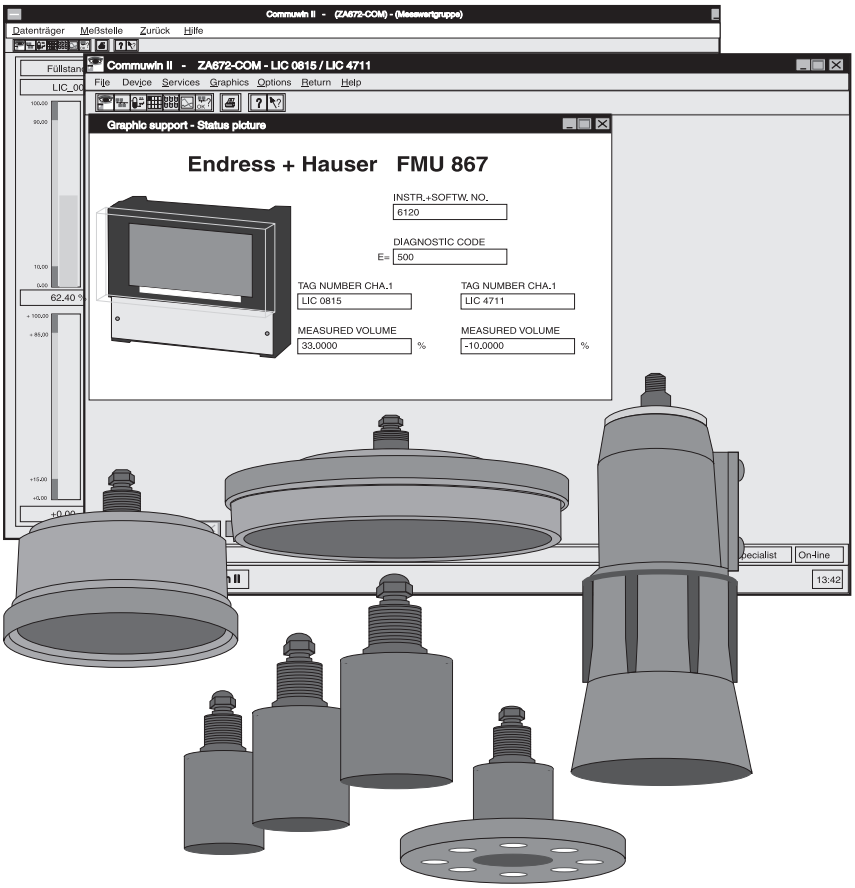
BA 128F/00/en/02.03
Part No. 016431-1000
Software Revision 2.3/2.4

Prosonic P
FMU 801
Ultrasonic Level Measurement

Operating Instructions



Endress + Hauser
The Power of Know How

Table of contents

Software Revision Index

Version	Changes	Remarks
1.x	Original software	Flow functions activated
2.0 2.1 2.2	Flow functions disabled Operation as version 1.x	In current Fieldmanager versions (to 5.2), instrument parameters from version 1.x cannot be downloaded into instruments with version 2.x vice versa. Until this is possible a special service program to this end can be supplied on request, call Endress+Hauser service.
2.3	Sensor FDU 86 introduced; Operation as version 2.0	
2.4	PROFIBUS-DP introduced. For instruments without PROFIBUS-DP interface version 2.3 remains valid.	

Safety and Certificates

The Prosonic P must be installed by qualified personnel according to the instructions in this manual. Where sensors are to be installed in hazardous areas containing, e.g. flammable liquids or combustible dusts, any additional specifications contained in the certificate must also be observed. The technician must also be familiar with local regulations for working in hazardous areas.

Certificates

The certificates available for the sensors are specified in the tecnical data (see section 7.2). Since the sensors are protected to EEX m II T5/T6 the Prosonic FMU 867 does not require a seperate certificate.

Safety conventions

In order to highlight safety-relevant or alternate operation procedures in the manual the following conventions have been used, each indicated by a corresponding icon in the margin.

Note!
A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

Caution!
Caution indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument.

Warning!
A warning indicates actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument.

1 Introduction

Operating manual

The Prosonic P measuring system enables configuration of several ultrasonic measuring points and visualisation of their measured values by a Personal Computer. In order to ensure quick and easy installation, the manual has been broken down as follows:

- Chapter 1: Introduction
  contains general information on the application
- Chapter 2: Installation
  contains information on the mounting, electrical connection and installation of the system components
- Chapter 3: Operation
  describes the operating elements of the Prosonic transmitter as well as the remote configuration of the transmitter from the operating programs
- Chapter 4: Configuration and Measurement
  describes both the basic settings required to produce a quick measurement as well as more advanced functions. Here you will find information on calibration, analogue outputs, relays, safety responses, measured value display and up- and downloading of parameters.
- Chapter 5: Trouble-Shooting
  describes the response to faults, error messages, trouble-shooting table, interference echo suppression, simulation and gives information on the exchange and repair of sensors and transmitters.
- Chapter 6: Technical Data
  contains the technical data of the system components

The index at the back of the manual allows quick access to specific subjects; the operating matrix in the back cover lists all operating parameters.

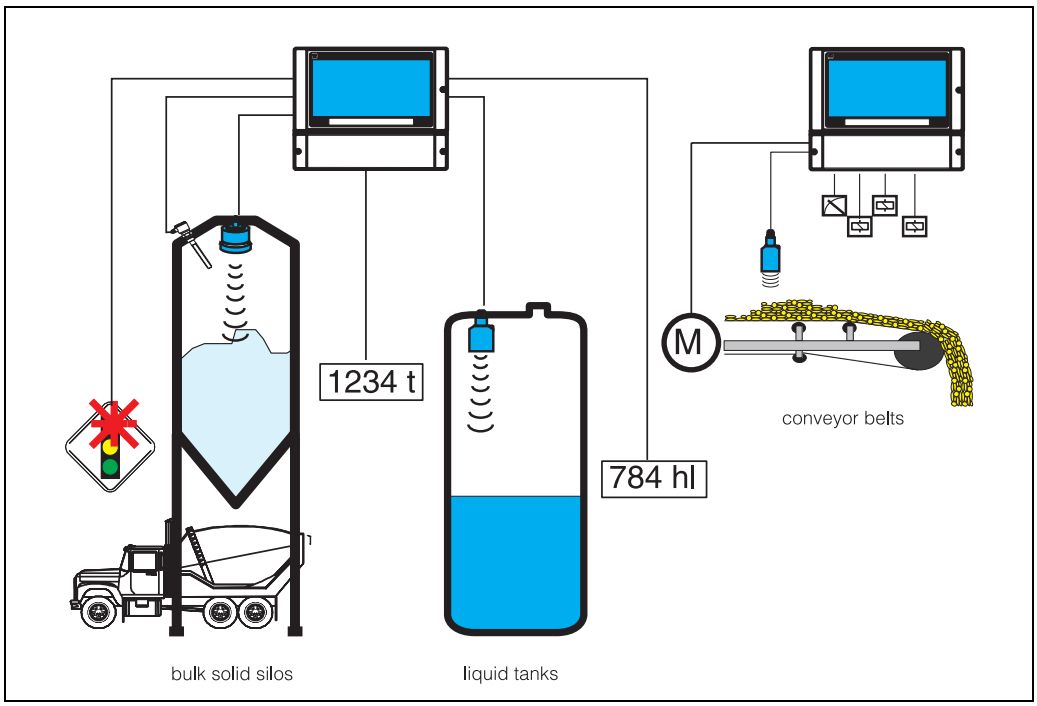
Supplementary documentation

Additional information on Prosonic P system components is contained in the following documentation:

- TI 189F, for the installation of ultrasonic sensors Prosonic FDU 8...
- BA 134F, for standard installation of the RS-485 bus and FXA 675 interface
- BA 198F, for planning and installation of a PROFIBUS-DP network
- TI 266F, for the installation of the Commubox FXA 192 interface
- Handbook, Addicom PA 732 for RS-485 interface card
- Handbook, RS-232C/RS-485 converter
- BA 124F, for operation of Commuwin II

Caution!
If Prosonic sensors are used in hazardous areas, the specifications in the certificate as well as local regulations must also be observed.

1.1 Application



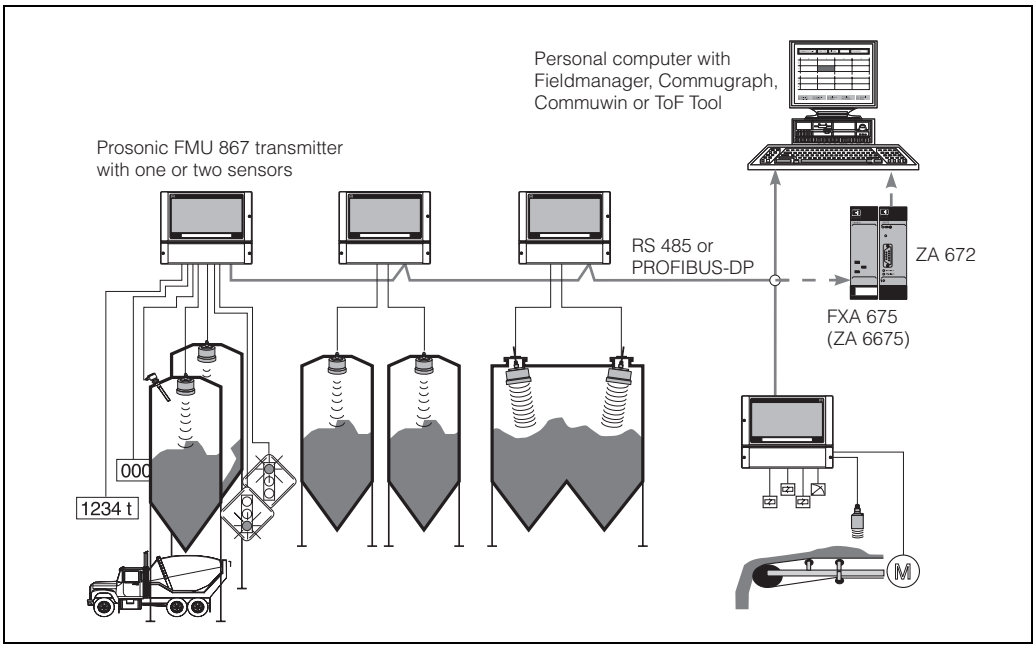
The Prosonic measurement system allows the configuration and display of parameters from several distributed ultrasonic measuring points via a personal computer. Such installations are often encountered in small and medium-sized facilities in the mineral processing industry, e.g., in gravel excavating and dressing plant or in cement production. Similar configurations can be found in storage depots for liquids and bulk solids, where the distribution of the storage farms is such that a central Rackbus/Commutec solution is difficult to realise, or a certain degree of local control via relays or analogue outputs is desired.

The measurement system is based on the Prosonic transmitter FMU 867 and sensors FDU 80 … 85, which are also suitable for use in hazardous areas where flammable liquids and combustible dusts are to be measured. The transmitter determines the level of product in the tank or silo and, if required, derives its volume or weight from a vessel characteristic entered as a linearization table. This describes the relationship between the level *h* and the volume *V* (or weight *G*). The most common shape, a horizontal cylinder, is permanently stored in the transmitter.

The measured values are made available to the personal computer via Rackbus RS-485 or PROFIBUS-DP. The values are displayed by the well-proven Fieldmanager 485 operating program or the Commugraph 485 visualisation program. Devices with a PROFIBUS-DP interfaces can also be operated by the ToF Tool program.

1.2 Measuring System

1.2.1 System components



The measuring system comprises severalt transmitters Prosonic FMU 867. One or two sensors FDU 80 ... 86 can be connected to each transmitter. For special applications furhter instruments can be connected to each measuring point:
- separate temperature transmitter
- separate limit switch

The transmitters can be operated by a Personal Computer in a RS 485 or PROFIBUS-DP network.

RS 485

Depending upon the system architecture, up to 50 measuring points can be integrated into the bus. The maximum bus length is 1200 m.

PROFIBUS-DP

A maximum of 126 transmitters can be connected to each trunk of the bus. The maximum bus length depends on the transmission rate:

transmission rate (kbit/s)	19,2 - 93,75	187,5	500	1500
max. cable length (m)	1200	1000	400	200

1.2.2 Interfaces to the Personal Computer

RS 485

- for the DOS programs "Fieldmanager" or "Commugraph":
  – RS 485 interface card
  – adapter interface RS485/RS232
- for the graphical operating program "Commuwin II":
  – Commubox FXA 192
  – Interface cards FXA 675 and ZA 672

PROFIBUS-DP

- PROFICARD (PCMCIA-Karte)
- PROFIBOARD (PCI Board)

1.2.3 Signal output

Analogue outputs

The Prosonic FMU 867 transmitter provides a standard 0/4...20 mA signal at each of its two channels. Depending upon configuration, these are proportional to either level or volume (weight). The start and end of the signal range can be programmed as required.

Relays

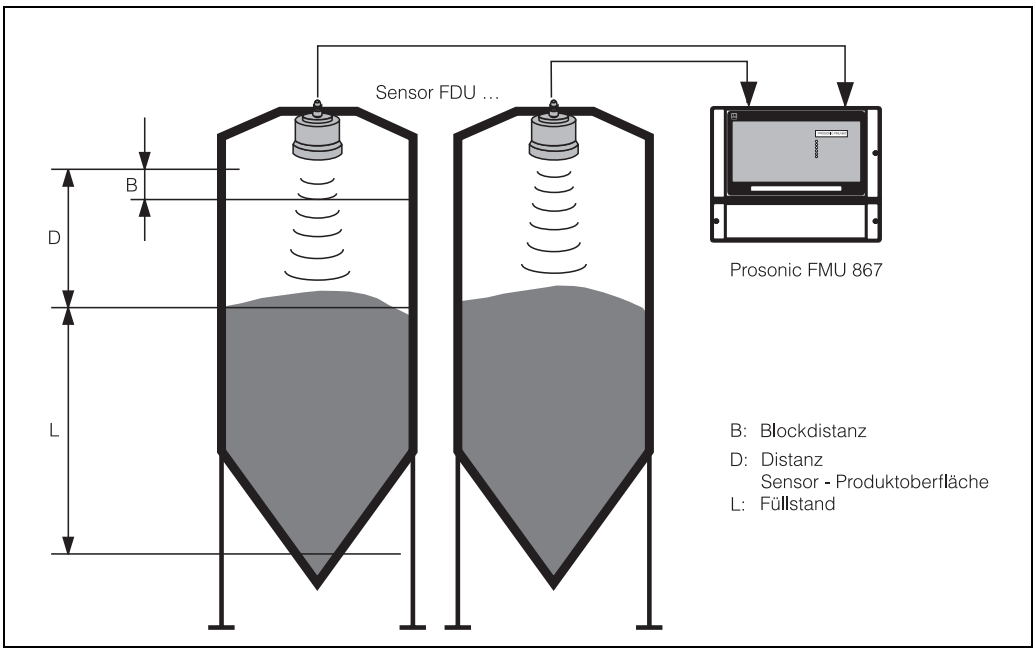
The transmitter is equipped with three relays which can be individually programmed as minimum or maximum fail-safe relays. The relay energises when the level rises above or drops below the switch-on point, respectively, or if an alarm occurs. The relays can be configured to switched individually or alternately. A time delay can be determined for the case of two relay switching simultaneously. Alternatively, the relays can be set up as trend or alarm relay.

Function monitoring

The Prosonic continuously monitors all signal lines from the sensor to the analogue outputs. On detection of a fault all LEDs flash. the analogue signals switch to -10%, +110% or hold the last value. The limit relays respond according to the fail-safe mode selected and an alarm relay de-energises.

1.3 Measuring Principle

Ultrasonic measurement



An ultrasonic emitter (sensor) mounted above the product is electrically excited and directs an ultrasonic pulse through the air towards the product. This pulse is reflected back from the surface of the product. The echoes reflected are detected by the same sensor, now acting as a receiver, and converted back into an electrical signal. The time taken between transmission and reception of the pulse - the *run time* - is directly proportional to the distance between the sensor and the product surface. The distance D is determined from the velocity of sound c and the run time t by the formula:

$$D = c\frac{t}{2}$$

With a velocity of sound (in air under normal conditions) c = 340 m/s, a run time of 10 ms corresponds to a transmission path of 3.4 m and thus to a distance of 1.7 m.

The measurement is independent of:
- product characteristics such as specific weight, conductivity, viscosity and dielectric constant
- temperature changes within the tank or basin: the Prosonic FMU compensates for variations in temperature as the integrated sensor for temperature also provides temperature information.

Measuring range

Due to the ringing time of the sensor, there is a zone immediately below it from which returning echoes cannot be detected. This is known as the *blocking distance* B and determines the minimum distance between the sensor diaphragm and the maximum level (100%) in the silo. The blocking distance is a function of the type of sensor used (p.12).
The end of the measuring range is determined by the attenuation of the ultrasonic pulse by the air as well as by the strength of the reflection from the product surface.

2 Installation

This chapter is concerned with the

- Location of the transmitters and sensors
- Mounting and connection of the sensor
- Mounting and connection of the Prosonic FMU 867
- Structure of the Rackbus RS-485 or the PROFIBUS-DP
- Connection and set-up of the interfaces to the Personal Computer
- Installation of the operating programs.

Caution!
It is assumed that suitably qualified personnel are to be used for the installation and electrical connection of the system components. This is particularly important when the sensors are to be installed in hazardous areas. Please note the following:

- The Prosonic transmitter must be installed in a safe area.
- Observe the specifications in the certificate as well as local regulations when mounting sensors in hazardous areas.
- When setting the Prosonic bus address or the jumpers on the RS-485 interface: electrostatic discharge can degrade performance or damage electronic modules. Touch a grounded object to rid yourself of charge before handling the modules.

2.1 Location

Where possible, find a shady, protected spot in which to mount the Prosonic and sensor (when the latter is not installed in a tank or silo).

Nominal operating temperature

Prosonic FMU 867	-20 °C … +60 °C
Sensor FDU 80	-20 °C … +60 °C -40 °C … +60 °C with reduced measuring range
Sensors FDU 81 … 83, 85	-20 °C … +80 °C -40 °C … +80 °C with reduced measuring range
Sensor FDU 86	-40 °C … +150 °C

Use a protective hood or provide cooling if the ambient temperature exceeds +60°C or +80°C. For temperatures below -20°C insulate the instrument.

Prosonic all-weather cover

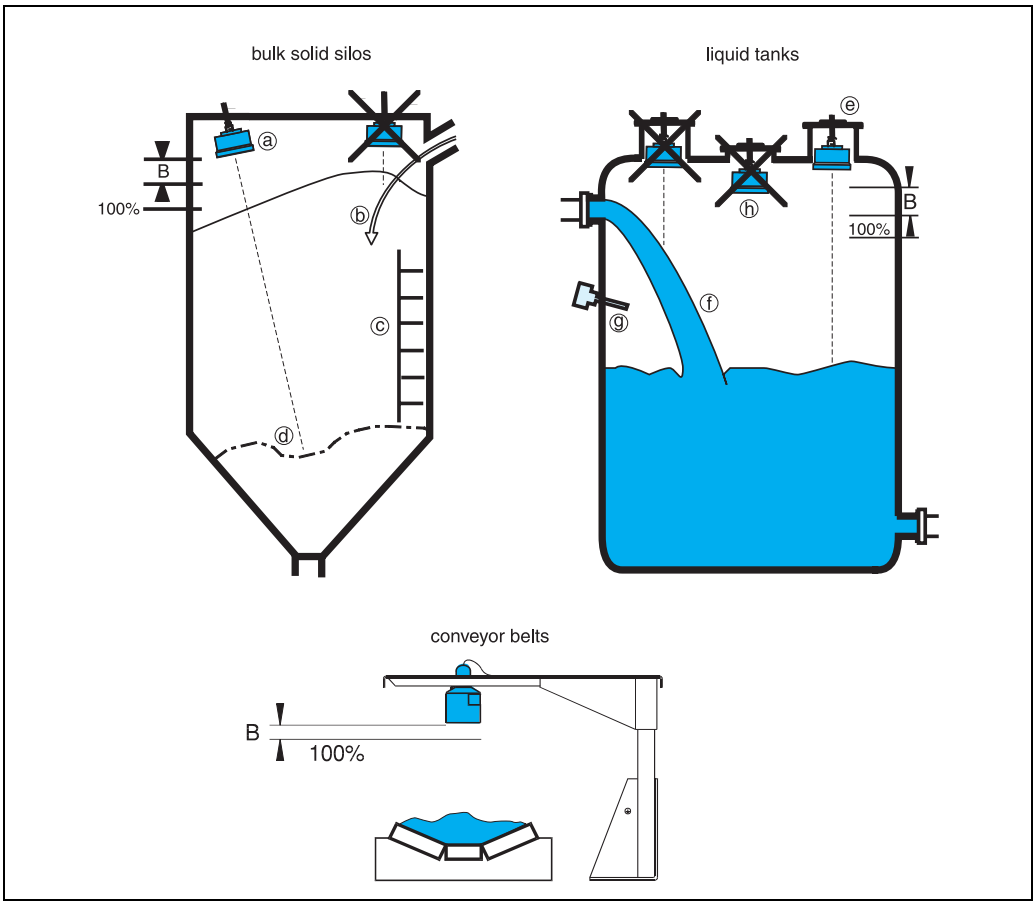
Material: Aluminium, blue paint-finish; Order No. 919567-0000
Material: Steel 1.4301 (SS 304 H); Order No. 919567-0001

All-weather cover for sensors FDU 80 and 81

Material: fibre-glass reinforced polypropylene; Order No. 919793-000
The measuring point designation is fixed to the all-weather cover: break at the prepared point on the sensor fixing ring.

2.2 Sensor

The principle requirement for reliable ultrasonic measurement is the correct positioning and alignment of the sensor:



Bulk solid silos

- For simple installation and accurate positioning use the FAU 40 alignment unit: Point the sensor at the centre of the outlet funnel (a), so that an echo is also received when the silo is empty
- Where possible, align the sensor such that the filling curtain (b) or internal fittings, e.g. a ladder (c) or an external limit switch, do not lie in the detection zone.
- Keep distance to the wall and check that the angle subtended at the product mound (d) or outlet funnel is as near to 90° as possible, since otherwise the measurement may be inexact.

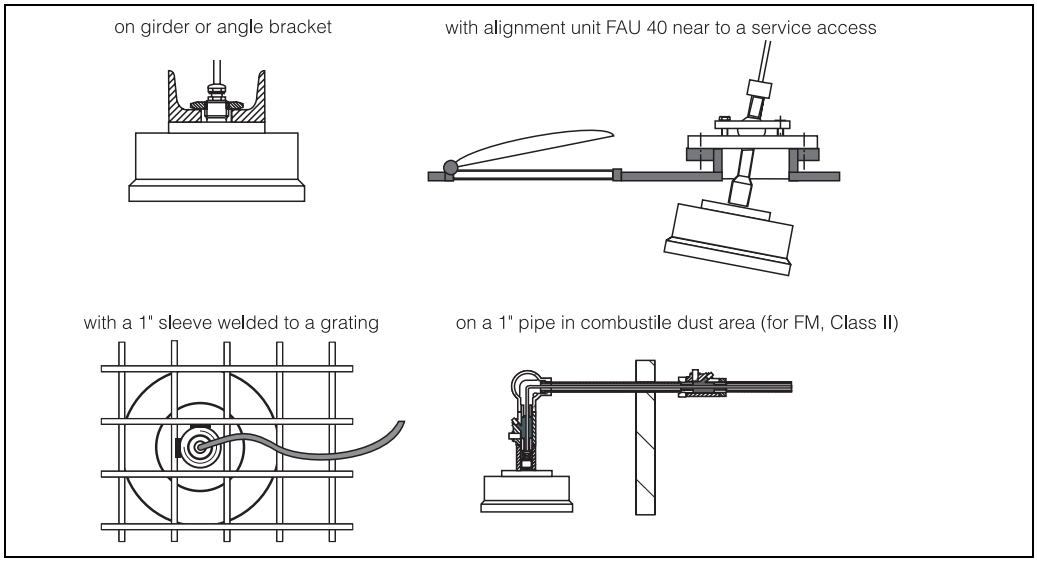
Liquid tanks

- Install the sensor such that its lower face projects into the tank.
- In nozzles (e), mount high enough to prevent the blocking distance being violated if the tank is overfilled (p.12).
- Where possible, align the sensor such that the filling curtain (f) or internal fittings, e.g. external limit switch (g), do not lie in the detection zone.
- Do not install in the centre of the tank top (h) (encourages the formation of multiple echoes!).
- Keep distance from the walls.

Conveyor belts

- The front diaphragm of the sensor should lie parallel to the belt.
- Stands and cantilevers are available as accessories.

Mounting



- The sensor can be mounted on the alignment unit FAU 40, or on a suitable girder, grid, or flange (see also TI 189F).
- Mount the sensor such that the distance between it and the maximum level to be measured (100%) is greater than the blocking distance B:

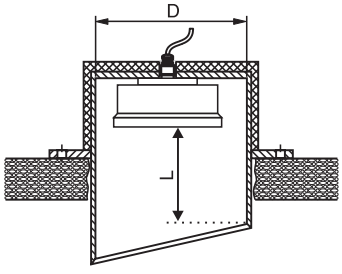
FDU	80	81	82	83	85	86
blocking distance	0.3 m 1.0 ft	0.5 m 1.6 ft	0.8 m 2.6 ft	1 m 3.3 ft	0.8 m 2.6 ft	1.6 m 5.2 ft

- The PE coating on the diaphragm of the FDU 85 resp. the PTFE coating on the diaphragm of the FDU 86 is an integral part of the measuring system and must not be damaged during installation.
- The connecting cable of the FDU sensor is not designed as a supporting cable. Do not use it as a suspension wire.

Caution!
- In combustible dusts local regulations concerning the cabling have to be strictly observed.
- The connecting cable of the FDU is not to be laid unprotected when the product to be measured is a combustible dust according to ATEX II 1 D.
- For applications in flammable gases (FM Class 1, Div. 1) the appropriate guidelines on installation must be observed.

