

DDI with PROFIBUS-DP

Ⓒ Supplement to installation and operating instructions



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Warning

These installation and operating instructions are also available on www.Grundfosalldos.com.

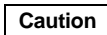
Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Symbols used in this document



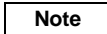
Warning

If these safety instructions are not observed, it may result in personal injury!



Caution

If these safety instructions are not observed, it may result in malfunction or damage to the equipment!



Note

Notes or instructions that make the job easier and ensure safe operation.

2. General

These installation and operating instructions contain all the information required for connecting a DDI dosing pump with PROFIBUS option to the PROFIBUS-DP V0 as a slave.

If you require further information or if any problems arise, which are not described in detail in this manual, please contact the nearest Grundfos Alldos company.



Warning

First read the installation and operating instructions for the DDI pump. Only the additional functions are described in this manual.

3. Technical data

PROFIBUS

PROFIBUS-DP V0.

Auto-detect baud rate

The following baud rates are recognised automatically:

12 Mbps, 6 Mbps, 3 Mbps, 1.5 Mbps, 500 kbps, 187 kbps, 93.75 kbps, 45.45 kbps, 19.2 kbps, 9.6 kbps.

Maximum permissible baud rate (transmission speed)

1.5 Mbps.

Bus connection

Via Y-M12 connector.

Identification of DDI pumps with PROFIBUS-DP option

The following is indicated on the DDI pump nameplate:

Control variant	Description
AP	With PROFIBUS
APF	With PROFIBUS and Flow Monitor

Enclosure class

IP 65.



Warning

IP 65 can only be ensured if the connectors have been screwed on correctly.

4. Connecting the DDI to the PROFIBUS-DP V0

4.1 PROFIBUS-DP V0

DP (Decentralised Peripherals) is the communication protocol for fast data transfer at field level. Using this protocol, the bus master (e.g. SPS) communicates with decentralised field devices/bus slaves (e.g. dosing pumps, analysis devices) via a fast serial port.

The communication functions are determined by the DP-V0 performance level. DP V0 stands for simple, fast, cyclic and deterministic exchange of process data between the bus master and the assigned slave devices.

4.2 Device master data file (GSD)

The DDI pump with PROFIBUS-DP option is integrated into the PROFIBUS-DP V0 network using the device master data file (GSD), which must be integrated into the engineering system of the PROFIBUS network. This file contains the properties of the device, specifications on its communication capabilities and additional information such as diagnosis values.

A CD for integration of the DDI pump with PROFIBUS-DP option into the device communication of the dosing pump (slave)/master (SPS) is supplied with the PROFIBUS-DP.

The CD contains

- a GSD file (device master data file)
- an illustration of the DDI pump for integration into visualisation programs
- documentation.

5. Electrical connections



Warning

Electrical connections must only be carried out by qualified personnel!

First read the installation and operating instructions for the DDI pump.

IP 65 can only be ensured if the connectors have been screwed on correctly.

5.1 PROFIBUS cabling and start-up, possible faults

5.1.1 Signal line

- Short-circuit between line A, line B or screen.
- Line A and line B interchanged or crossed.
- Line A, line B or screen interrupted.

5.1.2 Bus termination

- One end of the bus segment is not terminated.
- Two or more bus terminal resistors are switched on.
- The bus terminal resistor is not powered.
- No bus terminal resistor after a repeater without slaves.

5.1.3 PROFIBUS cable

- The bus cable installed is too long or the transmission speed is too high.
- Incorrect cable type installed (not a PROFIBUS cable).
- Cables from different manufacturers installed.
- The branch lines are too long.
- The minimum cable length of 1 metre between the devices on the bus has not been observed.

5.1.4 Electrical environment

- No or insufficient equipotential bonding conductors.
- Insufficient signal level on the RS-485 line.
- Electromagnetic interference problems:
 - capacitive coupling
 - discharges
 - leakage currents on screened cables
 - potential sources of interference, such as frequency converters, contactors, motors, etc.
 - PROFIBUS cable installed too close to potential sources of interference.
- Incorrect power supply concept.
- Unsuitable earthing concept.
- Screened cable not earthed on both sides. Earthing does not cover a sufficiently large area.

