

Description of

PROFIBUS DP Interface

for

IS1 field stations



PROFIBUS DP interface for IS1

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PROFIBUS DP interface for IS1

The historical development of field bus technology at R. STAHL

In the year 1986 R. STAHL SCHALTGERÄTE GMBH brought the ICS MUX field bus system onto the market as the first manufacturer to introduce an I.S. bus system world-wide for input and output of signals within the hazardous area (Zone 1).

This bus system consists of a master station installed in the control room as the coupling partner for automation units together with several completely explosion protected on-site stations or field stations (VOS) installed directly in the field (Zone 1). The connection between the master station and field stations is made via a single coaxial cable.

One of the many highlights of this I.S. bus system is that all the subassemblies of the system - even the power packs – can be plugged or unplugged during operation without affecting the explosion protection. This bus system enabled R. STAHL to present users from the chemical, petrochemical or pharmaceutical industries with an apparatus that can be installed in the hazardous area but can be operated like an apparatus installed in the control room.

This provided the ideal combination of the technical advantages of field bus technology (simple cabling structures, powerful diagnostic options) with the resulting economical advantages (lower investment costs).

The VOS 200 system variant based on this bus system was introduced in 1993 as a supplement that includes all the recognised advantages of the field bus system and was developed under two fundamental aspects:

- Field bus solution for low signal volumes or decentralised automation units that do not require a master station.
- Standard solution to enable the simple implementation of future standardised bus systems.

The VOS 200 can be coupled to the most varied automation devices in either a redundant or non-redundant configuration as a point-to-point connection or (multi-drop) bus connection.

The principle element of the VOS 200 system variant is the 9503 central unit (CU). This multi-processor subassembly with dual port RAM takes over both the data traffic from and to the connected I/O subassemblies as well as the upwards communication to distributed control systems or programmable logic controllers. The various coupling options of the VOS 200 were expanded again in 1997 and supplemented to include a PROFIBUS DP connection.

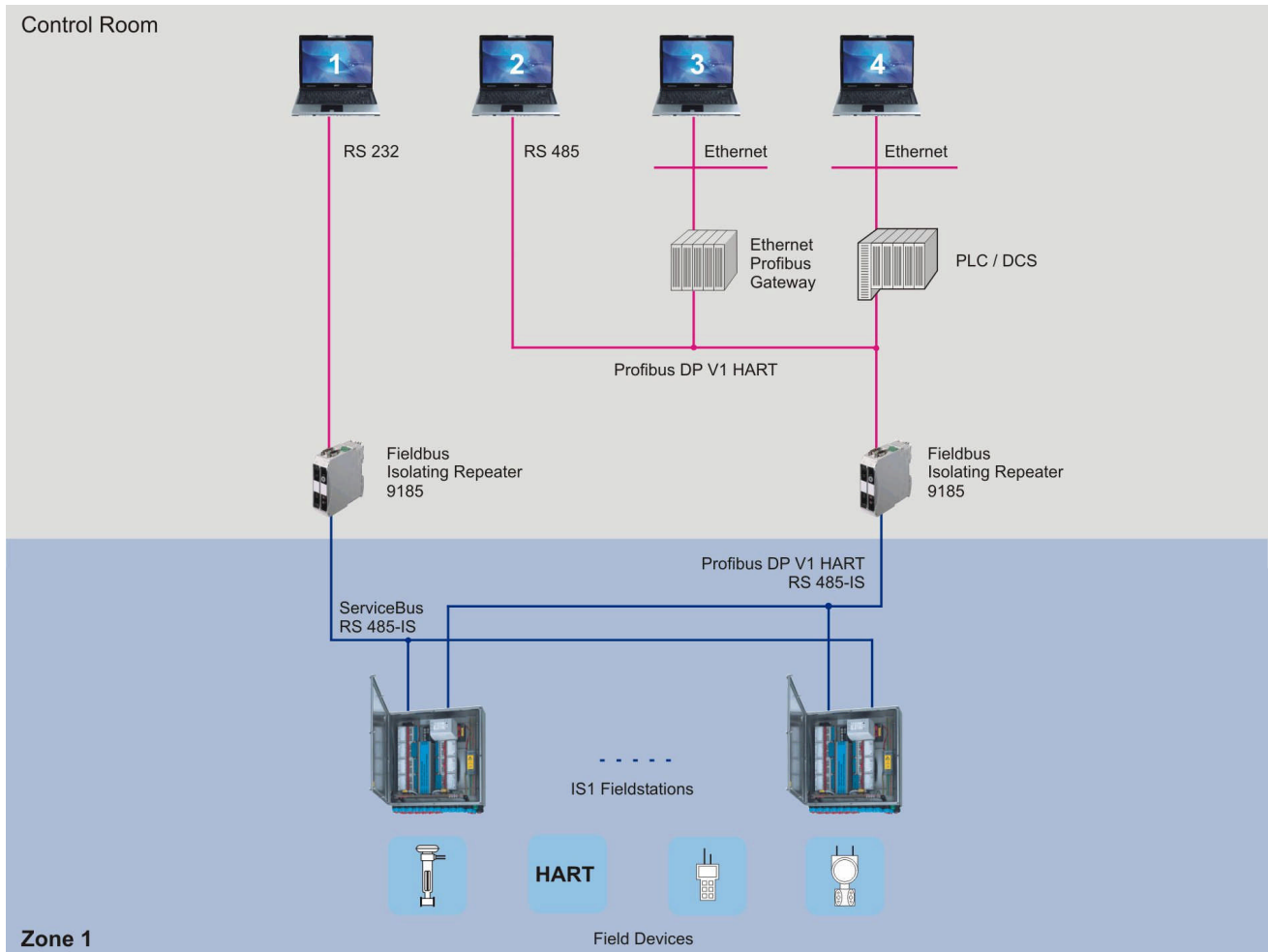
A further step for optimising this field bus technology was realised with the development of the IS1 system. Experience gained from previous systems was used to implement a new, more flexible and more powerful product for the user as well as to provide a solution to all types of automation tasks.

The following section describes the system characteristics of the IS1 system when coupled to an automation system via the PROFIBUS DP.

PROFIBUS DP interface for IS1

1 System Overview

1.1 Connection principle of IS1 field stations to the PROFIBUS DP



As an off-the-shelf explosion protected mounted unit, the IS1 field station can be installed directly in the hazardous area (Zone 1 or Zone 2). It can also be installed in the safe area. The adjacent diagram shows a Zone 1 solution.

The IS1 field station has two serial interfaces. One of them is used to connect to an automation system and the second serial interface can be used as a bus-capable maintenance interface for the configuration, error diagnosis and communication with HART field devices. This functions can optionally be used via FDT technology and IS1 DTMs. Communication via PROFIBUS DPV1 is used in this case.

Several IS1 field stations can be used in the hazardous area to form a PROFIBUS DP network that is connected directly - both hierarchically and topologically - with the PROFIBUS network in the non-hazardous area.

The following applies to Zone 1 installations:

From a safety-engineering aspect relating to explosion protection, the field bus isolating repeater for the PROFIBUS takes on the function of a "barrier" between the ex area and non-hazardous area.

The PROFIBUS installed in the hazardous area is using the RS485IS standard.

PROFIBUS DP interface for IS1

In such a PROFIBUS network, the IS1 field station behaves hierarchically as a PROFIBUS slave where the configuration of the field station is performed via the PROFIBUS master. Optional extended diagnostic and parameterising functions can be provided via PC-supported configuration programs (IS1 DTM via DPV1 or I.S. Wizard via Servicebus).

1.2 Transmission structures

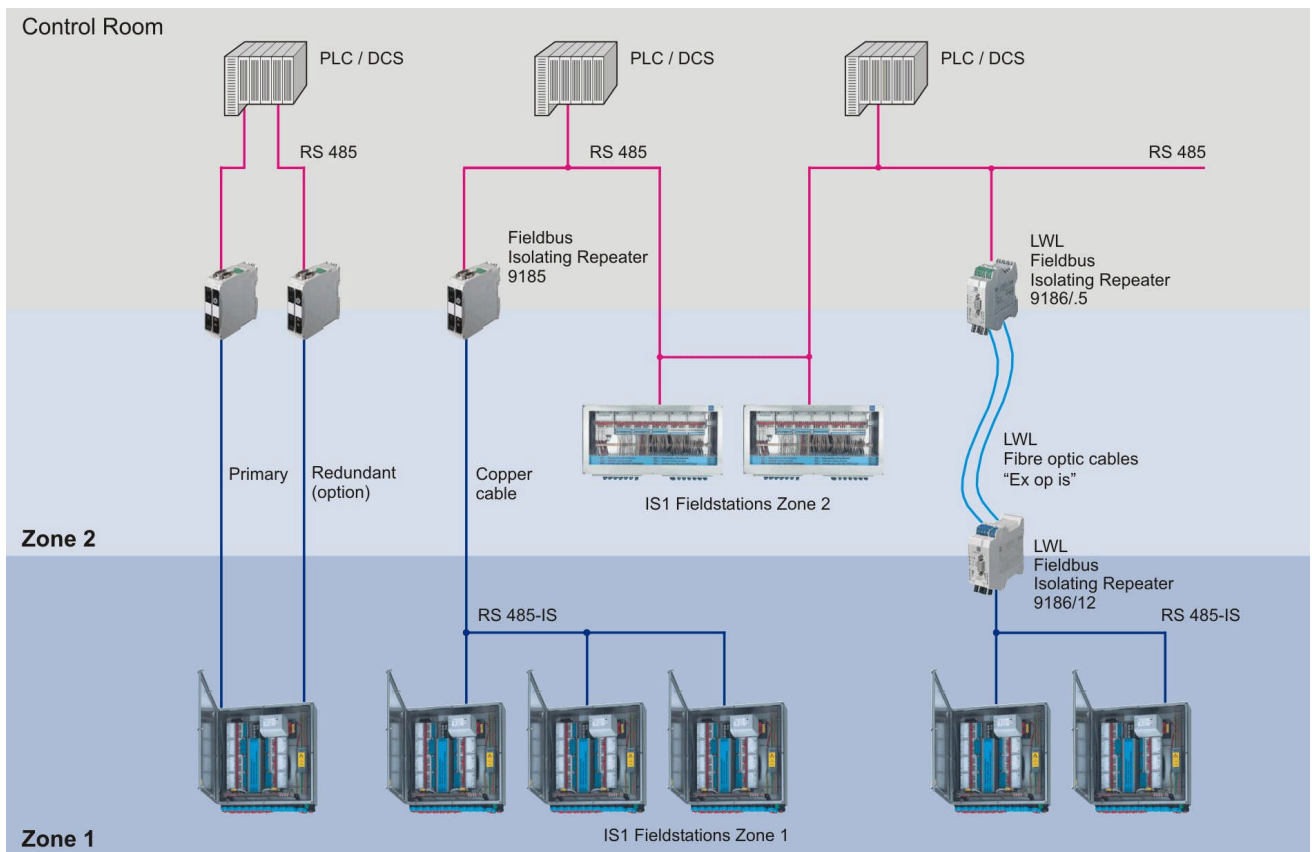


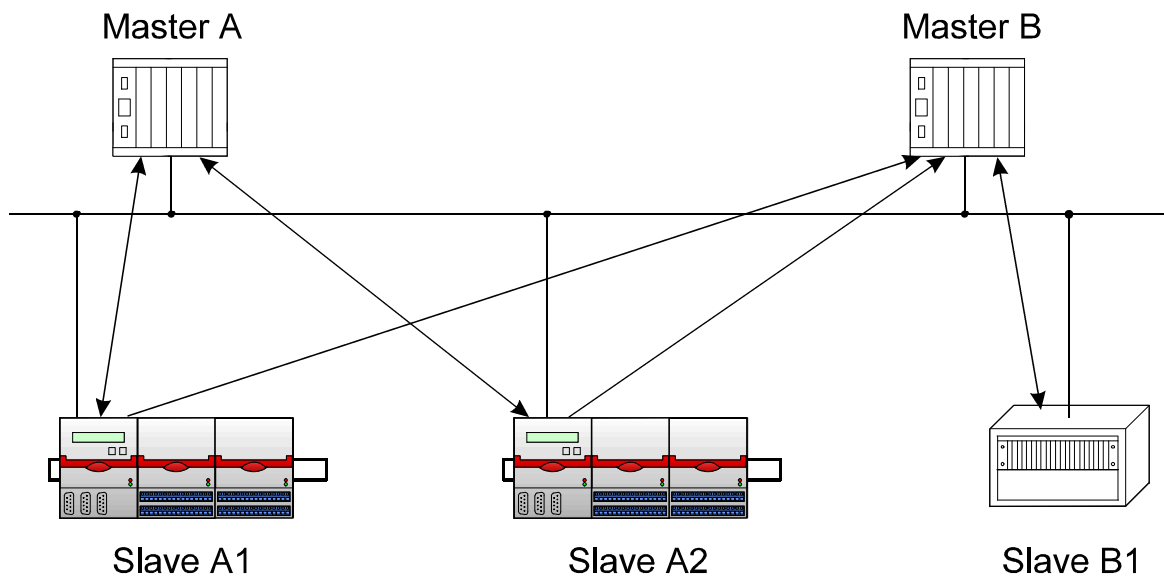
Fig. 2 shows the possible transmission structures of several IS1 field stations in a PROFIBUS network. IS1 field stations can be connected to the PROFIBUS in the hazardous area as well as in the non-hazardous area. Both fibre optic technology as well as bus structures in multi-drop cabling configurations are available in the hazardous area.

PROFIBUS DP interface for IS1

1.3 Access procedure of the PROFIBUS DP

Class 1 masters are masters that are allocated one or more slaves. Only class 1 masters have write (setting the outputs) and read (reading inputs) access to the slaves allocated to them. Class 2 masters only have read access to slaves. Each slave can have only one class 1 master but several class 2 masters can be available for each slave. A network can have several class 1 masters. However, only one class 1 master can have write access to the slaves allocated to it. Masters can be both class 1 masters for one particular slave while they are class 2 masters for other slaves.

Example:



Slaves A1 and A2 are allocated Master A as their class 1 master. Master A has no slaves allocated to it as class 2 master.

Master B is allocated as the class 1 master of the Slave B1 and as the class 2 master of both Slave A1 and Slave A2.

PROFIBUS DP services

| | |
|---------------|---|
| Data_Exchange | Cyclic data exchange with a class 1 master, e.g. an automation system with one slave. |
| RD_Inp | Reading of the input data by a class 2 master, e.g. PC for configuration and diagnosis or another automation system. |
| RD_Out | Reading of the output data of a slave by a class 2 master. |
| Slave_Diag | Diagnosis data are sent to the class 1 master. |
| Set_Prm | Configuration data are sent by the class 1 master to the slave (IS1). |
| Chk_Cfg | Transmission of configuration data by the class 1 master to the slave and checking of the configuration data received by the slave. |
| Get_Cfg | Request of a class2 master to read the current configuration data of a slave. |
| Set_Slave_Add | Not supported! The slave address is set by operating keys on the CPM of the IS1 field station. |

PROFIBUS DP interface for IS1

2 Commissioning

2.1 Overview

Planning of the complete PROFIBUS network:

- Which masters are in the network
- Which slaves are in the network
- Selection of network topology and network physics (repeaters, glass fibre links ...)
- Selection of the baud rate depending on lengths of cable, volumes of data and time requirements
- Unique allocation of the PROFIBUS addresses.

Perform the commissioning:

- Mechanical mounting of the IS1 field station.
- Mechanical mounting of the field bus isolating repeater.
- Mechanical mounting of all other bus users.

- Set up the bus connections. Ensure the correct bus termination of all segments!

- Set up the baud rate on the field bus isolating repeaters (9185, 9372. or 9373/21..) or select 'AutoBaudrate detection' (available with 9185).

- Set up the voltage supply of the IS1 field station.
- Set up the voltage supply of the isolating repeaters.

- Set up the slave addresses on the IS1 field stations.
- Set up the addresses of all other users.

- Optional use of the service bus:
 - Mechanical mounting of the service bus and the associated field bus isolating repeater.
 - Install the I.S. Wizard software on the PC.
 - Configure the IS1 field stations.

- Parameterise the DP master.
 - Select the IS1 parameter set (standard (GSD V1.xx) or extended (GSD V2.xx)). Use of associate GSD File.
 - Read the GSD file of the IS1 field station in the configurator of the master.
 - Configure the modules in the master according to the IOMs present in the field station.
 - Parameterise the IS1 field station and its IOMs.

- Put the master into operation. This results in the automatic start-up of the cyclic master <-> slave communication.

- Check communication on the PROFIBUS using the following tools:
 - Diagnosis information of the master or of the diagnostic tools belonging to the master.
 - LEDs on the 9185, 9372 or 9373 field bus isolating repeaters
 - LEDs and text display on the CPM of the IS1 field station

- Check I/O signals using the following tools:
 - Information of the master or of the diagnostic tool belonging to the master.
 - optional use of Diagnosis software I.S. WIZARD on a PC connected via the service bus.

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2.2 Engineering limits

The general regulations according to the IS1 operating instructions apply to the engineering of an IS1 field station. The use of the PROFIBUS DP interface gives rise to the following additional engineering regulations that must be observed in the PROFIBUS DP Slave implementation of an IS1 field station:

The data volume for the IOM of a IS1 field station that can be transmitted is limited in the PROFIBUS DP to:

max. 112 bytes of input data + max. 80 bytes of output data *1)

Thus, the maximum possible number of IOMs in a field station is limited.

