AVENTICS

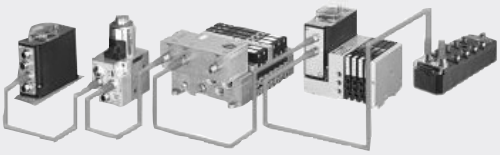
Operating instructions

System description Drive & Diagnostic Link

DDL

R499050031/2016-12, Replaces: 08.2014, EN

English



Contents

Contents

Contents

Contents

1 Safety Precautions

- Please pay attention to the general safety instructions and notice the content of the user manual, before you install, start up, put pressure or electrical power to the devices.
- The devices should be used only in areas and systems they are specified for and also comply with the tolerances of the technical data. In case of non compliance and upon exceeding the limits, which are mentioned under the point: technical data, the danger of overheating can be caused as well as damage to the device, interference in the function and/or the electrical security.
- The AVENTICS devices have been generally developed to be used within the industrial sector. If devices shall be used in living quarters (living and business and industry sector) a special permission has to be procured from the licensing authority. In Germany licences are issued by the Regulierungsbehörde für Telekommunikation und Post (RegTP).
- To observe the technical data you should only use cables and wires, being mentioned in the user manual or quotation drawing.
- The devices have to be grounded according to the instructions. The relevant DIN/VDE standards or the country specific standards have to be observed upon installation. Note especially:
  - VDE 0160 (EN 50178)
  - VDE 0100
- The supply voltage has to be applied from a powerpack with protective separation according to EN 60742, classification VDE 0551. Please pay attention that the external fuse of the devices is in accordance with the description.
- A faultless and safe operation of the devices requires an appropriate transport, storage, installation and start up.
- The devices have to be opened only by qualified staff. Electrostatic accidentally dangerous parts.

- The installation of the devices has to be effected only by qualified staff and without power supply and pressure. Please observe the installation position, mentioned in the user manual.
- To avoid dangerous movements, the electrical start up has to be made on in depressurized state.
- Start up the device only after installation and tests have been completely finished.
- Plugs must not be plugged or unplugged under voltage. To avoid electrical damage to the device, switch off the power supply before plugs are plugged/unplugged.
- To achieve the protection class and function all seals have to be intact and fit in correct position.
- The protection class can only be achieved if all unused plugs are sealed with covers or endplugs.
- Switches and configuration must not be changed during operation. Changed settings only become valid after power recycle.
- No equalizing currents due to potential differences must run via the shield, otherwise the earthing have to be made via separate wires.
- Use in explosive Area:
  Some DDL participants can be used in explosive areas. For these certified devices at the end of the corresponding chapter important notes can be found. If the devices are used in explosive areas, these notes have to be read and attention has to be paid.
- Further safety precautions in the user manual have to be followed.
- We refuse all liability for nonobservance of these notes, for handling of the device or use in an improper way. Furthermore the guarantee on our devices and accessories expires.

2 DDL General

The Drive & Diagnostic Link (DDL) from AVENTICS is a system to use solenoids, pressure control valves and digital and analog I/O modules with different field bus systems. Independent from the used field bus, the systems can be projected and with the corresponding bus coupler connected to common field busses like PROFIBUS DP, Interbus S, ControlNet and DeviceNet. DDL provides, independent from fieldbus, 128 inputs and 128 outputs per bus coupler. For the reason of the transfer mode system, there is a high data security which is even increased by the diagnostic functionality. In this way the DDL participants and the supply voltages are controlled and reported to the diagnostics. Furthermore the coils of valve units are observed according to open load and short circuit. Therefore errors can be quickly recorded up to the affected valve and measures initiated. In addition some DDL participants offer the possibility to determine via parameter the reaction upon failure of fieldbus and DDL. On the basis of the employment of M12 connectors the connection is very simple and safe. A total length of the cable of 40 m is permitted and offers a high flexibility with the DDL. Here the gap between the modules is regardless. Because of the high modularity most of the AVENTICS valve families can be employed with DDL.

2.1 DDL System Overview

Basically the DDL consists of two types of participants:

- The bus coupler makes it possible to transfer data between the fieldbus system (PROFIBUS DP, Interbus S, DeviceNet, ...) and the DDL. The bus coupler is therefore the DDL master and has to be existent once.
- The DDL participant is therefore the slave within the DDL system. Up to 14 participants can be connected to the DDL.

The bus coupler with drivers contains, in addition to the Master module, which is the real bus coupler, also a Slave module which represents the DDL participant. This Slave module is therefore a DDL participant and up to 13 other DDL participants can be connected.

2.2 DDL Addressing

In the DDL system a definite address has to be assigned to each participant (except for the Master module of the bus coupler). This is effected via a hex rotary switch at the devices.

Table 1: DDL address switch

Position of Switch	Meaning
0	automatic addressing
1	DDL address 1
2	DDL address 2
3	DDL address 3
4	DDL address 4
5	DDL address 5
6	DDL address 6
7	DDL address 7
8	DDL address 8
9	DDL address 9
A	DDL address 10
B	DDL address 11
C	DDL address 12
D	DDL address 13
E	DDL address 14
F	no function

The addressing can be effected in two different ways:

1. Manual addressing
2. Automatic addressing

Manual and automatic addressing cannot be effected at the same time.
Please take into consideration that upon effecting the address adjustments, changes will only be taken over after a reset of voltage.

2.2.1 Manual Addressing

A definite address, between 1 and 14, is allocated to each participant. No participant must have the address 0. Furthermore the lowest address must be 1 and there must not be any gaps between the addresses. The addressing is, however, independent from the physical position of the participant in the DDL and its type.
Example: 5 DDL participants are connected to a bus coupler Stand alone (needs no DDL address).

Table 2: Example for manual DDL addressing

Correct:		Incorrect: Gap (4) and lowest address ≠ 1		Incorrect: Address 0 is used	
DDL Address	DDL Node	DDL Address	DDL Node	DDL Address	DDL Node
1	pressure control valve	2	pressure control valve	0	pressure control valve
2	valve driver	3	valve driver	1	valve driver
3	valve driver	5	valve driver	2	valve driver
4	input module	6	input module	3	input module
5	output module	7	output module	4	output module

2.2.2 Automatic Addressing

If there is only one participant per type in the DDL system, the DDL can automatically address itself. For this the address 0 has to be allocated to all DDL participants. In this case the DDL system allocates the address automatically to the participants. The following table shows, what kinds of module types are available and where to find them in the data and the diagnosis range.

If not all module types are used, the following modules move up. If the automatic addressing is used, addresses between 1 ... 14 must not be used.

Table 3: Data range at automatic DDL addressing

Output Data Position	DDL Node Type	Input Data Position	DDL Node Type	Diagnosis Data Position	DDL Node Type
1	EP pressure control valve	1	EP pressure control valve	BC	bus coupler
2	valve driver	–	valve driver	1	EP pressure control valve
–	input module	2	input module	2	valve driver
3	output module	–	output module	3	input module
4[1)]	combi module	3[1)]	combi module	4	output module
–	–	–	–	5	combi module

[1)] only, if input or output data are configured.

2.2.3 Error Upon Addressing

In order that the DDL is able to recognize and control all participants, the above mentioned regulations have to be observed. If the DDL has not been addressed correctly, this will be indicated by the participant's red DDL LED. If two participants have the same address, this cannot be recognized that safely that the DDL gets not into Run mode. This type of wrong addressing can be recognized by checking the number of livebits. In case of a DDL communication diagnosis, the addressing of all participants shall be checked. Furthermore the same baud rate has to be adjusted with all participants, also with the Master module. In addition it has to be checked that all cables have been correctly connected. Upon problems with very long cables we recommend to run the DDL with 125 kBaud. For further information on the baud rate adjustments, please refer to the description of the device.

2.3 DDL Diagnosis

The DDL participants/bus couplers have two kinds of diagnosis. On the one hand, each DDL device has LEDs to indicate the diagnosis visually. On the other hand the DDL participants send diagnosis data via the DDL to the bus coupler, which transmits its own data and the diagnosis data of the DDL participants to the control. The meaning of the diagnosis data and further information can be taken from the corresponding chapters. The DDL communication respectively the availability of the DDL participants is constantly controlled by the bus coupler. As soon as all configured DDL participants exist and communicate, the red DDL LED turns off. If a participant does not communicate any more, the red DDL LED will light at the corresponding participant and the bus coupler reports the interference. In addition the corresponding livebit and the DDL LED at the bus coupler (Master module) lights (if existing). The communication to the other DDL participants will however be maintained. If the bus coupler recognizes the recurring participant (DDL LED at the participant will go off), that way the configuration will be all right, the DDL LED at the bus coupler will also go off.
In order to initialize the system correctly, the valves must not be controlled. All supply voltages must exist correspondingly.

2.4 DDL Data

2.4.1 DDL Connection

The connection of the DDL is effected via 5 pin M12x1 plugs. 5-wire, shielded lines have to be used as connecting cables. The shield has to be connected to the thread of the plug. The diameter of the wires is 0.34 mm^2 minimum. The DDL IN connection is performed by a mounting male plug and the DDL OUT connection as mounting female plug at the DDL participants. As DDL participants can be damaged if 24 V are applied to the signal line DDL H and DDL L or the supply lines have been exchanged, we recommend to use pre fabricated and

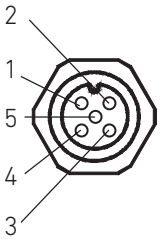


Fig. 1: DDL connection

examined wiring. This is also mentioned in chapter 5 “DDL Accessories“.

1 Pin 1 = 24 V electronics
2 Pin 2 = 24 V valves
3 Pin 3 = 0 V
4 Pin 4 = DDL H
5 Pin 5 = DDL L

2.4.2 DDL Cable Length

The total cable length of DDL system is limited to 40 m. Thereby it is irrelevant, whether the length between the two participants will be used or distributed equally.
With great cable length and great consumption of electricity, the voltage drop over the cables can provoke, that the supply voltages at the DDL participants fall below the respective tolerance limits. In such cases the DDL valve drivers can be used with an external power supply (337 500 015 0 or 1 827 030 190 0), which, because of the additional supply, indicate the voltage supply level.

2.4.3 DDL Cycle Times

DDL is constructed for a fast and secure data transfer. The DDL cycle times depend on several parameters. In that way the baud rate, number of participants and configured in and output data length (max. 128 bit) have influence on the cycle time.
In table 4 some applications and the corresponding DDL cycle times are shown.
The process times in the bus coupler (approx. 0.8 ms) and the cycle time of the field bus are not included in this overview. The cycle time can be seen as an average value. With an ideal data transmission the signal can be transmitted considerably earlier. With critical applications it should be taken into consideration that with an unfavorable data transmission it could take a cycle time twice as long, until the signals are output or transmitted to the field bus.

Table 4: Examples for DDL cycle times with different DDL configurations

Example	DDL Baud rates	DDL Participants	DDL Data length I/O	DDL Cycletime
1	**250 kBaud**	**2**	**0/32**	**3.0 ms**
2	250 kBaud	5	128/128	7.0 ms
3	250 kBaud	14	128/128	14.0 ms
4	125 kBaud	2	0/16	4.2 ms
5	125 kBaud	5	128/128	13.0 ms

2.4.4 Standards

The DDL system fulfills the standards for EMC, listed below:

- EN 61000-6-4
- EN 61000-6-2

3 Bus Coupler

AVENTICS bus couplers allow to connect pressure control valves, valve units and digital and analog in and output modules to a programmable logic control (PLC) by using a field bus system like PROFIBUS DP, Interbus S, ControlNet, DeviceNet, CANopen,... . One advantage of a serial control is the saving of the parallel output cards in the PLC as well as the necessary wiring. Another one is the possibility to transfer further information like Diagnosis and parameters.
Bus couplers are available in two different designs. On the one hand there is the Stand alone module. It consists only of the Master module. The Master module communicates with the field bus system and controls the DDL. On the other hand bus couplers with drivers to control the valve via a 25 pin D-Sub plug, are available. They have, in addition to the Master module, also a Slave module which operates like a single DDL participant, but is situated within the same housing.

3.1 PROFIBUS DP 337 500 025 0/337 500 026 0

The bus coupler for PROFIBUS DP is available in two different designs. The bus coupler with drivers (337 500 026 0) can be directly mounted onto a valve unit. Apart from controlling this unit, the DDL is also available for other DDL participants.
The bus coupler Stand alone (337 500 025 0) is mounted separately and offers only the DDL. The parts of description of the Slave module, do not apply to the bus coupler Stand alone.
Both modules are connected to the PROFIBUS DP via a shielded 2 wire cable.

3.1.1 Overview

PROFIBUS DP

The field bus system PROFIBUS DP which is used for the communication with the control, is a fast working bus system for the cyclic exchange of user data. PROFIBUS DP is a master slave bus system, where 2 master and 122 passive participants maximum can be connected to. Two designs as transmission medium are available:

- 2 wire line (shielded)
- optical fibre

For installation information of the networks and for the configuration of the lines, please refer to the documentation of the PROFIBUS association. http://www.profibus.com

Bus Coupler PROFIBUS DP

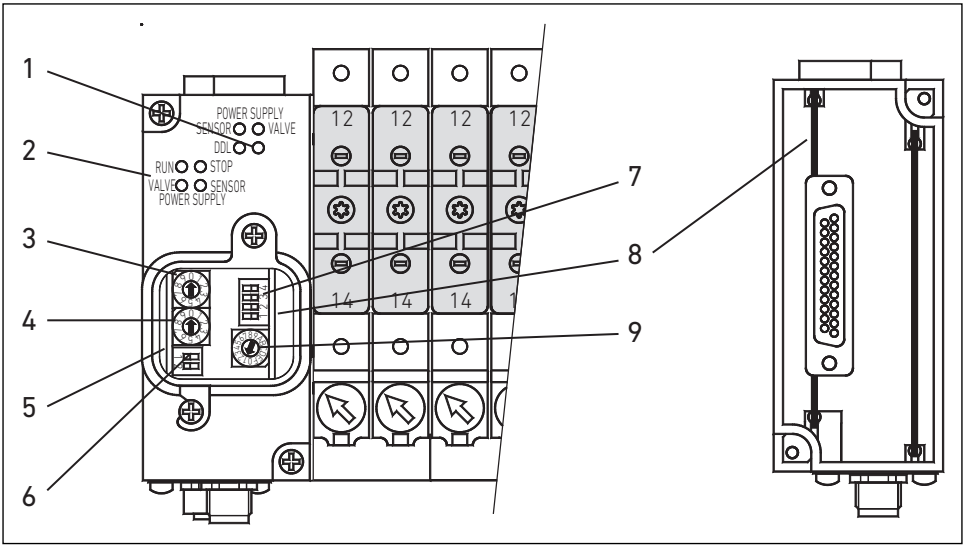


Fig. 2: LED and switch of 337 500 026 0

1 DDL LEDs
2 PROFIBUS LEDs
3 DP address S1
4 DP address S2
5 Master module
6 DDL mode S3
7 DDL mode S4
8 Slave module
9 DDL address S5

3.1.2 Master Module

The Master module is the interface between the PROFIBUS DP and the DDL. It controls the DDL and monitors the supply voltages.

PROFIBUS DP Addresses

Before a connection to the PROFIBUS DP System, an address will have to be assigned to the bus coupler. After opening the sealing cap, the address is assigned by two rotary switches. Addresses from 0 ... 99 can be assigned. With switch S1 the ten digit is set, with S2 the one digit is set. In the factory the devices are already adjusted to address 3.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

PROFIBUS DP – Baud Rates

The PROFIBUS transfer rates are adjusted with the PROFIBUS master (PLC) and are then automatically recognized by the slave (bus coupler). The following values can be adjusted as rates of transmission:
9.6 / 19.2 / 93.75 / 187.5 / 500 / 1500 / 3000 / 6000 / 12000 kBaud.

PROFIBUS DP Configuration

For the PLC configuration software, e. g. COM PROFIBUS the device master file **RXP_05EF.gsd** will be needed. This file is included in the delivery or can be ordered separately under the following no.: 546 046 941 2. The file has to be copied into the directory which was defined by the PLC configuration software. On this disk are also two Icon files for this bus coupler (RX_D05EF.dip/RX_R05EF.dib).
For the configuration of the bus coupler, the type of station bus coupler has to be selected (above folder Valves/AVENTICS). After selection of the field "configuration" and modules, the corresponding DDL modules have to be inserted. Each participant of the DDL has to be singly configured as a module. The DDL participant with address 1 has to be configured as module 0, participant 2 as module 1 etc.

Combi modules need 2 modules, but only one DDL address. Thereby the number of the module moves one digit per module towards the DDL address.

Also the length of the data of the valve unit and the input module must be correctly adjusted. Arbitrary addresses in the address area of the control can be assigned to each module (if the control permits this).
If the configuration differs from the real DDL system, the bus coupler will not be recognized correctly by the PROFIBUS master!

Parameter

These functions are deposited in the GSD file and can be displayed as plain text via a configuration tool (e.g. COM PROFIBUS or S7 Hardware configuration). Per each DDL participant one byte is transferred and also one byte for the bus coupler. Each single parameter byte for the participants can be individually adjusted. If no parameters are adjusted, the DDL participants use their default parameter.

Changed parameters only become valid if the device has been turned off and on again.

Bus Coupler Parameter

Table 5: Bus coupler parameter

Bit	Name of Parameter	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reserved		
2	reserved		
1	diagnosis send to PLC	no (default)	yes
0	reaction upon PROFIBUS failure	values at 0 (default)	freeze values

Bit 0 = 0 Upon failure of the PROFIBUS DP, the output data in the bus coupler are set at 0 (default).

Bit 0 = 1 Upon failure of the PROFIBUS DP, the output data in the bus coupler remain with the last value and the coils will be kept driven (values frozen).

Upon return of the PROFIBUS communication the outputs can be set at 0 of short duration.

Bit 1 = 0 No diagnosis data which go beyond the PROFIBUS DP standard diagnosis are sent to PLC (default).

Bit 1 = 1 User diagnosis data (DDL diagnosis) are send to the PLC via the PROFIBUS DP.

DDL Participant Parameter

The parameter descriptions of the individual DDL participants can be taken from the corresponding chapters.

DDL Address

At the Master module respectively. Stand alone bus coupler no DDL Address has to be set.

For correct function of the DDL (Drive & Diagnostic Link) following items must be fulfilled.

- same Baud rate at all DDL modules
- DDL Address within 1 ... 14, starting with 1, without gap, no double used Address
- DDL Address 0: see chapter 2.2 “DDL Addressing”.

DDL Mode

The transmission rate of the DDL is adjusted with the 2 bit DIP switch S3, next to the PROFIBUS DP address switches at the forefront. All DDL participants have to be adjusted to the same transmission rate.

Table 6: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

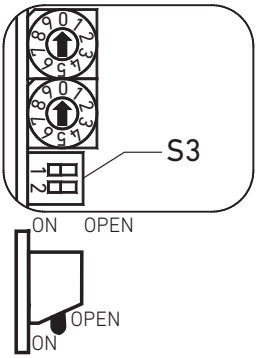


Fig. 3: DIP switch S3:
DDL mode

Diagnosis

LED Diagnosis

On the top side of the device LEDs indicate the state of the PROFIBUS DP interface as well as of the power supply.

Table 7: Overview on the LED indications

Description	Color of LED	Meaning
STOP	red lighting	bus stop / DDL configuration not ok / Hardware not OK
	red flashing	bus stop / DDL configuration ok / PROFIBUS configuration meets not the actual DDL configuration
Run	green	bus in operation / configuration ok / DATA exchange
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection of sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection of sensor supply (X1S, Pin 1)

Voltage Monitoring

The applied voltage is indicated by two green LEDs. The voltages at plug DDL are indicated. The liminal supply voltage is at 19.2 V/21.6 V for low voltage and at 26.4 V/28.8 V for overvoltage.

Short Circuit Monitoring

The bus coupler has a short circuit monitoring for the DDL. Both power supplies are monitored independently from each other. If the short circuit monitoring in the bus coupler starts up, the corresponding green LED begins to flash.

Software Diagnosis

In case of error, an „EXT_DIAG" message is send via the PROFIBUS DP, to the control. The length of the ext. diagnosis message depends on the number of participants. For the bus coupler Stand alone 337 500 025 0 the length is 4 byte diagnosis + 1 byte header (PROFIBUS Norm). After the bus coupler the diagnosis for the participants is sorted upwards, according to the DDL addresses. For each further DDL participant the commensurate diagnosis bytes are added. The diagnosis length of a valve driver consists of 1 Byte + the configurated data length. The Diagnosis data length for other DDL nodes can be read up on the corresponding chapters.
The bus coupler with drivers (337 500 026 0) behaves like the Stand alone module and an additional DDL participant for valve control (see Slave Module).
To use the diagnosis function, the corresponding parameter has to be adjusted (see table 5, parameter for the bus coupler).

Table 8: Example: diagnosis fieldbus module PROFIBUS DP with one valve unit incl. standard diagnosis

Byte	Regarding	Bit 7	6	5	4	3	2	1	0
0	DP Norm								
1	DP Norm								
2	DP Norm								
3	DP Norm								
4	DP Norm								
5	DP Norm								
6	Headerbyte	0	0			block length in Byte			
7	Bus coupler	–	–		DDL gaps between addresses or address 0 and 1 ... 14 have been mixed	DDL no units at DDL	24 V electronic input diagnosis	24 V valve voltage at DDL output diagnosis	24 V electronic voltage at DDL output diagnosis
8	Bus coupler								
9	Bus coupler	DDL addr.#8 exists	DDL addr.#7 exists	DDL addr.#6 exists	DDL addr.#5 exists	DDL addr.#4 exists	DDL addr.#3 exists	DDL addr.#2 exists	DDL addr.#1 exists
10	Bus coupler	–	–	DDL addr.#14 exists	DDL addr.#13 exists	DDL addr.#12 exists	DDL addr.#11 exists	DDL addr.#10 exists	DDL addr.#9 exists
11	module with address 1 (valve unit)	DDL comm. diagnosis		–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
12	module with address 1 (valve unit)	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
13	module with address 1 (valve unit)	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
14	module with address 1 (valve unit)	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
15	module with address 1 (valve unit)	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the diagnosis bits

- Byte 6:
  - Bit 0 ... 5: total length of the diagnosis data in byte
- Byte 7:
  - Bit 0: Electronic power supply of succeeding DDL modules below 19.2 V or beyond 28.8 V
  - Bit 1: Valve power supply of succeeding DDL modules below 21.6 V or beyond 26.4 V
  - Bit 2: Power supply of Master module electronics below 19.2 V or beyond 28.8 V
  - Bit 3: No external modules connected to DDL
  - Bit 4: Gaps between addresses, address 0 and 1 ... 14 have been mixed up or addresses have been assigned twice. (It cannot be assured that double addresses are recognized safely)
- Byte 8:
  - free
- Byte 9 + 10:
  - Bit 0 ... 7: For each existing address the corresponding bit will be set.

With automatic addressing the following is valid:

- Byte 9:
  - Bit 0: Pressure control valve
  - Bit 1: Valve driver
  - Bit 2: Input module
  - Bit 3: Output module
  - Bit 4: Combi module

3.1.3 Slave Module

The Slave module behaves like a DDL participant for valve control but it is situated within the housing of the bus coupler. According to this a DDL address and a baud rate have to be adjusted! The connection to the valve unit is effected via a 25 pin D-Sub plug at the bottom side of the module.

DDL Address

The DDL address is adjusted with the switch S5. The regulation for the adjustment can be found in chapter 2.2 “DDL Addressing“.

DDL Mode

The DDL baud rate is adjusted with switch S4. All participants have to be adjusted to the same baud rate.

Table 9: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

Output Data Length

With switch S4 the number of outputs is adjusted. With this it is possible to optimize the needed data range of the control for smaller valve units.

Table 10: Data length

Bit 3	Bit 4	Data length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

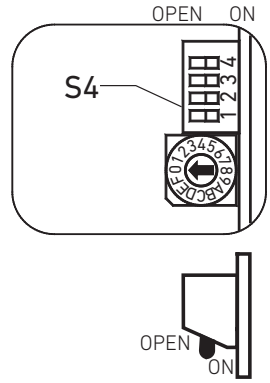


Fig. 4: DIP switch S4

The 4 byte mode offers a conformity with 16 bit PLC systems. But only the first 3 bytes are transferred to the outputs of the D-Sub plug.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Output Data Range of the Control

The DDL address determines the position of the output data in the data range of bus coupler and therefore the position in the address range of the control. The valve driver occupies, depending on the length set, 1 ... 4 byte in the output range of the control. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Table 11: Output bits

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

At Pin 25 of 25 pol. D-Sub plug 0 V is connected.
If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The valve driver does not occupy any data in the input range, only within the diagnosis range of the DDL.
Byte X is the start address of the output data range of the DDL participant in the control (see PROFIBUS DP Configuration).

Diagnosis

LED Diagnosis

Table 12: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see below)

The limits of power supply (electronics/valves) are at 19.2 V/ 21.6 V for low voltage and at 28.8/26.4 V for overvoltage. The voltages are measured at plug DDL OUT.
The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Voltage Monitoring

The applied voltage supplies are indicated by two green LEDs: Voltages at the plug DDL are shown. The threshold of the power supply (electronic/valves) are at 19.2 V/21.6 V for under voltage and at 28.8 V/26.4 V for overvoltage.

Software Diagnosis

The software diagnosis of the Slave module is 1 byte standard diagnosis + configured data length long.
With bus coupler 337 500 026 0 the outputs from 24 ... 31 are not really existent. For this reason there is no rational diagnosis. With smaller valve units further outputs and their diagnosis can not be used.
The address range of the diagnosis drives from the DDL address.

Bus Coupler

If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.

Table 13: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits

- Byte Z Bit 0: Power supply of the electronics below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: Output short circuit or open (see description of the parameter).
- Byte Z is the start address of the diagnosis range of the DDL participant in the control.

NOTICE

A short circuit can only be detected if the output is driven. An open output can only be detected if it is not driven.

Parameter

The Slave module provides the DDL master module for PROFIBUS DP with these functions. For each DDL participant one byte for parameter is available. The parameters are transferred only with the DDL initialization. Each parameter byte for the participants can be adjusted individually. In connection with the PLC the PROFIBUS provides comfortable possibilities for adjustment. If the control does not provide these functions, default parameters will be used.

Table 14: Parameter for the Slave module

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	for controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what coils do exist. This information is then transferred via a diagnosis message to the control. In the control this message can be compared with a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing coils can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the Slave module.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the Slave module and the coils are still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

3.1.4 Connectors

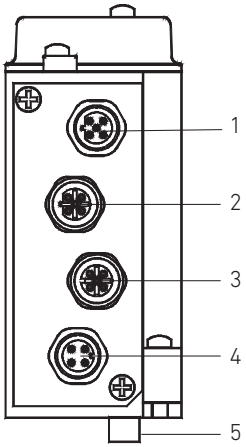


Fig. 5: Connectors

1 X7P2: PROFIBUS DP Input
2 X7P2: PROFIBUS DP Output
3 XPD: DDL OUT
4 X1S: Power supply
5 X2O: Valve driver (only 3375000260)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the bus coupler onto the valve driver is only allowed when the device is off circuit!

Power Supply

The power supply is connected via the circular plug X1S. Only 4 pin M12 connecting bushes should be used, where pin 5 is closed; in order to avoid a mix up with other connections. The diameter of the wires should be chosen as big as possible, but at least 0.5 mm^2.

Both power supplies must be secured with external 3 A T fuses. The maximum allowed voltage in the 0 V line is limited to 4 A by the connector.

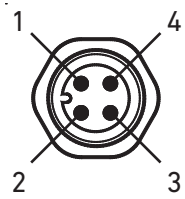


Fig. 6: X1S power supply

1 Pin 1: 24 V sensor voltage / electronics
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

The electronics of the bus coupler and the electronics of all I/O modules and initiators connected to the DDL (with modules without ext. power supply) are supplied via X1S, pin 1.
If modules without an external power supply are used, the switching voltage for connected valves must be supplied via X1S, pin 2.Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.

The 24 V supplies must be effected out of a common power supply unit respectively with a common 0 V connection. **A power supply unit with a secure separation according to EN 60742, classification VDE 0551 should be used.**

Data Line PROFIBUS DP

The connection to the PROFIBUS system is done with data plug M12 5 pin. B coded female at PROFIBUS DP IN (X7P2) or male at PROFIBUS DP OUT (X7P1). Both connections are connected in parallel and have the following assignment:

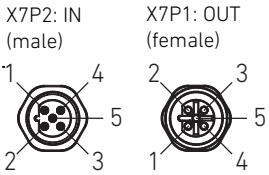


Fig. 7: PROFIBUS DP data plug

1 Pin 1: 5 V Supply for the connecting plug
2 Pin 2: A data line
3 Pin 3: 0 V supply voltage for the terminating plug (5 V)
4 Pin 4: B data line
5 Pin 5: shield

The connection is in correspondence with the recommendations of the PROFIBUS association for the allocation of the 5 pin M12 B coded plug.

