Description of

PROFIBUS DPV0 / DPV1 Interface

for

IS1+ field stations

PROFIBUS DP interface for IS1+

Content:

Historical development of remote I/O technology at R. STAHL

As one of the innovators in remote I/O technology, R. STAHL recognized the advantages that remote I/O technology offers for hazardous areas and has been developing innovative products and solutions for over 30 years since that time. The benefits to users are always the focus here. All communication, power supply and input/output modules in the system can be connected and disconnected during operation in hazardous areas. Thanks to an intrinsically safe system design, the installation process is almost identical to this process in safe areas. No special Ex d or Ex p enclosures are required. Remote I/O can be used to integrate conventional and HART-capable field devices into modern, digital network structures easily and affordably. Comprehensive diagnostics options using a separate ServiceBus or the process bus enable integration in modern plant asset management systems and increase the availability of systems.

1987 The "ICS MUX fieldbus system" from R. STAHL is the first intrinsically safe bus system for sensors and actuators in hazardous areas (Zone 1) on the market. A master station installed in the control room establishes the connection to the automation systems. Intrinsically safe communication with explosion-protected on-site or field stations (VOS) installed in Zone 1 is carried out using a single coaxial cable.

1993 The system variant "VOS 200", which is based on ICS MUX, is presented. The "VOS 200" is better suited to smaller signal quantities or decentralized automation units. A master station is no longer required. Multi-drop is supported and couplings are also available in redundant designs.

1997 "VOS 200" can now also communicate with the PROFIBUS DP, which was new at the time. R. STAHL achieved this by being the first to develop an intrinsically safe design which, with a few modifications, is part of the PNO standard today under the name RS485-IS.

2000 Drawing from experience with the ICS MUX and VOS 200, a completely new Remote I/O – IS1 is developed. This system is substantially more flexible, easier to use, more powerful and extremely affordable. Over the years, the IS1 has become the market leader in Zone 1 and is still used around the globe. IS1 supports open bus protocols such as PROFIBUS DP or Modbus RTU and is available in different versions for Zone 1, Zone 2 and even Division 1 and 2.

2009 A new communication unit for Ethernet is added to IS1. With this, IS1 is the first remote I/O system that operates at 100 Mbps/Ethernet in Zone 1. A fibre optic cable with the 'op is' type of protection is used as a communication medium. Modbus TCP, EtherNet/IP and PROFINET are supported protocols.

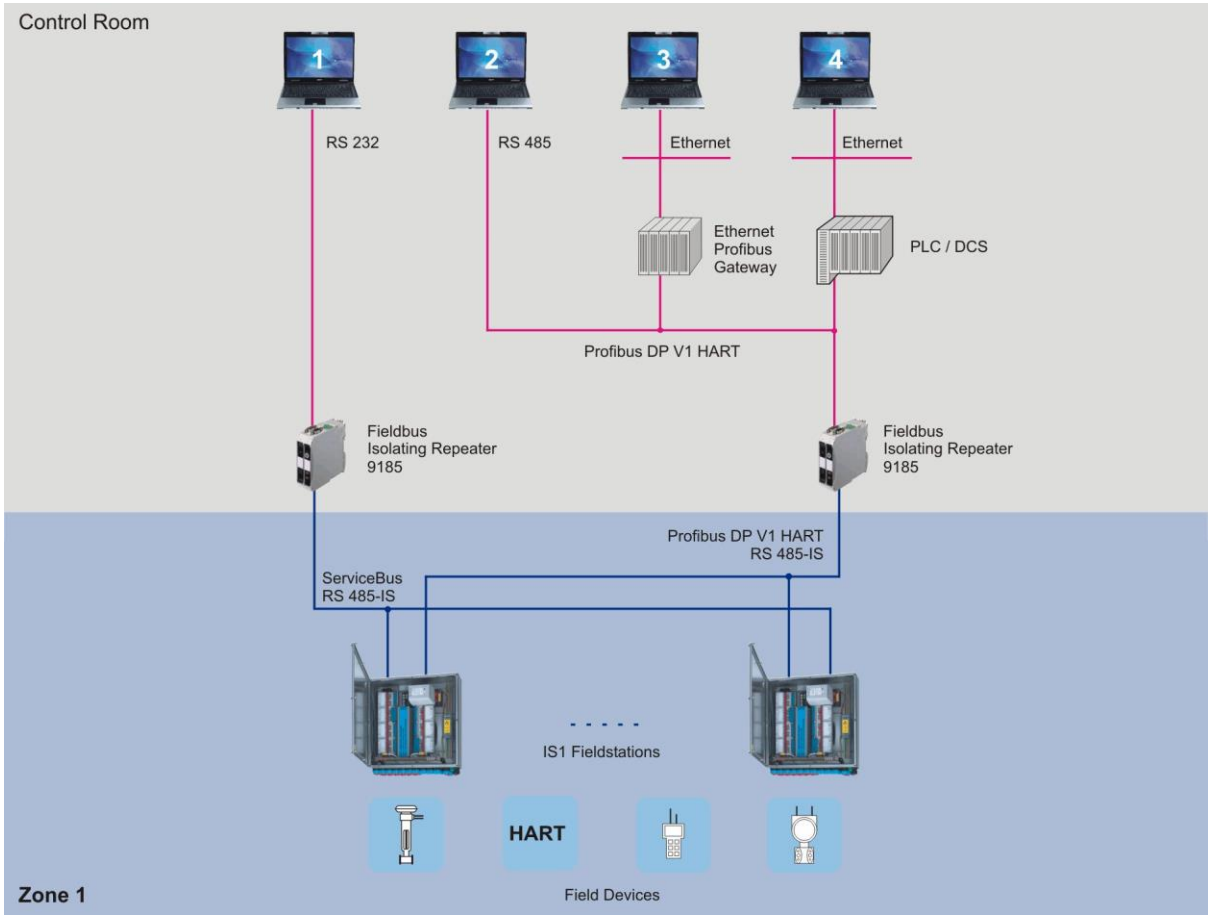
2013 The I/O level is completely modernised and introduced on the market as IS1+. The new multifunctional I/O modules have configurable inputs/outputs and an innovative diagnostics function that reports potential module failures up to 12 months before they would occur. IS1+ is even better suited to extreme ambient conditions from -40 to +75 °C. The new IS1+ modules are fully compatible with their IS1 predecessors.

2018 The new Zone 2 head assembly consists of a CPU, power module and socket makes IS1+ even more flexible and has expanded its application range. The previously supported protocols PROFIBUS DP, Modbus TCP+RTU, EtherNet/IP and PROFINET are now all supported by one CPU and can be selected by the user. The new assembly has the same predictive diagnostic functions and the extended temperature range of -40 to 75 °C that are features of the IS1+ modules.

The description below shows the system features of the IS1+ system when connecting to an automation system via PROFIBUS DP.

1 System Overview

1.1 Connection principle of IS1+ field stations to the PROFIBUS



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 and Division 1 or Division 2). It can also be installed in the safe area. The diagram above shows a Zone 1 solution.

The IS1+ field station has several interfaces. One of them is used to connect to an automation system (Process Bus) and the second 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 or Service Bus DTMs is used in this case.
In addition, the 9442 CPU has an Ethernet interface. Diagnostics and firmware update functions are available here via Web Server.

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 RS 485-IS standard.
In such a PROFIBUS DP 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 parameterizing functions can be provided via PC-supported configuration programs (IS1 DTM via PROFIBUS DP or IS Wizard via Servicebus).

1.2 Transmission structures

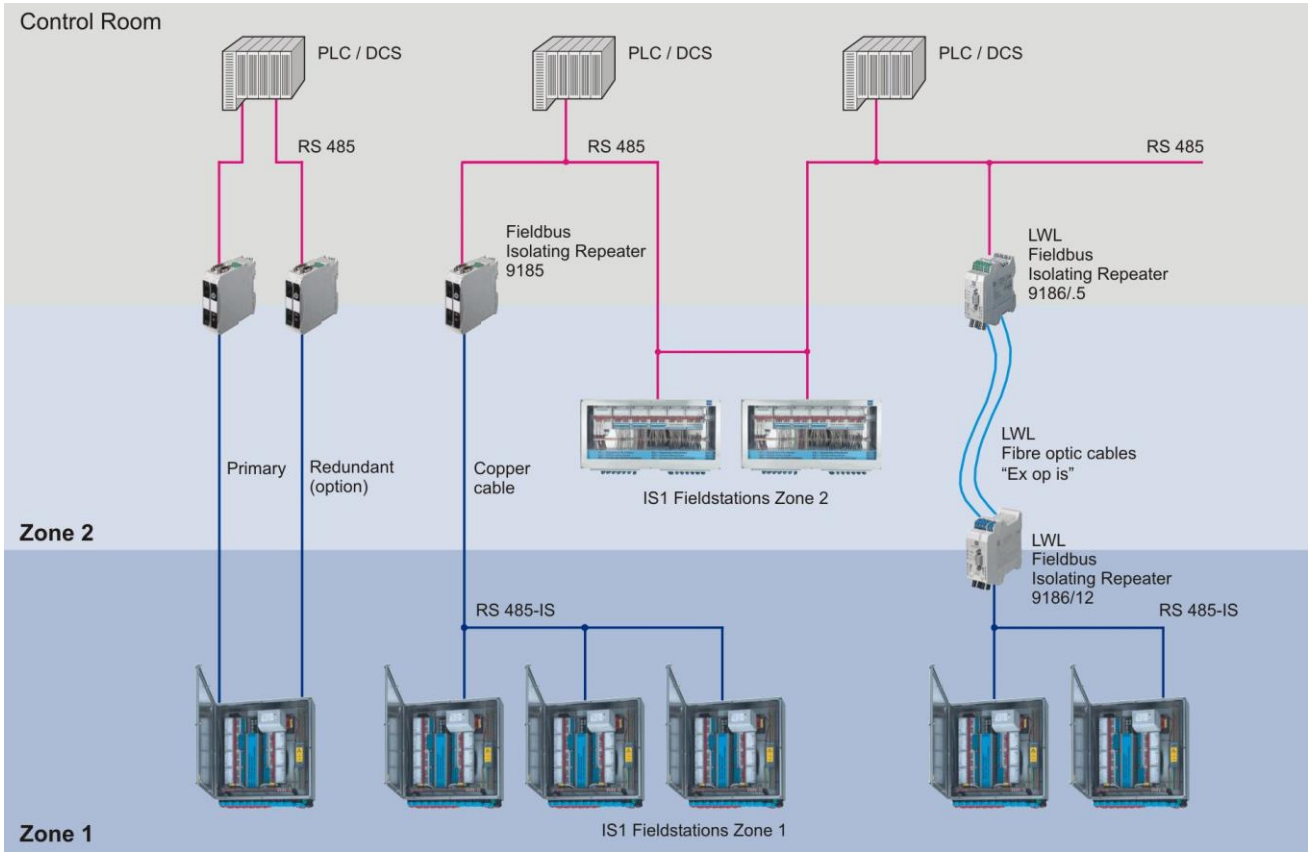
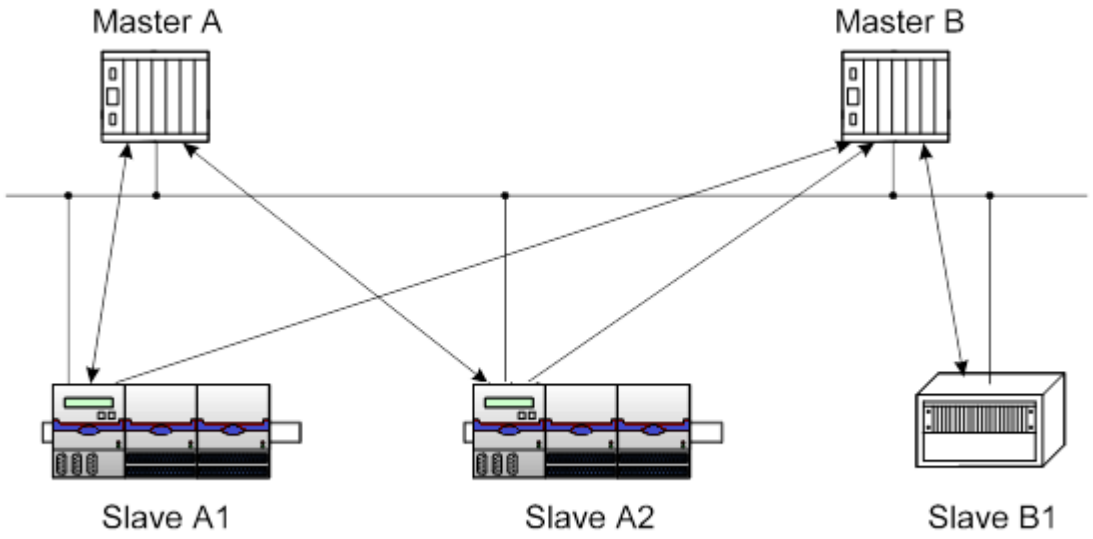


Fig. 2 shows the possible transmission structures of several IS1+ field stations in a PROFIBUS network. IS1+ field stations can be connected to the PROFIBUS in the hazardous area as well as in the non-hazardous area. Both fiber optic technology as well as bus structures in multi-drop cabling configurations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

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 DPV0 services (class 1 master)

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 9440 CPM of the IS1+ field station or via rotary switches on the Socket of the 9442 CPU.

PROFIBUS DPV1 services (class 2 master)

Initiate	open acyclic connection (C2 channel)
Read	read data acyclic
Write	write data acyclic
Abort	close connection

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 fiber links ...)
- Selection of the baud rate depending on lengths of cable, volumes of data and time requirements
- Unique allocation of the PROFIBUS DP 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, 9186,…) or select ´Auto Baudrate detection´ (available with 9185 and 9186).

- 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 RS485 service bus:
  - Mechanical mounting of the service bus and the associated field bus isolating repeater.
  - Install the IS Wizard software on the PC.
  - Configure the IS1+ field stations.

- Parameterize the DP master.
  - Read the GSE file of the IS1+ field station in the configurator of the master.
  - Configure the modules in the master according to the IO-Modules present in the field station.
  - Parameterize the IS1+ field station and its IO-Modules.

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

- Check communication on the PROFIBUS DP using the following tools:
  - Diagnosis information of the master or of the diagnostic tools belonging to the master.
  - LEDs on the 9185, 9186 field bus isolating repeaters
  - LEDs on the CPU 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 IS WIZARD on a PC connected via the service bus.
  - IS1+ DTMs using FDT technology.

2.2 Engineering limits

The general regulations according to the IS1 operating instructions apply to the mechanical and electrical 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.

PROFIBUS diagnostic telegrams are supported in the two variants **DPV0 and DPV1**. The selection is made by using different GSE file major versions (V2.xx, V3.XX, V4.xx V5.xx), as well as depending on the support of the used PROFIBUS masters (PLC, DCS). Details see Diagnosis data

The **data volume for the IO-Module** of an IS1+ field station that can be transmitted is limited in the PROFIBUS DP. Thus, the maximum possible number of IO-Modules in a field station is limited.

IS1+ CPU	**9440, 9442**		**9442**	
PROFIBUS Diagnostic	**DPV0**	**DPV1**	**DPV0**	**DPV1**
GSE Rev.	**V2.xx,**	**V3.xx**	**V4.xx**	**V5.xx**
Max_Input_Len [Byte]	240		244	
Max_Output_Len [Byte]	128		244	
Max_Diag_Data_Len [Byte]	122		244	
Max Number Signal Diagnoses	30	11 – 28	70	40 - 64
C1_READ_WRITE_SUPP	0		1	
C2_Max_Count_Channels	1		3	

9440 CPM limitations apply when using the 9442 CPU with GSE V2.xx or V3.xx.

Length of the cyclic CPU/CPM data using **GSE V2.xx und V3.xx**

Module selection text in the GSE file	**Cyclic data length** [bytes] Input	Output	**PROFIBUS identifier** [HEX]					
9440/12-01-11 **CPM** Z1 Stahl 24V	1	1	GIF	30	-	-	-	-
9440/15-01-11 **CPM** Z2 Stahl 24V	1	1		30	-	-	-	-
9440/22-01-11 **CPM** Z1 PNO 24V	1	1		30	-	-	-	-
9440/22-01-21 **CPM** Z1 PNO 230V	1	1		30	-	-	-	-
9440/.. **CPM** without cyc Data *1)	0	0		00	-	-	-	-

*1) CPM without cyclic data -> no CPM redundancy supported

Length of the cyclic 9442 CPU data using **GSE V4.xx and V5.xx**

Module selection text in the GSE file	**Cyclic data length** [bytes] Input	Output	**PROFIBUS identifier** [HEX]					
CPU Status and Control Register *2)	1	1	SIF	c2	00	00	00	35
*9445/35-12 PM 24V/5A Z2 *3)*	*0*	*0*		02	00	34	-	-
*EM Extension Module *3)*	*0*	*0*		02	00	36	-	-

*2) The CPU status / control registers can be projected at 9442 CPU if necessary on any slot optionally. It behaves like an empty module and the slot must remain empty. For this reason the slot address of the following IO-Module are moved.
Hint: If the status / control registers is projected as the last module the after the real plugged IO-Module, the slot addresses of the real plugged IO-Module remain unchanged.

**3) PM and EM will be added later with new IO-Module.*

PROFIBUS DP interface for IS1+

The following table shows the length of the cyclic data of different types of IO-Module:

Module selection text in the GSE file	Komp. Mode	Cyclic data length [bytes] Input	Output	PROFIBUS identifier [HEX]						IO-Module Type
9460/12-08-11 **AIM** 4/8 Exi	-	16	0	SIF	42	47	30	03	-	IS1
9461/12-08-11 **AIMH** 8 2w Exi		16	0		42	47	30	05	-	
9461/12-08-11 **AIMH** 8+4HV 2w Exi		32	0		42	4f (cf *1)	31	05	-	
9461/12-08-11 **AIMH** 8+8HV 2w Exi		48	0		42	57 (d7 *1)	32	05	-	
9461/12-08-21 **AIMH** 8 Exi		16	0		42	47	30	06	-	
9461/12-08-21 **AIMH** 8+4HV Exi		32	0		42	4f (cf *1)	31	06	-	
9461/12-08-21 **AIMH** 8+8HV Exi		48	0		42	57 (d7 *1)	32	06	-	
9461/15-08-12 **AIMH** 8 2w Ex**n**		16	0		42	47	30	07	-	
9461/15-08-12 **AIMH** 8+4HV 2w Ex**n**		32	0		42	4f (cf *1)	31	07	-	
9461/15-08-12 **AIMH** 8+8HV 2w Ex**n**		48	0		42	57 (d7 *1)	32	07	-	
9462/12-06-11 **SAIMH**6 V1 2w Exi	-	16	4	ESIF	see operating instructions SAIMH					PROFI safe
9462/12-06-11 **SAIMH**6 V2 2w Exi		16	4							
9462/12-08-11 **SAIMH**8 V1 2w Exi		22	6							
9462/12-08-11 **SAIMH**8 V2 2w Exi		22	6							
9465/12-08-11 **AOM** 8 Exi	-	0	16	SIF	82	47	40	09	-	IS1
9466/12-08-11 **AOMH** 8 Exi		0	16		82	47	40	0b	-	
9466/12-08-11 **AOMH** 8 +4HV Exi		16	16		c2	47	47 (c7 *1)	41	0b	
9466/12-08-11 **AOMH** 8 +8HV Exi		32	16		c2	47	4f (cf *1)	42	0b	
9466/15-08-12 **AOMH** 8 Ex**n**		0	16		82	47	40	0c	-	
9466/15-08-12 **AOMH** 8 +4HV Ex**n**		16	16		c2	47	47 (c7 *1)	41	0c	
9466/15-08-12 **AOMH** 8 +8HV Ex**n**		32	16		c2	47	4f (cf *1)	42	0c	
9468/3x-08-xx **8AIH**	-	18	0		42	48	70	2b	-	IS1+
9468/3x-08-xx **8AOH**		2	16		c2	47	40	71	2b	
9468/3x-08-xx **6AIH+2AOH**		14	4		c2	41	46	72	2b	
9468/3x-08-xx **8AIH/8AOH**		18	16		c2	47	48	73	2b	
9468/3x-08-xx **8AIH** +4HV		34	0		42	50 (d0 *1)	74	2b	-	
9468/3x-08-xx **8AOH** +4HV		18	16		c2	47	48 (c8 *1)	75	2b	
9468/3x-08-xx **8AIH/8AOH** +4HV		34	16		c2	47	50 (d0 *1)	76	2b	
9468/3x-08-xx **8AIH** +8HV		50	0		42	58 (d8 *1)	77	2b	-	
9468/3x-08-xx **8AOH** +8HV		34	16		c2	47	50 (d0 *1)	78	2b	
9468/3x-08-xx **8AIH/8AOH** +8HV		50	16		c2	47	58 (d8 *1)	79	2b	
9468/3x-08-xx 8AIMH **No Stat**	x	16	0		42	47	30	05	-	
9468/3x-08-xx 8AIMH+4HV **No Stat**		32	0		42	cf	31	05	-	
9468/3x-08-xx 8AIMH+8HV **No Stat**		48	0		42	d7	32	05	-	
9468/3x-08-xx 8AOMH **No Stat**		0	16		82	47	40	0b	-	
9468/3x-08-xx 8AOMH+4HV **No Stat**		16	16		c2	47	c7	41	0b	
9468/3x-08-xx 8AOMH+8HV **No Stat**		32	16		c2	47	cf	42	0b	
9469/35-08-xx **8IH** Exn	-	18	0		42	48	80	32	-	IS1+
9469/35-08-xx **8OH** Exn		2	16		c2	47	40	81	32	
9469/35-08-xx **6IH+2OH** Exn		14	4		c2	41	46	82	32	
9469/35-08-xx **8IH/8OH** Exn		18	16		c2	47	48	83	32	
9469/35-08-xx **8IH** +4HV Exn		34	0		42	50 (d0 *1)	84	32	-	
9469/35-08-xx **8OH** +4HV Exn		18	16		c2	47	48 (c8 *1)	85	32	
9469/35-08-xx **8IH/8OH** +4HV Exn		34	16		c2	47	50 (d0 *1)	86	32	
9469/35-08-xx **8IH** +8HV Exn		50	0		42	58 (d8 *1)	87	32	-	
9469/35-08-xx **8OH** +8HV Exn		34	16		c2	47	50 (d0 *1)	88	32	
9469/35-08-xx **8IH/8OH** +8HV Exn		50	16		c2	47	58 (d8 *1)	89	32	
9469/35-08-xx 8AIMH **No Stat**	x	16	0		42	47	30	07	-	
9469/35-08-xx 8AIMH+4HV **No Stat**		32	0		42	4f (cf *1)	31	07	-	
9469/35-08-xx 8AIMH+8HV **No Stat**		48	0		42	57 (d7 *1)	32	07	-	
9469/35-08-xx 8AOMH **No Stat**		0	16		82	47	40	0c	-	
9469/35-08-xx 8AOMH+4HV **No Stat**		16	16		c2	47	47(c7 *1)	41	0c	
9469/35-08-xx 8AOMH+8HV **No Stat**		32	16		c2	47	4f (cf *1)	42	0c	

9470/12-16-11 **DIM** 16 NamExi	-	4	0	SIF	42	83	11	0d	-	IS1
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	
9470/25-16-12 **DIM** 16 NamEx**n**	-	4	0		42	83	11	0e	-	
9470/25-16-12 **DIM** 16+CF NamEx**n**	-	8	1		c2	00	87	12	0e	
9470/3x-16-xx **DIM** 16	-	4	0		42	83	60	2c	-	IS1+
9470/3x-16-xx **DI/DO** 16	-	4	2		c2	01 (81 *1)	83	61	2c	
9470/3x-16-xx **DI/DO** 16+2CF	-	8	4		c2	03 (83 *1)	07 (87 *1)	62	2c	
9470/3x-16-xx **DI/DO** 16+6CF	-	16	4		c2	03 (83 *1)	0f (8f *1)	63	2c	
9470/3x-16-xx **DI/DO** 16+8CF	-	20	4		c2	03 (83 *1)	13 (93 *1)	64	2c	
9470/3x-16-xx **DIM** 16 **9470/2**	x	4	0		42	83	11	0d	-	
9470/3x-16-xx **DIM** 16+2CF **9470/2**	x	8	1		c2	00	87	12	0d	
9471/10-16-11 **DIM** 16 24V	-	4	0		42	83	11	0f	-	IS1
9471/10-16-11 **DIM** 16+CF 24V	-	8	1		c2	00	87	12	0f	
9471/15-16-12 **DIM** 16 24V Ex**n**	-	4	0		42	83	11	11	-	
9471/15-16-12 **DIM** 16+CF 24V Ex**n**	-	8	1		c2	00	87	12	11	
9471/35-16-xx **DIM** 16 Ex**n**	-	4	0		42	83	60	30	-	IS1+
9471/35-16-xx **DI/DO** 16 Ex**n**	-	4	2		c2	01 (81 *1)	83	61	30	
9471/35-16-xx **DI/DO** 16+2CF Ex**n**	-	8	4		c2	03 (83 *1)	07 (87 *1)	62	30	
9471/35-16-xx **DI/DO** 16+6CF Ex**n**	-	16	4		c2	03 (83 *1)	0f (8f *1)	63	30	
9471/35-16-xx **DI/DO** 16+8CF Ex**n**	-	**20**	4		c2	03 (83 *1)	13 (93 *1)	64	30	
9471/35-16-xx **DIM** 16 **9470/2**	x	4	0		42	83	11	11	-	
9471/35-16-xx **DIM** 16+2CF **9470/2**	x	8	1		c2	00	87	12	11	
9472/35-16-xx **DIM** 16 24V Ex**n**	-	4	0		42	83	60	31	-	
9472/35-16-xx **DI/DO** 24V Ex**n**	-	4	2		c2	01 (81 *1)	83	61	31	
9472/35-16-xx **DI/DO** 24V+2CF Ex**n**	-	8	4		c2	03 (83 *1)	07 (87 *1)	62	31	
9472/35-16-xx **DI/DO** 24V+6CF Ex**n**	-	16	4		c2	03 (83 *1)	0f (8f *1)	63	31	
9472/35-16-xx **DI/DO** 24V+8CF Ex**n**	-	**20**	4		c2	03 (83 *1)	13 (93 *1)	64	31	
9472/35-16-xx **DIM** 16 **9471/1**	x	4	0		42	83	11	11	-	
9472/35-16-xx **DIM** 16+2CF **9471/1**	x	8	1		c2	00	87	12	11	
9475/12-04-11 **DOM** 4 Exi1	-	0	1		82	00	20	12	-	IS1
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	-	
9475/22-04-21 **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	-	
9475/3x-04-xx **DOM** 4	-	2	1		C2	00	01	21	2d	IS1+
9475/3x-04-1x **DOM 4 No Stat**	x	0	1		82	00	20	12	-	
9475/3x-04-2x **DOM 4 No Stat**	x	0	1		82	00	20	24	-	
9475/3x-08-xx **DOM 8**	-	2	1		C2	00	01	21	2e	
9475/3x-08-5x **DOM 8 No Stat**	x	0	1		82	00	20	20	-	
9475/3x-08-6x **DOM 8 No Stat**	x	0	1		82	00	20	21	-	
9477/10-08-12 **DOM** 8 Rel	-	0	1	SIF	82	00	20	19	-	IS1
9477/12-08-12 **DOM** 8 60V Rel Z1	-	0	1		82	00	20	22	-	
9477/12-06-12 **DOM** 6 250VRel Z1	-	0	1		82	00	20	23	-	
9477/15-08-12 **DOM** 8 Rel Z2	-	0	1		82	00	20	1e	-	
9478/22-08-51 **DOMV**8 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	-	
9482/3x-08-xx **8TIM**	-	18	0		42	48	70	2f	-	IS1+
9482/3x-08-xx **TIM 8 R No Stat**	x	16	0		42	47	30	1a	-	
9482/3x-08-xx **TIM 8 mV No Stat**	x	16	0		42	47	30	1c	-	
AIM 4/8 (9460/.., 9461/..)	-	16	0	GIF	57	-	-	-	-	-
AOM 8 (9465/.., 9466/..)	-	0	16		67	-	-	-	-	
DIM 16 (9470/.., 9471/..)	-	2	0		11	-	-	-	-	
DOM 4/8 (9475/..)	-	0	1		20	-	-	-	-	

*1) Identifier used from GSE V3.04

GIF: **G**eneral **I**dentifier **F**ormat SIF: **S**pecial **I**dentifier **F**ormat
ESIF: (**E**xtended **S**pecial **I**dent. **F**ormat)

Hint compatible mode:
Module descriptors with ´**No Stat´, ´9470/2´** or ´**9471/1´** in the Profibus GSE description use the data format of the IS1 modules without separate signal status bits. The new IS1+ IO-Module operate in a compatible mode and emulate one of the older IS1 IO-Module in this case.
Signal Status via status code in the AI data word is available always.
Advantage: Support and easier engineering of AS systems, which do not support separate signal status.

