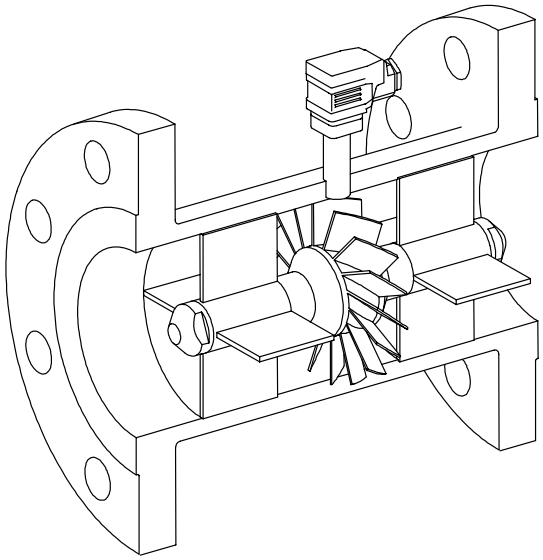
TURBOQUANT-S

TURBINE METERS



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APPLICATION FIELD

The TURBOQUANT type turbine meters – with their electronic signal processing and displaying units – are well proved and widely applicated instruments in industrial flow measurement. These instruments provide reliable, continuous and accurate measurement of the quantity of fluids flowing in closed conduits under pressure. The systems built of the signal processing units attached to them can be used for automatic control and recording of flow, control of batching and proportional mixing etc. The TURBOQUANT turbine meters are built with slide bearings therefore they are applicable for almost any kind of liquids, even for the strongly aggressive ones. Their field of application is widened by the fact that in intrinsically safe construction they can be used in explosive area, too (Figures 4, 5), according to the Category 2 of the Application Group II of the related UC Directives of ATEX 94/9.

Main industrial application field of turbine meters:

- in oil and gas industry measurement of crude oil, semi-final and final products of refineries;
- in chemical industry measurement of paints, lac, solvents and diluents;
- in machinery, power plants and communal plants measurement of water and fuel;
- measurement of most different fluids used in pharmaceutical and food industry.

PRINCIPLE OF OPERATION (Figure 1.)

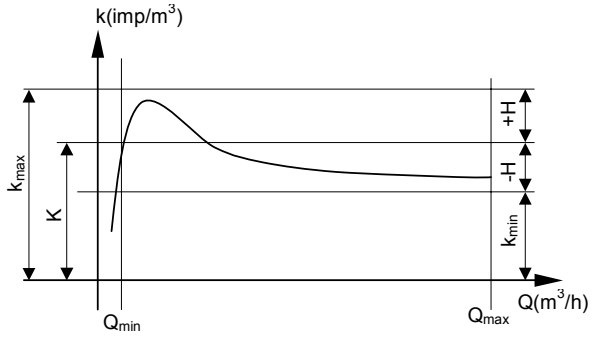
The turbine meter is a measuring device sensing the speed of fluid flowing in conduit under pressure. A rotor with axial flow through is placed in the way of the fluid flowing through the turbine meter, which is rotating with a speed proportional to the flowrate.
An inductive transducer senses the speed of the rotor. The flux of the coil assembled with permanent magnet is changed by the rotor blades made of ferromagnetic material, passing under the coil, inducing an electric pulse in the coil by each passing rotor blade. The frequency of the induced electric pulses is proportional to the speed of the rotor and through it to the flowrate of the measured fluid.

TECHNICAL DATA

Metrological data

Specific pulse number

The number of pulses induced during the flow through of volume unit is the specific pulse number (k). This is slightly depending on the flowrate (Q). This function is described by the calibration diagram:



Calibration factor

This is the arithmetic mean value of the maximal and minimal specific pulse numbers measured within the measuring range under reference conditions (K). This value is determined for each turbine individually and it is reported in the test certificate of the turbine meter. The calibration factors characteristic for the type can be found in Table 7. The individual values can differ from this with ±10%.

