



HIPRO-S V2

Configuration in SILworX + ELOP II

Manual

SAFETY
NONSTOP



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1 Introduction

This manual describes the configuration of HIPRO-S V2 in SILworX and ELOP II for controllers of the system families HIQuad, HIMax and HIMatrix.

1.1 Structure and Use of this Manual

The manual contains the following chapters:

- Introduction and writing conventions
- Safety
- Product description
- HIPRO-S V2 objects in SILworX
- ELOP II HK-COM-3 function block
- Example: HIPRO-S V2 connection between HIQuad and HIMax
- Upgrading HIQuad to HIPRO-S V2
- HIMA service, training and hotline

Additionally, the following documents must be taken into account:

Name	Content	Document no.
HIMax safety manual	Safety functions of the HIMax system.	HI 801 003 E
HIMatrix safety manual	Safety functions of the HIMatrix system.	HI 800 023 E
HIQuad safety manual	Safety functions of the HIQuad system.	HI 800 013 E
SILworX first steps manual	Introduction to SILworX.	HI 801 103 E
Communication manual	Description of the communication protocols.	HI 801 101 E
ELOP II first steps manual	Introduction to ELOP II.	HI 800 001 E
HIQuad F 8627X data sheet	Manual for the HIQuad Ethernet communication module.	HI 800 265 E

The latest manuals can be downloaded from the HIMA website at www.hima.com. The revision index on the footer can be used to compare the current version of existing manuals with the Internet edition.

1.2 Target Audience and Required Competence

This document addresses system planners, configuration engineers, programmers of automation devices and personnel authorized to implement, operate and maintain the devices and systems. Specialized knowledge of safety-related automation systems is required.

To understand the content of this document, HIMA strongly recommends to participate in a training course for ELOP II and SILworX, respectively.

All staff members (planning, installation, commissioning) must be informed about the risks and potential consequences resulting from the manipulation of a safety-related automation system.

The operator is responsible for qualifying the operating and maintenance personnel and providing them with appropriate safety instructions.

1.3 Writing Conventions

To ensure improved readability and comprehensibility, the following writing conventions are used in this document:

Format	Description
Bold	To highlight important parts. These are names of buttons, menu functions and tabs that can be clicked and used in SILworX.
<i>Italics</i>	Parameters, system variables and references to other text passages.
Courier	Literal user inputs, or texts that are identical to the printed value.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references to other chapters. They are implemented as hyperlinks. Click the hyperlink to jump to the referenced position.

Safety notices and operating tips are particularly marked.

1.3.1 Safety Notices

The safety instructions must be followed to ensure that the risk users are exposed to, is as low as possible.

The safety notices are represented as follows:

- Signal word: warning, caution
- Type and source of risk.
- Consequences arising from non-observance.
- Risk prevention.

SIGNAL WORD



Type and source of risk!

Consequences arising from non-observance

Risk prevention

Meaning of the signal words:

- **Warning:** It indicates hazardous situations which, if not avoided, could result in death or serious injury.
- **Caution:** It indicates hazardous situation which, if not avoided, could result in minor or modest injury.

1.3.2 Operating Tips

Additional information is structured as follows:



The text for additional information is located here.

2 Safety

All safety information, notices and instructions specified in this document must be strictly observed. The HIMA controllers may only be used if all guidelines and safety instructions are adhered to.

The HIMA controllers are operated with SELV or PELV. No imminent risk results from the controllers themselves. The use in the Ex zone is only permitted if additional measures are taken.

2.1 Intended Use

To use the HIMA controllers, all pertinent requirements must be met, see Chapter 1.1 in the corresponding manuals.

2.2 Residual Risk

No imminent risk results from a HIMA system itself.

Residual risk may result from:

- Faults related to engineering.
- Faults in the user program.
- Faults related to the wiring.

2.3 Safety Precautions

Observe all local safety requirements and use the protective equipment required on site.

2.4 Emergency Information

A HIMA system is a part of the safety equipment of a plant. If the controller fails, the system enters the safe state.

In case of emergency, no action that may prevent the HIMA systems from operating safely is permitted.

2.5 Cyber Security for HIMA Systems

Industrial controllers must be protected against IT-specific problem sources. Those problem sources are:

- Attackers inside and outside of the customer's plant
- Operating failures
- Software failures

All requirements about protection against manipulation specified in the safety and application standards must be met. The operator is responsible for authorizing employees and implementing the required protective actions.



WARNING

The controller must be protected against unauthorized access!

Careful planning should identify the measure to implement. The required measures are to be taken after the risk analysis is completed. Such measures are, for example:

- Meaningful allocation of user groups.
- Maintained network maps help ensuring that secure networks are permanently separated from public networks, and if required, only a well-defined connection exists (e.g., via a firewall or a DMZ).
- Use of appropriate passwords.

A periodical review of the security measures is recommended, e.g., every year.

The user is responsible for implementing the necessary measures in a way suitable for the plant!

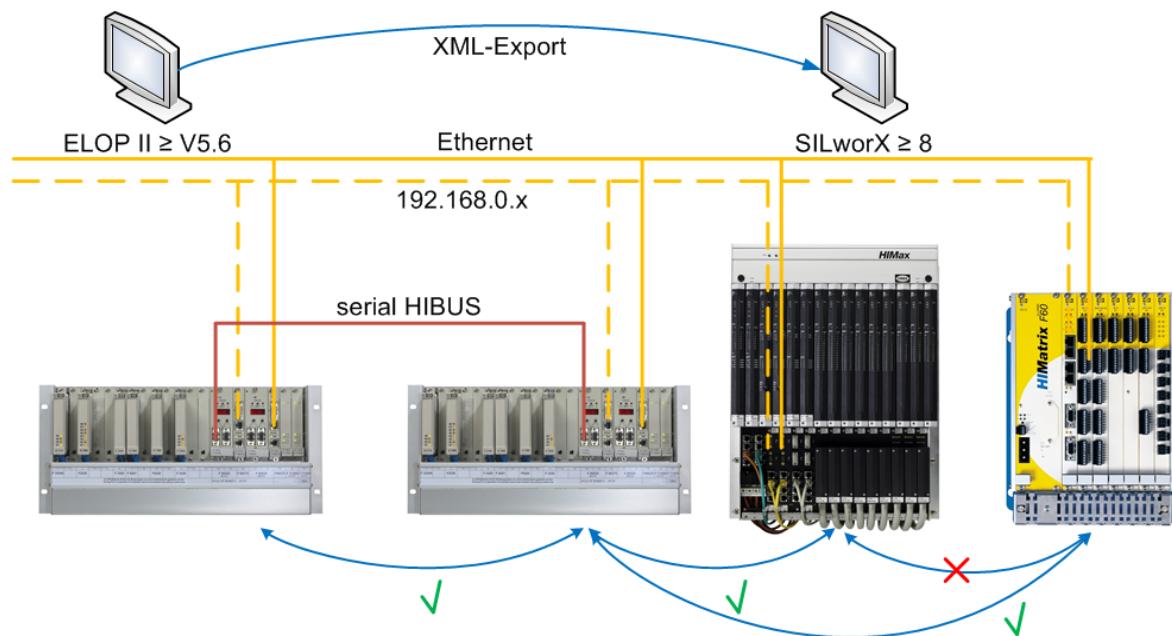
For more details, refer to the HIMA cyber security manual (HI 801 373 E).

3 Product Description

The HIPRO-S V2 protocol is used for safety-related SIL 3 communication between HIQuad (H41q/H51q) controllers and HIMax or HIMatrix controllers.

The HIPRO-S V2 protocol enables users to connect and extend HIQuad systems with HIMax and HIMatrix systems.

The configuration of the HIPRO-S V2 protocol begins in the ELOP II programming tool. The configuration data created in ELOP II is then exported to SILworX via an XML file.