5.1.5 Bus settings

- No master in the system.
- Bus option not set to "on".
- Incorrect bus address set.
- Bus address assigned more than once.
- Incorrect baud rate set for the master.
- Too many devices (more than 32) in a single bus segment.

Note For additional information, please refer to the **PROFIBUS Guidelines (PROFIBUS-DP/FMS Installation Guidelines, Order No. 2.111)** from the **Profibus User Organisation (www.profibus.com)**.

5.2 Connection to the DDI pump

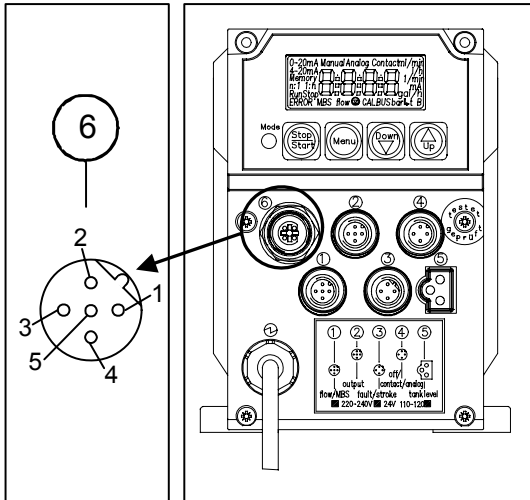


Fig. 1 Connection to DDI 209

TM03 6582 4506

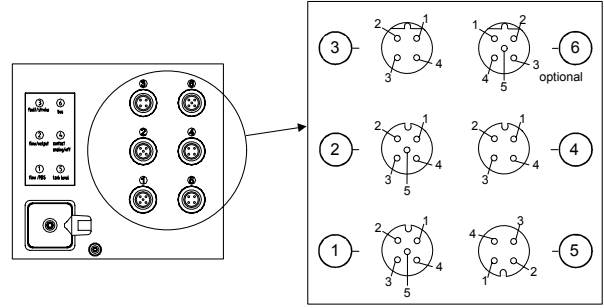


Fig. 2 Connection to DDI 222

TM03 6583 4506

- For the PROFIBUS-DP, attach a Y-M12 connector to socket 6 of the pump.
- Connect the bus to the sockets of the Y-M12 connector using 2-pin PROFIBUS cables.

5.2.1 Pin assignment, socket 6

Socket 6	Pin	Assignment	Used for
	1	+ 5 V	Bus terminal resistors
	2	RxD/TxD-N	Received/sent data (line A)
	3	GND	
	4	RxD/TxD-P	Received/sent data (line B)
	5	Screen/protective earth	

5.2.2 Bus connection

If the pump is the last device on the bus, it must be equipped with a bus terminal resistor.

- Screw the bus terminal resistor onto the Y-M12 plug.

Note To ensure the fault tolerance of the PROFIBUS system in the event of a device fault or when a device is replaced, a separate active bus terminal resistor is recommended.

5.3 Accessories: connector for PROFIBUS-DP

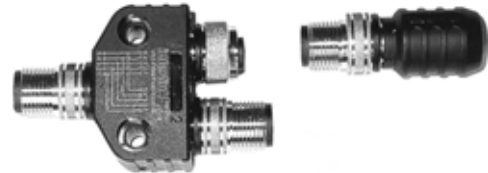


Fig. 3 Connector for PROFIBUS-DP

TM03 6584 4506

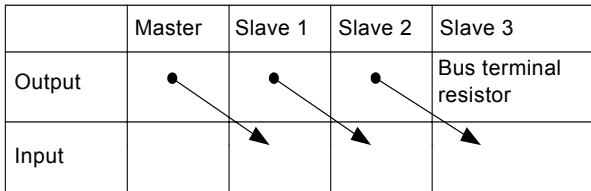
5.4 Installation diagram with terminal resistor