Bus Coupler

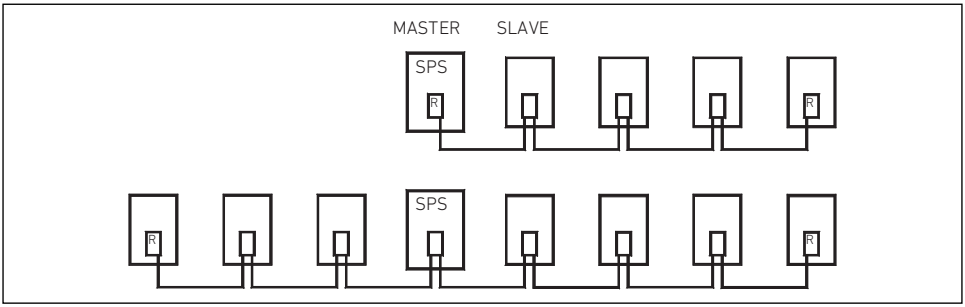


Fig. 8: Possible layout of bus participants

The terminating resistors integrated in the connecting plugs of the participants marked with a “R” have to be activated or with the bus coupler, the PROFIBUS DP terminating plug M12, B coded (see chapter 5 “DDL Accessories“) has to be plugged to the connector PROFIBUS DP OUT.
There has to be a terminator for the first and also for the last participant of a bus line (see illustration 8). The termination resistor is designed for a PROFIBUS DP cable of type A (wave resistance 135 ... 165 Ω) and integrated into the end plug.

Data Line DDL

The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason it is recommend to use pre fabricated cables (see chapter 5 “DDL Accessories“). The allocation of the DDL connections are described in chapter 2.4 “DDL Data“.
The DDL end plug (see chapter 5 “DDL Accessories“) is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

3.1.5 Technical Data

Profibus DP

Technical Data	
Operating voltage valves	24 V DC +10 -0 %
Operating voltage initiators and electronics	24 V DC ±20 %
Fuse of the valve voltage external	3 A T
Fuse of electronics external	3 A T
Attention: Maximum current in the 0 V line	max. 4 A
Voltage drop, internal	0.8 V
Required power electronics	90 mA
Power supply for sensors	max. 3 A per DDL branch
Power supply for valves	max. 3 A per DDL branch
Number of output bytes (only 337 500 026 0)	1 / 2 / 3 / 4 byte
Run up period after switching on the power supply	2 s
Ambient temperature range	+5°C ... +50°C +5°C ... +40°C (ATEX) +5°C ... +50°C (ATEX)*
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical data	s. quotation drawing

* With a current I of max. 2 A per valve and sensor

3.1.6 Dimensions

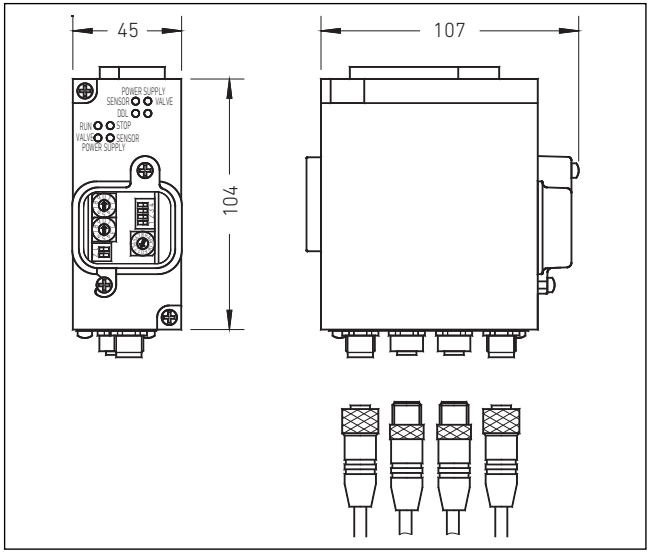


Fig. 9: Dimensions of the bus coupler with drivers (337 500 026 0)

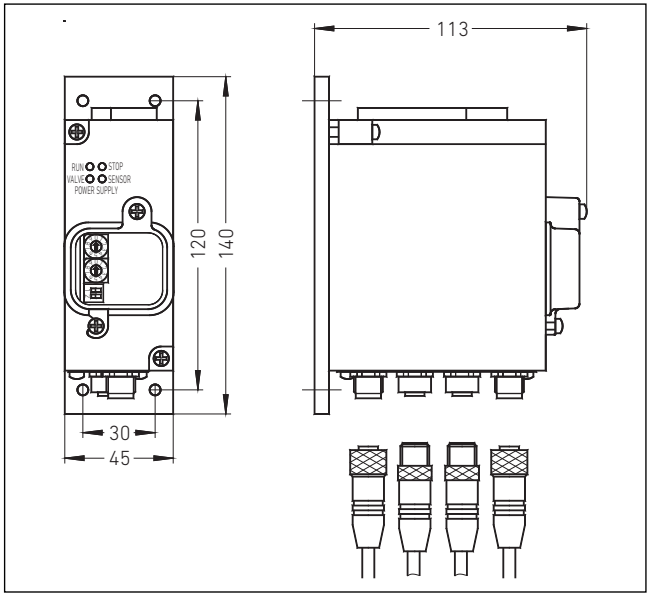


Fig. 10: Dimensions of the bus coupler Stand alone (337 500 025 0)

3.1.7 ATEX-Relevant Information

If the bus coupler PROFIBUS DP 337 500 025 0 is used in zone 2, attention has to be paid to the following ATEX-relevant information.
See chapter 3.6.1 “Ex-Relevant Excerpt from the Operating Instructions for S-Design Bus Couplers“.

3.2 DeviceNet R412006999/R412006998

The bus coupler DDL for DeviceNet is available in two different designs. The bus coupler with drivers (R412006998) can be directly mounted onto a valve unit. In addition to the control of this unit the DDL is also available for other DDL participants. The bus coupler Stand alone (R412006999) is separately mounted and provides only the DDL.
Parts of the description concerning the Slave module are not valid for the bus coupler Stand alone.

3.2.1 Overview

DeviceNet
DeviceNet is a CAN protocol that is based on a definite master/slave connection. Several masters can share a physical CAN data line and control several slaves. A slave though is always dedicated to one master and can only exchange data with this one. A master must first release a slave before another master is able to ask for the slave and activate him.
The electronic data sheet (EDS) can be downloaded from the Internet at www.aventics.com/mediadirectory:
0064000000040205.eds
Type: EDS Configuration File

For information concerning the installation of the network and regarding the preparation of the line, please refer to the documentation of the company Rockwell Automation/Allen-Bradley.

Bus Coupler

Bus Coupler DeviceNet

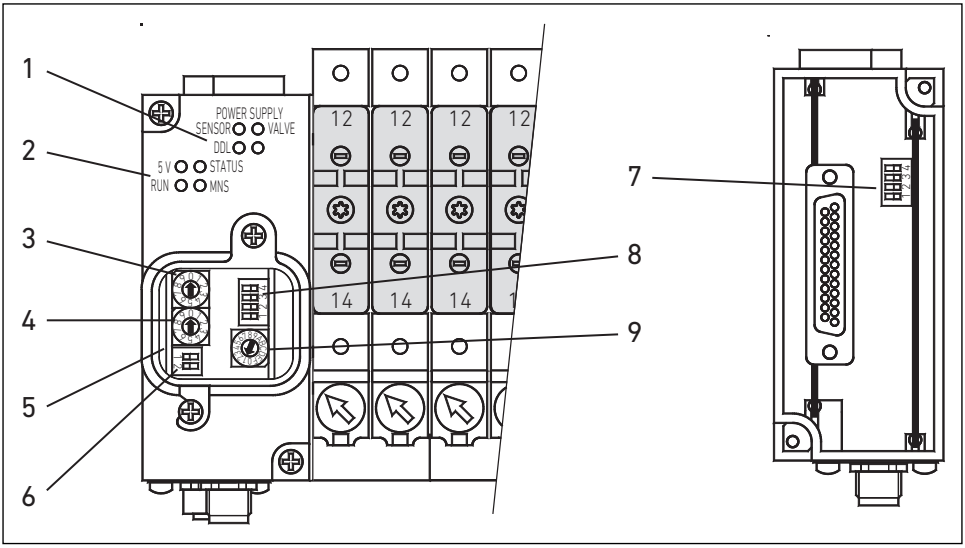


Fig. 11: LED and switches of R412006998

1 DDL LEDs
2 DeviceNet LEDs
3 DN address S1
4 DN address S2
5 Master module
6 DeviceNet baud rate S3
7 Master module S4
DDL baud rate
8 Slave module DDL mode S6
9 DDL address S5

3.2.2 Master Module

The Master module is the interface between the DeviceNet and the DDL. It controls the DDL and monitors the supply voltages.

DeviceNet Addresses

A definite address is allocated to each participant in the network. Via two rotary switches addresses from 0 ... 63 can be set. With switch S1 the ten digit and with S2 the one digit is adjusted. If the ID has been adjusted higher, it is reduced by 64. In the factory the devices are adjusted to address 2.

DeviceNet Baud Rates

The baud rate of the DeviceNet system is adjusted with the 2 bit DIP switch S3 next to the DeviceNet address switches at the front side.

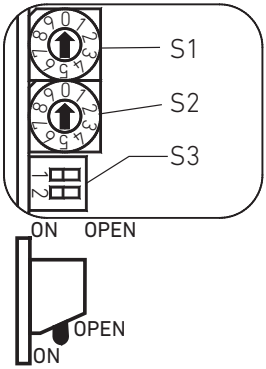


Fig. 12: DIP switch S3: DeviceNet baud rates

Table 15: Adjustment of the DeviceNet baud rates

Bit 1	Bit 2	Baud Rate
On	Open	500 kBaud
Open	On	250 kBaud (default)
Open	Open	125 kBaud

DeviceNet Data

The length of the output data range (valves, nominal value, ...) is fixed to 16 byte (10 hex) maximum. The length of the input data range (sensors, actual values, ...) is also adjusted to 16 byte maximum. Due to the diagnosis data of the bus coupler and the DDL participants the total input data range is enlarged up to 50 byte (32 hex). The diagnostic data is transmitted cyclic within the input data range to in the PLC.

Parameters

Some field bus systems offer the possibility to transfer parameters to the bus coupler and the DDL participants.
At present the bus coupler for DeviceNet does not offer this opportunity.

Bus Coupler Parameters

The bus coupler does not provide parameters for a modification. Upon a failure of the DeviceNet the bus coupler behaves that way that all output data are set at 0. Diagnostic data are transmitted cyclic within the input data.

DDL Participants Parameters

As with the bus coupler there is no parameter transfer for the DeviceNet available, the default parameters are used with all DDL participants. They are mentioned in the corresponding device descriptions.

DDL Address

At the Master module, respectively Stand alone bus coupler, no DDL Address has to be set.
For correct function of the DDL (Drive & Diagnostic Link) following items must be fulfilled:

- same Baud rate at all DDL modules
- DDL Address within 1 ... 14, starting with 1, without gap, no double used Address
- DDL Address 0: see chapter 2.2 “DDL Addressing“

DDL Mode

The transfer rate of the DDL is set with the 4 bit DIP switch S4 next to the D-Sub plug at the back side. All participants must be adjusted to the same baud rate.
For access to switch S4 at the bus coupler Stand alone R412006999 the bottom plate has to be removed.

Table 16: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	running mode (default)	assembly test
3	no function (default)	no function
4	no function (default)	no function

With switch S4 only the DDL Baud rate of the Master module will be configured. At the bus coupler R412006998 the Slave module has to be configured separately.

Diagnosis

LED Diagnosis

On the top side of the device LEDs indicate the state of the DeviceNet interface.

Table 17: Overview of the DN LED indications

LED		Function
+5V/ STATUS	flashing 2 Hz green	DDL configuration not OK
+5V	flashing 1 Hz green	voltage sensor below or beyond the tolerance
STATUS	flashing 1 Hz green	voltage valve below or beyond the tolerance
+5V/ STATUS	lighting green	after power reset: power supplies within tolerances, DDL OK
MNS	off	module waits for „Allocation" from master otherwise:
RUN	off	no process data transferred, Timeout „expected packet rate" without timeout
MNS RUN2	off lighting green	Process data communication
MNS	flashing red	Timeout „expected packet rate" with timeout, module waits for new configuration
RUN	off	
MNS	off	Power supply interruption in DeviceNet cable, module waits for new configuration
RUN	flashing green	
MNS	lighting red	major connection error

Voltage Monitoring

The thresholds for under voltage of the valve supply is at 21.6 V, for over voltage it is 26.4 V. The thresholds of the electronic voltage are at 19.2 for under voltage and 28.8 V for over voltage.

Short Circuit Monitoring

The bus coupler has a short circuit monitoring for the DDL. Both power supplies are observed individually from each other. If the short circuit monitoring is activated, the corresponding green LED (see Voltage Monitoring) will be flashing.

Bus Coupler

Software Diagnosis

After activating the power the configuration of the DDL is determined. Thereby the figure and the address of the connected DDL participant, its data length and the type is ascertained. After approx. 5 sec this configuration is redone and compared to the first one. A difference of the determined configurations is reported as a configuration error (byte 0, bit 5). In addition the configuration is also examined when the total output data range is set at 0 for more than 5 sec (set value = 0). The in- and output data of the participants will not be influenced thereby.

The software diagnosis of the Master module can be found in the first 4 bytes of the adjusted input data area of the control, before the input data. The whole software diagnosis of the other DDL participants is behind the input data area of all DDL participants. The length of the diagnosis range of further DDL participants is 1 byte + the adjusted output data length with valve driver. With other participants the diagnosis length can be taken from the corresponding descriptions.

Table 18: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
0	–	–	DDL length of the output data has changed since the last configura-tion	DDL gaps between addresses or address 0 and 1 ... 14 have been mixed up.	DDL no units connected to the DDL	24 V electronic supply diagnosis	24 V valve supply at DDL OUT diagnosis	24 V electronic supply at DDL OUT diagnosis
1	DDL heartbeat	**length of the total input range (7 Bit)**						
2	DDL addr. #8 exists	DDL addr. #7 exists	DDL addr. #6 exists	DDL addr. #5 exists	DDL addr. #4 exists	DDL addr. #3 exists	DDL addr. #2 exists	DDL addr. #1 exists
3	–	–	DDL addr. #14 exists	DDL addr. #13 exists	DDL addr. #12 exists	DDL addr. #11 exists	DDL addr. #10 exists	DDL addr. #9 exists

Meaning of the diagnosis bits

- Byte 0:
  - Bit 0: Electronic power supply of the succeeding DDL modules below 19.2 V or beyond 28.8 V
  - Bit 1: Valve power supply of the succeeding DDL modules below 21.6 V or beyond 26.4 V
  - Bit 2: Power supply of the Master module electronic below 19.2 V or beyond 28.8 V
  - Bit 3: No external modules connected to the DDL
  - Bit 4: Gaps between addresses, address 0 and 1 ... 14 have been mixed up or addresses have been assigned twice
  - Bit 5: Since the last configuration the number of DDL participants or the data length of the participants has changed. This diagnosis appears also after a reset of the power supply
- Byte 1:
  - Bit 0 ... 6: Total length of the input data, including the diagnosis data plus 4 byte of diagnosis data of the master
  - Bit 7: Heartbeat, is reversed all 2 ... 3 seconds
- Byte 2 + 3:
  - Bit 0 ... 7: For each existent address the corresponding bit is set. With automatic addressing the following is valid:
- Byte 2:
  - Bit 0: Pressure control valve
  - Bit 1: Valve unit
  - Bit 2: Input module
  - Bit 3: Output module
  - Bit 4: Combi module

3.2.3 Slave Module

The Slave module behaves like a DDL participant for valve control but it is situated within the housing of the bus coupler. According to this a DDL address has to be adjusted! The connection to the valve unit is effected via a 25 pin D-Sub plug at the bottom side of the module.

DDL Address

The DDL address is adjusted with a S5 switch.
The adjustment regulations for the addressing are described in chapter 2.2 "DDL Addressing".

DDL Mode

The DDL baud rate is adjusted with switch S6.
All participants must be adjusted to the same baud rate.

Table 19: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

Output Data Length

With switch S6 the number of outputs is adjusted. This provides the possibility to optimize the required data range in the control of smaller valve units.

Table 20: Data length

Bit 3	Bit 4	Data Length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

The 4 byte mode offers conformity with 16 bit PLC systems. Only the first 3 bytes are transferred to the outputs of the D-Sub plug.

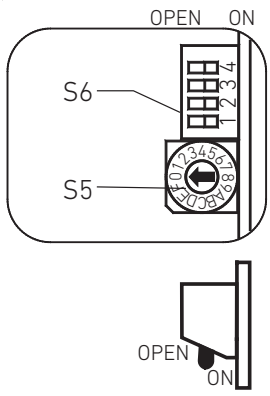


Fig. 13: DIP switch S6

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Output Data Range in the Control

The DDL address determines the position of the output data in the data range of the bus coupler and therefore the position of the address range of the control.

The valve unit occupies, depending on the adjusted length, 1 ... 4 bytes of the output range. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Table 21: Output bits

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

0 V is connected to pin 25 of the 25 pole D-Sub plug.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.

The valve unit does not occupy any data in the input range, only within the diagnosis range of the DDL.

Byte X is the start address of the output data range of the DDL participant in the control.

Diagnosis

LED Diagnosis

LED Diagnosis

Table 22: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see page 47)

The limits of power supply (electronics/valves) are at 19.2 V/ 21.6 V for low voltage and at 28.8/26.4 V for overvoltage. The voltages are measured at plug DDL OUT. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Voltage Monitoring

The applied voltages are indicated with two green LEDs: The voltages are indicated at plug DDL. The threshold of the power supply (electronic/valves) are at 19.2 V/21.6 V for under voltage and at 28.8 V/ 26.4 V at over voltage.

Software Diagnosis

The diagnosis data of the Slave module are situated behind the data of the input range, corresponding to the DDL address. If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The software diagnosis of the Slave module is 1 byte standard diagnosis + configured data length long.
With bus coupler R412006998 the outputs from 24 ... 31 are not really existent. For this reason there is no rational diagnosis. With smaller valve units further outputs and their diagnosis can not be used.

Table 23: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the Bits

- Byte Z Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: Output short circuit or open.
- Byte Z is the start address of the diagnosis data range of this DDL participant in the control.

NOTICE
A short circuit can only be recognized if the output is driven. An open output can only be recognized if it is not driven.

Parameter

As a parameter transmission is not available for the bus coupler for DeviceNet, the default parameter are used for all DDL participants.

- The default parameters are:
  - Reaction upon DDL failure: values at 0
  - Diagnosis message coils: at driven outputs

3.2.4 Connectors

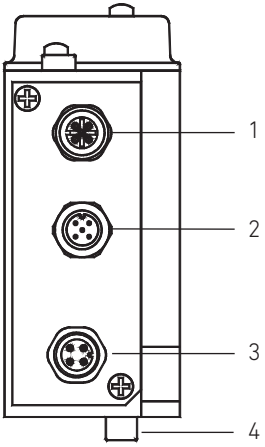


Fig. 14: Connectors

1 XPD: DDL OUT
2 X7D: DeviceNet connection
3 X1S: Power supply
4 X2O: Valve driver (only R412006998)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the bus coupler onto the valve unit is only allowed when the device is off circuit!

Power Supply

The power supply is connected via a circular plug X1S. Only 4 pin M12 connecting bushes should be used, whereas pin 5 is closed in order to avoid a mix up with other connections. The diameter of the wires should be chosen as big as possible, but at least 0.5 mm^2.

Both power supplies must be secured with external 3 A T fuses. The maximum allowed current in the 0 V line is limited to 4 A by the connector.

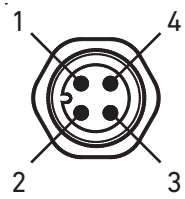


Fig. 15: X1S power supply

1 Pin 1: 24 V sensor voltage / electronics
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

The electronics of the bus coupler and the electronics of all I/O modules and initiators connected to the DDL (with modules without ext. voltage supply) are supplied via X1S, pin 1.
Via X1S, pin 2 the voltage for the valves must be supplied, if no module with external power supply is used. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.

The 24 V supplies must be effected out of a common power supply unit respectively with a common 0 V connection.
A power supply unit with a secure separation according to EN 60742, classification VDE 0551 should be used.

Data Line DeviceNet

The connection to the bus system is effected via the data plug X7D. According to the DeviceNet Norm a T connector is necessary to connect the bus coupler with the DeviceNet.

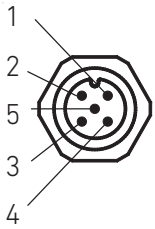


Fig. 16: X7D DeviceNet data plug

1 Pin 1 = shield
2 Pin 2 = 12 ... 24 V external CAN
3 Pin 3 = 0 V
4 Pin 4 = CAN H
5 Pin 5 = CAN L

Data Line DDL

The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to the signal lines DDL H and DDL L. For this reason we recommend to use pre configured cables (see chapter 5 "DDL Accessories"). The allocation of the DDL connections is described in chapter 2.4 "DDL Data".
The DDL end plug (see chapter 5 "DDL Accessories") is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

3.2.5 Technical Data

DeviceNet

Technical Data	
Operating voltage valves	24 V DC +10 -0 %
Operating voltage electronics	24 V DC ±20 %
Fuse of valve voltage external	3 A T
Fuse of electronics external	3 A T
Attention: Maximum power in OV line	4 A
Voltage drop intern	0.8 V
Supply electronics	300 mA
Power supply for sensors	max. 3 A per DDL branch
Power supply for valves	max. 3 A per DDL branch
Number of output bytes (only R412006998)	1 / 2 / 3 / 4 Byte
Ambient temperature range	+5°C ... +50°C +5°C ... +40°C (ATEX) +5°C ... +50°C (ATEX)*
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical Data	s. quotation drawing

* With a current I of max. 2 A per valve and sensor

3.2.6 Dimensions

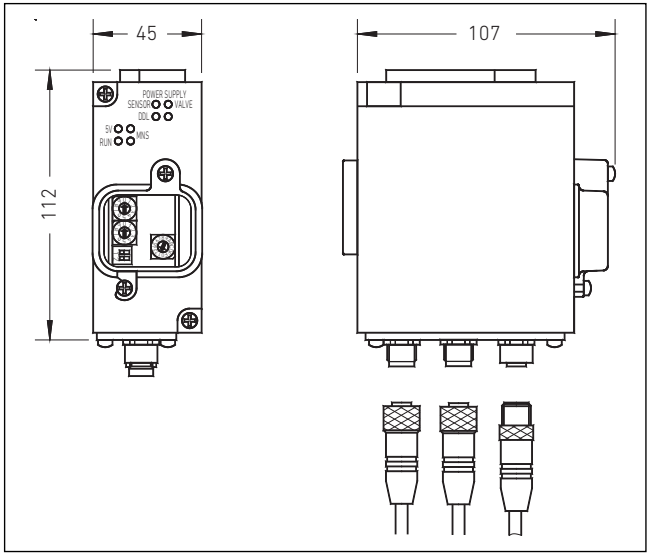


Fig. 17: Dimensions of the bus coupler with drivers (R412006998)

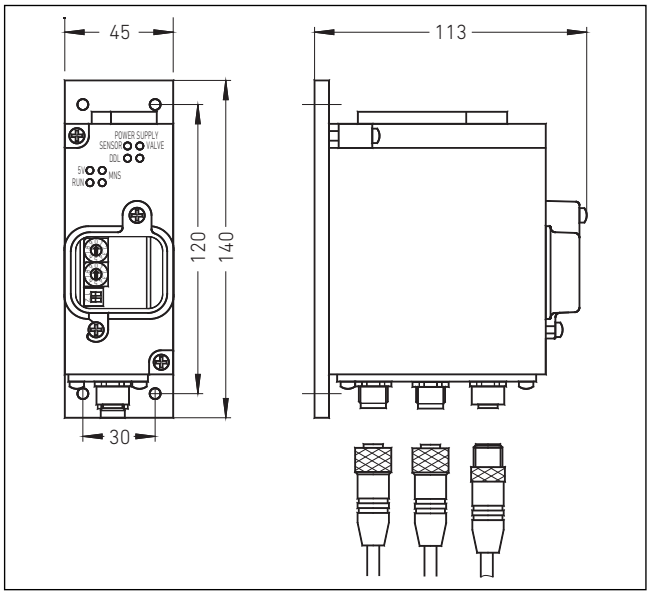


Fig. 18: Dimensions of the bus coupler Stand alone (R412006999)

3.2.7 ATEX-Relevant Information

If the bus coupler DeviceNet R412006999 is used in zone 2, attention has to be paid to the following ATEX-relevant information.
See chapter 3.6.1 “Ex-Relevant Excerpt from the Operating Instructions for S-Design Bus Couplers“.

3.3 Interbus S 337 500 045 0/337 500 046 0

The bus coupler for Interbus S is available in two different designs. The bus coupler with drivers (337 500 046 0) can be directly mounted onto a valve unit. In addition the control of this unit the DDL is also available for other DDL participants.
The bus coupler Stand alone (337 500 045 0) is separately mounted and provides only the DDL. Parts of the description concerning the Slave module are not valid for the bus coupler Stand alone.

3.3.1 Overview

Interbus S (IBS)
In the Interbus S process the data are serially pushed, in a closed loop, through all participants until they reach the dedicated address. There the output data (valve data) will be verified regarding faults, will then be output and replaced by input data (sensor state). These input data will be pushed into the master in the next cycle whereas at the same time the new output data are input into the loop. This principle permits to send and receive during one cycle. Upon initialization all length codes of the participants are read and recorded. The number of reference data per participants and the number of the participants has always to remain constant. The bus coupler is integrated into the Interbus S system as remote bus participant. A connection to a periphery bus is not possible.
Due to the word orientation of the in and output data there will be an exchange of high and lowbyte with byte oriented PLC

types (e. g. Siemens S7). If, for example, the address 30 has been allocated as data word, bits 0 ... 7 will appear in address 31.0 ... 31.7, bits 8 ... 15 in address 30.0 ... 30.7.

For information regarding the network build up and the packing of the lines, please refer to the documentation of the company Phoenix Contact or the Interbus Club.

Bus coupler Interbus S

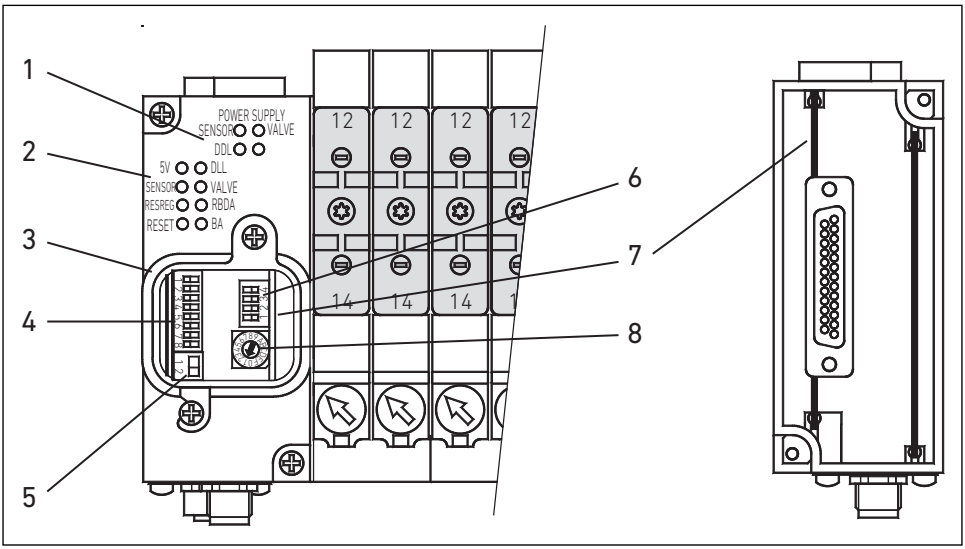


Fig. 19: LEDs and switches with 337 500 046 0

1 DDL LEDs
2 Interbus S LEDs
3 Master module
4 Interbus S DDL Mode S1
5 Interbus termination S2
6 DDL mode S3
7 Slave module
8 DDL address S4

3.3.2 Master Module

The Master module is the interface between the Interbus S and the DDL. It controls the DDL and monitors the supply voltages.

Interbus S Addresses/Last Participant

The Interbus S address of the bus coupler results from the position in the Interbus S system and can only be changed through a change in the sequence of the participants. On insertion or removal of a participant the addresses move within the ring.

If the bus coupler is the last participant in the Interbus S, the module must be correspondingly configured with switch S2.

Table 24: Interbus termination

Switch	Position 1	Position 2
S2	not last IBS participant (default)	last IBS participant

Interbus S Baud Rates

The baud rate of the Interbus is 500 kBaud and cannot be changed.

Interbus S Parameter

The bus coupler behaves like a digital in/output unit and reports back as a module type (identification) 03H.