The HIPRO-S V2 protocol may only be used for connecting HIQuad controllers to one another or to HIMax/HIMatrix controllers. Safety-related connections between HIMax/ HIMax, HIMatrix/HIMatrix and HIMax/HIMatrix controllers must be established with **safethernet**.

No HIPRO-S V2 connection is possible between a HIQuad controller and a HIMatrix remote I/O.

Any HIPRO-S V2 connection between two HIQuad controllers is configured in ELOP II, SILworX is not needed. HIMA recommends upgrading HIPRO-S to HIPRO-S V2 for connections between HIQuad controllers, since HIPRO-S V2 meets the current requirements for SIL 3 with respect to safety-related communication.

For further information about HIPRO-S V2 and upgrade details, refer to Chapter 7 .

3.1 Equipment and System Requirements

For using HIPRO-S V2

HIMA controllers and operating systems	HIMax <ul style="list-style-type: none"> • X-CPU 01 operating system ≥ V8 and X-COM 01 operating system¹⁾ ≥ V8 • X-CPU 31 operating system ≥ V8 and X-COM 01 operating system¹⁾ ≥ V8
	HIMatrix <p>CPU operating system ≥ V12 and COM operating system¹⁾ ≥ V16.10</p> <ul style="list-style-type: none"> • F30 03 • F35 03 • F60 CPU 03
	H41q/H51q <ul style="list-style-type: none"> • Central module operating system ≥ V7.0-8 BS (08.17) • Ethernet communication modules F8627/ F8627X OS ≥ V3.x (HIPRO-S Direct Mode activated)
Programming tools	<ul style="list-style-type: none"> • SILworX ≥ V8.34 • ELOP II ≥ V5.6
Activation	HIMax and HIMatrix A software activation code is required for HIPRO-S V2. For further details, refer to the HIMA website at: www.hima.com -> Products-> Registration-> Options SILworX
	H41q/H51q No activation is required
1) Only required if the HIPRO-S V2 connection runs via the COM module.	



The corresponding Ethernet interfaces of the HIMax CPU and COM modules as well as HIMatrix controllers can also be used for other protocols, unless denied by the subnet restrictions (192.168.0.X).

3.2 HIPRO-S V2 (Properties)

Element	Description
Required module/controller	HIPRO-S V2 is run on the safety-related CPU module.
Ethernet interfaces	The Ethernet interfaces in use can simultaneously be used for additional protocols.
Serial interfaces	The HIPRO-S V2 protocol cannot be used for connections via the RS485 interfaces.
Number of connections	64 HIPRO-S V2 connections for each controller. In total, a controller can operate up to 255 HIPRO-S V2 and safeethernet connections.
Connections between two controllers	1 HIPRO-S V2 connection.
Redundant connections	Up to 2 transport paths can be set up for each HIPRO-S connection.
Process data volume for each connection and data direction	505 bytes for each HIPRO-S V2 connection and direction.

3.2.1 Redundancy Monitoring

HIPRO-S V2 can be used as mono or redundant for all the connections. The redundancy monitoring options depend on the system family.

Controller	Programming tool	Description
H41q/H51q	ELOP II	The redundancy monitoring for HIQuad controllers can be implemented via the outputs of the HK-COM-3 function block <i>Number of Connected Nodes</i> and <i>Number of Non-Connected Nodes</i> .
HIMax and HIMatrix	SILworX	Similarly to safeethernet , the redundancy monitoring for HIMax and HIMatrix controllers can be implemented using system variables in the user program.

4 HIPRO-S V2 Objects in SILworX

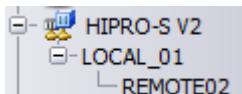
This section describes the SILworX HIPRO-S V2 objects and the system variables and parameters that they include.



Refer to Chapter 6 for further information on how to configure a HIPRO-S V2 connection.

To create a HIPRO-S V2 object in SILworX

- In the structure tree, open **Configuration, Resource**.
- Select **New, HIPRO-S V2** from the context menu of the resource to add a new HIPRO-S V2 object.
The HIPRO-S object already includes by default a **Local** object, which, in turn, includes a **Remote** object. Refer to Chapter 4.1 ...Chapter 4.4 for details.



4.1 HIPRO-S V2 Object

To open the Edit dialog box for the local object

- Right-click **HIPRO-S V2** and select **Edit** from the context menu.

The **Local** Resource Tab

This tab lists all the HIPRO-S V2 local resources.

Parameter	Description
Type	Local resource.
Name	The resource name must be exactly 8 characters long, the two last characters must be numbers, (e.g., LOCAL_01). Lowercase is not permitted. Range of values: 01...99

The **Properties** Tab

The following tab contains the parameters that cannot be changed.

Parameter	Description
Type	HIPRO-S V2.
Name	Name of the HIPRO-S V2 object.

4.2 Local Object

To open the Edit dialog box for the local object

- Select **HIPRO-S V2, Local** from the Object Panel and right-click **Edit**.

The **Remote Resource Tab**

This tab lists all the remote resources of the current local resource.

Parameter	Description
Type	Remote resource (not changeable).
Name	The resource names must be exactly 8 characters long, the two last characters must be numbers (e.g., REMOTE02). Lowercase is not permitted. Range of values: 01...99

The **Properties Tab**

Parameter	Description
Type	Local resource (not changeable).
Name	The resource name must be exactly 8 characters long, the two last characters must be numbers, (e.g., LOCAL_01). Lowercase is not permitted. Range of values: 01...99

4.3 Update Connection

The SILworX function *Update Connection* on the context menu for the HIPRO-S object can be used to import an XML file created in ELOP II. The XML file contains the configuration data for a HIPRO-S V2 connection between a HIQuad and a HIMax/HIMatrix controller.



For further details on how to export the XML file from ELOP II, refer to Chapter 6 .

Importing an XML File to SILworX

The connection update can be started from the context menu of the HIPRO-S object or the local object.

- In the structure tree, select **HIPRO-S** and open the context menu.
Alternatively, select **HIPRO-S, LOKAL_01** and open the context menu.
- Select **Update Connection** from the context menu. A dialog box for importing an XML file with the extension *.xml appears.
- Select the configuration file created in the ELOP II project, and click **OK**. Once the configuration file has been imported, the variables of the ELOP II proxy resource are automatically created in the SILworX project.

4.4 Remote Object

4.4.1 The Process Variables Tab

The process variables of the remote resource are added in this tab.

To open the remote object

- Select **HIPRO-S V2, Local, Remote** from the Object Panel and right-click **Edit**.

Add the process variables of the HIPRO-S V2 connection.

To connect process variables

- Select the **Process Variables** tab.
- Select the **Input Signals** area.
- In the Object Panel, select a global variable and drag it onto the input signal to be connected and located in the **Input Signals** area.
- Repeat this step for further variables.
- Select the **Output Signals** area.
- In the Object Panel, select a global variable and drag it onto the output signal to be connected and located in the **Output Signals** area.
- Repeat this step for further variables.

Verifying the HIPRO-S V2 Connection

To complete the configuration, perform a verification of the HIPRO-S V2 connection.

- In the structure tree, select **Resource, HIPRO-S V2** and open the context menu.
- Select **Verification** from the context menu, and click **OK** to confirm.
- Thoroughly verify the messages displayed in the logbook and correct potential errors.

4.4.2 The System Variables Tab

This tab contains the system variables of the remote resource.

► Select the **System Variables** tab.

To evaluate the system variables in the user program, they must be connected to global variables.

The following tables present the system parameters for the remote object.

