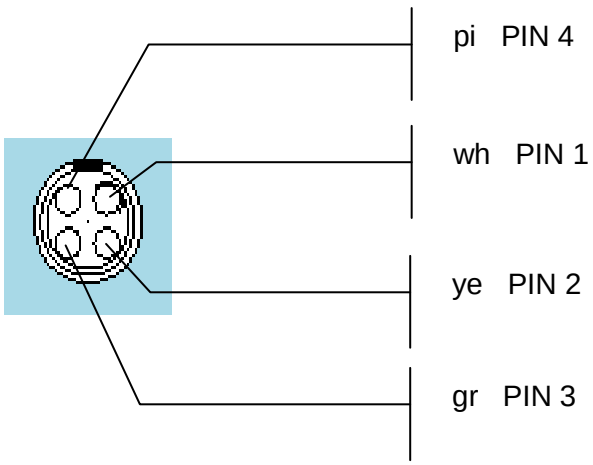
7.1.1 Pin Assignment of Plug

View of solder cup

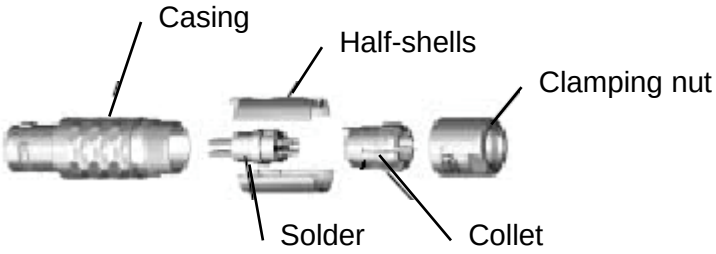


7.1.2 Pin Assignment of Socket (APS-K2 / APS-K7)

View of solder cup



7.2 Plug Connection

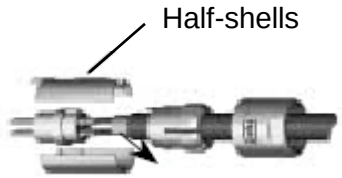


- Push the clamping nut and collet over the cable

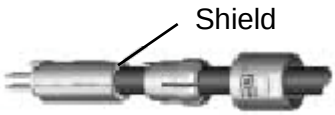
- Strip the cable and conductors. See table below for length of removed insulation
- Tin-plate the wires

Soldered connection		
L / mm	S / mm	A / mm
7	2.5	2

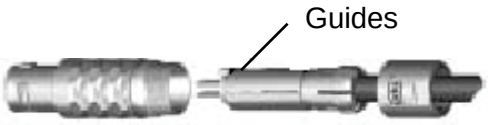
- When they are correctly assigned, solder the wires in the contacts