The length code of the bus coupler has to be firmly set for Interbus S, as the Interbus configuration depends on this. Depending on the used data length of the DDL participant the Interbus length code of the bus coupler can be optimized. The length code is configured to the maximum unit's stage of expansion of 10 words (length code 0AH). This length code is adjusted with switch S1.

The length code has to be calculated via the DDL configuration through the user, before initial operation.

The length code has to be determined as follows:

The maximum length can be calculated with the output data length plus 1 byte (diagnostic request without parameter transmission) respectively 4 byte (diagnostic request with

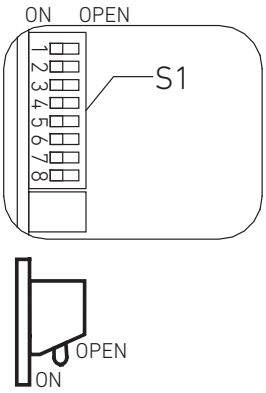


Fig. 20: DIP switch S1

parameter transmission) or the input data length plus 4 byte diagnosis address and – data. Here the greater value has to be used.
The in or output data range is the result of all data lengths of employed DDL participants.
How the different data ranges are composed can be taken from the corresponding chapters.

The data length in the DDL refers to bytes. The configuration of bus coupler's length code is adjusted word wise. Uneven byte sums have to be rounded up!

Example configuration for length code determination:
Parameters shall be transferred.

Table 25: Example for length code determination

DDL Device	Order No.	Output Data	Input Data	Diagnosis Data
bus coupler with drivers (2 byte)	337 500 046 0	2 byte	–	3 byte + 3 byte = 7 byte
valve driver (3 byte)	337 500 005 0	3 byte	–	1 byte + 3 byte = 4 byte
input module (2 byte)	337 500 200 0	–	2 byte	1 byte
valve (2 byte)	561 014 155 0	2 byte	2 byte	1 byte
		7 byte	4 byte	13 byte

a) Output data:
7 byte output data + 4 byte parameter transmission and diagnosis request = 11 byte (12 byte rounded up) = 6 words length code
b) Input data:
4 byte input data + 4 byte diagnosis address and data = 8 byte = 4 words length code
c) Length code:
6 words (a) > 4 words (b) = **length code = 6 words**
In table 26 the complete diagnosis rage is shown, which is available via the diagnosis request.

Bus Coupler

If the length code has been determined, it can be adjusted with switch S1 according to the following table:

Table 26: Length code of the bus coupler in the Interbus S

Bit 1	Bit 2	Bit 3	Bit 4	Length Code (Words)
Open	Open	Open	Open	1
On	Open	Open	Open	1
Open	On	Open	Open	2
On	On	Open	Open	3
Open	Open	On	Open	4
On	Open	On	Open	5
Open	On	On	Open	6
On	On	On	Open	7

Bit 1	Bit 2	Bit 3	Bit 4	Length Code (Words)
Open	Open	Open	On	8
On	Open	Open	On	9
Open	On	Open	On	10
On	On	Open	On	**1**
Open	Open	On	On	**2**
On	Open	On	On	**3**
Open	On	On	On	**4**
On	On	On	On	**5**

Parameter

The Interbus S does not offer a special possibility to transfer parameter to the bus coupler. For this reason it is not possible to parameterize the Master module. There is, however, an option to configure the parameters of the DDL participants or the Slave module via the Interbus. This can be effected via the output data field of the bus coupler (see table 27).
The parameterization of the DDL participants can be activated at the bus coupler. If the parameter transmission is not activated, the DDL participants use their default parameter. The parameter transmission is adjusted with switch S1 bit 7.

Table 27: Configuration of the parameter transmission

Switch S1	Open	On
bit 7	no parameter transmission (default)	parameter transmission

Parameter can only be changed after a voltage reset.

The switches bit 5 and 6 of switch S1 have no function.

Bus Coupler Parameter

The Master module does not provide parameters. With Interbus S failure all outputs are set at 0.

DDL Participants Parameter

The parameter descriptions of the different DDL participants can be taken from the corresponding chapters.

Parameter Transmission

In order to transmit parameter to the DDL system, the Master module has to be configured correspondingly (see table 26). Upon activated parameter transmission, all required parameters and the check sum (sum of all parameter bytes) has to be correctly transmitted first, (bytes 0 ... 13: parameter bytes of the single DDL participants (1 ... 14), byte 14: check sum), before the DDL system will be initialized. It is recommended to transmit all 14 parameter bytes and the checksum always. For not used parameter bytes 00h has to be used. **If the calculated check sum has the value 01, 55 must be send instead!** If no parameters have been sent, or if the checksum is not ok, this is reported via the diagnosis to the control. By way of security parameters shall be sent several times. Only the values sent last will be valid. The sequence the parameters are transmitted is not relevant.

The parameter bytes can be transmitted single or pair wise (see output data field parameter byte X and X+1).

As soon as the DDL is initialized parameters cannot be changed any longer. The parameter values and their meaning can be taken from the documentation of the DDL participants.

The checksum results from the sum of the single parameter bytes (without overflow).

The change of parameter data is only possible after a voltage reset of the Master module.

Table 28: Example for parameter checksum

Byte Address 0	Node 1: 01h	Node1: 01h	Node1: 01h	Node1: 00h
Byte Address 1	**Node 2: F0h**	**Node2: 00h**	**Node2: 08h**	**Node2: 00h**
Byte Address 2	**Node 3: 0Fh**	**Node3: 00h**	**Node3: 04h**	**Node3: 00h**
Byte Address 14	**Checksum: 00h**	**Checksum: 55h! (01)**	**Checksum: 0Dh**	**Checksum: 00h**

DDL Address

At the Master module respectively. Stand alone bus coupler no DDL Address has to be set.

For correct function of the DDL (Drive & Diagnostic Link) following items must be fulfilled:

- same Baud rate at all DDL modules
- DDL Address within 1 ... 14, starting with 1, without gap, no double used Address
- DDL Address 0: see chapter 2.2 “DDL Addressing“

DDL Mode

The DDL baud rate is adjusted with the bit 8 of DIP switch S1. All participants must have the same baud rate.

Table 29: DDL baud rate

Bit	Open	On
8	DDL 125 kBaud	DDL 250 kBaud (default)

Output and Input Data Fields of the Master Module

Because of the determined data length of each participant in the Interbus S, only the in and output data are transmitted in each cycle. The single diagnosis data have to be requested by the control.

Output Data Field

Without parameter bytes

Table 30: Output data field without parameters

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
W0 Lo	DDL node 1	output data							
W0 Hi	– –	output data							
– –	– –	–							
WY-1 Hi	– –	output data							
WY Lo	DDL node n	output data							
WY Hi	Bus coupler	–	–	–	byte address requested diagnosis byte X (5 bit)				

With parameter bytes

Table 31: Output data field with parameter

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
W0 Lo	DDL node 1	output data							
W0 Hi	– –	–							
– –	DDL node n	output data							
WY-1 Lo	Bus coupler	parameter byte X							
WY-1 Hi	Bus coupler	parameter byte X + 1							
WY Lo	Bus coupler	–	–	–	–	byte address sent parameter byte (4 bit)			
WY Hi	Bus coupler	–	–	–	byte address requested diagnosis byte (5 bit)				

English

Output data field:

- W0- Wy:
  - Output data of connected DDL participants, as well as byte addresses for Diagnosis and parameter. (The word length (Wy) results from the configured data lengths at the Master module (see Interbus S Parameter)
- WyHi:
  - The byte address of requested diagnosis data (5 Bit)

If parameter data shall be transmitted (S1 switch 7 at ON) the byte address is transmitted in the address WyLo and in word Wy-1 the parameter data.

Input Data Field

Table 32: Input Data Field

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
W0 Lo	Bus coupler	–	–	–	byte address requested diagnosis byte X (5 Bit)				
W0 Hi	Bus coupler	DDL Heartbeat	length of the total input range in byte (7 bit) = (W0Hi + input data + diagnosis data field (2 byte))						
W1 Lo	Bus coupler	diagnosis byte X							
W1 Hi	Bus coupler	diagnosis byte X + 1							
W2 Lo	DDL node 1	input data							
– –	– –	– –							
Wy Hi	DDL node n	input data							

Input data field:

- W0Lo-
  - W0Hi are always sent, independent from the number of connected DDL participants

- W0Lo:
  – Start address of the requested diagnosis byte in the output data field
- W0Hi:
  – Bit 0 ... 6: Length of the complete input range in byte (min 4)
  – Bit 7: DDL Heartbeat. Changes all 2 ... 3 sec.
- W1Lo:
  – requested diagnosis byte
- W1Hi:
  – requested diagnosis byte +1
- W2- Wy:
  – Input data of the connected DDL devices. (length (Wy) results from data length configured at the master (see Interbus S Parameter)

Diagnosis

LED diagnosis

On the top of the device LEDs indicate the state of the Interbus S interface. The power supply is monitored in the Slave module.

Table 33: Overview of the Interbus LED indications

LED			Function
ALLE	off		no power supply, not online
+5V	flashing	green	supply for bus driver is missing
	lighting	green	supply of processors within the tolerance
	off		No power supply, not online
BUS	Res.Reg.	green	incoming interface switched on, system data transfer takes place
	RBDA	red	incoming interface turned off; Bus master caused RESET; LED Res. Reg. green: module waits for initialization
	RESET	green	supply of the decoupled interbus inputs within the tolerance
	BA	green	reference data transfer takes place (BUS ACTIV)

Bus Coupler

Table 34: Overview of the DDL LEDs

LED	Color of the LED	meaning
SUPPLY SENSOR	green lighting	Voltage within the tolerance
	green flashing	Voltage below or beyond the tolerance
	green off	No voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	Voltage within the tolerance
	green flashing	Voltage below or beyond the tolerance
	green off	No voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see page 62)

The limits of the power supply (electronics/valves) are 19.2 V/ 21.6 V for low voltage and at 28.8 V/26.4 V for overvoltage. The voltages are measured at plug DDL OUT.
The LED DDL indicates that no communication of reference data takes place in the DDL. This can be due to:

- The adjusted baud rate of the DDL modules is not even
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Voltage Monitoring

The applied voltage supplies are indicated by two green LEDs: The voltages at plug DDL are indicated. The thresholds of the power supply (electronic/valves) are at 19.2 V/21.6 V for under voltage and at 28.8 V/26.4 V for over voltage.

Short Circuit Monitoring

The bus coupler has a short circuit monitoring for the DDL. Both supply voltages are controlled independently from each other. If the short circuit monitoring in the bus coupler is activated, the corresponding LED will start to flash.

Software Diagnosis

The complete diagnosis range is deposited in the DDL. This can be requested via the in and output data fields. The diagnosis area can be calculated from the sum of all single diagnosis areas. Thereby it has to be taken into consideration, that also the bus coupler (Master module) provides 3 bytes of diagnosis data. The length of the single participants can be taken from the corresponding descriptions.

After power up the configuration of the DDL will be determined. Thereby the figure and the address of the connected DDL participants, their data length and their type will be determined. After approx. 5 sec this configuration will be redone and compared to the first one. A difference between the determined configurations will be reported as configuration error (byte 0, bit 5). The configuration will also be verified, if the total output data range is set at 0 (set value = 0), for more than 5 sec. The in and output data of the participants will not be influenced hereby.

Diagnosis data have to be requested by the highest byte of the output data field!

Table 35: Diagnosis bits

Byte	Regarding	Bit 7	6	5	4	3	2	1	0
0	bus coupler	–	Check sum, param. byte uneven / param. incomplete	DDL Length of output data has changed since last cofiguration	DDL gaps between addresses or address 0 and 1 ... 14 have been mixed	DDL no units at DDL	24 V electronic input diagnosis	24 V valve voltage at DDL output diagnosis	24 V electronic voltage at DDL output diagnosis
1	bus coupler	DDL addr. #8 exists	DDL addr. #7 exists	DDL addr. #6 exists	DDL addr. #5 exists	DDL addr. #4 exists	DDL addr. #3 exists	DDL addr. #2 exists	DDL addr. #1 exists
2	bus coupler	–	–	DDL addr. #14 exists	DDL addr. #13 exists	DDL addr. #12 exists	DDL addr. #11 exists	DDL addr. #10 exists	DDL addr. #9 exists
3	diagnosis DDL addr. 1	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
4	diagnosis DDL addr. X	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
5	diagnosis DDL addr. max.	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

- XXX = Standard diagnosis bit or additional diagnosis with valve drivers (e. g. Slave module)
- Byte 0:
  - Bit 0: Electronic power supply of the subsequent DDL modules below 19.2 V or beyond 28.8 V
  - Bit 1: Valve power supply of the subsequent DDL modules below 21.6 V or beyond 26.4 V
  - Bit 2: Power supply of the Master module electronic below 19.2 V or beyond 28.8 V
  - Bit 3: No external modules connected to DDL
  - Bit 4: Gaps between addresses, address 0 and 1 ... 14 have been mixed up or addresses have been assigned twice (it cannot be assured that double addresses are recognized safely)
  - Bit 5: Data length of the outputs has changed since that last configuration. The diagnosis disappears after a new configuration (all set values will be set at 0 for more than 5 sec).
  - Bit 6: The sum of the parameter data of the DDL participants 1 ... 14 (parameter bytes 0 ... 13) are uneven to the check sum (parameter byte 14). Only if the parameter data have been recognized correctly, the DDL System will be initialized. Upon deactivated parameter transmission this bit is not active.
  - Bit 7: no meaning
- Bytes 1 and 2: life bits of DDL participants
  - Bits 1.0 ... 2.5 one bit set per existing device (14 devices maximum). Bit position is in correspondence with the DDL address. Bit is set to 0 after a communication diagnosis or is set to 1 after return of the device with the diagnosis.
  - With automatic addressing the following is valid:
    Bit 0: Pressure control valve
    Bit 1: Valve driver
    Bit 2: Input module
    Bit 3: Output module
    Bit 4: Combi module
- Bit 2.6. and 2.7.: no meaning
- Bytes 3 ... 5: Diagnosis data of the connected DDL participants

3.3.3 Slave Module

The Slave module behaves like a DDL participant for valve control but it is situated within the housing of the bus coupler. According to this a DDL address and a baud rate have to be adjusted! The connection to the valve unit is effected via a 25 pin D-Sub plug at the bottom side of the module.

DDL Address

The DDL address is adjusted with the switch S4. The regulation for the adjustment can be found in chapter 2.2 “DDL Addressing“.

DDL Mode

The DDL baud rate is adjusted with switch S3. All participants have to be adjusted to the same baud rate.

Table 36: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

Output Data Length

With switch S3 the number of outputs is adjusted. With this it is possible to optimize the needed data range of the control for smaller valve units.

Table 37: Data length

Bit 3	Bit 4	Data length
Open	Open	1 byte
On	Open	1 byte
Open	On	1 byte
On	On	4 Byte (default)

The 4 byte mode offers a conformity with 16bit PLC systems. But only the first 3 bytes are transferred to the outputs of the D-Sub plug.

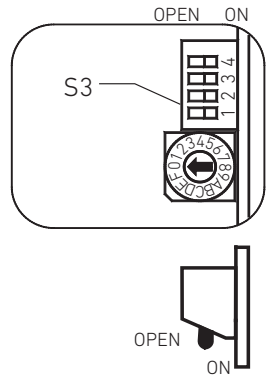


Fig. 21: DIP switch S3

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Output Data Range in the Control

The DDL address determines the position of the output data in the data range of bus coupler and therefore the position in the address range of the control. The valve driver occupies, depending on the length set, 1 ... 4 byte in the output range of the control. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Table 38: Output bits

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

At Pin 25 of 25 pol. D-Sub plug 0 V is connected.
If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The valve driver does not occupy any data in the input range, only within the diagnosis range of the DDL.
Byte X is the start address in the output data range of the DDL participant in the control.

Diagnosis

LED Diagnosis

Table 39: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see below)

The limits of power supply (electronics/valves) are at 19.2 V/ 21.6 V for low voltage and at 28.8/26.4 V for overvoltage. The voltages are measured at plug DDL OUT. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the Slave module are in the diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.

The length of the diagnosis range is 1 byte + the adjusted output data length. With bus coupler 337 500 046 0 the outputs 24 ... 31 do not really exist. For this reason there is no rational diagnosis. With smaller valve units further outputs and their diagnosis can not be used.

Bus Coupler

Table 40: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits

- Byte Z Bit 0: Power supply of the electronics below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: Output short circuit or open (see description of the parameter).
- Byte Z is the start address of the diagnosis range of the DDL participant in the control.

NOTICE

A short circuit can only be detected if the output is driven.
An open output can only be detected if it is not driven.

Parameter

The Slave module provides the DDL master module for Interbus S with these functions. For each DDL participant one byte for parameter is available. The parameters are not transferred cyclically. The parameter byte can be adjusted individually for each participant. With the Interbus S bus coupler the parameter of the DDL participants can be configured via the output data field If the parameter transmission is deactivated, the Slave module uses default parameter.

Table 41: Parameters for the Slave module

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	with controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1 With Interbus S diagnosis data can be recalled cyclically. Thereby missing coils can be determined upon the start of the system. During the cyclic operation diagnosis messages are only transmitted, if there have been changes. Open circuit is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the Slave module.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the Slave module and the coils will still be controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

3.3.4 Connectors

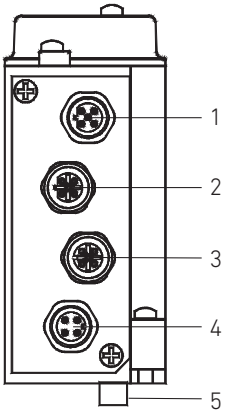


Fig. 22: Connectors

1 X7J2: Interbus S Input
2 X7J1: Interbus S Output
3 XPD: DDL OUT
4 X1S: Power supply
5 X2O: Valve driver (only 337 500 046 0)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the bus coupler onto the valve unit is only allowed when the device is off circuit!

Power Supply

The power supply is effected via the circular plug X1S. Only 4 pin M12 connecting bushes should be used, where pin 5 is closed; in order to avoid a mix up with other connections. The diameter of the wires should be chosen as big as possible, but at least 0.5 mm^2.

Both power supplies must be secured with external 3 A T fuses. The maximum allowed voltage in the 0 V line is limited to 4 A by the connector

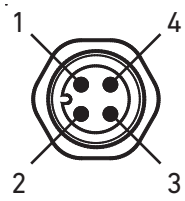


Fig. 23: X1S Power Supply

1 Pin 1: 24 V sensor voltage / electronics
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

The electronics of the bus coupler and the electronics of all I/O modules and initiators connected to the DDL (with modules without external power supply) are supplied via X1S, pin 1.

If modules without an external power supply are used, the switching voltage for connected valves must be supplied via X1S, pin 2. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.

The 24 V supplies must be effected out of a common power supply unit respectively with a common 0 V connection.
A power supply unit with a secure separation according to EN 60742, classification VDE 0551 should be used.

Data Line Interbus S

The connection to the bus system is effected with data plug M12, 5 pin. B coded female at Interbus S IN (X7J2) or male at Interbus S OUT (X7J1).

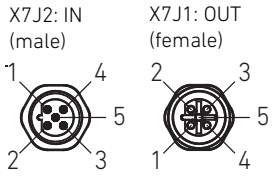


Fig. 24: Interbus S data plug

1 Pin 1: DO
2 Pin 2: /DO
3 Pin 3: DI
4 Pin 4: /DI
5 Pin 5: GND

Data Line DDL

The output of the DDL is short circuit protected for all lines. Nevertheless DDL participants can be damaged if 24 V is applied to signal lines DDL H and DDL L. For this reason we recommend to use pre configured cables (see chapter 5 “DDL Accessories“). The allocation of the DDL connectors is described in chapter 2.4 “DDL Data“.
The DDL end plug (see chapter 5 “DDL Accessories“) is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

3.3.5 Technical Data

Interbus S

Technical Data	
Operating voltage valves	24 V DC +10 -0 %
Operating voltage electronics	24 V DC ±20 %
Fuse of the valve voltage external	3 A T
Fuse of electronics external	3 A T
Attention: Maximum current in the 0 V line	max. 4 A
Voltage drop, internal	0.8 V
Required power electronics	90 mA
Power supply for sensors	max. 3 A per DDL branch
Power supply for valves	max. 3 A per DDL branch
Number of output bytes (for 337 500 046 0)	1 / 2 / 3 / 4 byte
Ambient temperature range	+5°C ... +50°C +5°C ... +40°C (ATEX) +5°C ... +50°C (ATEX)*
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical Data	s. quotation drawing

* With a current I of max. 2 A per valve and sensor

3.3.6 Dimensions

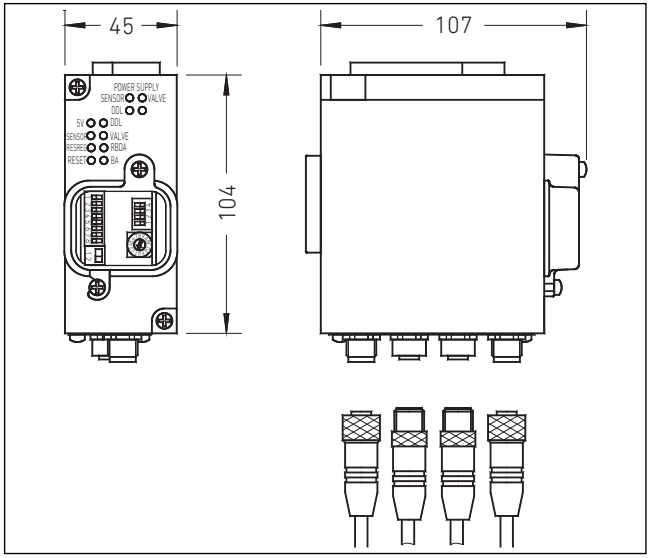


Fig. 25: Dimensions of the bus coupler with drivers (337 500 046 0)

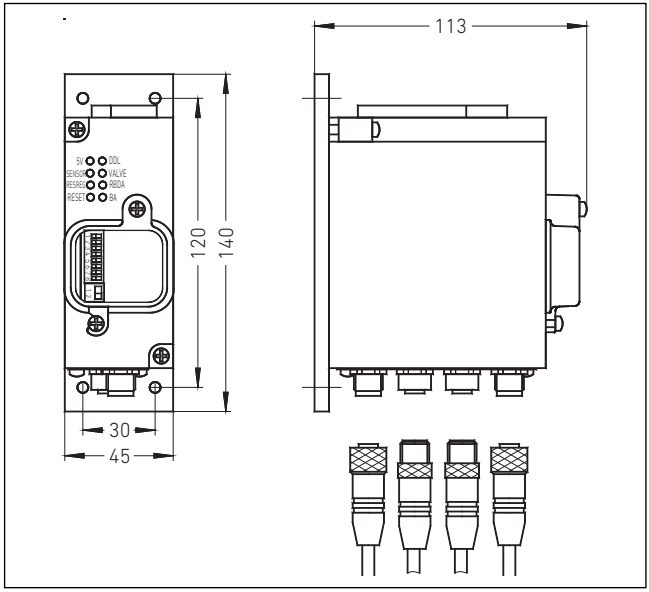


Fig. 26: Dimensions of the bus coupler Stand alone (337 500 045 0)

3.3.7 ATEX-Relevant Information

If the bus coupler Interbus S 337 500 045 0 is used in zone 2, attention has to be paid to the following ATEX-relevant information.
See chapter 3.6.1 “Ex-Relevant Excerpt from the Operating Instructions for S-Design Bus Couplers“.

3.4 ControlNet 337 500 056 0

The bus coupler for ControlNet is available in two different designs. The bus coupler with drivers (337 500 056 0) can be mounted directly onto a valve unit. In addition to the control of this unit, the DDL is also available for further DDL participants. The bus coupler Stand alone (order number on request) is separately mounted and provides only the DDL. Part of the description concerning the Slave module are not valid for the bus coupler stand alone except for the monitoring of the voltage.

3.4.1 Overview

ControlNet
The ControlNet which is used for communication with the control, is a fast working bus system to interchange time critical user dates. It offers not only real time data transmission but also intelligence service for direct data interchange between 2 participants. As a transmission medium a 75 Ω coaxial cable, terminated at both sides is used.
The device has to be driven at channel A and does not support redundant cabling.

Concerning the information for the assembly of the network and also for the preparation of the lines, please refer to the documentation of the company Rockwell Automation/Allen-Bradley.

Bus coupler ControlNet

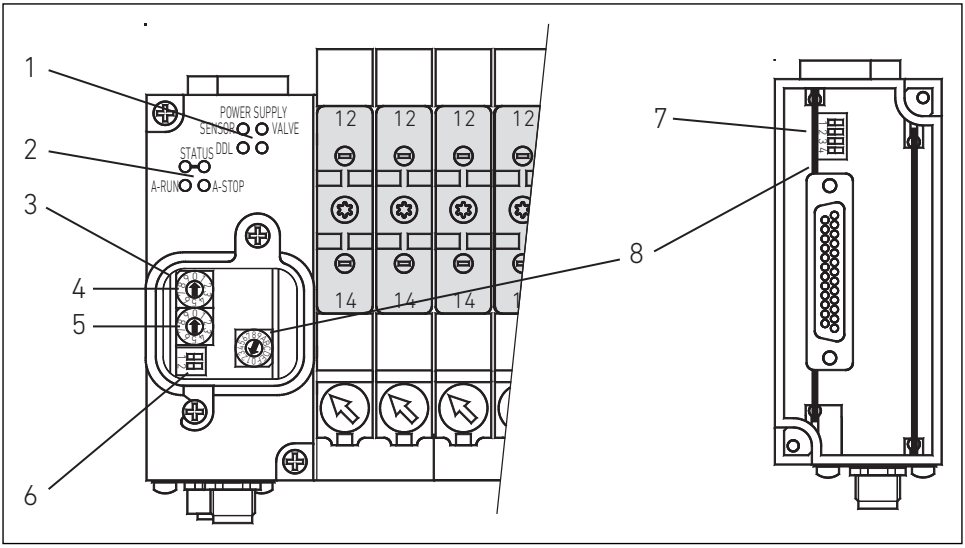


Fig. 27: LED and switch of 337 500 056 0

1 DDL LEDs
2 ControlNet LEDs
3 Master module
4 CN address S1
5 CN address S2
6 DDL Mode S3
7 DDL Mode S4
8 Slave module DDL address S5

3.4.2 Master Module

The Master module is the interface between the ControlNet and the DDL. It controls the DDL and monitors the supply voltages.

ControlNet Address

A definite address is allocated to each participant in the network. Via two rotary switches addresses from 0 ... 99 can be set. With switch S1 the ten digit and with S2 the one digit is adjusted. Address 0 and 1 are reserved for controls or for temporary diagnosis devices and shall not be used. The devices are already adjusted to address 2 in the factory.

ControlNet Baud Rate

The baud rate of the ControlNet is 5 MBaud and cannot be changed.

ControlNet Parameter

The length of the output data range (valves, nominal value, ...) is fixed to 16 byte (10 hex) maximum. The length of the input data range (sensors, actual values, ...) is also limited to 16 byte maximum. Due to the diagnosis data of the bus coupler and the DDL participants the total input data range is enlarged up to 48 byte (30 hex). The diagnostic data is transmitted cyclic within the input data range to in the PLC.

Table 42: ControlNet parameter

	Assembly Instance	max Size
Input	100	24 (16 bit)
Output	150	8 (16 bit)
Configuration	4	0 (8 bit)

An electronic data sheet (EDS) is available on the internet page of the company HMS (http://www.hms-networks.com)
Type: EDS Configuration File
Name: AnyBus-S ControlNet

Parameter

Some field bus systems offer the possibility to transfer parameters to the bus coupler and the DDL participants. At present the bus coupler for ControlNet does not offer this.

Bus Coupler parameter

The bus coupler does not provide parameter for modification. Upon a failure of the ControlNet the bus coupler behave in that way, that all output data are set at 0. Diagnostic data were transmitted cyclic within the input data.

DDL participant parameter

As with the bus coupler there is no parameter transfer for the ControlNet available, the default parameters are used with all DDL participants. They are mentioned in the corresponding device descriptions.

DDL Address

At the Master module respectively stand alone bus coupler no DDL Address has to be set.

For correct function of the DDL (Drive & Diagnostic Link) following items must be fulfilled:

- same Baud rate at all DDL modules
- DDL Address within 1 ... 14, starting with 1, without gap, no double used Address
- DDL Address 0: see chapter 2.2 “DDL Addressing”

DDL Mode

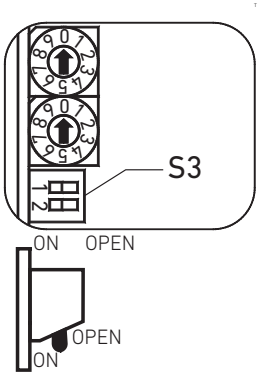


Fig. 28: DIP switch S3: DDL mode

The baud rate of DDL is defined by the 2 pole DIP switch S3 next to the ControNet address switches on the front side. All participants have to be adjusted to the same transfer rate.