Fig. 4 Installation diagram

TM03 6585 4506

5.4.1 Bus cabling, master to slave



TM03 6586 4506

Fig. 5 Bus cabling, master to slave

Note *The minimum cable length of 1 metre between the devices on the bus must be observed. Make sure that the PROFIBUS cables and power cables do not run in parallel.*

6. Operating the pump using PROFIBUS-DP

6.1 Activating the PROFIBUS

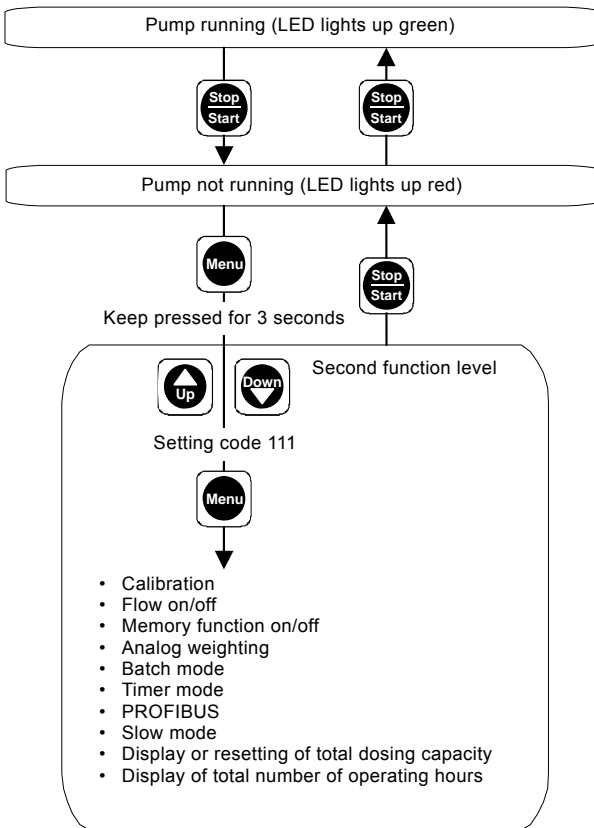
Note *First read the installation and operating instructions for the DDI pump. Only the additional functions are described in this manual.*

6.1.1 Display

As soon as PROFIBUS operation has been activated, the PROFIBUS module starts trying to accept bus operation. During correct bus operation, "BUS" is shown in the display. If an error occurs, the "ERROR" and "BUS" symbols will flash in the display.

6.1.2 Opening the second function level

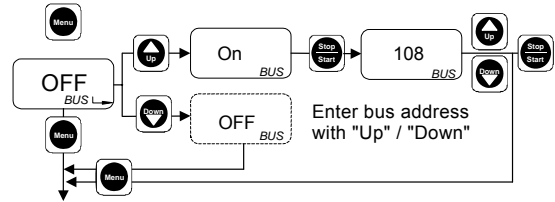
In the second function level, the PROFIBUS operation is activated and the bus address (slave address) is entered.



TM03 6587 4506

Fig. 6 Second function level

6.1.3 Activating PROFIBUS on the pump



TM03 6588 4506

Fig. 7 Activating PROFIBUS on the pump

The display shows the current PROFIBUS setting (default is OFF).

- To activate the PROFIBUS operation, press the "Up" button.
 - When PROFIBUS operation is activated, "BUS" appears in the display.
- Press the "Start/Stop" button.
 - The current bus address appears in the display.
- Use the "Up" and "Down" buttons to enter the desired bus address in the range 000-126.
 - Press the "Menu/Info" button (confirm the setting and move on to the next menu item), or
 - press the "Start/Stop" button (confirm the setting and close the second function level).

6.1.4 Bus error

A possible problem with the PROFIBUS communication is indicated on the pump. "ERROR" and "BUS" flash in the display. If there is no connection to the PROFIBUS master (cable connection, master failure), "ERROR", "BUS" and the "Arrow" icon flash in the display.