Linearity

The maximal relative deviation of the specific pulse numbers within the measuring range from the calibration factor (H). The linearity values characteristic for the type under reference conditions can be found in Table 6.

Repeatability

The deviation of specific pulse number values at a given flowrate measured under identical conditions. Their characteristic values are given in Table 6. This feature is significant when a measurement more accurate than the linearity of the turbine meter is necessary. Most of the signal processing units is capable to store more different values of the calibration diagram and take it in account during the measurement. With this method the accuracy of the turbine meter can be increased practically until the repeatability.

Reference conditions

Ambient air temperature:	25 ± 5 ºC
Relative humidity of air:	45...75 %
Reference fluid:	water
- temperature:	23 ± 8 ºC
- pressure downstream of the turbine meter	min. 1 bar overpressure

Electric data

Direct pickup

The inductive pickup of the turbine meter provides a nearly sinusoidal isolated frequency signal the electric features of it by maximal flowrate are given in Table7. Electric strength between the pickup coil and the body of the turbine meter is 500V. The turbine meter and its pickup is constructed to conform the prescriptions of standards EN50014 and EN50020. In case of intrinsically safe application the circuit on Figure 4. must be applied. In this case the protection mode of the measuring system is: II.2.G EEx ib IIC⟨Ex⟩…T6 within the temperature limits given in Table5.

Pickup assembled with preamplifier

The pulses in the range of mV of the inductive pickups of turbine meters can be transmitted to longer distances and free of disturbances to the signal processing units by applying the LA6/1 two wires preamplifier. The turbine meter, the pickup and the preamplifier has been constructed to conform the prescriptions of standards EN50014 and EN50020. In case of intrinsically safe application the circuit on Figure 5. must be applied. In this case the protection mode of the measuring system is:
⟨Ex⟩II.2.G EEx ib IIC T3…T6 within the temperature limits given in Table 5.
Technical parameters of the preamplifier:
Power supply: 4,5…28 V DC
Input: TURBOQUANT pickup (0…1500 Hz, 3…3000mVeff)
Ranges of output current:

Signal level	Types		
	6689-1-00**3**-0	6689-1-00**1**-0	6689-1-00**2**-0
"0"	max. 1,2 mA	max. 3 mA	max. 7 mA
"1"	max.4 mA min.3,6 mA	max.11 mA min.9 mA	max.15 mA min. 13 mA

Housing: B10 GDME (HIRSCHMANN connector)
Temperature range: -40…+110 °C
Protection: IP 65 EN 60529
Dimensions: Figure 3.

Application data

Size and type selection (Table 1.)

Measured fluid

Chemical composition: The turbine meter is suitable for measurement of all those fluids the corrosive effect of which the materials in contact with the fluid are resistant (Table 3.).
Viscosity: parameter affecting the linearity. Under 15cSt the effect of it is not more than 0,5%. The turbine meter can also measure fluids of higher viscosity, but in such cases it is recommended to determine the calibration factor by local calibration (so called provering).

Gas content: gas present in the liquid in form of bubble affects the accuracy of the measurement. Gas bubbles uniformly distributed cause error nearly equal to their volume rate. Care must be taken for separating larger volumes of gases in the upstream pipe section.
Solid particle contamination: contamination not larger than 50 g/m^3 is not influencing the durability significantly. In case of greater contamination concentration the application of filter is recommended. 80 % of the contamination can be under the size of 50μm, 20 % can be under the size of 0,5 mm. The hardness of contamination under the size of 50μm must be under 100HB, the hardness of those above 50μm can be on discretion.
Fibrous content: this kind of contamination is not allowed, it must be filtered.

Materials (Table 3.)

Temperature ranges

Temperature ranges in Tables 4. and 5. are valid only for the turbine meters assembled with Cannon connector without limitations. (Figure 3.). In case of Hirschmann connector the temperature range is only -40…+110°C.