Table 43: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

Diagnosis

LED diagnosis

On the top side of the device the LEDs indicate the state of the ControlNet interface. The power supply is observed by the Slave module. This applies also to the bus coupler Stand alone.

Table 44: Overview of CN LED indication

LED	Color of LED	Meaning
A-STOP	red	interference with cable connection
A-RUN	green	module connected with bus
Status left	green	scanner has recognized the device and exchanges data
Status right	green	PLC in the RUN Mode and outputs are set

After the appliance of the power supply, the red LED lights for approx. 1 second until other participants are recognized. Depending on the state of initialization of the ControlNet interface the A-RUN LED flashes according to the specification or lights continuously. A missing terminating resistor or an interfered connection can also provoke that the A-RUN (green) and the A-STOP (red) LED flash reciprocally.
The left STATUS LED indicates that the control has recognized the unit, has build up a connection and the incoming data are already being read. If the PLC is switched into the RUN Mode, the second STATUS LED lights and the outputs will be driven.

Voltage Monitoring

The description of the voltage monitoring can be found in chapter slave module.

Short Circuit Monitoring

The bus coupler has a short circuit monitoring for the DDL. Both power supplies are observed individually from each other. If a short circuit monitoring is activated, the corresponding green LED (see Voltage Monitoring) will be flashing.

Software – Diagnosis

After activating the power the configuration of the DDL is determined. Thereby the figure and the address of the connected DDL participant, its data length and the type is ascertained. After approx. 5 sec this configuration is redone and compared to the first one. A difference of the determined configurations is reported as a configuration error (byte 0, bit 5). In addition the configuration is also examined. when the total output data range is set at 0 for more than 5 sec (set value = 0).

The in and output data of the participants will not be influenced thereby.
The software diagnosis of the Master module can be found in the first 4 bytes of the adjusted input data area of the control, before the input data. The whole software diagnosis of the other DDL participants is behind the input data area of all DDL participants. The length of the diagnosis range of further DDL participants is 1 byte + the adjusted output data length with valve drivers. With other participants the diagnosis length can be taken from the corresponding descriptions.

Table 45: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
0	–	–	DDL length of the output data has changed since the last configu-ration	DDL gaps between addresses or address 0 and 1 ... 14 have been mixed up.	DDL no units connected to the DDL	24 V electronic supply diagnosis	24 V valve supply at DDL OUT diagnosis	24 V electronic supply at DDL OUT diagnosis
1	DDL heartbeat	**length of the total input range (7 Bit)**						
2	DDL addr. #8 exists	DDL addr. #7 exists	DDL addr. #6 exists	DDL addr. #5 exists	DDL addr. #4 exists	DDL addr. #3 exists	DDL addr. #2 exists	DDL addr. #1 exists
3	–	–	DDL addr. #14 exists	DDL addr. #13 exists	DDL addr. #12 exists	DDL addr. #11 exists	DDL addr. #10 exists	DDL addr. #9 exists

Meaning of the diagnosis bits

- Byte 0:
  - Bit 0: Electronic power supply of the succeeding DDL modules below 19.2 V or beyond 28.8 V
  - Bit 1: Valve power supply of the succeeding DDL modules below 21.6 V or beyond 26.4 V
  - Bit 2: Power supply of the Master module electronic below 19.2 V or beyond 28.8 V
  - Bit 3: No external modules connected to the DDL

  - Bit 4: Gaps between addresses, address 0 and 1 ... 14 have been mixed up or addresses have been assigned twice
  - Bit 5: Since the last configuration the number of DDL participants or the data length of the participants has changed. This diagnosis appears also after a reset of the power supply
- Byte 1:
  - Bit 0 ... 6: Total length of the input data, including the diagnosis data plus 4 byte of master diagnosis data
  - Bit 7: DDL Heartbeat, is reversed all 2 ... 3 seconds
- Byte 2 + 3:
  - Bit 0 ... 7: For each existing address the corresponding bit is set.
  - With automatic addressing the following is valid:
- Byte 2:
  - Bit 0: Pressure control valve
  - Bit 1: Valve driver
  - Bit 2: Input module
  - Bit 3: Output module
  - Bit 4: Combi module

3.4.3 Slave Module

The Slave module behaves like a DDL participant for valve control but it is situated within the housing of the bus coupler. According to this a DDL address has to be adjusted! The connection to the valve unit is effected via a 25 pin D-Sub plug at the bottom side of the module.

DDL Address

The DDL address is adjusted with switch S5.
The adjustment regulations for the addressing are described in chapter 2.2 “DDL Addressing“.

DDL Mode

The DDL baud rate is adjusted with switch S4.
The configuration of the baud rate of the Master module is combined with the baud rate configuration for the Slave module. A description can be found in the chapter concerning the Master module.

Output Data Length

With switch S4 the number of outputs is adjusted. This provides the possibility to optimize the required data range in the control of smaller valve units.

Table 46: Data length

Bit 3	Bit 4	Data length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

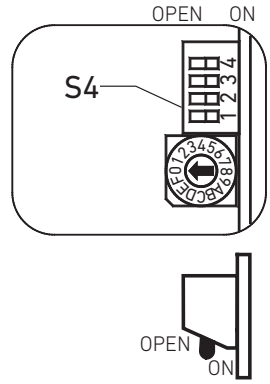


Fig. 29: DIP switch S4

The 4 byte mode offer a conformity with 16 Bit PLC systems. Only the first 3 bytes are transferred to the outputs of the D-Sub plug.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Output Data Range in the Control

The DDL address determines the position of the output data in the data range of the bus coupler and therefore the position of the address range of the control.
The valve driver occupies, depending on the adjusted length, 1 ... 4 bytes of the output range. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Bus Coupler

Table 47: Output bits

Byte	Regarding	Bit 7	6	5	4	3	2	1	0
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

0 V is connected to pin 25 of the 25 pole D-Sub plug.
If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The valve driver does not occupy any data in the input range, only within the diagnosis range of the DDL.
Byte X is the start address of the output data range of the DDL participant in the control.

Diagnosis

LED diagnosis

Table 48: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see below)

The limits of power supply (electronics/valves) are at 19.2 V/ 21.6 V for under voltage and at 28.8/26.4 V for overvoltage. The voltages are measured at plug DDL OUT. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Voltage monitoring

The applied voltage supplies are indicated by two green LEDs: Voltages at the plug DDL are shown. The threshold of the power supply (electronic/valves) are at 19.2 V/21.6 V for under voltage and at 28.8 V/26.4 V for overvoltage.

Software diagnosis

The software diagnosis of the Slave module is 1 byte standard diagnosis + configured data length long.
With bus coupler 337 500 056 0 the outputs from 24 ... 31 are not really existent. For this reason there is no rational diagnosis. With smaller valve units further outputs and their diagnosis can not be used.

The address range of the diagnosis derives from the DDL address. If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 "DDL Addressing".

Table 49: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits:

- Byte Z Bit 0: Power supply of the electronics below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: Output short circuit or open.
- Byte Z is the start address of the diagnosis range of the DDL participant in the control.

NOTICE

A short circuit can only be recognized if the output is controlled. An open output can only be recognized, if it is not controlled.

Parameter

As there is no parameter transmission with the bus coupler for ControlNet, default parameter are used for all participants.

- The default parameters are:
  - Reaction upon DDL failure: values at 0
  - Diagnosis message coils: at driven outputs

3.4.4 Connections

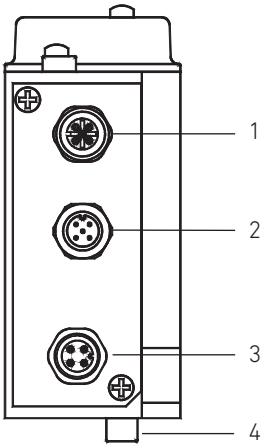


Fig. 30: Connectors

1 XPD: DDL OUT
2 X7D: ControlNet connection
3 X1S: Power supply
4 X2O: Valve driver (only 337 500 056 0)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the bus coupler onto the valve unit is only allowed when the device is off circuit!

Power Supply

The power supply is connected via a circular plug X1S. Only 4-pin M12 connecting bushes should be used, whereas pin 5 is closed in order to avoid a mix up with other connections. The diameter of the wires should be chosen as big as possible, but at least 0.5 mm^2.

Both power supplies must be secured with external 3 A T fuses. The maximum allowed voltage in the 0 V line is limited to 4 A by the connector.

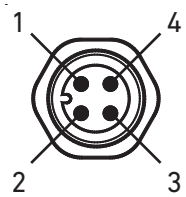


Fig. 31: X1S power supply

1 Pin 1: 24 V sensor voltage / electronics
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

The electronics of the bus coupler and the electronics of all I/O modules and initiators connected to the DDL (with modules without ext. voltage supply) are supplied via X1S, pin 1.
Via X1S, pin 2 the voltage for the valves must be supplied, if no module with external power supply is used. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.

The 24 V supplies must be effected via a common power supply unit or with a common 0 V connector.
A power supply unit with a safety separation according to EN 60742, classification VDE 0551.

Data Line ControlNet

The connection to the bus system is effected via the data plug X7N. This is a BNC plug customary in the trade. For further information we refer you to the documentation of the company Rockwell Automation/Allen-Bradley.

Data Line DDL

The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to the signal lines DDL H and DDL L. For this reason we recommend to use pre configured cables (see chapter 5 “DDL Accessories“). The allocation of the DDL connections is described in chapter 2.4 “DDL Data“. The DDL end plug (see chapter 5 “DDL Accessories“) is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

3.4.5 Technical Data

ControlNet

Technical Data	
Operating voltage valves	24 V DC +10 -0 %
Operating voltage electronics	24 V DC ±20 %
Fuse of the valve voltage	3 A T
Fuse of electronics	3 A T
Attention: Maximum current in 0 V line	4 A
Voltage drop, internal	0.8 V
Required power	300 mA
Power supply for sensors	max. 3 A per DDL branch
Power supply for valves	max. 3 A per DDL branch
Number of output bytes (for 337 500 056 0)	1 / 2 / 3 / 4 byte
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65
Installation position	arbitrary
Further technical Data	s. quotation drawing

3.4.6 Dimensions

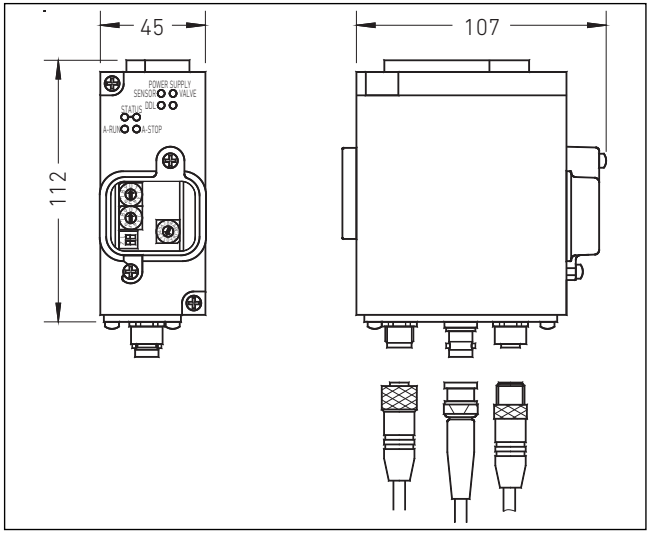


Fig. 32: Dimensions of the bus coupler with drivers (337 500 056 0)

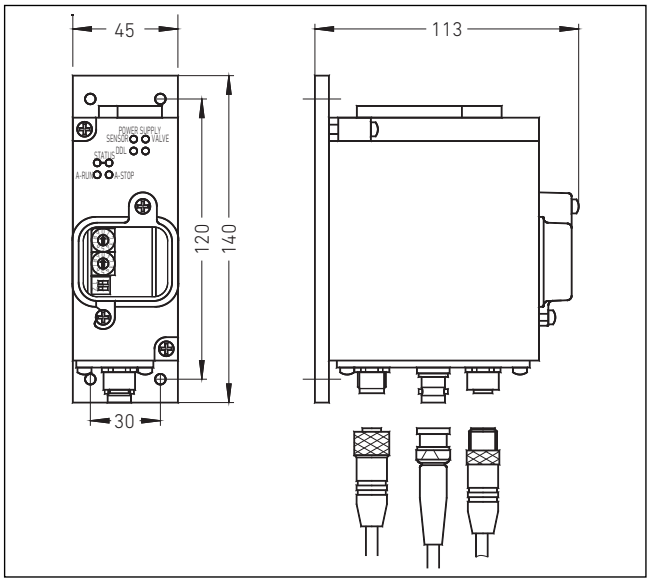


Fig. 33: Dimensions of the bus coupler stand alone (order number on request)

3.5 CANopen R412008000/R412008002

The bus coupler for CANopen is available in two different designs. The bus coupler with drivers (R412008002) can be directly mounted onto a valve unit. In addition to the control of this unit the DDL is also available for other DDL participants. The bus coupler Stand alone (R412008000) is separately mounted and provides only the DDL.
Parts of the description concerning the Slave module are not valid for the bus coupler Stand alone.

3.5.1 Overview

CANopen
The CAN profile CANopen was standardized by manufacturers and the user association CAN in Automation (CiA) under the number CiA DS 301.
Realtime data are transmitted with so called process and data objects (PDO). Parameter data, diagnosis data and program data are transmitted with Service data objects (SDO). Both objects are transmitted with different identifiers, which are based on the adjusted module ID.
A PDO consists only process data and no program overhead. A SDO otherwise consists in addition to the process data also the information which object has to be used. In addition to the regular objects as START, STOP or RESET some further optional objects are defined. For the PLC configuration software, the EDS file may be helpful.
The electronic data sheet (EDS) can be downloaded from the Internet at www.aventics.com/mediadirectory:
DDL_co.eds
Type: EDS Configuration File

For information concerning the installation of the network and regarding the preparation of the line and used objects please refer to the documentation of CiA Draft Standard 301 from CAN in Automation e. V.

Bus Coupler

Bus coupler CANopen

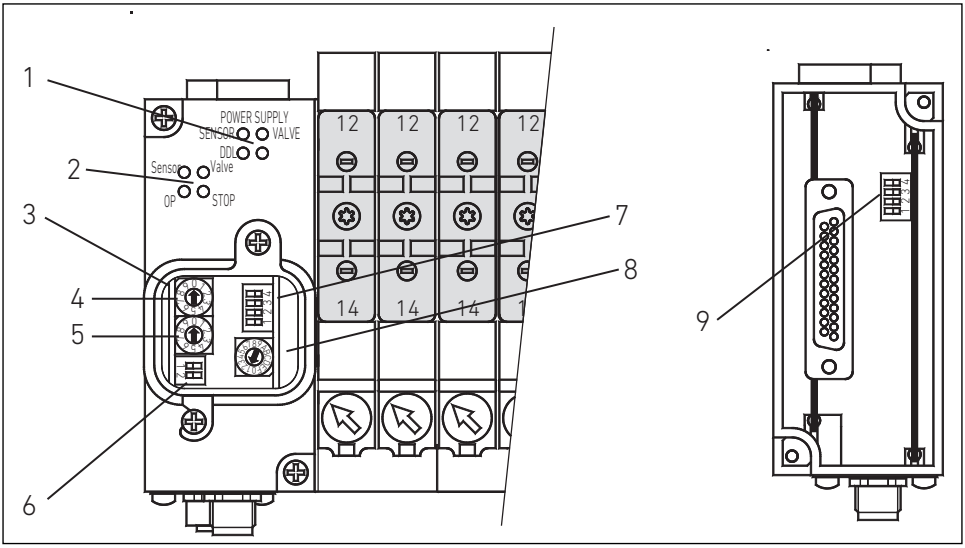


Fig. 34: LEDs and switches of R412008002

1 DDL LEDs
2 CANopen LEDs
3 Master module
4 CANopen address S1
5 CANopen address S2
6 CANopen baud rate S3
7 Slave module DDL mode S6
8 DDL address S5 (R412008002)
9 CANopen baud rate DDL mode S4

3.5.2 Master Module

The Master module is the interface between the CANopen and the DDL. It controls the DDL and monitors the supply voltages.

CANopen Address

A definite address is allocated to each participant in the network. Via two rotary switches addresses from 0 ... 99 can be set. With switch S1 the ten digit and with S2 the one digit is adjusted. The address 0 reserved for CANopen diagnosis functions and may not be used. In the factory the devices are adjusted to address 2.

CANopen Baud Rates

The baud rate of the CANopen system is adjusted with the 2 bit DIP switch S3 and with bit 2 of the 4 bit DIP switch S4 on the back side of the master module. For access to switch S4 at the Bus coupler Stand alone R412008000 the bottom plate has to be removed.

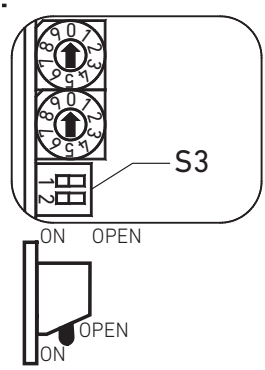


Fig. 35: DIP switch S3: DDL mode

Table 50: Adjustment of the CANopen Baud rates

Bit 1 DIP S3	Bit 2 DIP S3	Bit 2 DIP S4	Baud rate
Open	Open	Open (default)	1000 kBaud
On	Open	Open (default)	800 kBaud
Open	On	Open (default)	500 kBaud
On (default)	On (default)	Open (default)	250 kBaud
Open	Open	On	125 kBaud
On	Open	On	100 kBaud
Open	On	On	50 kBaud
On	On	On	20 kBaud

CANopen Data

The length of the output data range (valves, nominal value, ...) is fixed to 16 byte (10 hex) maximum. The length of the input data range (sensors, actual values, ...) is also adjusted to 16 byte maximum. With each TXD-PDO 8 data bytes are transmitted respectively requested with each RXD-PDO. In the communication area of the object dictionary the PDOs can be found under the index 1401 respectively 1400 (Transmit) and 1801 respectively 1800 (Receive).

Additionally it is possible to force the output data in the parameter area of the object dictionary with the index 6200 and 6300 within the subindexes 1 ... 8 each. The input data can be requested with the index 6000 and 6100 also within the subindexes 1 ... 8 each.

Parameter

The CANopen bus coupler provides the transmission of special communication profile objects as e.g. NodeGuarding.

Bus Coupler Parameters

The bus coupler does not provide parameters for a modification Upon a failure of the DeviceNet the bus coupler behaves that way that all output data are set at 0.

DDL Participants Parameter

The parameters for the DDL participants can be transmitted within the parameter area of the object dictionary with the index 2040. The transmission of all parameter must be finished before the bus coupler is switched to Pre/Operational. 16 byte data in four bloc within the subindexes 1 ... 4 are transmitted in total. The first byte will be sent to the DDL participant with the DDL address 1 when the bus coupler is switched to Operational. The other follow according to the DDL address. If no parameter data is defined the value 0 will be transmitted to the DDL participants.
The meaning of the parameters are mentioned in the corresponding device descriptions.

DDL Address

At the Master module, respectively Stand alone bus coupler, no DDL Address has to be set.
For correct function of the DDL (Drive & Diagnostic Link) following items must be fulfilled:

- same Baud rate at all DDL modules
- DDL Address within 1 ... 14, starting with 1, without gap, no double used Address
- DDL Address 0: see chapter 2.2 “DDL Addressing”.

DDL Mode

The transfer rate of the DDL is set with the 4 bit DIP switch S4 next to the D-Sub plug at the back side. All participants must be adjusted to the same baud rate.
For access to switch S4 at the bus coupler Stand alone R412008000 the bottom plate has to be removed.

Table 51: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)

Diagnosis

LED diagnosis

On the top side of the device LEDs indicate the state of the CANopen interface.

Table 52: Overview of the CANopen LED indications

LED		Meaning
Valve Sensor STOP	lighting green off lighting red	Module in Power reset, waiting for Stop or Operational request
Valve/ Sensor	flashing 2 Hz	DDL configuration not OK
Valve/ Sensor	flashing 1 Hz	voltage below or beyond the tolerance
OP STOP	lighting green lighting rot	module in Preoperational mode
OP STOP	off lighting rot	module in Reset or Stop mode
OP STOP	lighting green off	module in Operational mode

The LEDs of the DDL participants states according to the status of the initialization of the CANopen interface. Only after the bus coupler has switched to Preoperational or Operational the DDL system will be initialized and the red DDL LED may go off.

Voltage Monitoring

The threshold for under voltage of the valve supply is at 21.6 V, for over voltage it is 26.4 V. The thresholds of the electronic voltage are at 19.2 V for under voltage and 28.8 V for over voltage.

Short Circuit Monitoring

The bus coupler has a short circuit monitoring for the DDL. Both power supplies are observed individually from each other. If the short circuit monitoring is activated, the corresponding green LED (see Voltage Monitoring) will be flashing.

Software Diagnosis

After the bus coupler has switched to Pre/Operational the configuration of the DDL will be determined. Thereby the figure and the address of the connected DDL participant, its data length and the type is ascertained. After approx. 5 sec this configuration is redone and compared to the first one. A difference of the determined configurations is reported as a configuration error (byte 0, bit 5). In addition the configuration is also examined when the total output data range is set at 0 for more than 5 sec (set value = 0). The in and output data of the participants will not be influenced thereby.
The software diagnosis of the Master module can be found in the diagnosis area of the object dictionary with index 2020. The 32 byte diagnosis data are transmitted in four bloc within the subindexes 1 ... 8.
The length of the diagnosis range of further DDL participants is 1 byte + the adjusted output data length with valve driver. With other participants the diagnosis length can be taken from the corresponding descriptions.

Table 53: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
0	–	–	DDL length of the output data has changed since the last configu-ration	DDL gaps between addresses or address 0 and 1 ... 14 have been mixed up.	DDL no units connected to the DDL	24 V electronic supply diagnosis	24 V valve supply at DDL OUT diagnosis	24 V electronic supply at DDL OUT diagnosis
1	DDL heartbeat	**length of the total input range (7 Bit)**						
2	DDL addr. #8 exists	DDL addr. #7 exists	DDL addr. #6 exists	DDL addr. #5 exists	DDL addr. #4 exists	DDL addr. #3 exists	DDL addr. #2 exists	DDL addr. #1 exists
3	–	–	DDL addr. #14 exists	DDL addr. #13 exists	DDL addr. #12 exists	DDL addr. #11 exists	DDL addr. #10 exists	DDL addr. #9 exists

Meaning of the diagnosis bits

- Byte 0:
  - Bit 0: Electronic power supply of the succeeding DDL modules below 19.2 V or beyond 28.8 V
  - Bit 1: Valve power supply of the succeeding DDL modules below 21.6 V or beyond 26.4 V
  - Bit 2: Power supply of the Master module electronic below 19.2 V or beyond 28.8 V
  - Bit 3: No external modules connected to the DDL
  - Bit 4: Gaps between addresses, address 0 and 1 ... 14 have been mixed up or addresses have been assigned twice
  - Bit 5: Since the last configuration the number of DDL participants or the data length of the participants has changed. This diagnosis appears also after a reset of the power supply
- Byte 1:
  - Bit 0 ... 6: Total length of the input data, including the diagnosis data plus 4 byte of master diagnosis data
  - Bit 7: DDL Heartbeat, is reversed all 2 ... 3 seconds
- Byte 2 + 3:
  - Bit 0 ... 7: For each existing address the corresponding bit is set.
  - With automatic addressing the following is valid:
- Byte 2:
  - Bit 0: Pressure control valve
  - Bit 1: Valve driver
  - Bit 2: Input module
  - Bit 3: Output module
  - Bit 4: Combi module

3.5.3 Slave Module

The slave module behaves like a DDL participant for valve control but it is situated within the housing of the bus coupler. According to this a DDL address has to be adjusted! The connection to the valve unit is effected via a 25 pin D-Sub plug at the bottom side of the module.

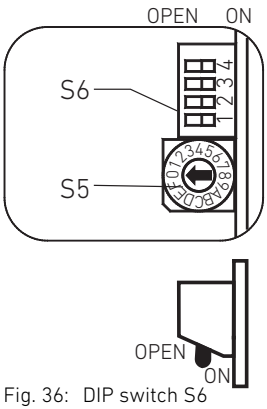


Fig. 36: DIP switch S6

DDL Address

The DDL address is adjusted with a S5 switch.

The adjustment regulations for the addressing are described in chapter 2.2 "DDL Addressing".

DDL Mode

The DDL baud rate is adjusted with switch S6.

All participants must be adjusted to the same baud rate.

Table 54: DDL Baud rate S6

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

Output Data Length

With switch S6 the number of outputs is adjusted. This provides the possibility to optimize the required data range in the control of smaller valve units.

Table 55: Data Length S6

Bit 3	Bit 4	Data Length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

The 4 byte mode offers a conformity with 16 bit PLC systems. Only the first 3 bytes are transferred to the outputs of the D-Sub plug.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Output Data Range in the Control

The DDL address determines the position of the output data in the data range of the bus coupler and therefore the position of the address range of the control.

The valve unit occupies, depending on the adjusted length, 1 ... 4 bytes of the output range. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Table 56: Output bits

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

0 V is connected to pin 25 of the 25 pole D-Sub plug.

If address 0 (automatic addressing) is set, the bus coupler with driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.

The valve unit does not occupy any data in the input range, only within the diagnosis range of the DDL.

Byte X is the start address of the output data range of the DDL participant in the control.

Diagnosis

LED Diagnosis

Table 57: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see below)

The limits of power supply (electronics/valves) are at 19.2 V/ 21.6 V for low voltage and at 28.8/26.4 V for overvoltage. The voltages are measured at plug DDL OUT. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 … 14 have been assigned at the same time
- Configuration has changed during operation
- DDL module is waiting for parameter (Master module “STOP” mode after power reset)

Voltage Monitoring

The applied voltages are indicated with two green LEDs: The voltages are indicated at plug DDL. The threshold of the power supply (electronic/valves) are at 19.2 V/21.6 V for under voltage and at 28.8 V/26.4 V at over voltage.

Software Diagnosis

The diagnosis data of the Slave module are situated behind the data of the input range, corresponding to the DDL address. If address 0 (automatic addressing) is set, the bus coupler with

driver behaves like a valve driver. Further information can be taken from chapter 2.2 "DDL Addressing".
The software diagnosis of the Slave module is 1 byte standard diagnosis + configured data length long.
With bus coupler R412008002 the outputs from 24 ... 31 are not really existent. For this reason there is no rational diagnosis.
With smaller valve units further outputs and their diagnosis can not be used.

Table 58: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the Bits

- Byte Z Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: Output short circuit or open.
- Byte Z is the start address of the diagnosis data range of this DDL participant in the control.

NOTICE
A short circuit can only be recognized if the output is driven. An open output can only be recognized if it is not driven.

Parameter

The Slave module provides the DDL master module for CANopen with these functions. For each DDL participant one byte for parameter is available. The parameters are transferred only with the DDL initialization. Each parameter byte for the participants can be adjusted individually.

Table 59: Parameter for the Slave module

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	for controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what coils do exist. This information is then transferred via a diagnosis message to the control. In the control this message can be compared with a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing coils can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the

complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the Slave module.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the Slave module and the coils are still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

3.5.4 Connectors

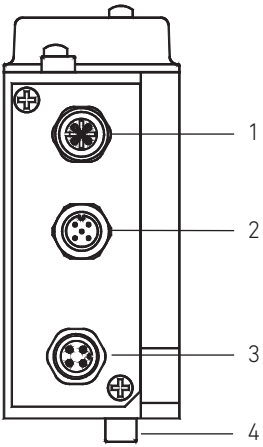


Fig. 37: Connectors

1 XPD: DDL OUT
2 X7C: CANopen connection
3 X1S: Power supply
4 X2O: Valve driver (only R412008002)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the bus coupler onto the valve unit is only allowed when the device is off circuit!

Power Supply

The power supply is connected via a circular plug X1S. Only 4-pin M12 connecting bushes should be used, whereas pin 5 is closed in order to avoid a mix up with other connections. The diameter of the wires should be chosen as big as possible, but at least 0.5 mm^2.

Both power supplies must be secured with external 3 A T fuses. The maximum allowed voltage in the 0 V line is limited to 4 A by the connector.

Bus Coupler

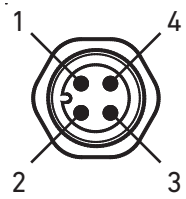


Fig. 38: X1S power supply

1 Pin 1: 24 V sensor voltage / electronics
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

The electronics of the bus coupler and the electronics of all I/O modules and initiators connected to the DDL (with modules without ext. voltage supply) are supplied via X1S, pin 1.
Via X1S, pin 2 the voltage for the valves must be supplied, if no module with external power supply is used. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.

The 24 V supplies must be effected out of a common power supply unit respectively with a common 0 V connection.
A power supply unit with a secure separation according to EN 60742, classification VDE 0551 should be used.

Data Line CANopen

The connection to the bus system is effected via the data plug X7C.

