SERVICE MANUAL

FLOWSIC600 DRU/DRU-S
Gas Flow Meter

Maintenance
Inspection
Repair

This Manual is intended exclusively for trained and authorized service technicians of SICK Engineering GmbH and their representatives.
Unauthorized intervention voids the manufacturer's warranty.

SICK
Sensor Intelligence.

Document Information

Product
Product name: FLOWSIC600 DRU

Document ID
Title: Service Manual FLOWSIC600 DRU
Part No.: 8023840/18BQ
Version: 1-1
Release: 2020-08

Publisher
SICK Engineering GmbH
Bergener Ring 27 · D-01458 Ottendorf-Okrilla · Germany
Tel.: +49 35205 52410
Fax: +49 35205 52450
E-mail: info.pa@sick.de

Glossary

Abbreviations used in this manual

act.	actual (under operating/flowing conditions)
AGC	**A**utomatic **G**ain **C**ontrol
ANSI	**A**merican **N**ational **S**tandards **I**nstitute
ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
ASME	**A**merican **S**ociety of **M**echanical **E**ngineers
AWG	**A**merican **W**ire **G**age
CBM	**C**ondition **B**ased **M**aintenance
CSA	**C**anadian **S**tandards **A**ssociation
DC	**D**irect **C**urrent
DIN	**D**eutsches **I**nstitut für **N**ormung (German Standards Institute)
DN	**N**ominal **D**iameter (internal)
DSP	**D**igital **S**ignal **P**rocessor
EC	**E**uropean **C**ommunity
EN	**E**uro **N**orm (European Standard)
Ex	Potentially **ex**plosive atmosphere (hazardous area)
EVC	Electronic Volume Corrector
HART®	Communication interface
IEC	**I**nternational **E**lectrotechnical **C**ommission
LCD	Liquid Crystal Display
LED	**L**ight **E**mitting **D**iode
MDR	**M**anufacturer **D**atal **R**ecord
MEPAFLOW	**Me**nu-assisted **Pa**rameterisation and Diagnosis for **FLOW**SIC600
NAMUR	**N**ormen**a**rbeitsgemeinschaft für **M**ess- **u**nd **R**egeltechnik in der chemischen Industrie (now "Interessengemeinschaft Prozessleittechnik der chemischen und pharmazeutischen Industrie"; ~ Association for Instrumentation and Control Standards in the Chemical Industry)
norm.	**norm**alized/corrected (under standard conditions)
OIML	**O**rganisation **I**nternationale de **M**etrologie **L**egale
PC	**P**ersonal **C**omputer
PTB	**P**hysikalisch **T**echnische **B**undesanstalt (~ Federal Metrology Office in Germany)
RTU	**R**emote **T**erminal **U**nit
SPU	**S**ignal **P**rocessing **U**nit
VDE	**V**erband **d**er **E**lektrotechnik Elektronik Informationstechnik (~ Association of German Electrical Engineers)
VOG	**V**elocity **O**f **G**as
VOS	**V**elocity **O**f **S**ound
WME	**W**eighted **M**ean **E**rror.

Warning Symbols


Hazard (general)

Hazard in potentially explosive atmospheres


Hazard by voltage

Warning Levels / Signal Words

WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION
Hazard or unsafe practice which *could* result in personal injury or property damage.

NOTICE
Hazard which *could* result in property damage.

Information Symbols


Information about the use in potentially explosive atmospheres


Important technical information for this product


Important information on electric or electronic functions


Supplementary information


Link to information at another place

FLOWSIC600 DRU

1 Important Information

About this document
Safety instructions
Authorized staff
General safety instructions and protective measures

1.1 About this document

This Service Manual is a part of the FLOWSIC600 DRU/DRU-S device documentation, which also includes

- Operating Instructions
- Short Manual MODBUS (available under www.sick.com)

The present version is valid for:

- FLOWSIC600 DRU, hardware version V2 or newer, firmware version V3.x.xx
- MEPAFLOW600 CBM control and configuration programme, version V1.0.47

This manual includes a description of any service work which can be carried out by trained staff. All instructions are valid for both the FLOWSIC600 DRU and the FLOWSIC600 DRU-S. For better readability, only the FLOWSIC600 DRU is named in the text.

As general information about the measuring principle, design and function of the measuring system and its components, and about the use of the equipment is given in the valid version of the Operating Manual, this Service Manual provides additional information only where necessary for understanding the functions. The Service Manual shall therefore only be used in conjunction with the Operating Manual.

NOTICE:

Always read this manual carefully before carrying out any work on the equipment. Always observe warnings and comply with all safety instructions.

Any obligations of SICK Engineering GmbH are set forth in the relevant Purchase Agreement. That agreement also includes the complete and solely applicable warranty conditions.

1.2 Safety instructions

1.2.1 Intended use of the equipment

The FLOWSIC600 DRU measuring system is used for measuring the actual velocity or volumetric flow rate of gases transported in pipelines. The FLOWSIC600 DRU measuring system can further be used for measuring the actual volume and velocity of sound in gases.

The measuring system shall only be used as specified by the manufacturer and as set forth below. Always observe the following information:

- Make sure the use of the equipment complies with the technical data, information about the permitted use, assembly and installation specifications and ambient and operating conditions (detailed in the project documentation, type plate, approval documents and in the Operating Manual).
- Any actions aiming at maintaining the value of the equipment, e.g. service and inspection, transport and storage etc., shall be performed as specified.
- Do not expose the equipment to mechanical stress, such as pig cleaning.

1.2.2 Authorised staff

Persons responsible for safety issues shall ensure the following:

- Any work on the measuring system shall only be carried out by qualified persons and must be approved by responsible skilled persons.
  Due to their professional training, knowledge and vocational experience, as well as their knowledge of the relevant standards, regulations, health and safety regulations and equipment conditions, qualified persons shall be assigned by the person responsible for personal and plant safety to carry out such work. Qualified persons must be able to identify possible dangers and to take preventive action in due time.
  Skilled persons are defined in DIN VDE 0105 and IEC 364, or comparable standards.
- Skilled persons shall have precise knowledge of process-specific dangers, e.g. due to the effects of hot, toxic and pressurised gases, gas-liquid mixtures and other process media, and of the design and working principle of the measuring system and shall have received and be able to document appropriate training.
- For any service on the measuring system is it important, that the persons should have a training from the company “SICK Engineering GmbH”
- In hazardous areas, wiring and installation shall only be carried out by staff trained according to EN 60079-14 and according to national regulations.

1.2.3 General safety instructions and protective measures

Using the equipment for any other purpose than intended, and improper operation may result in injuries and damage to the equipment. Read this section and the notes and warnings in the individual sections of this manual carefully and observe the instructions given therein when carrying out any work on the FLOWSIC600 DRU measuring system.

Generally,

- Always comply with the statutory provisions and the associated technical rules and regulations relevant for the present equipment when preparing and carrying out any work on the measuring system. Pay particular attention to potentially hazardous parts of the equipment, such as pressure pipes and explosion protection zones. Always observe the relevant regulations.
- Always consider local and equipment-specific conditions and process-specific dangers when carrying out any work on the equipment.
- Operating and service instructions and equipment documentation shall always be available on site. Always observe the safety instructions and notes on the prevention of injuries and damage given in these manuals.
- Make sure appropriate protective accessories are available in sufficient supply. Always use such protective accessories. Check that appropriate safety devices are fitted and working correctly.

1.2.4 Dangers due to hot, toxic, corrosive and explosive gases and high pressure

The FLOWSIC600 DRU measuring system is directly integrated into gas-carrying pipelines.

The operating company shall be responsible for safe operation and for complying with additional national and company-specific regulations.

WARNING:

In plants with toxic and explosive gases, high pressure or high temperatures, the FLOWSIC600 DRU measuring system shall only be mounted and dismounted if the pipelines are vented or if the plant is not working.

The same applies to repair and service work which involves opening measuring channel or the explosion-proof signal processing unit (SPU).

NOTICE:

Design, manufacture and inspection of the FLOWSIC600 DRU measuring system are performed in compliance with the safety requirements set forth in the European Pressure Equipment Directive 2014/68/EU. Any relevant information has been taken into account for the particular application as specified in the technical information questionnaire filled out by the customer before commencing order processing.

1.2.5 Dangers due to heavy loads

The FLOWSIC600 DRU measuring system must be safely attached to the carrying structure when being transported and installed.

CAUTION:

- ► Only use lifting gear and auxiliaries (e.g. lifting straps) which is suitable for the weight to be lifted. Max. load information can be found on the type plate of the lifting gear.
- ► The eye bolts attached to the equipment are suitable for the transport of the measuring device. However, additional loads (e.g. blind covers, filling for pressure tests) must not be lifted and transported together with the measuring system.
- ► Never attach hoisting gear to the signal processing unit or its mounting bracket and avoid contact between these parts and the hoisting gear (*see Operating Manual, Section 3.1*).

FLOWSIC600 DRU

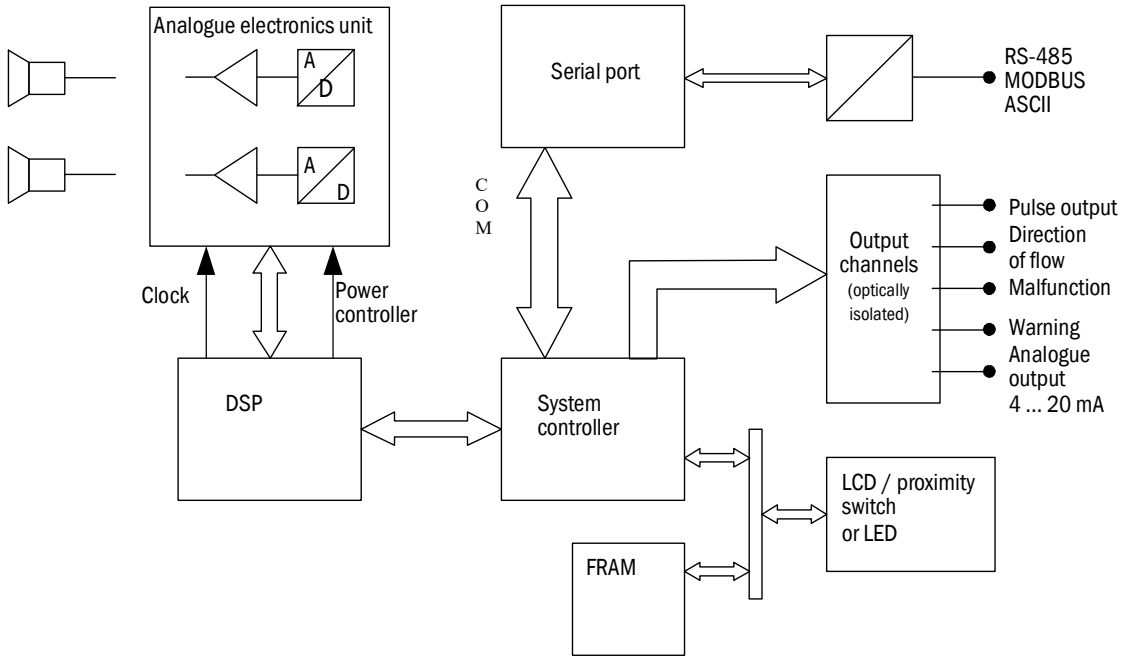
2 Signal Processing Unit (SPU) and Device Messages

Processes in the SPU
Generation of measuring values
System states
System startup
Device status
Path status

2.1 Processes in the SPU

The extensive and complex calculations are performed by two processors in the FLOWSIC600 DRU device. A digital signal processor (DSP) is used to generate and calculate the ultrasonic signals. The entire system including the DSP is monitored and controlled by a system controller.

Figure 1 Block diagram, SPU electronics unit



System controller (M16 C)

The system controller has the following functions:

- Parameter management
- Communication through serial interface RS-485 (MODBUS)
- Provision of output signals (analogue, digital, pulse)
- Display control (LCD or LEDs)
- DSP booting
- Process control (switching between operational modes, triggering the measuring cycles)
- Volume integration and storage of counter readings
- System monitoring

Digital signal processor (DSP)

The digital signal processor (DSP) is used for:

- Generation of transmitted signals
- Recording of received signals
- Multiplexing of the individual paths to the electronic signal generation and reception units
- Calculation of the signal transit times
- Calculation of actual and average flow velocity, volumetric flow rate and velocity of sound

Figure 2 Digital signal processor

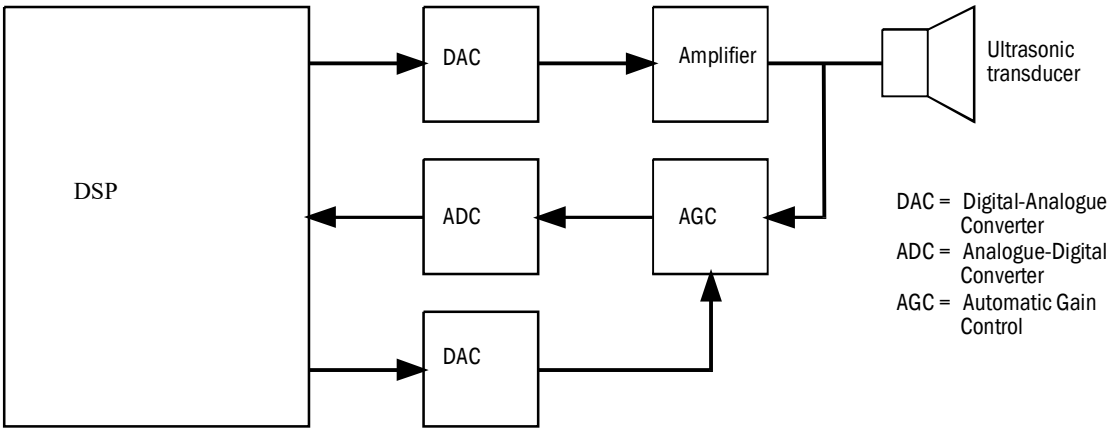
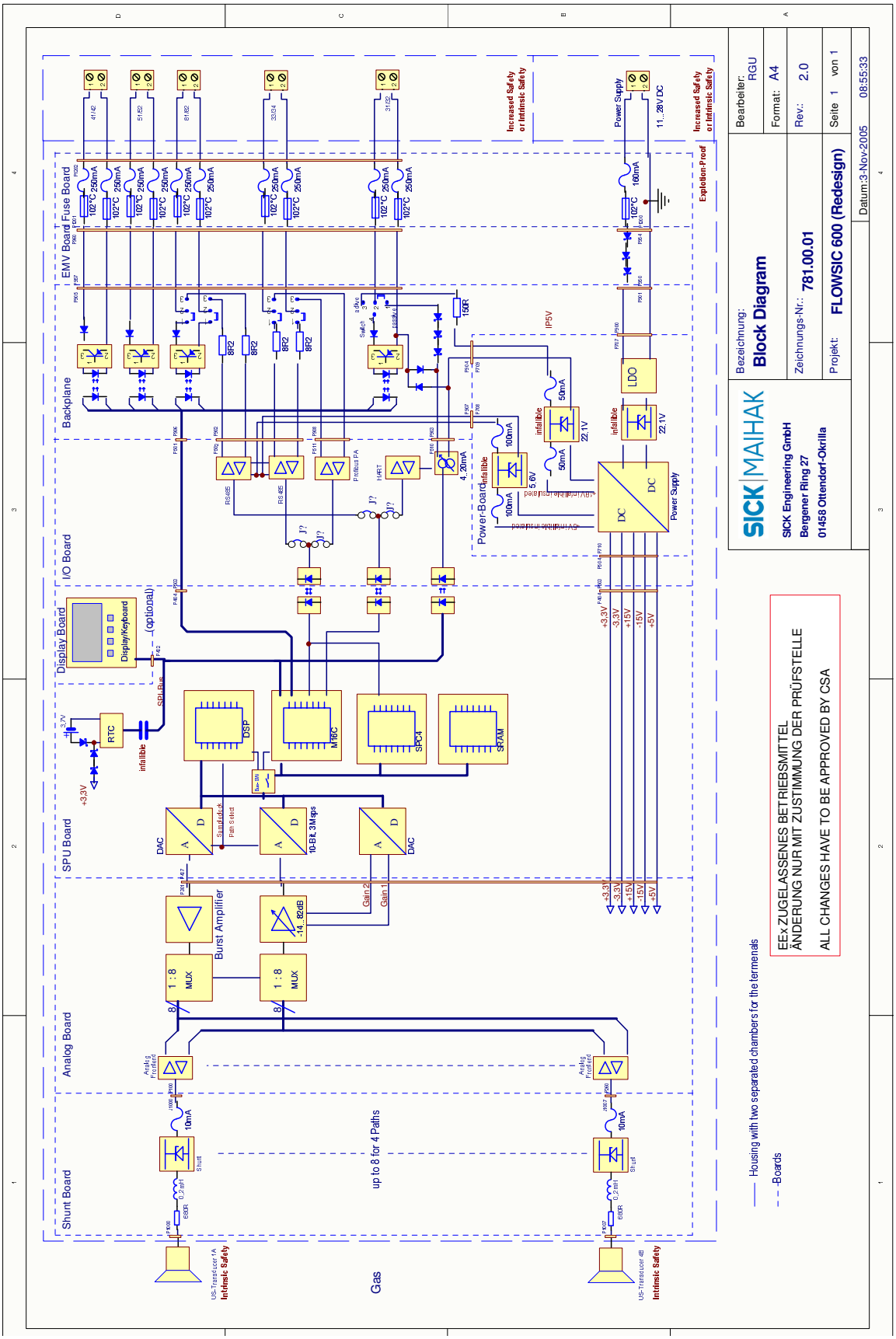


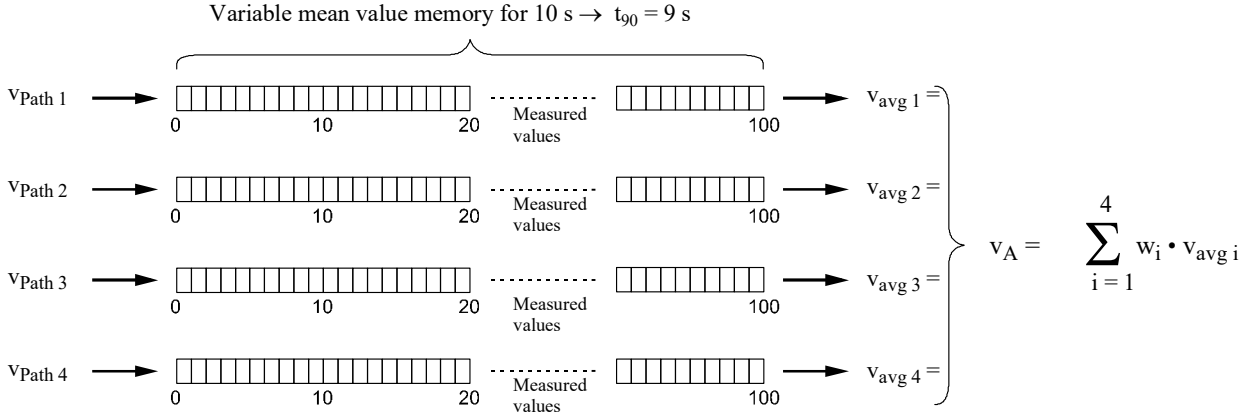
Figure 3 Block diagram, SPU



2.2 Generation of measuring values

The response time of the measurement depends on the configured sample rate (register #3501) and the size of the mean value memory (register #3502). The measuring rate defines the number of measurements performed on each measuring path per second. The default setting is 10 measurements per second. The actually measured path and sound velocities are stored in separate mean value memory blocks for each measuring path. The size of each mean value memory block is set to 100 by default. The mean measuring value is the variable averaged value of the last 100 valid readings. Each new value is added to the memory, thus overwriting the oldest entry (FIFO method). The memory thus represents the history of the last 100 measured values (i.e. the last 10 seconds in case of the default setting). The number of correct measurements in relation to the size of the mean value memory is output as the "%Performance" for each measuring path. This value is also used to decide whether or not the quality of the measuring path is sufficient to include the measured value into the calculation of the actual volumetric flow.

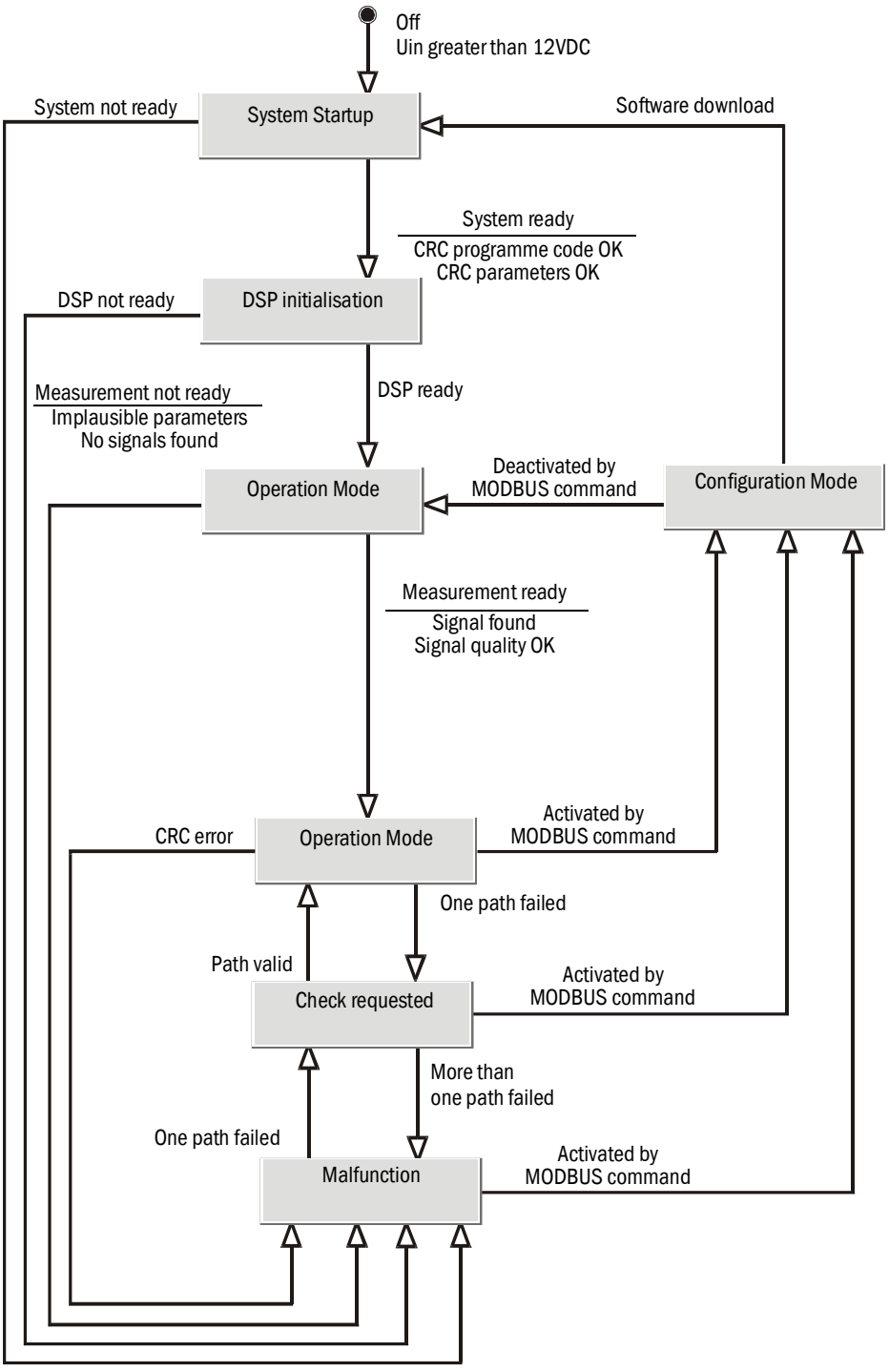
Figure 4 Example of response time: SampleRate (Reg.#3501) = 10; AvgBlockSize (Reg.#3502) = 100



2.3 System states

The states of the FLOWSIC600 DRU are shown schematically in the flowchart below.

Figure 5 System states flowchart



In the case of an interruption of the power supply, all data including the programme code, operating parameters and volume counters are saved in a non-volatile memory.

2.4 System startup

2.4.1 Power on / cold start

If the input voltage exceeds a threshold of 11.8 V, the reset signal is removed from the system controller and the microprocessor starts to boot the system. The following steps are executed one after another:

Table 1

Item	Step	Description
1	System controller initialization	
2	DSP initialization	The DSP is turned into the Idle16 mode in order to minimise the total power consumption of the entire system at that point of time. The power supply can thus securely start even at a minimum input voltage
3	Checking the check sum of the programme code	The microprocessor calculates the check sum for the 'programme code' memory section. The result is then compared with the stored check sum. If calculated and stored check sum differ, the 'Check sum error' flag is set in the General Status Register.
4	Checking the parameter memory check sum	The calculated check sum of the 'Parameters' memory section is then compared with the stored check sum. If calculated and stored check sum differ, the 'Check sum error' flag is set in the General Status Register.
5	Searching a valid counter reading	The last counter reading stored together with a time stamp is read from the real time clock (RTC) and saved as an entry in the logbook. The current time stamp is added and the entry is encoded as 'cold start'
6	DSP booting	The microprocessor writes the DSP programme code to the DSP programme memory (dRAM) via direct memory access (DMA) transfer. If the DMA transfer fails, another attempt will be initiated after 10 measuring cycles. The 'DSP Error' flag is set in the General Status Register
7	Measuring cycle trigger	After successful booting, the DSP is triggered cyclically in order to perform a complete measurement in all available paths. Completion of a measurement is indicated to the system controller through an acknowledgement signal. Immediately before the measuring cycle triggering, the system controller receives the results of the previous measurement via DMA transfer. The volumetric flow rate is integrated simultaneously with DSP operation, counter readings are recalculated and the pulse, analogue and digital outputs are updated. If a MODBUS register query is pending, it is answered with the updated register content

The sequential execution of these steps aims to keep the startup energy consumption at a minimum.

System initialization takes about 10 seconds and is completed when the LEDs start flashing or when measured values are displayed on the LCD.

If the operating voltage falls below 10.8 V, all operations will be terminated. In this state, the system requires less than 1 mA for the restart logic.

2.4.2 Warm start

After changing to the ‘Configuration’ mode, you may edit system parameters. Most parameters are applied immediately after the change was made. However, it is required to perform a warm start, i.e. a change from the ‘Configuration’ mode to the ‘Measurement’ mode, for the parameters listed below to be transferred to and used by the system. These parameters are:

- Baud rate
- Modbus Device Address
- Sample rate

2.5 Device status

The condition of the FLOWSIC600 DRU measuring system can be assessed with the help of the two following menus in the MEPAFLOW600 CBM software programme. Special knowledge is required in order to be able to evaluate the displayed status messages, such knowledge can be gained in special FLOWSIC600 DRU seminars.

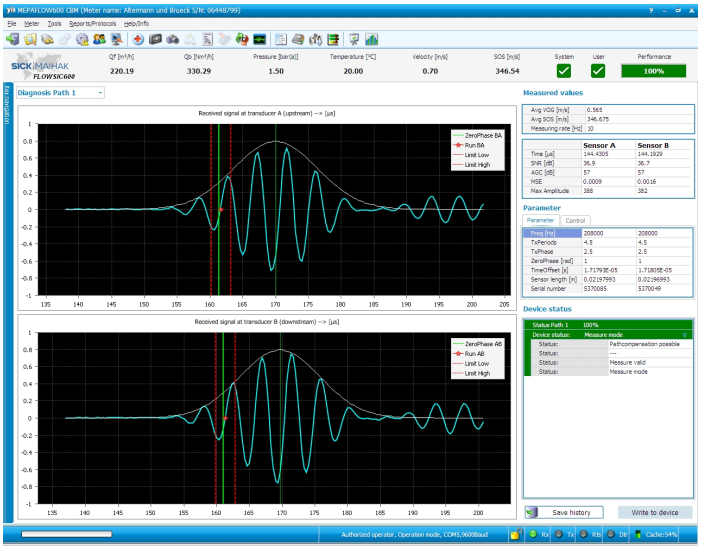
Figure 6 “Monitor / Meter Status” menu

Meter status

Bit		System state register	P1	P2	P3	P4	Path state register		System control register
0	●	Measurement	○	○	○	○	Warning SNR	○	Configuration mode
1	●	Measurement valid	○	○	○	○	Warning AGC deviation	○	Path 1 inactive
2	○	Check request	○	○	○	○	Warning AGC limit	○	Path 2 inactive
3	○	Limit warning	○	○	○	○	Warning SOS deviation	○	Path 3 inactive
4	○	Hardware write lock	○	○	○	○	Read signal from DSP	○	Path 4 inactive
5	○	Path error 1	○	○	○	○	Divide by Zero	○	Path 1 checkcycle
6	○	Path error 2	○	○	○	○	MAX too big	○	Path 2 checkcycle
7	○	Path error 3	○	○	○	○	MAX too small	○	Path 3 checkcycle
8	○	Path error 4	○	○	○	○	MAXPOS too early	○	Path 4 checkcycle
9	○	CRC error	○	○	○	○	MAXPOS too late	○	Reset error volume counters
10	○	Parameter invalid	○	○	○	○	Path error	●	Imperial unit system
11	●	Adjust range	○	○	○	○	SNR exceeds limit	○	Filter mode
12	○	I/O range error	○	○	○	○	Maximum iterations	○	Testing watchdog
13	○	DSP error	○	○	○	○	Time plausibility	○	Reset path conditions
14	●	Path compensation valid	○	○	○	○	Check cycle	●	Continuous measure mode
15	○	DSP parameter error	○	○	○	○	Limit MSE	○	Air test

Indicator LED is on: active
Indicator LED is off: inactive

Figure 7 Path diagnosis” diagram (“Service” user access level)



2.5.1 System status register

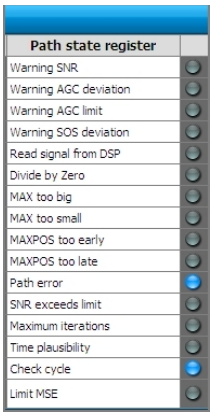
The current condition of the measuring system is stored in the system status register.

Figure 8 Status register

Bit	Description
0	An active bit indicates that the device is working correctly and that there is no malfunction.
1	An active bit indicates a valid measurement.
2	This bit will be active if one path is faulty. This status message is a warning. The device will remain in the normal measuring mode, and the measuring values will be counted as normal, because the integrated path failure compensation routine will simulate the measured values for the faulty path. However, if another path becomes faulty , the device will turn into the Malfunction state, and the measured values will be written to the error volume counter.
3	One or more paths produce measured values which exceed the specified limits. A detailed analysis is possible using the “Path diagnosis” tab.
4	Indicates that the hardware write protection is set.
5	An active bit indicates the faulty path(s).
6	
7	
8	
9	The calculated check sum for the device parameters which is custody relevant is not identical to the stored one.
10	The parameter plausibility test produced an error. The parameters must be checked.
11	A flashing bit indicates a flow out of range.
12	The current measured value exceeds the specified measuring range value of the respective output channel (frequency, current).
13	The system controller was unable to initialize the DSP. This may be caused by a hardware error on the SPU board.
14	This bit indicates whether or not the system is able to correct possible path failure with the help of the adaptive path failure compensation routine (see *Operating Manual, Section 2.8*). This bit is inactive when a meter is commissioned. It will not be activated before completion of the first 10,000 individual measurements which form a basis for a path failure compensation.
15	One or more parameters are implausible and would cause calculation errors in the DSP algorithm.