Disadvantage: When using IS1 DTM or I.S.Wizard is to note in this case, that the compatible older IS1 IO-Module without signal status bits has to be configured in these tools manually to enable a consistent upload of the parameter from IS1. The ´scan topology´ function of FDT frames or the function ´Generate Configuration Data According Hardware´of I.S.Wizard cannot be used in this case because here the descriptors of the IS1 + IO-Modules and not the descriptors of the older IS1 IO-Modules are added to the project. Mapping of compatible IO-Module see Compatibility of new IS1+ IO-Module
Therefore the use of module descriptions with ´**No Stat´, ´9470/2´** or ´**9471/1´** in combination with applications using IS1 DTM or I.S.Wizard is possible with above mentioned reservations, but not recommended.

The telegram length of the cyclic input and output data of a field station depends on the type and number of IO-Module used. The above mentioned limits of a field station depending on the used CPU and GSE version must also be observed here.

Moreover, further limitations of the number of IO-Modules, 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.

2.2.1 Compatibility of new 9442 CPU

9442 CPU with power module PM 9444 and socket 9496 can replace previous 9440/15 CPM fully compatible with the exception of line redundancy.
Existing configurations of 9440/15 with GSE V2.xx or GSE V3.XX can remain in the PROFIBUS Master unchanged. The limitations of data length on PROFIBUS of the CPM 9440/15 remain unchanged in this case.

If extended data length of 9442 CPU shall be used, a modified configuration with 9442 CPU and GSE V4.xx (DPV0) or V5.xx (DPV1) has to be configured.
Date Length see Engineering limits

2.2.2 Compatibility of new IS1+ IO-Module

New IS1+ IO-Module can be used in existing plants for compatible replacement of previous IS1 IO-Module.
No change of GSE File or configuration is required in such case.
The IS1+ IO-Module switch to a compatible mode in case of detection of an allowed configuration of the previous IO-Module.
If new features of the IS1+ IO-Module shall be used which are not supported by the previous IO-Module new configuration with new GSE file according type number of the IS1+ IO-Module is required.

Overview of compatible IO-Modules:

IS1 IO-Module		compatible IS1+ IO-Module	Remark
9460/12-08-11	AIM 8	9468/32-08-11 AUMH Zone 1 9468/33-08-10 AUMH Zone 2	-
9461/12-08-11	AIMH 8		-
9461/12-08-21			9164 additionally required
9465/12-08-11	AOM 8		-
9466/12-08-11	AOMH 8		-
9461/15-08-12	AIMH 8 Exn	9469/35-08-xx UMH Exn	-
9466/15-08-12	AOMH 8 Exn		-
9470/22-16-11	DIM 16	9470/32-16-11 DIOM Zone 1 9470/33-16-10 DIOM Zone 2	-
9475/12-08-41	DOM 8		for low power valves
9470/25-16-12	DIM 16 Nam Exn	9471/35-16-xx DIOM Zone 2 Exn 9472/35-16-xx DIOM 24V Exn (from IOM Firmware V03-06)	-
9471/15-16-12	DIM 16 24V Exn		-
9471/10-16-11	DIM 16 24V		-
9475/12-04-11	DOM 4	9475/32-04-12 DOM Zone 1	-
9475/12-04-21		9475/32-04-22 DOM Zone 1	-
9475/12-04-31		-	discontinued
9475/12-08-41	DOM 8	siehe oben 9470/3x DIOM	-
9475/12-08-51		9475/32-08-52 DOM Zone 1 9475/33-08-50 DOM Zone 2	-
9475/12-08-61		9475/32-08-62 DOM Zone 1 9475/33-08-60 DOM Zone 2	-
9475/22-04-21	DOM 4 OD	9475/32-04-22 DOM Zone 1	-
9475/22-08-51	DOM 8 OD	9475/32-08-52 DOM Zone 1	-
9475/22-08-61		9475/32-08-62 DOM Zone 1	-
9480/12-08-11	TIM R	9482/3x-08-xx 8TIM	-
9481/12-08-11	TIM mV		–

2.3 System requirements

Hardware requirement CPM/CPU:

- 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

- CPU 9442/xx-01-11 (Z2) all Revisions

Software requirements:

9442 CPU: All CPU FW Revisions together with IS1 IO-Module from FW 02-00
or IS1+ IO-Module (94xx/3x….) from FW 03-01

Older IS1 IO-Modules with firmware 01-xx can be operated with 9440 CPUs only!

GSE File selection see Engineering limits

9440 CPM:

<table>
<tr><th rowspan="2"></th><th rowspan="2">IO-Module FW</th><th colspan="2">DPV0 operation
without C2 communication</th><th colspan="2">DPV1 operation
with C2 communication</th></tr>
<tr><th>DPV0 Diagnosis</th><th>DPV1 Diagnosis</th><th>DPV0 Diagnosis</th><th>DPV1 Diagnosis</th></tr>
<tr><td rowspan="3">IS1 IO-Module</td><td>01-xx</td><td>GSE V1.xx</td><td>-</td><td>GSE V1.xx</td><td>-</td></tr>
<tr><td rowspan="2">from 02-00</td><td>CPM FW from V01-32</td><td>CPM FW from V01-41</td><td colspan="2">CPM FW from V02-41, 03-41 or 09-41</td></tr>
<tr><td>GSE from V2.00</td><td>GSE from V3.00</td><td>GSE from V2.00</td><td>GSE from V3.00</td></tr>
<tr><td rowspan="2">IS1+ IO-Module
(94xx/3x….)</td><td rowspan="2">from 03-01</td><td colspan="2">CPM FW from V01-47</td><td colspan="2">CPM FW from V02-47, 03-47 or 09-47</td></tr>
<tr><td>GSE from V2.32</td><td>GSE from V3.10</td><td>GSE from V2.32</td><td>GSE from V3.10</td></tr>
</table>

Software requirements for CPM Redundancy see: CPM redundancy

The IS1+ Remote I/O-system with PROFIBUS DPV1 supports the following additional functions:

- PROFIBUS according DPV1
  - Diagnosis status messages
  - I&M Functions
- Support of PROFIsafe I/O modules (9440 CPM only)
- HART communication
- Support of IS1 DTMs (FDT) with communication via DPV1

System behavior if newer and older Versions are used together:

The usage of younger GSE files with older CPM Firmware Revisions as indicated above is not permitted. While the startup procedure of the DP slave the CPU will respond with ´parameter error´ in the 6 Byte standard DP diagnosis telegram in case of incompatibility of GSE file and CPU Firmware. The IS1 CPU will not go into data exchange operation.

Older GSE versions are running on CPMs/CPUs with newer firmware revisions with the old functionality described in the GSE. Details see Appendix A

Upgrade older installations for DPV1:

- Install IS1 9442 CPU or update IS1 9440 CPM to new Firmware Version (take care of required Hardware Revision using 9440 CPM)
- Import GSE V2.xx or V3.xx using 9440 CPU or GSE V4.xx or V5.xx using 9442 CPU in PROFIBUS Configuration tool and engineering project
- Check firmware revision of existing I/O modules
    - from Revision 02-00 and up for non PROFIsafe IS1 I/O modules
    - from Revision 03-00 for all IS1+ I/O modules (94xx/3x……)
- Using 9442 CPUs or 9440 CPM with firmware from V02-40 and GSE from V3.00 the contents of the diagnosis telegram for the complete IS1+ station has been changed according DPV1 rules. Check if Master System supports DPV1 diagnosis mechanism.

Documentation of IS1+ PROFIBUS Versions and IS1 Parameter sets:

<table>
<tr><th>PROFIBUS diagnosis</th><th>IS1 Parameter set</th><th>GSE File</th><th>Documentation</th><th>Application</th></tr>
<tr><td rowspan="2">DPV0</td><td>Standard</td><td>Revisions V1.xx
(File name: STA_049A.gse)</td><td>document ´ Operating Instructions PROFIBUS DP for IS1+ field stations´</td><td>Product maintenance
(Use of IO-Modules V1.xx)
Not for new projects !
Not supported by 9442 CPU.</td></tr>
<tr><td rowspan="4">extended</td><td>Revisions V2.xx
(File name: STA2049A.gse)</td><td rowspan="4">this document</td><td>Standard solution for new projects with 9440 CPM</td></tr>
<tr><td>DPV1</td><td>Revisions V3.xx
(File Name: STA3049A.gse)</td><td>New projects with DPV1 compatible DP Masters
and for use with
PROFIsafe
e.g. S7-400H
S7-300F, S7-400F …</td></tr>
<tr><td>DPV0</td><td>Revisions V4.xx
(File Name: S4xx049A.GSE)</td><td rowspan="2">Standard solution for new projects with 9442 CPU</td></tr>
<tr><td>DPV1</td><td>Revisions V5.xx
(File Name: S5xx049A.GSE)</td></tr>
</table>

2.4 Configuration of the DP master

The documentation of the master will describe the exact procedure for the parameterization of your master. As a result of the high degree of standardization 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:

GSE files are available for the IS1+ field stations. This files contain all the information important for the master on the communication behavior of the IS1+ field station.
GSE files are usually read by the configuration software of the master.
The configuration Software of the master takes the information on the module types possible in an IS1+ field station from the GSE file.

Configuration rules:

9440 CPM with GSE V2.xx and V3.xx	**9442 CPU with GSE V4.xx and V5.xx**
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 is only one CPM per IS1+ Fieldstation.	Only I/O modules are configured starting from slot 1. A separate CPU descriptor as used with 9440 CPMs is not used. Optionally the status / control register can be projected once when needed as a separate module.
Configuration of the IO-Module slot coded from slot 1 (module no. 1) according to the IO-Modules that are planned or are present in the system.	
Only PROFIBUS Identifiers ac. the list in chapter 2.2 are allowed	
max. telegram length (239 (+1) Bytes Input and 127 (+1) Byte Output data is checked	max. telegram length (244) Bytes Input and 244 Byte Output data is checked
max. number of IO-Module (max. 16) is checked with GSE V2.xx and up to V3.02 max. number of IO-Module (**max. 15**) is checked with GSE **from V3.03** supporting PNO redundancy and structured parameterization.	Check of - **max. 16 IO-Modules** using GSE V4.xx - **max. 15 IO-Modules** using GSE V5.xx + status / control register (once, optional)

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

Attention!

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

-> In case of error, the CPU 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 CPU 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 do not correspond with the configuration data of the master are indicated in the diagnosis data.
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).

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

DPV0 with 9440 CPU and GSE V2.xx

Module no. (slot)	DP Identifier	Order Number	I addr. *1)	O addr. *1)
0 ←	1 Byte In/Out	**9440/15-01-11 CPM Z2 Stahl 24V**		
1	8 AI	9461/12-08-11 AIM 4/8 Exi		-
2	8 AI	9461/12-08-11 AIM 4/8 Exi		-
3	16 DI	9470/12-16-11 DIM 16 NamExi		-
4	empty module		-	-
5	8 AO	9466/12-08-11 AOM 8 Exi	-	
7	8 DO	9475/12-08-41 DOM 8 Exi1	-	
8	8 AI / 8AO	9468/3x-08-xx 8AIH/8AOH		
9			-	-

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

DPV1 with 9440 CPU and GSE V3.xx

Module no. (slot)	DP Identifier	Order Number	I addr. *1)	O addr. *1)
1 ←	1 Byte In/Out	**9440/15-01-11 CPM Z2 Stahl 24V**		
2	8 AI	9461/12-08-11 AIM 4/8 Exi		-
3	8 AI	9461/12-08-11 AIM 4/8 Exi		-
4	16 DI	9470/12-16-11 DIM 16 NamExi		-
5	empty module		-	-
7	8 AO	9466/12-08-11 AOM 8 Exi	-	
8	8 DO	9475/12-08-41 DOM 8 Exi1	-	
9	8 AI / 8AO	9468/3x-08-xx 8AIH/8AOH		
10			-	-

DPV1 with 9442 CPU and GSE V4.xx or V5.xx

Module no. (slot)	DP Identifier	Order Number	I addr. *1)	O addr. *1)
1 ←	8 AI	9461/12-08-11 AIM 4/8 Exi		-
2	8 AI	9461/12-08-11 AIM 4/8 Exi		-
3	16 DI	9470/12-16-11 DIM 16 NamExi		-
4	empty module		-	-
5	8 AO	9466/12-08-11 AOM 8 Exi	-	
7	8 DO	9475/12-08-41 DOM 8 Exi1	-	
8	8 AI / 8AO	9468/3x-08-xx 8AIH/8AOH		
9			-	-
10			-	-

2.5 Bus assembly

Assembly, pin allocation and end of line termination in Ex i segments see operating instructions:
Project Planning, Installation and Commissioning of the RS 485 Fieldbus System from R. STAHL for Non- Hazardous and Hazardous Areas.

2.6 PROFIBUS address of the IS1+ field station

A common station address is used from the 9442 CPU for the protocols PROFIBUS, MODBUS RTU (RS485), as well as the STAHL service bus via USB/RS485, which is adjustable via two rotary (S2, S3) switches on the first IS1+ socket (Bank 0). The switches are located under the left CPU. Thus, an accidental change with plugged CPU is not possible. Changed switch settings will be accepted after CPU boot only.

CPM 9440	**CPU 9442**
Setting with operating keys on the CPM module	Setting via two rotary switches 0…9 Address = S2 x 10 + S3 x 1 on socket under CPU in Slot 0
Address range 0 to 127	Address range 0 to 99
Recommended range 1 to 99	Recommended range 1 to 99

Please note that addresses may only be allocated once in a PROFIBUS network.
The same address is also valid for addressing the IS1+ field station on the service bus.
(see also the CPU operating manual)

2.7 Protocol Selection

The required AS Protocol can be set by a rotary switch S1 on the IS1+ 9442 CPU backplane.
In case of CPU exchange this settings keep unchanged.
After changes of the selected Protocol, matching configuration and parameter data must be created and loaded to the IS1+ field station.

AS-Protocol	**S1 switch setting**
Reserved	0
PROFIBUS PNO Red. *1)	**1**
PROFIBUS Stahl Red. Addr. Offs. 1 *1)	**2**
PROFIBUS Stahl Red. Addr. Offs. 0 *1)	**3**
PROFINET	4
Reserved	5
Modbus TCP	6
EtherNet/IP	7
Reserved	8
Reserved	*9*

*1) For standard PROFIBUS without 9442 CPU redundancy all S1 switch positions 1 to 3 can be used with identical behavior.

2.8 Transmission rate

The central unit of the IS1+ field stations (CPU) and the fieldbus isolating repeaters 9185 and 9186 (switched to ´autobaud detection´) have an automatic transmission rate detection for the PROFIBUS DP interface and can set itself to all standardized PROFIBUS baud rates
The 9440 CPM supports baud rates in the range of 9.6 kbit/s up to 1.5 Mbit/s according to RS485-IS specification.
The 9442 Zone2 CPU use a standard RS 485 network which support baud rates from 9.6 kbit/s to 12 Mbit/s.

2.9 Start-up behavior

The start-up behavior of the cyclic communication between a class 1 master and a DP slave is standardized 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 behaviors of class 1 masters can be differentiated:

2.9.1 Slave is configured by the master:

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

The class 1 master transmits configuration data to the CPU by means of the "Chk_config" service. This service checks the data for compatibility. After checking this successfully, the CPU 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 behavior requires the parameterization 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 GSE file (device specific file) of a slave.

The implementation of the service bus and the I. S. Wizard PC software is not necessary in this operating mode. However, these tools and the HART Management System can be used if required.

2.9.2 Master configures itself with data from the slave:

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

The data block length and module assignment are not parameterized 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 CPU 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 CPU 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 cannot be read in this operation mode.

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

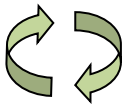
The following table shows the typical telegram traffic between master and slave during the start-up process:

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 addr.	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:
		57H 8 word input	4 modules with input data
		11H 16 bit input	3 modules with output data
		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 addr.	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

2.10 CPU redundancy

Attention! Two different solutions for CPU redundancy with PROFIBUS DP are available:

- **CPU redundancy according to PNO specification ´Slave Redundancy´** Doc. 2.212 R1.2 2004
- **CPM redundancy according to R.STAHL specification** is a proprietary solution from 2000.

IS1 supports both solutions. The two solutions are **not** compatible with one another and must be projected differently. Therefore, a clear distinction must be made as to which version is to be used.

Selection for the 9442 CPU via the backplane switch S1:

- S1 = 1 **PROFIBUS PNO Redundancy.** (recommended for new projects)
- S1 = 2 PROFIBUS Stahl Redundancy Addr. Offs. 1
- S1 = 3 PROFIBUS Stahl Redundancy Addr. Offs. 0

The distinction between STAHL and PNO redundancy for the 9440 CPM is done by selecting the CPM firmware and the associated GSE file:

<table>
<tr><th rowspan="2">-</th><th colspan="3">CPM 9440 redundancy</th><th rowspan="2">Usage</th></tr>
<tr><th>STAHL
CPM redundancy according Stahl specification</th><th colspan="2">PNO
CPM redundancy according to PNO specification</th></tr>
<tr><td rowspan="2">GSE</td><td>GSE V2.xx
DPV0 diagnosis
from PROFIBUS firmware version V0x-30</td><td>from
GSE V2.25</td><td rowspan="2">for masters non-compliant with PNO slave redundancy</td><td>Standard solution
for new projects</td></tr>
<tr><td>GSE from V3.03
DPV1 diagnosis
with status and structured parameterization *1)
from PROFIBUS firmware version V0x-42
(GSE V3.00 to V3.02 from PROFIBUS firmware version V0x-40)</td><td>from
GSE V3.03</td><td>for masters compliant with PNO slave redundancy
(max. 15 IO-Module!)</td><td>New projects
with DPV1 compatible
DP Masters
and for use with
PROFIsafe
e.g. S7-400H, S7-300F, S7-400F …</td></tr>
<tr><td rowspan="3">IS1 CPM
Firmware</td><td>V01-42</td><td colspan="2">-</td><td>DPV0 Version
without C2 communication</td></tr>
<tr><td>V02-42</td><td colspan="2">from V03-42</td><td>DPV1 Version
(with C2 communication, HART, DTM support, I&M, …)</td></tr>
<tr><td>V09-42</td><td colspan="2">-</td><td>DPV1 Version
(as above, but
Offset backup addr. = 0)</td></tr>
</table>

***1) Attention!** When using GSE files from V3.03 in connection with IS1 9440 firmware up to V0x-41, a parameterization error is reported when IS1 is started, if the PLC supports structured parameterization according to DPV1 (e.g. S7-300 and S7-400). In this case, IS1 will not enter Data_Exchange.
Remedy: use firmware from V0x-42 or GSE up to 3.02.

A maximum of 15 IO-Modules with IS1+ GSE **from V3.03**

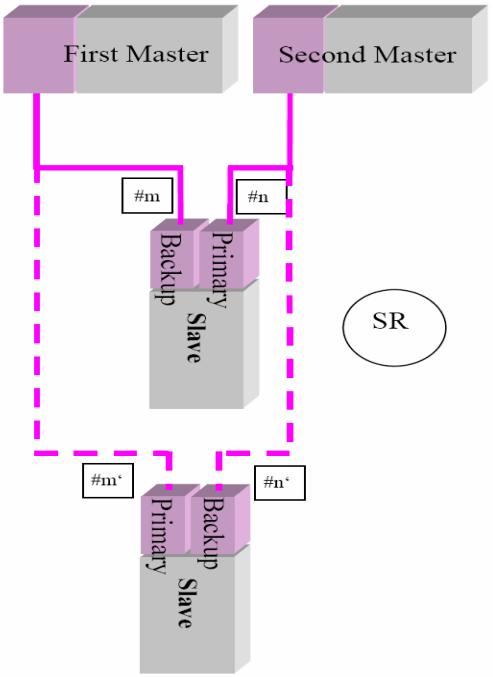
A mix of redundant CPMs with firmware acc. R.STAHL spec. and PNO spec. is not allowed in one IS1 field station. Rule for redundant operation of two IS1 CPMs: Firmware from the same row (01-xx or 02-xx or 03-xx or 09-xx) shall be used in both CPMs.

2.10.1 CPU redundancy according to PNO specification

In the PNO specification for PROFIBUS slave redundancy (Doc. 2.212 R1.2), different redundancy structures have been defined. IS1 supports all versions of these redundancy structures. Master and Slave redundancy are independent and can be combined optionally.

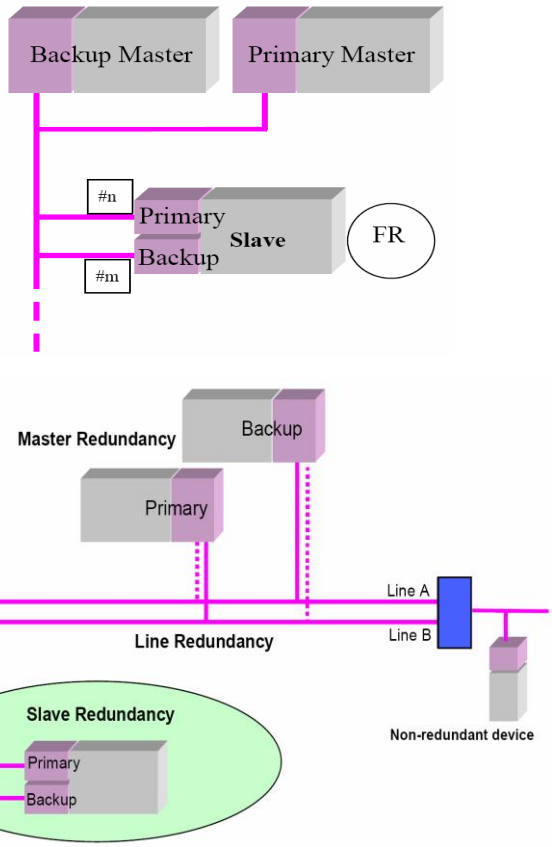
System Redundancy (SR):

- Two seperate PROFIBUS Netzworks.
- Primary- and backup slave have the same address



Flying Redundancy (FR):

- One logical PROFIBUS Netzwork.
- Primary- and backup slave have different addresses



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 CPU takes over and becomes primary. Input and output signals are frozen during the switchover.
Optionally in case of system redundancy, the DP master can trigger a switchover of a redundant slave, for example for testing, via a control command (DPV1 PrmCmd).
In case of flying redundancy the primary- and backup address of a redundant slave are exchanged during switch over.
A failure of the backup CPU is reported via the “Backup Slave Not Available” device-specific diagnosis as well as the CPU status register in the cyclic data of the primary CPU.

Possible reasons for message ´Backup CPU not available´

- Backup CPU 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 CPU failed
- Power fail of backup CPU
- Hardware fault of backup CPU

2.10.1.1 Software requirements

Software requirements for masters compliant with PNO slave redundancy

- CPM 9440 firmware DPV1 from version V03-42 or
- CPU 9442 with Protocol selection rotary switch S1 = 1 -> PROFIBUS PNO Red.
- IO-Module firmware from version 2.00
- PROFIBUS GSE file V4.xx or V5.xx with 9442 CPU or from GSE Rev. V3.03 with 9440 CPM

Behavior when mixed with older versions:

The use of GSE V3.xx with older 9440 CPM firmware versions is not permitted. When using GSE V3.xx with older 9440 CPM firmware versions, a DP slave start-up is answered with a ´Parameterization Error´ in the 6 standard bytes of the diagnosis telegram.
IS1 CPM will not enter Data_Exchange.

2.10.1.2 Project planning

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

- IS1 CPU 9442 with protocol selection switch S1 = 1 or CPM 9440 with Firmware from V03-42 is required.

PROFIBUS connection to IS1+ Fieldstation

- Both 9442 CPUs or 9440 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 on 9440 CPUs is not used. X2 is used for line redundancy with 9440 CPUs only.

DP Addresses of redundant CPUs

- Both 9442 CPUs of an IS1+ field station work with the DP address set via rotary switches S2 and S3 on the socket.
- Both 9440 CPMs in one redundant IS1+ field station are set to the same DP Address.
- The backup CPU or CPM adds an offset to this address according the parameter ´Address offset backup CPU PNO Red´.

Configuration of PROFIBUS master

- Only one of two redundant CPUs is configured in the DP master with the primary DP address. The application in PLC/DCS is using only the primary CPU for exchanging I/O data.
- Consider that the backup address according parameter ´Address offset backup CPU PNO Red´ is allocated and shall not be used twice.
- Cyclic or acyclic communication between DP master and the backup CPU 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.

  Rule for 9440 CPM:

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

DP master cycle *[ms]*	***Max. Slave switch over time [ms]*** *Worst case time between disturbing DP bus on primary CPU to Data_Exchange of previous backup CPU.*					***Setting of Parameter ´Timeout for output modules´*** **>=** [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)´.

Setting of CPU Parameters

- ´CPU Redundant´ = Yes
  This activates the mutual supervision of both CPUs and the first slot on the right of the right CPU becomes slot 1.
- ´ Line redundancy AS bus´ = No (available for 9440 CPU only)
  (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:

  Timeout for output modules [ms] >= (4 * DP_Master cycle) + 700ms

  Hint: Additionally to the IS1 GSE parameter a parameter Output_Hold_Time may exist in the DP master or slave parameter area of some DPV1 host systems supporting slave redundancy according PNO specification.
  IS1 GSE parameter remain always effective. Settings from the host system are not applied in this case to achieve identical behavior in all systems.

- ´Address offset backup CPU PNO Red´ = xx see table below

Parameter: Address offset backup CPU PNO Red

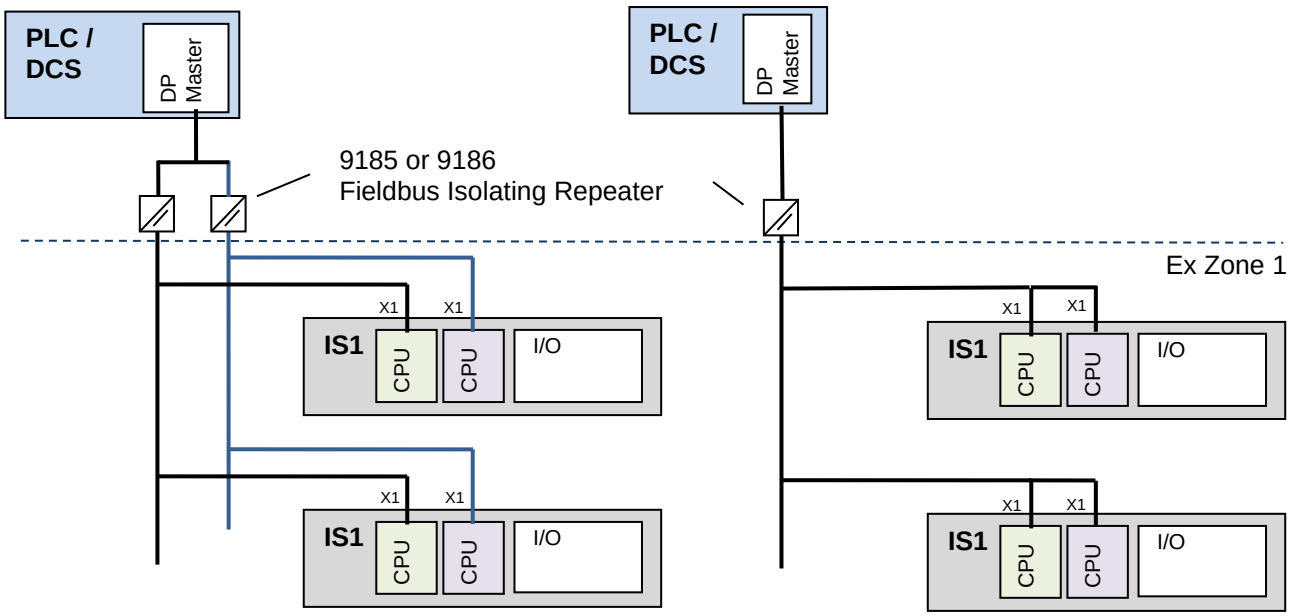
Redundancy Structure	Address offset backup CPU	Master
SR System Redundancy	**0**	Offset according PNO Spec. for SR e. g. S7-400H
FR Flying Redundancy	**1**	proprietary Solutions
	64 *1)	Offset according PNO Spec. for FR. e. g. ABB
	128	**Feature supported by 9440 CPM only.** Backup address out of PPROFIBUS address range. Communication with backup CPM via DP is not possible.

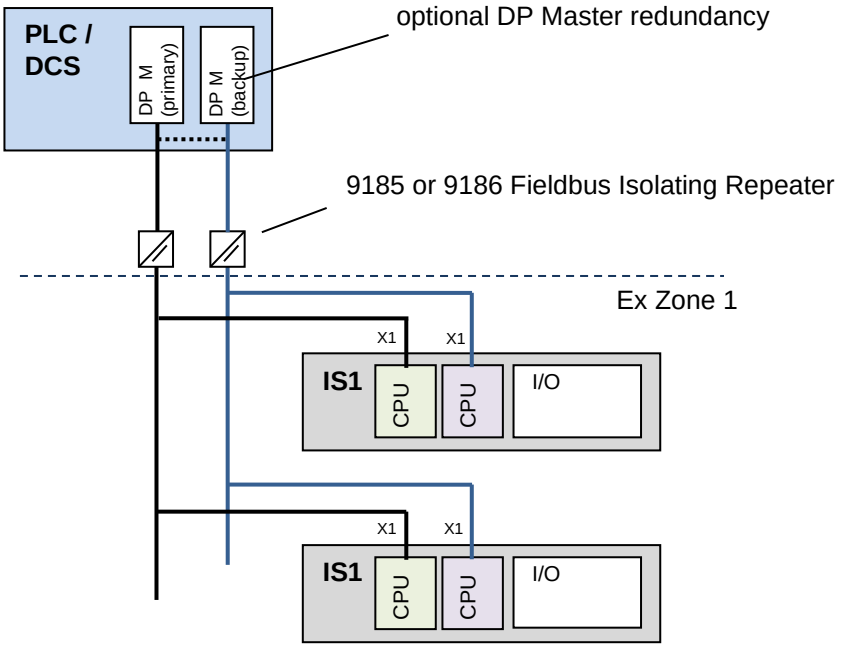
* 1) The address of the backup CPU must be as at all DP devices in the range 1 to 127.
Therefore, only addresses from 1 to 63 are allowed for the primary CPUs.