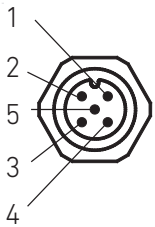


Fig. 39: X7C CANopen data plug

1 Pin 1 = shield
2 Pin 2 = nc
3 Pin 3 = 0 V
4 Pin 4 = CAN H
5 Pin 5 = CAN L

Data Line DDL

The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to the signal lines DDL H and DDL L. For this reason we recommend to use pre configured cables (see chapter 5 “DDL Accessories“). The allocation of the DDL connections is described in chapter 2.4 “DDL Data“.

The DDL end plug (see chapter 5 “DDL Accessories“) is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

3.5.5 Technical Data

CANopen

Technical Data	
Operating voltage valves	24 V DC +10 -0 %
Operating voltage electronics	24 V DC ±20 %
Fuse of the valve voltage external	3 A T
Fuse of electronics external	3 A T
Attention: Maximum power in the 0 V line	4 A
Voltage drop, internal	0.8 V
Supply electronics	300 mA
Power supply for sensors	max. 3 A per DDL branch
Power supply for valves	max. 3 A per DDL branch
Number of output bytes (R412008002)	1 / 2 / 3 / 4 byte
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical Data	s. quotation drawing

3.5.6 Dimensions

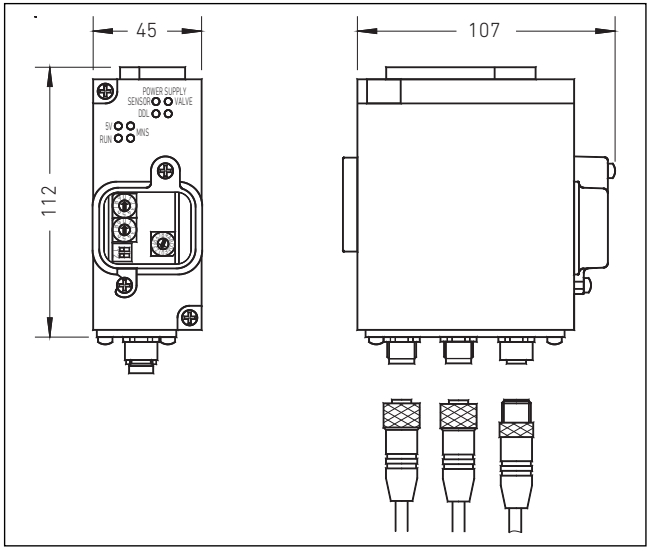


Fig. 40: Dimensions of the bus coupler with drivers (R412008002)

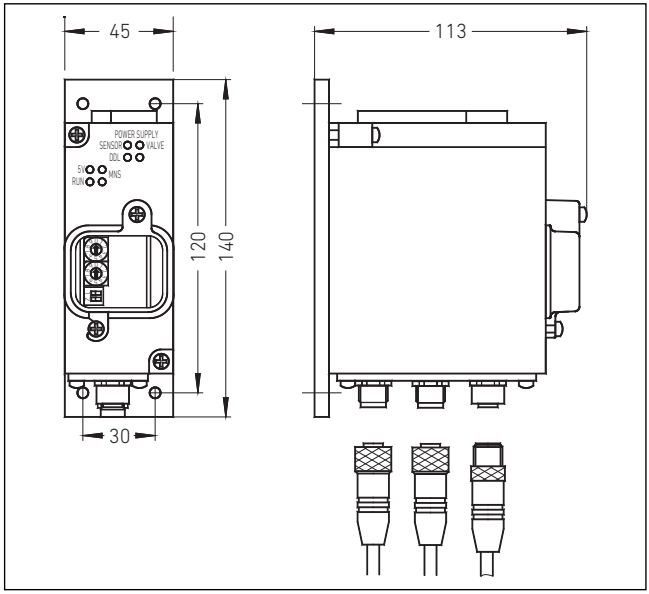


Fig. 41: Dimensions of the bus coupler Stand alone (R412008000)

3.5.7 ATEX-Relevant Information

If the bus coupler Can Open R412008000 is used in zone 2, attention has to be paid to the following ATEX-relevant information.
See in chapter 3.6.1 “Ex-Relevant Excerpt from the Operating Instructions for S-Design Bus Couplers“.

3.6 ATEX-Relevant Information for Bus Couplers

3.6.1 Ex-Relevant Excerpt from the Operating Instructions for S-Design Bus Couplers

Preamble
This excerpt from the operating instructions only contains those aspects relevant to explosion protection. It is included in the same or a corresponding form in the original operator instructions; text changes are permitted but the aspects related to explosion protection remain the same.
To ensure function and your own safety, carefully read the enclosed operating instructions before beginning installation. Contact AVENTICS GmbH if you have any further questions.

General information on explosion protection
The bus couplers convert a field bus protocol to a protocol that can be processed by the valve systems. The connections for power supply, field bus and VDS lines are made using pre assembled lines that must be appropriately protected. The data electric circuit may be galvanically isolated, but does not need to be, as this has no effect on explosion protection.
The bus couplers may only be used in accordance with the specifications outlined in the technical documentation from AVENTICS GmbH and information on the product rating plate. They comply with the valid standards and directives and fulfill the requirements in directive 94/9/EC. The installation regulations (e.g. EN 60079-14) for systems in explosive areas must be observed.

The bus couplers can be used as follows:

- In zone 2 (gas-ex, category 3G) in explosion groups IIA and IIB

In the Ex area, 135°C is the reference temperature for determining the temperature class (T4) and for further considerations with respect to the safety distance from the smoldering temperature. The permissible ambient temperature range is listed in section “Rating plate presentation“.
Further important details can be found in the declaration of conformity ExGuide 11 ATEX 0014 X.

General requirements

1. The manufacturer is not liable for damages in the case of non compliance with these instructions or improper interventions in the device. Furthermore, the warranty for appliances and accessory parts will no longer apply.
2. Observe the information in these instructions, as well as the operating conditions and permissible values stated on the labels/rating plates of the respective devices.
3. Observe the general technical rules for the selection and operation of devices.
4. Take suitable measures to prevent unintended activation or impermissible interference.
5. The bus couplers are only permitted for appropriate and intended use in normal industrial settings. In the case of violation, all manufacturer liability and warranty claims will no longer apply!
6. Ensure that the device is only fitted with ignition protection complying with the respective zones!
7. All connected electrical devices must be suitable for their respective functions.
8. The operator must provide sufficient lightning protection in accordance with local regulations.
9. Be aware of electrostatics when assembling the bus couplers.
10. Make sure that no falling objects can hit the bus coupler.
11. Protect light alloy housing parts from external impact energy.

12. The following applies in ATEX areas requiring category 3 equipment: It must be installed in a housing that corresponds to the requirements for impacts and IP protection in accordance with EN 60079-15 (gas explosion protection) or EN 61241-0 and EN 61241-1 (dust explosion protection).
13. These devices are "low energy instruments and devices" in accordance with paragraph 13 of EN 60079-15. The requirements in sub section c) (transient limitation to 40 % above the nominal voltage) must be observed during installation.

Rating plate presentation

AVENTICS with address
Type: S-Design *** [part number]
[Serial number] CE Year of manufacture
Ex II 3G Ex nA IIB T4 Gc X
+5°C ≤ Ta ≤ 40°C/50°C

Commissioning, installation

Install the bus couplers in a superior system. The required cleaning intervals for the equipment (dust deposits) depend on the IP protection class. Ensure that the device is only fitted with ignition protection complying with the respective zones/ categories! Always observe the nationally valid installation guidelines (e.g. EN 60079-14). Other important facts:

1. The devices are designed for protection class IP 54 and may require further protection if used under more adverse ambient conditions. See also section "General requirements", point 12).
2. Note the declaration of conformity and the special conditions listed therein.
3. To ensure explosion protection, associated electrical and mechanical equipment must correspond to the requirements of the applicable zones on site and must be checked separately by the person installing the machine.
4. The device may only be used as intended.
5. Electrostatic charges and/or insulated metal parts must be avoided. Only clean with a damp cloth!

6. If located in an explosive area, tight parts (e.g. due to frost or corrosion) may not be removed violently.
7. Protect against unauthorized opening and attach a sign stating “Do not disconnect under power”.
8. Tighten the nuts on the connection plug with a torque of at least 0.6 Nm.
9. If vibrations occur during operation which could loosen the plugs, secure them with threadlocker. A separation force of at least 0.6 ... 2.5 Nm must be achieved on an equivalent M12 thread.
10. An open or not securely closed plug must not be energized in explosive areas!
11. Circuits in zone 2 may only include devices that are suitable for operation in this zone and which have appropriate documentation.
12. The devices must be protected against UV light.
13. The device must have a low induction connection with the PA in the system.
14. Operation of the bus couplers is only permissible in fully assembled housings that are free of defects. Operation is prohibited in damaged housings.
15. When ordering spare parts, include the material number located on the devices (label, rating plate).
16. Avoid contact between external liquid or corrosive media and the device.
17. Do not place any deflection or torsion loads on the device.
18. The bus couplers must not be used in systems with electric corrosion protection or may only be used on consultation with the manufacturer and after implementing special measures.
19. Assembly work in Ex areas may only be carried out in accordance with the local installation regulations. Observe the following (partial) guidelines:
    - Assembly and maintenance tasks must only be performed in non-Ex areas. A fire permit is required.
    - Additional safety precautions are necessary if there is a probability of hydrogen sulfide, ethylene oxide and/or carbon monoxide. These substances have a very low

ignition energy threshold!

– Where any potential for explosion exists, only use non sparking tools for these substances and all substances in explosion group IIC!

Usage

The bus couplers are only permitted for appropriate and intended use. In the case of violation, all manufacturer liability and warranty claims will no longer apply!

- See sections "General information on explosion protection", "Commissioning, installation", and "Service, maintenance".

Definition of types

	Part no.:
DDL PROFIBUS	3375000250
DDL Interbus	3375000450
DDL DeviceNet	R412006999
DDL CanOpen	R412008000

The permissible ambient temperature range is +5°C ... +40°C/ 50°C.

Service, maintenance

Definition of terms in accordance with IEC 60079-17:

Maintenance and service A combination of all tasks carried out to maintain an object in or return it to a condition which corresponds to the requirements of the respective specifications and ensures that the required functions can be performed.

Inspection Careful examination of the object with the goal of making a reliable statement on the condition of the object. Inspection is carried out without disassembly or, if necessary, with partial disassembly, supplemented by procedures such as taking measurements.

Visual inspection An inspection which determines visible faults, such as missing screws, without the use of access equipment or tools.

Close inspection An inspection which, in addition to the faults determined by visual inspection, also determines faults, such as loose screws, that can only be found by using access equipment, e.g. steps (if required) and tools. For close inspections, the housing usually does not need to be opened and the equipment can usually stay energized.

Detailed inspection An inspection which, in addition to the aspects determined by close inspection, determines faults, such as loose connections, that can only be found by opening housings and/or using tools and testing equipment, if required.

- Maintenance measures may only be performed by personnel with equal or comparable qualification acc. to TRBS 1203.
- Accessory parts for use in explosive areas must comply with the requirements stipulated in the European directives and national laws.
- Components may only be exchanged for original spare parts that are also approved for use in explosive areas.
- Devices in ex areas must be cleaned regularly. The intervals must be stipulated by the operator in accordance with the local ambient conditions.
- After service and/or maintenance, all barriers and warnings must be returned to their original locations.
- Disassemble the device as soon as malfunctions occur. Maintenance of internal components cannot be conducted on site. Send the device to the manufacturer for inspection.

	Activity	Visual inspection monthly	Close inspection every 6 months	Detailed inspection every 12 months
1	Visually inspect the integrity of the bus couplers, remove dust deposits	•		
2	Inspect the entire system		Responsibility of the operator	

Disposal

Dispose of packaging and used parts in accordance with the regulations of the country where the device has been installed.

4 DDL Participants

4.1 Valve Driver 337 500 005 0/337 500 015 0

With the DDL valve driver, valve units, which have a 25 pin D-Sub connection can be connected. Thereby it is possible to control up to 24 valves respectively 24 coils. The valve driver is available with an external voltage supply (337 500 015 0) or with a valve supply via the DDL (337 500 005 0). A further advantage of the valve driver with an external voltage supply, is that with long DDL cabling and high current consumption the voltage drop can be compensated. The DDL power supply behind the valve driver with external power supply is also supplied via the external power supply.

4.1.1 Overview

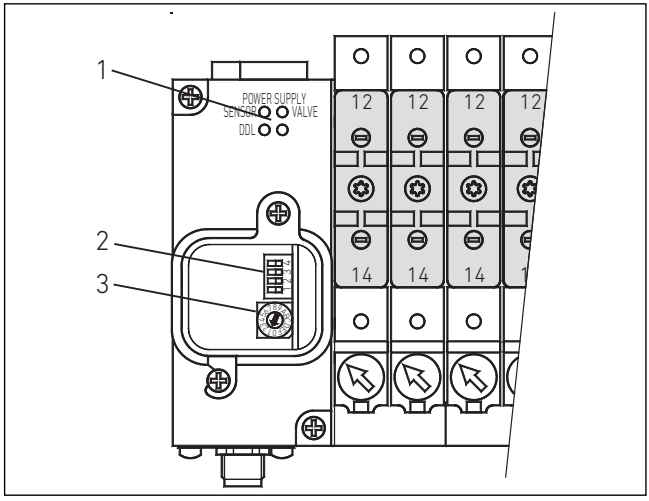


Fig. 42: LEDs and switches

1 DDL LEDs
2 DDL mode S3
3 DDL addressS2

4.1.2 DDL Address

The DDL address is adjusted with switch S2.
The regulations for the adjustment can be found in chapter 2.2 “DDL Addressing“.

4.1.3 DDL Mode

The DDL baud rate is adjusted with switch S1. All participants must be adjusted to the same baud rate.

Table 60: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

4.1.4 Output Data Length

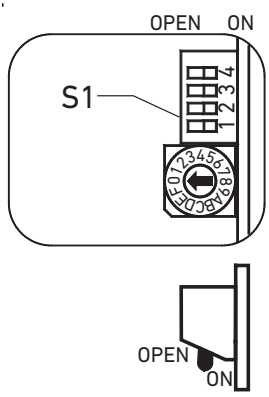


Fig. 43: DIP switch S1

With switch S1 the number of the outputs is adjusted. With this it is possible to optimize the required data range of the control for smaller valve units.

Table 61: Data length

Bit 3	Bit 4	Data Length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

The 4 byte mode offers a conformity with 16 bit PLC systems. But only the first 3 bytes are transferred to the outputs of the D-Sub plug.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.1.5 Output Data Range in the Control

The DDL address determines the position of the output data in the data area of the bus coupler and therefore the position in the address area of the control. The valve driver occupies, depending on the length set, 1 ... 4 byte in the output range of the control. Whereby the 4th byte does not represent real outputs and serves only for the 16 bit conformity.

Table 62: Output bits

Byte	Regarding	Bit							
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
X	valve unit	output 7	output 6	output 5	output 4	output 3	output 2	output 1	output 0
	Pin 25 pol. D-Sub	8	7	6	5	4	3	2	1
X + 1	valve unit	output 15	output 14	output 13	output 12	output 11	output 10	output 9	output 8
	Pin 25 pol. D-Sub	16	15	14	13	12	11	10	9
X + 2	valve unit	output 23	output 22	output 21	output 20	output 19	output 18	output 17	output 16
	Pin 25 pol. D-Sub	24	23	22	21	20	19	18	17
X + 3	valve unit	not existent	not existent	not existent	not existent	not existent	not existent	not existent	not existent
	Pin 25 pol. D-Sub	Nc	Nc	Nc	Nc	Nc	Nc	Nc	Nc

At Pin 25 of 25 pol. D-Sub plug 0 V is connected.
If address 0 (automatic addressing) is set, the valve driver behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The valve driver does not occupy any data in the input range only within the diagnosis range of the DDL.
Byte X is the start address of the output data range of the DDL participant in the control.

4.1.6 Diagnosis

LED diagnosis

Table 63: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply (X1S, Pin 1)
DDL	red lighting	no DDL communication (see below)

The range for the power supply (electronic/valves) is 19.2 V/ 21.6 V for undervoltage and 28.8 V/26.4 V for overvoltage. The voltages are measured at plug DDL out. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rates of the DDL modules are not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Voltage Monitoring

The applied voltage supplies are indicated by two green LEDs: Voltages at the plug DDL are shown. The threshold of the power supply (electronic/valves) are at 19.2 V/21.6 V for undervoltage and at 28.8 V/26.4 V for overvoltage.

Software diagnosis

The diagnosis data of the valve driver are in the diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the valve driver behaves like a valve driver.

Further information can be taken from chapter 2.2 "DDL Addressing". The length of the diagnosis range is one byte + configured data length long.
The software diagnosis consists of two parts:
The first byte is the standard diagnosis and the second part consists of up to 4 byte output diagnosis.
With the valve driver 337 500 005 0 respectively 337 500 015 0 the outputs from 24 ... 31 are not really existent. For this reason there is no rational diagnosis. With smaller valve units further outputs and their diagnosis can not be used.

Table 64: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits

- Byte Z Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: output short circuit or open (see description of the parameter).
- Byte Z is the start address of the diagnosis range of this DDL participant in the control.

NOTICE
A short circuit can only be recognized if the output is controlled. An open output can only be recognized, if it is not controlled.

4.1.7 Parameter

This function is provided by the valve driver to the bus coupler. Depending on the field bus system the parameter bytes can be used. Per DDL participant one byte for parameter is available. The parameter are not transmitted cyclically. Each parameter byte for the participants can be adjusted individually.

Table 65: Parameter for valve driver

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	with controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what coils exist. This information is then transmitted via a diagnosis message to the control. In the control this message can be compared to a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing coils can be determined upon the start of the system. During the cyclic

operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the valve driver.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the valve driver and the coils will be still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.1.8 Connections

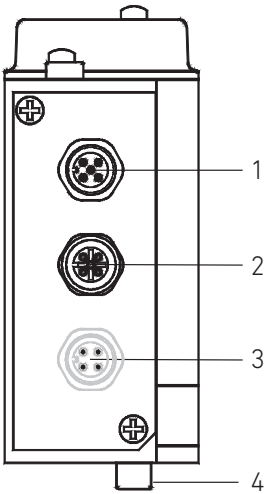


Fig. 44: Connectors

1 XPD2: DDL IN

2 XPD1: DDL OUT

3 X1S: Power supply (only 337 500 015 0)

4 X2O: Valve driver

NOTICE

The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the valve driver onto the valve unit is only allowed when the device is off circuit!

Power Supply (only for 337 500 015 0)

The external supply voltage for the valves and the sensors/ electronics is connected via a circular plug (X1S) M12x1 4 pin. Only 4 pin M12 connecting bushes should be used, where Pin 5 is closed; in order to avoid a mix up with other connections. All subsequent modules are supplied by this supply. The supply voltage at connection DDL OUT is internally protected by electronic fuses in the device. These restart automatically after the reason for the activation has been cleared. Both supply voltages must be protected by an external 3 A T fuse.

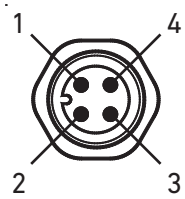


Fig. 45: X1S External power supply

The maximum allowed power in the 0 V line is limited by the connector to 4 A.

1 Pin 1: 24 V sensor voltage / electronic
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

With an additional input, longer DDL lines can be established (up to 40 m) as the voltage drop on the DDL line means no restriction to this. There is no galvanic separation between the voltages of the DDL and the external power supply, the 0 V lines have to be connected with each other.

The voltage supply should come from the power pack, which also supplies the bus coupler!

The diameter of the external power supply should be ≥ 0.5 mm^2. With the additional power supply it is possible to establish an additional EMERGENCY STOP circuit. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.
The voltages coming from the bus coupler DDL IN are not transmitted to the DDL OUT.
When using a valve driver without an external power supply (337 500 005 0) plug X1S does not exist. The power supply is taken from the DDL. The maximum power (3 A at 24 V and 4 A at 0 V) must not be exceeded. The voltages coming from the DDL IN are transferred to the DDL OUT and serve for the supply of further DDL modules.

Data Line DDL

The valve driver is connected to the bus coupler or further DDL devices by plugs XPD1 and XPD2. Plug XPD2 (integrated plug) is the DDL IN and plug XPD1 (integrated bush) is the DDL OUT.
The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason it is recommend to use pre fabricated cables (see chapter 5 "DDL Accessories"). The allocation of the DDL connections are described in chapter 2.4 "DDL Data".
The DDL end plug (see chapter 5 "DDL Accessories") is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the module is the last or the only participant of a DDL line.

4.1.9 Technical Data

Technical Data	
Operating voltage valves external (only 337 500 015 0)	24 V DC +10 -0 %
Operating voltage sensors electronic external (only 337 500 015 0)	24 V DC + 20 %
Protection of the voltages (only 337 500 015 0) external	3 A T
Attention: Maximum power in 0 V line	4 A
Operating voltage (only 337 500 005 0) via DDL	24 V DC
Voltage drop, internal	0.8 V (with 337 500 015 0)
Voltage drop, internal	0.2 V (with 337 500 005 0)
Required electronic	50 mA
Max. output power per output	200 mA (short circuit protected)
Number of outputs	maximum 24
Number of output bytes	switchable 1 / 2 / 3 / 4 byte
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65
Further technical Data	s. quotation drawing

4.1.10 Dimensions

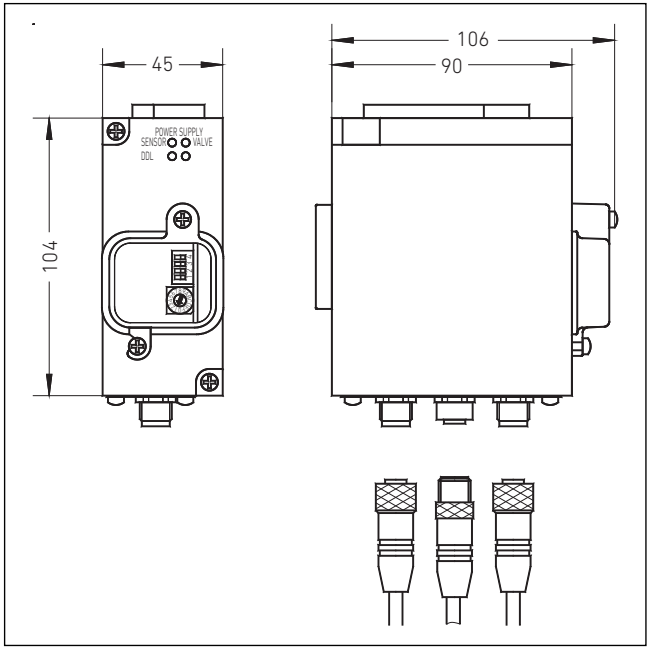


Fig. 46: Dimensions of valve driver (337 500 005/337 500 015 0)

4.2 Valve Driver V-Design 1 827 030 189 0/1 827 030 190 0

With the DDL valve driver V-Design, valve unit families HF02, HF03, VS02 and MC can be connected. Thereby it is possible to control up to 16 valves respectively 32 coils. The valve driver is available with an external voltage supply (1 827 030 190) or with a valve supply via the DDL (1 827 030 189). A further advantage of the valve driver with an external voltage supply, is that with long DDL cabling and high current consumption the voltage drop can be compensated. The DDL power supply behind the valve driver with external power supply is also supplied via the external power supply.

4.2.1 Overview

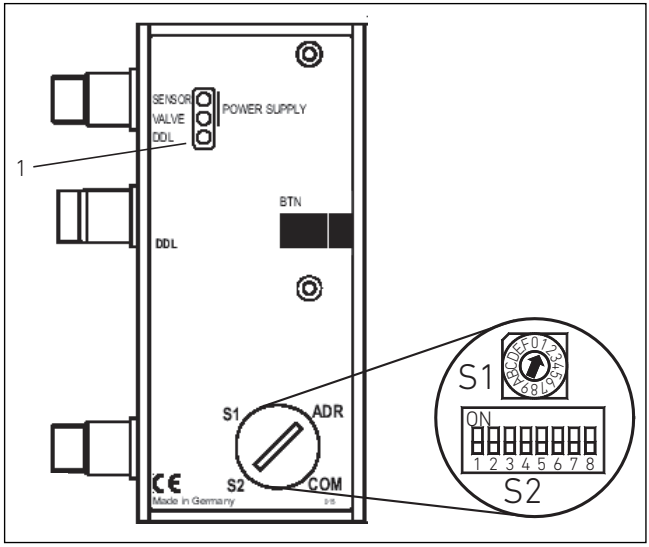


Fig. 47: LEDs and switches

1 DDL LEDs

4.2.2 DDL Address

The DDL address is adjusted with switch S1.
The regulations for the adjustment can be found in chapter 2.2 “DDL Addressing“.

4.2.3 DDL Mode

The DDL baud rate is adjusted with switch S2. All participants must be adjusted to the same baud rate.

Table 66: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)

4.2.4 Output Data Length

With switch S2 the number of the outputs is adjusted. With this it is possible to optimize the required data range of the control for smaller valve units.

Table 67: Data length

Bit 3	Bit 4	Data Length
Open	Open	1 Byte
On	Open	2 Byte
Open	On	3 Byte
On	On	4 Byte (default)

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

Bit 2,5,6,7 of switch S2 have no function but should be set open generally.

4.2.5 Output Data Range in the Control

The DDL address determines the position of the output data in the data area of the bus coupler and therefore the position in the address area of the control. The valve driver occupies, depending on the length set, 1 ... 4 byte in the output range of the control.

Table 68: Output bits

Byte	Valve unit	Bit 7	6	5	4	3	2	1	0
X	valve	4		3		2		1	
	coil	12	14	12	14	12	14	12	14
X + 1	valve	8		7		6		5	
	coil	12	14	12	14	12	14	12	14
X + 2	valve	12		11		10		9	
	coil	12	14	12	14	12	14	12	14
X + 3	valve	16		15		14		13	
	coil	12	14	12	14	12	14	12	14

If address 0 (automatic addressing) is set, the valve driver behaves like a valve driver. Further information can be taken from chapter 2.2 "DDL Addressing".
The valve driver does not occupy any data in the input range only within the diagnosis range of the DDL.
Byte X is the start address of the output data range of the DDL participant in the control.

4.2.6 Diagnosis

LED Diagnosis

Table 69: Overview of the DDL LED indication

Description	Color of LED	Meaning
SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply
SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply
DDL	red lighting	no DDL communication (see page 124)

The range for the power supply (electronic/valves) is 19.2 V/ 21.6 V for undervoltage and 28.8 V/26.4 V for overvoltage. The voltages are measured at plug DDL out. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rates of the DDL modules are not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the valve driver are in the diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the valve driver behaves like a valve driver. Further information can be taken from chapter 2.2 "DDL Addressing".
The length of the diagnosis range is one byte + configured data length long.
The software diagnosis consists of two parts:
The first byte is the standard diagnosis and the second part consists of up to 4 byte output diagnosis.
With valve units having less than 16 valves for the output without coils diagnosis can not be used.

Table 70: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits

- Byte Z Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: output short circuit or open (see description of the parameter).
- Byte Z is the start address of the diagnosis range of this DDL participant in the control.

NOTICE

A short circuit can only be recognized if the output is controlled. An open output can only be recognized, it is not controlled.

4.2.7 Parameter

These functions are provided to the bus coupler by the valve driver. Depending on the field bus system the parameter bytes can be used. Per DDL participant one byte for parameter is available. The parameter are not transmitted cyclically. Each parameter byte for the participants can be adjusted individually.

Table 71: Parameter for valve driver

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	for controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0: Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1: Upon starting the system it is first determined what coils exist. This information is then transmitted via a diagnosis message to the control. In the control this message can be compared to a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing coils can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0: Upon failure of the DDL, the output data are set at 0 in the valve driver.

Bit 3 = 1: Upon failure of the DDL, the output data are stored in the valve driver and the coils will be still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.2.8 Connections

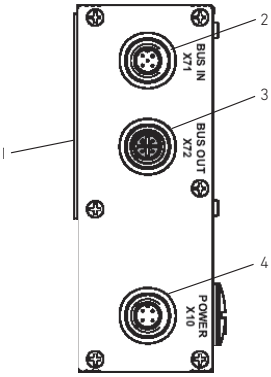


Fig. 48: Connectors

1 X20: Valve driver
2 X71: DDL IN
3 X72: DDL OUT
4 X10: Power supply (only 1 827 030 190 0) (M12x1, 4 pin, male)

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the valve driver onto the valve unit is only allowed when the device is off circuit!

Power Supply (only for 1 827 030 190 0)

The external supply voltage for the valves and the sensors/ electronics is connected via a circular plug M12x1 4 pin. Only 4 pin M12 connecting bushes should be used, where Pin 5 is closed; in order to avoid a mix up with other connections. All subsequent modules are supplied by this supply. The supply voltage at connection DDL OUT is internally protected by electronic fuses in the device. These restart automatically after the reason for the activation has been cleared. Both supply voltages must be protected by an external 3 A F fuse. The maximum allowed power in the 0 V line is limited by the connector to 4 A.