2.6

Path status



Detailed information about the current path status is stored in the path status register in binary encoding, grouped into information, warnings and errors.

- Register #3004 “Path 1 status”
- Register #3005 “Path 2 status”
- Register #3006 “Path 3 status”
- Register #3007 “Path 4 status”

The status of the corresponding bits in this register is signalled by status ‘lamps’ on the “Monitors / Device status” monitor (see Fig. 6). The status can also be monitored on the “Path diagnosis” page when logged on to the program on level 2 (“Connection” menu).

Category	Bit	Description
Self-diagnosis	0	Indicates a reduction of the amplitude of the received signal in relation to the background noise. Background noise is the sum of the electronic noise in the receiving unit and the acoustic noise coupled in to the ultrasonic transducer (e.g. caused by pressure regulators or valves which are near the measuring system) The background noise does usually not affect the device function, because ● The electronic noise is insignificant compared with the acoustic noise (as it is found in the frequency range below 100 kHz), whereas ● The ultrasonic transducers in the FLOWSIC600 DRU work at frequencies above 100 kHz.
	1	The AGC* levels of transducers A and B of a path should be almost identical. Differences may be caused by attenuation of the signal transmitted against the direction of flow at a high gas velocity. The AGC deviation limits in the parameter table should be set for the max. possible velocity of gas in the application concerned. Increased deviations of the AGC levels at low or high gas velocities in comparison with standard conditions or the conditions during commissioning may indicate transducer wear in the path concerned. When the deviation limits are exceeded it is recommended to check the shape of the received signal.
	2	Pressure changes affect the acoustic coupling of the transducers and thus the required reception sensitivity. The receiver electronics unit works with a bandwidth of 98 dB (1:64000). This bandwidth is sufficient for an operating pressure range from ambient pressure to 150 bar (2200 psig) for all meter sizes. The max. AGC level should be identical to the value determined at the lowest operating pressure in the application concerned.
	3	The velocity of sound is affected by the thermo-physical properties and the actual condition of the gas (pressure and temperature). The temperature has a greater influence (square function) than the pressure. Normally, the velocity of sound values for each path should be very close to each other. A deviation of the velocity of sound in a path from the average value of all paths indicates a time measurement problem. If this bit is set, it is recommended to check the shape of the received signal. **Note** This warning may be neglected if the following conditions apply: ● Solar radiation and no or low flow, which leads to thermal stratification in the meter body and thus to a great variation of the velocity of sound values among the individual paths. ● Passage of different gases (e.g. nitrogen as a purge gas).
	4	Signal from the DSP is being read.

* AGC = Automatic Gain Control

Signal processing	5	Division by zero during signal processing. Signal processing was terminated.
Signal quality	6	The amplitude of the received signal exceeded 95% of the ADC input range. Processing of this signal was terminated. Signals can be highly dynamic in particular with faulty flow profiles. In these rare cases it may be advisable to reduce the control level of the signal amplitude to 50% of the ADC* range in order to decrease the number of rejected signals.
	7	The amplitude of the received signals is below the level set at the factory (register #3509 “MinAmplitude”). Processing of this signal was terminated. Possible reasons: ● Error in the electronics unit ● Transducer failure ● Velocity of gas above the max. permitted value ● Foreign objects in the signal path
	8	The received signal is too close to the start time of the time window (Fig. 7). The shape of the received signal should be checked.
	9	The received signal is too close to the end time of the time window (Fig. 7). The shape of the received signal should be checked.
	10	The amplification of the received signal exceeds the AGC limit set at the factory (register #3515 “WarningAGC”). The signal level is too low, signal processing is affected by internal electronic noise, which may reduce the accuracy of the signal transit time measurement. Reasons may be defective transducers or depositions on the transducer surface. Both transducers of the path concerned should be checked.
	11	The received signal exceeds the SNR limit set at the factory (register #7211 “WarningSNR”). The signal is too high, the measured values are thus not reliable. The shape of the received signal should be checked. Eliminate possible noise sources.
Signal processing	12	An iterative algorithm is used to process the received signals. This flag indicates that no convergence was found in the specified number of repeated calculations. The results will not be processed further and signal processing will be terminated.
	13	The transit time of the received signal is determined by three independent algorithms. The results of these algorithms must be within half a signal period (cycle). If this is not the case, signal processing will be terminated.
	14	The test cycle of the path(s) concerned is active/inactive.
Signal processing	15	The signal processing algorithm repeatedly tries to adapt the theoretically determined signal model to the actually received signal. The difference between theoretical and actual signal shape (also known as mean square error MSE) serves as a quality parameter. MSE = 0.000: The received signal is absolutely identical to the theoretical model. This ideal case is only possible mathematically. The MSE is therefore always greater than zero. MSE < 0.001: 99.9% of the received signal were able to be processed and used. MSE < 0.010: 99.0% of the received signal were able to be processed and used. If this bit is set, the difference between the theoretical model and the actual signal is too great and has exceeded the limit set at the factory (register #7204). Processing of this signal will be terminated, because the result would not be reliable.

* ADC = Analogue-Digital Converter

Self-diagnosis category

The parameter table contains parameter limits, e.g. for the signal-to-noise ratio, AGC level and measured velocity of sound, the compliance with which is continuously monitored for each path by the measuring system. If a parameter exceeds the set limits, an alarm is triggered and the corresponding flag is set in the path status register.

Default limits are set at the factory which ensure normal function of the device. The limits are rather wide in order to avoid unnecessary alarms. However, most limits depend on the actual application and can be modified by the user to suit a specific installation.

Troubleshooting is very convenient when taking advantage of the self-diagnosis tool provided as a part of the MEPAFLOW600 CBM software (“Device diagnosis” and “Path diagnosis” tabs), provided some basic knowledge of ultrasonic measuring technologies.

Messages in this category indicate that the measuring system has detected a problem which needs to be attended to. However, measuring results in the path concerned are still valid.

Signal quality category

The received signals of the individual paths are displayed graphically on the “Path diagnosis” page. Start and end time, position and size of this time window (registers #3503 “InitWinSize” and #3504 “MeasWinSize”) are defined by the size of the meter body and the path length.

The strength of the received signal is influenced by the acoustic signal coupling (ultrasonic transducer $\rightarrow$ gas $\rightarrow$ ultrasonic transducer) and the ultrasonic attenuation in the gas. The measuring system controls the window position such that the signal amplitude peak is centred in the window. The maximum signal amplitude is set in the ADC level register #3510 “NormAmplitude”.

Messages in this category indicate that the signal is substantially weakened or even unusable.

Signal processing category

Messages in this category indicate that during signal processing a condition was detected in which the system was unable to complete the calculations and in which a complete measurement was therefore not possible.

FLOWSIC600 DRU

3 Output Configuration

Hardware variants
Hardware signal setting - jumper settings

3.1 Hardware variants

The output channels of the FLOWSIC600 DRU can be configured in several ways. Different output configurations require different hardware variants of the electronic unit. The individual electronics cards are described in detail in Section 8.

Table 2 Output configuration

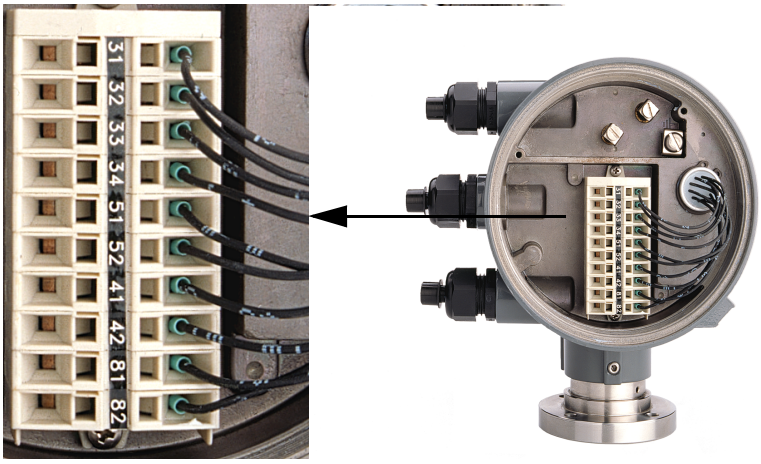
Terminal	Hardware variant /output configuration						
	1/1	1/2	1/3	2/4*	2/5**	3/6***	4/7
31/32	Pulse	Pulse	Status	Analogue	Analogue	p, T Sensor HART	Analog
33/34	RS-485	RS-485	RS-485	RS-485	RS-485	RS-485	RS-485
51/52	Pulse	Pulse	Pulse	Pulse	Status	Pulse	Pulse
41/42	Status	Status	Status	Status	Status	Status	Status
81/82	Status	RS-485	Status	Status	Status	Status	RS-485

* Can be fitted with HART(R) communication

** This configuration is used to activate the internal EVC function of the FLOWSIC600 DRU

*** Can be used for operation with integrated EVC when P and T transmitters are powered by FLOWSIC600 DRU

Figure 9 Terminals in the FLOWSIC600 DRU signal processing unit (cover openend)



3.2 Hardware signal setting – jumper settings

The jumpers on the back plane (see Fig. 11) must be set as desired and in accordance with the hardware version used (1, 2 or 3).

Figure 10 SPU without front panel

Figure 11 Back plane with jumper positions

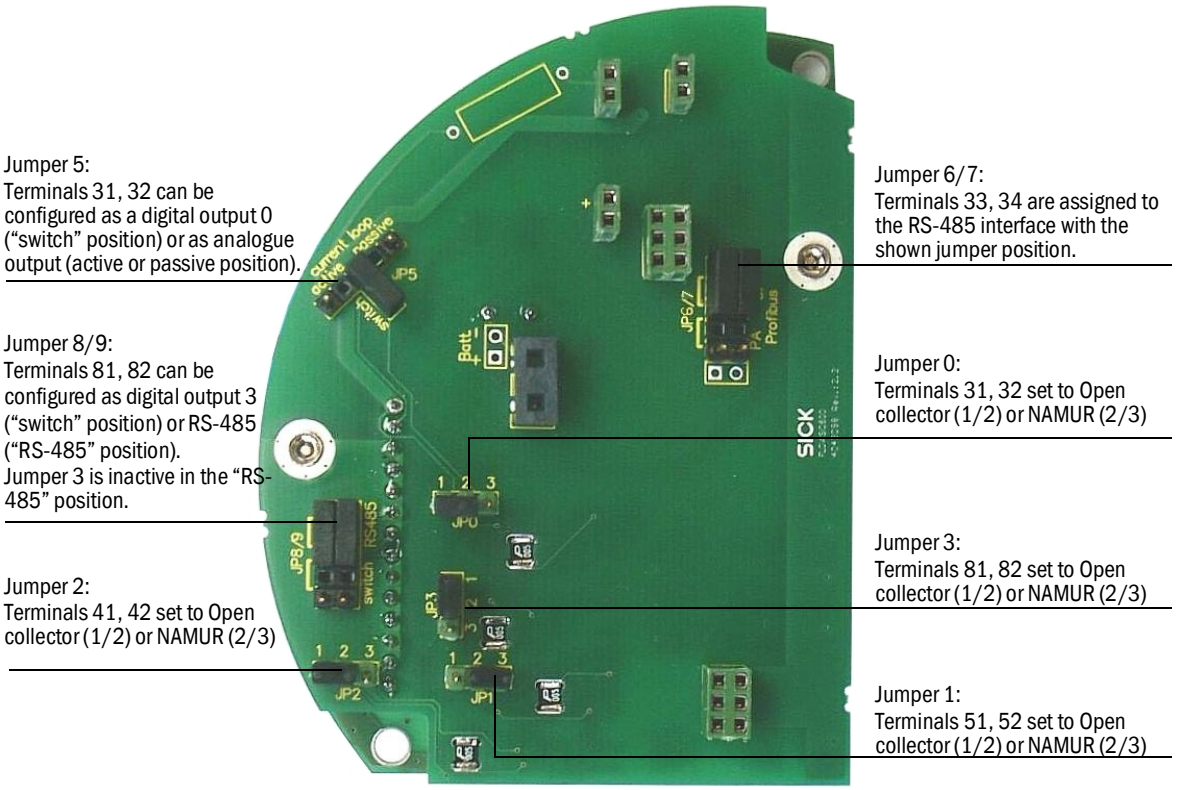


Figure 12 Hardware variant 1, output configurations 1 and 3, with “Open collector

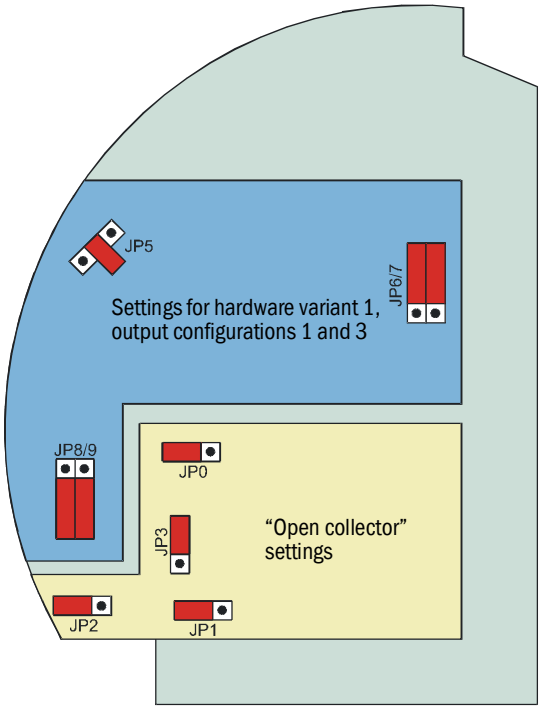


Figure 13 Hardware variant 1, output configuration 2, with NAMUR

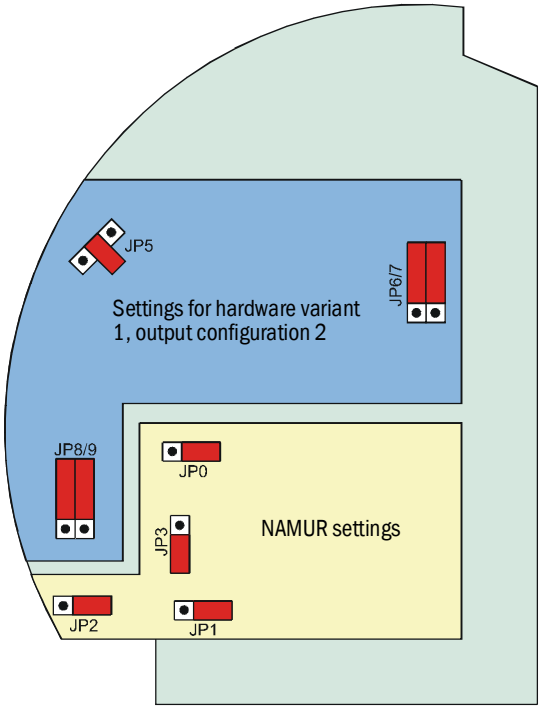


Figure 14 Hardware variant 2, output configuration 4, with active AO and “Open collector”

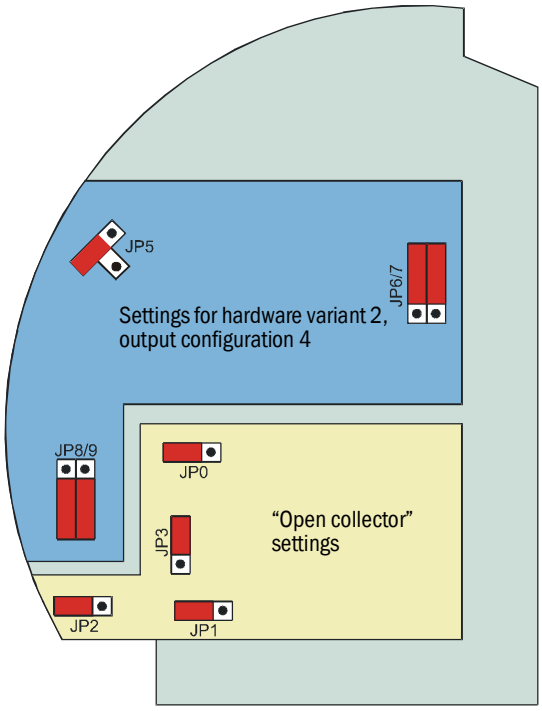


Figure 15 Hardware variant 2, output configuration 5, with passive AO and NAMUR

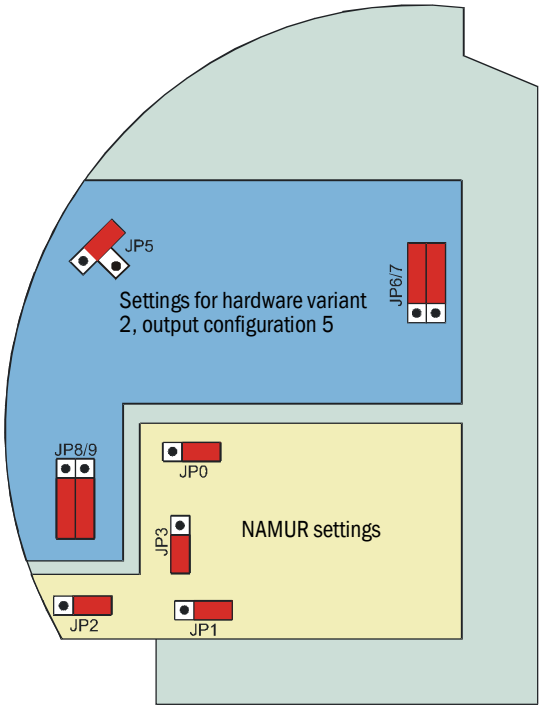
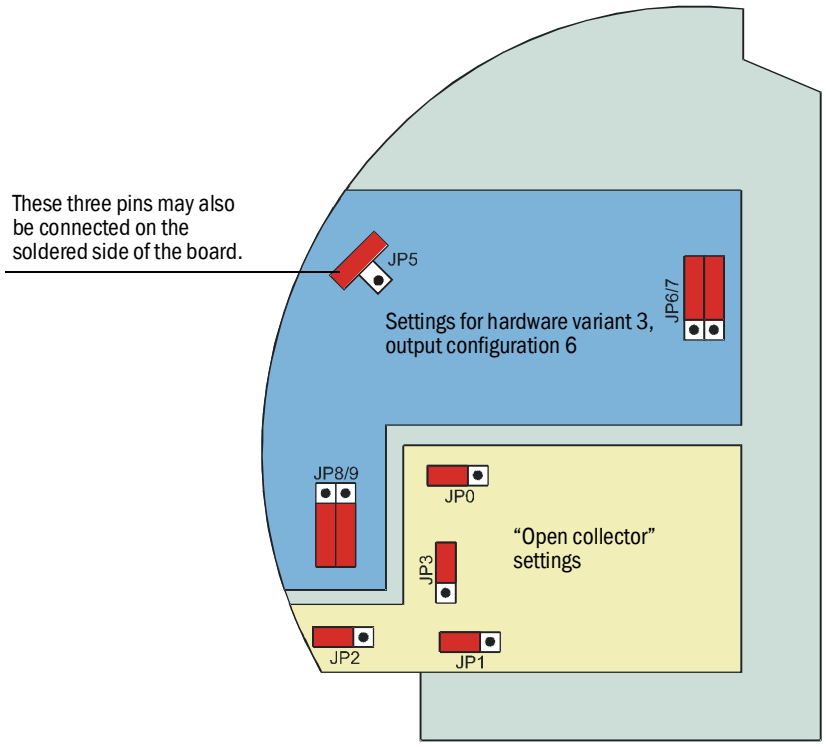


Figure 16 Hardware variant 3, output configuration 6, with “Open collector”



FLOWSIC600 DRU

4 Measured Value Outputs and Interfaces

Pulse output
Status outputs
Analogue output
RS-485 serial interface

CAUTION:
Always observe all relevant safety instructions when working on the FLOWSIC600 DRU.

4.1 Pulse output

4.1.1 General

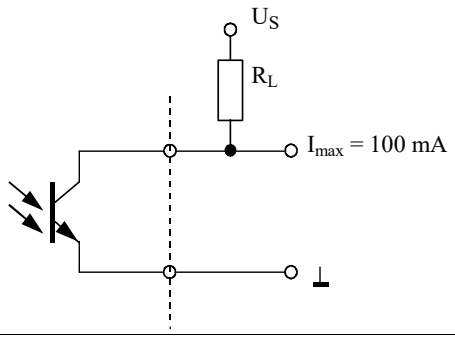
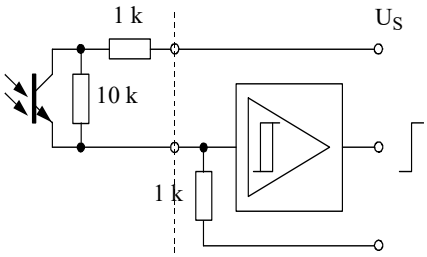
The measured values of the operating volumetric flow (register #7001) or normalised volumetric flow (register #7002) are output as a pulse sequence to terminals 31, 32 (DO0) and 51, 52 (DO1) in accordance with the selected output configuration (see Section 3.1).

Various interdependencies can be set between the two pulse outputs (see Operating Manual, Section 2.5.5 and Technical Information).

If the output frequency exceeds 5 kHz, the “Range Overflow” bit will be set in the status register. The output frequency is limited to 6 kHz and this value will be maintained even if a greater set-point value is calculated.

Electrical properties

Table 3 Electrical properties

Setting	Open collector	NAMUR (factory setting)
		
Output	electrically isolated, passive	
Output current	max. 100 mA	
Short circuit behaviour	short-circuit-proof: The corresponding fuse on the fuse board will be destroyed.	
	With output currents of > 100 mA and if U_S is supplied without pull-up resistor	With output currents of > 100 mA
Max. output frequency	6 kHz	
Pulse duration	50 ... 1000 m	
Supply voltage U_S	30 V	8.2 V
Switch status ’closed’	$0\ V \le U_{CE\ L} \le 2\ V$, $2\ mA \le I_{CE\ L} \le 20\ mA$	I_0 = 6.5 mA
Switch status ’open’	$16\ V \le U_{CE\ H} \le 30\ V$, $0\ mA \le I_{CE\ H} \le 0{,}2\ mA$	I_0 = 0.8 mA

Output update

The output values are updated in accordance with the setting in the “PulseUpdateRate” register (register #7043), value range: 100 ms ... 1 s, factory setting: 1s.

Scale

$$f[kHz] = \frac{Q\left[\frac{m^3}{h}\right]}{3600} \bullet \text{pulse value}\left[\frac{1}{m^3}\right]$$

The “Pulse value” parameter is saved in register #7027.

4.1.2 Testing

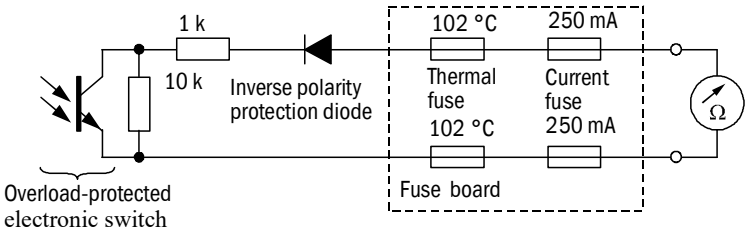
Testing the output circuit

In order to test the correct function of the output circuits with inverse polarity protection diode, fuses and overload protection, a multimeter must be connected to terminals 31, 32 or 51, 52 (see Fig. 17) while the FLOWSIC600 DRU is turned on in order to measure the output resistance.

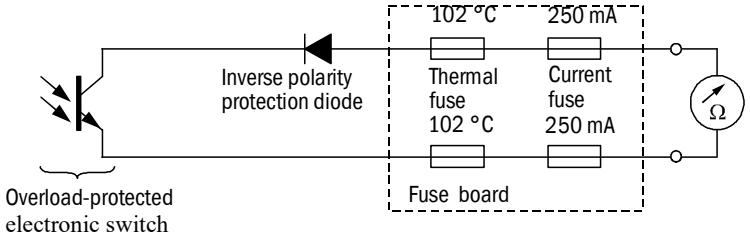
CAUTION: Other devices besides the multimeter, such as a flow computer, must not be connected to the output to be tested.

Figure 17 Electric test of the pulse outputs

NAMUR



Open collector



In order to turn the device to a certain switch state, the FLOWSIC600 DRU must be connected with the control and configuration programme MEPAFLOW600 CBM. Call up the “I/O Check menue, go to Terminal 51/52, go to Status test and set the switch as desired (see Fig. 18).

Result:

The resistance readings displayed at the multimeter should be distinctly different during the two switch states ON and OFF. If not, the fuse board must be replaced (see Sections 7.2.5 and 7.2.6).

Figure 18 Status test digital output, Terminal 51/52

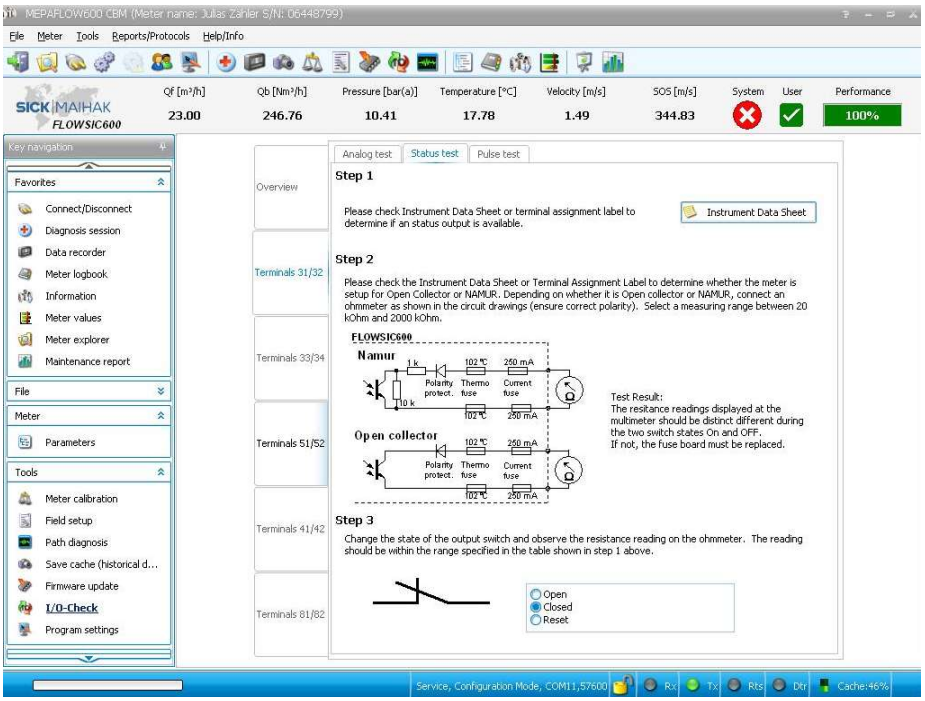
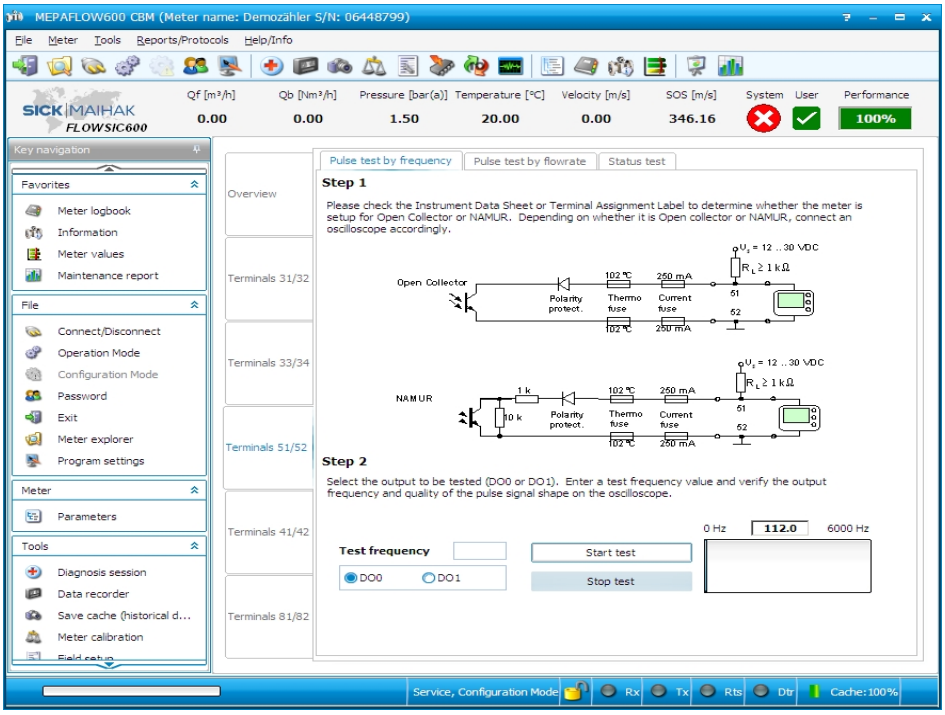


Figure 19 Adjust test frequency



Testing the pulse dignals

The quality of the pulses can be tested with the help of an oscilloscope, as shown in Fig. 20, while the FLOWSIC600 DRU is turned on. The test frequency can be edited in the control and configuration programme MEPAFLOW600 CBM, I/O-Check, Terminals 51/52, Pulse test by frequency (see Fig. 19). The shape of the signal should be as shown in Fig. 21

CAUTION:

- Other devices besides the oscilloscope, such as a flow computer, must not be connected to the output to be tested.
- U_S in Fig. 20 is an auxiliary voltage to be supplied by an external source. It must not be mixed up with the standard supply voltage (this concerns in particular the case where NAMUR settings are used).