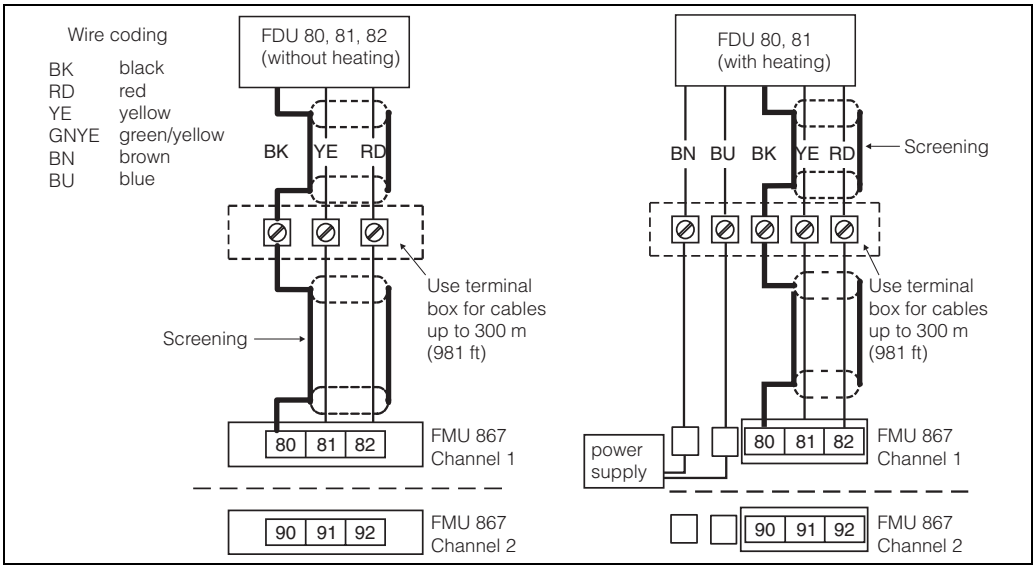
Nozzle Mounting

Sensor	D / mm	L / mm
FDU 80, 81	80 mm (3.15 in)	250 mm (9.84 in)
FDU 82	150 mm (5.91 in)	300 mm(11.8 in)
FDU 83	200 mm (7.87 in)	400 mm (15.7 in)
FDU 85	250 mm (9.84 in)	500 mm (19.7 in)
FDU 86	300 mm (11.8 in)	600 mm (23.6 in)

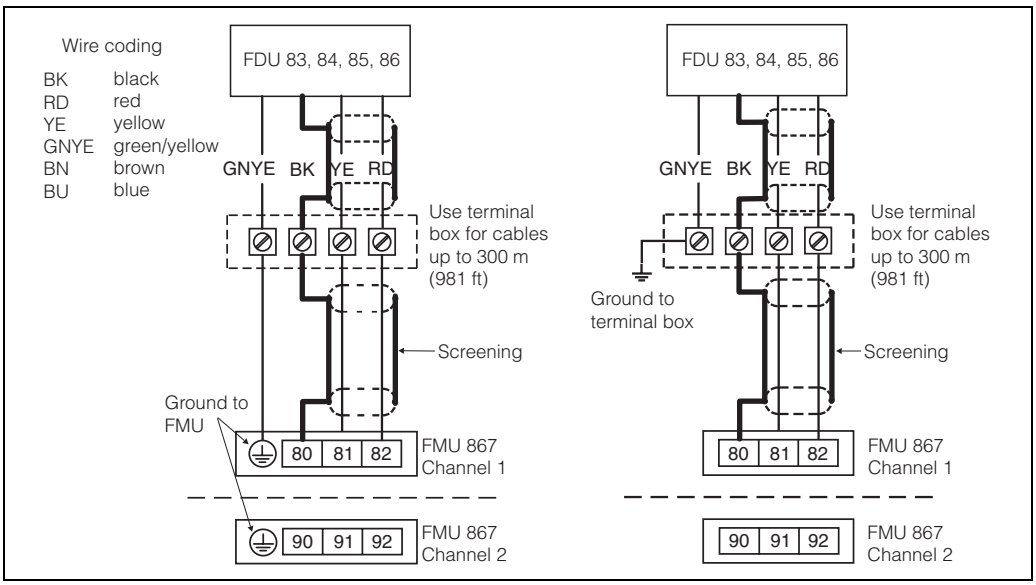


The sensor should be mounted on a nozzle only when the maximum level to be measured would otherwise lie within the blocking distance. Please note:
- No condensate or build-up of material may form in the nozzle.
- Select the diameter as large as possible (see figure for recommended dimensions).
- If build-up may form in the nozzle the diameter must be significantly larger.
- The inner surface of the nozzle should be as smooth as possible (no edges or welding seams).
- When mounting in the open, the nozzle should be insulated as the temperature within it can differ significantly from that in the vessel.

Electrical connection FDU 80... 82 (with or without heating)



Electrical connection FDU 83…86 (Grounding at FMU or at terminal box)



Switch off the power supply before attempting to connect the sensor and transmitter. The sensors are supplied with a fixed cable (up to 30 m long) as standard. They can be connected:

- directly into the FMU connection area. The connecting terminals are designed for cable diameters up to 2.5 mm^2
- via a terminal box;
  an additional screened cable is then required. Use commercial, two-core screened cable which may be up to 300 m in length, up to 6 Ω per core, max. 60 nF; screening braided metal max. 6 Ω (terminal box and cable not included in delivery; - suitable cable can be ordered from Endress+Hauser). The screening acts as a return line and should exhibit electrical continuity between sensor and transmitter.

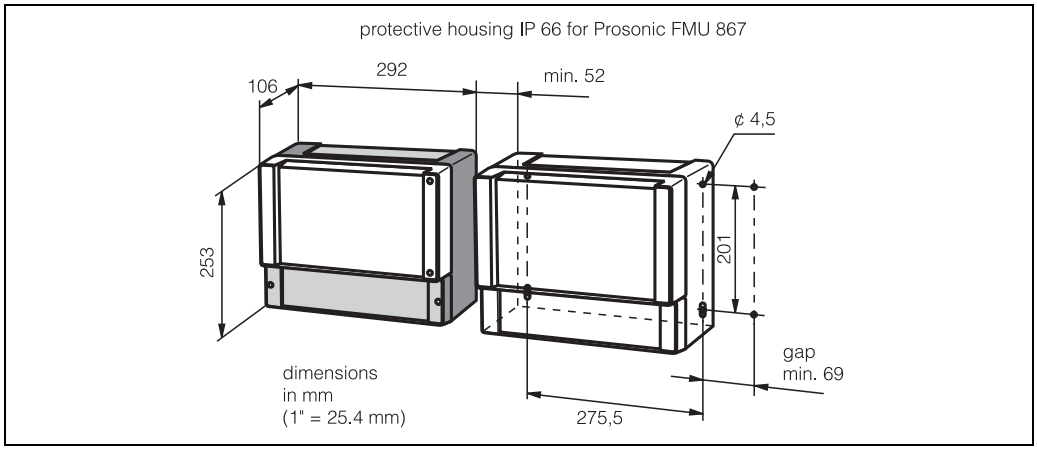
Caution!

- If the terminal box is installed in a hazardous area, observe the local regulations.
- The screening (BK) is used as an active conductor and must be connected as shown in the figures. In order to guarantee its effectiveness, it must be laid in one piece between Prosonic transmitter and sensor.

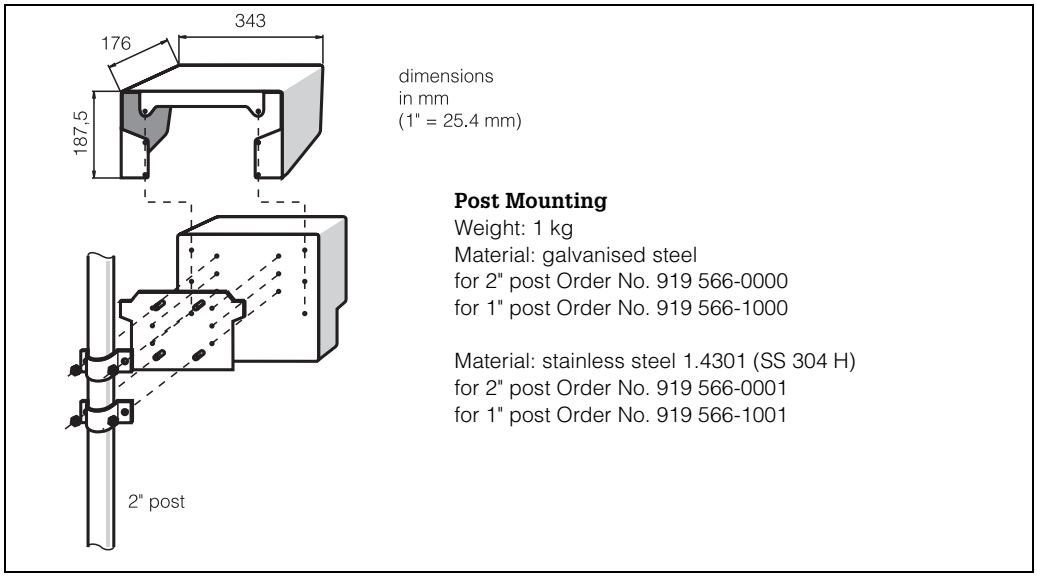
2.3 Prosonic FMU 867

The Prosonic FMU 867, with IP 66 protective housing, can be mounted on a wall or post outdoors on in the control room.

Wall mounting



Post mounting

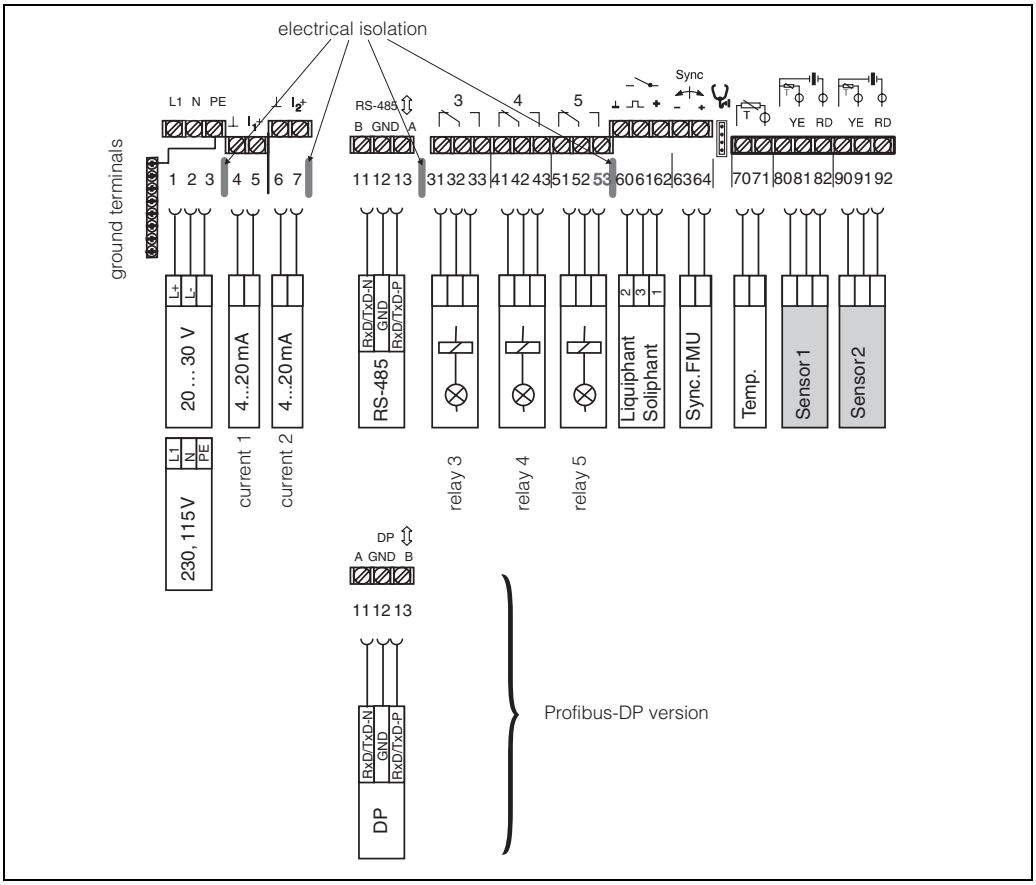


The fastenings (nuts and bolts) for both post mounting and all-weather cover are supplied with the units.

Caution!

- Over voltage protection:
  The external over voltage protection unit HAW 262 for signal outputs is recommended for protecting the transmitter from voltage peaks, especially when mounted in the field. The HAW 261 should be used to protect against mains power voltage peaks.
- An over voltage complete unit is also available in protective housing for post mounting: TSP 215095.0001.

Terminal strip



The terminal strip for cable diameters up to 2.5 mm^2 is in a separate connection compartment. All terminals are precisely marked. (Terminal 3 is reserved for the internal protective ground):

- Remove the plastic cover from the front of the terminal compartment.
- Press out the pre-stamped cable entries as required
  - underside: 5 x Pg 16, 4 x Pg 13.5 (M20x1,5);
  - rear: 5 x Pg 16.

Power

The power requirements are printed on the nameplate at the right-hand side of the nameplate, see also Chapter 6, "Technical Data".

Caution!

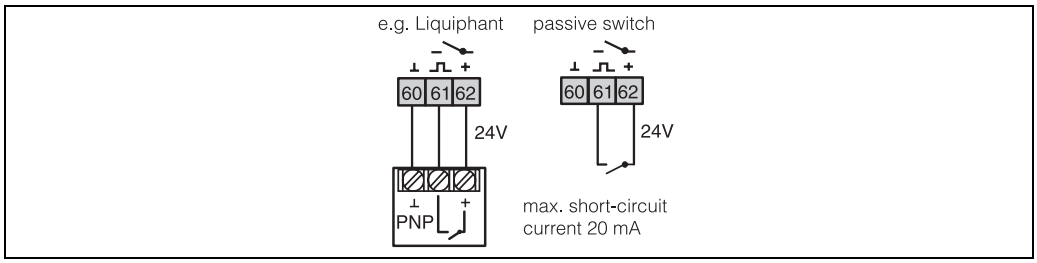
- If the specifications on the nameplate do not correspond to those of your power supply, do not connect up - you may damage the instrument!
- Connect the protective ground to the metallic terminal strip provided at the left - this ensures safe isolation and contact protection.
- Current output, relay outputs, power connection and sensor input are all electrically isolated from one another. Insulation is ensured up to 250 V_{eff} according to DIN/VDE 0160. The analogue outputs share a negative line, as do the sensor inputs.
- The max. short-circuit current is 20 mA at a voltage of 24 V.
- When using the public power supply, install an easily accesible power switch in the proximity of the device. Mark the power switch as a disconnector for the device (IEC/EN 61010).

Analogue outputs and Relays

Only one non-floating device can be connected to each of the current outputs.

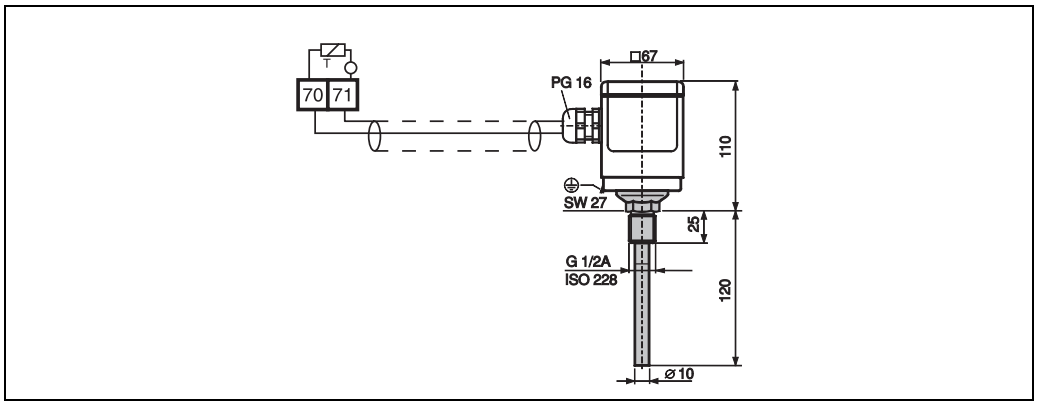
- There is no limit to the number of floating devices, apart from that imposed by considerations of maximum or minimum load.
- For the switching capacity of the relays see the technical data in Chapter 6.
- The first relay has the number 3 and operates the 3rd LED, the second relay has the number 4 and operates the 4th LED, the third relay has the number 5 and operates the 5th LED.

External limit switch



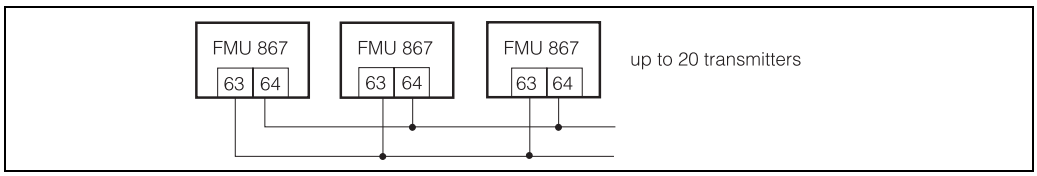
The Prosonic transmitter has an additional input for the connection of an external limit switch. A Liquiphant or Soliphant provides additional overspill protection. Normally the limit switch is installed at the 100% level for overspill protection or 0% for dry-running protection. Set the limit switch to the corresponding operating mode (maximum or minimum detection).

External temperature sensor FMT 131



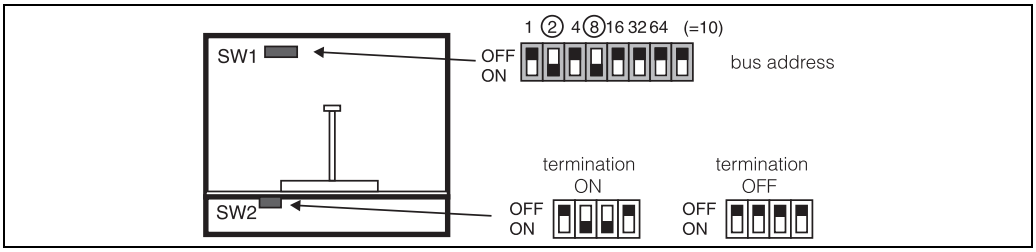
When using the heated sensors FDU 80/81 an external temperature sensor must be installed. When using sensors without heating the temperature sensor can be applied if the temperature is to be measured at a different point in the tank or silo.

Synchronisation line



In order to avoid cross-talk between parallel routed sensor lines connect the transmitters (max. 20) to a synchronisation line. The sensors are then scanned in sequence. If more devices are present, groups of 20 transmitters should be used. The cables within one group can be in parallel. The cables of different groups must be separated. Common screened cable can be used.

Bus address



Every transmitter must have a unique bus address:
- Switch off power, loosen screws and pull down the front panel
- Set the address at DIP-switch SW1 (Example: 2 + 8 = 10)
- Close front panel, tighten screws.

For the last transmitter on the bus, i.e. furthest away from the computer switch in the terminal resistance at DIP-switch SW2: OFF; ON; ON; OFF
For all other transmitters the terminal resistance must be switched off, that is DIP switch SW2 takes the position: OFF, OFF, OFF, OFF.

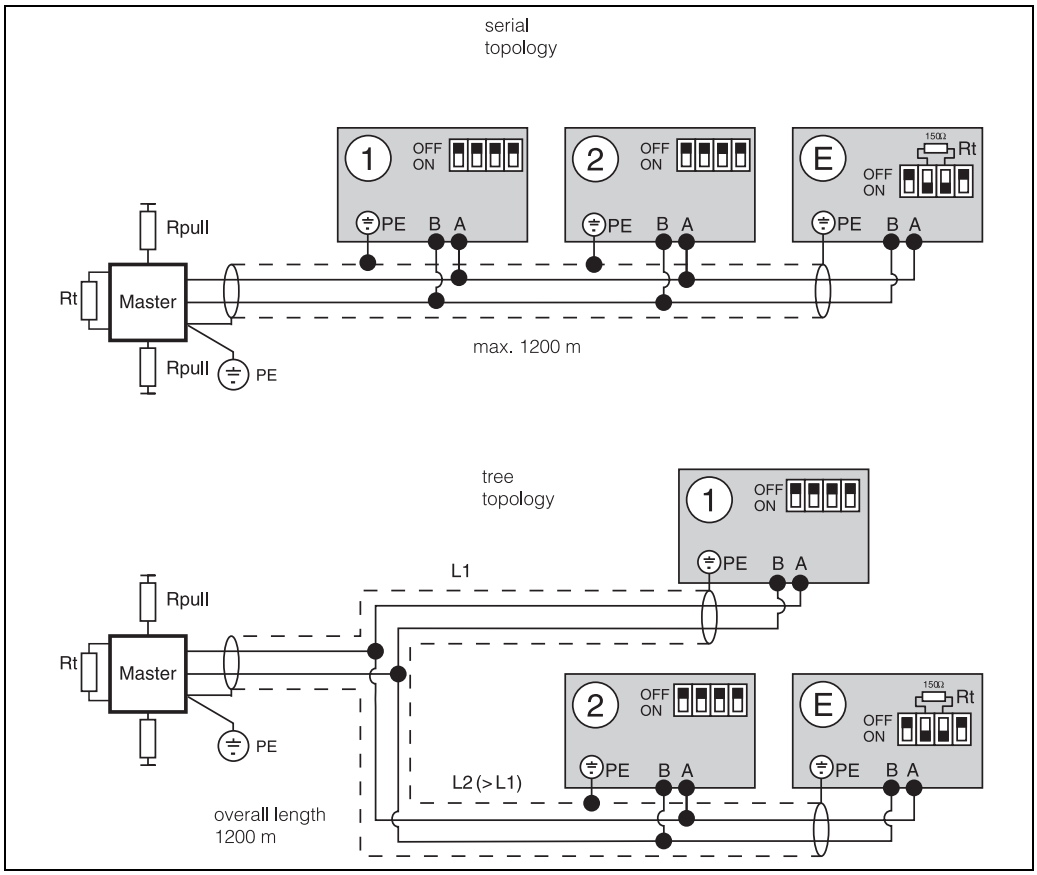
Note!
The addressing as described above is only valid for instruments with RS 485 interface.
For devices with PROFIBUS-DP interface see p.67

2.4 Rackbus RS-485

Up to 25 Prosonic transmitters can be connected to the Rackbus RS-485. The bus is connected to the personal computer via an RS-485 interface card or an external RS-232C/RS-495 adapter (both electrically isolated), which also provides power. The bus uses:

- connecting cable (2-core, twisted and screened)
- cable length: max. 1200 m (3900 ft)

Topology



When planning the system, attention should be paid to the possible segmentation of the bus according to plant sections. Suitable topologies are:

- serial bus, wired through the transmitters or with spurs
- tree with max. line length 1200 m (3900 ft), including spurs >10 m.

Bus Termination

A terminal resistance must be provided at the PC card and the last Prosonic on the bus The standard setting is retained by all other transmitters (p.17).

Ground

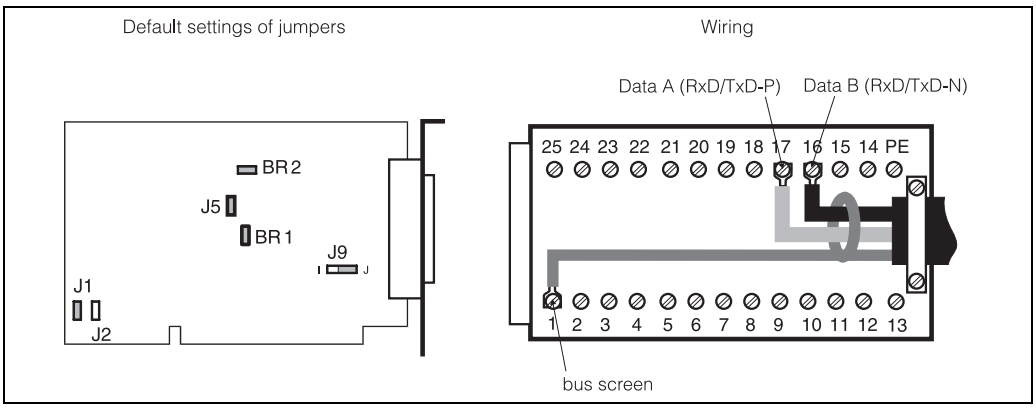
The bus is electrically isolated from the transmitter and PC card/converter.

- The screening must be grounded and have electrical continuity throughout.
- EMC tests indicate that grounding at both ends and at each transmitter gives good results.
- If there is a difference in potential between the grounds, take measures to equalise the potentials, e.g. by neutral star point bonding or creation of an equipotential lane.
- All necessary information for the alternative interface PROFIBUS-DP is contained in chapter chapter 6.

2.5 Interfaces to the Personal Computer

Depending upon the order the Prosonic P is supplied with different interfaces to the Personal Computer (PC). The following sections describe how they are installed.

2.5.1 RS-485 Interface Card Type Addicom PA 732



Default settings

Jumper/Bridge	Inserted	Function
BR1	yes	Pull-Up-/Pull-Down resistance 391 Ω for RS-485 (inserted/removed together)
BR2	yes	
J1	yes	COM 3, address 3E8H
J2	no	
J5	yes	Termination resistance 150 Ω
J9	yes (Position J)	Protective ground on pin 1 of connector (Position I, if bus screen is to be grounded at transmitter end only)

Standard Installation

1. Install the card in the computer in an 8- or 16-bit slot according to the manufacturer's instructions. A 25 pole plug with screw terminals for connection of a bus cable is supplied for connection of a bus cable.
2. Wire the connector (s. fig. above):
   – Data B, Terminal 16
   – Data A, Terminal 17
   – DGND (bus screen), Terminal 1
3. Plug into PC card and tighten fixing screws (grounds bus screening!)
4. Enter the card address in the COM port menu of the Fieldmanager program (p.23).

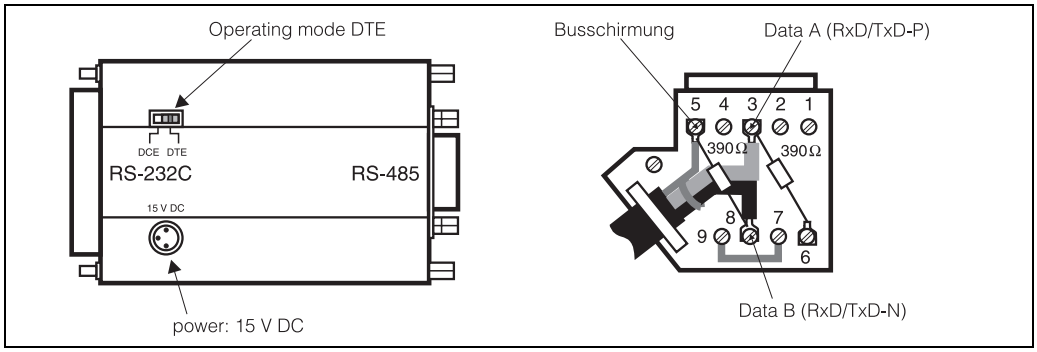
Configuration as COM 4

1. Configure card as COM 4: J1 and J2 inserted; address 2E8H.
2. Enter the card address in the COM port menu of the Fieldmanager program (p.23).

2.5.2 RS-232C/RS-485 Converter

In this alternative, the converter is plugged into a free RS-232C computer port (normally COM1 or COM2).

Installation



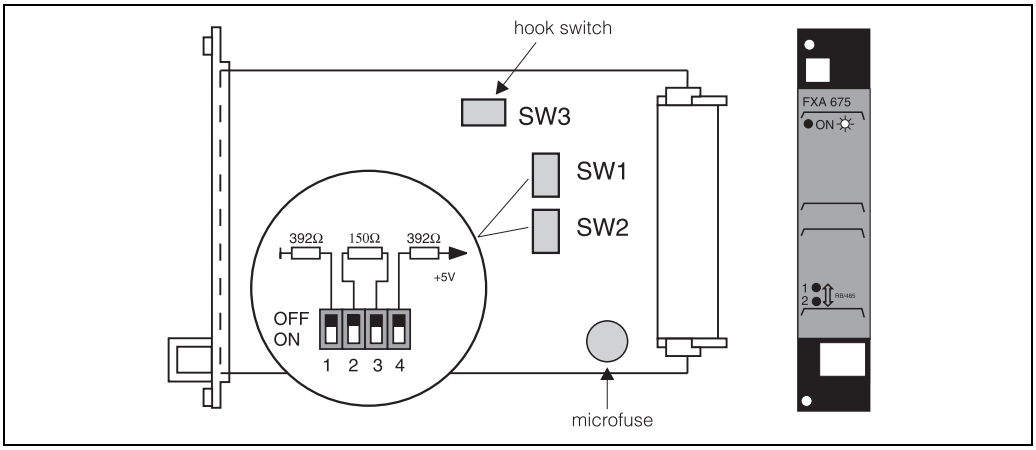
1. Set the switch to operating mode DTE (data terminal equipment)
2. Connect bus line to a 9-pin Min-D connector
   – Jumper, Terminals 9 - 7
   – 390 Ω resistors, Terminals 3 -6, 5 - 8
   – Data A, Terminal 3
   – Data B, Terminal 8
   – DGND (bus screen), Terminal 5
3. Plug converter into COM1 or COM2.
4. Tighten fixing screws to both PC card and bus connector (grounds bus screen to computer)
5. Plug in converter power supply and switch on.

