

Description CPU 9442

EtherNet/IP™

Interface for

IS1+ field stations



EtherNet/IP interface description

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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.

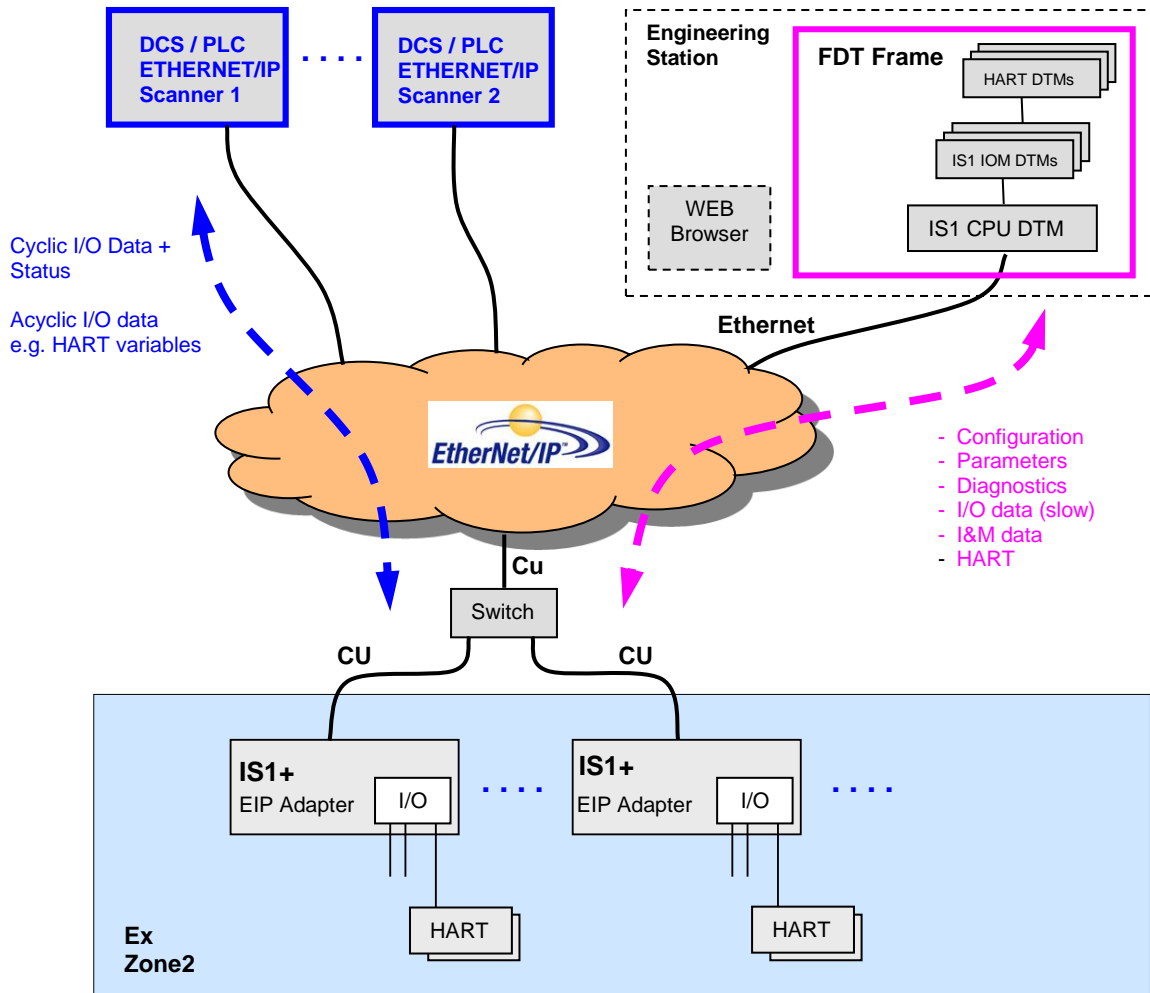
- 1987 The "ICS MUX fieldbus system" from R. STAHL is the first intrinsically safe bus system for sensors and actuators in hazardous areas (Zone 1) on the market. A master station installed in the control room establishes the connection to the automation systems. Intrinsically safe communication with 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 with 9442 CPU when connecting to an automation system via EtherNet/IP.

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1 System overview



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

The IS1+ field station operates as an EtherNet/IP adapter and comes with an Ethernet fibre optic connection (9441 CPU, Zone1) or two Ethernet copper connections (9442 CPU, Zone 2).

Configuration, parameter setting, diagnostics and HART communication for the IS1+ field station and its I/O modules are carried out via IS1 DTMs interfaced using FDT technology.

A webserver is integrated in the IS1+ CPUs which offers additional diagnostic functions.

[List of abbreviations](#)

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2 Commissioning

2.1 Overview

Planning of the complete EtherNet/IP network:

- Which masters (EtherNet/IP Scanner) are in the network?
- Which slaves (EtherNet/IP Adapter) are in the network?
- Selection of network topology and network physics (switches, repeaters, glass fibre links ...)
- Unique allocation of the IP addresses.

Perform the commissioning:

- Mechanical installation of the IS1+ field stations.
- Mechanical installation of the Ethernet switches
- Mechanical installation of all other bus users.

- Set up the bus connections.

- Set up the voltage supply of the IS1+ field station.
- Set up the voltage supply of the switches and other network components

- Set up the IP addresses, Subnet Mask, Gateway.... on the IS1+ Fieldstations.
- Set up the addresses of all other users.

- Install a FDT Frame and the IS1 DTMs on the PC.
- Configure the IS1+ field stations with its I/O modules using the FDT software.

- Configuration of EtherNet/IP Scanner.
Import EDS file (Electronic Data Sheet) in configuration software of EtherNet/IP Scanner and configure communication to IS1+.

- Put the EtherNet/IP Scanner into operation. This results in the automatic start-up of the cyclic communication.

- Check Ethernet connection using:
 - LED's on Ethernet Switches
 - Link LED's of CPU on IS1+ Fieldstation
 - „Ping“ command. Ping is responding in any IS1+ CPU state.

- Check communication on the EtherNet/IP using the following tools:
 - Diagnostics information from the EtherNet/IP scanner or from the diagnostic tools for the scanner.
 - LEDs on the CPU of the IS1+ field station and text display using 9441 CPUs
 - Webserver in IS1+ CPU

- Check I/O signals using the following tools:
 - Information from the EtherNet/IP scanner or its diagnostic tool.
 - Use of diagnostics functions for the IS1 DTMs.

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2.2 System requirements

Hardware requirements:

- IS1 field station with CPU 9441/12-00-00
- single socket 9492/12-11-41 or redundant socket 9492/12-11-42

- IS1+ Fieldstation with CPU 9442/35-10-00, Socket 9496/.. and Power Module PM 9445/..

Software requirements:

IO Module	IO Module Firmware	9442 CPU		IS1 DTM
		Firmware	EDS	
IS1 IOM	from 02-00	from V1.0.x	Depending on CPU parameter 'Data Structure': Struct 1: Less big Connections -> from STAHL_RIO9442_EIP_Struct1_01_01.eds Struct 2: Many small Connections -> from STAHL_RIO9442_EIP_Struct2_01_01.eds	from V3.0.13
IS1+ IOM (94xx/3..)	from 03-01			

2.3 Engineering limits

The general regulations according to the IS1+ operating instructions apply to the engineering of an IS1+ field station.

Possible limitations due to EtherNet/IP scanner:

- Memory for I/O data in scanner and with this a limitation of the number of I/O modules and a maximum number of signals.
- Maximum number of adapters in a network

Thus, the limits on the EtherNet/IP scanner used must also be taken into account during the engineering.

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2.4 Compatibility of new IS1+ IO Modules

New IS1+ IOM can be used in existing plants for compatible replacement of previous IS1 IOM.

No change of GSD File or configuration is required in such case.

The IS1+ IOM switch to a compatible mode in case of detection of an allowed configuration of the previous IOM.

If new features of the IS1+ IOM shall be used which are not supported by the previous IOM new configuration according type number of the IS1+ IOM is required.

Overview of compatible IO Modules:

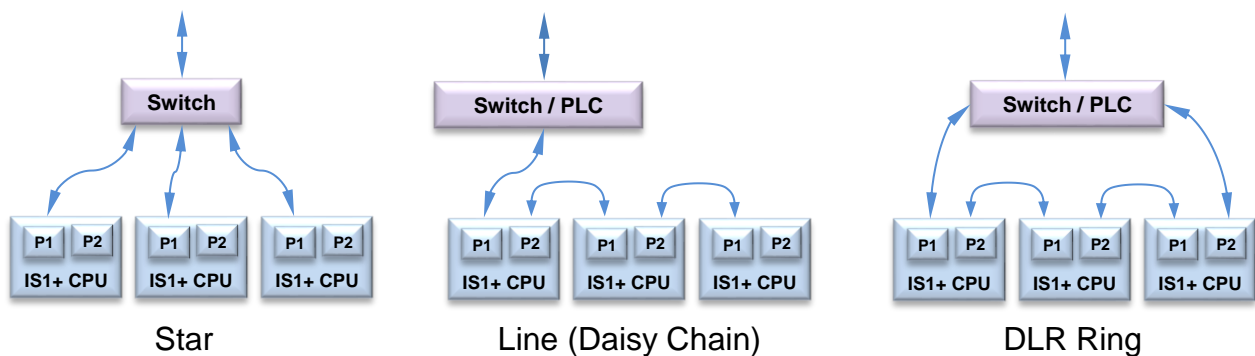
IS1 IO Modules		compatible IS1+ IO Module	Remark
9460/12-08-11	AIM 8	9468/32-08-11 AUMH Zone 1 9468/33-08-10 AUMH Zone 2	-
9461/12-08-11	AIMH 8		-
9461/12-08-21			9164 additionally required
9465/12-08-11	AOM 8		-
9466/12-08-11	AOMH 8		-
9461/15-08-12	AIMH 8 Exn	9469/35-08-xx UMH Exn	-
9466/15-08-12	AOMH 8 Exn		-
9470/22-16-11	DIM 16	9470/32-16-11 DIOM Zone 1	-
9475/12-08-41	DOM 8	9470/33-16-10 DIOM Zone 2	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		-

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2.5 EtherNet/IP Network Topology

The IS1 + 9442 CPU has two Ethernet ports (X2, P1, as well as X2, P2) which are internally connected via an Ethernet switch. Thus, it is possible to build Ethernet star-, line- (daisy chains) as well as DLR Ring topologies (Device Level Ring).

To build up ring topologies DLR enabled components in accordance with EtherNet/IP specification are to be used and configured.



Maintenance Note: The internal switch and the Port P2 of a 9442 CPU are disabled during a software update. Following Network participants connected on port P2 are therefore unavailable in this phase of the operation.

2.5.1 Device Level Ring (DLR)

The 9442 CPU supports Announce-based device level ring (DLR) as a DLR client (node).