Figure 20 Testing the signal quality

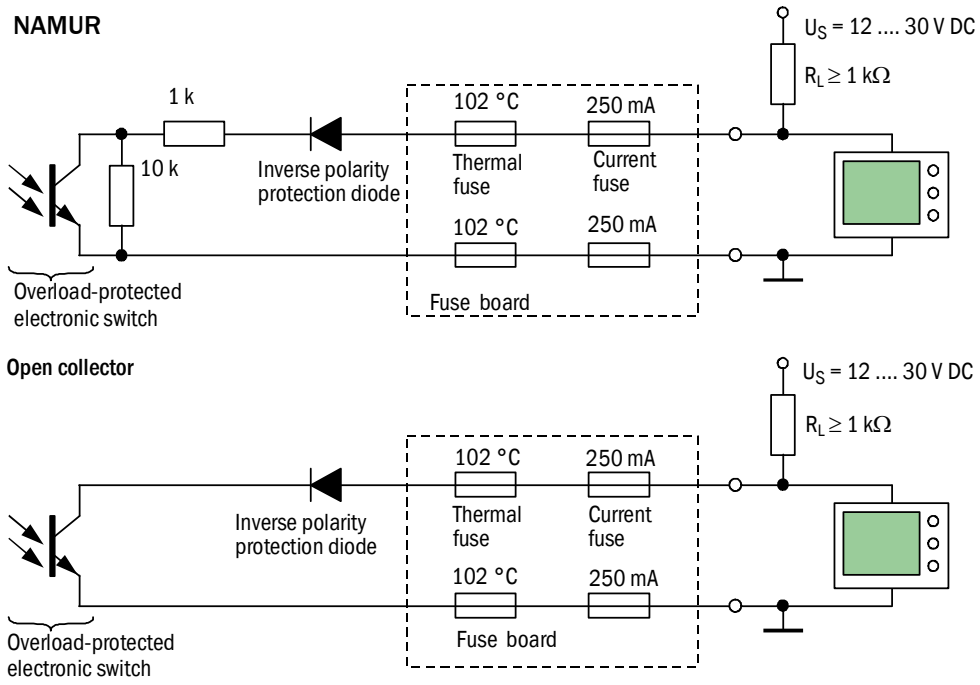
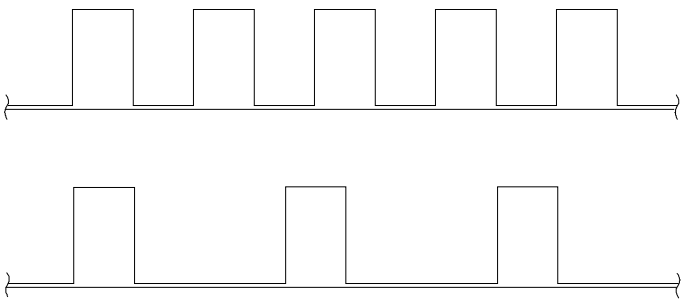
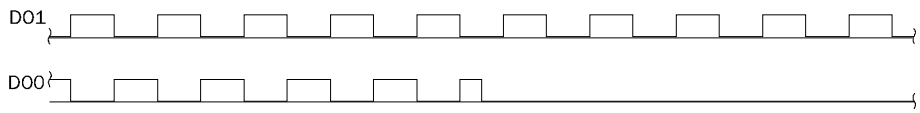
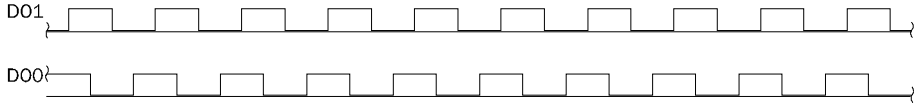
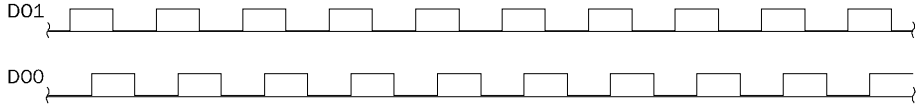
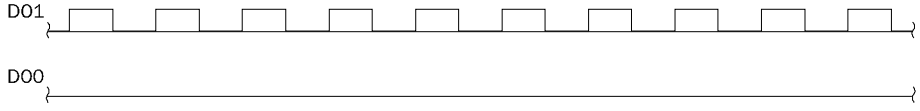
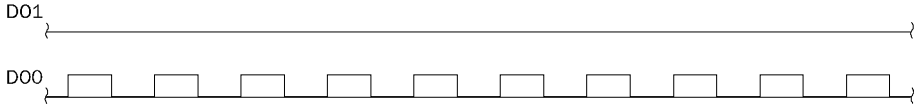
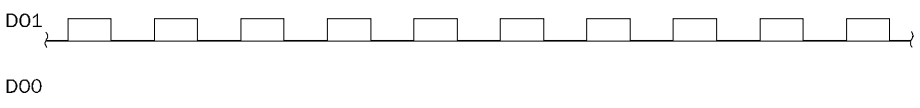


Figure 21 Pulse signal shapes



When testing the pulse outputs, note that their behaviour depends on the configured output mode (“Parameters” page, see Fig. 19).

Figure 22 Pulse output

Output signal / LCD / port			Signal behavior			
			Measurement state	Check request state	Configuration Mode	Measurement invalid*
Pulse output signals	Inverted with error signal **					
	Phase shift 90 ° ***	Positive flow rate				
		Negative flow rate				
	Separate outputs for each direction ***	Positive flow rate				
		Negative flow rate				
	Single pulse output ***					

* Default setting on delivery

** Optional setting on customer request

*** The “active” or “inactive” state can be assigned to the electric switch status “normally open” or “normally closed” by configuration in the MEPAFLOW600 CBM software (adjust settings for register #5101 on the “Parameters” screen, also see the next Sections in this maual). The default setting for “Check request”, “Configuration” and “Measurement invalid” is “normally closed”.

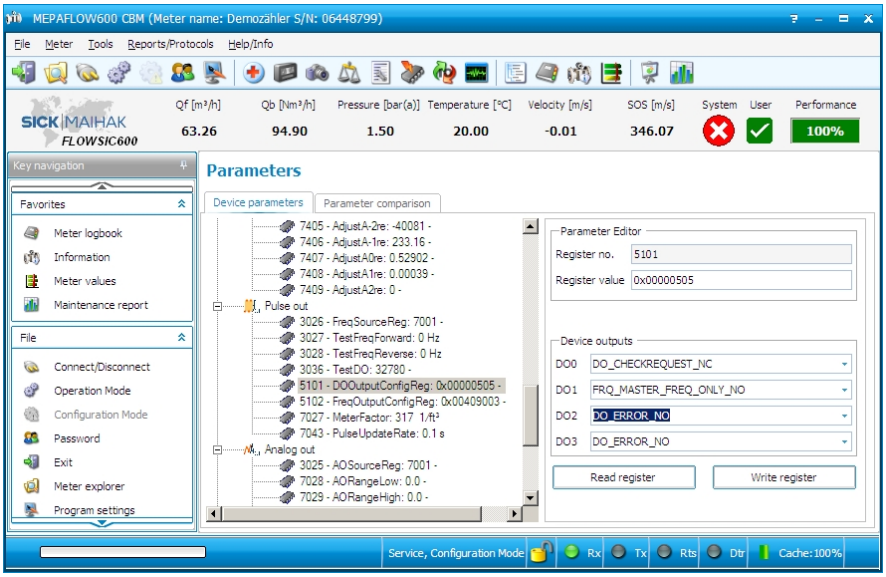
4.2 Status outputs

4.2.1 General

The FLOWSIC600 DRU provides up to 3 status outputs which indicate the operational states error, warning, check request and flow direction. These status signals can be assigned to the outputs DO0 to DO3 with the help of the MEPAFLOW600 CBM, sheet “Parameters” (see Fig. 23).

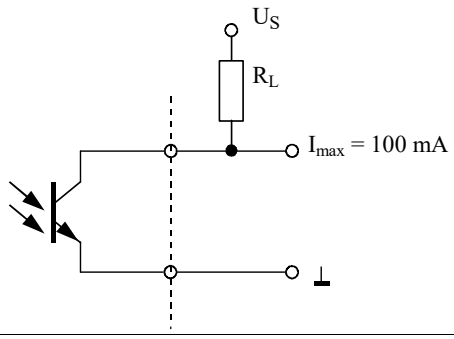
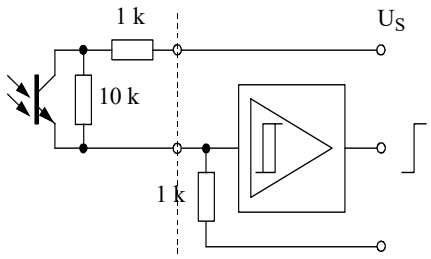
The logical assignment (*active high* or *active low*) is done in register #5101.

Figure 23 Output configuration



Electrical properties

Figure 24 Electrical properties

Setting	Open collector	NAMUR (factory setting)
		
Output	electrically isolated, passive	
Output current	max. 100 mA	
Short circuit behaviour	short-circuit-proof: The corresponding fuse on the fuse board will be destroyed.	
	With output currents of > 100 mA and if U_S is supplied without pull-up resistor	With output currents of > 100 mA
Max. output frequency	6 kHz	
Pulse duration	50 ... 1000 m	
Supply voltage U_S	30 V	8.2 V
Switch status ’closed’	$0\ V \le U_{CE\ L} \le 2\ V$, $2\ mA \le I_{CE\ L} \le 20\ mA$	I_0 = 6.5 mA
Switch status ’open’	$16\ V \le U_{CE\ H} \le 30\ V$, $0\ mA \le I_{CE\ H} \le 0.2\ mA$	I_0 = 0.8 mA

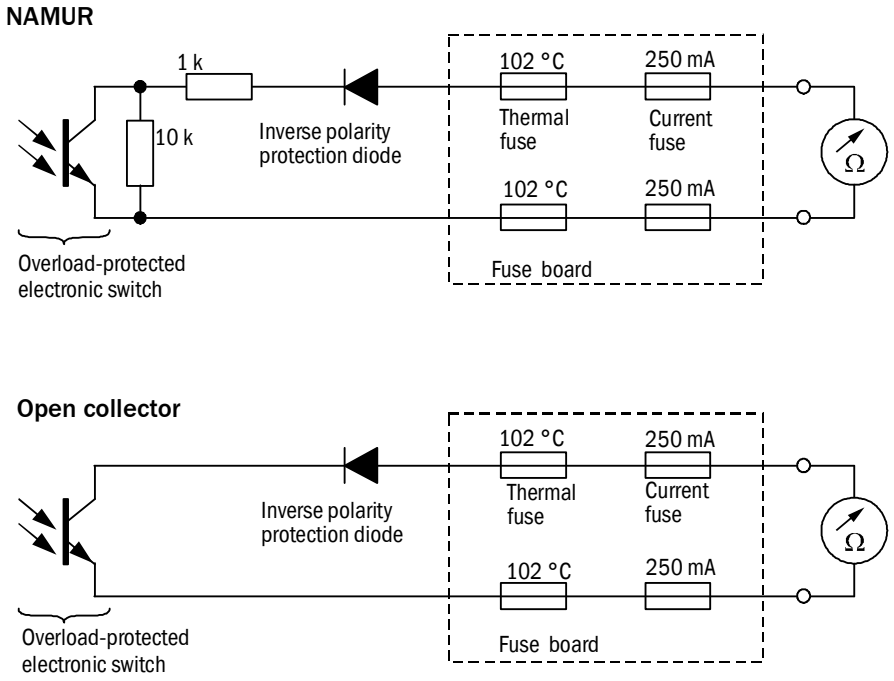
4.2.2 Testing

Testing the output circuit

In order to test the correct function of the output circuits with inverse polarity protection diode, fuses and overload protection, a multimeter must be connected to the respective terminals (see Fig. 17) while the FLOWSIC600 DRU is turned on in order to measure the output resistance.

CAUTION:
Other devices besides the multimeter, such as a flow computer, must not be connected to the output to be tested.

Figure 25 Electrical test of the pulse outputs



The switch states can be changed on the menue “I/O-Check”

Result:

The resistance readings displayed at the multimeter should be distinct different during the two switch states ON and OFF. If not, the fuse board must be replaced (see Sections 7.2.5 and 7.2.6).

4.3 Analogue output

4.3.1 General

The analogue output is only available with the hardware variant 2. It can be fitted optionally with a HART(R) communication interface.

Electrical properties

Working principle: active or passive (jumper settings see Section 3.2)

Figure 26 Active analogue output

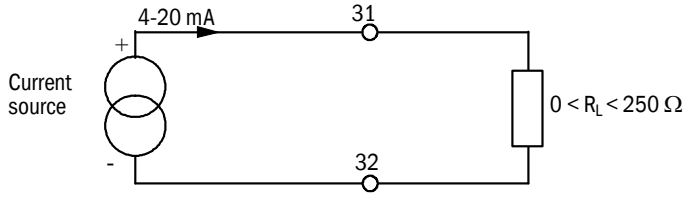
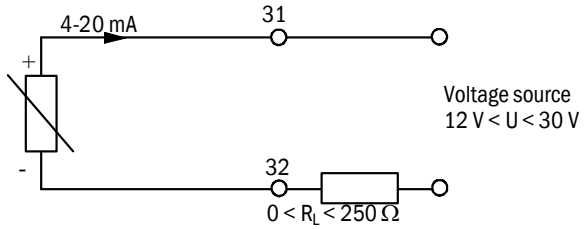


Figure 27 Passive analogue output



The analogue output is updated after each measuring cycle.

The current value to be output in the case of a malfunction can be edited in register #7032.

> ***NOTICE:***
> If the analogue output is set to “active”, the minimum input voltage will increase from 12 V to 15 V. This means that solar power supply will no longer be possible.

Scale

$$I_{out} = 16\ mA \cdot \frac{Q - AORangeLow}{(AORangeHigh - AORangeLow)} + 4\ mA$$

Q:	Actual volumetric flow rate, normalised volumetric flow rate, velocity of sound, mass flow rate, molecular weight
AORangeHigh:	Upper range limit (must be set)
AORangeLow:	Lower range limit (must be set)

4.3.2 Testing

CAUTION:
Always disconnect the measuring system from the power supply and connect it to earth before you connect or disconnect cables at the terminal block in the SPU.

- ► Disconnect the cable from terminals 31, 32.
- ► Connect an ammeter instead of R_L in Fig. 26 and Fig. 27.
- ► Select the **"Device diagnosis"** tab in the MEPAFLOW600 CBM programme.
- ► Enter a test value in the "Analogue output" box.
- ► Measure the output current.

If there is no current or if the meter reading does not correspond with the entered test value, check the following:

- Hardware variant setting (must be variant 2)
- Polarity at terminals 31 (+) and 32 (-)
- Load resistor (max. 250 Ω)
- Jumper setting for the current loop (active: pin 1-2, passive: pin 2-3)
- External power source for the passive circuit (U > 12 V)

4.4 RS-485 serial interface

A serial interface (RS-485) for data transfer is available at terminals 33 and 34. In the output configuration 2 (see Section 3.1), an additional RS-485 interface is available at terminals 81 and 82.

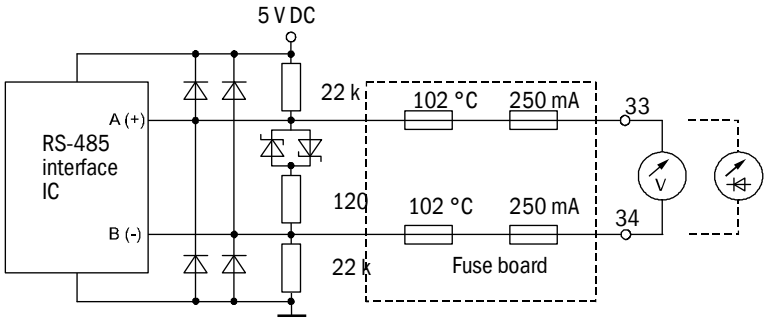
Testing the interface

In order to test the correct function of the output circuits with inverse polarity protection diode, fuses and overload protection, as well as the power supply of the interface IC, a multimeter must be connected to the respective terminals (see Fig. 28) while the FLOWSIC600 DRU is turned on in order to measure the voltage. The output resistance must be measured with the help of the multimeter while the FLOWSIC600 DRU is turned off.

CAUTION:
Other devices besides the multimeter, such as a flow computer, must not be connected to the output to be tested.

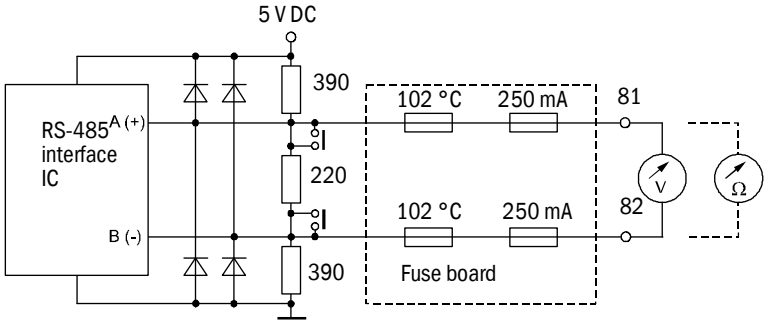
Figure 28 Electrical test of the interface outputs

Standard RS-485 at terminals 33 and 34



1 Voltage measurement. Approx. 270 mV while the device is turned on → power supply to the interface IC, network and fuses are ok.
2 Diode testing 400 ... 500 mV while the device is turned off → network and fuses are ok.

Standard RS-485 at terminals 81 and 82



1 Voltage measurement Approx. 1 V while the device is turned on → power supply to the interface IC, network and fuses are ok.
2 Resistance measurement. Approx. 220 Ω while the device is turned off → network and fuses are ok.

FLOWSIC600 DRU

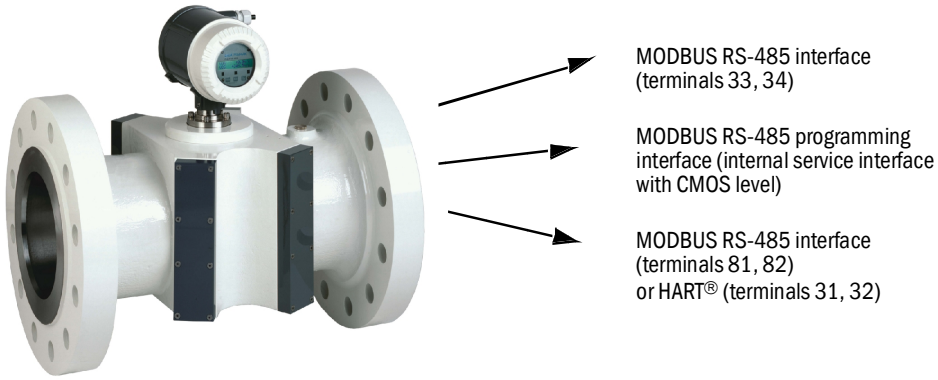
5 Serial Interfaces

Programming interface
MODBUS RS-485 interface

Available interfaces

The FLOWSIC600 DRU has up to three independent serial interfaces. A MODBUS RS-485 interface (terminals 33, 34) and the MODBUS RS-485 programming interface* are available as a standard. In the hardware variant 1, output configuration 2, another RS-485 interface is available at terminals 81, 82 (see section 3.1)

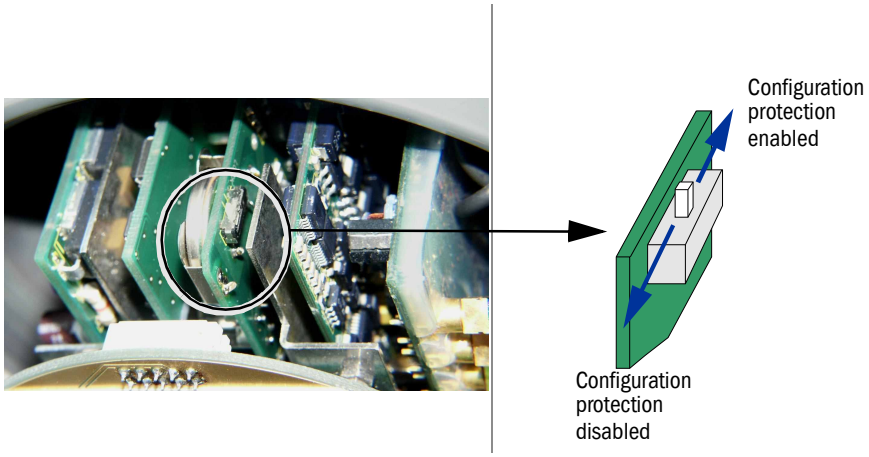
Figure 29 Serial interfaces at the FLOWSIC600 DRU



Configuration protection switch

In order to prevent unauthorised modifications to parameters, the entire parameter memory section can be protected by activating the configuration protection switch. This only allows data to be read through the interfaces, but not to be edited. The configuration protection switch is located in the signal processing unit, under the sealed front panel (mechanical and official seal).

Figure 30 Configuration protection switch



* Can only be accessed after removing the front cover of the housing.

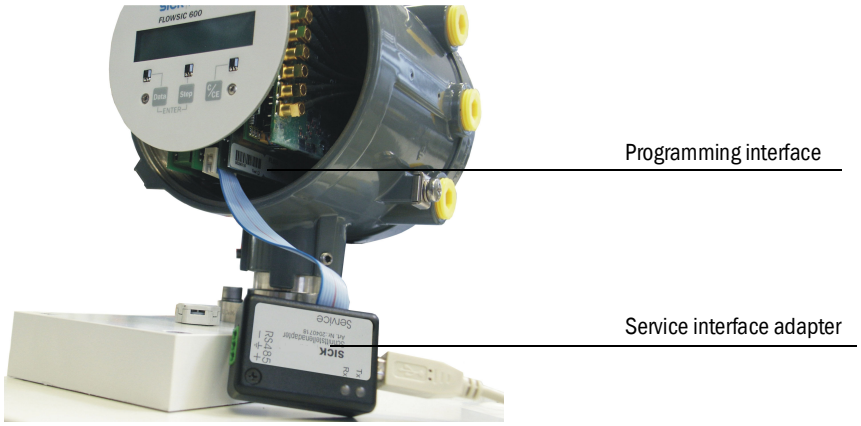
5.1 Programming interface

The programming interface (in-system programming) provides access to the entire device software (DSP and system controller) and to the parameter memory section of the system controller. Firmware can for example be uploaded with the help of the MEPAFLOW600 CBM and a service interface adapter, which provided the necessary control signals. Data will be written serially to the Flash ROM. The serial interface of the system controller will be used for that. The FLOWSIC600 DRU will not supply any measured values during this process.

In addition, the service interface adapter can also be used as a 'normal' interface adapter between the programming interface and an USB port on the PC. The scope of commands and the interface protocol are identical without any restrictions to the MODBUS interface RS-485.

Further details about interface handling and software upload can be found in section 8.

Figure 31 Programming with service interface adapter



5.2 MODBUS RS-485 interface

The MODBUS RS-485 interface can be used for configuration and for transmission of measured and diagnosis values. Write access to the parameters is controlled through passwords (see Table below). Read access is always possible without password protection.

The FLOWSIC600 DRU communicates as a slave or in the burst mode. If it acts as a slave device, the FLOWSIC600 DRU will only answer to query commands; and in the burst mode it will cyclically send data packages to the BUS, so that connected devices can read these data without having queried.

The MEPAFLOW600 CBM can only communicate with the FLOWSIC600 DRU via MODBUS ASCII.Cabling, settings and troubleshooting see FLOWSIC600 Manual Section 2.1 and 2.2.

User	Access level	Notes	Password #3024	References to the weights and measures regulations
Operator	0	Only information relevant for display and recording is provided, parameters cannot be modified. Device logbook: Error volume counter can be reset (display, operator tool)	Not required	No unsecured configurations possible, logbook registration for resetting the error volume counters
Authorized Operator	1	For trained staff: I/O parameters can be modified, otherwise see level 0	“xxxx” * Required, cannot be changed.	Secured configuration of the parameters in access level 1 possible
Service (field)	2	Any diagnosis information available. Parameters can be modified, but no access to signal models. Software update possible	“yyyy” * Required, cannot be changed	Secured configuration of the parameters in access level 2 possible
Service (manufacturer)	3	No restrictions	“zzzz” * Required, cannot be changed	Secured configuration of all parameters possible

* The required passwords are provided where appropriate in the Service Manual.

Data protocol

Transfer rate:	9,600 bps (standard), 19,200 bps, 38,400 bps, 57,600 bps
Start bits:	1 bit
Data bits:	8 bit
Stop bits:	1 bit
Parity bits:	none

5.2.1 MODBUS ASCII

Telegram structure

In the case of data transfer with the ASCII protocol, two bytes of ASCII code (0-9, A-F) are used to represent a data byte. The communication frame is opened with a ':' as preamble and closed with the string 'carriage return (CR) line feed (LF)' as postamble.

Start	Address	Function	Data	LRC Check	End
1 Char	2 Chars	2 Chars	n Chars	2 Chars	2 Chars
0x3A	1 - 127	1 - 255			0x0D 0x0A

Timeout

The max. permitted response delay for a query is 2 seconds. The max. permitted timeout delay between two received characters is 1 second. Generally, each query is responded to within a measuring cycle, but not later than during the subsequent measuring cycle (typically faster than about 100 ms). If the downstream data transfer equipment requires greater response delays for switching the data transfer direction, an additional delay (100, 200 ... 1000 ms) can be configured with the help of the parameter "MODBUSDelay" (register #5022, #5025, #5028).

Error recognition

A check sum (LRC = Longitudinal Redundancy Check)) is appended to the data in order to secure the data which are transferred in the communication frame. This 8-bit check sum is calculated by converting the hexadecimal characters into 8-bit binary characters and subsequent addition of all binary characters while neglecting the overflow flag. Finally, the two's complement of the summation is calculated. Preamble and postamble are not considered in the calculation of the check sum.

Slave address

Slave addresses in the range of between 1 and 127 can be used (register #5020). After a parameter reset, the address is "1" (default setting). When using the broadcast address '0', the system will always return the configured address.

5.2.2 MODBUS RTU

Telegram structure

With the RTU format, data are transferred in the binary format. Possible characters are 0–9 and A–F (hexadecimal characters).

Start	Address	Function	Data	CRC check	End
	8 Bit	8 Bit	n x 8 Bit	16 Bit	
3.5 t_{Byte}	1 - 127	1 - 255		CRC low, CRC high	3.5 t_{Byte}

Character length at 57,600 baud:

t_{Bit} = 1/57600 = 17.36 µs $\rightarrow$ t_{Byte} = 10 Bit * 17.36 µs = 173.6 µs

Timeout

In order to start a telegram in the RTU mode, there must be a pause of at least 3.5 byte times. The entire telegram must be transferred in a continuous stream. If the transfer pauses for more than 1.5 byte times, the current telegram will be abandoned.

Error recognition

When taking advantage of the RTU format, check sum is also calculated as described for the ASCII protocol. This check sum is calculated as the CRC sum of the entire data section of the telegram.

The CRC sum is represented by a 16-bit number, divided into two bytes. The lower-valued byte is entered first in the telegram, followed by the higher-valued byte.

CRC: Cyclic Redundancy Check

5.2.3 Recommended MODBUS register for communication with a flow computer

Register	Register #	Notes
Velocity of gas, path 1	7009	
Velocity of gas, path 2	7010	
Velocity of gas, path 3	7011	
Velocity of gas, path 4	7012	
Velocity of gas, sound 1	7005	
Velocity of gas, sound 2	7006	
Velocity of gas, sound 3	7007	
Velocity of gas, sound 4	7008	
Average velocity of gas	7004	
Average velocity of sound	7003	
Flow rate	7001	
Volume counter, forward	5010	
Volume counter, reverse	5012	
Error volume counter, forward	5011	
Error volume counter, reverse	5013	
Amplifier gain control (AGC) A → B 1	3012	
Amplifier gain control (AGC) B → A 1	3013	
Amplifier gain control (AGC) A → B 2	3014	
Amplifier gain control (AGC) B → A 2	3015	
Amplifier gain control (AGC) A → B 3	3016	
Amplifier gain control (AGC) B → A 3	3017	
Amplifier gain control (AGC) A → B 4	3018	
Amplifier gain control (AGC) B → A 4	3019	
Signal noise ratio (SNR) A → B 1	7013	
Signal noise ratio (SNR) B → A 1	7014	
Signal noise ratio (SNR) A → B 2	7015	
Signal noise ratio (SNR) B → A 2	7016	
Signal noise ratio (SNR) A → B 3	7017	
Signal noise ratio (SNR) B → A 3	7018	
Signal noise ratio (SNR) A → B 4	7019	
Signal noise ratio (SNR) B → A 4	7020	

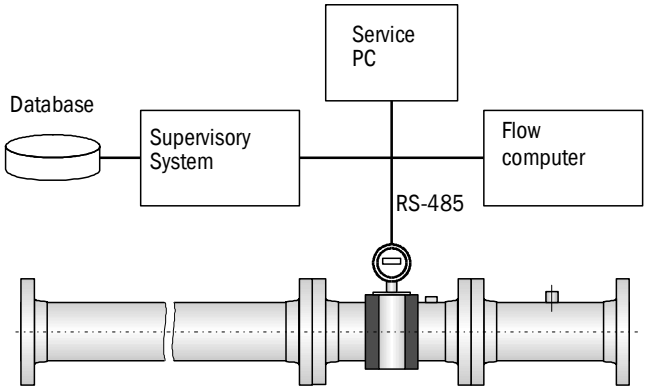
Percent error, path 1	3008	in correspondence with register #5014
Percent error, path 2	3009	
Percent error, path 3	3010	
Percent error, path 4	3011	
Number of paths	3500	
Serial number	5003	
System status	3003	
Status, path 1	3004	
Status, path 2	3005	
Status, path 3	3006	
Status, path 4	3007	

5.2.4 Burst mode

A burst mode was implemented in order to enable the FLOWSIC600 DRU to transfer data to more than two devices. Data packages are cyclically sent on to the RS485 bus. Connected devices can read these data without having sent a query. The FLOWSIC600 DRU should act as the master device in order to avoid bus conflicts.

The telegram structure of the data packages complies with the MODBUS ASCII specification. Data can thus be read in the same way as if it was queried when the cyclic transfer was not activated. All values in the data blocks are simple copies of the values which are stored in the respective registers at the moment of data transfer (e.g. flow rate or gas velocity).

Figure 32 Communication possibilities



Temporal behaviour

The longest data structure has 33 positions (32 bit). When taking advantage of the ASCII protocol, 8 characters are possible per position, i.e. altogether 264 characters. The data structure uses the standard MODBUS protocol frame with 11 additional characters (preamble, address, function code, byte count, LRC, postamble). Then, the transfer time at the lowest baud rate of 9,600 baud is

131 characters • 11 bit/character / 9,600 bit/s = 0.15 s.

At a minimum transfer time of 1 s, communication with the FLOWSIC600 DRU as slave device is possible at 85% of the time. This enables a control by a different device as the master device (e.g. a PC with the control and configuration programme MEPAFLOW600 CBM).

Register definition

INT: 2-byte integer
LIN: 4-byte long int
FLOAT: 4-byte float

Register	Range	Unit	Type	Description
#5024	0 ... 10	s	LINT	Duration of the cyclic data transfer 0: deactivated >0: The FLOWSIC600 DRU transfers cyclically the data frame (communication channel in hardware version V2.x; channel 1 uses register #5029, channel 2 uses register #5034
#5025	#5200 or #5207 or #5224	-	LINT	Source (start register) of the structure to be transferred #5200: Flow rate, velocity of sound, the four volume counters, system status #5207: In addition: status, velocity of sound, and velocity of gas per path #5224: In addition, the signal-to-noise ratio and and AGC level per path

Data block structure

Data blocks with three different structures can be sent.

The MEPAFLOW600 CBM generally uses English descriptions of the individual registers.