- Lever out the shield, affix the half-shells to the insert



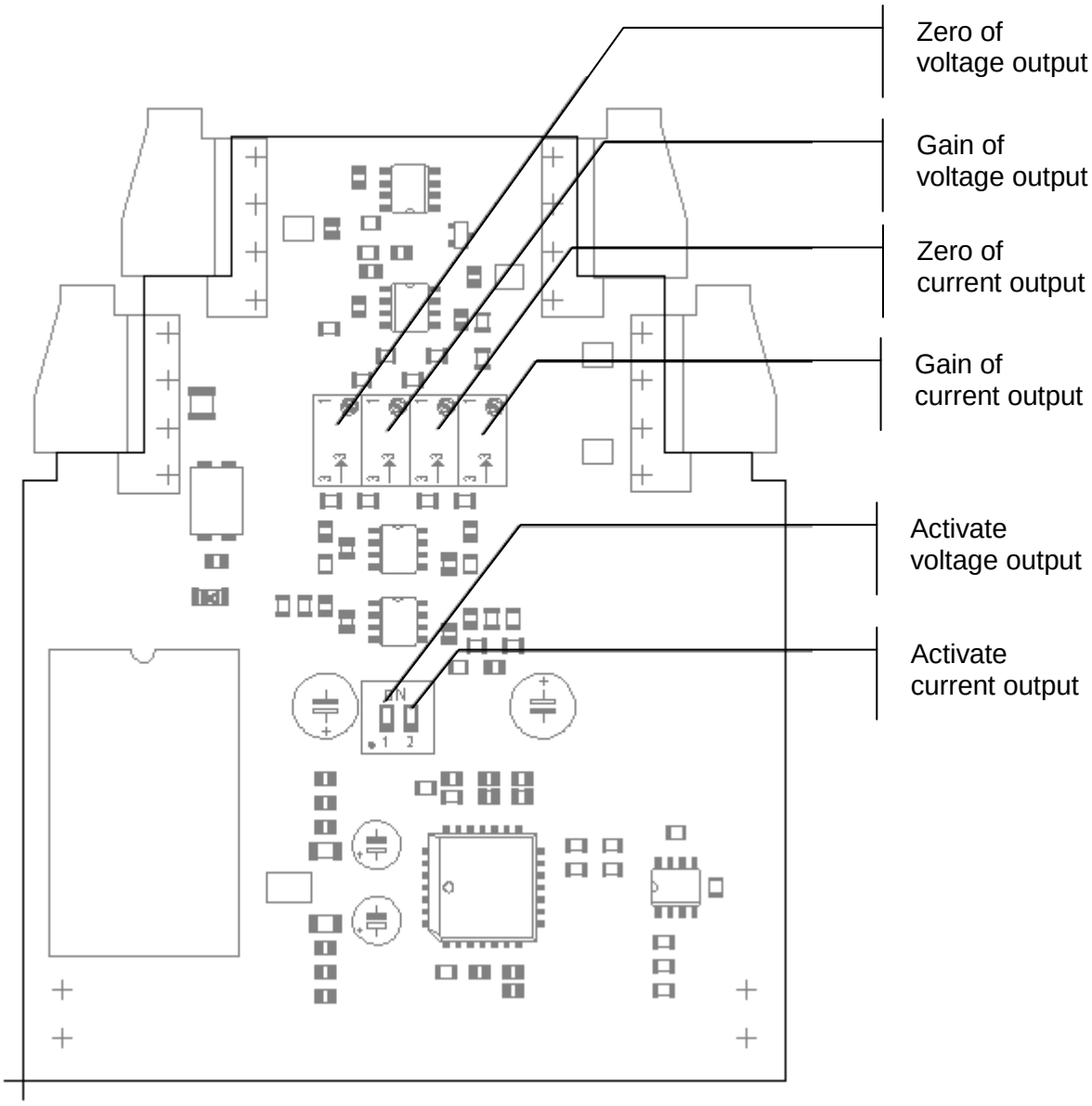
- Push the collet against the half-shells, so that the shield is clamped between the collet and the half-shells.



- Push the assembled cable into the plug casing, taking care to use the guides

- Screw the clamping nut onto the assembled plug and tighten using an open-end wrench A/F 7. Assembly is now complete.

8 Calibrating the Electronic Processor



For calibration, you will need the following additional equipment.

Calibrating screwdriver, gage blocks

Before you can calibrate the electronic processor, you must ensure that the following steps have been carried out:

- The gripper must be connected to the pneumatic control lines
- The mounting kit with inclined plane must be installed
- The sensor must be firmly secured in the bracket
- The control pressure must be roughly constant
- The gripper fingers must be fitted to the gripper
- The gripper fingers must be open
- **The electronic processor must be electrically connected correctly.**
- **The power supply must be switched on.**
- **The electronic processor must be at operating temperature.**