Parameter	Data type	R/W	Description										
Ack.Frame No.	UINT	R	Receive counter (revolving)										
Number of Faulty Messages	UDINT	R	Number of bad messages per channel since statistics reset (invalid CRC, invalid header, other faults).										
Number of Inconsistent Sequences	UDINT	R	Number of inconsistent sequences occurred since statistics reset (the sequence AckSeqNum is not contained in the SendTimeQueue).										
Number of Connection Losses	UDINT	R	How many times the connection has been lost since statistics reset.										
Number of Lost Messages	UDINT	R	Number of messages dropped out on one of the two transport paths since statistics reset.										
Number of Lost Messages for Redundant Channel	UDINT	R	The counter only continues to run until a channel completely fails.										
Number of Late Messages	UDINT	R	Number of late messages since statistics reset.										
Output Signature	WORD	R	A signature is created from the structure of the input data to be received and the output data to be sent; this signature uniquely identifies the corresponding data structure.										
Input Signature	WORD	R											
Receive Status	USINT	R	Current receive status of the channel. It is the channel state (Seq. no X-1) when a message with Seq. no. X is being received. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Status</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No message about the receive status of channel x.</td> </tr> <tr> <td>1</td> <td>Channel 1 OK.</td> </tr> <tr> <td>2</td> <td>The last message was faulty, the current one is OK.</td> </tr> <tr> <td>3</td> <td>Error on channel x.</td> </tr> </tbody> </table>	Status	Description	0	No message about the receive status of channel x.	1	Channel 1 OK.	2	The last message was faulty, the current one is OK.	3	Error on channel x.
Status	Description												
0	No message about the receive status of channel x.												
1	Channel 1 OK.												
2	The last message was faulty, the current one is OK.												
3	Error on channel x.												
Redundant Channel Receive Status	USINT	R											
Frame No.	UINT	R	Frame No. is a revolving message send counter. It is initialized with a random value prior to establishing or re-establishing a HIPRO-S V2 connection. It is incremented by 1 whenever a new message is created.										
Max. Frame Difference	USINT	R	Maximum frame difference between two frame numbers since statistics reset. The maximum frame difference allowed for HIPRO-S V2 is ≤ 16.										

Parameter	Data type	R/W	Description															
			Range of values: 0...16															
Channel State	BYTE	R	<p>Transport path state of the HIPRO-S V2 connection.</p> <table border="1"> <thead> <tr> <th>Bit no.</th><th>Bit = 0</th><th>Bit = 1</th></tr> </thead> <tbody> <tr> <td>0</td><td>Transport path not used</td><td>Transport path actively used</td></tr> <tr> <td>1</td><td>Transport path not connected</td><td>Transport path connected</td></tr> <tr> <td>2</td><td>-</td><td>Transport path first provides message</td></tr> <tr> <td>3...7</td><td>Reserved</td><td>Reserved</td></tr> </tbody> </table>	Bit no.	Bit = 0	Bit = 1	0	Transport path not used	Transport path actively used	1	Transport path not connected	Transport path connected	2	-	Transport path first provides message	3...7	Reserved	Reserved
Bit no.	Bit = 0	Bit = 1																
0	Transport path not used	Transport path actively used																
1	Transport path not connected	Transport path connected																
2	-	Transport path first provides message																
3...7	Reserved	Reserved																
Last Channel Latency	UDINT	R	<p>The channel latency specifies the delay between two redundant transport paths and the reception time of messages with identical SeqNo.</p> <p>A statistic is kept specifying the average, minimum, maximum and last latency.</p> <p>If Min Value is greater than Max Value, the statistics values are invalid.</p> <p>Then, <i>Last Channel Latency</i> and <i>Average Channel Latency</i> are set to 0.</p>															
Last Redundant Channel Latency	UDINT	R																
Max. Channel Latency	UDINT	R																
Max. Redundant Channel Latency	UDINT	R																
Min. Channel Latency	UDINT	R																
Min. Redundant Channel Latency	UDINT	R																
Average Channel Latency	UDINT	R																
Average Redundant Channel Latency	UDINT	R																
Rcv. Frame No.	UINT	R	Rcv. Frame No. is a revolving message send counter and corresponds to Peer Frame No.															
Response Time	UDINT	R	Time in milliseconds (ms) until the acknowledgment of a message is received by the sender.															
Reset Statistics	BYTE	W	<p>In the user program, reset the statistical values for the communication connection (e.g., number of faulty messages, channel state, timestamp for the last fault on the red. channel [s], resends).</p> <table border="1"> <thead> <tr> <th>Value</th><th>Function</th></tr> </thead> <tbody> <tr> <td>0</td><td>No reset</td></tr> <tr> <td>1...255</td><td>Reset of HIPRO-S V2 statistics when the value changes from 0 to \geq 1...255.</td></tr> </tbody> </table>	Value	Function	0	No reset	1...255	Reset of HIPRO-S V2 statistics when the value changes from 0 to \geq 1...255.									
Value	Function																	
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1...255	Reset of HIPRO-S V2 statistics when the value changes from 0 to \geq 1...255.																	

Parameter	Data type	R/W	Description								
Connection Control	WORD	W	<p>Use this system variable to control the HIPRO-S V2 connection from within the user program.</p> <table border="1"> <thead> <tr> <th>Command</th><th>Description</th></tr> </thead> <tbody> <tr> <td>Autoconnect (0x0000)</td><td> Default value: After a HIPRO-S V2 communication loss, the controller attempts to re-establish the connection in the following CPU cycle. </td></tr> <tr> <td>Toggle Mode 0 (0x0100) Toggle Mode 1 (0x0101)</td><td> After a communication loss, the user program can change the toggle mode to re-establish the connection. <ul style="list-style-type: none"> TOGGLE MODE 0 (0x100) set: Set to TOGGLE MODE 1 (0x101) to re-establish the connection. TOGGLE MODE 1 (0x101) set: Set to TOGGLE MODE 0 (0x100) to re-establish the connection. </td></tr> <tr> <td>Disabled (0x8000)</td><td>HIPRO-S V2 communication is disabled.</td></tr> </tbody> </table>	Command	Description	Autoconnect (0x0000)	Default value: After a HIPRO-S V2 communication loss, the controller attempts to re-establish the connection in the following CPU cycle.	Toggle Mode 0 (0x0100) Toggle Mode 1 (0x0101)	After a communication loss, the user program can change the toggle mode to re-establish the connection. <ul style="list-style-type: none"> TOGGLE MODE 0 (0x100) set: Set to TOGGLE MODE 1 (0x101) to re-establish the connection. TOGGLE MODE 1 (0x101) set: Set to TOGGLE MODE 0 (0x100) to re-establish the connection. 	Disabled (0x8000)	HIPRO-S V2 communication is disabled.
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Disabled (0x8000)	HIPRO-S V2 communication is disabled.										
Connection State	UINT	R	<p>The connection state evaluates the status of the communication between two controllers from within the user program.</p> <table border="1"> <thead> <tr> <th>Status/Value</th><th>Description</th></tr> </thead> <tbody> <tr> <td>Closed (0)</td><td>The HIPRO-S V2 connection is closed and no attempt is made to open it.</td></tr> <tr> <td>Try_open (1)</td><td>The HIPRO-S V2 connection is closed and attempts are made to open it.</td></tr> <tr> <td>Connected (2)</td><td>The HIPRO-S V2 connection is established and functioning (active time monitoring and data exchange).</td></tr> </tbody> </table>	Status/Value	Description	Closed (0)	The HIPRO-S V2 connection is closed and no attempt is made to open it.	Try_open (1)	The HIPRO-S V2 connection is closed and attempts are made to open it.	Connected (2)	The HIPRO-S V2 connection is established and functioning (active time monitoring and data exchange).
Status/Value	Description										
Closed (0)	The HIPRO-S V2 connection is closed and no attempt is made to open it.										
Try_open (1)	The HIPRO-S V2 connection is closed and attempts are made to open it.										
Connected (2)	The HIPRO-S V2 connection is established and functioning (active time monitoring and data exchange).										
Channel Use	USINT	R	<p>Percentage of messages that were first received on the corresponding channel. The evaluation is performed based on the messages received in the last 120 s.</p> <p>Example: 90 % of the messages are first received on channel 1 and 10 % of the messages on channel 2. This means that channel 1 is faster than channel 2 in 90 % of the cases.</p> <p>Range of values: 0...100 %</p>								
Redundant Channel Use	USINT	R									
Timestamp for Channel State Change [ms]	UDINT	R	Millisecond fraction of the timestamp (current system time).								
Timestamp for Channel State Change [s]	UDINT	R	Second fraction of the timestamp (current system time).								
Timestamp for Redundant Channel State Change [ms]	UDINT	R	Millisecond fraction of the timestamp (current system time).								
Timestamp for Redundant Channel State Change [s]	UDINT	R	Second fraction of the timestamp (current system time).								