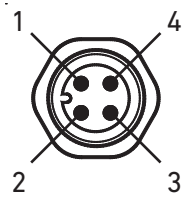


Fig. 49: X10 external power supply

1 Pin 1: 24 V sensor voltage / electronic
2 Pin 2: 24 V valve voltage
3 Pin 3: 0 V
4 Pin 4: Function earth

With an additional input, longer DDL lines can be established (up to 40 m) as the voltage drop on the DDL line means no restriction to this. There is no galvanic separation between the voltages of the DDL and the external power supply, the 0 V lines have to be connected with each other.

The voltage supply should come from the power pack, which also supplies the bus coupler!

The diameter of the external power supply should be ≥ 0.5 mm^2. With the additional power supply it is possible to establish an additional EMERGENCY-STOP circuit. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the valves, whereas the PLC, the serial interfaces and the initiators remain in operation. Turning off the power supply for the serial interface can lead to the state STOP of the PLC.
The voltages coming from the bus coupler DDL IN are not transmitted to the DDL OUT.
When using a valve driver without an external power supply (1 827 030 189 0) plug X10 does not exist. The power supply is taken from the DDL. The maximum power (3 A at 24 V and 4 A at 0 V) must not be exceeded. The voltages coming from the DDL IN are transferred to the DDL OUT and serve for the supply of further DDL modules.

Data Line DDL

The valve driver is connected to the bus coupler or further DDL devices by plugs X71 and X72. Plug X71 (integrated plug) is the DDL IN and plug X72 (integrated bush) is the DDL OUT.
The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason it is recommend to use pre fabricated cables (see chapter 5 "DDL Accessories"). The allocation of the DDL connections are described in chapter 2.4 "DDL Data".

DDL Termination

The DDL line has to be terminated after the last physical DDL node in the line. The termination can be made with:

- DDL terminating plug
  – The DDL termination plug (see chapter 5 "DDL Accessories") guarantees a defined end of the line, also the module fulfills the protection degree IP 65.
- Internal termination resistor
  – With the switch S2.8 = On the DDL line is electrically terminated. Additionally the connection DDL OUT X72 has to be closed with a M12×1 cover to guarantee the protection degree IP 65.

It is not allowed to have the switch S2.8 = On **and** a DDL terminating plug is used.

If this module is the last node in the line, switch S2.8 has to set Open.

4.2.9 Technical Data

Technical Data	
Operating voltage valves external (only 337 500 015 0)	24 V DC +10 -0 %
Operating voltage sensors electronic external (only 337 500 015 0)	24 V DC +20 %
Protection of the voltages (1 827 030 190) external	3 A F
Attention: Maximum power in 0 V line	4 A
Operating voltage (only 1 827 030 189) via DDL	24 V DC
Voltage drop, internal	0.8 V (with 1 827 030 190)
Voltage drop, internal	0.2 V (with 1 827 030 189)
Required electronic	30 mA
Max. output power per output	70 mA (short circuit protected)
Number of outputs	maximum 32
Number of output bytes	switchable 1 / 2 / 3 / 4 byte
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65
Further technical Data	s. quotation drawing

4.2.10 Dimensions

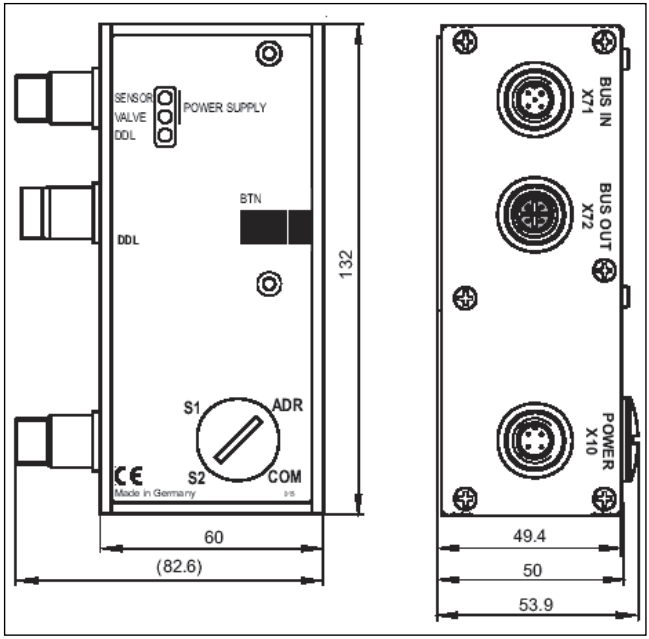


Fig. 50: Dimensions of valve driver (1 827 030 189/1 827 030 190)

4.3 Valve System LP04

In the valve system (VS) the complete DDL electronic is integrated. Therefore the system a very compact and easy to use.
The system is available with 4, 6, 8, 10, 12, 14 or 16 valves.
32 coils can be maximum controlled.

4.3.1 Overview

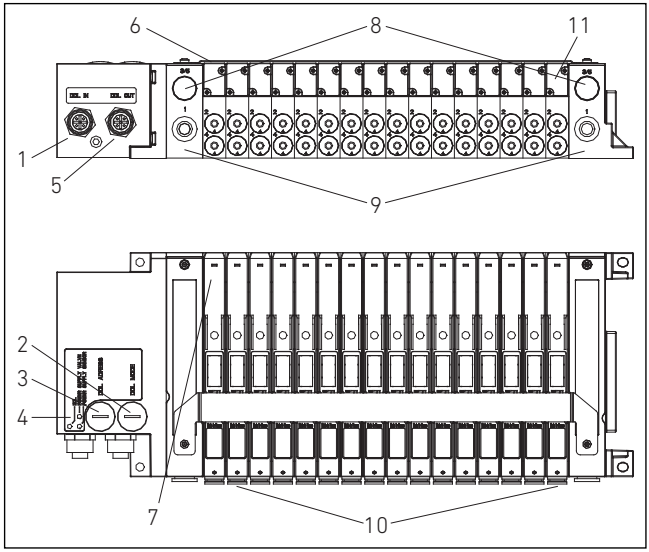


Fig. 51: LEDs and switches

1 DDL IN
2 DDL Mode S1
3 DDL Address S2
4 DDL LEDs
5 DDL OUT
6 Valve 1
7 Valve status LEDs 14 and 12
8 Common air exhaust for 3&5 through internal silencer
9 Port 1, Air supply Ø8 x 1 mm
10 Port 2&4, Working ports Ø6 x 1 mm. 4 x 1 mm as option
11 Valve 16

4.3.2 DDL address

The DDL address is adjusted with switch S2.
The regulations for the adjustment can be found in chapter 2.2 “DDL Addressing“.

4.3.3 DDL Mode

The DDL baud rate is adjusted with switch S1. All participants must be adjusted to the same baud rate.

Table 72: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

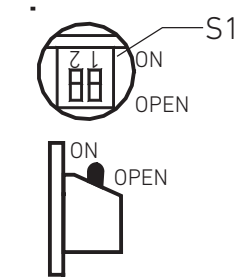


Fig. 52: DIP switch S1: DDL mode

4.3.4 Output Data Length

The number of the outputs is set by the hardware. The length of the output data is corresponding to the lengths of the valve system. A system with 4 valves occupies 1 byte, a system with 6 or 8 or valves occupies 2 bytes, a system with 10 or 12 valves occupies 3 byte and a system with 14 or 16 valves occupies 4 bytes.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.3.5 Output Data Range in the Control

The DDL address determines the position of the output data in the data area of the bus coupler and therefore the position in the address area of the control. The valve system occupies, depending on the length set, 1 ... 4 byte in the output range of the control.

Table 73: Output bits

Byte	Regarding	Bit							
		7	6	5	4	3	2	1	0
X	Valve	4		3		2		1	
	Coil	12	14	12	14	12	14	12	14
X + 1	Valve	8	8	7	7	6	6	5	5
	Coil	12	14	12	14	12	14	12	14
X + 2	Valve	12	12	11	11	10	10	9	9
	Coil	12	14	12	14	12	14	12	14
X + 3	Valve	16	16	15	15	14	14	13	13
	Coil	12	14	12	14	12	14	12	14

If address 0 (automatic addressing) is set, the VS behaves like a valve driver. Further information can be taken from chapter 2.2 “DDL Addressing“.
The valve system does not occupy any data in the input range only within the diagnosis range of the DDL.
Byte X is the start address of the output data range of the DDL participant in the control.

4.3.6 Diagnosis

LED Diagnosis

Table 74: Overview of the DDL LED indication

Description	Color of LED	Meaning
POWER SUPPLY SENSOR	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply
POWER SUPPLY VALVE	green lighting	voltage within the tolerance
	green flashing	voltage below or beyond the tolerance
	green off	no voltage at connection sensor supply
DDL	red lighting	no DDL communication (see page 135)

The range for the power supply (electronic/valves) is 19.2 V/ 21.6 V for undervoltage and 28.8 V/26.4 V for overvoltage. The voltages are measured at plug DDL OUT. The LED DDL indicates that no reference data communication takes place in the DDL system. This can be due to:

- The adjusted baud rates of the DDL modules are not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the valve system are in the diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the VS behaves like a valve driver. Further information can be taken from chapter 2.2 "DDL Addressing". The length of the diagnosis range is one byte + configured data length long.
The software diagnosis consists of two parts:
The first byte is the standard diagnosis and the second part consists of up to 4 byte output diagnosis according to the extension of the valve system.

DDL Participants

Table 75: Diagnosis bits

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V valve supply diagnosis	24 V electronic supply diagnosis
Z + 1	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis	output 0 diagnosis
Z + 2	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis	output 8 diagnosis
Z + 3	output 23 diagnosis	output 22 diagnosis	output 21 diagnosis	output 20 diagnosis	output 19 diagnosis	output 18 diagnosis	output 17 diagnosis	output 16 diagnosis
Z + 4	output 31 diagnosis	output 30 diagnosis	output 29 diagnosis	output 28 diagnosis	output 27 diagnosis	output 26 diagnosis	output 25 diagnosis	output 24 diagnosis

Meaning of the bits

- Byte Z Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Byte Z Bit 1: Power supply of the valves below 21.6 V or beyond 26.4 V
- Byte Z Bit 7: Communication to the DDL module interrupted
- Byte (Z + 1) – (Z + 4) Bit 0 ... 7: output short circuit or open (see description of the parameter).
- Byte Z is the start address of the diagnosis range of this DDL participant in the control.

NOTICE

A short circuit can only be recognized if the output is controlled.
An open output can only be recognized, it is not controlled.

4.3.7 Parameter

These functions are provided to the bus coupler by the valve system. Depending on the field bus system the parameter bytes can be used. Per DDL participant one byte for parameter is available. The parameter are not transmitted cyclically. Each parameter byte for the participants can be adjusted individually.

Table 76: Parameter for valve system

Bit	Parameter Name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reaction at DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the coils	for controlled outputs (default)	changes are transferred
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which coils do exist. If an output is controlled, where no coil exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what coils exist. This information is then transmitted via a diagnosis message to the control. In the control this message can be compared to a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing coils can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the valve system.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the valve system and the coils will be still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.3.8 Connections

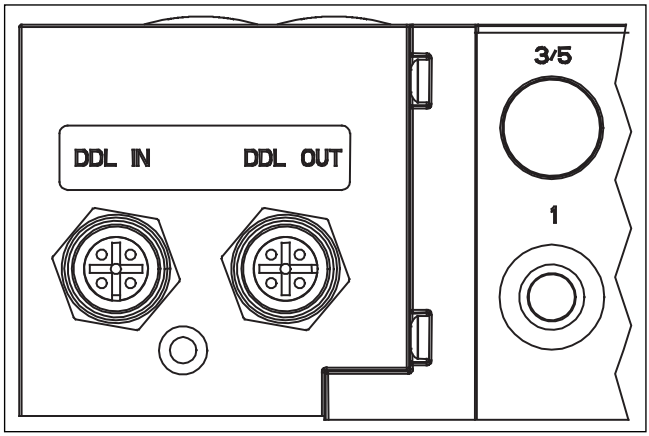


Fig. 53: Connectors

NOTICE
The connectors must not be plugged or pulled under load. The assembly or the plugging and pulling of the valve driver onto the valve unit is only allowed when the device is switched off!

The power supply for the valve system is taken from the DDL. The maximum power (3 A at 24 V and 4 A at 0 V) must not be exceeded. The voltages coming from the DDL IN are transferred to the DDL OUT and serve for the supply of further DDL modules.

Data Line DDL

The valve system is connected to the bus coupler or further DDL devices by plugs XPD1 and XPD2. Plug XPD2 (integrated plug) is the DDL IN and plug XPD1 (integrated bush) is the DDL OUT.
The output of the DDL is short circuit protected at all lines. Nevertheless DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason it is recommend to use pre fabricated cables (see chapter 5 "DDL Accessories"). The allocation of the DDL connections are described in chapter 2.4 "DDL Data".
The DDL end plug (see chapter 5 "DDL Accessories") is necessary to guarantee a definite termination of the line and the protection degree IP 65, if the system is the last or the only participant of a DDL line.

4.3.9 Technical Data

Technical Data	
Operating voltage via DDL	24 V DC
Attention: Maximum power in 0 V line	4 A
Voltage drop, internal	0.2 V
Required electronic	50 mA
Max. output power per output	100 mA
Number of outputs	maximum 32
Number of output bytes	1 / 2 / 3 / 4 byte
Ambient temperature range	0°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65
Further technical Data	s. manual R402000142 R402000143

Valve data	
Power consumption	0.35 W
Voltage	24 V DC +/-10 %
Manual override	Turn and detent
Working pressure	3 ... 8 bar
LED	yellow

4.3.10 Dimensions

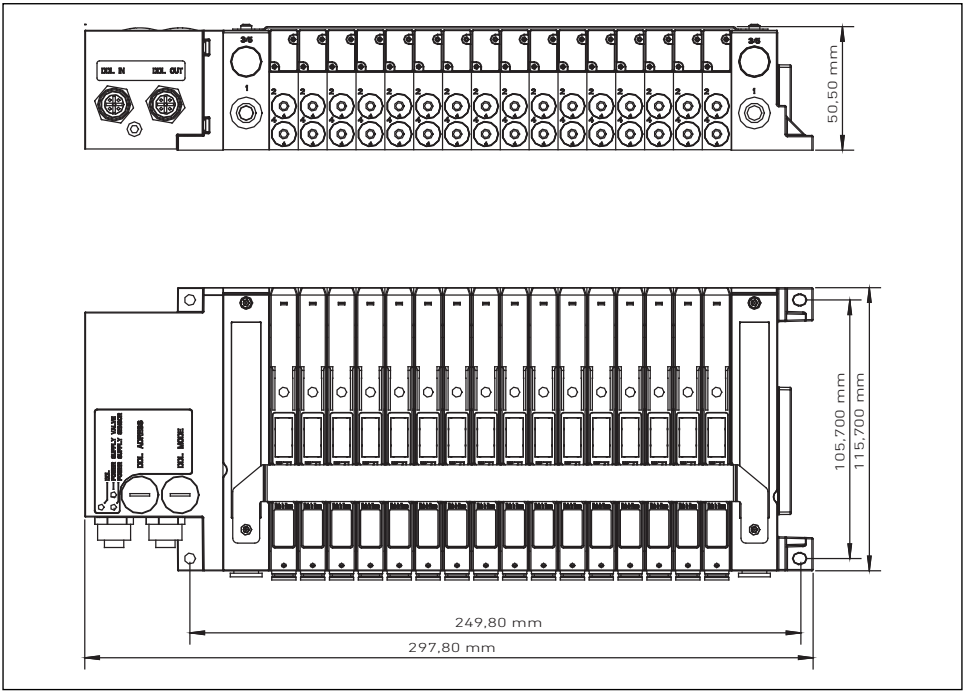


Fig. 54: Dimensions of valve system LP04 without inputs

4.3.11 Extension for LP04 Valve System with Inputs

In addition to up to 32 valve coils, the valve system with digital inputs can read 10 digital PNP inputs via 5 M12 sockets.
In the DDL system, the VS takes up 1 ... 4 bytes of output data, 2 bytes of input data and 2 ... 5 bytes of diagnosis data. A 1 byte parameter is transmitted from the pilot control to the input module.
The part of the description dealing with the valves can be taken from the VS without inputs. In this part of the description, only the deviations in the input section will be covered.

Overview

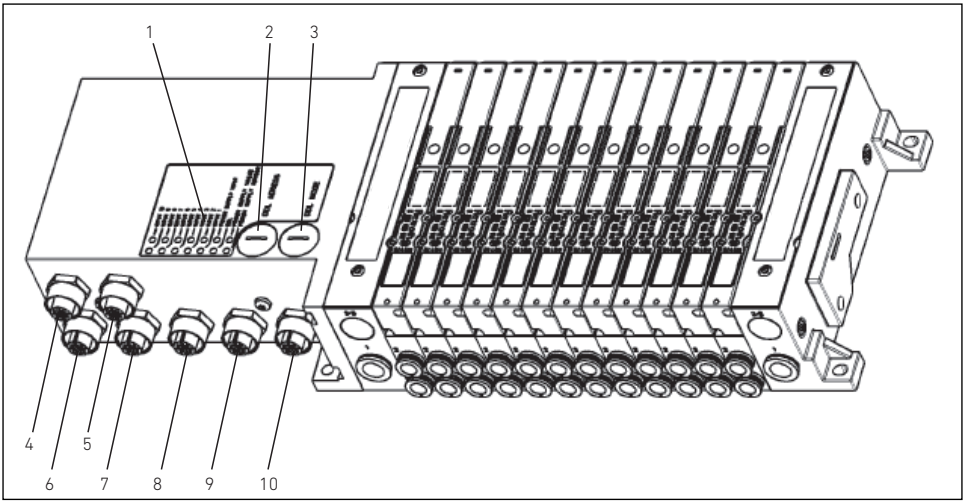


Fig. 55: Overview LP04 with inputs

1 DDL LEDs
2 DDL Address S2
3 DDL Mode S1
4 XPD2: DDL IN
5 X2I5
6 XPD1: DDL OUT
7 X2I4
8 X2I3
9 X2I2
10 X2I1

Input data section in the pilot control

The DDL address sets the position of the input data in the data section of the bus coupler and thus sets the position in the address section of the pilot control. The input module takes up 2 bytes in the input section of the PLC. If address 0 (automatic addressing) is set, the VS with inputs behaves like a combi module. Further information can be taken from chapter 2.2 "DDL Addressing". The assignment of the input signals to bit positions is listed in the following table. Byte 0 represents the first byte of the input module in the input range of the control.

Table 77: Pin assignment bit position assignment

Plug		X2I1	X2I2	X2I3	X2I4	X2I5
Bit position	Pin 4	0.0	0.2	0.4	0.6	1.0
	Pin 2	0.1	0.3	0.5	0.7	1.1

Output data section in the pilot control

If address 0 (automatic addressing) is set, the VS with inputs behaves like a combi module. Further information can be taken from chapter 2.2 "DDL Addressing".

Diagnosis

LED diagnosis

The status of an input module is indicated by the LEDs on the front of the device.

Table 78: LED displays

LED	Color	Meaning
Input 1	Green	On = Signal on sensor 0.0
Input 2	Green	On = Signal on sensor 0.1
Input 3	Green	On = Signal on sensor 0.2
Input 4	Green	On = Signal on sensor 0.3
Input 5	Green	On = Signal on sensor 0.4
Input 6	Green	On = Signal on sensor 0.5
Input 7	Green	On = Signal on sensor 0.6
Input 8	Green	On = Signal on sensor 0.7
Input 9	Green	On = Signal on sensor 1.0
Input 10	Green	On = Signal on sensor 1.1

Software Diagnosis

The software diagnosis of the VS with input corresponds to the diagnosis of the VS without inputs except at automatic addressing: If address 0 (automatic addressing) is set, the VS with inputs behaves like a combi module. Further information can be taken from chapter 2.2 “DDL Addressing“. There are no additional diagnosis data from the inputs.

Parameter

Next to the DDL parameter for the valve driver, no further parameter for the inputs are available!

Overload protection

The sensor power supply is diverted from the DDL sensor voltage. If the sensor power supply has a short circuit at a socket or exceeds the total voltage of 0.5 A for all sockets, then the short circuit protection is triggered. The green LED supply input is either off or flashing. The power supply for the sensors is then switched off at all 5 sockets.

Upon overload the sensor supply will be interrupted, at all plugs as long as the interference is dispatched. The interference will not be stored, the module returns automatically into the normal operating state.

Signal Input Connections

The input signals are connected via five 5 pin M12 sockets (female).

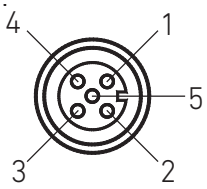


Fig. 56: Input socket X2In

1 Pin 1: 24 V power supply, short circuit proof
2 Pin 2: see table 77
3 Pin 3: 0 V
4 Pin 4: see table 77
5 Pin 5: FE

Table 79: Plug assignment

Plug	Pin 2	Pin 4
X2I1	Input 0.1	Input 0.0
X2I2	Input 0.3	Input 0.2
X2I3	Input 0.5	Input 0.4
X2I4	Input 0.7	Input 0.6
X2I5	Input 1.1	Input 1.0

NOTICE
Plugs may not be plugged in or pulled under load.

Technical Data for the Inputs

Technical Data	
Operational voltage via DDL	24 V DC
Power consumption from the DDL (SENSOR SUPPLY)	100 mA
Max. total power supply	0.5 A (short circuit proof)
Thermal area of application	+0°C ... +50°C
Storage temperature	-20°C ... +70°C
Protection class with corresponding closed line socket	IP 65
Time constant signal transition	0.7 ... 3 ms
Maximum length of the sensor lines	30 m
Installation position	Any
Switching level	acc. to IEC 61131-2 input type 1
Further technical data	s. manual R402000143

Dimensions

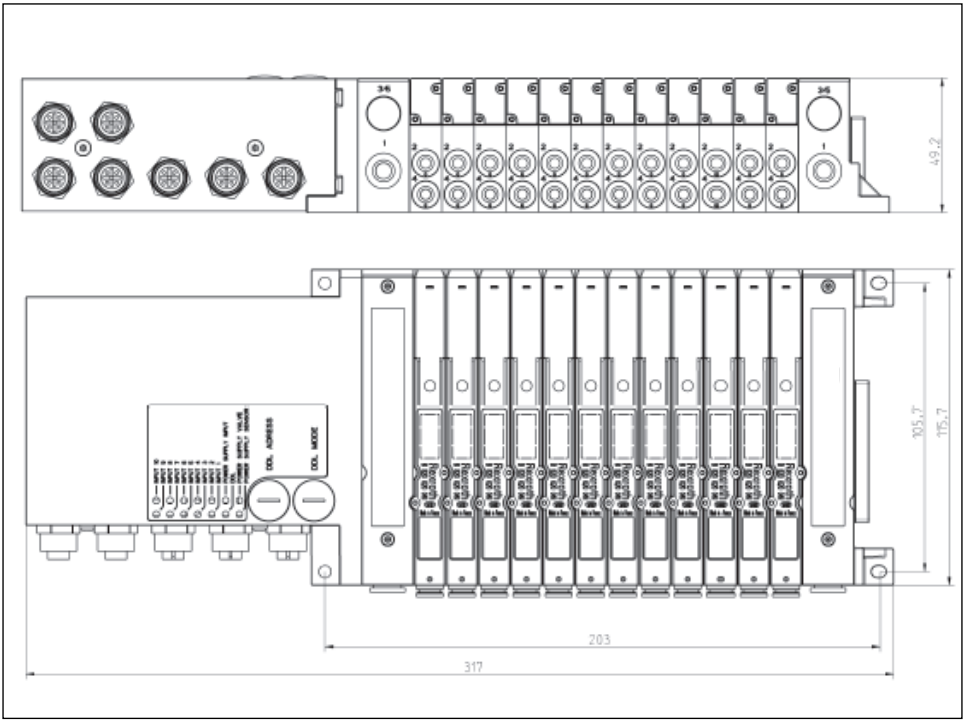


Fig. 57: Dimensions of the VS LP04 with inputs

4.4 Pressure Control Valve ED05 561 014 155 0

Electropneumatic pressure control valves convert an electric signal into a pneumatic pressure. The pressure control valve can thereby be used as a purely actuating element for the pressure or take on the control of other process factors as for example force or position.

The electronic control of the pressure control valve can be effected in various ways. The device described here uses the DDL.

4.4.1 Overview

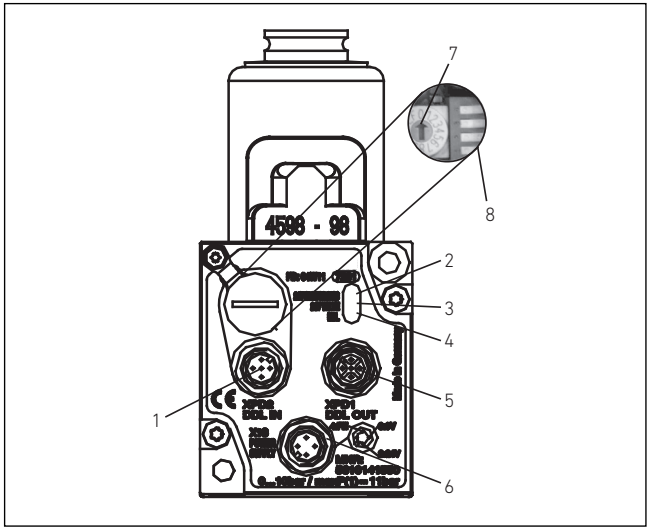


Fig. 58: LEDs, switches, and electrical connectors

1 XPD2: DDL IN
2 LED 24 V ELECTRONIC
3 LED 24 V VALVE
4 LED Interface DDL
5 XPD1: DDL OUT
6 X1S: Power supply
7 DDL Address S2
8 DDL Mode S1

4.4.2 DDL Address

The DDL address is adjusted with switch S2.
The regulations for the adjustments can be found in chapter 2.2 “DDL Addressing”.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.4.3 DDL Mode

The transfer rate of the DDL is set with the 4 bit DIP switch S1 bit 1. All DDL participants have to be adjusted to the same baud rate.
By the use of word orientation of the in and output data a mix up of high and low byte might occur with a byte oriented PLC type. If the data word e. g. the address 30 has been allocated, bits 0 ... 7 will appear in the byte address 31.0 ... 31.7, bits 8 ... 15 in byte address 30.0 ... 30.7.
With the 4 bit DIP switch S2 bit 2 the high and low byte of the control and the actual value can be exchanged. Thereby a simple transfer of the control and actual values is possible with the control. The diagnosis byte will not be influenced by the exchange.

Table 80: DDL mode

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	High, Low byte exchanged	high, low byte **not** exchanged (default)
3	no function	no function
42	no function	no function

4.4.4 Data Format

The DDL address determines the position of the in- and output data in the data range of the bus coupler and therefore the position of the address range in the control.
The device is controlled with 2 byte output data and returns to the bus coupler 2 byte input data.
If address 0 (automatic addressing) is set, the pressure control valve behaves like a pressure control valve. Further information can be taken from chapter 2.2 “DDL Addressing“.

Output Data

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
						X	X	X	X	X	X	X	X	X	X
						Control value: 10 bit									

Control value 10 bit (bit 0 ... bit 9)
Pressure control: 0 ... 10 bar, resolution 10 mbar,
thereby 1000 Steps = 10 bar

All non defined bits should be basically set at "0".

Input Data

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
						X	X	X	X	X	X	X	X	X	X
						Actual value: 110 bit									

Actual value 10 bit (bit 0 ... bit 9)
The actual value has the same resolution as the control value.
Pressure control 0 ... 10 bar, resolution 10 mbar,
thereby 1000 Steps = 10 bar

Status bit

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
X	Status bit														

The status bit (bit 15) permits a control of the data flow. It is always reported backwards as set. Therefore the data flow in the DDL line can be controlled without driving a control value.

4.4.5 Diagnosis

LED Diagnosis

The status of the pressure control valve DDL can be read by means of 3 LEDs at the front side of the device.

Table 81: Overview of the LEDs

Plate	Color of LED	Meaning
24 V ELECTRONIC	green lighting	Voltage at DDL interface within the tolerance
	green flashing	Voltage below or beyond the tolerance
24 V VALVE	green lighting	Voltage of the pressure control valve within the tolerance
	green flashing	Voltage below or beyond the tolerance (X1S, pin 2)
DDL	red lighting	No DDL communication (see below)

The limits for the tolerance of the power supply are 19.2 V for undervoltage and 28.8 V for overvoltage.
The LED "DDL" indicates that no reference communication takes place in the DDL. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the pressure control valve are within the diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the pressure control valve behaves like a pressure control valve. Further information can be taken from chapter 2.2 "DDL Addressing". The length of the diagnosis range is one byte.