The pump continues trying to establish bus communication.

Note *A faulty connection to the PROFIBUS master is only indicated if response monitoring is enabled in the master.*

6.2 Communication between the PROFIBUS master and the pump

6.2.1 General / classification of remote control and local operation

During PROFIBUS operation, the pump can still be operated locally or controlled (remotely) via the PROFIBUS master (e.g. SPS).

It is possible to allow local operation in addition to remote control via PROFIBUS-DP, but this can also be locked via the code.

Independently of the pump control mode, the current data such as dosing volumes, chamber pressure, pump status messages and error messages are sent from the pump (bus slave) to the PROFIBUS master for further processing.

Pump settings (in local operation) are not saved as new setpoints in the PROFIBUS master. Instead they are simply sent to the PROFIBUS master as status messages.

Note

As soon as the command "Release setpoint" or "Release operating mode" is executed in the PROFIBUS master (automatically or manually), the settings from the PROFIBUS master apply.

Remote control via PROFIBUS-DP

In remote control via PROFIBUS, commands are sent from the PROFIBUS master (e.g. SPS) to the bus slaves (e.g. the pump), which means that the pump is controlled via control signals from the PROFIBUS master.

When using remote control via PROFIBUS, the following operating modes are available:

- manual
- contact
- current control 0-20 mA
- current control 4-20 mA.

Remote on/off via PROFIBUS-DP

Starting and stopping the pump using remote control via PROFIBUS have the same effects on the pump as external remote off via a contact signal at the "remote on/off" input port. External remote off and switching off via PROFIBUS switch the pump off independently of each other.

Local operation

When operating the pump locally, the settings are made directly on the pump.

During local operation, all operating modes in manual, contact or current control are available:

- manual
- contact
- current control 0-20 mA
- current control 4-20 mA
- batch dosing with manual start
- batch dosing with contact start
- timer mode with manual start
- timer mode with contact start.

Local operation can be restricted using the code function or locking "run" (locks the "Start/Stop" button).

6.3 Data protocol

The control of the pump can be different, depending on the PROFIBUS master and the visualisation software.

For remote control of the pump via PROFIBUS and for feedback from the pump, the following basic functions and setting options are available.

6.3.1 Remote control of pump via PROFIBUS-DP

Data flow from the PROFIBUS master to the pump

4 bytes are available for controlling the pump:

Byte	Data type	Data length [byte]
1	Byte	1
2	Byte	1
3, 4	Unsigned 16 Highbyte, Lowbyte	2

To control the pump using the PROFIBUS master, proceed as follows:

1. Select the operating mode (byte 1/bits 0, 1)
 - manual
 - contact
 - current control 0-20 mA
 - current control 4-20 mA.

Bit	Byte 1: Set and release operating mode, enter setpoint		
	Bit 1	Bit 0	Operating mode
0, 1	0	0	Manual
	0	1	Contact
	1	0	Current control 0-20 mA
	1	1	Current control 4-20 mA
2, 3	Reserve		
4	0 -> 1 = confirmation (release) of operating mode		
5	0 -> 1 = confirmation (release) of setpoint		
6	Transfer of actual value	0	= volume flow
		1	= pressure value (mbar) when pressure control is enabled
7	Reserve		

2. The operating mode is enabled when bit 4 changes from 0 to 1.
3. Enter the setpoint (bytes 3, 4).
Enter hexadecimal or binary as a binary number with 16 bits.
The setpoint depends on the operating mode:
 - For manual operating mode: Setpoint = volume flow.
DDI 209: Enter value in ml/h from 4 ml/h to 50,000 ml/h.
DDI 222: Enter value in cl/h from 7.5 cl/h to 15,000 cl/h.
 - For contact operating mode: Setpoint = volume per contact.
DDI 209: Enter value in µl from 1 µl to 7,860 µl.
DDI 222: Enter value in µl from 111 µl to 55,500 µl.
 - For current control operating mode 0-20 mA/4-20 mA:
Setpoint = gradient of flow rate.
DDI 209: Enter the dosing rate at 20 mA in ml/h from 4 ml/h to 50,000 ml/h.
DDI 222: Enter the dosing rate at 20 mA in cl/h from 7.5 cl/h to 15,000 cl/h.
4. The setpoint is enabled when bit 5 changes from 0 to 1.

