SIEMENS

SITRANS FM Intermag1/Transmag1
Magnetic-inductive flow transmitter

Operating Instructions 10/02

7ME5030
7ME5031

A5E00183614 Ausgabe 01 10/02

Contents

1 General

These Operating Instructions supply the necessary information for

- safe installation and assembly as well as
- proper and safe use

of the INTERMAG / TRANSMAG converters. For this, these Operating Instructions need to be studied with care.

All information contained herein must be observed. This will

- avoid hazards during installation and assembly,
- avoid errors during operation,
- increase efficiency,
- reduce down times,
- increase the reliability and service life of the INTERMAG / TRANSMAG converters.

Before switching on the INTERMAG / TRANSMAG converters for the first time, the operator must carefully read all chapters of these Operating Instructions. All details must be noted and taken into account.

These Operating Instructions

- must be read and observed by all staff involved in work on the INTERMAG / TRANSMAG converters. Besides these Operating Instructions and the accident prevention regulations which apply at the particular location, all applicable engineering standards and regulations covering safety and professional engineering issues must be observed.
- must at all times be at hand where the INTERMAG / TRANSMAG converters are being operated.
- must be supplemented by the operator of the system with national regulations which apply to the prevention of accidents and the protection of the environment.

2 Safety Information

2.1 General

In addition to the Operating Instructions

- all national accident prevention regulations[1],
- all other generally accepted rules which apply to the areas of safety engineering and industrial medicine,
- the binding rules for the protection of the environment,
- the obligations to supervise and inform as to special operating conditions (for example as to the way in which work is organised, work processes, staff assigned to a job etc.)

must be observed.

The staff assigned to installation and maintenance work on the measurement system must have read these Operating Instructions, and in particular the chapter "Safety Information" first before embarking on such work.

[1] In Germany the general notes as to safety and the prevention of accidents are contained in the accident prevention regulations „General Regulations“ (VBG 1) (These can be obtained from Carl Heymanns Verlag KG, Luxemburger Straße 449, D-50939 Cologne).

2.2 Proper Usage

The measurement system consisting of the converter (INTERMAG or TRANSMAG) and a flow sensor has exclusively been designed to measure the flows of conducting liquids in sealed and fully filled tubes.

Any other usage is considered improper. Any damage resulting from such usage is at the sole responsibility of the operator.

Observing the information contained in these Operating Instructions is part of proper usage.

The measurement system must only be operated provided it is in a perfect condition engineering-wise. During commissioning and while operating the system, strict compliance with the safety regulations and the Operating Instructions is mandatory. All failures, and in particular such failures which may impair the safety of staff and equipment must be remedied before work is continued. The responsible superiors must be informed immediately about any failures which have occurred during operation.

Modifications, additions and conversions on the equipment which may impair its safety must not be performed.

2.3 Approved Operator

The measurement system must only be operated by staff which has been ordered by the operator of the system and which has undergone suitable training. This staff must have read these Operating Instructions and must have understood the contents in full.

Work on the measurement system must only be performed by trained personnel. The responsibilities of the staff as to operation, setting up, maintenance and refurbishing need to be clearly defined. It needs to be ensured that only such personnel will work on the measurement system which has been ordered and trained to do so.

2.4 Explanations for the Symbols Used

The measuring instruments INTERMAG / TRANSMAG are manufactured according to the latest and generally accepted engineering rules and the current state-of-the-art. However, the equipment presents certain risks which can not be avoided by design. In order to provide to the operators an adequate degree of safety, additional safety information is provided. Only when observing this safety information will there be an adequate degree of safety when using the measuring system.

Thus certain parts of the text have been emphasised. The text emphasised in this way indicates the following:

Warning!
Indicates instructions, which, when not observed, will result in injury to persons.

Caution!
Indicates instructions, which, when not observed, will result in faulty operation of, or damage to the equipment.

Note:
Indicates important details which should be especially observed or will simplify work.

2.5 Safety Information

Warning:
The INTERMAG and TRANSMAG converters are operated with potentially lethal voltages.

Warning:
The TRANSMAC supplies the connected flow sensors MG 911/... with potentially lethal voltages.

Blown fuses must not be bypassed. A blown fuse must always be replaced by a fuse of the same rating and the same characteristic.

The electrical subassemblies of the measurement systems must be checked at regular intervals. Deficiencies like loose or charred wiring must be remedied immediately.

2.6 Safety Regulations

The measurement system must only be installed, electrically assembled, commissioned and maintained by trained staff which has been authorised by the operator of the system.

Warning:
Before beginning work on the electrical system, the power supply must – as a rule – be switched off and protected by adequate means from being switched on inadvertently (by fitting a lock to the mains switch in its "0" position, warning signs and alike).

3 Description

3.1 Introduction

INTERMAG and TRANSMAG are microprocessor controlled converters for magnetic flow sensing according to the PAC or PDC principle. They are each equipped with a 16 bit processor and a HART[1]-interface. In connection with a magnetic flow sensor for filled tubes from Siemens, the INTERMAG / TRANSMAG form a complete measurement system. In the case of the compact model, both converter and sensor are delivered as one unit. In the case of the remote model (separate model) the converter and the flow sensor may be fitted separately from each other.

The converters may be operated in full through three infra-red touch pads (optional) without any additional aids. For this, the housing will not need to be opened. Through the TURBO-TORUS interface controlling the operating modes is mostly self-explanatory and also identical between INTERMAG and TRANSMAG. Alternatively, the units may be operated through the handheld or a PC using the HART protocol.

[1] Highway Addressable Remote Transducer - Interface for intelligent field instruments; for bidirectional digital data transfer.

Upon starting up the measurement system, the smartPLUG automatically supplies the calibration data of the flow sensor. Thus it is possible to easily exchange both the flow sensor and the converter.

In the case of the INTERMAG and TRANSMAG identical interface options are used.

An optional dot-matrix display having

- two rows with 16 characters each,
- backlighting

may be used.

The standard models of INTERMAG and TRANSMAG are rated IP 67.

3.2 Areas of Application for the Entire Unit Including the Flow Sensors

Together with a flow sensor, the INTERMAG / TRANSMAG converters form a complete measurement system for magnetic flow measurements.

The INTERMAG converter

- operates according to the pulsed DC principle (PDC).
- is suited for connecting flow sensors from the MG 711/... series of a nominal size ranging from DN 2 to DN 2000 as well as the magnetic sensors from Siemens.
- may be operated at flow velocities ranging from 0.25 and 12 m/s.

When using the INTERMAG converter

- together with flow sensors MG 711/A, ~/D, ~/E, ~/H, ~/S or magnetic probes, a minimum conductance of the medium of over 3 µS/cm must be ensured.
- together with the flow sensors MG 711/F4, ~/F5 or ~/F6, a minimum conductance of the medium of over 10 µS/cm must be ensured.

The TRANSMAG converter

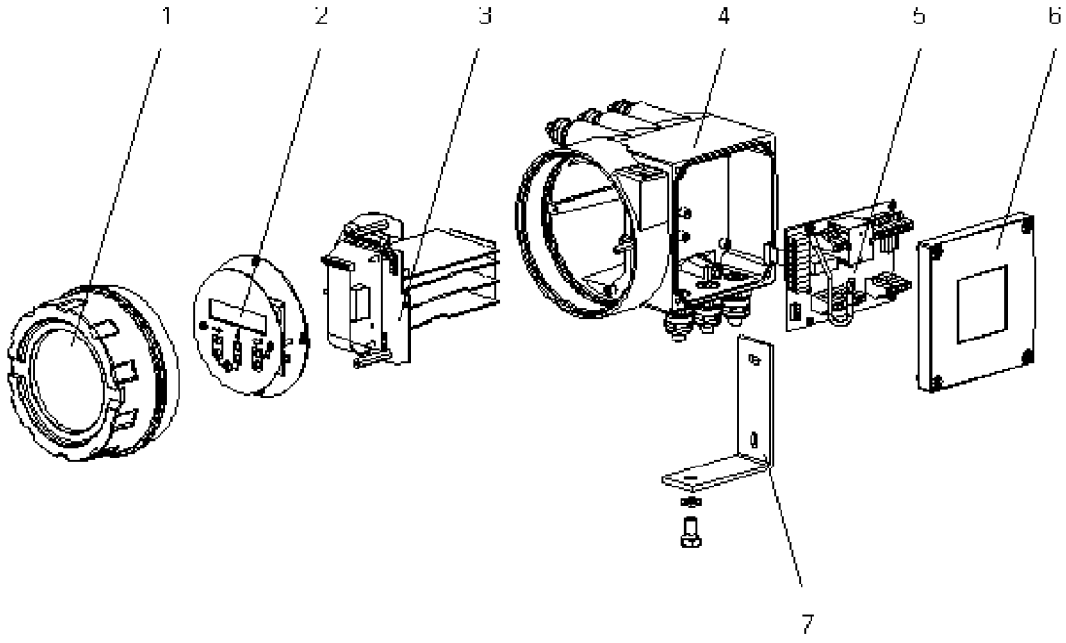
- operates according to the pulsed AC principle (PAC).
- is suited for connecting flow sensors from the MG 911/... series of a nominal size ranging from DN 2 to DN 2000.
- may be operated at flow velocities ranging from 0.21 and 12 m/s.

When using the TRANSMAG converter, a minimum conductance of over 0.008 µS/cm must be ensured. When using the TRANSMAG converter together with a flow sensor from the MG 911/F5 or ~/F6 series, the minimum conductance of the medium must exceed 0.1 µS/cm .

Generally the minimum conductance requirement depends on the medium and the flow sensor used.

At conductances below 1 µS/cm you should discuss the particular application with engineers from Siemens first.

3.3 Components



1 Screw-on lid
(with window when using the display unit)

2 Display unit (optional)

3 Electronics subassembly

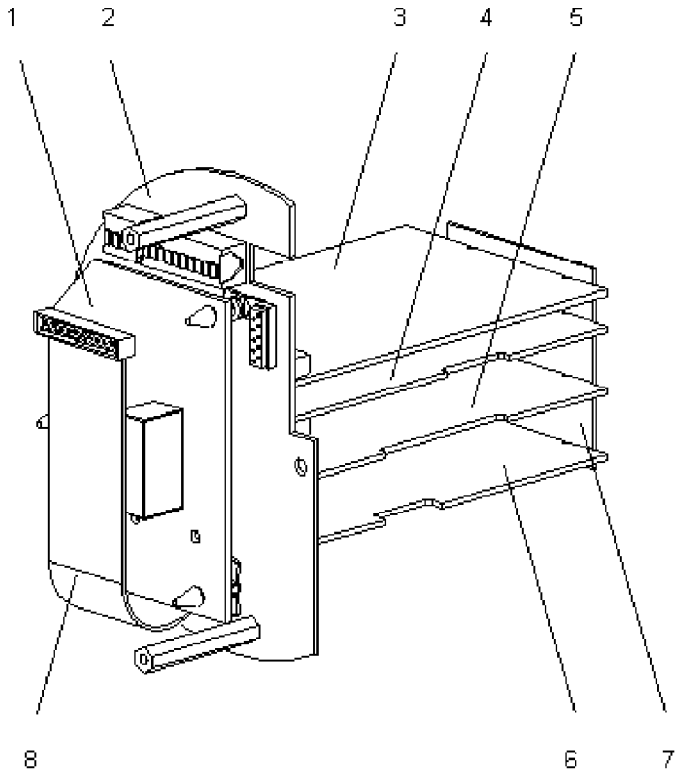
4 Housing

5 Connection pcb.

6 Terminal cover

7 Bracket (remote model only)

Fig. 3-1: Components



1 Magnet current stage / Triac stage

2 Bus pcb.

3 Power supply pcb.

4 I/O module with inputs and outputs

5 Microcontroller module (MC module)

6 ADC module for INTERMAG / TRANSMAG

7 Guide

8 Flat cable for display / touch pad

Fig. 3-2: Electronics subassembly

3.4 DIL Switches for Setting Up the Inputs and the Outputs

With the aid of the DIL switches on the bus pcb., the connections S1, S2 and S3 may be set up as either passive or active inputs or outputs.
Connections S1 and S2 may be set up independently of each other as either active or passive outputs. Connection S3 may be set up either as an active or passive input or output.

The DIL switches are located on the bus pcb. of the electronics subassembly.

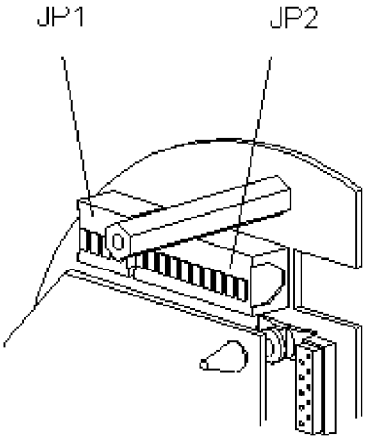


Fig. 3-3: Location of the DIL switches on the bus pcb.

