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KROHNE

Ultrasonic Flowmeters

OPTISONIC 7060

Electrical & mechanical installation manual

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Product Liability and warranty

Responsibility for suitability and intented use of these ultrasonic flowmeters rests solely with the operator.

Improper installation and operation of the flowmeters (systems) may lead to loss of warranty.

In addition, the “General conditions of sale” forming the basis of the purchase contract are applicable.

If flowmeters need to be returned to KROHNE, please note the information given on the last-but-one page of these instructions. KROHNE regret that they cannot repair or check your flowmeter(s) unless accompanied by the completed form sheet.

About this document

This manual describes the measuring system OPTISONIC 7060 used to determine the actual volume flow, actual volume and the velocity of sound in gases transported in pipelines. It provides general information on the measuring method employed, design and function of the entire system and its components, and on planning, assembly, installation, commissioning, maintenance and troubleshooting. Contrasting characteristic properties of available system variants aims to facilitate a decision on a configuration that is ideally adapted to the measuring task already in the planning phase.

This manual covers standard applications which conform with the technical data specified. Additional information and assistance for special applications is available from your KROHNE representative.
This manual is part of the OPTISONIC 7060 documentation package. This package includes the following documents:

- Operating Instructions OPTISONIC 7060 (this document)
- Documentation CD

Option, for trained staff only:

- Service Manual OPTISONIC 7060
- Software Manual MEPAFLOW IV

Symbols used in this document

Important information, in particular regarding safety, are highlighted in this document to facilitate quick reference. Such information is provided where necessary within each section of this manual.

Note To provide information about special features of the device/ system and further recommendations.


IMPORTANT

Important

To indicate potential dangers to the equipment and possible functional impairment.


WARNING

Warning

To indicate potential dangers to the operating staff, in particular due to electrical equipment and improper use of the device/ system. Always observe such warnings, as they aim to protect you from serious injuries.

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

Any obligation of KROHNE are set forth in the relevant purchase agreement. This agreement also includes the complete and solely valid warranty conditions.

Abbreviations used in this manual

act.	actual (operating condition)
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
CSA	**C**anadian **S**tandards **A**ssociation
DC	**D**irect **C**urrent
DIN	**D**eutsches **I**nstitut für **N**ormung (German Industrial Standard)
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)
HART	Communication interface
IEC	**I**nternational **E**lectrotechnical **C**ommission
norm.	normalised (standard condition)
LED	**L**ight **E**mitting **D**iode
MEPAFLOW	**Me**nu-assisted **Pa**rameterisation and Diagnosis for **OPTISONIC 7060**
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)
PC	**P**ersonal **C**omputer
VDE	**V**erband **d**er **E**lektrotechnik Elektronik Informationstechnik (~ Association of German Electrical Engineers)

1 Safety Instructions

1.1 Intended Use of the Equipment

The OPTISONIC 7060 measuring system was designed to determine the actual volume flow rate of gases transported in pipelines. The OPTISONIC 7060 measuring system can further be used to measure 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 points:

- 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. Any relevant information is provided in the order documentation, type plate, certification documents and this 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 Authorized Staff

Persons responsible for safety issues shall ensure the following points:

- Any work on the measuring system shall only be carried out by qualified persons and must be checked 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 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 appropriate training.
- In hazardous areas, wiring and installation shall only be carried out by staff trained according to EN 60079-14 and according to national regulations.

1.3 General Safety Instructions and Protective Measures

Using the equipment for any other purpose than intended, and improper operation may result in personal 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 OPTISONIC 7060 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 number. Always use such protective accessories. Check that appropriate safety devices are fitted and working correctly.

1.3.1 Danger Due to Hot, Corrosive and Explosive Gases and High Pressure

The OPTISONIC 7060 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


WARNING

In plants with toxic and explosive gases, high pressure or high temperatures, the OPTISONIC 7060 measuring system shall only be mounted and dismounted when the pipelines are vented or when the plant is not working.

The same applies to repair and service work which involves opening measuring channel or the explosion-protected measuring transducer (CONVERTER).

Note Design, manufacture and inspection of the OPTISONIC 7060 measuring system are performed in compliance with the safety requirements set forth in the European Pressure Equipment Directive 97/23/EC. 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.

1.3.2 Dangers Due to Heavy Loads Overhead

The OPTISONIC 7060 measuring system must be safely attached to the lifting gear when being transported and installed.

Important


IMPORTANT

- Only use the hoisting gear and auxiliaries (e.g. lifting straps) suitable for the load to be lifted. Max. load information can be found on the type plate of the hoisting 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 measuring transducer or its mounting bracket and avoid contact between these parts and the hoisting gear.

2 Product Description

2.1 Features and Applications

System features

The OPTISONIC 7060 measuring system is a compact gas meter used for ultrasonic volumetric gas flow measurements. The measuring system is characterised by the following features:

- Specially designed, compatible assemblies
- Ultrasonic sensors integrated into the meter body
- Concealed cabling

As a result, this measuring system is extremely robust and provides maximum accuracy, even under extremely harsh operating conditions. Its compact design also provides protection from mechanical damage, thereby ensuring a long-term stable gas measurement that is insensitive to mechanical or electrical interference.

Fig. 2.1: OPTISONIC 7060

Applications

The OPTISONIC 7060 is ideally suited for a wide range of applications in process measurements, such as

- Chemical and petrochemical industries
- Power stations and other gas-consuming installations
- Compressed air distribution systems.

2.2 Conformity, Configuration, Technical Data

2.2.1 CE Certificate

The OPTISONIC 7060 has been developed, manufactured and tested in accordance with the following EC directives:

- Pressure Equipment Directive 97/23/EC
- Directive 94/9/EC (ATEX100)
- EMC Directive 89/336/EC

Conformity with above directives has been verified and the equipment given the CE label.

2.2.2 Technical Data

Flow rate range

			Max gas velocity		Max flowrate		Max flowrate @ 30m/s		Minimum flowrate	
Meter size			[m/s]	[ft/s]	[m3/h]	[ft3/h]	[m3/h]	[ft3/h]	[m3/h]	[ft3/h]
DN	50	2"	57	187	402	14197	212	7486,74	7,1	249
DN	65	2,5"	57	187	680	24014	357	12607,4	11,9	417
DN	80	3"	57	187	1000	35315	540	19070	18	630
DN	100	4"	53	174	1600	56503	900	31783	30	1050
DN	150	6"	45	148	3000	105944	2000	70629	67	2345
DN	200	8"	43	141	4800	169510	3360	118657	112	3920
DN	250	10"	45	148	7800	275454	5220	184342	174	6090
DN	300	12"	32	105	7800	275454	7380	260622	246	8610
DN	400	16"	30	98	12000	423776	12000	423776	400	14000
DN	450	18"	30	98	17170	606353	17170	606353	572	20020
DN	500	20"	30	98	21200	748761	21200	748761	707	24745
DN	600	24"	30	98	30550	1078993	30550	1078993	1018	35630

- Any flow rates given above are also valid in the bidirectional mode.

Other information

Meter characteristics	
Number of measuring paths	< DN80 (4"): 1; >= DN80: 2
Min. Gas velocity	1 m/s (for standard accuracy)
V_{min}/v_{max}	Min.: 1:30
Measuring medium	
Gas	process gas, air
Pressure range	From ambient pressure to 103 bar; higher pressure on request
Temprature range	Standard: -25 °C to + 100 °C Extended: -25 °C to +180 °C
Measuring accuracy	
Reproducibility	< 0.2 of the measured value
Typical measuring uncertainty *	< ± 1% of measured value for a flowspeed > 1 m/s (3 ft/s) (2 acoustic path's) < ± 2% of measured value for a flowspeed > 1 m/s (3 ft/s) (1 acoustic path)
Outputs	
Measuring quantities	Act. volume flowrate, act. volume, gas velocity, velocity of sound
Pulse and status outputs	Passive; electrically isolated; open collector; U_{Imax} = 30 V, I_{Imax} = 100 mA, f_{max} = 6 kHz, pulse width = 0.05…1 s or in accordance with NAMUR (EN50227)
Measuring rate	20 measurements /s
Interfaces	
MODBUS (RS 485)	ASCII protocol, for parameterisation, measured value inquiry and diagnosis (9600,8, N.1)
Explosion protection	
Europe	II 2G EEx de ib [ia] IIA or IIC T4 in accordance with RL94/9/EG (ATEX) ** Ultrasonic signal converter intrinsically safe "ia"
Power supply	
Operating voltage Voltage limits When supplied through solar-panel-fed battery	U_{min} = 12 V DC, U_{max} = 28.8 V DC Start-up voltage: 11.8V Turn-off voltage for integrated total discharge protection: 10.8V
Typical power consumption	<1 W (approx. 37 mA at 24 V DC, approx. 66 mA at 12 V DC)
Ambient conditions	
Temperature range	ATEX: - 20 °C to + 60 °C (- 40 °C to + 60 °C on request) CSA: - 40 °C to + 60 °C
Storage temperature	- 40 °C… + 60 °C
Type of protection	IP 67
Relative humidity	< 95 %

* Related to the measured value in the range 0.1…1 Q_{max} with min. straight inlet length of 10 DN and min. straight outlet length of 5 D, for calibrated measuring system


IMPORTANT

Important

When used in hazardous areas, comply with the required type of explosion protection during installation (intrinsically safe or increased safety)!

2.3 System Components

The OPTISONIC 7060 measuring system consists of the hardware components,

- Meter body
- Ultrasonic transducers
- CONVERTER (signal processing unit)

Fig. 2.3: OPTISONIC 7060

1. Converter
2. Flange
3. Flowmeter body
4. Indication of positive flow direction
5. Transducer holder

2.3.1 Meter Body

The meter body consists of a section for mounting the ultrasonic transducers and flanges used for installing in the pipeline.
Standard meter bodies are available in carbon steel and stainless steel.
The meter bodies can be delivered in several nominal sizes (see Section *2.2.4*).

2.3.2 Ultrasonic Transducers

The OPTISONIC 7060 ultrasonic transducers are optimised to suit the system requirements. The high quality of the transducer parameters provides the basis for accurate and highly stable propagation time measurements with nanosecond precision. The ultrasonic transducers are of an intrinsically safe design (class "ia").

2.3.3 Signal Processing Unit (CONVERTER)

The CONVERTER contains all the electrical and electronic components required for controlling the ultrasonic transducers. It generates transmission signals and uses the received signals to calculate the measured values. The CONVERTER also contains several interfaces for communication
with a PC, or standardised process control system.

Event logging see Section 2.7

The current volume counter value, fault, warning, and power failure alarms are stored in a battery-buffered data memory (FRAM) along with the time of day. On system restart, the counter value that was last saved is restored as the start value for the volume counter. The FRAM back-up provides an unlimited number of writing cycles and protects the saved data for at least 10 years.

The CONVERTER is supplied with a front panel containing a two-line LCD to display current measured
values, diagnosis and logbook information (see Fig. **2.4**). You can select the values you want to display using a magnetic pen while the front cover is kept closed (for details on operation and menu structure see Section *8.2* in the appendix).

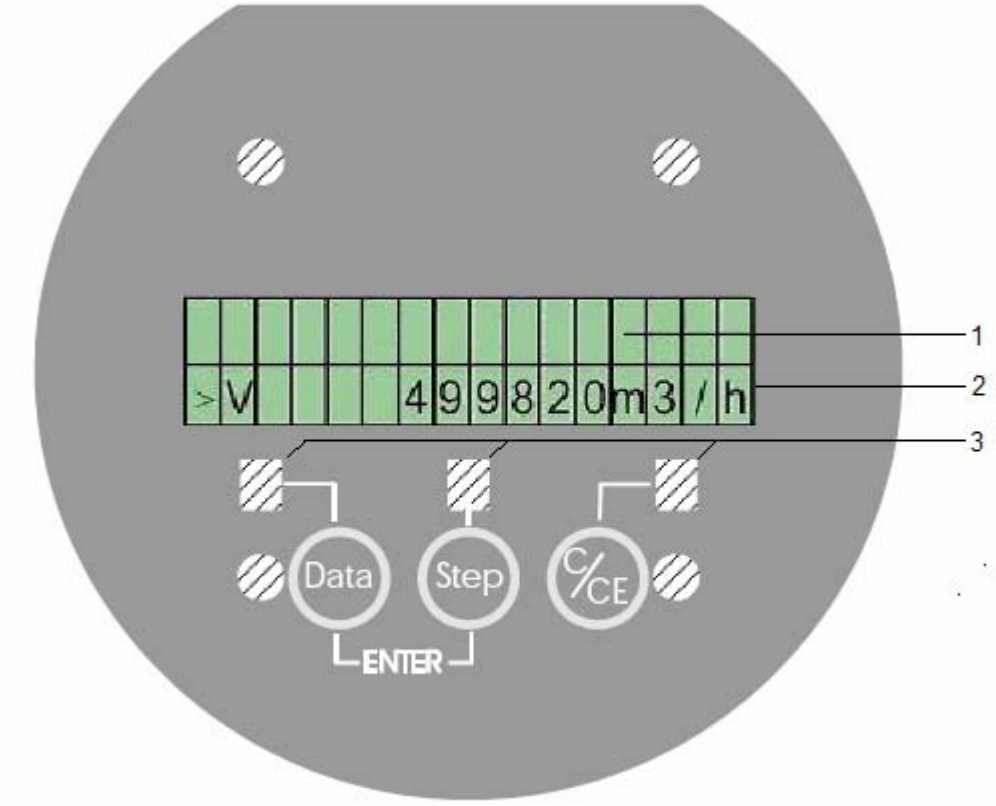


Fig. 2.4: Front panel for the OPTISONIC 7060 CONVERTER
1. Selected measured value / device status
2. Current measured value
3. Control area for operation by a magnetic pin

The connection terminals for the power supply and field connections are located on the back of the CONVERTER in a separate terminal box (see Section *3.4.4*).