Note!
An additional adapter is supplied with the power supply in countries which do not have the standard European 230 V 2-pin plug/American 115 V plug.

2.5.3 Rackbus RS-485/Rackbus interface card FXA 675

The interface FXA 675 (also available with single port in Monorack housing ZA 6675) connects Rackbus-485 devices to the Rackbus. From there a connection can be made via a gateway to a supervisory bus operating with Modbus, PROFIBUS-DP, PROFIBUS-FMS or FIP, INTERBUS-S or CONTROLNET. Up to 25 devices can be connected to each of the two ports of the FXA 675, in hazardous areas up to 10. The devices are operated by the Commuwin II operating program. The connection in Commuwin II is made via the server appropriate to the gateway. For detailed information see Operating Instructions BA 134F/00/en.

Configuration

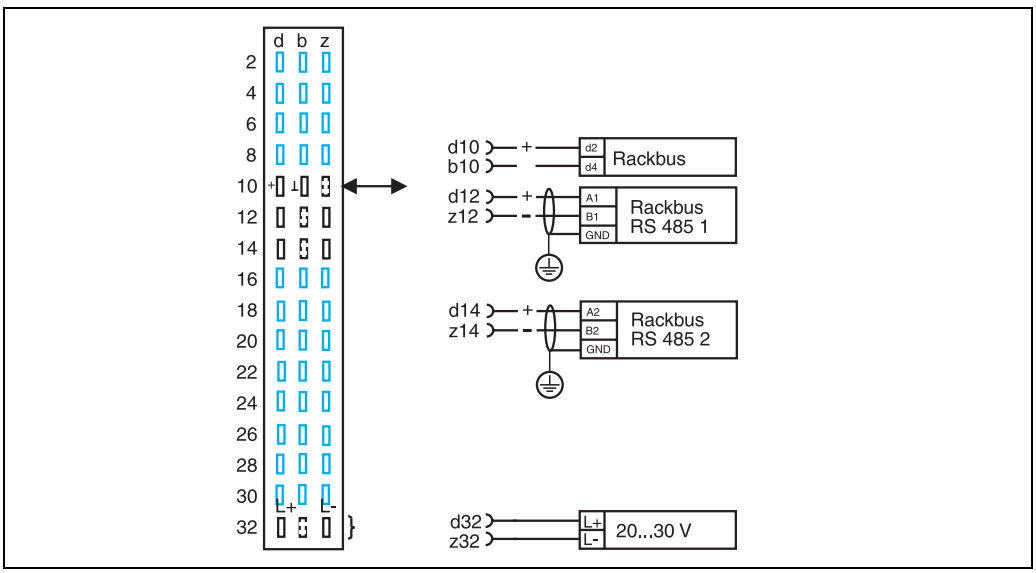


Two DIP switches, SW 1 for channel 1 and SW 2 for channel 2, specify the bus power and the termination resistance:

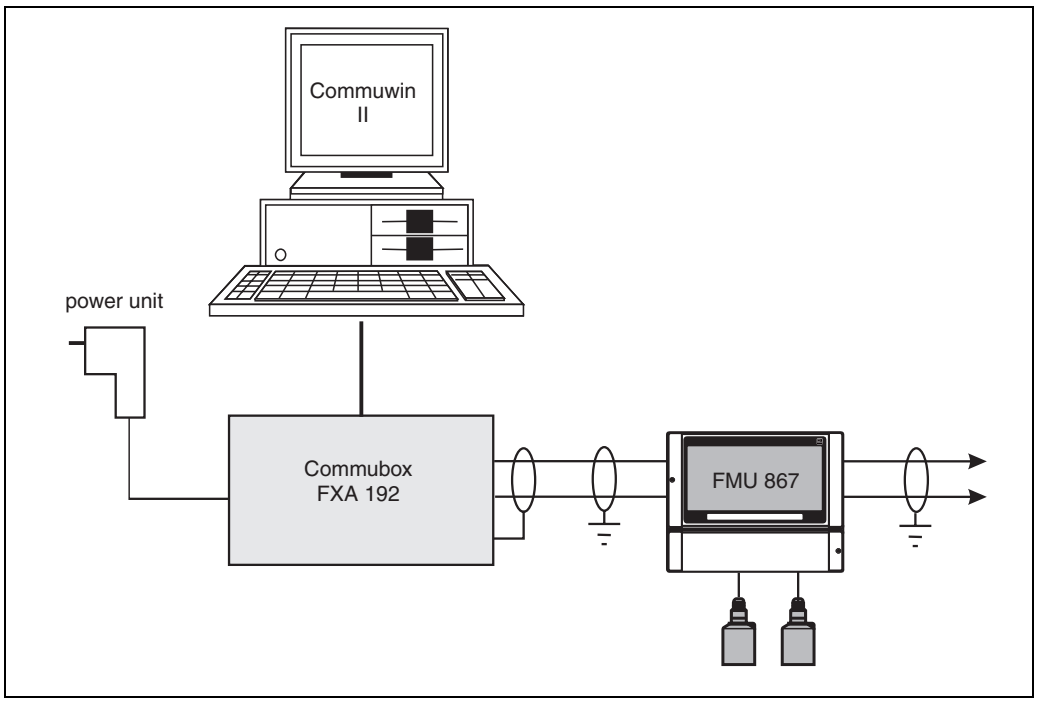
- For the interface in the master rack bus power and termination resistance are switched on (ON;ON;ON;ON).
- For an interface in a secondary rack, the bus power is switched off and the termination resistance is switched on (OFF;ON;ON;OFF).
- For unused channels the setting remains ON;ON;ON;ON
- If less than 33 transmitters are present at the secondary rack the hook switch SW 3 must be closed.

The bus screening must be grounded externally, e.g. at the grounding rail. The assembly rack is to be grounded as well.

Pin assignment



2.5.4 Commubox FXA 192



Commubox FXA 192 connects Rackbus RS-485 devices directly to a personal computer. This allows them to be remotely operated by means of the operating program Commuwin II.

Installation

1. Connect the Rackbus RS-485 line to the sockets marked A and B, the screening to the socket marked ⊥.
2. Plug-in the power supply
3. Check that the communication parameters are as follows:
   baudrate 9600 bit/s; data bits 7; stopbits 1; even parity

The connection to the devices is opened in Commuwin II by means of the ZA 672 server.

2.5.5 Profiboard/Proficard

The following interfaces are available for communication between PROFIBUS-DP and a Personal Computer or Laptop:

Profiboard
PCI Board, Order No. 52005721

Proficard
PCMCIA-Karte; Order No. 016570-5200

2.6 Programs

2.6.1 Fieldmanager/Commugraph

System requirements

Before the Fieldmanager operating program or Commugraph display program are started, the measuring system must be correctly connected and fully operational. To run the programs you require:
- AT-compatible computer
- Keyboard and screen (monochrome or colour)
- Memory with min. 640 K
- 1 disk drive
- 1 serial interface RS-232C or RS-485
- 1 parallel interface (Centronics)
- MS DOS operating system, Version 3.1 or above

Start-up

The operating program Fieldmanager 485 and visualisation program Commugraph 485 can be started from either the hard disk or floppy drive. The diskette contains an English and German version; for Commugraph, other languages can be programmed by using the TRANSLAT program.

Fieldmanager is started by entering:
- "FM" for German
- "FM E" for English

Commugraph is started by entering:
- "CG" for German
- "CG E" for English
- "CG X" for language X

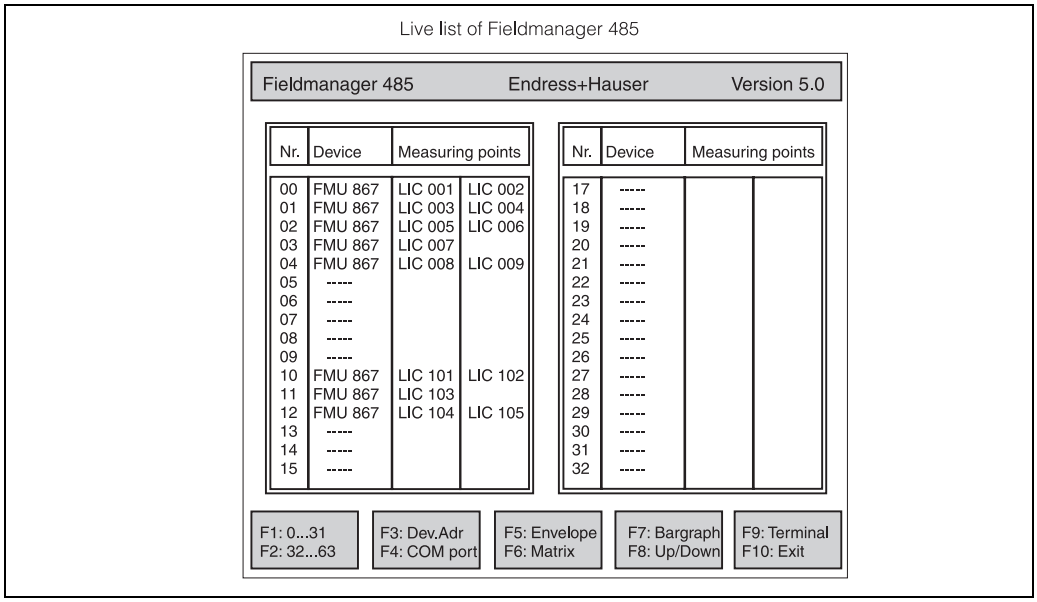
The texts in the native language can be entered via the TRANSLAT program.

COM port selection

On initial start-up the COM port must be set in both programs. After pressing F4 (for Fieldmanager) or F7 for (Commugraph) the correct COM Port (1 … 4) can be entered.

If, after the selection of another menu, the message "no communication" appears:
- check the configuration of the PC card; for the converter, try switching the DCE/DTE switch to the DCE setting
- check the bus wiring
- check that the computer recognises the address set on the PC card by using the DEBUG command.

Transmitter status



The instrument status menu is selected by pressing F1 (Fieldmanager 485) or F8 (Commugraph). The so-called live list is displayed, i.e. a list of all transmitters which are connected to the bus. If a transmitter is missing, it points to a:

- bus address error - two or more transmitters have the same address
- bus wiring error
- bus configuration error

When everything is running satisfactorily, you can begin with the configuration of the transmitters (see section 4).

2.6.2 Commuwin II

Installation of the operating- and visualization program Commuwin II is described in the Operating instructions BA 124F.

Note!
The communication parameters - baudrate 19 200 Bit/s, parity even, data bits 7 and stop bits 1 - are specified by the Rackbus protocol, and cannot be changed by the programs.

2.6.3 ToT Tool

Installation instructions for the ToF Tool are delivered together with the program on a CD-ROM.
ToF Tool operation is possible for the PROFIBUS-DP version of the Prosonic only.

3 Operation

This chapter deals with the operation of the Prosonic FMU 867. It is divided up as follows:

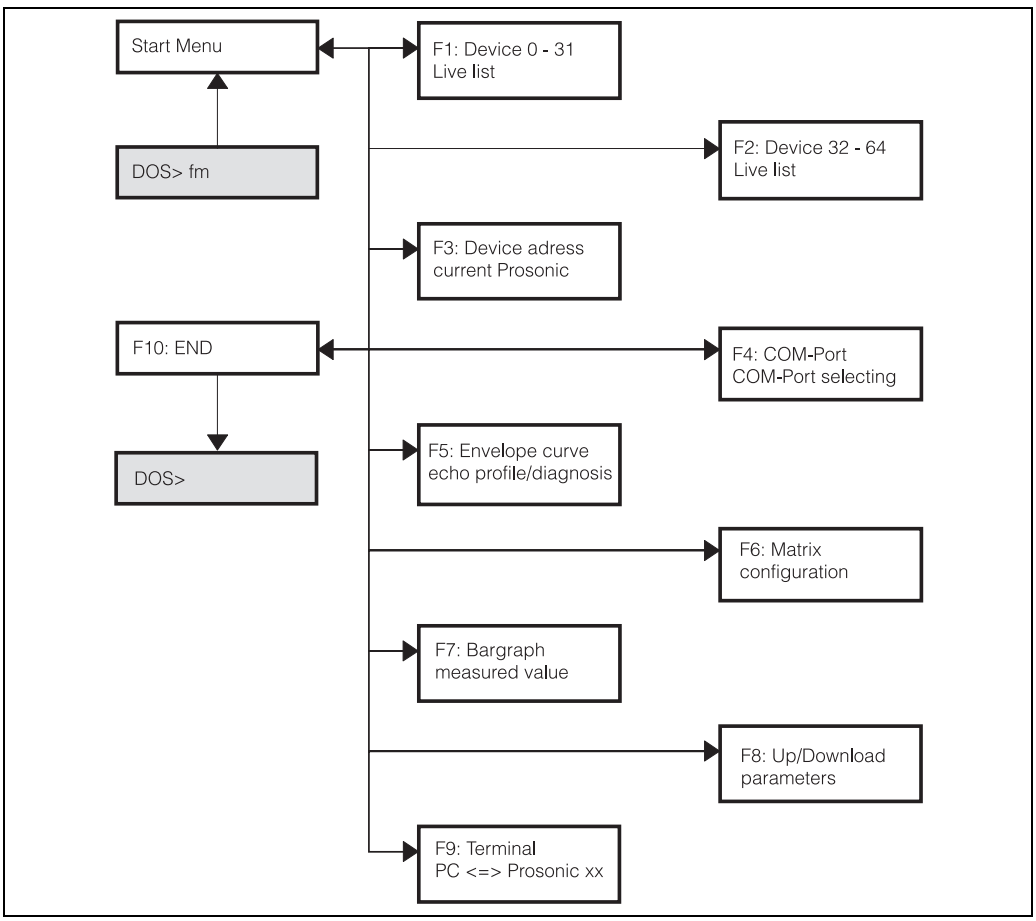
- Fieldmanager 485 operating program
- Commugraph 485 visualisation program
- Commuwin II operating program
- Prosonic display elements

3.1 Fieldmanager

After installation (see section 2.6.1) the Fieldmanager operating program is started by entering the command "FM E" (for English version). It offers the following functions:

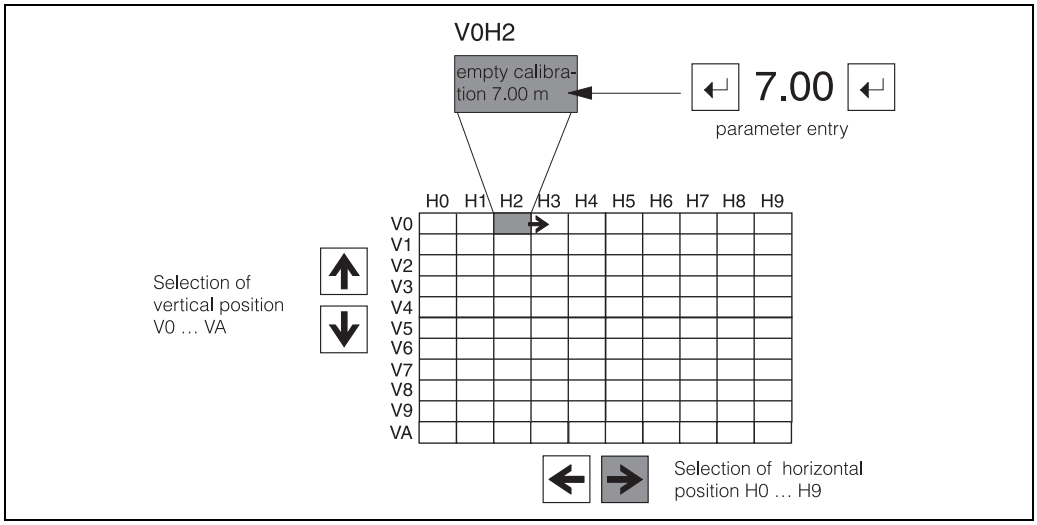
- List of connected and operational transmitters - the so-called live list
- Selection of Prosonic transmitter
- Configuration of the selected transmitter via the operating matrix
- Visualisation of the measured values in the form of a moving column
- Back-up of the parameters by means of the up-/download functions
- Envelope curve display
- Configuration of communication port
- Terminal program for on-line communication with individual transmitters

Structure of Fieldmanager 485



The menus are called by means of the function keys F1…F10.

Operating Matrix



All instrument parameters are configured via an 11 x 10 operating matrix:

- Every field in the matrix has a horizontal and vertical position, which can be selected in the operating program.
- The fields are selected by using the computer cursor keys.
- The ENTER key releases the field for parameter entry.
- After the parameter has been entered, press the ENTER key again to register the entry.

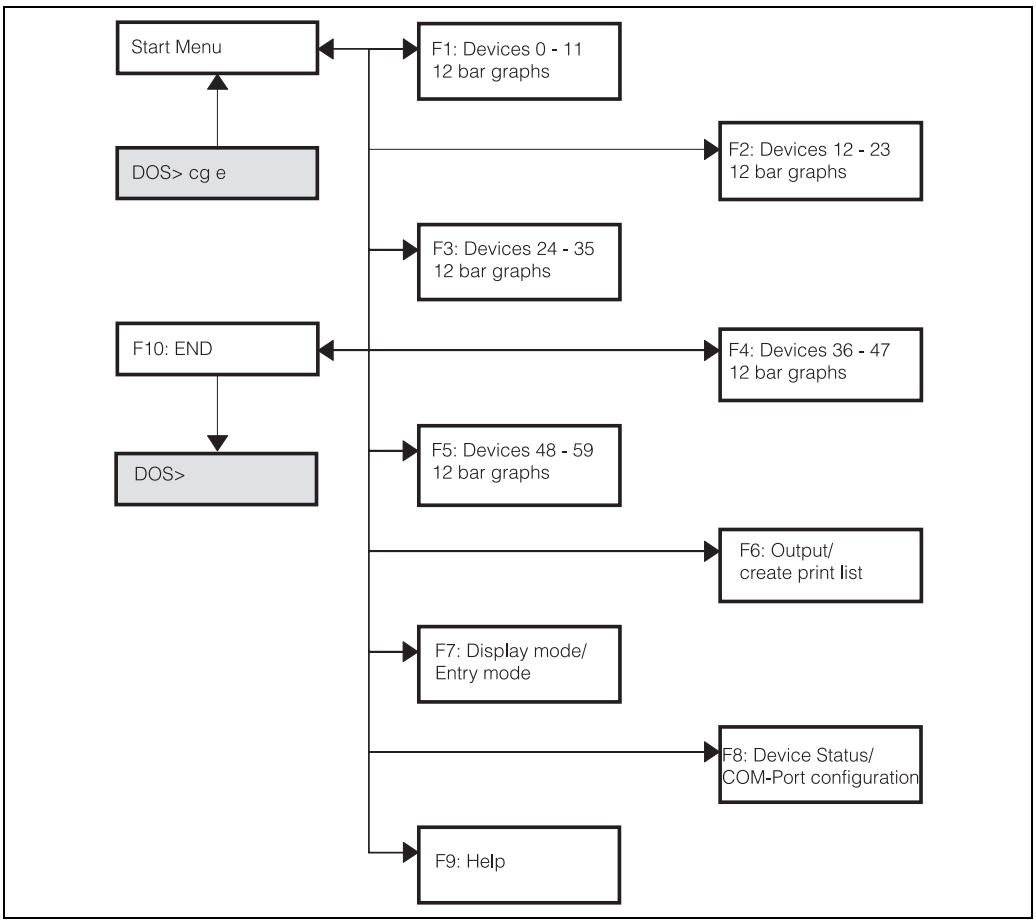
The operating matrix is to be found on p.83. A folded matrix is also to be found in the front cover of the Prosonic.

3.2 Commugraph

After installation (see section 2.6.1) Commugraph is started with the command "CG E" (for English version). It offers the following functions:

- Analogue display of measured values as columns:
  12 measuring points with RS 485 interface (level, pressure, liquid flow) can be displayed simultaneously, 60 in all
- Limit value display:
  When the limit value is violated, the column changes from green to red.
- Measured value displayed as numerical value with technical units.
- List of connected transmitters.
- Printed log of measured values.

Structure of Commugraph

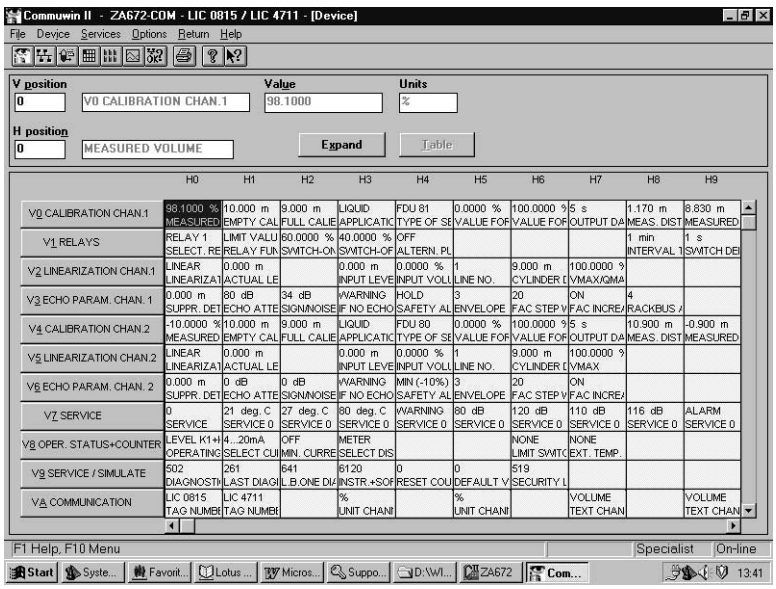


The operating program menus are called by means of the function keys F1 ... F10. Entries are made by means of the cursor and entry keys. Individual menus are described in section 4.6.

3.3 Commuwin II

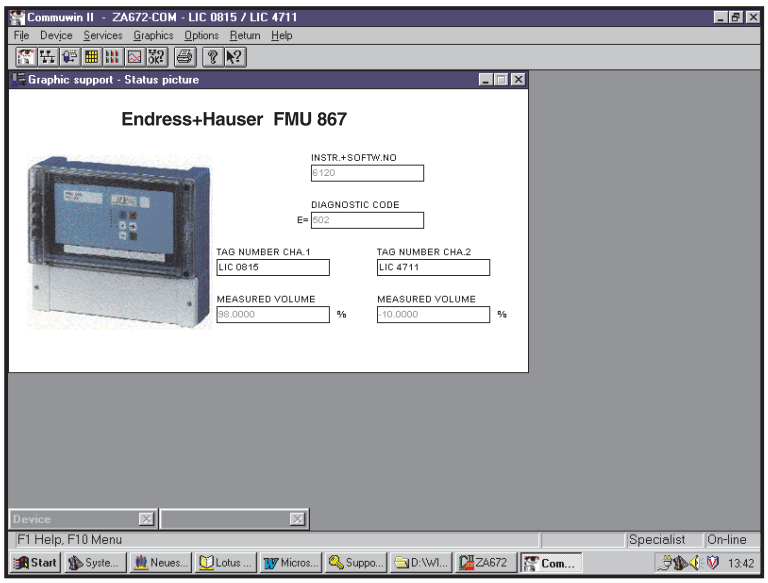
When operating via the Commuwin II display and operating program (from Version 1.5 onwards) the Prosonic transmitter is set and operated using either an operating matrix or the graphic operating mode. The appropriate server (e.g. HART or ZA 672) must be activated. A description of the Commuwin II operating program is given in the operating instructions BA 124F.

3.3.1 Operating matrix



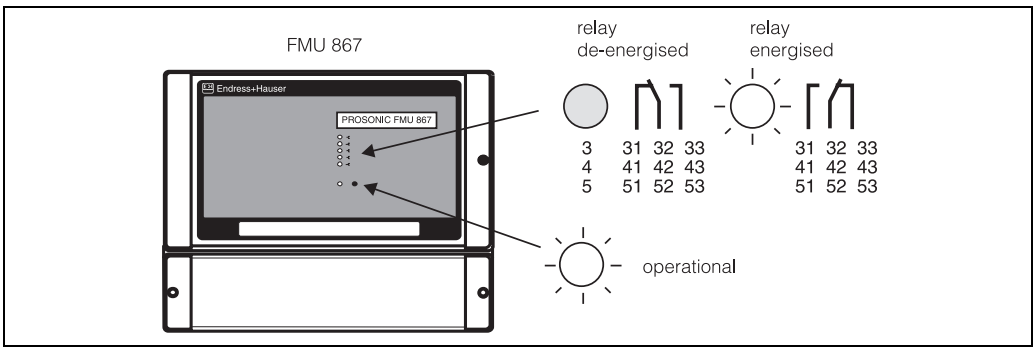
The advanced functions of the Prosonic FMU can be called up in this operating mode within the instrument parameters menu. Every row is assigned to a function group. Every field shows one parameter. The calibration parameters are entered in the appropriate fields.

3.3.2 Graphical operation



In this operating mode the parameters for specific configuration procedures are entered in the appropriate places on the screen.