An expansion of this data area was made in junction with the extended parameter set of IS1 (see separate instructions). The following table shows the length of the cyclic data of different types of IOM:

| Module selection text in the GSD file (standard param. set: GSD V1.xx) | Cyclic data length [bytes] | | PROFIBUS identifier [HEX] | | | | | | |
|---|----------------------------|--------|---------------------------|-----|----|----|----|----|---|
| | Input | Output | | | | | | | |
| 9440/12-01-11 CPM Z1 Stahl 24V | 0 | 0 | AKF | 00 | - | - | - | - | |
| 9440/12-01-11 CPM Z1 Stahl 24V Red | 1 | 1 | | 30 | - | - | - | - | |
| 9440/15-01-11 CPM Z2 Stahl 24V | 0 | 0 | | 00 | - | - | - | - | |
| 9440/15-01-11 CPM Z2 Stahl 24V Red | 1 | 1 | | 30 | - | - | - | - | |
| 9440/22-01-11 CPM Z1 PNO 24V | 0 | 0 | | 00 | - | - | - | - | |
| 9440/22-01-11 CPM Z1 PNO 24V Red | 1 | 1 | | 30 | - | - | - | - | |
| 9440/22-01-21 CPM Z1 PNO 230V | 0 | 0 | | 00 | - | - | - | - | |
| 9440/22-01-21 CPM Z1 PNO 230V Red | 1 | 1 | | 30 | - | - | - | - | |
| 9460/12-08-11 AIM 4/8 Exi | 16 | 0 | SKF | 42 | 47 | 30 | 03 | - | |
| 9461/12-08-11 AIMH 8 2w Exi | 16 | 0 | | 42 | 47 | 30 | 05 | - | |
| 9461/12-08-21 AIMH 8 Exi | 16 | 0 | | 42 | 47 | 30 | 06 | - | |
| 9465/12-08-11 AOM 8 Exi | 0 | 16 | | 82 | 47 | 40 | 09 | - | |
| 9466/12-08-11 AOMH 8 Exi | 0 | 16 | | 82 | 47 | 40 | 0b | - | |
| 9470/12-16-11 DIM 16 NamExi | 4 | 0 | | 42 | 83 | 11 | 0d | - | |
| 9470/22-16-11 DIM 16 NamExi | 4 | 0 | | 42 | 83 | 11 | 0d | - | |
| 9470/22-16-11 DIM 16+CF NamExi | 8 | 1 | | c2 | 00 | 87 | 12 | 0d | |
| 9471/10-16-11 DIM 16 24V | 4 | 0 | | 42 | 83 | 11 | 0f | - | |
| 9471/10-16-11 DIM 16+CF 24V | 8 | 1 | | c2 | 00 | 87 | 12 | 0f | |
| 9475/12-04-11 DOM 4 Exi1 | 0 | 1 | | 82 | 00 | 20 | 12 | - | |
| 9475/12-04-21 DOM 4 Exi2 | 0 | 1 | | 82 | 00 | 20 | 13 | - | |
| 9475/12-04-31 DOM 4 Exi3 | 0 | 1 | | 82 | 00 | 20 | 14 | - | |
| 9475/12-08-41 DOM 8 Exi1 | 0 | 1 | | 82 | 00 | 20 | 16 | - | |
| 9475/12-08-51 DOM 8 Exi2 | 0 | 1 | | 82 | 00 | 20 | 17 | - | |
| 9475/12-08-61 DOM 8 Exi3 | 0 | 1 | | 82 | 00 | 20 | 18 | - | |
| 9475/12-07-71 DOM 7 Exi4 | 0 | 1 | | 82 | 00 | 20 | 1f | - | |
| 9475/22-04-21 DOM 4 OD Exi2 | 0 | 1 | | 82 | 00 | 20 | 24 | - | |
| 9475/22-08-51 DOM 8 OD Exi2 | 0 | 1 | | 82 | 00 | 20 | 20 | - | |
| 9475/22-08-61 DOM 8 OD Exi3 | 0 | 1 | | 82 | 00 | 20 | 21 | - | |
| 9477/10-08-12 DOM 8 Rel | 0 | 1 | | 82 | 00 | 20 | 19 | - | |
| 9477/12-08-12 DOM 8 60V Rel Z1 | 0 | 1 | | 82 | 00 | 20 | 22 | - | |
| 9477/12-06-12 DOM 6 250V Rel Z1 | 0 | 1 | | 82 | 00 | 20 | 23 | - | |
| 9477/15-08-12 DOM 8 Rel Z2 | 0 | 1 | | 82 | 00 | 20 | 1e | - | |
| 9478/28-08-51 DOMV8 OD Exi1 | 0 | 1 | | 82 | 00 | 20 | 2a | - | |
| 9480/12-08-11 TIM 8 R Exi | 16 | 0 | | 42 | 47 | 30 | 1a | - | |
| 9481/12-08-11 TIM 8 mV Exi | 16 | 0 | | 42 | 47 | 30 | 1c | - | |
| AIM 4/8 (9460/..., 9461/...) | 16 | 0 | | AKF | 57 | - | - | - | - |
| AOM 8 (9465/..., 9466/...) | 0 | 16 | | | 67 | - | - | - | - |
| DIM 16 (9470/..., 9471/...) | 2 | 0 | | | 11 | - | - | - | - |
| DOM 4/8 (9475/...) | 0 | 1 | | | 20 | - | - | - | - |

AKF: standard identifier format

SKF: special identifier format (is not supported from all DP masters, but should be used preferred)

The telegram length of the cyclic input and output data of a field station depends on the type and number of IOM used. The field station limits mentioned above must also be observed here.

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Example: If only AIM modules are used in an FS, each with 8 AI (2 bytes per AI = 16 bytes of input data per AIM), a maximum of 112 bytes / 16 bytes = 7 AIM can be projected in this FS.

Moreover, further limitations of the number of IOMs, the maximum number of signals and the maximum number of slaves in a network ... depend on the performance of the DP master used. Thus, the limits of the DP master used must also be taken into account during the engineering.

***1): using redundant CPM:**

Using redundant CPM the status- and control register of the CPM can be transmitted cyclically in addition to the data of the IOM. In this case the following maximum telegram length is supported:

max. 113 Byte input data + max. 81 Byte output data

Attention!

The maximum telegram length of IS1 fieldstations has been extended using the [Extended Parameter Set](#) of IS1



see: 'New features with the Extended Parameter Set'

PROFIBUS DP interface for IS1

2.3 Configuration of the DP master

The documentation of the master will describe the exact procedure for the parameterisation of your master. As a result of the high degree of standardisation of the PROFIBUS DP, the configuration of the network is performed in a very similar fashion - even for the products of different manufacturers. The following procedure usually applies:

A GSD file is supplied with the IS1 field station. This file contains all the information important for the master on the communication behaviour of the IS1 field station.

The GSD file is usually read by the configuration software of the master.

The configurator of the master takes the information on the module types possible in an IS1 field station from the GSD file.

Configuration rules:

- The CPM module (module no. / slot = 0) must be configured first.
Even if redundant CPMs are used, only the CPM in slot 0 needs to be configured as, from the point of view of the master, there are two slaves each with one CPM.
- Configuration of the IOM slot coded from slot 1 (module no. 1) according to the IOMs that are planned or are present in the system.
- Only PROFIBUS Identifiers ac. the list in chapter 2.2 are allowed.
- max. telegram length (112 (+1) Bytes Input and 80 (+1) Byte Output data) is checked
- max. number of IOM (max. 16) is checked
- the number of parameter bytes must fit to the number of configured IOM's.
(10 Byte for CPM + 5 Byte per IOM)
- Byte 6 of CPM parameters has to be '1' for check of version conflict GSD / CPM.

The configuration data and parameters required for the slave are transmitted from the master to the slave during the start-up process.

Attention !

The CPM checks the a. m. engineering and configuration rules.

-> In case of error, the CPM does not go into the "Data_Exchange" state.

The "Cfg_Fault" message is transmitted in the diagnosis telegram.

If none of the errors listed above occur, the CPM accepts the configuration data and goes into the "Data Exchange" state with the DP master.

If the modules that are plugged in do not correspond to the modules configured in the master, those modules that do not correspond with the configuration data of the master are displayed in the "Device-specific diagnosis" area.

The signals of the wrongly configured modules are considered to be garbled (corrupted) and processed according to the parameterised behaviour that applies if an error occurs.

All signals of modules which correspond to the modules configured in the master are in operation (signals are updated cyclically).

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Example of a configuration list of an IS1 field station in the configurator of a DP master:

| Module (slot) no. | DP Identifier | Order Number | TAG no. (comment) | I addr. *1) | O addr. *1) |
|-------------------|---------------|-----------------------------|-------------------|-------------|-------------|
| 0 | empty module | 9440/15-01-11 CPM Zone 2 | | | |
| 1 | 8 AI | 9460/12-08-11 AIM 4/8 Exi | | | |
| 2 | 8 AI | 9460/12-08-11 AIM 4/8 Exi | | | |
| 3 | 16 DI | 9470/12-16-11 DIM 16 NamExi | | | |
| 4 | empty module | | | | |
| 5 | 8AO | 9465/12-08-11 AOM 8 Exi | | | |
| 6 | 8AO | 9465/12-08-11 AOM 8 Exi | | | |
| 7 | 8DO | 9475/12-08-41 DOM 8 Exi1 | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |

*1) For example, register addresses of a PLC. An address can only be allocated in the white areas. Grey areas are locked as no slave data are allocated here.

PROFIBUS DP interface for IS1

2.4 CPM redundancy

Attention!

Two different solutions for CPM redundancy with PROFIBUS DP are available:

- **CPM redundancy according to Stahl specification** is a proprietary solution from 2000.
- **CPM redundancy according to PNO specification 'Slave Redundancy'** Doc. 2.212 R1.2 2004

IS1 supports both solutions. The two solutions are **not** compatible with one another, require different IS1 firmware and must be projected differently.

Therefore, a clear distinction must be made as to which version is to be used.

The distinction between STAHL and PNO redundancy is done by selecting the CPM firmware and the associated GSD file:

| | CPM redundancy | | | |
|------------------|---|--------------|---------------------------------------|--|
| | STAHL | | PNO | |
| GSD | GSD V1.xx for all PROFIBUS firmware versions IS1 standard parameter set + DPV0 diagnosis | | from GSD V1.25 | for masters non-compliant with PNO slave redundancy |
| | GSD V2.xx from PROFIBUS firmware version V0x-30 IS1 extended parameter set + DPV0 diagnosis | | from GSD V2.25 | |
| | GSD V3.00 to V3.02 from PROFIBUS firmware version V0x-40 GSD from V3.03 *1) from PROFIBUS firmware version V0x-42 Extended parameter set + DPV1 diagnosis with status | | from GSD V3.03 | for masters compliant with PNO slave redundancy (max. 15 IOM!) |
| IS1 CPM firmware | DPV0 Standard version | DPV1 Version | DPV1 Version (Offset Backup Adr. = 0) | DPV1 Version |
| FW Version | V01-42 | V02-42 | V09-42 | from V03-42 |

***1) Attention!** When using GSD files from V3.03 in connection with IS1 firmware up to V0x-41, a parameterisation error is reported when IS1 is started, if the PLC supports structured parameterisation according to DPV1 (e.g. S7-300 and S7-400). In this case, IS1 will not enter DataExchange. Remedy: use firmware from V0x-42 or GSD up to 3.02.

A maximum of 15 IOM modules with IS1 GSD from V3.03

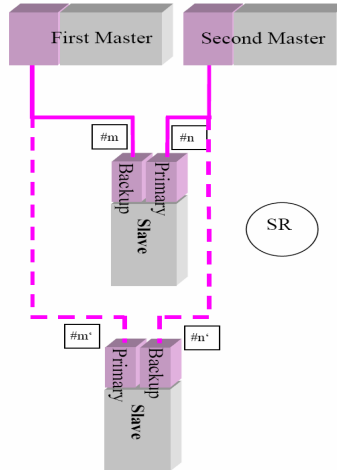
A mix of redundant CPMs with firmware acc. Stahl spec. and PNO spec. is not allowed in one IS1 field station. Rule for redundant operation of two IS1 CPMs: Firmware from the same row (01-xx or 02-xx or 03-xx or 09-xx) shall be used in both CPMs.

PROFIBUS DP interface for IS1

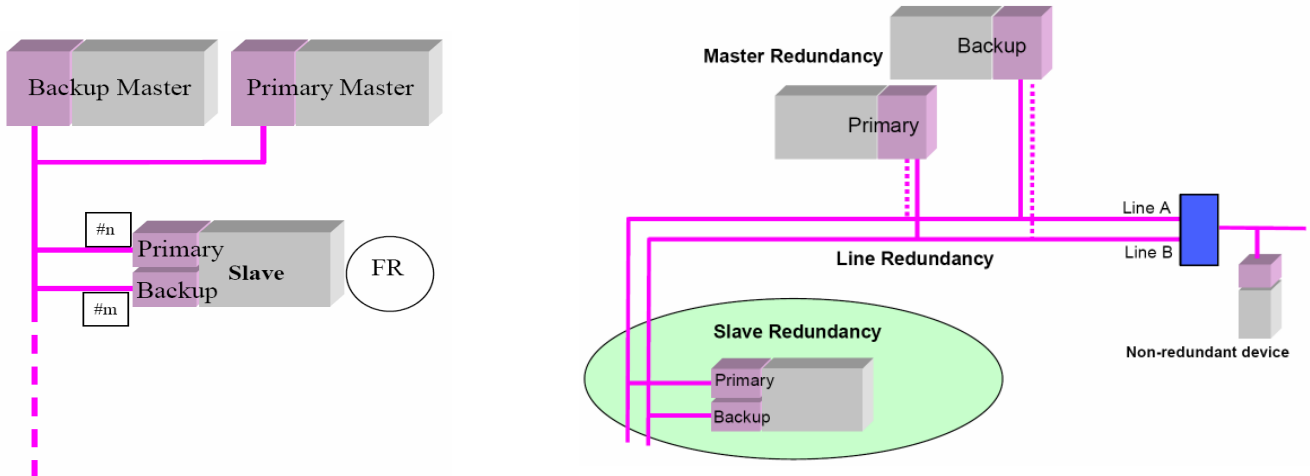
2.4.1 CPM redundancy according to PNO specification

In the PNO specification for PROFIBUS slave redundancy (Doc. 2.212 R1.2), different redundancy structures have been defined:

System Redundancy (SR):



Flying Redundancy (FR):



IS1 supports all versions of these redundancy structures. Master and Slave redundancy are independent and can be combined optionally.

Function:

During slave start-up, the DP master transmits specific parameters redundantly to the slaves and monitors the connection both to the primary and the backup slave. Cyclic data are exchanged with the primary slave. The decision to switch over when an error occurs is made by the slave. When a switchover takes place, the previous backup CPM takes over and becomes primary. Input and output signals are frozen during the switchover.

Optionally, the DP master can trigger a switchover, for example for testing, via a control command (DPV1 PrmCmd).

A failure of the backup CPM is reported via the "Backup Slave Not Available" device-specific diagnosis as well as the CPM status register in the cyclic data of the primary CPM.

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Possible reasons for message 'Backup CPM not available'

- Backup CPM has no connection to PROFIBUS and does not detect 'Baudrate found'.
 - Short- or open circuit on Profibus
 - Wrong end of line termination switching
 - Fault or no power of fieldbus isolation repeater
- Communication between primary and backup CPM failed
- Power fail of backup CPM
- Hardware fault of backup CPM

2.4.1.1 Project planning

Rules to be considered for use of IS1 field stations with redundant CPM according PNO Slave redundancy specification:

- IS1 CPM Firmware from V03.42 is required.

PROFIBUS connection to IS1 CPMs

- Both CPMs of a redundant IS1 field station are connected via the X1 connector to the PROFIBUS segments.
- In case of PNO redundancy the X2 connector is not used. X2 is used for line redundancy only.

DP Addresses

- Both CPMs in one IS1 field station are set to the same DP Address.
- The backup CPM adds an offset to this address according the parameter 'Address offset backup CPM PNO Red'.

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Configuration of PROFIBUS master

- Only one of two redundant CPMs is configured in the DP master with the primary DP address. The application in PLC/DCS is using only the primary CPM for exchanging I/O data.
- Consider that the backup address according parameter 'Address offset backup CPM PNO Red' is allocated and shall not be used twice.
- Cyclic or acyclic communication between DP master and the backup CPM may be optionally used for checking the backup communication line.
- The accepted 'Max. Slave switch over time' from the DP master for bumpless switch over depends on the setting of DP Watchdog time and the DP master cycle.

$$\text{Max. Slave switch over time [ms]} = \text{DP-Watchdog} + (3 * \text{DP master cycle}) + 470\text{ms}$$

| DP master cycle [ms] | Max. Slave switch over time [ms] <i>Worst case time between disturbing DP bus on primary CPM to DataExchange of previous backup CPM.</i> | | | | | Setting of Parameter 'Timeout for output modules' \geq [s] |
|----------------------|---|-----|------|------|------|--|
| | DP-Watchdog [ms] | | | | | |
| | 50 | 100 | 200 | 500 | 1000 | |
| 10 | 550 | 600 | 700 | 1000 | 1500 | 1,0 |
| 30 | 610 | 660 | 760 | 1060 | 1560 | 1,0 |
| 50 | - | 720 | 820 | 1120 | 1620 | 1,0 |
| 70 | - | 780 | 880 | 1180 | 1680 | 1,0 |
| 80 | - | 810 | 910 | 1210 | 1710 | 1,1 |
| 100 | - | - | 970 | 1270 | 1770 | 1,2 |
| 150 | - | - | 1120 | 1420 | 1920 | 1,4 |
| 200 | - | - | - | 1570 | 2070 | 1,6 |

Recommendation using Siemens PLCs with IS1: use DP Master profile 'Universal (DP/FMS)'.

PROFIBUS DP interface for IS1

Setting of CPM Parameters

- 'CPM Redundant' = Yes -> this activates the mutual supervision of both CPMs and the first slot on the right of the right CPM becomes slot 1.
- 'Line redundancy AS bus' = No (Line redundancy and X2 connection are not used together with PNO redundancy)
- 'Timeout for output modules (x 100 ms)' = 10 (default value = 10 x 100ms = 1 Sec).
Using big amount of data on the DP bus with the result of a higher DP master cycle time, this parameter value must be increased according the following rule:

$$\text{Timeout for output modules [ms]} \geq (4 * \text{DP_Master cycle}) + 700\text{ms}$$

- 'Address offset backup CPM PNO Red' = xx see table below

Parameter: Address offset backup CPM PNO Red

| Redundancy Structure | Address offset backup CPM | Master |
|-------------------------|---------------------------|---|
| SR System Redundancy | 0 | Offset according PNO Spec. for SR e. g. S7-400H |
| FR Flying Redundancy | 1 | proprietary Solutions |
| | 64 | Offset according PNO Spec. for FR. e. g.. ABB |
| | 128 | Backup address out of PPROFIBUS address range. Communication with backup CPM via DP is not possible. |

Prepared Redundancy

Usecase:

Initially the IS1 Field station is used with a single CPM but shall be prepared for later extension with a redundant CPM.