The electronics units are mounted in a housing certified to EN 50018 or IEC 60079-1 with type of protection "d" (flameproof enclosure). The transducer circuits are of an intrinsically safe design (type "ia").

2.4 Operating modes and signal output

The OPTISONIC 7060 measuring system has the following operating modes:

- Measurement
  Normal, fault-free system operation. The pulse and switching outputs, as well as the current output are updated periodically. The “Warning” status signal may be set automatically by the system in the course of the self-diagnosis (for details see Section *2.6*).
- Check requested
  This mode is active for multipath flowmeters only, if one measuring path has failed and the adaptive path failure compensation has been activated. The measuring system compensates for this failure but the measurement accuracy can be slightly reduced.
- Configuration
  Mode for changing parameters and performing system tests. When this mode is active, the measured values are considered to be invalid, although all the measurements and calculations are carried out as in the "Measurement" mode (except system tests).
- Malfunction
  This mode is activated when faults occur that prevent the system from measuring accurately. If the cause for the fault ceases to exist, the system returns to "Measurement" mode automatically.

Any operating modes are recorded in the logbook together with their respective activation and deactivation time.

Output, signal	Output value in operating mode			
	Measurement	**Check requested**	**Configuration**	**Malfunction**
“Measured value”	Frequency signal proportional to the volumetric flow		“open”, measurement fault *	
“Check requested” * Status signal	“open” Measurement valid	“closed” Compensation of a faulty path (reduced accuracy)	“undefined”	“undefined”
“Direction of flow” * Status signal	“open” positieve direction of flow; “closed” negative direction of flow	“open” positieve direction of flow; “closed” negative direction of flow	“undefined”	“undefined”
“Warning”	If “Warning” active, then digital output “closed”, else “open”	If “Warning” active, then digital output “closed”, else “open”	“undefined”	“undefined”
LCD	>V 123456 m^3 <V 1234 m^3	>V 123456 m^3 <V 1234 m^3 Display flashing	OPTISONIC 7060	>V 123456 m^3 <V 1234 m^3 Display flashing
Serial port RS485	• Measured value, diagnosis information and parameters • Measuring data logging, diagnosis and parameterisation • Connection with external process control equipment through implemented MODBUS protocol (data polling)			

* Output value can be changed by test commands.

The digital output 2 is assigned at the factory with the status signal “Check requested”, and digital output 3 the status signal “Direction of flow”.

As a standard, the LCD shows the two major counters, one for each direction of flow.

Changes in the logbook status are indicated by a flashing character at the far right end of the first line of the display. The character depends on the status:

- “I” for information
- “W” for warning
- “E” for error

The character will disappear after acknowledgement. For details on reading the logbook contents, acknowledgement and menu structure, refer to Section *8.2.4*.

2.5 Self-diagnosis

In the measurement mode, the ratios of sound and path velocities, amplification settings, and signal-to-noise are continuously monitored. If these parameters deviate from a preset range, a warning signal is generated. This enables immediate measures to be taken to prevent possible system malfunctions.

During commissioning or operation, you can adjust the signalling threshold values to suit individual application requirements. This enables you to create the most effective status warning system.

Note The "Warning" status signal does not affect the device function.

Parameter	Default threshold value	Warning message	Notes
Velocity of sound	< 5 m/s	Warning SOS Deviation	This message is produced when the current measured path velocity of sound deviates from the mean value of the mean velocities of sound calculated for all the paths by more than the specified threshold value. The current flow velocity is used as a weighting factor, so that temperature stratification is disregarded at very low flow velocities. Used to indicate whether or not the path is measuring the correct propagation time. **Note** When setting the parameters, take into account plausible conditions for normal operation (in particular temperature stratification).
Reception gain	< 6 dB	Warning AGC Deviation	The absolute difference between both path gain factors is evaluated and must remain below the threshold value. **Important** High flow rates can also increase the difference in gain.
	< 93 dB	Warning AGC Limit	The absolute value of the reception gain is monitored. **Important** The current receiving sensitivity largely depends on the current process pressure (inversely proportional in initial approximation, that is, when the pressure doubles, the required receiving sensitivity is halved).
			If one of the alarms is triggered by a path, this can indicate a malfunction in the ultrasonic transducers, electronics, probe cables or parameter settings (signal models, standard threshold values).
Signal-to-noise ratio	< 13 dB	Warning SNR	This alarm is activated when the signal-to-noise ratio is too small. Reasons for this include interference noise caused by fittings in the pipeline, valves that are not fully open, sources of noise near the measuring location, or defective ultrasonic transducers.

Additional signal and system diagnosis functions monitor the accuracy of the measured values, by checking the plausibility of the ultrasonic signals received and the ultrasound signal propagation times calculated from them.

2.6 Event logging

Important system events (max. 250) are stored in a verification logbook. Each entry consists of the event, time stamp and the valid volume counter value along with acknowledgement status present at the time the event occurred. The events are logged continuously in the order they occur and, each event can be acknowledged manually. Logbook queries provide information on the number of registered events and the remaining memory space. The entries are classified as follows:

- Active events
- Inactive acknowledged and unacknowledged events
- Acknowledged events

If there is no space left in the logbook, the logbook is closed and the system signals a fault. Until the logbook is reset (deleted), the measured volumes are stored in the error volume counters, in accordance with the direction of flow, irrespective of the measuring accuracy.

Overview of event entries

Name	Class	Description	Value (second line on the display)
Power On	"I" information	System is cold started or rebooted after a watchdog reset.	Time stamp of the last counter value stored is considered to be the time of the "Power off" event.
Change of operating mode	"I" information	System was changed to the configuration mode after password input, or back from the configuration mode to the measurement mode. Parameter modifications that affect the measured values may have been carried out.	Activated password level
Volume counter reset	"I" information	Resetting the volume counters to zero	Reset volume
Error volume counter reset	"I" information	Resetting the error volume counters to zero	Reset volume
Counter overflow	"I" information	One of the four volume counters completed its counter range.	
Logbook reset	"I" information	Entire logbook was deleted ("Reset" is always the first entry and indicated the point of time the logbook was opened.)	
Set clock	"I" information	Date and/ or time register of the real time clock was/ were changed.	Time stamp of the change
Check requested	"W" warning	The measured value of one path must be substituted by the replacement value calculation routine.	Path index and cause for deactivation
Output range	"W" warning	The current measured value can no longer be represented by the pulse output, because the maximum output frequency was reached.	
Measurement invalid	"E" error	More than one path must be substituted by the replacement value calculation routine, or the activated adaptive path failure compensation is not yet active.	Value is assigned with the four path states
System error	"E" error	Safe operation of the system is not guaranteed.	Cause for the fault • CRC program code • CRC parameter • CRC counter value • CRC replacement path weights • Implausible parameter • DSP malfunction

2.7 Configurations

Output	Terminal	Assignment
AO 0	31, 32	Measured value (current signal 4..20 mA) fault current signal at configuration or malfunction
DO 1	51, 52	• Measured value (frequency signal) • Direction of flow • Malfunction • Check requested • Warning
DO 2	41, 42	• Measured value (frequency signal) • Direction of flow • Malfunction • Check requested • Warning
DO 3	81, 82	• Measured value (frequency signal) • Direction of flow • Malfunction • Check requested • Warning

3 Assembly and Installation

3.1 General Notes

3.1.1 Delivery

The OPTISONIC 7060 is delivered in a pre-assembled condition in robust packaging. When unpacking the device,
check for possible damage in transit. Pay particular attention to the interior of the meter body, any visible transducer components and the sealing surfaces of the flanges. Any damage must be documented and reported to the manufacturer immediately.

Also check the consignment for completeness. The standard scope of delivery comprises:

- OPTISONIC 7060 measuring system (meter body with CONVERTER and transducers)
- Operating instructions (this document)
- Documentation CD
- Certificates
  – OPTISONIC 7060 manufacturer information
  – EC Declaration of Conformity

Important

IMPORTANT

Make sure the actual site conditions match the information provided on the labels at the converter (see Fig. 3.1), in order to guarantee a safe operation of the measuring equipment.

KROHNE Altometer, 3313 LC Dordrecht, NL	II 2G EEx de IIb [Ia] IIA or IIC T4 TÜV 0x ATEX 553048X
OPTISONIC 7060 C-EEx Manufactured: 2006 CE 0344	Do not open when energized! Maintain following time-delay before opening of the converter after de-energizing: T6 > xx min.; T5 > xx min.
www.krohne.com Docu cd:7,xxxxx,xx,00	Tamb = -40...+60°C or -20...+60°C Tgas = -25...+100°C or -25...+180°C
	Intrinsically safe circuits (only power supply): Ui = 16 V, Ii = 200 mA, Pi = 2.6 W, Um = 253 V Details -> see EC-Type Exam. Certif. TÜV 0x ATEX xxxx X
Un = 12 - 24 V DC IP67 according to EN 60529	Non-Intrinsically safe circuits:

Fig. 3.1: OPTISONIC 7060 type plate label

3.1.2 Transport and Storage


IMPORTANT

Important

Only use the hoisting gear and auxiliaries (e.g. lifting straps) suitable for the weight to be lifted. Max. load information can be found on the type plate of the hoisting gear. It is strongly recommended to use the eye bolts supplied with the device only.

During OPTISONIC 7060 transport and storage operations, make sure that:
- The sealing surfaces of the flanges are protected with special caps
- The measuring device is firmly secures at all times
- Measures are taken to avoid mechanical damage
- Humidity and ambient temperature are within specified limits (see Section *2.2.4*).

If the device is to be stored outside for more than one day, sealing surfaces of the flanges and the interior of the meter body must be protected from corrosion, e.g. with Anticorit spray (not required for stainless steel meter bodies). The same measure shall be taken if the device is to be stored in dry condition, but for more than a week.

Note Due to natural temperature fluctuation in the course of a day, or if the measuring device is transported to a place with different temperature and humidity, moisture will condense on any material. Carbon steel surfaces may corrode if left unprotected.

3.2 Assembly

Generally, the installation arrangement is specified during the project planning phase, i.e. before installation of the system. Nominal width, material and type of flange should therefore be defined in accordance with the design of the existing plant. It is particularly important that the internal diameters of the meter body and adjacent pipelines are identical.

Fixing bolts, nuts and flange seals used must be suited to the operational conditions, and comply with legal regulations and relevant standards.

Note Any deviation from the planned design of the OPTISONIC 7060 and installation arrangement shall be agreed with the supplier and documented prior to installing the measuring device.

Measuring location

- The OPTISONIC 7060 can be installed in customary straight inlet and outlet pipes. The adjacent pipes must have the same nominal width as the meter body. The internal diameter can be derived from the marked flange standard and the type key information (Appendix, Table 8.2). Any welding beads on the flanges of the inlet pipe shall be flattened.
- The meter body may be installed in horizontal or vertical position. In case of horizontal installation, make sure that the meter body is adjusted so that the measuring planes are in horizontal position. This aims to prevent dirt or moisture in the pipeline from entering the transducer ports. Vertical installation is only possible if the measuring system is used for dry, noncondensing gases. The gas flow must be free from any foreign material, dust and liquids. Otherwise, filters and traps shall be used.
- Avoid installations which may adversely affect the gas flow to be mounted directly upstream the OPTISONIC 7060.
- Seals at the flange connections between meter body and pipeline must not protrude into the pipeline. Otherwise, the flow profile and thus the measuring accuracy may be adversely affected.
- Temperature measuring devices shall be fitted in the outlet pipe no closer than 1.5x DN, or – in case of nominal widths of ≧ DN 400 – no closer than 300 mm.