Preconditions for trouble-free operation of a Device Level Ring (DLR)

- The maximum number of devices per ring is limited (such as typical max. 50 devices). Details see the operating instructions of the DLR Ring Supervisor. Exceeding the number of devices can lead to the loss of traffic or to higher switch over times in case of failure.
- The ring, in which you want to use DLR, shall consist of devices that support this feature.
Do not connect non-DLR devices directly to the DLR network.
- All devices must be connected to each other through their ring ports.
- For all devices in the ring "DLR" must be enabled - all devices as "DLR Client" except for a device with the Ring Supervisor role. Optional back-up Supervisor can be used.
- The IS1+ 9442 CPU has the role of "DLR Client".
- Reconfiguration time of an Announce-based DLR ring after error: typ. **ms**

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Rule for loading the devices of a DLR domain

- Loading devices of a DLR ring can come to circular frames (broadcast storm) and thus the loss of the network if there is an invalid DLR project planning.
- Example: You change the DLR roles from multiple devices and load the configuration in the participating devices one at a time. Configurations may arise which conflict with the above rules.
- Open the DLR ring before downloading to avoid an invalid configuration which will lead to a failure of the network.
- Proceed as follows:
 1. Open the ring.
 2. Download the healthy and consistent DLR project planning of your project to all participating devices and make sure that the devices are in data exchange.
 3. Close the ring.

DLR and Realtime (RT)

RT operation is possible with the use of DLR. During the reconfiguration time of the ring after a failure, the I/O data will be frozen.

Caution! Select the Watchdog time of the IO devices large enough.

Typical ≥ 200 ms.

The RT communication is interrupted (station failure) if the reconfiguration time of the ring is greater than the Watchdog time of the IO devices.

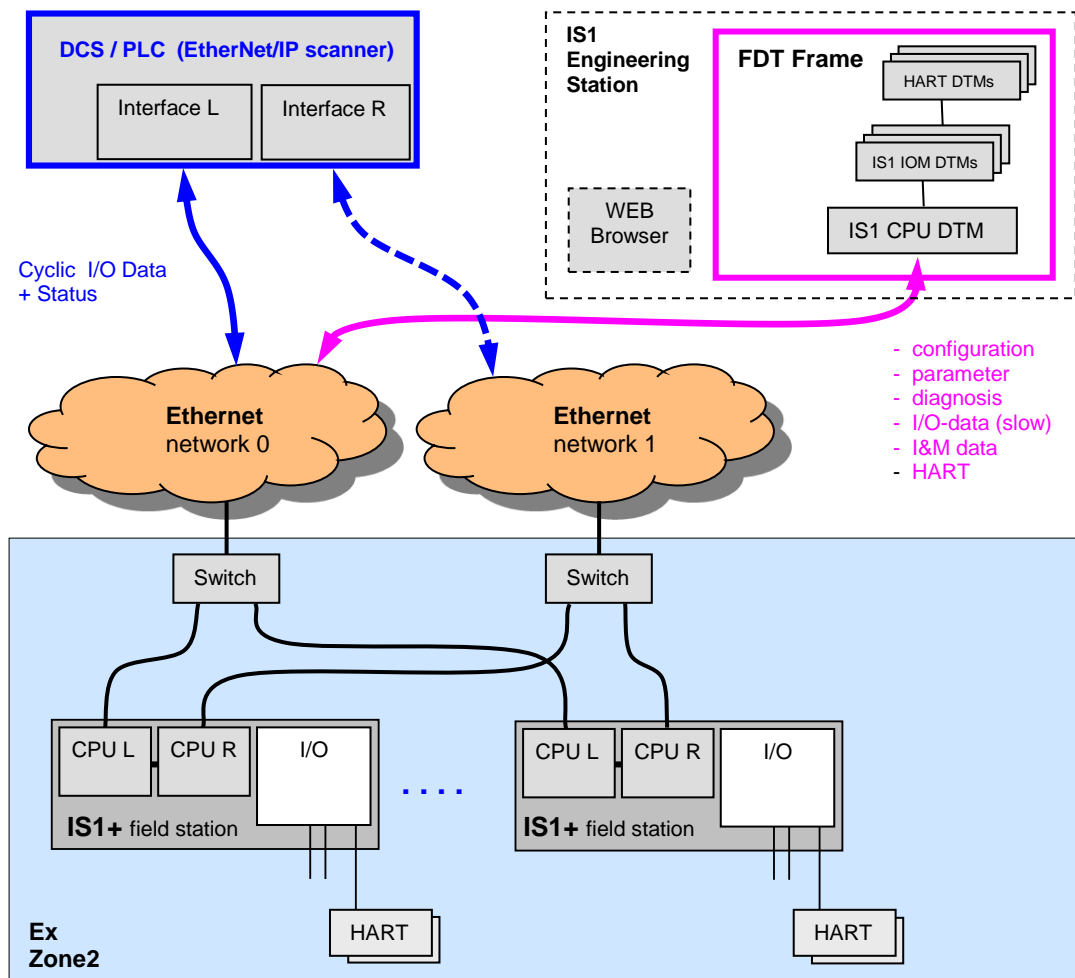
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2.5.2 CPU redundancy

Redundant IS1+ CPUs can be connected to EtherNet/IP scanner that support the following functions:

- EtherNet/IP scanner will establish identical cyclic connections to both 9442 CPUs of an IS1+ field station.
- Input data are read from both IS1 + CPUs. Maximum delay of the input data of both CPUs approx. 10 ms.
- Identical output data is shall be written from the EtherNet/IP scanner to both IS1 + CPUs.
- The remaining available connection will be used in case of a failure of one of the connections.

Example: Redundant Ethernet networks



Using one single Ethernet network (not redundant or with media redundant DLR ring) the IP addresses of both CPUs of an IS1+ field station are to set differently.

Connection of the IS1+ Engineering Station:

IS1+ engineering station is bound to one of two 9442 CPUs. Configuration- parameter- and diagnostic data, as well as input and output data of both CPUs are synchronized between CPUs and are available in the DTM.

Parameterization

The parameter 'CPU Redundant = Yes' has to be set in IS1 DTM for redundant operation an IS1+ field station with two redundant = CPU. This activates the synchronization and tracking of redundant CPUs.

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2.6 Addressing and Protocol selection 9442 CPUs

2.6.1 DP/RS485 + SB Address setting

A common station address is used from the 9442 CPU for the protocols PROFIBUS DP as well as the STAHL service bus via USB/RS485, which is adjustable via two rotary switches S2, S3 on the first IS1+ socket (Bank 0).

The switch is located under the left CPU.

This has the advantage that the switches can not accidentally be changed during operation.

Changed switch settings will be accepted after CPU boot only.

Address Range (0 – 99)

Address = S2 x 10 + S3



2.6.2 Protocol Selection

The required AS Protocol can be set by a rotary switch S1 on the IS1+ 9442 CPU socket.

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
<i>Reserved</i>	0
PROFIBUS PNO Red.	1
PROFIBUS Stahl Red. Addr. Offs. 1	2
PROFIBUS Stahl Red. Addr. Offs. 0	3
PROFINET	4
<i>Reserved</i>	5
Modbus TCP	6
EtherNet/IP	7
<i>Reserved</i>	8
<i>Reserved</i>	9

2.6.3 IP Address setting

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

- IP-AS: Realtime bus to automation system (MODBUS TCP, PROFINET, EtherNet/IP,)
- IP-SB: Service Bus Functions: Web-Server, IS1 DTM, HART, Standard TCP Traffic, SW-Update

This separation of IP Addresses allows enhanced independence of the different data streams also if both data streams are transmitted via the same Ethernet ports. A change of IP addresses is blocked during active data exchange to the Automation System.

Caution! IP-AS, IP-SB addresses and Devicenames of CPUs must be unique as all 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.

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2.6.3.1 IP-AS Address of IS1+ field station

The following information is required to address an IS1+ field station on EtherNet/IP:

- IP-AS address
- SubNet mask
- optional: Gateway (only necessary for communication via routers)

The addresses for an IS1+ field station can be set via:

- IS1+ Detect Tool
- IS1+ Webserver
- DHCP Server

2.6.3.2 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. Gateway	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

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2.6.3.3 IS1+ Web Server

The IP-AS address for the EtherNet/IP interface and the IP-SB Address can be adjusted via the Web server of 9442 CPU optionally.

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 MODBUS TCP client. 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.

The screenshot shows the IS1+ Web Server interface with the following configuration details:

CPU 9442 - Left (connected)		CPU 9442 - Right	
Device Name:	Station22.3	Device Name:	-
	IP-AS	IP-SB	
IP-Address:	172.24.47.75	172.24.47.74	IP-Address: 0.0.0.0
Subnet	255.255.255.0	255.255.255.0	Subnet 0.0.0.0
Default GW:	0.0.0.0	0.0.0.0	Default GW: 0.0.0.0
MAC Address:	00:1d:f7:02:00:28	00:1d:f7:02:00:2b	MAC Address: 00:00:00:00:00:00

Service Bus / RS485 Addr.	16
AS Protocol	EtherNet/IP
SB-DHCP	Disable

Warning! Use for authorized personal only! Changing address data during operation may cause loss of concerned ethernet communication connections.

Buttons: **Accept changes** | **Refresh Data**

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2.7 Configuration of EtherNet/IP Scanner

- Dependent on the properties of the used Ethernet/IP scanner, one of the two optional data structures supported by an IS1 + CPU are to be selected. See [CPU parameters](#)
- Import the IS1+ EDS File (Electronic Data Sheet) related to the coosen data structure to EtherNet/IP Scanner configuration tool.

IS1+ CPU Parameter 'Data structure'	EDS File
Struct 1: Less big Connections	STAHL_RIO9442_EIP_Struct1_01_00.eds
Struct 2: Many small Connections	STAHL_RIO9442_EIP_Struct2_01_00.eds

- Select EtherNet/IP cyclic connections and size according the highest slot number of used IS1+ I/O modules.
- Set EtherNet/IP scanner into cyclic operation.

Cyclic input- and output data of one IS1+ fieldstation are grouped to assemblies and allocated to connections with different size:

2.7.1 Cyclic I/O Data - Struct 1: Less big Connections

Data	Connections		Input Instance	Input Size (T->O) [Byte]	Output Instance	Output Size (O->T) [Byte]	Config Instance	Config Size [Byte]
IOM 1-12	Exclusive Owner	EO IOM 1-12	141	252	131	252 *1)	107	0
	Input Only	IO IOM 1-12			197	0		0
	Listen Only	LO IOM 1-12			198	0		0
IOM 1-4	Exclusive Owner	EO IOM 1-4	142	84	132	84 *1)	108	2
	Input Only	IO IOM 1-4			197	0		1
	Listen Only	LO IOM 1-4			198	0		0
IOM 13-16	Exclusive Owner	EO IOM 13-16	142	84	132	84	108	2
	Input Only	IO IOM 13-16			197	0		1
	Listen Only	LO IOM 13-16			198	0		0
Ext. HART	Input Only	IO Ext HART	143	220	197	0	109	110
	Listen Only	LO Ext HART			198	0		0

Allowed connection combinations:

transmitted IO Module slots	Exclusive Owner	Input Only	Listen Only
1 – 4	EO IOM 1-4	IO IOM 1-4 IO Ext HART	LO IOM 1-4 LO Ext HART
1 – 12	EO IOM 1-12	IO IOM 1-12 IO Ext HART	LO IOM 1-12 LO Ext HART
1 – 16	EO IOM 1-12 EO IOM 13-16	IO IOM 1-12 IO IOM 13-16 IO Ext HART	LO IOM 1-12 LO IOM 13-16 LO Ext HART

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Attention!