Warning:
Open the screw-on lid only after having switched the power supply off first.

Caution:
Operate the DIL switches only after having switched off the power supply first.

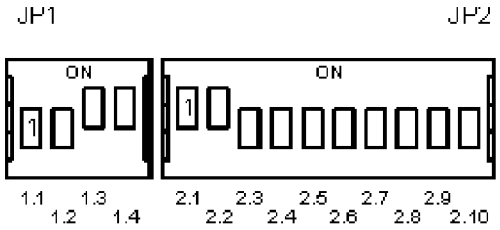


Fig. 3-4: Arrangement of the DIL switches (default settings)

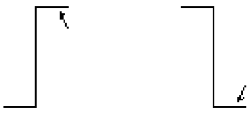
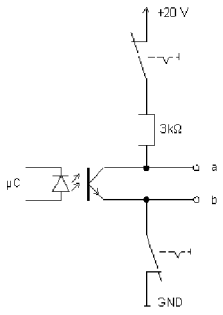
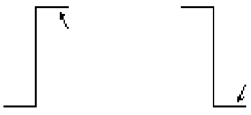
3.4.1 Setting up S1 or S2 as Outputs

Caution:
Note the polarity of the input and the output signals.

Caution:
Make sure that the settings of the DIL switches match the programming for the operating mode "E - Assignment of the Switch Outputs".

Note:
When operating the connections as passive inputs or outputs, an external power supply (30 V DC max.) will be required.

Note:
When using active outputs they are electrically connected to the common ground of the current output (I_{out} -, terminal 9).

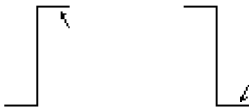
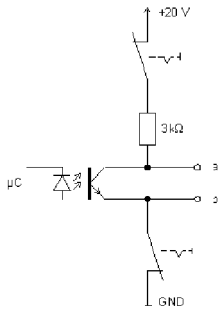
Circuit sketch	Status output	Logic for the output signal, programmable in operating mode "E – Assignment of the Switch Outputs"	Output S1 DIL switch 2.4	2.5	2.8	Output S2 DIL switch 2.6	2.7	2.9
	passive	Hi active or Lo active 	off	off	off	off	off	off
	active	Hi active or Lo active 	on	on	on	on	on	on

3.4.2 Setting up S3 as an Output

Caution:
Note the polarity of the input and output signals.

Caution:
Make sure that the settings of the DIL switches match the programming for the operating mode "E – Assignment of the Switch Outputs".

Note:
When operating the connections as passive inputs or outputs an external power supply (30 V DC max.) will be required.

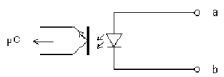
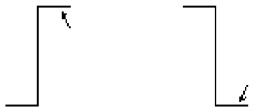
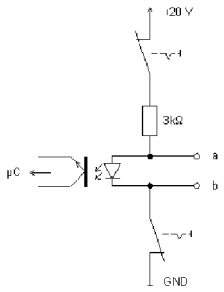
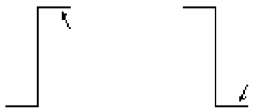
Circuit sketch	Status output	Logic for the output signal, programmable in operating mode "E – Assignment of the Switch Outputs"	DIL switches						
			1.1	1.2	1.3	1.4	2.1	2.2	2.10
	passive	Hi active or Lo active 	on	on					
					off	off	off	off	off
	active	Hi active or Lo active 	on	on			on	on	on
					off	off			

3.4.3 Setting up S3 as an Input

Caution:
Note the polarity of the input and output signals.

Caution:
Make sure that the settings of the DIL switches match the programming for the operating mode "E – Assignment of the Switch Outputs".

Note:
When operating the connections as passive inputs or outputs an external power supply (30 V DC max.) will be required.

Circuit sketch	Status input	Logic for the output signal, programmable in operating mode "E-Assignment of the Switch Outputs"	DIL switch						
			1.1	1.2	1.3	1.4	2.1	2.2	2.10
	passive	Hi active or Lo active 			on	on			on
			off	off			off	off	
	active	Hi active or Lo active 			on	on	on	on	
			off	off					off

4 Installation

4.1 Supplied Equipment

In the case of the compact model, both converter and flow sensor are supplied combined in a single unit.

In the case of the remote model, the converter is supplied with a bracket for wall mounting.

In the case of units supplied without a display, customer-specific entries may only be entered by means of the HART protocol.

Check the supplied equipment against the information given on the delivery note. In case you discover any damage please get in touch with our after sales service. Please look for our local agency at the appendix or at **http://www.feldgeraete.de**.

4.2 Return Shipments

If it should be required to return the measurement system back to Siemens AG for repair, please observe the following:

Include with the equipment a note with details on

- the fault
- the application and
- the chemical and physical properties of the measurement liquid.

Warning:
Measurement liquids may present a hazard to health (requiring to be marked as such).
Completely remove all residues which might be present in or on the equipment! This applies in particular to acid, radioactive or other kinds of residue which present a health hazard.

If proper cleaning can ultimately not be ensured, you should refrain from returning such equipment.
Any costs arising for the disposal of waste or from injury to persons due to insufficient cleaning are at the customer's expense.

Returns from Germany:

Postal address

Siemens AG
A&D Retouren-Center
Postfach 26 63
D-90713 Fürth
Tel.-Nr.: 0180-5050-448
Fax-Nr.: 0180-5050-449

Delivery address

Siemens AG
A&D Retouren-Center
Siemensstraße 2 – 4
D-90766 Fürth

Returns from all other countrys:

Postal address

Siemens AG
A&D EC LZN
Retourenstelle
Postfach 46 52
D-90025 Nürnberg

Delivery address

Siemens AG
A&D EC LZN
Retourenstelle
Winter-Günter-Str. 11
D-90441 Nürnberg

4.3 Installation

4.3.1 General Information

The converters meet the protection requirements of protection class IP 67.
In order to ensure compliance with these requirements also after installation or repair work, you must under all circumstances observe the following:

Please ensure that

- the two O-rings (one each in the screw on lid and in the terminal cover) are clean and not damaged in any way. Possibly you will have to dry the O-rings, clean them or replace them by new ones.
- all bolts on the housing and the covers are seated tightly.
- the cables used have the required outside diameter so that a proper seal is attained at the PG feedthroughs.
- the cables are rated at least for protection class IP 67.
- the PG feedthroughs are tightened firmly.
- the cables ahead of the PG feedthroughs are laid in a loop so that any humidity which may arise can not pass to the PG feedthroughs.
- PG feedthroughs which are not used are firmly blanked off by a stopper.

When installing the converter out in the open, it needs to be protected by a hood against direct exposure to sunlight.

4.3.2 Installing the Sensor (Compact Model)

For information on how to install the sensor please refer to the separate installation instructions for the sensor used.

4.3.3 Installing the INTERMAG / TRANSMAG Converter (Remote Model)

First mount the supplied bracket at a suitable place.

Then screw the INTERMAG / TRANSMAG converter to the bracket.

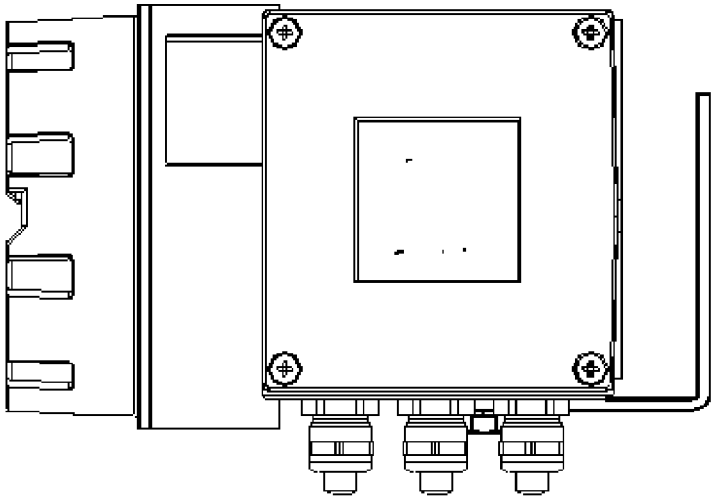


Fig. 4-1: INTERMAG / TRANSMAG converter fitted to the mounting bracket

Now you will only need to provide the electrical connections (see page: 4-5: "4.4 Electrical Connection").

4.4 Electrical Connection

Warning:
Work on electrical systems must only be done by trained staff. Moreover, the accident prevention regulations "Electrical Systems" (VBG 4) or the equivalent national regulations must be observed.

Warning:
Before beginning to work on the electrical system the power supply must – as a rule – be switched off and protected by adequate means from being switched on inadvertently (by fitting a lock to the mains switch in its "0" position, warning signs and alike).

Note:
Observe the information as to the supply voltage given on the name plate.

Caution:
Ensure that

- **the permissible length for the cable has not been exceeded, as otherwise measurement errors will have to be expected.**
- **the cable guides are firmly in place as otherwise moving cables will cause measurement errors.**
- **the potential between converter and sensor has been equalised as otherwise measurement errors will have to be expected.**
- **potential equalisation with the medium is ensured.**

Note:
If required, loosen the screw on the mounting bracket slightly so as to swivel the converter to a more favourable position with respect to the connecting cables.

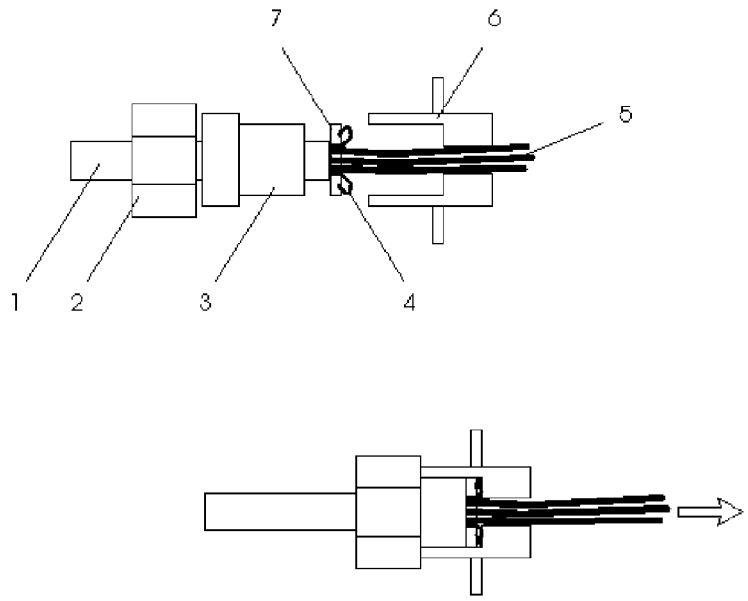
Loosen the four screws at the terminal cover and remove the cover.

Connect the cables according to the wiring diagrams:

- Fig. 4-3: Wiring diagram for INTERMAG
  see page 4-11.
- Fig. 4-4: Wiring diagram for TRANSMAG
  see page 4-12.

Caution:
Use only such cables which fit firmly into the openings of the PG feedthroughs used as otherwise compliance with protection class IP 67 is not ensured.

Push the corresponding cable through the PG feedthrough in each case.



1 Cable

2 PG union nut

3 Plastic nipple

4 Screen

5 Conductors

6 PG screw-in insert

7 Metal disk

☞ *Note:*
Slightly pull at the conductors while assembling the PG feedthrough.

Fig. 4-2: PG feedthrough

Tighten the PG feedthrough properly as shown in Fig. 4.2: PG feedthrough.
You can only ensure in this way that electromagnetic interference can not be radiated from the housing or enter the housing.

Connect the cables to the corresponding terminals.

Make sure that the protective ground conductor is properly connected to the pcb. and the cover.

Finally screw the terminal cover in place.

If required turn the converter back to its initial position and firmly tighten the screw at the mounting bracket.