Application:

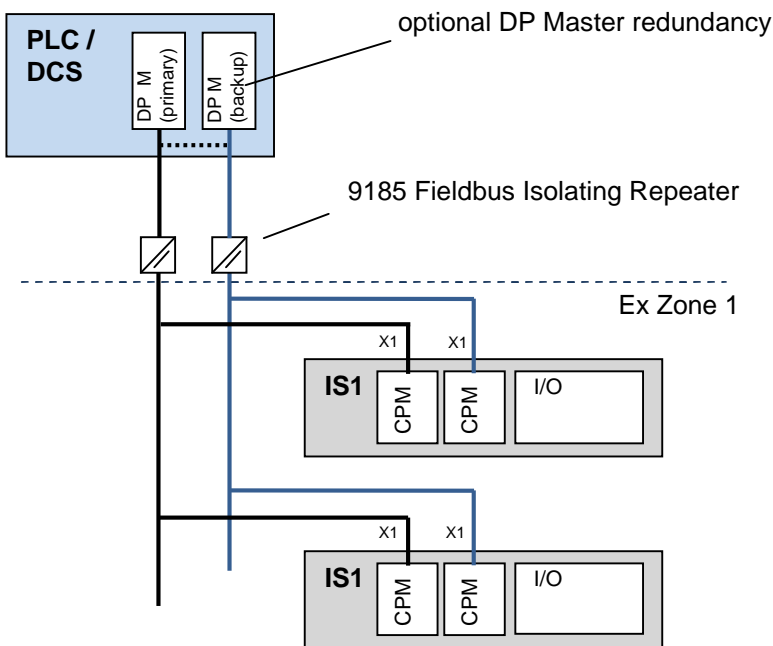
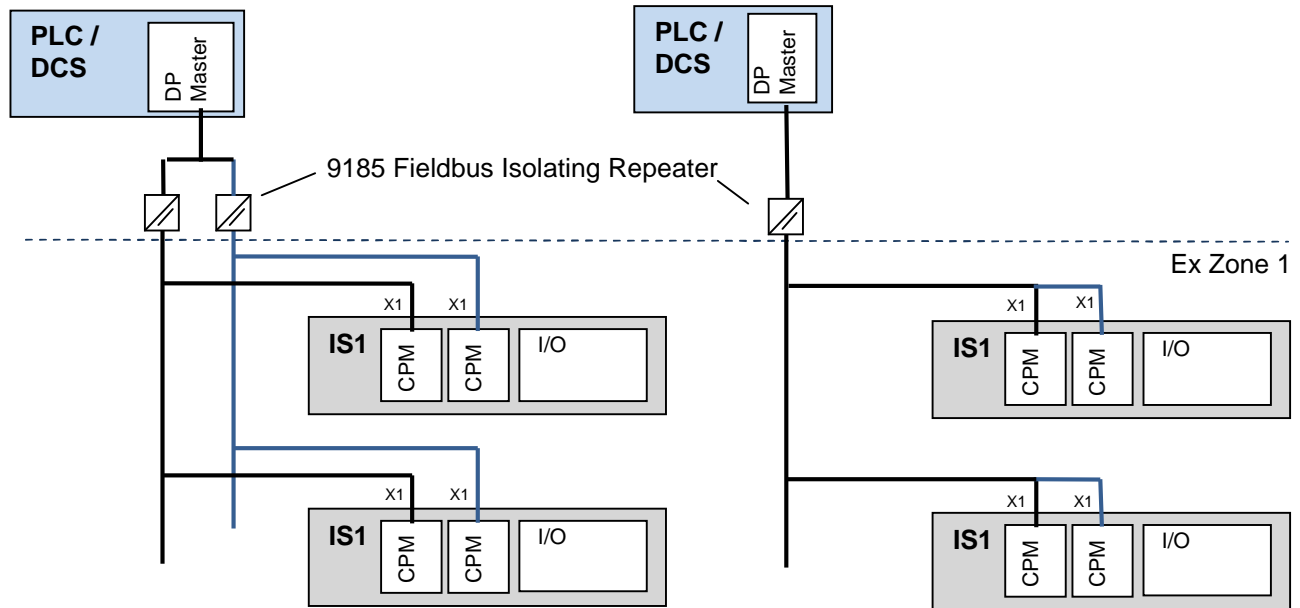
Plug in right CPM and remain left CPM slot empty for later extension.
Set Parameter CPM Redundancy = No

PROFIBUS DP interface for IS1

2.4.1.2 PNO redundancy without class 1 master support

The operation of redundant IS1 CPUs is also possible without support by the DP master defined in the PNO slave redundancy specification.

Topology Example FR:



PROFIBUS DP interface for IS1

Function:

- The switchover criterion between primary and backup CPM is generated in the IS1 CPUs. No support from control commands by the DP master is required.
- Our GSD versions 1.xx and 2.xx support DP master systems which do not yet support DPV1 diagnoses.
- A failure of the backup CPM is reported via the “Backup Slave Not Available” device-specific diagnosis as well as the CPM status register in the cyclic data of the primary CPM.
- From the point of view of the DP masters, the slave (IS1 CPM) will fail for a short period during a switchover between the primary and backup CPM and return to the DataExchange after approx. 500 ms - 800 ms using 1,5 MBaud (see table on page 16).

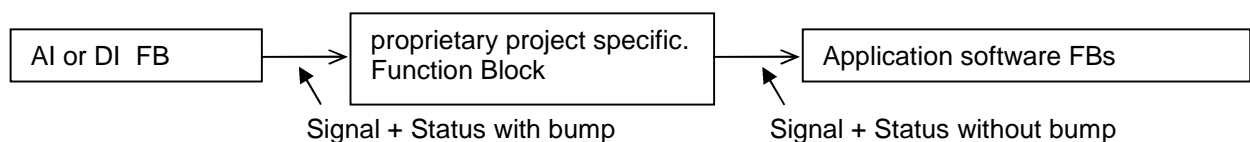
During the switchover of IS1, output signals are frozen and thus bumpless. For bumpless switchover of the input signals, the only additional support required by the DP master is a toleration of such a short-term slave failure. Input signals and the signal and device status must be frozen during this DP master switchover time. Thus, the short slave failure is hidden from the application software in AS. If possible, the slave failure time tolerated by the DP master should be configurable. If a slave fails for more than the configured slave failure time, the appropriate safety reaction can take place in the AS.

- For standard DP masters which do **not** tolerate such a short slave failure, the application software will see this short slave failure in the AS.
With some systems and suitable design of the application software, such a bump can be tolerable. This must be checked in each individual project.

- Optionally, **the bumpless switchover of input signals can be effected on the application level in the AS for each specific project.**

For example, input signals can be copied from the DP master input/output image to a second memory area the remaining application software has access to. In this case, during the slave switchover phase, transfer between these two memory images is prevented, thus freezing the memory area of the application. The behaviour of the system messages in the AS must also be taken into account.

For function-block-based systems, it is possible, for example, to insert a proprietary block, which carries out a bumpless switchover, for each input signal.



PROFIBUS DP interface for IS1

2.4.1.3 Software requirements

Software requirements for masters compliant with PNO slave redundancy

- CPM firmware DPV1 from version V03-xx
- IOM firmware from version 2.00
- PROFIBUS GSD file from version V3.03

Software requirements for masters non-compliant with PNO slave redundancy

- CPM firmware PROFIBUS versions V0x-42
- IOM firmware all versions (1.xx and 2.xx)
- PROFIBUS GSD files from versions V1.25, V2.25, V3.03

Behaviour when mixed with older versions:

The use of GSD V3.xx with older CPM firmware versions is not permitted. When using GSD V3.xx with older CPM firmware versions, a DP slave start-up is answered with a 'Parameterisation Error' in the 6 standard bytes of the diagnosis telegram. IS1 CPM will not enter DataExchange.

PROFIBUS DP interface for IS1

2.4.2 CPM redundancy according Stahl specification

2.4.2.1 Functions

An IS1 field station can be equipped with two central units (CPM), whereby each CPM has its own independent PROFIBUS DP interface.

From the point of view of the automation system, each field station has 2 separate DP slaves, and both are involved in the cyclical data exchange with the DP master. Thus, there are two independent transmission paths between the DP master and the field station.

These two transmission paths are monitored for proper and error-free operation by **user software in the automation system**. In addition, one of the transmission paths is selected to transmit the useful data. The CPM linked to the transmission path selected by the AS is switched to primary mode (active) by transmitting a control register from the AS to the CPM.

Of course, data can also be transmitted through the other (inactive) transmission path. However, it only helps to monitor the connection. Data transmitted here is not used.

Only the active CPM handles the data traffic to the field station I/O modules. The active CPM monitors the inactive CPM and likewise provides it with the current input data.

For programming of the user software in the automation system the separate document 'IS1 remote I/O system - Redundant coupling via PROFIBUS DP' is available.

2.4.2.2 Configuration and parameterisation of the IS1 fieldstation in the DP Master

The super ordinate automation system provides two DP slave devices on the PROFIBUS with address n (left) and address n+1 (right).

Both slave devices must be configured separately in the DP master configurator with identical I/O arrangements and parameterised with identical slave parameters.

(Recommendation: first configure and parameterise the left slave and then copy the complete slave to slave address n+1).

Consequently, there is a separate memory area with the respective associated I/O data for each of the CPMs.

For the CPM parameters, set the parameter 'CPM redundant = Yes' in the DP master configurator.

When configuring a field station with CPM redundancy, the CPM with the additional 'Red.' from the module list of the GSD file must be configured as the first module in both slaves (Module No. / Slot = 0) (for example, '9440/...-... CPM Zone 1 Red.') in the DP master.

The CPM module for redundancy has 1 byte input data (status register) and 1 byte output data (control register), which is transmitted in the cyclical data area from PROFIBUS DP. These registers help to control and monitor the redundancy by means of the AS.

Even if redundant CPMs are used, you must configure only one CPM in slot 0 per field station, as from the point of view of the master, there are two slaves with one CPM each respectively.

PROFIBUS DP interface for IS1

2.4.2.3 Prepared Redundancy

It is possible to use only one CPM and one empty slot for the redundant CPM in future (prepared redundancy).

With the parameter 'CPM redundant = Yes / No' and the different CPM Modul descriptors the following configurations are possible: (available with CPM firmware V01-20 or higher)

| Operation | not Redundant Operation | | not allowed | Redundant Operation |
|----------------------------|---|---|--|---|
| | No | No | | |
| Parameter 'CPM redundant': | No | No | Yes | Yes |
| DP Module-descriptor CPM: | 9440/1.-... CPM Zone. not redundant (without status- and controlreg.) | 9440/1.-... CPM Zone. Red. redundant (with status- and controlreg.) | 9440/1.-... CPM Zone. not redundant (without status and controlreg.) | 9440/1.-... CPM Zone. Red. redundant (with status- and controlreg.) |
| behaviour: | <p>The CPM can be located on all slots of the rail !</p> <p>To prepare a later redundancy (prepared Redundancy) the CPM has to be located on redundant slots (1 red, 3 red). The Slave address of the CPM will be incremented (+1) by using the CPM in these slots.</p> <p>The left slot beside the CPM remains empty for later extension with the redundant CPM. The right slot beside the CPM is the slot 1 for IOM modules.</p> | | <p>Configuration error on PROFIBUS DP, no Data Exchange, Diagnosis message 'Redundant CPM descriptor required' in device specific diagnosis.</p> | <p>control of the redundancy via the control register from the AS required.</p> |
| | *1) | <p>The content of the control register is not considered..</p> <p>The Status register is updated.</p> | | |

*1):

It is possible to install two CPM on one rail, configure both 'not redundant' and put only one of both into Data Exchange. Without or with prepared redundancy only one CPM can be put to Data Exchange, because the CPM is getting active without control register. If two CPM are used and both are in Data Exchange they are toggling between active and inactive (app. 10 sec).

PROFIBUS DP interface for IS1

2.5 Line Redundancy

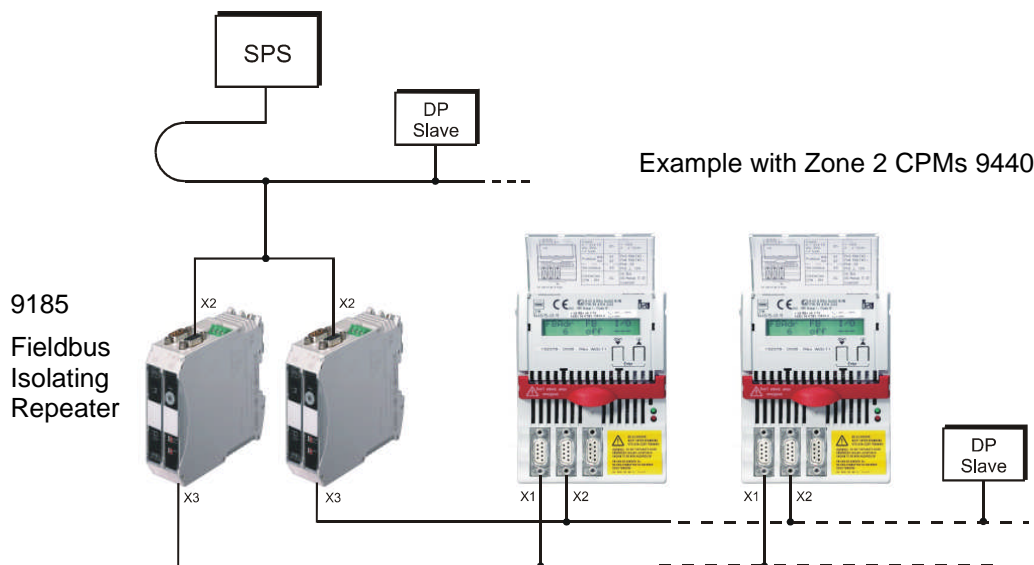
The flexibility of the Remote I/O System IS1 has been further improved. To substantially **enhance** its **availability** even if a transmission path has been broken, the **Line Redundancy** has been implemented. The function is suitable for non-redundant PROFIBUS Masters.

In order to do this, the two fieldbus isolating repeaters, Type 9185, are interconnected at the X₂ interface with a PROFIBUS DP cable via Sub D connectors and connected to the PROFIBUS Master (PLC, process control system (DCS)). One PROFIBUS DP cable with Sub D connector is connected to each X₃ interface of the 9185, and connected to the two X₁ and X₂ interfaces of the CPU & Power Module (CPM), Type 9440. The PROFIBUS line between the fieldbus isolating repeaters and the IS1 field stations (CPM, Type 9440) thus has a redundant structure.

Data is exchanged via both channels and is evaluated in the CPM, Type 9440, with an internal logic. Data arriving first is prioritised and the other data is rejected. If one line suffers a fault, data transmission continues undisturbed between automation system and IS1 field station. If the disturbed channel is operational again, redundant data traffic resumes automatically. The outputs in the connected I/O modules revert to safety position after the hold time configured user-specifically only if both transmission paths between PLC and the CPM, Type 9440, are broken. If a disturbed channel is operational again or if both disturbed channels are operational again, data communication resumes automatically. Faults on the two redundant transmission paths are signalled in the PROFIBUS diagnosis telegram and optionally in the I.S. Wizard.

Devices supporting Line Redundancy:

| Zone | Type | Power supply | Protocol | as of Release | | Interface | |
|---------|---------------|--------------|----------|---------------|----------------|---------------------------------|----------------|
| | | | | | | CPM / FB-TÜ | PLC |
| 1 | 9440/22-01-11 | 24 V DC | PROFIBUS | A | 01-32 02-32 | X ₁ / X ₂ | |
| 1 | 9940/22-01-21 | 90-250 V AC | PROFIBUS | B | 01-32 02-32 | X ₁ / X ₂ | |
| 2 | 9440/15-01-11 | 24 V DC | PROFIBUS | G | 01-32 02-32 | X ₁ / X ₂ | |
| 1 (bus) | 9185/11-35-10 | 24 V DC | | D | 01-02 | X ₃ | X ₂ |
| 2 | 9185/12-45-10 | 24 V DC | | D | 01-02 | X ₃ | X ₂ |



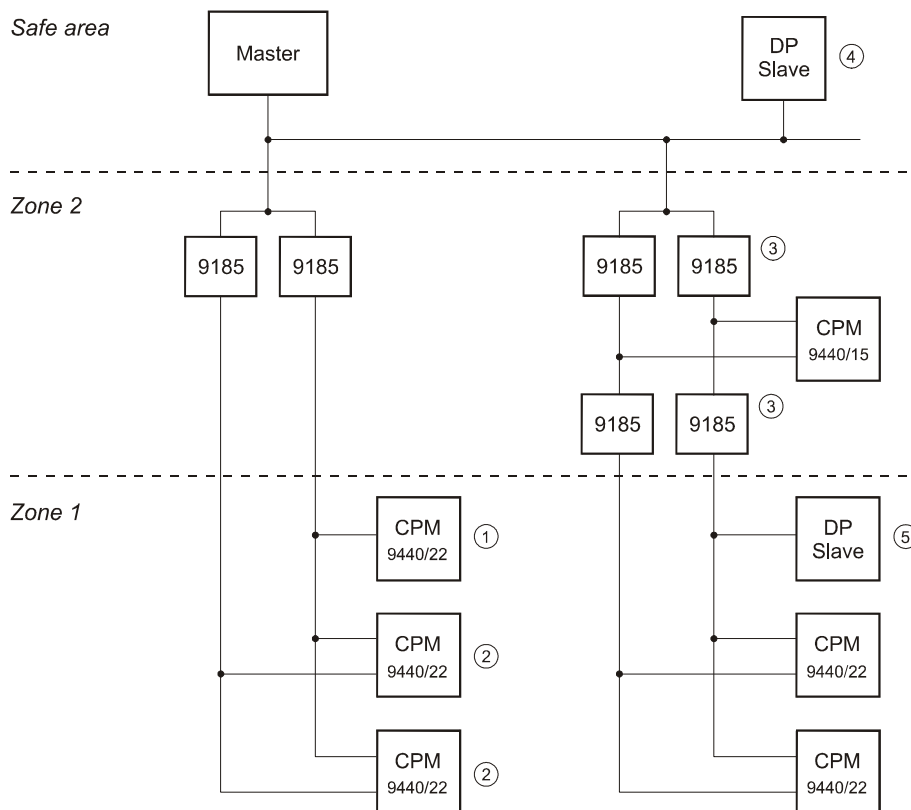
PROFIBUS DP interface for IS1

2.5.1 System data 'Line Redundancy'

Protocol: PROFIBUS DP

Baudrates: 9,6 K; 19,2 K; 93,75 K; 187,5 K; 500 K; 1,5 M

Bus structure:



- ① CPM without Line Redundancy
- ② CPM with Line Redundancy
- ③ max. 2 repeater 9185 in series allowed
- ④ DP Slave on non redundant bus
- ⑤ mixed operation of CPM with Line Redundancy + DP Slave without Line Redundancy

Bus data:

- CPM with and without Line Redundancy can be used on one redundant bus segment.
- Number of devices per bus segment ≤ 32
- Max 2 repeater 9185 can be used in series. ③
- Cable length per bus segment according PNO standard
- Operation of any PROFIBUS slaves on redundant and on non redundant bus segment allowed (④ and ⑤). For all DP slaves on the redundant bus segment ⑤ the parameter $T_{sdr-min}$ must be set to ≥ 33 t-bit in the PROFIBUS DP master !

PROFIBUS DP interface for IS1

2.5.2 Settings in PROFIBUS master

Protocol: PROFIBUS DP
 Retry: $\geq 3 - 5$ (recommended 5)
 $T_{sdr-min}$ ≥ 33 t-bit for all DP slaves on the redundant bus segment

Hint: We recommend to use the profile „Universal (DP / FMS)“ using SIEMENS PLCs with Baudrates $\geq 93,75$ kBaud.

2.5.3 CPM parameter:

The CPM-Parameter „IS1 Line Redundancy “ must be set to „ON“ for all IS1 field stations on redundant bus segments.

2.5.4 Settings on Fieldbus Isolating Repeater 9185

Baudrate: - Autobaudrate
 - fixed Baudrates 1,5 Mbit, 500 kBit, 187,5 kBit, 93,75 kBit
 (The fixed Baudrates 9,6...57,6 kBit are not allowed using Line Redundancy)

Isolating Repeater types: 9185/11-35-10(RS485 IS to zone 1)
 9185/12-45-10(Standard PROFIBUS in zone 2)

Revisions: as of Release D, V01-02

2.6 Bus segments

A PROFIBUS network is based on RS485 bus physics with a twisted pair cable as the transmission medium. A network can consist of several **line-type** segments that are connected by repeaters or optical transmission routes.