Other operational conditions

- The specified measuring accuracy can be obtained in case the turbine meter is operated in a measuring section according to Figure 2.
- Installation position horizontal ± 5°, direction of flow as indicated by the arrow on the body.
- Generally the meter must not be overloaded, but a 5% overload is permitted in 5 % of the operating time.
- Ambient magnetic field: max. 200 A/m
- Acceleration due to vibration: max. 0,5g (0-500 Hz)

Accessories

1 pc. Electric connector
1 pc. Instrument manual
1 pc. Certificate of quality
1 pc. Test certificate
1 pc. Piece test certificate (only in case of intrinsically safe applications)

PRELIMINARY RECOMMENDATIONS

Preparation of operation

Unpacking, transporting to site

It is practical to transport the turbine meter to site in factory packing. The general prescriptions are valid for unpacking. **It is forbidden to lift and move the turbine meter by grabbing the pickup!** After removing the protective caps and dust protection cover make sure that the transport did not cause visible changes at the inner parts of the turbine meter. Protect the turbine meter freed of protective cap and dust protection cover but not yet installed from ambient contamination.

Safety regulations

At unpacking, moving and installing the turbine meters the safety regulations for lifting burden must be followed. For connecting turbine meters operated at fire and explosion hazardous site zener barriers with parameters according to figures 9. and 10. can be applied. In this case the protection mode of the measuring system is:

EEx ib IIC T3...T6 (MSZ EN 50014, MSZ EN 50020).

Fluid temperatures corresponding to the temperature classes are in Table 5.

Assembling conditions

Regarding flow technical considerations, in order to obtain specified accuracy a so-called measuring section must be built in the direct neighbourhood of the turbine meter (Figure 3.). At installation of upstream and downstream pipe sections the prescription for uniaxiality corresponding to IT14 accuracy class must be followed. Care must be taken for sizing the gaskets without deflection and the concentric positioning.

Filtering

In case of measuring liquids containing fibrous materials or sediments care must be taken for proper filtering of the liquid. The filter must be positioned before the 10DN long upstream pipe section. For filter selection generally the considerations described in chapter "Measured fluid" should be followed, but in all cases it is recommended to ask the advice of our application expert, too.

Electric connection

The turbine meter must be connected to the display and signal-processing unit of the flow measuring system with flexible shielded cable according to the instructions in their manuals. The connection of the connector on the turbine meter and the diameter of the applied cable can be seen on Figure 3. The turbine meter must be protected against the effect of external magnetic fields. In most cases it is enough to keep 1-2 m distance from disturbing sources (transformers, electric motors, magnetic switches etc.). After the final arrangement of the connecting cable make sure that in zero-flow case (by standing rotor) the electronic unit displays zero flow. If electric noises cause flow indication, the source of the noise must be located and by shielding or rearrangement of the cable their effect must be eliminated.

Installation

When starting a new technology the turbine meter (and, if possible, the whole measuring section) must be protected against the stronger contamination occurring at first fill up of the conduit, by using a bypass section or substituting section temporarily. After flushing follow the steps below:

1. After pressurizing the tightness must be checked.
2. Check the correct setting of calibration factor at the signal processing unit.
3. Switch the electronic display unit on.
4. Gradually start the flow of the fluid.

MAINTENANCE

The maintenance of the measuring section should be performed according to the operational conditions. When filter is applied it practically means the cleaning or replacing of filter insert before clogging. It is recommended to re-calibrate or re-approve the turbine meters once a year, this time the condition of the rotor and the shafts must be checked in an expertised workshop.

REPAIR

When measuring uncertainties get over the specified limits the parts containing bearings (stators and the rotor) can be replaced if necessary. Only parts certified by the manufacturer can be used for replacing. Disassembling and repairing of the turbine meters must be performed or directed only by properly skilled experts. Repair should be performed in well-equipped workshop by using the proper special tools according to directions. After disassembling and repair the turbine meters must be calibrated. After the new calibration the determined new calibration factor must be set at the electronic display unit. Parts necessary for maintenance and repair of turbine meters can be ordered from our issue titled "Parts list of TURBOQUANT turbine meters".