3.4 Prosonic Display Elements

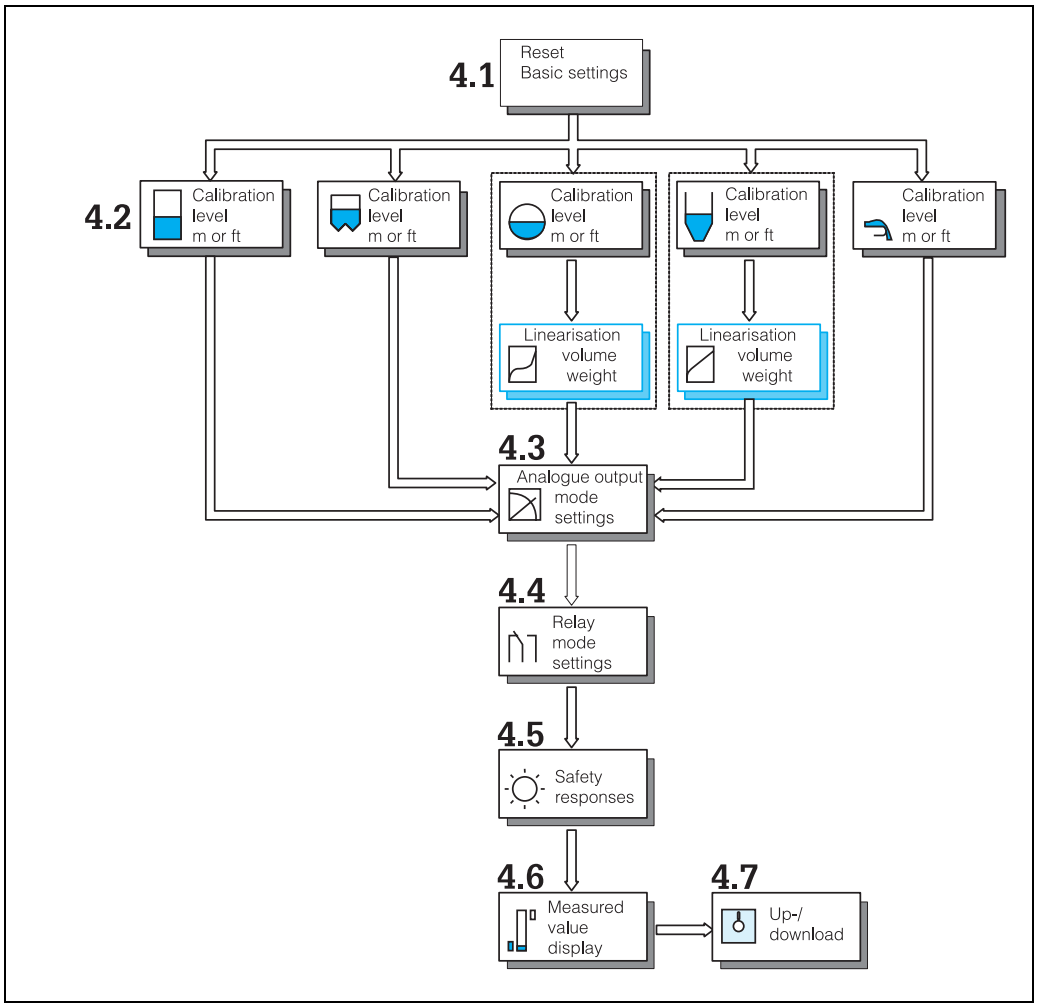


- The FMU 867 has got three relays, which are assigned to the yellow LEDs 3, 4 and 5.
- A relay LED lights, when the corresponding relay is energised. The operation mode of each relay (limit, trend or alarm) can be selected during the configuration of the FMU 867 (see section 4.4).
- A green LED lights when the transmitter is operational and flashes when a warning is present (see section 5.1).

4 Configuration and Measurement

This chapter deals with the configuration and measured value display of the Prosonic transmitters. The figure summarises the steps required for a level measurement:

Procedure: Configuration and measured value display



In this chapter the configuration is described as it is carried out in the Fieldmanager program. When operating via Commuwin II the calibration works in the same way, if "Parameter matrix" is selected in the Device Menu. Operation via ToF Tool is based on the same matrix, too. Alternatively Commuwin II can be operated in the "Graphics" mode, which is described in the Operating instructions BA 124F/00/de.

Note!

- The Prosonic transmitter outputs a warning until it has been properly calibrated.
- Configure channel 1 first, then channel 2.
- When one device has been configured, the same parameters can be transferred to other devices by the Up/Download function (see section 4.7).

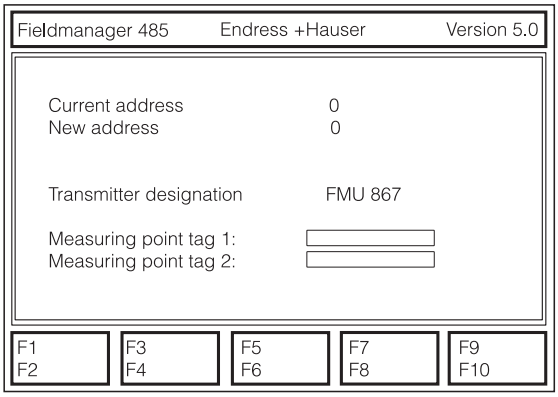
4.1 Basic settings

The following basic settings must be made before the transmitter is calibrated:

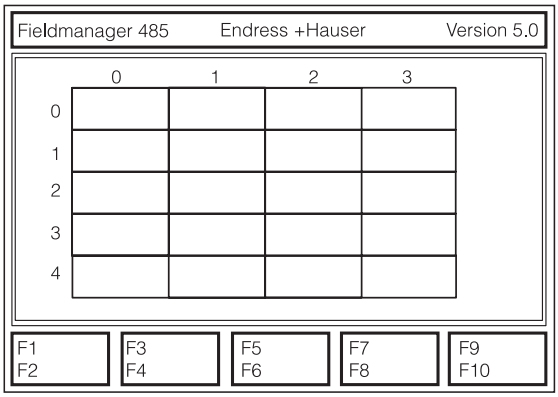
- Selection of the transmitter address in the operating program
- Transmitter reset on commissioning
- Selection of length units
- Selection of operating mode
- Entry of sensor type(s)
- Entries for external instruments (limit switch or temperature sensor)

Transmitter selection

1. Start Fieldmanager with FM E
   (Commuwin II: see section 3.3)
2. Press F1 - Live list
   Note address of the concerning device
3. Press F3 - Transmitter address
   Enter transmitter address and measuring point tag:



4. Press F6 - Matrix selection
   Matrix for the configuration of the concerning device appears:



Reset: V9H5=333

On commissioning it is recommended that the transmitter be reset to the original factory settings (default setting). The reset is performed by entering "333" into the matrix field V9H5. (For operation via PROFIBUS-DP use "1" instead of "333".)
After a reset:
- the length units remain unchanged
- any user linearization remains intact but is deactivated, the transmitter selects the "linear" mode.

Length units: V8H3

V8H3	Length unit
0	meter (Default)
1	Feet

Caution!
Once you have selected the units, do not change the setting: any change requires the changing of all associated parameters (analogue output, relays, linearization).

Operating mode: V8H0

V8H0	Operating mode
0	channel 1
1	channel 1 and channel 2
3	channel 2
5	Average of channel 1 and channel 2

Sensor type: V0H4/V4H4

V0H4 (for channel 1) V4H4 (for channel 2)	Sensor type
80	FDU 80
81	FDU 81
82	FDU 82
83	FDU 83
85	FDU 85
86	FDU 86

External limit switch: V8H6
External temperature sensor: V8H7

V8H6	external limit switch	V8H7	external temperature switch
0	no external limit switch	0	no external temperature switch
1	Minimum/channel 1	1	channel 1
2	Maximum/channel 1	2	channel 2
3	Minimum/channel 2	3	channels 1 and 2
4	Maximum/channel 2		
5	Minimum/channels 1 and 2		
6	Maximum/channels 1 and 2		

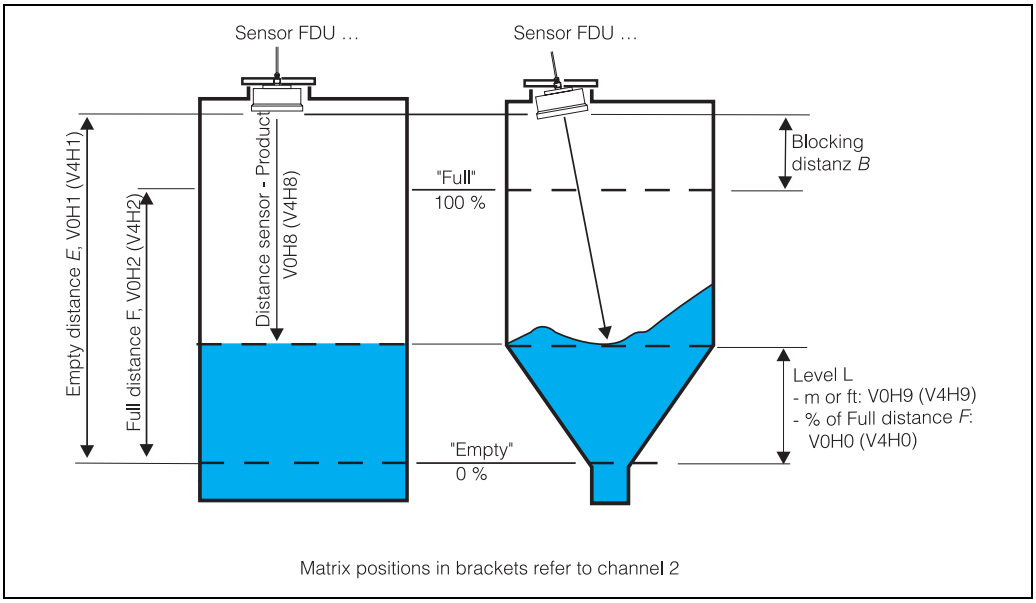
Note!
Operation with an external limit switch is described in detail in section 4.5.

4.2 Calibration

This section describes five possibilities for calibration:

- Calibration for level measurement in m or ft
- Calibration for average level measurement
- Calibration with linearization for level or volume measurement in horizontal cylinders
- Calibration with manual or semi-automatic linearization for level, volume or weight measurement in silos with conical outlets
- Calibration for conveyor belt applications

Parameters for basic calibration



The basic calibration requires the entry of at least three parameters:

- The Empty distance *E* in V0H1: *E* is the distance from the membrane of the sensor to the desired 0% point.
- The Full distance (measuring range) *F* in V0H2. *F* is the distance from the 0% point to the desired 100% point.
- The application parameter *A*: It optimizes the signal processing by setting several further parameters to values, which have proven the best for the respective application. Five applications can be selected

Application parameter A	
channel 1: V0H3 channel 2: V4H3	**Application**
0	Liquids
1	Liquids with rapidly changing levels
2	Fine-grained bulk-solids
3	Coarse-grained bulk solids
4	Conveyor belts (bulk solids with rapidly changing levels)

4.2.1 Calibration for level measurement in m or ft

The procedure

#	Matrix position channel1 (channel 2)	Input/Display
1	V0H1 (V4H1)	Empty distance *E* in the units selected by V8H3 (m or ft)
2	V0H2 (V4H2)	Full distance *F* in the units selected by V8H3 (m or ft)
3	V0H3 (V4H3)	Application parameter A (0 ... 4), p.33
Now the following values can be displayed:		
	V0H0 (V4H0)	Level *L* as % of the measuring range *F*
	V0H9 (V4H0)	Level *L* in the units selected by V8H3 (m or ft)

After calibration the transmitter measures in %, the 0/4 … 20 mA signal is referenced to 0 …100 % and the relays must be set in %.

Actual level V2H1 (V5H1)

If the application requires high precision, the accuracy can be increased by entering the actual level, e.g. measured with a dip stick, in V2H1(resp. V5H1 for channel 2).

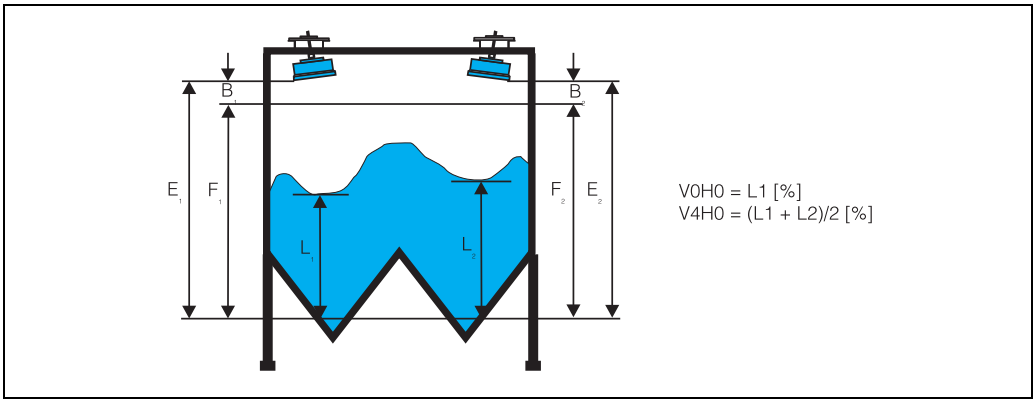
Level measurement in technical units

To display the measured value V0H0 (V4H0) in any units other than %, a manual calibration with only two values must be carried out:

#	Matrix position channel1 (channel 2)	Input/Display
1	V2H0 (V5H0)	"0": linear
2	V2H7 (V5H7)	Full distance *F* in desired units
Now the following values can be displayed:		
	V0H0 (V4H0)	Level *L* in the same unit as V2H7 (V5H7)
	V0H9 (V4H0)	Level *L* in the units selected by V8H3 (m or ft)

The analogue output (see section 4.3) and the relays (see section 4.4) follow the value in V0H0 (V4H0) and must be adjusted to the new units, too.

4.2.2 Calibration for average level measurement



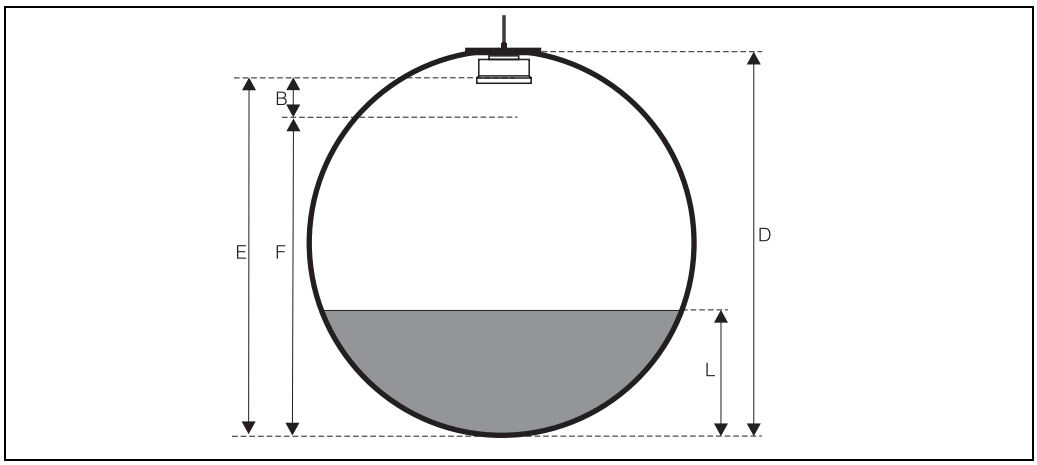
In large silos the average value of the level measured at two different points describes the content of the silo much better than a single value. In the operation mode 5 this average calculation is carried out automatically.
The average level is displayed in channel 2. Channel 1 delivers the single level L_1.

The procedure

#	Matrix position	Input/Display
1	V8H0	"5": (Operation mode "Average value")
2	V0H1	Empty distance E_1 in the units selected by V8H3 (m or ft)
3	V0H2	Full distance F_1 in the units selected by V8H3 (m or ft)
4	V0H3	Application parameter *A* (0 ... 4) for channel 1 (p.33)
5	V4H1	Empty distance E_2 in the units selected by V8H3 (m or ft)
6	V4H2	Full distance F_2 in the units selected by V8H3 (m or ft)
7	V0H3	Application parameter *A* (0 ... 4) for channel 2 (p.33)
Now the following values can be displayed:		
	V0H0	Level L_1 as % of the measuring range *F*
	V4H0	Average level *L* as % of the measuring range *F*
	V4H9	Average level *L* in the units selected by V8H3 (m or ft)

Note!
- When the operation mode "Average value" is active, all values for the analogue output and the relays must be in % of the measuring range.
- In order to display volume or weight instead of the average level a manual or semi-automatic linearization must be carried out in channel 2 (see section 4.2.4).

4.2.3 Calibration for horizontal cylindrical tanks



For this calibration, the transmitter uses a pre-stored linearization, valid for all horizontal cylindrical tanks, to calculate the volume from the measured level. After the basic calibration, only two entries are required to display the volume in V0H0 (V4H0):

- Tank diameter *D*
- Tank volume V_{tot}

The Procedure

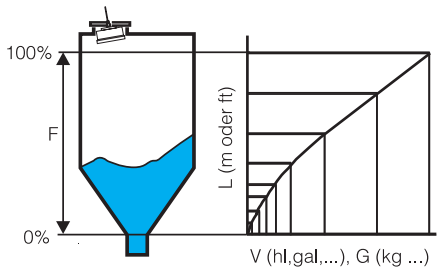
#	Matrix position channel1 (channel2)	Input/Display
1	V0H1 (V4H1)	Empty distance *E* in the units selected by V8H3 (m or ft)
2	V0H2 (V4H2)	Full distance *F* in the units selected by V8H3 (m or ft)
3	V0H3 (V4H3)	Application parameter *A* (0 ... 4), see p.33
V0H0 displays the level *L* as % of the measuring range *F*. V0H9 displays the level *L* in the units selected by V8H3 (m or ft).		
4	V2H6 (V5H6)	Tank diameter *D* in the units selected by V8H3 (m or ft)
5	V2H7 (V5H7)	Tank volume V_{tot} in the desired volume unit (hl, gal, ...)
6	V2H0 (V5H0)	"1": Linearization mode "cylinder"
Now, the following values can be displayed:		
	V0H0 (V4H0)	Volume *V* in the same units as V2H7 (hl, gal, …)
	V0H9 (V4H9)	Level *L* in the units selected by V8H3 (m or ft)

Note!
If "100" is entered at step 5, the volume in % is displayed.

After linearization

- Set analogue outputs in volume units (see section 4.3)
- Set relays in volume units (see section 4.4)

4.2.4 Calibration for silos with conical outlet



Tabular values for linearisation:

L	V	G
L1	V1	G1
L2	V2	G2
...	....	...
Ln	Vn	Gn

For volume or weight measurement in silos with conical outlet, the transmitter uses a table in which the volumes (or weights) at several levels are stored. This table can be entered by hand or generated semi-automatically.

Manual linearization

If the pairs of values Level/Volume (*L*/*V*) or Level/Weight (*L*/*G*) for the vessel are known, they can be entered manually:

#	Matrix position channel 1 (channel 2)	Input/Display
1	V0H1 (V4H1)	Empty distance *E* in the units selected by V8H3 (m or ft)
2	V0H2 (V4H2)	Full distance *F* in the units selected by V8H3 (m or ft)
3	V0H3 (V4H3)	Application parameter *A* (0 ... 4), see p.33
V0H0 displays the level *L* as % of the measuring range *F*. V0H9 displays the level *L* in the units selected by V8H3 (m or ft).		
4	V2H3 (V5H3)	Level L_1 of the first pair of values
5	V2H4 (V5H4)	Volume V_1 or Weight G_1 of the first pair of values in the desired unit (hl, gal, kg, ...)
6	V2H5 (V5H5)	"2" (... "32") : Number of the next pair of values
7	V2H3 (V5H3)	Level L_2 of the second pair of values
8	V2H4 (V5H4)	Volume V_2 or Weight G_2 of the second pair of values in the desired unit (hl, gal, kg, ...)
9	Repeat steps 6 to 8 for up to 32 pairs of values.	
10	V2H0 (V5H0)	"3": Activate linearization
Now the following values can be displayed:		
	V0H0 (V4H0)	Volume *V* or Weight *G* in the same units as V2H4 (hl, gal, …)
	V0H9 (V4H9)	Level *L* in the units selected by V8H3 (m or ft)

Note!
- The first pair of values must correspond to 0% level
- The last pair of values must correspond to 100% level
- The pairs of value must be entered in monotonously increasing order. Error code E 602 indicates nonmonotonous order. In this case all pairs of values must be entered again.

After linearization
- Set analogue outputs in volume units (see section 4.3)
- Set relays in volume units (see section 4.4)

Semi-automatic linearization

During a semi-automatic linearization the vessel is filled stepwise. At every step the FMU 867 itself measures the level. The corresponding volume or weight is entered manually:

#	Matrix position channel1 (channel2)	Input/Display
1	V0H1 (V4H1)	Empty distance *E* in the units selected by V8H3 (m or ft)
2	V0H2 (V4H2)	Full distance *F* in the units selected by V8H3 (m or ft)
3	V0H3 (V4H3)	Application parameter *A* (0 ... 4), see p.33
V0H0 displays the level *L* as % of the measuring range *F*. V0H9 displays the level *L* in the units selected by V8H3 (m or ft).		
4	Vacate vessel to 0 %.	
5	V2H4 (V6H4)	"4": Activate semi-automatic linearization
6	V2H3 (V6H3)	The current level is displayed. Press "ENTER" to insert it into the table.
7	V2H4 (V6H4)	Enter the corresponding volume V_1 or weight G_1 in the desired unit (hl, gal, kg, ...)
8	Continue filling of the vessel up to the next desired level.	
9	V2H5 (V6H5)	"2" (... "32") : Number of the next pair of values
10	V2H3 (V6H3)	The current level is displayed. Press "ENTER" to insert it into the table.
11	V2H4 (V6H4)	Enter the corresponding volume V_2 or weight G_2 in the desired unit (hl, gal, kg, ...)
12	Repeat steps 8 to 11 for up to 32 pairs of values.	
13	V2H0 (V6H0)	"3": Activate linearization
Now the following values can be displayed:		
	V0H0 (V4H0)	Volume *V* or Weight *G* in the same units as V2H4 (hl, gal, …)
	V0H9 (V4H9)	Level *L* in the units selected by V8H3 (m or ft)

After linearization

- Set analogue outputs in volume units (see section 4.3)
- Set relays in volume units (see section 4.4)

4.2.5 To delete the linearization

To delete a value pair

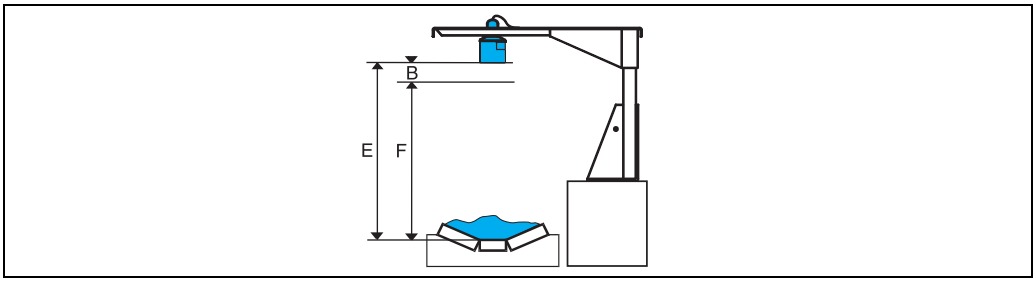
To delete a pair of values:
- Enter its number in V2H5 (for channel 2: V5H5).
- Enter "19999" in V2H4 (for channel 2: in V5H4).

The linearization goes on working with the remaining value pairs.

To delete the whole linearization

There are two possibilities for deleting a linearization:
- Enter "0" in V2H0 (for channel 2: V6H0): The linearization is de-activated but the table remains stored. Enter 1 or 3, to re-activate.
- Enter "5" in V2H0 (for channel 2: V6H0): the manual or semi-automatic linearization is deleted. The linearization for horizontal cylinders is deactivated but remains stored.

4.2.6 Calibration for conveyor belts



Application parameter A = 4 configures the transmitter to measure bulk solids with rapidly changing level, e.g. as met on conveyor belts. You need in addition the following parameters:
- Empty distance *E*
- Full distance *F*

The procedure

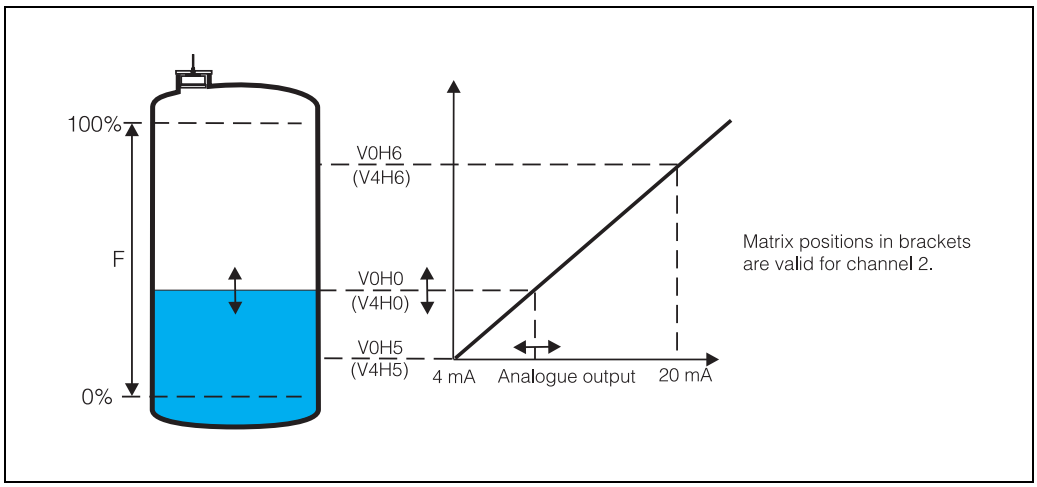
#	Matrix position channel1 (channel2)	Input/Display
1	V0H1 (V4H1)	Empty distance *E* in the units selected by V8H3 (m or ft)
2	V0H2 (V4H2)	Full distance *F* in the units selected by V8H3 (m or ft)
3	V0H3 (V4H3)	"4": Conveyor belt
Now the following values can be displayed:		
	V0H0 (V4H0)	Level *L* as % of the measuring range *F*
	V0H9 (V4H9)	Level *L* in the units selected by V8H3 (m or ft)

After calibration the transmitter measures in %, the 0/4 … 20 mA signal is referenced to 0 …100 % and the relays must be set in %.

Actual level V2H1 (V5H1)

If the application requires high precision, the accuracy can be increased by entering the actual level, e.g. measured with a dip stick, in V2H1(resp. V5H1 for channel 2)

4.3 Analogue Outputs



This section describes the setting of the analogue output.
- The analogue output for channel 1 is driven by the measured value displayed in V0H0, channel 2 by the value in V4H0.
- If the average level mode is selected, channel 1 displays the level in channel 1, channel 2 the average level.

The following parameters can be entered or changed:
- Value for 4 mA and 20 mA
- Output damping
- Signal output 4 ... 20 mA or 0 ... 20 mA

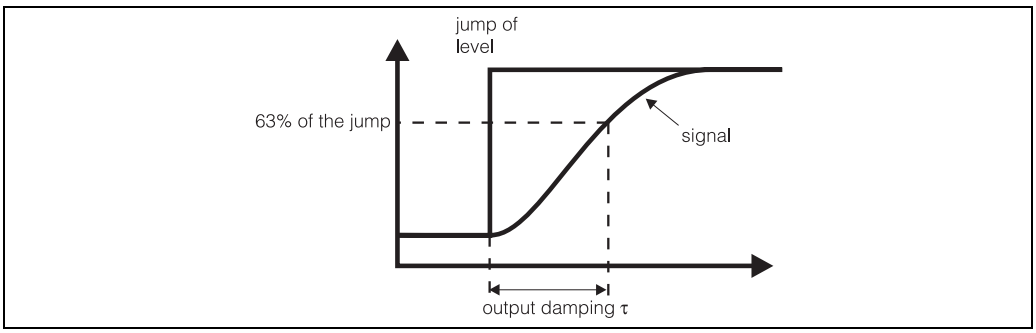
4.3.1 Value for 4 mA and 20 mA

After a linearization in channel 1, the 4mA (V0H5) and 20 mA (V0H6) values for channel 1 must be set in customer units (default values 0% and 100%):

Matrix position for channel 1	Matrix position for channel 2	Default	Meaning
V0H5	V4H5	0	Measuring value for 4 mA: If V0H0 and V0H5 (V4H0 and V4H5) coincide, the analogue output is 4 mA.
V0H6	V4H6	100	Measuring value for 20 mA: If V0H0 and V0H6 (V4H0 and V4H6) coincide, the analogue output is 20 mA.

Note!
- If no linearization is active, the default settings map the complete measuring range *F* to the interval 4 … 20 mA.
- Any 4 mA and der 20 mA values can be entered. If the 4 mA value is greater than the 20 mA value, the signal is inverted.