4.4.3 The Properties Tab

This tab contains the properties of the remote resource.

- Select the **Properties** tab.

Parameter	Description								
Type	Remote resource.								
Name	The resource names must be exactly 8 characters long, the two last characters must be numbers (e.g., REMOTE02). Range of values: 01...99								
IF Channel 1	Ethernet interfaces available on this resource.								
IF Channel 2	Ethernet interfaces available on this resource.								
Receive Timeout [ms]	Monitoring time of PES1 within which a correct response from PES2 must be received, see the communication manual (HI 801 101 E) for further details. Default value: 1000 ms								
Production Rate [ms]	The production rate specifies a minimum time interval in milliseconds (ms) between two new data packets, see Chapter 5.3.11 Range of values: 0...6 553 499 ms Default value: 50 ms								
Behavior on Connection Loss [ms]	If the connection to the remote resource is lost, the input variables are initialized or are still used unchanged in the process module, depending on this parameter. <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Use Initial Value</td> <td>Input variables are reset to their initial values. Default setting</td> </tr> <tr> <td>Freeze Process Value with no Limits</td> <td>The input variables are frozen to the current value and used until a new connection is established.</td> </tr> <tr> <td>Initial Value after [ms]</td> <td>The input variables are frozen to the current value and used until the configured timeout. Afterwards, the initial data are used for the input variables. The timeout can be extended by up to a CPU cycle. Default value: 1000</td> </tr> </tbody> </table> <p style="border: 1px solid black; padding: 5px; margin-top: 10px;">  For safety-related functions implemented via HIPRO-S V2, <i>Use Initial Value</i> is the only setting that may be used. </p>	Value	Description	Use Initial Value	Input variables are reset to their initial values. Default setting	Freeze Process Value with no Limits	The input variables are frozen to the current value and used until a new connection is established.	Initial Value after [ms]	The input variables are frozen to the current value and used until the configured timeout. Afterwards, the initial data are used for the input variables. The timeout can be extended by up to a CPU cycle. Default value: 1000
Value	Description								
Use Initial Value	Input variables are reset to their initial values. Default setting								
Freeze Process Value with no Limits	The input variables are frozen to the current value and used until a new connection is established.								
Initial Value after [ms]	The input variables are frozen to the current value and used until the configured timeout. Afterwards, the initial data are used for the input variables. The timeout can be extended by up to a CPU cycle. Default value: 1000								
Input Signature	A signature is created from the structure of the input data to be received and the output data to be sent; this signature uniquely identifies the corresponding data structure.								
Output Signature									

5 ELOP II HK-COM-3 Function Block

The HK-COM-3 function block is used to configure and monitor the communication modules F 8625, F 8626, F 8627 and F 8628.

Additionally, the functions, which are also supported by the F 8627 and F 8628 modules, can be configured and monitored for the communication modules F 8627X and F 8628X.

The F 8627 and F 8627X modules with operating system V3.x and higher are suitable for HIPRO-S. The HIQuad modules, F 8626, F 8628 and F 8628X, are not suitable for HIPRO-S V2!

5.1 General Information

Valid for operating system ≥	BS41q/51q V7.0-8 (0213) Connection-specific configuration: ≥ BS41q/51q V7.0-8 BS (08.17)
Reload change	The user program may be loaded without stopping the CPU. The test authority and the operating company are responsible for this action.
Use	Tested and certified by the TÜV for use in safety-related controllers with operating system ≥ BS41q/51q V7.0-8 BS (08.17).

The HK-COM-3 function block can be used for setting up HIPRO-S V2 after the central module has been updated to HIQuad operating system ≥ V7.0-8 BS (08.17). To this end, the inputs E3 through E5 must be used.

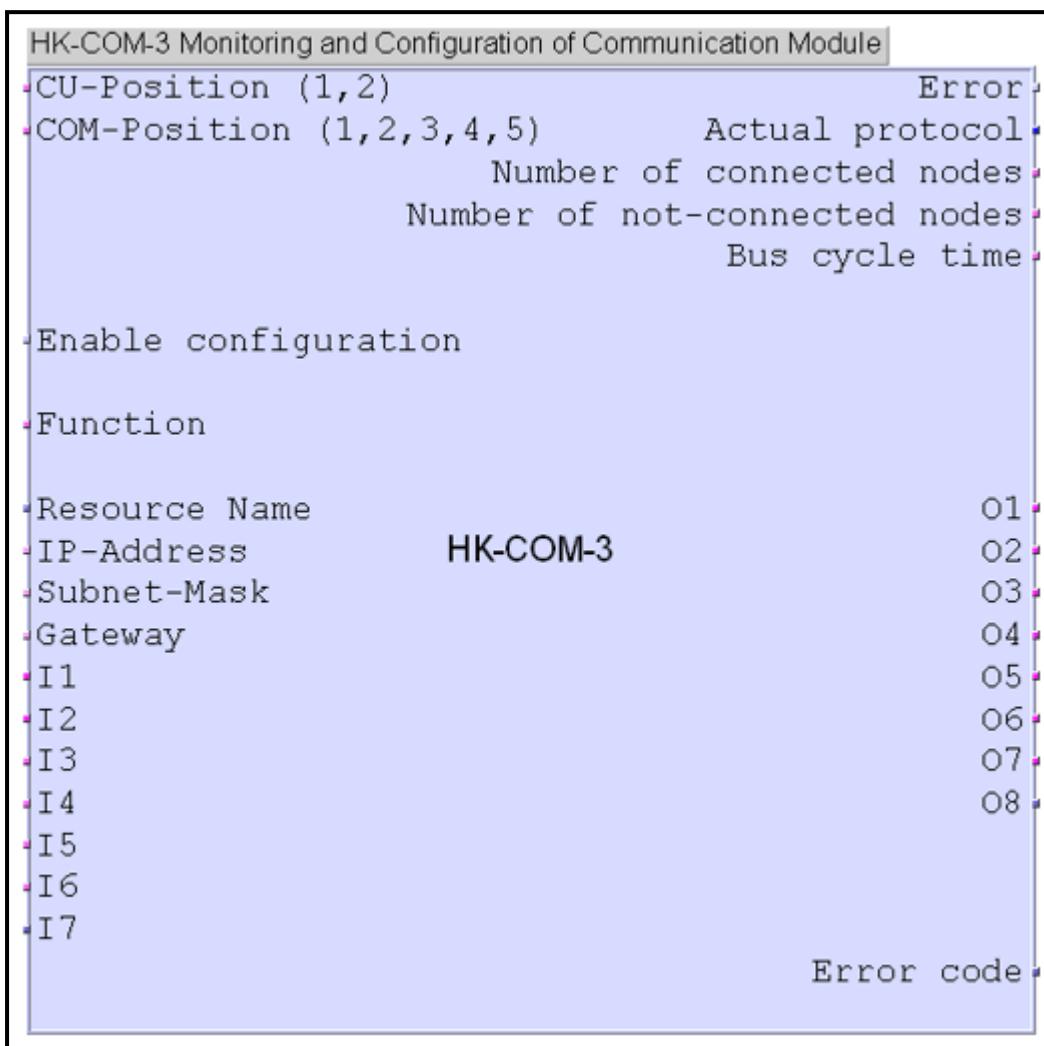
The HIPRO-S V2 protocol is used for safety-related SIL 3 communication between HIQuad (H41q/H51q) controllers and HIMax or HIMatrix controllers.