*1) Only one of the possible exclusive owner connections EO IOM 1-4 or EO IOM 1-12 are allowed at the same time because output signals of a IS1 fieldstation must come unique from one EIP scanner. If a second EO connection is established while a first EO connection is active then the output data of the second connection are rejected and following messages are generated:

TBD:

Web Server 9442: Message 'The output data will not be forwarded!' on page 'Protocol' in Ext. CIP Status Identity Objekt: Status = 0x0A 'Multiple EO connections!'

2.7.2 Cyclic I/O Data - Struct 2: Many small Connections

Data	Connections		Input Instance	Input Size [Byte]	Output Instance	Output Size [Byte]
IO Module and CPU Status	Exclusive Owner	EO STAT	1	4	2	4
	Input Only	IO STAT			197	0
	Listen Only	LO STAT			198	0
IOM 1 and 2	Exclusive Owner	EO IOM 1-2	3	40	4	40
	Input Only	IO IOM 1-2			197	0
	Listen Only	LO IOM 1-2			198	0
IOM 3 and 4	Exclusive Owner	EO IOM 3-4	5	40	6	40
	Input Only	IO IOM 3-4			197	0
	Listen Only	LO IOM 3-4			198	0
IOM 5 and 6	Exclusive Owner	EO IOM 5-6	7	40	8	40
	Input Only	IO IOM 5-6			197	0
	Listen Only	LO IOM 5-6			198	0
IOM 7 and 8	Exclusive Owner	EO IOM 7-8	9	40	10	40
	Input Only	IO IOM 7-8			197	0
	Listen Only	LO IOM 7-8			198	0
IOM 9 and 10	Exclusive Owner	EO IOM 9-10	11	40	12	40
	Input Only	IO IOM 9-10			197	0
	Listen Only	LO IOM 9-10			198	0
IOM 11 and 12	Exclusive Owner	EO IOM 11-12	13	40	14	40
	Input Only	IO IOM 11-12			197	0
	Listen Only	LO IOM 11-12			198	0
IOM 13 and 14	Exclusive Owner	EO IOM 13-14	15	40	16	40
	Input Only	IO IOM 13-14			197	0
	Listen Only	LO IOM 13-14			198	0
IOM 15 and 16	Exclusive Owner	EO IOM 15-16	17	40	18	40
	Input Only	IO IOM 15-16			197	0
	Listen Only	LO IOM 15-16			198	0
Extended HART	Input Only	IO Ext HART	143	220	197	0
	Listen Only	LO Ext HART			198	0

EtherNet/IP interface description

2.8 System start-up behaviour

Configuration data and parameter data for CPU and all I/O modules are generated using the IS1 DTMs, transferred to the IS1+ field station by 'download' and are stored in non-volatile memory in the socket for the IS1 CPU.

After power on the entire data range of the output register is initialised with the value 0x8000. All output signals therefore remain in the safe setting. The remaining data areas are initialised with 0x0000.

After power on the CPU checks that valid configuration data and parameter data are available.

Without valid data the CPU enters 'Config or parameter error' state.

If valid data is available the CPU remains in the state 'No data exchange' until as a scanner starts up cyclic communication.

The output signals remain in safe setting until valid output data is written by the AS or by the IS1 DTMs.

Possible CPU states:

Configuration data and parameter data	Message on the display	CPU state after checking and booting
Data valid and cyclic data exchange with EtherNet/IP scanner	Data Exchange	Data Exchange with Scanner (2) Config + Param. from DTM
No data available	No Data Exchange	No data exchange (3)
Data invalid (e.g. CRC error)	Config Error	Config or parameter error (4)
Data valid	Quit Data Exchange	Data exchange with AS quit (5)

IOM exchange and restart

Changing I/O modules during operation is possible. After plugging in a new module, parameters are automatically transferred from CPU to the I/O module, followed by a restart of the I/O module. -> Hot swap I/O module.

Exception: Module TIM R 9480/.. : The calibration value for 2 wire operation is stored in the I/O module. After changing of I/O modules a new calibration is required.

2.9 Online configuration change

Online configuration change of IS1+ I/O modules within the the limits of the selected assembly is possible.

Requirements for online configuration changes:

Changes of the assembly size and with this the size of the cyclic data can not be changed online.

Changes must be done offline by choosing a different assembly.

To allow online extensions of I/O modules of an IS1+ fieldstation, the assemblies have to be chosen big enough through project planning phase. Spare for future extensions should be considered.

3 Data traffic

3.1 Cyclic Data (Implicit Messages)

- For each I/O-module slot, independent from I/O module type and configuration, 18 byte Input- and 18 byte Output Data are reserved by the 9442 CPU.
Using Struct 2 additional 2 bytes with signal status are transmitted after for each slot.
Here 20 byte Input- and 20 byte Output data are transmitted for each IO module slot.
-> With the constant data length there is no shift of data in memory for the unchanged I/O modules in case of online configuration changes of IO modules and is **'bumpfree'**.
- I/O modules are allocated to the different slots of an IS1 fieldstation using FDT and the IS1 DTMs.
- Module data is mapped to the allocated areas according the selected I/O module types. Not allocated areas remain empty but are cyclically exchanged by the EIP scanner.
- Different Assemblies with different size of cyclic data and with this the number of exchanged I/O module slots can be configured in EtherNet/IP scanner.

EtherNet/IP interface description

3.1.1 Connections: EO IOM 1-4, IO IOM 1-4, LO IOM 1-4

Slot	IOM Type	Cyclic Data (Implicit Messages)			
		Byte No.	Input Assembly		Output Assembly
1	-	0	1	Signal Status Slot 1	-
2	-	2	3	Signal Status Slot 2	-
3	-	4	5	Signal Status Slot 3	-
4	-	6	7	Signal Status Slot 4	-
1 - 4	-	8	9	Module Status Slot 1 to 16	-
CPU	-	10	11	CPU Status	Control Register CPU
1	AUM 18 Byte per IOM see Data Formats	12	13	AI 0	AO 0
		14	15	AI 1	AO 1
		16	17	AI 2	AO 2
		18	19	AI 3	AO 3
		20	21	AI 4	AO 4
		22	23	AI 5	AO 5
		24	25	AI 6	AO 6
		26	27	AI 7	AO 7
		28	29	-	-
		30	31	-	DO 0 – 7
		32	33	-	-
		34	35	-	-
		36	37	-	-
		38	39	-	-
2	DOM	40	41	-	-
		42	43	-	-
		44	45	-	-
		46	47	-	-
		48	49	-	AO 0
		50	51	-	AO 1
		52	53	-	AO 2
		54	55	-	AO 3
		56	57	-	AO 4
		58	59	-	AO 5
		60	61	-	AO 6
		62	63	-	AO 7
		64	65	-	-
		3	AOM	66	67	DI 0 – 15	DO 0 – 15
68	69			CF 15	Reset 8–15 | Start/Stop 8-15
70	71			CF 14	-
72	73			CF 13	-
74	75			CF 12	-
76	77			CF 11	-
78	79			CF 10	-
80	81			CF 9	-
82	83			CF 8	-
4	DIOM				

EtherNet/IP interface description

3.1.2 Connections: EO IOM 1-12, IO IOM 1-12, LO IOM 1-12

Slot	IOM Type	Cyclic Data (Implicit Messages)			
		Byte No.		Input Assembly	Output Assembly
1	-	0	1	Signal Status Slot 1	-
....	-	-
16	-	30	31	Signal Status Slot 16	-
1 - 16	-	32	33	Module Status Slot 1 to 16	-
CPU	-	34	35	CPU Status	Control Register CPU
1	AIM 18 Byte per IOM see Data Formats	36	37	AI 0	-
		38	39	AI 1	-
		40	41	AI 2	-
		42	43	AI 3	-
		44	45	AI 4	-
		46	47	AI 5	-
		48	49	AI 6	-
		50	51	AI 7	-
		52	53	-	-
		54	55	DI 0 – 15	-
		56	57	CF 15	Reset 8–15 | Start/Stop 8-15
		58	59	CF 14	-
		60	61	CF 13	-
		62	63	CF 12	-
2	DIM	64	65	CF 11	-
		66	67	CF 10	-
		68	69	CF 9	-
		70	71	CF 8	-
		72	73	-	AO 0
		74	75	-	AO 1
		76	77	-	AO 2
		78	79	-	AO 3
		80	81	-	AO 4
		82	83	-	AO 5
3	AOM	84	85	-	AO 6
		86	87	-	AO 7
		88	89	-	-
		90	91	DI 0 – 15	DO 0 – 15
		92	93	CF 15	Reset 8–15 | Start/Stop 8-15
		94	95	CF 14	-
		96	97	CF 13	-
		98	99	CF 12	-
		100	101	CF 11	-
		102	103	CF 10	-
4	DIOM	104	105	CF 9	-
		106	107	CF 8	-

.....

EtherNet/IP interface description

Slot	IOM Type	Cyclic Data (Implicit Messages)			
		Byte No.		Input Assembly	Output Assembly
5	AUM	108	109	AI 0	AO 0
		110	111	AI 1	AO 1
		112	113	AI 2	AO 2
		114	115	AI 3	AO 3
		116	117	AI 4	AO 4
		118	119	AI 5	AO 5
		120	121	AI 6	AO 6
		122	123	AI 7	AO 7
		124	125	-	-
	
12	DOM	234	235	-	DO 0 – 7
		236	237	-	-
		238	239	-	-
		240	241	-	-
		242	243	-	-
		244	245	-	-
		246	247	-	-
		248	249	-	-
		250	251	-	-

EtherNet/IP interface description

Slot	IOM Type
-	-
-	-
-	-
-	-
-	-
-	-
13	AUM 18 Byte per IOM see Data Formats
14	DOM
15	AOM
16	DIOM

Cyclic Data (Implicit Messages)			
Byte No.		Input Assembly	Output Assembly
0	1	Reserved	Reserved
2	3		
4	5		
6	7		
8	9		
10	11		
12	13	AI 0	AO 0
14	15	AI 1	AO 1
16	17	AI 2	AO 2
18	19	AI 3	AO 3
20	21	AI 4	AO 4
22	23	AI 5	AO 5
24	25	AI 6	AO 6
26	27	AI 7	AO 7
28	29	-	-
30	31	-	DO 0 – 7
32	33	-	-
34	35	-	-
36	37	-	-
38	39	-	-
40	41	-	-
42	43	-	-
44	45	-	-
46	47	-	-
48	49	-	AO 0
50	51	-	AO 1
52	53	-	AO 2
54	55	-	AO 3
56	57	-	AO 4
58	59	-	AO 5
60	61	-	AO 6
62	63	-	AO 7
64	65	-	-
66	67	DI 0 – 15	DO 0 – 15
68	69	CF 15	Reset 8–15 | Start/Stop 8-15
70	71	CF 14	-
72	73	CF 13	-
74	75	CF 12	-
76	77	CF 11	-
78	79	CF 10	-
80	81	CF 9	-
82	83	CF 8	-