Table 82: DDL standard diagnosis

Bit							
7	6	5	4	3	2	1	0
DDL comm. diagnosis	–	–	–	–	–	24 V sensor supply diagnosis	24 V electronic supply DDL diagnosis

Meaning of the bits

- Bit 0: Power supply of the electronic below 19.2 V or beyond 28.8 V
- Power supply of the pressure valve below 19.2 V or beyond 28.8 V
- Communication connection to the DDL module interrupted

4.4.6 Parameter

The pressure control valve 561 014 155 0 provides the possibility via the DDL parameter byte to change the behavior at a DDL communication fault. Following behaviors can be chosen:
The pressure of 0 bar/psi is controlled upon DDL failure (parameter bit 3 = 0).
The last controlled pressure if freezed upon DDL failure (parameter bit 3 = 1).

4.4.7 Controller

The controller is integrated in the device has been established and optimized for the pressure control. The controller compares the control value from the PLC with the actual value of the integrated pressure sensor and readjusts the pressure accordingly. The parameters of the controller are firmly specified and need not to be adjusted. At control values below 30mbar the device controls 0 bar. In order to reduce the temperature of the solenoid the control power is reduced, if the pressure supply of the valve is too low to control the control value. Therefore the device need not to be turned off, in case the air supply has been shortly interrupted.

The temperature of the solenoid can be considerably higher than the ambient temperature. Please take care when touching the solenoid.

4.4.8 Connections

The pressure control valve is connected via 3 plugs. Each plug has a certain function. The position of the plug can be taken from the drawing in the chapter "Overview".

Power Supply

The pressure control valve is supplied with voltage via plug X1S, M12x1, 4 pin, male. An external fuse of M 1.6 A should be used. The power supply of the interface is effected via the DDL.

The pressure control valve must not be used with a turned off interface, as undefined operating states might occur.

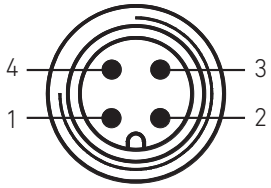


Fig. 59: X1S: Power supply

1 Pin 1: not connected
2 Pin 2: 24 V power supply of the pressure control valve
3 Pin 3: 0 V
4 Pin 4: Functional earth

There is no galvanic isolation between the voltages of the DDL and the external power supply, the 0 V lines are linked with each other.

The power supply has to come from the power pack, which supplies also the bus coupler!

The power supply of the valve can, if necessary, be integrated into the EMERGENCY-STOP circuit. If the voltage supply is interrupted in an emergency stop situation, the DDL interface of the device keeps on working, that means that the device will exhaust in an emergency stop situation and will then readjust the pressure, after the power supply has been applied again to the device. Input and diagnosis data are also transmitted in an emergency stop situation. The missing voltage of the controller is reported via the diagnosis data.

With reversed power supply and no external fuse as specified the device can be damaged.

Data Line DDL

With the plugs XPD1 and XPD2 the pressure control valve is connected to the bus coupler or to the other devices connected to the DDL. Plug XPD2 (built in plug) is the DDL IN and plug XPD1 (built in bush) is the DDL OUT plug.

The DDL power supply of the pressure control valve is not protected against polarity reversal, furthermore DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason we recommend to use pre fabricated wires (see chapter 5 “DDL Accessories“). The allocation of the DDL connections is described in chapter 2.4 “DDL Data“.

The DDL terminating plug (see chapter 5 “DDL Accessories“) is necessary if the module is the last or the only participant of a DDL line. To guarantee a definite termination of the line and that the module fulfills the protection class IP 55.

4.4.9 Technical Data

Technical Data	
Allowed medium	condensate and non lubricated compressed air, filtered 50 µm
Pressure supply	maximum 11 bar
Ambient temperature range	0°C ... +50°C
Stock temperature	-20°C ... +70°C
Power supply	24 V DC +/-20 %
Protection of external controller voltage	M 1,6 A
Allowed harmonic content	5 %
Current consumption	maximum 1.3 A
Pressure range	0 ... 10 bar (0 ... 145 psi)
Flow with input pressure 7 bar Control pressure 6 bar and pressure drop Δ p=0.2 bar	1000 l/min
Hysteresis and reproducibility	0.06 bar
Resolution	0.01 bar
Protection class (with closed connectors)	IP 55
Installation position	see chapter Dimensions
Further technical Data	s. quotation drawing

4.4.10 Dimensions

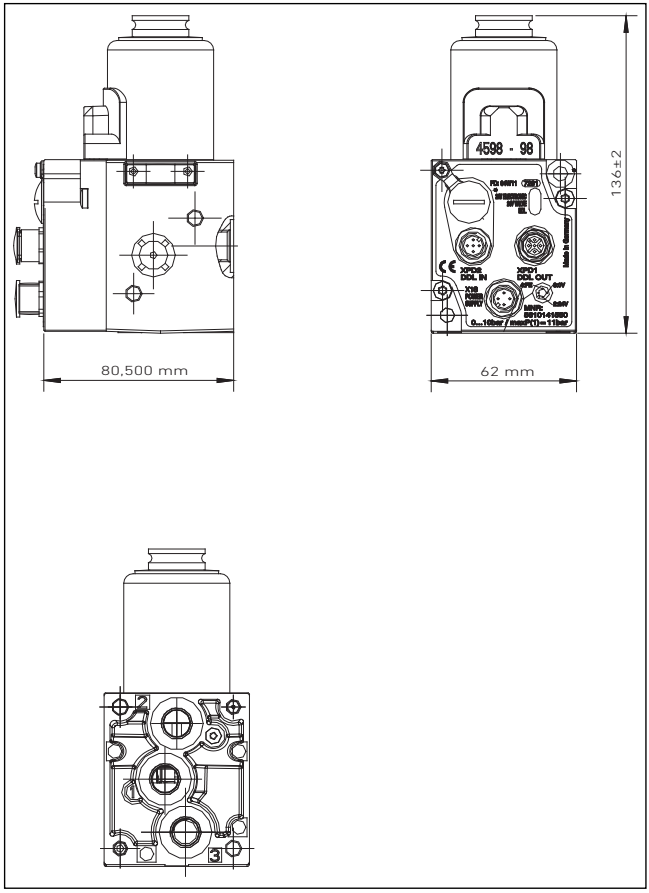


Fig. 60: Dimensions of the pressure control valve ED05 (561 014 155 0)

4.5 Digital Input Module 337 500 200 0

With the digital input module 8 or 16 digital 24 V PNP inputs can be read. Via the DDL, the input module sends 1 byte or 2 byte input data and 1 byte diagnosis data to the bus coupler. The bus coupler transmits 1 byte parameter to the input module.

4.5.1 Overview

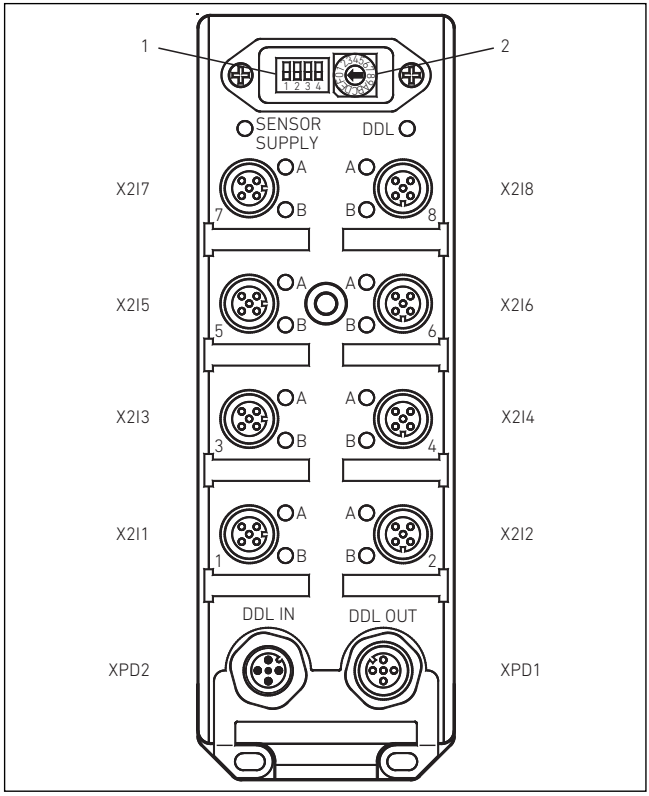


Fig. 61: Handling elements and plugs

1 coding switch S1 **2** address switch S2

4.5.2 DDL Address

The coding and also the address switch are behind a transparent captive cap which can be opened via 2 screws. The DDL address is adjusted with switch S2. The adjustment regulations for the addressing can be found in chapter 2.2 “DDL Addressing“.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.5.3 DDL Mode and Data Length

The DDL baud rate and the data length are defined with switch S1. All participants have to be adjusted to the same baud rate.

Table 83: DDL Baud rate and data length

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function
3	8 input channels 1 byte in DDL	16 input channels 2 bytes in DDL (default)
4	no function	no function

4.5.4 Input Data Range in the Control

The DDL address determines the position of the input data in the data range of the bus coupler and therefore the position in the address area of the control. Depending on the length set, the input module occupies 1 ... 2 byte in the input area of the control. If address 0 (automatic addressing) is set, the input module behaves like a input module. Further information can be taken from chapter 2.2 "DDL Addressing".
The allocation of the input signals in connection with the bit position is shown in the following table. Thereby byte 0 is the first byte of the input module in the data range in the control.

Table 84: Allocation of pinning bit position

Plug		X2I1	X2I2	X2I3	X2I4	X2I5	X2I6	X2I7	X2I8
Bit position	Pin 4	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
	Pin 2	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7

The input module does not occupy data in the output data range, but in the diagnosis range of the DDL.

4.5.5 Diagnosis

LED Diagnosis

The status of the input module can be read by means of the LEDs at the front of the device.

Table 85: LED indications

LED	Color	Meaning
X2I1 A	green	on = signal to sensor 0.0
X2I2 A	green	on = signal to sensor 0.1
X2I3 A	green	on = signal to sensor 0.2
X2I4 A	green	on = signal to sensor 0.3
X2I5 A	green	on = signal to sensor 0.4
X2I6 A	green	on = signal to sensor 0.5
X2I7 A	green	on = signal to sensor 0.6
X2I8 A	green	on = signal to sensor 0.7
X2I1 B	green	on = signal to sensor 1.0
X2I2 B	green	on = signal to sensor 1.1
X2I3 B	green	on = signal to sensor 1.2
X2I4 B	green	on = signal to sensor 1.3
X2I5 B	green	on = signal to sensor 1.4
X2I6 B	green	on = signal to sensor 1.5
X2I7 B	green	on = signal to sensor 1.6
X2I8 B	green	on = signal to sensor 1.7
DDL	red	on = no DDL communication (see page 158)
Supply Sensor	green	on = 24 V sensor supply OK within range 19.2 V ... 28.8 V flashing = 24 V sensor supply beyond 19.2 V ... 28.8 V off = sensor supply DDL not existing

The LED DDL indicates that no reference communication takes place in the DDL. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the input module are within diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the input module behaves like a input module. Further information can be taken from chapter 2.2 “DDL Addressing“.
The input module return 1 byte of diagnosis data to the PLC:

Table 86: Diagnosis data

Bit							
7	6	5	4	3	2	1	0
DDL comm. diagnosis	–	–	–	–	–	24 V sensor supply diagnosis	24 V electronic supply DDL diagnosis

Meaning of the bits

- Bit 0: Power supply of the electronic is below 19.2 V or beyond 28.8 V
- Bit 1: Power supply of the sensor supply at M12 bushes X2In (sensor inputs) is below 19.2 V or beyond 28.8 V
- Bit 7: Communication connection to DDL module interrupted

4.5.6 Overload Protection and Parameter

If the initiator supply voltage is short circuited to one bush or the total current of all outputs exceeds 0.5 A the short circuit protection is activated. The green LED sensor supply flashes and a diagnosis message is given to the bus coupler. The power supply for the initiators is then switched off at all 8 bushes.
A parameter byte is send from the control via bus coupler to the input module. In case of overload of the sensor supply voltage the behavior of the device can be influenced via this parameter byte. If the bit 0 = 1 is set in the parameter byte, the state “overload” is stored in the input module, even though the reason for this diagnosis no longer exists, and can only be reset by an interruption of the DDL power supply.
If the parameter bit 0 is not set (default), the sensor supply will be interrupted upon overload, at all plugs as long as the interference is dispatched. The interference will not be stored, the module returns automatically into the normal operating state.

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.5.7 Connections

Signal Inputs

The Input signals have to be connected via the 8 5 pin M12 connectors (female) X2In.

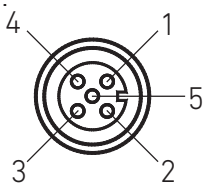


Fig. 62: Input bush X2In

1 Pin 1: 24 V power supply, short circuit protected
2 Pin 2: see table Assignment and allocation
3 Pin 3: 0 V
4 Pin 4: see table Assignment and allocation
5 Pin 5: Function earth

Table 87: Assignment and allocation

Plug	Pin 2	Pin 4
X2I1	Input 1.0	Input 0.0
X2I2	Input 1.1	Input 0.1
X2I3	Input 1.2	Input 0.2
X2I4	Input 1.3	Input 0.3
X2I5	Input 1.4	Input 0.4
X2I6	Input 1.5	Input 0.5
X2I7	Input 1.6	Input 0.6
X2I8	Input 1.7	Input 0.7

NOTICE
The connectors must not be plugged or pulled under load!

Data Line DDL

The input module is connected to the bus coupler and further DDL devices via plugs XPD1 and XPD2. Plug XPD2 (integrated plug) is DDL IN and plug XPD1 is DDL OUT (integrated bush).
The DDL power supply of the input module is not protected against polarity reversal, furthermore DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason we recommend to use pre fabricated wires (see chapter 5 "DDL Accessories"). The allocation of the DDL connections is described in chapter 2.4 "DDL Data".
The DDL terminating plug (see chapter 5 "DDL Accessories") is necessary if the module is the last or the only participant of a DDL line. To guarantee a definite termination of the line and the module fulfills the protection class IP 65.

4.5.8 Technical Data

Technical Data	
Power supply via DDL	24 VDC
Power consumption for electronic (SENSOR SUPPLY)	100 mA
max. power supply for Sensors in total	0.5 A (short circuit protected)
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
signal transmission time	0.7 ... 3 ms
The time delay at the transition of the signals 0 > 1 or 1 > 0 depends to the voltage	
Maximum length of sensor cables	30 m
Installation position	arbitrary
Further technical Data	s. quotation drawing

Table 88: Switch level

	Signal = 0	Signal = 1
voltage	≤ 5 V	> 11 V
current	≤ 5 V	> 2.5 mA

4.5.9 Dimensions

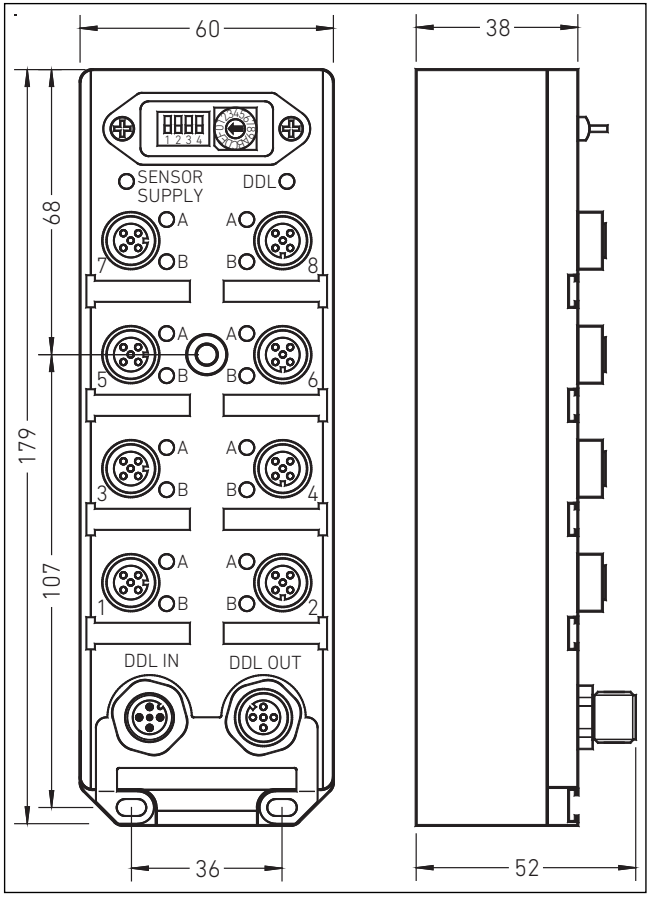


Fig. 63: Dimensions of the input module (337 500 200 0)

4.5.10 ATEX-Relevant Information

If the DDL input module 337 500 200 0 is used in zone 2, attention has to be paid to the following ATEX-relevant information.

See chapter 4.8.1 “Ex-Relevant Excerpt from the Operating Instructions for I/O Modules“.

4.6 Digital Output Module 337 500 202 0

With the digital output module 8 digital 24 V outputs can be controlled. Each output can be loaded with 2 A. In total for each output group (U_A respectively U_B) a load of maximum 6 A is allowed. The output module drives 1 byte output data from the control at the outputs. From the bus coupler 1 byte parameter are transmitted to the output the output module sends back 2 Byte diagnosis data to the bus coupler.
The outputs were supplied via two external power supplies. The power supply U_A supplies the outputs 1 ... 4 (0.0 ... 0.3) and the power supply U_B supplies the outputs 5 ... 8 (0.4 ... 0.7).

4.6.1 Overview

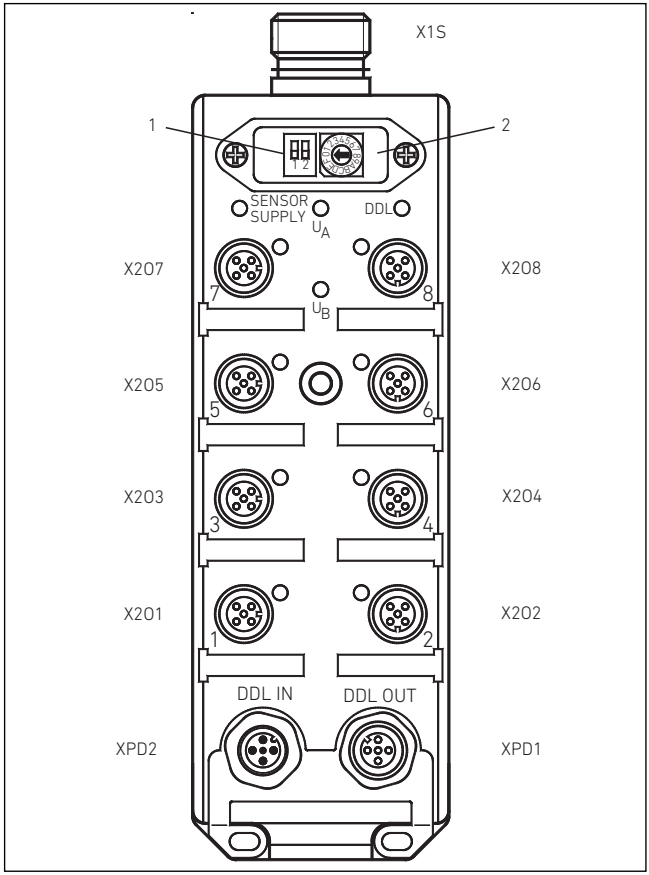


Fig. 64: Handling elements and plugs

1 Coding switch S1 **2** Address switch S2

4.6.2 DDL Address

The coding and also the address switch are behind a transparent captive cap which can be opened via 2 screws. The DDL address is adjusted with switch S2. The adjustment regulations for the addressing can be found in chapter 2.2 “DDL Addressing“.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.6.3 DDL Mode

The DDL baud rate is defined with switch S1. All participants have to be adjusted to the same baud rate.

Table 89: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function

4.6.4 Output Data Range in the Control

The DDL address determines the position of the input data in the data range of the bus coupler and therefore the position in the address area of the control.
The output module occupies 1 byte in the output area of the control.
If address 0 (automatic addressing) is set, the output module behaves like a input module. Further information can be taken from chapter 2.2 “DDL Addressing“.
The output module does not occupy data in the input data range, but in the diagnosis range of the DDL.
The allocation of the outputs in connection with the bit position is shown in the following table. Thereby byte 0 is the first byte of the output module in the data range in the control.

Table 90: Allocation of pinning bit position

Output	1	2	3	4	5	6	7	8
Bit position	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Plug, Pin	X201, Pin 4	X202, Pin 4; X201, Pin 2	X203, Pin 4	X204, Pin 4; X203, Pin 2	X205, Pin 4	X206, Pin 4; X205, Pin 2	X207, Pin 4	X208, Pin 4; X207, Pin 2

4.6.5 Diagnosis

LED Diagnosis

The status of the output module can be read by means of the LEDs at the front of the device.

If there is no load at the output the LED can glimmer a bit, without controlling the output. This is no malfunction.

Table 91: LED indications

Output / LED	Color	Meaning
X201	yellow	on = output 1 activated
X202	yellow	on = output 2 activated
X203	yellow	on = output 3 activated
X204	yellow	on = output 4 activated
X205	yellow	on = output 5 activated
X206	yellow	on = output 6 activated
X207	yellow	on = output 7 activated
X208	yellow	on = output 8 activated
DDL	red	on = no DDL communication (see page 166)
SUPPLY SENSOR	green	on = 24 V sensor supply OK within range 19.2 V ... 28.8 V flashing = 24 V sensor supply beyond 19.2 V ... 28.8 V off = sensor supply DDL not existing
U_A	green	on = 24 V power supply U_A OK within range 21.6 ... 26.4 V flashing = 24 V power supply U_A beyond 21.6 ... 26.4 V off = sensor supply DDL not existing
U_B	green	on = 24 V power supply U_B OK within range 21.6 ... 26.4 V flashing = 24 V power supply U_B beyond 21.6 ... 26.4 V Off = sensor supply DDL not existing

The LED DDL indicates that no reference communication takes place in the DDL. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the output module are within diagnosis data range according to the DDL address. If address 0 (automatic addressing) is set, the output module behaves like a output module. Further information can be taken from chapter 2.2 “DDL Addressing“.
The length of the diagnosis data range is 2 byte standard diagnosis + 1 byte output diagnosis.

For a correct function of the output diagnosis, the load must be inductive or ohmic and be smaller than 4 kΩ.

Table 92: Diagnosis data

Byte	Bit							
	7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	24 V power supply U_B diagnosis	24 V power supply U_A diagnosis	24 V sensor supply DDL diagnosis
Z + 1	output 8 diagnosis	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis

Meaning of the bits

- Power supply of the electronic is below 19.2 V or beyond 28.8 V
- Bit 1: Power supply U_A is below 21.6 or beyond 26.4
- Bit 2: Power supply U_B is below 21.6 or beyond 26.4
- Bit 7: Communication connection to DDL module interrupted
- Byte (Z + 1) Bit 0 ... 7: Outputs short circuit or open (see description of parameter).

- Byte Z is the start address in the diagnosis data range of this DDL participant.

NOTICE
A short circuit can only be recognized if the output is controlled. An open output can only be recognized, it is not controlled.

4.6.6 Parameter

These functions are provided to the bus coupler by the output module. Depending on the field bus system the parameter bytes can be used. Per DDL participant one byte for parameter is available. The parameter are not transmitted cyclically. Each parameter byte for the participants can be adjusted individually.

Table 93: Parameters for the output module

Bit	Parameter name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	reserved		
2	reserved		
1	diagnosis message of the outputs	for controlled outputs (default)	changes are transmitted
0	reserved		

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which loads do exist. If an output is controlled, where no load exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what loads exist. This information is then transmitted via a diagnosis message to the control. In the control this message can be compared to a

deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing loads can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.6.7 Connections

Power Supply

The external power supply for output is connected via the circular plug M23 X1S.
Via the circular plug both output groups U_A (outputs 1 ... 4) and U_B (outputs 5 ... 8) are supplied.
Both power supplies must be protected by an external 6 A T fuse.

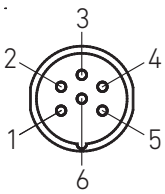


Fig. 65: X1S
power supply

1 Pin 1: functional earth
2 Pin 2: 24 V power supply U_A
3 Pin 3: 0 V power supply U_A
4 Pin 4: 24 V power supply U_B
5 Pin 5: 0 V power supply U_B
6 Pin 6: Nc

With the additional power supply it is possible to establish an additional EMERGENCY-STOP circuit. Because of the separate supply of this power supply it is possible, in an emergency stop situation, only to turn off the outputs whereas the PLC, the serial interfaces and the initiators remain in operation.

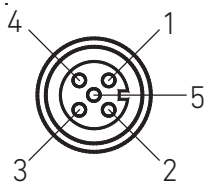


Fig. 66: Output plug, X2On

Signal Outputs

NOTICE
The connectors must not be plugged or pulled under load.

Table 94: Assignment and allocation

Plug	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X2O1	Nc	Output 0.1	0 V	Output 0.0	FE
X2O2	Nc	Nc	0 V	Output 0.1	FE
X2O3	Nc	Output 0.3	0 V	Output 0.2	FE
X2O4	Nc	Nc	0 V	Output 0.3	FE
X2O5	Nc	Output 0.5	0 V	Output 0.4	FE
X2O6	Nc	Nc	0 V	Output 0.5	FE
X2O7	Nc	Output 0.7	0 V	Output 0.6	FE
X2O8	Nc	Nc	0 V	Output 0.7	FE

Data Line DDL

The output module is connected to the bus coupler and further DDL devices via plugs XPD1 and XPD2. Plug XPD2 (integrated plug) is DDL IN and plug XPD1 is DDL OUT (integrated bush).
The DDL voltage supply of the output module is not protected against polarity reversal, furthermore DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason we recommend to use pre fabricated wires (see chapter 5 “DDL Accessories”). The allocation of the DDL connections is described in chapter 2.4 “DDL Data“.
The DDL terminating plug (see chapter 5 “DDL Accessories“) is necessary if the module is the last or the only participant of a DDL line. To guarantee a definite termination of the line and the module fulfills the protection class IP 65.

4.6.8 Technical Data

Technical Data	
Power supply via DDL	24 VDC
Power consumption for electronic	100 mA
Power supply for the output groups U_A and U_B	24 VDC ±10 %
max. output current per output	1 A (short circuit protected)
max. total current of each output group	6 A at 40°C
Protection of power supply U_A and U_B, external	6 A T
Diagnostic capable output load	max. 4 kOhm
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical Data	s. quotation drawing

4.6.9 Dimensions

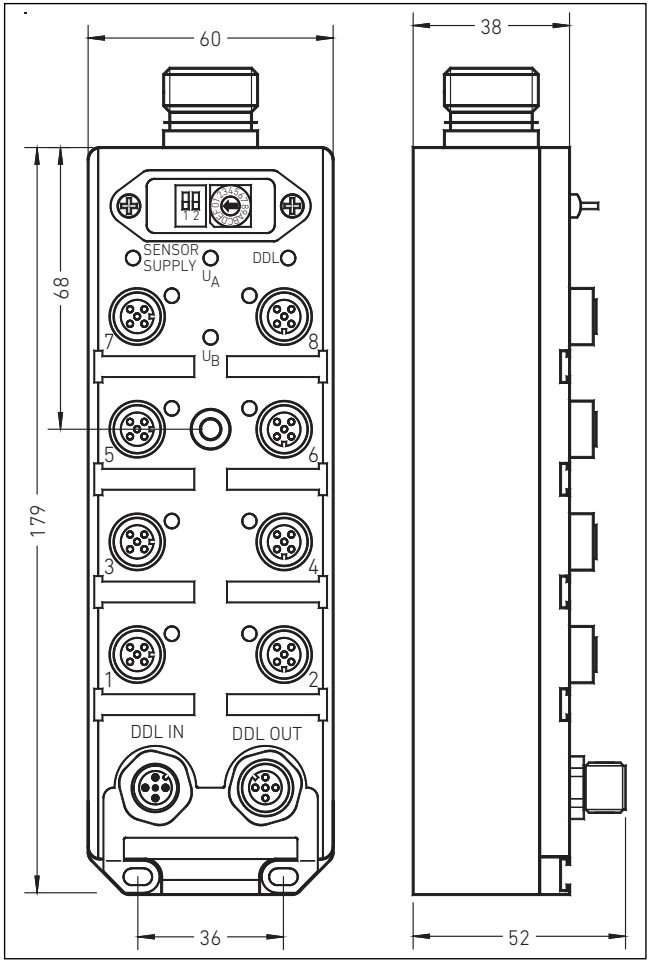


Fig. 67: Dimensions of output module (337 500 202 0)

4.6.10 ATEX-Relevant Information

If the DDL output module 337 500 202 0 is used in zone 2, attention has to be paid to the following ATEX-relevant information.
See chapter 4.8.1 “Ex-Relevant Excerpt from the Operating Instructions for I/O Modules“.

4.7 Digital In/Output Module R412006712

With the digital I/O module 16 digital 24 V outputs can be controlled, or 8 digital 24 V outputs can be controlled and 8 digital 24 V inputs can be read. Each output can be loaded with 100 mA.
The I/O module drives 2 byte output data from the control at the outputs. Or the I/O module drives 1 byte output data from the control at the outputs and 1 byte input data will be sent to the control. From the bus coupler 1 byte parameter is transmitted to the I/O module. Also the I/O module sends back up to 3 Byte diagnosis data to the bus coupler.
The outputs were supplied via DDL (power supply valve).