No HIPRO-S V2 connection is possible between a HIQuad controller and a HIMatrix remote I/O.



Refer to Chapter 6 for further information on how to configure a HIPRO-S V2 connection.

5.2 Function Block View



Defining the HK-COM-3 Operating Mode

A HIQuad system may contain up to 10 Ethernet modules.

The HK-COM-3 function block is used to control communication via the individual modules. It can be set up as channels-specific or connection-specific.

Channel-Specific Configuration

With a channel-specific configuration, the user can specify the communication type for the associated Ethernet module. The communication type determines which protocol type (BUSCOM, OPC, etc.) is processed via the Ethernet communication module.

For channel-specific communication, an Ethernet module must be assigned to a central module. Each of these CU/COM combinations is a channel for incoming or outgoing messages, hence the term 'channel-specific'.

Connection-Specific Configuration

The connection-specific configuration can be used for HIPRO-S and HIPRO-S V2.

In particular, the connection-specific configuration is required for HIPRO-S V2 connections to different system families with differing cycle times. The communication cycle can be adjusted by setting the production rate in accordance with the communication connection requirements.

Inputs Assignment for the Previous Operating Mode

The following inputs determine if the function block is operating in a channel-specific or connection-specific mode.

The key input is *Resource Name*. If this input is assigned with the correct default, the HK-COM-3 instance is connection-specific. The inputs CU Position (1, 2), COM Position (1, 2, 3, 4, 5) and Function may only have certain value.

Chapter 5.3 and Chapter 5.4 provide a detailed description of all the inputs and outputs of the HK-COM-3 function block.

Inputs assignment for channel-specific configuration

Input	Description
CU Position (1, 2)	Must be used.
COM Position (1, 2, 3, 4, 5)	Must be used.
Function	0...4
Resource Name	This input must be set to 0 or remain empty, otherwise the connection-specific configuration is not activated.

Inputs assignment for connection-specific configuration

Input	Description
CU Position (1, 2)	Must be set to 0 or remain empty!
COM Position (1, 2, 3, 4, 5)	Must be set to 0 or remain empty!
Function	5
Resource Name	Must be allocated with a valid ASCII character string (BYTE array[8]). The string in this input specifies the resource name of the communication partner and has therefore a connection-specific assignment to that resource.

5.3 Inputs

The inputs are described in the same order as implemented in the ELOP II function block HK-COM-3.

5.3.1 CU Position (1, 2)

Function	For allocating the communication module to central module 1 or 2 (CU1, CU2).
Description	The <i>CU Position (1, 2)</i> defines the central module slot.
Range of values	0...2 If the values are not allowed, the Error output is set to TRUE and the Error Code output displays the corresponding error code.
Type	UINT
Notice	In connection-specific configurations, this input must remain unused or be set to 0!

5.3.2 COM Position (1, 2, 3, 4, 5)

Function	For allocating the communication module slots (1...5) next to central module 1 or 2.
Description	The <i>COM Position (1, 2, 3, 4, 5)</i> defines the communication module slot. The slot on the right, next to the central module (CU1 or CU2), is slot 1.
Range of values	0...5 If the values are not allowed, the Error output is set to TRUE and the Error Code output displays the corresponding error code.
Type	UINT
Notice	In connection-specific configurations, this input must remain unused or be set to 0!

5.3.3 Enable Configuration

Function	Enables the current configuration of this HK-COM-3 instance.							
Description	TRUE	The current configuration of this HK-COM-3 instance is activated.						
	FALSE	<p>The current configuration of this HK-COM-3 instance remains active. The inputs of the HK-COM-3 instance can be reconfigured without affecting the currently active configuration. The new configuration is only activated after <i>Enable Configuration</i> is set to TRUE.</p> <p>A preview test for all the inputs detects potentially inconsistent parameter settings.</p> <p>In case of inconsistent parameter settings, the <i>Error</i> output is set to TRUE and a preview error code is issued at the <i>Error Code</i> output. The 6th half-byte (nibble) in a preview error code is always 1.</p>						
Example: An invalid slot was configured at the <i>COM Position</i> input.								
<table border="1"> <tr> <td>Enable Configuration</td> <td>Error Code</td> </tr> <tr> <td>FALSE</td> <td>16#110020</td> </tr> <tr> <td>TRUE</td> <td>16#10020</td> </tr> </table>		Enable Configuration	Error Code	FALSE	16#110020	TRUE	16#10020	
Enable Configuration	Error Code							
FALSE	16#110020							
TRUE	16#10020							
Range of values	TRUE, FALSE							
Type	BOOL							
Notice	This input must be used!							

5.3.4 Function

Function	For selecting the communication type.												
Description	<p>In a channel-specific HK-COM-3 instance, the <i>Function</i> input defines the communication type for a communication module.</p> <p>The communication type determines which protocol type (BUSCOM, OPC, etc.) is processed via the Ethernet communication module.</p> <p>The selection of the communication type has no effects on the connection to the programming device.</p>												
Range of values	<p>0...5</p> <table border="1"> <tr> <td>0</td><td>Unrestricted function as implemented in all the operating systems since provision of technical support for the F 8625 module. All data (HIPRO-S, HIPRO-S V2 and BUSCOM) is exchanged via the communication module.</td></tr> <tr> <td>1</td><td>Safety-related data exchange over HIPRO-S, HIPRO-S V2 for the Ethernet modules F 8625 and F 8627(X) only.</td></tr> <tr> <td>2</td><td>OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.</td></tr> <tr> <td>3</td><td>Safety-related data exchange HIPRO-S, HIPRO-S V2 and OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.</td></tr> <tr> <td>4</td><td>PROFIBUS DP (BUSCOM), for the PROFIBUS DP modules F 8626 and F 8628 only.</td></tr> <tr> <td>5</td><td>Setting for connection-specific HK-COM-3 instance!</td></tr> </table>	0	Unrestricted function as implemented in all the operating systems since provision of technical support for the F 8625 module. All data (HIPRO-S, HIPRO-S V2 and BUSCOM) is exchanged via the communication module.	1	Safety-related data exchange over HIPRO-S, HIPRO-S V2 for the Ethernet modules F 8625 and F 8627(X) only.	2	OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.	3	Safety-related data exchange HIPRO-S, HIPRO-S V2 and OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.	4	PROFIBUS DP (BUSCOM), for the PROFIBUS DP modules F 8626 and F 8628 only.	5	Setting for connection-specific HK-COM-3 instance!
0	Unrestricted function as implemented in all the operating systems since provision of technical support for the F 8625 module. All data (HIPRO-S, HIPRO-S V2 and BUSCOM) is exchanged via the communication module.												
1	Safety-related data exchange over HIPRO-S, HIPRO-S V2 for the Ethernet modules F 8625 and F 8627(X) only.												
2	OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.												
3	Safety-related data exchange HIPRO-S, HIPRO-S V2 and OPC (BUSCOM), for the Ethernet modules F 8625 and F 8627(X) only.												
4	PROFIBUS DP (BUSCOM), for the PROFIBUS DP modules F 8626 and F 8628 only.												
5	Setting for connection-specific HK-COM-3 instance!												
Notice	<p>Notice to the Modbus TCP communication:</p> <p>If BUSCOM variables are defined, Modbus TCP over port 502 is always possible, regardless of the configured communication type.</p> <p>Modbus TCP over port 8896 is supported for the values 0, 2, 3 and 5.</p>												
Type	UINT												



For a channel-specific HK-COM-3 instance, the following behavior must be avoided!
 If the value at the *Function* input is changed and the *Enable Configuration* input is TRUE, a configuration process is triggered for the corresponding Ethernet module. While the configuration process is running, no process data traffic is routed via this Ethernet module. As a result, disconnections may occur for each communication connection running through this Ethernet module.