4.3.2 Output damping V0H7 (V4H7)



This parameter sets the degree of damping of the analogue output: on a sudden change in level, 63% of the new value is attained in the set time (0...300 s).

Channel	Matrix position for output damping	Range of values
1	V0H7	0 ... 300 (seconds)
2	V4H7	0 ... 300 (seconds)

Note!
For average level mode, set the same value in both channels.

4.3.3 0...20 mA signal

Instead from 4 to 20 mA, the output range can be scaled from 0 to 20 mA. The output range is set in V8H1 and affects both channels.

V8H1	Analogue output when V0H0 = V0H5 (V4H0 = V4H5)	Analogue output when V0H0 = V0H6 (V4H0 = V4H6)
1	0 mA	20 mA
2 (default)	4 mA	20 mA

4.4 Relays

This section describes the setting of the relays. The Prosonic transmitter has three relays (Nos. 3, 4 and 5) with potential-free change over contacts. The relays are mutually independent and can be assigned different functions. Depending on the function assigned, the relays switch according to the measured value, a derived value, on a fault or in sympathy with the optional external limit switch (see section 4.5.3).

Relay LEDs

Each relay is assigned a yellow light emitting diode (LED) which indicates its status. The LED lights when the relay is energised.

Relay functions

The relays can be assigned the following functions:

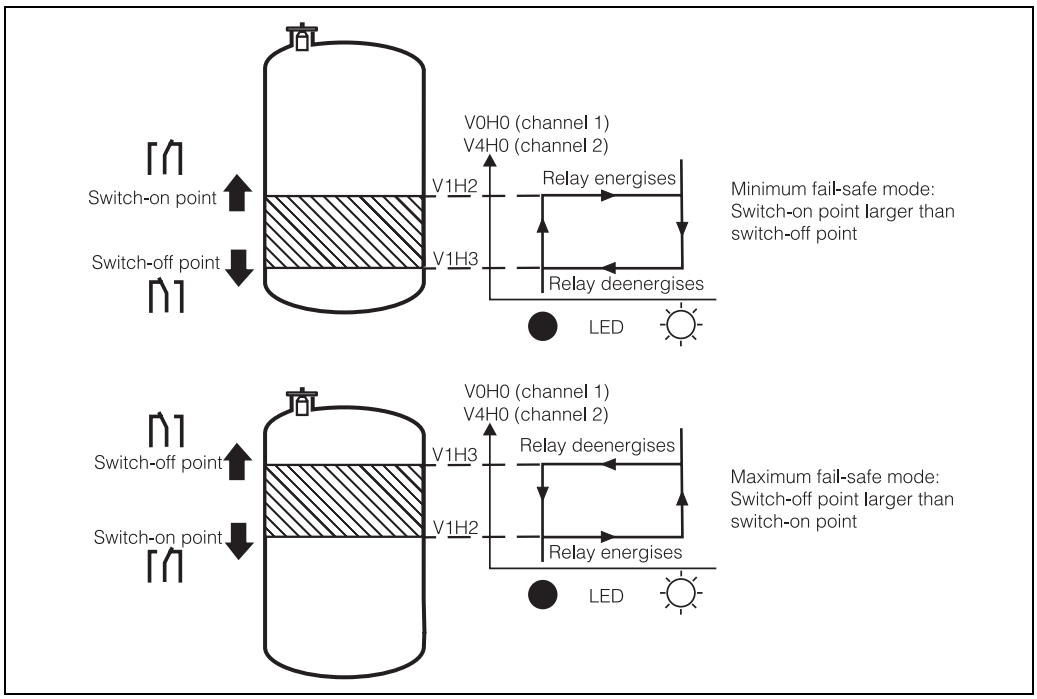
- Limit value relay:
  monitors a level limit. The relay switches according to the value displayed in V0H0/ V4H0.
- Trend relay:
  monitors the rate of change of level. The relay switches in accordance with its switch-on and switch-off points.
- Alarm relay:
  signals a fault. The relay switches according to the fault status of the transmitter.

The factory settings are: relays 3 and 4, limit value relays; relay 5, alarm relay.

4.4.1 Limit value relay

In this operating mode the relay switches as a function of the measured value displayed in V0H0 for channel 1 or V4H0 for channel 2.

Minimum- or Maximum fail-safe-mode



- If the switch-on point (V1H2) is greater than the switch-off point (V1H3), the relay functions in minimum fail-safe mode. It energises when the measuring value rises above V1H2. It de-energises again, when the measuring value drops below V1H3.
- If the switch-off point (V1H3) is greater than the switch-on point (V1H2), the relay functions in maximum fail-safe mode. It de-energises, when the measuring value rises above V1H3. It energises again when the measuring value drops below V1H2.

Parametrization of the limit value relays

The switch points are entered in the current technical units, i.e. % level after a calibration and customer units after a linearization.

#	Matrix position	Input
1	V1H0	"3", "4" or "5" (Selection of relay)
2	V1H1	"0" (Limit value relay for channel 1) or "1" (Limit value relay for channel 2)
3	V1H2	Switch-on point (in the same units as the measuring value V0H0 or V4H0)
4	V1H3	Switch-off point (in the same units as the measuring value V0H0 or V4H0)

Note!
- On the occurrence of a fault with an alarm, the relay switches according to the mode selected in "Output on alarm" in V3H4 (channel 1) or V6H4 (channel 2), see section 4.5.1.
- For relay behaviour with an external limit switch, see section 4.5.3.
- In this operating mode, the third relay can be used as an alarm relay, see section 4.4.4.
- Two additional settings allow modification of the switching behaviour: "Alternating pump control" (see section 4.4.2) and "Switching delay" (p.44)

4.4.2 Alternating pump control

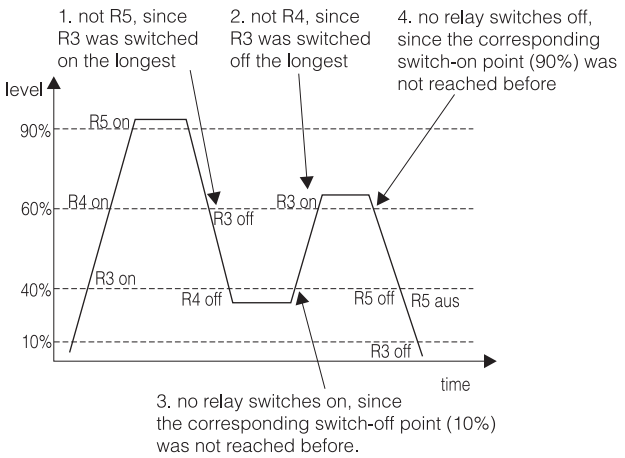
If several level limit relays are used for controlling pumps, it is often practical to ensure that the pumps are equally loaded. Here the additional function "Alternating pump control" (V1H4), which can be activated for one channel, can be helpful. The alternating pump control links the switch-on and switch-off points of several relays:

1. If the level rises above one of the switch-on points, that relay switches on, which at that moment has been switched off the longest time. This is not necessarily the relay to which the switch on point belongs.
2. If the level drops below one of the switch-off points, that relay switches off, which at that moment has been switched on the longest time. This is not necessarily the relay to which the switch-off point belongs.

There are only two restrictions to these rules:
3. Rising of the level above a switch-on points effects switching of a relay only if the corresponding switch-off point has been reached before.
4. Dropping of the level below a switch-off points effects switching of a relay only if the corresponding switch-on point has been reached before.

Example: Pump control with 3 relays

Relay	Off	On
3	10%	40%
4	40%	60%
5	60%	90%



Alternating pump control: parametrization (Example)

#	Matrix position	Input
1	V1H0	"3": Selection of relay 3
2	V1H1	"1": Selection of channel 1
3	V1H2	e.g. "40": Switch-on point for relay 3 in the same units as V0H0
4	V1H3	e.g. "10": Switch-off point for relay 3 in the same units as V0H0
5	V1H4	"1": Activate alternating pump control
6	V1H0	"4": Selection of relay 4
7	V1H1	"1": Selection of channel 1
8	V1H2	e.g. "60": Switch-on point for relay 4 in the same units as V0H0
9	V1H3	e.g. "40": Switch-off point for relay 4 in the same units as V0H0
10	V1H4	"1": Activate alternating pump control
11	V1H0	"5": Selection of relay 5
12	V1H1	"1": Selection of channel 1
13	V1H2	e.g. "90": Switch-on point for relay 5 in the same units as V0H0
14	V1H3	e.g. "60": Switch-off point for relay 5 in the same units as V0H0
15	V1H4	"1": Activate alternating pump control

Note!
- The switching ranges can overlap.
- All relays, for which V1H4=1, take part in the alternating pump control.
- If V1H4=0 for a relay, it does not take part in the alternating pump control.
- Faults can be detected via the 0/4 … 20 mA signal line as -10 % or +110 % signal. In this case the use of an external limit switch is recommended.

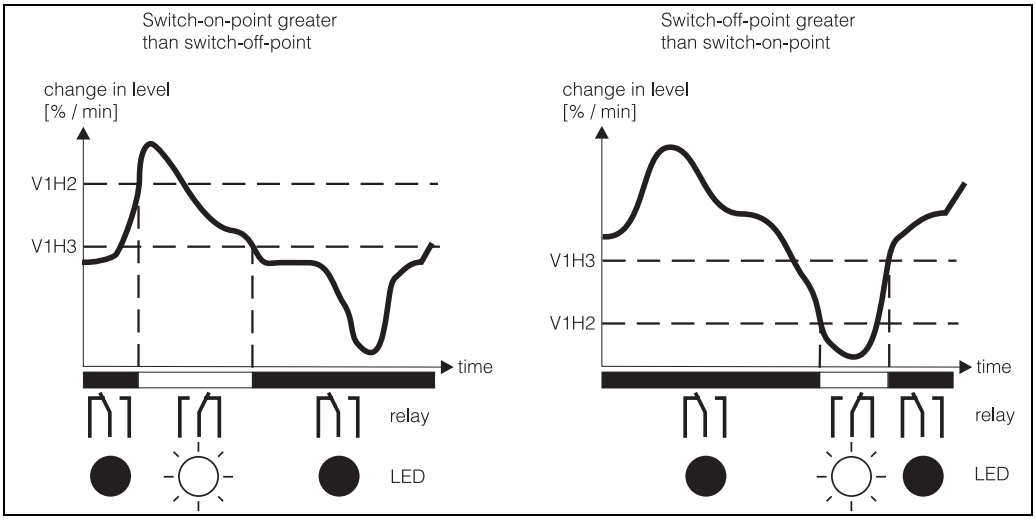
Switching delay

In order to avoid overloading when two or more pieces of equipment switch simultaneously, in the operating mode "alternating pump control" a switching delay can be set in V1H9:
- If two relays are set to switch on at the same level, the relay with the lower number switches immediately, while the relay with the higher number switches only after a delay, which can be specified in V1H9 (Default: 1s).
- If three relays are set to switch on at the same level, the relay with the highest number switches only after a delay twice as large as the time specified in V1H9.
- The delay in V1H9 must be given in seconds.

4.4.3 Trend relay

A trend relay is used to monitor the rate of change of the product level. The trend is always based on the maximum level, i.e., 100% after calibration or the equivalent volume or weight after linearization.

- The trend is +1% when the value in V0H0 increases by 1% of the maximum level per minute.
- The trend is -1% when the value in V0H0 decreases by 1% of the maximum level per minute.



The relay switches according to the switch-on and switch-off points set:

- Switch-on point greater than switch-off point:
  The relay energises when the trend exceeds the value entered as switch-on point and switches off when the switch-off point is dropped below.
- Switch-on point smaller than switch-off point:
  The relay energises when the trend drops below the value entered as switch-on point and switches off when the switch-off point is exceeded.

Parametrization

#	Matrix position	Input
1	V1H0	"3", "4" or "5" (Selection of relay)
2	V1H1	"2" (Trend relay for channel 1) or "3" (Trend relay for channel 2)
3	V1H2	Switch-on point (% / min)
4	V1H3	Switch-off point (% / min)

Note!
If the Prosonic detects a fault, the relays hold their switching status.

4.4.4 Alarm relay

In this operating mode, the relay switches according to the operational status of the Prosonic transmitter (see section 5.1).

- On a fault with alarm, the relay de-energises: the LED expires.
- For external fault indication, warning lamps or hooters can be connected to the normally-closed contact of the alarm relays.

Alarm relay: Parametrization

#	Matrix position	Input
1	V1H0	"3", "4" oder "5" (Selection of relay)
2	V1H1	"8" (Alarm relay)

4.5 Safety Responses

This section describes, among other things, how the Prosonic can be configured to assure defined behaviour on the detection of a fault. In detail:

- Response of the analogue output on a fault
- Switch-on of the 4 mA threshold
- Response when external limit switch is connected
- Response on missing echo
- Locking the matrix against accidental entries

4.5.1 Output on alarm

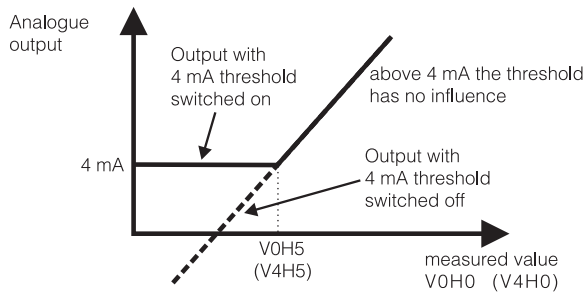
The analogue output can be set such that it takes on distinctive values when a fault with alarm is detected.

V3H4 (channel 1) V6H4 (channel 2)	Analogue output on a fault
0	-10% of the measuring range (Default): 2,4 mA for 4 ... 20 mA; -2 mA for 0 ... 20 mA
1	+110% of the measuring range: 21,6 mA for 4 ... 20 mA; 22 mA for 0 ... 20 mA
2	last value is held

Note!
Relays which are not defined as alarm relays follow the analogue output.

Warning!
If setting 2 is chosen, the fault recognition system on the 0/4 … 20 mA signal line is effectively deactivated. Although the transmitter recognises a fault, i.e. the alarm relay de-energises and the associated LED goes out, the signal output to any follow-up instrumentation appears to indicate a correct measured value.

4.5.2 4 mA threshold



If the measuring value V0H0 (for channel 2: V4H0) falls below the 4 mA-value, the analogue output will consequently be less than 4 mA. Some control instruments, on the other hand, can not handle such signals. Therefore a 4 mA threshold can be switched on for the analogue output of the FMU 867. The threshold ensures, that the analogue output remains at least 4 mA, even if the measuring value is lower. Measuring values above the 4 mA value are not influenced by the threshold.

V8H2	4 mA threshold
0	4 mA threshold off (Default); Analogue output may fall below 4 mA.
1	4 mA threshold on; Analogue output remains at least 4 mA.

Caution!
- On an alarm, the analogue output always falls to -10% of the signal range when this mode is selected in "output on alarm", despite the 4 mA threshold being set.
- With the threshold switched on the analogue output remains at least 4 mA, even if it has been scaled between 0 and 20 mA.

4.5.3 External limit switch

Normally the external limit switch is used to detect the presence of product within the blocking distance and to set the analogue output accordingly. It can also be used to prevent dry-running of pumps and other equipment. Depending upon its task, the switch is installed at either the 100% or 0% level (maximum or minimum mode). The table summarises the response of the analogue output and relays as a function of the operating mode of the limit switch.

V8H6	limit switch		Analogue output	Response of limit relay for	
	Operating mode	on channel		Min. fail-safe	Max. fail-safe
0	none	-	none	none	none
1	Minimum	1	0/4 mA	de-energises	energises
2	Maximum	1	20 mA	energises	de-energises
3	Minimum	2	0/4 mA	de-energises	energises
4	Maximum	2	20 mA	energises	de-energises
5	Minimum	1 u. 2	0/4 mA	de-energises	energises
6	Maximum	1 u. 2	20 mA	energises	de-energises

Caution!
If the limit switch switches when a fault is present, the limit value relays respond according to the above table, i.e. the external limit switch has precedence. The analogue output responds according to the settings in V3H4 (or V6H4), "output on alarm" (see section 4.5.1)

4.5.4 Lost echo

In order to measure, the transmitter requires a good echo. When the echo is missing, i.e. the signal/noise ratio is too small or the echo attenuation is too large, the user can set the response of the alarm relay in V3H3 and V6H6.

V3H3 (channel 1) V6H3 (channel 2)	Behaviour of alarm relay
0	"Warning" (Default): The relay remains energised. Last measured value is held.
1	"Alarm": The relay de-energises. The analogue output takes on the value determined in V3H4 (V6H4), i.e. -10%, 110% or the last measured value.

4.5.5 Locking the matrix

In order to avoid accidental entries in the matrix, it can be locked in V9H6 as follows:

V9H6	Meaning
Number ≠ 519	Matrix locked; no input possible
"519" (if operated via the PROFIBUS-DP interface: 2457)	Matrix unlocked

4.6 Measured Value Display

This section describes the display of measured values:

- in the matrix
- in the Fieldmanager operating program
- in the Commugraph visualisation program

The possibilities offered by Commuwin II for the display of measured values, up and download, as well as the storage of configuration parameters are described in the Operating Instructions BA 124F/00/a2.

4.6.1 Operating matrix

The following table summarises the measured values which can be displayed via the operating matrix. Matrix positions in brackets are valid for channel 2.

Matrix position channel1 (channel2)	Measured value	Remarks
V0H0 (V4H0)	Level or volume	Display in %, hl, m^3, ft^3, ..., dependent on whether a linearization was made.
V0H8 (V4H8)	Distance Sensor - Product surface	Distance between sensor and product surface in the units selected by V8H3 (m oder ft)
V0H9 (V4H9)	Level	in the units as selected by V8H3 (m oder ft)
V3H1 (V6H1)	Echo damping (dB)	Damping which occurs between transmission and reception of the ultrasonic pulse
V3H2 (V6H2)	Signal/noise ratio	Difference between the actual echo and the background noise. The higher the signal/noise ratio, the better the echo can be evaluated (10 dB or more is a good value).
V9H0	Current error code	
V9H1	Last error code	Can be deleted by pressing "Enter"
V9H2	Last but one error code	Can be deleted by pressing "Enter"
V9H3	Devicecode und Software-Revision	The first two numbers indicate the device code, the last numbers the software revision.
VAH1 (VAH2)	Measuring point tag	User information for the measuring point (see operating program)

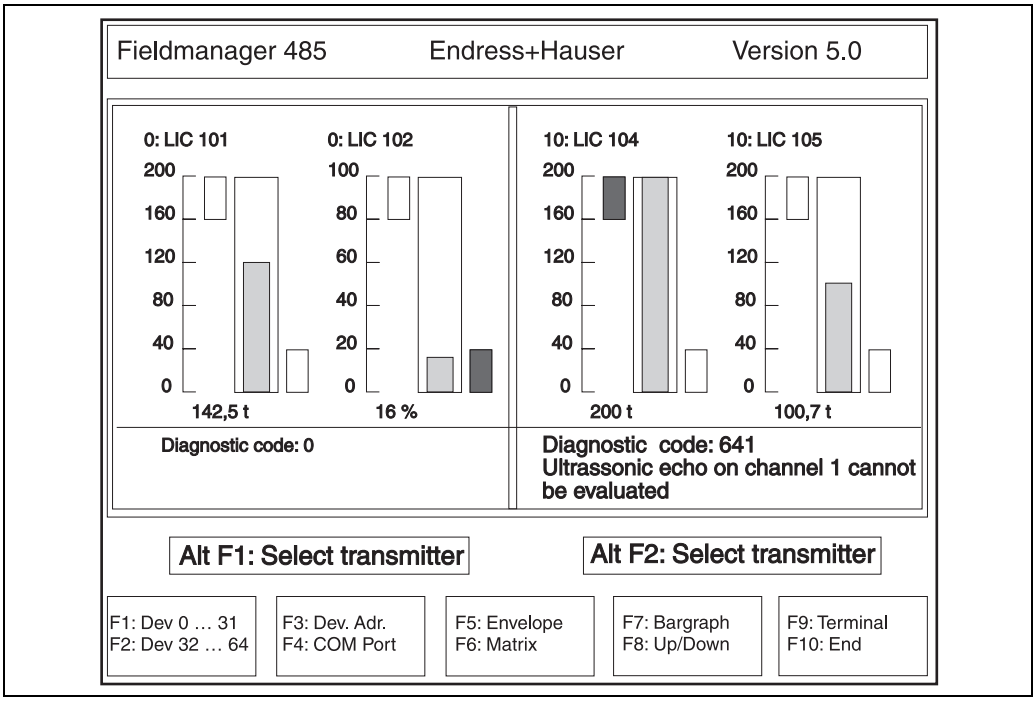
4.6.2 Fieldmanager 485

The operating program for the Rackbus RS-485 offers the following possibilities for displaying measured values:

- F1: Live-List transmitters 0 … 31 (p.24)
- F2: Live-List transmitters 32 … 64
- F3: Transmitter address with measuring point tags (p.31)
- F5: Envelope curve with echo profile and diagnosis (p.59)
- F6: Matrix (this is the menu you have used for configuration)
- F7: Bar graph with measured value and diagnosis (see below)
- F8: Up-/Download (see section 4.7)
- F9: Terminal program (p.51)
- F10: End

F7: Bar diagram

This menu displays as bar diagram the measured values in V0H0 and V4H0 of the transmitter selected in F3. Data from two transmitters, i.e. max. 4 measurements, can be displayed.



- Press Alt F1 or Alt F2 and enter a new address to display measured values from another transmitter.
- The values are displayed as moving upright columns, limit values as smaller, fixed columns. If a limit value is violated the colour of the columns change from green to red.
- If a fault is detected, the fault code together with an error message is displayed under the appropriate display.

F9: Terminal

On first call, this menu is guarded by a password (= Service). It is used for service purposes only, and allows the direct addressing of individual transmitters using the Rackbus commands (described in BA 054/00/e). It has no function in the normal operation of the Prosonic P measuring system.

4.6.3 Commugraph

The Commugraph visualisation program offers the following possibilities:

- F1 ... F5: analogue display of measured values in groups of 12 measuring points
- F6: Output of measured values on a printer
- F7: Display/entry of parameters
- F8: Live list of connected transmitters with operational status
- F9: Help

Parameter entry

The F7 toggles between entry and display mode. The function of the keys is indicated in the space under the main display field.

F1 ... F5: Measuring point groups

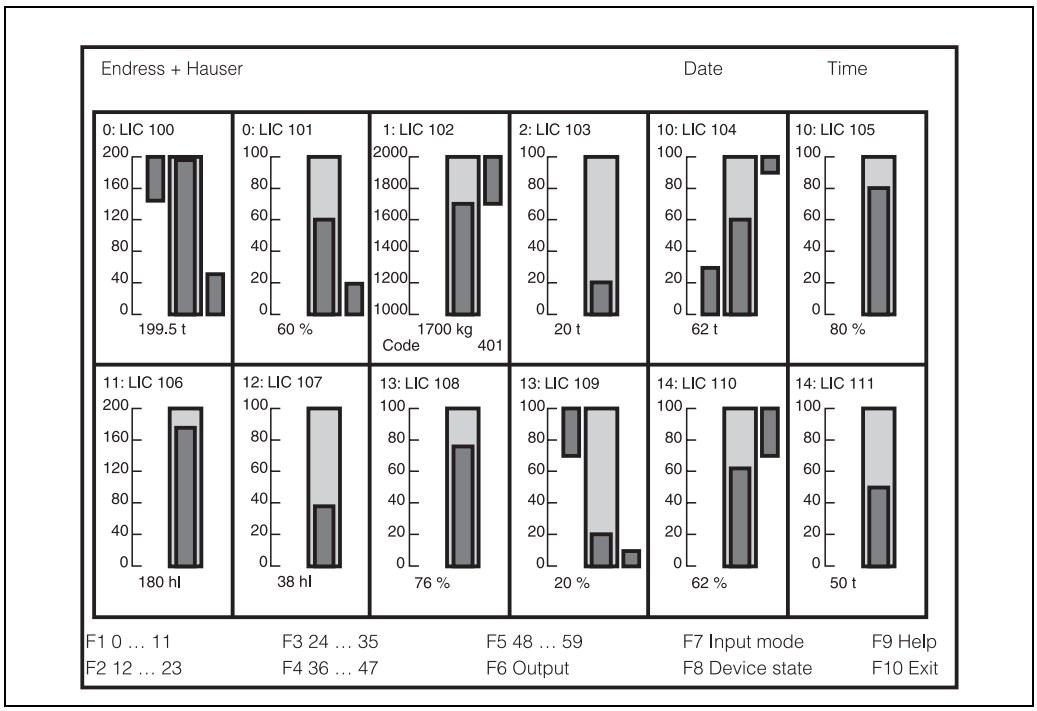
Five groups, each with 12 measuring points can be defined and displayed.

- Press F1 … F5 to select groups 1 to 5 respectively.
- The desired entry can be selected with the cursor keys.
- Press F2 to enter a measuring point, F3 to delete an entry.

The following details must be entered for each measuring point:

- Rackbus RS-485 address: 0 … 63 (can be displayed by pressing F8)
- Transmitter type and channel
  – The transmitter type can be selected by the cursor keys.
- Technical units (default = units set at the measuring point)
  – Factor, the measured value is multiplied by this factor (default = 1)

Display the groups by toggling from entry to display mode with F7:



- Each display group contains 12 measuring points which are continuously updated.
- If a limit value is violated, the colour of the column changes from green to red.

Print list

Nr.	Meas. pt.	Contents	Meas.val.	Unit	Factor
0	LIC 100	Sand, coarse	199.5	t	1
0	LIC 101	Sand, fine	60	%	1
1	LIC 102	Fly ash	1700	kg	1
2	LIC 103	Grit	20	t	1
10	LIC 104	Rubble	62	t	1
10	LIC 105	Cement	80	%	1
11	LIC 106	Slurry	180	hl	1
12	LIC 107	Slurry	20	hl	1
13	LIC 108	Conveyer 1	75	%	1
13	LIC 109	Conveyer 2	62	%	1

The format and content of the measured value printout are determined by the print list. The following parameters must be entered for every entry:

- RS-485 address
- Vertical and horizontal position of the parameter in the operating matrix
- Measuring point tag
- Other entries (e.g. type of product)
- Technical units
- Factor

General parameters

The following parameters complete the list:

- Company name
- COM port
- Headline for the printout
- Group name

Press F6 (in display mode) to print out the current measured values of the transmitters entered in the print list on a printer (file = *.prn) or into a file. The list can also be printed automatically at preset intervals from 1 minute to 1 day.