2.10.1.3 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:

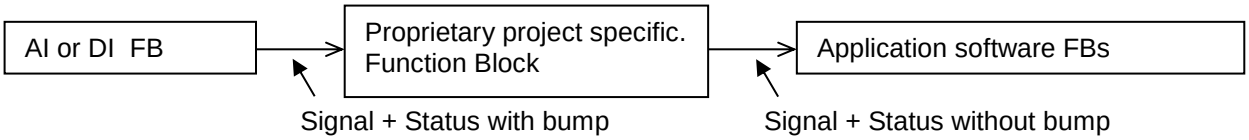
- The switchover criterion between primary and backup CPU is generated in the IS1 CPUs. No support from control commands by the DP master is required.
- Our GSE versions 2.xx support DP master systems which do not yet support DPV1 diagnoses.
- A failure of the backup CPU is reported via the “Backup Slave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

  During the switchover of IS1, output signals are frozen are thus bumpless. The maximum allowed switch over time can be set by the parameter ´timeout output modules´.
  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 behavior 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.



2.10.2 CPU redundancy according Stahl specification

2.10.2.1 Functions

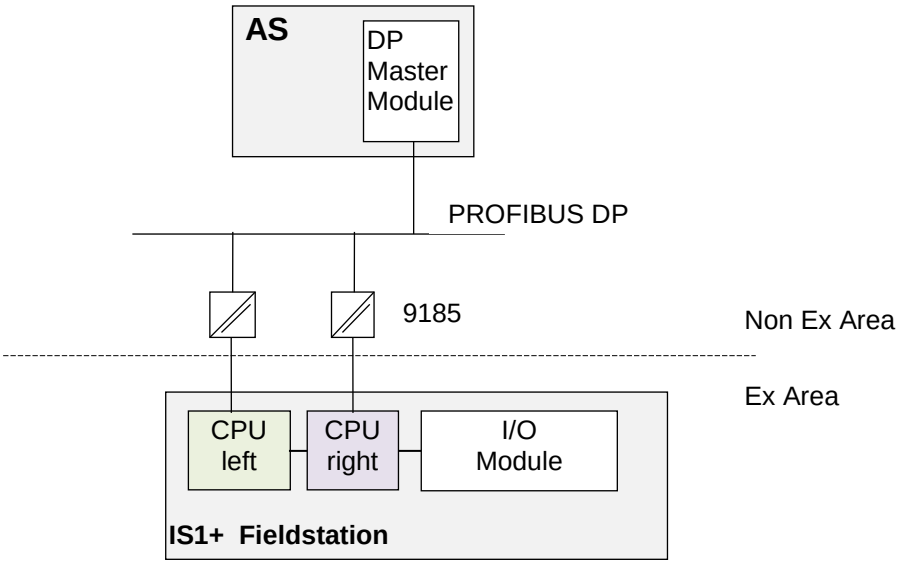
An IS1+ field station can be equipped with two central units (CPU), whereby each CPU has its own independent PROFIBUS DP interface.
From the point of view of the automation system, each field station has 2 separate DP slaves, and both are involved in the cyclical data exchange with the DP master. Thus, 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 CPU 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 CPU.
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 CPU handles the data traffic to the field station I/O modules. The active CPU monitors the inactive CPU and likewise provides it with the current input data.

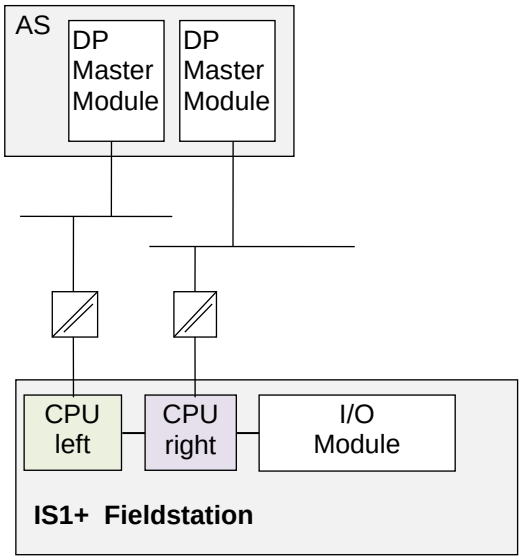
2.10.2.2 Redundancy structures

The following redundant PROFIBUS network structures are supported:

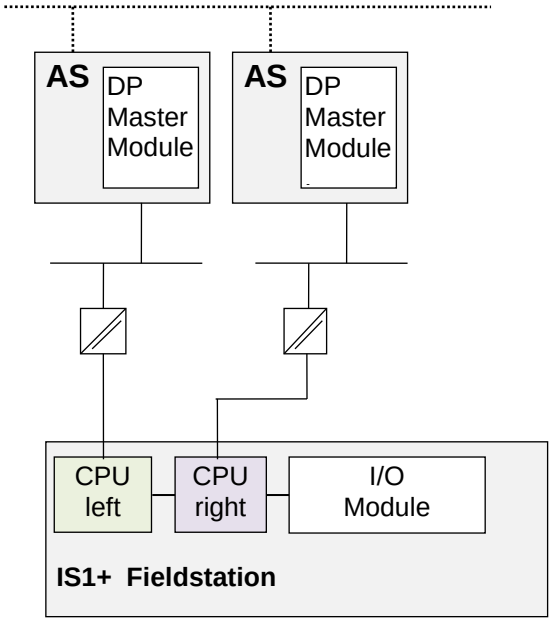
Cable redundancy in the Ex Area
Redundant transmission units (CPU) in the IS1+ field station,
Non-redundant DP master.



Redundant PROFIBUS networks (redundant DP master modules in the AS)
Non-redundant AS,
Redundant transmission units (CPU) in the IS1+ field station,



Redundant AS, redundant PROFIBUS networks
Redundant transmission units (CPU) in the IS1+ field station



Behavior of IS1+ CPU

Parallel cyclical data traffic can be defined via PROFIBUS DP for both CPUs (both CPUs are in data exchange).

Both CPUs in an IS1+ fieldstation are connected with the non-redundant installed I/O modules.
The two CPUs in an IS1+ fieldstation are not allowed simultaneous access to the I/O modules. For this reason, only one CPU is switched to active status by a control register from the AS software.
The active CPU takes over the access to the I/O modules (read and write).
The other CPU is in the 'inactive' status. The active CPU updates the input data in the inactive CPU in a cycle and monitors it for correct operation.
As a result, input data can be read cyclically by both CPUs, in error free standard operation mode.
The data between the active CPU and the inactive CPU can be different in case of error! Therefore the data of the inactive CPU should not be used for the application software.

Although the automation system does receive output data in 'inactive' status via the PROFIBUS and this data is stored in the CPU RAM, it is, however, not forwarded to the output modules.

Control and Status register CPU

The CPU to be activated is selected by a logic in the AS.
Either CPU in a redundant IS1+ fieldstation can be enabled by writing a control register from the automation system for both CPUs.
The selected (active) CPU is permanently (cyclically) controlled with the respective control code. This facilitates automatic restart after malfunctions. The control register for switching to redundancy is updated with identical content for both CPUs (prim. and red.).
Coding of the control register see Control register CPM.

The actual status of the two redundant CPUs can be read from the Status register CPM

2.10.2.3 Timeout time for Output modules

If an active transmission route fails, the cyclical updating of the output module stops. There are Watchdog circuits on the output modules that monitor the cyclical data transmission between the CPU and the output modules.
If no valid data is transmitted to the output module beyond the time T_{Mod}, the module places its outputs in safety position. This should not be done for error-free redundancy switching.

This produces the following requirement for error-free switching:

Parameterising rule for the timeout for output modules (T_{Mod}):

T_{Mod} must be parameterised **greater** than the maximum total time between the occurrence of a transmission error and the activation of the hitherto inactive CPU (switching time).

The maximum switching time is defined by the parameterized DP master bus cycle, the PROFIBUS baud rate, the monitoring software cycle time in the automation system and the startup delay of the CPU (< 500 ms).
The IS1 timeout time for output modules (T_{MOD}) can be parameterized in the DP master in the range of 100 ms to 25.5 sec. (default value: 1 s).

Startup delay of the CPU:

When the status of a CPU is changed from inactive to active via the control register, there is a delay of 500ms (maximum) before the CPU will report its status as active.
If the (previously active) CPU contains valid input data, then this information is transferred to the AS within this time. The AS can then use this input data immediately after switch over.

If the now active CPU receives new configuration data, so that the input data of the previously active CPU cannot be used, all the IO-Module must be initialized by the now active CPU. In this case, new input data is not available before the CPU reports its status as active in the status register.
The AS therefore cannot use any data that was transmitted before the CPU reported its status as active.

2.10.2.4 Behavior of the DP Master (AS)

Configuration and parameterization of the redundant IS1+ fieldstation in the DP Master

The super ordinate automation system provides two DP slave devices on the PROFIBUS

CPM 9440 Firmware Rev.	**CPU 9442 Protocol selection** (Socket Switch S1)	**left CPU**	**right CPU**	**Offset right CPU address**	**Application**
V01-xx, V02-xx	S1 = 2 PROFIBUS Stahl Red. Addr. Offs. 1	address n	address n+1	+1	**standard**
V09-xx	S1 = 3 PROFIBUS Stahl Red. Addr. Offs. 0	address n	address n	0	on demand only

Both slave devices must be configured separately in the DP master configurator with identical I/O arrangements and parameterized with identical slave parameters.
(Recommendation: first configure and parameterize the left slave and then copy the complete slave to the second (right) slave.
Consequently, there is a separate memory area with the respective associated I/O data for each of the CPUs.

For the CPU parameters, set the parameter 'CPU redundant = Yes' in the DP master configurator.
When configuring a field station with CPU redundancy, the CPU with the additional **'Red.'** from the module list of the GSE 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 CPU 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 CPUs are used, you must configure only one CPU in slot 0 per field station, as from the point of view of the master, there are two slaves with one CPU each respectively.

Software functions in the AS

The following software functions are required in the automation system (AS):
- Functionality to update the I/O data to the user program.
- Switching logic and redundancy control

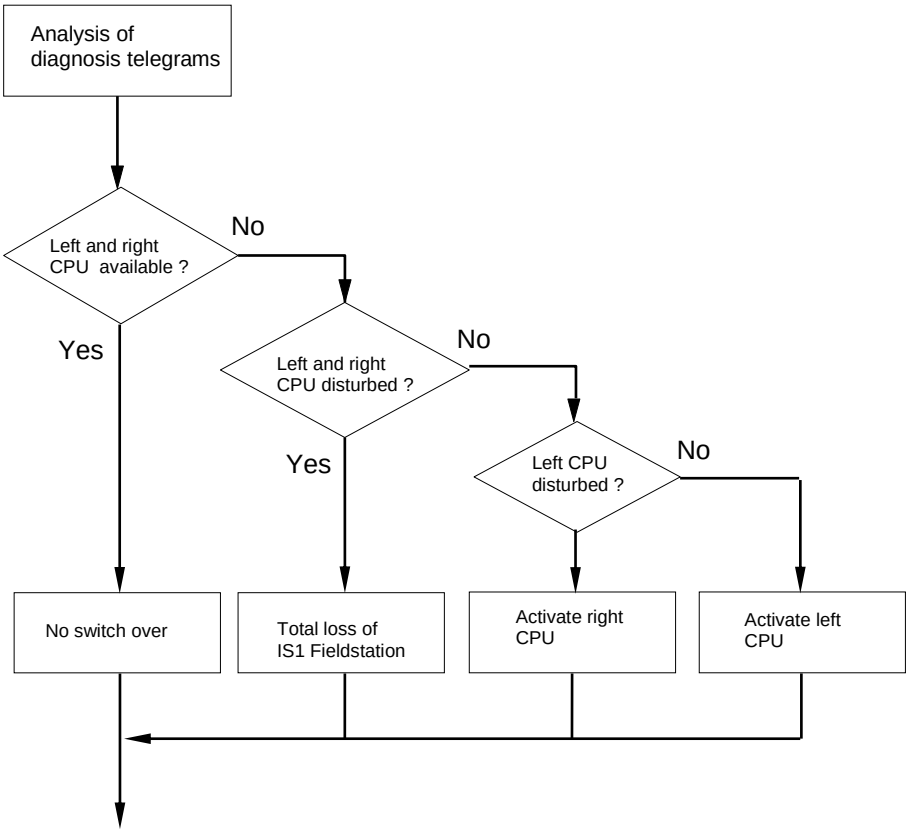
Software parts required in the automation system for redundancy support are almost identical for all the described redundancy structures.

Switching logic and redundancy control in the AS

Check the availability of both transmission paths in the automation system by using an application program and make one of the transmission paths active. Data can be exchanged between the application software and the IS1+ fieldstation I/O modules only via the active transmission path.

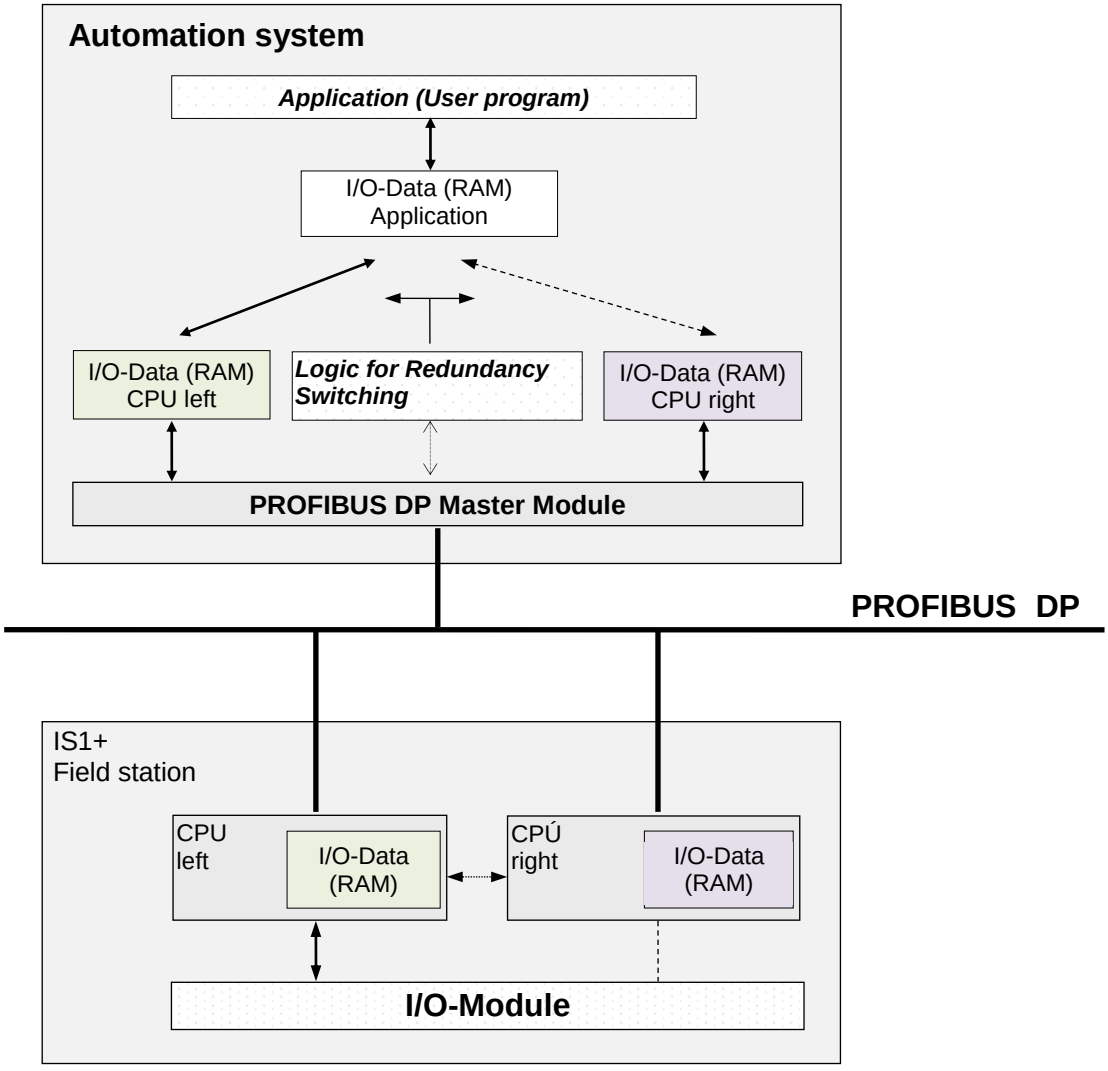
The automation system monitors the redundant transmission paths by implementation and analysis of the PROFIBUS service 'Read Slave Diagnosis'.
In the first byte of the received diagnosis telegram, Bit No. 0 returns and indicates whether the addressed PROFIBUS slave is involved in the cyclical data exchange or not.
After using this service for both CPUs, a logic in the AS helps to select one of the transmission paths (from either CPU) to be activated. By transmitting the control register from the AS to the CPUs, the result of this decision is notified to the CPUs, which react accordingly.

Switching logic in the AS for controlling the redundancy switching:

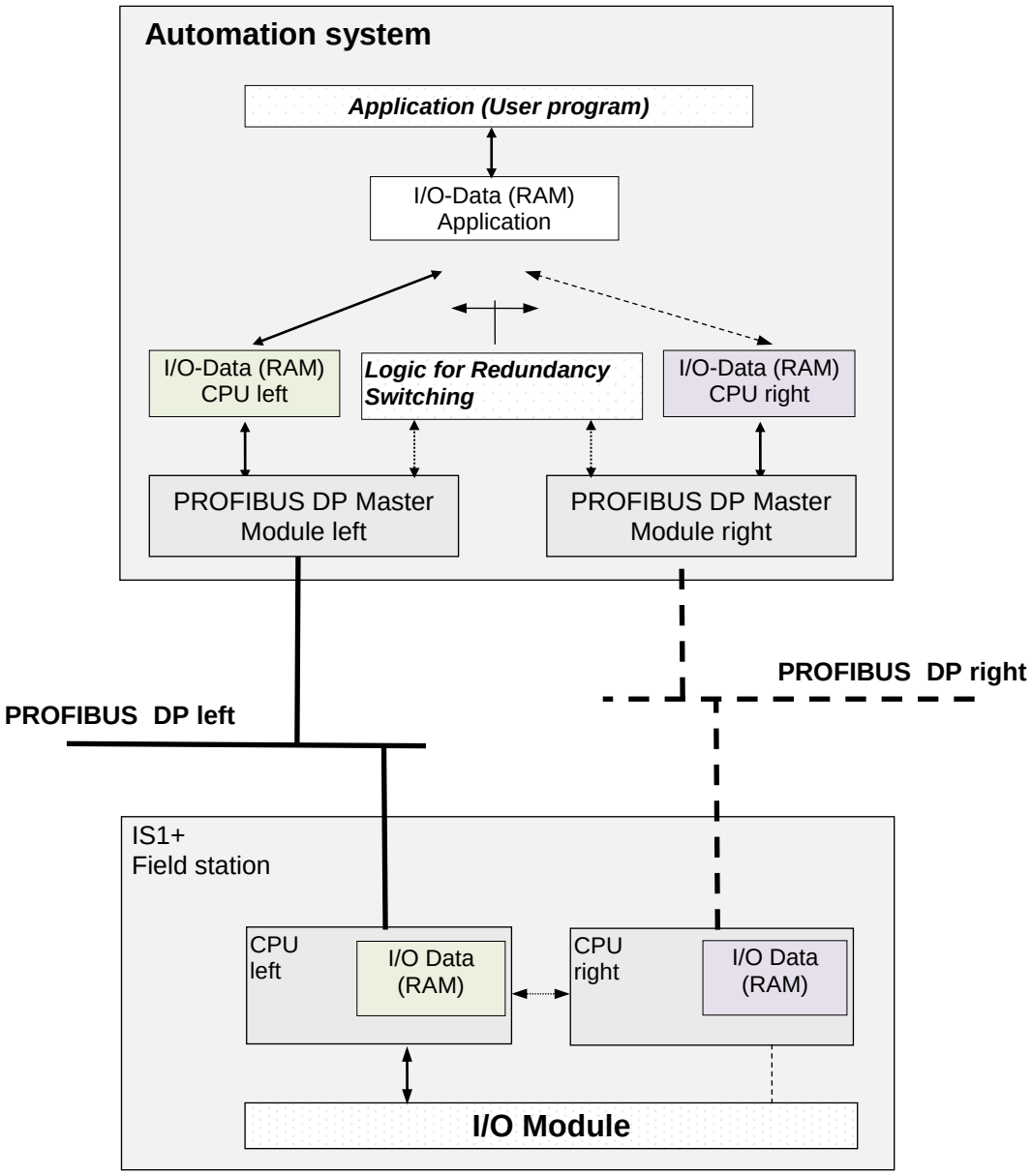


2.10.2.5 Updating the I/O data to the user program

In the AS, there is a third memory area for the application I/O data. This application memory area must be updated cyclically with the memory area of the active CPU by using the user program.
The memory area for the inactive CPU output data must not be updated cyclically.
However, note that during a redundancy switching, the control command for activation and the current output data in the same DP cycle of the hitherto inactive CPU must be transmitted.

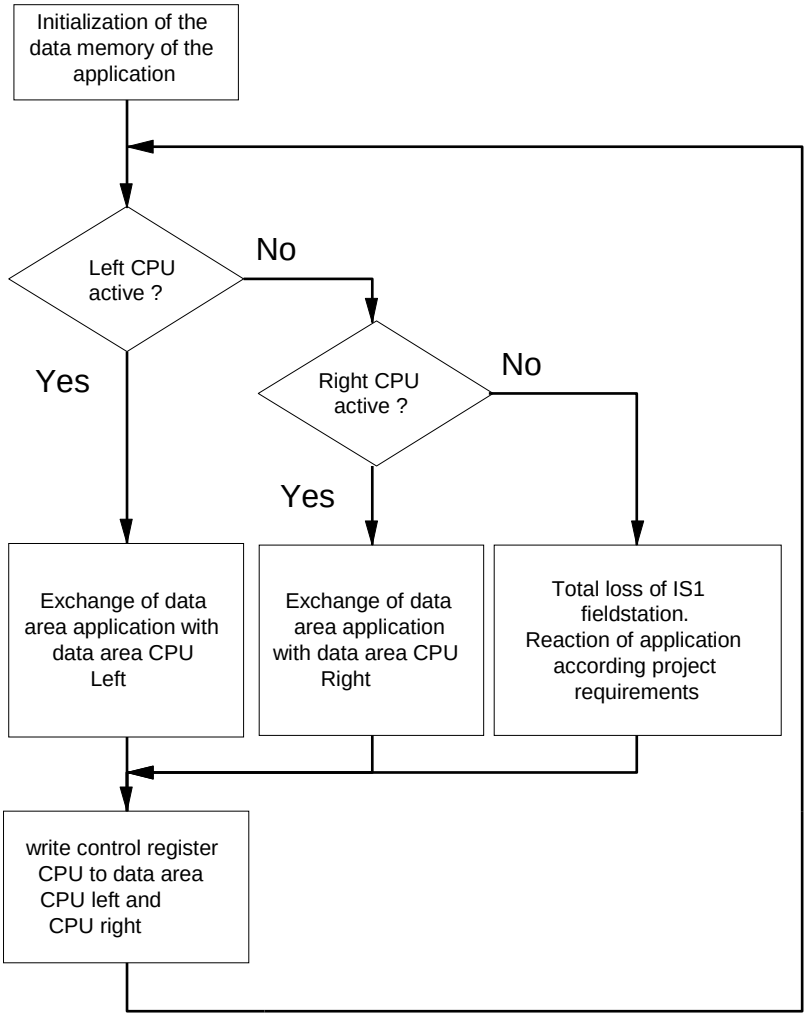


Example 1: Non-redundant automation system with redundant IS1+ field station



Example 2: Automation system with redundant PROFIBUS interface

Logic for controlling data update in the AS:



2.11 Line Redundancy

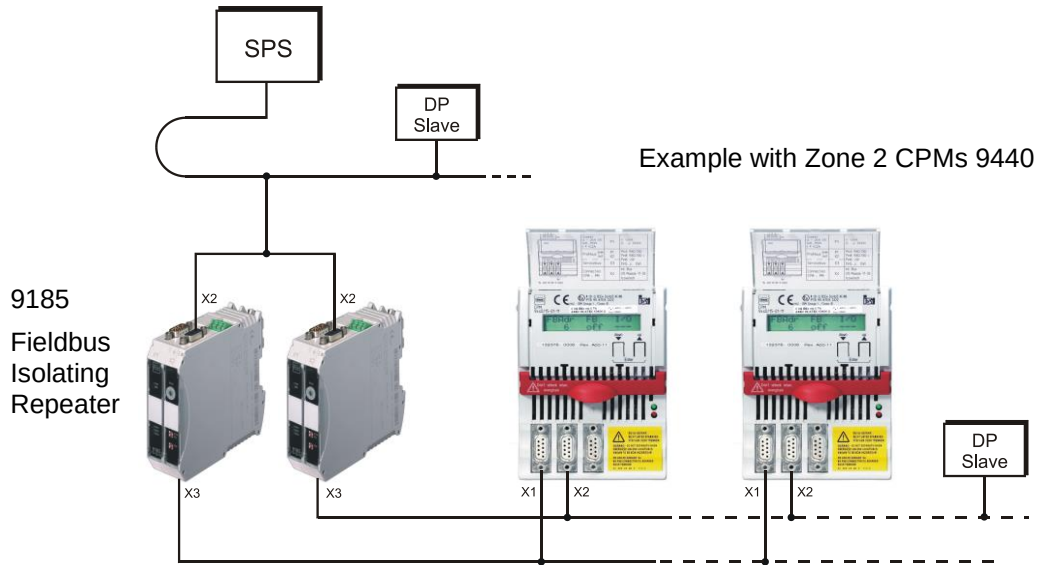
Line Redundancy may be used with 9440 CPM to enhance the availability of the IS1 system even if a transmission path has been broken. Line Redundancy should not be used in combination with CPM redundancy according to PNO specification or CPM redundancy according Stahl specification.

Line Redundancy is no longer supported by the 9442 CPU. See Change from 9440 CPM Line Redundancy to 9442 CPU Redundancy

Line Redundancy is suitable for non-redundant PROFIBUS Masters.
In order to do this, the two fieldbus isolating repeaters, Type 9185, are interconnected at the X_2 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 X_3 interface of the 9185, and connected to the two X_1 and X_2 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 prioritized 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 signaled in the PROFIBUS diagnosis telegram and optionally in the IS1 DTMs or in IS 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	X1 / X2	-
1	9940/22-01-21	90-250 V AC	PROFIBUS	B	01-32, 02-32	X1 / X2	-
2	9440/15-01-11	24 V DC	PROFIBUS	G	01-32, 02-32	X1 / X2	-
1 (bus)	9185/11-35-10	24 V DC	-	D	01-02	X3	X2
2	9185/12-45-10	24 V DC	-	D	01-02	X3	X2

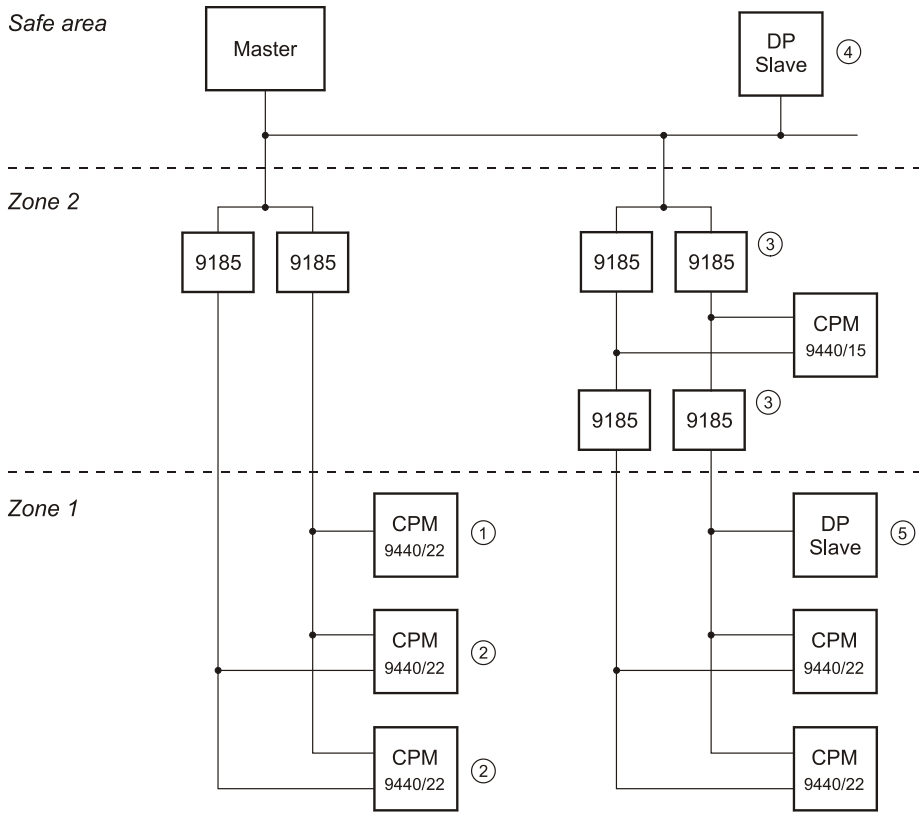


2.11.1 System data ´Line Redundancy´

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 $T_{sdr\text{-}min}$ must be set to ≥ 33 t-bit in the PROFIBUS DP master !