Typical installation configuration:

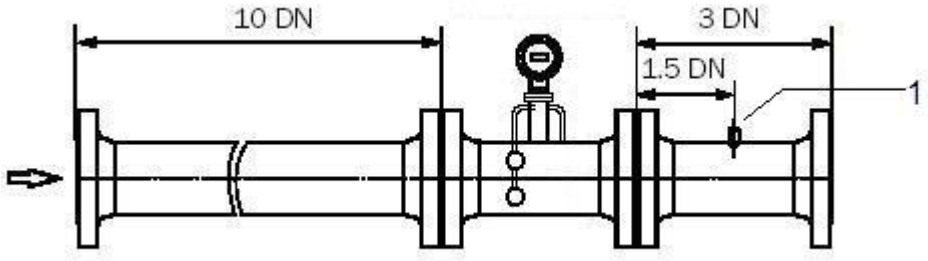


Fig. 3.2: OPTISONIC 7060 installation in the pipeline for unidirectional use
1. Temperature measurement point

The choice of the installation configuration depends on type and extent of the flow disturbance at the installation position (according to TR G13).

Type of disturbance	Possible installation configuration
None	Configuration 1 (fig. 3.2)
Elbow, reducer	
Double elbow out of plane, T piece	
Gas pressure controller with/ without muffler	Configuration 1 (fig. 3.2), >= 20 DN distance from device and not “in sight” of the flowmeter
Diffuser	
Diffuser with swirling flow	

For bidirectional use, inlet and outlet section at both sides of the meter body shall be of identical, independent of the configuration used (see Fig. **3.3**). The temperature measuring point shall in this case be installed at a distance of 5x DN to the meter body (configuration 1),

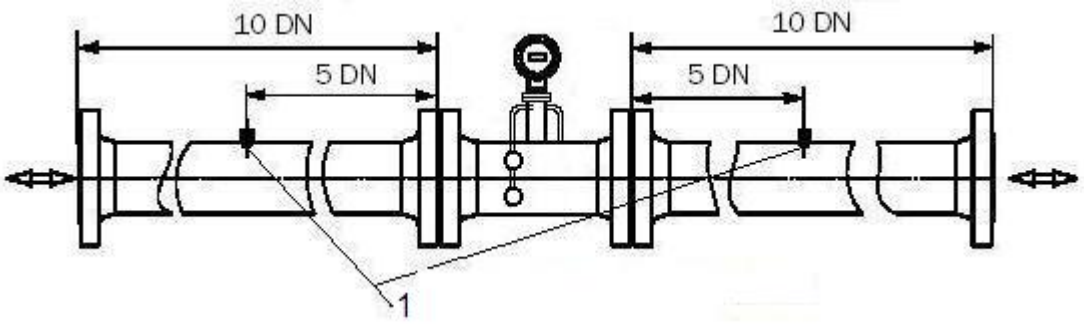


Fig. 3.3: OPTISONIC 7060 installation in the pipeline for bidirectional use
1. Temperature measurement point

3.3 Mechanical Installation

Work on the pipelines in preparation to installing the gas flow meter is not included in the scope of delivery.

It is recommended to use the following tools and auxiliaries for proper installation of the OPTISONIC 7060:

- Hoisting gear or fork lift (load capacity according to the weight information given on the type plate)
- Suitably sized ring wrench for flange mounting
- Sealing and separating agents
- Bolt lubricant
- Leak detection spray

Warning

WARNING

- Always observe the general safety regulations and safety instructions given in Section 1 when carrying out any assembly work.
- The OPTISONIC 7060 must only be mounted to pressure-free and vented pipelines.
- Take appropriate measures to avoid potential local or plant-specific dangers.

3.3.1 Choosing flanges, seals and other parts

Use pipeline flanges, bolts, nuts, and seals that withstand the maximum operational pressure and temperature, as well as ambient and operational conditions (external and internal corrosion) for the flange connections. For installation lengths and flange dimensions, see Section *8.1*.

Important

IMPORTANT

- Always strictly observe the safety instructions for the installation of pressure equipment including the connection of several pressure components set forth in the Pressure Equipment Directive 97/23/EC.
- Installation staff must be familiar with the directives and standards applicable for pipeline construction.

3.3.2 Mounting the OPTISONIC 7060 to the pipeline

An arrow on the meter body indicates the main direction of flow. It is recommended to install the OPTISONIC 7060 as indicated by this arrow id the device is to be used for unidirectional flow applications. If the device is to be used in the bidirectional mode, the arrow indicates the positive direction of flow.

Installation work to be carried out

➢ Take the OPTISONIC 7060 in the right position of the pipeline using the hoisting gear. Only use the hoisting eyes provided to lift and transport the device. If you use lifting straps, wrap them around the meter body.

Important

IMPORTANT

– The hoisting eyes are designed for transporting the measuring device only. Do not lift the OPTISONIC 7060 using these eyes when additional loads (such as blind covers, filling for pressure tests) are attached.
– Never attach hoisting gear to the signal processing unit or its mounting bracket and avoid contact between these parts and the hoisting gear.
– The OPTISONIC 7060 must not turn over or swing while being transported. Flange sealing surfaces, CONVERTER housing and transducer cover caps may be damaged when the device is hoisting gear is not attached properly.
– Do not remove the caps protecting the sealing surfaces of the meter body flanges before necessary.
– Take suitable measures to prevent damage to the measuring device when carrying out any work (welding, painting) in the vicinity of the OPTISONIC 7060.

➢ Check the correct seat of the flange seals after inserting the first fixing bolts on both sides.
➢ Align the OPTISONIC 7060 so that the mismatch between inlet pipe, meter body and outlet pipe becomes as small as possible.
➢ Insert the remaining fixing bolts and tighten the nuts cross-wise. Make sure to apply the tightening torque specified in the project planning.
➢ Mount the pressure line between pressure tap and pressure transmitter.
➢ Fill the pipeline and check the OPTISONIC 7060 installed for leaks.

Note It is recommended to perform a leak test in accordance with the relevant regulations and standards after completion of the mechanical installation.

3.3.3 CONVERTER alignment

The CONVERTER can be turned to a position which provides a good view on the display and good conditions for cable routing (see Fig. **3.4**). A stop on the housing prevents the CONVERTER from being turned more than 330 . This aims to protect the cables from the meter body from damage.

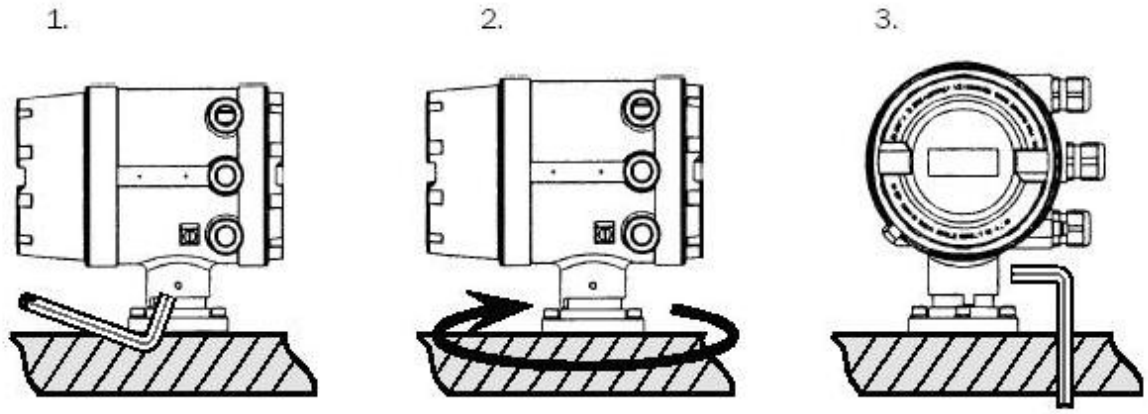


Fig. 3.4: Positioning the CONVERTER
1. Loosen the Allen screw, use 3 mm Allen key
2. Position the converter housing
3. Tighten the Allen screw

Note Do not forget to tighten the Allan screw after positioning the CONVERTER.

3.4 Electrical Installation

3.4.1 General information

Pre-requisites

Wiring work (laying and connecting the power supply and signal cables) as a part of installing the gas flow meter is not included in the scope of delivery. The mechanical installation described in Section *3.3* must be completed. Comply with the minimum requirements of the cable specs in accordance with Section *3.4.2*.

Notes on cable laying

- Cables shall be laid in conduits or on cable trays to provide protection from mechanical damage.
- Observe the permitted bending radiuses (generally, min. six times the cable diameter for multi-lead cables).
- Connections outside of conduits shall be as short as possible.

Warning

WARNING

- Always observe the general safety regulations and safety instructions given in Section 1 when carrying out any installation work.
- Installation work shall only be carried out by trained staff and in accordance with the relevant regulations issued by the operating company.
- Take appropriate measures to avoid potential local or plant-specific dangers.

3.4.2 Cable specs

Power supply 12 … 24 V DC

	Specification	Notes
Type of cable	Tow leads	Connect shielding (if present) to ground terminal
Min./ max. cross-sectional area	0.5 mm² / 1.5 mm²	
Maximum cable length	Depending on loop resistance; min. input voltage at the OPTISONIC 7060: 12 V	Peak current 150 mA
Cable diameter	6 ... 12 mm	Fixing range of the cable glands

Digital output / current output

	Specification	Notes
Type of cable	Twisted pair, shielded	Connect shielding at other end to ground terminal
Min./ max. cross-sectional area	2 / 0.5 mm²	Do not connect unused lead pairs and prevent them form accidental short-circuit.
Maximum cable length	Loop resistance under load ≤ 250 Ω	
Cable diameter	6 ... 12 mm	Fixing range of the cable glands

Serial port (RS485)	Specification	Notes
Type of cable	Twisted pair, shielded, impedance approx. 120 Ω	Connect shielding at other end to ground terminal
Min./ max. cross-sectional area	2 x 0.5 mm^2	
Maximum cable length	100 m at 0.5 mm² 200 m at 1.5 mm²	Do not connect unused lead pairs and prevent them from accidental short-circuit.
Cable diameter	6 ... 12 mm	Fixing range of the cable glands

3.4.3 Checking the cable loops

To verify the cables to be correctly connected, check the cable loops. Proceed as follows:

- Disconnect both ends of the cable of the loop to be tested.
- This is to prevent connected devices from interfering with the measurement.
- Test the entire cable loop between CONVERTER and final device by measuring the loop resistance.
- If you want to test the insulation resistance as well, you must disconnect the cables at the electronics unit before using the insulation resistance tester.


IMPORTANT

Important

The test voltage applied would seriously damage the electronics unit!

- Reconnect all cables after the loop resistance test.


IMPORTANT

Important

- In non-intrinsically safe installations, only open the terminal boxes protected for use in hazardous areas and connect/ disconnect cables when the system is disconnected from the power supply.
- The front housing cover (with viewing panel) must only be opened when the system is disconnected from the power supply and no less than 10 minutes after the system has been switched off.
- Incorrect cabling may cause the OPTISONIC 7060 to fail.
  This will lead to the annulment of any warranty claims. The manufacturer excludes any liability for consequential damage.

3.4.4 Terminal box on the CONVERTER

Open the rear housing cover.

- Loosen the securing bracket using a 3 mm Allan key.
- Turn the rear housing cover in a counter-clockwise direction and take it off.

A schematic wiring diagram is provided on the inside of the rear housing cover (see also Appendix, Section *8.3*).