4.4.1 Terminal Assignments

Power supply	1	L1 for AC	L+ for DC (positive supply)
	2	N for AC	L- for DC (negative supply)
	3	PE	PE
I_{out} (HART)	8	+	Current output, 0 - 20 mA, 4 - 20 mA, max. 1.000 Ω load; HART: 4 - 20 mA, min. 250 Ω load, max. 1.000 Ω load
	9	-	
S1	10	a	Configurable output: switch output, frequency or pulse output passive: max. 30 V, 30 mA active: 24 V(+10%), R_i = 3kΩ depending on the programming in E1, E2 and the DIL switch settings
	11	b	
S2	12	a	Configurable output: switch output, frequency or pulse output passive: max. 30 V, 30 mA active: 24 V(+10%), R_i = 3kΩ depending on the programming in E3, E4 and the DIL switch settings
	13	b	
S3	14	a	Configurable input / output: switch output, pulse output or switch input Output: passive: max. 30 V, 30 mA active: 24 V(+10%), R_i = 3kΩ Input: passive: max. 30 V, R_i = 3kΩ active: 24 V(+10%), R_i = 3kΩ depending on the programming in E5 to E9 and the DIL switch settings
	15	b	

Connection cable for:			
Magnet current	5		**Warning:** **In the case of the TRANSMAG converters hazardous voltages are present when switched on.**
	6		
	7	Ground / PE	
Preamplifier	30	+5 V DC	
	29	-5 V DC	
Electrodes	24	Electrode signal	
	23		
	22	Reference potential for the measurements	
Reference coil (TRANSMAG)	55	TRANSMAG only: connection for the reference coil	
	66		

4.4.2 Wiring diagram for INTERMAG

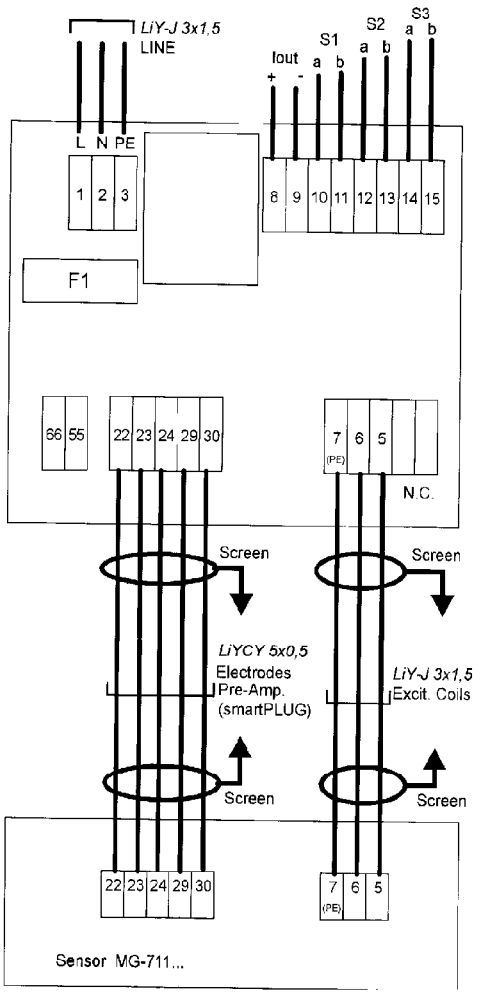


Fig. 4-3: Wiring diagram for INTERMAG

Caution:
Tighten the PG feedthrough properly as shown in Fig. 4.2: PG feedthrough.

4.4.3 Wiring diagram for TRANSMAG

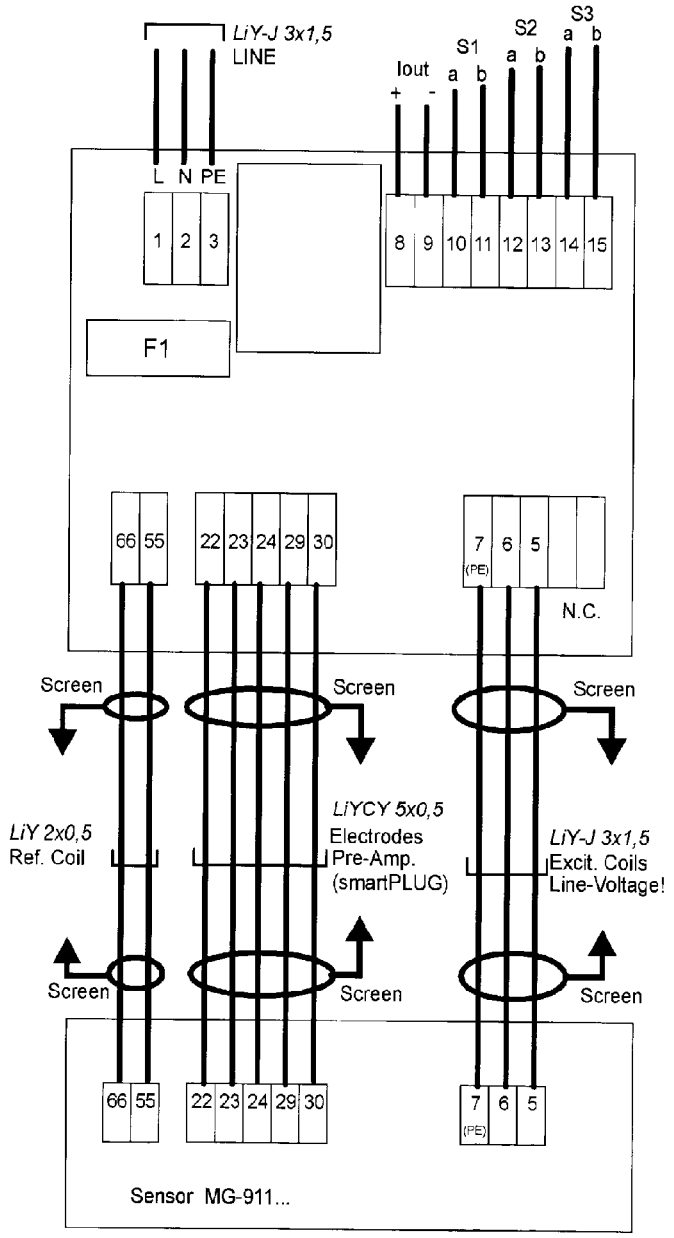


Fig. 4-4: Wiring diagram for TRANSMAG

Caution:
Tighten the PG feedthrough properly as shown in Fig. 4.2: PG feedthrough.

4.5 Exchanging the INTERMAG / TRANSMAG Converters

4.5.1 Exchanging the Converter in the Case of the Remote Model

Please observe the safety regulations given in Chapter "2.6 Safety Regulations", page 2-4.

If it should be required to exchange the converter of the remote model, then proceed as follows:

- Open the terminal cover.
- Indicate on the each cable the number of the terminal it is connected to.
- Disconnect the cables.
- Loosen the corresponding PG feedthroughs.
- Pull the cables out.
- Unscrew the converter from its mounting bracket.
- Screw the new converter to the mounting bracket.
- Reconnect the cables in accordance with the previously noted terminal numbers (see also page 4-5: "4.4 Electrical Connection").
- Make sure that the protective ground conductor has been properly connected to the pcb. and the cover.
- Finally screw the terminal cover in place.

4.5.2 Exchanging the Converter in the Case of the Compact Model

Please observe the safety regulations given in Chapter "2.6 Safety Regulations", page 2-4.

Before starting to exchange the converter make sure, that the tubes are empty and clean.

If it should be required to exchange the converter of the compact model, then proceed as follows:

with smartPLUG:	without smartPLUG:
– Open the terminal cover.	– Open the terminal cover.
– Note the terminal numbers on the corresponding cables (terminals 5, 6 and 7).	– Note the terminal numbers on the corresponding cables.
– Pull the plug off from the pcb. The plug is secured by a screw.	– Disconnect the cables.
– Disconnect the cables.	
– Unscrew the converter from the flow sensor and pull the cables fully out.	– Unscrew the converter from the flow sensor and pull the cables fully out.
– Fit the new converter to the flow sensor and insert the cables again.	– Fit the new converter to the flow sensor and insert the cables again.
– Screw the converter to the flow sensor.	– Screw the converter to the flow sensor.
– Insert the plug into the connector on the pcb. The plug can only be fitted in one way. Secure the plug with the screw.	– Reconnect the cables according to the previously noted terminal numbers (see also page 4-5: "4.4 Electrical Connection").
– Reconnect the cables according to the previously noted terminal numbers (see also page 4-5: "4.4 Electrical Connection").	
– Make sure that the protective ground conductor is properly connected to the pcb. and the cover.	– Make sure that the protective ground conductor is properly connected to the pcb. and the cover.
– Finally screw the terminal cover back on.	– Finally screw the terminal cover back on.

4.6 Turning the Display Unit by 90°

If required, the display may be turned by 90°.

Please observe the safety regulations given in Chapter "2.6 Safety Regulations", page 2-4.

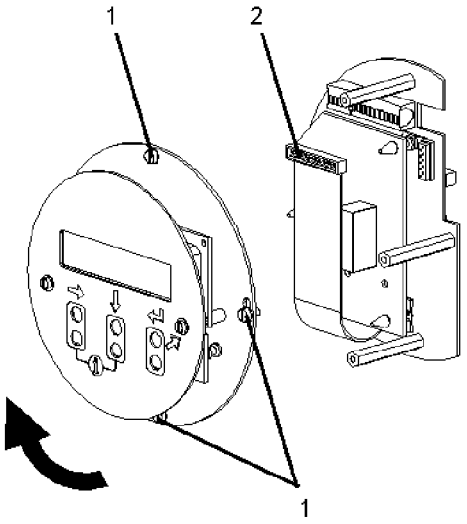


Fig. 4-5: Turning the display unit by 90°

In order to turn the display unit proceed as follows:

- Remove the screw-on lid.
- Loosen the three screws (1 in *Fig. 4-5*) at the display unit.
- Pull the plug off (2 in *Fig. 4-5*) from underneath the display unit and reconnect it.
- Turn the display unit by 90° and screw it tight.
- Finally fit the screw-on lid once more.

4.7 Turning the Converter on the Flow Sensor by 180° (Compact Version)

If required, the converter may be turned by 180° on the flow sensor.

Please observe the safety regulations given in Chapter "2.6 Safety Regulations", page 2-4.

In order to turn the converter please proceed as follows:

- Remove the mounting screws.
- Turn the converter by 180°.
- Firmly tighten the mounting screws.

5 Start-Up

Please ensure that

- all electrical connections and the way in which the cables are wired are correct.
- the flow sensor has been properly fitted to the tube (direction of flow).
- the tube is filled at all times.

☞ *Note:*
Make sure that upon switching on, the infra-red touch pads are not covered. Otherwise the converter will take about 10 minutes to adapt to the ambient conditions.

Switch the power supply on.

☞ *Note:*
If not certain settings have been entered in the factory, it will be required to enter customer-specific settings after the self-test has been completed.

After switching on, the converter runs a self-test. During this self-test and if present, the smartPLUG data from the connected flow sensor is read.
Then the dot matrix display will revert to its home position (default display, absolute flow rate in m^3/h). Now the system is ready to make measurements and the measurements begin.

IIIIIIIIIIIIIIII	flashes only briefly
Start EEProm	about 2 s
EEProm valid	about 2 s
READING SENSOR PLEASE WAIT	about 8 s without smartPLUG or about 12 s with smartPLUG
SENSOR WITHOUT smartPLUG	about 2 s, without smartPLUG
Measurement started	flashes only briefly
A: Flow Rate +000,00 m3/h	Home position

Fig. 5-1: Messages displayed during the self-test

☞ *Note:*
After a mains power failure, the converter will run the self-test once more. Thereafter it will revert to the "home position".
The passwords are not enabled even it the passwords were enabled at the time of the mains power failure.
In the event of a mains power failure, all programmed data are retained.

6 Operation

The converters are operated by means of an optimised TURBO-TORUS via three infra-red touch pads.
Thus the converters may be operated without having to open the housing. Operation of the INTERMAG and TRANSMAG is identical.

The touch pads respond to reflections and will operate regardless of the ambient lighting conditions.

Actions are initiated by briefly touching the touch pads. Therefore touch the touch pads only briefly and within the marked area. The touch pads respond as soon as the finger is retracted.

6.1 Controls and Displays

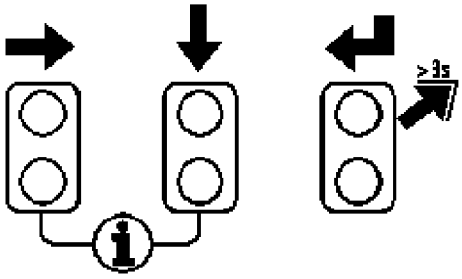


Fig. 6-1: Controls

With the aid of these touch pads you may invoke all functions of the TURBO-TORUS.

Control		Invoked function
→	Right	Change to the next operating mode, decimal point, entry position
↓	Down	Change to the next function, number, unit of measurement
↵ >3s	Enter	– Selection of the function – Start programming – Accept value – Enable program
	Escape	When operated for over three seconds, the current action is cancelled (display or programming) and the instrument returns to its home position.
→ + ↓ + ⓘ +	Right + Down = INFO	Invoking the information function, can only be called from the home position.