Type 1 structure (total size 28 bytes, seven long integer registers)

Register	Size	Unit	Type	Description
#5200				Type 1 structure (memory dump)
(#7001)	4 bytes	m^3/h	FLOAT	Current flow rate
(#7003)	4 bytes	m/s	FLOAT	Velocity of sound
(#5010)	4 bytes		LINT	Forward volume counter *
(#5012)	4 bytes		LINT	Reverse volume counter *
(#5011)	4 bytes		LINT	Forward error volume counter *
(#5013)	4 bytes		LINT	Reverse error volume counter *
(#3003)	2 bytes		UINT	System status
	2 bytes		UINT	Not used (just to complete the frame)

*:Calculation based on the incremental volume register and the counter resolution parameter

Type 2 structure (total size 68 bytes)

Register	Size	Unit	Type	Description
#5207				Type 1 structure (memory dump)
(#7001)	4 bytes	m^3/h	FLOAT	Current flow rate
(#7003)	4 bytes	m/s	FLOAT	Velocity of sound
(#5010)	4 bytes		LINT	Forward volume counter *
(#5012)	4 bytes		LINT	Reverse volume counter *
(#5011)	4 bytes		LINT	Forward error volume counter *
(#5013)	4 bytes		LINT	Reverse error volume counter *
(#3003)	2 bytes		UINT	System status
	2 bytes		UINT	Not used (just to complete the frame)
(#3004)	2 bytes		UINT	Path 1 status
(#3005)	2 bytes		UINT	Path 2 status
(#3006)	2 bytes		UINT	Path 3 status
(#3007)	2 bytes		UINT	Path 4 status
(#7009)	4 bytes	m/s	FLOAT	Velocity of gas in path 1
(#7010)	4 bytes	m/s	FLOAT	Velocity of gas in path 2
(#7011)	4 bytes	m/s	FLOAT	Velocity of gas in path 3
(#7012)	4 bytes	m/s	FLOAT	Velocity of gas in path 4
(#7005)	4 bytes	m/s	FLOAT	Velocity of sound in path 1
(#7006)	4 bytes	m/s	FLOAT	Velocity of sound in path 2
(#7007)	4 bytes	m/s	FLOAT	Velocity of sound in path 3
(#7008)	4 bytes	m/s	FLOAT	Velocity of sound in path 4

*:Calculation based on the incremental volume register and the counter resolution parameter

Type 3 structure (total size 118 bytes)

Register	Size	Unit	Type	Description
#5224				Type 1 structure (memory dump)
(#7001)	4 bytes	m^3/h	FLOAT	Current flow rate
(#7003)	4 bytes	m/s	FLOAT	Velocity of sound
(#5010)	4 bytes		LINT	Forward volume counter *
(#5012)	4 bytes		LINT	Reverse volume counter *
(#5011)	4 bytes		LINT	Forward error volume counter *
(#5013)	4 bytes		LINT	Reverse error volume counter *
(#3003)	2 bytes		UINT	System status
(#3004)	2 bytes		UINT	Path 1 status
(#3005)	2 bytes		UINT	Path 2 status
(#3006)	2 bytes		UINT	Path 3 status
(#3007)	2 bytes		UINT	Path 4 status
(#7009)	4 bytes	m/s	FLOAT	Velocity of gas in path 1
(#7010)	4 bytes	m/s	FLOAT	Velocity of gas in path 2
(#7011)	4 bytes	m/s	FLOAT	Velocity of gas in path 3
(#7012)	4 bytes	m/s	FLOAT	Velocity of gas in path 4
(#7005)	4 bytes	m/s	FLOAT	Velocity of sound in path 1
(#7006)	4 bytes	m/s	FLOAT	Velocity of sound in path 2
(#7007)	4 bytes	m/s	FLOAT	Velocity of sound in path 3
(#7008)	4 bytes	m/s	FLOAT	Velocity of sound in path 4
(#7013)	4 bytes	m/s	FLOAT	SNR in path 1 AB
(#7014)	4 bytes	m/s	FLOAT	SNR in path 1 BA
(#7015)	4 bytes	m/s	FLOAT	SNR in path 2 AB
(#7016)	4 bytes	m/s	FLOAT	SNR in path 2 BA
(#7017)	4 bytes	m/s	FLOAT	SNR in path 3 AB
(#7018)	4 bytes	m/s	FLOAT	SNR in path 3 BA
(#7019)	4 bytes	m/s	FLOAT	SNR in path 4 AB
(#7020)	4 bytes	m/s	FLOAT	SNR in path 4 BA
(#7013)	4 bytes	m/s	FLOAT	AGC in path 1 AB
(#7014)	4 bytes	m/s	FLOAT	AGC in path 1 BA
(#7015)	4 bytes	m/s	FLOAT	AGC in path 2 AB
(#7016)	4 bytes	m/s	FLOAT	AGC in path 2 BA
(#7017)	4 bytes	m/s	FLOAT	AGC in path 3 AB
(#7018)	4 bytes	m/s	FLOAT	AGC in path 3 BA
(#7019)	4 bytes	m/s	FLOAT	AGC in path 4 AB
(#7020)	4 bytes	m/s	FLOAT	AGC in path 4 BA

*:Calculation based on the incremental volume register and the counter resolution parameter

FLOWSIC600 DRU

6 Function Test

Function verification
Transducer test
No signal reception
Check cycle

6.1 Function verification

The correct function of the FLOWSIC600 DRU can be checked easily by testing the zero flow and speed of sound, and by taking advantage of the integrated self-diagnosis function. The tests can be conducted with air or gas and at atmospheric or high pressure; special gases (such as N2) and high gas pressure are not necessary.

Zero flow
Velocity of sound
Self-diagnosis

→ **FLOWSIC600** ✔

6.1.1 General

The measuring result is based on a transit time measurement of the ultrasonic signals in a geometrically precisely defined environment (meter body). It thus depends directly on the geometrical data of meter body (and ultrasonic transducers) and the electric properties of the electronic unit (and ultrasonic transducers).

Test options are:

- Verification of the geometry of the meter body by comparing the parameters entered in the software with the 3D measurement report:
  In addition, the correctness of these data can be verified by conducting a zero flow test (zero flow in the meter body) in conjunction with the device characteristic line of the gas meter.
- Verification of the correctness of the transit time measurement by testing the velocity of sound:
  Each gas or gas mix has a specific velocity of sound, which is dependent on temperature and pressure. This (theoretical) velocity of sound can be calculated (e.g. with the help of software programmes such as SonicWareTM or according to AGA Report No. 10) and compared with the velocities of sound measured in by the FLOWSIC600 DRU in each individual path. This comparison provides reliable information about the measuring accuracy of the transit time measurement.

See Section 2.5

- Using the integrated self-diagnosis functions:
  Status messages provide information about the correct function of the device and indicate possible malfunctions. If the Device status monitor does not indicate errors or warnings (see Fig. 6), the FLOWSIC600 DRU is working properly.

6.1.2 Testing the Zero Point and Speed of Sound

Zero point and Speed of Sound (SOS) tests can be conducted with the FLOWSIC600 DRU anywhere with air or gas, and at atmospheric or high pressure. Special test gases (such as N_2) and high gas pressure are not necessary with this measuring system. The two tests can be conducted at the same time.

Testing under laboratory conditions

Conditions for usable measuring results:

- The FLOWSIC600 DRU must be in a thermal equilibrium (storage in a test room at constant temperature for 24 h).
- Both flanges must be covered (standardised blind flanges are not necessary though.

Test criteria:

- The zero point measurement of the FLOWSIC600 DRU is ok if the velocities of gas measured in the individual paths do not exceed 12 mm/s.
- The velocity of sound measured by the FLOWSIC600 DRU is ok if its deviation from the calculated one does not exceed 0.2%.

Testing on the installation site

Notes on Zero Point Tests (ZeroFlowTest)

If the FLOWSIC600 DRU cannot be removed from the pipeline, at least the section of the pipeline where the gas meter is mounted must be shut off properly. Otherwise the zero flow test does not produce any useful results.

Measuring results must be evaluated under consideration of ambient conditions

Because there may be gas flows even though the pipeline (section) is shut off, e.g. caused by unequal heating of the pipe due to solar radiation, or possible leaks (of valves), laboratory values can hardly be achieved under field conditions because of said influences, all the more if you take into consideration that the FLOWSIC600 DRU has a very high sensitivity, so that gas velocities as low as 1 mm/s can still be detected securely. The smallest leak in the stop valves will therefore result in a flow rate greater than zero.

Test criterion:

The velocities of gas measured in the individual paths should not be greater than 12 mm/s while the FLOWSIC600 DRU is fully isolated.

Notes on the Speed of Sound Test

Temperature has a major impact on the determination of the velocity of sound, both as regards the measuring results found with the FLOWSIC600 DRU, and the theoretical calculation. Measuring installations with temperature stratification in the gas pipeline should therefore be avoided, because otherwise different velocities of sound may be measured in the individual paths.

If measured and theoretical velocities of sound differ significantly, make sure the geometrical and transducer parameters are entered correctly in the configuration table (for configuration tables see the Operating Instructions, Section 8.4.7) and transducers and electronics unit are working properly.

Only valid for constant gas composition

Temperature stability is of major importance for these measurements. The latter can be tested with the help of the FLOWSIC600 DRU. A change in the velocity of sound of 0.2 m/s or more during a test may indicate a temperature variation of 0.3 K.

Test criteria:

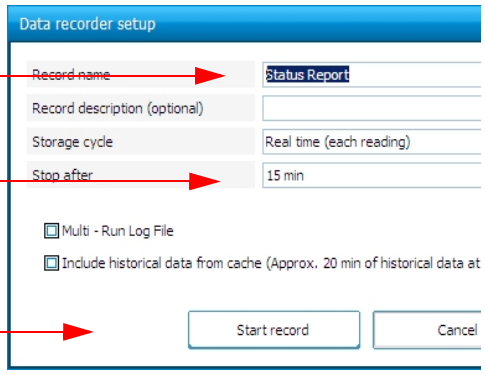
- Temperature stability is sufficient with changes in the velocity of sound of < 0.2 m/s over a test duration of about 15 min.
- If pressure, temperature and humidity can be determined with great accuracy, a deviation between the theoretical and measured velocity of sound of 0.3% will be sufficient. The differences of the SOS in the individual paths should not be greater than 0.3 m/s.

Conducting the test

The measured values are logged with the help of the MEPAFLOW600 CBM programm over a period up to 30 min and then saved in a text file. Pressure, temperature and humidity of the ambient air shall be logged once in a minute and the average values shall be entered in the measurement report later.

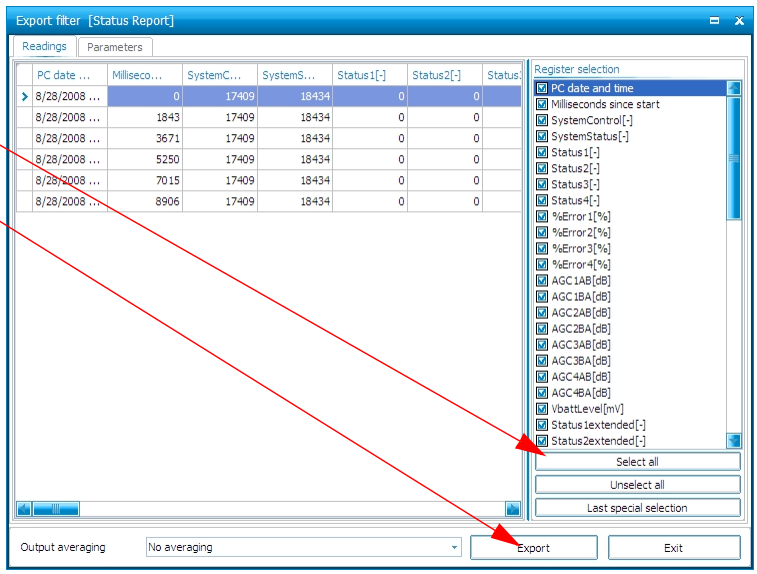
- Run MEPAFLOW600 CBM, connect to the meter (password level 1 or 2) and click the data recorder start button.

- Enter a file name.
- Select a duration of 15 minutes.
- Click on <*Start record*>.

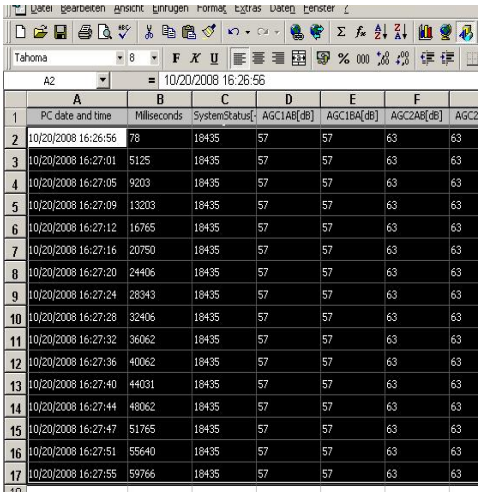


- After completion of the recording, activate the data export button.

- Activate “Select all“, then “Export” and save the data in a XLS file
- Close the data recorder.



- Open the created Excel file, in which the exported readings are stored. Copy all readings of this file starting at cell A2 into the Clip board of the PC.
- Open the file “ZeroFlow_and_SOS_Protocol.xls”, go to table “Data from MEPAFLOW600 CBM” (see Fig. 33) and insert the readings from Clip board, also beginning with the cell A2, into the table “Data from MEPAFLOW600 CBM”.



	A	B	C	D	E	F
1	PC date and time	Milliseconds	SystemStatus[-	AGC1AB[dB]	AGC1BA[dB]	AGC2AB[dB]
2	10/20/2008 16:26:56	78	18435	57	57	63
3	10/20/2008 16:27:01	5125	18435	57	57	63
4	10/20/2008 16:27:05	9203	18435	57	57	63
5	10/20/2008 16:27:09	13203	18435	57	57	63
6	10/20/2008 16:27:12	16765	18435	57	57	63
7	10/20/2008 16:27:16	20750	18435	57	57	63
8	10/20/2008 16:27:20	24406	18435	57	57	63
9	10/20/2008 16:27:24	28343	18435	57	57	63
10	10/20/2008 16:27:28	32406	18435	57	57	63
11	10/20/2008 16:27:32	36062	18435	57	57	63
12	10/20/2008 16:27:36	40062	18435	57	57	63
13	10/20/2008 16:27:40	44031	18435	57	57	63
14	10/20/2008 16:27:44	48062	18435	57	57	63
15	10/20/2008 16:27:47	51765	18435	57	57	63
16	10/20/2008 16:27:51	55640	18435	57	57	63
17	10/20/2008 16:27:55	59766	18435	57	57	63

- Now go to the table “ZeroFlowSOSProtocol” (see Fig. 33) and fill in the yellow fields. The results will be displayed at the two diagrams “Speed of Sound” and “Velocity of Gas”. The results must be displayed within the red limit lines of the diagrams.

Figure 33 Test report for zero flow and Speed of Sound test (example)

FLOWSIC600 - SOS and Zero Flow Test / SOS- und Nullpunkt-Test

Device	FLOWSIC 600	**Device SN**	08328593
Type	FL600-4P3D06CL0600SC0080RF2N-S2-1DC1N1Y	**ID-Number**	1877
Path number	4	**TAG-Number**	nein
Date	2008-08-22	**File name**	zerologging_1877.TXT
Operator	TWE	**Log time [min]**	15

Test Conditions

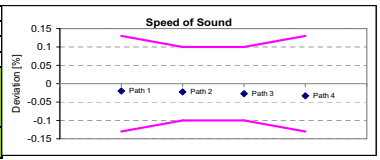
Test Gas	Rel. Humidity	Temp. [°C]	Pressure [bara]	Theoretical VOS [m/s]
Ambient air	50%	23.5	0.993	346.20

Speed of Sound Check

Max. allowed SOS Path Deviation [%]	Max. allowed SOS Path Deviation [m/s]
0.2	0.7

Measuring values

	VOS [m/s]	Diff. to theor. [%]	Result
Path 1	346.132	-0.020	ok
Path 2	346.123	-0.022	ok
Path 3	346.106	-0.027	ok
Path 4	346.087	-0.033	ok
Maximum	346.132	0.05	ok
Minimum	346.087		

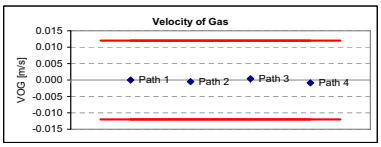


Zero Flow Test

Max. Error VOG [m/s]	0.012

Measuring values

	VOG [m/s]	Result
Path 1	0.000	ok
Path 2	0.000	ok
Path 3	0.000	ok
Path 4	-0.001	ok
Maximum	0.000	0.001
Minimum	-0.001	



Diagnosis Values

	SNR [dB] down	SNR [dB] up	AGC [dB] down	AGC [dB] up	%Error
Path 1	26.0	25.9	67.7	67.7	0
Path 2	23.3	23.6	71.0	71.0	0
Path 3	28.4	28.4	71.0	71.0	0
Path 4	22.9	22.8	67.0	67.0	0

Date : _____ Approved by: _____

6.2 Transducer test

The ultrasonic transducers can be checked for correct function with the help of the following points:

- Signal propagation, signal shape
- Velocity of sound
- AGC level (Automatic Gain Control)
- Signal-to-noise ratio (SNR)

> It is recommended to conduct these tests at a flow rate of 0 m^3/h (cut off the pipeline or cover the openings of the meter body with blind flanges or other suitable caps).

If one or more criteria are not fulfilled, both transducers of a path must be replaced (see Section 7.3)

6.2.1 Setting the "ZeroPhase" parameter

Click on the **"Path diagnosis"** tab in the MEPAFLOW600 CBM program and select the path concerned with the corresponding option button. Check the ultrasonic signals shown for both transducers for compliance with the following criteria:

- Symmetric signal shape with a signal-to-noise ratio (SNR) > 20 dB.
- No signal deformation or bias in the region where the amplitude converges to zero.
- Adaptation error MSE (**M**ean **S**quare **E**rror) < 0.008.
- Evaluation of the cursors "RunXX" and "ZeroPhaseXX"
  - The cursors should overlap at the point where the end of the second period of the received signal intersects the zero line.
  - Time difference between the two cursors is lower than half a period of the RunXX value.
  - The RunXX cursors should intersect the zero line at the end of the second signal period.

The parameter must be adjusted for one or both transducers, as necessary.

Correctly adjusted zero phases of the individual paths is the basis for accurate transit time measurement of the ultrasonic signals. The "ZeroPhase" parameters are correctly adjusted if the ZeroPhaseXX (ZeroPhasXX = corrected runtime) is at least close and the blue cursor (RunXX = runtime) is exactly on the second positive zero passage of the received ultrasonic signal (see Fig. 34).

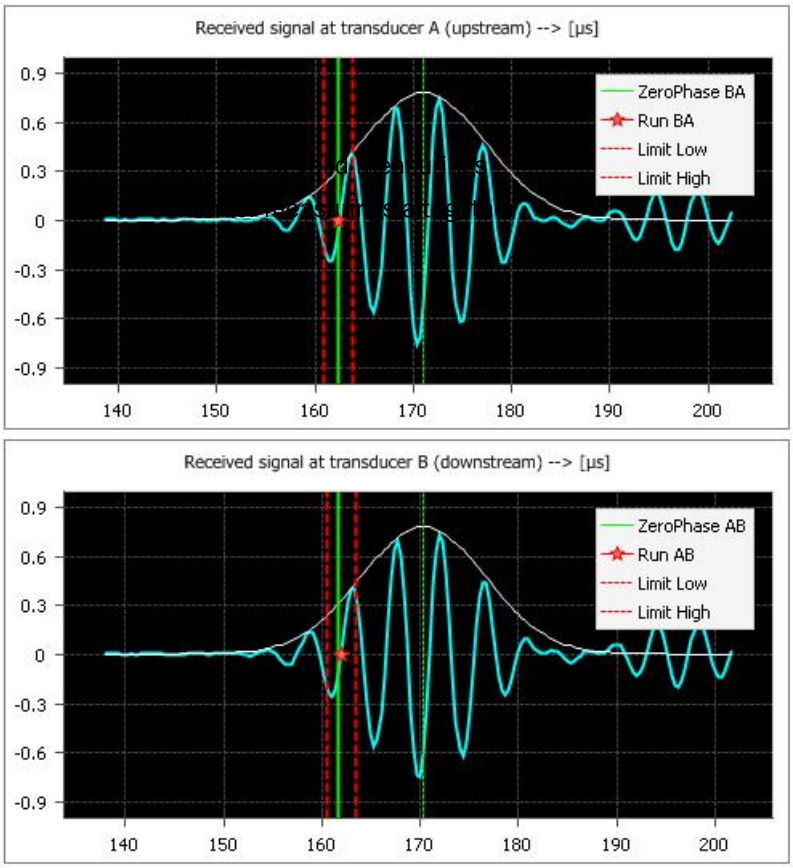
If this is not the case, the evaluation cursors must be displaced with the help of "ZeroPhase up" (transducer B correction parameter) and "ZeroPhase down" (transducer A correction parameter) until their zero passages are at the correct position. These corrections should be made under operating conditions, i.e. under operating pressure and with the real gas.

The value of the "ZeroPhase" parameter can be determined empirically or by way of calculation. Examples for the effect on the phase lag:

- "ZeroPhase" + 6.28 rad (= 2 π):
- $\rightarrow$ Displacement of the COR line by about one period to the right
- "ZeroPhase" - 3.14 rad (= π):
- $\rightarrow$ Displacement by about half a period to the left

It is recommended to use a start value of 5 for the parameters "ZeroPhase down" and "ZeroPhase up".

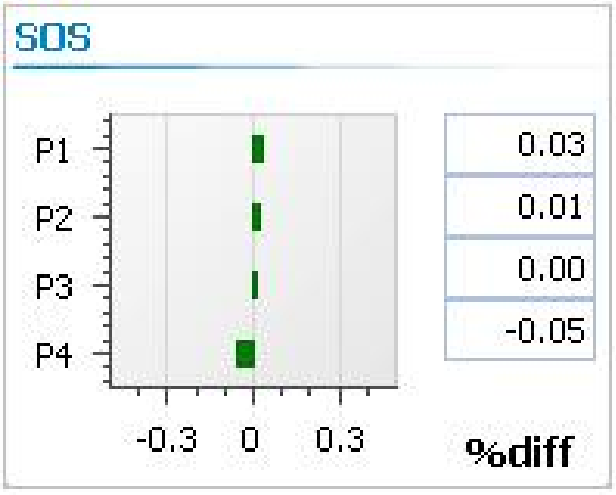
Figure 34 Received ultrasonic signals, position of the evaluation cursorsZeroPhaseXX and RunXX



If it is not sure whether or not the correct zero passage was selected, the following criteria can be used for testing:

- The velocities of sound in the individual paths should not deviate from the average SOS value by more than 1.5% (see Fig. 35).
- The deviation of the velocity of sound measured by the FLOWSIC600 DRU from the theoretical one (calculated on the basis of the gas composition) should not exceed 0.3% (see Section 6.1.2). This method requires accurate values of gas temperature, composition and pressure.

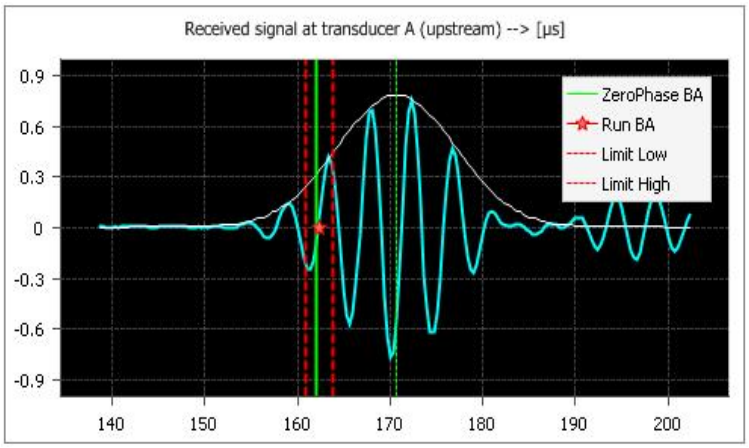
Figure 35 SOS differences screen at MEPAFLOW600 CBM, “Meter values” page



6.2.2 Evaluation of the signal shape

Ideal signal

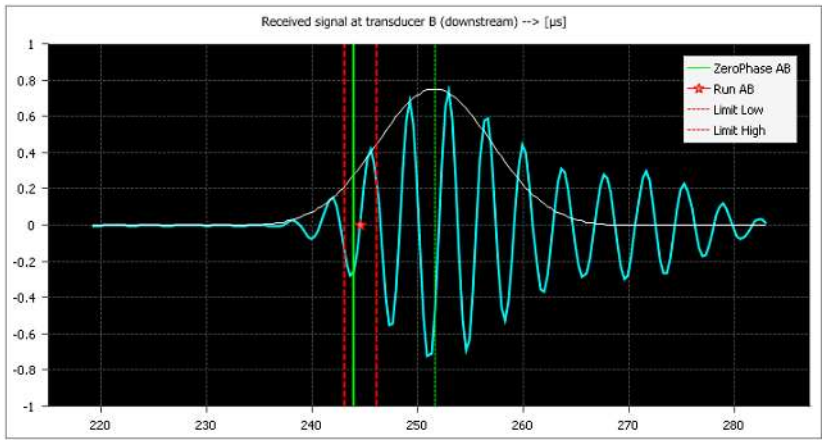
Figure 36 Ideal signal



- Symmetric signal shape with a signal-to-noise ratio (SNR) of > 20 dB.
- ZeroPhaseXX and RunXX cursors are (almost) overlapped and cross the zero line at the end of the second signal phase.

Acceptable signal

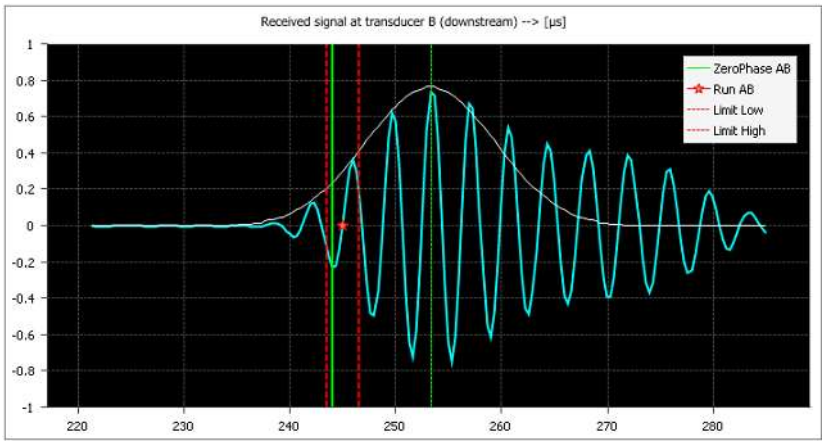
Figure 37 Acceptable signal



- The signal shape is not fully symmetrical (longer die-away delay)
- Signal-to-noise ratio of > 20 dB.
- ZeroPhaseXX and RunXX cursors are almost overlapped and cross the zero line at the end of the second signal phase.

Critical signal

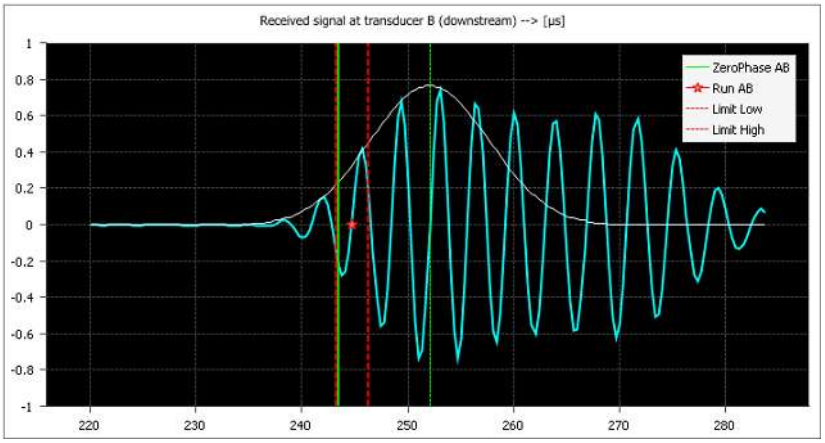
Figure 38 Critical signal



- The signal shape is not symmetrical (longer die-away delay)
- Signal-to-noise ratio of > 20 dB.
- ZeroPhaseXX and RunXX cursors are not overlapped, but the time difference is less than half a period of the received signal.
- The RunXX cursor crosses the zero line at the end of the second signal phase.

Faulty signal

Figure 39 Faulty signal



- The signal shape is not symmetrical (very long die-away delay)
- Signal-to-noise ratio of < 20 dB
- ZeroPhaseXX and RunXX cursors are not overlapped, but the time difference is less than half a period of the RT value..
- ZeroPhaseXX and RunXX cursors do not cross the zero line at the end of the second signal phase.

6.2.3 Testing the AGC values

The FLOWSIC600 DRU is equipped with an automatic gain control (AGC) circuit for each transducer. The maximum amplitude of each received signal is amplified to a certain percentage of the ADC input range (default: 75 per cent). The amplification depends mainly on the path length. This is why the AGC value is smaller for short paths than for long ones.

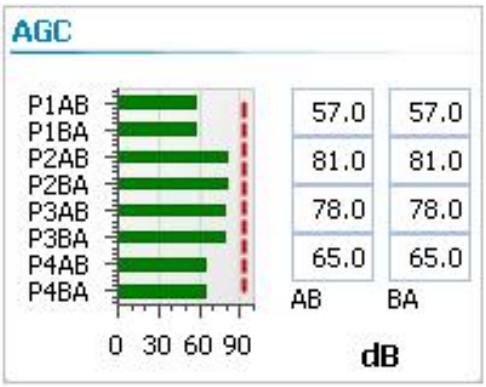
As the gas pressure rises, the acoustic coupling of the ultrasonic signal from the transducer to the gas is improved, which results in a falling AGC value.

The transducer AGC values in the individual paths should be identical at a gas velocity of 0 m/s. As the velocity of gas rises, the difference between the AGC values along the direction of flow and those against the direction of flow becomes greater. The AGC value of the transducer which receives the signal transmitted against the direction of flow (the weaker signal) is greater than the AGC value of the transducer which receives the signal transmitted along the direction of flow (stronger signal).

At a high velocity of gas, the AGC values are relatively high because of signal drift and turbulences in the gas.

The rise of the AGC value of a path compared with that of another path of the same path length does not adversely affect the measuring accuracy. The acoustic signal may be attenuated more than usual in case of oily depositions on the transducers or high water content in the gas. Detailed investigations only become necessary if the AGC value deviates by more than 50% from the normal value.

Figure 40 Typical AGC values of a four-path measuring system



AGC test criteria:

- AGC values of transducers with the same path lengths should be about the same.
- The variation among the AGC values of the transducers of a path should be < 3 dB.
- The ratio of the AGC values of the transducers of paths with a different length should always be identical, irrespective of the gas pressure.

6.2.4 Testing the SNR

The signal-to-noise ratio is calculated separately for each transducer. It must be greater than the parameter “SNR limit” (register #7202, default: 13 dB). If the SNR values of a transducer fall below “SNR limit”, the corresponding path will be marked faulty.

The signal-to-noise ratio rises as the gas pressure increases, because of the improved signal coupling at the transducer-gas interface. The transmission frequency of the transducers is greater than 200 kHz. Disturbing noise generated in the pipeline (valves, gates) is usually below this frequency range so that it does not interfere with the measurement under normal conditions. The SNR is therefore usually not affected by it

SNR = Ratio of noise (measured immediately before signal reception) and maximum of the received signal.

6.2.5 Checking the performance

The percentage of valid measurements is calculated separately for each path. The calculations are based on at least 100 measurements.