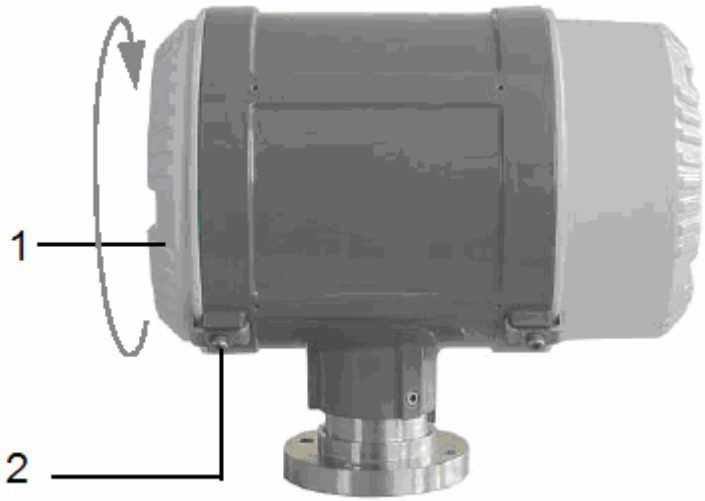


Fig. 3.6: CONVERTER housing, opening the cover
1. Housing cover
2. Securing bracket

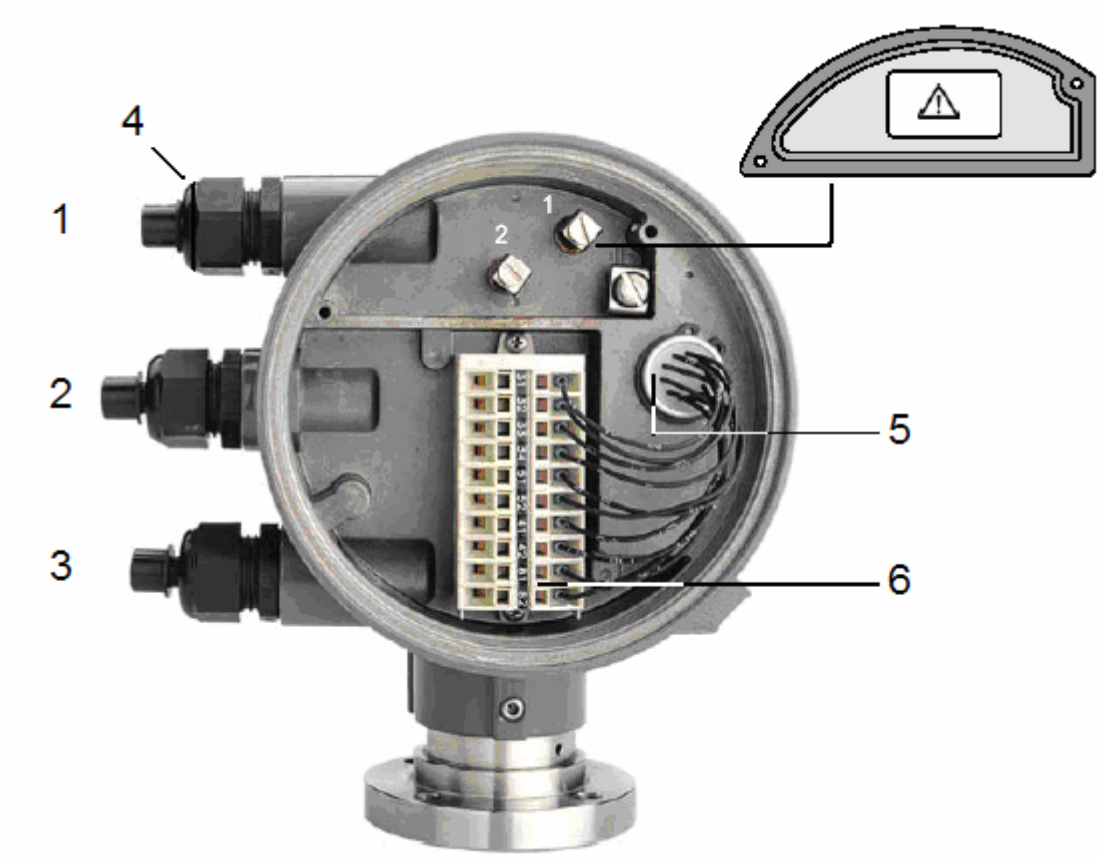


Fig. 3.7: Terminal box on the rear of the CONVERTER

1. Power supply, 2x1,5mm2 (UYCY or equivalent)
2. Digital output / current output, 4 x 2 x 0,5 mm2 (UYCY [TP] or equivalent)
3. Modbus, 4 x 2 x 0,5 mm2 (UYCY [TP} or equivalent)
4. HSK-K cable glands, M20 x 1,5 plastic (EU) or ½ In NPT (North America)
5. Cabel entry for internal 10-wire cable
6. 10-connection terminal strip for singal inputs and outputs

3.4.5 Connecting the OPTISONIC 7060 for use in non-hazardous areas

Assign the terminals in the CONVERTER terminal box (see Fig. **3.7**) in accordance with the following table.

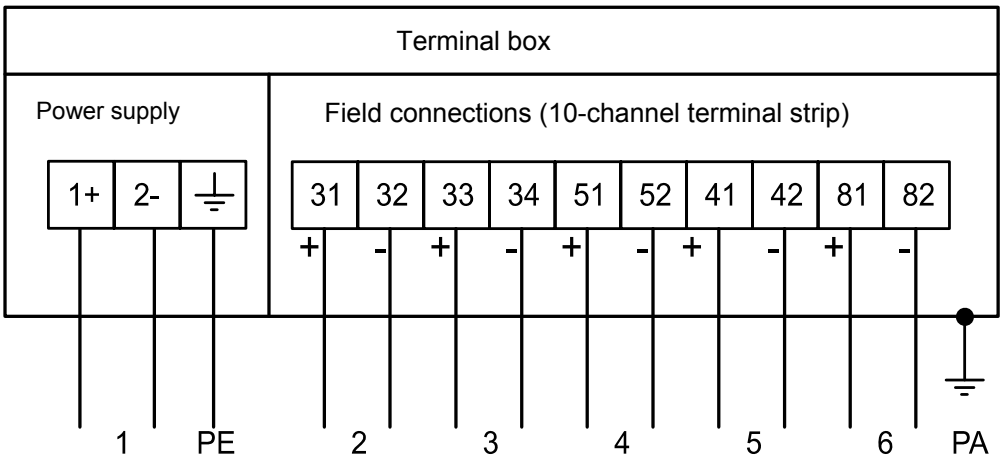


Fig. 3.8: Terminal assignment for use in non-hazardous areas

No.	Connection for	Function	Terminal	Value	Notes
1	Power supply		1+, 2-	12 ... 24 (+20 %) V DC	
2	Analog output	Passive	31, 32		
3	Serial port	Modbus (RS 485)	33, 34	9600 Baud, 8 data bits, no parity, 1 stop bit	Baud rate to be set through software
4	Digital output D0 1	Passive	51, 52	f_{max} = 6 kHz, pulse duration 0.05 s - 1 s Range: Freely selectable number of pulses per volume unit “closed”: 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤I_{CEL} ≤ 20 mA (L=Low) “open”: 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA (H = High)	With NAMUR contact for connection to switching amplifier (to DIN 19234)
5	Digital output D0 2	Passive	41, 42	“closed”: 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤I_{CEL} ≤ 20 mA (L=Low) “open”: 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA (H = High) “Check requested”	
6	Digital output D0 3	Passive	81, 82	“closed”: 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤I_{CEL} ≤ 20 mA (L=Low) “open”: 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA (H = High) “Direction of flow” (alternative “Warning”)	

3.4.6 Operation in hazardous areas in accordance with Directive 94/9/EC (ATEX)

The power supply and field connections are designed with the increased type of protection ("e"). The transducer connections are of an intrinsically safe design ("ia").

All screw-type terminals as well as air and creepage distances of the OPTISONIC 7060 comply with EN 50019.

Connection characteristics

Power supply connection	Field connections
Separate terminal box, separated from the field connections with partition wall in the housing and cover to EN 50020.	Separate terminal box, separated from the power supply connections with partition wall in the housing and cover to EN 50020.
Cable routing via EExe cable gland, M5 ground terminal integrated into housing section (cast).	Cable routing via 2x EExe cable gland

Connection variants

The protection concept for the OPTISONIC 7060 permits the following connection variants:
- Power supply connection and field connections with increased type of protection ("e")
- Intrinsically safe power supply connection and field connections ("i")
- Power supply connection with increased type of protection ("e"), where the field connections are intrinsically safe ("i")

The user must decide which variant to use, taking into account EN 60079-14.

A combination of intrinsically safe and non-intrinsically safe circuits is not permitted in the terminal box for the field connections.

The rated voltage of non-intrinsically safe circuits is U_M = 253 V.

Requirements regarding cabling in hazardous areas (Europe)

- The cables must fulfill the requirements to EN 60079-14.
- Cables that are subject to exceptional thermal, mechanical, or chemical loads must be specially protected (e.g. laid in open-ended conduits).
- Cables that are not fire protected must be verified to DIN VDE 0472, Part 804, test type B with regard to fire resistance.
- Attach ferrules to the wire ends to ensure that they do not split up.
- The applicable requirements regarding air and creepage distances must be observed in accordance with EN 50019. The available air and creepage distances in the terminal box must not be reduced when connecting the cables.
- Unused cable glands must be replaced by the EExe plugs supplied.
- The equipotential bonding must be in accordance with EN 60079-14.
- The meter body and CONVERTER housing must be connected to the potential equalizer.
- In intrinsicallysafe circuits, install potential equalizers along the wiring runs of the current outputs.
- The applicable national specifications must also be observed.

Terminal assignment

Assign the terminals in the CONVERTER terminal box (see Fig. 3.7) in the same way as for the OPTISONIC 7060 in non-hazardous areas (see table in Section *3.4.5*).

Important

IMPORTANT

The protective conductor must not be connected within the hazardous area. For measurement reasons, the equipotential bonding must, as far as possible, be identical to the pipeline potential. Additional grounding with the protective conductor PE via the terminals is not permitted!

Notes for safe operation in hazardous areas

Approval of the ultrasonic transducers in zone 0 only valid for operation under atmospheric conditions.

- Protection against explosion: II 2G EEx de ib [ia] IIC T4 or II 2G EEx de ib [ia] IIA T4
- Ambient temperature: -20°C to +60°C
  In the extended temperature range from -40 C to +60 C, only use metal cable glands.
- The cable glands delivered are black. If connections are wired with intrinsically safe circuits, it is recommended to replace these with the light-blue cable connections (RAL 5015) provided.
- For the temperature class according to the ambient and media temperature, see the EC Type Examination Certificate.
- The type of protection for the field and power supply connections is determined by the external circuits that are connected (for options see "Connection variants").
- Safety-relevant data for intrinsically safe circuits is provided in the EC Type Examination Certificate.
- Ensure that the power supply connection cover is properly sealed. In intrinsically safe installations, the terminal box can be opened and cables connected and disconnected while the system is live.
- If the meter body is insulated, the CONVERTER housing must not be insulated.

Important

IMPORTANT

Always observe the temperature specifications for use in hazardous areas.

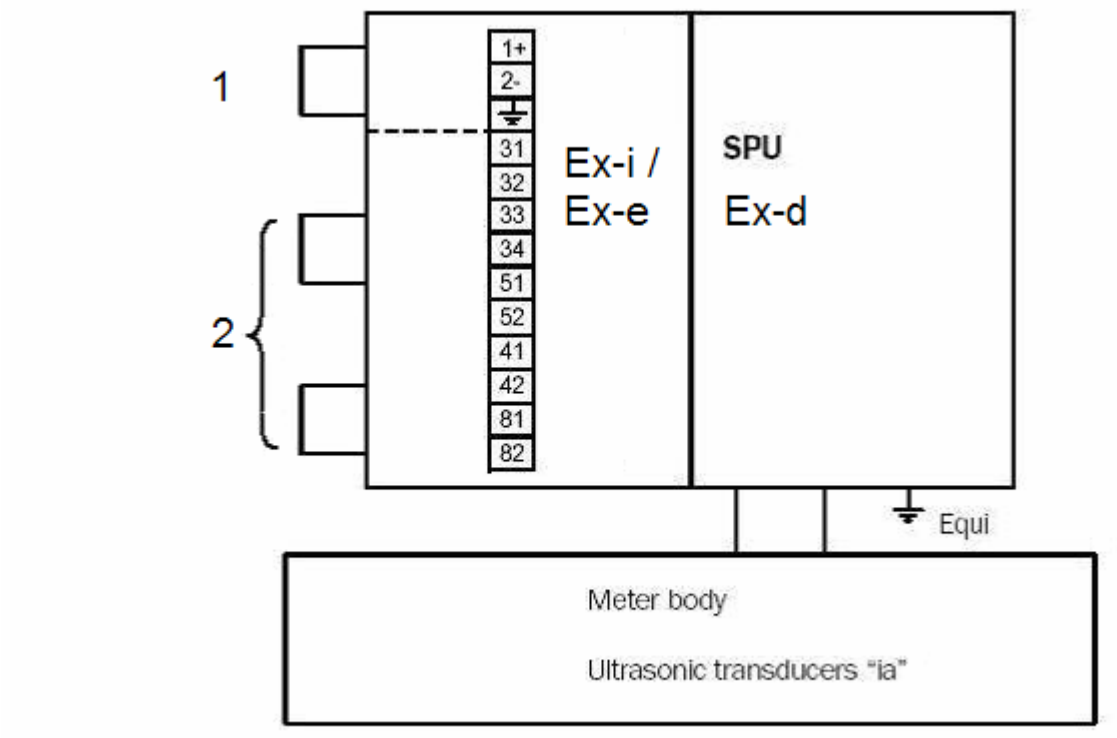


Fig. 3.9: Explosion protection of the OPTISONIC 7060 components
1. Power supply
2. I/O connections