6.2 TURBO-TORUS

6.2.1 General

The individual functions of the converter have been assigned to particular operating modes. All these operating modes together make up the TURBO-TORUS (Menu).

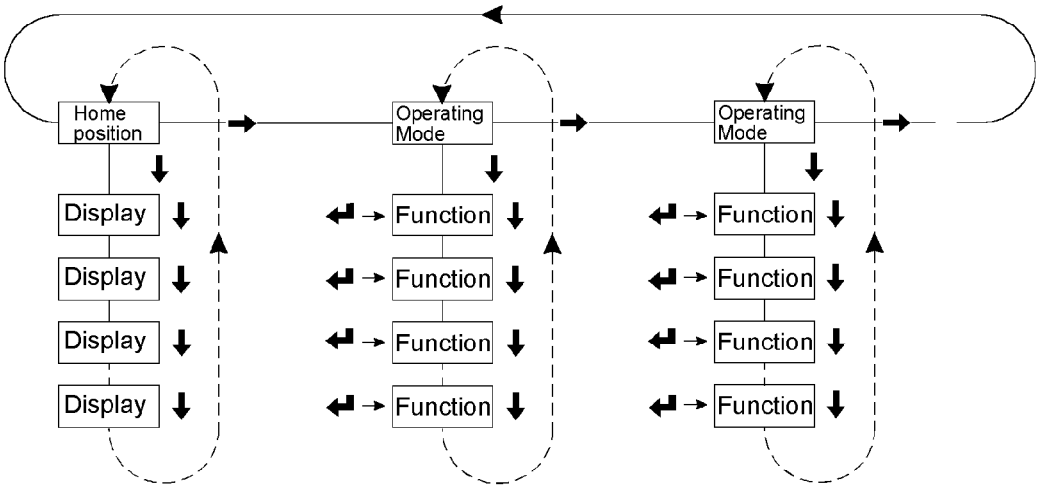


Fig. 6-2: The TURBO-TORUS (Menu)

Not all functions of the TURBO-TORUS are freely accessible. There are four types of access:

1. Display only (Mode "A – Display")
2. Freely accessible functions, i.e. changeable display / programming
3. Functions protected by customer password 1.
   Customer password 1 is: **4711**. It is used to prevent any inadvertent changes in the programming.
4. Functions protected by customer password 2.
   Customer password 2 will be made available as required after getting in touch with Siemens AG first.

6.2.2 Overview on the TURBO-TORUS used by INTERMAG / TRANSMAG

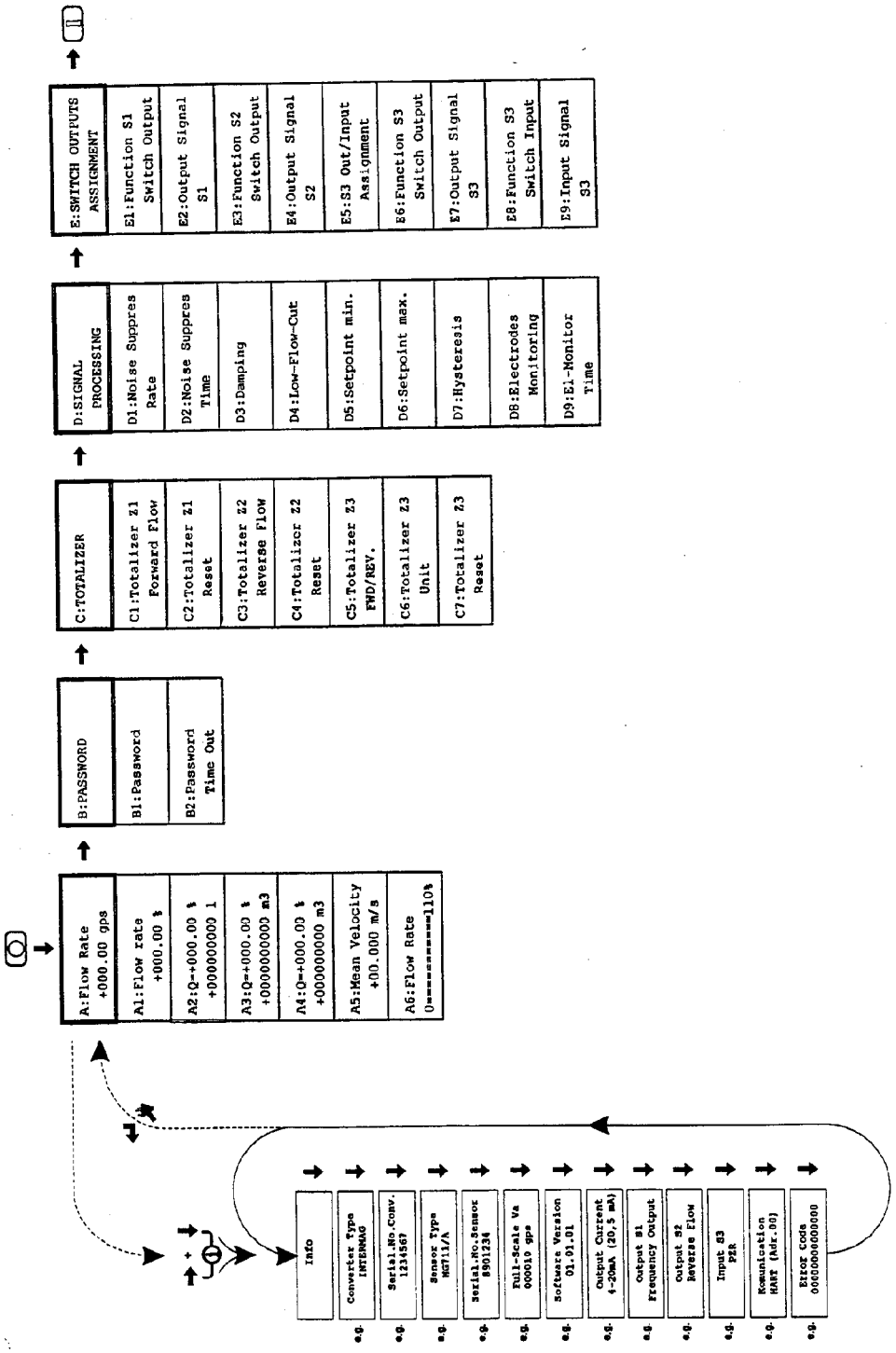


Fig. 6-3: Overview on the TURBO-TORUS

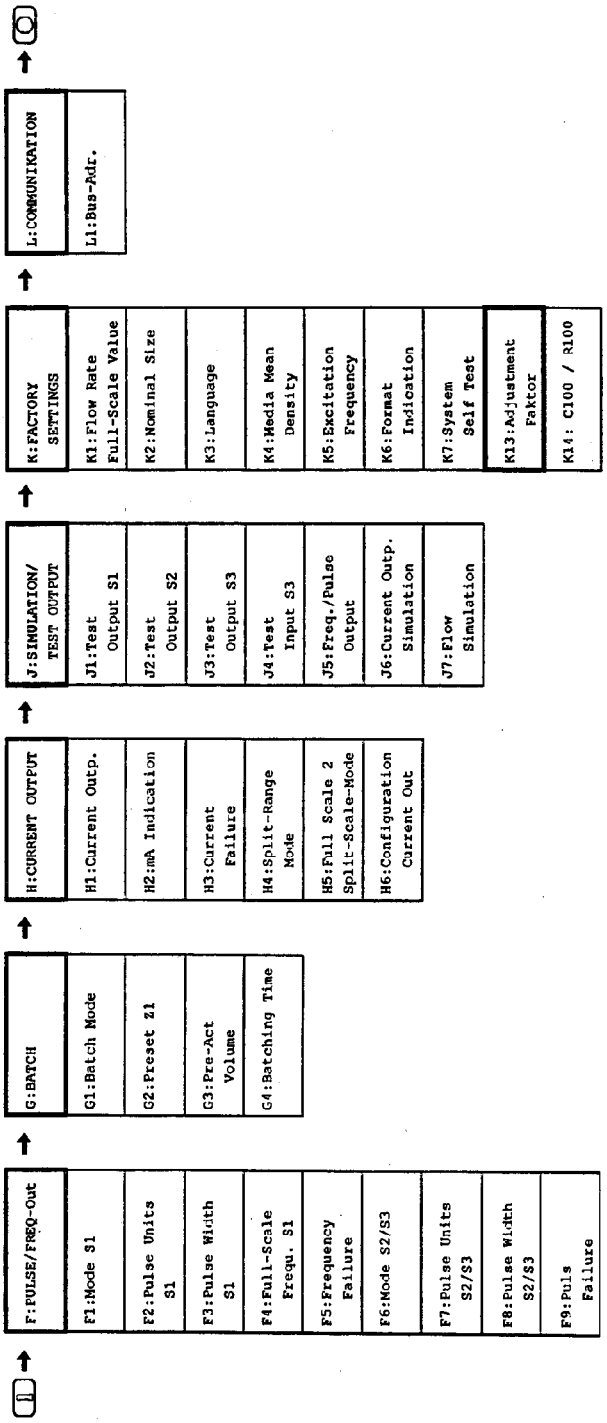


Fig. 6-4: Overview on the TURBO-TORUS

6.2.3 Scrolling through the TURBO-TORUS

6.2.3.1 Touch Pad "Right" – Scrolling through the Operating Modes

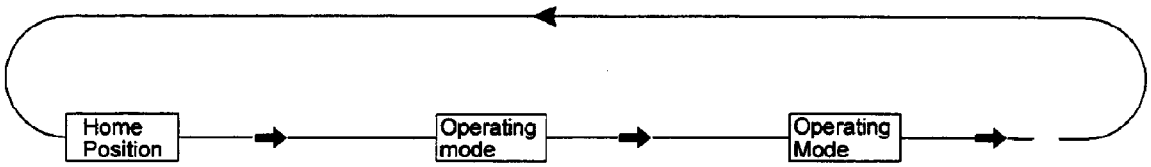


Fig. 6-5: Scrolling through the operating modes

Operate the touch pad "Right" in order to scroll to the next operating mode.

After having arrived at the last operating mode ("L – Communication") and when operating the "Right" touch pad once more the instrument returns to its home position.

6.2.3.2 Touch Pad "Down"- Scrolling through the Functions

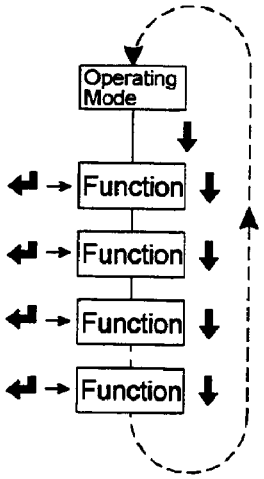


Fig. 6-6: Scrolling through the functions

After having selected the desired operating mode, you may change to the desired function by operating the "Down" touch pad.

After having arrived at the bottom most function and when operating the "Down" touch pad once more the instrument reverts to the default display for the particular operating mode.

If the selected function belongs to mode "A – Display" then the displayed data remain on the display until a touch pad is operated.

6.2.4 Touch Pad "Enter / Escape"

Through the touch pad "Enter / Escape"

- you select a function
- you start the programming
- you accept a value
- you enable the program

In addition you may use the touch pad "Enter / Escape" to invoke the following.

6.2.4.1 Cancelling the Entry of Parameters

When entering parameters and when operating the touch pad "Enter / Escape" for over three seconds, then the TURBO-TORUS will return to the home position without accepting the current entry.

6.2.4.2 Returning Manually to the Home Position

When operating the touch pad "Enter / Escape" for over three seconds then the TURBO-TORUS will return to the home position.

6.2.5 Auto Home - Returning Automatically to the Home Position

When no touch pad is operated for over 15 seconds, then the TURBO-TORUS will automatically return to the home position.

Within the INFO function, automatic return to the home position (Auto Home) is disabled. In order to exit the INFO function you need to operate the touch pad "Enter / Escape".

6.2.6 Home Position

In the home position (`A: Flow Rate`) the absolute flow is indicated in the selected unit of measurement (Function K1).

A	:	F	l	o	w		R	a	t	e				
		1	0	0	0	0	0		m	3	/	h		

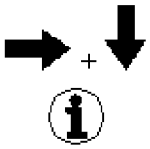
Fig. 6-7: Home position

Within the operating mode "A – Display" the automatic return to the home position (auto home, see 6.2.5 "Auto home – Returning Automatically to the Home Position") is disabled.

Operate the touch pad "Down" in order to scroll through the remaining displays of operating mode "A – Display".