The maximum flow rate of the pump must not be exceeded!

For current control operating mode, the setpoint (with or without weighting) must always be assigned with reference to 20 mA.

Note

Please see the additional description of current control in the installation and operating instructions for the DDI pump!

Setting and executing additional control functions

- Remote on/off (byte 2/bit 0)
 - Switches the pump on and off. For switching on, the pump must not have been manually stopped or switched off via external remote on/off. External remote off and switching off via PROFIBUS switch the pump off independently of each other.
- Slow mode (byte 2/bit 1)
 - Slow-mode operation is switched on and off.
- Continuous operation for deaeration and suction (byte 2/bit 2)
- Deletion (resetting) of the total capacity dosed (byte 2/bit 3)
 - The display of the total capacity dosed (since the pump was last reset) is reset to zero.
- Error resetting (byte 2/bit 4)
 - Resetting of an error that has occurred and restarting of the pump if it was set to "Start" locally.
- Dosing controller (byte 2/bit 5)
 - An installed Flow Monitor can be switched on and off.

Bit	Byte 2: Control functions for DDI 209	Byte 2: Control functions for DDI 222
0	Remote on/off 0 = off 1 = on	Remote on/off 0 = off 1 = on
1	Slow mode 0 = off 1 = on	Slow mode 1 0 = off 1 = on
2	Continuous operation (deaeration mode) 0 = off 1 = on	Continuous operation (deaeration mode) 0 = off 1 = on
3	Deletion (resetting) of the total capacity dosed 0 -> 1 = Resets the total capacity dosed	Deletion (resetting) of the total capacity dosed 0 -> 1 = Resets the total capacity dosed
4	Error resetting 0 -> 1 = Resets the error	Error resetting 0 -> 1 = Resets the error
5	Flow 0 = off 1 = on	Flow 0 = off 1 = on
6	Reserve	Slow mode 2
7	Pressure monitoring, only with Flow Monitor option 0 = on 1 = off	Pressure monitoring 0 = on 1 = off

6.3.2 Messages returned from the pump

Data flow from the pump to the PROFIBUS master

8 bytes are available for returning messages from the pump:

Byte	Data type	Data length [byte]
1, 2	Unsigned 16 Highbyte, Lowbyte	2
3, 4	Unsigned 16 Highbyte, Lowbyte	2
5, 6	Unsigned 16	2
7, 8	Byte	2

The following data is sent from the pump to the PROFIBUS master via PROFIBUS-DP:

- Actual value: volume flow (ml/h) / chamber pressure (mbar) (bytes 1, 2)
 - The set setpoint is determined if "Transfer of actual value" is set to "Volume flow" (DDI 209 in ml/h, DDI 222 in cl/h). The chamber pressure in mbar is transferred when "Pressure value" is set and "Pressure control" is activated.
- Display of the total capacity dosed (bytes 3, 4)
 - Display of the total capacity dosed in dl (decilitres) since the value was last reset.
- Error messages (bytes 5, 6/bits 15-0)
 - dosing controller
 - diaphragm leakage detection
 - external pre-empty signal
 - empty signal
 - Hall sensor (for motor monitoring)
 - PROFIBUS communication
 - current control – for operating mode "manual" 4-20 mA. An error message is sent if the current input is < 2 mA.