2.11.2 Settings in PROFIBUS master

Protocol: PROFIBUS DP

Retry ≥ 3 – 5 (recommended 5)

MinTsdr: ≥ 33 t-bit for all DP slaves on the redundant bus segment

MaxTsdr:

Baudrate	MaxTsdr
<= 187,5 kBaud	> 80 TBit
500 kBaud	> 120 TBit
1,5 MBaud	> 170 TBit

Hint: We recommend to use a user specific profile similar to the profile „Universal (DP / FMS)“ using SIEMENS PLCs with Baudrates >= 93,75 kBaud.

2.11.3 CPM 9440 parameter:

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

2.11.4 Settings on Fieldbus Isolating Repeater 9185

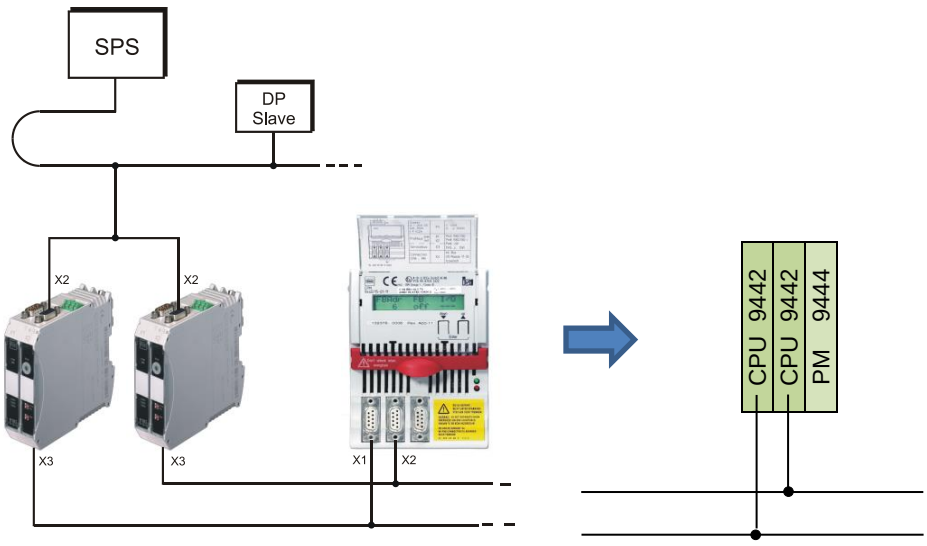
Baudrate:
- Autobaudrate
- fixed Baudrates 1,5 Mbit, 500 kBit, 187,5 kBit, 93,75 kBit
  (The fixed Baudrates 9,6…57,6 kBit are not allowed using Line Redundancy)

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

2.11.5 Change from 9440 CPM Line Redundancy to 9442 CPU Redundancy

Cable redundancy in the form used with the 9440 CPM is not supported by the 9442 CPU.
In case of Upgrades of existing facilities, which were operated with 9440 line redundancy, alternatively the 9442 CPU redundancy according PNO specification can be used. Output signals are held shock-free by IS1 during redundancy switching.
From PLC vision the is a short failure of the DP connection during switch over, which must be filtered out in the PLC to the application software if necessary. More details see PNO redundancy.



3 Data traffic

3.1 Configuration

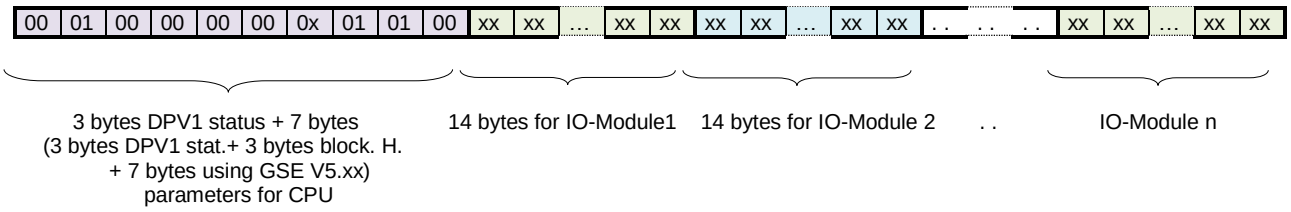
Input data (Read) and output data (Write) are each transmitted cyclically in a telegram.
In this case, the data blocks of the individual modules are grouped into telegrams in the order defined in the configuration software of the PROFIBUS master.
If empty modules are configured, no data is transported in these locations of the data telegram and no diagnosis data is generated for the associated slot.

3.2 Parameterization of the IS1+ field station and the IO-Module

3.2.1 Transmission of parameter data

During the start-up of the automation system, parameters are transmitted by the DP class 1 master to the CPU in the "Set parameters" telegram. In addition to the standardized 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 3 Bytes DPV1 status + 7 bytes (10 Bytes using GSE V5.xx) for the CPU and additional 14 Bytes (extended parameter set) for every IO-Module.

User parameter data area ("USER_PRM_DATA"):



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

3.2.2 CPU parameters

Byte	Bit	Default Value						Function
0	-	0x00	(0x00 using DPV0) Content pending on used DPV1 functions according DPV1 Spec.					DPV1 Status Bytes
1	-	0x01						
2	-	0x00						
	-	0x0a	(used with GSE V5.xx only)					3 Byte Block header
	-	0x81						
	-	0x00						
3	0	0x00	**Bit 1**	**Bit 0**	**Address offset backup CPU using PNO Redundancy**			CPU Parameter
			0	***0***	***128***	FR	-	
	1		0	1	0	SR	acc. PNO Spec.	
			1	0	1	FR	-	
			1	1	64	FR	acc. PNO Spec.	
	2 - 7		Reserved					
4	-	0x00	Reserved					
5	-	0x00						
6	-	0x01 0x02 0x03 0x04 0x05	DPV0 + standard parameter set (GSE 1.xx) for 9440 CPM DPV0 + extended parameter set (GSE 2.xx) “ DPV1 + extended parameter set (GSE 3.xx) “ DPV0 + extended parameter set (GSE 4.xx) for 9442 CPU DPV1 + extended parameter set (GSE 5.xx) “					
7	-	0x0a	**timeout output modules (x 100 ms)** Unsigned8 (1 - 255)					
8	0	0x01	**Channel-related diagnosis** 0=Off / ***1= On***					
	1		**PM Redundant** ***0 = No*** / 1 = Yes *3)					
	2 - 3		Reserved					
	4		**Slot Offset DPV1 Diagnosis** **0** / 1 *1)					
	5		**IO-Module 9 -16 on rail X4** ***0 = No*** / 1 = Yes *2)					
	6		**Line redundancy AS bus** ***0 = No*** / 1 = Yes *2)					
	7		**CPU Redundant** ***0 = No*** / 1 = Yes					
9	-	0x00	Reserved					

*1) GSE V3.xx and V5.xx only: Slot information in DPV1 diagnosis telegram is incremented by 1 in Module status und IO-Module status blocks if parameter **Slot Offset DPV1 Diagnosis = 1.**

Usage:
For DPV1 Master systems which start slot counting from 1 and not from 0 as usual for IS1+ systems. (e. g. Siemens S7). Available with 9440 CPM firmware from Rev. 03-45 and GSE V3.05

*2) used with CPM 9440 and GSE V2.xx and V3.xx only

*3) used with CPU 9442 and PM 9445 only

3.2.3 IO-Module parameters

3.2.3.1 AIM / AIMH

(SAIMH see operating instruction SAIMH 9462/... PROFIsafe)

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Input Filter	Medium	Small ***Medium*** Big (50 Hz) Big (60 Hz)
Signal in case of error I 0	Status code	-10 % (4 mA only) 0 % 100 % ***Status code*** freeze (initial value 0%) freeze (initial value 100%)
Signal in case of error I 1	Status code	
Signal in case of error I 2	Status code	
Signal in case of error I 3	Status code	
Signal in case of error I 4	Status code	
Signal in case of error I 5	Status code	
Signal in case of error I 6	Status code	
Signal in case of error I 7	Status code	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
Error detection I 2	On	
Error detection I 3	On	
Error detection I 4	On	
Error detection I 5	On	
Error detection I 6	On	
Error detection I 7	On	
Input range I 0	4…20 mA	0…20 mA ***4…20 mA***
Input range I 1	4…20 mA	
Input range I 2	4…20 mA	
Input range I 3	4…20 mA	
Input range I 4	4…20 mA	
Input range I 5	4…20 mA	
Input range I 6	4…20 mA	
Input range I 7	4…20 mA	
Measurement range ac. NAMUR I 0	No	***No*** Yes
Measurement range ac. NAMUR I 1	No	
Measurement range ac. NAMUR I 2	No	
Measurement range ac. NAMUR I 3	No	
Measurement range ac. NAMUR I 4	No	
Measurement range ac. NAMUR I 5	No	
Measurement range ac. NAMUR I 6	No	
Measurement range ac. NAMUR I 7	No	
Scan HART livelist	On	Off ***On***
Input No. HART device for pos. 1	Not used	0…7 ***´Not used´***
Input No. HART device for pos. 2	Not used	
Input No. HART device for pos. 3	Not used	
Input No. HART device for pos. 4	Not used	
Input No. HART device for pos. 5	Not used	
Input No. HART device for pos. 6	Not used	
Input No. HART device for pos. 7	Not used	
Input No. HART device for pos. 8	Not used	
No. HART variable for pos. 1	HART variable No. 2	HART variable No. 1 ***HART variable No. 2*** HART variable No. 3 HART variable No. 4
No. HART variable for pos. 2	HART variable No. 2	
No. HART variable for pos. 3	HART variable No. 2	
No. HART variable for pos. 4	HART variable No. 2	
No. HART variable for pos. 5	HART variable No. 2	
No. HART variable for pos. 6	HART variable No. 2	
No. HART variable for pos. 7	HART variable No. 2	
No. HART variable for pos. 8	HART variable No. 2	

Default values in ***´bold´*** letters

Available only on HART modules (AIMH) !

3.2.3.2 AUMH 9468

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Input Filter	Medium	Small ***Medium*** Big (50 Hz) Big (60 Hz)
Signal in case of error I 0	AI Status code / AO 0%	-10 % (4 mA only) 0 % 100 % **AI Status code / AO 0%** freeze (initial value 0%) freeze (initial value 100%)
Signal in case of error I 1	AI Status code / AO 0%	
Signal in case of error I 2	AI Status code / AO 0%	
Signal in case of error I 3	AI Status code / AO 0%	
Signal in case of error I 4	AI Status code / AO 0%	
Signal in case of error I 5	AI Status code / AO 0%	
Signal in case of error I 6	AI Status code / AO 0%	
Signal in case of error I 7	AI Status code / AO 0%	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
Error detection I 2	On	
Error detection I 3	On	
Error detection I 4	On	
Error detection I 5	On	
Error detection I 6	On	
Error detection I 7	On	
Input range I 0	4…20 mA	0…20 mA ***4…20 mA***
Input range I 1	4…20 mA	
Input range I 2	4…20 mA	
Input range I 3	4…20 mA	
Input range I 4	4…20 mA	
Input range I 5	4…20 mA	
Input range I 6	4…20 mA	
Input range I 7	4…20 mA	
Measurement range ac. NAMUR I 0	No	***No*** ****1)*** Yes
Measurement range ac. NAMUR I 1	No	
Measurement range ac. NAMUR I 2	No	
Measurement range ac. NAMUR I 3	No	
Measurement range ac. NAMUR I 4	No	
Measurement range ac. NAMUR I 5	No	
Measurement range ac. NAMUR I 6	No	
Measurement range ac. NAMUR I 7	No	

Default values in ***´bold´*** letters

*1) The parameters ´ Measurement range ac. NAMUR ´ are valid only for Input Signals!
The parameters are visible for all switchable AI/AO Signals but are without effect for the AO signals.

Signal type S0	Analog Input	**Analog Input** ****2)*** Analog Output
Signal type S1	Analog Input	
Signal type S2	Analog Input	
Signal type S3	Analog Input	
Signal type S4	Analog Input	
Signal type S5	Analog Input	
Signal type S6	Analog Input	
Signal type S7	Analog Input	

*2) The parameters ´**Signal type Sx**´ are available only for AI/AO switchable channels in the operating modes 9468/3x-08-xx 8AIH/8AOH (+4HV / +8HV)

Scan HART livelist	On	Off ***On***
Input No. HART device for pos. 1	Not used	0…7 ***´Not used´***
Input No. HART device for pos. 2	Not used	
Input No. HART device for pos. 3	Not used	
Input No. HART device for pos. 4	Not used	
Input No. HART device for pos. 5	Not used	
Input No. HART device for pos. 6	Not used	
Input No. HART device for pos. 7	Not used	
Input No. HART device for pos. 8	Not used	
No. HART variable for pos. 1	HART variable No. 2	HART variable No. 1 ***HART variable No. 2*** HART variable No. 3 HART variable No. 4
No. HART variable for pos. 2	HART variable No. 2	
No. HART variable for pos. 3	HART variable No. 2	
No. HART variable for pos. 4	HART variable No. 2	
No. HART variable for pos. 5	HART variable No. 2	
No. HART variable for pos. 6	HART variable No. 2	
No. HART variable for pos. 7	HART variable No. 2	
No. HART variable for pos. 8	HART variable No. 2	

Available only on HARTmodules (AIMH) !

3.2.3.3 UMH 9469 Exn

Parameter	Default value	Value range/selection
Diagnostic messages of the module	On	Off ***On***
Signal Filter	Medium	Small ***Medium*** Big (50 Hz) Big (60 Hz)
DI Pulse extension 1,2 s	Off	***Off*** On
Measurement range ac. NAMUR	No	***No*** ****1)*** Yes
Signal range	4-20 mA	0-20 mA **4-20 mA**
Signal in case of error I 0	AI Status Code / AO 0% / 0	-10 % (nur 4 mA) / 0 0 % / 0 100 % / 1 ***AI Status Code /*** AO110 % / 1 ***AI Status Code / AO 0% / 0*** freeze (initial value 0% / 0) freeze (initial value 100% / 1)
Signal in case of error I 1	AI Status Code / AO 0% / 0	
Signal in case of error I 2	AI Status Code / AO 0% / 0	
Signal in case of error I 3	AI Status Code / AO 0% / 0	
Signal in case of error I 4	AI Status Code / AO 0% / 0	
Signal in case of error I 5	AI Status Code / AO 0% / 0	
Signal in case of error I 6	AI Status Code / AO 0% / 0	
Signal in case of error I 7	AI Status Code / AO 0% / 0	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
Error detection I 2	On	
Error detection I 3	On	
Error detection I 4	On	
Error detection I 5	On	
Error detection I 6	On	
Error detection I 7	On	
Connection S 0	*2 wire analog*	***2 wire analog***
Connection S 1	*2 wire analog*	
Connection S 2	*2 wire analog*	
Connection S 3	*2 wire analog*	
Connection S 4	*2 wire analog*	***2 wire analog*** *3/4 wire analog (Input only)* digital
Connection S 5	*2 wire analog*	
Connection S 6	*2 wire analog*	
Connection S 7	*2 wire analog*	
Signal type S0	Input	**Input** ****2)*** Output
Signal type S1		
Signal type S2		
Signal type S3		
Signal type S4		
Signal type S5		
Signal type S6		
Signal type S7		

Scan HART Livelist	On	Off **On**	Available if HART variables (HV) are configured only.
Input No. HART device for pos. 1	Not used	0…7 ***´Not used´***	
. . .	. . .		
Input No. HART device for pos. 8	Not used		
No. HART variable for pos. 1	HART variable No. 2	HART variable No. 1 ***HART variable No. 2*** HART variable No. 3 HART variable No. 4	
. . .	. . .		
No. HART variable for pos. 8	HART variable No. 2		

Parameter dependency / impact

Signal	Parameter						
	Signal type	connection	Signal range	Error detection	Measurement range ac. NAMUR	Signal in case of error	Input Filter
2 wire 0/4-20 mA Input	Input	***2 wire analog***	0-20 / 4-20	On / Off	Yes / No	-10 % (nur 4 mA) / 0 0 % / 0 100 % / 1 ***AI Status Code /*** AO110 % / 1 ***AI Status Code / AO 0% / 0*** freeze (initial value 0% / 0) freeze (initial value 100% / 1)	Small ***Medium*** Big (50 Hz) Big (60 Hz)
2/3 wire Initiator Input	Input	2/3 wire digital	-		-		
3/4 wire 0/4-20 mA Input	Input	*3/4 wire analog (Input only)*	0-20 / 4-20		Yes / No		
2 wire 0/4-20 mA Output	Output	***2 wire analog***	0-20 / 4-20		-		-
Digital Output	Output	2/3 wire digital	-		-		-

*1) The parameter ´Measurement range ac. NAMUR ´ are effective for analog input signals only!

*2) The Parameter ´**Signal type**´ is available for switchable signals in the operating modes with 8I + 8O only.

3.2.3.4 TIMR 9480

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Input Filter	50 Hz	***50 Hz*** 60 Hz Off (not recommended)
Operation mode	8 inputs	***8 inputs*** 2 inputs
Signal in case of error I 0	Status code	***Status code*** freeze (initialization value 0%)
Signal in case of error I 1	Status code	
Signal in case of error I 2	Status code	
Signal in case of error I 3	Status code	
Signal in case of error I 4	Status code	
Signal in case of error I 5	Status code	
Signal in case of error I 6	Status code	
Signal in case of error I 7	Status code	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
Error detection I 2	On	
Error detection I 3	On	
Error detection I 4	On	
Error detection I 5	On	
Error detection I 6	On	
Error detection I 7	On	
Type I 0	Pt 100	***Pt100*** Pt500 Pt1000 Ni100 Ni500 Ni1000 Resistance 10k Resistance 5k Resistance 2k5 Resistance 500R Pt100 GOST M50 GOST } from Fw. V02-04 M100 GOST Cu53 GOST Pt46 GOST } from Fw. V02-05 Pt50 GOST
Type I 1	Pt 100	
Type I 2	Pt 100	
Type I 3	Pt 100	
Type I 4	Pt 100	
Type I 5	Pt 100	
Type I 6	Pt 100	
Type I 7	Pt 100	
Connection I 0	4 wire	2 wire 3 wire ***4 wire***
Connection I 1	4 wire	
Connection I 2	4 wire	
Connection I 3	4 wire	
Connection I 4	4 wire	
Connection I 5	4 wire	
Connection I 6	4 wire	
Connection I 7	4 wire	

3.2.3.5 TIM mV 9481

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Input Filter	50 Hz	***50 Hz*** 60 Hz
Signal in case of error I 0	Status code	***Status code*** freeze (initialization value 0%)
Signal in case of error I 1	Status code	
Signal in case of error I 2	Status code	
Signal in case of error I 3	Status code	
Signal in case of error I 4	Status code	
Signal in case of error I 5	Status code	
Signal in case of error I 6	Status code	
Signal in case of error I 7	Status code	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
Error detection I 2	On	
Error detection I 3	On	
Error detection I 4	On	
Error detection I 5	On	
Error detection I 6	On	
Error detection I 7	On	
Type I 0	THC Type K	0…100 mV THC Type B THC Type E THC Type J ***THC Type K*** THC Type N THC Type R THC Type S THC Type T THC Type L THC Type U THC Type XK (L)
Type I 1	THC Type K	
Type I 2	THC Type K	
Type I 3	THC Type K	
Type I 4	THC Type K	
Type I 5	THC Type K	
Type I 6	THC Type K	
Type I 7	THC Type K	
Input signal I 0	Balanced	***Balanced*** Unbalanced
Input signal I 1	Balanced	
Input signal I 2	Balanced	
Input signal I 3	Balanced	
Input signal I 4	Balanced	
Input signal I 5	Balanced	
Input signal I 6	Balanced	
Input signal I 7	Balanced	

3.2.3.6 TIM 9482

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Module operation mode	8 channel precise	**8 channel precise** 4 channel fast
Signal in case of error I 0	Status code	***Status code*** freeze (initialization value 0%)
Signal in case of error I 1	Status code	
. . .	. . .	
Signal in case of error I 6	Status code	
Signal in case of error I 7	Status code	
Error detection I 0	On	Off ***On***
Error detection I 1	On	
. . .	. . .	
Error detection I 6	On	
Error detection I 7	On	
Selection TC cold junction	Internal	**Internal** External 3 wire
Type TC ext. cold junction I6-I7	PT100	**PT100** PT1000 PT100 GOST
Type I 0	PT100	**Pt100** Pt500 Pt1000 Ni100 Ni500 Ni1000 Resistance (Pot) 10k Resistance (Pot) 5k Resistance (Pot) 2k5 Resistance (Pot) 500R Pt100 GOST M50 GOST M100 GOST Cu53 GOST Pt46 GOST Pt50 GOST 0…100 mV THC Type B THC Type E THC Type J THC Type K THC Type N THC Type R THC Type S THC Type T THC Type L THC Type U THC Type XK (L)
Type I 1	PT100	
Type I 2	PT100	
Type I 3	PT100	
Type I 4	PT100	
Type I 5	PT100	
Type I 6	PT100	
Type I 7	PT100	
Connection (R) I 0 *1)	*4 wire* measure (R in Ohm)	2 wire measure (Pot in Ohm) 3 wire measure (Pot in %) ***4 wire* measure (Pot in Ohm)** *4 wire* measure (Pot in %)
Connection (R) I 1	*4 wire* measure (R in Ohm)	
. . .	. . .	
Connection (R) I 6	*4 wire* measure (R in Ohm)	
Connection (R) I 7	*4 wire* measure (R in Ohm)	

*1) Parameter ´Connection´ using THC not functioning. 2 wire measurement is used for TCH

3.2.3.7 DIM (9470/3x in compatible mode)

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Signal in case of error I 0	0	***0*** 1 freeze (initial value 0) freeze (initial value 1)
Signal in case of error I 1		
. . . .		
Signal in case of error I 14		
Signal in case of error I 15		
Error detection I 0	On	Off ***On***
Error detection I 1		
. . . .		
Error detection I 14		
Error detection I 15		
Invert I 0	No	***No*** Yes
Invert I 1		
. . . .		
Invert I 14		
Invert I 15		
Pulse extension I 0	0 Sec.	***0 s*** 0.6 s 1.2 s 2.4 s
Pulse extension I 1		
. . . .		
Pulse extension I 14		
Pulse extension I 15		
Operation mode I 14	Freq. 0-1 kHz / DI	Counter ***Freq. 0-1 kHz / DI*** Freq. 0-20 kHz gate 50 ms / DI Freq. 0-20 kHz gate 200 ms / DI Freq. 0-20 kHz gate 1 s / DI
Counter event I 14	Positive edge	***Positive edge*** Negative edge
Operation mode I 15	Freq. 0-1 kHz / DI	s. a.
Counter event I 15	Positive edge	s. a.

Parameter not available for DIM 24 V ! (9471/...)

Parameters available only in the case of operating mode DIM16 + CF!

3.2.3.8 DIOM 9470/3x, 9471/35, 9472/35 (IS1+)

Parameter	Default value	Value range / selection		
Diagnostic messages of the module	On	Off ***On***		
Signal in case of error S 0 Signal in case of error S 1 Signal in case of error S 2 . . . . Signal in case of error S 14 Signal in case of error S 15	0	***0*** 1 freeze (initial value 0) freeze (initial value 1)		
Error detection S 0 Error detection S 1 Error detection S 2 . . . . Error detection S 14 Error detection S 15	On	Off ***On***		
Invert DI S0, S1 Invert DI S2, S3 Invert DI S4, S5 Invert DI S6, S7 Invert DI S8, S9 Invert DI S10, S11 Invert DI S12, S13 Invert DI S14, S15	No	***No*** Yes (affects DI signals only)		
Pulse extension / Filter S0, S1 Pulse extension / Filter S2, S3 Pulse extension / Filter S4, S5 Pulse extension / Filter S6, S7 Pulse extension / Filter S8, S9 Pulse extension / Filter S10, S11 Pulse extension / Filter S12, S13 Pulse extension / Filter S14, S15	0 Sec.	***0 s / Off*** 0,6 s / Small 1,2 s / Medium 2,4 s / Large		
Signal type S0, S1 Signal type S2, S3 Signal type S4, S5 Signal type S6, S7 Signal type S8, S9 Signal type S10, S11 Signal type S12, S13 Signal type S14, S15	Input	**9470/3x** **Input** Output	**9471/35, 9472/35** **NAMUR Ini/ contact** 3-wire Initiator PNP Output	Parameters available only in the case of operating mode with DI/DO
Operation mode S8, S9 Operation mode S10, S11 Operation mode S12, S13 Operation mode S14, S15	Freq. 1Hz - 3kHz (0,05Hz/Bit)	0 = Counter 16 Bit 1 = Freq. 0,1 - 600 Hz (0,01Hz/Bit) **2 = Freq. 1 Hz - 3 kHz (0,05Hz/Bit)** 3 = Freq. 1 Hz - 20 kHz (0,5Hz/Bit) 4 = Up/Down Counter 16 Bit 5 = Up/Down Counter 32 Bit 6 = Freq. 1 Hz - 20 kHz with direction		Parameters available only in the case of operating mode with CF (counter/frequency)
Counter event S8, S9 Counter event S10, S11 Counter event S12, S13 Counter event S14, S15	Positive edge	***Positive edge*** Negative edge		

3.2.3.9 AOM / AOMH 9466

Parameter	Default value	Value range / selection
Diagnostic messages of the module	On	Off ***On***
Signal in case of error O 0	0 %	-10 % (4 mA only) ***0 %*** 100 % 110 % freeze
Signal in case of error O 1	0 %	
Signal in case of error O 2	0 %	
Signal in case of error O 3	0 %	
Signal in case of error O 4	0 %	
Signal in case of error O 5	0 %	
Signal in case of error O 6	0 %	
Signal in case of error O 7	0 %	
Error detection O 0	On	Off ***On***
Error detection O 1	On	
Error detection O 2	On	
Error detection O 3	On	
Error detection O 4	On	
Error detection O 5	On	
Error detection O 6	On	
Error detection O 7	On	
Output range O 0	4…20 mA	0…20 mA ***4…20 mA***
Output range O 1	4…20 mA	
Output range O 2	4…20 mA	
Output range O 3	4…20 mA	
Output range O 4	4…20 mA	
Output range O 5	4…20 mA	
Output range O 6	4…20 mA	
Output range O 7	4…20 mA	
Scan HART livelist	On	Off ***On***
Output No. HART device for pos. 1	Not used	0…7 ***Not used***
Output No. HART device for pos. 2	Not used	
Output No. HART device for pos. 3	Not used	
Output No. HART device for pos. 4	Not used	
Output No. HART device for pos. 5	Not used	
Output No. HART device for pos. 6	Not used	
Output No. HART device for pos. 7	Not used	
Output No. HART device for pos. 8	Not used	
No. HART variable for pos. 1	HART variable No. 2	HART variable No. 1 ***HART variable No. 2*** HART variable No. 3 HART variable No. 4
No. HART variable for pos. 2	HART variable No. 2	
No. HART variable for pos. 3	HART variable No. 2	
No. HART variable for pos. 4	HART variable No. 2	
No. HART variable for pos. 5	HART variable No. 2	
No. HART variable for pos. 6	HART variable No. 2	
No. HART variable for pos. 7	HART variable No. 2	
No. HART variable for pos. 8	HART variable No. 2	

Available only on HART modules (AOMH) !