The decision whether or not a measurement is valid is made by the software based on several criteria (SNR, AGC level, signal shape etc.). The error rate is calculated according to the equation

$$\text{Performance} = \frac{\text{Number of valid measurings}}{\text{Number measurings altogether}} \times 100\%$$

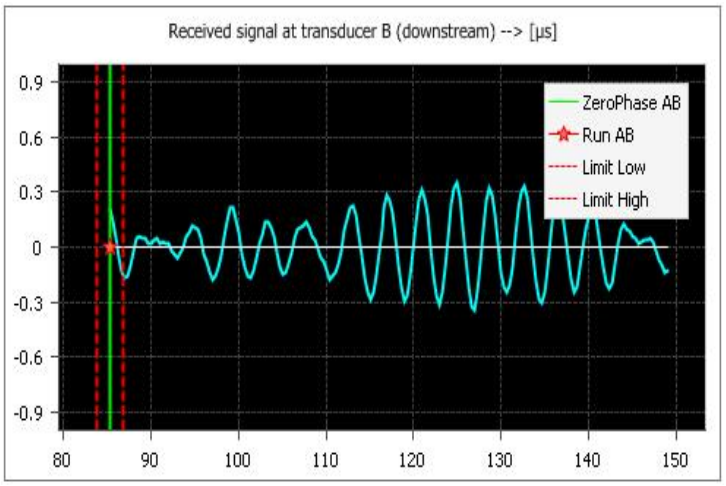
The performance should be 100% at a velocity of gas of 0 m/s. The value may go up as the velocity of gas rises and the acoustic signal is increasingly affected by turbulences. At an extremely high velocity of gas (e.g. 60 m/s) the Performance can go down to 80% without the measuring accuracy being adversely affected. The default setting of the limit value “LimitErrorCnt” (register #3514) is 80%. If this limit is exceeded, the measuring path will be marked faulty and a compensation algorithm (see Operating Instructions) will be activated. The FLOWSIC600 DRU then turns into the “Maintenance required” state and continues measurement at slight reduced accuracy.

6.3 No signal reception

Diagnosis

- Velocity of gas, AGC and SNR values are implausible (limits are exceeded).
- The performance is 0 %.
- Only a noise signal is received (see Fig 41)

Figure 41 No signal reception



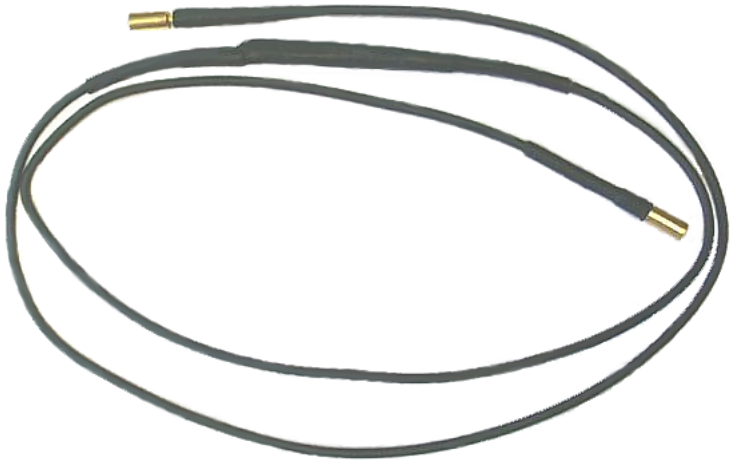
Troubleshooting

- ► Check the transducer cable.
- ► Initiate a check cycle (see 6.4).
- ► Check correct path and transducer lengths in the parameters.
- ► Connect transducers of the faulty path with the transducer cables of a properly working path. If the error disappears the cable feedthrough must be replaced (see Section 7.2.7).
- ► Replace the transducer pair with the transducer pair of another path for testing. If no signal is received after this substitution, the electronics unit must be replaced. If the previously faulty path now produces a plausible signal, the transducer pair which was previously installed there must be replaced.

6.4 Check cycle

This function aims to find out easily which component of the measuring system has produced an error. Using this function requires a transducer simulator (optional accessory, enquire from SICK).

Figure 42 Transducer simulator



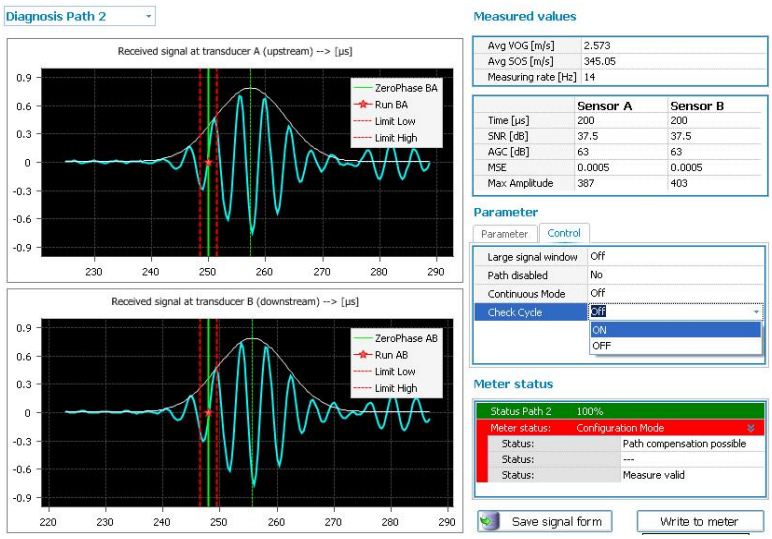
Proceed as follows to start a check cycle:

- Connect the transducer simulator to the two plugs of one path at the shunt board (one board of the analog block). See 7.2.2 for corresponding plugs.
- Run the MEPAFLOW600 CBM and select the **“Path diagnosis”** page.
- Start the check cycle for the defective measuring path. See Fig. 43.
- Change the signal display.

If error-free signals with a transit time of about 6 µs are displayed now, the electronics unit is ok. In this case the transducers are defective and need to be replaced.

If no received signal is displayed, the electronics unit is defective and must be replaced.

Figure 43 Switch the check cycle on



FLOWSIC600 DRU

7 Repairs

7.1 General notes

The work described below shall only be done by qualified staff according to Section 1.2 and after training at the manufacturer's.

Repairs which are not authorised by the manufacturer may result in a refusal of warranty claims.

It is recommended to save all system parameters before mounting/dismounting the equipment and before replacing any components in a session file (*.fsf), see Technical Information. If the parameter table was not saved, start a MEPAFLOW600 CBM session for parameter back-up. See Technical Information FLOWSIC600.

Tools required

- 3 mm Allen key
- 5 mm Allen key
- 4 mm socket wrench
- Size 1 cross-tip screwdriver
- Size 2 slotted screwdriver (3 mm wide blade)
- Size 3 slotted screwdriver (6 mm wide blade)
- Needle-nosed pliers
- Snap ring pliers (not always required)
- Transducer extraction tool (part no. 7041772)
- Coax plug-on auxiliary (part no. 4047938)
- 22 mm torque wrench (range up to 10 Nm)
- Adjustable wrench (8 in)
- 19 mm wrench

CAUTION:

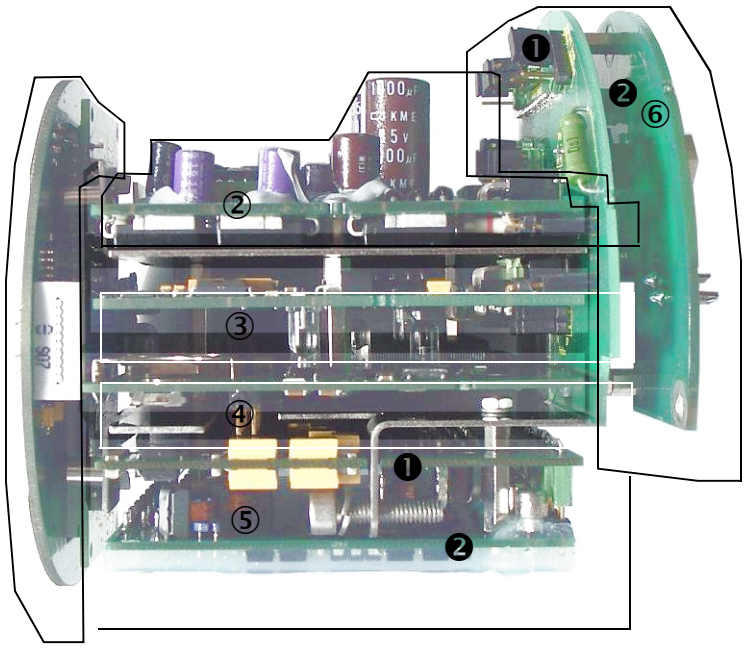
- ► Make sure the measuring system is disconnected from the power supply before you start any work on the FLOWSIC600 DRU.
- ► If the FLOWSIC600 DRU is used in a hazardous area, power must be disconnected in the safe zone (disconnection in the hazardous zone is only permitted if an intrinsically safe power supply is used).
- ► The pipeline section in which the meter is installed must be depressurised and vented before the ultrasonic transducers can be replaced, unless the optional extraction tool is used (for details on how to use it see the Extraction Tool Manual)

Any repair work shall be documented in the Malfunction report, which is attached hereto in the Appendix. This report shall be sent to SICK in order to enable them to update the device logbooks kept at the manufacturer's.

7.2 SPU

7.2.1 Electronics cards

Figure 44 Arrangement of the electronics cards



Other functional assemblies (see also list of spare parts)

- Electronics block basic

  This assembly consists of SPU board and I/O board, mounting bracket and other required mounting parts
- Electronics block

  This assembly consists of the electronics block basic, power board and analogue block.
- Electronics upgrade kit Rev2

  This kit includes all parts which are necessary to upgrade a Rev1 electronics for a Rev2 electronics and thus to maintain full Rev2 functionality. These are the electronics block basic, the connection block and mounting parts.

Repairing a Rev1 electronics unit with the help of Rev2 electronics cards

Since September 2006 most FLOWSIC600 gas meters have been delivered with new (Rev2) electronics. In general, only electronic cards of that electronics version will be available as spare parts.

Modifications (Rev1-Rev2) concern the following components:

- SPU board, IO board, Back plane

If a Rev1 electronics card has to be replaced, it may happen that other boards must be substituted as well for compatibility reasons. The table below provides an overview of the compatibilities and necessary actions.

The greater scope of functions provided by the Rev2 electronics unit cannot always be achieved if individual cards of a Rev1 system are replaced for Rev2 cards.

Upgrade from 32kb to 128kb

If you want to use the new loggerfunctions you need an upgrade to 128 kb ROM

Table 4 Hardware compatibility between Rev1 and Rev2

Electronics card	Part no., Rev1 system	Part no., Rev2 system	Compatibility	Necessary actions
LED front panel	7041659	7041659	Yes	None
LCD front panel	7041660	7041660	Yes	
Analog block 2L7 IIA/D (135 kHz)	2031456	2031456	Yes	
Analog block 2L7 IIC/BCD (135 kHz)	2031485	2031485	Yes	
Analog block 1L6 IIA/D (200 kHz)	7041795	7041795	Yes	
Analog block 1L6 IIC/BCD (200 kHz)	7048528	7048528	Yes	
SPU board	7048506	2040272	No	If the SPU board is defective, the I/O board must be replaced as well. ▶ Save parameters in a *.cof file or start a MEPAFLOW600 CBM session ▶ Attach new mounting bracket (part no. 4043108). ▶ Mount Rev2 connection block. ▶ Load new firmware (see section 8.1). ▶ Read *.cof file or send the parameters from the MEPAFLOW600 CBM database to the meter next time the meter is connected to a computer (see page 78) ▶ Fill in the “Sticker for connection terminal SPU Rev2” and attach it to the backside cap. ▶ Attach the “II+” label to the main type plate.
SPU board with battery		2041950	No	
I/O board	7048507	2040271	No	If the I/O board is defective, the SPU board must be replaced as well. ▶ Save parameters in a *.cof file or start a MEPAFLOW600 CBM session. ▶ Attach new mounting bracket (part no. 4043108). ▶ Mount Rev2 connection block. ▶ Load new firmware (see section 8.1). ▶ Read *.cof file or send the parameters from the MEPAFLOW600 CBM database to the meter next time the meter is connected to a computer (see page 78). ▶ Fill in the “Sticker for connection terminal SPU Rev2” and attach it to the backside cap. ▶ Attach the “II+” label to the main type plate.
I/O board H	7041822	2040270	No	▶ If the I/O board is defective, the SPU board must be replaced as well. ▶ Save parameters in a *.cof file or start a MEPAFLOW600 CBM session. ▶ Attach new mounting bracket (part no. 4043108). ▶ Mount Rev2 connection block. ▶ Load new firmware (see section 8.1). ▶ Read *.cof file or send the parameters from the MEPAFLOW600 CBM database to the meter next time the meter is connected to a computer (see page 78). ▶ Fill in the “Sticker for connection terminal SPU Rev2” and attach it to the backside cap. ▶ Attach the “II+” label to the main type plate.
Power supply board	7048504	7048504	Yes	This board was modified, but is fully downward compatible.

Connection block for hardware variant 1 and 2	7041665	2040275	Yes	This board was modified (main board), but is fully downward compatible.
Connection block for hardware variant 3	-	2041154	Yes	This board is only used in conjunction with Rev2 electronics units.
Fuse board with mounting accessories	2039149	2041502	Yes	None

Table 5 Rev2 hardware identification

Electronics card	Label on the board	Part no., Rev2 system
LED front panel	LED-SMG	7041659
LCD front panel	LCD-SMG	7041660
Analogue block 2L7 IIA/D (135 kHz)	SHUNT 2L7IIA	2031457
	ANA	7048500
Analogue block 2L7 IIC/BCD (135 kHz)	SHUNT 2L7IIC	2031484
	ANA	7048500
Analogue block 1L6 IIA/D (200 kHz)	SHUNT 1L6IIA	7048505
	ANA	7048500
Analogue block 1L6 IIC/BCD (200 kHz)	SHUNT 1L6IIC	7048520
	ANA	7048500
SPU board	SPU	2040272
I/O board	IO-RS485	2040271
I/O board H	IO-HART	2040270
Power supply board	POWER	7048504
Connection block for HW1 and HW2 (EMC board and back plane)	EMC	7048502
	BKPL	2040269
Connection block for HW3 (EMC board and back plane)	EMC	7048502
	BKPL-EVC	2041153
Fuse board with mounting accessories	FUSE	2039149

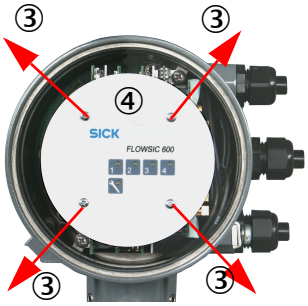
7.2.2 Replacing the front panel

Figure 45 Replacing the front panel

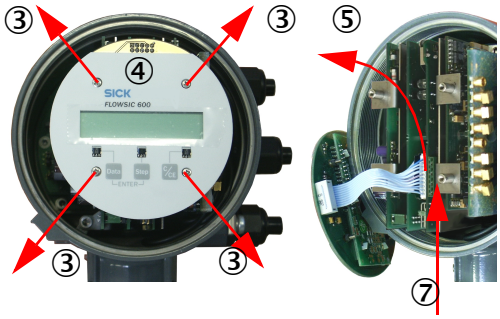
Spare parts
SICK LED front panel Part no. 7041659

SICK LCD front panel Part no. 7041660

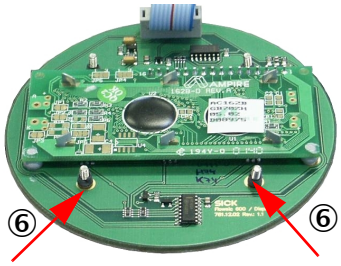

- ► Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).
- ► Unscrew the front cap (2) of the housing.



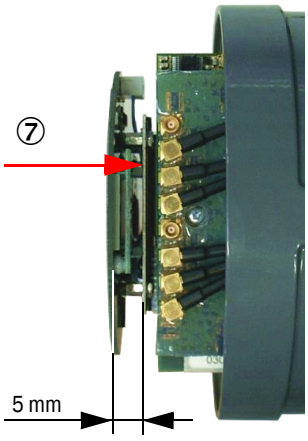
- ► Loosen the front panel fastening screws (3) using a size 1 cross-tip screwdriver.



- ► Pull off the front panel (4). With the LCD front panel, unplug the connector (5) at electronics block.



- ► Mount the new front panel.
- – Plug on the LED front panel and insert the fastening screws.
- – With the LCD front panel, check the rubber spacers (6) at the back (screws must project at least two threads), then plug in the connector (5) and screw on the front panel so that there is a distance of 5 mm between board and mounting bracket (7). Make sure no parts of the board touch the bracket.



- ► Screw on the front cap of the housing again, attach and fasten the securing clip.
- ► Connect to power.

7.2.3 Replacing the electronics block, the analogue block or the SPU board

Before you start replacing components ensure that a current session file exist in the MEPAFLOW600 CBM data base from the meter which will be updated/repaired, because in the session file there are all parameters and settings saved, which have to be reloaded to the meter after replacing the elctronics boards and uploading the firmware (if there sn‘t any already)

After having replaced the boards, upload the parameters of the meter with help of a current session according to the description in this section under point 5 “Loading/editing parameters”.

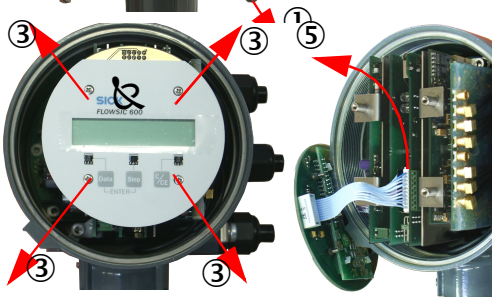
1 Removing the electronics block

Figure 46 Removing the electronics block

Spare parts
Electronics block IIA/D 135 kHz (power, SPU, I/O, analogue) Part no. 2040382
Electronics block IIA/D H 135 kHz (power, SPU, I/O, analogue) Part no. 2040384
Electronics block IIA/D 200 kHz (power, SPU, I/O, analogue) Part no. 2040386
Electronics block IIA/D H 200 kHz (power, SPU, I/O, analogue) Part no. 2040388

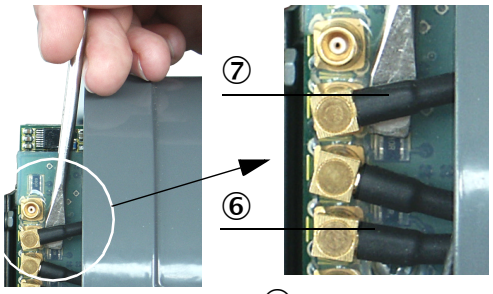
► Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).

► Unscrew the front cap (2) of the housing.

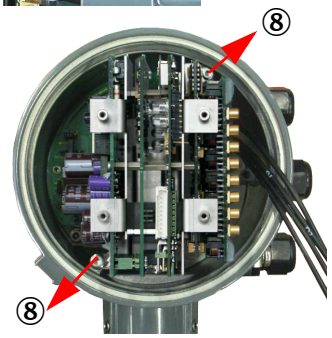


► Loosen the front panel fastening screws (3) using a size 1 cross-tip screwdriver.

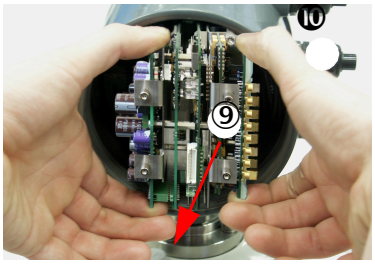
► Pull off the front panel (4). With the LCD front panel, unplug the connector (5) at electronics block.



► Remove the transducer cable (6) from the circuit board (7) using a slotted screwdriver.



► Loosen the fastening screws of the electronics block (8) with a 3 mm Allen key.

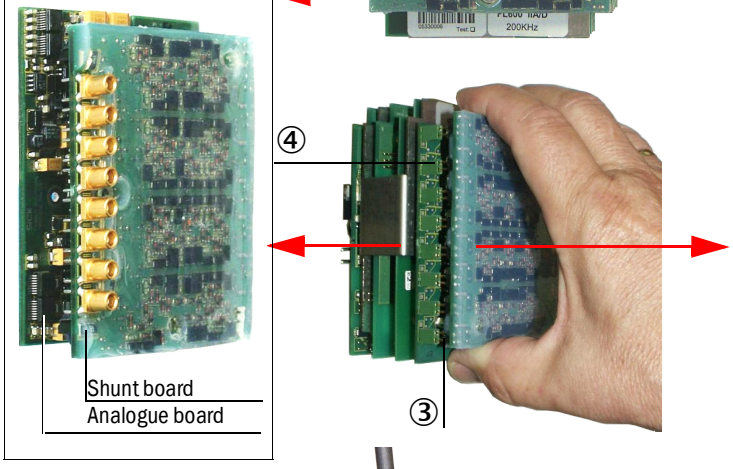


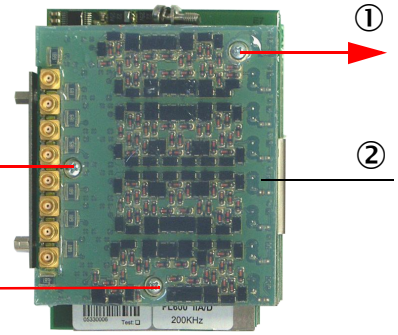
► Pull the electronics block (9) off the main board and take it out of the SPU housing (10) carefully.

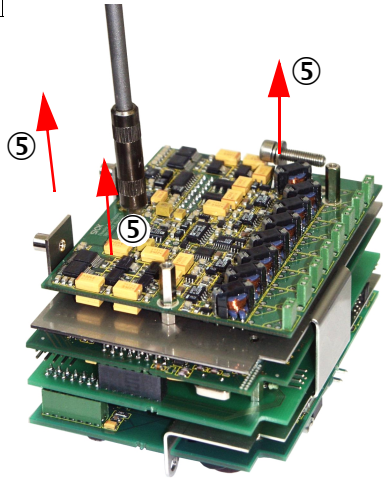
2 Detaching the several components from the electronics block

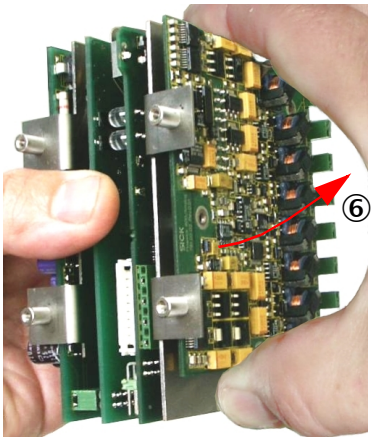
Figure 47 Detaching the analogue block from the electronics block

Spare parts
Analogue block IIA/D 2L7 Part no. 2031456
Analogue block IIA/D Part no. 7041795

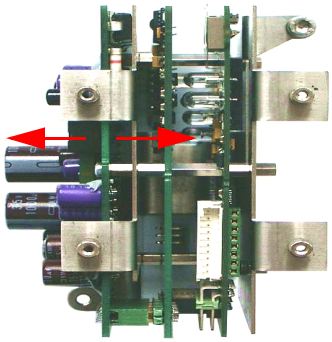




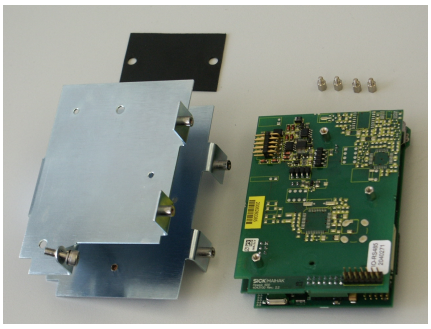




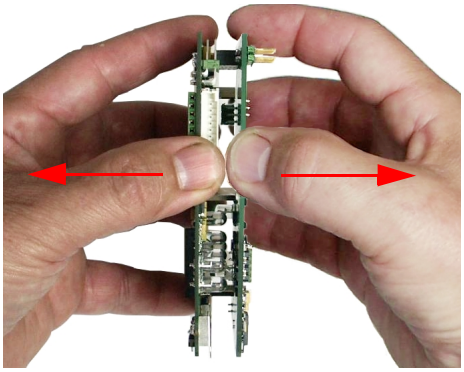
- ► Loosen the fastening screws (1) at the shunt board (2).
- ► Hold the analog board (4) with one hand and pull off the main board cautiously at the connector side (3).
- ► Loosen the three fastening bolts (5) on the analogue board with the help of a 4 mm socket wrench.
- ► Pull the analog board off the electronics block cautiously and take it off as shown in the Figure.



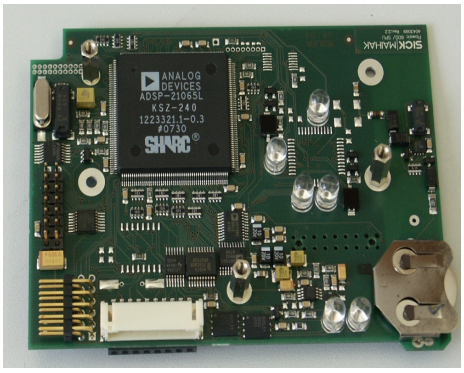
► After detaching the analog board the electronic block should look like this..



► Loosen the bolts on the power board and then remove the two boards from the metal case.



► Detach the I/O board from the SPU board cautiosly as shown in the figure.



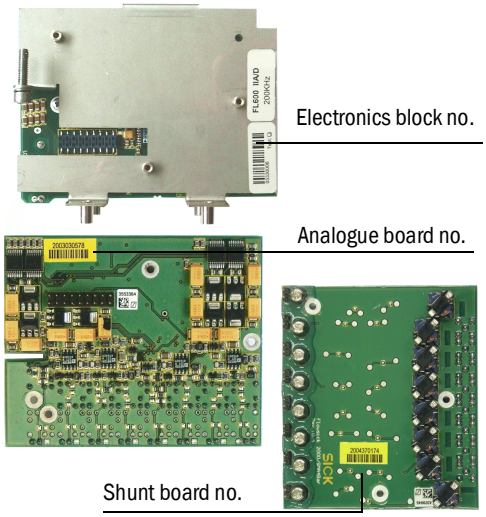
► Now you can change the SPU board and then you have to put together the Printed Circuit Boards (PCB) in reversed sequence.

Note:

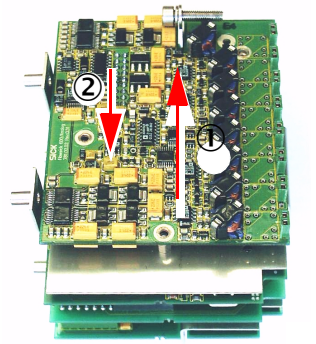
Please be careful during detachment and assembling of the electronic boards. Do not touch the board inside or the components on the board.

3 Mounting a Rev2 analogue block to a Rev2 electronics block

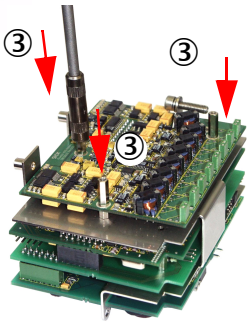
Figure 48 Mounting the analogue block to the electronics block



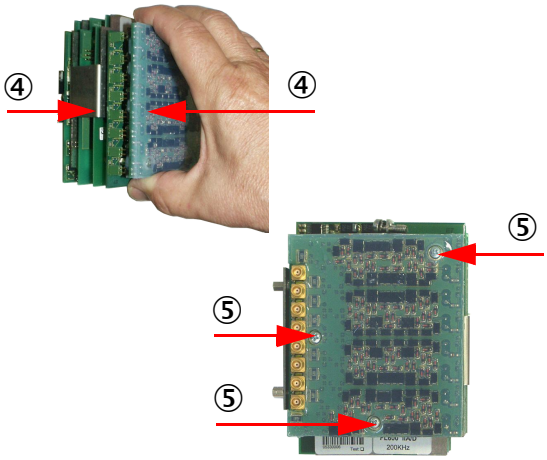
- If you replace the electronics block, note down the number of the electronics block.
- If you replace the analogue block, note down the number of the analogue board and that of the shunt board.



- Slide the analogue board on to the electronics block (1) as shown in the Figure and plug it on (2).



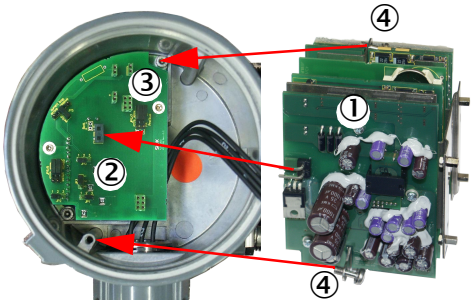
- Attach the analogue board to the electronics block with the help of the fastening bolts (3), do not tighten the bolts too much.

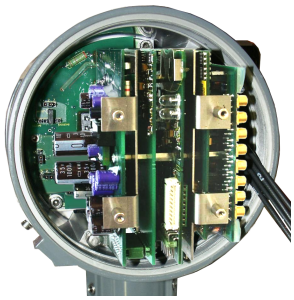


- Plug the shunt board on to the analogue board cautiously on the connector side and fix it with the fastening screws (5).

4 Insert the electronics block into the SPU housing again

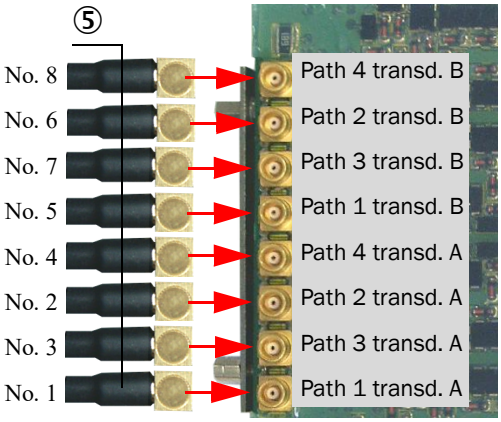
Figure 49 Mounting the electronics block with the analogue block



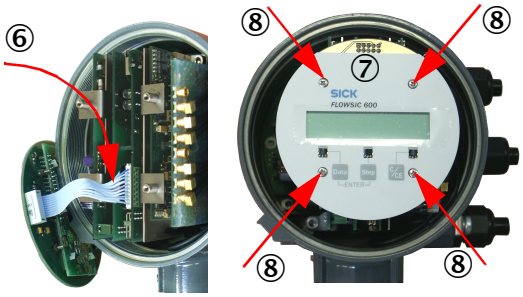


► Insert the electronics block (1) cautiously into the SPU housing (2) as shown in the Figure, plug it on to the back plane (3) and fix it with the two fastening bolts (4).

CAUTION:
Do not damage the connector when inserting the electronics block.



► Plug the transducer cable (5) on to the corresponding socket, store excess cables in the SPU housing.



► With the LCD front panel, plug on the connector (6) and mount the front panel (7) to the electronics block.
► Fix the front panel fastening screws (8) using a size 1 cross-tip screwdriver.

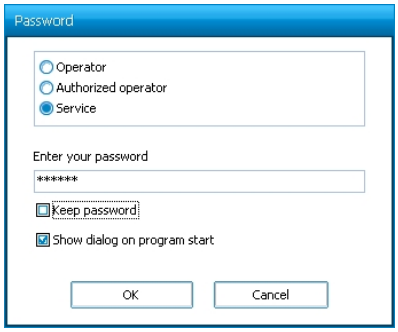
► Screw on the front cover (9) of the housing.
► Attach the securing clamp (10) and fix it.
► Connect to power.

5 Loading/editing parameters

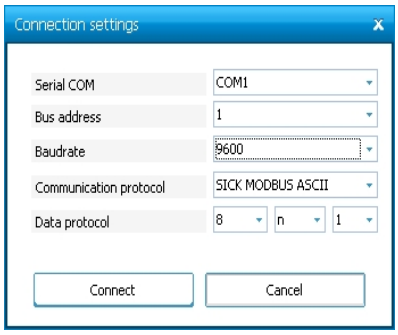
After having replaced the components, the parameters and data of the new components must be entered into the FLOWSIC600 DRU.