8.1 Procedure

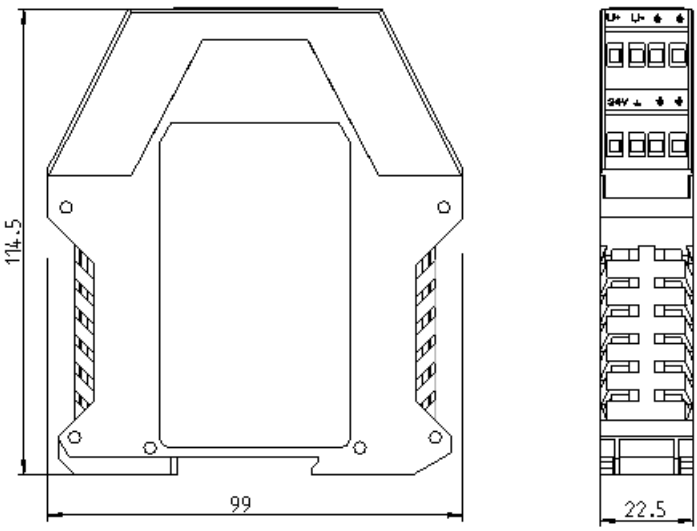
- Set the standard signal output (0-10V / 4-20mA) on the DIP switches (you must deactivate the unused standard signal output !!!))
- Insert a gage block between the gripper fingers and pneumatically close the gripper
- Set the zero potentiometer to a standard signal value that corresponds to the inserted gage block.
- Open the gripper
- Insert a gage block that corresponds to the maximum stroke of the gripper
- Close the gripper
- Set the gain potentiometer to a standard signal value that corresponds to the inserted gage block.

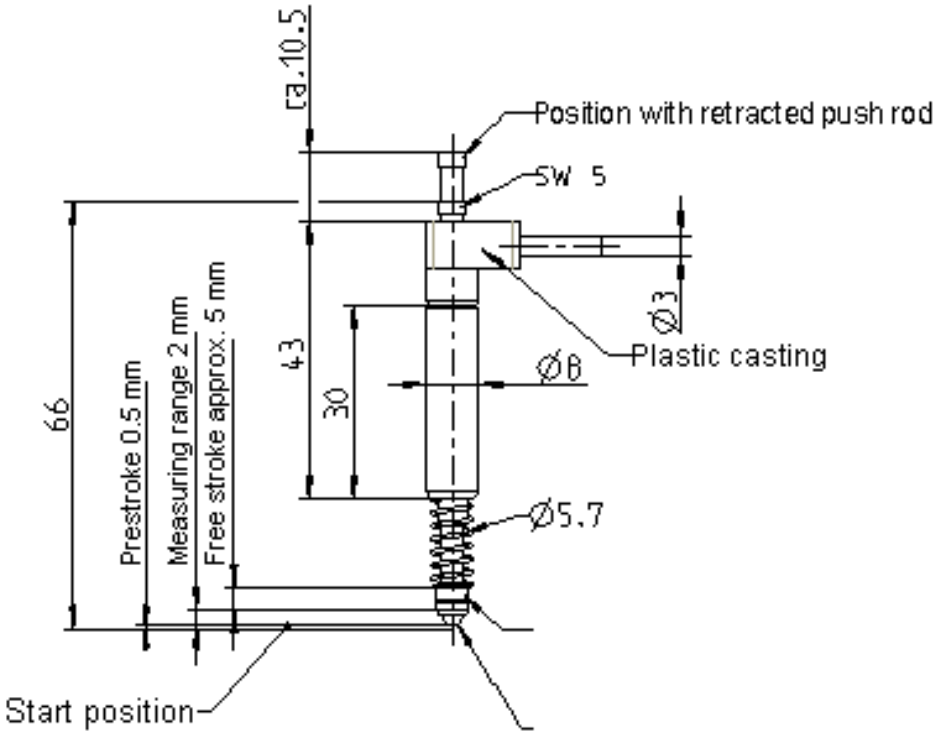
8.2 Example for Calibrating the Electronic Processor

Overall gripper stroke:	0...33 mm
Standard signal output:	0...10V
Voltage / mm	0.303030303 V/mm

- Insert a gage block 1 mm thick
- Close the gripper
- Set the zero potentiometer to 0.303 V
- Open the gripper
- Insert a gage block 33 mm thick
- Close the gripper
- Set the gain potentiometer to 10 V