STORAGE, TRANSPORT

Temperature of storing room:
At flange 1.4541 or 1.0566 : -50...+60 °C
At flange 1.1106 : -20...+60 °C

It is forbidden to lift the turbine by the pickup!
It is forbidden to drop the turbine hard!
it is forbidden to roll the turbine on the flanges!

The manufacturer takes the warranty for the operation of the turbine meters by specification only in case of following the prescriptions above.

RIGHT FOR CHANGES

MMG FLOW Ltd. keeps the right to perform changes on the turbine meters without preliminary notice in order of technical improvement.

Table 1. **Type selection**

66**AB**-0-**CDE-FG**

AB		**SIZE**	
		DN	$Q_{max.}$
(*)	**(**)**	mm	m^3/h
07	**60**	40	35
08	**61**	50	70
09	**62**	80	140
10	**63**	100	280
11	**64**	150	560
12	**65**	200	1120
13	**66**	250	2000
C		**BEARING MATERIAL**	
1		Tungsten carbide	
2		Ceramic	
D		**BODY MATERIAL**	
		Body	Flange
1		1.4541	1.4541
2		1.4541	1.0566
3		1.4541	1.1106
E		**PRESSURE RATE**	
		bar	
1		16	
2		25	
3		40	
4		64	
5		100	
6		160	
7		250	
F		**SEALING SURFACE**	
1		Recess	
2		Notch	
3		Flat	
4		Lens	
5		ANSI flange	
G		**PREAMPLIFIER**	
0		Pick-up coil	
1		Preamplifier (3…10 mA)	
2		Preamplifier (7…15mA)	
3		Preamplifier (1,2…4mA)	
S		Special	

(*) single puck-up

(**) double pick-up

Table 2. **Pressure rates**

PN	**DN (mm)**					
(bar)	**40**	**50**	**80**	**100**	**150**	**200-400**
16	↑	↑	↑	*	*	*
25	↑	↑	↑	↑	↑	*
40	*	*	*	*	*	*
64	↑	*	*	*	*	*
100	↑	*	*	*	*	-
160	*	*	*	*	*	-
250	*	*	*	*	-	-

Table 3. **Materials of the wetted parts**

Body, stators	1.4541
Rotor	1.4034
Bearing	Tungsten carbide, Ceramic (Al_2O_3)

Table 4. **Operating temperature ranges**

Flange material	**1.0566**	**1.1106, 1.4541**
Ambient*	-20…+60 °C	-50…+60 °C
Fluid*	-20…+150 °C	-50…+150 °C

* See also the temperature limits for connectors on Figure 3.

Table 5. **Fluid temperature and Ex temperature classes***

T3	-50…+150 °C	**T4**	-50…+110 °C
T5	-50… +75 °C	**T6**	-50… +60 °C

* See also the temperature limits for connectors on Figure 3.

Table 6. **Metrological data**

Range (100%=Qmax)	10-100%	20-100%	40-100%
Linearity (%)	0,25 %	0,15 %	0,1 %
Repeatability (%)	0,05 %	0,02 %	0,02 %

Table 7. **Main application technical features**

DN	**Max. flow**	**Calibration factor**	**Frequency[(1)]**	**Signal level[(1)]**	**Pressure drop[(2)]**	**Mass[(3)]**
(mm)	**(m3/h)**	**(pulses/m3)**	**(Hz)**	**(mV_{eff})**	**(bar)**	**(kg)**
40	35	98743	960	250	0,5	7 / 11
50	75	52800	1100	300	0,5	8,5 / 12,5
80	145	15145	610	400	0,5	12,5 / 22
100	285	7832	620	200	0,5	27 / 41
150	580	3103	500	200	0,5	42 / 75
200	1140	1579	500	200	0,5	80 / 137
250	2000	630	350	200	0,5	110 / 200