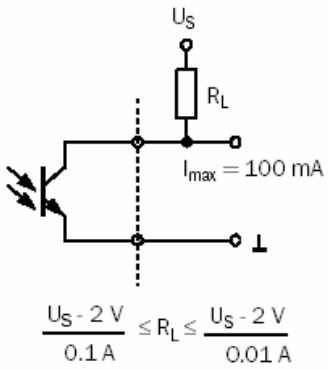
Safety-relevant data of inputs and outputs

<table>
<tr><td>Output circuit</td><td colspan="6">Intrinsically safe EEX ia IIA / IIB / IIC</td><td>Non-intrinsically safe U_M = 253 V</td></tr>
<tr><td rowspan="4">Active current output
Terminals 31/32</td><td colspan="6">U_o = 22.1 V</td><td rowspan="4">U_B = 18 V
I_B = 35 mA</td></tr>
<tr><td rowspan="2">I_o [mA]</td><td rowspan="2">P_o [mW]</td><td colspan="2">EEx ia IIA</td><td colspan="2">EEx ia IIC</td></tr>
<tr><td>C_o [nF]</td><td>L_o [mH]</td><td>C_o [nF]</td><td>L_o [mH]</td></tr>
<tr><td>155 / 155</td><td>857 / 857</td><td>4100</td><td>7</td><td>163</td><td>1</td></tr>
<tr><td colspan="6">Characteristic curve: linear
Internal capacity C_i = 4 nF, internal inductance L_i = 0.075 mH
Only for connection to passive, intrinsically safe circuits or intrinsically safe circuits with the following maximum values: U_i = 30 V</td></tr>
<tr><td>Passive current output
Terminals 31/32</td><td colspan="3">U_i = 30 V
I_i = 100 mA
P_i = 750 mW</td><td colspan="2">C_i = 4 nF
L_i = 0.075 mH</td><td>U_B = 30 V
I_B = 35 mA</td></tr>
<tr><td>Digital output
Terminals 51/52, 41/42, 81/82</td><td colspan="3">U_i = 30 V
I_i = 100 mA
P_i = 750 mW</td><td colspan="2">C_i = 4 nF
L_i = 0.075 mH</td><td>U_B = 30 V
I_B = 100 mA</td></tr>
<tr><td>RS 485
Terminals 81/82</td><td colspan="3">Characteristic curve: linear
U_o = 5.88 V
I_o = 313 mA
P_o = 460 mW
C_o = 1000 µF/43 µF
L_o = 1.5/0.2 mH</td><td colspan="2">U_i = 10 V
I_i = 275 mA
P_i = 1420 mW</td><td>U_B = 5 V
I_B = 175 mA</td></tr>
<tr><td>PROFIBUS PA
Terminals 33/34</td><td colspan="5">U_i = 30 V
I_i = 100 mA
P_i = 750 mW</td><td></td></tr>
<tr><td rowspan="2">Ultrasonic transducer connections</td><td colspan="2">EEx ia IIA</td><td colspan="2">EEx ia IIB</td><td>EEx ia IIC</td><td></td></tr>
<tr><td colspan="2">Characteristic curve: linear
Max. transmission voltage U_o = 60.8 V
Short-circuit current I_o = 95 mA
P_o = 1444 mW
C_o = 300 nF</td><td colspan="2">U_o = 51.2 V
I_o = 80 mA
P_o = 1024 mW
C_o = 187 nF</td><td>U_o = 38.9 V
I_o = 60 mA
P_o = 584 mW
C_o = 34 nF</td><td></td></tr>
</table>

Special conditions

For connection to a NAMUR amplifier, the digital output (terminals, 51/52, 41/42, 81/82) can be wired internally as a NAMUR contact by setting a jumper (for details see Service manual). Open Collector or NAMUR configuration is carried out at the factory in accordance with the order details. If no configuration was specified in the purchase order, the digital output is configured as Open Collector.

Digital output as Open Collector



Digital output in accordance with NAMUR

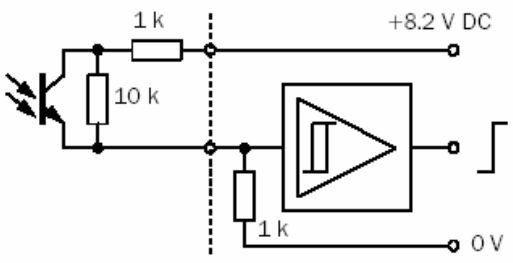


Fig. 3.10: Wiring digital outputs

3.4.7 Operation in hazardous areas to North American Guidelines (CSA)

The system must be installed as shown in **Fig. 8.3** to Fig**. 8.5** in the appendix. The notes provided in **Fig. 8.3** and **Fig. 8.4** must be observed at all times.

Installation in Division 1 / Zone 0 / Zone 1

The following applies to devices installed in this area and that are connected to the UFC 060 electronics installed in Division 1 / Zone 1:
The maximum device voltage must not exceed 125 V.

You must observe the applicable national regulations, such as:
– In the USA, the device must be installed in accordance with NEC (ANSI/NFPA 70 and ANSI/ISA RP 12.6.)
– In Canada, the conditions according to CEC part 1 apply.

Exchanging components impairs the intrinsic safety.

In intrinsically safe installations (Entity system), only equipment certified to CSA safety barriers, or other CSA equipment that fulfills requirements regarding the Entity system, must be used (Voc ≤ Vmax, Isc ≤ Imax.,
Ca ≥ Ci + Ccable, La ≥ Li + Lcable).

Installation in Division 2 / Zone 2

Installation to CEC or NEC


IMPORTANT

Important
Danger of explosion: Do not loosen any components without switching the power supply off beforehand or where it states that the area is potentially explosive.
Exchanging components affects compatibility with Class 1, Division 2.

4 Operation of the converter

4.1 Operation and menu structure of the CONVERTER with LCD

4.1.1 Operation

The current measurement, volume counter, and diagnosis values can be displayed on the two-line LCD on the front of the CONVERTER. You can select the values you want to display using a magnetic pen while the front cover is kept closed or using the buttons while the front cover is open (see Fig. 8.2).

IMPORTANT

Important

When the CONVERTER housing is open, there is no EMC protection or protection against electric shock!

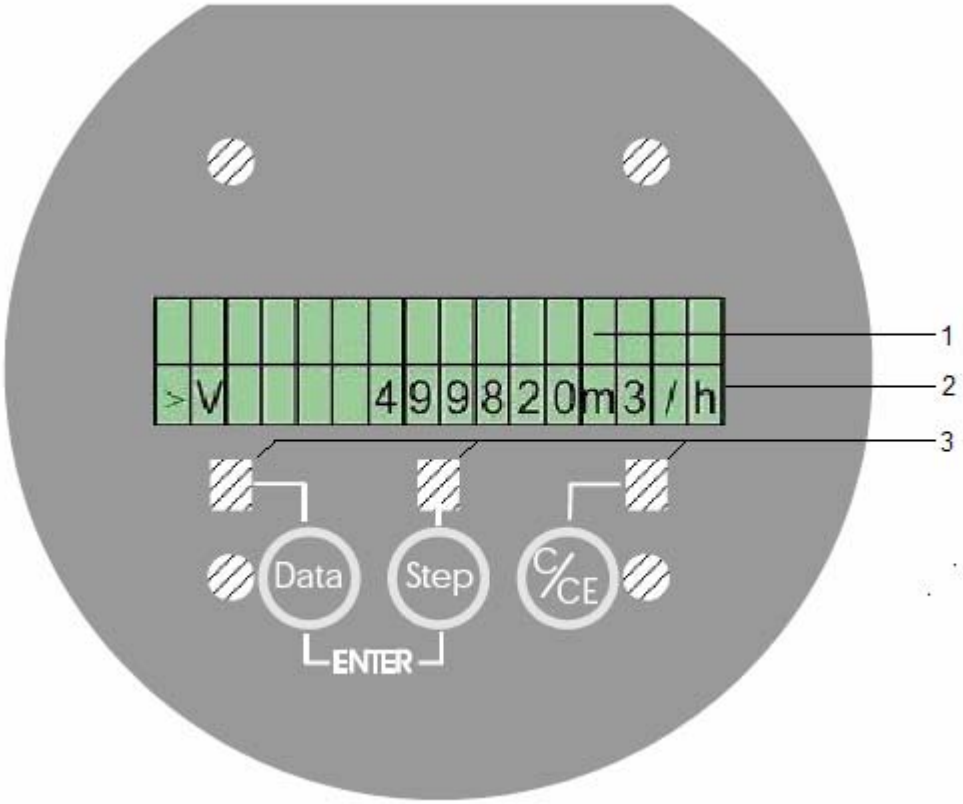


Fig. 4.1 : Front panel with LCD

1. Selected measured value / device status
2. Current measured value
3. Control area for operation by a magnetic pin

The control panels and buttons have the following functions:

- C/CE control panel/ button
  Used to call up the menu from the measured value display. Within the menu, you can go back a level, or return from the top level menu to the measured value display.

- STEP control panel/ button
  Used to scroll forward in the menu.
- DATA control panel/ button
  Used to scroll backward in the menu.

- ENTER function
  Used to select a menu level, to acknowledge log book entries and to reset the error volume counter.
  – Magnetic pen operation:
    The ENTER function is executed when you hold the pen on the DATA/ENTER control panel for at least 2 s.
  – Button operation:
    The ENTER function is executed by pressing STEP and DATA simultaneously. Alternatively, you can press the DATA button for at least 2 s.

4.1.2 Menu structure

You can call up information, acknowledge logged events and reset the error volume counters in the display menu, using the control panels and buttons described above.

Main menu	Sub-menu	Indication on the	Notes
1. System		OPTISONIC 7060 System	Information on the system. The following information may be called in detail by activating the ENTER function.
	1.1 Current operating volume counter values	>V 34569870 m³ <V 0 m³	Indication of the current operating volume counter values for each direction of flow (first line: positive direction, second line: negative direction)
	1.2 Current error volume counter values	>EV 70 m³ <EV 0 m³	Indication of the current error volume counter values for each direction of flow (first line: positive direction, second line: negative direction). For information on resetting the counter values, see Section 8.2.6
	1.3 Device type	Meter body 8 in 4 path	Design of the meter body with reference to the nominal width and number of measuring paths.
	1.4 Device serial number	S/N device 03138703	Serial number of the device
	1.5 Analogue circuit board serial number	S/N analog board 00112233	Serial number of the analogue circuit board installed
	1.6 Ultrasonic transducer serial number	S/N transducer xy 00112233	Serial number of the transducers installed x = path no., y = mounting direction (A or B)
	1.7 System date	Date 2. April 2, 2003	Present system date
	1.8 System time	Time 09:10:00	Present system time
	1.9 Rated pressure range	$p_{e,min}$ $p_{e,max}$ ..... bar ..... bar	Rated pressure range for which the FLOWSIC 600 is designed and adjusted

Main menu	Sub-menu	Indication on the	Notes
2. Software		OPTISONIC 7060 Software	Information on the installed software and parameter sets. The following information may be called in detail by activating the ENTER function.
	OPTISONIC 7060		
	2.1 Software version	Version 2.08 Mar 17, 2003	Version number and corresponding time index
	2.2 Program code check sum	CRC code 12345678	16 bit check sum for the entire program code range
	2.3 Parameters check sum	CRC parameters 12345678	16 bit check sum for the entire parameter range
	2.4 Manufacturer constants check sum	CRC constants 12345678	16 bit check sum for the parameter range the content of which is predefined by the manufacturer. This range is a subset of the whole parameter range. By comparing this check sum with the default, conformity with the manufacturer defaults can be checked. Unauthorised modifications of these parameters may lead to failure of the device!
3. Log book		OPTISONIC 7060 Log book	Information on the present content of the device log book. The following pieces of information may be called in detail by activating the ENTER function:
	3.1 Content	Log book unacknowledg. 2/5	Display of the total number of saved log book entries and of the number of those entries which have not yet been acknowledged. Example: 5 entries are saved in the log book, 2 of which have not yet been acknowledged. The entries can be individually selected by activating the ENTER function. In this, the display goes to the most recent event entry. The entry chronologically before is reached with DATA. STEP takes you to the next entry. In this, entries which have not been acknowledged are identified by the flashing of the whole display.
	3.2 Display of log book entries	I Power supply 3 Apr 18, 2003 12:13	The classification and type of event, the position in the list of entries and the type of occurrence are always presented in the first line. Further information may be presented in the second line. The content of these depends on the entry. By activating the ENTER function, the accompanying time stamp of the entry can be displayed. Returning to the list of log book entries takes place via C/CE. Example:
		<ENTER>	
		April 18, 2003 12:20:23	Failure of the power supply on April 18, 2003 at 12:13. The time stamp is displayed by activating the ENTER function. It here corresponds to the point in time from which the measuring system was available again (April 18, 2003, 12:20).