The 9185/11-35-10 field bus isolating repeater can be seen as a repeater that connects a non-hazardous bus segment with an I.S. bus segment (RS485IS).

2.7 Length of bus segments and stubs

Stubs are bus lines that branch off from the line-type main cable of a bus segment, e.g. via a conduit tee. Stubs should be avoided whenever possible.

Due to the line physics of the bus cable, the sum of the lengths of the stubs in a bus segment is limited. The following table shows the maximum lengths of stubs that are allowed for each bus segment. The table is valid for both non-I.S. and I.S. bus segments.

| Baud rate | Max. sum of the lengths of stubs per segment | Max. length of a bus segment when using a standard PROFIBUS cable (type A) |
|--------------------|--|--|
| 9.6 to 93.75 kbaud | 96 m | 1200 m |
| 187.5 kbaud | 75 m | 1000 m |
| 500 kbaud | 30 m | 400 m |
| 1.5 Mbaud | 10 m | 200 m |

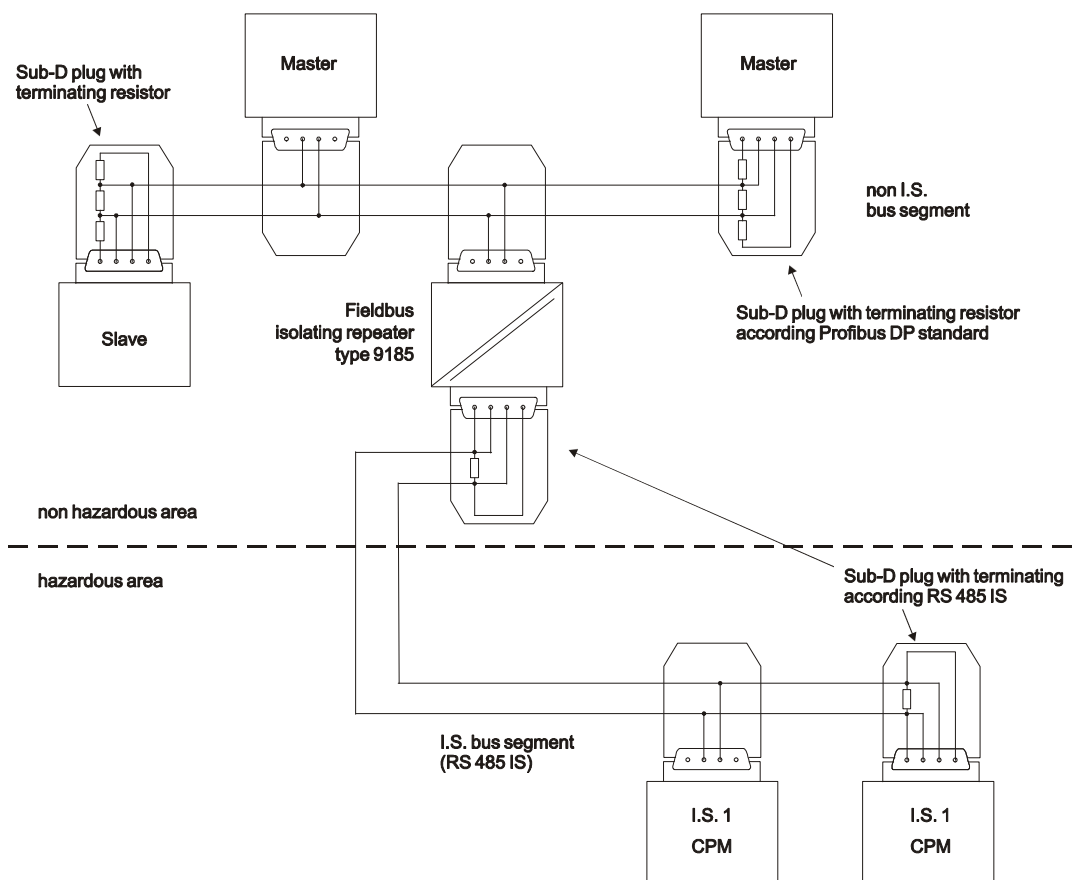
PROFIBUS DP interface for IS1

2.8 Bus termination

Every RS485 bus segment must be terminated at the first and last device of a segment with a bus termination resistor. As the bus terminations draw their auxiliary voltage from the PROFIBUS devices, make sure that the stations terminated by termination resistors are always supplied with voltage during start-up and operation.

All devices without a bus termination can be plugged into or out of the bus during operation without affecting the data traffic between the other devices.

Example of a possible bus configuration with termination resistors:



Attention !

Standard (non Exi) PROFIBUS SUB-D connectors are not allowed for PROFIBUS Exi segments. Only sub-D connectors approved by R. STAHL may be employed for the Ex i segment of the fieldbus.

End of line resistor in Ex i segment see operating instructions:

Project Planning, Installation and Commissioning of the RS 485 Fieldbus System from R. STAHL for Non-Hazardous and Hazardous Areas.

PROFIBUS DP interface for IS1

2.9 PROFIBUS address of the IS1 field station

The setting of the PROFIBUS address of an IS1 field station is performed by means of operating keys on the CPM module.

An address within the range 0 to 127 can be given here. Parts of this address area are reserved for specific tasks although the address area of 1 to 123 is freely available in most master systems. Please note that addresses may only be allocated once in a PROFIBUS network.

The address that is set on the CPM is also valid for addressing the I. S. 1 field station on the service bus. (see also the CPM operating manual)

2.10 Baud rate

The central unit of the IS1 field station (CPM) and the fieldbus isolating repeater 9185 (set switch to pos.0 = autobaud detection) have an automatic baud rate detection for the PROFIBUS DP interface and can set itself to all standardised PROFIBUS baud rates within the range 9.6 kbaud to 1.5 Mbaud.

Attention!

The selected baud rate for the 9372 or 9373 field bus isolating repeaters must be set on DIP switches.

2.11 Pin allocation of 9-pole D-type connectors:

The CPM and the field bus isolating repeaters (9185, 9372/21 and 9373/21) have 9-pole D-type sockets with the following allocation for connecting the PROFIBUS:

| Pin no. | Signal name | Description |
|---------|---------------|---|
| 1 | - | - |
| 2 | - | - |
| 3 | RxD / TxD (+) | B data (+) |
| 4 | - | - |
| 5 | GND | Reference potential for interface (from device) *1) |
| 6 | +5V | Supply voltage (from device) *1) |
| 7 | - | - |
| 8 | RxD / TxD (-) | A data (-) |
| 9 | - | - |

*1): Not connected on Zone 1
CPM 9440/12-01-11

End of line resistors in non Ex segment:

220 R between data lines (Pin 3 to 8)
390 R between data B (+) and +5V (Pin 3 to 6)
390 R between data A (-) and GND (Pin 8 to 5)

PROFIBUS DP interface for IS1

2.12 Start-up behaviour

The start-up behaviour of the cyclic communication between a class 1 master and a DP slave is standardised and is handled automatically by the master. During the start-up process, the master and slave exchange information on data block length, structure of data blocks (assignment to modules), parameters and Watchdog status Two different start-up behaviours of class 1 masters can be differentiated:

2.12.1 Slave is configured by the master:

(Procedure predominantly used by class 1 masters (Automation Systems))

The class 1 master transmits configuration data to the CPM by means of the "Chk_config" service. This service checks the data for compatibility. After checking this successfully, the CPM takes over the new configuration data and subsequently responds to "Get_Config" telegrams with the new data.

Hence, the slave adapts itself to the configuration of the master.

This start-up behaviour requires the parameterisation of the data block length and module assignment in the class 1 master.

The configuration tools of the master are available to do this. They enable the configuration based on the GSD file (device specific file) of a slave.

The implementation of the service bus and the I. S. Wizard PC software can be dispensed with in this operating mode. However, these tools and the HART Management System can be used if required.

2.12.2 Master configures itself with data from the slave:

(Predominantly used by class 2 masters as diagnostic and parameterisation tools)

The data block length and module assignment are not parameterised in the configurator of the master in this variant. This information is read by the master from the slave during the start-up process using the "Get_Config" service. Only the allocation of data to the internal registers needs to be either defined in the master or automatically allocated.

If the CPM is involved in cyclic data exchange with a class 1 master, the module configuration defined by the class 1 master is used vis-à-vis the class 2 master.

If the CPM is **not** involved in cyclic data exchange with a class 1 master, empty modules are transmitted to the class 2 master by means of the "Get_Config" service. The real present modules can not be read in this operation mode.

PROFIBUS DP interface for IS1

2.12.3 Typical start-up process between a class 1 master (M) and slave (S)

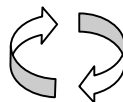
The following table shows the typical telegram traffic between master and slave during the start-up process:

Start-up process:

| | | | |
|-------|---------------------|------------------------|--|
| M → S | Req. Slave Diag | | |
| M ← S | Res. Slave Diag | Status_1: | Not Ready |
| | | Status_2: | PRM_REQ (parameter request) |
| | | Status_3: | OK |
| | | master adr. | FFH |
| | | ident number | 049AH |
| ----- | | | |
| M → S | Req. Set parameters | LOCK+SYNC+FREEZE+WD_ON | |
| | | WD_Factor_1: | 1 |
| | | WD_Factor_2: | 10 |
| | | min st.delay | 11 |
| | | ident number: | 049AH |
| | | group ident | 0000H |
| | | user prm data | (variable data area with parameters) |
| M ← S | Res. SC | (short confirmation) | |
| ----- | | | |
| M → S | Req. Check Config | 57H 8 word Input | Example of configuration: 4 modules with input data 3 modules with output data |
| | | 57H 8 word input | |
| | | 11H 16 bit input | |
| | | 11H 16 bit input | |
| | | 67H 8 word output | |
| | | 67H 8 word output | |
| | | 20H 8 bit output | |
| M ← S | Res. SC | (short confirmation) | |
| ----- | | | |
| M → S | Req. Slave Diag | | |
| M ← S | Res. Slave Diag | Status_1: | OK |
| | | Status_2: | WD_ON |
| | | Status_3: | OK |
| | | master adr. | 01H |
| | | ident number | 049AH |

Cyclic data exchange:

| | |
|-------|----------------------------------|
| M → S | Req. Data Exchange (output data) |
| M ← S | Res. Data Exchange (input data) |



Abbreviations:

| | |
|-------|--|
| Req. | = Request |
| Res. | = Response |
| SC | = Short Confirmation |
| M → S | = Request telegram of master to slave |
| M ← S | = Response telegram of slave to master |

PROFIBUS DP interface for IS1

3 Data traffic

3.1 Configuration

Input data (Read) and output data (Write) are each transmitted cyclically in a telegram.

In this case, the data blocks of the individual modules are grouped into telegrams in the order defined in the configuration software of the PROFIBUS master.

If empty modules are configured, no data is transported in these locations of the data telegram and no diagnosis data is generated for the associated slot.

3.2 Parameterisation of the IS1 field station and the IOM

3.2.1 New features with the **Extended Parameter Set**

The functionality of the IS1 Remote I/O-System has been extended with the extended parameter set in following points:

- **Increased telegram length:**
 - 239+1 Byte Input data (112+1 Byte before)
 - 127+1 Byte Output data (80+1 Byte before)
 - 14 Byte Parameter data per IOM (5 Byte before)
 - 30 signal diagnosis messages (18 before)
- **Signal parameter**
 - predominant separate parameters for each single signal of IOM (previous partially module global).
- **HART Variables**
 - HART variables can be mapped to the cyclic data exchange of PROFIBUS DP and transmitted to the PROFIBUS master (PLC/DCS).
- **Status Fieldstation**
 - A common alarm bit of all alarms of one IS1 fieldstation is mapped to the cyclic data on PROFIBUS DP

PROFIBUS DP interface for IS1

3.2.2 System requirements

Requirements for use of the **Extended Parameter Set** of the IS1 Remote I/O System:

Hardware requirements:

- CPM 9440/12-01-11 (24V Z1 Stahl) as of Revision F
- CPM 9440/15-01-11 (24V Z2 Stahl) as of Revision F
- CPM 9440/22-01-11 (24V Z1 PNO) all Revisions
- CPM 9440/22-01-21 (230V Z1 PNO) all Revisions

Software requirements:

- IOM Firmware as of Revision 2.00
- GSD file as of Revision V2.00
- without I.S.Wizard
 - CPM Firmware DPV0 as of Revision V01-30 or
 - CPM Firmware DPV1 as of Revision V02-30
- with I.S.Wizard V3.x.x and Service Bus
 - CPM Firmware DPV0 as of Revision V01-32 or
 - CPM Firmware DPV1 as of Revision V02-32

IMPORTANT

If using older hardware or firmware versions, GSD files with Version V1.xx (less than V2.00) without extended parameter set must be used with PROFIBUS DP.

Using IS1 with I.S.Wizard and without PROFIBUS master the standard parameter set has to be selected.

PROFIBUS DP interface for IS1

3.2.3 Selection and documentation of the IS1 parameter sets and GSD Files

Using PROFIBUS DP, the configuration and parameterisation of IS1 field stations is done with the configuration software of the PROFIBUS DP master using GSD files.

The selection of the IS1 parameter set is made by using one of the associated GSD files.

Three different GSD Files are available. The selection depends on the used IS1 parameter set and the PROFIBUS version:

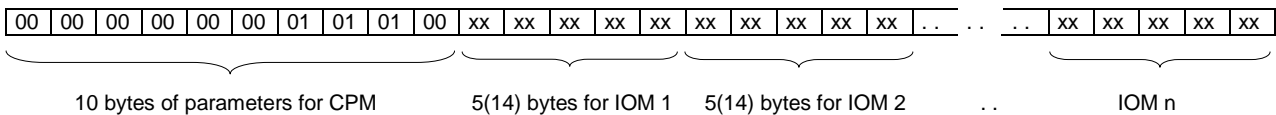
| PROFIBUS | IS1 Parameter set | GSD File | Documentation |
|----------|-------------------|--|---|
| DPV0 | Standard | Revisions V1.xx (File name: STA_049A.gse) | this document |
| | extended | Revisions V2.xx (File name: STA2049A.gse) | additional document: ‘Operating Instructions Extended Parameter Set for IS1 Remote I/O-System’ |
| DPV1 | extended | Revisions V3.xx (File Name: STA3049A.gse) | see ‘Operating Instructions PROFIBUS DPV1 for IS1 Fieldstations’ |

Each GSD file of an IS1 field station contains all necessary data for configuration and parameterisation of all IS1 modules. This provides the advantage that all the parameters of the field station can be accessed in easy-to-use screen masks in the configuration software of the DP master.

3.2.4 Transmission of parameter data

During the start-up of the automation system, parameters are transmitted by the DP class 1 master to the CPM in the "Set parameters" telegram. In addition to the standardised part of this telegram, the optional "USER_PRM_DATA" data area is also transmitted. The data area used for an IS1 field station has a fixed length of 10 bytes for the CPM and additional 5 bytes (14 Bytes with extended parameter set) for every IOM.

User parameter data area ("USER_PRM_DATA"):



The CPM checks the length of the parameter data and rejects the parameter data if this length is incorrect. If an error occurs, the CPM does not go into the "Data_Exchange" state. The "Prm_Fault" message is transmitted in the diagnosis telegram.

PROFIBUS DP interface for IS1

3.3 Standard Parameter Set for IS1

3.3.1 CPM parameters

Byte 0 – 2: Reserved (Default = 0)

Byte 3:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|

Bit no. CPM parameter

| Bit 1 | Bit 0 | Address offset backup CPM PNO Red | |
|-------|-------|-----------------------------------|-------------------|
| 0 | 0 | 128 | FR |
| 0 | 1 | 0 | SR acc. PNO spec. |
| 1 | 0 | 1 | FR |
| 1 | 1 | 64 | FR acc. PNO spec. |

Byte 4 – 5: Reserved (Default = 0)

Byte 6: Reserved (Default = 1)

Byte 7: timeout for output modules (x 100 ms) Unsigned8 (1 - 255) Default: 1

Byte 8:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|

Bit no. CPM parameters

Channel-related diagnosis 0=Off / 1= On

RESERVED

Reserved

Reserved

Reserved

IOM 9 -16 on rail X4 **0 = No / 1 = Yes**

Line redundancy AS bus **0 = No / 1 = Yes**

CPM redundant **0 = No / 1 = Yes**

Byte 9:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|

Bit no. CPM parameters

Reserved

Reserved

Reserved

Reserved

Reserved

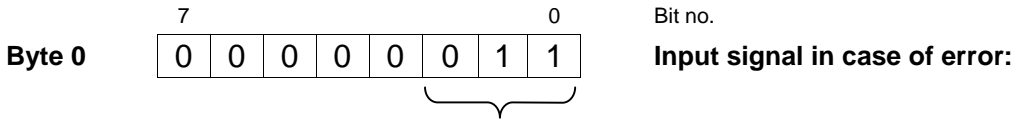
Reserved

Reserved

PROFIBUS DP interface for IS1

3.3.2 I/O module parameters

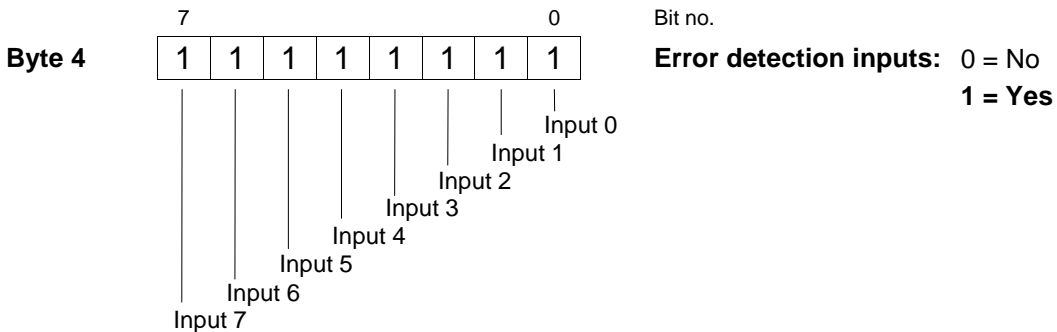
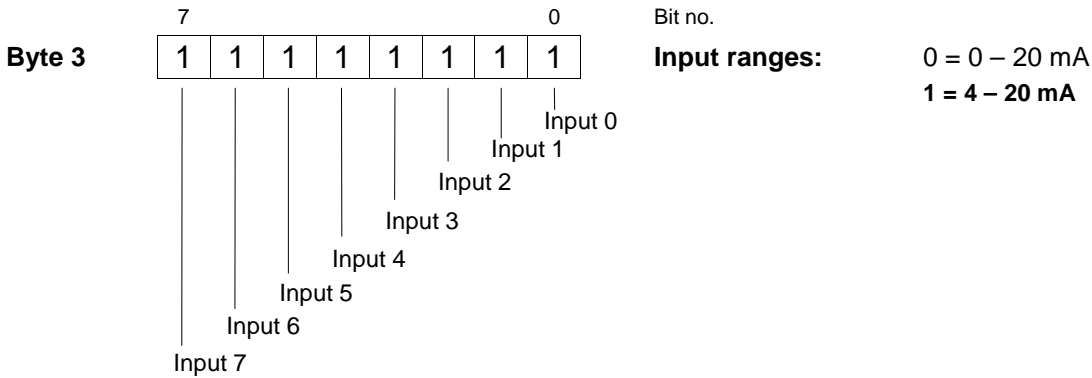
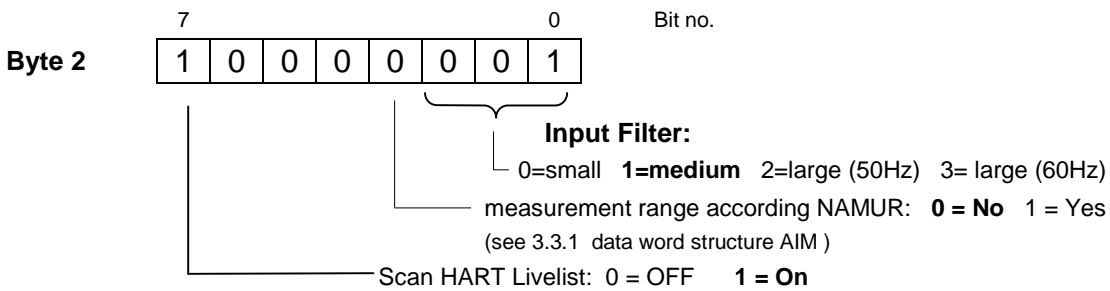
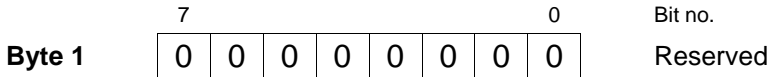
3.3.2.1 AIM parameters (9460/..., 9461/..)