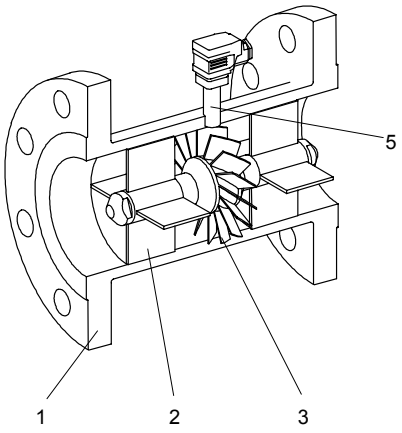
Notes:

(1) By maximal flowrate

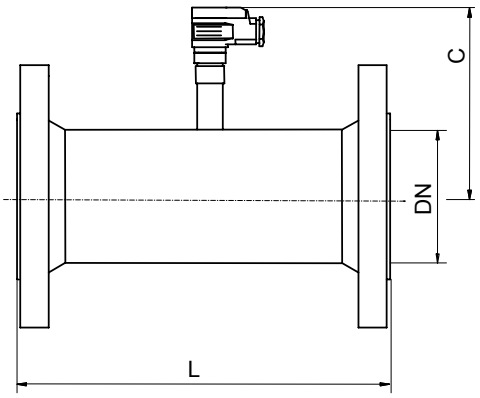
(2) With water, by maximal flowrate.

(3) The value before the "/" sign refers to minimal, the value following it refers to maximal pressure class.

Figure 1. **Mechanical construction, dimensions.**



1-body, 2-stators, 3-rotor, 5-pickup.



ØDN	C	L
40	120	152
50	126	152
80	140	254
100	154	305
150	180	368
200	236	402
250	236	402

(dimensions in mm)

Figure 2. **Measuring section layout.**

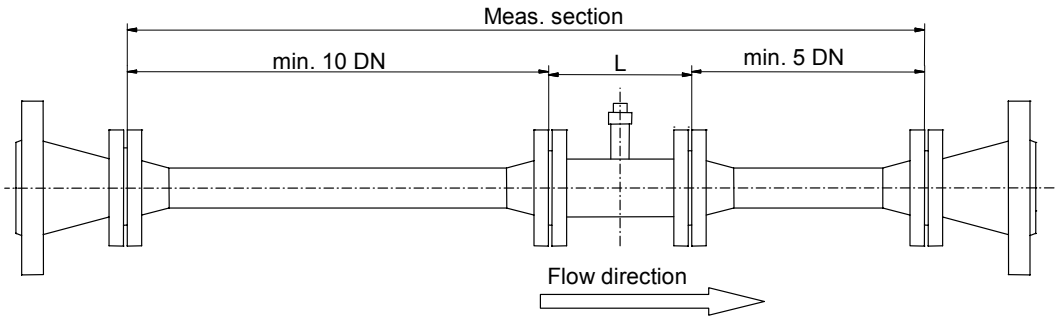
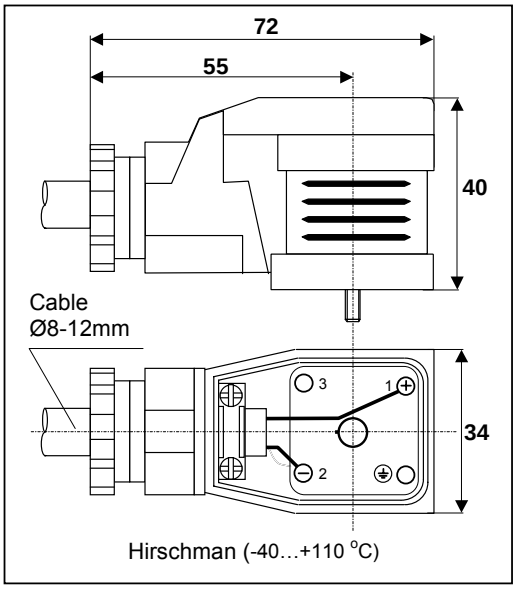
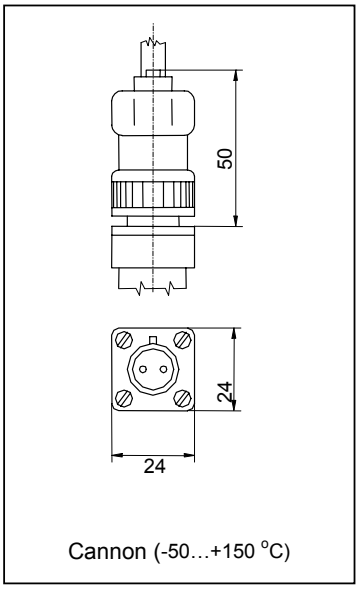