6.2.7 INFO Function

The INFO function may only be selected from the home position (`A: Flow Rate`).



Operate the touch pads "Right" and "Down" simultaneously so as to invoke the INFO function.

The INFO function provides data on the converter. When the flow sensor has been connected by means of a smartPLUG, then also the information on the sensor will be indicated by the INFO function.
Operate the "Down" touch pad in order to scroll through the other displays of the INFO function.

In order to exit the INFO function you need to operate the touch pad "Enter / Escape".

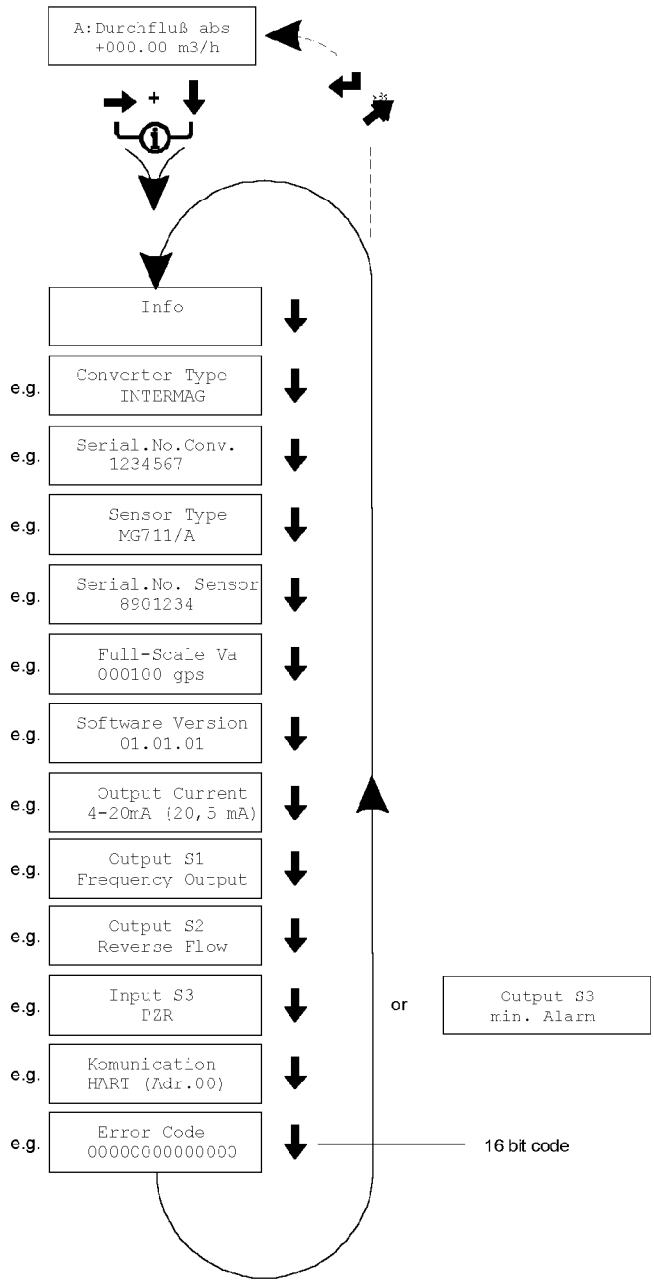


Fig. 6-8: Changing between the displays of the INFO function

6.2.8 Programming Example – Changing the Full Scale Value within Function K1

In order to demonstrate the concept of the TURBO-TORUS, please find in the following an example of how to change the full scale value within the function K1 of the operating mode "K – Factory settings".

☞ *Note:*
When entering parameters and when operating the touch pad "Enter / Escape" for over three seconds then the TURBO-TORUS will return to the home position without accepting the current entry.

☞ *Note:*
In order to gain access, you must first enter customer password 1 (4711) within function B1.

Make sure that the TURBO-TORUS is in its home position.

Fig. 6-9: Home position

Operate the "Right" touch pad nine times in order to scroll from the home position to the operating mode "K – Factory settings".

K	:	F	A	C	T	O	R	Y							
		S	E	T	T	I	N	G							

Fig. 6-10: Operating mode "K – Factory settings"

Operate the "Down" touch pad once in order to change to the function K1.

K	1	:	F	u	l	l		S	c	a	l	e			

Fig. 6-11: Function "K1 – Flow Rate/Full-Scale-Value"

Operate the touch pad "Enter / Escape". Programming is now enabled. Now the first digit will flash. This indicates that you may now make your entry.

K	1	:	F	u	l	l		S	c	a	l	e			
1	0	0	0	0	0	,	0	0		m	3	/	h		

Fig. 6-12: Function "K1 – Flow Rate/Full-Scale-Value" – request to enter, first digit

Next operate the "Down" touch pad so as to select one of the numbers "0" to "9".

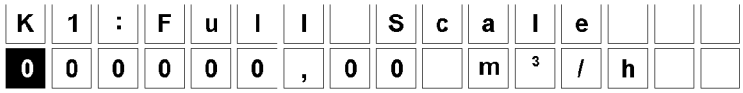


Fig. 6-13: Function "K1 Flow Rate/Full-Scale-Value" - Request to enter, first digit

Operate the "Right" touch pad in order to change to the next digit.

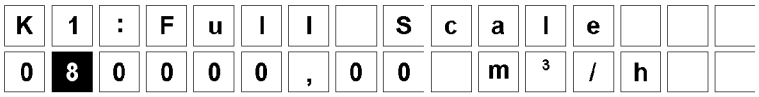


Fig. 6-14: Function "K1 – Flow Rate/Full-Scale-Value" - Request to enter, second digit

Next operate the "Down" touch pad once more so as to select one of the numbers "0" to "9".

After having entered the value for the last digit, the unit of measurement will be displayed next.

Fig. 6-15: Function "K1 – Flow Rate/Full-Scale-Value" - Request to enter, unit of measurement

Operate the "Down" touch pad to select one of the unit of measurement.

Operate the "Right" touch pad in order to change to the first digit.

K	1	:	F	u	l	l		S	c	a	l	e			
0	8	0	0	0	0	,	0	0	c	m	3	/	m	i	n

Fig. 6-16: Function "K1 – Flow Rate/Full-Scale-Value" - Request to enter, first digit

Check your entry.

☞ *The INTERMAG / TRANSMAG will check all entries as to their validity. If the entered value is not accepted, an error message will be displayed. The TURBO-TORUS will then return to the point where it requests a new entry.*

Acknowledge your entry by operating the touch pad "Enter / Escape" (for no longer than three seconds).
The changed values are saved and the selected function (K1) is displayed once more.

Next, when operating the touch pad "Enter / Escape" for over three seconds then the instrument reverts to the home position.

K	1	:	F	u	l	l		S	c	a	l	e			

Fig. 6-17: Function "K1 -Flow Rate/Full-Scale-Value"

A	:	F	l	o	w		R	a	t	e					
		0	8	0	0	0	0		c	m	3	/	m	i	n

Fig. 6-18: Home position

7 Operating Modes and Functions

7.1 Operating Mode "A – Display"

Operating mode with home position and displays with free access.

Display	Explanation
A: Flow Rate +000.00 m3/h	Absolute flow rate 6 digits in all (including decimal point) are displayed independently of the full scale value (K1)§
A1:Flow Rate +000.00 %	Relative flow rate with reference to the full scale value (K1)§
A2:Q=+000.00 % +000000000 m3	Totalizer 1, Forward flow§
A3:Q=+000.00 % +000000000 m3	Totalizer 2, Reverse flow§
A4:Q=(+/-)000.00 % Z3=000000000 m3	Totalizer 3, depending on the configuration in C5§
A5: Mean Velocity 11.000 m/s	Flow velocity§
A6:Flow Rate 0==========110%	Flow rate in percent, displayed through an 11 segment bar graph

§ The flow data is displayed depending on the number of significant digits set up in K6.

7.2 Operating Mode "B – Password"

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
B:PASSWORD	
B1: Password	Entry of the password *Customer password 1: 4711.*
B2: Password ▮ timeout	Entry of the time for "timeout" *Range: 1 - 99 minutes* *Default: 10 minutes* As soon as no touch pad is operated any longer, the timeout period starts. After this time has elapsed, programming of the selected function is disabled and the instrument returns to its home position. If a parameter which is entered is not valid the instrument reverts to its home position after the timeout has elapsed. In such a case it can happen that the converter will no longer continue to measure and an error message will then be displayed.

7.3 Operating Mode "C – Totalizer"

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
C: Totalizer	
C1: Totalizer Z1 Forward Flow	Units for totalizer Z1 *Available units:* *l, hl, m3, Gal[1], ImpGal[2], CuFt, kg* *Default: m3*
C2: Totalizer Z1 Reset	Resetting the totalizer Z1 to "0" *Possible entries: yes or no* *Default: no*
C3: Totalizer Z2 Reverse Flow	Units for totalizer Z2 *Available units:* *l, hl, m3, Gal[1], ImpGal[2], CuFt, kg* *Default: m3*
C4: Totalizer Z2 Reset	Resetting the totalizer Z2 to "0" *Possible entries: yes or no* *Default: no*
C5: Totalizer Z3 FWD/REV	Selection of operating mode *Possible operating modes: forward flow or reverse flow* *Default: Reverse flow*
C6: Totalizer Z3 Unit	Units for totalizer Z3 *Available units:* *l, hl, m3, Gal[1], ImpGal[2], CuFt, kg* *Default: m3*

[1] US-Gallons

[2] Imperial Gallons

Display	Explanation
C7: Totalizer Z3 Reset	Resetting totalizer Z3 to "0" *Possible entries: yes or no* *Default: no*

7.4 Operating Mode "D – Processing of Measurement Data"

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
`D: Signal`	
`D1: Noise Suppress Rate`	This value defines a tolerance range for the adaptive mean. This value is effective both above and below the mean value. Measured values outside this tolerance range are not taken into account for the time set up in D2. This noise suppression function is disabled when setting in D2 the value to 0 seconds. *Range: 00.0 to 99.9 %* *Default: 00.0 %*
`D2: Noise Suppress Time`	This value defines a period of time during which interfering pulses will not be taken into account. This period begins as soon as the measured value exceeds or drops below the setpoint set up in D1. This noise suppression function is disabled when setting in D2 the value to 0 seconds. *Range:* *00.00 to 99.99 seconds* *Default: 00.00 seconds*

Display	Explanation
D3: Damping	The value for damping influences the way in which the output signal responds to the measurement signal. In the case of a sudden change in the measurement signal, the output signal will reach 63% of the final value after the time constant which has been entered here has elapsed. *Range: 000 to 120 seconds* *Default: 005 seconds*
D4: Low-Flow-Cut	The value entered here defines the flow which is still considered by the system as a "0" flow. *Range: 0.00 to 9.99 %* *Default: 0.75 %*
D5: Setpoint min.	If the flow drops below a minimum value, a signal is set. This signal can be accessed via switch outputs S1, S2 or S3. Which signal is applied to the switch outputs is defined through functions E1, E3 and E6. The signal remains set until the entered value (D5) plus hysteresis (D7) is exceeded by the currently measured value. The minimum setpoint D5 must be lower than the maximum setpoint D6. *Range: 000 to 110 %* *Default: 010 %*

Display	Explanation
D6: Setpoint max.	If the flow exceeds a maximum value, a signal is set. This signal can be accessed via switch outputs S1, S2 or S3. Which signal is applied to the switch outputs is defined through functions E1, E3 and E6. The signal remains set until the entered value (D6) minus hysteresis (D7) is not exceeded by the currently measured value an longer. *Range: 000.0 to 999.9 %* *Default: 090.0 %*
D7: Hysteresis	The value entered for the hysteresis defines the delay in the response to the setpoint signals (D5 and D6). *Range: 0.00 to 9.99 %* *Default: 1.00 %*
D8: Electrodes - Monitoring	Enables electrode monitoring (with smartPLUG only). The instrument checks whether or not the electrodes of the flow sensor are covered by the medium. *Possible entries: yes or no* *Default: no*
D9: El-Monitor Time	The value entered here defines the interval after which the electrode is remonitored (repeat frequency). *Range: 0000 to 3600 seconds* *Default: 0000 seconds*

7.5 Operating Mode "E – Assignment of the Switch Outputs"

> **Caution:**
> **Make sure that the settings of the DIL switches match the programming for the operating mode "E – Assignment of the Switch Outputs".**

Note:
The settings of the DIL switches do not influence the programming.