Initialisation value for
 'Input signal in case of error':

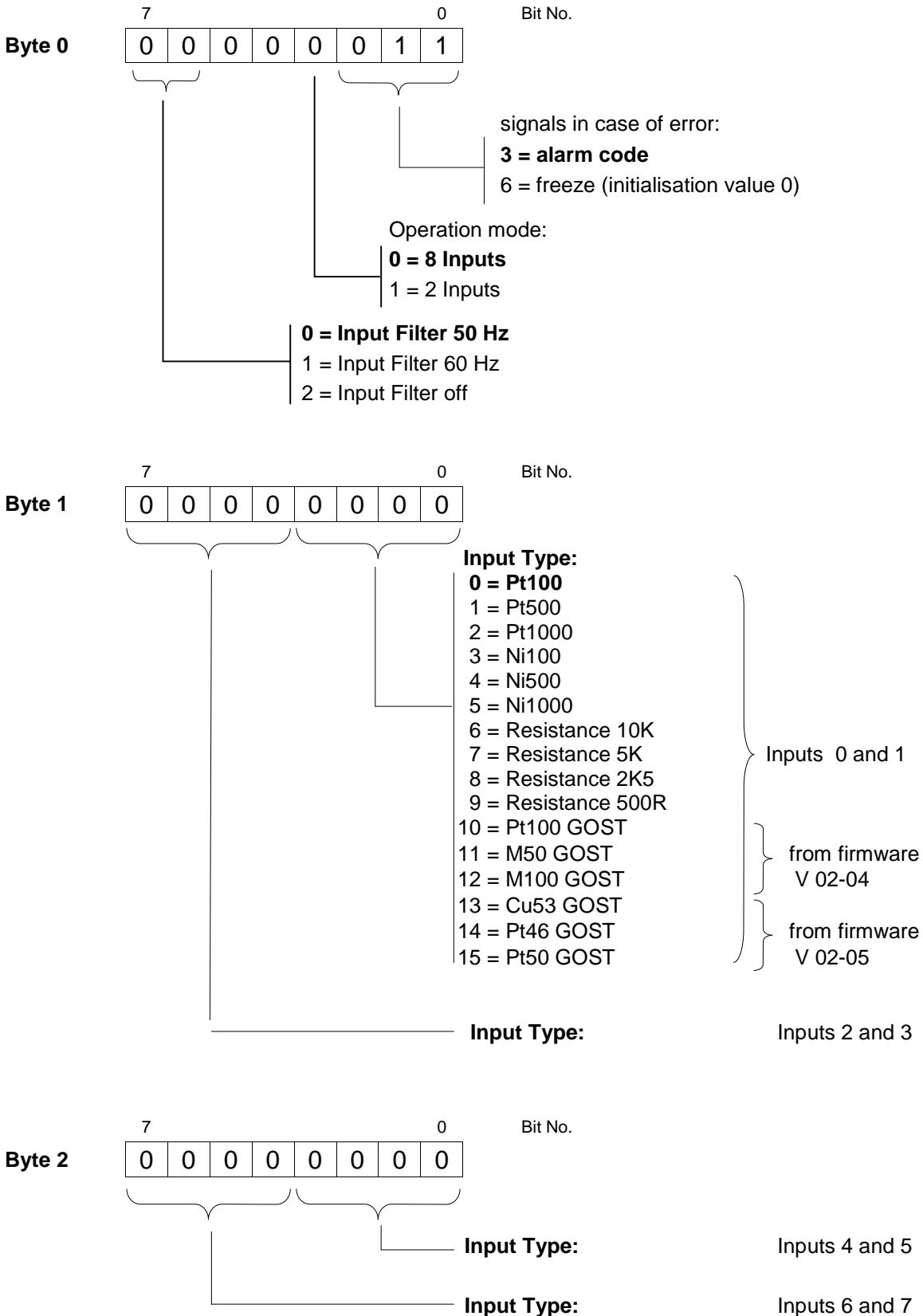
If no valid old value for the "freeze" function is present in the system (e.g. after return of voltage to the FS or after start-up of the Master-Slave communication), the selected initialisation value is used.

- 0 = -10% (only if live zero)
- 1 = 0%
- 2 = 100%
- 3 = Alarm code**
- 6 = freeze (initialisation value 0%)
- 7 = freeze (initialisation value 100%)

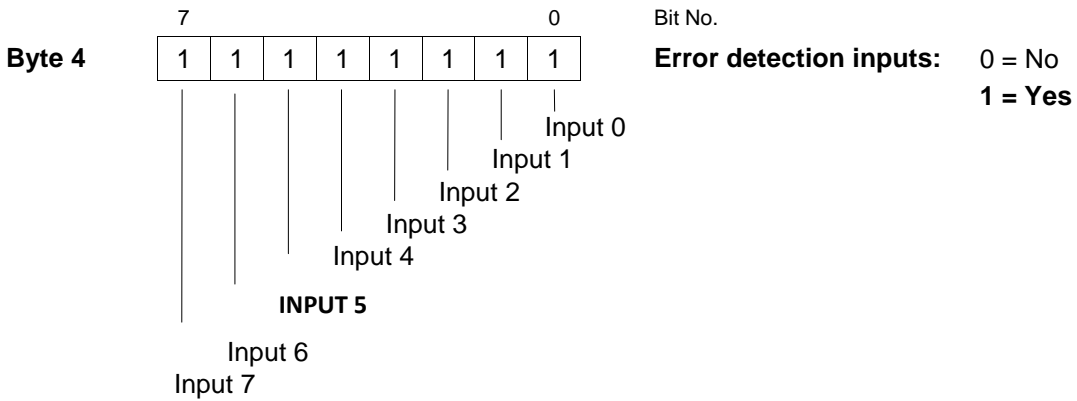
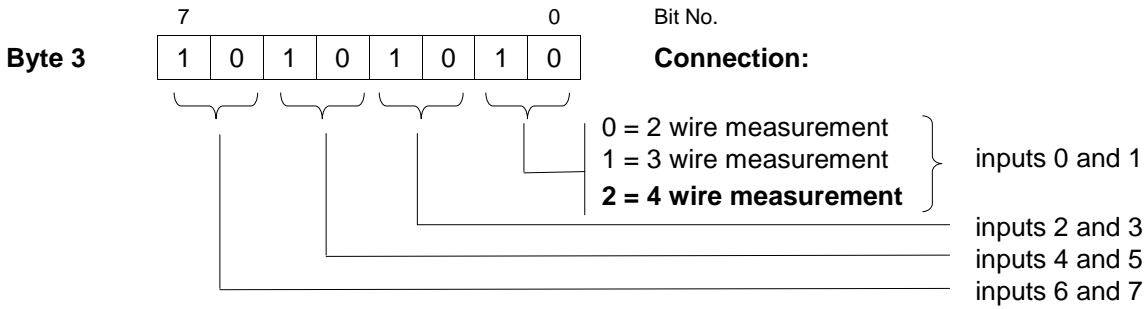


PROFIBUS DP interface for IS1

3.3.2.2 TIM 8 R parameters (9480/...)



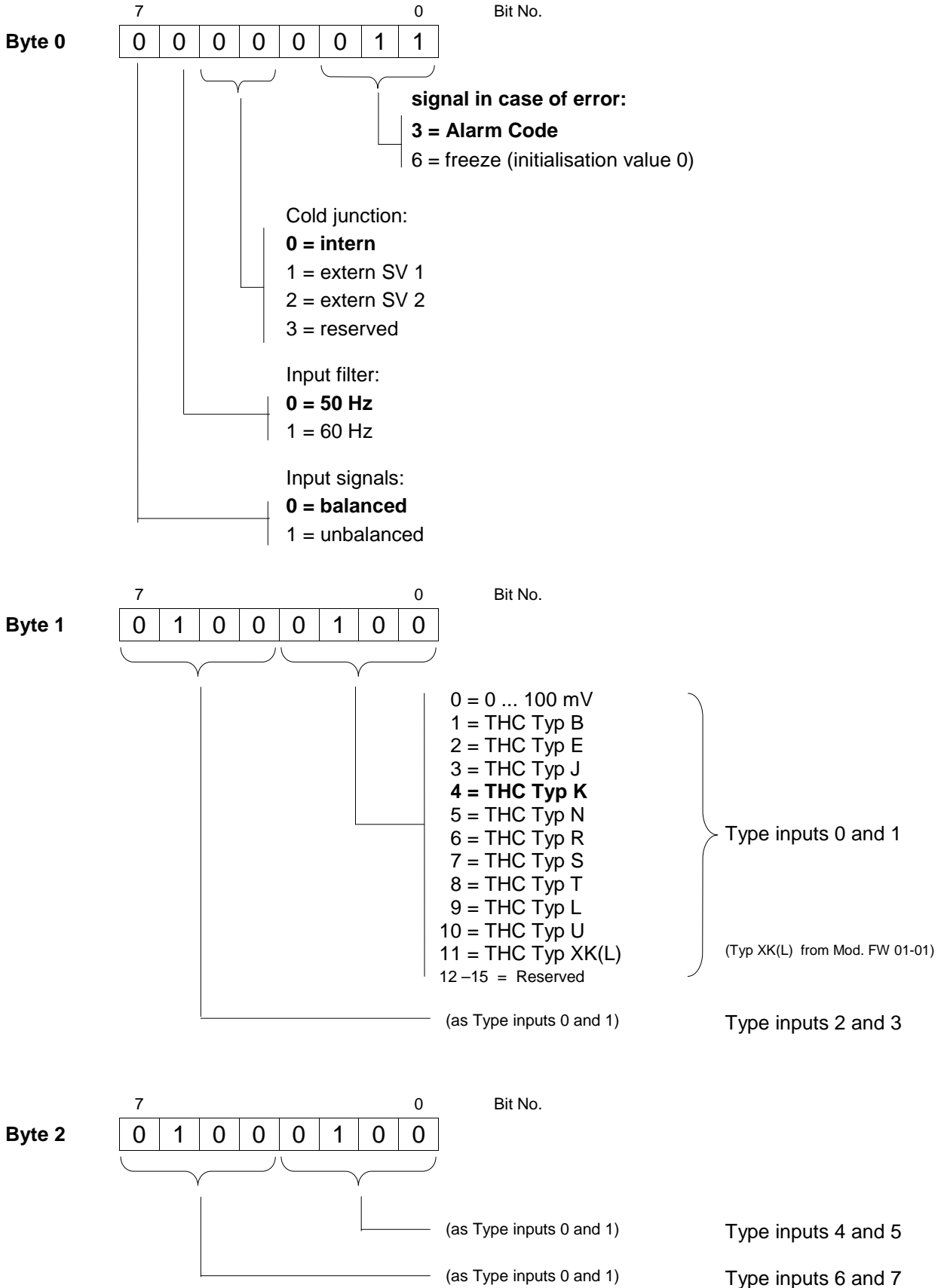
PROFIBUS DP interface for IS1



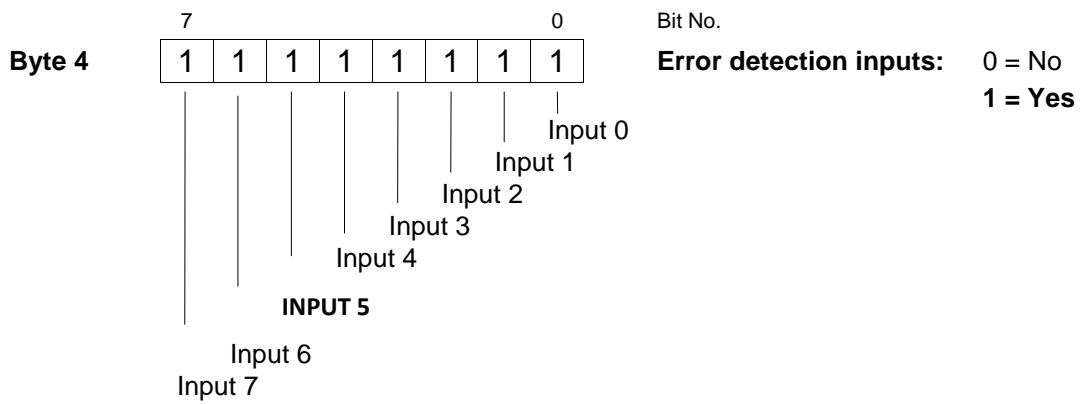
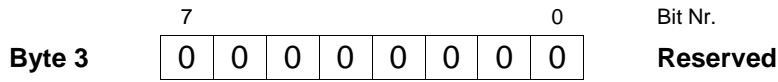
The update time for the input signals is influenced by the parameters 'Operation mode', 'Input Filter' and 'Error detection Inputs' (see data sheet 9480/..).

PROFIBUS DP interface for IS1

3.3.2.3 TIM 8 mV parameters (9481/...)

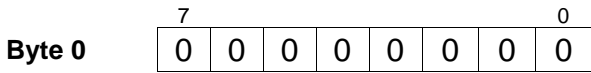


PROFIBUS DP interface for IS1



PROFIBUS DP interface for IS1

3.3.2.4 DIM / CIM+CF parameters (9470/..., 9471/..)

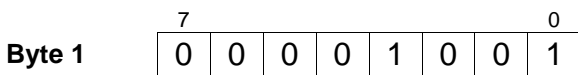


Bit no.
DI signals in case of error:

- 0= '0'
- 1= '1'
- 2= freeze (initial value 0)
- 3= freeze (initial value 1)

INITIAL VALUE FOR 'FREEZE':

IF NO VALID OLD VALUE FOR THE "FREEZE" FUNCTION IS PRESENT IN THE SYSTEM (E.G. AFTER RETURN OF VOLTAGE TO THE ES OR AFTER START UP)

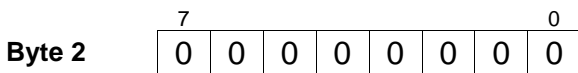


Bit no.

- Operation mode input 14:**
- 0 = Counter
 - 1 = freq. 0-1 kHz / DI**
 - 2 = freq. 0-20 kHz gate time. 50 ms / DI
 - 3 = freq. 0-20 kHz gate time 200 ms / DI
 - 4 = freq. 0-20 kHz gate time 1 s / DI
- Operation mode input 15:**
 (allocation as input 14)

Parameters only used if DIM 16 + CF is selected

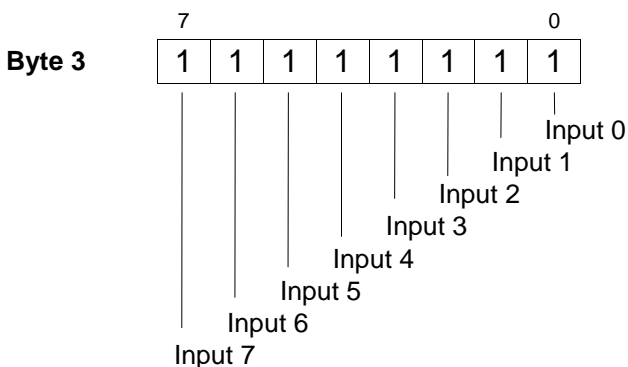
Counter event: **0 = positive** / 1 = negative edge



Bit no.
DIM parameters

- Pulse extension inputs 0 – 3 :
- 0=0 sec.** 1=0.6 sec. 2=1.2 sec. 3=2.4 sec.
- Pulse extension inputs 4 – 15 :
- 0=0 sec.** 1=0.6 sec. 2=1.2 sec. 3=2.4 sec.

1 = Invert all inputs of the module



Bit no.
Error detection inputs: 0 = No
 1 = Yes

Parameter 'Error detection inputs' only available for 9470/..

Byte 3 + 4 = 0 for 9471/...

PROFIBUS DP interface for IS1

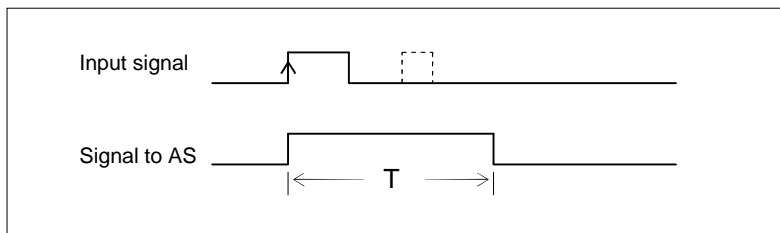
Pulse extension:

This function can be used to increase the length of short pulses. With this e.g. a short activity of a manual sensor (term approx. 10 .. 50 ms) can be extended to a time selectable by parameterisation (T = 0,6 sec., 1.2 sec., 2.4 sec.).

Short pulses can be recognized surely from the AS also with slower cycle times of the application software

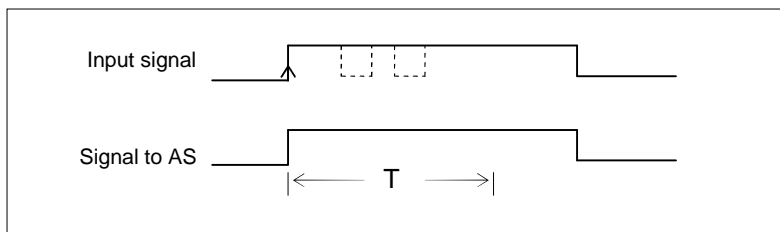
Pulse extension with not inverted operation:

(Parameter 'Invert all inputs of the module' = No)



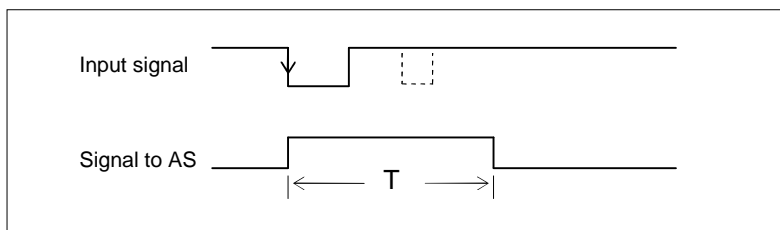
T = 0,6 sec., 1,2 sec., 2,4 sec.
(parameterizable)

Pulses which are longer than the parametrised time T, are not extended.
Short pulses during time T are suppressed.