Figure 3. **Connector types, dimensions, operating temperature limits and electric connection.**



Hirschman (-40…+110 °C)



Cannon (-50…+150 °C)

Figure 4. **Explosion hazardous application without preamplifier (G=0).**

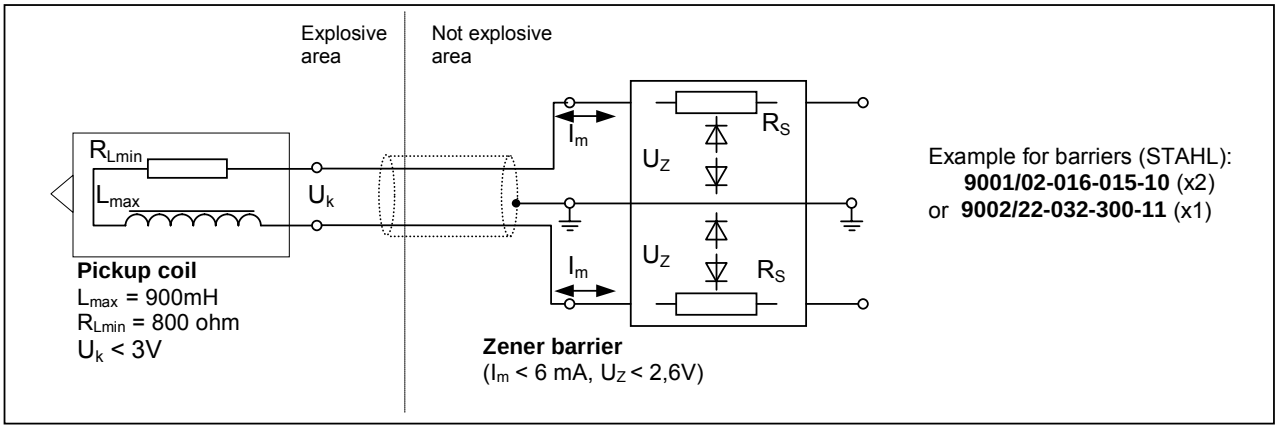
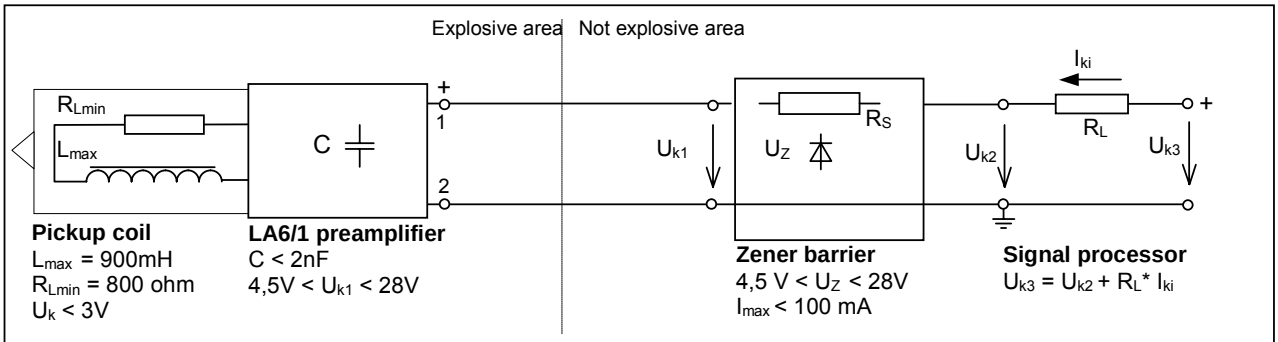