Actions after having replaced the electronics block

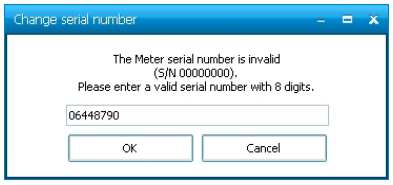
Figure 50 Parameter upload after having replaced the electronics block



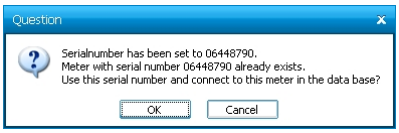
- Connect a laptop or PC where the MEPAFLOW600 CBM programme is installed with the FLOWSIC600 DRU using a RS-232/ RS-485 or USB/RS-485 adapter.
- Connect the FLOWSIC600 DRU to the power supply (if not yet done).
- Run the MEPAFLOW600 CBM software.
- In the “Password” menu, select the User Access Level “Service” and enter the password “expert”.



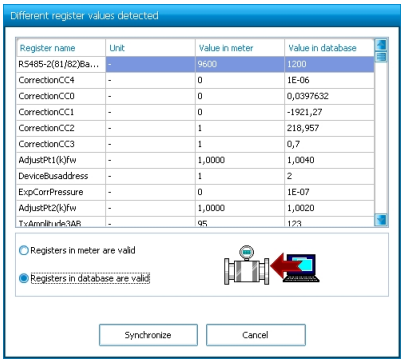
- If there is no firmware on the meters new electronics (e.g. no information display on the LCD) then upload a firmware acc. to section 8.2.
- Select your connection settings and establish a connection to the device.



- In the Dialog ‘‘Change serial number”, enter the serial number of your meter and click ‘‘OK”.



- The software will detect that this meter already exists in the data base and offer to connect to this meter in the data base. Click ‘‘OK”.

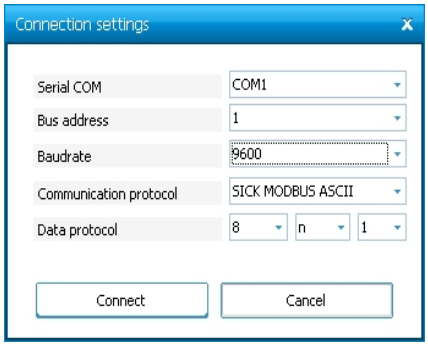


- After connecting to the meter in the data base, the software will detect the different parameters in the meter after the exchange of the components. See dialog ‘‘Different register values detected”.
- Choose the option ‘‘Registers in database are valid”, to write the parameters from the last session to the meter. Click ‘‘Synchronize”.

Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4

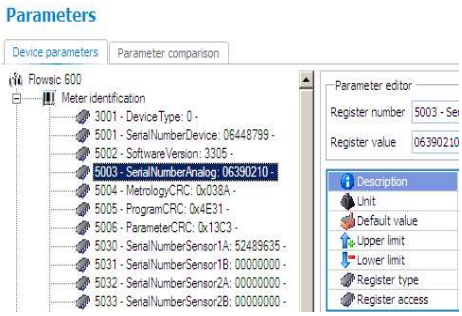
Actions after having replaced the analogue block

Figure 51 Parameter input after having replaced the analogue block

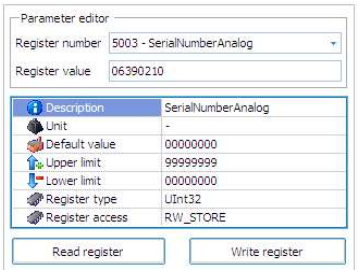


- Connect a laptop or PC where the MEPAFLOW600 CBM programm is installed with the FLOWSIC600 DRU using a RS232/RS485 or USB/RS485 adapter.
- Connect the FLOWSIC600 DRU to the power supply (if not yet done).
- Run the MEPAFLOW600 CBM programm.
- In the “Connection” menu, select the password level “Service” and enter the password “expert”.
- Select a port and establish a connection to the device.

- Set the device into the configuration mode and change to the “Parameters”.

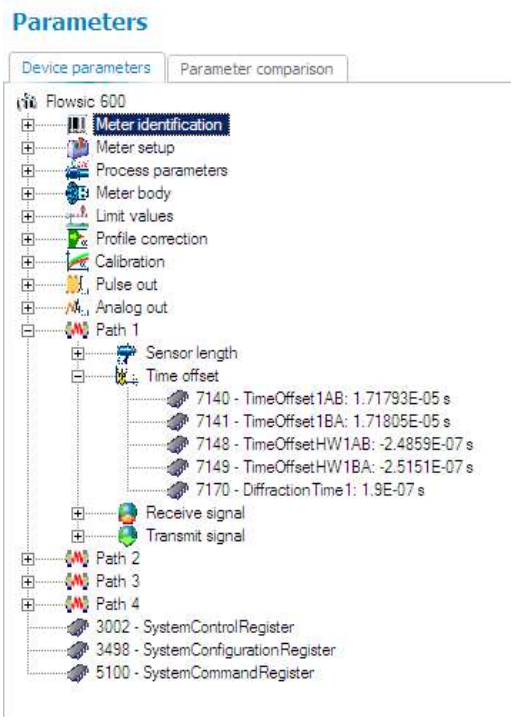


- Select the parameter “SerialNumberAnalog”.



- Enter the number of the new analogue board into the register value box.

Figure 52 Parameter input after having replaced the analogue block



► Enter the path-specific parameters for all paths.

– 7140; 41 TimeOffset ... defines the system offset times of the sensors. They should be kept as they are after having changed electronics modules, but be edited after sensor replacement as specified on the data sheets which are part of the delivery.

– 7148; 49 TimeOffsetHW ... defines the system offset times of the hardware/analogue block (comprising the analogue board and the shunt board, which should always be replaced together). The offset times of the electronics unit shall be entered after having replaced the analogue block or the entire electronics block according to the information set forth on the data sheets which are included in the delivery. The offset times may have a negative sign.

– 7170 DiffractionTime ... is a specific quantity used in acoustic physics, which is dependent on the acoustic distance (zählkörper, transducer type, frequency and exit diameter). It will not change during the replacement of electronics modules.

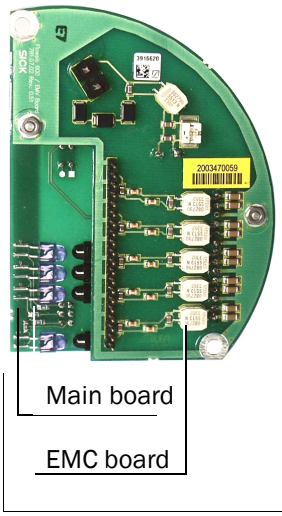
Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4

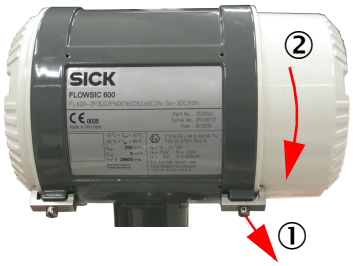
7.2.4 Replacing the connection block

1 Removing the electronics block

Figure 53 Removing the electronics block

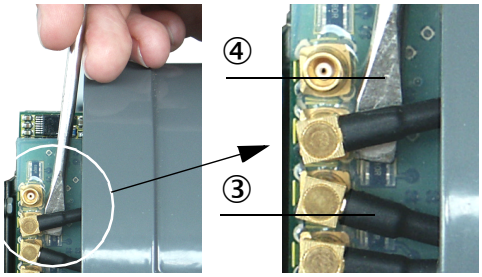
Spare parts
Connection block Part no. 2040275



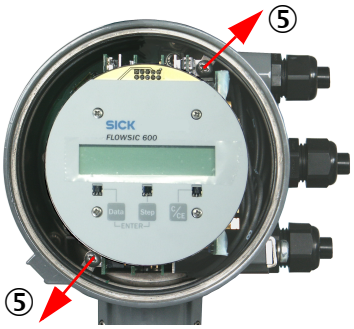


► Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).

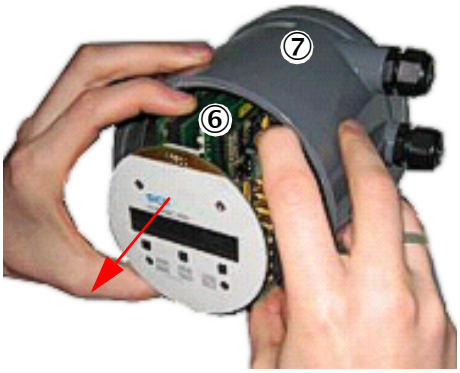
► Unscrew the front cover (2) of the housing.



► Remove the transducer cables (3) from the circuit board (4) using a slotted screwdriver.



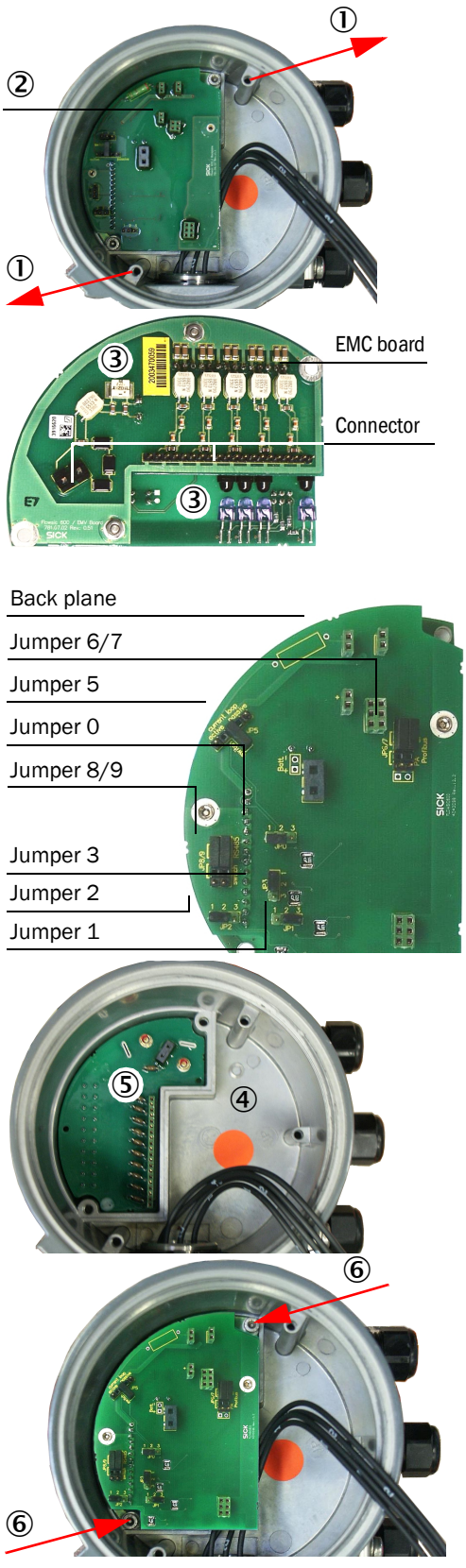
► Loosen the fastening screws of the electronics block (5) with a 3 mm Allen key.



► Pull the electronics block (6) off the back plane and take it out of the SPU housing (7) carefully together with the fastening screws.

2 Replacing the connection block

Figure 54 Replacing the connection block



- ► Loosen the fastening screws with a 3 mm Allen key (1).
- ► Pull the terminal block (2) cautiously off the fuse board and take it out of the SPU housing.

CAUTION:
The boards must not be stressed on one side, because otherwise the connectors on the EMC board may be twisted.

- ► Note down the board numbers of the new connection block (3).

- ► Compare the jumper settings on the old and new back plane and change the jumper settings on the new board so to conform with those on the old one if necessary (for details see Section 3.2).

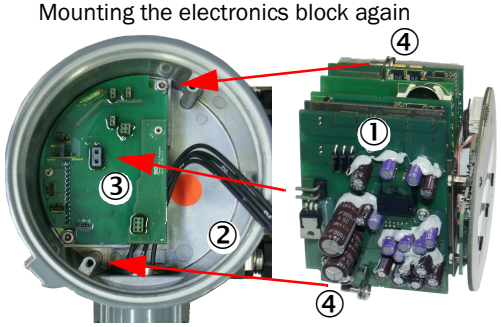
- ► Insert the new connection block into the SPU housing (4) and plug it on to the fuse board (5) cautiously.

CAUTION:
If the board is inserted at an angle, the connectors may be deformed.

- ► Fix the connection block to the housing with the help of fastening screws (6).

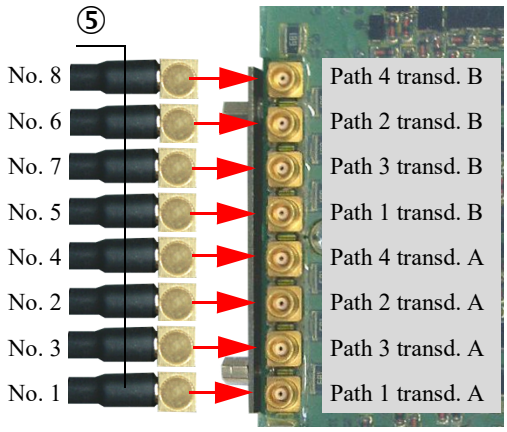
3 Inserting the electronics block into the SPU housing again

Figure 55 Mounting the electronics block again



► Insert the electronics block (1) cautiously into the SPU housing (2) as shown in the Figure, plug it on to the connection block (3) and fix it with the two fastening bolts (4).

CAUTION:
Do not damage the connector when inserting the electronics block.



► Plug the transducer cable (5) on to the corresponding socket, store excess cables in the SPU housing.

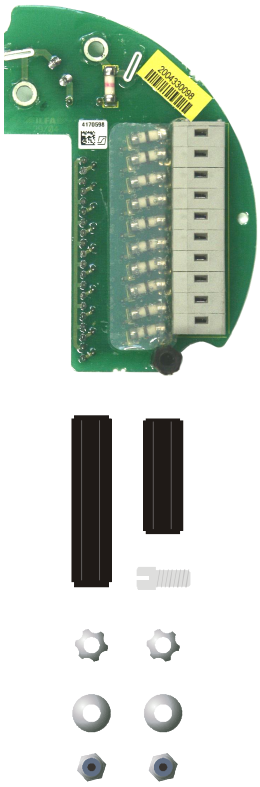
► Screw on the front cap (6) of the housing.
► Attach the securing clamp (7) and fix it.
► Connect to power.

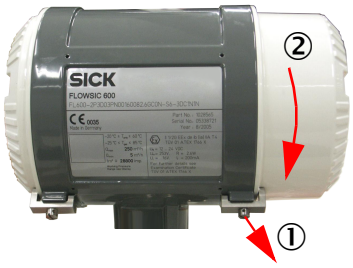
7.2.5 Replacing the fuse board

1 Removing the electronics block

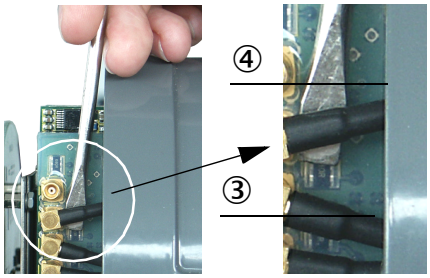
Figure 56 Removing the electronics block

Spare parts
Fuse board with mounting accessories Part no. 2041502



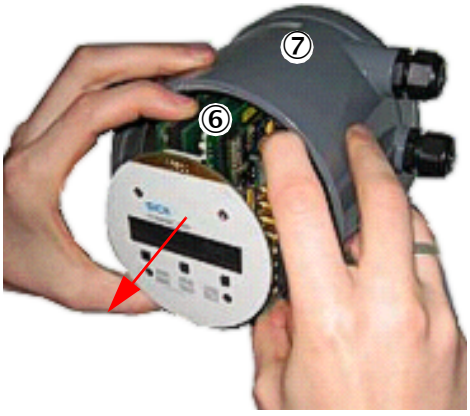


- Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).
- Unscrew the front cap (2) of the housing.



- Remove the transducer cables (3) from the circuit board (4) using a slotted screwdriver.

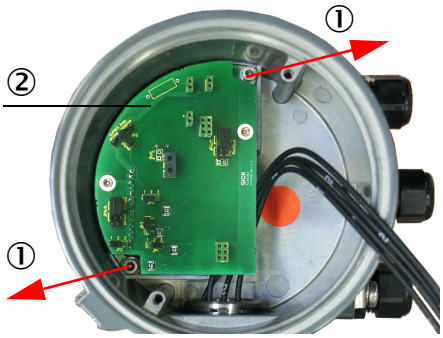
- Loosen the fastening screws of the electronics block (5) with a 3 mm Allen key.



- Pull the electronics block (6) off the back plane and take it out of the SPU housing (7) carefully together with the fastening screws.

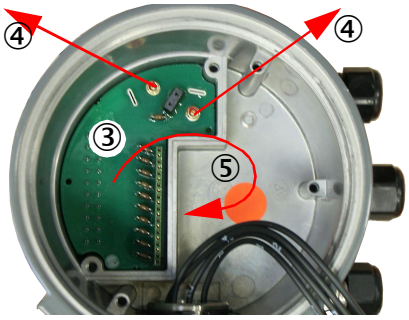
2 Replacing the fuse board

Figure 57 Replacing the fuse board

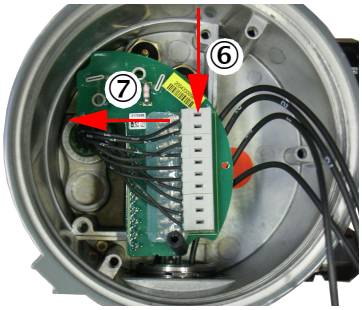


- Loosen the fastening screws of the terminal block (1).
- Pull the connection block (2) cautiously off the fuse board and take it out of the SPU housing.

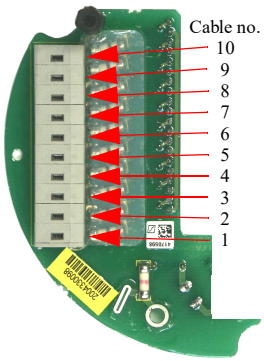
CAUTION:
The boards must not be stressed on one side, because otherwise the connectors on the EMC board may be twisted.

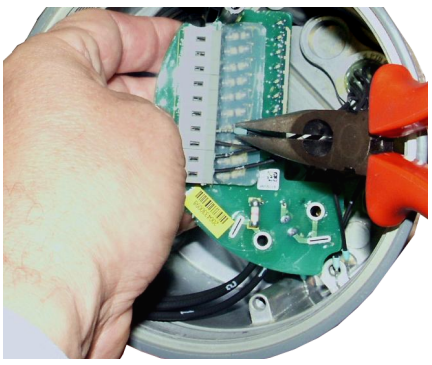


- Loosen the fastening nut of the fuse board (3) using a 5 mm socket wrench (4) and remove nuts, plain washers and lock washers.
- Pull the fuse board towards the front and turn it around (5).

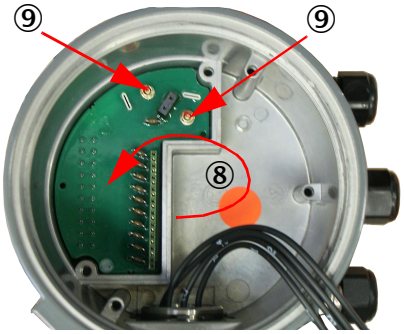


- Open the clamps (6) using a narrow screwdriver and pull out the cables (7).
- Take out the fuse board and insert a new board into the housing.





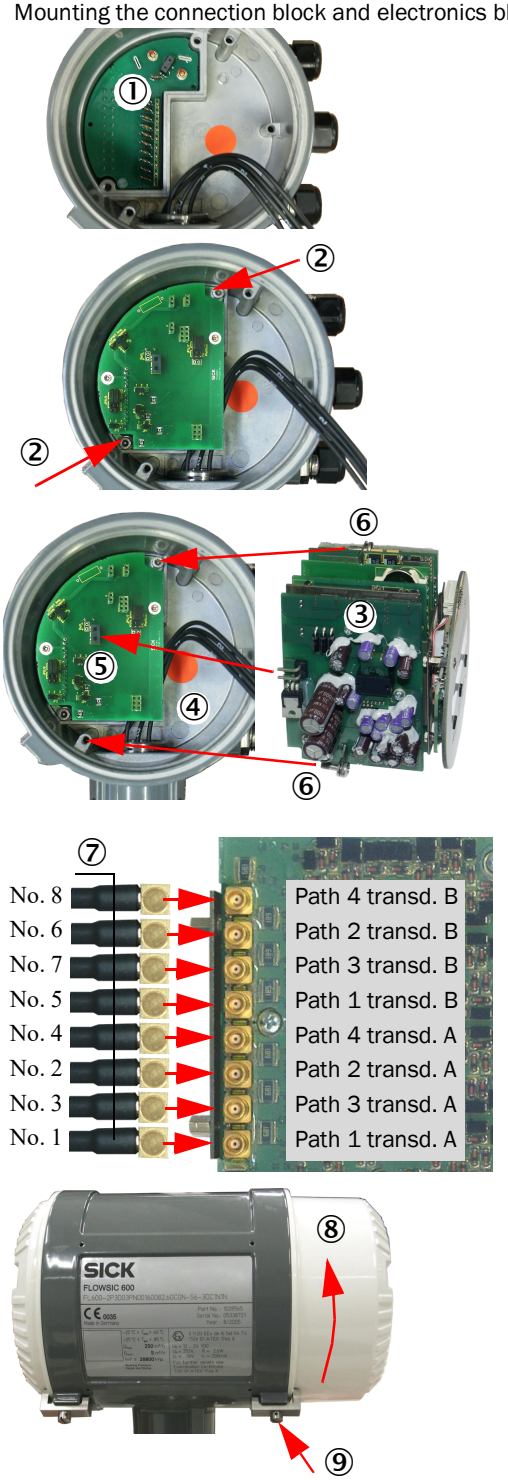
- Connect the cables to the new board using small pliers (terminal assignment see Figure on the left). Push the cable end with the end sleeve into the clamp opening as far as it will go. The clamps are of a self-securing type.



- Place the fuse board with the connected cables in the mounting position and make sure the cables are not crushed (8).
- Fix the board in the housing using the following mounting parts in the given order (9): board → lock washer → plain washer → nut.

3 Mounting the connection block and electronics block again

Figure 58 Mounting the connection block and electronics block again



- ► Insert the connection block into the SPU housing and plug it on to the fuse board (1) cautiously.

CAUTION:

If the board is inserted at an angle, the connectors may be deformed.

- ► Fix the connection block to the housing with the help of fastening screws (2).

- ► Insert the electronics block (3) cautiously into the SPU housing (4) as shown in the Figure, plug it on to the main board (5) and fix it with the two fastening bolts (6).

- ► Plug the transducer cable (7) on to the corresponding socket, store excess cables in the SPU housing.

- ► Screw on the front cap (8) of the housing.
- ► Attach the securing clamp (9) and fix it.
- ► Connect to power.

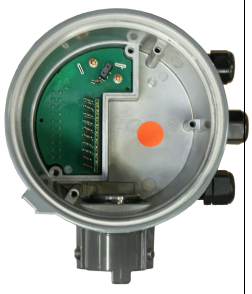
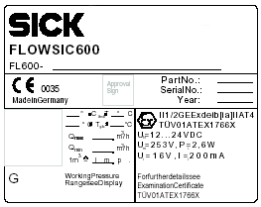
Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4

7.2.6 Changing the SPU housing with the “old” fuse board

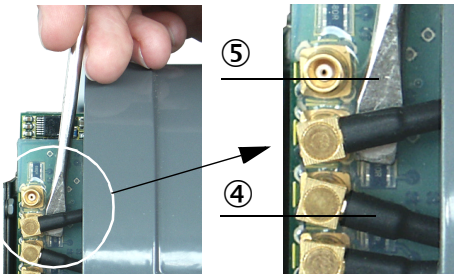
In the old version, the fuse board is soldered to the back wall of the electronics enclosure so that it cannot be replaced individually without special tools, the entire SPU housing with fuse board must be changed

1 Dismounting the electronics block with analogue block

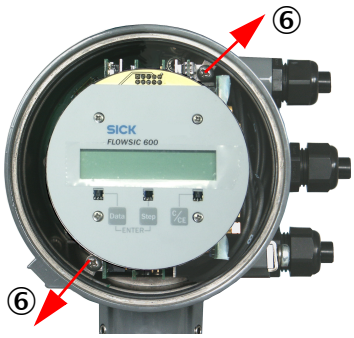
Figure 59 Removing the electronics block

Spare parts
Housing Ex NPT with fuse board Part no. 2031304
Housing Ex M20 with fuse board Part no. 2031300

Replacement SPU type plate Part no. 4043905


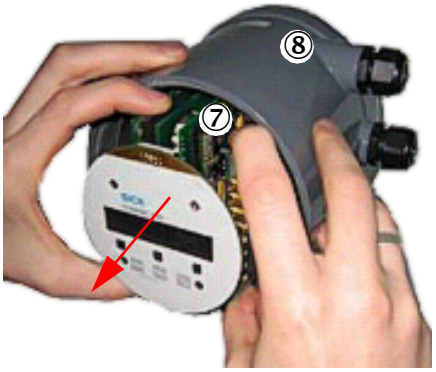
- Loosen the fastening screws with a 3 mm Allen key and remove the securing clamps (1).
- Unscrew the front (2) and back cap (3) of the SPU housing.
- In the terminal box of the signal processing unit: disconnect the signal cables, take off the power terminal cap and disconnect the power cables.



- Remove the transducer cables (4) from the circuit board (5) using a slotted screwdriver.



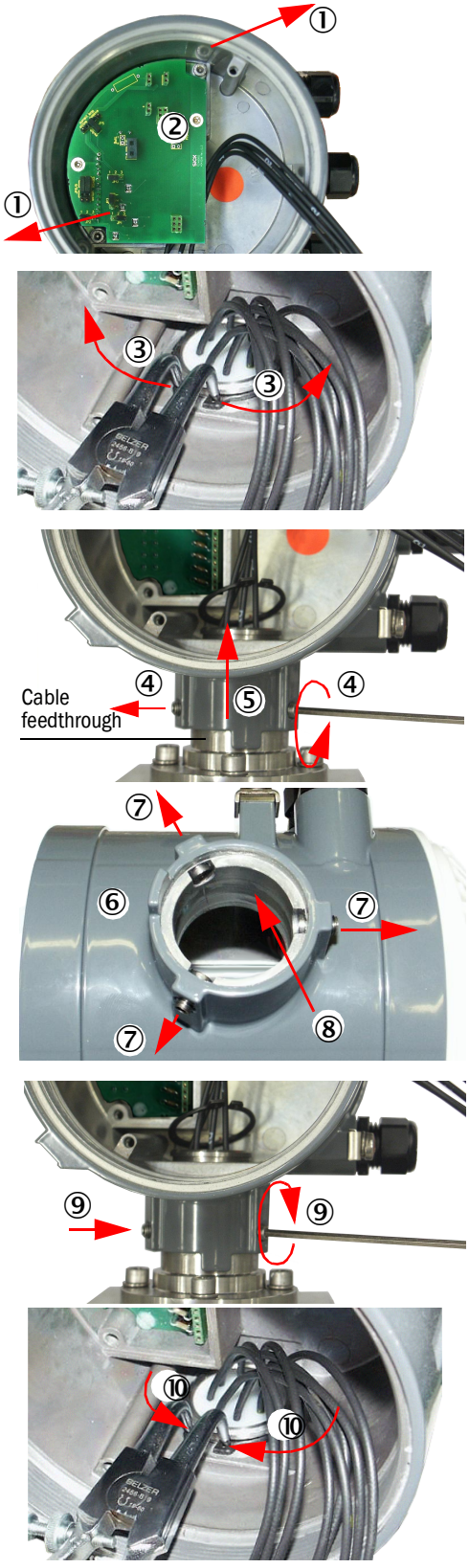
- Loosen the fastening screws of the electronics block (6) with a 3 mm Allen key.



- Pull the electronics block (7) off the main board and take it out of the SPU housing (8) carefully together with the fastening screws.

2 Changing the housing with the fuse board

Figure 60 Replacing the SPU housing



- ► Loosen the fastening screws of the connection block (1).
- ► Pull the connection block (2) cautiously off the fuse board and take it out of the SPU housing.

CAUTION:

The boards must not be stressed on one side, because otherwise the connectors on the EMC board may be twisted.

- ► Open and remove the snap ring using snap ring pliers (3).
- ► Loosen the three locking screws at the housing base using a 3 mm Allen key (4) and cautiously pull off the SPU housing upwards (5). Make sure the transducer cables and the sealing faces at the neck (cable feedthrough) are not damaged.
- ► Check on the new SPU housing with fuse board (6) whether the locking screws (7) are turned out enough to prevent damage to the sealing face (8) of the neck feedthrough. If this is not the case, turn them further out.
- ► Insert the snap ring into the groove provided using snap ring pliers (10).
- ► Route the transducer cables through the opening in the new SPU housing and cautiously position the housing on to the neck feedthrough.

NOTICE:

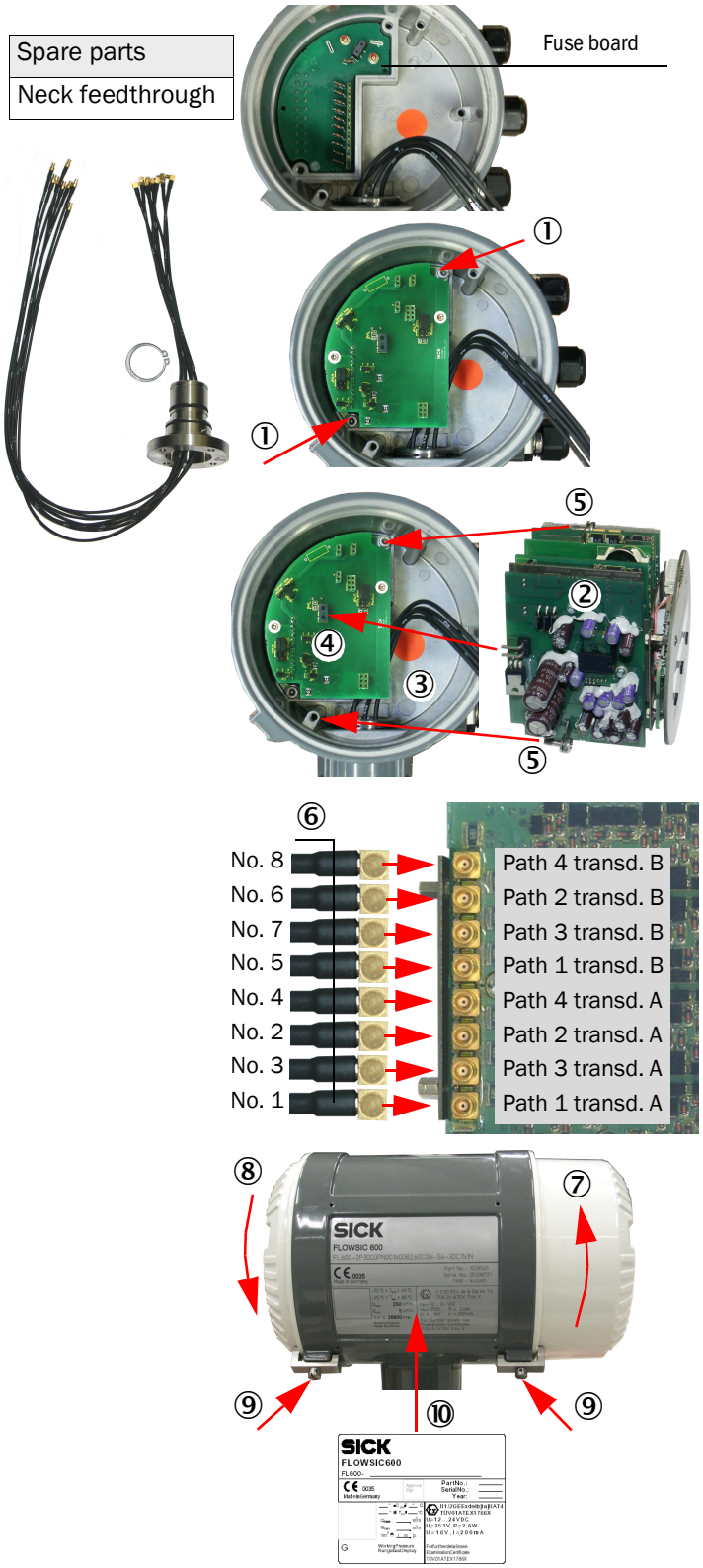
- – Observe the direction of the housing.
- – Do not damage the sealing faces.