Pulse extension with inverted operation:

(Parameter 'Invert all inputs of the module' = Yes)



PROFIBUS DP interface for IS1

3.4 Data word structure of the I/O modules

3.4.1 Analog modules

Analogue signals are exchanged between the IS1 field station and an automation system in 16-bit two's complement format (signed integer). Converting to and from floating point variables (physical values) must be performed in the automation system if required.

AIM, AIMH (9460/..., 9461/...) 0 – 20 mA

| Measuring range 0 – 20 mA | Units | | % | Parameter: Measurement range limits according NAMUR | Range | Alarms / Diagnoses |
|----------------------------------|--------------------------|------------------------|-------------------------|---|---------------|-----------------------|
| | Decimal | Hex | | | | |
| >23.518 mA >21 mA | *1) | *1) | | No Yes | | Short circuit |
| 23.518 mA 21 mA | 32511 29030 | 7EFF 7166 | 117.6% 105 % | No Yes | Over range | - |
| 20 mA 10 mA 0 mA < 0 mA | 27648 13824 0 0 | 6C00 3600 0 0 | 100% 50% 0% 0% | | Nominal range | - |

AIM 4 – 20 mA

| Measuring range 4 – 20 mA | Units | | % | Parameter: Measurement range limits according NAMUR | Range | Alarms / Diagnoses |
|------------------------------|---------------------|----------------------|--------------------|---|------------------|-----------------------|
| | Decimal | Hex | | | | |
| >22.814 mA >21 mA | *1) | *1) | | No Yes | | Short circuit |
| 22.814 mA 21 mA | 32511 29376 | 7EFF 72C0 | 117.6% 106,25 % | No Yes | Over range | - |
| 20 mA 12 mA 4 mA | 27648 13824 0 | 6C00 3600 0 | 100% 50% 0% | | Nominal range | - |
| 3.999 mA 3,6 mA 2,4 mA | -1 -691 -2765 | FFFF FD4D F533 | -2,5% -10% | Yes No | Under range | - |
| < 3,6 mA < 2,4 mA | *1) | *1) | | Yes No | | Line break |

*1) Transmitted value depends on parameterised behaviour if an error occurs:

| Parameterised behaviour if an error occurs | Type of error | Value transmitted if an error occurs | |
|--|-----------------------------|--------------------------------------|------|
| freeze | All IOM errors | Last valid value | |
| -10% | All IOM errors | -2765 | F533 |
| 0% | All IOM errors | 0 | 0 |
| 100% | All IOM errors | 27648 | 6C00 |
| Alarm code | Short circuit | 32767 | 7FFF |
| | Open circuit | -32762 | 8006 |
| | IOM does not respond | -32736 | 8020 |
| | Config. unequal from module | -32735 | 8021 |
| | Data not available | -32734 | 8022 |
| | IOM hardware error | -32733 | 8023 |

General rule to generate status information in AS for all AI signals:
Signal is disturbed if Value >= 32512 or Value <= -32512
see 3.4.1 Behaviour of input signals in case of error

PROFIBUS DP interface for IS1

Measurement range limits according NAMUR:

The limits of the measurement range to the short circuit and open circuit area can be modified by the parameter 'Measurement range limits according NAMUR' according the above table.

This parameter is available with firmware Revision V01-02 of all AIM and AIMH modules (9460/.. und 9461/..).

Modules with older firmware revisions do not support this parameter. This modules use the fix setting 'Measurement range limits according NAMUR = No'.

PROFIBUS DP interface for IS1

TIM (9480/... , 9481/...)

Temperature measurement (1 Digit = 0,1 °C)

| Temperature | Units | | Range | Alarms / Diagnoses |
|-------------|---------|-------------|-------------------------------|----------------------|
| | Decimal | hexadecimal | | |
| | *1) | *1) | | Upper limit exceeded |
| *2) | *2) | *2) | Temperature measurement range | |
| 1000 °C | 10000 | 2710 | | |
| 1 °C | 10 | 000A | | |
| 0 °C | 0 | 0 | | |
| -1 °C | -1 | FFFF | | |
| -100 °C | -1000 | FC18 | | |
| *2) | *2) | *2) | | Lower limit exceeded |
| | *1) | *1) | | |

*2) The limits of the measurement range are pending on the parameterised input type (see Operating instructions IS1)

2 wire and 4 wire Resistance Measurement 500 R 10K (modul 9480 /)

| Range | | | | Units | | % | Range | Alarms / Diagnoses |
|--------|---------|---------|----------|---------|-------------|--------|---------------|--------------------|
| 500 R | 2 K 5 | 5 K | 10 K | decimal | hexadecimal | | | |
| >588 R | >2,94 K | > 5,88K | >11,76 K | *1) | *1) | | | Line break |
| 588 R | 2,94 K | 5,88 K | 11,76 K | 32511 | 7EFF | 117,6% | Over range | - |
| 500 R | 2 K 5 | 5 K | 10 K | 27648 | 6C00 | 100% | Nominal range | - |
| 250 R | 1K250 | 2K5 | 5 K | 13824 | 3600 | 50% | | |
| 0 K | 0 K | 0 K | 0 K | 0 | 0 | 0% | | |

3 wire Resistance / Position Measurement 500 R 10K (modul 9480/..)

| Range | | | | Units | | % | Range | Alarms / Diagnoses |
|----------------|---------|---------|---------|---------|-------------|------|---------------|--------------------|
| 500R | 2K5 | 5 K | 10 K | decimal | hexadecimal | | | |
| >588 R | >2,94 K | >5,88 K | >11,76K | *1) | *1) | | | Line break |
| position 100 % | | | | 27648 | 6C00 | 100% | Nominal range | - |
| position 50 % | | | | 13824 | 3600 | 50% | | |
| position 0 % | | | | 0 | 0 | 0% | | |
| < 50 R | < 250 R | < 500 R | < 1 K | *1) | *1) | | | short circuit |

| | | | | | | | | |
|--------|-------|-------|-------|----------------------|--|--|--|--|
| 0,02 R | 0,1 R | 0,2 R | 0,4 R | Resolution per Digit | | | | |
|--------|-------|-------|-------|----------------------|--|--|--|--|

PROFIBUS DP interface for IS1

0 ... 100 mV measurement (9481/..)

| Range 0 ... 100 mV | Units | | % | Range | Alarms / Diagnoses |
|-----------------------|---------|-------------|---------|---------------|-----------------------|
| | decimal | hexadecimal | | | |
| >117,6 mV | *1) | *1) | | | Upper limit exceeded |
| 117,6 mV | 32511 | 7EFF | 117,6 % | Over range | - |
| 100 mV | 27648 | 6C00 | 100 % | Nominal range | - |
| 50 mV | 13824 | 3600 | 50 % | | |
| 0 mV | 0 | 0 | 0 % | | |
| -0,0036 mV | -1 | FFFF | | Under range | - |
| -10 mV | -2765 | F533 | -10 % | | |
| < -10 mV | *1) | *1) | | | |

Short circuit alarm can not be detected at Resistance and Voltage measurement !

*1) Transmitted value depends on parameterised behaviour if an error occurs:

| Parameterised behaviour if an error occurs | Type of error | Value transmitted if an error occurs | |
|--|-----------------------------|--------------------------------------|-------------|
| freeze | All IOM errors | Last valid value | |
| Alarm code <small>General rule to generate status information in AS for all AI signals: Signal is disturbed if value >= 32512 or value <= -32512 see 3.4.1 Behaviour of input signals in case of error</small> | Short circuit *1) | + / - 32767 | 7FFF / 8001 |
| | Open circuit *1) | + / - 32762 | 7FFA / 8006 |
| | Upper limit exceeded | 32761 | 7FF9 |
| | Lower limit exceeded | -32760 | 8008 |
| | Cold Junction error | -32752 | 8010 |
| | IOM does not respond | -32736 | 8020 |
| | Config. unequal from module | -32735 | 8021 |
| | Data not available | -32734 | 8022 |
| | IOM hardware error | -32733 | 8023 |

*1) depending of the direction of signal change at the respective error type a positive or negative alarm code is used:

| error type | TIM R 9480 / ... | TIM mV 9481 / ... |
|---------------|------------------|-------------------|
| short circuit | -32767 (8001) | not detectable |
| open circuit | +32762 (7FFA) | -32762 (8006) |

For 2 wire calibration of module TIM R 9480/.. the user interface (LCD display with buttons) of the CPM has to be used.

PROFIBUS DP interface for IS1

AOM 0 – 20 mA

| Measuring range 0 – 20 mA | Units | | % | Range |
|------------------------------|---------|-------------|------|---------------|
| | Decimal | Hexadecimal | | |
| *1) | >30137 | >75B9 | | |
| 21,8 mA | 30137 | 75B9 | 109% | Over range |
| . | . | . | | |
| 20 mA | 27648 | 6C00 | 100% | Nominal range |
| . | . | . | | |
| 10 mA | 13824 | 3600 | 50% | |
| . | . | . | | |
| 0 mA | 0 | 0 | 0% | |
| 0 mA | < 0 | < 0 | | |

AOM 4 – 20 mA

| Measuring range 4 – 20 mA | Units | | % | Range |
|------------------------------|---------|-------------|---------|---------------|
| | Decimal | Hexadecimal | | |
| *1) | >30759 | >7827 | | |
| 21,8 mA | 30759 | 7827 | 111,25% | Over range |
| . | . | . | | |
| 20 mA | 27648 | 6C00 | 100% | Nominal range |
| . | . | . | | |
| 12 mA | 13824 | 3600 | 50% | |
| . | . | . | | |
| 4 mA | 0 | 0 | 0% | |
| 3,999 mA | -1 | FFFF | | Under range |
| 0 mA | -6912 | E500 | -25% | |
| 0 mA | < -6912 | < E500 | | |

*1): The AOM attempts to increase the current further according to the control value. However, depending on the burden effective resistance, the maximum output voltage of the AOM may be reached whereby the current can no longer be increased.

Safety position after Power On:

After Power On of the CPM the data area of the outputs is initialized with the value -32768 (0x8000) als signal for the safety position.

The outputs remain in the save position as long as the allocated register is overwritten with a valid output value (<> -32768 (0x8000)) from AS or from I.S. Wizard.

(see also chapter 3.4.2)

PROFIBUS DP interface for IS1

3.4.2 DIM, DIM+CF (9470/.. 9471/..)

On the modules 9470 und 9471 the inputs 14 und 15 can optionally be used as digital- (DI), counter- (C) or frequency input (F).

Through selection of different module descriptions from the GSD-file the transmitted data area as well as the used identifier format on PROFIBUS DP can be chosen.

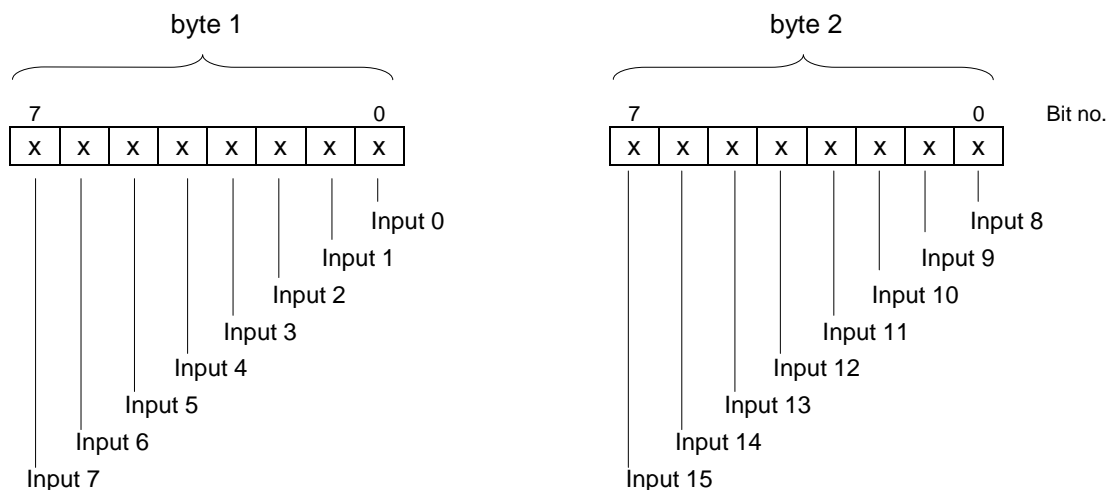
| module selection text in GSD | input data | output data | available signal types for inputs 14 and 15 | DP identifier |
|--|---|---|---|---------------|
| DIM 16 (9470/.. , 9471/..) | 2 Byte (16 Bit DI) | - | only DI (without status) | AKF |
| 9470 / . . -16-1. DIM 16 9471 / . . -16-1. DIM 16 | 4 Byte (16 Bit DI + 16 Bit status) | - | only DI (with status) | SKF |
| 9470 / . . -16-1. DIM 16+CF 9471 / . . -16-1. DIM 16+CF | 8 Byte (16 Bit DI + 16 Bit status + 2 words CF) | 1 Byte (control register for counter) | DI or Counter or Frequency (with status) | SKF |

AKF: standard identifier format

SKF: special identifier format (is not supported from all DP masters, but should be used preferred)

Even if DIM 16+CF (with counter / frequency) is selected the inputs 14 und 15 are mapped to the standard DI data area (byte 2) and therefore can be used as standard DI inputs.

Data word structure DI

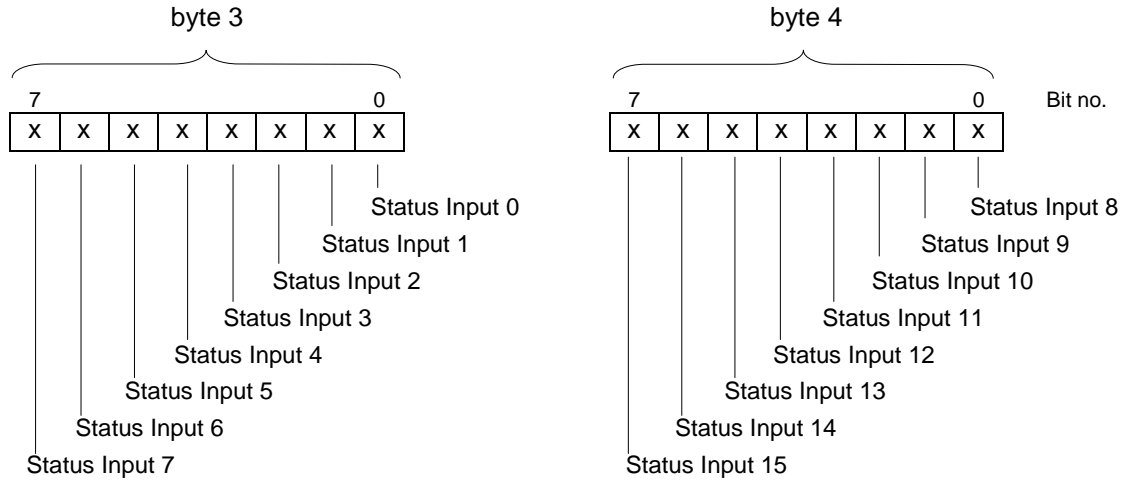


Signal definition with Parameter 'Invert all inputs of the module = No':

| Module | open circuit alarm | signal = 0 | signal = 1 | short circuit alarm |
|-----------|-----------------------|----------------------|----------------------|-------------------------|
| 9470/ ... | $I < 0,05 \text{ mA}$ | $I < 1,2 \text{ mA}$ | $I > 2,1 \text{ mA}$ | $R_L < 100 \text{ Ohm}$ |
| 9471/ ... | - | $U < 5 \text{ V}$ | $U > 13 \text{ V}$ | - |

PROFIBUS DP interface for IS1

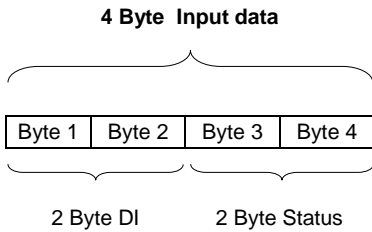
Data word structure status



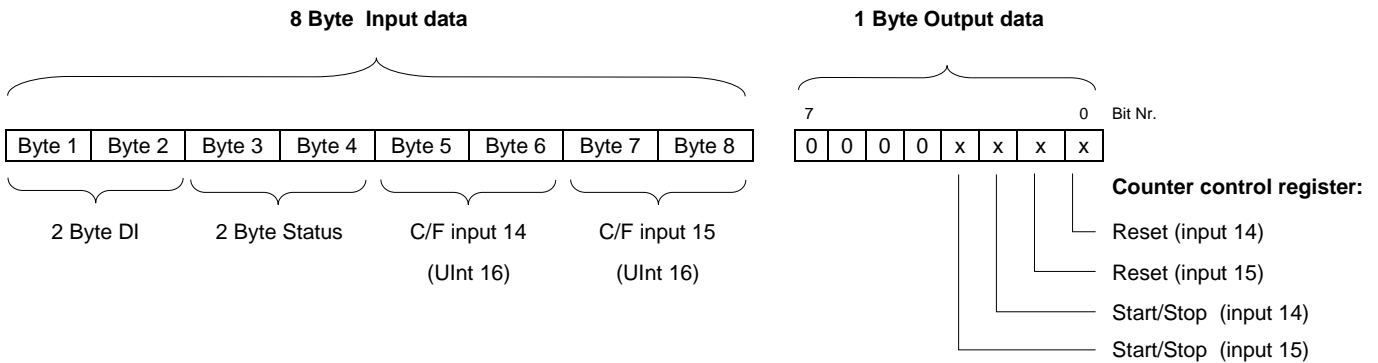
status bit = 1: Signal OK
 status bit = 0: Signal disturbed

Signal and status are transmitted synchronized and consistent !

Data word structure (DIM 16 with status)



Data word structure (DIM 16+CF)



| | |
|------------------------------|----------------------------------|
| Reset = "0": counter running | Start/Stop = 0 : counter running |
| Reset = "1": counter = 0 | Start/Stop = 1 : counter stopped |

PROFIBUS DP interface for IS1

Operation mode 'counter'

Incremental operation with overflow (after 65535 register changes to 0)

| | |
|--------------------------|---|
| Count range: | 0 – 65535 (Unsigned Integer UInt16) |
| Count event: | Positive / Negative edge selectable. |
| Signal in case of error: | freeze last value (Initial value 0) |
| Alarming: | Status and channel diagnosis |
| Reset: | Reset counter register to '0' |
| Start/Stop: | in 'Stop' mode input pulses are ignored (not counted) |

Signal status in operation mode 'counter':

The status bit is initialized with '0' = signal disturbed.