Bit	Bytes 5, 6: Error messages
0	Dosing controller 0 = no error 1 = error
1	Diaphragm leakage detection (MLS) 0 = no error 1 = error
2	Pre-empty signal 0 = no error 1 = error
3	Empty signal 0 = no error 1 = error
4	Hall sensor (for motor monitoring) 0 = no error 1 = error
5	PROFIBUS communication (inverse) 0 = error 1 = no error
6	Current control (< 2 mA in operating mode 4-20 mA) 0 = no error 1 = error
7, 8	Reserve
9	Internal pre-empty signal 0 = no error 1 = error
10	Reserve
11	Only for DDI 209 with Flow Monitor and DDI 222: If the pressure is exceeded 5 times (starting can be initiated after 10 minutes) 0 = no error 1 = error
12	Only for DDI 209 with Flow Monitor and DDI 222: If the pressure is exceeded 1-5 times in succession 0 = no error 1 = error
13-15	Reserve

- General status messages (bytes 7, 8/bits 4-0)
 - current pump status: pump off/on
 - remote off inactive/active
 - dosing controller off/on
 - slow mode off/on
 - memory function (contact memory) off/on.
- Status messages for current operating mode (bytes 7, 8/ bits 11-8)
 - manual
 - contact
 - current control 0-20 mA
 - current control 4-20 mA
 - batch dosing with manual start
 - batch dosing with contact start
 - timer with manual start
 - timer with contact start
 - calibration.

Bit	Bytes 7, 8: Status messages for DDI 209
0	Pump status 0 = pump off 1 = pump on
1	Remote off 0 = inactive 1 = active
2	Dosing controller 0 = off 1 = on
3	Slow mode 0 = off 1 = on
4	Memory function 0 = off 1 = on
5	Reserve
6	Pressure control (only for DDI 209 with Flow Monitor) 0 = off 1 = on
7	Transfer of actual value (only for DDI 209 with Flow Monitor) 0 = volume flow 1 = pressure value (mbar) with activated pressure control
8-11	Operating mode
	Manual
	Contact
	Current control 0-20 mA
	Current control 4-20 mA
	Batch dosing with manual start
	Batch dosing with contact start
	Timer with manual start
	Timer with contact start
	Calibration
12-15	Reserve

Bit	Bytes 7, 8: Status messages for DDI 222
0	Pump status 0 = pump off 1 = pump on
1	Remote off 0 = inactive 1 = active
2	Dosing controller 0 = off 1 = on
3	Slow mode 1 0 = off 1 = on
4	Slow mode 2 0 = off 1 = on
5	Memory function
6	Pressure control 0 = off 1 = on
7	Pressure control 0 = volume flow 1 = pressure value (mbar) with activated pressure control
8-11	Operating mode
	Manual
	Contact
	Current control 0-20 mA
	Current control 4-20 mA
	Batch dosing with manual start
	Batch dosing with contact start
	Timer with manual start
	Timer with contact start
	Calibration
12-15	Reserve

6.4 Data transmission (programming examples)

Example 1

The pump is to be switched on and off via PROFIBUS. The setpoint (volume flow) and the operating mode are set on the pump.

PROFIBUS settings

- for switching on the pump
 - byte 1 = 00h
 - byte 2 = 01h – set bit 0, switch on the pump
 - byte 3 = 00h
 - byte 4 = 00h.
- for switching off the pump
 - byte 1 = 00h
 - byte 2 = 00h
 - byte 3 = 00h
 - byte 4 = 00h.

Example 2

The pump is to be switched on and off via PROFIBUS. The setpoint is 1 l/h and is transferred via PROFIBUS. The pump is to be operated in slow mode.

PROFIBUS settings

- for transferring the setpoint
 - byte 1 = 20 – set bit 5, accept setpoint
 - byte 2 = 00h
 - byte 3 = 03h – setpoint 1000 ml/h (decimal)
 - byte 4 = E8h – corresponds to 03E8 in hexadecimal format.
The transferred setpoint can be read and monitored via the feedback actual value for bytes 1 and 2.
- for switching on the pump and slow mode:
 - byte 1 = 00h
 - byte 2 = 03h – set bits 0 and 1, switch on pump and slow mode
 - byte 3 = 00h
 - byte 4 = 00h.

7. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use appropriate waste collection services.
2. If this is not possible, contact the nearest Grundfos or Grundfos Alldos company or service workshop.

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