3.2.3.10 DOM

Parameter	Default value	Value range / selection	Parameter available		
			DOM	DOMR	DOMV
Diagnostic messages of the module	On	Off ***On***	✓	✓	✓
Signal in case of error O 0	0	***0*** 1 Freeze	✓	✓	✓
Signal in case of error O 1	0				
Signal in case of error O 2	0				
Signal in case of error O 3	0				
Signal in case of error O 4	0				
Signal in case of error O 5	0				
Signal in case of error O 6	0				
Signal in case of error O 7	0				
Error detection O 0	On	Off On without test current ***On***	✓	-	-
Error detection O 1	On				
Error detection O 2	On				
Error detection O 3	On				
Error detection O 4	On				
Error detection O 5	On				
Error detection O 6	On				
Error detection O 7	On				
Output 0 and 1 parallel	Outputs separate	***Outputs separate*** Outputs parallel	✓	✓	-
Output 2 and 3 parallel	Outputs separate				
Output 4 and 5 parallel	Outputs separate				
Output 6 and 7 parallel	Outputs separate				

3.2.4 Bit coding of IO-Module parameters

3.2.4.1 AIM / AIMH / AUMH (SAIMH see operating instruction SAIMH 9462/... PROFIsafe)

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	13								1	Diagnostic messages of the module	0 =Off ***1 = On***
						0	0	1		Input Filter	0 = small ***1 = medium*** 2 = big (50 Hz) 3 = big (60 Hz)
					1					Scan HART Livelist	0 = Off ***1 = On***
		0	0	0						Not used	
1	BB						0	1	1	Signal in case of error S 0	0 = -10 % (4 mA only) 1 = 0 % 2 = 100 % ***3 = AI Status code / AO 110%*** *(def. AIM)* ***4 = AI Status code / AO 0%*** *(def. AUM)* 6 = freeze (initial value 0%) 7 = freeze (initial value 100%)
						1				Error detection S 0	0 = Off ***1 = On***
			0	1	1					Signal in case of error S 1	
		1								Error detection S 1	
2	BB						0	1	1	Signal in case of error S 2	
						1				Error detection S 2	
			0	1	1					Signal in case of error S 3	
		1								Error detection S 3	
3	BB						0	1	1	Signal in case of error S 4	s. a.
						1				Error detection S 4	
			0	1	1					Signal in case of error S 5	
		1								Error detection S 5	
4	BB						0	1	1	Signal in case of error S 6	
						1				Error detection S 6	
			0	1	1					Signal in case of error S 7	
		1								Error detection S 7	
5	FF								1	Input range S 0	0 = 0…20 mA ***1 = 4…20 mA***
								1		Input range S 1	
							1			Input range S 2	
						1				Input range S 3	
					1					Input range S 4	
				1						Input range S 5	
			1							Input range S 6	
		1								Input range S 7	
6	00								0	Measurement range ac. NAMUR I 0	***0 = No*** 1 = Yes
								0		Measurement range ac. NAMUR I 1	
							0			Measurement range ac. NAMUR I 2	
						0				Measurement range ac. NAMUR I 3	
					0					Measurement range ac. NAMUR I 4	
				0						Measurement range ac. NAMUR I 5	
			0							Measurement range ac. NAMUR I 6	
		0								Measurement range ac. NAMUR I 7	
7	88					1	0	0	0	Input No. HART device for pos. 1	0…7 ***8 = ´not used´*** (9 – 15 Reserved)
		1	0	0	0					Input No. HART device for pos. 2	
8	88					1	0	0	0	Input No. HART device for pos. 3	
		1	0	0	0					Input No. HART device for pos. 4	
9	55							0	1	No. HART variable for pos. 1	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 2	
				0	1					No. HART variable for pos. 3	
		0	1							No. HART variable for pos. 4	
10	88					1	0	0	0	Input No. HART device for pos. 5	0…7 ***8 = ´ not used ´*** (9 – 15 Reserved)
		1	0	0	0					Input No. HART device for pos. 6	
11	88					1	0	0	0	Input No. HART device for pos. 7	
		1	0	0	0					Input No. HART device for pos. 8	
12	55							0	1	No. HART variable for pos. 5	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 6	
				0	1					No. HART variable for pos. 7	
		0	1							No. HART variable for pos. 8	
13	00								0	Signal type S 0	**0 = Analog Input** *1 = Analog Output* ***(9468/3x only)***
								0		Signal type S 1	
							0			Signal type S 2	
						0				Signal type S 3	
					0					Signal type S 4	
				0						Signal type S 5	
			0							Signal type S 6	
		0								Signal type S 7	

3.2.4.2 UMH 9469

Byte	Hex	7	6	5	4	3	2	1	0	Bezeichnung	Wert
0	53								1	Diagnostic messages of the module	0 =Off ***1 = On***
						0	0	1		Input Filter	0 = small ***1 = medium*** 2 = big (50 Hz) 3 = big (60 Hz)
					1					Scan HART Livelist	0 = Off ***1 = On***
				0						Measurement range ac. NAMUR	***0 = No*** 1 = Yes
			1							Signal range	0 = 0-20 mA **1 = 4-20 mA**
		0								DI Pulse extension 1,2 s	***0 =Off*** 1 = On
1	CC						1	0	0	Signal in case of error S 0	0 = -10 % (live zero only) / 0 1 = 0 % / 0 2 = 100 % / 1 3 = AI Status Code / AO 110% / 1 ***4 = AI Status Code / AO 0% / 0*** 6 = freeze (initial value 0% / 0) 7 = freeze (initial value 100% / 1)
						1				Error detection S 0	0 = Off ***1 = On***
			1	0	0					Signal in case of error S 1	
		1								Error detection S 1	
2	CC						1	0	0	Signal in case of error S 2	
						1				Error detection S 2	
			1	0	0					Signal in case of error S 3	
		1								Error detection S 3	
3	CC						1	0	0	Signal in case of error S 4	s. a.
						1				Error detection S 4	
			1	0	0					Signal in case of error S 5	
		1								Error detection S 5	
4	CC						1	0	0	Signal in case of error S 6	
						1				Error detection S 6	
			1	0	0					Signal in case of error S 7	
		1								Error detection S 7	
5	00							0	0	Connection S0	***0 = 2 wire analog*** 1-3 = Reserved
						0	0			Connection S1	
				0	0					Connection S2	
		0	0							Connection S3	
6	00							0	0	Connection S4	***0 = 2 wire analog*** 1 = 3/4 wire analog (Input only) 2 = 2/3 wire digital 3 = Reserved
						0	0			Connection S5	
				0	0					Connection S6	
		0	0							Connection S7	
7	88					1	0	0	0	Input No. HART device for pos. 1	0…7 ***8 = ´not used´*** (9 – 15 Reserved)
		1	0	0	0					Input No. HART device for pos. 2	
8	88					1	0	0	0	Input No. HART device for pos. 3	
		1	0	0	0					Input No. HART device for pos. 4	
9	55							0	1	No. HART variable for pos. 1	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 2	
				0	1					No. HART variable for pos. 3	
		0	1							No. HART variable for pos. 4	
10	88					1	0	0	0	Input No. HART device for pos. 5	0…7 ***8 = ´ not used´*** (9 – 15 Reserved)
		1	0	0	0					Input No. HART device for pos. 6	
11	88					1	0	0	0	Input No. HART device for pos. 7	
		1	0	0	0					Input No. HART device for pos. 8	
12	55							0	1	No. HART variable for pos. 5	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 6	
				0	1					No. HART variable for pos. 7	
		0	1							No. HART variable for pos. 8	
13	00								0	Signal type S 0	**0 = Input**
								0		Signal type S 1	*1 = Output*
										…	
		0								Signal type S 7	

Signal in case of error for DI/DO: 0%, -10% = 0,
100%, 110% = 1

3.2.4.3 TIMR 9480

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	01								1	Diagnostic messages of the module	0 = Off ***1 = On***
							0	0		Input Filter	***0 = 50 Hz*** 1 = 60 Hz 2 =Off (not recommended)
						0				not used	
					0					Operation mode	***0 = 8 inputs*** 1 = 2 inputs
		0	0	0						not used	
1	BB						0	1	1	Signal in case of error I 0	***3 = Status code*** 6 = freeze (Init. value 0%)
						1				Error detection I 0	0 = Off ***1 = On***
			0	1	1					Signal in case of error I 1	
		1								Error detection I 1	
2	BB						0	1	1	Signal in case of error I 2	
						1				Error detection I 2	
			0	1	1					Signal in case of error I 3	
		1								Error detection I 3	
3	BB						0	1	1	Signal in case of error I 4	
						1				Error detection I 4	
			0	1	1					Signal in case of error I 5	
		1								Error detection I 5	
4	BB						0	1	1	Signal in case of error I 6	
						1				Error detection I 6	
			0	1	1					Signal in case of error I 7	
		1								Error detection I 7	
5	AA							1	0	Connection I 0	0 = 2 wire 1 = 3 wire ***2 = 4 wire***
						1	0			Connection I 1	
				1	0					Connection I 2	
		1	0							Connection I 3	
6	AA							1	0	Connection I 4	
						1	0			Connection I 5	
				1	0					Connection I 6	
		1	0							Connection I 7	
7	00					0	0	0	0	Type I 0	***0 = Pt100*** 1 = Pt500 2 = Pt1000 3 = Ni100 4 = Ni500 5 = Ni1000 6 = Resistance 10k 7 = Resistance 5k 8 = Resistance 2k5 9 = Resistance 500R 10 = Pt100 GOST 11 = M50 GOST } from Fw. V02-04 12 = M100 GOST 13 = Cu53 GOST 14 = Pt46 GOST } from Fw. V02-05 15 = Pt50 GOST
		0	0	0	0					Type I 1	
8	00					0	0	0	0	Type I 2	
		0	0	0	0					Type I 3	
9	00					0	0	0	0	Type I 4	
		0	0	0	0					Type I 5	
10	00					0	0	0	0	Type I 6	
		0	0	0	0					Type I 7	
11 ..13	00									not used	

3.2.4.4 TIM mV 9481

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	01								1	Diagnostic messages of the module	0 = Off ***1 = On***
								0		Input Filter	***0 = 50 Hz*** 1 = 60 Hz
		0	0	0	0	0	0			Not used	
1	BB						0	1	1	Signal in case of error I 0	***3 = Status code*** 6 = freeze (Init. value 0%)
						1				Error detection I 0	0 = Off ***1 = On***
			0	1	1					Signal in case of error I 1	
		1								Error detection I 1	
2	BB						0	1	1	Signal in case of error I 2	
						1				Error detection I 2	
			0	1	1					Signal in case of error I 3	
		1								Error detection I 3	
3	BB						0	1	1	Signal in case of error I 4	
						1				Error detection I 4	
			0	1	1					Signal in case of error I 5	
		1								Error detection I 5	
4	BB						0	1	1	Signal in case of error I 6	
						1				Error detection I 6	
			0	1	1					Signal in case of error I 7	
		1								Error detection I 7	
5	00								0	Input signal I 0	***0 = Balanced*** 1 = Unbalanced
								0		Input signal I 1	
							0			Input signal I 2	
						0				Input signal I 3	
					0					Input signal I 4	
				0						Input signal I 5	
			0							Input signal I 6	
		0								Input signal I 7	
6	44						0	1	0	0	Type I 0	0 = 0…100 mV 1 = THC Type B 2 = THC Type E 3 = THC Type J ***4 = THC Type K*** 5 = THC Type N 6 = THC Type R 7 = THC Type S 8 = THC Type T 9 = THC Type L 10 = THC Type U 11 = THC Type XK (L) (12…15 = reserved)
		0	1	0	0					Type I 1	
7	44						0	1	0	0	Type I 2	
		0	1	0	0					Type I 3	
8	44						0	1	0	0	Type I 4	
		0	1	0	0					Type I 5	
9	44						0	1	0	0	Type I 6	
		0	1	0	0					Type I 7	
10 .. 13	00									Not used	

3.2.4.5 TIM 9482

Byte	Default [Hex]	7	6	5	4	3	2	1	0	Parameter	Value
0	01								1	Diagnostic messages of the module	0 = Off **1 = On**
								0		Module operation mode	**0 = 8 channel precise** 1 = channel fast
		0	0	0	0	0	0			Reserviert	
1	BB						0	1	1	Signal in case of error I 0	***3 = Status Code*** 6 = freeze (initialization value 0%)
						1				Error detection I 0	0 = Off ***1 = On***
			0	1	1					Signal in case of error I 1	
		1								Error detection I 1	
2	BB									I 2 see Byte 1	
										I 3 see Byte 1	
3	BB									I 4 see Byte 1	
										I 5 see Byte 1	
4	BB						0	1	1	Signal in case of error I 6	
						1				Error detection I 6	
			0	1	1					Signal in case of error I 7	
		1								Error detection I 7	
5	00								0	Selection TC cold junction	**0 = Internal** 1 = External 3 wire
								0			
							0			Type TC ext. cold junction I6-I7	**0 = PT100** 1 = PT1000 2 = PT100 GOST
						0					
					0					Reserviert	
				0						Reserviert	
			0							Reserviert	
		0								Reserviert	
6	80			0	0	0	0	0	0	Type I 0	***Type :*** ***0 = Pt100*** 1 = Pt500 2 = Pt1000 3 = Ni100 4 = Ni500 5 = Ni1000 6 = Resistance (Pot)10k 7 = Resistance (Pot) 5k 8 = Resistance (Pot) 2k5 9 = Resistance (Pot) 500R 10 = Pt100 GOST 11 = M50 GOST 12 = M100 GOST 13 = Cu53 GOST 14 = Pt46 GOST 15 = Pt50 GOST *(16…31 = reserved)* 32 = 0…100 mV 33 = THC Type B 34 = THC Type E 35 = THC Type J *36 = THC Type K* 37 = THC Type N 38 = THC Type R 39 = THC Type S 40 = THC Type T 41 = THC Type L 42 = THC Type U 43 = THC Type XK(L) *(44…63 = reserved)* **Connection (R):** *1) 0 = 2 wire measure (Pot in Ohm) 1 = 3 wire measure (Pot in %) **2 = 4 wire measure (Pot in Ohm)** 3 = 4 wire measure (Pot in %)
		1	0							Connection (R) I 0	
7	80			0	0	0	0	0	0	Type I 1	
		1	0							Connection (R) I 1	
8	80			0	0	0	0	0	0	Type I 2	
		1	0							Connection (R) I 2	
9	80			0	0	0	0	0	0	Type I 3	
		1	0							Connection (R) I 3	
10	80			0	0	0	0	0	0	Type I 4	
		1	0							Connection (R) I 4	
11	80			0	0	0	0	0	0	Type I 5	
		1	0							Connection (R) I 5	
12	80			0	0	0	0	0	0	Type I 6	
		1	0							Connection (R) I 6	
13	80			0	0	0	0	0	0	Type I 7	
		1	0							Connection (R) I 7	

*1) Parameter ´Connection´ using THC not functioning. 2 wire measurement is used for TCH

3.2.4.6 DIM (9470/3x in compatible mode)

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	01								1	Diagnostic messages of the module	0 = Off ***1 = On***
		0	0	0	0	0	0	0		Not used	
1	FF								1	Error detection I 0	0 = Off ***1 = On***
								1		Error detection I 1	
							1			Error detection I 2	
						1				Error detection I 3	
					1					Error detection I 4	
				1						Error detection I 5	
			1							Error detection I 6	
		1								Error detection I 7	
2	FF								1	Error detection I 8	
			1	1	1	1	1	1		...	
		1								Error detection I 15	
3	00							0	0	Signal in case of error I 0	***0 = 0*** 1 = 1 2 = freeze (initial value 0) 3 = freeze (initial value 1)
						0	0			Signal in case of error I 1	
				0	0					Signal in case of error I 2	
		0	0							Signal in case of error I 3	
4	00							0	0	Signal in case of error I 4	
				0	0	0	0			...	
		0	0							Signal in case of error I 7	
5	00							0	0	Signal in case of error I 8	
				0	0	0	0			...	
		0	0							Signal in case of error I 11	
6	00							0	0	Signal in case of error I 12	
				0	0	0	0			...	
		0	0							Signal in case of error I 15	
7	00							0	0	Pulse extension I 0	***0 = 0 s*** 1 = 0,6 s 2 = 1,2 s 3 = 2,4 s
						0	0			Pulse extension I 1	
				0	0					Pulse extension I 2	
		0	0							Pulse extension I 3	
8	00							0	0	Pulse extension I 4	
				0	0	0	0			...	
		0	0							Pulse extension I 7	
9	00							0	0	Pulse extension I 8	
				0	0	0	0			...	
		0	0							Pulse extension I 11	
10	00							0	0	Pulse extension I 12	
				0	0	0	0			...	
		0	0							Pulse extension I 15	
11	00								0	Invert I 0	***0 = no*** 1 = yes
								0		Invert I 1	
							0			Invert I 2	
						0				Invert I 3	
					0					Invert I 4	
				0						Invert I 5	
			0							Invert I 6	
		0								Invert I 7	
12	00								0	Invert I 8	
			0	0	0	0	0	0		...	
		0								Invert I 15	
13	11						0	0	1	Operation mode I 14	0 =counter ***1 = Freq. 0-1 kHz / DI*** 2 = Freq. 0-20 kHz gate 50 ms / DI 3 = Freq. 0-20 kHz gate 200 ms / DI 4 = Freq. 0-20 kHz gate 1 s / DI
						0				Counter event I 14	***0 = Positive edge*** 1 = Negative edge
			0	0	1					Operation mode I 15	s. a.
		0								Counter event I 15	

3.2.4.7 DIOM 9470/3x, 9471/35, 9472/35 (IS1+)

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value	
0	01								1	Diagnostic messages of the module	0 = Off ***1 = On***	
		0	0	0	0	0	0	0		Not used		
1	FF								1	Error detection I 0	0 = Off ***1 = On***	
								1		Error detection I 1		
							1			Error detection I 2		
						1				Error detection I 3		
					1					Error detection I 4		
				1						Error detection I 5		
			1							Error detection I 6		
		1								Error detection I 7		
2	FF								1	Error detection I 8		
			1	1	1	1	1	1		...		
		1								Error detection I 15		
3	00							0	0	Signal in case of error I 0	***0 = 0*** 1 = 1 2 = freeze (initial value 0) 3 = freeze (initial value 1)	
						0	0			Signal in case of error I 1		
				0	0					Signal in case of error I 2		
		0	0							Signal in case of error I 3		
4	00							0	0	Signal in case of error I 4		
				0	0	0	0			...		
		0	0							Signal in case of error I 7		
5	00							0	0	Signal in case of error I 8		
				0	0	0	0			...		
		0	0							Signal in case of error I 11		
6	00							0	0	Signal in case of error I 12		
				0	0	0	0			...		
		0	0							Signal in case of error I 15		
7	00							0	0	Pulse extension / Filter S0, S1	***0 = 0 s / Off*** 1 = 0,6 s / Small 2 = 1,2 s / Medium 3 = 2,4 s / Large	
						0	0			Pulse extension / Filter S2, S3		
				0	0					Pulse extension / Filter S4, S5		
		0	0							Pulse extension / Filter S6, S7		
8	00							0	0	Pulse extension / Filter S8, S9		
				0	0	0	0			...		
		0	0							Pulse ext. / Filter S14, S15		
9	00							0	0	Signal type S0, S1	**9470/3x**	**9471/35, 9472/35**
				0	0	0	0			. . . .		
		0	0							Signal type S6, S7	**0=Input** 1=Output 2=(Reserved) 3=(Reserved)	**0 = NAMUR Ini/ contact** 1 = 3-wire Initiator PNP 2 = Output 3 = (Reserved)
10	00							0	0	Signal type S8, S9		
				0	0	0	0			. . . .		
		0	0							Signal type S14, S15		
11	00								0	Invert DI S0, S1	***0 = No*** 1 = invert (affects DI signals only)	
								0		Invert DI S2, S3		
				0	0	0	0			. . . .		
			0							Invert DI S12, S13		
		0								Invert DI S14, S15		
12	22						0	1	0	Operation mode S8, S9	0 = Counter 16 Bit 1 = Freq. 0,1 - 600 Hz (0,01Hz/Bit) **2 = Freq. 1 Hz - 3 kHz (0,05Hz/Bit)** 3 = Freq. 1 Hz - 20 kHz (0,5Hz/Bit) 4 = Up/Down Counter 16 Bit 5 = Up/Down Counter 32 Bit 6 = Freq. 1 Hz - 20 kHz with direction	
						0				Counter event S8, S9	***0 = Positive edge*** 1 = Negative edge	
			0	1	0					Operation mode S10, S11	**s. a.**	
		0								Counter event S10, S11		
13	22						0	1	0	Operation mode S12, S13	s. a.	
						0				Counter event S12, S13		
			0	1	0					Operation mode S14, S15	s. a.	
		0								Counter event S14, S15		

3.2.4.8 AOM / AOMH 9466

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	11								1	Diagnostic messages of the module	0 = Off ***1 = On***
						0	0	0		not used	
					1					Scan HART Livelist	0 = Off ***1 = On***
		0	0	0						not used	
1	99						0	0	1	Signal in case of error O 0	0 = -10 % (4 mA only) ***1 = 0 %*** 2 = 100 % 3 = 110 % 7 = freeze
						1				Error detection O 0	0 = Off ***1 = On***
			0	0	1					Signal in case of error O 1	
		1								Error detection O 1	
2	99						0	0	1	Signal in case of error O 2	
						1				Error detection O 2	
			0	0	1					Signal in case of error O 3	
		1								Error detection O 3	s. a.
3	99						0	0	1	Signal in case of error O 4	
						1				Error detection O 4	
			0	0	1					Signal in case of error O 5	
		1								Error detection O 5	
4	99						0	0	1	Signal in case of error O 6	
						1				Error detection O 6	
			0	0	1					Signal in case of error O 7	
		1								Error detection O 7	
5	FF								1	Output range O 0	0 = 0…20 mA ***1 = 4…20 mA***
								1		Output range O 1	
							1			Output range O 2	
						1				Output range O 3	
					1					Output range O 4	
				1						Output range O 5	
			1							Output range O 6	
		1								Output range O 7	
6	88					1	0	0	0	Output No. HART device for pos. 1	0…7 ***8 = ´Not used´*** (9 – 15 Reserved)
		1	0	0	0					Output No. HART device for pos. 2	
7	88					1	0	0	0	Output No. HART device for pos. 3	
		1	0	0	0					Output No. HART device for pos. 4	
8	55							0	1	No. HART variable for pos. 1	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 2	
				0	1					No. HART variable for pos. 3	
		0	1							No. HART variable for pos. 4	
9	88					1	0	0	0	Output No. HART device for pos. 5	0…7 ***8 = ´ Not used ´*** (9 – 15 Reserved)
		1	0	0	0					Output No. HART device for pos. 6	
10	88					1	0	0	0	Output No. HART device for pos. 7	
		1	0	0	0					Output No. HART device for pos. 8	
11	55							0	1	No. HART variable for pos. 5	0 = HART Variable No. 1 ***1 = HART Variable No. 2*** 2 = HART Variable No. 3 3 = HART Variable No. 4
						0	1			No. HART variable for pos. 6	
				0	1					No. HART variable for pos. 7	
		0	1							No. HART variable for pos. 8	
12 .. 13	00									Not used	

3.2.4.9 DOM

Byte	Hex	7	6	5	4	3	2	1	0	Parameter	Value
0	01								1	Diagnostic messages of the module	0 = Off ***1 = On***
		0	0	0	0	0	0	0		Not used	
1	00						0	0	0	Signal in case of error O 0	***0 = 0*** 1 = 1 2 = Freeze
						0				Not used	
			0	0	0					Signal in case of error O 1	
		0								Not used	
2	00						0	0	0	Signal in case of error O 2	
						0				Not used	
			0	0	0					Signal in case of error O 3	
		0								Not used	
3	00						0	0	0	Signal in case of error O 4	
						0				Not used	
			0	0	0					Signal in case of error O 5	
		0								Not used	
4	00						0	0	0	Signal in case of error O 6	
						0				Not used	
			0	0	0					Signal in case of error O 7	
		0								Not used	
5	AA							1	0	Error detection O 0	0 = Off 1 = On without test current ***2 = On***
						1	0			Error detection O 1	
				1	0					Error detection O 2	
		1	0							Error detection O 3	
6	AA							1	0	Error detection O 4	
						1	0			Error detection O 5	
				1	0					Error detection O 6	
		1	0							Error detection O 7	
7	00								0	Output 0 and 1 parallel	***0 = Outputs separate*** 1 = Outputs parallel
								0		Output 2 and 3 parallel	
							0			Output 4 and 5 parallel	
						0				Output 6 and 7 parallel	
		0	0	0	0					Not used	
8 .. 13	00									Not used	

3.3 Data word structure of the I/O modules

3.3.1 Analog modules

(SAIMH see operating instruction SAIMH 9462/... PROFIsafe)

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.

3.3.1.1 AIM, AIMH (9460/..., 9461/..., 9468/…, 9469/…)

Measuring range 0 – 20 mA	Units		%	Parameter: Measurement range limits according NAMUR	Range	Diagnosis messages
	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	27648 13824 0	6C00 3600 0	100% 50% 0%		Nominal range	-
< 0 mA	0	0	0%			

Measuring range 4 – 20 mA	Units		%	Parameter: Measurement range limits according NAMUR	Range	Diagnosis messages
	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 parameterized behavior if an error occurs:**

Parameterized behavior if an error occurs	Type of error	Value transmitted if an error occurs	
freeze	All IO-Module errors	Last valid value	
-10%		-2765	0xF533
0%		0	0x0000
100%		27648	0x6C00
Status code 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 Behavior of input signals in case of error	Short circuit	32767	0x7FFF
	Open circuit	-32762	0x8006
	2 wire calibration failed	-32749	0x8013
	Parametrization error	-32748	0x8014
	Plant Stop	-32747	0x8015
	IO-Module does not respond	-32736	0x8020
	Config. unequal from module	-32735	0x8021
	Data not available	-32734	0x8022
	IO-Module hardware error	-32733	0x8023

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.
For 9468 AUMH the parameters ´ Measurement range ac. NAMUR ´ are valid for Input Signals only!
The parameters are visible for all switchable AI/AO Signals but are without effect for the AO signals.

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´.

Data word structure cyclic analog data AIM 9460/…, AIMH 9461/…, AUMH 9468/.. (No Stat) without Signal Status

<table>
<tr><th rowspan="2">Data</th><th rowspan="2">Byte</th><th colspan="3">Operation mode</th><th rowspan="2">Var. Type</th><th rowspan="2">Signals</th></tr>
<tr><th>8AI</th><th>8AI+4HV</th><th>8AI+8HV</th></tr>
<tr><td rowspan="16">Input</td><td>1 – 2</td><td></td><td>AI0</td><td></td><td rowspan="8">INT16</td><td rowspan="8">Analog Input signals AI0 – AI7</td></tr>
<tr><td>3 - 4</td><td></td><td>AI1</td><td></td></tr>
<tr><td>5 – 6</td><td></td><td>AI2</td><td></td></tr>
<tr><td>7 – 8</td><td></td><td>AI3</td><td></td></tr>
<tr><td>9 – 10</td><td></td><td>AI4</td><td></td></tr>
<tr><td>11 – 12</td><td></td><td>AI5</td><td></td></tr>
<tr><td>13 – 14</td><td></td><td>AI6</td><td></td></tr>
<tr><td>15 – 16</td><td></td><td>AI7</td><td></td></tr>
<tr><td>17 – 20</td><td rowspan="8">-</td><td colspan="2">HV-P1</td><td rowspan="8">Float 32</td><td rowspan="8">HART Variables transmitted on positions P1 - P8</td></tr>
<tr><td>21 – 24</td><td colspan="2">HV-P2</td></tr>
<tr><td>25 – 28</td><td colspan="2">HV-P3</td></tr>
<tr><td>29 – 32</td><td colspan="2">HV-P4</td></tr>
<tr><td>33 – 36</td><td rowspan="4">-</td><td>HV-P5</td></tr>
<tr><td>37 – 40</td><td>HV-P6</td></tr>
<tr><td>41 – 44</td><td>HV-P7</td></tr>
<tr><td>45 – 48</td><td>HV-P8</td></tr>
</table>

Data word structure cyclic data AUMH 9468/… and UMH 9469/.. with Signal Status

9468:		8AI	8AO	6AI+2AO	8AI/8AO	8AI +4HV	8AO +4HV	8AI/8AO +4HV	8AI +8HV	8AO +8HV	8AI/8AO +8HV
9469:		8I	8O	6I+2O	8I/8O	8I +4HV	8O +4HV	8I/8O +4HV	8I +8HV	8O +8HV	8I/8O +8HV
Data	**Byte**	**Operation mode**									
Input	1	I0	S0 - S7	I0	I0	I0	S0 - S7	I0	I0	S0 - S7	I0
	2		0				0			0	
	3	I1		I1	I1	I1	HV-P1	I1	I1	HV-P1	I1
	4										
	5	I2		I2	I2	I2		I2	I2		I2
	6										
	7	I3		I3	I3	I3	HV-P2	I3	I3	HV-P2	I3
	8										
	9	I4		I4	I4	I4		I4	I4		I4
	10										
	11	I5		I5	I5	I5	HV-P3	I5	I5	HV-P3	I5
	12										
	13	I6		S0-S7	I6	I6		I6	I6		I6
	14			0							
	15	I7			I7	I7	HV-P4	I7	I7	HV-P4	I7
	16										
	17	S0 - S7			S0 - S7	S0 - S7		S0 - S7	S0 -		S0 - S7
	18	0			0	0		0	0		0
	19 - 22	-		-	-	HV-P1	-	HV-P1	HV-P1	HV-P5	HV-P1
	23 - 26					HV-P2		HV-P2	HV-P2	HV-P6	HV-P2
	27 - 30					HV-P3		HV-P3	HV-P3	HV-P7	HV-P3
	31 - 34					HV-P4		HV-P4	HV-P4	HV-P8	HV-P4
	35 - 38					-		-	HV-P5	-	HV-P5
	39 - 42								HV-P6		HV-P6
	43 - 46								HV-P7		HV-P7
	47 - 50		-						HV-P8		HV-P8
Output	1-2	-	O0	O6	O0	-	O0	O0	-	O0	O0
	3-4		O1	O7	O1		O1	O1		O1	O1
	5-6		O2	-	O2		O2	O2		O2	O2
	7-8		O3		O3		O3	O3		O3	O3
	9-10		O4		O4		O4	O4		O4	O4
	11-12		O5		O5		O5	O5		O5	O5
	13-14		O6		O6		O6	O6		O6	O6
	15-16		O7		O7		O7	O7		O7	O7

Readback: In all 8AI/8AO operation modes using channel parameterization as AO the written output value can be read via the associated AI signal (Readback). Using channel parameterization as AI, written dedicated AO signals have no effect.