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
`E: SWITCH OUTPUTS`	
`E1: Function S1 Switch Output`	The entry here defines which signal is assigned to switch output S1. *Possible assignments: setpoint min., setpoint max., setpoint min./max., alarm, overdrive alarm, electrode alarm, noise suppression enabled, Zero flow quantity enabled, reverse flow, full scale 2 enabled, not used* *Default: not used* *Locking: If S1 has been already assigned through function F1 or G1, function E1 will be locked and can not be programmed.*
`E2: Output Signal - S1`	Defines the assignment of the logic signals at output S1. *Possible logic assignments: Hi active or Lo active* *Default: Hi active*

Display	Explanation
E3: Function S2 Switch Output	The entry here defines which signal is assigned to switch output S2. *Possible assignments: setpoint min., setpoint max., setpoint min./max., alarm, overdrive alarm, electrode alarm, noise suppression enabled, Zero flow quantity enabled, reverse flow, full scale 2 enabled, not used* *Default: not used* *Locking: If S2 has been already assigned through function F6 or G3, function E3 will be locked and can not be programmed.*
E4: Output Signal - S2	Defines the assignment of the logic signals at output S2. *Possible logic assignments: Hi active or Lo active* *Default: Hi active*
E5: Out/Input S3	The value entered here defines whether S3 is to operate as a switch output or as a switch input. *Possible assignments: switch output or switch input* *Default: switch output* *Locking: If S3 has been already assigned through function F6 or G4, functions E5, E6, E8 and E9 will be locked.*

Display	Explanation
E6: Function S3 Switch Output	The entry here defines which signal is assigned to switch output S3. *Possible assignments: setpoint min., setpoint max., setpoint min./max., alarm, overdrive alarm, electrode alarm, noise suppression enabled, Zero flow quantity enabled, reverse flow, full scale 2 enabled, not used* *Default: not used* *Locking: If S3 has been assigned in E5 as an input, E6 must be set to "not used".*
E7: Output Signal - S3	Defines the assignment of the logic signals at output S3. *Possible logic assignments: Hi active or Lo active* *Default: Hi active*
E8: Function S3 Switch Input	The entry here defines which signal is assigned to switch input S3. *Possible assignments: PZR[1], Reset Totalizer Z1, not used* *Default: PZR* *Locking: If S3 has been assigned in E5 as an output, E8 must be set to "not used".*

[1] PZR = positve zero return
scts all outputs and displays to "0" and stops all totalizers.

Display	Explanation
E9: Input Signal - S3	Defines the assignment of the logic signals at input S3. *Possible logic assignments: Hi active or Lo active* *Default: Lo active*

7.6 Operating Mode "F – Imp./Freq. Outputs"

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
F: IMP.-FREQ OUTPUTS	
F1: Mode S1	The current measurement data may be output by way of a pulse or a frequency signal at switch output S1. *Possible settings: pulse output, frequency output, not used.* *Default: not used* *Locking: When S1 has been assigned in function G1 or E1, functions F1, F2, F3, F4 and F5 can not be assigned.*
F2: Pulse Units S1	The value entered here defines how many pulses per unit set up are output. In the maximum flow case, no settings must be used due to which a frequency of 10 kHz would be exceeded. *Range: 00001 to 10000* *Possible units:* *l, hl, m3, Gal*[1]*, ImpGal*[2]*, CuFt, kg* *each per pulse* *Default: [one pulse per] 1 m*^{3}

[1] US-Gallons

[2] Imperial Gallons

Display	Explanation
F3: Pulse Width S1	The pulse width setting defines for which period the pulse output will be active between two pulses. Pulse width is automatically reduced to 50% of the pulse spacing if the pulse width is over 50% of the time for the occurrence of the next pulse. No error message will be displayed. *Possible pulse width:* *31 µs to 1 second* *[Units of time: µs, ms, s]* *Default: 100 ms*
F4: Full-Scale Frequ. S1	The full scale frequency corresponds to 100 % of the full scale value (K1). Example: If K1 = 100 m^3/h and F4 = 10 kHz, then a currently measured value of 50 m^3/h will correspond to an output signal of 5 kHz. *Possible frequencies: 2 to 10.000 Hz* *Output signal: symmetrical square wave*
F5: Frequency Failure	This setting defines how the output signal will respond in the case of an error. *Possible assignments: 0 Hz, last value, ignore error* *Default: 0 Hz*

Display	Explanation
F6: Mode S2/S3	The current measurement data may be output by means of a pulse signal to switch outputs S2 and S3. F6 defines which flow direction is used by the pulse signal. Possible flow directions: *S2 = For + Rev, S3 = For + Rev,* *S2 = For, S3= Rev,* *S2 = Rev, S3 = not used* *Default: not used* *Locking: When S1 has been assigned in function G1 or E1, functions F1, F2, F3, F4 and F5 can not be assigned.*
F7: Pulse Units S2/S3	The value entered here defines how many pulses per unit set up are output. In the maximum flow case no settings must be used due to which a frequency of 450 Hz would be exceeded. *Range: 00001 to 00450* *Possible units:* *l, hl, m3, Gal[1], ImpGal[2], CuFt, kg* *Default: [one pulse per] 1 m^3*

[1] US-Gallons

[2] Imperial Gallons

Display	Explanation
F8: Pulse Width S2/S3	The pulse width setting defines for which period the pulse output will be active. Pulse width is automatically reduced to 50% of the pulse spacing if the pulse width is over 50% of the time for the occurrence of the next pulse. No error message will be displayed. *Possible pulse width:* *50 ms to 1 second* *[Units of time: ms, s]* *Default: 100 ms*
F9: Pulse Failure	This setting defines how the output signal will respond in the case of an error. *Possible assignments: 0 Hz, last value, ignore error* *Default: 0 Hz*

7.7 Operating Mode "G – Batch"

Caution:
The flow meter is only capable of detecting a passing flow. In order to prevent overfilling of a system, you must install a suitable safety switch (filling level meter).

Note:
The logic mode for the outputs and the inputs may be defined in mode "E – Assignment of the Switch Outputs".

Note:
When the batch mode is set to "on" then the following functions will change automatically:
E1 = "Not used", E3 = "Not used".
If in addition G4 is set to "Input S3" then the following functions will change automatically:
E5 = "Switch input", E6 = "Not used",
E8 = "Reset Z1".
If thereafter the batch mode is set of "Off" again, the aforementioned settings are retained.

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
G: BATCH	
G1: Batch Mode	Switches the batch mode on. In the batch mode, S1 is automatically made to perform as a contact for the attained pre-set volume, all other assignments are disabled. *Possible entries:* *on, off, with pre-act. (G3)* *Default: off*

Display	Explanation
G2: Preset Z1	If the totalizer has reached the volume set up here, output S1 goes active. Thus a valve or a pump may be driven. The unit of measurement for the volume for G2 is set up in C1. *Possible entries:* *000000000 - 999999999* *Default: 000000000*
G3: Pre-Act Volume	Entry in percent of the volume to be filled. As soon as the pre-act volume has been reached by totalizer Z1, the output S2 goes active. Thus it is possible to reduce the flow in advance so as to obtain a more accurate filling result. *Possible entries: 50.0 to 99.0 %* *Default: 99.0 %*

Display	Explanation
G4: Reset Time	The reset time is used to initiate the next filling process. If the pre-selected volume (G2) has been reached (S1 active) the reset time starts. After this time has elapsed, totalizer Z1 is reset and the switch outputs are set to passive.

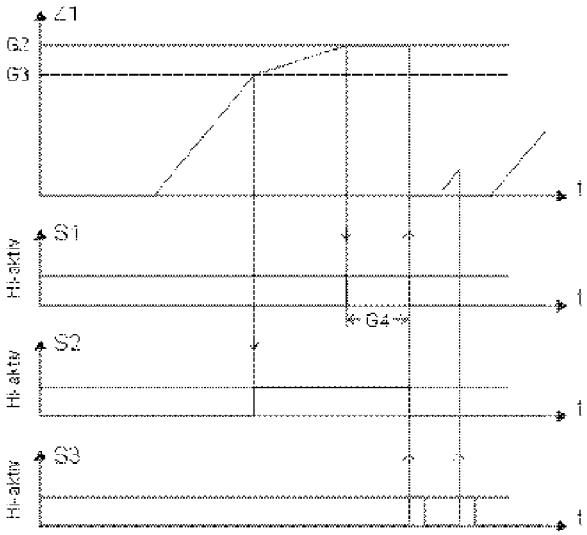


Fig. 7-1: Filling process with pre-act volume setting and external reset

Warning:
The vessel may be overfilled if
- the vessel was not empty to start with,
- the measurement was impaired or
- there was a power failure.

The point of time after which the reset time has elapsed may also be indicated through switch input S3.

Caution:
Make sure that the DIL switches (see 3.4.3 S3 set up as an input) have been configured correctly for the input S3.

When S3 has been activated, the totalizer Z1 will be reset and the switch outputs S1 and S2 will be set to passive (regardless of whether or not the filling process has been completed).

Possible entries:

00 to 60 seconds, input S3

Default: 00 s

7.8 Operating Mode "H – Current Output"

	Display	Explanation
	H: CURRENT OUTPUT	
Operating mode with free access; changes are only possible after entering customer password 1	H1: Current Output	The entry here defines the range for the current signal at the connection I_{out} (terminals 8, 9). The full scale value will in each case be 20 mA. The current is proportional to the measured value. When using the HART protocol, the value must be set to "4 to 20 mA (22 mA)" or "4 to 20 mA (20.5 mA)"*. *Possible ranges:* *0 to 20 mA (22 mA)** *4 to 20 mA (22 mA)** *0 to 20 mA (20.5 mA)** *[NAMUR]* *4 to 20 mA (20.5 mA)** *[NAMUR]* *Default: 0 to 20 mA (22 mA)**

* The value given in brackets corresponds to the maximum current which may be reached (20 mA = 100 %).

Display	Explanation
H2: mA Indication	Only displays the currently measured value. Displays the current which should be available at I_{out} (terminals 8, 9). The active measurement range is indicated in the second line of the display.
H3: Current - Failure	Defines how the output signal will respond in the event of a fault. *Possible assignments: 0/2 mA#, last value, 22/20.5 mA#, ignore fault* *Default: 0/2 mA#*

depending on the range set up in H1

Display	Explanation
H4: Split Range Mode	In the split range mode, the measurement range is split into two ranges: 1. "0" to full scale 2 (H5) and 2. Full scale 2 (H5) to full scale of the measuring range (K1). Both ranges are each output as a proportional current at I_{out}. At the switch outputs S1, S2 or S3 the signal "Full scale 2 active" should be applied (depending on the programming in E1, E3 or E6). If the selected switch output provides the corresponding signal, then the measured value is in the range between full scale 2 (H5) and the full scale value of the range (K1). *Possible assignments: off or on* *Default: off*
H5: Full Scale 2 Split-Scale-Mode	Entry defining full scale value 2, which splits the measurement range into two ranges. *Possible assignments: 0 to 99.999 [Volume per unit as in K1]*

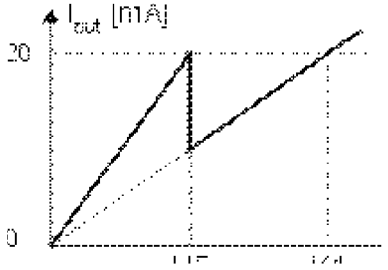


Fig. 7-2: Splitting the measurement range into two ranges

Display	Explanation
H6: Configuration Current Out	H6 defines which flow direction is used for the output signal. At the switch outputs S1, S2 or S3 the signal (reverse flow) may be present (depending on the programming in E1, E3, or E6). In order to be able to evaluate the signal, H6 must be set to forward and reverse flow. *Possible flow directions:* *forward flow, forward and reverse flow*

7.9 Operating Mode "J – Simulation / Test Outputs"

☞ *Note:*
During the simulation process, the selected functions J1 to J6 can not be exited.
Only after termination, will the related switch inputs and outputs become effective again.