Main menu	Sub-menu	Indication on the	Notes
4. Pulse output		OPTISONIC 7060 Pulse output	Information on the pulse output parameterisation. The following information may be called in detail by activating the ENTER function.
	4.1 Pulse value	Pulse value 1000 pulses/m³	Indication of the number of output pulses to represent a cubic metre.
	4.2 Refresh rate	Current rate 1.0 s	Indication of the rate at which the current output frequency with the measured value to be signalled is refreshed.
	4.3 Current output frequency	Current frequency 1560 Hz	Indication of the current output frequency of the pulse output
5. Diagnosis		OPTISONIC 7060 Diagnosis	Information on the status of the system and individual measuring paths. The following pieces of information may be called in detail by activating the ENTER function:
	5.1 Path overview	% Error 0 % 0 % 0 % 0%	Indication of the measuring quality for all active paths In this, the ratio of invalid and total number of measurements is presented in the second line (path 1 to 4, from left to right).
	5.2 Path-specific detail information	Path 1 Measured values	Display of further information on path x (x = 1 to 4) The following information may be called in detail by activating the ENTER function.
	5.2.1 Current flow velocity in the path	Path x VOG 6.7 m/s	Indication of the current flow velocity in path x
	5.2.2 Current velocity of sound in the path	Path x SOS 343.1 m/s	Indication of the current velocity of sound in path x
	5.2.3 Current signal-to-noise ratio (SNR)	Path x SNR 25 dB 25 dB	Indication of the current signal-to-noise ratio in path x, one value for each direction of measurement (left: along with the gas flow, right: against the gas flow)
	5.2.4 Current receiver amplification sensitivity (AGC)	Path x AGC 51 dB 51 dB	Indication of the current receiver amplification sensitivity (automatic gain control) in path x, one value for each direction of measurement (left: along with the gas flow, right: against the gas flow)
	5.2.5 Path weight	Path weight x 0.3161	Indication of the current weighting factor for the path as used in the calculation of the mean area value. In case of an active path failure compensation, values deviating from the standard may be shown here.

Main menu	Sub-menu	Indication on the	Notes
	5.3 Detailed system information	System Measured values	Indication of further system information The following information may be called in detail by activating the ENTER function.
	5.3.1 Current volume flow rate	>Qv +1289.3 m³/h	Indication of the current volume flow rate together with the direction of flow (positive direction marked by ">Qv" and +, negative direction marked by "<Qv" and –).
	5.3.2 Current measured values	VOG 8.9 m/s SOS 343.2 m/s	Indication of the current measured values flow velocity (first line) and velocity of sound (second line)
6. Parameters		Register # Value	Indication of the entire register list with register no. and value. You may scroll forward and backward in this list.

4.1.3 Definition of measured value displays

Each line of the LCD can be configured separately as regards the measured value shown. In addition, the display lines may be configured with a multiplex layout (shifted LCD content). If this configuration is active, the two display contents are shown alternately (display changes every 5 s).

Display

>Qv 1000.0 m^3/h	Operating volume flow rate ">" forward "<" reverse
>V 1234567 m^3/h	Forward volume counter value
<V 1234567 m^3/h	Reverse volume counter value
>EV 1234567 m^3/h	Forward error volume counter value
<EV 1234567 m^3/h	Reverse error volume counter value
VOG 20.23 m/s	Average flow velocity (velocity of gas)
SOS 343.15 m/s	Average velocity of sound (speed of sound)

4.1.4 Definition of log book entries

1. Classification

The entries are distinguished into three classes and identified by the initial character in the first line.

- "I" Information
- "W" Warning
- "E" Error/ malfunction

2. Type of occurrence

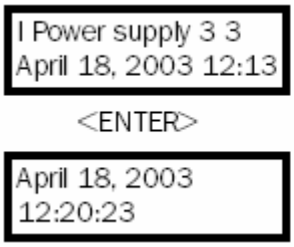
- "S+" Point in time of the event identifying the beginning of a state
- "S-" Point in time of the event identifying the end of a state

3. Overview of event entries

Name	Class	Description	Value
Power on I Power supply April 18, 2003 12:13	I	System is cold started or rebooted after a watchdog reset.	Time stamp of the last stored counter value is considered to be the time of the "Power off" event.
Change of operating mode I Operation S+ Password 2	I	System was changed to the configuration mode after password input, or back from the configuration mode to the measurement mode. Parameter modifications that affect the measured values may have been carried out.	Activated password level.
Set clock I Real time clock April 18, 2003 12:13	I	Date and/or time register of the real time clock was/were changed.	Time stamp of the change.
Volume counter reset I Reset V S+	I	Resetting the volume counters to zero.	Counter value at the time of the event.
Error volume counter reset I Reset V S+	I	Resetting the error volume counters to zero.	Counter value at the time of the event.
Counter overflow I Overflow S+	I	One of the four volume counters has run through completely.	
Log book reset I Reset Log S+	I	Entire log book was deleted ("Reset" is always the first entry and indicates the point in time the log book was opened.)	
Check requested W Check re. S+ Path no.	W	The measured value of one path must be substituted by the replacement value calculation routing.	Path index

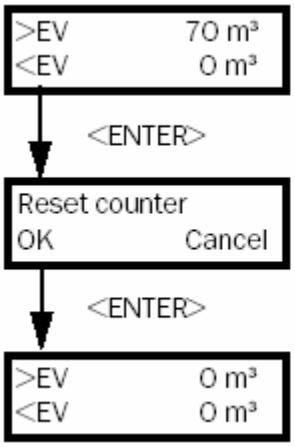
Name	Class	Description	Value
Output range W Output S+	W	The current measured value can no longer be represented by the pulse output, because the maximum output. frequency was reached.	
Measurement invalid E Measurement S+ Path	E	More than one path must be substituted by the replacement value calculation routine, or the activated adaptive path failure compensation is not yet active.	
System error E System S+ Parameter	E	Safe operation of the system is not guaranteed.	Cause of the fault • CRC program code • CRC parameters • CRC counter value • CRC replacement path weights • Parameters (implausible) • DSP

4.1.5 Acknowledgement of a log book entry



The selection of an entry which has not yet been acknowledged (display is flashing) is carried out via STEP or DATA. The corresponding time stamp is displayed by activating the ENTER function. The display is still flashing. By activating the ENTER function again, the entry is acknowledged (display stops flashing). Return to the list of log book entries via C/CE.

4.1.6 Resetting the error volume counters



After selection of the desired display, activate the ENTER function. A confirmation dialog will appear.

Activate the ENTER function again to reset the error volume counter to zero. This event is recorded in the log book together with the time stamp.

Press C/CE to cancel the reset.

5 Verification and Commissioning

5.1 Verification

5.1.1 Examining the condition

The following conditions must be fulfilled before you can start the verification procedure for the OPTISONIC 7060:

- o CONVERTER: Make sure there is no visible sign of damage, in particular to the sealing surfaces and the internal contours of the connection flanges.
- o The meter body must be approved for the max. test pressure that is to be applied.

5.1.2 Testing the functions

Check that the OPTISONIC 7060 is properly installed mechanically and electrically, as detailed in Section 3, to ensure successful commissioning.

The major system parameters have been configured at the factory. The default settings should allow trouble-free operation of the ultrasonic gas flow meter.

Checking without PC and MEPAFLOW IV control and diagnosis software

The information listed below is shown directly on the LCD of the OPTISONIC 7060 (for details on the menu structure and operation with a magnetic pen, see chapter *4*).

5.2 Commissioning

5.2.1 Installation

Install the OPTISONIC 7060 in the line at the measurement position after completion of the calibration. The necessary working steps are detailed in Section 3. Observe the safety instructions provided in that Section.

5.2.2 Checking the functions

The current values of the operating volume counters (forward and reverse) are shown on the LCD (see Appendix, Section *6.2.2*). If these values are displayed continuously, the OPTISONIC 7060 is working correctly. A flashing display indicates a warning state or fault, which should be analysed as described in Section 6.

Fasten the magnetic pen which is part of the measuring system and which is used to operate the LCD on the CONVERTER using the strap provided on the OPTISONIC 7060 so that it cannot be lost.

5.2.3 Pressure testing of a gas pipeline with liquid (water)

For example when a pipeline in which the OPTISONIC 7060 is installed will be pressure tested with a liquid (water) the following precautions must be taken to prevent the transducers from getting wet:

- The transducers must be removed.
- Blindstops must be fitted in the tranducer positions. A set of blindstops can be ordered at KROHNE.

For the detailed procedure to remove and refit the transducers, consult the service manual.

6 Maintenance

6.1 General

The OPTISONIC 7060 does not contain any components that move mechanically. Meter body and ultrasonic transducers are the only components that come into contact with the gaseous media. Titanium and high-quality stainless steel ensure that these components are resistant to corrosion, provided that the device is implemented in accordance with the relevant specifications. This means that the OPTISONIC 7060 is a low-maintenance system. Maintenance essentially involves routine checks to determine the plausibility of the measured and diagnosis values calculated by the system.

It is recommended to record a diagnosis and status log on a regular basis (see software manual) and compare these values with the initial situation when the system was commissioned. The operating conditions (gas composition, pressure, temperature, flow velocity) of the individual logs should be comparable or documented separately and taken into account when the comparison is evaluated.

6.2 Routine checks

You can check the front panel of the OPTISONIC 7060 to ensure that the system is functioning properly (see Section *4.3*).

The routine checks relate to the following values (see also the table below and Section 6).

Velocity of sound

The velocity of sound measured is usually highly stable. Sudden changes in the measured value can indicate signal detection problems, which can affect propagation time measurements, or changes in the gas composition. A theoretical velocity of sound value can be calculated by analysing the gas or recording the pressure and temperature during log measurement. Implausible measurements can then be indicated by comparing theoretical and measured velocity of sound values and identifying any marked discrepancies. The velocity of sound values in the paths should also be approximately equal.

Number of rejected measurements

The number of rejected measurement (% inaccurate measurement) for the measuring path(s) should be as close to 0 % as possible, although this largely depends on the flow velocity. With high flow velocities, the figure can be as high as 50% without affecting accuracy. Marked discrepancies in the values under similar conditions (pressure, temperature, gas flow rate, gas composition) indicate that changes have been made to the device or plant (e.g. malfunctions caused by a valve that is not fully open).

Receiving sensitivity

The receiving sensitivity set by the device largely depends on the process pressure. Under normal conditions, this value is highly stable. The difference between the ultrasonic transducers for a measuring path is small, although it can increase with greater velocities. Significant fluctuations in the receiving sensitivity indicate a low-quality receiving signal. A significant increase under similar process conditions is normally caused by contamination on the ultrasonic transducers (for instructions on cleaning them, see the service manual).

Signal-to-noise ratio

These values are typical for the plant and do not change, providing the conditions remain the same. A reduction in the signal-to-noise ratio with similar reception sensitivity indicates sources of acoustic interference (e.g. pressure regulator) near the measuring location.

Overview of the typical values

Parameter	Standard value	Error	Comments
Velocity of sound	Deviation from the theoretical velocity of sound less than ± 0.3 %	Greater than ± 0.3 %	When calculating the theoretical velocity of sound, you must take special care to ensure that the gas composition, pressure and, in particular, the temperature are the same as at the measuring location when the log was recorded.
	The differences between the velocities of sound in the paths should not be greater than ± 1.5 m/s.	Greater than ± 1.5 m/s	Temperature stratification can occur with low flow rates.
Signal-to-noise ratio	~20 dB This depends on the nominal width of the meter body and the current process pressure.	Permanently less than 10 dB	Possible sources of interference include electrical noise caused by bad contacts on the connectors or sources of acoustic interference, such as control valves or very high flow velocities.
Receiving sensitivity / AGC level	This depends on the nominal width of the meter body and the current process pressure.	Significant deviations (greater than 50%) from the historical data with similar process pressures	The receiving sensitivity is inversely proportional to the process pressure: when the pressure doubles, the sensitivity halves.
Number of rejected measurements	< 5 % with zero point < 35 % with flow	Permanently greater than 50%	

Deviations from the standard values specified in the table can indicate a malfunction. In addition to diagnosing the error (as described in Section 6), you can also create a diagnosis and status log and send this to KROHNE for analysis (see software manual).