3.1.3 C
on-
nec-
tions:
EO
IOM
13-16,
IO
IOM
13-16,
LO
IOM
13-16

EtherNet/IP interface description

3.1.4 Connections: EO STAT, IO STAT, LO STAT

Slot	IOM Type	Cyclic Data (Implicit Messages)			
		Byte No.		Input Assembly	Output Assembly
1 - 16	-	0	1	Module Status IOM Slot 1 to 16	-
CPU	-	2	3	CPU Status	Control Register CPU

3.1.5 Connections: EO IOM 1-2, EO IOM 15-16

Slot	IOM Typ	Cyclic Data (Implicit Messages)				
		Byte No.		Input Assembly	Output Assembly	
n *1)	AUM	0	1	AI 0	AO 0	18 Byte I/O-Data see Data Formats
		2	3	AI 1	AO 1	
		4	5	AI 2	AO 2	
		6	7	AI 3	AO 3	
		8	9	AI 4	AO 4	
		10	11	AI 5	AO 5	
		12	13	AI 6	AO 6	
		14	15	AI 7	AO 7	
		16	17	-	-	
		18	19	Signal Stati Slot n			-	Signal Status
n + 1	DOM	20	21	-	DO 0 – 7	18 Byte I/O-Data see Data Formats
		22	23	-	-	
		24	25	-	-	
		26	27	-	-	
		28	29	-	-	
		30	31	-	-	
		32	33	-	-	
		34	35	-	-	
		36	37	-	-	
		38	39	Signal Stati Slot n+1			-	Signal Status

*1) Slot n = 1, 3, 5, .., 15

EtherNet/IP interface description

3.1.6 Connections: IO Ext HART, LO Ext HART

Input Assembly:

Function	Byte Offset	Signal	Data Type	T -> O Size	Config #2 Size	Connection Path
Extended HART Variables	0 – 3	HV 01	Float	220 Byte	110 Byte	20 04 24 6C 2C C5 2C 8F
	4 – 7	HV 02				
	8 – 11	HV 03				
				
	216 – 219	HV 55				

55 hard variables with variable mapping via Configuration Assembly can be transmitted cyclically. This advanced mapping of HART data is supported by IOM 9468 and 9469 only.

Configuration Assembly

The address (slot, channel and HART variable HV 1-4) for each of the 55 cyclically read and transferred HART variables of the IOM can be configured.

Parameters	Value	Datatype	Default	Help String
IO HART				
Config#2 Data				
HV 01: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 01: Channel & HV	Channel 0, HV 1	USINT	Unused	Select Channel and HART Variable
HV 02: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 02: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 03: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 03: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 04: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 04: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 05: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 05: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 06: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 06: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 07: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 07: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 08: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 08: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 09: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 09: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 10: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 10: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 11: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 11: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 12: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 12: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 13: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 13: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable
HV 14: Slot	Slot 1	USINT	Slot 1	Set Slot Number
HV 14: Channel & HV	Unused	USINT	Unused	Select Channel and HART Variable

Slot 1
 Slot 16
 Slot 15
 Slot 14
 Slot 13
 Slot 12
 Slot 11
 Slot 10
 Slot 9
 Slot 8
 Slot 7
 Slot 6
 Slot 5
 Slot 4
 Slot 3
 Slot 2
 Slot 1
 Unused

Channel 0, HV 1
 Channel 7, HV 1
 Channel 6, HV 4
 Channel 6, HV 3
 Channel 6, HV 2
 Channel 6, HV 1
 Channel 5, HV 4
 Channel 5, HV 3
 Channel 5, HV 2
 Channel 5, HV 1
 Channel 4, HV 4
 Channel 4, HV 3
 Channel 4, HV 2
 Channel 4, HV 1
 Channel 3, HV 4
 Channel 3, HV 3
 Channel 3, HV 2
 Channel 3, HV 1
 Channel 2, HV 4
 Channel 2, HV 3
 Channel 2, HV 2
 Channel 2, HV 1
 Channel 1, HV 4
 Channel 1, HV 3
 Channel 1, HV 2
 Channel 1, HV 1
 Channel 0, HV 4
 Channel 0, HV 3
 Channel 0, HV 2
 Channel 0, HV 1
 Unused

EtherNet/IP interface description

3.2 CIP Common Classes

The following classes are supported by the IS1+ EtherNet/IP firmware:

Class	Name
0x01	Identity
0x02	Message Router
0x04	Assembly
0x06	Connection Manager
0xF5	TCP/IP Interface Objekt
0xF6	Ethernet Link Objekt

3.2.1 Assembly / Parameter 9442 CPU Class 0x04

Class Attributes

Attribute ID	Name
1	Revision
2	Max Instance

Class/Instance Services

Servicecode	Service supported		Service Name
	Class	Instance	
0x01	No	No	Get_Attribute_All
0x0E	No	Yes	Get_Attribute_Single

Acyclic data, readable as assembly from 9442 CPU:

In-stance	Ac-cess	Name	Description	Attribut	Connection-Path	Size [Byte]
101	Get	CpuStatus	See CPU status register	3	20 04 24 65 30 03	2
102		ModulStatus	1 Bit Status per module	3	20 04 24 66 30 03	4
103		SignalStatus	1 Bit Status per signal	3	20 04 24 67 30 03	32
110		HART LiveList	1 Bit Livelist per HART channel	3	20 04 24 6E 30 03	16
111		HART IOMx	Max. 8 routed HART Variables per IO module	X = 101 to 116 (Slot + 100)	20 04 24 6F 30 xx	32
112		Ext HART IOMx	4HV + EXDEVSTAT of all 8 HART Devices of one IO module		20 04 24 70 30 xx	192

Acyclic readable Data (Assemblies) of the 9442 CPU:

All above described cyclic readable data (assemblies) may optionally also read acyclically using attribute = 3

See: [Cyclic I/O Data - Struct 1: Less big Connections](#)
[Cyclic I/O Data - Struct 2: Many small Connections](#)

EtherNet/IP interface description

3.3 Data Formats

3.3.1 I/O Assembly Data Attribute Format

3.3.1.1 Digital Input / Output Module – DIM, DIOM

Data	Byte Offset	alle 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	0	DI signals 0 – 7 *1)								BitStr	
	1	DI signals 8 – 15 *1)									
	2 + 3	/		C/F I14			C/F S15	C/F S15	C/F S15	UINT16 (UINT32)	
	4 + 5			C/F I15			C/F S14	C/F S14	C/F S14		
	6 + 7						C/F S13	C/F S13			
	8 + 9						C/F S12	C/F S12			
	10+11	-	-	-	-	-	C/F S11	C/F S11			
	12+13						C/F S10	C/F S10			
	14+15							C/F S9			
	16+17							C/F S8			
	0			*2)		DO 0 - 7	DO 0 - 7	DO 0 - 7	DO 0 - 7		BitStr
	1			-		DO 8 - 15	DO 8 - 15	DO 8 - 15	DO 8 - 15		
	2	-	-	-	-		Reset C14-15	Reset C10-15	Reset C8-15		
	3			-		-	Start/Stop C14-15	Start/Stop C10-15	Start/Stop C8-15		
	4-17			-			-	-	-		

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

Byte	Bit	DO	Reset Counter	Start/Stop Counter
see above	0	DO 0 / 8	Reset C8	Start/Stop C8
	1	.	Reset C9	Start/Stop C9

	6	.	Reset C14	Start/Stop C14
	7	DO 7 / 15	Reset C15	Start/Stop C15

0 = output high Impedance (actuator = Off)
 1 = output is powered (actuator = On)
 0 = Run,
 1 = Reset (Counter=0)
 0 = Counter Run
 1 = Counter Stop

Output Data **DI/DO+xCF**

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

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

0 = Run,
 1 = Reset (Counter = 0)
 0 = Counter Run,
 1 = Counter Stop

EtherNet/IP interface description

3.3.1.2 Digital Output Module – DOM

Data	Byte Offset	Bit	DOM 8	DOM 6	DOM 4
				9477/12-06-12	
Input	0 - 17	0 - 7	0 (Reserved)		
Output	0	0	DO 0	DO 0	DO 0
		1	DO 1	DO 1	DO 1
		2	DO 2	DO 2	DO 2
		3	DO 3	DO 3	DO 3
		4	DO 4	DO 4	-
		5	DO 5	DO 5	
		6	DO 6	-	
		7	DO 7	-	
1 - 17	0 - 7	Reserved			

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	

EtherNet/IP interface description

3.3.1.3 Analog Input / Output / Universal Module – AIM / AOM / AUM / UMH

Data	Byte Offset	Operation mode									
		8AI	8AO	6AI+2AO	8AI/8AO	8AI+4HV	8AO+4HV	8AI/8AO+4HV	8AI+8HV	8AO+8HV	8AI/8AO+8HV
Input	0	10	/	10	10	/	10	10	/	10	10
	1	11		11	11		11	11		11	
	2			11	11		11	11		11	
	3	12		12	12		12	12		12	
	4			12	12		12	12		12	
	5	13		13	13		13	13		13	
	6			13	13		13	13		13	
	7	14		14	14		14	14		14	
	8			14	14		14	14		14	
	9	15		15	15		15	15		15	
	10			15	15		15	15		15	
	11	16		16	16		16	16		16	
	12			16	16		16	16		16	
	13	17		17	17		17	17		17	
	14			17	17		17	17		17	
	15	-		-	-		-	-		-	-
16 - 17	-	-	-	-	-	-	-	-	-	-	
Output	0-1	/	O0	O6	O0	/	O0	O0	/	O0	O0
	2-3		O1	O7	O1		O1	O1			
	4-5		O2	/	O2		O2	O2		O2	
	6-7		O3		O3		O3	O3		O3	
	8-9		O4		O4		O4	O4		O4	
	10-11		O5	-	O5		O5	O5		O5	
	12-13		O6	O6	O6		O6	O6		O6	
	14-15		O7	O7	O7		O7	O7		O7	
	16-17		-	-	-		-	-		-	

Attention! The operation modes marked in purple make no sense using EIP because 18 Byte input + 18 Byte output data are always transported.

Alternative + 4 HV or + 8 HV with routed HART data also make no sense, since all HART data are available in a separate assembly.

Engineering rule: Always configuration as 8AI/8AO. Other operation modes are not recommended.

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.

S0 – S7 = Signal Status bits of signals 0 to 7.

Status Bit	Signal	
0	disturbed	
1	OK	

DI/DO I0-I7 / O0-O7 available with 9469/.. only:

INT16	DI: 0 = Off, 1 = On	DO: <=0 = Off, >0 = On
-------	---------------------	------------------------

Signal Status Information is available as Status Code within the Integer values (INT16) and as separate signal status bit (see [Analog input modules](#))

EtherNet/IP interface description

3.3.2 Signal Status

Function	Byte Offset	Signal Status								Data Type
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Signal status Slot 1	0	S 7	S 6	S 5	S 4	S 3	S 2	S 1	S 0	Bit
	1	S 15	S 14	S 13	S 12	S 11	S 10	S 9	S 8	
Slot 2 - 15	...	.	.	.	.	.	.	.	.
	