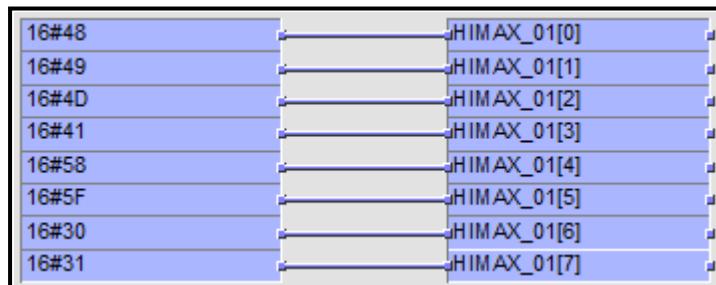
5.3.5 Resource Name

Function	Resource name of the HIPRO-S or HIPRO-S V2 communication partner. This input is necessary for a connection-specific configuration of the HK-COM-3 instance! For a channel-specific configuration of the HK-COM-3 instance, this input must be set to 0 or remain empty.
Description	For entering an 8-byte long array that contains the resource name of the HIPRO-S/HIPRO-S V2 communication partner. As soon as the resource name is entered, the function block refers to that connection.
Type	Array of BYTE [8]
Notice	If this input is assigned, the current function block is configured as connection-specific (except if all 8 bytes of the array are set to 0). The following inputs must be set to 0 or remain empty: <ul style="list-style-type: none"> • CU Position (1, 2) • COM Position (1, 2, 3, 4, 5) Lowercase is not allowed for a HIPRO-S V2 connection to HIMax/ HIMatrix.

Example: The resource name is HIMax_01

Create array of BYTE [8] in the user program.

The individual bytes of the resource name must be entered in the ARRAY as ASCII characters. To this end, use an ASCII table.



5.3.6 IP Address

Function	-
Description	Reserved for a freely configurable IP address.
Type	Array of USINT [4].
Notice	This input must not be used!

5.3.7 Subnet Mask

Function	-
Description	Reserved for a freely configurable subnet mask.
Type	Array of USINT [4].
Notice	This input must not be used!

5.3.8 Gateway

Function	-
Description	Reserved for a freely configurable gateway.
Type	Array of USINT [4].
Notice	This input must not be used!

5.3.9 I1...I2

Function	-
Description	Reserved for future configuration data.
Type	UDINT
Notice	This input must not be used!

5.3.10 I3

Function	Release of HIPRO-S V2 This input is necessary for a connection-specific configuration of the HK-COM-3 instance!				
Description	This input is SIL 3-relevant. Which mode of operation should be used (the previous or new one) can be defined separately for each individual HK-COM-3 instance. <table border="1"><tr><td>0</td><td>Previous mode of operation; this is the default setting.</td></tr><tr><td>1</td><td>Enables the new mode of operation for HIPRO-S V2. Only if both communication partners operate in the new mode, the upgrade to HIPRO-S V2 is performed automatically.</td></tr></table>	0	Previous mode of operation; this is the default setting.	1	Enables the new mode of operation for HIPRO-S V2. Only if both communication partners operate in the new mode, the upgrade to HIPRO-S V2 is performed automatically.
0	Previous mode of operation; this is the default setting.				
1	Enables the new mode of operation for HIPRO-S V2. Only if both communication partners operate in the new mode, the upgrade to HIPRO-S V2 is performed automatically.				
	Range of values: 0, 1				
Type	UINT				
Notice	--				

5.3.11 I4

Function	<p>Production Rate</p> <p>This input is necessary for a connection-specific configuration of the HK-COM-3 instance!</p> <p>For a channel-specific configuration of the HK-COM-3 instance, this input must be set to 0 or remain empty.</p>
Description	<p>The production rate in a connection-specific HK-COM-3 instance is a setting for the HIPRO-S or HIPRO-S V2 connection. It specifies a minimum time interval in milliseconds (ms) between two new data packets.</p> <p>The production rate is used to limit the number of data packets and prevent a (slow) communication partner from being overloaded. The faster communication partner continues to send data packets in the same time intervals, but also using the same sequence number. This results in increased availability since the same data packets are repeatedly sent to the communication partner.</p> <p>A 0 production rate means that new data packets are created and sent in every user program cycle.</p> <p>Range of values: 0...65535 ms</p>
Type	UINT
Notice	--

5.3.12 I5

Function	<p>Connection-specific communication enable</p> <p>This input is necessary for a connection-specific configuration of the HK-COM-3 instance!</p> <p>For a channel-specific configuration of the HK-COM-3 instance, this input must be set to 0 or remain empty.</p>																																			
Description	<p>Used Ethernet modules (EN-M) are enabled by setting bits 0...9. Bits 10...15 must be 0.</p> <table border="1"> <thead> <tr> <th>Module</th><th>Bit</th><th>UINT</th></tr> </thead> <tbody> <tr> <td>EN-M 1 (CU1)</td><td>0</td><td>0000 0000 0000 0001</td></tr> <tr> <td>EN-M 2 (CU1)</td><td>1</td><td>0000 0000 0000 0010</td></tr> <tr> <td>EN-M 3 (CU1)</td><td>2</td><td>0000 0000 0000 0100</td></tr> <tr> <td>EN-M 4 (CU1)</td><td>3</td><td>0000 0000 0000 1000</td></tr> <tr> <td>EN-M 5 (CU1)</td><td>4</td><td>0000 0000 0001 0000</td></tr> <tr> <td>EN-M 1 (CU2)</td><td>5</td><td>0000 0000 0010 0000</td></tr> <tr> <td>EN-M 2 (CU2)</td><td>6</td><td>0000 0000 0100 0000</td></tr> <tr> <td>EN-M 3 (CU2)</td><td>7</td><td>0000 0000 1000 0000</td></tr> <tr> <td>EN-M 4 (CU2)</td><td>8</td><td>0000 0001 0000 0000</td></tr> <tr> <td>EN-M 5 (CU2)</td><td>9</td><td>0000 0010 0000 0000</td></tr> </tbody> </table> <p>Therefore, 33 (Hex 21) is the resulting value when the communication modules, EN-M1 (CU1) and EN-M1 (CU2) are enabled. Input in accordance with IEC 61131: 16#21 or 2#100001. A scientific calculator such as the Windows® calculator with the corresponding view can be used to convert bit strings to decimal values.</p>			Module	Bit	UINT	EN-M 1 (CU1)	0	0000 0000 0000 0001	EN-M 2 (CU1)	1	0000 0000 0000 0010	EN-M 3 (CU1)	2	0000 0000 0000 0100	EN-M 4 (CU1)	3	0000 0000 0000 1000	EN-M 5 (CU1)	4	0000 0000 0001 0000	EN-M 1 (CU2)	5	0000 0000 0010 0000	EN-M 2 (CU2)	6	0000 0000 0100 0000	EN-M 3 (CU2)	7	0000 0000 1000 0000	EN-M 4 (CU2)	8	0000 0001 0000 0000	EN-M 5 (CU2)	9	0000 0010 0000 0000
Module	Bit	UINT																																		
EN-M 1 (CU1)	0	0000 0000 0000 0001																																		
EN-M 2 (CU1)	1	0000 0000 0000 0010																																		
EN-M 3 (CU1)	2	0000 0000 0000 0100																																		
EN-M 4 (CU1)	3	0000 0000 0000 1000																																		
EN-M 5 (CU1)	4	0000 0000 0001 0000																																		
EN-M 1 (CU2)	5	0000 0000 0010 0000																																		
EN-M 2 (CU2)	6	0000 0000 0100 0000																																		
EN-M 3 (CU2)	7	0000 0000 1000 0000																																		
EN-M 4 (CU2)	8	0000 0001 0000 0000																																		
EN-M 5 (CU2)	9	0000 0010 0000 0000																																		
Type	UINT																																			
Notice	This input must be set to 0 for connections the serial HIBUS and not via the Ethernet communication modules.																																			