4.7.1 Overview

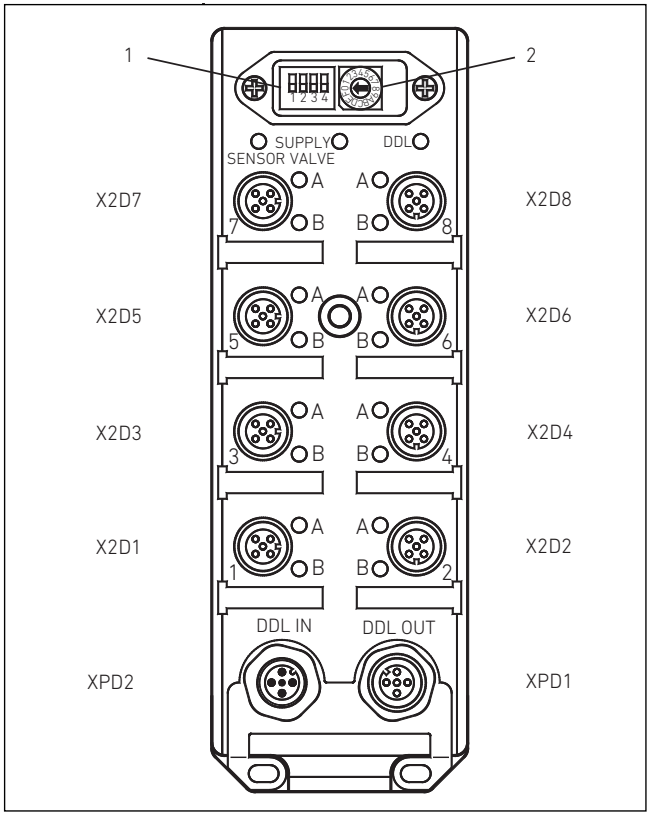


Fig. 68: Handling elements and plugs

1 coding switch S1 **2** address switch S2

4.7.2 DDL Address

The coding and also the address switch are behind a transparent captive cap which can be opened via 2 screws. The DDL address is adjusted with switch S2. The adjustment regulations for the addressing can be found in chapter 2.2 “DDL Addressing“.

The switches must not be changed during operation. Changed switch positions will only become valid, after the device has been turned off and restarted.

4.7.3 DDL Mode and Data Length

The DDL baud rate is defined with switch S1. All participants have to be adjusted to the same baud rate.
The I/O module can be configured via Bit 3 of switch S2 as a module with 16 output or a I/O module with 8 outputs and 8 inputs.

If a bus coupler for PROFIBUS is used, attention has to be paid that always one module for inputs and one module for outputs is used in the PROFIBUS configuration. The module for inputs of the DDL node has to be always configured first.

Table 95: DDL baud rate

Bit	Open	On
1	DDL 125 kBaud	DDL 250 kBaud (default)
2	no function	no function
3	16 outputs 2 Byte outputs (default)	8 outputs / 8 inputs 1 Byte inputs/outputs each
4	no function	no function

4.7.4 Data Range in the Control

The DDL address determines the position of the input and output data in the data range of the bus coupler and therefore the position in the address area of the control.

Output Module (16 Outputs)
If the I/O module is used as a output module with 16 outputs (S1 Bit 3 = OPEN) the module occupies 2 Byte of the output range of the control.
The module does not occupy data in the input data range, but in the diagnosis range of the DDL.

If address 0 (automatic addressing) is set, the I/O module behaves like a combi module. Further information can be taken from chapter 2.2 "DDL Addressing".
The allocation of the outputs in connection with the bit position is shown in the following table. Thereby byte 0 is the first byte of the output module in the data range in the control.

Table 96: Allocation of pinning bit position

Plug		X2D1	X2D2	X2D3	X2D4	X2D5	X2D6	X2D7	X2D8
Bit position	Pin 4	0.0	0.2	0.4	0.6	1.0	1.2	1.4	1.6
	Pin 2	0.1	0.3	0.5	0.7	1.1	1.3	1.5	1.7

In/Output Module (8 Inputs, 8 Outputs)

If the I/O module is used as a in/output module with 8 inputs and 8 outputs (S1 Bit 3 = ON) the module occupies 1 Byte of the output range and 1 Byte of the input range of the control.
The module occupies in the diagnosis range of the DDL.
If address 0 (automatic addressing) is set, the I/O module behaves like a combi module. Further information can be taken from chapter 2.2 "DDL Addressing".
The allocation of the In and outputs in connection with the bit position is shown in the following table. Thereby byte 0 is the first byte of the output module in the data range in the control.

Table 97: Allocation of pinning bit position

Signal		Output				Input			
Plug		X2D1	X2D2	X2D3	X2D4	X2D5	X2D6	X2D7	X2D8
Bit position	Pin 4	0.0	0.2	0.4	0.6	0.0	0.2	0.4	0.6
	Pin 2	0.1	0.3	0.5	0.7	0.1	0.3	0.5	0.7

4.7.5 Diagnosis

LED Diagnosis

The status of the output module can be read by means of the LEDs at the front of the device.

If there is no load at the output the LED can glimmer a bit, without controlling the output. This is no malfunction.

Table 98: LED indications

Signal / LED	Color	Meaning
X2D1 A	Yellow	On = Output 0.0 activated
X2D1 B	Yellow	On = Output 0.1 activated
X2D2 A	Yellow	On = Output 0.2 activated
X2D2 B	Yellow	On = Output 0.3 activated
X2D3 A	Yellow	On = Output 0.4 activated
X2D3 B	Yellow	On = Output 0.5 activated
X2D4 A	Yellow	On = Output 0.6 activated
X2D4 B	Yellow	On = Output 0.7 activated
X2D5 A	Green / Yellow	On = Signal to sensor 0.0 / On = Output 1.0 activated
X2D5 B	Green / Yellow	On = Signal to sensor 0.1 / On = Output 1.1 activated
X2D6 A	Green / Yellow	On = Signal to sensor 0.2 / On = Output 1.2 activated
X2D6 B	Green / Yellow	On = Signal to sensor 0.3 / On = Output 1.3 activated
X2D7 A	Green / Yellow	On = Signal to sensor 0.4 / On = Output 1.4 activated
X2D7 B	Green / Yellow	On = Signal to sensor 0.5 / On = Output 1.5 activated
X2D8 A	Green / Yellow	On = Signal to sensor 0.6 / On = Output 1.6 activated
X2D8 B	Green / Yellow	On = Signal to sensor 0.7 / On = Output 1.7 activated
DDL	Red	On = no DDL communication

Table 98: LED indications

Signal / LED	Color	Meaning
Supply Sensor	Green	on = 24 V sensor supply OK within range 19.2 V ... 28.8 V flashing = 24 V sensor supply beyond 19.2 V ... 28.8 V off = sensor supply DDL not existing
Supply Valve	Green	on = 24 V valve supply OK within range 21.6 ... 26.4 V flashing = 24 V valve supply beyond 21.6 ... 26.4 V off = sensor supply DDL not existing

The LED DDL indicates that no reference communication takes place in the DDL. This can be due to:

- The adjusted baud rate of the DDL modules is not equal
- Gaps in the addressing
- Same address has been assigned for 2 modules
- Address 0 and 1 ... 14 have been assigned at the same time
- Configuration has changed during operation

Software Diagnosis

The diagnosis data of the I/O module are within diagnosis data range according to the DDL address.
If address 0 (automatic addressing) is set, the I/O module behaves like a combi module. Further information can be taken from chapter 2.2 “DDL Addressing“.
The length of the diagnosis data range is 1 byte standard diagnosis+ 1 byte (In and 8 outputs), respectively 2 byte (16 outputs) output diagnosis.

For a correct function of the output diagnosis, the load must be inductive or ohmic and be smaller than 4 kΩ.

DDL Participants

Table 99: Diagnosis data with 16 outputs

Byte	Bit 7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V power supply valve diagnosis	24 V sensor supply DDL diagnosis
Z + 1	output 8 diagnosis	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis
Z + 2	output 16 diagnosis	output 15 diagnosis	output 14 diagnosis	output 13 diagnosis	output 12 diagnosis	output 11 diagnosis	output 10 diagnosis	output 9 diagnosis

Table 100: Diagnosis data with 8 inputs and 8 outputs

Byte	Bit 7	6	5	4	3	2	1	0
Z	DDL comm. diagnosis	–	–	–	–	–	24 V power supply valve diagnosis	24 V sensor supply DDL diagnosis
Z + 1	output 8 diagnosis	output 7 diagnosis	output 6 diagnosis	output 5 diagnosis	output 4 diagnosis	output 3 diagnosis	output 2 diagnosis	output 1 diagnosis

- Byte Z:
  - Bit 0: Power supply of the electronic is below 19.2 V or beyond 28.8 V
  - Bit 1: Power supply valve is below 21.6 or beyond 26.4
  - Bit 2: Sensor supply is below 19.2 V or beyond 28.8 V
  - Bit 7: Communication connection to DDL module interrupted
- Byte Z + n Bit 0 ... 7: Outputs short circuit or open (see description of parameter).
- Byte Z is the start address in the diagnosis data range of this DDL participant.

NOTICE
A short circuit can only be recognized if the output is controlled. An open output can only be recognized, it is not controlled.

4.7.6 Parameter

These functions are provided to the bus coupler by the output module. Depending on the field bus system the parameter bytes can be used. Per DDL participant one byte for parameter is available. The parameter are not transmitted cyclically. Each parameter byte for the participants can be adjusted individually.

Table 101: Parameters for the I/O module

Bit	Parameter name	Bit = 0	Bit = 1
7	reserved		
6	reserved		
5	reserved		
4	reserved		
3	Reaction upon DDL failure	values at 0 (default)	freeze values
2	reserved		
1	diagnosis message of the outputs	for controlled outputs (default)	changes are transmitted
0	overload of the sensor supply at X2Dn	Automatic reset (default)	manual reset

Bit 0 = 1 The state “overload” is stored in the I/O module, even though the reason for this diagnosis no longer exists, and can only be reset by an interruption of the DDL power supply.

Bit 1 = 0 Output based diagnosis messages are only sent, if the output is controlled. Upon starting the system it is not checked, which loads do exist. If an output is controlled, where no load exists, a diagnosis message is generated.

Bit 1 = 1 Upon starting the system it is first determined what loads exist. This information is then transmitted via a diagnosis message to the control. In the control this message can be compared to a deposited configuration of the system. (This function is only supported by PROFIBUS DP; with other field bus systems the diagnosis data are transferred cyclic). Missing loads can be determined upon the start of the system. During the cyclic operation only diagnosis messages are sent, if there have been changes according to this configuration. Thereby the complete diagnosis range is transferred. Open load is immediately reported, the valve needs not to be controlled.

Bit 3 = 0 Upon failure of the DDL, the output data are set at 0 in the output module.

Bit 3 = 1 Upon failure of the DDL, the output data are stored in the output module and the outputs will be still controlled (freezing values).

Changed parameters only become valid, if the device has been switched off and has been restarted.

4.7.7 Connections

Input/Output plug

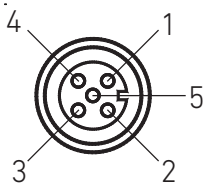


Fig. 69: Signal bush, X2Dn

NOTICE
The connectors must not be plugged or pulled under load.

Table 102: Assignment and allocation

Plug	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X2D1	Nc	Output 0.1	0 V	Output 0.0	FE
X2D2	Nc	Output 0.3	0 V	Output 0.2	FE
X2D3	Nc	Output 0.5	0 V	Output 0.4	FE
X2D4	Nc	Output 0.7	0 V	Output 0.6	FE
X2D5	24 VDC	Output 1.1/ Input 0.1[1)]	0 V	Output 1.0/ Input 0.0[1)]	FE

Table 102: Assignment and allocation

Plug	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X2D6	24 VDC	Output 1.3/ Input 0.3[1)]	0 V	Output 1.2/ Input 0.2[1)]	FE
X2D7	24 VDC	Output 1.5/ Input 0.5[1)]	0 V	Output 1.4/ Input 0.4[1)]	FE
X2D8	24 VDC	Output 1.7/ Input 0.7[1)]	0 V	Output 1.6/ Input 0.6[1)]	FE

[1)] Via coding switch S1 Bit 3 it can be chosen between Inputs and outputs

Data Line DDL

The I/O module is connected to the bus coupler and further DDL devices via plugs XPD1 and XPD2. Plug XPD2 (integrated plug) is DDL IN and plug XPD1 is DDL OUT (integrated bush).
The DDL power supply of the input module is not protected against polarity reversal, furthermore DDL participants can be damaged if 24 V are applied to signal lines DDL H and DDL L. For this reason we recommend to use pre fabricated wires (see chapter 5 “DDL Accessories“). The allocation of the DDL connections is described in chapter 2.4 “DDL Data“.
The DDL terminating plug (see chapter 5 “DDL Accessories“) is necessary if the module is the last or the only participant of a DDL line. To guarantee a definite termination of the line and the module fulfills the protection class IP 65.

4.7.8 Technical Data

Technical Data	
Power supply via DDL	24 VDC
Power consumption for electronic (SENSOR SUPPLY)	100 mA
Ambient temperature range	+5°C ... +50°C
Stock temperature	-20°C ... +70°C
Protection class (with closed connectors)	IP 65 IP 54 (ATEX)
Installation position	arbitrary
Further technical Data	s. quotation drawing
Technical Data of Inputs	
max. power supply for Sensors in total (X2D5 ... X2D8)	0.5 A (short circuit protected)
signal transmission time	0.7 ... 3 ms
The time delay at the transition of the signals 0 > 1 or 1 > 0 depends on the voltage	
Maximum length of sensor cables	30 m

Table 103: Switch level

	Signal = 0	Signal = 1
voltage	≤ 5 V	> 11 V
current	≤ 1.5 mA	> 2.5 mA

Technical Data of Outputs	
max. output current per output	100 mA (short circuit protected)
Diagnostic capable output load	max. 4 kOhm

4.7.9 Dimensions

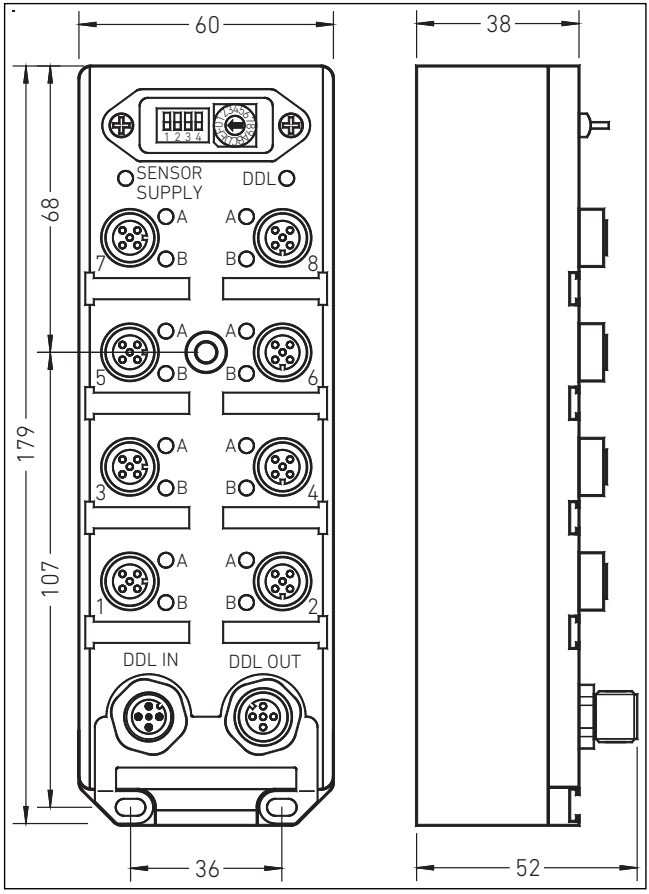


Fig. 70: Dimensions of I/O module (R412006712)

4.7.10 ATEX-Relevant Information

If the DDL I/O module R412006712 is used in zone 2, attention has to be paid to the following ATEX-relevant Information.
See chapter 4.8.1 “Ex-Relevant Excerpt from the Operating Instructions for I/O Modules“.

4.8 ATEX-Relevant Information for I/O Modules

4.8.1 Ex-Relevant Excerpt from the Operating Instructions for I/O Modules

Preamble

This excerpt from the operating instructions only contains those aspects relevant to explosion protection. It is included in the same or a corresponding form in the original operator instructions; text changes are permitted but the aspects related to explosion protection remain the same.

To ensure function and your own safety, carefully read the enclosed operating instructions before beginning installation. Contact AVENTICS GmbH if you have any further questions.

General information on explosion protection

Digital input module 337 500 200 0:

8 or 16 digital 24 V PNP inputs can be read in with the digital input module.

Digital output module 337 500 202 0:

8 digital 24 V outputs can be controlled with the digital output module. Each output can be loaded with 2 A. A total of 6 A is permissible within an output circuit (U_A or U_B).

The outputs are supplied via 2 separate external power supplies. Power supply U_A supplies outputs 1 ... 4 (0.0 ... 0.3) and power supply U_B supplies outputs 5 ... 8 (0.4 ... 0.7).

Digital input/output module R412006712

With the digital I/O module, 16 digital 24 V outputs can be controlled, or 8 digital 24 V outputs controlled and 8 digital 24 V input signals read in. Each output can be loaded with 100 mA. The power supply for the outputs is provided via the DDL (supply valve).

The I/O modules may only be used in accordance with the specifications outlined in the technical documentation from AVENTICS GmbH and information on the product rating plate. They comply with the valid standards and directives and fulfill the requirements in directive 94/9/EC. The installation regulations (e.g. EN 60079-14) for systems in explosive areas must be observed.

The I/O modules can be used as follows:

- In zone 2 (gas-ex, category 3G) in explosion groups IIA and IIB, temperature class T4.

The permissible ambient temperature range is listed in section "Rating plate presentation".
Further important details can be found in the declaration of conformity ExGuide 10 ATEX 0015 X.

General requirements

1. The manufacturer is not liable for damages in the case of non compliance with these instructions or improper interventions in the device. Furthermore, the warranty for appliances and accessory parts will no longer apply.
2. Observe the information in these instructions, as well as the operating conditions and permissible values stated on the labels/rating plates of the respective devices.
3. Observe the general technical rules for the selection and operation of devices.
4. Take suitable measures to prevent unintended activation or impermissible interference.
5. Note that lines under voltage must not be disconnected! There is a danger to life if an explosive atmosphere is present.
6. The I/O modules are only permitted for appropriate and intended use in normal industrial settings. In the case of violation, all manufacturer liability and warranty claims will no longer apply!
7. Ensure that the device is only fitted with ignition protection complying with the respective zones!
8. All connected electrical devices must be suitable for their respective functions.
9. The operator must provide sufficient lightning protection in accordance with local regulations.
10. Be aware of electrostatics when assembling the I/O modules.
11. Make sure that no falling objects can hit the I/O module.

12. The equipment does not fulfill the requirements for impacts. It must be protected on site against shock energy and have IP protection in accordance with section 26.4 of EN 60079-0.
13. These devices are "low energy instruments and devices" in accordance with paragraph 13 of EN 60079-15. The requirements in sub section c) (transient limitation to 40 % above the nominal voltage) must be observed during installation.

Rating plate presentation

AVENTICS with address
Type: DDL I/O module *** [part number]
[Serial number] CE Year of manufacture
Ex II 3G Ex nA IIB T4 Gc X
+5°C ≤ Ta ≤ 40°C

Commissioning, installation

Install the I/O modules in a superior system. The required cleaning intervals for the equipment (dust deposits) depend on the IP protection class. Ensure that the device is only fitted with ignition protection complying with the respective zones/ categories! Always observe the nationally valid installation guidelines (e.g. EN 60079-14). Other important facts:

1. The devices are designed for protection class IP 54 and may require further protection if used under more adverse ambient conditions. See also section "General requirements", point 12).
2. Note the declaration of conformity and the special conditions listed therein.
3. To ensure explosion protection, associated electrical and mechanical equipment must correspond to the requirements of the applicable zones on site and must be checked separately by the person installing the machine.
4. The device may only be used as intended.
5. Electrostatic charges and/or insulated metal parts must be avoided. Only clean with a damp cloth!
6. If located in an explosive area, tight parts (e.g. due to frost or corrosion) may not be removed violently.

7. Protect against unauthorized opening and attach a sign stating “Do not disconnect under power”.
8. Tighten the nuts on the connection plug with a torque of at least 0.6 Nm.
9. If vibrations occur during operation which could loosen the plugs, secure them with threadlocker. A separation force of at least 0.6 ... 2.5 Nm must be achieved on an equivalent M12 thread.
10. An open or not securely closed plug must not be energized in explosive areas!
11. Circuits in zone 2 may only include devices that are suitable for operation in this zone and which have appropriate documentation.
12. The devices must be protected against UV light.
13. The device must have a low induction connection with the PA in the system.
14. Operation of the I/O modules is only permissible in fully assembled housings that are free of defects. Operation is prohibited in damaged housings.
15. When ordering spare parts, include the material number located on the devices (label, rating plate).
16. Avoid contact between external liquid or corrosive media and the device.
17. Do not place any deflection or torsion loads on the device.
18. The I/O modules must not be used in systems with electric corrosion protection or may only be used on consultation with the manufacturer and after implementing special measures.
19. Assembly work in Ex areas may only be carried out in accordance with the local installation regulations. Observe the following (partial) guidelines:
    - Assembly and maintenance tasks must only be performed in non Ex areas. A fire permit is required.
    - Additional safety precautions are necessary if there is a probability of hydrogen sulfide, ethylene oxide and/or carbon monoxide. These substances have a very low ignition energy threshold!

– Where any potential for explosion exists, only use non sparking tools for these substances and all substances in explosion group IIC!

Usage

The I/O modules are only permitted for appropriate and intended use. In the case of violation, all manufacturer liability and warranty claims will no longer apply!

- See sections "General information on explosion protection", "Commissioning, installation", and "Service, maintenance".

Definition of types

	part no.
Digital input module	3375002000
Digital output module	3375002020
Digital input/output module	R412006712

The permissible ambient temperature range is 0 ... 50°C.

Service, maintenance

Definition of terms in accordance with IEC 60079-17:

Maintenance and service A combination of all tasks carried out to maintain an object in or return it to a condition which corresponds to the requirements of the respective specifications and ensures that the required functions can be performed.

Inspection Careful examination of the object with the goal of making a reliable statement on the condition of the object. Inspection is carried out without disassembly or, if necessary, with partial disassembly, supplemented by procedures such as taking measurements.

Visual inspection An inspection which determines visible faults, such as missing screws, without the use of access equipment or tools.

Close inspection An inspection which, in addition to the faults determined by visual inspection, also determines faults, such as loose screws, that can only be found by using access equipment, e.g. steps (if required) and tools. For close inspections, the housing usually does not need to be opened and the equipment can usually stay energized.

Detailed inspection An inspection which, in addition to the aspects determined by close inspection, determines faults, such as loose connections, that can only be found by opening housings and/or using tools and testing equipment, if required.

- Maintenance measures may only be performed by personnel with equal or comparable qualification acc. to TRBS 1203.
- Accessory parts for use in explosive areas must comply with the requirements stipulated in the European directives and national laws.
- Components may only be exchanged for original spare parts that are also approved for use in explosive areas.
- Devices in ex areas must be cleaned regularly. The intervals must be stipulated by the operator in accordance with the local ambient conditions.
- After service and/or maintenance, all barriers and warnings must be returned to their original locations.
- Disassemble the device as soon as malfunctions occur. Maintenance of internal components cannot be conducted on site. Send the device to the manufacturer for inspection.

	Activity	Visual inspection monthly	Close inspection every 6 months	Detailed inspection every 12 months
1	Visually inspect the integrity of the I/O modules, remove dust deposits	•		
2	Inspect the entire system		Responsibility of the operator	

Disposal

Dispose of packaging and used parts in accordance with the regulations of the country where the device has been installed.

5 DDL Accessories

5.1 Cables

5.1.1 DDL Cable

For the connection of DDL following cables with M12 connection are available at AVENTICS. All DDL cables are drag chain capable.

	Order no.
Data cable 0.3 m	894 605 466 2
Data cable 0.5 m	894 605 467 2
Data cable 1 m	894 605 468 2
Data cable 2 m	894 605 469 2
Data cable 5 m	894 605 470 2
Data cable 10 m	894 605 471 2

5.1.2 Sensor Cables

	Order no.
Cable 5 pin 2 m Plug, male M12x1 180°; Plug, female M12x1 180°	894 620 348 2
Cable 5 pin 5 m Plug, male M12x1 180°; Plug, female M12x1 180°	894 620 349 2
Cable 3 pin 2 m Plug, male M12x1 180°; Plug, female M8x1 180°	894 620 346 2
Cable 3 pin 5 m Plug, male M12x1 180°; Plug, female M8x1 180°	894 620 347 2
Cable 5 pin 2 m Plug, male M12x1 180°; Open end	894 620 343 2
Cable 5 pin 5 m Plug, male M12x1 180°; Open end	894 620 344 2
Cable 5 pin 10 m Plug, male M12x1 180°; Open end	894 620 345 2

5.2 Plugs

5.2.1 Terminating Plugs

	Order no.
DDL terminating plug	894 105 426 4
PROFIBUS terminating plug	894 105 406 4
DeviceNet terminating plug	894 105 426 4

5.2.2 Data Plugs

	Order no.
PROFIBUS DP/Interbus S IN, B coded, 180° female	894 105 404 4
PROFIBUS DP/Interbus S OUT, B coded, 180° male	894 105 405 4
DeviceNet, 180°, female	440 723 002 0
T Connector, 5 pin, M12x1 shielded	R419800162

5.2.3 Power Supply Plugs

	Order no.
M12x1, 4 pin. 180° female	894 105 432 4
M12x1, 4 pin 90° female	894 105 442 4
M23, 6 pin 180° female	894 105 454 4

5.2.4 Other Connectors

	Order no.
Circular plug, M12x1, 4 pin, male	894 205 121 2
Circular plug, metal, M12x1, 5 pin, 180°, female	894 205 160 2
Circular plug, metal, M12x1, 5 pin, 180°, male	894 205 161 2
Circular plug, M12x1, 5 pin, 90°, male	894 205 204 2
Duo plug, M12x1, 4 pin, male	894 101 640 2
Angle plug, M12x1, 4 pin, male	894 100 144 2
T connector, 5 pin, M12x1, male to 2x M12x1, female	894 100 239 2
T connector, 4 pin, M12x1, male to 2x M8x1.3 pin, female	894 100 238 2
Cable connector M12x1 IDC, self tailoring	894 100 237 2
Cover for build in bushes, M12x1	894 135 029 4
Safety chip for M12 plugs in ATEX Zone 22	895 580 060 4

5.3 Subplates (for Pressure Control Valves)

5.3.1 Pressure Control Valve ED05

	Order no.
single	561 014 100 2
single, flat, D12	R414002184
single, flat, G1/4	R414002187
double	561 014 101 2
triple	561 014 102 2
The subplates include the required seals & screws	
Seals & screws	561 014 030 2

5.3.2 Pressure Control Valve ED07

	Order no.
single	561 021 105 2
single, D12	561 023 100 2
intermediate	898 504 993 2
end bases (right and left) for intermediate	898 504 114 2

6 List of Abbreviations

Table 104: Abbreviations

Abbreviation	Meaning
ATEX	Atmosphere Explosive
CN	ControlNet
DDL	Drive & Diagnostic Link
DN	DeviceNet
EDS	Electronic Data Sheet
EP (ED)	Electropneumatic pressure control valve, direct controlled
FE	Functional Earth
GSD	General Station Description
IBS	Interbus S
LED	Light emitting diode
LP	Low Profile
PLC	Programmable Logic Controller
VS	Valve System

7 Declaration of Conformity (ATEX)

7.1 Bus Coupler (3375000250, 3375000450, R412006999, R412008000)

You will find the document in the AVENTICS Media Centre at www.aventics.com/en/media-centre
Please use the search screen to search for the following number: 3375000250

7.2 DDL Input and Output Modules (33750020x0, R412006712)

You will find the document in the AVENTICS Media Centre at www.aventics.com/en/media-centre
Please use the search screen to search for the following number: 3375002000

AVENTICS GmbH
Ulmer Straße 4
30880 Laatzen
Phone: +49 (0) 511-21 36-0
Fax: +49 (0) 511-21 36-2 69
www.aventics.com
info@aventics.com

Further addresses:
www.aventics.com/contact

The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The given information does not release the user from the obligation of own judgement and verification. It must be remembered that our products are subject to a natural process of wear and aging.

An example configuration is depicted on the title page. The delivered product may thus vary from that in the illustration.

Translation of the original operating instructions. The original operating instructions were created in the German language.

R499050031–BAL–001–AH/2016-12