Signal status Slot 16	30	S 7	S 6	S 5	S 4	S 3	S 2	S 1	S 0	
	31	S 15	S 14	S 13	S 12	S 11	S 10	S 9	S 8	

2 bytes (16 bits) with signal status information of signals S0 to S15 are transmitted for each I/O module. Depending on the selected connection, Signalstati from 1, 4, or 16 I/O modules are transferred in accordance with the structure above.

Status bit = 0 -> Signal malfunction (short circuit, open circuit, module error....)

Status bit = 1 -> No signal malfunction or signal not available. No signal or module alarms present.

Details of the alarms can be displayed via the IS1 DTMs.

3.3.3 Module Status

In the bytes 0 to 3 module status information can be read. These registers contain one bit per I/O module with the following allocation:

Status bit = 0 -> At least one signal alarm (short circuit, open circuit....) or a module alarm is present.

Status bit = 1 -> No alarms in module. All inputs or outputs on the module are without errors or module is not configured.

Signal Diagnoses:

- Short circuit
- Line break
-

Module Diagnoses:

- IO module not responding
- Wrong IO module
- Prim/Red. rail connection disturbed
- Maintenance Alarm IOM,

With these status bits, alarm messages can be generated in the automation system. For input and output signals additional status information is available in the cyclic data area (see chapter [Signal behaviour in case of errors](#)). Details of the alarms can be displayed via the IS1 DTMs.

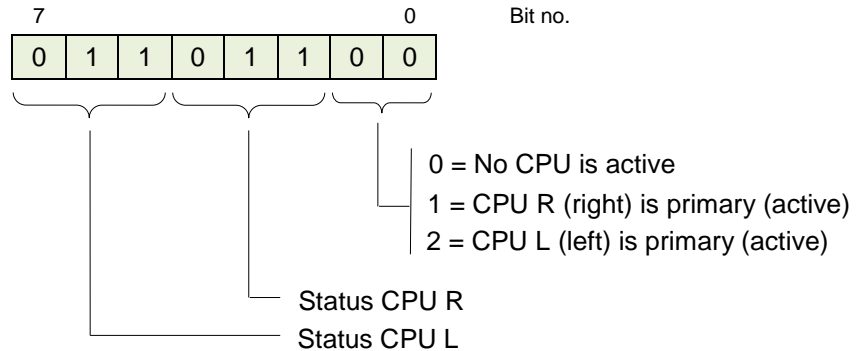
Function	Byte Offset	Module Status								Data Type
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Modul Status IOM	32	Status Slot 8	Status Slot 7	Status Slot 6	Status Slot 5	Status Slot 4	Status Slot 3	Status Slot 2	Status Slot 1	Bit
	33	Status Slot 16	Status Slot 15	Status Slot 14	Status Slot 13	Status Slot 12	Status Slot 11	Status Slot 10	Status Slot 9	

EtherNet/IP interface description

3.3.4 CPU Status

Through the status register the actual status of the CPU (both CPUs in redundant operation) can be read:

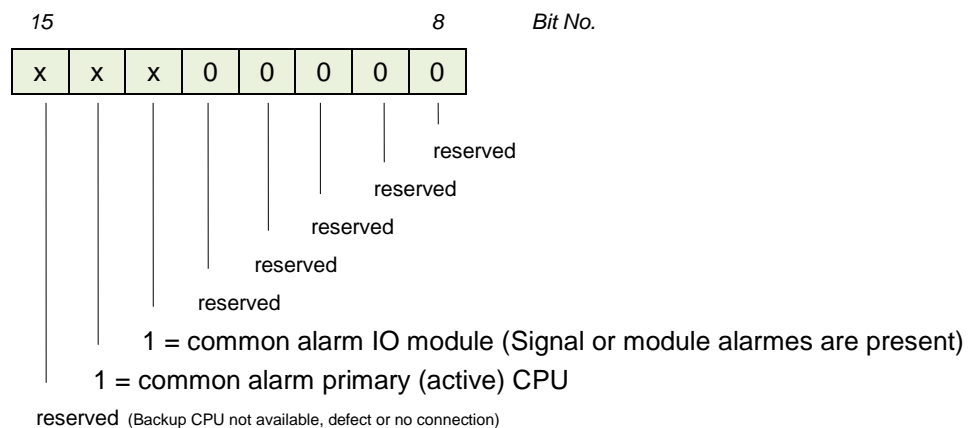
Low Byte (Byte 34):



Status CPU:

value 1 (000)	Reserved
value 1 (001)	Hardware error CPU
value 2 (010)	Data exchange with AS (config + parameters from IS1 DTM)
value 3 (011)	No data exchange (after power on without config- and parameter data)
value 4 (100)	Configuration- or parameter failure
value 5 (101)	Data exchange with AS quit (as well after PowerOn, if config- and parameter data are valid)
value 6 (110)	Reserved
value 7 (111)	Reserved (red. CPU not available)

High Byte (Byte 35) :



3.3.5 Control register

Reserved

EtherNet/IP interface description

3.3.6 HART Livelist

Function	Byte Offset	Signal								Data Type
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
HLL Slot 1	0	LL Channel 7	LL Channel 6	LL Channel 5	LL Channel 4	LL Channel 3	LL Channel 2	LL Channel 1	LL Channel 0	Bit
HLL Slot ...	...	...	...	...	...	...	...	...	...
HLL Slot 16	15	LL Channel 7	LL Channel 6	LL Channel 5	LL Channel 4	LL Channel 3	LL Channel 2	LL Channel 1	LL Channel 0	

LL: HART device is available on channel: 0= No, 1=Yes

Livelist Info is updated only if activated via Parameter 'Scan HART Livelist' = On

Anzeige der HART Livelist in IS1 DTM:

HART Livelist

Slot	Channel							
	0	1	2	3	4	5	6	7
1	✓	✓	—	—	✓	✓	✓	—
2								
3	--	--	--	--	--	--	--	--
4	✓	✓	✓	✓	✓	✓	✓	✓
5	🔄	🔄	🔄	🔄	🔄	🔄	🔄	🔄
6	✓	✓	✓	✓	✓	✓	✓	✓
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								

Description

This dialog represent the state of all channels of an IS1 STAHL Remote I/O. Refresh cycle: 1s (new devices up to 15s).

Legend

- ✓ HART communication OK
- No response from HART
- Scan deactivated
- ☐ No HART module detected
- 🔄 Reset IOM

Refresh State

- 🟢 CPM Online
- 🟡 Refresh

Overview of the status of all HART field devices connected to one IS1+ field station for simplified commissioning and maintenance.

For further information for use of the IS1 DTMs see operating instructions 'DTM IS1 Mod'.

EtherNet/IP interface description

3.3.7 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: PV, SV, TV, QV) from the transmitter.

Routed HART Variables - HART IOMx

IS1+ offers the option of mapping routed HART variables to acyclic assemblies HART IOMx.

Optionally, no HART variables, four or eight HART variables of an IS1+ HART module (AIMH, AUMH, AOMH) can be routed and transmitted in addition to the cyclic data.

This can be selected optionally when configuring a field station.

Extended HART Variables - Ext HART IOMx

With IS1+ 9442 CPUs together with 9468 AUMH from Rev. V03-06 or 9469 UMH, all 32 HV from the max. 8 HART field devices (HFD) of one IS1+ IOMH and additional HART device stati can be read cyclically or acyclically. This additional extended HART data is available in parallel to the above mentioned routed option.

Supply of HART devices using Analog Universal Module AUMH 9468/3x or 9469 UMH

Each channel of an AUMH or UMH can be parametrised 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 are in the position 'Output' and HART communication is possible with HART actuators only.

Availability of HART Variables and acyclic HART communication:

Configuration	Parameter	routed +4/ +8 HV	Extended 32 HV	acycl. HART	polling HV from AUMH/UMH
no config	no parameter	-	Yes, HART actuators only	Yes, HART actuators only	Yes
9468/9469 no HV	Livelist = OFF	-	-	Yes	No
	Livelist = ON	-	Yes	Yes	Yes
9468/9469 + HV	HV mapping	Yes	Yes	Yes	

EtherNet/IP interface description

3.3.7.1 Module selection in IS1 DTM

Module selection text	Number of HART variables (HVs) transmitted via routing
9461/12-08-11 AIMH8 2w Exi	None
9461/12-08-11 AIMH8+4HV 2w Exi	4 HV
9461/12-08-11 AIMH8+8HV 2w Exi	8 HV
9461/12-08-21 AIMH8 Exi	None
9461/12-08-21 AIMH8+4HV Exi	4 HV
9461/12-08-21 AIMH8+8HV Exi	8 HV
9466/12-08-11 AOMH8 Exi	None
9466/12-08-11 AOMH8+4HV Exi	4 HV
9466/12-08-11 AOMH8+8HV Exi	8 HV
9468/3x-08-xx 8AIH +4HV	4 HV
9468/3x-08-xx 8AOH +4HV	
9468/3x-08-xx 8AIH/8AOH +4HV	
9468/3x-08-xx 8AIH +8HV	8 HV
9468/3x-08-xx 8AOH +8HV	
9468/3x-08-xx 8AIH/8AOH +8HV	
9469/35-08-xx 8IH Exn	None
9469/35-08-xx 8OH Exn	
9469/35-08-xx 6IH+2OH Exn	
9469/35-08-xx 8IH/8OH Exn	
9469/35-08-xx 8IH +4HV Exn	4 HV
9469/35-08-xx 8OH +4HV Exn	
9469/35-08-xx 8IH/8OH +4HV Exn	
9469/35-08-xx 8IH +8HV Exn	8 HV
9469/35-08-xx 8OH +8HV Exn	
9469/35-08-xx 8IH/8OH +8HV Exn	

3.3.7.2 Data format

HART variables are transmitted as IEEE floating-point numbers (4 bytes).

Scaling and engineering unit settings are made in the HART device.

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 on the HART field devices can be evaluated via HART Management Systems.

EtherNet/IP interface description

3.3.7.3 Routed HART Variables - HART IOMx

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 means that a maximum of 32 HART variables are possible per IS1+ HART module.

The assignment (routing) of 4 or 8 out of these 32 variables to the positions P1 to P8 in the cyclic transmission area 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)

Assembly structure - HART IOMx:

(x = Slot address 1 – 16)

Function	Byte Offset	Signal	Data Type
Marshaled HART Variables	0 – 3	HV Pos 1	Float
	4 – 7	HV Pos 2	
	8 – 11	HV Pos 3	
	
	28 - 31	HV Pos 8	

EtherNet/IP interface description

3.3.7.4 Extended HART Variables - Ext HART IOMx

Function	Byte Offset		Data	Data Type
Extended HART Variables (HV)	0 – 3	Channel 0	HV 1 (PV)	Float
	4 – 7		HV 2 (SV)	
	8 – 11		HV 3 (TV)	
	12 – 15		HV 4 (QV)	
	16 – 19	Channel 1	HV 1 (PV)	
	20 – 23		HV 2 (SV)	
	24 – 27		HV 3 (TV)	
	28 – 31		HV 4 (QV)	
	
	112 – 115	Channel 7	HV 1 (PV)	
	116 – 119		HV 2 (SV)	
	120 – 123		HV 3 (TV)	
124 – 127	HV 4 (QV)			
Status	128	Channel 0	Extended Device Status EXTDEVSTATUS	Byte
	129	Channel 1		
		
	135	Channel 7		

EXTDEVSTATUS:

Contains NAMUR NE107-compatible Condensed Status information.