With the Reset bit in the control register the counter register is set to '0' and the status bit is set to '1' = signal OK.

In case of errors (short circuit, open circuit, bus failure ...) the status bit is set to '0' and will be held at '0' until the next Reset. Therefore disturbances during the count procedure are recognizable via the status bit.

Operation mode 'Frequency'

| Selection operation mode: | Measurement method | Scaling | Resolution |
|-------------------------------------|------------------------|---------------|-------------|
| Frequency 1 Hz -1 kHz | Pulse time measurement | 0,05 Hz / Bit | +/- 0,05 Hz |
| Frequency 0-20 kHz gate time 50 ms | Gate time measurement | 1 Hz / Bit | +/- 20 Hz |
| Frequency 0-20 kHz gate time 200 ms | Gate time measurement | 1 Hz / Bit | +/- 5 Hz |
| Frequency 0-20 kHz gate time 1 s | Gate time measurement | 1 Hz / Bit | +/- 1 Hz |

| Measuring range 1 Hz – 1 kHz | Measuring range 0 – 20 kHz | Units | | % | Range |
|---------------------------------|-------------------------------|---------|------|-------|---------------|
| | | decimal | hex | | |
| 1,3 kHz | - | 26000 | 6590 | 130 % | Over range |
| 1,1 kHz | 22 kHz | 22000 | 55F0 | 110 % | |
| 1 kHz | 20 kHz | 20000 | 4E20 | 100 % | Nominal range |
| 500 Hz | 10 kHz | 10000 | 2710 | 50 % | |
| 0 Hz | 0 kHz | 0 | 0 | 0 % | |

| | |
|--------------------------|------------------------------|
| Signal in case of error: | freeze (Initial value 0) |
| Alarming: | status und channel diagnosis |

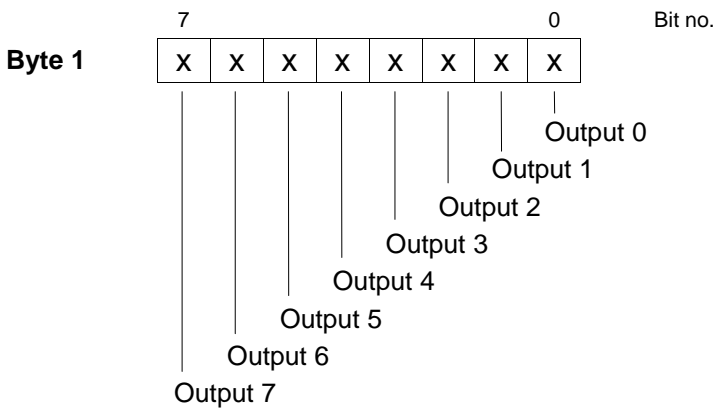
Behaviour in case of too high input frequencies:

If the input frequency is higher as the maximum allowed over range value input pulses can be lost. In this case the measured value is smaller as the existing frequency at the input. No alarm is generated.

PROFIBUS DP interface for IS1

3.4.3 DOM (9475/..., 9476/..., 9477/..., 9478/..)

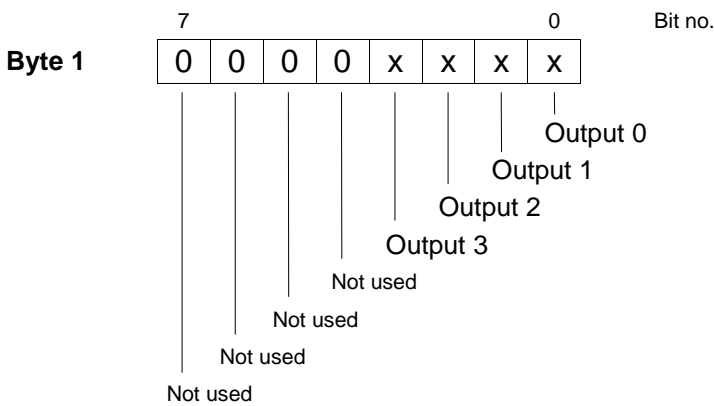
DOM 8 channels:



DOM 6: The module 9477/12-06-12 is not using the output 6 and 7. All other outputs are allocated as shown above.

DOM 7: The module 9475/12-07-71 is not using the output 7. All other outputs are allocated as shown above.

DOM 4 channels:



Signal definition:

| signal bit = 0 | signal bit = 1 | Type |
|---|--|------|
| output high impedance (actuator = Off) | output is powered according type specification (actuator = On) | DOM |
| relay contact = open | relay contact = closed | DOMR |
| Valve closed | Valve open | DOMV |

PROFIBUS DP interface for IS1

3.5 LED and LCD displays of the CPM

The operational state and the communication on the PROFIBUS DP can be assessed on site using the LEDs and the LCD display on the CPM of an IS1 field station.

Additionally the signal values, the signal- and module alarms can be displayed on the LCD using CPM firmware rev. 01-22 or higher.

For details, see the IS1 operating instructions.

PROFIBUS DP interface for IS1

3.6 Signal behaviour in case of errors

3.6.1 Behaviour of the input signals in case of errors

If no valid signal value can be formed as a result of a malfunction (short circuit, open circuit, defective subassembly...), a diagnosis information is created and transmitted to the master. Despite the outstanding malfunction, data continues to be transmitted to the master.

The behaviour of the signal values transmitted if a malfunction has occurred can be selected separately for every module using parameterisation (see 3.2.2 IOM parameters).

Application hint:

If the behaviour of input signals in case of error is realized through the IS1 system, this behaviour seen from the application software in the automation system can only be guaranteed with undisturbed communication on PROFIBUS DP.

At loss of cyclic communication on PROFIBUS DP additional project specific reactions have to be realized in the application software in the automation system.

To guarantee the same behaviour of all input signals in any case of error (even in case of bus failure), we recommend the following procedure:

Generate a Status Bit for each input signal in the automaton system:

- for DI signals the optional available statusbits of IS1 in the cyclic data of PROFIBUS DP can be used.
- for AI signals the 'behaviour in case of error = Alarmcode' has to be chosen in the parameters of all AI signals (default). In the application software of the automation system the following function has to be used for each AI signal:

```

If SignalValue >= 32512 Or SignalValue <= -32512 then
  SignalStatusBit = disturbed
Else
  SignalStatusBit = OK
End IF
  
```

The signal behaviour in case of error (freeze, substitute value ...) should now be realized in the automation system

In this case the event 'loss of cyclic communication on PROFIBUS' can be logical wired with the signal status bit whereby the 'signal behaviour in case of error' is always the same under all error conditions.

The additional information of the diagnosis telegram can be used optionally to generate message lists for maintenance purposes.

PROFIBUS DP interface for IS1

3.6.2 Behaviour of the output signals in case of errors

Communication error between the master and IS1 field station:

The cyclic data traffic between the class 1 master and the IS1 is checked in the IS1 using response monitoring.

Response monitoring in the CPM makes sure that if the master suffers a failure or there is some other communication loss to the master after expiry of the time (T_{WD}), the outputs adopt the safe state.

The T_{WD} time can be parameterised in the class 1 master within the range 10 ms to 650 seconds and is transferred by means of the "SET_PARAMETER" DP service from the master to the CPM.

After expiry of T_{WD} , the cyclic updating of the output modules is stopped by the CPM of the IS1 field station.

The response monitoring of the slaves can also be deactivated by the master. In this case, the slave cannot recognise a loss of communication to the master. The output signals of the slaves are frozen if updating from the master cannot be performed.

Communication error between the CPM and output module:

There are Watchdog circuits on the output modules that monitor the data transmission between the CPM and the output modules. If an output module does not receive any valid data for more than T_{Mod} , the subassembly adopts the safety position.

T_{MOD} (timeout for output modules) can be parameterised in the DP master within the range 100 ms to 25.5 sec. (default value: 100 ms).

Consequently, the safety position of the output modules follows at a delay of T_S after failure of the communication to the master where:

$$T_S = T_{WD} + T_{Mod}$$

The safety position of the output signals can be parameterised separately for every module (see 3.2.2 IOM parameters).

Global Control - Clear Data:

Under some conditions the command 'Global Control - Clear Data' will be transmitted from the DP master. In this case the CPM is putting all output signals to save position even if the data exchange is still working. First after the command 'Global Control - Operate' from the DP master the transmitted output data is passed through to the output drivers of the output modules.

PROFIBUS DP interface for IS1

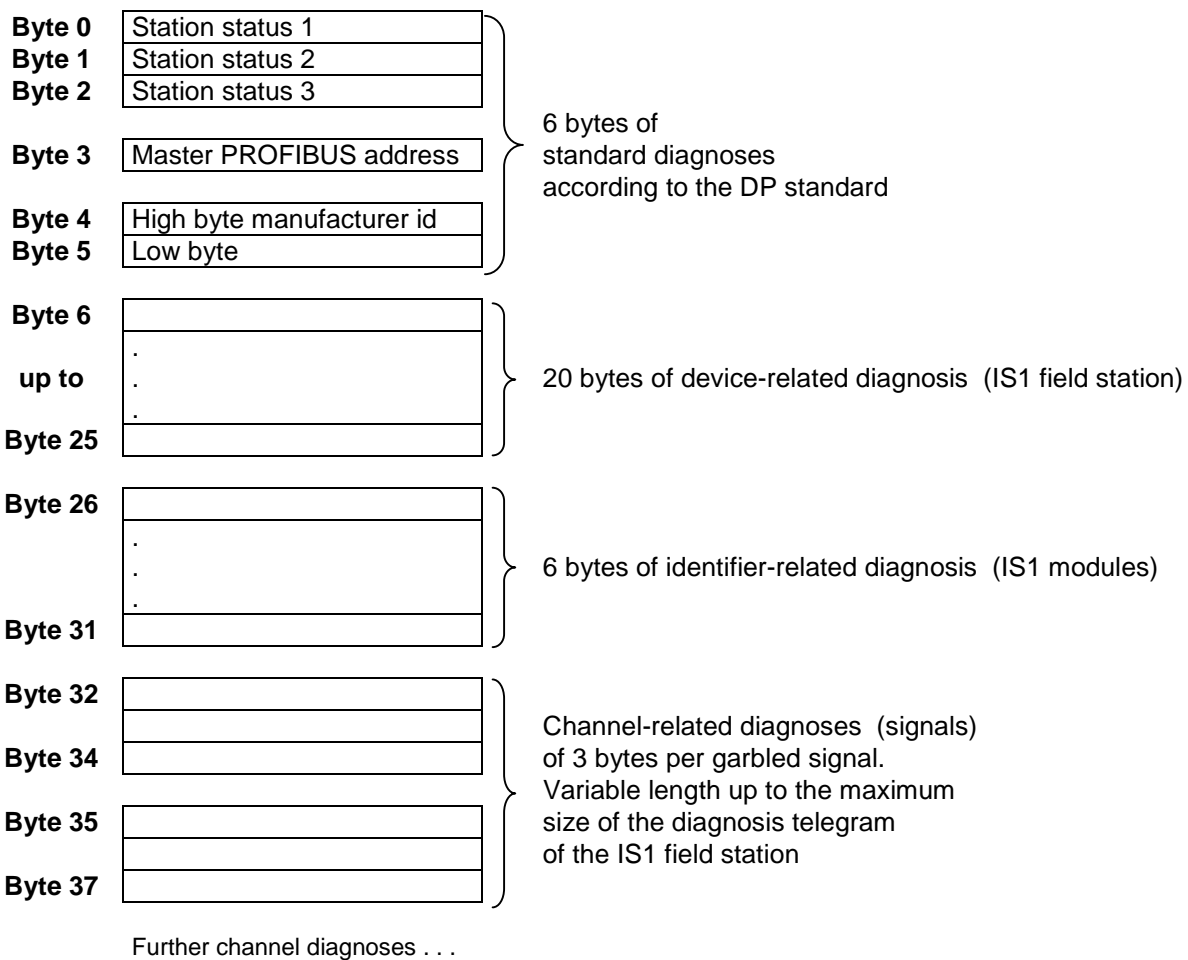
3.7 Diagnosis data

The occurrence of alarm changes is registered to the class 1 master by the IS1 field station in the cyclic data exchange. The class 1 master then demands the diagnosis data from the IS1 field station in an acyclic telegram.

In addition to the 6 bytes of standard information complying with the DP standard, the IS1 field station can supply device-related, identifier-related (module-related) and channel-related (signal-related) diagnosis data. Diagnosis data can be displayed in a diagnosis user interface of the master configuration software and can be evaluated via the user program in the automation system.

If there are **no alarms** in a field station, then only the 6 bytes of standard information (byte 0 to byte 5) are transmitted. Only if one or more alarms are present, the additional information (starting from byte 6) is transmitted. This has to be considered at the evaluation of diagnosis data in the AS.

Set-up of the diagnosis data



PROFIBUS DP interface for IS1

3.7.1 Standard diagnosis information in PROFIBUS DP

The first 6 bytes of a diagnosis telegram contain the following information in compliance with the PROFIBUS standard:

Station status 1 (Byte 0):

| Bit | Meaning | Remedy |
|-----|--|--|
| 0 | 1 = DP slave cannot be accessed by the DP master. | <ul style="list-style-type: none"> - Correct PROFIBUS address set up on the DP slave? - Bus connector connected? - Voltage on the IS1 field station and the isolating repeaters? - Field bus isolating repeater correctly set (baud rate..)? |
| 1 | 1 = DP slave is not yet ready for the data exchange. | - Wait as the IS1 station is just booting. |
| 2 | 1 = The configuration data of the DP master was rejected by the IS1 station. | - Enter the correct station set-up of the IS1 station into the configuration of the DP master. |
| 3 | 1 = Diagnosis data of the IS1 station are present. | - The diagnosis data can be read out. (global alarm bit of complete fieldstation) |
| 4 | 1 = Telegram type not supported | - Slave cannot answer a telegram type used by the master. |
| 5 | 1 = DP Master cannot interpret the response of the slave. | - Check the bus physics |
| 6 | 1 = "Set parameters" telegram is rejected by slave. | - Check the parameterisation of the slave in the master |
| 7 | 1 = DP slave was parameterised by another DP master | - Another master accesses the IS1 station (see 1.3 Access procedure) |

Station status 2 (Byte1):

| Bit | Meaning |
|-----|---|
| 0 | 1 = DP slave must be newly parameterised by the master. |
| 1 | 1 = There is a diagnosis message. The slave cannot continue to run if the error has not been remedied (static diagnosis) |
| 2 | Bit is also set to '1' if the slave with this DP address is present. |
| 3 | 1 = Response monitoring of the IS1 field station is active (Watchdog = On). The cyclic data traffic is monitored by the slave. |
| 4 | 1 = The slave has received the "FREEZE" control command. *1 |
| 5 | 1 = The slave has received the "SYNC" control command. *1 |
| 6 | 0 = Bit is always set to "0". |
| 7 | 1 = DP slave is deactivated by the master and will not be processed by the master. |

*1 Bit is only updated if a further diagnosis also changes.

Station status 3 (Byte2):

Bit 0 – 6: Reserved
 Bit 7: Ext_Diag_Overflow is set if more channel diagnoses are present than can be transmitted in the diagnosis telegram.

Master PROFIBUS address (Byte 3): PROFIBUS address of the master that parameterised the DP slave and has read and write access to the DP slave.

Manufacturer ID (Byte 4, 5): The manufacturer ID is stored in the DP slave as well as in the related GSD file.

PROFIBUS DP interface for IS1

3.7.2 Device-related diagnosis of the IS1 field station

The CPM supplies a data field with 20 bytes (19 bytes + header). This data field contains 3 bytes of diagnosis data of the transmission unit (CPM) of the IS1 field station and 16 bytes of module global diagnosis data (4 bits per IOM).

Overview:

| Byte no. | MSB | LSB | function |
|----------|-----------|-----------|--|
| 6 | 0 0 0 1 | 0 1 0 0 | (0x14) Header for device-related diagnosis |
| 7 | | | } CPM diagnosis data |
| 8 | | | |
| 9 | | | |
| 10 | Module 2 | Module 1 | } IOM module global diagnosis data |
| 11 | Module 4 | Module 3 | |
| 12 | Module 6 | Module 5 | |
| 13 | Module 8 | Module 7 | |
| 14 | Module 10 | Module 9 | |
| 15 | Module 12 | Module 11 | |
| 16 | Module 14 | Module 13 | |
| 17 | Module 16 | Module 15 | |
| 18 | Reserved | | |
| 19 | Reserved | | |
| 20 | Reserved | | |
| 21 | Reserved | | |
| 22 | Reserved | | |
| 23 | Reserved | | |
| 24 | Reserved | | |
| 25 | Reserved | | |

Set-up:

Byte 6

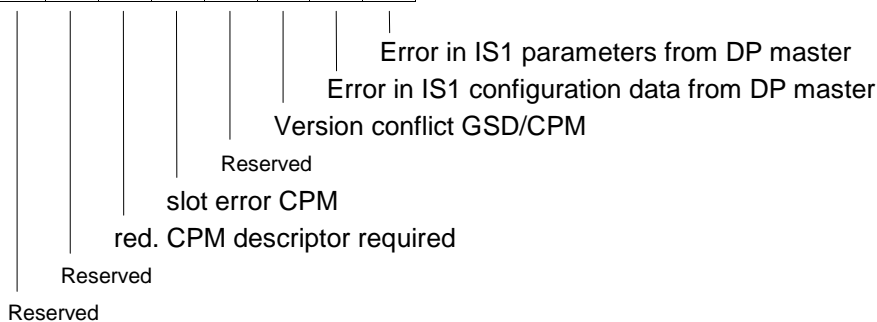
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
|---|---|---|---|---|---|---|---|

 Header = 20 (0x14)

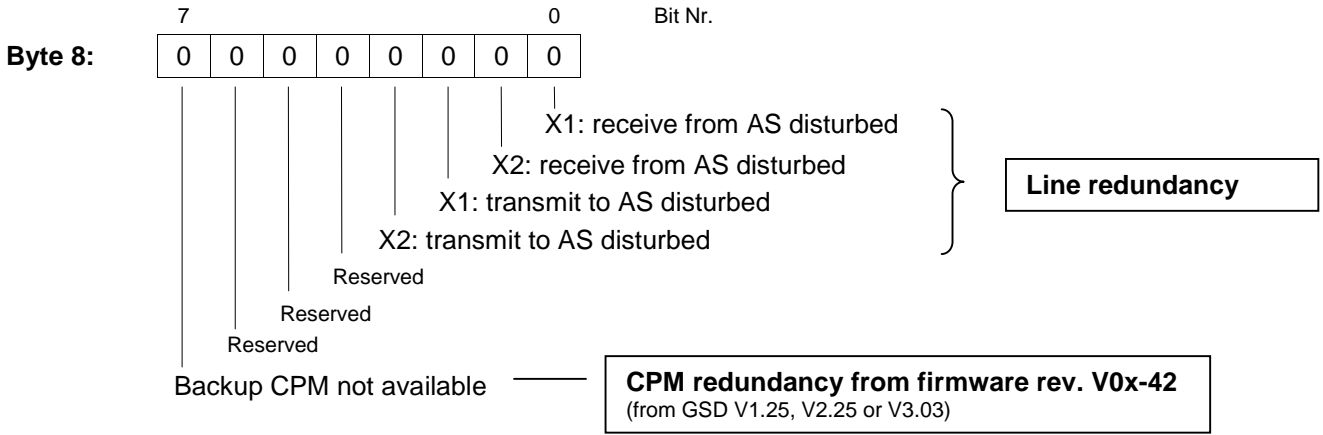
Byte 7

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|

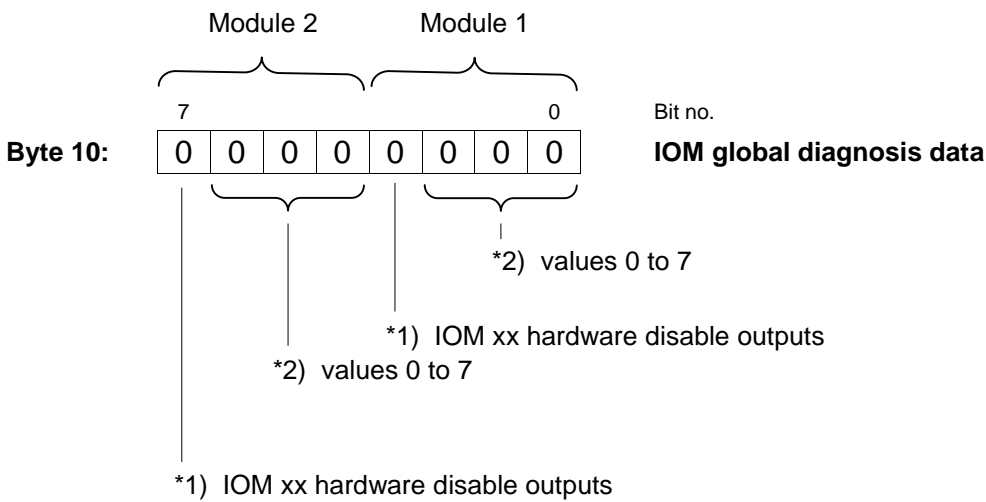
 Bit no.
CPM diagnosis data



PROFIBUS DP interface for IS1



Byte 9: Diag update counter -> is incremented when the diagnosis data changes).