Figure 5. **Explosion hazardous application with preamplifier (G=1,2,3) using Zener-barrer.**



At the selection of Zener barrier the inductivity and capacity increased with 2nFof the applied cable must be considered and the following conditions necessary for the operation of the measuring system:

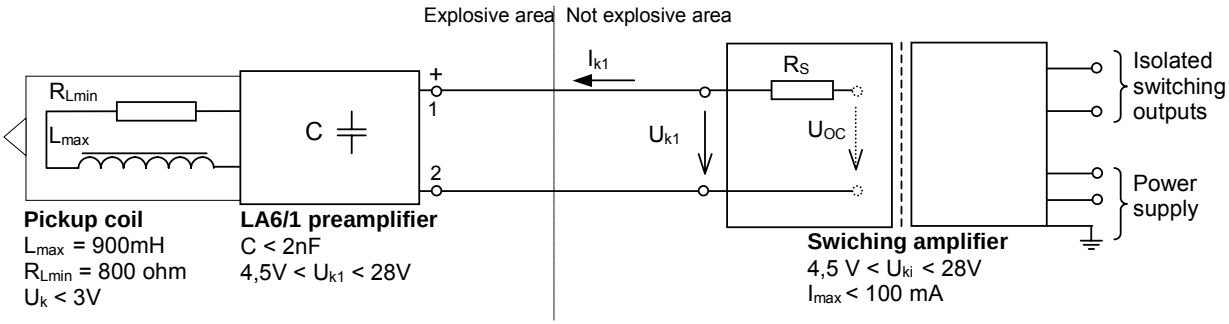
$$U_{k1min} = (U_{k3} - (R_L + R_S)*I_{ki}) > 4,5V; \qquad U_{k3} < U_Z$$

Where the values of I_{ki} can be found in table bellow:

Signal level	"G" position of type (Table 1)		
	1	2	3
"0"	max. 3 mA	max. 7 mA	max. 1,2 mA
"1"	max.11 mA min.9 mA	max.15 mA min.13 mA	max.4 mA min. 3,6 mA

Example for barriers (STAHL):
9001/01-280-085-10,
or **9001/01-280-100-10**

Figure 5a. **Explosion hazardous application with preamplifier (G= 1,2,3) using Switching amplifier.**



At the selection of Switching Amplifier the inductivity and capacity increased with 2nFof the applied cable must be considered and the following conditions necessary for the operation of the measuring system:

$$U_{k1min} = U_{OC} * (1–I_{k1} / I_{SC}) > 4,5V;$$

Where:

U_{OC} - open circuit input voltage of switching amplifier
I_{SC} - short circuit input current of switching amplifier
I_{k1} - max.loading current depending on the type of preamplifier (see table bellow)

Signal level	"G" position of type (Table 1)		
	1	2	3
"0"	max. 3 mA	max. 7 mA	max. 1,2 mA
"1"	max.11 mA min.9 mA	max.15 mA min.13 mA	max.4 mA min. 3,6 mA
Recommended Switching amplifiers		K-130/3-E-10 (RECHNER)	BES-526-607-A (BALLUFF)