7 Troubleshooting

If the routine checks described in Section *5.2* or the functional checks described in Section *4.1.2* indicate that the device is not functioning properly, the following table will help you diagnose the fault. If you still cannot find the cause for the fault, you can use the ALTO IV program to carry out a more detailed fault diagnosis (see software manual, service manual).

Display, parameter	Possible cause	Corrective action
• No display • No pulse frequency • No active status signal	Faulty power supply	• Check the input voltage at terminals 1 and 2 • Check cables and terminal connections **Important** Take the relevant safety precautions!
	Defective device	Contact the manufacturer
"Warning" on the LCD	Transducer(s) are dirty	Clean the transducer(s)
	Transducer(s) are defective	Replace the transducer(s) (see service manual)
	Cabling swapped when transducer was cleaned	Check and, if necessary, correct
Different velocities of sound in the individual paths	Transducer or electronics fault	Replace the transducer(s) (see service manual) **Note** Temperature stratification can result in differences between the individual paths, especially with very low flow (higher temperatures generate higher velocities of sound). Even when the plant is being filled or when it is shut down, different velocities of sound can occur on the individual paths as a result of gas stratifications.
Implausible sound velocity	Gas analysis, pressure or temperature measurement incorrect	
• Lower signal-to-noise ratio and reception sensitivity • Increased number of rejected measurements in individual paths	Transducer(s) damaged during maintenance	Replace the transducer(s) (see service manual)
	Additional sources of noise due to a valve that is not fully open, fittings, noise sources near the device	Check the measurement plausibility and number of rejected measurements and, if necessary, remove noise sources.
Increased reception sensitivity	Different gas composition or process pressure	No work required on the device
	Transducer(s) are dirty	Clean the transducer(s)
Increased number of rejected measurements in all paths	Additional noise sources	Remove noise sources
	Gas velocity outside the measurement range	

8 ATEX / CSA converter terminal assignment

8.1 Converter terminal assignments ATEX

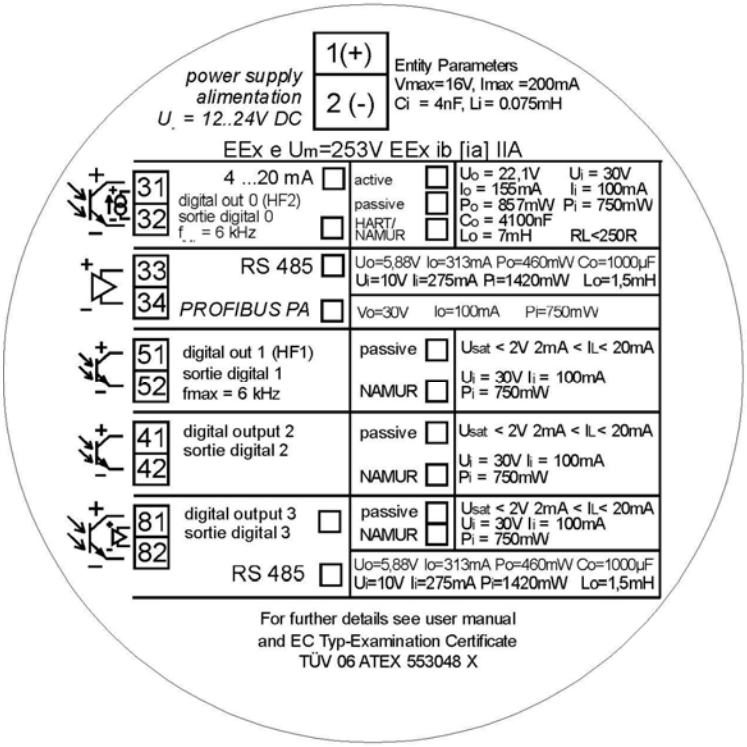


Fig. 8.1: Terminal assignment in accordance with ATEX IIA

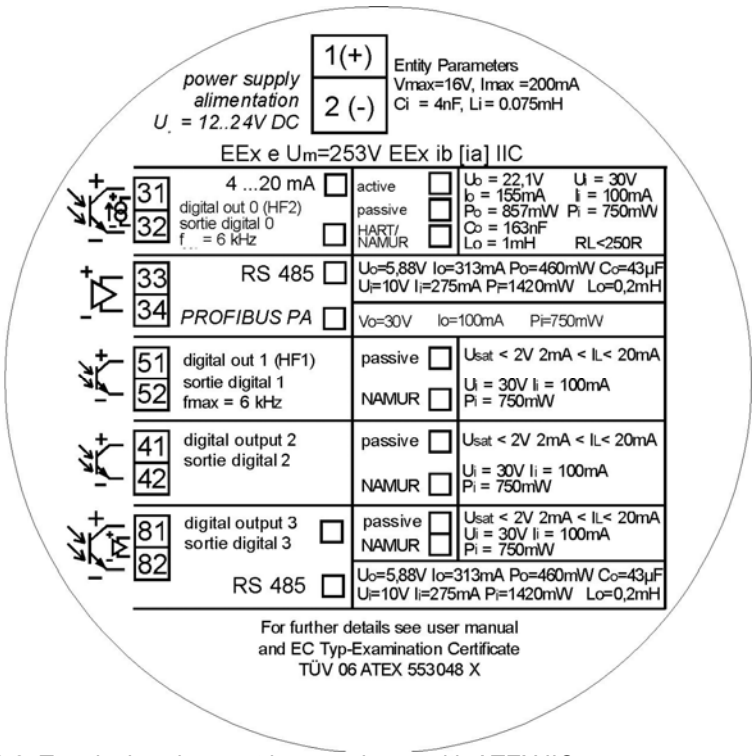


Fig. 8.2: Terminal assignment in accordance with ATEX IIC

8.2 Converter terminal assignments CSA

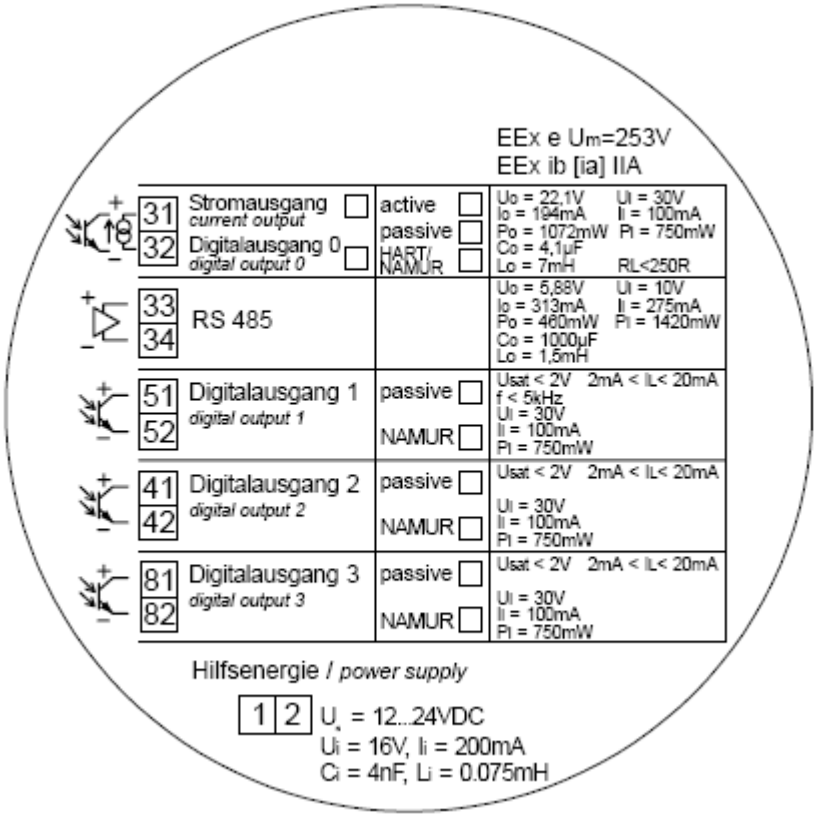


Fig. 8.3: Terminal assignment in accordance with CSA Group D

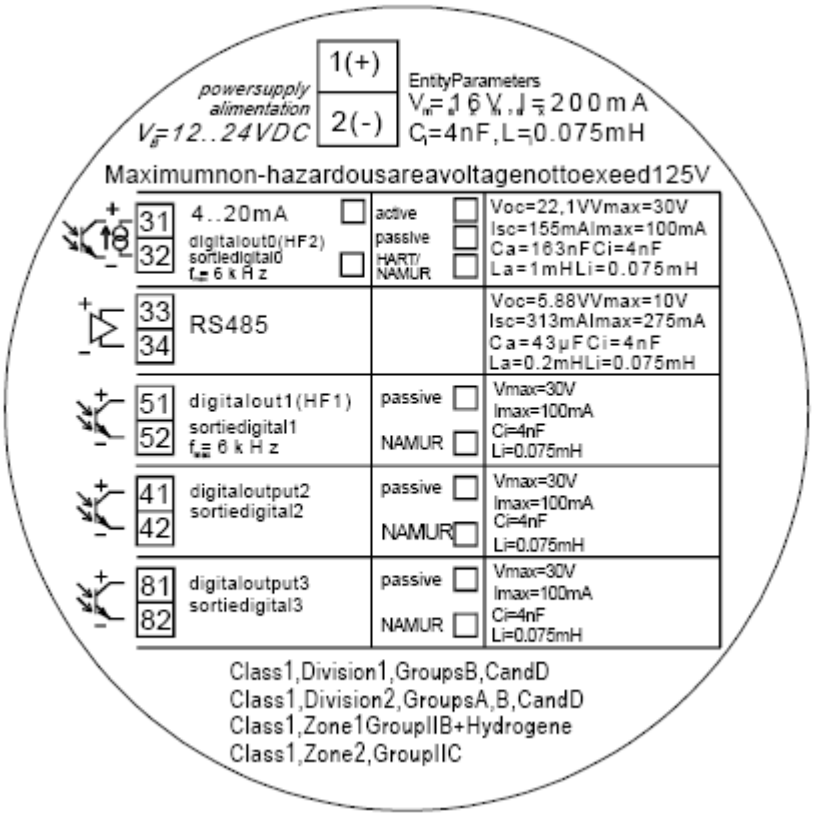


Fig. 8.4: Terminal assignment in accordance with CSA Group BCD

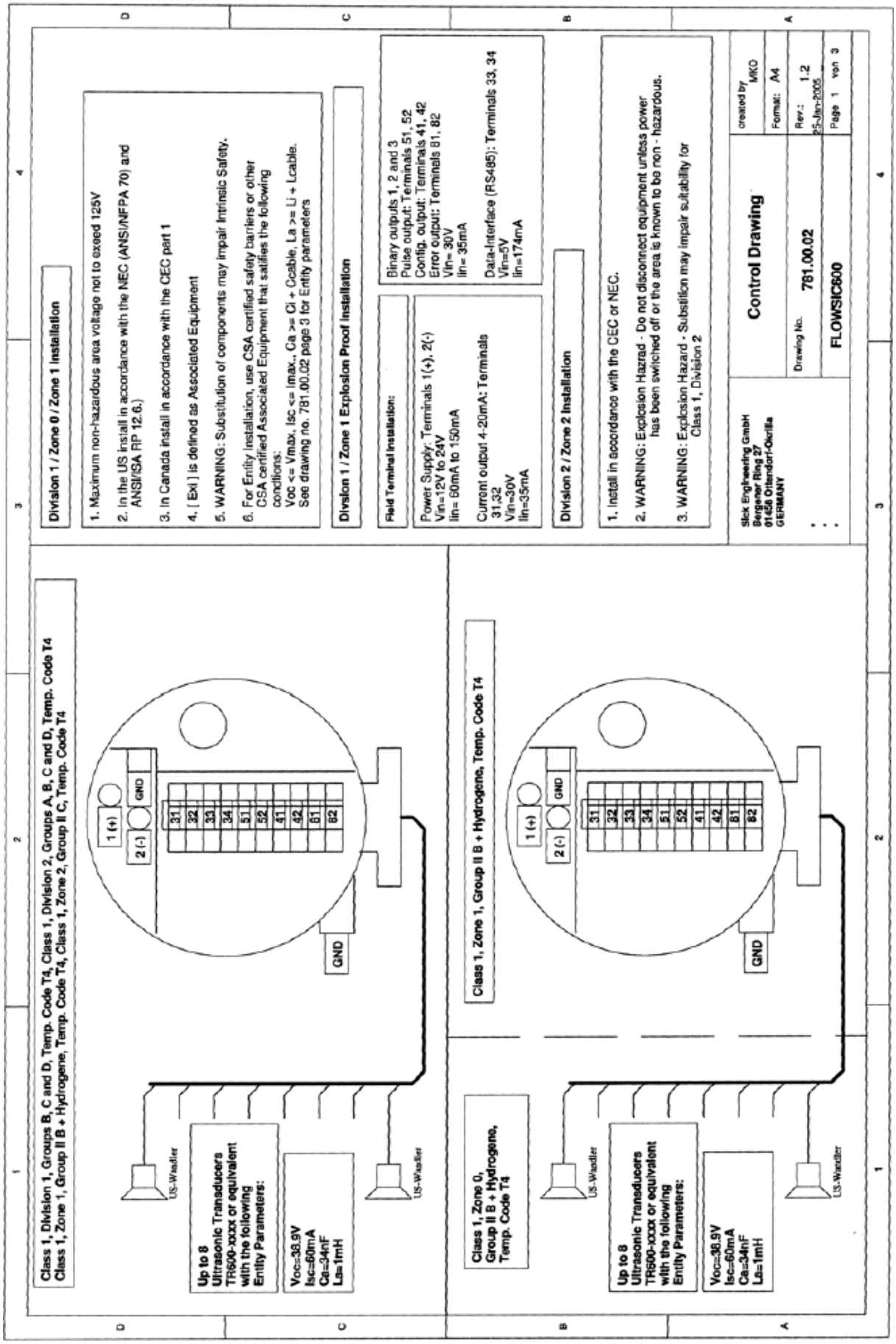


Fig. 8.5: Control drawing CSA 781.00.02 (page 1)