5.3.13 I6

Function	Reset of the statistics output O3...O6, is the <i>Enable Configuration</i> input is TRUE. This input can be used for a connection-specific configuration of the HK-COM-3 instance!
Description	For a statistics reset at the outputs O3...O6, the value at the I6 output must be greater than or equal to 0 for at least a cycle.
Type	UINT

5.3.14 I7

Function	-
Description	Reserved for future configuration data.
Type	DWORD
Notice	This input must not be used!

5.3.15 I8

Function	-
Description	Reserved for future configuration data.
Type	DWORD
Notice	This input must not be used!

5.4 Outputs

5.4.1 Error

Function	Set to TRUE for signalling an error or fault.
Description	If errors occur, the <i>Error</i> output is set to TRUE and the corresponding error code is issued at the <i>Error Code</i> output.
Type	BOOL

5.4.2 Current Protocol

Function	<p>The communication protocol parameters are only issued if the HK-COM-3 instance is operating with a valid configuration.</p> <p>The parameters are only displayed if the HK-COM-3 instance has a channel-specific configuration.</p> <p>0 is displayed if the configuration is connection-specific.</p>																																
Description	The <i>Current Protocol</i> issues the status flags (bits) of the current protocol.																																
	<table border="1"> <thead> <tr> <th>Bit</th><th>Status</th><th>Description</th></tr> </thead> <tbody> <tr> <td>0</td><td>TRUE</td><td>Primary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the primary.</td></tr> <tr> <td>1</td><td>TRUE</td><td>Secondary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the secondary.</td></tr> <tr> <td rowspan="2">2</td><td>FALSE</td><td>Redundant Ethernet protocol: If the redundant communication module, F 8625 or F 8627(X), is used and bit 3 is set, the Ethernet protocol is also active on the redundant module.</td></tr> <tr> <td>TRUE</td><td>Mono Ethernet protocol: No redundant F 8625 or F 8627 (X) communication module exists, or the Ethernet protocol is not active on the redundant module.</td></tr> <tr> <td>3</td><td>TRUE</td><td>Active Ethernet protocol: The communication module exchanges data with the communication partners (connected nodes) in the network.</td></tr> <tr> <td>4</td><td>TRUE</td><td>Active PROFIBUS DP: The communication module is currently connected to the PROFIBUS DP master and exchanges data with it cyclically.</td></tr> <tr> <td rowspan="2">5</td><td>FALSE</td><td>Module type: The module is a Ethernet module.</td></tr> <tr> <td>TRUE</td><td>Module type: The module is a PROFIBUS DP module.</td></tr> <tr> <td rowspan="2">6</td><td>FALSE</td><td>The F 8625/F 8627(X) is operating in HIPRO-S protocol mode (token passing).</td></tr> <tr> <td>TRUE</td><td>The F 8627X is operating in HIPRO-S DIRECT protocol mode. The F 8625 does not support HIPRO-S DIRECT.</td></tr> </tbody> </table>			Bit	Status	Description	0	TRUE	Primary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the primary.	1	TRUE	Secondary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the secondary.	2	FALSE	Redundant Ethernet protocol: If the redundant communication module, F 8625 or F 8627(X), is used and bit 3 is set, the Ethernet protocol is also active on the redundant module.	TRUE	Mono Ethernet protocol: No redundant F 8625 or F 8627 (X) communication module exists, or the Ethernet protocol is not active on the redundant module.	3	TRUE	Active Ethernet protocol: The communication module exchanges data with the communication partners (connected nodes) in the network.	4	TRUE	Active PROFIBUS DP: The communication module is currently connected to the PROFIBUS DP master and exchanges data with it cyclically.	5	FALSE	Module type: The module is a Ethernet module.	TRUE	Module type: The module is a PROFIBUS DP module.	6	FALSE	The F 8625/F 8627(X) is operating in HIPRO-S protocol mode (token passing).	TRUE	The F 8627X is operating in HIPRO-S DIRECT protocol mode. The F 8625 does not support HIPRO-S DIRECT.
Bit	Status	Description																															
0	TRUE	Primary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the primary.																															
1	TRUE	Secondary: The F 8625 or F 8627(X) adopted the Ethernet protocol function of the secondary.																															
2	FALSE	Redundant Ethernet protocol: If the redundant communication module, F 8625 or F 8627(X), is used and bit 3 is set, the Ethernet protocol is also active on the redundant module.																															
	TRUE	Mono Ethernet protocol: No redundant F 8625 or F 8627 (X) communication module exists, or the Ethernet protocol is not active on the redundant module.																															
3	TRUE	Active Ethernet protocol: The communication module exchanges data with the communication partners (connected nodes) in the network.																															
4	TRUE	Active PROFIBUS DP: The communication module is currently connected to the PROFIBUS DP master and exchanges data with it cyclically.																															
5	FALSE	Module type: The module is a Ethernet module.																															
	TRUE	Module type: The module is a PROFIBUS DP module.																															
6	FALSE	The F 8625/F 8627(X) is operating in HIPRO-S protocol mode (token passing).																															
	TRUE	The F 8627X is operating in HIPRO-S DIRECT protocol mode. The F 8625 does not support HIPRO-S DIRECT.																															
Type	WORD																																

If an error occurs, the value 0 is issued at the *Current Protocol* output.

 For the F 8625 and F 8626 modules, this piece of information is only available in operating system V1.12 and higher. For previous operating systems, the *Current Protocol* output is set to 0 and the corresponding error code is issued at the [Error Code](#) output.

5.4.3 Number of Connected Nodes

Function	<p>Displays the number of communication partner that are currently connected to the F 8625 or F 8627X, including the OPC server. Only displayed if the HK-COM-3 instance is operating with a valid configuration.</p> <p>Modbus TCP communication partners of an F 8627X are not taken into account.</p> <p>The parameters are only displayed if the HK-COM-3 instance has a channel-specific configuration.</p> <p>0 is displayed if the configuration is connection-specific.</p>
Description	See Function
Type	UINT



For the F 8625 module, this piece of information is only available in operating system V1.12 and higher. For previous operating systems, the *Number of Connected Nodes* output is set to 0 and the corresponding error code is issued at the [Error Code](#) output.

5.4.4 Number of Non-Connected Nodes

Function	<p>Displays the number of communication partner that are currently not connected to the F 8625 or F 8627X. Only displayed if the HK-COM-3 instance is operating with a valid configuration.</p> <p>The parameters are only displayed if the HK-COM-3 instance has a channel-specific configuration.</p> <p>0 is displayed if the configuration is connection-specific.</p>
Description	<p>The <i>Number of Non-Connected Nodes</i> output displays the number of communication partner to which no communication can be established.</p> <p>The displayed value takes the safety-related communication partner as well as the four non-safety-related communication partners configured for HIPRO-S and those (up to 14) configured for HIPRO-S DIRECT (OPC server).</p> <p>If all safety-related communication partners are connected and no OPC server is used, <i>Number of Non-Connected Nodes</i> is 4 (for HIPRO-S protocol operation).</p> <p>0 is displayed if a parameter error occurred.</p>
Type	UINT



For the F 8625 module, this piece of information is only available in operating system V1.12 and higher. For previous operating systems, the *Number of Non-Connected Nodes* output is set to 0 and the corresponding error code is issued at the [Error Code](#) output.