Variable	Type	Hint		
AI/AO I0-I7 / O0-O7	INT16	scaling see above		
DI/DO I0-I7 / O0-O7 (9469/..)	INT16	DI: 0 = Off, 1 = On DO: <=0 = Off, >0 = On		
Status S0 – S7	UINT16	**Status Bit**	**Signal**	**Status**
		0	disturbed	❌
		1	OK	✅
HART variables HV	Float 32	HART Variables (HV-Px) are transmitted on positions P1 to P8		

3.3.1.2 TIM (9480/... , 9481/..., 9482/…)

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

Temperature	Units		Range	Diagnosis messages
	Decimal	hexadecimal		
	*1)	*1)		Line break / Upper limit exceeded
*2) . 1000 °C . 1 °C . 0 °C	*2) . 10000 . 10 . 0	*2) . 2710 . 000A . 0	Temperature measurement range	
-0,1 °C . -100 °C . *2)	-1 . -1000 . *2)	FFFF . FC18 . *2)		
	*1)	*1)		Lower limit exceeded / short circuit

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

2 wire and 4 wire Resistance Measurement Pot in Ohm 500 R ...10K (module 9480 /.. , 9482/..)

Range				Units		%	Range	Diagnosis messages
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 250 R 0 K	2 K 5 1K250 0 K	5 K 2K5 0 K	10 K . 5 K . 0 K	27648 . 13824 . 0	6C00 . 3600 . 0	100% 50% 0%	Nominal range	-

3 wire and 4 wire Resistance Position Measurement Pot in % 500 R...10K (module 9480/.. , 9482/..)

Range				Units		%	Range	Diagnosis messages
500R	2K5	5 K	10 K	decimal	hexadecimal			
>588 R	>2,94 K	>5,88 K	>11,76K	*1)	*1)			Line break
position 100 % . position 50 % . position 0 %				27648 . 13824 . 0	6C00 . 3600 . 0	100% 50% 0%	Nominal range	-
< 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

Hint: 9480 supports no 4 wire Resistance Position Measurement in %.

0 ... 100 mV measurement (9481/.., 9482/..)

Range 0 ... 100 mV	Units decimal	Units hexadecimal	%	Range	Diagnosis messages
>117,6 mV	*1)	*1)			Upper limit exceeded
117,6 mV	32511	7EFF	117,6 %	Over range	-
100 mV . 50 mV . 0 mV	27648 . 13824 . 0	6C00 . 3600 . 0	100 % 50 % 0 %	Nominal range	-
-0,0036 mV -10 mV -117,6 mV	-1 -2765 -32511	FFFF F533 8101	 -10 % -117,6%	Under range (9481/..) (9482/..)	-
<	*1)	*1)			Lower limit exceeded

Short circuit alarm cannot be detected at Resistance and Voltage measurement!

***1) Transmitted value depends on parameterized behavior if an error occurs:**

Parameterized behavior if an error occurs	Type of error	Value transmitted if an error occurs	
freeze	All IO-Module errors	Last valid value	
Status code 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 Behavior of input signals in case of error	Short circuit ***2)**	+ / - 32767	7FFF / 8001
	Open circuit ***2)**	+ / - 32762	7FFA / 8006
	Upper limit exceeded	32761	7FF9
	Lower limit exceeded	-32760	8008
	Cold Junction error	-32752	8010
	2 wire calibration failed	-32749	8013
	IO-Module does not respond	-32736	8020
	Config. unequal from module	-32735	8021
	Data not available	-32734	8022
	IO-Module hardware error	-32733	8023

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

error type	TIM R 9480/.. TIM 9482/.. (R measurement)	TIM mV 9481/.. TIM 9482/.. (mV measurement)
short circuit	-32767 (8001)	not detectable
open circuit	+32762 (7FFA)	-32762 (8006)

For 2 wire calibration of module TIM R 9480/.. and TIM 9482/.. the user interface (LCD display with buttons) of the CPM 9440 has to be used.

Automatic 2 wire calibration of derTIM modules by short circuit at the end of the line can be used in combination with 9442 CPUs. Details see the operating instructions of the TIM modules.

Data word structure cyclic data TIM 9482/.. with Signal Status

Type	Byte	Data / channel	Var. Type	Usage
Input	1	I0	INT 16	Analog input data
	2			
	3	I1		
	4			
	5	I2		
	6			
	7	I3		
	8			
	9	I4		
	10			
	11	I5		
	12			
	13	I6		
	14			
	15	I7		
	16			
	17	S0 - S7	INT 16	Signal Stati 0-7 0=Signal disturbed, 1=Signal OK
	18	0		

3.3.1.3 AOM 0 – 20 mA (9465/... , 9466/..., 9468/..)

Measuring range 0 – 20 mA	Units		%	Range
	Decimal	Hexadecimal		
*1)	>30137	>75B9		
21,8 mA .	30137 .	75B9 .	109%	Over range
20 mA . 10 mA . 0 mA	27648 . 13824 . 0	6C00 . 3600 . 0	100% 50% 0%	Nominal range
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 . 12 mA . 4 mA	27648 . 13824 . 0	6C00 . 3600 . 0	100% 50% 0%	Nominal range
3,999 mA 0 mA	-1 -6912	FFFF E500	 -25%	Under range
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 CPU the data area of the outputs is initialized with the value -32768 (0x8000) as 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 IS Wizard.

(see also chapter 3.4.2)

Data word structure cyclic analog data AOM 9460/…, AOMH 9461/…, AUMH 9468/.. (No Stat)

	Byte	Operation mode			Var. Type	Signals
		8AO	8AO+4HV	8AO+8HV		
Input	1 – 4	-	HV-P1		Float 32	HART Variables transmitted on positions P1 - P8
	5 – 8		HV-P2			
	9 – 12		HV-P3			
	13 – 16		HV-P4			
	17 – 20		-	HV-P5		
	21 – 24			HV-P6		
	25 – 28			HV-P7		
	29 – 32			HV-P8		
Output	1 – 2		AO 0		INT16	Analog output signals AO 0 – AO 7
	3 - 4		AO 1			
	5 – 6		AO 2			
	7 – 8		AO 3			
	9 – 10		AO 4			
	11 – 12		AO 5			
	13 – 14		AO 6			
	15 – 16		AO 7			

3.3.2 DIM, DIM+CF, DIOM (9470/.. 9471/.. 9472/..)

On the modules 9470, 9471 and 9472 some of the 16 inputs can optionally be used as digital- (DI), counter- (C) or frequency input (F).
Through selection of different module descriptions from the GSE-file the transmitted data area as well as the used identifier format on PROFIBUS DP can be chosen.

module selection text in GSE		**Input data** [Byte]	**Output data** [Byte]	**CF Channels**	**available signal types**	**DP identifier**
DIM 16 (9470/.. , 9471/..)		2 (16 Bit DI)	-	-	DI without status	AKF
9470 / . . -16-1. **DIM 16** ... 9471 / . . -16-1. **DIM 16** ...		4 (16 Bit DI + 16 Bit status)	-	-	DI with status	SKF
9470 / . . -16-1. **DIM 16+CF** … 9471 / . . -16-1. **DIM 16+CF** ...		8 (16 Bit DI + 16 Bit status + 2 words CF)	1 (control register for counter)	14 – 15	DI and CF (**C**ounter or **F**requency) with status	
9470/3x-16-xx 9471/35-16-xx 9472/35-16-xx	DIM 16	4	0	-	DI with Status	
	DI/DO 16	4	2	-	DI or DO with status	
	DI/DO 16+2CF	8	4	14 - 15	DI and CF or DO with status	
	DI/DO 16+6CF	16	4	10 - 15		
	DI/DO 16+8CF	20	4	8 - 15		

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

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

9470/ ...	**9471/ ...**	
I < 0,05 mA	-	open circuit alarm
I < 1,2 mA	U < 5 V	Signal = 0
I > 2,1 mA	U > 13 V	Signal = 1
R_L < 100 Ohm	-	short circuit alarm

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.

Status allocation:

Status Bit	**Signal**	
0	disturbed	❌
1	OK	✅

Signals and states are generated and transmitted synchronized and consistent
if parameter ´Error detection´ = On

Data

Data	Byte	all DIM (947x/3x in compatible mode)			DIOM 9470/3x, 9471/35, 9472/35 (IS1+)					Type
		DIM	DIM +Stat	DIM +2CF	DIM	DI/DO	DI/DO +2CF	DI/DO +6CF	DI/DO +8CF	
Input	1	DI signals 0 – 7 *1)								UINT16
	2	DI signals 8 – 15 *1)								
	3		Signal Status 0 – 7							
	4		Signal Status 8 – 15							
	5 + 6			C/F I14			C/F S15	C/F S15	C/F S15	UINT16 (UINT32)
	7 + 8			C/F I15			C/F S14	C/F S14	C/F S14	
	9 + 10	-	-	-	-	-	-	C/F S13	C/F S13	
	11+12							C/F S12	C/F S12	
	13+14							C/F S11	C/F S11	
	15+16							C/F S10	C/F S10	
	17+18							-	C/F S9	
	19+20								C/F S8	
Output	1	-	-	*2)	-	DO 0 - 7	DO 0 - 7	DO 0 - 7	DO 0 - 7	UINT16
	2			-		DO 8 - 15	DO 8 - 15	DO 8 - 15	DO 8 - 15	
	3					-	Reset C14-15	Reset C10-15	Reset C8-15	UINT8
	4						Start/Stop C14-15	Start/Stop C10-15	Start/Stop C8-15	

*1) In operation mode DI/DO and parameterization as DO written output values can be read back via the dedicated DI signals.
In operation mode DI/DO and parameterization as DI the dedicated DO signals have no effect.

Output Data **DI/DO+xCF**

Byte	Bit	DO		Reset Counter		Start/Stop Counter	
see above	0	DO 0 / 8	0 = output high Impedance (actuator = Off) 1 = output is powered (actuator = On)	Reset C8	0 = Run, 1 = Reset (Counter=0)	Start/Stop C8	0 = Counter Run 1 = Counter Stop
	1	.		Reset C9		Start/Stop C9	
	. .	.		. .		. .	
	6	.		Reset C14		Start/Stop C14	
	7	DO 7 / 15		Reset C15		Start/Stop C15	

*2) Output Data **DIM+2CF:**

Byte	Bit	Function	
1	0	Reset Counter S14	0 = Run, 1 = Reset (Counter = 0)
	1	Reset Counter S15	
	2	Start/Stop S14	0 = Counter Run, 1 = Counter Stop
	3	Start/Stop S15	
	4 - 7	0 (Reserved)	-

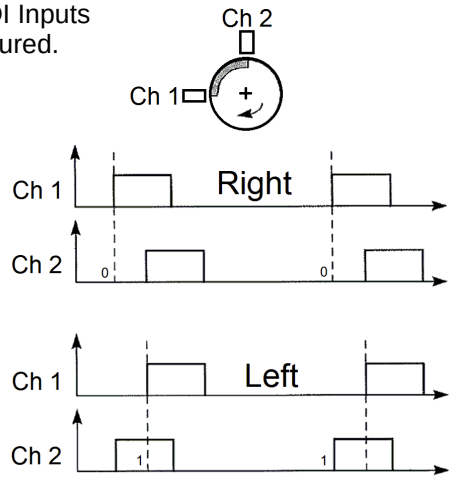
Operation mode ´counter´

Count mode:	Incremental / decremental with overflow / underflow
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)

all DIM with counter (9470/3x in comp. mode)	**DIOM 9470/3x (IS1+)**	**count range**	**count event**
Counter 16 Bit		UINT16 0 – 65535	Increment on edge
-	Up/Down Counter 16 Bit		Increment / Decrement depending on rotation direction
-	Up/Down Counter 32 Bit	UINT32 0 – 4.294.967.295	

Counting and rotation direction detection:

For counting and frequency measurement with direction detection two DI Inputs are used as a functional pair. The phase shift of the two signals is measured. The mechanical positioning of the two sensors must be chosen to ensure the overlapping of associated pulses.



Operation mode	**Application**
Up/Down Counter	Up- or down counting of incoming pulses depending on direction
Frequency with direction	Rotation frequency and direction detection for rotating machines

Signal allocation in cyclic Input data in operation mode Up/Down Counter or Frequency with direction:

Input data	**Usage**
first DI bit of a input pair	DI digital value of first input
second DI bit of a input pair	Rotation direction 0 = Right / forward (Pulse on first input comes first) 1 = Left / backward (Pulse on second input comes first)

Signal and status in operation mode ´counter´:

Counters are set to 0 during IO-Module startup.
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.
In case of lost Data Exchange with the AS and recover within the parameterized output holt time or in case of CPU redundancy switch over the count procedure will not be disturbed.
Using an input pair in operation mode Up/Down counter or frequency with direction the status bits of both channels are set to 0 = bad in case of a signal error of one of the two channels.

For **summation of 16 Bit counters** in the AS the count difference of two consecutive read cycles must be added from the AS. Counter overflow / underflow must be detected and considered. Maximum one overflow / underflow within one AS cycle shall occur.

32 Bit counter with direction input
For counting without direction detection only the first input of a 32 Bit Up/Down Counter channel pair shall be used. The direction bit must not be used by PLC in this case. Error detection of the second not used input channel shall be set to Off. Pulses on the first input will increment the counter if the second input is open. Pulses on the first input will decrement the counter if the second input is shorted.

Operation mode ´Frequency´

Module	**Max. number signals per module**	**Operation mode**	**Measurement method**	**Scaling** [Hz / Bit]	**Resolution** [Hz]
all DIM with Frequency-measurement (9470/3x in comp. Mode)	2	Frequency 1 Hz - 1 kHz	Pulse time measurement	0,05	+/- 0,05
		Frequency 20 Hz - 20 kHz	Gate time 50 ms	1	+/- 20
		Frequency 5 Hz - 20 kHz	Gate time 200 ms	1	+/- 5
		Frequency 1 Hz - 20 kHz	Gate time 1 s	1	+/- 1
DIOM 9470/3x, 9471/35, 9472/35 (IS1+)	8	Frequency 0,1 - 600 Hz	Pulse time measurement	0,01	+/- 0,01
		Frequency 1 Hz - 3 kHz		0,05	+/- 0,05
		Frequency 1 Hz - 20 kHz		0,5	+/- 0,5
	4 pairs	Frequency 1 Hz - 20 kHz **with direction**		0,5	+/- 0,5

Signal scaling:

all DIM with Frequency measurement (9470/3x in compatible mode)**:**					
Measuring range		**Units**		**% *1)**	**Range**
1 Hz – 1 kHz	**x – 20 kHz**	**decimal**	**hex**		
1,3 kHz 1,1 kHz	- 22 kHz	26000 22000	6590 55F0	130 % 110 %	Over range
1 kHz	**20 kHz**	**20000**	**4E20**	**100 %**	
. 500 Hz . 0 Hz	. 10 kHz . 0 kHz	. 10000 . 0	. 2710 . 0	. 50 % . 0 %	Nominal range

DIOM 9470/3x, 9471/35, 9472/35 (IS1+)						
Measuring range			**Units**		**% *1)**	**Range**
0,1 Hz – 600 Hz	**1 Hz – 3 kHz**	**1 Hz - 20 kHz**	**Dec.**	**Hex**		
> 655,34 Hz	> 3,276 kHz	-	65535	0xFFFF		Overflow
655,34 Hz	3,276 kHz	-	65534	0xFFFE	164 %	Over range
600 Hz	3 kHz	-	60000	0xEA60	150 %	
440 Hz	2,2 kHz	22 kHz	44000	0xABE0	110 %	
400 Hz	**2 kHz**	**20 kHz**	**40000**	**0x9C40**	**100 %**	
. 500 Hz . 0 Hz	. 1 kHz . 0 kHz	. 10 kHz . 0 kHz	. 20000 . 0	. 0x4E20 . 0x0000	. 50 % . 0 %	Nominal range

*1) Scaling of frequency measurements in IS1 DTM und I.S.Wizard:

all DIM with Frequency (9470/3x in comp. mode)	Phys. 0 – 100% correlate digital 0 – 20000
DIOM 9470/3x (IS1+)	Phys. 0 – 100% correlate digital 0 – 40000

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

Behavior in case of too high input frequencies:
If the input frequency is higher than the maximum of the selected measurement range, input pulses can be lost. In this case the measured value is smaller as the existing frequency at the input. No alarm is generated.

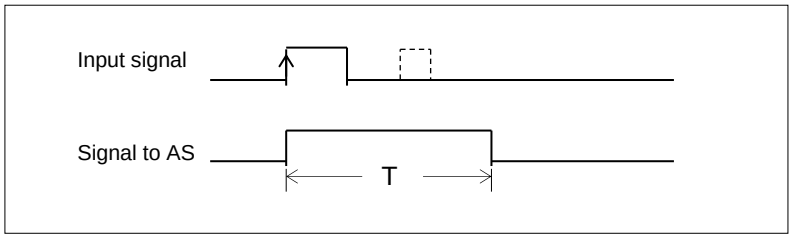
Signal Filter:
The measured frequency signal can be filtered by the DIOM 9470/3x to reduce jitter.
Additionally a pulse extension function is executed for the DI signals.

Parameter	**Selection**	**Pulse extension for DI signals**	**Filter / smoothing for frequency measurement**
Pulse extension / Frequency Filter	**0 s / off**	0 s	off
	0,6 s / small	0,6 s	small
	1,2 s / medium	1,2 s	medium
	2,4 s / large	2,4 s	large

Pulse extension:

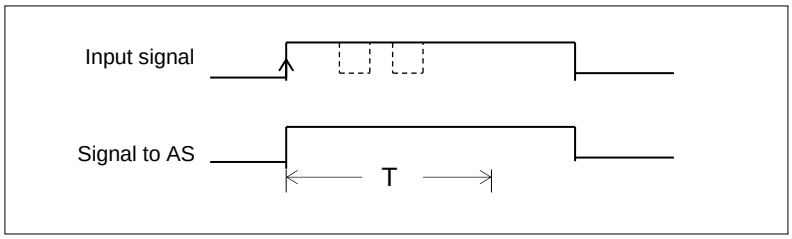
This function can be used to increase the length of short pulses. With this e.g. a short activity of a manual sensor (term approx. 10 .. 50 ms) can be extended to a time selectable by parameterization (T = 0,6 sec., 1.2 sec., 2.4 sec.).
Short pulses can be recognized surely from the AS also with slower cycle times of the application software

Pulse extension with not inverted operation:
(Parameter ´Invert all inputs of the module´ = No)

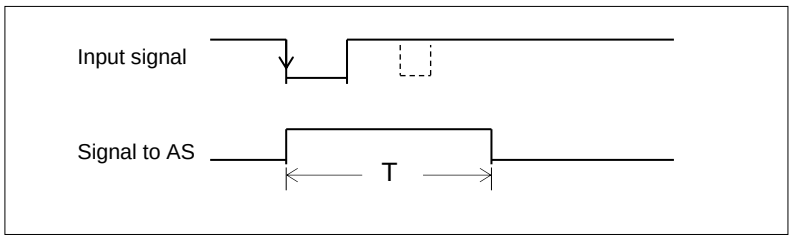


T = 0,6 sec., 1,2 sec., 2,4 sec.
(parametrisable)

Pulses which are longer than the parameterized 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)



Signal LEDs:
DIOM with signal LEDs display the extended ´Signal to AS.

3.3.3 DOM (9475/.., 9477/.., 9478/..)

Signal allocation

Data	Byte	Bit	DOM 8 + Status	DOM 4 + Status	DOM 8	DOM 6	DOM 4
			9475/3x	9475/3x		9477/12-06-12	
Input	1	0	Status_S0	Status_S0	-		
		1	Status_S1	Status_S1	-		
		2	Status_S2	Status_S2	-		
		3	Status_S3	Status_S3	-		
		4	Status_S4	-	-		
		5	Status_S5	-	-		
		6	Status_S6	-	-		
		7	Status_S7	-	-		
	2	0 – 7	0	0	-		
Output	1	0	DO 0	DO 0	DO 0	DO 0	DO 0
		1	DO 1	DO 1	DO 1	DO 1	DO 1
		2	DO 2	DO 2	DO 2	DO 2	DO 2
		3	DO 3	DO 3	DO 3	DO 3	DO 3
		4	DO 4	-	DO 4	DO 4	-
		5	DO 5	-	DO 5	DO 5	-
		6	DO 6	-	DO 6	-	-
		7	DO 7	-	DO 7	-	-

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

status bit	signal	
0	disturbed	❌
1	OK	✅

3.4 Signal behavior in case of errors

3.4.1 Behavior 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, cyclic data including signal status information continues to be transmitted to the master.

The behavior of the signal values transmitted if a malfunction has occurred can be selected separately for every module using parameterization (see IO-Module parameters).

Application hint:

If the behavior of input signals in case of error is realized through the IS1+ system, this behavior 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 behavior 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 and for all signals of IS1+ IO-Modules (FW 03-xx)) the signal status bits available optionally from IS1 are used in the input data area.