EXTDEVSTATUS -> Can be read only from device with HART7+.

From HART6 only Bits 0 and 1 are supported.

Delivers information from a responding HFD.

If HFD is not responding or EXTDEVSTATUS is not supported by HFD the IOMH will set:

- EXTDEVSTATUS = Good (0x00) if HV Variable is readable.
- EXTDEVSTATUS = Failure (0x08) if HV Variable is not readable.

HART Condition Monitoring

For easy Condition Monitoring of HART field devices the EXTDEVSTATUS of all HFD can be read by the AS in a slow cycle. Operator warnings may be generated in the AS if required.

In case of error the maintenance personal can check the affected HFD e. g. via FDT for details and perform maintenanc actions if required.

EtherNet/IP interface description

HCF / FCG SPEC-183 Tab. 17 EXTDEVSTATUS (Contains NAMUR NE107-compatible Condensed Status):

Code Description

- 0x01 **Maintenance Required.** [*Condensed Status*] This bit is set to indicate that, while the device has not malfunctioned, the Field Device requires maintenance. Devices supporting this bit should support the Condensed Status Commands (see *Common Practice Command Specification*).
- 0x02 **Device Variable Alert.** This bit is set if any Device Variable is in an Alarm or Warning State. The host should identify the Device Variable(s) causing this to be set using the Device Variable Status indicators.
- 0x04 **Critical Power Failure.** For devices that can operate from stored power. This bit is set when that power is becoming critically low. For example, a device scavenging power loosing that power source would set this bit. Devices must be able to sustain their network connection for at least 15 minutes from the when this bit is set. A device may begin gracefully disconnecting from the network if its power level drops too low.
- 0x08 **Failure.** [*Condensed Status*] When this bit is set one or more Device Variables (i.e., measurement or control values) are invalid due to a malfunction in the field device or its peripherals. Devices supporting this bit must support the Condensed Status Commands (see *Common Practice Command Specification*).
- 0x10 **Out of Specification.** [*Condensed Status*] When set, this bit indicates deviations from the permissible ambient or process conditions have been detected that may compromise measurement or control accuracy (i.e., device performance may be degraded given current operating conditions). Devices supporting this bit must support the Condensed Status Commands (see *Common Practice Command Specification*).
- 0x20 **Function Check.** [*Condensed Status*] This bit is set if one or more Device Variables are temporarily invalid (e.g. frozen) due to ongoing work on the device. Devices supporting this bit must support the Condensed Status Commands (see *Common Practice Command Specification*).

EtherNet/IP interface description

3.4 Setting parameters for the IS1+ field station and the I/O modules

Configuration, parameter setting, diagnostics and HART communication for the IS1+ field stations is handled via the IS1 DTMs using FDT technology.

Example:

The screenshot shows the 'Offline Parameter' window for an IS1 IOM DIM 9470 module. The window title is '<Slot 02:2> IS1 IOM DIM 9470 - Offline Parameter'. The top left corner displays the IS1 logo and the module information: '9470/22-16-11', 'IS1 IOM (Slot 2)', and 'IS1 CPM 225'. The top right corner has the STAHL logo. The main area is divided into several sections:

- Parameter IOM**: Shows 'Module type' as 9470/22-16-11 and 'Operation mode' as '2 - DIM+Stat+CF'.
- Parameter**: A table with columns 'Name' and 'Value'.

Name	Value
Diagnosis messages of module	On
Operation mode input 14	Freq. 0 - 1 kHz / DI
Counter event input 14	positive edge
Operation mode input 15	Freq. 0 - 1 kHz / DI
Counter event input 15	positive edge
- Signals**: A table with columns 'No', 'Tag', 'Comment', 'Terminals', 'Signal...', 'Phys. 0%', 'Phys. 100%', 'Unit', and 'Register/Coil'.

No	Tag	Comment	Terminals	Signal...	Phys. 0%	Phys. 100%	Unit	Register/Coil
0	DI 0		1(+), 2(-)	DI 0	0,0000	1,0000		32 / 497
1	DI 1		3(+), 4(-)	DI 1	0,0000	1,0000		32 / 498
2	DI 2		5(+), 6(-)	DI 2	0,0000	1,0000		32 / 499
3	DI 3		7(+), 8(-)	DI 3	0,0000	1,0000		32 / 500
4	DI 4		9(+), 10(-)	DI 4	0,0000	1,0000		32 / 501
5	DI 5		11(+), 12(-)	DI 5	0,0000	1,0000		32 / 502
6	DI 6		13(+), 14(-)	DI 6	0,0000	1,0000		32 / 503
7	DI 7		15(+), 16(-)	DI 7	0,0000	1,0000		32 / 504
8	DI 8		17(+), 18(-)	DI 8	0,0000	1,0000		32 / 505
9	DI 9		19(+), 20(-)	DI 9	0,0000	1,0000		32 / 506

At the bottom of the window, there are three buttons: 'OK', 'Cancel', and 'Apply'.

For further information on the use of the IS1 DTMs see operating instructions 'DTM IS1'.

EtherNet/IP interface description

3.5 Parameter set for IS1

3.5.1 CPU parameters

Parameter name	Parameter value
Timeout for output modules T_{Mod} (x 100 ms)	Unsigned8 (1 - 255) Default: 10
CPU Redundant	No Yes
PM Redundant	No Yes
Data Structure *1)	Struct 1: Less big Connections Struct 2: Many small Connections

*1) Attention!

Depending on the parameter 'data structure' an corresponding .EDS file shall be used for the configuration of the EtherNet / IP scanner. See [System requirements](#)



In case of incorrect assignment of CPU parameter 'Data Structure' and corresponding EDS file, an EIP connection will be rejected with an error message. A change of the CPU parameter during operation is rejected and a 'Upload' with the previous Settings is requested.

EtherNet/IP interface description

3.5.2 I/O module parameters

3.5.2.1 AIM / AIMH

Default values in **'bold'**

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	
Measurem. range ac. NAMUR I 0	No	No Yes
Measurem. range ac. NAMUR I 1	No	
Measurem. range ac. NAMUR I 2	No	
Measurem. range ac. NAMUR I 3	No	
Measurem. range ac. NAMUR I 4	No	
Measurem. range ac. NAMUR I 5	No	
Measurem. range ac. NAMUR I 6	No	
Measurem. 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	

Routing of HART Variables.
Available only on HART modules in operation mode with HV !

EtherNet/IP interface description

3.5.2.2 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'**

- *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)

EtherNet/IP interface description

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	

Routing of HART Variables.
Available only on HART modules in operation mode with HV !

EtherNet/IP interface description

3.5.2.3 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 % (4 mA only) / 0 0 % / 0 100 % / 1 AI Status Code / AO 110 % / 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	<i>2 wire analog</i>	2 wire analog
Connection S 1	<i>2 wire analog</i>	
Connection S 2	<i>2 wire analog</i>	
Connection S 3	<i>2 wire analog</i>	
Connection S 4	<i>2 wire analog</i>	2 wire analog <i>3/4 wire analog (Input only)</i> digital
Connection S 5	<i>2 wire analog</i>	
Connection S 6	<i>2 wire analog</i>	
Connection S 7	<i>2 wire analog</i>	
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
Input No. HART device for pos. 1	Not used	0...7 'Not used'
...	...	
Input No. HART device for pos. 8	Not used	HART variable No. 1 HART variable No. 2 HART variable No. 3 HART variable No. 4
No. HART variable for pos. 1	HART variable No. 2	
...	...	
No. HART variable for pos. 8	HART variable No. 2	

Routing of HART Variables. Available only on HART modules in operation mode with HV !

EtherNet/IP interface description

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 / AO 110 % / 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	<i>3/4 wire analog (Input only)</i>	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.

EtherNet/IP interface description

3.5.2.4 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 } from Fw. V02-04 M50 GOST } M100 GOST } Cu53 GOST } from Fw. V02-05 Pt46 GOST } 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	

EtherNet/IP interface description

3.5.2.5 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	

EtherNet/IP interface description

3.5.2.6 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 I0-I2	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

EtherNet/IP interface description

3.5.2.7 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!

EtherNet/IP interface description

3.5.2.8 DIOM 9470/3x (IS1+)

Parameter	Default value	Value range / selection		
Diagnostic messages of the module	On	Off On		
Signal in case of error S 0	0	0 1 freeze (initial value 0) freeze (initial value 1)		
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				
Error detection S 0	On	Off On		
Error detection S 1				
Error detection S 2				
....				
Error detection S 14				
Error detection S 15				
Invert DI S0, S1	No	No Yes (affects DI signals only)		
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				
Pulse extension / Filter S0, S1	0 Sec.	0 s / Off 0,6 s / Small 1,2 s / Medium 2,4 s / Large		Filter active for Frequency Measure- ment only
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				
Signal type S0, S1	Input	9470/3x	9471/35, 9472/35	Parameters availa- ble only in the case of operating mode with DI/DO
Signal type S2, S3				
Signal type S4, S5				
Signal type S6, S7				
Signal type S8, S9		NAMUR Ini/ contact 3-wire Initiator PNP Output		
Signal type S10, S11				
Signal type S12, S13				
Signal type S14, S15				
Operation mode S8, S9	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 availa- ble only in the case of operating mode with CF (coun- ter/frequency)
Operation mode S10, S11				
Operation mode S12, S13				
Operation mode S14, S15				
Counter event S8, S9	Positive edge	Positive edge Negative edge		
Counter event S10, S11				
Counter event S12, S13				
Counter event S14, S15				

EtherNet/IP interface description

3.5.2.9 AOM / AOMH

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)!

EtherNet/IP interface description

3.5.2.10 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				

EtherNet/IP interface description

3.6 Data word structure of the I/O modules

3.6.1 Analog input modules

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

3.6.1.1 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 < 0 mA	27648 13824 0 0	6C00 3600 0 0	100% 50% 0% 0%		Nominal range	-

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			Under range	-
< 3,6 mA < 2.4 mA	*1)	*1)		Yes No		Line break

*1) Transmitted value depends on behaviour set in the parameters if an error occurs:

Behaviour set in the parameters if an error occurs	Type of error	Value transmitted if an error occurs	
Freeze	All I/O 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 has malfunction if value >= 32512 or value <= -32512 see Behaviour of the input signals in case of errors	Short circuit	32767	0x7FFF
	Open circuit	-32762	0x8006
	2 wire calibration failed	-32749	0x8013
	Parametrization error	-32748	0x8014
	Plant Stop	-32747	0x8015
	I/O module does not respond	-32736	0x8020
	Config. unequal from module	-32735	0x8021
	Data not available	-32734	0x8022
IOM hardware error	-32733	0x8023	

EtherNet/IP interface description

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 and 9469 UMH 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'.