Cursor

If the cursor can be seen in the display mode, the numbers for »Cursor Start« and »Cursor End« can be changed to make it disappear:

Graphics technology	Cursor Start	Cursor End
CGA	13	12
EGA	18	15
VGA	18	16
HGC	18	15

Transmitter status (Live-List)

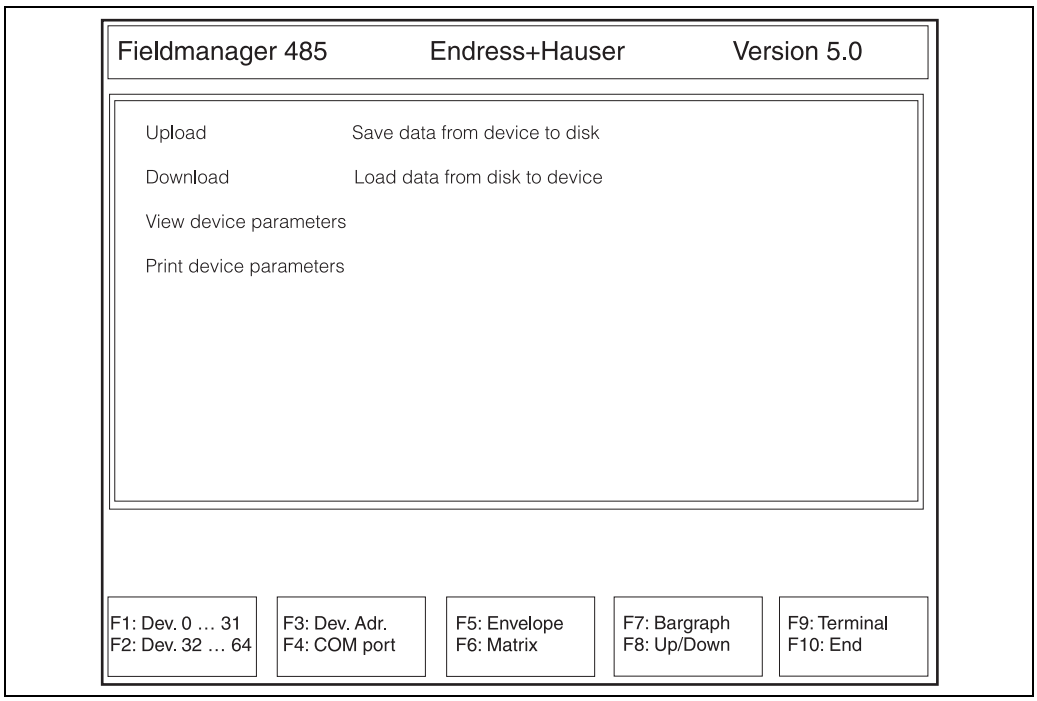
Press F8 to display the operational and communication status of all transmitters on the bus (Rackbus RS-485 addresses 0 … 63).

- If the code »0« appears, the transmitter is operating correctly.
- If a code greater than »0« appears, the transmitter has found a fault.
- If no code is displayed, the transmitter cannot be addressed.

The listing can be interrupted at any time by pressing the »ESC« key.

4.7 Up/Download of parameters

Once a transmitter has been configured and is running correctly, the same set of parameters can be loaded into another transmitter by using the up/download function in the operating program.



Operation

- Press F8, to call the Up-/download menu.
- "Upload" stores the parameters of the transmitter currently selected in F3 in the file entered:
  – Enter path and name of file
  – Press "Enter". The data are read in and stored.
- With "Download" the saved parameters can be transmitted into another device.
  – Enter file name and path (existing file names can be listed with Alt F2: select with the cursor keys and ENTER)
  – Enter target transmitter address or addresses (syntax is shown in mask)
  – Confirm your inputs
- "View" displays the parameters of the selected file or the transmitter selected in F3 on the screen.
- "Print" outputs the parameters of the selected file or the transmitter selected in F3 on the printer.

Note!
Depending on the Fieldmanager version installed, a download may require that both instruments have the same software version - a corresponding error message is output.

5 Trouble-Shooting

This chapter describes:

- Prosonic fault recognition system
- Error messages and trouble-shooting
- Elimination of incorrect measurements
- Simulation functions to test external equipment
- Exchange of the sensor or transmitter
- Repairs

5.1 Fault Recognition

The transmitter constantly checks that the measurement line is operating correctly. Should a fault be detected:

- the LEDs on the front panel flash
- an error code appears in V9H0
- an error message appears in the "bar" menu of the operating program; the error code appears in the live list of the Commugraph or Commuwin II program
- the analogue outputs respond as set in "output on alarm"
- the relays respond according to their function.

The Prosonic recognises two types of fault: an "alarm" when a serious fault occurs, a "warning" when the fault still allows the transmitter to function, e.g. after an operating error. If an alarm is detected, the transmitter ceases to measure. For a warning it attempts to measure, whereby it is possible that the measurement is incorrect.

"Alarm"

If the Prosonic detects an "alarm", i.e. a fault which does not allow the transmitter to measure, it responds as follows:

- All yellow relay LEDs flash.
- The alarm relay de-energises.
- The analogue output responds according to the settings in "output on alarm" (i.e. -10 %, +110 % of the signal range or the last value is held (see section 4.5).
- Limit value relays follow the analogue output, see below:

V3H4 (channel 1) V6H4 (channel 2)	Output on alarm	Function of limit value relay	Response of limit value relay
0	-10 %	Minimum fail-safe	de-energises
		Maximum fail-safe	energises
1	+110 %	Minimum fail-safe	energises
		Maximum fail-safe	de-energises
2	hold last value	Minimum fail-safe	switching status held
		Maximum fail-safe	switching status held

- Trend relays retain their switching status.
- If the (optional) external limit switch switches when a fault is present, the limit value relays follow it(see section 4.5.3).

An error code or error message is displayed to indicate the cause of the fault. In section 5.2 the error codes with their meanings are listed.

"Warning"

If the Prosonic detects an operating error or a fault which allows it to continue measuring, it responds with a warning.

- The green LED flashes
- The alarm relay remains energised, all other relays are unaffected.
- The analogue output may be completely wrong, e.g. as the result of an incorrect parameter.

An error code or error message is displayed to indicate the cause of the fault. The error codes with their meanings are listed in section 5.2.

5.2 Error messages

The Prosonic gives the following information for error diagnosis:

- The code for the most important fault is displayed at V9H0.
- The code for the fault corrected last is displayed at V9H1. If the ENTER key is pressed, this code and that of the last-but-one fault is deleted.
- The code for the last-but-one corrected fault is displayed in V9H2. If the ENTER key is pressed, this code and that of the last fault is deleted.

The priorities of the error messages corresponds to their position in the following table:

Error code		Type	Description Remedy
Channel 1	Channel 2		
E 112 E 112 E 113 E 114 E 115		Alarm	Fault in electronics; Call Endress+Hauser service
E 121	E 122	Alarm	incorrect calibration of analogue output; Call Endress+Hauser service
E 613	E 614	Warning	Instrument in simulation mode. Warning disappears when normal operating mode is selected (see section 5.4)
E 501	E 502	Warning	No sensor type has been entered (p.32). E 501: Enter sensor type for channel 1 in V0H4 E 502: Enter sensor type for channel 2 in V4H4
E 601	E 602	Warning	Faulty linearization: Characteristic does not rise monotonously, i.e. two successive level points rise but the volume points fall or remain constant Correct characteristics (see section 4.2.4)
E 231	E 232	Alarm	Internal temperature sensor short-circuited; Check sensor connections to Prosonic (p.13). If alarm occurs with correct connections, call Endress+Hauser service.
E 250		Alarm	External temperature sensor short-circuited. Call Endress+Hauser service.
E 261	E 262	Alarm	Internal temperature sensor interrupted; Check sensor connections to Prosonic. If alarm occurs with correct connections, call Endress+Hauser service
E 260		Alarm	External temperature sensor interrupted; Call Endress+Hauser service
E 641	E 642	Warning or Alarm	Lost echo: ultrasonic echo cannot be evaluated, last measurement held. If fault remains for a long period, check the sensor connection (p.13), if the connections are correct, call Endress+Hauser service.
E 661	E 662	Warning	Sensor temperature to high; Check measuring point (Temperature compensation works to 80 °C)

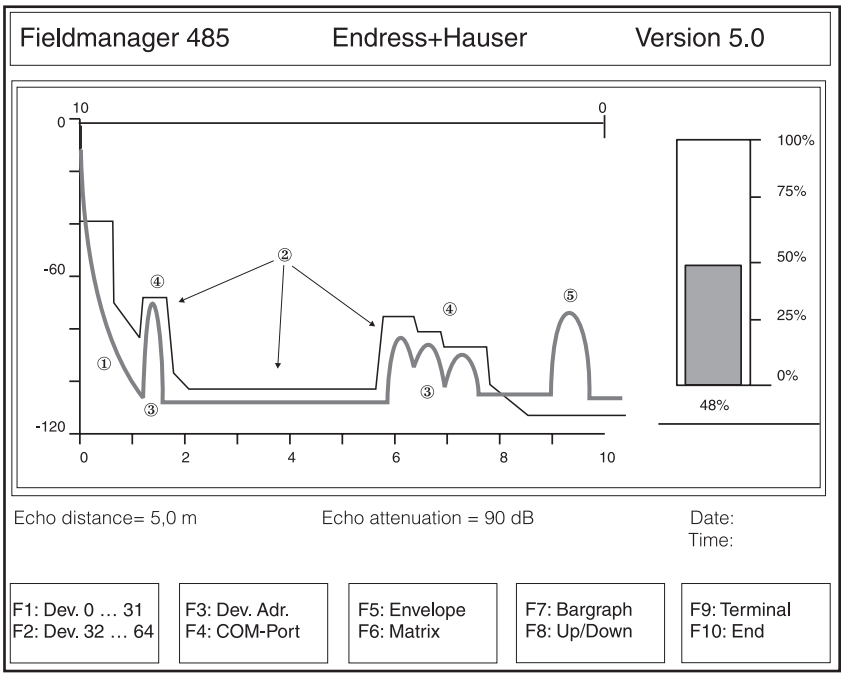
The operating programs also give a short description of the error in plain text. (see p.51, 53 or – when using Commuwin II – Operating instructions BA 124F/00/a2).

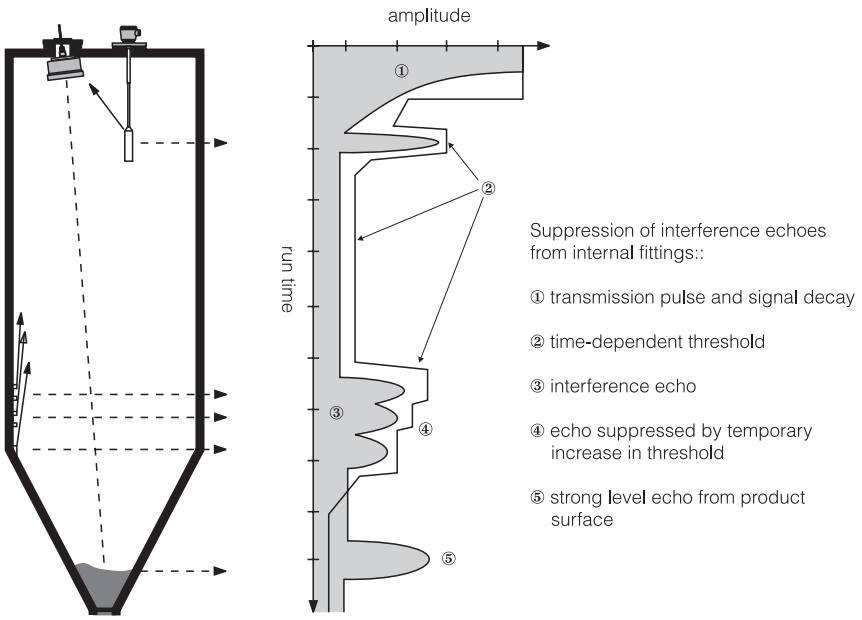
5.3 Incorrect measurements

The following table summarises the most common operating errors which lead to an incorrect measurement from the Prosonic transmitter. Most can be eliminated by simply realigning the sensor or changing the application parameter. Interference echoes from internal fittings can be suppressed by the Prosonic as described in the following pages.

Error	Cause and remedy
Incorrect meausred value	Check the distance between sensor and product surface in V0H8. • if the right distance is displayed, check the empty and full calibration V0H1 (V4H1) and V0H2 (V4H2) (p.33). • if linearization is active check the linearization parameters
"Full" is indicated when the vessel is empty or the display stays constant for rising level	Interference echoes: The sensor is measuring an echo from an internal fitting (see section 2.2). • check with envelope curve, operating program F5 • realign sensor (see section 2.2) • activate fixed target suppression (see section 5.3.1).
Low level indicated although vessel is full; Meaured value jumps around under steady conditions	Multiple echoes • check with envelope curve, operating program F5 • check whether product in blocking distance (check 100%calibration, p.33) • realign sensor (see section 2.2) • select another application parameter in V0H3 (V4H3) (s. Seite 33).
Display sticks at one value although the level is falling	Interference echoes • check with envelope curve, operating program F5 • realign sensor (see section 2.2). • Activate fixed target suppression (see section 5.3.1).
Sporadic errors or fluctuations in measured value, e.g. during stirring of contents	Echoes from stirrer when uncovered of from filling curtain • check with envelope curve, operating program F5 • Increase envelope curve statistics factor (see section 5.3.2) • Increase integration time of analogue output (s. Seite 41)
E 641 if vessel is filled or emptied	Echo to weak • check with envelope curve, operating program F5 • select another application parameter in V0H3 (V4H3) (s. Seite 33) • realign sensor (see section 2.2)
Relay switches incorrectly	Incorrect inputs(e.g. wrong units) • Check parametrization of relays (see section 4.4) • Check with level simulation (see section 5.4) • If present check settings of external limit switch (see section 4.5.3).

5.3.1 Fixed target suppression





The fixed target suppression function allows echoes originating from internal fittings to be eliminated from measurements. A pre-condition is that the level echo is larger than the interference echo at this point: this is the case when the fitting is at the edge of the detection zone of the sensor. The fixed target suppression is activated from the Envelope curve menu, F5, of the Fieldmanager operating program (for Commuwin II, see BA 124F):

- The tank or silo should be as empty as possible
- Press F5, in order to start the envelope menu.
- Determine the distance from sensor to product surface
- Press F7, enter the distance measured.
  – The Prosonic scans all echoes which appear before the level echo and suppresses them.

Other functions

The envelope curve menu has the additional functions:

- F1, F2 call up the Envelope or the Fixed target suppression once
- Press F3 to display another transmitter, F6 another channel
- Press F5 to enter a parameter at the selected position in the matrix
- F8 loads the factory TDT - the fixed target suppression made with F7 is deleted!

5.3.2 Envelope curve statistics for sporadic interference echoes

All echoes received by the sensor are temporarily stored by the Prosonic transmitter. This allows a statistical mean to be built, which takes account of the amplitude and run time of all signals. Sporadic echoes, e.g. due to stirrer blades or filling curtains can be suppressed by the selection of a suitable filter factor.

This factor can be set between 1 and 100. If the transmitter must follow a rapidly changing level, then a low factor is recommended. For slower changes in level, a higher factor can be set, thus increasing immunity to interference echoes.

The factor is set in V3H5 for channel 1 and in V6H5 for channel 2.

V3H5 (channel 1) V6H5 (channel2)	Effect
1	no statistical evaluation
5	low filtering; rate of change max. 20 cm/s (default)
10	medium filtering; rate of change max. 10 cm/s
20	high filtering; rate of change max. 1 cm/s

5.3.3 First echo recognition

Multiple echoes may occur by reflections in the silo or tank. In this case the application parameter for fine-grained solids or for fluids (p.33) which switches on the First echo recognition, should be applied. Then the first echo of sufficient strength is recognized as the measuring signal, though it might be not the strongest echo.

5.4 Simulation

By the simulation of the output current, external devices such as displaying or controlling units can be calibrated and their function be checked. The value, which for example is entered into the matrix position V9H9, is forwarded as current to the analogue outputs. Moreover, level and volume can be simulated in order to test the linearization.

- When operating mode 7 (simulation on channel 1) or 8 (simulation on channel 2) is selected in V8H0, the green LED flashes.
- Enter a level (V9H7), a volume (V9H8) or a current (V9H9). The other matrix positions and the analogue output follow these values.

The procedure

#	Matrix position	Input/Display
1	V8H0	"7" (Simulation in channel 1) or "8" (Simulation in channel 2)
a) Simulation of level:		
2	V9H7	Level *F* in the units selected by V8H3 (m oder ft)
Now the following values can be displayed:		
	V9H8	The volume *V* in the same units as V0H0 (V4H0) which corresponds to the level *F*. The linearization can be checked in this way.
	V9H9	The current corresponding to the level *F*
	The relays switch according to the level *F*.	
b) Simulation of volume:		
2	V9H8	Volume *V* in the same units as V0H0 (V4H0)
Now the following values can be displayed:		
	V9H9	The current corresponding to the volume *V*
c) Simulation of output current		
2	V9H9	Output current in mA
3		Step 2 can be repeated for as many values as desired.
4	V8H0	"0", "1" or "5": Terminate the simulation by switching to another operating mode.

5.5 Exchanging Transmitters and Sensors

Transmitter

If the Prosonic transmitter is exchanged, the stored parameters can be downloaded and the measurement continues without the need for calibration.

- Remember to give the transmitter a bus address
- If a particular order has to be maintained on configuration, e.g. as for the linearization, then activate these functions after download.

Sensor

If a sensor is exchanged, it is recommended that the Prosonic be checked for correct function. This is particularly true for the case where the fixed target suppression function was in use, see section 5.2, »Error messages«.

5.6 Repair

If you have to send an ultrasonic sensor or Prosonic transmitter to Endress+Hauser for repair, please send a note with it containing the following information:

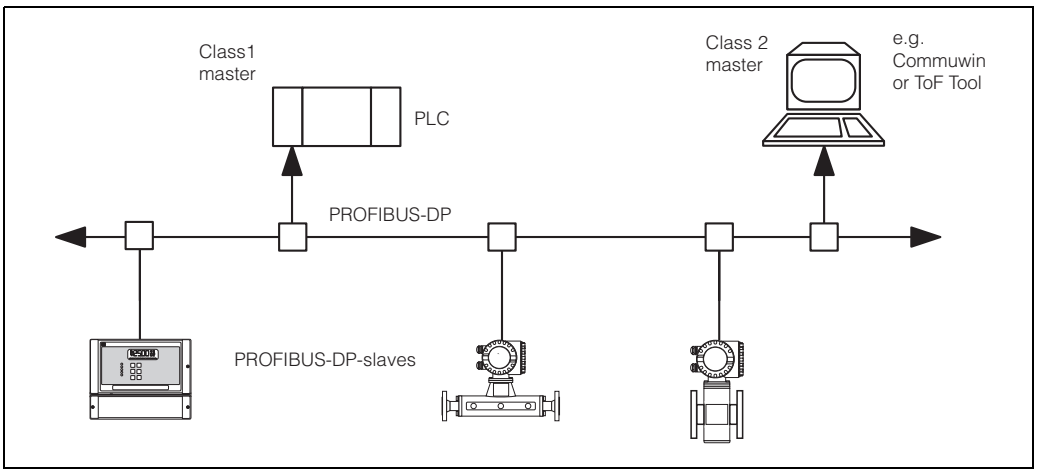
- an exact description of the application
- a short description of the fault which occurred
- the chemical and physical properties of the product measured.

Caution!
Before you send a sensor back please take the following precautions:

- Remove all traces of the product from the sensor
- This is particularly important when the medium presents a danger to health, e.g. is corrosive, poisonous, carcinogenic. radioactive, etc.
- We ask you not to send in any sensor or transmitter for which it is not certain that all traces of dangerous products have been removed, because for example, it has penetrated into fissures of diffused into the plastic.

6 PROFIBUS-DP Interface

6.1 Synopsis



Application

PROFIBUS-DP is used primarily for factory automation. In PROFIBUS-PA systems for process automation, a PROFIBUS-DP system is used at the control level for quick transmission of the data. Here, a variant of PROFIBUS-DP, DPV1 is used. In addition to the cyclic exchange of data with a PLC, this allows the field devices to be configured via acyclic services. The principle technical data for DPV1 are listed in Table 2.1.

Standard	EN 50170, Parts 1 - 3, Version DPV1
Support	PROFIBUS User Organisation (PNO)
Physical layer	RS-485 and/or fibre optics
Max. length	1200 m (copper) or several kilometres (optics)
Participants	Max. 126, including max. 32 as master
Transmission rate	up to12 MBit/s
Bus access method	Token passing with master-slave

Tab. 6-1Technical data PROFIBUS-DP

Participants

Depending upon the application at hand, the participants in a PROFIBUS-DP system might be frequency converters, remote I/Os, actuators, sensors, links, gateways etc. as well as the PLC or process control system.

6.2 Topology

PROFIBUS-DP is based on a linear topology. For lower data transmission rates, a tree structure is also possible.

Cable

EN 50 170 specifies two types of bus cable. For transmission rates up to 12Mbit/s, cable type A is recommended. The specification is given in Table 2.2

Terminator	135 Ω to 165 Ω at a measuring frequency of 3 MHz to 20 MHz
Cable capacitance	< 30pF per Meter
Core cross-section	>0.34 mm^2, corresponds to AWG 22
Cable type	twisted pairs, 1x 2, 2x 2 or 1x4 core
Loop resistance	110 Ω per km
Signal attenuation	max. 9 dB over the entire length of the segment
Screening	woven copper sheath or woven sheath and foil sheath

Tab. 6-2Specification of Cable type A of the PROFIBUS-DP standard

Structure

The following points should be noted when the bus structure is being planned:
- The max. permissible cable length depends upon the transmission rate. For PROFIBUS RS-485 cable of type A (see table 2.2) the dependency is as follows:

Transmission rate(kBit/s)	19.2 - 93.75	187.5	500	1500
Cable length(m)	1200	1000	400	200

The maximum transmission rate is limited by the slowest instrument on the bus. The maximum rate of the Prosonic FMU is 3 Mbit/s. The FMU recognizes the rate present on the bus and adjusts its own rate automatically.

- A maximum of 32 participants per segment is allowed.
- A terminating resistance must be installed at both ends of every segment (ohmic load 220 Ω).
- The cable length and/or the number of participants can be increased by using repeaters.
- There must never be more than three repeaters between any two participants
- The total number of participants in the system is limited to 126 - (2x number of repeaters).

Spurs

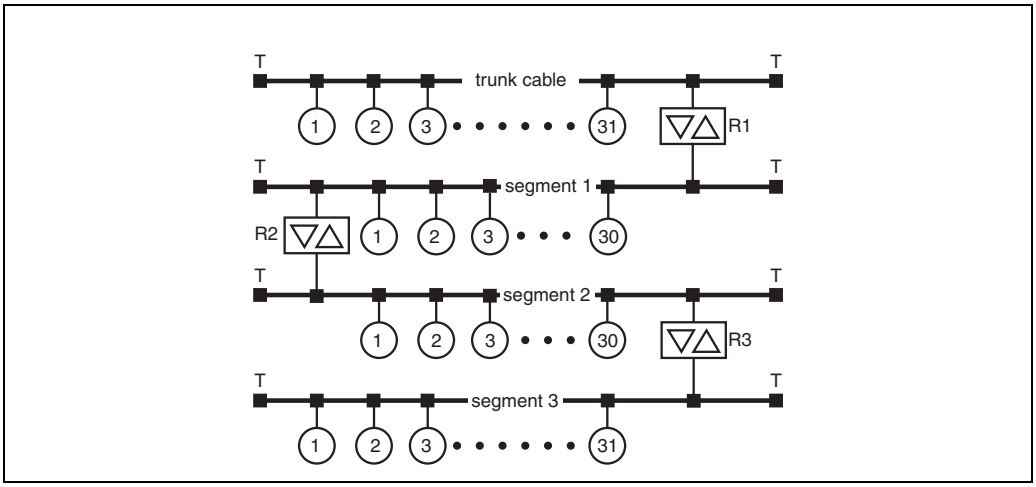
A spur is the cable connecting the field device to the T-box. As a rule of thumb:
- For transmission rates up to 1500 kbits/s, the total length (sum) ot the spurs may not exceed 6.6 m.
- Spurs should not be used for transmission rates greater than 1500 kbits/s.

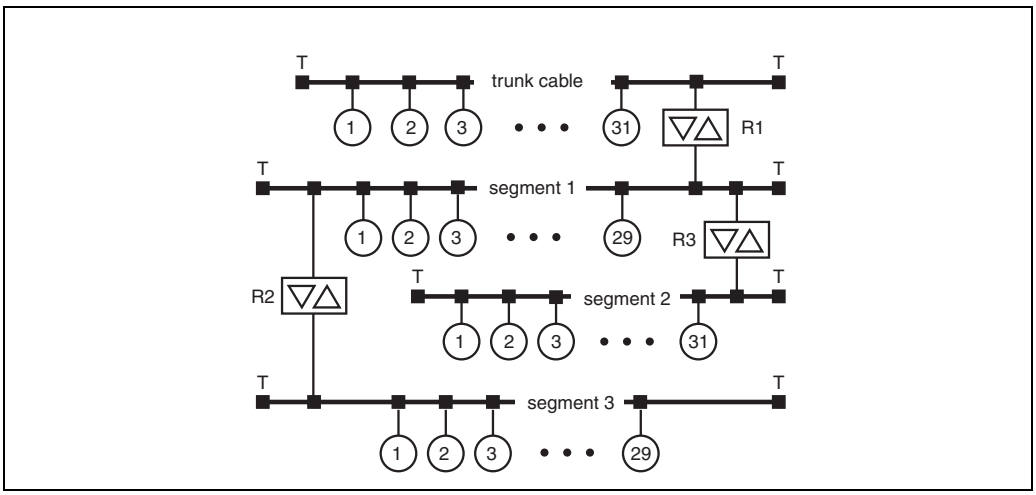
Examples

Figs. 2.2 and 2.3 show examples for a linear and tree bus structure.

Fig. 2.2. shows that three repeaters are necessary if the PROFIBUS-DP system is to be developed to the full. The maximum cable length corresponds to 4x the value quoted in the table above. Since three repeaters are used, the maximum number of participants is reduced to 120.

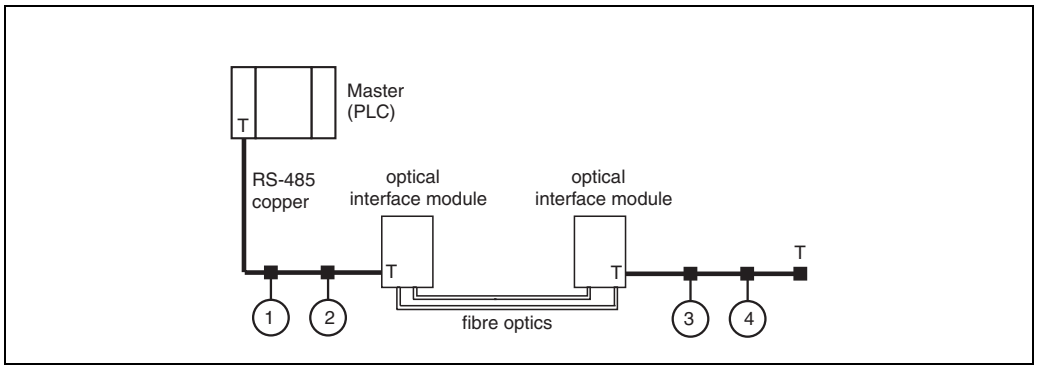
Fig. 2.3. shows how several repeaters can be used to create a tree structure. The number of participants allowable per segment is reduced by one per repeater: the total number of participants is limited to 126 - (2x number of repeaters).


T
trunk cable
T
1
2
3
31
R1
segment 1
R2
30
segment 2
R3
segment 3


T
trunk cable
1
2
3
31
R1
segment 1
29
R3
R2
segment 2
segment 3

Optical network

If the PROFIBUS-DP system has to be routed over large distances or in a plant with heavy electromagnetic interference, then an optical or mixed optical/copper network can be used. Provided that all participants support them, very high transmission rates are possible. Fig. 2.4 shows a possible structure for an optical network, whereby the technical details can be taken from the PROFIBUS standard.