- For AI signals of the IS1 IO-Modules (FW 02-xx) the behavior in case of error = ´Status code´ 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 Signal Value >= 32512  Or  Signal Value <= -32512 then
      SignalStatusBit = disturbed
Else
      SignalStatusBit = OK
End IF
```

The signal behavior 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 behavior in case of error´ is always the same under all error conditions.

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

3.4.2 Behavior 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 CPU 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 parameterized 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 CPU.
After expiry of T_{WD}, the cyclic updating of the output modules is stopped by the CPU of the IS1+ field station.
The response monitoring of the slaves can also be deactivated by the master. In this case, the slave cannot recognize 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 CPU and output module:
There are Watchdog circuits on the output modules that monitor the data transmission between the CPU 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 parameterized 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 parameterized separately for every module (see 3.2.2 IO-Module parameters).

PROFIBUS Failsafe Mode Support: Behavior of different IS1 CPUs in the PROFIBUS DP clear mode.

IS1 GSE	Failsafe Mode	GSE: Fail_safe =	Cyclic Data from DP Master on DP Bus in DP Clear Mode	Global Control Clear	Safety position of Output Signals in IS1 parameterisable
V2.xx V3.xx	Without	0	Length of Output Data unchanged. All Output Signals = 0	Yes	9440 CPM: Yes
					9442 CPU: No Output Signals = 0
V4.xx V5.xx	With	1	Length of Output Data Telegram = 0	Yes	9442 CPU: Yes

Using the 9442 CPU with GSE V2.xx or V3.XX all output signals are set to the value ´ 0 ´ in the DP clear mode regardless of the parameterized safe positions in the IS1 parameters.
Using the 9440 CPM or 9442 CPU with GSE V4.xx or V5.xx, the projected security positions of the output signals are processed correctly as parameterized in the IS1 parameters.

3.5 HART variables

In addition to the analogue process value, HART field devices offer the option of digitally reading up to four process variables (HART variables HV) from the transmitter.
IS1+ offers the option of mapping such HART variables to the cyclic input data area of PROFIBUS DP.
Optionally, no HART variables, four or eight HART variables of an IS1+ HART module (AIMH, AUMH, UMH, AOMH) can be transmitted in addition to the cyclic data.
This can be selected optionally when configuring a field station via the GSE file, IS1 DTM or in IS Wizard :

Supply of HART devices using Analog Universal Module AUMH 9468/3x and UMH 9469
Each channel of an AUMH can be parameterized as analog input for HART sensors or as analog output for HART actuators. The supply of HART sensors and HART actuators is different and will be switched too.
For communication with a HART sensor the channel shall be parameterized as ´Input´.
For communication with a HART actuator the channel shall be parameterized as ´Output´.
In a non-parameterized state the channels of an AUMH are in the position ´Output´ and HART communication is possible with HART actuators only.

3.5.1 Module selection in GSE file / IS1 DTM / IS Wizard

Module selection text	Length cyclic data [bytes]		Number of HART variables (HVs) transmitted
	Input	Output	
9461/12-08-11 **AIMH**8 2w Exi	16	0	None
9461/12-08-11 **AIMH**8+4HV 2w Exi	32	0	4 HV
9461/12-08-11 **AIMH**8+8HV 2w Exi	48	0	8 HV
9461/12-08-21 **AIMH**8 Exi	16	0	None
9461/12-08-21 **AIMH**8+4HV Exi	32	0	4 HV
9461/12-08-21 **AIMH**8+8HV Exi	48	0	8 HV
9466/12-08-11 **AOMH**8 Exi	0	16	None
9466/12-08-11 **AOMH**8+4HV Exi	16	16	4 HV
9466/12-08-11 **AOMH**8+8HV Exi	32	16	8 HV
9468/3x-08-xx **8AIH** +4HV	34	0	4 HV
9468/3x-08-xx **8AOH** +4HV	18	16	
9468/3x-08-xx **8AIH/8AOH** +4HV	34	16	
9468/3x-08-xx **8AIH** +8HV	50	0	8 HV
9468/3x-08-xx **8AOH** +8HV	34	16	
9468/3x-08-xx **8AIH/8AOH** +8HV	50	16	
9469/35-08-xx **8IH** +4HV Exn	34	0	4 HV
9469/35-08-xx **8OH** +4HV Exn	18	16	
9469/35-08-xx **8IH/8OH** +4HV Exn	34	16	
9469/35-08-xx **8IH** +8HV Exn	50	0	8 HV
9469/35-08-xx **8OH** +8HV Exn	34	16	
9469/35-08-xx **8IH/8OH** +8HV Exn	50	16	

3.5.2 Data format

HART variables are transmitted as IEEE floating-point numbers (4 byte).
If a HART variable cannot be read (e.g. HART device undergoing startup, not connected, defective or HART variable not found, ...), value 7F A0 00 00 (Not a Number) is transmitted. This may be evaluated in the AS for generation of a signal status of the HART variables. Detailed status and diagnostic information of the HART field devices can be evaluated via HART Management Systems.

3.5.3 Selection of the HART variables

Up to 8 HART field devices can be connected to one HART module of IS1. Since each HART field device may have up to 4 variables, this mean that a maximum of 32 HART variables are possible per module.
The assignment of 4 or 8 out of these 32 variables to the positions P1 to P8 in the cyclic transmission area of PROFIBUS DP or to MODBUS Registers can be selected by parameter assignment:

Parameter name	Value range	Function
Input No. HART device for pos. 1	0 ... 7, Not used	Selection of the channel No. (input / output No.) of the HART module to which the HART field device is connected which is to be transmitted at pos. 1. If ´Not Used´ is selected, value ´Not a Number´ (7F A0 00 00) is transmitted.
Input No. HART device for pos. 2		Selection for pos. 2
. . . . .		
Input No. HART device for pos. 4 (8)		Selection for pos. 4 (8)
HART variable for pos. 1	1 … 4	Selection of the variables of the HART field device which is to be transmitted at pos. 1.
HART variable for pos. 2		Selection for pos. 2
. . . . .		
HART variable for pos. 4 (8)		Selection for pos. 4 (8)

3.6 Diagnosis data

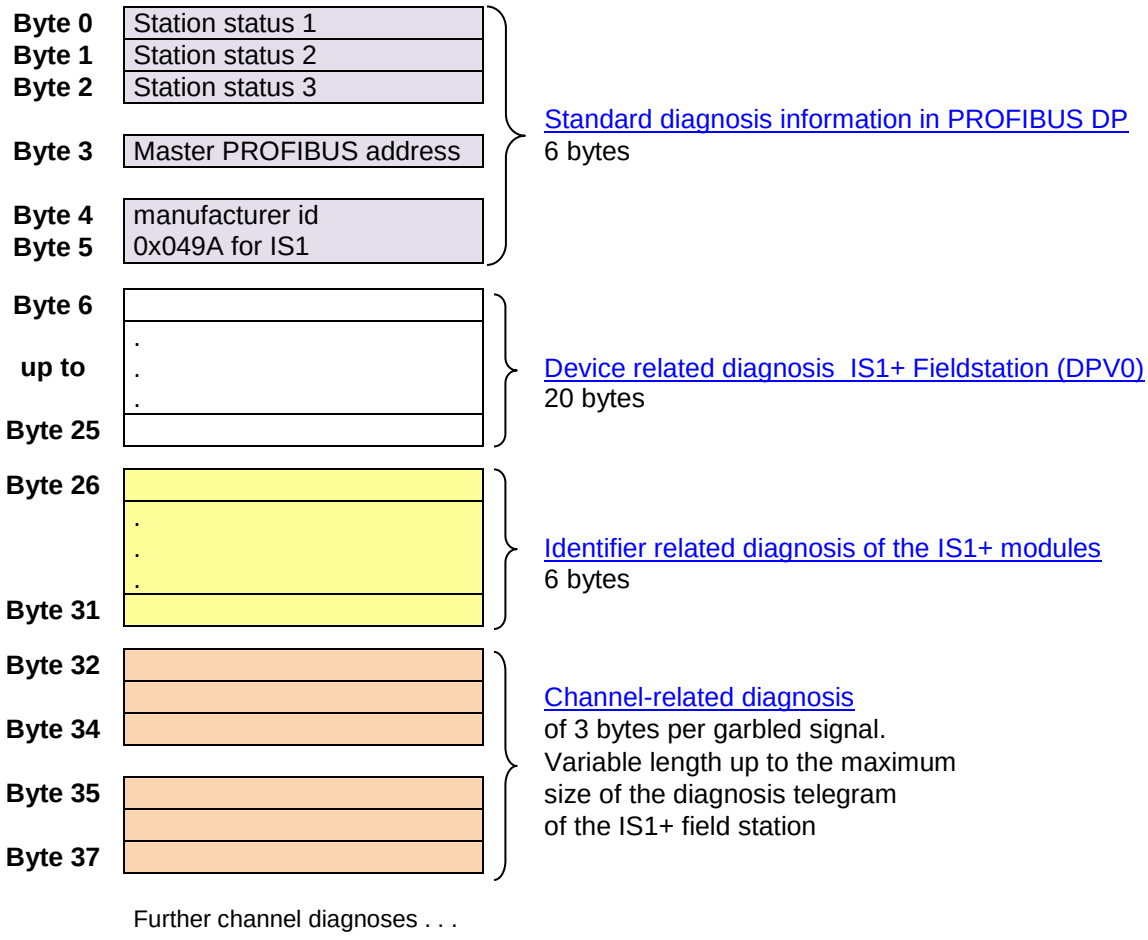
Depending on the PROFIBUS diagnosis format supported by the automation system IS1+ is able to transmit diagnosis data according DPV0 or DPV1 specification. Selection is done by use of different GSE files:

PROFIBUS DP Diagnosis Format according Spec.	DPV1 Alarms	GSE File Version	GSE File Name	CPU	
DPV0	-	V2.xx	STA2049A.gsg	9440	9442
DPV1	-	V3.xx	STA3049A.gsg		
DPV0	-	V4.xx	S4xx049A.GSE	-	
DPV1	optional	V5.xx	S5xx049A.GSE	-	

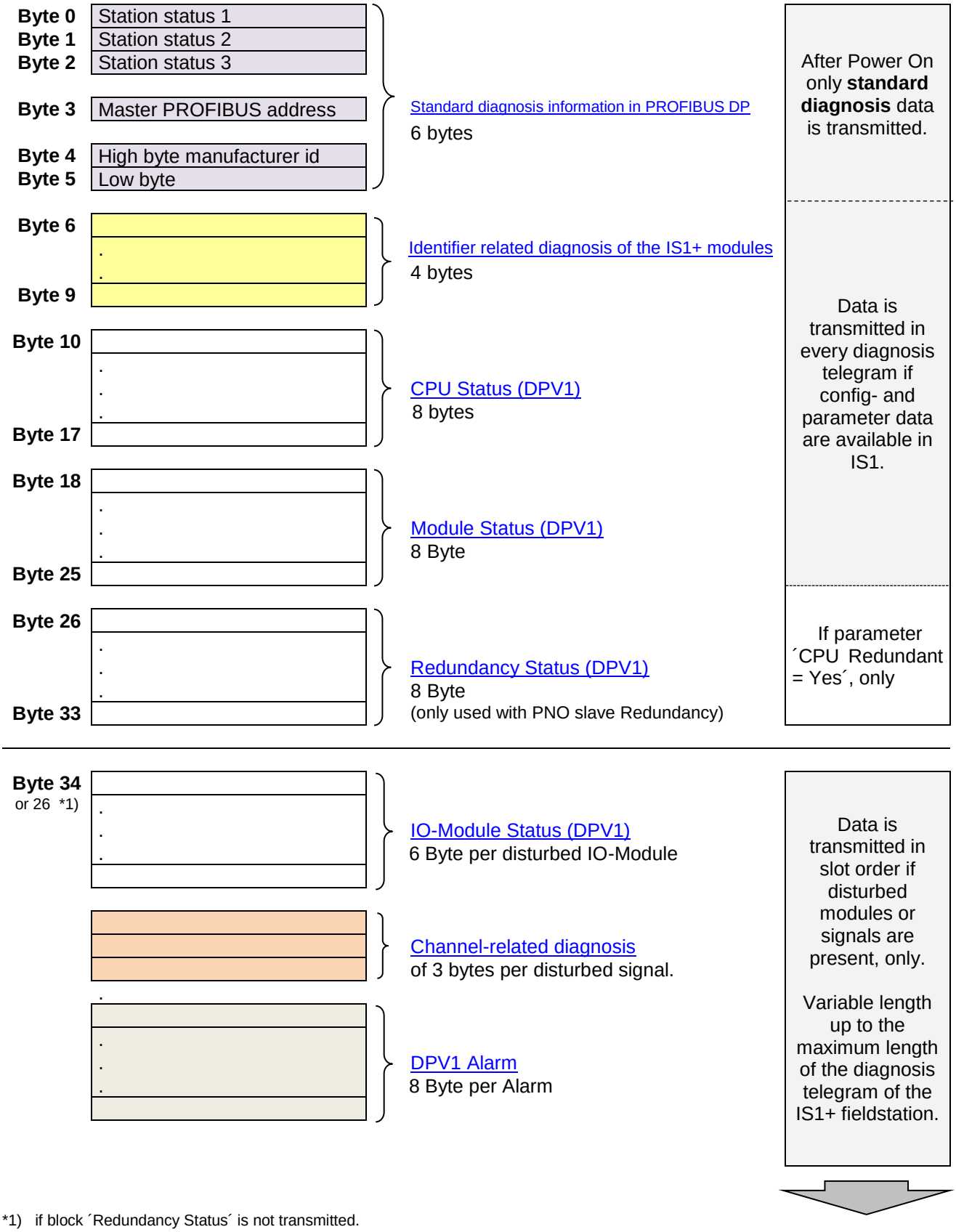
The occurrence of diagnosis changes is registered to the class 1 master by the IS1+ field station in the cyclic data exchange. The class 1 master then demands the diagnosis data from the IS1+ field station in an acyclic telegram.
In addition to the 6 bytes of standard information complying with the DP standard, the IS1+ field station can supply identifier-related diagnosis data, CPU-, module- redundancy and IO-Module status and channel-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 in DPV0. 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 DPV0 diagnosis data



Set-up of the DPV1 diagnosis data



*1) if block ´Redundancy Status´ is not transmitted.

3.6.1 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.	- 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 field station)
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 parameterization of the slave in the master
7	1 = DP slave was parameterized 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 parameterized 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 parameterized 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 GSE file.
(0x049A for IS1)

3.6.2 Identifier related diagnosis of the IS1+ modules

Module diagnosis data				
DPV 0	**DPV1**	**Bit**	**Message / Function**	**Info**
Byte	**Byte**			
26	6	-	Header	value = 0x46 (DPV0) value = 0x44 (DPV1)
27	7	0	Diagnosis in module (CPU)	0 = all signals of the IO-Module are transmitted without errors. 1 = One or more signals of the IO-Module are disturbed. Diagnosis messages with status ´Maintenance required´ or ´Out of specification´ will not set this bits. Further details see device related diagnosis (DPV0) or Module – and IO-Module Status (DPV1) and Channel related diagnosis.
		1	Diagnosis in module 1	
		2	Diagnosis in module 2	
		3	Diagnosis in module 3	
		4	Diagnosis in module 4	
		5	Diagnosis in module 5	
		6	Diagnosis in module 6	
		7	Diagnosis in module 7	
28	8	0	Diagnosis in module 8	
		1	Diagnosis in module 9	
		2	Diagnosis in module 10	
		3	Diagnosis in module 11	
		4	Diagnosis in module 12	
		5	Diagnosis in module 13	
		6	Diagnosis in module 14	
		7	Diagnosis in module 15	
29	9	0	Diagnosis in module 16	
		1 - 7	Reserved	
30	-		Reserved	
31	-		Reserved	

3.6.3 Device related diagnosis IS1+ Fieldstation (DPV0)

Byte	Bit	Value / Info	Message / Function	Measure / Remedy	CPU Status (NE107)	
6	-	0x14	Header Byte	-	-	-
7	0	CPU Diagnosis-data	Error in IS1 parameters from DP master	Check parameter setting in DP master.	Failure	
	1		Error in IS1 configuration data from DP master	Check configuration data in DP master		
	2		Version conflict GSE/CPU	Version conflict of GSE file and CPU Firmware. Use GSE file compatible to CPU Firmware.		
	3		Redundancy Parameterization PM: OK / red. PM observation is deactivated	Parameter ´Red. PM = Yes´ shall be enabled if red. PM are plugged.	Main-tenance Required	
	4		Slot address error CPU	The CPM has detected an incorrect change of the slot address during operation. -> Exchange CPM		
	5		9440: red. CPU descr. Required 9442: Redundancy Parameterization CPU: OK / red. CPU observation is deactivated	9440: Change configuration. 9442: Parameter ´Red. CPU = Yes´ shall be enabled if red. CPU are plugged.		
	6		Failure CPU-L	Check PM supply voltage. CPU exchange required if OK.	Failure	
	7		Failure CPU-R			
8	0	Line-redundancy (9440 only)	X1: receive from AS disturbed	Check: Bus connections, Bus wiring, Termination, Fieldbus isolating repeater …	Main-tenance Required	
	1		X2: receive from AS disturbed			
	2		X1: transmit to AS disturbed			
	3		X2: transmit to AS disturbed			
	4	9442 CPU only *1)	Failure PM-L	Check PM supply voltage. PM exchange required if OK.	Failure	
	5		Failure PM-R			
	6		Socket backup memory disturbed.	System operation till next Power On/CPU Reset is possible. Socket exchange is required on next operation stop.	Main-tenance Required	
	7	CPU redundancy	Backup CPU not available (Message of CPM Redundancy from 9440 Firmware V0x-42 and from GSE V1.25, V2.25 or V3.03)	Check: - Bus connection of red. CPU - Function of red. CPU - Rail connection between red. CPUs		
9	0	9442 CPU only *1)	Temperature Alarm CPU / PM	Ambient temperature around the CPU or PM is out of spec. In case of overtemperature reduce ambient temperature or increase ventilation, shadowing ….	Out of Spec.	
	1		PM overload	Reduce PM load!		
	2		Maintenace Request CPU-L	Exchange of module recommended due to operating conditions.	Main-tenance Required	
	3		Maintenace Request CPU-R			
	4		Maintenace Request PM-L			
	5		Maintenace Request PM-R			
	6		Slot address error PM-L	The module has detected an incorrect change of the slot address during operation. -> Exchange PM and send it back to STAHL.		
	7		Slot address error PM-R			

*1) 9442 CPU with GSE Files from V2.34 only.

10	0 – 2	IO-Module 1	**Module Diagnosis Data**	see table below	-	-
	3		IO-Module xx hardware disable signals. Module is OK. All signals of module are switched off by Plant Stop input. Output data from AS is rejected. Check and clear reason for external Plant Stop.		Failure	✗
	4 – 6	IO-Module 2	**Module Diagnosis Data**	see table below	-	-
	7		IO-Module xx hardware disable signals.	see above	Failure	✗
11-17	Format of bytes 11 to 17 for module 3 to 16 as Byte 10!				**-**	**-**
18	0-3	IO-Module 1	**Module Maintenance Data**	see table below	**-**	**-**
	4-7	IO-Module 2				
19-25	Format of bytes 19 to 25 for module 3 to 16 as Byte 18!				**-**	**-**

Module Diagnosis Data (in byte 10 – 17)					
Value	**Message**	**Identifier related diagnosis** *3)	**Measure / Remedy**	**IO-Module Status (NE107)**	
0 (000)	Communication to IO-Module xx OK	0 signals available	-	No Error	✓
1 (001)	IO-Module xx prim. rail bus disturbed		Check IO-Module, Rail communication and CPU	Maintenance Required	◆
2 (010)	IO-Module xx red. rail bus disturbed				
3 (011)	IO-Module xx does not respond	1 all IO-Module signals disturbed	Plug correct module type or exchange module.	Failure	✗
4 (100)	IO-Module xx configuration unequal from module		Plug configured module type or change configuration of DP master.		
5 (101)	IO-Module xx hardware failure		Exchange module		
6 (110)	Reserved		-	-	-
7 (111)					

*3) From FW 0x-43: Behavior of Identifier related diagnosis bits in case of undisturbed signals and without other module diagnoses (e.g. ´ IO-Module xx hardware disable outputs will set Identifier related diagnosis = 1)

Module Maintenance Data (in byte 18 – 25)					
Bit	**Message**	**Measure / Remedy**		**IO-Module Status (NE107)**	
0, 4	Overtemperature	The temperature around the IO-Module is too high. Reduce ambient temperature or increase ventilation, shadowing …		Out of Spec.	
1, 5	Slot address error	The module has detected a incorrect change of the slot address during operation. -> exchange IO-Module and send it back to STAHL.		Maintenance Required	
2, 6	Module maintenance request	Exchange of module recommended due to operating conditions.			
3, 7	Check module note	IO-Module	Note	-	-
		9475/3x-04-72 DOM4	Maximum total output current of module exceeded. Channel 3 is switched off. Reduce total loop current.	Out of Spec.	
		9471/35-16-xx DIOM Z2 Ex n	wrong external wiring. Check external signal wiring or signal type configuration	Failure	
		9472/35-16-xx DIOM 24V Z2 Ex n	wrong external supply (18 .. 32V) or wrong external wiring. Check external supply (18..32V) or external signal wiring or signal type configuration	Failure	

3.6.4 CPU Status (DPV1)

Byte	Bit	Value / Info	Message / Function	Measure / Remedy	CPU Status (NE107)	
10	-	0x08	Header Byte	-	-	-
11	-	160 (0xA0)	Status_Type			
12	-	0x00	Slot_Number			
13	-	0x00	Specifier			
14	0	CPU Diagnosis-data	Error in IS1 parameters from DP master	Check parameter setting in DP master.	Failure	
	1		Error in IS1 configuration data from DP master	Check configuration data in DP master		
	2		Version conflict GSE/CPU	Version conflict of GSE file and CPU Firmware. Use GSE file compatible to CPU Firmware.		
	3		Redundancy Parameterization PM: OK / red. PM observation is deactivated	Parameter ´Red. PM = Yes´ shall be enabled if red. PM are plugged.	Main-tenance Required	
	4		Slot address error CPU	The CPM has detected an incorrect change of the slot address during operation. -> Exchange CPM		
	5		9440: red. CPU descr. Required 9442: Redundancy Parameterization CPU: OK / red. CPU observation is deactivated	9440: Change configuration. 9442: Parameter ´Red. CPU = Yes´ shall be enabled if red. CPU are plugged.		
	6		Failure CPU-L	Check PM supply voltage. CPU exchange required if OK.	Failure	
	7		Failure CPU-R			
15	0	Line-redundancy (9440 only)	X1: receive from AS disturbed	Check: Bus connection, Bus wiring, Termination, Fieldbus isolating repeater….	Main-tenance Required	
	1		X2: receive from AS disturbed			
	2		X1: transmit to AS disturbed			
	3		X2: transmit to AS disturbed			
	4	9442 CPU only *1)	Failure PM-L	Check PM supply voltage. PM exchange required if OK.	Failure	
	5		Failure PM-R			
	6		Socket backup memory disturbed.	System operation till next Power On/CPU Reset is possible. Socket exchange is required on next operation stop.	Main-tenance Required	
	7	CPU redundancy	Backup CPU not available (Message of CPM Redundancy 9440 from Firmware V0x-42 and from GSE V1.25, V2.25 or V3.03)	Check: - Bus connection of red. CPU - Power of red. CPU - Function of red. CPU - Rail connection between red. CPUs		

*1) 9442 CPU with GSE Files from V2.34, V3.12, V4.13 or V5.13 only.

16 *1)	0	9442 CPU only	Temperature Alarm CPU / PM	Ambient temperature around the CPU or PM is out of spec. In case of overtemperature reduce ambient temperature or increase ventilation, shadowing. …	Out of Spec..	
	1		PM overload	Reduce PM load!		
	2		Maintenace Request CPU-L	Exchange of module recommended due to operating conditions.	Main-tenance Required	
	3		Maintenace Request CPU-R			
	4		Maintenace Request PM-L			
	5		Maintenace Request PM-R			
	6		Slot address error PM-L	The module has detected an incorrect change of the slot address during operation. -> Exchange PM and send it back to STAHL.		
	7		Slot address error PM-R			
17	-	0x00	Reserved	-	-	-

*1) Byte 16 was used als ´Diag Update Counter´ which was fixed to zero from 9440 CPM Rev. 0x-49. Byte was allocated for the 9442 CPU with new features.

3.6.5 Module Status (DPV1)

Byte	MSB			LSB	Function
18	0x08				Header Byte
19	130 (0x82)				Status_Type
20	0x00				Slot_Number
21	0x00				Specifier
22	Mod. 4	Mod. 3	Mod. 2	Mod. 1	Module Status: 2 Bit per IO-Module see below
23	Mod. 8	Mod. 7	Mod. 6	Mod. 5	
24	Mod.12	Mod. 11	Mod. 10	Mod. 9	
25	Mod. 16	Mod. 15	Mod. 14	Mod. 13	

Bit Value	Module Status	Identifier related Diagnosis	Measure / Remedy	Module Status (NE107)	
0 0	Module OK	0 = All signals of IO-Module undisturbed	-	No Error	
0 1	Module- and signal common error (e. g. Line break, Short circuit, Rail error, Overtemperature ...)		See details in IO-Module Status and signal diagnosis	Maintenance Required	
		1 = one or more signals of IO-Module are disturbed		Failure	
1 0	Wrong module Type	1 = all signals of IO-Module are disturbed	Plug configured module type or change configuration of DP master.	Failure	
1 1	No module (No or wrong response)		Plug correct module type or exchange module.	Failure	

3.6.6 Redundancy Status (DPV1)

Byte	Bit	Value / Info	Function	
26	-	0x08	Header Byte	
27	-	159 (0x9F)	Status_Type	158 (0x9E) in case of command confirmation
28	-	Slot	Slot_Number	
29	-	0x00	Specifier	
30	-	-	Function	
31	0	Backup	Red_State_1	state from the initiator of the State_diagnosis
	1	Primary		
	2	HW-Defect		
	3	Data_Exchange		
	4	Master_State_Clear		
	5	Baudrate found		
	6	Toh started = 0 (Not supported)		
	7	Reserved		
32	0 – 7	allocation as Byte 31	Red_State_2	state from the other Slave-Device
33	-	Reserved	Red_State_3	

Attention! The Redundancy Status is only transmitted with activated PNO Slave Redundancy (supported by 9440 CPM firmware from revision V03-42).

3.6.7 IO-Module Status (DPV1)

Byte	Value / Info	Message / Function
n	0x06	Header Byte
n+1	129 (0x81)	Status_Type
n+2	Slot	Slot_Number
n+3	0x00	Specifier
n+4	see below	**IO-Module global diagnosis data**
n+5		**PROFIsafe status (only for PROFIsafe modules)**

n = first byte of a Status block

IO-Module global diagnosis data						
Byte	**Bit**	**Message / Function**	**Measure / Remedy**		**IO-Module Status (NE107)**	
n+4	0	IO-Module xx prim. rail bus disturbed	Check IO-Module, Rail connection and CPU		Maintenance Required	
	1	IO-Module xx red. rail bus disturbed				
	2	Hardware error	Exchange Module		Failure	
	3	IO-Module xx hardware disable signals.	Module is OK.		No error	
			All signals of module are switched off by Plant Stop input. Output data from AS is rejected. Check and clear reason for external Plant Stop.		Failure	
	4	Overtemperature	Ambient temperature around the IO-Module is too high. Reduce ambient temperature or increase ventilation, shadowing …		Out of spec.	
	5	Slot address error	The module has detected an incorrect change of the slot address during operation. -> Exchange IO-Module and send it back to STAHL.		Maintenance Required	
	6	Module maintenance request	Exchange of module recommended due to operating conditions.			
	7	Check module note	**IO-Module**	**Note**	-	-
			9475/3x-04-72 DOM4	Maximum total output current of module exceeded. Channel 3 is switched off. Reduce total loop current.	Out of spec.	
			9471/35-16-xx DIOM Z2 Ex n	Wrong external wiring. Check external signal wiring or signal type configuration	Failure	
			9469/35-08-xx AUM Z2 Ex n 9472/35-16-xx DIOM 24V Z2 Ex n	Wrong external supply (18 ..32V) or wrong external wiring. Check external supply (18..32V) or external signal wiring or signal type configuration	Failure	

PROFIsafe status				
Byte	**Value**		**Diagnosis Text**	**Diagnosis Help Text**
	Hex	Dec		
n+5	0x40	64	F_Dest_Add mismatch	Mismatch of safety destination address
	0x41	65	F_Dest_Add not valid	Safety destination address not valid
	0x42	66	F_Source_Add not valid	Safety source address not valid
	0x43	67	F_WD_Time not defined	Safety watchdog time value is 0 ms
	0x44	68	F_SIL parameter error	Parameter „F_SIL“ exceeds SIL from specific device application
	0x45	69	F_CRC_Length error	Parameter „F_CRC_Length“ does not match the generated values
	0x46	70	F-Param. version error	Version of F-Parameter set incorrect
	0x47	71	CRC1-Fault	CRC1-check of received F-data failed

3.6.8 Channel-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.

Byte	Bit	Value / Info	Message / Function
1	0 - 5	1 – 16	Module slot
	6 - 7	0x02	Header
2	0 – 5	0 – 15	Channel / Signal number
	6 - 7	00 = reserved 01 = Input 10 = Output 11 = In- / Output	Signal Type
3	0 – 4	0 – 31	**Error type - see below**
	5 – 7	000 = reserved 001 = Bit 010 = 2 Bit 011 = 4 Bit 100 = Byte 101 = word 110 = 2 words 111 = reserved	Data Type

Error type	Message / Function	Status Code in cyclic Data [Hex]	Measure / Remedy	Signal Status (NE107)	
0	Reserved	-	-	-	-
1	Short circuit	7FFF / 8001	• Check connection between IO-Module and sensor/actuator and remove short. • Check sensor / actuator and replace if required	Failure	✗
2 – 5	Reserved	-	-	-	-
6	Open circuit	7FFA / 8006	• Check and reestablish connection between IO-Module and sensor/actuator. • Check sensor / actuator and replace if required	Failure	✗
7	Upper limit exceeded	7FF9	Measurement range limit of IO-Module (TIM) is exceeded. Use input signal inside allowed measurement range or choose different range if possible.		
8	Lower limit exceeded	8008			
9 – 15	Reserved	-	-	-	-
16	Cold Junction error	8010	Range of Cold Junction Compensation exceeded. • Check ambient temperature of IO-Module. • Change module	Failure	✗
17	Hardware error	8011	Change module		