*1) message only from modules 9475/22-...

*2) Values 0 to 7:

| Values | Bit in Identifier related diagnosis | Signal availability |
|--|-------------------------------------|---|
| Value 0 (000) = "Communication to IOM xx OK" | 0 | Signals of IOM are available |
| Value 1 (001) = "IOM xx prim. rail bus disturbed" | 1 | |
| Value 2 (010) = "IOM xx red. rail bus disturbed " | 1 | |
| Value 3 (011) = "IOM xx does not respond" | 1 | All the signals of the IOM are not available |
| Value 4 (100) = "IOM xx configuration unequal from module" | 1 | |
| Value 5 (101) = "IOM xx hardware failure" | 1 | |
| Value 6 (110) = (Reserved) | 1 | |
| Value 7 (111) = (Reserved) | 1 | |

Bytes 11 – 25: Set-up of bytes 11 to 25 for modules 3 to 32 is just like byte 10 !

PROFIBUS DP interface for IS1

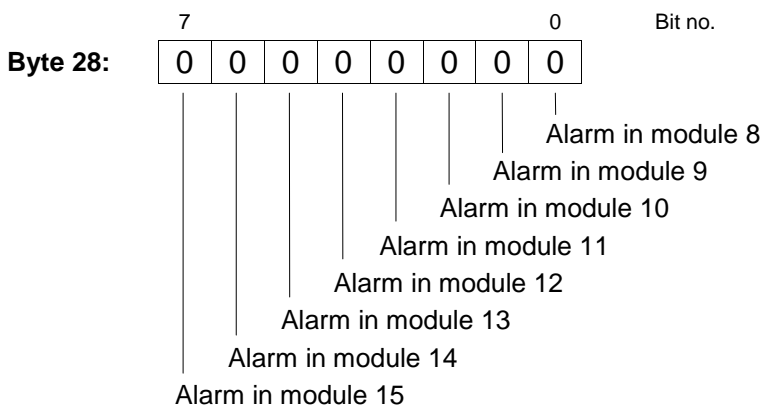
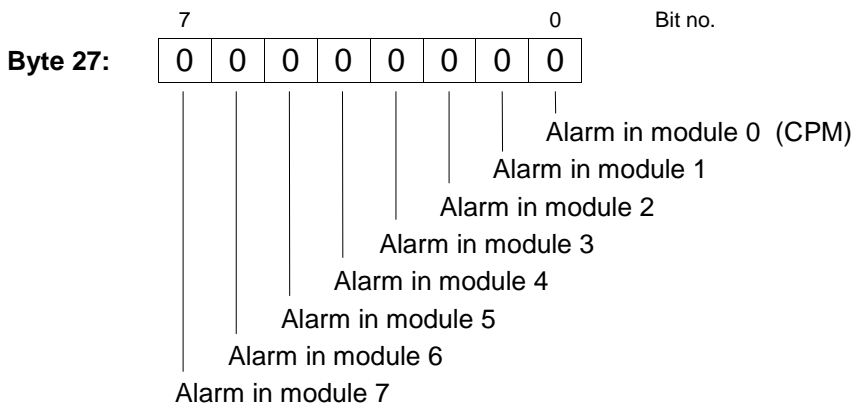
3.7.3 Identifier-related diagnosis of the IS1 modules

The IS1 field station supplies a data field with 6 bytes (5 bytes + header). This data field contains an alarm bit for every configured module.

Data field with module diagnosis data:

| Byte no. | Value | Bit no. | Function |
|----------|--|----------|---|
| | 7 0 | | |
| 26 | 0 1 0 0 0 1 1 0 | (0x46) | Header of identifier-related diagnosis data |
| 27 | see below | | Alarm in modules 0 to 7 |
| 28 | “ | | Alarm in modules 8 to 15 |
| 29 | “ | | Alarm in module 16 |
| 30 | “ | | reserved |
| 31 | “ | | reserved |

Set-up:

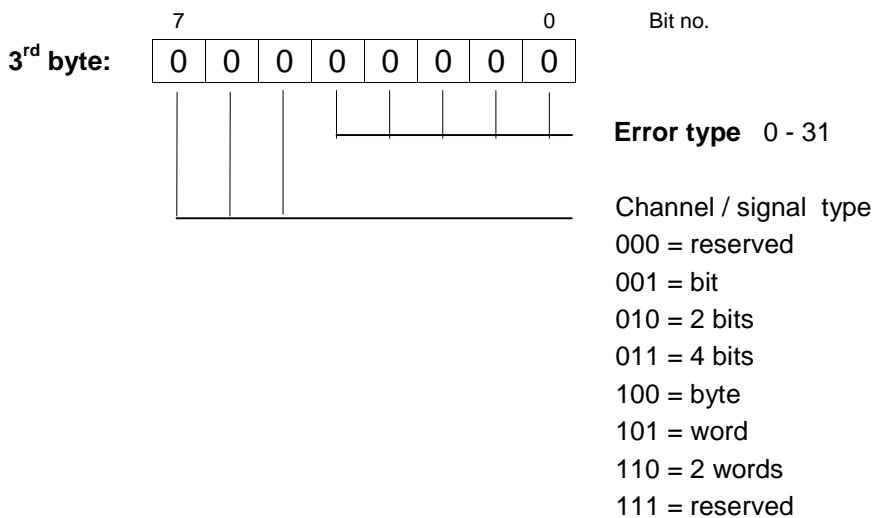
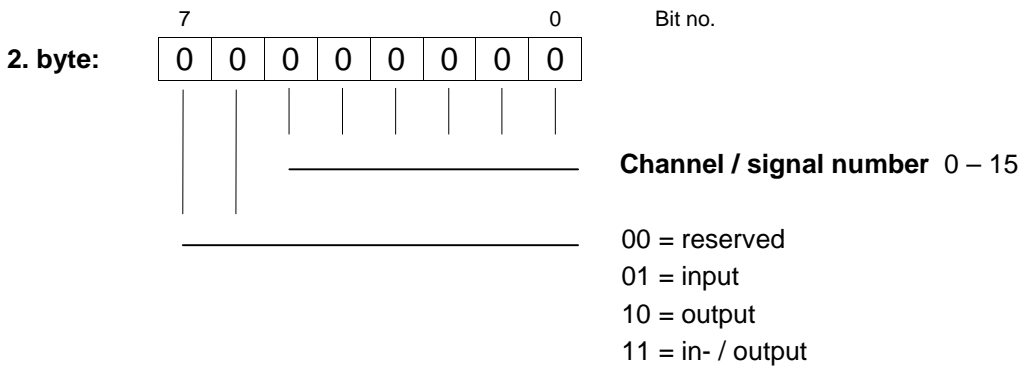
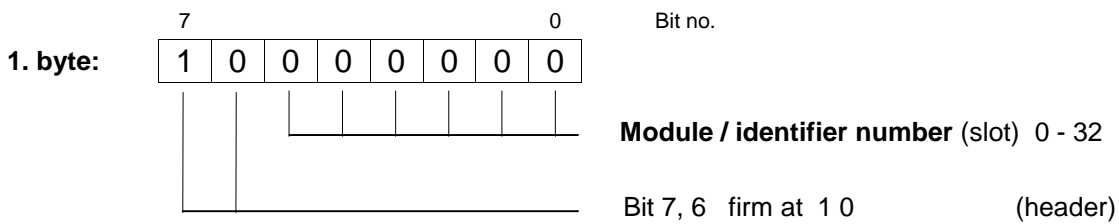


PROFIBUS DP interface for IS1

3.7.4 Channel-related (signal-related) diagnosis

Optionally, additional channel-related diagnosis information in the diagnosis telegram to the master can also be transmitted. The generation of the channel-related diagnosis can be released in the "USER_PRM_DATA" area. For each outstanding alarm of the input signals, 3 bytes are transmitted. Thus, the size of the transmitted data field is dependent on the number of the outstanding alarms.

The 3 bytes of a channel-related diagnosis contain the following information:



PROFIBUS DP interface for IS1

The error type area contains the following information:

| Error type | Meaning | Alarmcode in cyclic signal data area |
|------------|----------------------|--------------------------------------|
| 0 | Reserved | |
| 1 | Short circuit | 7FFF / 8001 |
| 2 – 5 | Reserved | |
| 6 | Open circuit | 7FFA / 8006 |
| 7 | Upper limit exceeded | 7FF9 |
| 8 | Lower limit exceeded | 8008 |
| 9 – 15 | Reserved | |
| 16 | Cold Junction error | 8010 |
| 17 | Reserved | |
| 18 | Reserved | |
| 19 | Reserved | |
| 20 | Reserved | |
| 21 | Reserved | |
| 22 | Reserved | |
| 23 | Reserved | |
| 24 | Reserved | |
| 25 | Reserved | |
| 26 | Reserved | |
| 27 | Reserved | |
| 28 | Reserved | |
| 29 | Reserved | |
| 30 | Reserved | |
| 31 | Reserved | |

Attention

The maximum telegram length of the diagnosis telegram is restricted. When using device-related, identification-related and channel-related diagnosis, the maximum transmittable data volume of the diagnosis data can be exceeded if there are many outstanding alarms present at the same time which causes channel-related diagnosis data to be lost. The CPM can transmit a maximum of 21 *1) (19 with CPM Firmware Rev. 01-19 and higher) channel-related diagnosis data. If not all of the channel-related diagnosis data can be transmitted due to a diagnosis buffer overflow, this is displayed in the standardised diagnosis area by the message, "Diagnosis overflow".



Independently of this, the transmission of the device-related and identifier-related diagnoses is always guaranteed.

*1) max. 30 channel related diagnosis data using the Extended Parameter Set of IS1 !

PROFIBUS DP interface for IS1

3.8 Online behaviour of the IS1 fieldstation.

The IS1 fieldstation is supporting the standard start-up behaviour with a class 1 master (see 2.11 start-up behaviour). Additionally the following features are supported:

3.8.1 Parameter change.

If a I. S.1 fieldstation is in data exchange with a DP master, the telegram 'Set_Prm' (send parameter) can be transmitted from the master to the fieldstation between the cyclic data telegrams.

The fieldstation checks the length of the telegram 'Set_Prm' and accepts the new parameter data without leaving data exchange if the length of the telegram is OK.

With this, online changes of parameter data of the IS1 fieldstation from a PROFIBUS DP (class1 V0) master are possible.

If the length of the 'Set_Prm' telegram is not OK the new parameter data are not accepted. The fieldstation changes to the mode 'wait parameter' whereby a new start-up of the cyclic communication is forced.

3.8.2 Configuration change.

If a IS1 fieldstation is in data exchange with a DP master, the telegram 'Chk _Cfg' is only accepted from the fieldstation if the configuration data of the fieldstation has not changed.

If a telegram 'Chk _Cfg' with changed configuration data is received during data exchange, the fieldstation is leaving the data exchange and goes to the mode 'wait parameter' whereby a new start-up of the cyclic communication is forced.

If a master wants to change the configuration data of the fieldstation or wants to interrupt the data exchange for a defined time, the data exchange should be stopped from the master by sending the telegram 'Set_Prm' with 'Unlock_Req = TRUE' (Lock). This will bring the fieldstation to the mode 'wait parameter'.

After this the master can do a new start-up with new configuration and parameter data.

With the parameter 'timeout for output modules' or via response monitoring (see chapter 3.4.2) the output signals of the fieldstation can be freezed during a interruption of the data exchange for a parameterizable time.

If the master is coming back to data exchange with the fieldstation before exceeding of this watchdog times, the output signals are not going to the selected save position and are now updated cyclic from the master again.

If the master has changed configuration data, which has influence to the signal marshalling in the data telegrams, he is responsible for the correct new marshalling inside of the master and the PLC / DCS.

During the new start-up the fieldstation is checking the new configuration and parameter data individually for each slot (each I/O-module).

All modules of the fieldstation where the configured module type agree with the existing module type in the fieldstation are updated cyclically after start-up.

For modules, which do not agree with the configuration data, alarms are generated. The signals of this modules are not updated and react according the parameterized behaviour in case of error.

PROFIBUS DP interface for IS1

4 List of abbreviations:

| | |
|------|--|
| AS | A utomation S ystem |
| AIM | A nalogue I nput m odule |
| AIMH | A nalogue I nput m odule + H ART |
| AOM | A nalogue O utput m odule |
| AOMH | A nalogue output module +HART |
| CPM | C PU + P M = CPM Central unit consisting of communication processor with power pack |
| DIM | D igital I nput M odule |
| DOM | D igital O utput M odule |
| DOMR | D igital O utput M odule R elays |
| DOMV | D igital O utput M odule V alves |
| HW | H ardware |
| IOP | I/O Processor of the central unit |
| IOM | General description of I/O M odule |
| PM | P ower M odule (power pack) |
| SW | S oftware |
| TIM | T emperature I nput M odule |

PROFIBUS DP interface for IS1

5 Release Notes:

| Revision (Description of PROFIBUS DP interface for IS1) | Revision GSD file | Extensions / Changes |
|--|-------------------|---|
| 10/99.11 | 0.64 | - Negative alarm codes for AI signals added. |
| 12/99.12 | 1.00 | - Documentation added: 9471, 9475, 9477, 9480, 9481 - Special identifier format for IOM added to GSD V1.00. The special identifier format can only be used with CPM firmware revision 00-11 or higher. |
| 01/00.13 | 1.00 | - Max. output current of modules 9465 (AOM) u. 9466 (AOMH) changed to 21,8 mA. |
| 05/00.14 | 1.01 | - Parameter 'measurement range limits according NAMUR' added for all AIM. This parameter is available for all AIM and AIMH modules (9460/.. and 9461/..). with firmware revision V01-02 or higher. Modules with older firmware revisions do not support this parameter. This modules work fix with the function 'measurement range limits according NAMUR = No'. - New measurement ranges added for 9480 and 9481 - New modules: 9477/15-08-12 DOM 8 Rel Z2 9475/12-07-71 DOM 7 Exi4 |
| 01/01.15 | 1.05 | - module descriptor for CPM redundant added - 3 wire Resistance / Position Measurement (module 9480/..) added - alarm codes of module TIM R (9480/...) changed (9480 firmware rev. V 01-00) - Values for MaxTsdR changed new CPM PROFIBUS firmware rev. 01-19: - max. number of signal diagnosis in diagnosis telegram reduced to 18 new CPM PROFIBUS firmware rev. 01-20: - limitation of datablock length extended by 1 Byte to: max. 113 Byte Input + 81 Byte Output Data ! new CPM PROFIBUS firmware rev. 01-22: - PNO conformity test - input signal update in inactive CPM - CPM display: signal- and diagnosis information supported. - 2 wire calibration for TIM R 9480/.. supported (9480 firmware rev. V 01-00). - startup delay (inactive -> active) of CPM optimized from 800 to < 500 ms |
| 11/01.16 | 1.07 | - New I/O-modules added: 9475/22-08-51 DOM 8 OD Exi2 (OD=Output disable) 9475/22-08-61 DOM 8 OD Exi3 9477/12-08-12 DOM 8 60V Rel Z1 9477/12-06-12 DOM 6 250VRel Z1 - New Parameter 'Test current On / Off ' for DOM 9475/.. Rev. E . new CPM PROFIBUS Firmware Rev. 01-24: - CPM Parameter added: - IOM 9 -16 on Rail X4 - Line redundancy AS bus |

PROFIBUS DP interface for IS1

| Revision (Description of PROFIBUS DP interface for IS1) | Revision GSD file | Extensions / Changes |
|--|----------------------|--|
| 05/02.17 | 1.08 | New parameter for TIM 8 mV 9481/.. : Thermocouple Typ XK(L) from 9481 module FW-Revision 01-01) |
| 06/02.18 | 1.08 | Parameter 'Test current On / Off' for DOM 9475/.. Rev. F |
| 08/02.19 | 1.09 | - New I/O-module added: 9475/22-04-21 DOM 4 OD Exi2 (OD=Output disable) |
| 06/04.20 | 1.20 2.20 | - Extended parameter set for IS1 - HART Variables in cyclic data exchange to cl. 1 Master (PLC/DCS) - Line Redundancy |
| 07/04.21 | 1.21 2.21 | Parameter 'Scan HART Livelist On / Off' added for all HART modules |
| 12/06.22 | | Description DP master profile for 'Line redundancy' changed |
| 05/07.23 | 1.24 2.24 | New parameter for 9480: (9480 module FW-Revision from 02-04 required) - PT100 GOST - M50 GOST - M100 GOST |
| 1.25 | 1.25 2.25 | - Module added: DOMV 9478/28-08-51 - Description PNO slave redundancy added. - CPM parameter added: 'Address Offset backup CPM PNO Red' - CPM diagnosis added: 'Backup CPM not available' - 9480 TIMR Parameters added for CU53 GOST, Pt46 GOST, Pt50 GOST |
| 1.27 | 1.25 2.25 | Description PNO slave redundancy extended. |

6 Support address

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