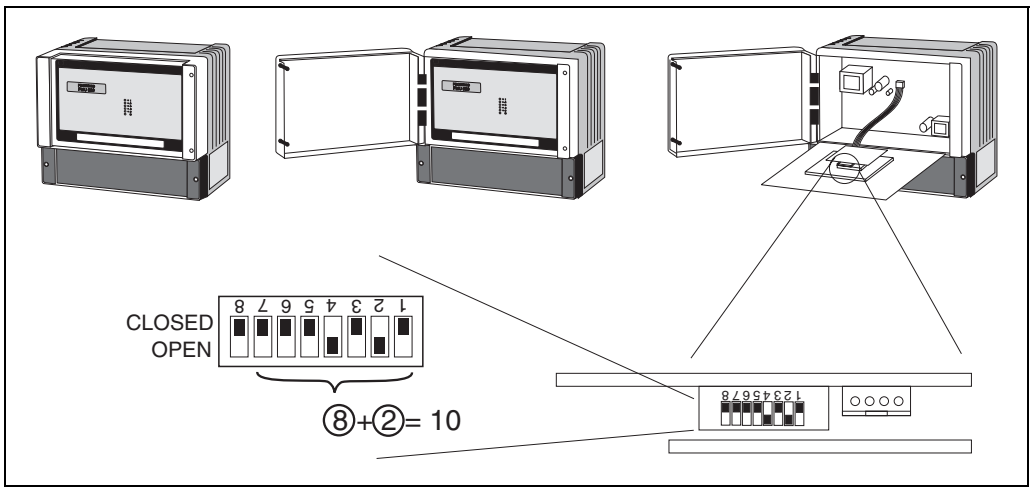
6.3 Address, Termination

Address

Selecting the device address

- Every PROFIBUS-DP device must be given an address. If the address is not set correctly, the device will not be recognised by the process control system.
- A device address may appear only once within a particular PROFIBUS-DP network, see BA 198F.
- Valid device addresses are in the range from 1 to 126.

Setting of the device address



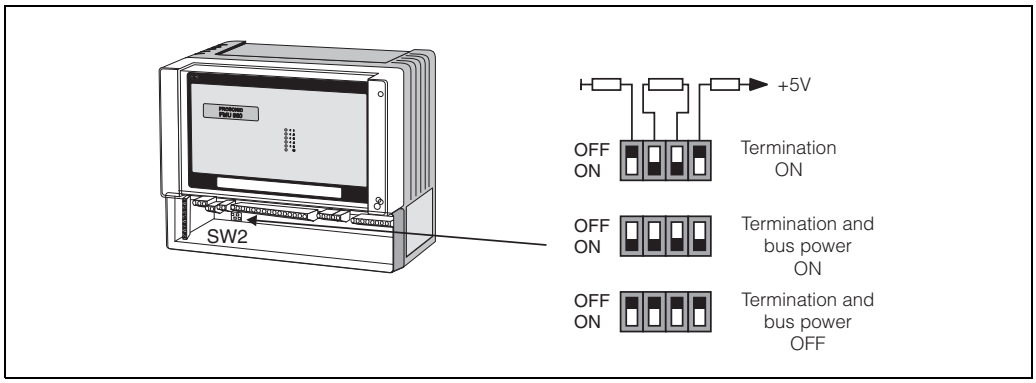
The address is determined by the position of the DIP-switches 1 to 7 according to the following table:

Switch No.	1	2	3	4	5	6	7
Value in position "CLOSED"	0	0	0	0	0	0	0
Value in position "OPEN	1	2	4	8	16	32	64

The new address becomes valid at a restart of the Prosonic (power on). For the Prosonic, DIP-switch 8 ist without function.

Termination

- At the last instrument on the bus, a terminating resistance must be switched on at DIP-switch SW 2: OFF, ON, ON, OFF.
- Optionally, the bus power can be supplied by this instrument: ON, ON, ON, ON.
- At the remaining instruments the terminating resistance must be switche off: OFF, OFF, OFF, OFF.



6.4 Device database and type files

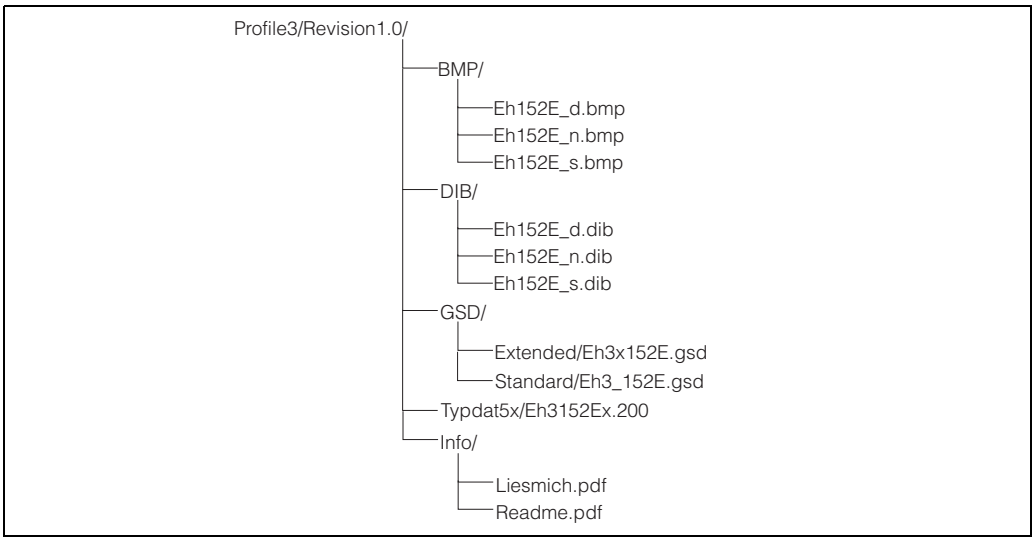
A device database file (*.gsd) contains a description of the properties of the PROFIBUS-DP device, e.g. the supported transmission rates and the type and format of the digital information that can be transfered to the PLC.
Additional bitmap files are required in order to represent the device by an icon in the network design software.
Every device is allocated an identity code by the PROFIBUS User Organisation (PNO). This appears in the device data base file name (.gsd). The Prosonic has the ID number 152E.

Source of supply

- Internet: www.endress.com
- CD-ROM with GSD files for all E+H devices. Order-Code: 50097200
- GSD library of the PROFIBUS User Organisation (PNO):http: //www.PROFIBUS.com

Directory structure

The files are oranized in the folowing strucutre:



- The GSD files in the directory "Extended" are needed for the network design software STEP 7 of the S7-300/400 PLC family.
- The GSD files in the directory "Standard" are used for PLCs, which do not support an identifier format but only an identifier byte (e.g. PLC5 of Allen-Bradley)
- For the network design tool COM ET200 with Siemens S5 instead of an GSD file the Type file "EH_1522x.200" and instead of the BMP files the DIB files have to be used.

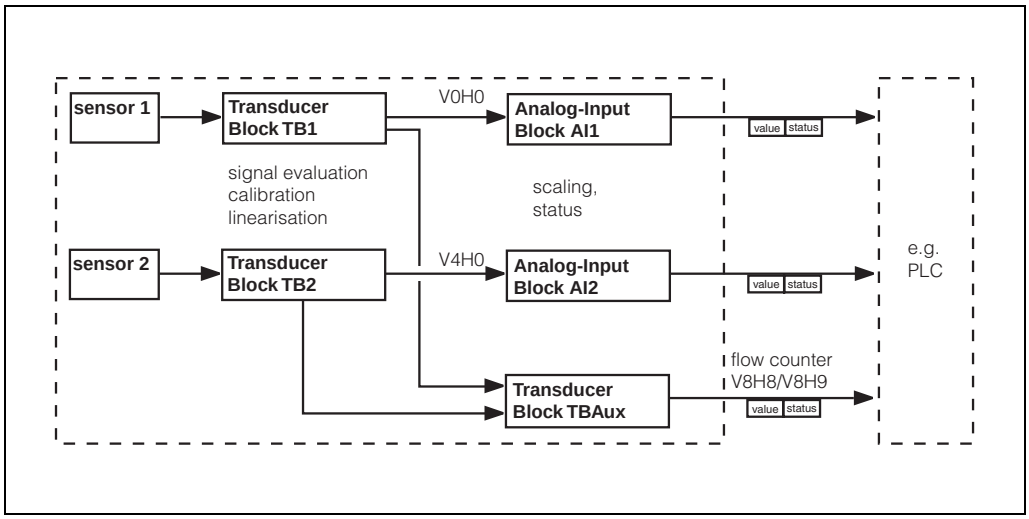
Universal Database File

The PNO also provides an universal database file with the designation PA139701.gsd for devices with two analogue input blocks. Should this be used instead of the Prosonic GSD, then only the two main values can be transmitted. The counter can not be transmitted.
If the universal profile is used, the option "profiles" must be selected in the Physical Block at the matrix position V0H4 (Ident number).

6.5 Cyclic data exchange

Block model of the Prosonic FMU 867

The block model shows, which data are exchanged continously (i.e. by cyclic data transfer) between the Prosonic and the PLC.



Modules for the cyclic data telegram

For the cyclic data telegram the Prosonic provides the following modules:

1. **Analog Input**
   Depending on the configuration (see below) this is main value 1 (V0H0) or main value 2 (V4H0). Before they are sent to the PLC these values may be scaled in the respective Analog Input Block.
2. **Counter**
   This flow counter is composed of the matrix fields V8H8 (counter high) and V8H9 (counter low).
3. **Empty**
   This module must be applied during configuration (see below), if main value 2 is not to appear in the data telegram.

Configuration of the cyclic data telegram

Use the configuration software of your PLC in order to compose the data telegram from these modules in one of the following ways:

1. **Main value 1**
   In order to transmit only main value 1, select the module **Analog Input**.
2. **Main value 1 and flow counter**
   In order to transmit main value 1 and the flow counter, select the modules in the following order: **Analog Input, Empty, Counter**.
3. **Main value 1 and main value 2**
   In order to transmit both main values , select **Analog Input** twice.
4. **Main value 1, main value 2 and flow counter**
   In order to transmit both main values and the flow counter, select the modules in the following order: **Analog Input, Analog Input, Counter**.

The exact way of performing the configuration depends on the configuration software of the PLC.

Data formats

Main value 1/2

Bytes	Data	Format
1, 2, 3, 4	main value	32 bit floating point number (IEEE-757, see below)
5	status code	see below "Stauts codes"

Flow counter

Bytes	Data	Format
1, 2, 3, 4	flow counter	LONG INTEGER (see below)
5	status code (identical to status of main value 1)	see below "Stautscodes"

IEEE-754 floating point number

The measured values are transmitted as IEEE 754 floating point numbers, whereby:

measured value = $(-1)^{VZ} \times 2^{(E-127)} \times (1+F)$

Byte 1								Byte 2							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Sign	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}
	Exponent (E)							Mantissa (F)							

Byte 3								Byte 4							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}
Mantissa (F)															

LONG INTEGER

The flow counter is transmitted as LONG INTEGER, whereby:

Byte 1								Byte 2							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}

Byte 3								Byte 4							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Status codes

The status codes comprise one byte and have got the following meaning:

Status-Code	Device status	Significance
00 Hex	BAD	non-specific
1F Hex	BAD	out-of-service (target mode)
40 Hex	UNCERTAIN	non-specific (simulation)
47 Hex	UNCERTAIN	last usable value (Fail-safe-Mode aktiv)
48 Hex	UNCERTAIN	Ersatzmenge (fail-Safe mode active)
4C Hex	UNCERTAIN	initial value (fail-Safe mode active)
5C Hex	UNCERTAIN	Configuration error (limits not set correctly)
80 Hex	GOOD	OK
84 Hex	GOOD	Active block alarm (static revision counter incremented)
89 Hex	GOOD	LOW_LIM (alarm active)
8A Hex	GOOD	HI_LIM (alarm active)
8D Hex	GOOD	LOW_LOW_LIM (alarm active)
8E Hex	GOOD	HI_HI_LIM (alarm active)

6.6 Acyclic data exchange

The device parameters in the physical block, transducer blocks and analog input blocks, as well as the device management can be accessed by a Class 2 PROFIBUS-DP master (e.g. Commuwin II) using the acyclic data services.

Slot/Index-Tabellen

The device parameters are listed in the following tables. The parameters are accessed via the slot and index number.
The Analog-Input and physical blocks contain standard parameters, block parameters and manufacturer-specific parameters. The transducer blocks are E+H specific.

Physical Block

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Physikal Block block objekt		0	16	20	DS32*	x		C
PB Static revision		0	17	2	unsigned16	x		N
PB Device tag		0	18	32	Octet String(32)	x	x	S
PB Strategy		0	19	2	unsigned16	x	x	S
PB Alert key		0	20	1	unsigned8	x	x	S
PB Target mode		0	21	1	unsigned8	x	x	S
PB Mode block		0	22	3	DS37*	x		D
PB Alarm summary		0	23	8	DS42*	x		D
Blockparameter								C
PB Software revision		0	24	16	Visible String(16)	x		C
PB Hardware revision		0	25	16	Visible String(16)	x		C
PB Device manufacturer identity		0	26	2	unsigned16	x		C
PB Device identity		0	27	16	Visible String(16)	x		C
PB Device serial number		0	28	16	Visible String(16)	x		C
PB Diagnosis		0	29	4	Octet String(4)	x		D
PB Diagnosis extention		0	30	6	Octet String(6)	x		D
PB Diagnosis mask		0	31	4	Octet String(4)	x		C
PB Diagnosis extention mask		0	32	6	Octet String(6)	x		C
PB Security locking	V9H6	0	34	2	unsigned16	x	x	N
PB General reset	V9H5	0	35	2	unsigned16	x	x	S
PB Device message		0	37	32	Octet String(32)	x	x	S
PB Ident Number selector		0	40	1	unsigned8	x	x	S
PB Diagnostic code	V9H0	0	54	2	unsigned16	x		D
PB Last diagnostic code	V9H1	0	55	2	unsigned16	x	x	D
PB Device and software number	V9H3	0	60	2	unsigned16	x		C
PB Last but one diagnostic code	V9H2	0	61	2	unsigned16	x	x	D
PB View 1		0	70	13	OSTRING	x		D

Transducer Block TBAux

Transducer Block TBAux contains those device parameters which can not be assigned to one of the channels.

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Transducer block Aux block objekt		0	120	20	DS32*	x		C
TBAux Static revision		0	121	2	unsigned16	x		N
TBAux Device tag		0	122	32	Octet String(32)	x	x	S
TBAux Strategy		0	123	2	unsigned16	x	x	S
TBAux Alert key		0	124	1	unsigned8	x	x	S
TBAux Target mode		0	125	1	unsigned8	x	x	S
TBAux Mode block		0	126	3	DS37*	x		D
TBAux Alarm summary		0	127	8	DS42*	x		D

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
E+H-Parameter								
TBAux Relay selection	V1H0	0	128	1	unsigned8	x	x	S
TBAux Relay funktion	V1H1	0	129	1	unsigned8	x	x	S
TBAux Switch-on point	V1H2	0	130	4	floating point	x	x	S
TBAux Switch-off point	V1H3	0	131	4	floating point	x	x	S
TBAux Alternating pump control	V1H4	0	132	1	unsigned8	x	x	S
TBAux Count factor C1	V1H5	0	133	4	floating point	x	x	S
TBAux Count factor C2	V1H6	0	134	4	floating point	x	x	S
TBAux Count factor C3	V1H7	0	135	4	floating point	x	x	S
TBAux Internal time	V1H8	0	136	2	unsigned16	x	x	S
TBAux Switch delay	V1H9	0	137	1	unsigned8	x	x	S
TBAux Operating mode	V8H0	0	138	1	unsigned8	x	x	S
TBAux Select current	V8H1	0	139	1	unsigned8	x	x	S
TBAux 4 mA threshold	V8H2	0	140	1	unsigned8	x	x	S
TBAux Select distance unit	V8H3	0	141	1	unsigned8	x	x	S
TBAux Flow unit	V8H4	0	142	1	unsigned8	x	x	S
TBAux Counter unit	V8H5	0	143	1	unsigned8	x	x	S
TBAux Limit switch	V8H6	0	144	1	unsigned8	x	x	S
TBAux External temperatur sensor	V8H7	0	145	1	unsigned8	x	x	S
TBAux Internal counter high	V8H8	0	146	2	unsigned16	x		S
TBAux Internal counter low	V8H9	0	147	2	unsigned16	x		S
TBAux Reset counter	V9H4	0	148	2	unsigned16	x	x	D
TBAux Simulation level	V9H7	0	149	4	floating point	x	x	S
TBAux Simulation volume	V9H8	0	150	4	floating point	x	x	S
TBAux Simulation current	V9H9	0	151	4	floating point	x	x	S
TBAux View1		0	152	13	OSTRING	x		D

Device management

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Directory objekt header		1	0	12	OSTRING	x		C
Composite list directory entries		1	1	24	OSTRING	x		C

Analog Input Block AI1

Analog Input Block 1 transmits the measured value of channel 1. It is connected to the Transducer Block TB 1 and contains the following parameters:

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Analog input block 1 block objekt		1	16	20	DS32*	x		C
AI1 Static revision		1	17	2	unsigned16	x		N
AI1 Device tag		1	18	32	Octet String(32)	x	x	S
AI1 Strategy		1	19	2	unsigned16	x	x	S
AI1 Alert key		1	20	1	unsigned8	x	x	S
AI1 Target Mode		1	21	1	unsigned8	x	x	S
AI1 Mode block		1	22	3	DS37*	x		D
AI1 Alarm summary		1	23	8	DS42*	x		D
Blockparameter								
AI1 OUT		1	26	5	DS33*	x		D
AI1 PV_SCALE		1	27	8	floating point(2)	x	x	S
AI1 OUT_SCALE		1	28	11	DS36*	x	x	S
AI1 LIN_TYPE		1	29	1	unsigned8	x	x	S
AI1 CHANNEL		1	30	2	unsigned16	x	x	S
AI1 PV_FTIME		1	32	4	floating point	x	x	S
AI1 ALARM_HYSTERESIS		1	35	4	floating point	x	x	S
AI1 HI_HI_LIMIT		1	37	4	floating point	x	x	S
AI1 HI_LIMIT		1	39	4	floating point	x	x	S
AI1 LO_LIMIT		1	41	4	floating point	x	x	S
AI1 LO_LO_LIMIT		1	42	4	floating point	x	x	S
AI1 HI_HI_ALM		1	46	16	DS39*	x		D
AI1 HI_ALM		1	47	16	DS39*	x		D
AI1 LO_ALM		1	48	16	DS39*	x		D
AI1 LO_LO_ALM		1	49	16	DS39*	x		D
AI1 SIMULATE		1	50	6	DS50*	x	x	S
AI1 OUT_UNIT_TEXT		1	51	16	Octet String(16)	x	x	S
AI1 View1		1	61	13	OSTRING	x		D

Transducer Block TB1

Transducer Block TB 1 contains the device parameters for channel 1.

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Transducer block 1 block object		1	120	20	DS32*	x		C
TB1 Static revision		1	121	2	unsigned16	x		N
TB1 Device tag		1	122	32	Octet String(32)	x	x	S
TB1 Strategy		1	123	2	unsigned16	x	x	S
TB1 Alert key		1	124	1	unsigned8	x	x	S
TB1 Target mode		1	125	1	unsigned8	x	x	S
TB1 Mode block		1	126	3	DS37*	x		D
TB1 Alarm summary		1	127	8	DS42*	x		D
E+H-Parameter								
TB1 Measured value Channel 1	V0H0	1	128	4	floating point	x		D
TB1 Empty calibration Channel 1	V0H1	1	129	4	floating point	x	x	S
TB1 Full calibration Channel 1	V0H2	1	130	4	floating point	x	x	S
TB1 Application Channel 1	V0H3	1	131	1	unsigned8	x	x	S
TB1 Type of sensor Channel 1	V0H4	1	132	1	unsigned8	x	x	S
TB1 Value for 0/4mA Channel 1	V0H5	1	133	4	floating point	x	x	S
TB1 Value for 20mA Channel 1	V0H6	1	134	4	floating point	x	x	S
TB1 Output damping Channel 1	V0H7	1	135	4	floating point	x	x	S
TB1 Measured distance Channel 1	V0H8	1	136	4	floating point	x		D
TB1 Measured level Channel 1	V0H9	1	137	4	floating point	x		D
TB1 Linearization Channel 1	V2H0	1	138	1	unsigned8	x	x	S
TB1 Actual level Channel 1	V2H1	1	139	4	floating point	x	x	S
TB1 Q/h curve Channel 1	V2H2	1	140	1	unsigned8	x	x	S
TB1 Input level Channel 1	V2H3	1	141	4	floating point	x	x	D
TB1 Input volume Channel 1	V2H4	1	142	4	floating point	x	x	D
TB1 Line number Channel 1	V2H5	1	143	1	unsigned8	x	x	D
TB1 Diameter of vessel Channel 1	V2H6	1	144	4	floating point	x	x	S
TB1 Vmax / Qmax Channel 1	V2H7	1	145	4	floating point	x	x	S
TB1 Low flow cut off Channel 1	V2H8	1	146	4	floating point	x	x	S
TB1 Crest length Channel 1	V2H9	1	147	4	floating point	x	x	S
TB1 Range for auto. suppression Channel 1	V3H0	1	148	4	floating point	x	x	S
TB1 Echo attenuation Channel 1	V3H1	1	149	2	integer16	x		S
TB1 Signal / noise ratio Channel 1	V3H2	1	150	1	unsigned8	x		S
TB1 If no echo Channel 1	V3H3	1	151	1	unsigned8	x	x	D
TB1 Safety alarm Channel 1	V3H4	1	152	1	unsigned8	x	x	D
TB1 Envelope curve statistics Channel 1	V3H5	1	153	1	unsigned8	x	x	S
TB1 FAC threshold Channel 1	V3H6	1	154	1	unsigned8	x	x	S
TB1 FAC rise Channel 1	V3H7	1	155	1	unsigned8	x	x	S
TB1 Device tag Channel 1	VAH0	1	156	16	Octet String(16)	x	x	S
TB1 Unit Channel 1	VAH3	1	157	1	unsigned8	x	x	S
TB1 Text Channel 1	VAH7	1	158	1	unsigned8	x	x	S
TB1 View1		1	159	13	OSTRING	x		D

Analog Input Block AI2

Analog Input Block 2 transmits the measured value of channel 2. It is connected to Transducer Block TB 2 and contains the following parameters:

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Analog input block 2 block objekt		2	16		DS32*	x		C
AI2 Static revision		2	17	2	unsigned16	x		N
AI2 Device tag		2	18	32	Octet String(32)	x	x	S
AI2 Strategy		2	19	2	unsigned16	x	x	S
AI2 Alert key		2	20	1	unsigned8	x	x	S
AI2 Target Mode		2	21	1	unsigned8	x	x	S
AI2 Mode block		2	22	3	DS37*	x		D
AI2 Alarm summary		2	23	8	DS42*	x		D

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Blockparameter								
AI2 OUT		2	26	5	DS33*	x		D
AI2 PV_SCALE		2	27	8	floating point(2)	x	x	S
AI2 OUT_SCALE		2	28	11	DS36*	x	x	S
AI2 LIN_TYPE		2	29	1	unsigned8	x	x	S
AI2 CHANNEL		2	30	2	unsigned16	x	x	S
AI2 PV_FTIME		2	32	4	floating point	x	x	S
AI2 ALARM_HYSTERESIS		2	35	4	floating point	x	x	S
AI2 HI_HI_LIMIT		2	37	4	floating point	x	x	S
AI2 HI_LIMIT		2	39	4	floating point	x	x	S
AI2 LO_LIMIT		2	41	4	floating point	x	x	S
AI2 LO_LO_LIMIT		2	43	4	floating point	x	x	S
AI2 HI_HI_ALM		2	46	16	DS39*	x		D
AI2 HI_ALM		2	47	16	DS39*	x		D
AI2 LO_ALM		2	48	16	DS39*	x		D
AI2 LO_LO_ALM		2	49	16	DS39*	x		D
AI2 SIMULATE		2	50	6	DS50*	x	x	S
AI2 OUT_UNIT_TEXT		2	51	16	Octet String(16)	x	x	S
AI2 View1		2	61	13	OSTRING	x		D

Transducerblock TB2

Transducer Block TB 2 contains the device parameters for channel 2.

Parameter	E+H Matrix (CW II)	Slot	Index	Size [bytes]	Type	Read	Write	Storage Class
Standardparameter								
Transducer block 2 block object		2	120	20	DS32*	x		C
TB2 Static revision		2	121	2	unsigned16	x		N
TB2 Device tag		2	122	32	Octet String(32)	x	x	S
TB2 Strategy		2	123	2	unsigned16	x	x	S
TB2 Alert key		2	124	1	unsigned8	x	x	S
TB2 Target mode		2	125	1	unsigned8	x	x	S
TB2 Mode block		2	126	3	DS37*	x		D
TB2 Alarm summary		2	127	8	DS42*	x		D
E+H-Parameter								
TB2 Measured value Channel 2	V4H0	2	128	4	floating point	x		D
TB2 Empty calibration Channel 2	V4H1	2	129	4	floating point	x	x	S
TB2 Full calibration Channel 2	V4H2	2	130	4	floating point	x	x	S
TB2 Application Channel 2	V4H3	2	131	1	unsigned8	x	x	S
TB2 Type of sensor Channel 2	V4H4	2	132	1	unsigned8	x	x	S
TB2 Value for 0/4mA Channel 2	V4H5	2	133	4	floating point	x	x	S
TB2 Value for 20mA Channel 2	V4H6	2	134	4	floating point	x	x	S
TB2 Output damping Channel 2	V4H7	2	135	4	floating point	x	x	S
TB2 Measured distance Channel 2	V4H8	2	136	4	floating point	x		D
TB2 Measured level Channel 2	V4H9	2	137	4	floating point	x		D
TB2 Linearization Channel 2	V5H0	2	138	1	unsigned8	x	x	S
TB2 Actual level Channel 2	V5H1	2	139	4	floating point	x	x	S
TB2 Input level Channel 2	V5H3	2	140	4	floating point	x	x	D
TB2 Input volume Channel 2	V5H4	2	141	4	floating point	x	x	D
TB2 Line number Channel 2	V5H5	2	142	1	unsigned8	x	x	D
TB2 Diameter of vessel Channel 2	V5H6	2	143	4	floating point	x	x	S
TB2 Vmax / Qmax Channel 2	V5H7	2	144	4	floating point	x	x	S
TB2 Limit back water alarm Channel 2	V5H8	2	145	1	unsigned8	x	x	S
TB2 Range for auto. suppression Channel 2	V6H0	2	146	4	floating point	x	x	S
TB2 Echo attenuation Channel 2	V6H1	2	147	2	integer16	x		D
TB2 Signal / noise ratio Channel 2	V6H2	2	148	1	unsigned8	x		D
TB2 If no echo Channel 2	V6H3	2	149	1	unsigned8	x	x	S
TB2 Safety alarm Channel 2	V6H4	2	150	1	unsigned8	x	x	S
TB2 Envelope curve statistics Channel 2	V6H5	2	151	1	unsigned8	x	x	S
TB2 FAC threshold Channel 2	V6H6	2	152	1	unsigned8	x	x	S
TB2 FAC rise Channel 2	V6H7	2	153	1	unsigned8	x	x	S
TB2 Device tag Channel 2	VAH1	2	154	16	Octet String(16)	x	x	S
TB2 Unit Channel 2	VAH5	2	155	1	unsigned8	x	x	S
TB2 Text Channel 2	VAH9	2	156	1	unsigned8	x	x	S
TB2 View1		2	157	13	OSTRING	x		D

7 Technical Data

7.1 Prosonic FMU 867

Construction

- Dimensions: see p.14
  Weight: 2,6 kg
- Ingress protection (DIN 40 050): IP 66 for closed housing and cable gland with same protection (for opened housing: IP 40; for open connection compartment IP 20)
- Material: Housing ASA/PC, transparent cover: PC (polycarbonat)

Operating conditions

- Nominal operating temperature: -20...+60 °C (Storage: -40...+80 °C)
- Protection to DIN 40 040: Type R W
  – Relative humidity: 95 % in annual mean, condensation permissible
  – Vibration tests: 2 g (10...55 Hz) and 15 g for 11 ms

Electromagnetic compatibility

Interference Emission to EN 61326 ; Electrical equipment Class B
Interference Immunity to EN 61326 , Annex A (Industrial)
for PROFIBUS-DP instruments:
Interference Emission to EN 61326 ; Electrical equipment Class A
Interference Immunity to EN 61326

Signal inputs

- Sensors:
  two FDU 8... (can be different).
- External switching input
  for external limit switch or PNP contactor, e.g. Liquiphant or Soliphant (24 V, maximum short circuit current 20 mA)
- External temperature sensor FMT 131
  for temperature compensation of the run time, NTC version, required for sensors with heating or used where the temperature should not be measured by the sensors.