- ► Tighten the locking screws (9).

3 Mounting the connection block and electronics block again

Figure 61 Mounting the connection block and electronics block again

Spare parts
Neck feedthrough



- ► Insert the connection block into the SPU housing and plug it on to the fuse board cautiously.

CAUTION:

If the board is inserted at an angle, the connectors may be deformed.

- ► Fix the connection block to the housing with the help of fastening screws (1).
- ► Insert the electronics block (2) cautiously into the SPU housing (3) as shown in the Figure, plug it on to the main board (4) and fix it with the two fastening bolts (5).
- ► Plug the transducer cable (6) on to the corresponding socket, store excess cables in the SPU housing.
- ► Reconnect signal and power cables in the terminal box of the signal processing unit as described in the Operating Manual, Section 3.4.
- ► Screw on the front (7) and back caps (8) of the SPU housing.
- ► Attach the securing clamps (9) and fix them.
- ► Stick the replacement label over the old main type plate (10) and fill in the empty boxes (serial no. and article no.) using the water-proof pen which is included in the delivery.

CAUTION:

Only use the replacement type plate which corresponds with the ignition group of the device!

Connect to power.

NOTICE:

The replacement main type plate is a temporary label. It shall be substituted for a new main type plate later which is to be ordered from the manufacturer.

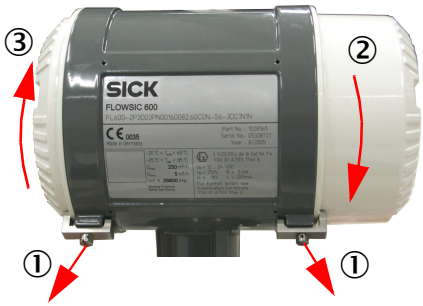
Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4.

7.2.7 Replacing the neck (cable feedthrough)

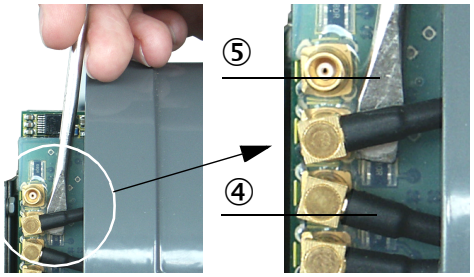
The actual model to be used depends on the type of FLOWSIC600 DRU (number of paths, nominal size), which is why it will not be specified here (for description and part no. see List of spare parts in Section 9.1).

1 Dismounting the electronics block

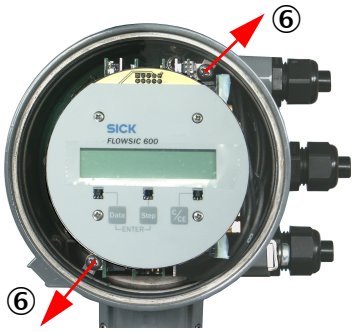
Figure 62 Removing the electronics block



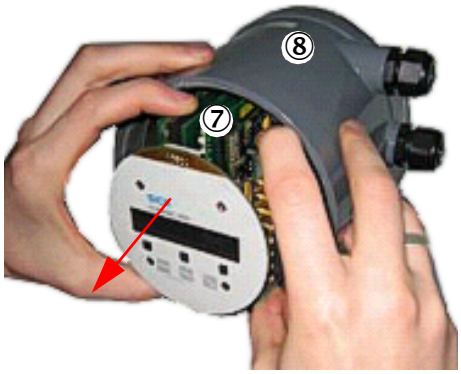
- Loosen the fastening screws with a 3 mm Allen key and remove the securing clamps (1).
- Unscrew the front (2) and back caps (3) of the SPU housing.
- In the terminal box of the signal processing unit: disconnect the signal cables, take off the power supply cap and disconnect the power cables.



- Remove the transducer cables (4) from the circuit board (5) using a slotted screwdriver.



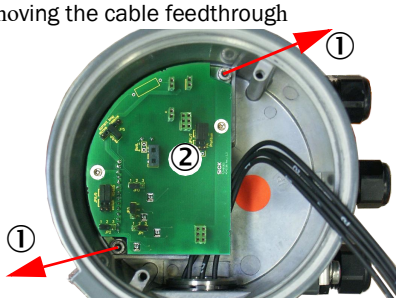
- Loosen the fastening screws of the electronics block (6) with a 3 mm Allen key.



- Pull the electronics block (7) off the back plane and take it out of the SPU housing (8) carefully together with the fastening screws.

2 Removing the neck feedthroug

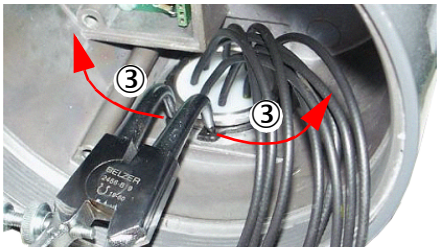
Figure 63 Removing the cable feedthrough



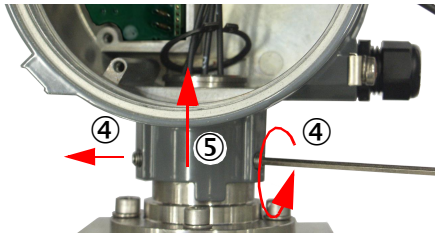
- ► Loosen the fastening screws of the connection block (1).
- ► Pull the connection block (2) cautiously off the fuse board and take it out of the SPU housing.

CAUTION:

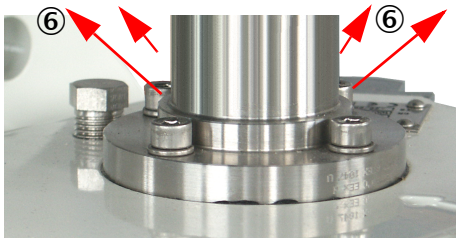
The boards must not be stressed on one side, because otherwise the connectors on the EMC board may be twisted.



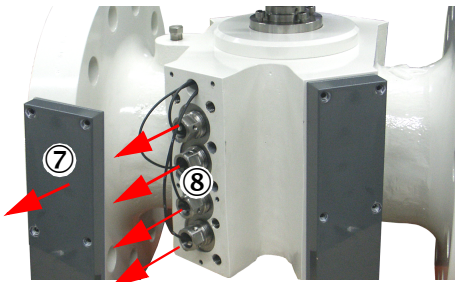
- ► Open and remove the snap ring using snap ring pliers (3).



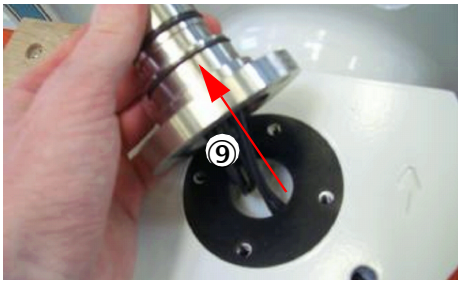
- ► Loosen the three locking screws at the housing base using a 3 mm Allen key (4) and cautiously pull off the SPU housing upwards (5). Make sure the transdducer cables and the sealing faces at the housing are not damaged.



- ► Loosen and remove the fastening screws at the neck feedthrough (6).



- ► Loosen the fastening screws of the transducer cover cap and take the cover cap off (7). If a cover cap is stuck although all screws are removed, hitting the lower edge with a block of wood may help to detach the cap.
- ► Pull the transducer cables off the transducers (8).



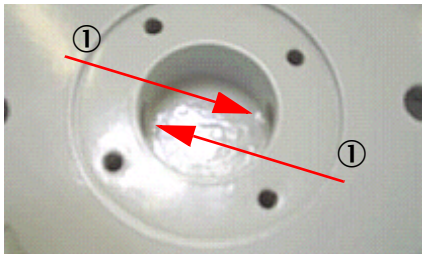
NOTICE:

If the cable marking is difficult to read, label the cables in a suitable way before you remove them.

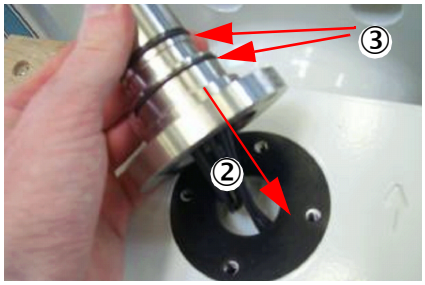
- ► Take off the neck feedthrough and cautiously pull the transducer cables out of the cable conduits (9).

3 Mounting a new cable feedthrough

Figure 64 Mounting a new cable feedthrough



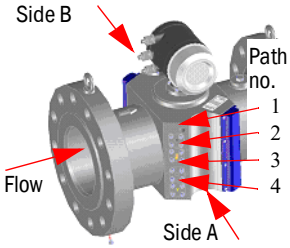
► Slide the transducer cables of the new neck feedthrough cautiously into the cable conduits (1), as shown in the Figure left.



► Position the new neck feedthrough on the meter body such that the bores match (2).

CAUTION:

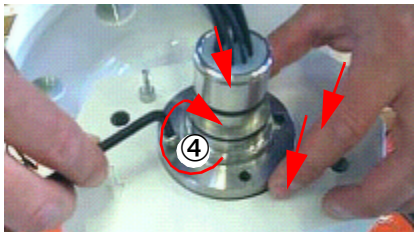
All O rings must be existing and treated with silicone grease (3).



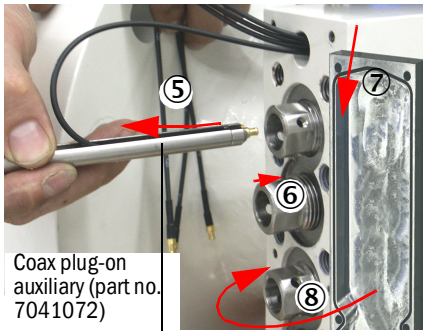
Cable assignment

Side	Path no.	Cable no.
A	1	1
	2	2
	3*	3*
	4*	4*
B	1	5
	2	6
	3*	7*
	4*	8*

*does not apply to 2-path meters

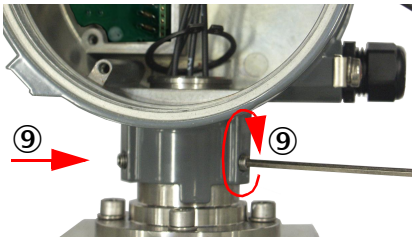


► Mount the neck feedthrough with the help of the fastening screws and snap rings (4).



► Slide the transducer cables into the plug-on auxiliary (5) and plug them on to the transducer connectors (6). Observe the cable assignment shown on the left.

► Treat the sealing faces of the transducer cover cap with silicone grease (7) and attach the cover caps to the meter body again (8).

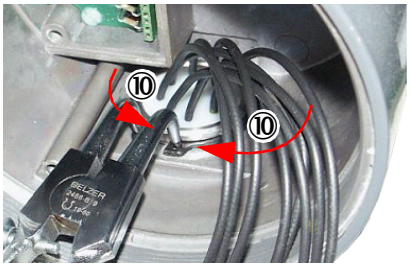


► Insert the snap ring into the groove provided using snap ring pliers (10).

► Insert the transducer cables into the SPU housing and cautiously position the housing on to the neck feedthrough.

NOTICE:

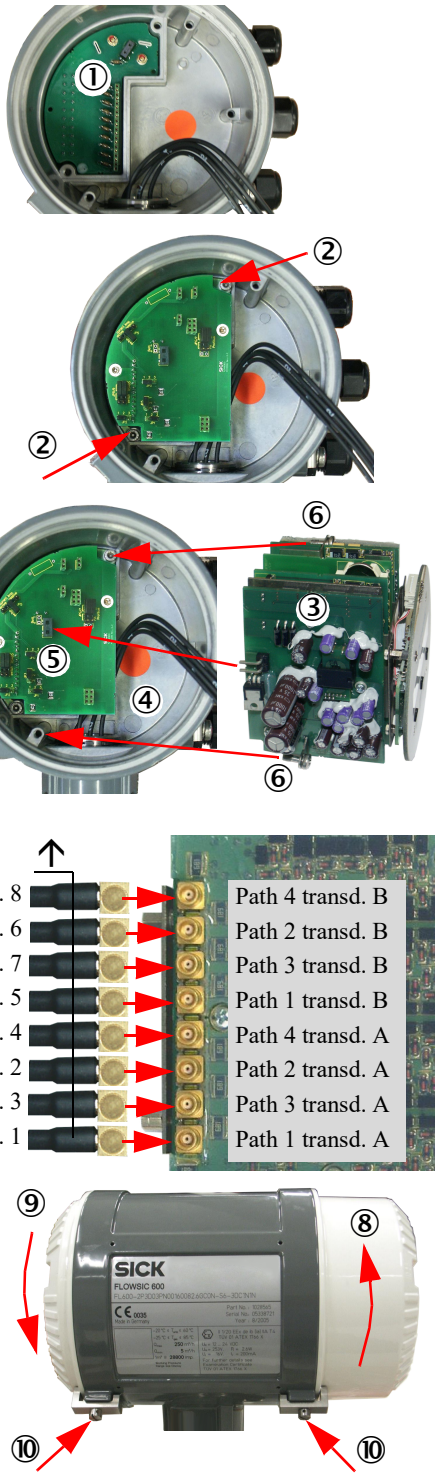
- Observe the direction of the housing.
- Do not damage the sealing faces.



► Tighten the locking screws (9).

4 Mounting the terminal block and electronics block again

Figure 65 Mounting the terminal block and electronics block again



- ► Insert the connection block into the SPU housing and plug it on to the fuse board (1) cautiously.

CAUTION:
If the board is inserted at an angle, the connectors may be deformed.

- ► Fix the connection block to the housing with the help of fastening screws (2).
- ► Insert the electronics block (3) cautiously into the SPU housing (4) as shown in the Figure, plug it on to the back plane (5) and fix it with the two fastening bolts (6).
- ► Plug the transducer cable (7) on to the corresponding socket, store excess cables in the SPU housing.
- ► Reconnect signal and power cables in the terminal box of the signal processing unit as described in the Operating Manual, Section 3.4.
- ► Screw on the front (8) and back caps (9) of the SPU housing.
- ► Attach the securing clamps (10) and fix them.
- ► Connect to power.

Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4

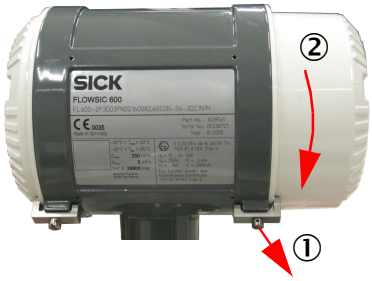
7.2.8 Replacing the battery

The real time clock of the FLOWSIC600 DRU is buffered by a BR 2032 type lithium battery. This battery should be replaced when necessary (e.g. in conjunction with a re-verification of the device).

CAUTION:
If the FLOWSIC600 DRU is used in a hazardous area, make sure that the installation is not surrounded by an explosive atmosphere when replacing the battery.

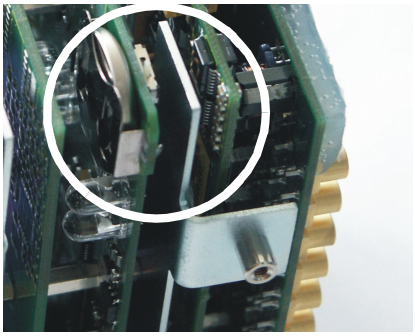
Figure 66 Replacing the battery

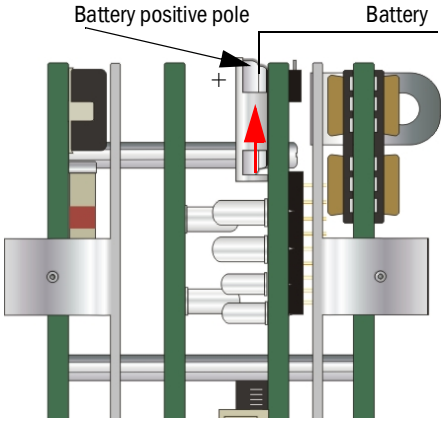
Spare parts
Lithium battery for real-time clock Part no. 7048533

- Switch OFF the power
- Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).
- Unscrew the front cap (2) of the housing.

- Take the battery out of its socket using non-conducting tweezers (plastic or ceramic) and insert a new battery of the same type (4).
- Set the correct date and time using the MEPAFLOW600 CBM programme.





- Screw on the front cap of the housing again (5), attach and fasten the securing clamps (6).
- Connect to power.

NOTICE:
See also Operating Instructions Chap. 2.4.6 and 10.2.6!

7.3 Ultrasonic transducers

CAUTION:

- Any work on the meter body shall only be carried out if the pipeline section in which the meter is installed is depressurised and vented.
- However, if you take advantage of the optional extraction tool, the transducers may also be replaced under process conditions (for details see Extraction Tool Manual).

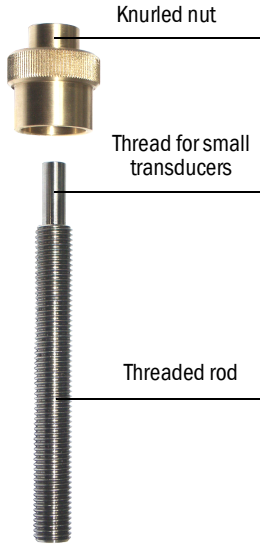
7.3.1 Dismounting and cleaning the transducers

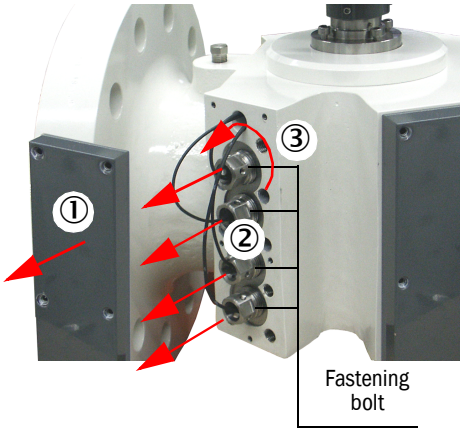
NOTICE:

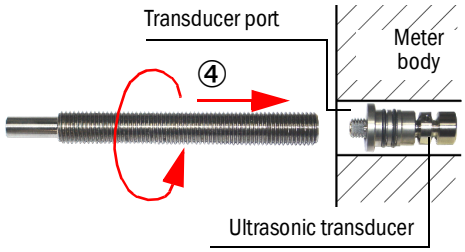
The ultrasonic transducers should be dismounted one by one in order to prevent the transducer positions in the meter body to be mixed up. If transducers are mounted to a wrong position, measuring errors will occur.

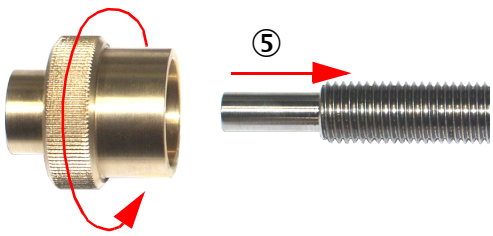
Table 6 Dismounting the transducers

Spare parts
Transducer puller Part no. 7041172









- Loosen the fastening screws of the transducer cover caps using a 4 mm Allen key and take off the cover caps (1). If a cover cap is stuck although all screws are removed, hitting the lower edge with a block of wood may help to detach the cap.
- Pull the transducer cables off the transducers (2).

NOTICE:

If the cable marking is difficult to read, label the cables in a suitable way before you remove them.

- Unscrew the fastening bolts from the transducer port in the meter body (3).
- Take spacer sleeve and lock washer out of the transducer port.
- Dismount the transducer from the transducer port using the transducer puller.
  - Screw the threaded rod on to the ultrasonic transducer in clockwise direction (4).

NOTICE:

  - Hold the threaded rod upside down to dismount small transducers (type S6, 26, M6, S5).
  - Slide the knurled nut on to the threaded rod (5) and turn until the ultrasonic transducer can be pulled out of the transducer port.
- Unscrew the transducer from the transducer extraction tool.

After dismounting, clean the transducers as necessary and check them for corrosion.

CAUTION:

- The ultrasonic transducers are sensitive components and shall thus be handled with special care. Protect the transducer ends from damage immediately after dismounting.
- Take care when cleaning the transducers. Do not use abrasive cleaning materials. Always avoid mechanical stress

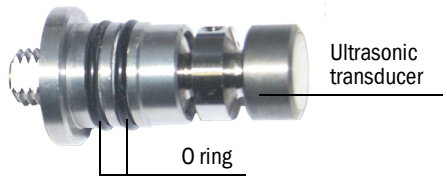
7.3.2 Mounting cleaned or new transducers

NOTICE:

- Replace defective transducers for new ones (for information on testing the transducer function see Section 6.2).
- Ultrasonic transducers are made in pairs. This is why transducers must always be changed in pairs (A and B), even if only one transducer is defective.
- Each transducer replacement must be documented

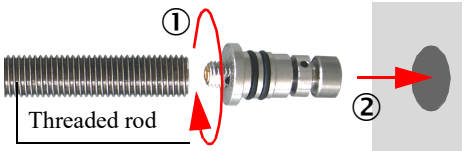
Figure 67 Mounting a transducer

Spare parts
Transducer pair with report (see Fig. 68) (Type depends on the type of FLOWSIC600 DRU; see List of spare parts)

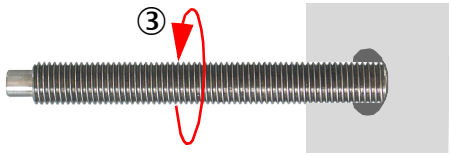



► Check the sealing O rings for damage, replace defective or leaky O rings; treat O rings with silicone grease.

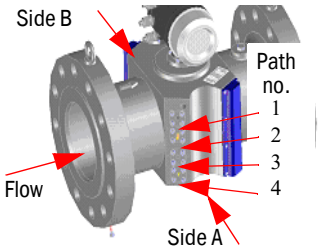
► Note down transducer no. and path position of new transducers.



► Screw the threaded rod on to the cleaned or new transducer (1), insert the transducer into the transducer port and plug it in as far as it will go (2). You will need to exert little pressure (because of the O rings in the female part of the transducer port).



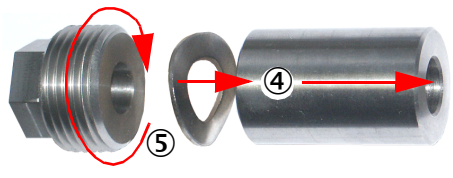
► Unscrew the threaded rod from the transducer (3).



Cable assignment

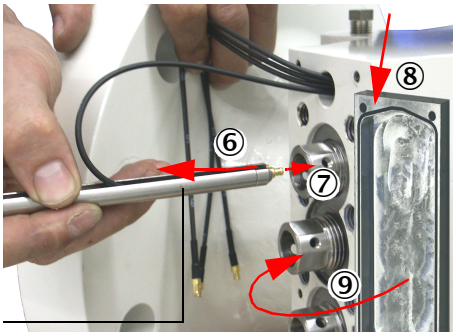
Side	Path no.	Cable no.
A	1	1
	2	2
	3*	3*
	4*	4*
B	1	5
	2	6
	3*	7*
	4*	8*

*does not apply to 2-path meters



► Slide the spacer sleeve and the lock washer into the transducer port (4).

► Insert the fastening screw into the thread and tighten at a torque of 8 Nm (5).



► Slide the transducer cables into the coax connection tool (6) and plug them on to the transducer connectors (7). Observe the cable assignment shown on the left.

► Treat the sealing faces of the transducer cover cap with silicone grease (8) and attach the cover caps to the meter body again (9).

► Connect to power.

Figure 68 Configuration protocol of a transducer pair

FLOWSIC600 - Datenblatt Sondenpaare / Data Sheet Transducer Pairs

Sondentyp / Transducer type: S2
Ident-Nummer / Identity Number: 7042600

Pfad 1 / Path 1

	Sonde A Transducer A	Sonde B Transducer B
Seriennummer Serial number	08060049	08060003
Länge Sonde [m] Transducer length [m]	3.8986E-02	3.8970E-02
Zeit Sonde [s] Timeoffset	1.62618E-05	1.62618E-05
Sendefrequenz [Hz]: Tx Frequency	220000	
Anzahl Gesamtperioden Tx Periods	5	
Anz. ungebremste Perioden Tx Phase	2.5	

Pfad 2 / Path 2

	Sonde A Transducer A	Sonde B Transducer B
Seriennummer Serial number	08060013	08060006
Länge Sonde [m] Transducer length [m]	0.038971422	0.038984903
Zeit Sonde [s] Timeoffset	1.63327E-05	1.63331E-05
Sendefrequenz [Hz]: Tx Frequency	220000	
Anzahl Gesamtperioden Tx Periods	5	
Anz. ungebremste Perioden Tx Phase	2.5	

Pfad 3 / Path 3

	Sonde A Transducer A	Sonde B Transducer B
Seriennummer Serial number	08060021	08060010
Länge Sonde [m] Transducer length [m]	0.038965159	0.038982164
Zeit Sonde [s] Timeoffset	1.62838E-05	1.62838E-05
Sendefrequenz [Hz]: Tx Frequency	220000	
Anzahl Gesamtperioden Tx Periods	5	
Anz. ungebremste Perioden Tx Phase	2.5	

Pfad 4 / Path 4

	Sonde A Transducer A	Sonde B Transducer B
Seriennummer Serial number	08060033	08060011
Länge Sonde [m] Transducer length [m]	0.038970463	0.038963806
Zeit Sonde [s] Timeoffset	1.62848E-05	1.62869E-05
Sendefrequenz [Hz]: Tx Frequency	220000	
Anzahl Gesamtperioden Tx Periods	5	
Anz. ungebremste Perioden Tx Phase	2.5	

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7.3.3 Parameter input

After having changed ultrasonic transducers the transducer parameters included in the delivery must be entered into the FLOWSIC600 DRU. It is recommended to note down the serial numbers of the new transducers in your device documentation when you replace transducers.

Connection between PC and FLOWSIC600 DRU see Technical Information FLOWSIC600

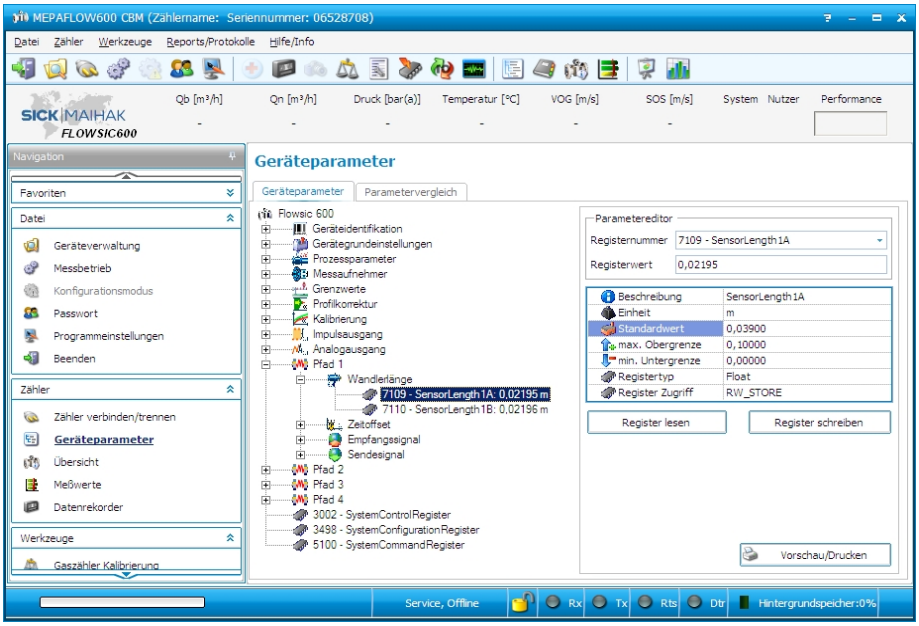
Run the MEPAFLOW600 CBM programm, connect to the device (service level with password “expert“), change to the configuration mode, call up the **“Device parameters”** tab and activate the folder of the path concerned. Click on a transducer parameter to open the corresponding edit box. The following information can be found on the transducer configuration protocol which is included in the delivery. Enter this information in the parameter table (see Fig. 69).

Connection between PC and FLOWSIC600 DRU see Technical Information FLOWSIC600.

Parameter	Transducer A	Transducer B	
Serial number	SerialNumberSensor xA	SerialNumberSensor xB	x = path number
Transducer length	SensorLength xA	SensorLength xB	
Offset time	TimeOffset xAB	TimeOffset xBA	
Transmission frequency	Tx Freq xAB	TxFreq xBA	
Number of periods	TxPeriods xAB	TxPeriods xBA	
Non-decelerated periods	TxPhase xAB	TxPhase xBA	

Then, the correct function shall be verified with the help of the tests described in Section 6.2

Figure 69 Device parameters” tab, transducer parameters



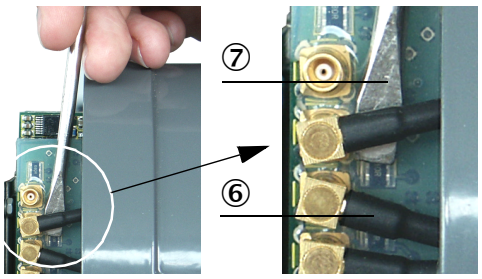
7.4 Replacing the I/O board for the I/O board H

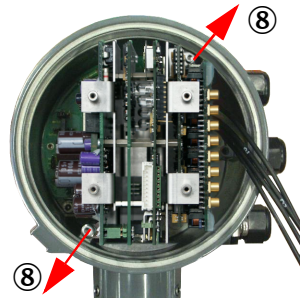
The I/O board H will be required if you want to run the FLOWSIC600 DRU in the hardware version 2 or 3 (see Tab. 2). In the hardware version 2, an analogue current output is provided on that board. This enables communication in accordance with the HART® protocol.

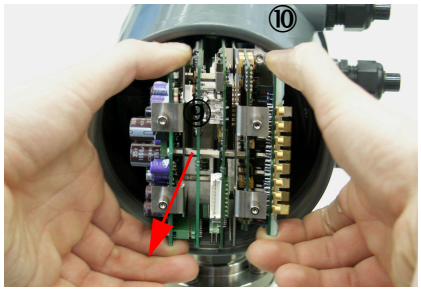
The I/O board H will also be required if you want to run the FLOWSIC600 DRU with integrated flow correction feature (hardware version 3).