9 Dimensions





10 Technical Data

10.1 Technical Data of Electronic Processor APS-M1E

Supply voltage	VDC	24 ± 3 stab.
Power consumption, max.	W	2.5
Oscillator frequency	Hz	4800 ± 8%
Oscillator voltage	VSS sinusoidal	7
Thermal drift	%/°C	0.05
Temperature range	°C	0...60
Output 1	V	0...10
Gain	-	Adjustable
Zero drift	-	Adjustable
Permitted load RL	kohms	>= 2
Output 2	mA	4...20
Gain	-	Adjustable
Zero drift	-	Adjustable
Load impedance	ohms	0...250
Max. cable length between position encoder and APS-M1E	m	10
Max. cable length between APS-M1E and programmable controller	m	3

10.2 Technical Data of the Sensor APS-M1S

Nominal measuring distance	mm	2
Nominal output span (between starting point and end point with output not under load)	mV/V	80
Nominal signal at starting point	mV/V	-40
Nominal signal at end point	mV/V	40
Tolerance of nominal output span	%	± 1
Zero signal		The output signal is zero at the center position of the nominal measuring distance
Setting tolerance of zero signal	mV/V	± 4
Linearity error (max. error between starting point and end point – including hysteresis)	%	± 0.2
Nominal temperature range	°C	10...60
Operating temperature range	°C	-20...80
Influence of temperature on zero signal within the nominal temperature range, based on the nominal output span per 10K	%	± 0.1
Influence of temperature on nominal output span within the nominal temperature range, based on the actual value per 10K	%	± 0.2
Weight of measuring element without connecting cable	g	12
Weight of moving parts	g	4.25
Input resistance	ohms	100 ± 10%
Output resistance	ohms	570 ± 10%
Nominal supply voltage (effective)	Veff	2.5
Carrier frequency	Hz	4800 ± 8%
Protection class to EN 60529 for pickup tube and core duct		IP67
Surface material		Non-rusting
Resistance to sinusoidal vibrations DIN40046/8, IEC Part 2-6 (type-tested)		
Frequency range	Hz	5...65
Vibration acceleration	m/s2	150
Duration (in each plane)	h	0.5
Resistance to mechanical shock (type-tested)		
Number of shocks (in each plane)	-	1000
Shock acceleration	m/s2	650
Duration of shock	ms	3
Form of shock	-	Sinusoidal half-wave
Spring constant	N/mm	0.1
Spring force at starting point	N	0.8
Spring force at end point	N	1
Max. permitted acceleration of prod	m/s2	180
Limit frequency of prod		
at ± 1 mm stroke, approx.	Hz	68
at maximum stroke, approx.	Hz	68
Cable length, approx.	m	3
Cable type	-	PUR

11 EMC Test Report

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Prüfdatum : 28. Juli 2004

Anwesend : Hr. Scholz (Fa. Schunk)

Prüfer : R. Irion, Fa. NKL GmbH

Prüfgegenstand : Analoger Positionssensor **APS-M1E**

Betriebsspannung: 24 VDC

Betriebsart : Messen

Prüfungen : Störaussendung nach EN 55011:1998 Klasse A
Störfestigkeit nach EN 61000-6-2:2001

Prüfung und Prüfergebnis :

Die Anforderungen der o.a. Normen wurden bereits im Anlieferungszustand erfüllt.

Dieser Prüfbericht besteht aus 11 Seiten, davon 10 Seiten Messprotokolle und 4 Bilder. Das Prüfergebnis bezieht sich ausschließlich auf den oben beschriebenen Prüfgegenstand. Dieser Prüfbericht darf ohne unsere schriftliche Genehmigung nur vollständig, aber nicht auszugsweise vervielfältigt werden. Die von uns verwendeten Prüfgeräte unterliegen einer regelmäßigen Kalibrierung.

Wolpertshausen, den 28. Juli 2004

Ralf Irion
EMV-Labor

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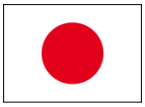

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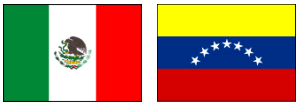

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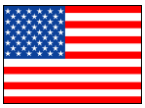

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