Outputs

- Analogue outputs
  Two, 1 per channel, 4...20 mA, switchable to 0...20 mA,
  R_{Lmax} 600 Ω
  Output current limit: 24 mA
- Relays
  Three independent relays, each with a potential-free change over contact
  Switching capacity: 4A, 250V; 1000VA at cos φ =0.7
  35 V_{DC} and 100 W
  programmable functions: alarm relay, limit value relay (with switching delay and alternating control functions), trend relay
  (selectable for each relay, switch-on and switch-off points freely selectable)
- Synchronisation
  Parallel connection of up to 20 transmitters if several sensor cables are laid in parallel

Rackbus RS 485 interface

- Bus dress set via DPD-switch, dress range 0 … 63
- Operation via operating program or Commugraph

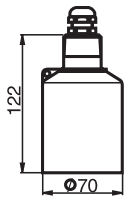
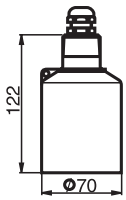
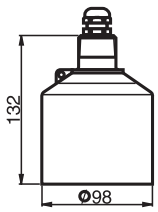
PROFIBUS-DP interface

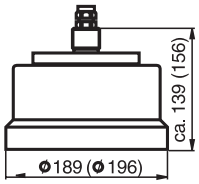
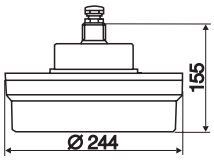
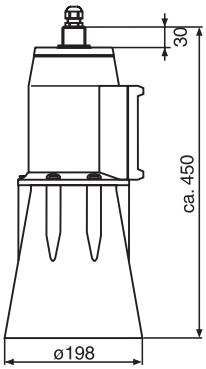
- Profiles 3.0
- supported baudrates: 19.2 kBaud, 45.45 kBaud, 93.75 kBaud, 187.5 kBaud, 500 kBaud, 1.5 MBaud
- Connection to PC via PROFIBOARD or PROFICARD
- Operation via Commuwin II or ToF Tool

Accuracy, effect of external influences

- Measuring uncertainty: typically 0,2 % for maximum range and flat reflector (sum of linearity, hysteresis and reproducibility)
- Maximum resolution: 1 mm for FDU 80
- Load effects: negligible within permissible range

7.2 Sensors FDU 80 ... 86

Type	FDU 80	FDU 81	FDU 82
Dimensions			
maximum measuring range (liquids)	5 m (16 ft)	10 m (32 ft)	20 m (65 ft)
maximum measuring range (solids)	2 m (7 ft)	5 m (16ft)	10 m (32 ft)
blocking distance	0,3 m (1 ft)	0,5 m (1.6 ft)	0,8 m (2.6 ft)
Operating frequency at 23 °C	58 kHz	44 kHz	29 kHz
for explosion hazardous areas	• ATEX II 2 G EEx m II T5/6 (s. XA 117F-A) • FM Cl.I Div.1	• ATEX II 2 G EEx m II T5/6 (s. XA 117F-A) • FM Cl.I, Div.1	• ATEX II 2 G EEx m II T5/6 (s. XA 117F-A) • FM Cl.I Div.1
Materials housing/ thread	PG-GF	PG-GF	PG-GF
Weight	0,55 kg (1.2 lbs)	0,6 kg(1.3 lbs)	1,2 kg (2.6 lbs)
Operating temperature	-20 °C ... +60 °C	-20 °C ... +80 °C	-20 °C ... +80 °C
Limits	-40 °C ... +60 °C	-40 °C ... +80 °C	-40 °C ... +80 °C
Max. operating pressure $p_{absolut}$	2 bar (29 psi)	2 bar (29 psi)	2 bar (29 psi)
Relative humidity	100 %	100 %	100 %
Ingress protection	IP 68	IP 68	IP 68
Mounting	G1B or 1-11 1/2 NPT	G1B or 1-11 1/2 NPT	G1B oder 1-11 1/2 NPT
Integrated temperature sensor	x	x	x

Type	FDU 83	FDU 85	FDU 86
Dimensions	 Dimensions in brackets are for the combustible dust version		
maximum measuring range (liquids)	25 m (82 ft)	—	—
maximum measuring range (solids)	15 m (49 ft)	45 m (147 ft)	70 m (230 ft)
blocking distance	1 m (3.3 ft)	0,8 m (2.6 ft)	1,6 m (5.2 ft)
Operating frequency at 23 °C	30 kHz	17 kHz	11 kHz
for combustible dusts	• ATEX II 1/2 D IP 68 T110°C (s. XA 032F-A) • FM Cl.II Div.1	• ATEX II 1/2 D IP 68 T105°C (s. XA 032F-A) • FM Cl.II Div.1	• ATEX II 1/2 D IP 68 T168°C (s. XA 056F-B) • ATEX II 2 G EEx m II T3...T6 (s. XA 065F-B) • FM Cl. I/II/III Div.1+2, HT, -40 ... 140°C • ATEX II 1/2 D IP 68 T105°C (s. XA 056F-B) • FM Cl. I/II/III Div.1+2, NT, -40 ... +80°C
Material			
Housing	PA-GF	UP	UP
Thread	1.4304 or aluminum 1.4571	UP	UP or 1.4301
Diaphragm	EPDM	AL/PE	Al/PTFE
Diaphragm sealing		EPDM	Silicone
Weight	3,1 kg (6.8 lbs)	5,0 kg (11 lbs)	5,0 kg (11 lbs)
Operating temperature	-20 °C ... +80 °C	-20 °C ... +80 °C	-40 °C ... +150 °C
Limits	-40 °C ... +80 °C	-40 °C ... +80 °C	-40 °C ... +150 °C
Maximum operating pressure $p_{absolut}$	1,5 bar (22 psi)	1,5 bar (22 psi)	3 bar (44 psi)
Relative humidity	100 %	100 % (up to 60 °C) 95% (up to 80 °C)	100 %
Ingress protection	IP 68	IP 68	IP 68
Mounting	G1A or 1-11 1/2 NPT	G1A or 1-11 1/2 NPT	G1A or 1 NPT
Integrated temperature sensor	x	x	x

7.3 System Components

Rackbus RS 485

- No. of participants: max. 25 Prosonic transmitters
  If other Endress+Hauser instruments with RS-485 interface are used:
  – max. 25 instruments for safe applications
  – max. 10 instruments in explosion hazardous locations
- Protocol: Rackbus RS 485
- Baudrate: 19 200 Bits/s, fixed
- Cable: twisted, screened pairs
- Topology: serial bus, electrically isolated, tree structure optional; taps max. 10 m
- Lengths: max. 1200 m, including taps and branches (For lengths <3 m negligible)

PC card RS-485

- Connector: 25-pin Min D connector, wiring see p.19
- Baudrate: 1200 ... 38.400 Bits/s (set by software)
- electrically isolated
- Slot size: 16 bit

Adapter RS-232C/RS-485

- Computer connector: 25 pin Min D connector, wiring see p.19
  Bus connector: 9 pin MinD connector, p.20
- Baudrate: 1200 ... 38,400 Bits/s, set by software
- electrically isolated

Commubox FXA 192

- Power: external power pack 115 V or 230 V as ordered
- Electrical connection: 9 pin Sub D connector for the computer; 4 mm screw terminals for the bus
- Operating temperature: 0 °C...+70 °C; Storage temperature: –20 °C...85 °C
  Humidity: 0 %...+95 % (no condensation)
- Communication to PC: Baudrate 9600 Bit/s, 7 Data bits, 1 Stop bit, even parity

Interface FXA 675

- Power: 24 VDC (20...30 VDC)
- Electrical power: p.21
- Operating temperature: 0 °C...+70 °C; Storage temperature: –20 °C...85 °C
- Climatic class to DIN 40 040: KSE
- Interference emission according to EN 61326 apparatus of class A
  Interference immunity according to EN 61326, app. A (industrial area) and NAMUR-recommendations EMV (NE 21)
- Interface: Rackbus/Rackbus RS 485 with two ports
- Baudrate: 19.2 kBit/s

PROFIBUS-DP

- see p.63 ff.

PROFIBUS interfaces

- PROFICARD (PCMCIA card); Order-No. 016570-5200
- PROFIBOARD (PCI Board); Order-No. 52005721

Hardware requirements for Fieldmanager and Commugraph

- Computer, AT compatible
- Operating system MS DOS Version 3.1 upwards
- Main memory: min. 640 KByte
- Port for PC card RS 485 or parallel port (Centronics)
- 3 1/2" disk drive

Hardware requirements for Commuwin II

- PC, minimum 386/25 MHz, recommended >486 / >100 MHz
- Operating system: Windows 3.1/3.11, Windows 95 or Windows NT 4.xx
- Main memory:
  – Windows 3.1/3.11: minimum 4 MB, recommended 8 MB
  – Windows 95: minimum 4 MB, recommended 16 MB
  – Windows 98: minimum 12 MB, recommended 16 MB
  – Windows NT 4.xx: minimum 12 MB, recommended 32 MB
- Hard disk memory: 60 MB
- VGA graphics card (640x480)
- Port for PC card RS 485 or parallel port (Centronics)
- 3 1/2" disk drive or CD-ROM drive

Hardware requirements for ToF Tool

	minimum	recommended
Personal Computer	Intel P5; 133 MHz	Intel P6; 200 MHz or higher
Main memory	32 MB	64 MB
VGA graphics card	256 colours 800 x 600	True color 1024 x 768
Operating system	• Windows 95 (Y2K Bugfixes) • Windows 98 (Y2K Bugfixes) • Windows NT 4.xx (SP 6a or höher) • Windows 2000 (SP 1) • Windows XP	
Hard disk memory	approx. 10 MB for ToF Tool approx. 1 MB for each DD (device driver) approx. 0,5 MB for each DDE server (interface server)	
Drive	• CD-ROM-drive	

8 Operating Matrix FMU 867

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration Channel 1	Measured value User unit	Empty calibration Meter/Feet	Full calibration Meter/Feet	Application 0: Liquids 1: Liquids fast 2: fine-grained solids 3: coarse-grained solids 4: conveyor belts	Sensor type 80: FDU 80 81: FDU 81 … … 86: FDU 86	Value for 0/4 mA User unit	Value for 20 mA User unit	Output damping Seconds	Measured distance Meter/feet	Measured level Meter/Feet
V1 Relays	Relay selection 1: Relay 3 2: Relay 4 3: Relay 5	Relay function 0: Limit value channel 1 1: Limit value channel 2 2: Trend channel 1 3: Trend channel 2 8: Alarm	Switch-on point -Limit value: User unit -Trend: % / min	Switch-off point -Limit value: User unit -Trend: % / min	Alternating pump control 0: on 1: off					Switch delay Seconds
V2 Linarization channel 1	Linearization 0: linear 1: horizontal cylinder 3: manual 4: semi-automatic 5: cancel	Actual level Meter/Feet		Input level Meter/Feet	Input volume User units	Line No.	Diameter of vessel Meter/Feet	Volume of vessel User unit		
V3 Echo parameter channel 1	Range for automatic suppression Meter/Feet	Echo damping dB	Signal/Noise ratio dB	If no echo 0: Warning 1: Alarm	Safety alarm 0: -10% 1: +110% 2: hold last value	Envelope statistics			Rackbus-RS-485 address	
V4 Calibration Channel 2	Measured value User unitt	Empty calibration Meter/Feet	Full calibration Meter/Feet	Application 0: Liquids 1: Liquids fast 2: fine-grained solids 3: coarse-grained solids 4: conveyor belts	Sensor type 80: FDU 80 81: FDU 81 … … 86: FDU 86	Value for 0/4 mA User unit	Value for 20 mA User unit	Output damping seconds	Measured distance Meter/feet	Measured level Meter/Feet
V5 Linearization channel2	Linearization 0: linear 1: horizontal cylinder 3: manual 4: semi-automatic 5: cancel	Actual level Meter/Feet		Input level Meter/Feet	Input volume User units	Line No.	Diameter of vessel Meter/Feet	Volume of vessel User units		
V6 Echo parameter channel 2	Range for automatic suppression Meter/Feet	Echo damping dB	Signal/Noise ratio dB	If no echo 0: Warning 1: Alarm	Safety alarm 0: -10% 1: +110% 2: hold last value	Envelope statistics				
V7 Service										
V8 Operating status and counter	Operating mode 0: Level channel 1 1: Level channel 1 + 2 5: Average 7: Simulation channel 1 8: Simulation channel 2	Current outputs 0: 0 … 20 mA 1: 4 … 20 mA	4 mA threshold 0: off 1: on	Length units 0: Meter 1: Feet			Limit switch 0: none 1: Min. channel 1 2: Max. channel 1 3: Min. channel 2 4: Max. channel 2 5: Min. channels 1+2 6: Max. channels 1+2	External temperature sensor 0: none 1: Channel 1 2: Channel2 3: Channel1+2		
V9 Simulation	Current diagnostic code	Last diagnostic code E: Delete	Last but one diagnostic code E: Delete	Instrument and Software version	Reset counter	General reset 333: Default settings (for DP: 1)	Security locking 519: Matrix free (for DP: 2451)	Simulation level Meter/Feet	Simulation volume User units	Simulation current mA
VA Communication		Measuring point tag channel 1	Measuring point tag channel 2							

Display field (shaded) **Input field** (white)

Index

Europe

Austria – Wien
❑ Endress+Hauser Ges.m.b.H.
Tel. (01) 88 05 60, Fax (01) 88 05 63 35

Belarus – Minsk
Belorgsintez
Tel. (017) 2 50 84 73, Fax (017) 2 50 85 83

Belgium / Luxembourg – Bruxelles
❑ Endress+Hauser S.A. / N.V.
Tel. (02) 2 48 06 00, Fax (02) 2 48 05 53

Bulgaria – Sofia
Intertech-Automation Ltd.
Tel. (02) 9 62 71 52, Fax (02) 9 62 14 71

Croatia – Zagreb
❑ Endress+Hauser GmbH+Co.
Tel. (01) 6 63 77 85, Fax (01) 6 63 78 23

Cyprus – Nicosia
I+G Electrical Services Co. Ltd.
Tel. (02) 48 47 88, Fax (02) 48 46 90

Czech Republic – Praha
❑ Endress+Hauser Czech s.r.o.
Tel. (02) 66 78 42 31, Fax (026) 66 78 41 79

Denmark – Søborg
❑ Endress+Hauser A/S
Tel. (70) 13 11 32, Fax (70) 13 21 33

Estonia – Tartu
Elvi-Aqua
Tel. (7) 30 27 32, Fax (7) 30 27 31

Finland – Helsinki
❑ Metso Endress+Hauser Oy
Tel. (204) 8 31 60, Fax (204) 8 31 61

France – Huningue
❑ Endress+Hauser S.A.
Tel. (389) 69 67 68, Fax (389) 69 48 02

Germany – Weil am Rhein
❑ Endress+Hauser Messtechnik GmbH+Co. KG
Tel. (07621) 9 75 01, Fax (07621) 97 55 55

Greece – Athens
I & G Building Services Automation S.A.
Tel. (01) 9 24 15 00, Fax (01) 9 22 17 14

Hungary – Budapest
❑ Endress+Hauser Magyarország
Tel. (01) 4 12 04 21, Fax (01) 4 12 04 24

Iceland – Reykjavik
Sindra-Stál hf
Tel. 5 75 00 00, Fax 5 75 00 10

Ireland – Clane / County Kildare
❑ Flomeaco Endress+Hauser Ltd.
Tel. (045) 86 86 15, Fax (045) 86 81 82

Italy – Cernusco s/N, Milano
❑ Endress+Hauser S.p.A.
Tel. (02) 92 19 21, Fax (02) 92 19 23 62

Latvia – Riga
Elekoms Ltd.
Tel. (07) 33 64 44, Fax (07) 33 64 48

Lithuania – Kaunas
UAB Agava Ltd.
Tel. (03) 7 20 24 10, Fax (03) 7 20 74 14

Netherlands – Naarden
❑ Endress+Hauser B.V.
Tel. (035) 6 95 86 11, Fax (035) 6 95 88 25

Norway – Lierskogen
❑ Endress+Hauser A/S
Tel. 32 85 98 50, Fax 32 85 98 51

Poland – Wroclaw
❑ Endress+Hauser Polska Sp. z o.o.
Tel. (071) 7 80 37 00, Fax (071) 7 80 37 60

Portugal – Cacem
❑ Endress+Hauser Lda.
Tel. (21) 4 26 72 90, Fax (21) 4 26 72 99

Romania – Bucharest
Romconseng S.R.L.
Tel. (01) 4 10 16 34, Fax (01) 4 11 25 01

Russia – Moscow
❑ Endress+Hauser GmbH+Co
Tel. (095) 1 58 75 64, Fax (095) 7 84 63 91

Slovak Republic – Bratislava
Transcom Technik s.r.o.
Tel. (2) 44 88 86 90, Fax (2) 44 88 71 12

Slovenia – Ljubljana
❑ Endress+Hauser (Slovenija) D.O.O.
Tel. (01) 5 19 22 17, Fax (01) 5 19 22 98

Spain – Sant Just Desvern
❑ Endress+Hauser S.A.
Tel. (93) 4 80 33 66, Fax (93) 4 73 38 39

Sweden – Sollentuna
❑ Endress+Hauser AB
Tel. (08) 55 51 16 00, Fax (08) 55 51 16 55

Switzerland – Reinach/BL 1
❑ Endress+Hauser Metso AG
Tel. (061) 7 15 75 75, Fax (061) 7 11 16 50

Turkey – Levent/Istanbul
Intek Endüstriyel Ölcü ve Kontrol Sistemleri
Tel. (0212) 2 75 13 55, Fax (0212) 2 66 27 75

Ukraine – Kiev
Photonika GmbH
Tel. (44) 2 68 81 02, Fax (44) 2 69 07 05

Great Britain – Manchester
❑ Endress+Hauser Ltd.
Tel. (0161) 2 86 50 00, Fax (0161) 9 98 18 41

Yugoslavia Republic – Beograd
Meris d.o.o.
Tel. (11) 4 44 29 66, Fax (11) 3 08 57 78

Africa

Algeria – Annaba
Symes Systemes et Mesures
Tel. (38) 88 30 03, Fax (38) 88 30 02

Egypt – Heliopolis/Cairo
Anasia Egypt For Trading (S.A.E.)
Tel. (02) 2 68 41 59, Fax (02) 2 68 41 69

Morocco – Casablanca
Oussama S.A.
Tel. (02) 22 24 13 38, Fax (02) 2 40 26 57

Rep. South Africa – Sandton
❑ Endress+Hauser (Pty.) Ltd.
Tel. (011) 2 62 80 00, Fax (011) 2 62 80 62

Tunisia – Tunis
CMR Controle, Maintenance et Regulation
Tel. (01) 79 30 77, Fax (01) 78 85 95

America

Argentina – Buenos Aires
❑ Endress+Hauser Argentina S.A.
Tel. (11) 45 22 79 70, Fax (11) 45 22 79 09

Brazil – Sao Paulo
❑ Samson Endress+Hauser Ltda.
Tel. (011) 50 31 34 55, Fax (011) 50 31 30 67

Canada – Burlington, Ontario
❑ Endress+Hauser (Canada) Ltd.
Tel. (905) 6 81 92 92, Fax (905) 6 81 94 44

Chile – Santiago de Chile
❑ Endress+Hauser (Chile) Ltd.
Tel. (02) 3 21 30 09, Fax (02) 3 21 30 25

Colombia – Bogota D.C.
Colsein Ltda.
Tel. (01) 2 36 76 59, Fax (01) 6 10 78 68

Costa Rica – San Jose
Euro-Tec (Costa Rica) S.A.
Tel. 2 20 28 08, Fax 2 96 15 42

Ecuador – Quito
Insetec Cia. Ltda.
Tel. (02) 2 26 91 48, Fax (02) 2 46 18 33

El Salvador – San Salvador
Automatizacion y Control Industrial de El Salvador, S.A. de C.V.
Tel. 2 84 31 51, Fax 2 74 92 48

Guatemala – Ciudad de Guatemala
Automatizacion y Control Industrial, S.A.
Tel. (03) 34 59 85, Fax (03) 32 74 31

Honduras – San Pedro Sula, Cortes
Automatizacion y Control Industrial de Honduras, S.A. de C.V.
Tel. 5 57 91 36, Fax 5 57 91 39

Mexico – México, D.F
❑ Endress+Hauser (México), S.A. de C.V.
Tel. (5) 5 55 68 24 07, Fax (5) 5 55 68 74 59

Nicaragua – Managua
Automatización y Control Industrial de Nicaragua, S.A.
Tel. 2 22 61 90, Fax 2 28 70 24

Peru – Lima
Process Control S.A.
Tel. (2) 61 05 15, Fax (2) 61 29 78

USA – Greenwood, Indiana
❑ Endress+Hauser Inc.
Tel. (317) 5 35 71 38, Fax (317) 5 35 84 98

USA – Norcross, Atlanta
❑ Endress+Hauser Systems & Gauging Inc.
Tel. (770) 4 47 92 02, Fax (770) 4 47 57 67

Venezuela – Caracas
Controval C.A.
Tel. (212) 9 44 09 66, Fax (212) 9 44 45 54

Asia

Azerbaijan – Baku
Modcon Systems
Tel. (12) 92 98 59, Fax (12) 92 98 59

Brunei – Negara Brunei Darussalam
American International Industries (B) Sdn. Bhd.
Tel. (3) 22 37 37, Fax (3) 22 54 58

Cambodia – Khan Daun Penh, Phom Penh
Comin Khmere Co. Ltd.
Tel. (23) 42 60 56, Fax (23) 42 66 22

China – Shanghai
❑ Endress+Hauser (Shanghai) Instrumentation Co. Ltd.
Tel. (021) 54 90 23 00, Fax (021) 54 90 23 03

China – Beijing
❑ Endress+Hauser (Beijing) Instrumentation Co. Ltd.
Tel. (010) 65 88 24 68, Fax (010) 65 88 17 25

Hong Kong – Tsimshatsui / Kowloon
❑ Endress+Hauser (H.K.) Ltd.
Tel. 8 52 25 28 31 20, Fax 8 52 28 65 41 71

India – Mumbai
❑ Endress+Hauser (India) Pvt. Ltd.
Tel. (022) 6 93 83 36, Fax (022) 6 93 83 30

Indonesia – Jakarta
PT Grama Bazita
Tel. (21) 7 95 50 83, Fax (21) 7 97 50 89

Iran – Tehran
Patsa Industry
Tel. (021) 8 72 68 69, Fax (021) 8 71 96 66

Israel – Netanya
Instrumetrics Industrial Control Ltd.
Tel. (09) 8 35 70 90, Fax (09) 8 35 06 19

Japan – Tokyo
❑ Sakura Endress Co. Ltd.
Tel. (0422) 54 06 11, Fax (0422) 55 02 75

Jordan – Amman
A.P. Parpas Engineering S.A.
Tel. (06) 5 53 92 83, Fax (06) 5 53 92 05

Kazakhstan – Almaty
BEI Electro
Tel. (72) 30 00 28, Fax (72) 50 71 30

Saudi Arabia – Jeddah
Anasia Industrial Agencies
Tel. (02) 6 53 36 61, Fax (02) 6 53 35 04

Kuwait – Safat
United Technical Services Est. For General Trading
Tel. 2 41 12 63, Fax 2 41 15 93

Lebanon – Jbeil Main Entry
Network Engineering
Tel. (3) 94 40 80, Fax (9) 54 80 38

Malaysia – Shah Alam, Selangor Darul Ehsan
❑ Endress+Hauser (M) Sdn. Bhd.
Tel. (03) 78 46 48 48, Fax (03) 78 46 88 00

Pakistan – Karachi
Speedy Automation
Tel. (021) 7 72 29 53, Fax (021) 7 73 68 84

Philippines – Pasig City, Metro Manila
❑ Endress+Hauser (Phillipines) Inc.
Tel. (2) 6 38 18 71, Fax (2) 6 38 80 42

Singapore – Singapore
❑ Endress+Hauser (S.E.A.) Pte. Ltd.
Tel. (65) 66 82 22, Fax (65) 66 68 48

Korea, South – Seoul
❑ Endress+Hauser (Korea) Co. Ltd.
Tel. (02) 6 58 72 00, Fax (02) 6 59 28 38

Sultanate of Oman – Ruwi
Mustafa & Sultan Sience & Industry Co. L.L.C.
Tel. 63 60 00, Fax 60 70 66

Taiwan – Taipei
Kingjarl Corporation
Tel. (02) 27 18 39 38, Fax (02) 27 13 41 90

Thailand – Bangkok 10210
❑ Endress+Hauser (Thailand) Ltd.
Tel. (2) 9 96 78 11-20, Fax (2) 9 96 78 10

United Arab Emirates – Dubai
Descon Trading L.L.C.
Tel. (04) 2 65 36 51, Fax (04) 2 65 32 64

Uzbekistan – Tashkent
Im Mexatronika-Tes
Tel. (71) 1 91 77 07, Fax (71) 1 91 76 94

Vietnam – Ho Chi Minh City
Tan Viet Bao Co. Ltd.
Tel. (08) 8 33 52 25, Fax (08) 8 33 52 27

Australia + New Zealand

Australia – Sydney, N.S.W.
❑ Endress+Hauser (Australia) Pty. Ltd.
Tel. (02) 88 77 70 00, Fax (02) 88 77 70 99

New Zealand – Auckland
EMC Industrial Group Ltd.
Tel. (09) 4 15 51 10, Fax (09) 4 15 51 15

All other countries

❑ Endress+Hauser GmbH+Co. KG
Instruments International
Weil am Rhein, Germany
Tel. (07621) 9 75 02, Fax (07621) 97 53 45

http://www.endress.com

Endress+Hauser
The Power of Know How

❑ Members of the Endress+Hauser group 09.02

BA 128F/00/en/02.03
016431-1000
CCS/FM+SGML 6.0

016431-1000