1 Removing the electronics block

Figure 70 Removing the electronics block



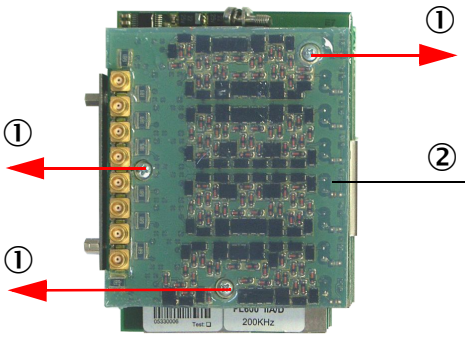




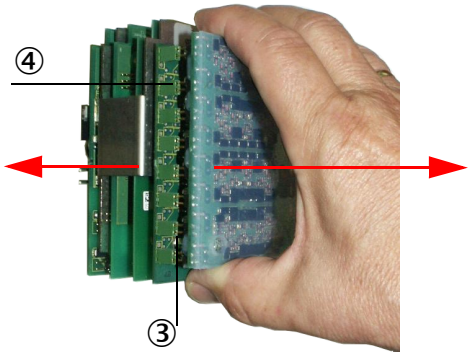
- ► Loosen the fastening screw with a 3 mm Allen key and remove the securing clamp (1).
- ► Unscrew the front cap (2) of the housing.
- ► Loosen the front panel fastening screws (3) using a size 1 cross-tip screwdriver.
- ► Pull off the front panel (4). With the LCD front panel, unplug the connector (5) at electronics block.
- ► Remove the transducer cables (6) from the circuit board (7) using a slotted screwdriver.
- ► Loosen the fastening screws of the electronics block (8) with a 3 mm Allen key.
- ► Pull the electronics block (9) off the main board and take it out of the SPU housing (10) carefully together with the fastening screws.

2 Detaching the analogue block from the electronics block

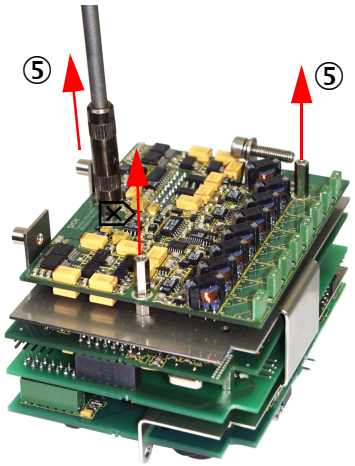
Figure 71 Detaching the analogue block from the electronics block



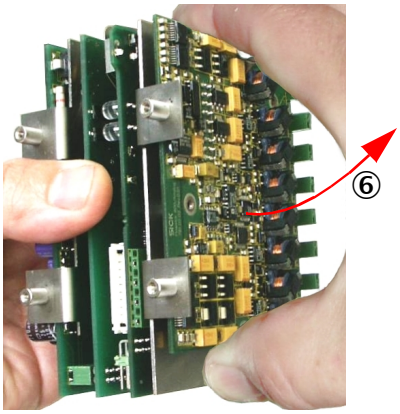
► Loosen the fastening screws (1) at the shunt board (2).



► Hold the analogue board (4) with one hand and pull off the shunt board cautiously at the connector side (3).



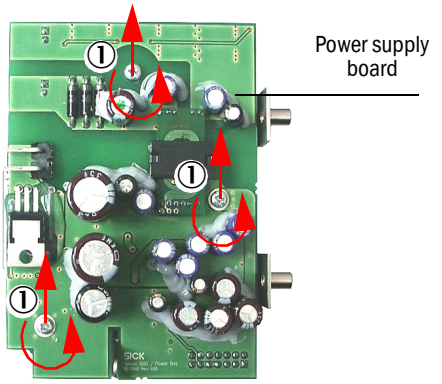
► Loosen the three fastening bolts (5) on the analogue board with the help of a 4 mm socket wrench.



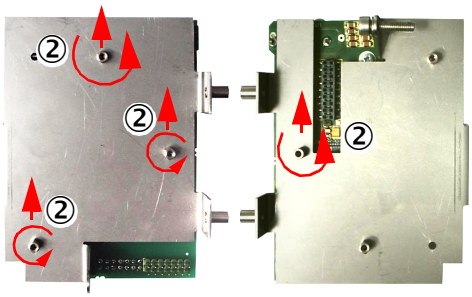
► Pull the analogue board off the electronics block cautiously and take it off as shown in the Figure.

3 Removing the I/O board

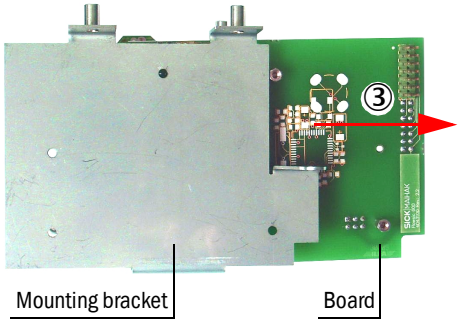
Figure 72 Removing the I/O board



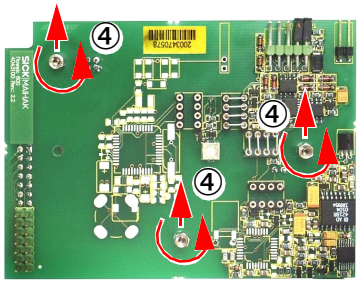
► Loosen the three fastening screws of the power board using a size 1 cross-tip screwdriver (1) and cautiously pull the power supply block off the electronics block.



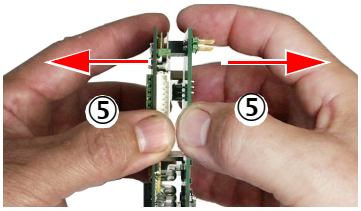
► Loosen the four fastening bolts (2) of the mounting bracket with the help of a 4 mm socket wrench.



► Pull the I/O board and the SPU board out of the mounting bracket (3) cautiously.



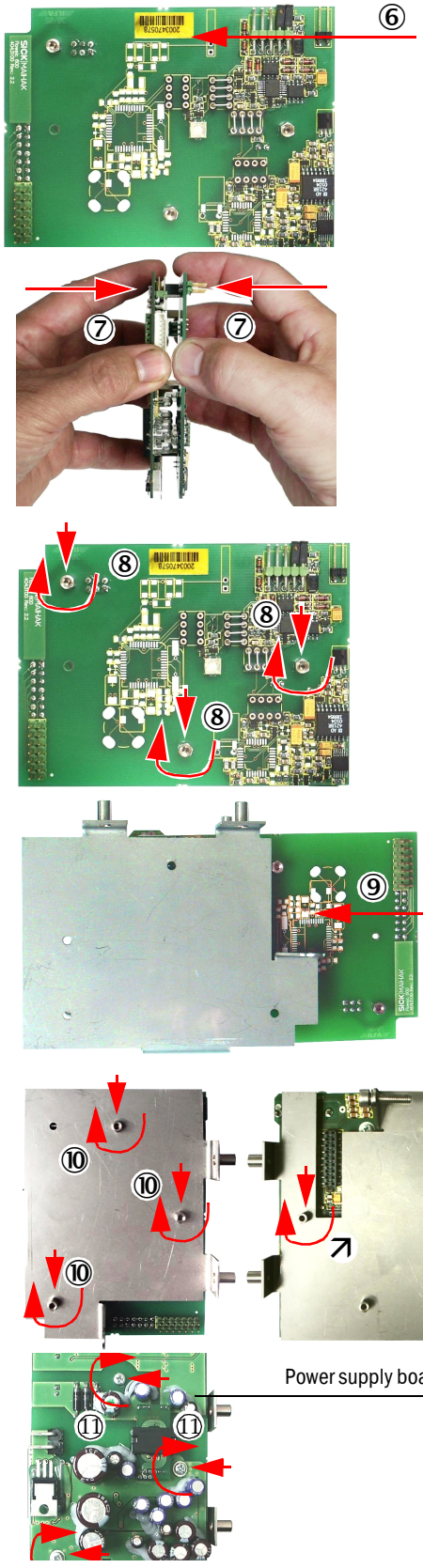
► Loosen the three fastening bolts on the I/O board with the help of a 4 mm socket wrench (4).



► Detach the I/O board from the SPU board cautiously as shown in the Figure (5).

4 Mounting a new I/O board H

Figure 73 Mounting the I/O board H



► Note down the number of the new I/O board H (6).

► Connect the boards again cautiously as shown in the Figure (7).

► Insert the three fastening bolts on the I/O board H with the help of a 4 mm socket wrench (8).

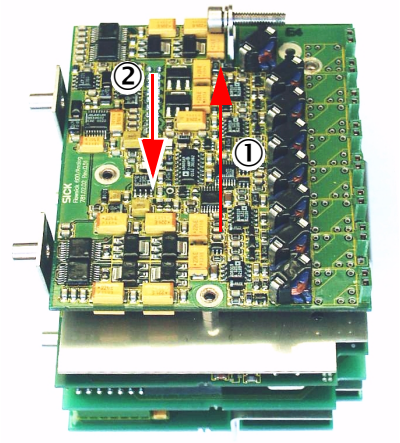
► Push the I/O board H and the SPU board into the mounting bracket (9) cautiously.

► Fix the four fastening bolts to the mounting bracket (10).

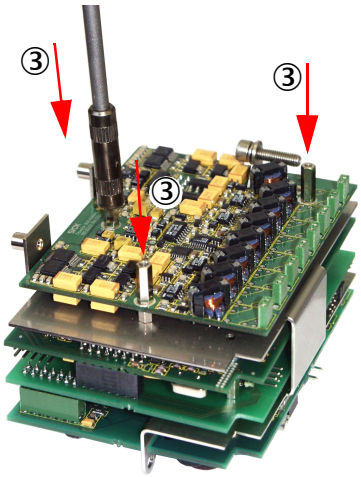
► Plug the power supply board on to the electronics block cautiously and fix it with the three fastening screws using a size 1 cross-tip screwdriver (11).

5 Mounting the analogue block to the electronics block

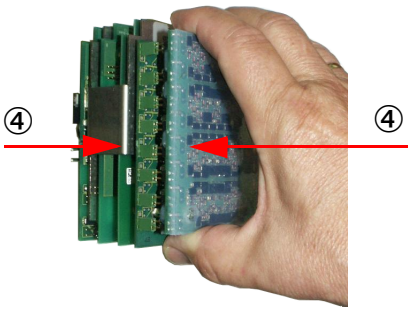
Figure 74 Mounting the analogue block to the electronics block



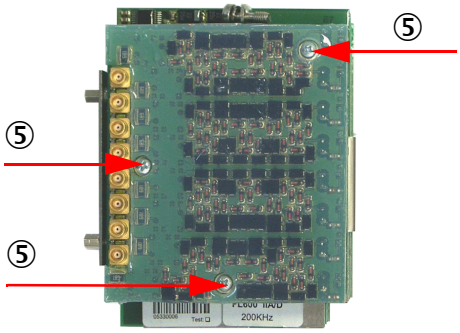
► Slide the analogue board on to the electronics block (1) as shown in the Figure and plug it on (2).



► Attach the analogue board to the electronics block with the help of the fastening bolts (3), do not tighten the bolts too much.

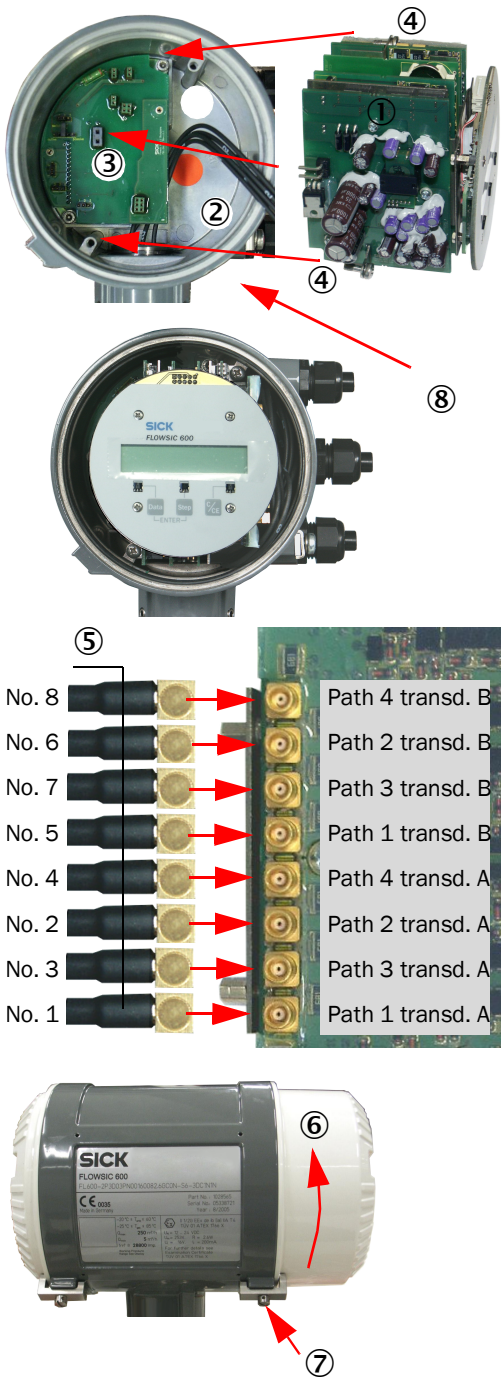


► Plug the shunt board on to the analogue board (4) cautiously on the connector side and fix it with the fastening screws (5).



6 Inserting the electronics block into the SPU housing again

Figure 75 Mounting the electronics block again



- ► Set jumper no. 5 to “Analogue active” or to “Analogue passive” (see Fig. 3.3). (“Analogue passive” is recommended.)
- ► Insert the electronics block (1) cautiously into the SPU housing (2) as shown in the Figure, plug it on to the main board (3) and fix it with the two fastening bolts (4).

CAUTION:
Do not damage the connector when inserting the electronics block.

- ► Check the jumper s on the main board (8).
- ► Plug the transducer cables (5) on to the corresponding sockets, store excess cables in the SPU housing.
- ► Screw on the front cover (6) of the housing.
- ► Attach the securing clamp (7) and fix it.
- ► Connect to power.

After completion of the hardware work described above, the firmware must be updated as described in Section 9 with a HART® bus capable version.

Then, the correct function of the new electronics block shall be verified with the help of the tests described in Section 4.1 to 4.3 and in Section 6.2.1 to 6.2.4.

FLOWSIC600 DRU

8 Firmware Update

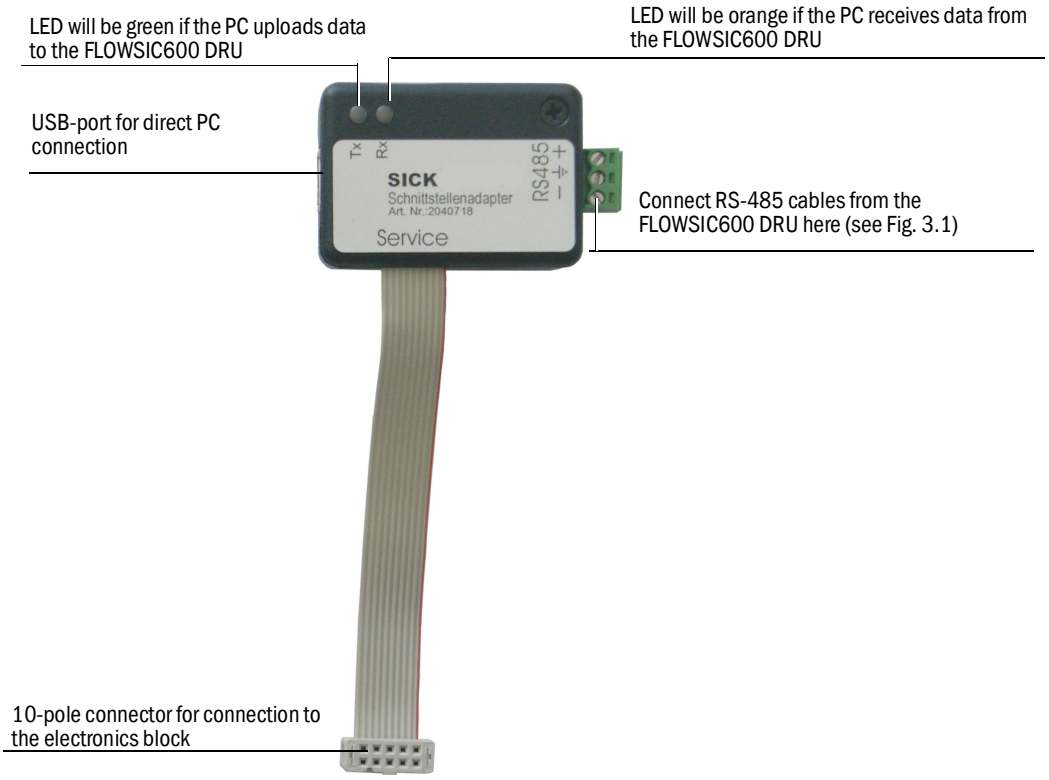
Required tools and accessories
Installing the software driver for the interface adapter
Connecting the interface adapter
Firmware upload procedure

8.1 Required tools and accessories

The firmware can be updated by connecting a special interface adapter (76) to the system-internal programming interface. Memory elements (IC's) do not need to be replaced. The entire programme code is stored in a flash memory and protected from modification with the help of a check sum.

The interface adapter is designed to allow both direct access to the flash memory and the use of the serial interface using the MODBUS protocol.

Figure 76 Service interface adapter USB Rev2 (part no. 2040718).



NOTICE:

If the communication from MEPAFLOW600 CBM to the meter does not work, disconnect the 10-pole connector briefly from the FLOWSIC600 DRU and plug it on again.

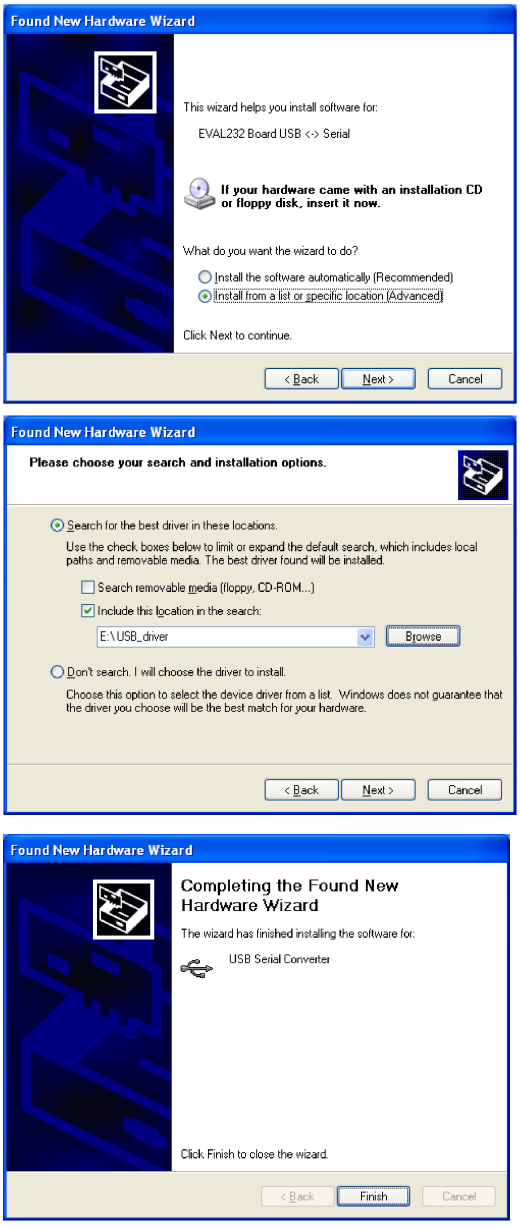
The two connectors (10-pole connector or RS485 connector) can't be linked to the FLOWSIC600 DRU at the same time -> communication conflicts.

8.2 Installing the software driver for the interface adapter

> ***NOTICE:***
> The interface adapter can only be used on PCs which run under the operating systems , Windows 2000, Windows XP or higher.

- Plug in the USB connector at the PC.
- The operating system will signal to have found new hardware. Insert the FLOWSIC600 DRU product CD which is included in the delivery and follow the installation assistant (see Fig. 77).
- After completion of the installation, a second installation will be performed for software reasons. This second installation must not be interrupted -- please follow the assistant again

Figure 77 Installing the driver

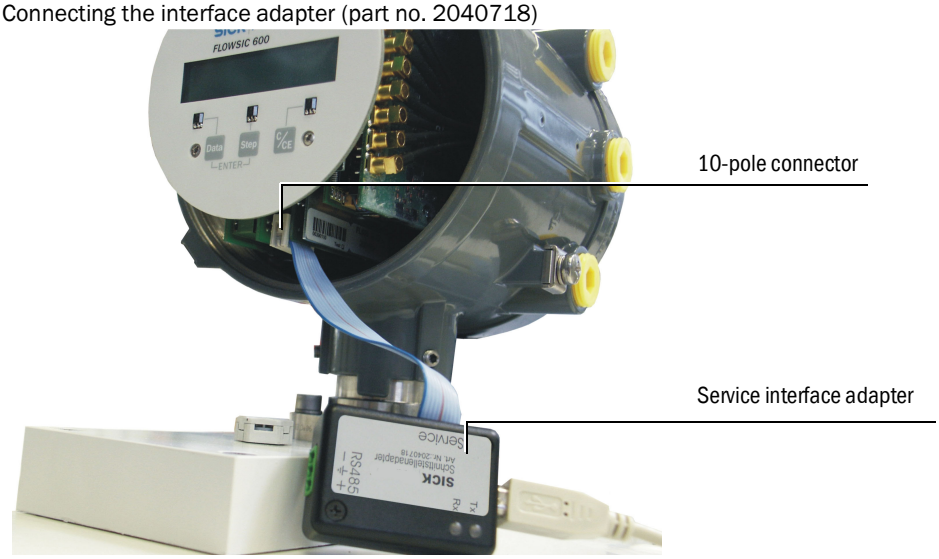


8.3 Connecting the interface adapter

CAUTION:
The SPU housing must be opened to be able to connect the interface adapter. Always observe the additional safety precautions if the FLOWSIC600 DRU is installed in a hazardous area.

- ► Plug in the USB connector at the PC.
- ► Take off the front cap of the SPU housing (remove the securing clip first !)
- ► Plug the 10-pole connector of the interface adapter on to the pin row on the SPU board. Make sure the protrusion on the plug faces away from the board (polarity reversal protection, see Fig. 78).

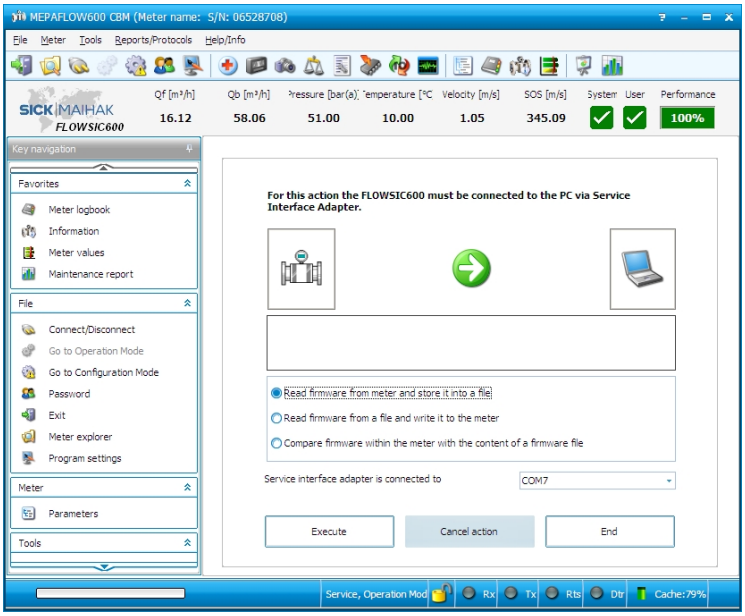
Figure 78 Connecting the interface adapter (part no. 2040718)



8.4 Firmware upload procedure

- ► Run the MEPAFLOW600 CBM program at the user access level “Service” with the password “expert”.
- ► Open the “Firmware update” page
- ► Select the right COM-port
- ► Carry out the three actions listed of the right of the radio buttons (start frim above) by clicking the buttons followed by the “Execute” button (See Fig. 79) Follow the instructions you will be given at the single steps.

Figure 79 Firmware update



FLOWSIC600 DRU

9 Spare Parts

SPU parts
Electronic boards
Necks and gaskets
Transducer cable extensions
O-rings for transducers
Sensor covers
Interface adapters
Other
Cable extensions

9.1 SPU parts

Order number	Description
7041671	Power supply cover with gasket
7041670	Terminal strip, 10 pole
2042889	cable feed trough 10 pole with retaining ring
2031000	SPU-clamp set (sealable)
4041791	Mass bridge
7048533	Backup battery FL600
2031300	Electronics housing AL EEX M20 with fuse board
2031304	Electronics housing AL EEX NPT 1/2” with fuse board
2033309	Electronics housing SS EEX M20 with fuse board
2045198	Electronics housing SS EEX NPT 1/2” with fuse board
2031301	Front cap for SPU housing FL600
2031302	Backside cap for SPU housing FL600
5319161	O-Ring 117*3,8 - EPDM 70 Shore (For front and backside cap of SPU)
4043905	Tag plate sticker for SPU FLOWSIC600
5314151	Magnetic pen
2032787	Control set for LCD front panel (magnetic pen, adhesive straps)

9.2 Electronic boards

Order number	Description
7041660	Front panel LCD SICK
7041659	Front panel LED SICK
2031456	ANALOG BLOCK IIA/D 2L7 (135kHz)
7041795	ANALOG BLOCK IIA/D 1L6 (200 kHz)
2040272	SPU board FL600 Rev2
2040271	I/O board FL600 rev2 (For I/O Config. 1/1, 1/2, 1/3)
2040270	I/O board H FL600 Rev2 (For I/O Config. 2/4, 2/5)
2046348	I/O board H FL600 Rev2 (For I/O Config. 4/7)
7048504	Power board FL600
2040275	Connection block hardware variant 1 and 2 Rev2 (EMV board and backplane)
2041154	Connection block hardware variant 3 Rev2 (EMV board and Back Plane)
2041502	Fuse board with mounting accessoires FL600
2040343	Electronics block Basic (SPU-Board, I/O-Board, Mounting bracket)
2040344	Elctronic block H Basic (SPU-Board, I/O-Board H, Mounting bracket)
2040382	Electronics block IIA/D 135kHz (Power, SPU, I/O, Analog)

Order number	Description
2040384	Electronics block IIA/D H 135 kHz (Power, SPU, I/O, Analog)
2046414	Electronics block IIA/D A4/7 135 kHz, for I/O config. 4/7 (Power, SPU, I/O, Analog
2040386	Electronics block IIA/D 200 kHz (Power, SPU, I/O, Analog)
2040388	Electronics block IIA/D H 200 kHz (Power, SPU, I/O, Analog)
2046354	Electronics block IIA/D A4/7 200 kHz, for I/O config. 4/7 (Power, SPU, I/O, Analog)
4043108	Mounting bracket for electronics block FL600 Rev2

9.3 Necks and gaskets

Order number	Description
2042058	Cable and feedtrough for >2 inch meter 2P EEx d (neck with 50 mm cable
7041495	Gasket K61 (neck)
7045209	O-Ring 37,82*1,78 - VITON 70 SHORE (neck sealing)
7045210	O-Ring 29,82*2,62 - VITON 80 SHORE (neck sealing

9.4 Transducer cable extensions

Order number	Description
2032601	Cable extension 350 mm (up to 100°C, cable type RG187)
2032578	Cable extension 450 mm (up to 100°C, cable type RG187)
2044396	Cable extension 450 mm 90° (up to 100°C, cable type RG187)
2032600	Cable extension 550 mm (up to 100°C, cable type RG187)
2031633	Cable extension 650 mm (up to 100°C, cable type RG187)

9.5 Transducers and accessoires

Order number	Description
2055670	Transducer pair type S16 (200 kHz, 100 bar, 120 °C, Titanium, P14) Special transducers for: – condensate loaded gas
2039997	Transducer pair type S22 (200 kHz, 250 bar(g), 120 °C, Titanium, P18) Special transducers for: – condensate loaded gases – increased condensate protection

9.6 O-rings for transducers

Order number	Description
7045173	O-Ring 15 * 2.0 (Viton, natural gas resistant, -25 ... +200 °C)
5313739	O-Ring 11,5 * 1,5 (Viton, natural gas resistant, -25 ... +200 °C
7044129	O-Ring 7,5 * 1,5 (Viton, natural gas resistant, -25 ... +200 °C
5314393	O-Ring 15 * 2 (Viton, LT170-TT, natural gas resistant, -40 ... +200 °C
5318606	O-Ring 11,5 * 1,5 (Viton, LT170-TT, natural gas resistant, -40 ... +200 °C
5315493	O-Ring 7 * 2 (Viton, LT170-TT, natural gas resistant, -40 ... +200 °C
5314241	O-Ring 11,5 * 1,5 (Viton, V747-75, -25 ... +200 °C
5315517	O-Ring 15 * 2 (Celrez, FFKM-900, -15 ... +260 °C
5314490	O-Ring 11,5 * 1,5 (Celrez, FFKM-900, -15 ... +260 °C

9.7 Sensor covers

Order number	Description
2061495	Cover, transducer, Aluminum
5308767	Sealing cord for cover cap 2,0-EPDM 60 Shore A (yard good)
5314109	Sealing cord for cover cap 4,0-EPFDM 30 Shore (yard good)
2039452	Set of screws for transducer covers

9.8 Interface adapters

Order number	Description
2040718	Service interface adapter RS485/USB for Rev2 electronics (Adapter, USB cable, CD-ROM FL600
7041773	MEPA interface set RS485/USB (Converter, Cable, Terminal plug, CD-ROM with Software (Nientech)

9.9 Other

Order number	Description
5320603	Plug 1/2” NPT 1.4571
7047797	Breather cap M12x1,5 PA
5314131	breather cap M12x1,5 SS
7048511	MEPAFLOW600 CBM (software)
2033761	CD_ROM FLOWSIC600 (MEPAFLOW600 CBM, manuals, device driver software)

9.10 Cable extension by using the cable feedthroughs 2042057 or 2042058

Meter size	HT	1P	2P	4P	1R	2R	4R	5C	2X	4X	Length [mm]	Cable type	Order-number
3”	x	x	x	x	x	x	x	x	x	x	450	RG187/W	2044396
				x			x	x			450	RG187	2032578
4”	x				x	x	x	x	x	x	450	RG187/W	2044396
							x	x		x	450	RG187	2032578
6”		x	x	x	x	x	x	x	x	x	350	RG187	2032601
	x				x	x	x	x	x	x	550	RG187	2032600
8”		x	x	x							450	RG187	2032578
	x				x	x	x	x	x	x	650	RG187	2031633

W: 90° plug at one side of the cable
HT: High temperature application > 100°C
At a 5C meter:2 long cables and 8 short ones

1P	1-Path
2P	2-Path
4P	4-path
1R	1+1 Path redundant
2R	2+2-Path redundant
4R	4+4-path (Quatro)
5C	4+1-path (2plex)
2X	2-Path crossed
4X	4-Path crossed

8023840/18BQ/V 1-1/2020-08

Australia
Phone +61 (3) 9457 0600
1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 234 719 500
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 010
E-Mail info@sick.de

Greece
Phone +30 210 6825100
E-Mail office@sick.com.gr

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972 97110 11
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mexico@sick.com

Netherlands
Phone +31 (0) 30 229 25 44
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Russia
Phone +7 495 283 09 90
E-Mail info@sick.ru

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 10 060 0550
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321/4
E-Mail infokorea@sick.com

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail contact@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Detailed addresses and further locations at **www.sick.com**

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