18	Critical temperature	8012	Ambient temperature of IO-Module is too high. Reduce ambient temperature or increase ventilation, shadowing …		
19	2 wire calibration failed	8013	Repeat 2 wire calibration. Look for a good short at the wire end during calibration.		
20	Parametrization error	8014	Clear incorrect parameter combination		
21	Plant Stop	8015	Check and clear reason for external Plant Stop.		
22 – 31	Reserved	-	-	-	-

Attention!

The maximum telegram length of the diagnosis telegram is restricted:
max. 122 Bytes with GSE V2.xx or V3.xx using 9440 CPM or 9442 CPU
max. 244 Bytes with GSE V4.xx or V5.xx using 9442 CPU

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 that causes channel-related diagnosis data to be lost.

If not all of the IO-Module status and 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 standard -, identifier-related - diagnoses as well as the CPM-, Module- and Redundancy status and Alarms is always guaranteed.

3.7 Group alarm / field station status

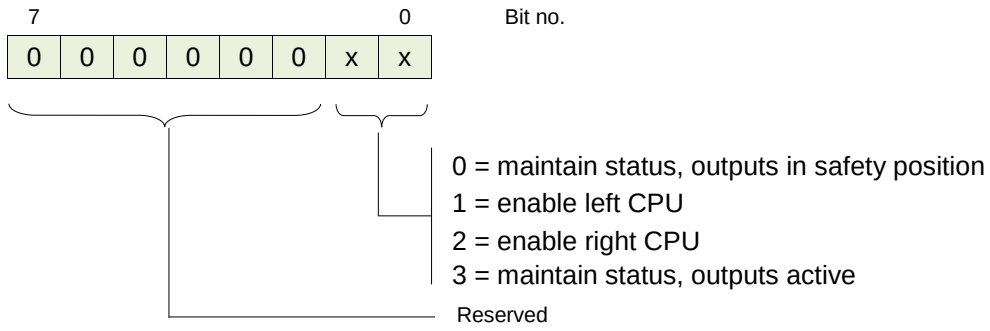
1 byte input data (status register) and 1 byte output data (control register) are transmitted for the CPU in the cyclic range of PROFIBUS DP.

The contents of the status register can be used in the AS for generation of a field station-global group alarm. In the case of applications without Stahl CPU redundancy, the function on the control register is deactivated by parameter ´CPU redundant = No´ (default setting).

Using GSE V2.xx and V3.XX this data is included in the CPM Module descriptor.
Using GSE V4.xx or V5.xx with the 9442 CPU the optional module descriptor ´CPU status / control registers´ can be projected on any slot optionally if necessary. The slot address of the following IO-Modules are moved in this case.
Maximum of 15 IO-Modules + status / control registers are configurable, as far as no cyclical data length limits are violated.
Hint: If the status / control registers is projected as the last module the after the real plugged IO-Module, the slot addresses of the real plugged IO-Modules remain unchanged.

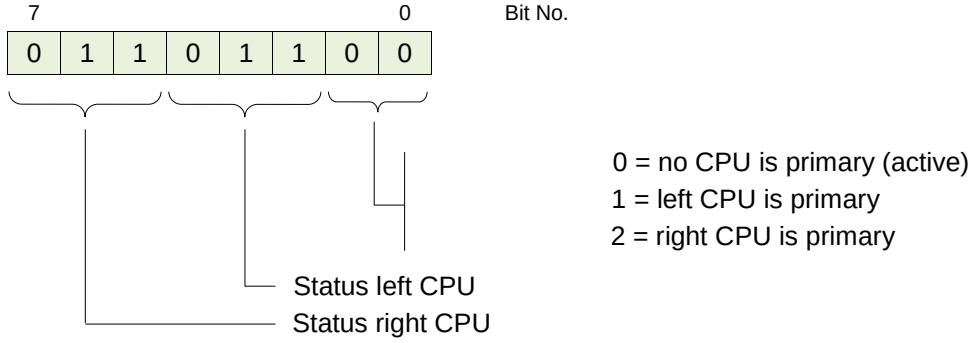
3.7.1 Control register CPU

If using redundant CPUs according Stahl specification, the control register serves to control the operating states of the two redundant CPUs. The same value has to be transmitted to both CPUs. It is strongly recommended to use the values 1 and 2 only for control of the redundancy switching.
In the case of applications with CPU redundancy according PNO Spec. the control register is not used.



3.7.2 Status register CPU

The status register contains information on both possible CPUs (left and right).
In the case of operation without CPU redundancy, only the status of the left CPU must be evaluated.
The status register can be used to read back the current status of the two CPUs for checking by the AS:



Status CPU:

Value		Message / Function	Measure / Remedy	
Value 1 (001)	*1)	*Hardware fault CPU*	Exchange CPU	
Value 2 (010)		**Data exchange with AS <u>with</u> diag. data! --> Generate group alarm FS**	Use diagnostic tool of AS or IS1 DTM to check for details.	
Value 3 (011)	*1)	*No data exchange (after Power On)*	Startup data exchange from DP master	
Value 4 (100)	*1)	*Configuration or parameter error*	Check configuration and parameter data in DP master	
Value 5 (101)	*1)	*Quit data exchange with AS*	Check bus connection to AS. Startup data exchange from DP master	
Value 6 (110)		**Data exchange with AS <u>without</u> diag. data --> all IO-Modules and CPUs are error free**	No errors	
Value 7 (111)	*1)	*Backup CPU not accessible*	Check: - Bus connection of red. CPU - Power of red. CPU - Function of red. CPU - Rail connection between red. CPUs	

***1) Important:**
Value can be evaluated practically only in the case of CPU redundancy.
In the case of operation without CPU redundancy, the status register can no longer be updated in the event of bus or slave failure in the AS. Group alarm ´Diagnostic data available´ can thus be practically evaluated only in the case of cyclic bus operation. Status ´Slave failure´ must be scanned separately in the AS and cannot be detected by evaluation of the status register.

The status register contains information about both CPUs. During regular operation, this status information is cross-coupled between both CPUs and can thus be read by both CPUs. However, in case of malfunction, the status information in the backup CPU may be lost. Therefore, the AS always analyses just the status register of the primary (active) CPU.

3.8 LED and LCD displays CPM 9440

The operational state and the communication on the PROFIBUS DP can be assessed on site using the LEDs and the LCD display of the 9440 CPM of an IS1+ field station.
Additionally signal values as well as signal- and module alarms can be displayed on the LCD.

For details, see the IS1 **operating instructions CPM 9440** and **operating instructions IS1 CPM display**.

3.9 LED displays CPU 9442

The operational state and the communication on the PROFIBUS DP can be assessed on site using the LED display of the 9442 CPU of an IS1+ field station.
Additionally signal values as well as signal- and module alarms can be displayed on the LCD.

For details, see the IS1+ **operating instructions CPU 9442**

3.10 DPV1 records

Following DPV1 records are supported:

Slot	write_ind [DS Index]	read_ind [DS Index]	Telegram transaction	Description	
0 (CPU)	255 -> 65000	255	write_ind -> read_ind	I&M0 Function	
	…	…	…	I&M1 … I&M3	Supported by 9442 CPU only
	255 -> 65004	255	write_ind -> read_ind	I&M4 Function	
	-	7	read_ind	HART Livelist	
	8	8	write_ind -> read_ind	Servicebus protocol tunneling via DPV1	
	-	9	read_ind	Readback of adjusted ´F-Destination address´ of all PROFIsafe I/O modules	
	-	129	read_ind	HART Parameter	
	-	148	read_ind	HART DS Information	
	-	149	read_ind	HART Feature Flags	
1-16 (IOM)	255 -> 65000	255	write_ind -> read_ind	I&M0 Function	
	…	…	…	I&M1 … I&M3	Supported by 9442 CPU only
	255 -> 65004	255	write_ind -> read_ind	I&M4 Function	
	-	129	read_ind	HART Parameter	
	-	148	read_ind	HART DS Information	
	-	149	read_ind	HART Feature Flags	
	80	81	write_ind -> read_ind with delayed response	HART transaction channel 0	
	82	83		HART transaction channel 1	
	84	85		HART transaction channel 2	
	86	87		HART transaction channel 3	
	88	89		HART transaction channel 4	
	90	91		HART transaction channel 5	
	92	93		HART transaction channel 6	
	94	95		HART transaction channel 7	

Structure of HART records according PNO Spec. 2.312
Structure of I&M records according PNO Spec. 3.502
Structure of HART Livelist and Servicebus Protocol according Stahl specification. -> Access via IS1 DTM

Even when using multiple parallel C2 channels only one HART telegram processing is supported at a time.

3.11 I&M Function (DPV1)

IS1+ supports the I&M (Identification and maintenance) function according PNO specification and delivers the following I&M data on Index 255:

I&M0 on Index 255 / 65000, Read/Write:

Name	Size	Data Type	Content
Header			
manufacturer specific	10 Octets		0x00 (not used)
I&M Block			
DEVICE_MAN_ID	2 Octets	Uint16	158 (0x9e)
ORDER_ID	20 Octets	Visible String	e.g. ´ 9440/15-01-11´ (STAHL Type No.)
SERIAL_NUMBER	16 Octets	Visible String	e.g. ´ 115337-0004´
HARDWARE_REVISION	2 Octets	Uint16	e.g. ´F´ = 0x0046 ***1)**
SOFTWARE_REVISION	4 Octets	*2)	e.g. ´02-31´ ***2)**
REVISION_COUNTER	2 Octets	Uint16	0
PROFILE_ID	2 Octets	Uint16	0x0000
PROFILE_SPECIFIC_TYPE	2 Octets	Uint16	0x0000
IM_VERSION	2 Octets	2 Uint8	1.0
IM_SUPPORTED	2 Octets	Bit Array	0 (0x1E with 9442 CPU and GSE V4.xx or V5.xx)

***1)** HARDWARE_REVISION:
STAHL is using the letters ´A´ to ´X´ which are represented as characters (example: ´A´ = 0x0041).

***2)** SOFTWARE_REVISION:

example of allocation:

Stahl software revision:	V 02-31			
Data Type	Char	Uint8	Uint8	Uint8
Data	´V´ = 0x56	0x02	0x1F	0x00
displayed	´V´	02	31	0

I&M1 on Index 255 / 65001, Read/Write:

Name	Size	Data Type	Content
Header			
manufacturer specific	10 Octets		empty = 0 (not used)
I&M Block			
TAG_FUNCTION	32 Octets	Visible String	User specific data which is stored in the device. Default: filled with ´0x20´ (blank)
TAG_LOCATION	22 Octets	Visible String	

I&M1 to I&M4 supported by 9442 CPU only.

I&M2 on Index 255/ 65002, Read/Write:

Name	Size	Data Type	Content
Header			
manufacturer specific	10 Octets		empty = 0 (not used)
I&M Block			
INSTALLATION_DATE	16 Octets	Visible String	YYYY-MM-DD hh:mm e. g. 1995-02-04 16:23 Default: filled with ´0x20´ (blank)
RESERVED	38 Octets		

I&M3 on Index 255/ 65003, Read/Write:

Name	Size	Data Type	Content
Header			
manufacturer specific	10 Octets		empty = 0 (not used)
I&M Block			
DESCRIPTOR	54 Octets	Visible String	User specific data which is stored in the device. Default: filled with ´0x20´ (blank)

I&M4 on Index 255/ 65004, Read/Write:

Name	Size	Data Type	Content
Header			
manufacturer specific	10 Octets		empty = 0 (not used)
I&M Block			
SIGNATURE	54 Octets	OctetString	Project specific data from parameterization tools which is stored in the device. Default: filled with ´0x00´

3.12 Online behavior of the IS1+ field station.

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

3.12.1 Parameter change.

If an IS1+ field station is in data exchange with a DP master, the telegram ´Set_Prm´ (send parameter) can be transmitted from the master to the field station between the cyclic data telegrams.
The field station 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+ field station 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 field station changes to the mode ´wait parameter´ whereby a new start-up of the cyclic communication is forced.

3.12.2 Configuration change.

If a IS1+ field station is in data exchange with a DP master, the telegram ´Chk _Cfg´ is only accepted from the field station if the configuration data of the field station has not changed.
If a telegram ´Chk _Cfg´ with changed configuration data is received during data exchange, the field station 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 field station 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 field station 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 field station can be freezed during an interruption of the data exchange for a parametrizable time.
If the master is coming back to data exchange with the field station 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 marshaling in the data telegrams, he is responsible for the correct new marshaling inside of the master and the PLC / DCS.
During the new start-up the field station is checking the new configuration and parameter data individually for each slot (each I/O-module).
All modules of the field station where the configured module type agree with the existing module type in the field station 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 behavior in case of error.

4 Ethernet Interface 9442 CPU

4.1 Ethernet Network Topology

The IS1 + 9442 CPU has two Ethernet ports (X2, P1, as well as X2, P2).
Using PROFIBUS protocol the port X2, P1 can be used only.
X2, P2 is not supported in this case.

4.2 IP Address setting

Two separate IP addresses for the Ethernet communication are available for the 9442 IS1 CPU:

- IP-AS: Not used with PROFIBUS
- IP-SB: Service Bus Functions: Web-Server, SW-Update

A change of IP addresses is blocked during active data exchange to the Automation System.

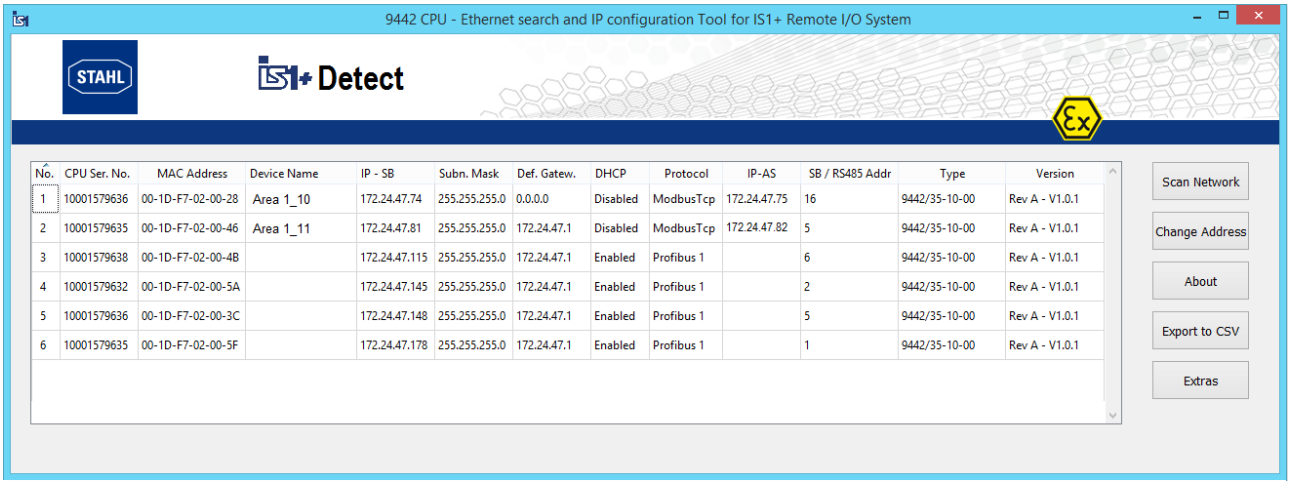
Caution! IP-AS and IP-SB addresses of a CPU must be unique as all IP addresses of an Ethernet network. The IP address information is stored in the socket backup memory as well. Configuration and address information of an IS1+ field station are therefore preserved in case of exchange of CPUs.

4.3 IS1+ Detect

The ´IS1+ Detect´ tool can scan the Ethernet Network for connected IS1+ field stations with 9442 CPUs and display the IP addresses of the found CPUs.
This applies also to stations which are outside of the IP-addressable address range of the network.

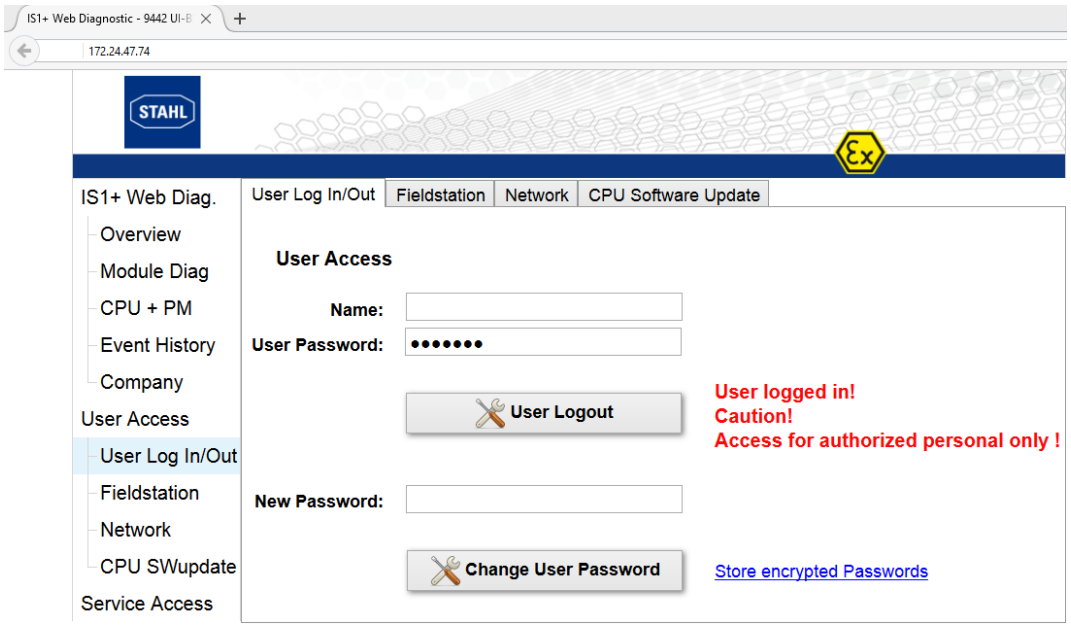
IP-SB addresses of found IS1+ 9442 CPUs can be changed if necessary and must be inside of the IP-addressable address range of the network.

Thus the IS1+ CPUs are accessible via the integrated Web server. Diagnostic information can be displayed here and further adjustments can be made.



No.	CPU Ser. No.	MAC Address	Device Name	IP - SB	Subn. Mask	Def. Gatew.	DHCP	Protocol	IP-AS	SB / RS485 Addr	Type	Version
1	10001579636	00-1D-F7-02-00-28	Area 1_10	172.24.47.74	255.255.255.0	0.0.0.0	Disabled	ModbusTcp	172.24.47.75	16	9442/35-10-00	Rev A - V1.0.1
2	10001579635	00-1D-F7-02-00-46	Area 1_11	172.24.47.81	255.255.255.0	172.24.47.1	Disabled	ModbusTcp	172.24.47.82	5	9442/35-10-00	Rev A - V1.0.1
3	10001579638	00-1D-F7-02-00-4B		172.24.47.115	255.255.255.0	172.24.47.1	Enabled	Profibus 1		6	9442/35-10-00	Rev A - V1.0.1
4	10001579632	00-1D-F7-02-00-5A		172.24.47.145	255.255.255.0	172.24.47.1	Enabled	Profibus 1		2	9442/35-10-00	Rev A - V1.0.1
5	10001579636	00-1D-F7-02-00-3C		172.24.47.148	255.255.255.0	172.24.47.1	Enabled	Profibus 1		5	9442/35-10-00	Rev A - V1.0.1
6	10001579635	00-1D-F7-02-00-5F		172.24.47.178	255.255.255.0	172.24.47.1	Enabled	Profibus 1		1	9442/35-10-00	Rev A - V1.0.1

4.4 Web Server



Password and Access concept:

The various menu items of the IS1 + Web server are divided into three groups

Group	Page	Function
IS1+ Web Diagnostic	Diagnostic Overview Plugged Modules Configured Modules Backplanes HART Live List Module Diagnostic System Diagnostic AS- Protocol CPU Parameter License Event History Company	Standard Diagnosis Information – Read Only
User Access	User LogIn/Out Fieldstation Network CPU Software Update	Network Settings and Software Update CPU Without User Passwort: Read Only With User Passwort: Read- und Write of important User Data like IP-Address, Device Name, ….
Service Access	Service LogIn/Out	Service Information

User LogIn/Out

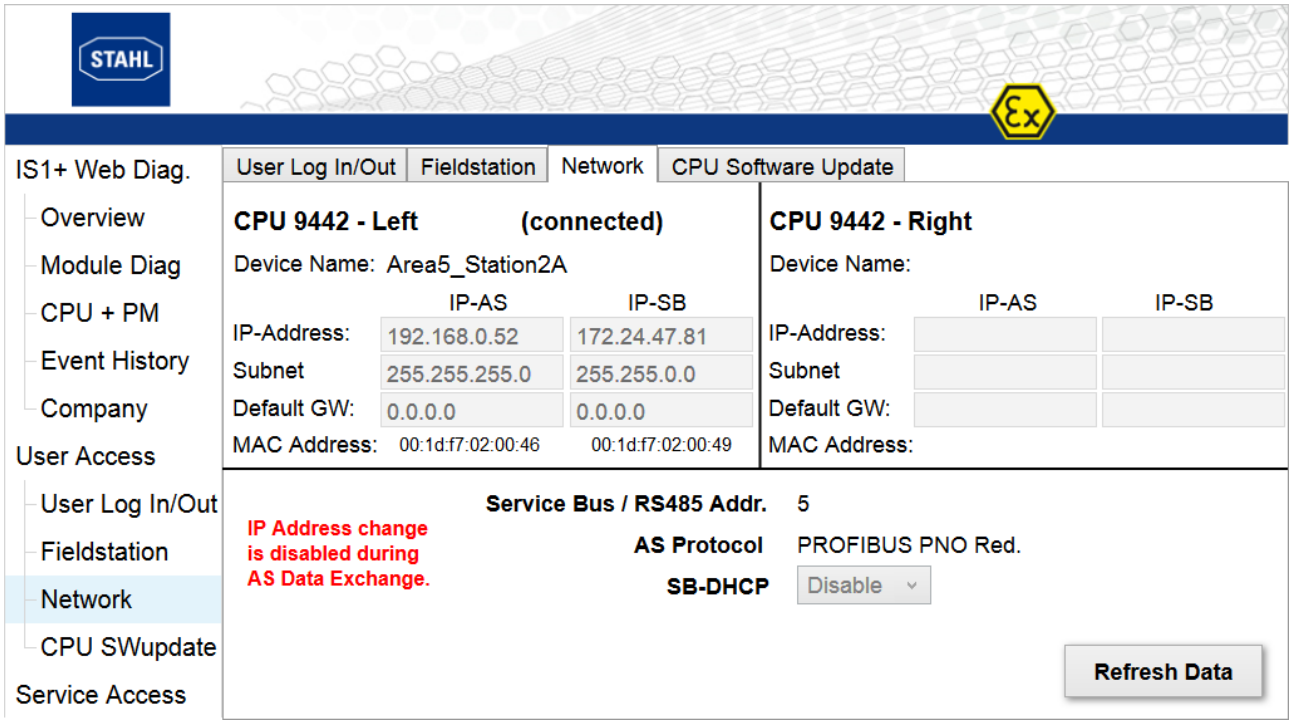
The user password by default is set to: **R.STAHL**
The user shall to change it after a successful user login.
In case of forgotten password the function ´store encrypted passwords´ can be used to save a file from which the R.STAHL Service can read the used password. So that a login is possible and the used password is to change again by the user afterwords.

IP-SB Address
The IP-AS address for the IP-SB Address can be adjusted via the Web server of 9442 CPU optionally.
The IP-AS address is not used with PROFIBUS.

The IP-AS, IP-SB addresses and the Device Name of both CPUs (left - and right CPU) of a redundant pair are displayed in the IS1 Webserver while the Web server is connected with one of the two CPUs (connected).

The IP-SB as well as IP-AS address can only be changed in the CPU, with which the Web server is currently connected. A valid user login is required for change.

A manual change is only possible with a valid user login and without DataExchange with an Automation System. DHCP must be disabled. An existing connection to the Web server is closed after a change of IP SB address and must be reopened to the modified IP SB address.



5 IS1+ APL Driver library for PCS7

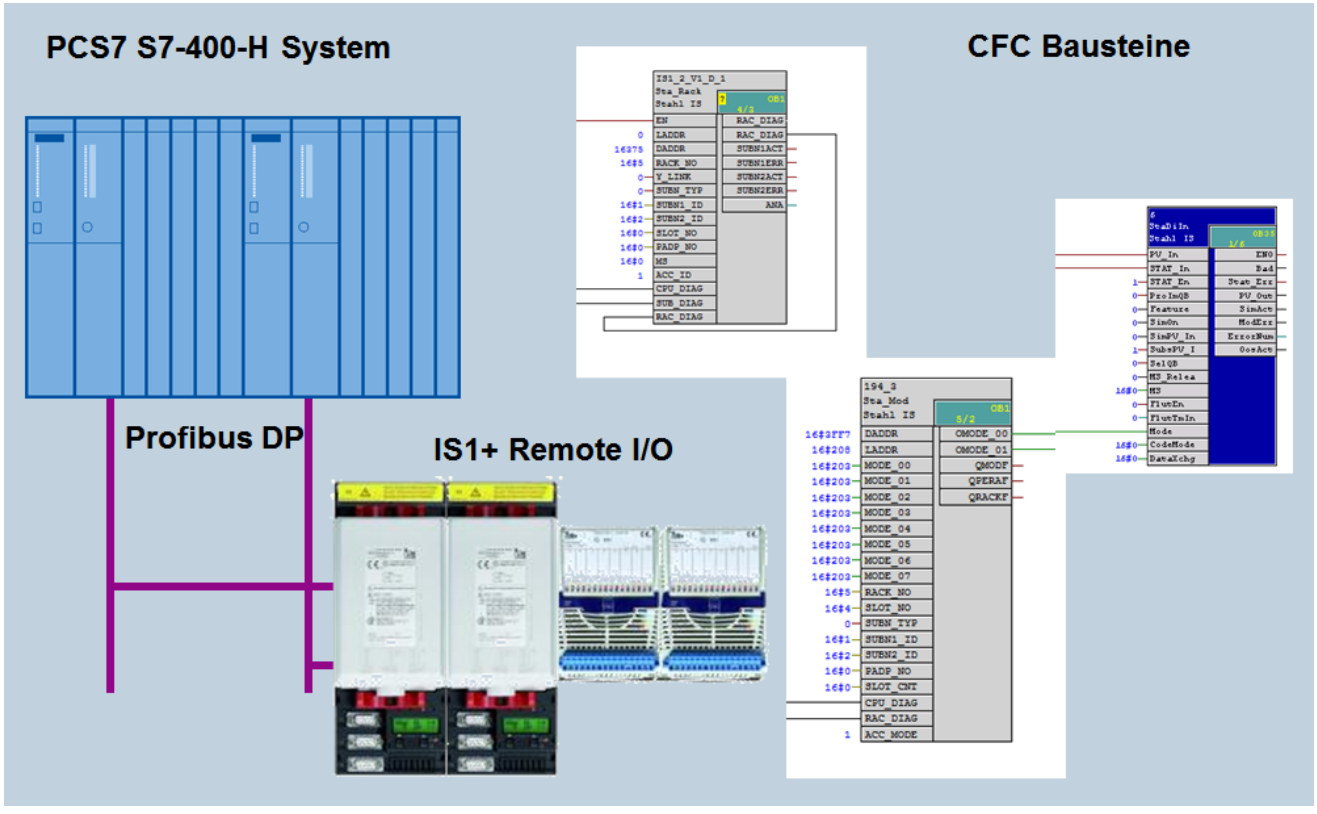
With implementing modern Siemens PCS7 based automation projects, you are often faced with special challenges, where the standard PCS7 environment is not a solution.
The R. STAHL IS1 PCS7 APL Driver library gives you the opportunity to simply connect R. STAHL IS1 modules to the control system PCS7 from Siemens via PROFIBUS. The library contains PCS7 conform CFC blocks and an English documentation. Standard functionalities as Driver Wizard and Asset Management are supported.
The PCS7 driver blocks allow you to prevent errors, to save own resources and to be focused to your automation project. You have no risk, as you have calculable costs, thanks to a professional development team.
The APL driver library is compatible up to PCS7 V8.0 SP2.
Sales and support directly from Siemens in Karlsruhe.
Contact: function.blocks.industry@siemens.com

Supported functionalities

- Use of R. STAHL IS1 in a non redundant S7-400 CPU system
- Use of R. STAHL IS1 in a redundant S7-400-H CPU system
- Use of R. STAHL IS1 behind a Y-Link device
- Module and channel granular diagnosis
- Asset Management
- Driver Wizard
- HART Variables

Customer benefit

- Extensive library with tested and approved driver blocks
- Easy calculation of costs thanks to fixed prices
- Hotline & Support from our special team
- English documentation for the library



Driver for PCS7 V8. 0 SP2 based IS1 GSE V3 05 supports CPM 9440 redundancy.
Support for 9442 with CPU redundancy in preparation.

6 List of abbreviations:

AS	**A**utomation **S**ystem
AIM	**A**nalogue **I**nput **m**odule
AIMH	**A**nalogue **I**nput **m**odule + **H**ART
AUMH	**A**nalog **U**niversal **M**odule AI/AO with **H**ART
SAIMH	**S**afety **A**nalogue **I**nput **m**odule + **H**ART (PROFIsafe)
AOM	**A**nalogue **O**utput **module**
AOMH	Analogue output module +HART
CPM	**C**PU + **PM** = CPM Central unit 9440 consisting of communication processor with power pack
DIM	**D**igital **I**nput **M**odule
DIOM	**D**igital **I**nput **O**utput **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	Hardware
IOP	**I/O P**rocessor of the central unit
IOM	General description of **I/O M**odule
PM	**P**ower **M**odule (power pack)
SW	Software
SIL	**S**afety **I**ntegrity **L**evel
TIM	**T**emperature **I**nput **M**odule

7 Release Notes:

Revision This document	Revision GSE file	Extensions / Changes
1.00	3.00	• PROFIBUS according DPV1 - Diagnosis status messages - I&M Functions • Support of PROFIsafe I/O modules • Support of IS1 DTMs (FDT) with communication via DPV1
1.01	3.01	• MaxTsdr values for operation with line redundancy added • Signal diagnoses message ´critical temperature´ for 9462 module added
1.02	3.02	• Field IM_SUPPORTED in I&M0 changed.
1.03	3.03	• Description PNO Slave Redundancy added. - CPM parameter added: ´Address Offset backup CPM PNO Red´ - CPM diagnosis added: ´Backup CPM not available´ - Max. 15 IO-Modules from GSE V3.03 • Module added: DOMV 9478/22-08-51 • 9480 TIMR Parameters added for CU53 GOST, Pt46 GOST, Pt50 GOST
1.04	3.03	• Description PNO Slave Redundancy extended
2.00	2.26 (DPV0) 3.04 (DPV1)	• DPV0 and DPV1 now both described in this document • IS1+ extension with new IO-Modules 9468, 9470/3 and 9475/3 • Description of STAHL redundancy added
2.01	3.05 (DPV1)	• New parameter: Slot Offset DPV1 Diagnosis = 0/1
2.02	2.28 (DPV0) 3.06 (DPV1)	• Diagnostic message ´check module note´ added for 9475 DOM4
2.03	2.29 (DPV0) 3.07 (DPV1)	• new IS1+ IO-Module 9482 TIM added
2.04	2.30 (DPV0) 3.08 (DPV1)	• IS1+ Module descriptors with IS1 compatible data formats without separate signal status added. (No Stat.)
2.05	2.31 (DPV0) 3.09 (DPV1)	• IS1+ Module descriptors with IS1 compatible data formats added: 9470/3x-16-xx DIM 16 9470/2
2.07	2.33 (DPV0) 3.11 (DPV1)	• new IS1+ modules added: - 9469/35 UMH Z2 Ex n - 9471/35 DIO-Module Z2 Ex n - 9472/35 DIO-Module-24V Z2 Ex n
3.00_b7	2.34 (DPV0) 3.12 (DPV1) 4.13 (DPV0) 5.13 (DPV1)	• new 9442 Zone2 CPU added • 9469: DI Pulse extension 1,2 s added.

8 Support address

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9 Appendix A: GSD File Rev. vs. CPM 9440 Firmware Rev.

The Table shows allowed GSD File revisions for different IS1 CPM 9440 firmware revisions.
In general, it is allowed to use an old GSD revision with later firmware versions, but you cannot use a new GSD revision with an older firmware. This will cause a configuration error.
Be carefully if you have different versions of GSD and firmware in your plant to avoid unexpected problems.

Firmware 9440				**GSD Revision**																
DP-V0	DP-V1	DP-V1	DP-V1	**DP V1 Diagnosis message**						**DP V0 Diagnosis message**							**DP V0 Diagnosis message**			
1-33	2-33	9-33								V2.23							V1.23			
1-34	2-34	9-34								V2.23							V1.23			
1-35	2-35	9-35								V2.23	V2.24						V1.23	V1.24		
1-41	2-41	9-41	3-41	V3.02						V2.23	V2.24						V1.23	V1.24		Last version
1-42	2-42	9-42	3-42	V3.02	V3.03					V2.23	V2.24	V2.25					V1.23	V1.24	V1.25	V1.26
1-43	2-43	9-43	3-43	V3.02	V3.03					V2.23	V2.24	V2.25					V1.23	V1.24	V1.25	V1.26
1-44	2-44	9-44	3-44	V3.02	V3.03	V3.04				V2.23	V2.24	V2.25	V2.26				V1.23	V1.24	V1.25	V1.26
1-45	2-45	9-45	3-45	V3.02	V3.03	V3.04	V3.06			V2.23	V2.24	V2.25	V2.26	V2.28			V1.23	V1.24	V1.25	V1.26
1-46	2-46	9-46	3-46	V3.02	V3.03	V3.04	V3.06	V3.07		V2.23	V2.24	V2.25	V2.26	V2.28	V2.29		V1.23	V1.24	V1.25	V1.26
1-47	2-47	9-47	3-47	V3.02	V3.03	V3.04	V3.06	V3.07	V3.11	V2.23	V2.24	V2.25	V2.26	V2.28	V2.29	V2.33	V1.23	V1.24	V1.25	V1.26
1-48	2-48	9-48	3-48	V3.02	V3.03	V3.04	V3.06	V3.07	V3.11	V2.23	V2.24	V2.25	V2.26	V2.28	V2.29	V2.33	V1.23	V1.24	V1.25	V1.26
1-49	2-49	9-49	3-49	V3.02	V3.03	V3.04	V3.06	V3.07	V3.11	V2.23	V2.24	V2.25	V2.26	V2.28	V2.29	V2.33	V1.23	V1.24	V1.25	V1.26
For **IS1 +** I/O Modules CPM firmware and GSD revision, I/O module firmware is V3.xx																				
Firmware IS1 I/O Modules: →				V2.xx and V3.xx						V2.xx and V3.xx							V 1.xx, V2.xx and V 3.xx (1*)			
CPM Redundancy																				
According STAHL					According STAHL					According STAHL							According STAHL			
			PNO		According PNO							According PNO								
Usable amount of I/O Data →				238 Byte Input and 127 Byte output						238 Byte Input and 127 Byte output							112 Byte Input and 80 Byte output			

1*) Firmware V3.xx (IS1+ I/O modules) is only in compatibility mode (as 1 to 1 replacement of old I/O modules) usable.

The CPM firmware mentioned here will run on 9440/15, 9440/12 hardware rev.F (released end 2001) and later and 9440/22 all hardware rev. If older CPM firmware than x-33 is used or the I/O module firmware is 1-xx (version 2-xx was released June 2003) contact: **support.automation@stahl.de** for upgrade options.

In general the latest CPM firmware and the latest GSD version should be used (latest mean: V1.xx, V2.xx, V3.xx => were xx has the highest available count)

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