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
`J:SIMULATION / TEST OUTPUT`	
`J1: Test Output S1`	Here a test signal is routed to output S1 (provided S1 has been set up as an output through the DIP switches). During the simulation process any assigned function (frequency for example) is switched off. The event (Hi/Lo) is independent of the setting in E2. The assigned function will only become effective once more upon exiting the simulation process through *no* and ENTER. *Possibly entry: on or off* *Default: off*

Display	Explanation
J2: Test Output S2	Here a test signal is routed to output S2 (provided S2 has been set up as an output through the DIP switches). During the simulation process any assigned function (frequency for example) is switched off. The event (Hi/Lo) is independent of the setting in E4. The assigned function will only become effective once more upon exiting the simulation process through *no* and ENTER. *Possibly entry: on or off* *Default: off*
J3: Test Output S3	Here a test signal is routed to output S3 (provided S3 has been set up as an output through the DIP switches). During the simulation process any assigned function (frequency for example) is switched off. The event (Hi/Lo) is independent of the setting in E7. The assigned function will only become effective once more upon exiting the simulation process through *no* and ENTER. *Possibly entry: on or off* *Default: off*

Display	Explanation
J4: Test Input S3	Displays only: off or on. Indicates the signal status at S3 (provided it has been set up as an input through the DIP switches). During the simulation process any assigned function (PZR, for example) is switched off. The event (Hi/Lo) is independent of the setting in E9. The assigned function will only become effective once more upon exiting the simulation process through *no* and ENTER. *Possibly entry: on or off* *Default: off*
J5:Freq./Pulse Output	Outputs a test signal through output S1.[1] During the simulation process any assigned function is switched off. The assigned function will only become effective once more upon exiting the simulation process through *no* and ENTER. *Range:* *0 to 110 % (of the full scale value for the measurement range)* *Default: 0*
J6: Current Outp. Simulation	Outputs a corresponding test signal to the terminals I_{out} (8, 9). *Range: 0 to 110 %* *Default: 0*

[1] At S1 the frequency or the pulse rate is simulated corresponding to the settings in operating mode F – Imp./Frequ. Outputs.

Display	Explanation
J7: Flow Simulation	Simulates a flow of the given magnitude. Both a forward (+) or a reverse flow (-) may be simulated. During the simulation process all entries which have been programmed are checked. While the simulation is in progress, you may change to the home position and all other functions. The simulation process is terminated automatically after the timeout (B2) has elapsed. *Range: 0 to +/- 110 %* *Default: 0*

7.10 Operating Mode "K – Factory Settings"

☞ *Note:*
In the operating mode "K – Factory settings" the functions K8 to K12 (factory parameters which may only be changed by TURBO) are not accessible.
Function K13 is protected by an additional password.

Operating mode with partly password protected access.

Display	Explanation
K: FACTORY SETTINGS	
K1: Flow Rate Full-Scale- Value	Entering the unit of measurement for the flow measurements. *Possible entries[1]: l/s, l/min, hl/min, hl/h, ml/min, Ml/day[2], cm3/min, dm3/s, dm3/min, dm3/h, m3/s, m3/min, m3/h, m3/d, gps[3], gpm[3], gph[3], Mgd[3], gal/s[4], gal/min[4], gal/h[4], gal/day[4], cfs, cfm, cfh, cfd, kg/s, kg/min, kg/h* *Default: m3/h*

[1] m3 = m^3
[2] Megaliter per day
[3] US-Gallons
[4] Imperial Gallons

Display	Explanation
K2: Nominal Size	Entry of nominal size (DN) corresponding to the connected flow sensor. ☞ *Note:* *In the case of flow sensors equipped with a smartPLUG the nominal size is set automatically.* *Range: 2 to 2.000 mm* *Default: 100 mm*
K3: Language	Entry defining the language for the messages appearing on the display. *Possible languages: German, English, Français, Español, Italiano, Português* *Default: German*

Display	Explanation
K4: Media Mean Density	Entry of the mean fluid density in kg/l *Range: 0 to 20* *Default: 1*
K5: Excitation Frequency	Entry of the frequency for coil current, depending on the type of flow sensor

Range for INTERMAG

Power supply		
Possible settings		
DC	AC	Nominal size DN
12 Hz	1/4 mains	2 to 100
6 Hz	1/8 mains	100 to 300
3 Hz	1/16 mains	300 to 1000

Default: 1/8 mains

Range for TRANSMAG

Possible settings	Explanation	Application
bip. without PP	bipolar without pre-pulse	For fast applications
bip. with. PP	bipolar with pre-pulse	For standard applications
unipolar	unipolar operation	For very large nominal sizes to reduce power dissipation.

Default: bip. with PP

	Display	Explanation
	K6: Format Indicator	Defines the display format (number of significant digits) *Possible assignments: 3, 4, 5 digits [xxx000, xxxx00, xxxxx0]* *Default: 5*
	K7: System Self-test	Runs a self-test on the converter (real hardware test, all measurement functions are disabled briefly). *Possible entries: yes or no* *Default: no*
Factory parameters can only changed by Siemens	K8:	Not displayed
	K9:	
	K10:	
	K11:	
	K12:	
is displayed only, and may only be changed after entering customer password 2	K13: Adjustment Factor	Is used to adapt to the hydraulic characteristics of the particular location.
	K14: C100 / R100	Is used in the case of instruments without smartPLUG to enter the constants for the flow sensor (see information provided on the corresponding name plate). *Possible entries:* *C100 = 00000.0000000 to 99999.9999999* *R100 = 0000000 to 9999999*

7.11 Operating Mode "L – Communication"

Operating mode with free access; changes are only possible after entering customer password 1

Display	Explanation
`L: Communication`	
`L1: Bus-Adr.`	Entry of the bus address *Possible bus address: 00 to 15* *Default: 00*

8 Error Messages

☞ *Note:*
"#" indicates that the current function is continued at the corresponding output.

☞ *Note:*
Several faults may occur simultaneously. In such a case the error codes are combined by a logic AND (for example 0000000000011 = *sensor alarm and electrode alarm a).*

Error code (displayed in the INFO panel)	Display (displayed in operating mode A in alternation with the measured value)	Explanation	Output response for ... defined in function		Response of the totalizers Z1, Z2, Z3	Alarm [1]
			Current	Imp. / Freq.		
0000000000000		No alarm				
0000000000001	Sensor alarm	Magnet current / reference voltage error Has the flow sensor been connected properly?	H3	F5 / F9	Stop	X
0000000000010		Electrode alarm a only used internally	#	#	#	
0000000000100		Electrode alarm b only used internally	#	#	#	

[1] May be signalled as a general alarm through S1, S2 or S3.

Error code (displayed in the INFO panel)	Display (displayed in operating mode A in alternation with the measured valuc)	Explanation	Output response for ... defined in function: Current	Output response for ... defined in function: Imp. / Freq.	Response of the totalizers Z1, Z2, Z3	Alarm [1]
0000000001000		Electrode alarm a and b simultaneously Ensure that – there are no deposits on the electrodes of the flow sensor. – there are no bubbles of air in the measurement tubc. – that the measurement tube is filled with the medium.	H3	F5 / F9	Stop	X

[1] May bc signallcd as a gcncral alarm through S1, S2 or S3.

Error code (displayed in the INFO panel)	Display (displayed in operating mode A in alternation with the measured value)	Explanation	Output response for ... defined in function		Response of the totalizers Z1, Z2, Z3	Alarm [1]
			Current	Imp. / Freq.		
0000000010000	`Overdriven`	– relative measured value over 110 % – flow sensor not filled with the medium – for the remote model: cable link interrupted or damaged *Remedy:* – if required, increase the measurement range – ensure that the flow sensor is filled with the medium at all times – check the cables and have them repaired as required	#	#	#	
0000000100000	`Sensor without smartPLUG`	smartPLUG faulty or not present Message appears only once and will not impair the measurements	#	#	#	

[1] May be signalled as a general alarm through S1, S2 or S3.

Error code (displayed in the INFO panel)	Display (displayed in operating mode A in alternation with the measured valuc)	Explanation	Output response for ... defined in function: Current	Output response for ... defined in function: Imp. / Freq.	Response of the Totalizers Z1, Z2, Z3	Alarm [1]
0000001000000	Wrong Sensor	Only in the case of flow sensors with smartPLUG a wrong flow sensor has been connected; INTERMAG and TRANSMAG have been interchanged	H3	F5 / F9	Stop	X
0000010000000	Communication Error	HART error = RS232 error Check the programming for the HART protocol (H1)	#	#	#	
0000100000000		Information for Siemens				
0001000000000	Range too high / low	Parameter error Please correct you entries	H3	F5 / F9	Stop	X
0010000000000	Pulse units not valid?	Pulse units not valid? Correct your entries	H3	F5 / F9	Stop	X
0100000000000		Not used	#	#	#	
1000000000000		Not used	#	#	#	
	Trap x	Software error	H3	F5 / F9	Stop	X
	HARDWARE ERROR	Hardware error	H3	F5 / F9	Stop	X

[1] May bc signallcd as a gcncral alarm through S1, S2 or S3.

Error code (displayed in the INFO panel)	Display (displayed in operating mode A in alternation with the measured valuc)	Explanation	Output response for ... defined in function		Response of the Totalizers Z1, Z2, Z3	Alarm [1]
			Current	Imp. / Freq.		
	`Enter pad not assigned`	Enter touch pad has been operated although it may not be used while a function / operating mode is active				
No display		Ensure that – the mains power supply rating matches the specifications on the name plate. – the mains power has been properly connected. If required also check the mains fuse.				

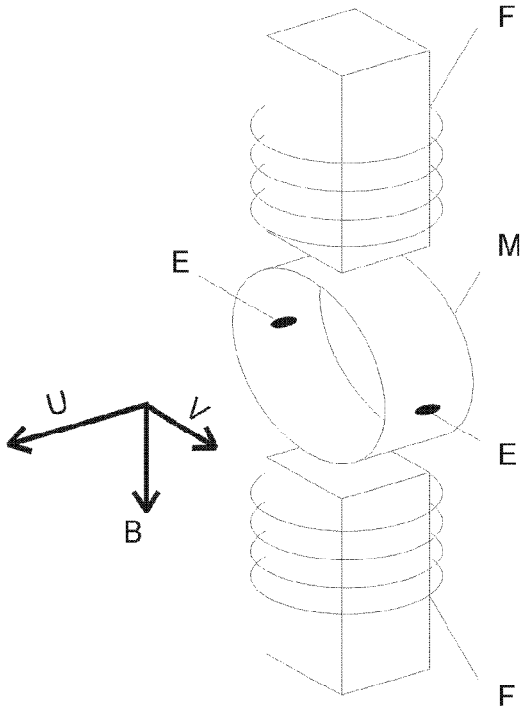
[1] May be signalled as a general alarm through S1, S2 or S3.

9 Principle of Measurement

The principle of measurement for liquids in sealed tubes is based on Faraday's law of induction.

9.1 Measured Voltage as the Quantity Representing the Velocity of the Flow

When a sufficiently electrically conductive liquid is displaced at a mean velocity v perpendicular to a magnetic induction B, an electrical field will be generated perpendicular to both. The strength of the thus generated field is proportional to the velocity of the flow and the level of the magnetic induction.



F	Field generating coil
M	Measurement tube
E	Electrode
U_{ref}	Reference voltage[1] (TRANSMAG only)
v	Velocity of the flow
B	Magnetic flux
U	Measurement voltage

Fig. 9-1: Schematic diagram depicting the principle of measurement

[1] Reference voltage (unit Volt [V]), strictly proportional to the change in the strength of the magnetic field dB/dt

When the liquid flows through a tube, the wall of which is perpendicular to the magnetic field and where with respect to the direction of the flow two opposing electrodes are present, a measurement voltage U is generated due to the electric field. This voltage is proportional to the velocity of the flow.

The aforementioned physical relationship can be described through the following formula: $U = k * B * D * v$

Where

U = Measurement voltage (unit Volt [V])

k = Constant (unit 1)

B = Magnetic induction
(unit Tesla [T], 1 T = 1 Vsm^{-2})

D = Inside diameter of the measurement tube (unit [m])

v = Mean axial velocity of the liquid flow (unit [m/s])

In the case of a given system, the measurement voltage thus represents the mean velocity of the liquid flow for the duration of the measurement.

9.1.1 The PDC Method

The PDC method (Pulsed Direct Current) is a method of measurement which employs a pulsed DC field for magnetic flow sensors. Here the magnet is excited by means of an electronically controlled square wave bipolar current using transistors as the final control element.

9.1.2 The PAC Method (TRANSMAG)

The PAC method (Pulsed Alternating Current) is a patented method of measurement which employs a pulsed AC field for the magnetic flow sensors. The exciting current is taken from the mains supply and switched by a TRIAC whereby the repetition frequency is adjustable (see page 7-27, Operating Mode "K – Factory settings"). In the period between the current pulses, the Zero level is continuously aligned to compensate for drift.

9.2 Further Measured Quantities

With the aid of expanded formulae further quantities may be determined.

9.2.1 Flow Volume

From the inside diameter D, the surface area of the tube at the location of the measurement may be calculated by ($A = \pi D^2/4$). Together with a calibration factor f(V) it will then be possible to determine the volume of the flow Q_V per unit of time t:

$$Q_V = f(V) * U * \pi D^2/4 * t$$

9.2.2 Mass per Unit of Time

When multiplying the volume Q_V with the density ρ of the liquid, then the mass m which has flowed through per unit of time t is obtained:

$$m = \rho * Q_V = \rho * f(V) * U * \pi D^2/4 * t$$

If the density can be adjusted it will then be possible to determine the mass flow for different liquids.