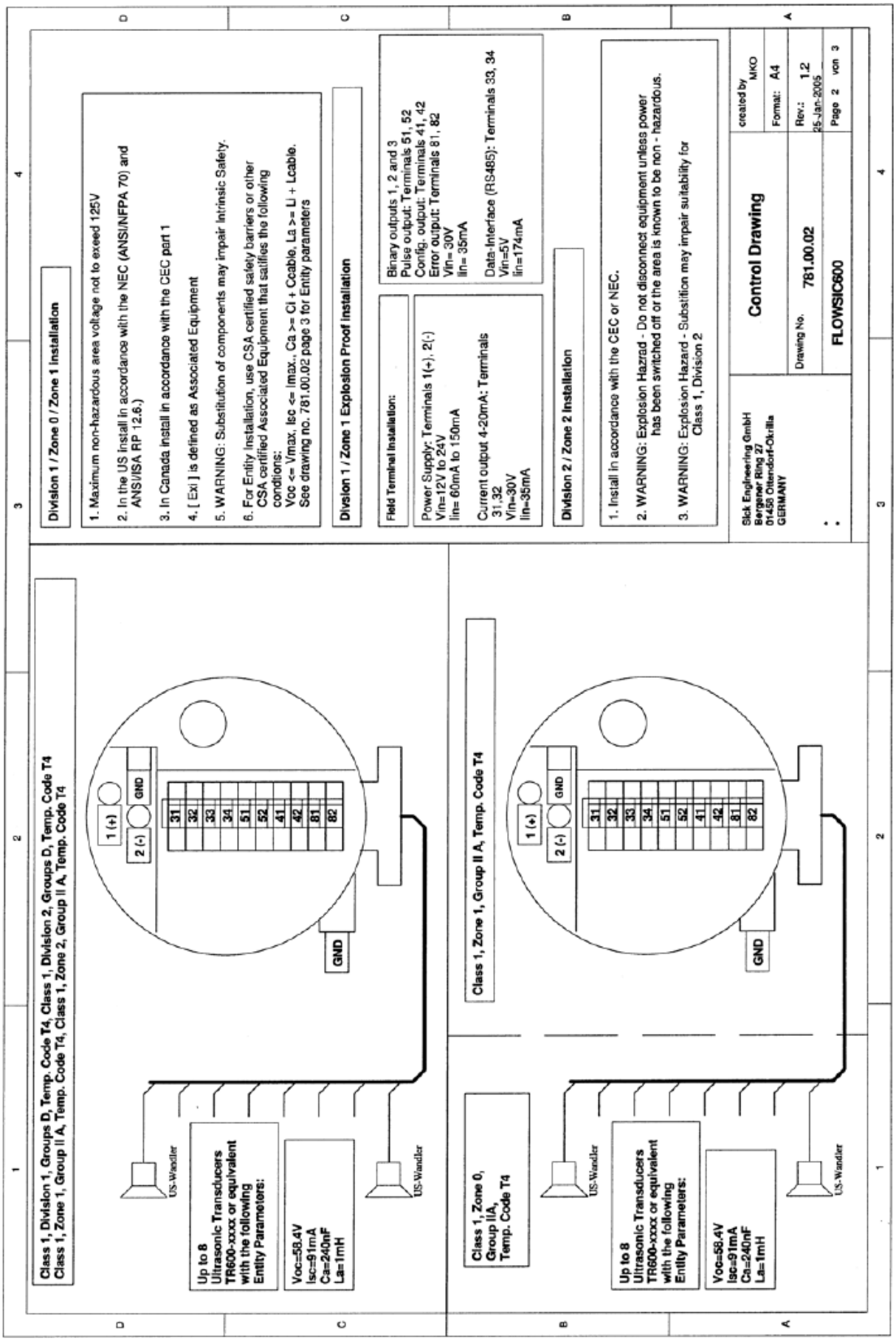


Fig. 8.6: Control drawing CSA 781.00.02 (page 2)

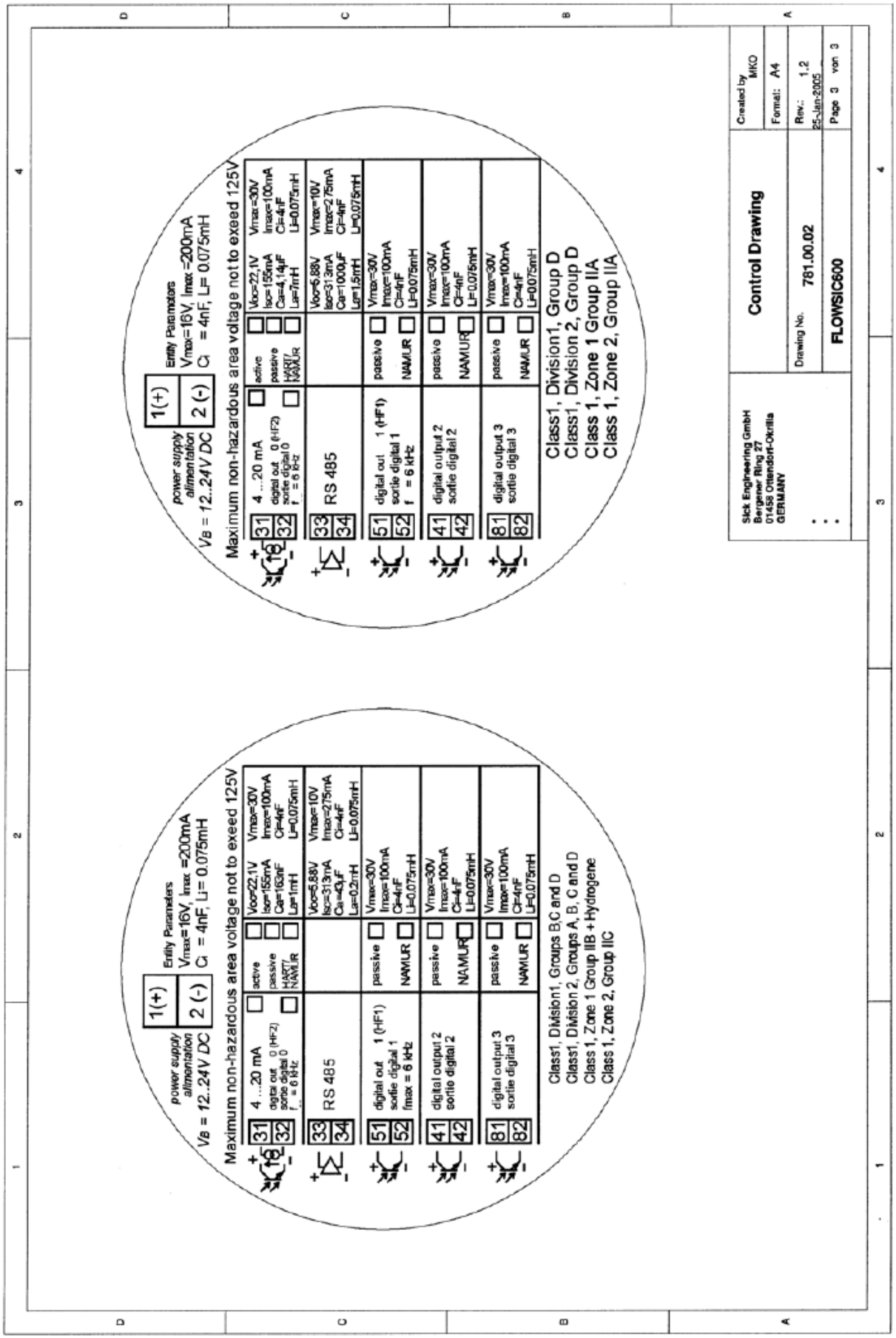
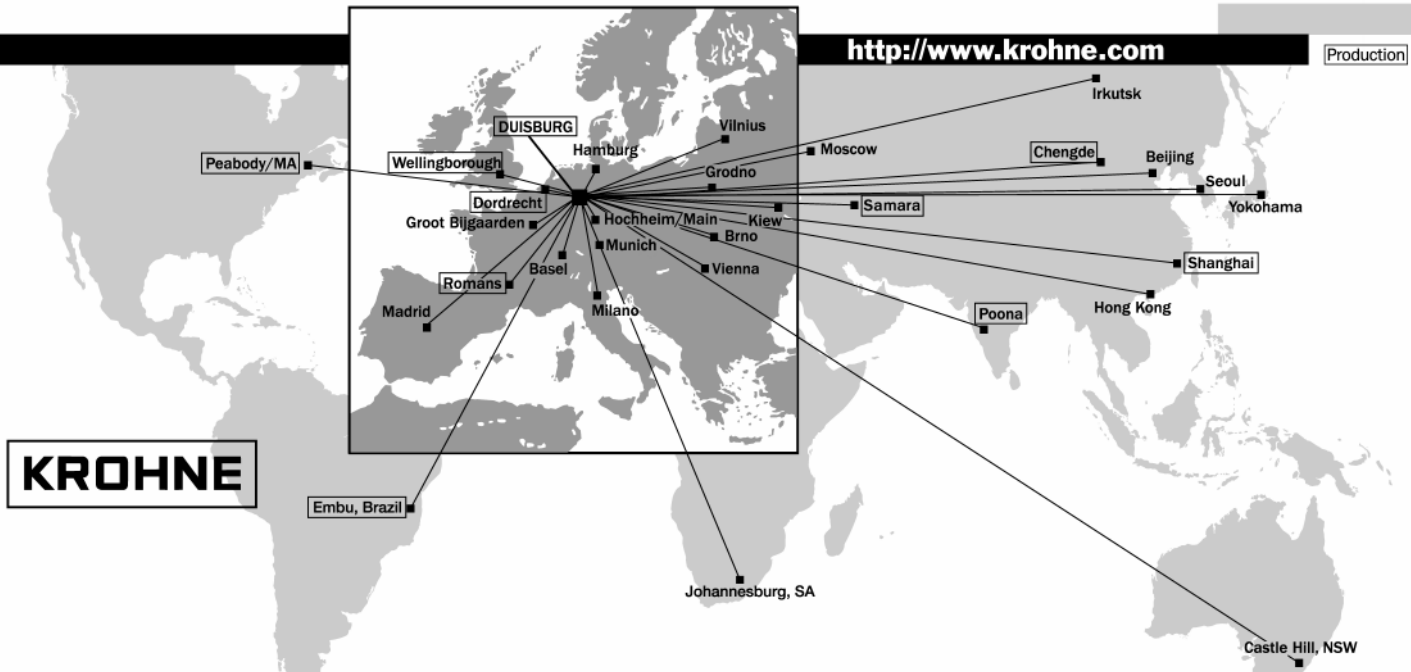


Fig. 8.7: Control drawing CSA 781.00.02 (page 3)



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