Datastructures see [Analog Input / Output / Universal Module – AIM / AOM / AUM](#)

EtherNet/IP interface description

3.6.1.2 TIM (9480/.. , 9481/.. , 9482/..)

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

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

*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	2 K 5	5 K	10 K	27648	6C00	100%	Nominal range	-
250 R	1K250	2K5	5 K	13824	3600	50%		
0 K	0 K	0 K	0 K	0	0	0%		

3 wire 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 %				27648	6C00	100%	Nominal range	-
position 50 %				13824	3600	50%		
position 0 %				0	0	0%		
< 50 R	< 250 R	< 500 R	< 1 K	*1)	*1)			short circuit

0,02 R	0,1 R	0,2 R	0,4 R	Resolution per Digit
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Hint: 9480 supports no 4 wire Resistance Position Measurement in %.

EtherNet/IP interface description

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

Range 0 ... 100 mV	Units		%	Range	Diagnosis messages
	decimal	hexadecimal			
>117,6 mV	*1)	*1)			Upper limit exceeded
117,6 mV	32511	7EFF	117,6 %	Over range	-
100 mV	27648	6C00	100 %	Nominal range	-
50 mV	13824	3600	50 %		
0 mV	0	0	0 %		
-0,0036 mV	-1	FFFF		Under range	-
-10 mV	-2765	F533	-10 %	(9481/..)	
-117,6 mV	-32511	8101	-117,6%	(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 Behaviour of the input signals in case of errors	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
	IOM does not respond	-32736	8020
	Config. unequal from module	-32735	8021
	Data not available	-32734	8022
	IOM 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)

An automatic 2 wire calibration function of the TIM 9482 /... or the user interface (LCD display with buttons) of the 9441 CPU can be used optionally, see operating instructions 9482.

EtherNet/IP interface description

3.6.1.3 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	27648	6C00	100%	Nominal range
.	.	.		
10 mA	13824	3600	50%	
.	.	.		
0 mA	0	0	0%	
0 mA	< 0	< 0		

AOM 4 – 20 mA

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

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

Safety position after Power On:

After Power On of the IS1+ 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 I.S. Wizard.

EtherNet/IP interface description

3.6.2 DIM, DIM+CF (9470/.. 9471/.. 9472/..)

On the modules 9470, 9471 and 9472 the inputs 14 and 15 can optionally be used as digital- (DI), counter- (C) or frequency input (F).

Through selection of different module descriptions the transmitted data area can be chosen.



module selection text	Input data [Byte]	Output data [Byte]	CF Channels	available signal types
DIM 16 (9470/.. , 9471/..)	2 (16 Bit DI)	-	-	DI without status
9470 / .. -16-1. DIM 16 ... 9471 / .. -16-1. DIM 16 ...	4 (16 Bit DI + 16 Bit status)	-	-	DI with status
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 (Counter or Frequency) 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/DO 16+6CF	16	4	10 - 15
	DI/DO 16+8CF	18	4	10 - 15

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 and 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

Datastructure see [Digital Input / Output Module – DIM, DIOM](#)

EtherNet/IP interface description

Operation mode 'counter'

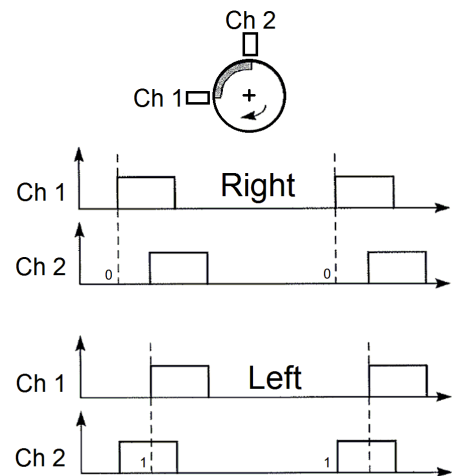
- Count mode: Incremental / decremental with overflow / underflow
- Count event: Positive / Negative edge selectable.
- Signal in case of error: freeze last value (Initial value 0)
- Alarming: Status and channel diagnosis
- Reset: Reset counter register to '0'
- Start/Stop: In 'Stop' mode input pulses 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



EtherNet/IP interface description

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 IOM 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 hold 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+)	6	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
	3 pairs	Frequency 1 Hz - 20 kHz with direction		0,5	+/- 0,5

EtherNet/IP interface description

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	-	26000	6590	130 %	Over range
1,1 kHz	22 kHz	22000	55F0	110 %	
1 kHz	20 kHz	20000	4E20	100 %	Nominal range
500 Hz	10 kHz	10000	2710	50 %	
0 Hz	0 kHz	0	0	0 %	

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 %	Nominal range
440 Hz	2,2 kHz	22 kHz	44000	0xABE0	110 %	
400 Hz	2 kHz	20 kHz	40000	0x9C40	100 %	
500 Hz	1 kHz	10 kHz	20000	0x4E20	50 %	
0 Hz	0 kHz	0 kHz	0	0x0000	0 %	

*1) Scaling of frequency measurements in IS1 DTM

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

EtherNet/IP interface description

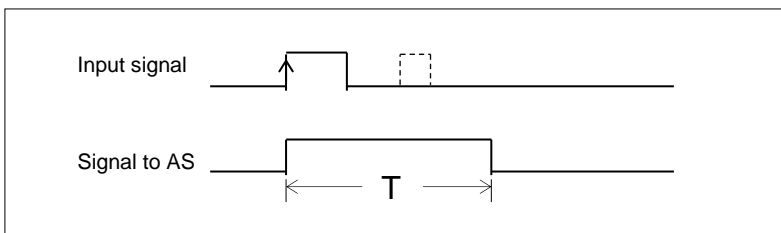
Pulse extension:

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

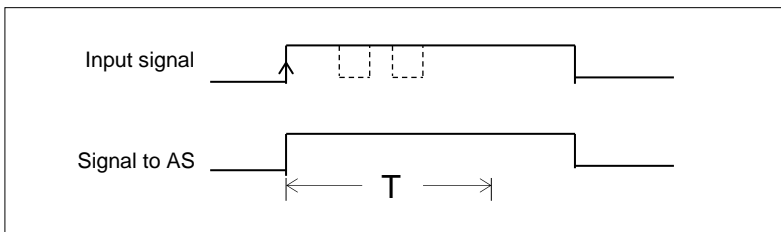
Pulse extension with not inverted operation:

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



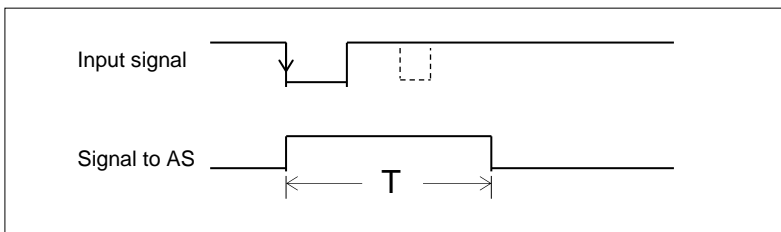
T = 0,6 sec., 1,2 sec., 2,4 sec.

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'.

EtherNet/IP interface description

3.6.3 DOM (9475/..., 9476/..., 9477/..)

Datastructure see [Digital Output Module – DOM](#)

EtherNet/IP interface description

3.7 Signal behaviour in case of errors

3.7.1 Behaviour of the input signals in case of errors

If no valid signal value can be formed as a result of a malfunction (short circuit, open circuit, defective subassembly...), an item of diagnostics information is created which can be read via the IS1 DTMs. Despite the outstanding malfunction, cyclic data including signal status information continues to be transmitted to the AS.

The behaviour of the signal values transmitted if a malfunction has occurred can be selected separately for every module by setting parameters (see [I/O module parameters](#)).

Application hint:

If the behaviour of input signals in case of errors is realised through the IS1 system, this behaviour seen from the application software in the automation system can only be guaranteed with correct communication on EtherNet/IP.

In the event of the failure of the EtherNet/IP communication additional project specific reactions must be realised in the application software.

To guarantee the same behaviour of all input signals in the event of an error, we recommend the following procedure:

Generate a status bit for each input signal in the automation system:

- For DI signals and for all signals of IS1+ IOMs (FW 03-xx) the signal status bits available optionally from IS1 may be used in the input data area.
(see [Data word structure of the I/O modules](#))
- For AI signals optionally the behavior in case of error = 'Status Code' may to be chosen in the parameters of all AI signals (default). In the application software of the automation system the following function has to be used for each AI signal:

```

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

The signal behaviour in case of an error (freeze, substitute value ...) can now be realised in the automation system controlled by the related status bit.

In this case the event 'communication failure on EtherNet/IP' of the EIP adapter can be logical linked to the signal status whereby the signal behaviour in case of an error is always the same under all error conditions.

To generate alarm messages for output modules, in the automation system one bit per module (module alarm bit) can be read from the IS1 CPU to generate messages (see [Module Status](#)). The details on the diagnostics information should be read and displayed via the IS1 DTMs.

EtherNet/IP interface description

3.7.2 Behaviour of the output signals in case of errors

Communication error between the master and IS1+ field station:

The cyclic data traffic between the EtherNet/IP scanner and IS1+ (EtherNet/IP adapter) is checked in the IS1+ CPU.

In case of a lost exclusive owner connection all output registers of the associated IOM are set to 0x8000H and the outputs adopt the safe state.

Via the Run/Idle Bit in the EIP Status Header (32Bit) the output modules adopt safe state after entering the 'Idle Mode' and after expiration of T_{Mod} .

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 safe setting.

T_{Mod} (timeout for output modules) parameter can be set in the range 100 ms to 25.5 sec. (default value: 1s).

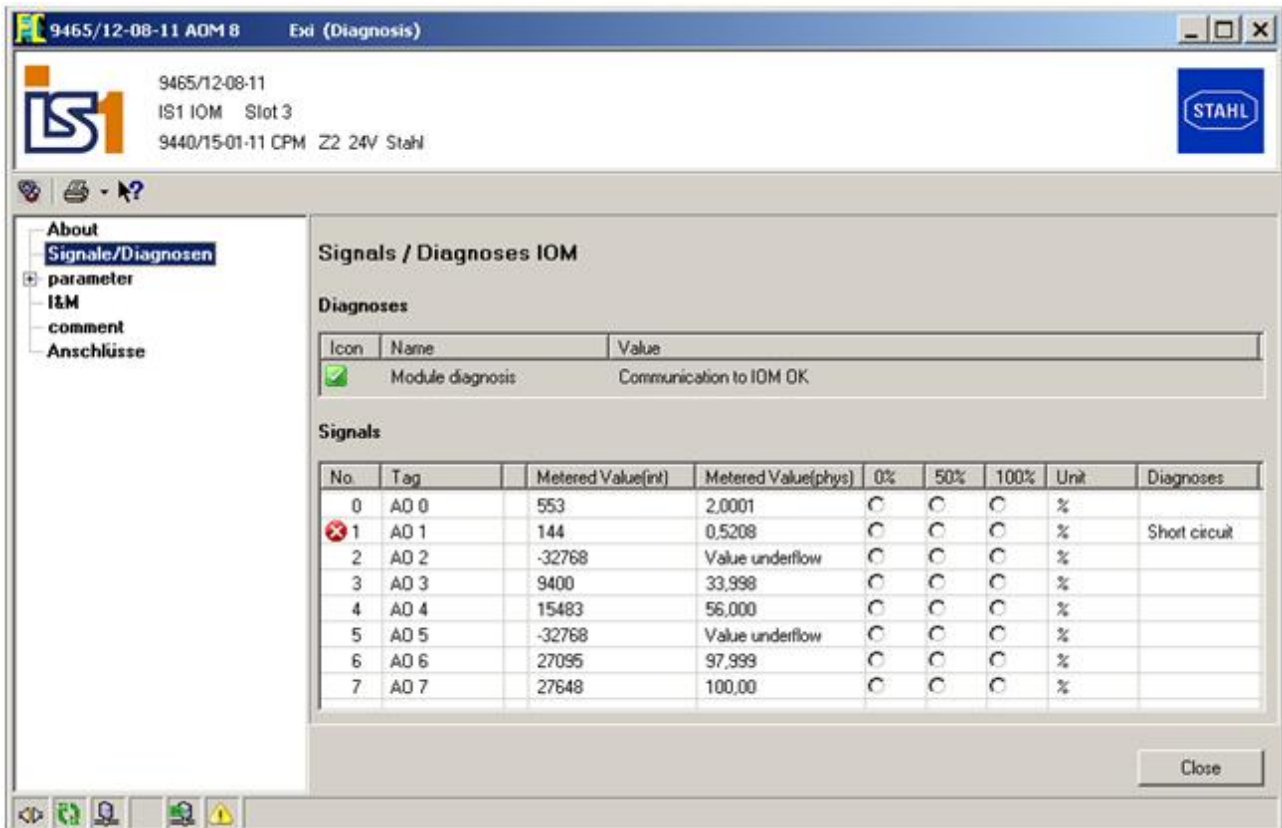
The safe setting parameter for the output signals can be set separately for each module (see [IOM Parameter](#)).

EtherNet/IP interface description

3.8 IS1 DTMs

Configuration, parameter setting, diagnostics and HART communication for the IS1+ field stations is handled via the IS1 DTMs using FDT technology.

Example: Signals / Diagnostics



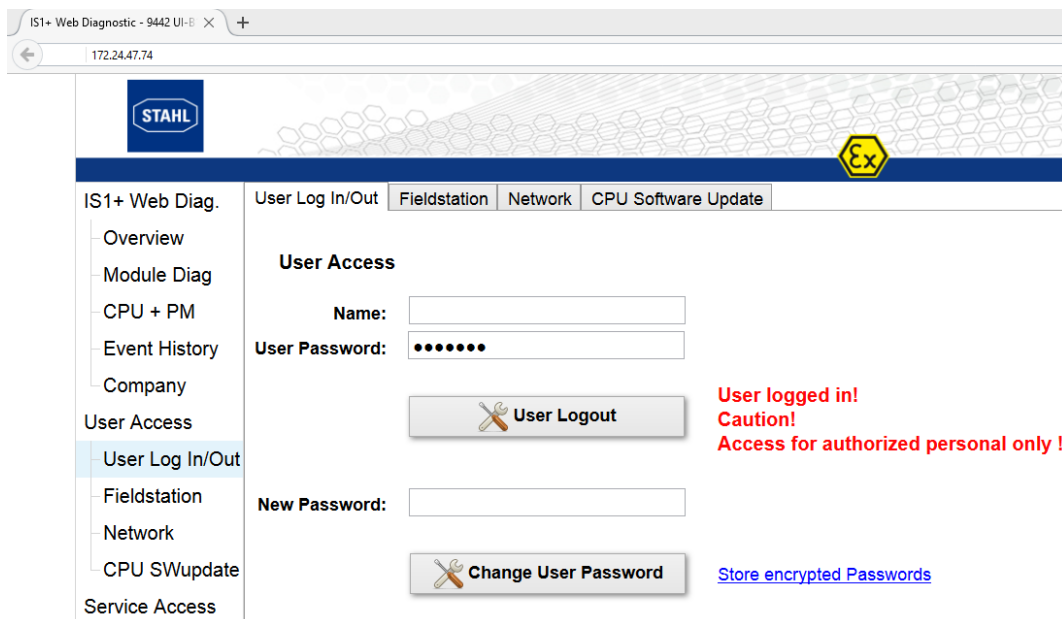
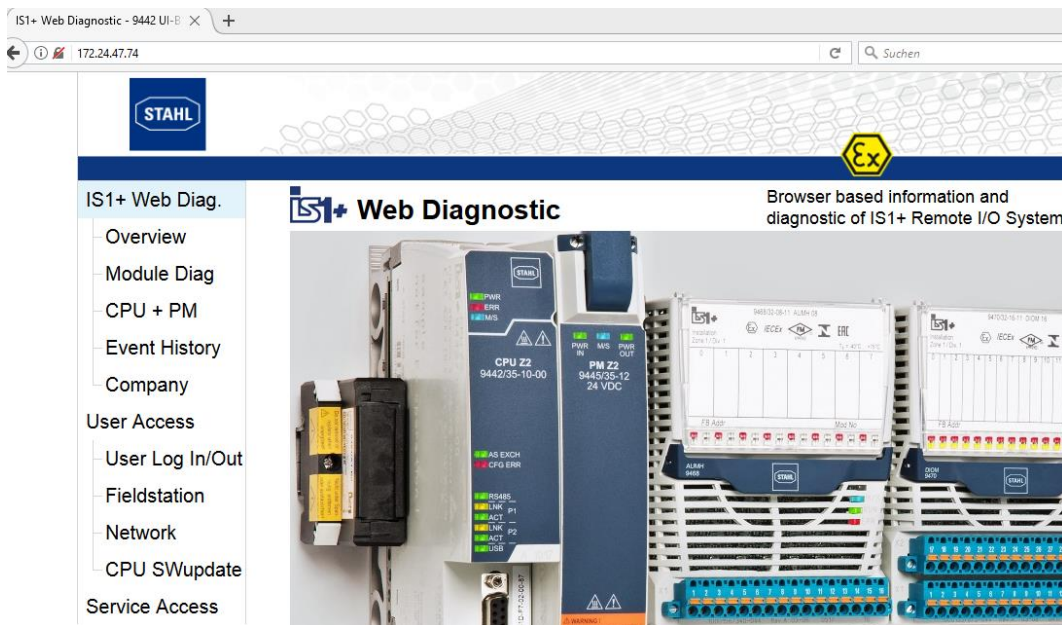
For further information on the use of the IS1 DTMs see operating instructions 'DTM IS1'.

EtherNet/IP interface description

3.9 Webserver in IS1+ CPU

A webserver is integrated in the IS1+ CPUs which offers additional diagnostic functions for commissioning, maintenance and OEM service support. For access standard WEB browsers can be used.

Examples:



EtherNet/IP interface description

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 afterwards.

EtherNet/IP interface description

3.10 Online behaviour of the IS1+ field station.

3.10.1 Parameter changes.

If an IS1+ field station is in cyclic data exchange with an EtherNet/IP Scanner (exclusive owner connection), parameters can be modified online via the IS1 DTMs.

3.10.2 Configuration changes.

Module configuration of IS1+ field stations can be changed or extended online during operation. Configuration data can be downloaded from the IS1 DTMs to the IS1+ CPU while the CPU is in cyclic exchange on EtherNet/IP.

Precondition for online module extension:

- Spare must already be planned during project planning of an IS1+ field station.
- Spare slots on the IS1 rail must be available.
- The data areas of the spare slots must already be communicated cyclically with the EtherNet/IP scanner.

After a download, the IS1+ CPU checks the real existing modules (actual state) against the configuration data (target state). All modules of the field station where the configured modules agree with the existing module type in the field station are updated cyclically after restart.

For modules, which do not agree with the configuration data, alarms are generated. The signals for these modules are not updated and react according to the behaviour set in the parameters in case of error. The signals of not changed modules remain bumpless in data exchange.

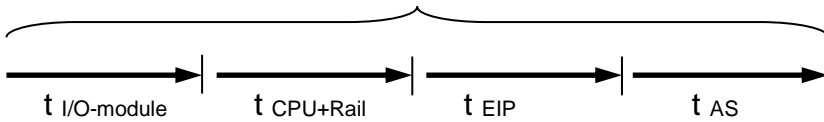
Process for online expansion:

- Add new modules (expansions to an existing field station) in free slots on the rail.
- Add new modules to configuration offline in FDT frame.
- Online download of the configuration to the IS1+ CPU while EtherNet/IP is in online operation.
- Expansion of the PLC software for use of the signals of the newly added modules.

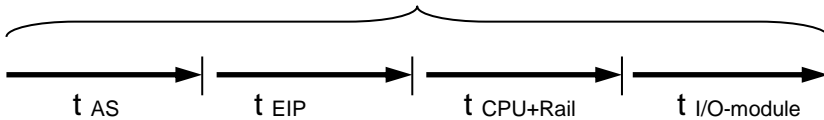
EtherNet/IP interface description

3.11 Transmission time:

Total delay of input signals (worst case):



Total delay of output signals (worst case):



- $t_{I/O\text{-module}}$ max. Signal delay see operation manual of the different IS1 I/O modules.
- $t_{CPU+Rail}$ ca. $4ms + \text{Number IOM} * 1 ms$
- t_{EIP} RPI (Requested Packet Interval) configured from EIP Scanner
- t_{AS} AS cycle + further delays in automation system (AS)

3.12 Technical Data

RPI Requested Packet Interval (RPI) is configured at the EIP Scanner.

9441 CPU:

Connection	CIP Connection size (TxRx) [Byte]	Max. Packets per second	Anzahl EIP Scanner je IS1 Feldstation		
			1 Scanner	2 Scanner	3 Scanner
			min. RPI [ms]		
4 – 8 IOM	70 – 134	125	8	16	24
12 - 16 IOM	198 - 262	100	10	20	30

9442 CPU:

EtherNet/IP interface description

4 List of abbreviations

AS	A utomation S ystem
AIM	A nalogue I nput M odule
AIMH	A nalogue I nput M odule + H ART
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 M odule
AOMH	Analogue Output Module +HART
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 Processor of the central unit
IOM	General description of I/O Module
PM	P ower M odule (power pack)
SW	Software
SIL	S afety I ntegrity L evel
TIM	T emperature I nput M odule

CIP™	Common Industrial Protocol
ODVA	Open DeviceNet Vendor Association siehe www.odva.org
RPI	Requested Packet Interval
EtherNet/IP	EtherNet/IP stands for Ethernet Industrial Protocol. Products compliant with this specification as well as the CIP Common specification are known as EtherNet/IP products. [Source: RFC1392]

EtherNet/IP interface description

5 Release notes

Version Interface description EtherNet/IP	Extensions / Changes
V3.00_b12	First Release 9442 Z2 CPU with EIP New Parameter PM 9445 Redundant added 9442 CPU redundancy added

6 Further reading

Find more details about CIP protocols and EtherNet/IP on: <http://www.odva.org/>

7 Support address

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