10 Specifications

☞ *Hinweis:*
The converter does not contain any Lithium batteries. The data are saved permanently through modern technologies.

10.1 General Data

10.1.1 Application Class

JUZ to DIN 40040

-20 to +60 °C without display

-10 to +60 °C with display

10.1.2 Protection Class

IP 67 to DIN EN 60529 and IEC 529

10.1.3 Length of the Cables for the Remote Model

In the case of the remote model, the length of the cable between flow sensor and converter must not exceed 50 m max.

The cable used must be approved for at least protection class IP 67.

10.1.4 Magnetic Field Frequencies

INTERMAG

3.125 / 6.25 / 12.5 Hz for AC operation (50 Hz) or DC supply

3.75 / 7.5 / 15 Hz for AC operation (60 Hz)

TRANSMAG

8.33 / 10.0 / 16.66 Hz for AC operation (50 Hz)

10 / 12 / 20 Hz for AC operation (60 Hz)

10.1.5 Error Limits

±0.5 % of the measured value

±0.01 % of the full scale value (v = 12 m/s)

plus

±0.2 % reproducibility

±0.1 % converter error for the analogue output

10.2 Electrical Specifications

10.2.1 Power Supply

85 to 264 V AC, 50/60 Hz

optional for INTERMAG:

18 to 30 V AC/DC

10 to 28 V DC

(absolute voltages)

10.2.2 Power Consumption

20 VA for AC operation

20 W for DC power supply

For TRANSMAG: 30 to 500 VA,
depending on the nominal size of the flow sensor

10.2.3 Fuses

10.2.3.1 Mains Fuse (F1)

The mains fuse (F1) is located on the connection pcb.

Voltage version	Fuse rating
85 to 264 V AC, 50/60 Hz	250 mA T (slow blow)
18 to 30 V AC/DC	1 A T (slow blow) (INTERMAG only)
10 to 28 V DC	2 A T (slow blow) (INTERMAG only)

10.2.3.2 Fuse for the magnet current (F2)

The fuse for the magnet current (F2) is located in the current output or TRIAC stage (under the optional display)

	Fuse rating
INTERMAG	315 mA T (slow blow)
TRANSMAG	5 A FF (very fast blow)

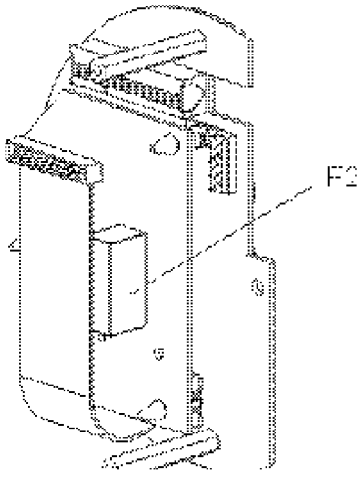


Fig. 10-1: Location of the magnet current fuse in the current output or Triac stage

10.2.4 Current Output

0/4 to 20 mA, electrically isolated

When using the HART interface 4 to 20 mA

Max. load 1 kΩ

Minimum load for HART: 250 Ω

10.2.5 Switch Outputs and Inputs

All switch outputs and inputs are electrically isolated by means of opto-couplers. Via switches they may be set to either the active or passive mode.

When in the active mode all inputs and outputs are electrically linked and connected to the negative terminal (I_{out}, terminal 9).

The pulse width of the outputs S2 and S3 may be configured freely.

Switch output S1	0 to 10 kHz
Switch output S2, S3	500 Hz
Switch input	Debounced
Specifications for the active outputs	24 V DC (+10 %), R_i = 3 kΩ
Specifications for the passive outputs	max. 30 V, 30 mA
Specifications for the active input	24 V DC (+10 %), R_i = 3 kΩ
Specifications for the passive input	max. 30 V, R_i = 3 kΩ

10.3 INTERMAG

Connection to flow sensor	*Flow velocity*
MG 711/... of nominal sizes DN 2 to DN 2000 or magnetic probes	0.25 to 12 m/s
	Minimum conductance for of the medium
MG 711/A, ~/D, ~/E, ~/H, ~/S or magnetic probes	> 3 µS/cm
MG 711/F4, ~/F5, ~/F6	> 10 µS/cm

Generation of the magnet current	Current control
Pulsed DC field	600 mA_{pp}

10.4 TRANSMAG

Connection to flow sensor	*Flow velocity*
MG 911/... of nominal sizes DN 2 to DN 2000	0.15 to 12 m/s
	Minimum conductance of the medium
MG 911/... (except MG 911/F5, ~/F6)	0.008 µS/cm (depending on the medium and the flow sensor)
MG 911/F5, ~/F6	0.1 µS/cm (depending on the medium and the flow sensor)

Generation of the magnet current	Triac stage
Pulsed AC field	

At conductances below 1 µS/cm you should discuss the particular application with engineers from Siemens first.

10.5 Wiring Diagram

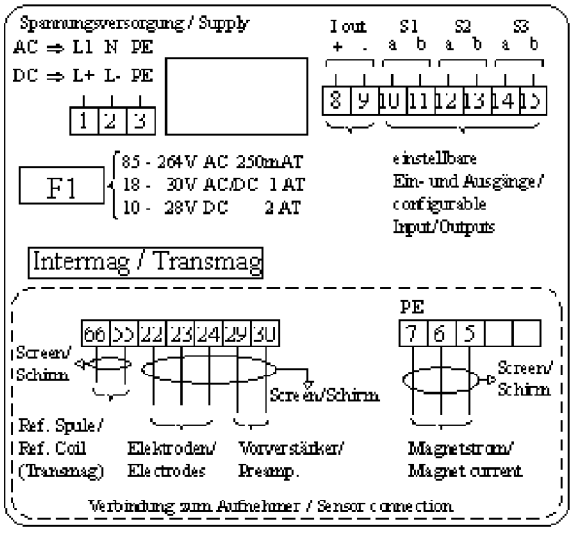


Fig. 10-2: Wiring diagram attached within the cover

10.6 Dimensions and Weight

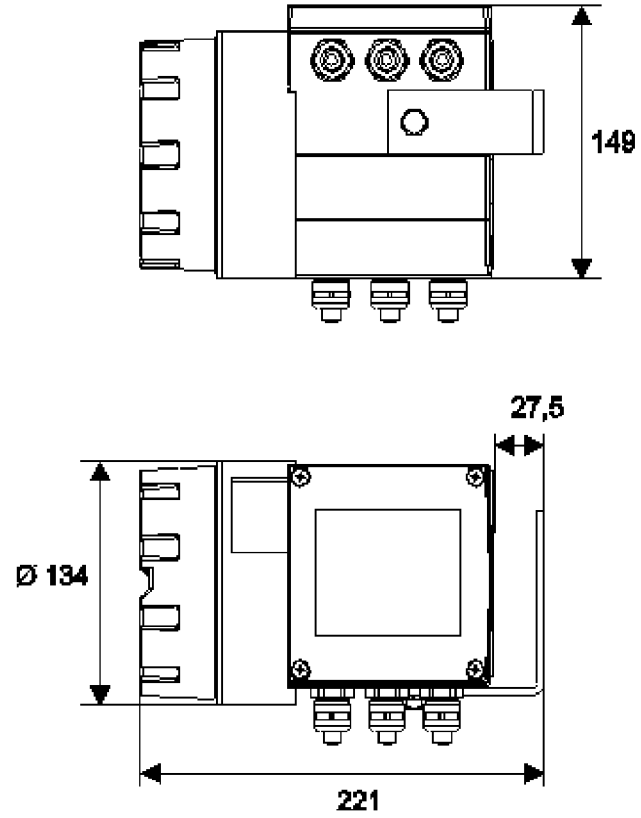


Fig. 10-3: Dimensions of the converters

The INTERMAG / TRANSMAG converters weigh 3.4 kg (without flow sensor).

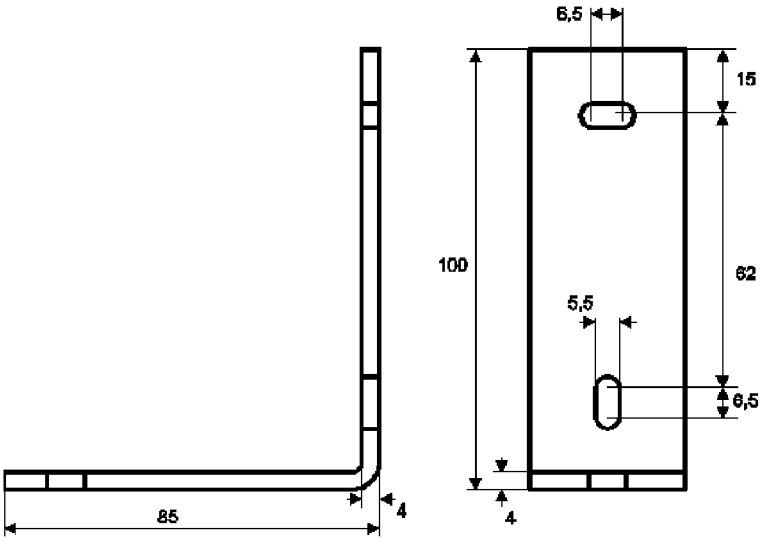


Fig. 10-4: Mounting bracket, remote model only

10.7 Name Plate

10.7.1 Standard

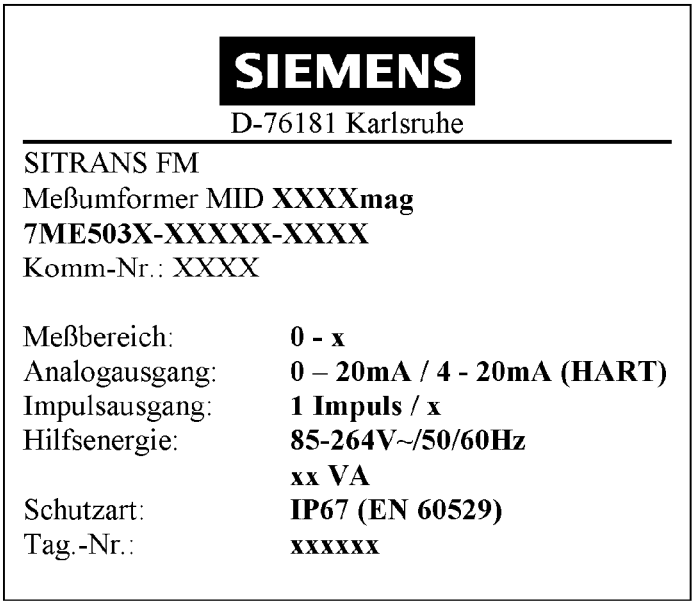


Fig. 10-5: Example of a standard name plate

In the case of instruments with such a name plate the equipment settings need to be entered by the customer.

10.7.2 Customer-specific

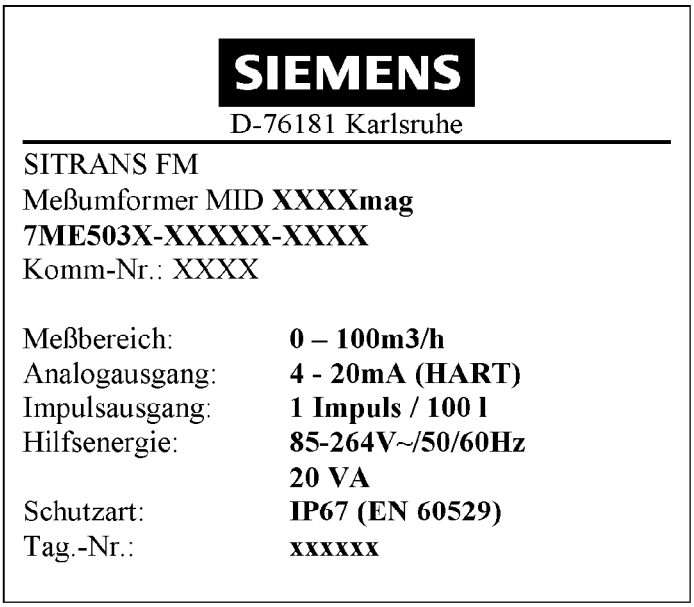


Fig. 10-6: Example of a customer-specific name plate

Instruments with such a name plate have already been programmed in the factory.

10.8 Spare Parts

For spare parts please get in touch with our after sales service. Please look for our local agency at the appendix or at **http://www.feldgeraete.de**.

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