5.4.5 Bus Cycle Time

Function	Displays the average token rotation time of the F 8625 and F 8627(X) modules if the HK-COM-3 instance is operating with a valid configuration. The parameters are only displayed if the HK-COM-3 instance has a channel-specific configuration. 0 is displayed if the configuration is connection-specific.
Description	The average token rotation time, which is provided by the communication module during the HIPRO-S protocol mode of operation, is issued at the <i>Bus Cycle Time</i> output. 0 is displayed if a parameter error occurred or the module is operating in HIPRO-S DIRECT protocol mode.
Type	UINT



For the F 8625 modules, this piece of information is only available in operating system V1.12 and higher. For previous operating systems, the *Bus Cycle Time* output is set to 0 and the corresponding error code is issued at the [Error Code](#) output.

5.4.6 O1

Function	Validity of the HK-COM-3 instance data.
Description	<p>Channel-specific instance</p> <p>In a channel-specific instance, the data at the outputs of the current function block is valid and the <i>O1</i> output is set to 1 if the following requirements are met.</p> <ul style="list-style-type: none"> • The COM module defined at the COM Position input are accessible. • The central module assigned to the COM module (see CU Position) is in RUN. • The COM module is suitable for the communication type defined in the <i>Function</i> input. • The data at the outputs of the current function block is valid and up-to-date. <p>If at least one of the previous requirements is not met, the value 0 is issued at the <i>O1</i> output. The data at the outputs of the current function block is invalid (except O1).</p> <p>Connection-specific instance</p> <p>In a connection-specific instance, the data at the outputs of the current function block is valid and the <i>O1</i> output is set to 1 if the following requirements are met:</p> <ul style="list-style-type: none"> • The inputs <i>CU Position</i> and <i>COM Position</i> must be set to 0. • To enable the connection-specific communication, the <i>Function</i> input must contain the value 5. • The <i>Resource Name</i> input must contain a valid character string of a HIPRO-S V2 communication partner. • The configuration presets are identical to the settings currently valid for this connection-specific instance. If they do not match, it may be due to a second connection-specific instance with the same character string at the <i>Resource Name</i> input, which overwrites them. <p>If at least one of the previous requirements is not met, the value 0 is issued at the <i>O1</i> output. The data at the outputs of the current function block is invalid (except O1).</p>
Type	UDINT

5.4.7 O2

Function	HIPRO-S/HIPRO-S V2 operating state. Only displayed for a connection-specific HK-COM-3 instance if this is operating with a valid configuration.																																			
Description	<p>The O2 output always groups multiple operating states bit by bit. If both communication partners are operating in HIPRO-S V2 mode, all the bits are set and the value 31 is issued at the output.</p> <table border="1"> <thead> <tr> <th>Bit</th><th>Status</th><th>Description</th></tr> </thead> <tbody> <tr> <td>0</td><td>TRUE</td><td>A current message from the partner was received and accepted.</td></tr> <tr> <td></td><td>FALSE</td><td>No current message received.</td></tr> <tr> <td>1</td><td>TRUE</td><td>The local resource operates with HIPRO-S V2.</td></tr> <tr> <td></td><td>FALSE</td><td>No HIPRO-S V2 on the local resource.</td></tr> <tr> <td>2</td><td>TRUE</td><td>The remote resource operates with HIPRO-S V2.</td></tr> <tr> <td></td><td>FALSE</td><td>No HIPRO-S V2 on the remote resource.</td></tr> <tr> <td>3</td><td>TRUE</td><td>Import process data available.</td></tr> <tr> <td></td><td>FALSE</td><td>No import process data available.</td></tr> <tr> <td>4</td><td>TRUE</td><td>In the HIPRO-S dialog box, the <i>Reset Imported Variable</i> is set. The HIPRO-S import variables are reset after expiration of the monitoring time. The HIPRO-S import variables (see bit 3) are therefore not older than the monitoring time.</td></tr> <tr> <td></td><td>FALSE</td><td>In the HIPRO-S dialog box, the <i>Reset Imported Variable</i> is not set. The HIPRO-S import variables are not reset after expiration of the monitoring time. The age of the HIPRO-S import variables (see bit 3) is therefore undefined.</td></tr> </tbody> </table>			Bit	Status	Description	0	TRUE	A current message from the partner was received and accepted.		FALSE	No current message received.	1	TRUE	The local resource operates with HIPRO-S V2.		FALSE	No HIPRO-S V2 on the local resource.	2	TRUE	The remote resource operates with HIPRO-S V2.		FALSE	No HIPRO-S V2 on the remote resource.	3	TRUE	Import process data available.		FALSE	No import process data available.	4	TRUE	In the HIPRO-S dialog box, the <i>Reset Imported Variable</i> is set. The HIPRO-S import variables are reset after expiration of the monitoring time. The HIPRO-S import variables (see bit 3) are therefore not older than the monitoring time.		FALSE	In the HIPRO-S dialog box, the <i>Reset Imported Variable</i> is not set. The HIPRO-S import variables are not reset after expiration of the monitoring time. The age of the HIPRO-S import variables (see bit 3) is therefore undefined.
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Type	UDINT																																			

5.4.8 O3

Function	RcvSeqNum Delta (Maximum). Only displayed for a connection-specific HK-COM-3 instance if this is operating with a valid configuration.
Description	The output issues the maximum sequence number delta for the received data packets after statistics has been reset for this connection. Ideally, the sequence number delta for the received data packets should always be 1. If the delta is greater than 1, the partner resource may have a higher production rate. Range of values: 1...16
Type	UDINT

5.4.9 O4

Function	Response Time (Maximum). Only displayed for HIPRO-S V2. For HIPRO-S, 0 is always displayed.
Description	This output displays the maximum response time for received data packets expressed in deciseconds, after the last statistics reset performed for this connection. Range of values: 0...4294967295 ds
Type	UDINT

5.4.10 O5

Function	(Minimum) residual monitoring runtime. Only displayed for a connection-specific HK-COM-3 instance if this is operating with a valid configuration.
Description	This outputs displays the minimum residual monitoring runtime expressed in deciseconds, after the last statistics reset performed for this connection. Range of values: 0...4294967295 ds
Type	UDINT

5.4.11 O6

Function	SentTimeQueue (current number of entries). Only displayed for a connection-specific HK-COM-3 instance if this is operating with a valid configuration.
Description	Current number of entries in the SentTimeQueue for the current HIPRO-S V2 connection. SentTimeQueue is a ring buffer with a maximum of 17 entries. In HIPRO-S mode, 0xffff.ffff is displayed.
Type	UDINT

5.4.12 O7

Function	--
Description	For future use.
Type	DWORD

5.4.13 O8

Function	--
Description	For future use.
Type	DWORD

5.4.14 Error Code

The *Error Code* output issues the error codes specified below (16# = hexadecimal).

Only one error is issued to this output, even if multiple errors occurred.

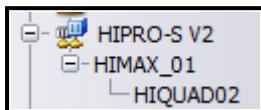
Type: DWORD

Code	Description	Remark
16#0	No error.	-
	Configuration error	
16#1	No enable: The Enable Configuration input is not set to TRUE.	Set the input to TRUE.
16#2	Double assignment: Two HK-COM-3 function blocks have been configured for a communication module (see inputs CU Position (1, 2) and COM Position (1, 2, 3, 4, 5)).	The HK-COM-3, which was processed first, configures the communication module. The subsequent HK-COM-3 outputs the error: 16#2.
16#10001	Incorrect position of the central module: the CU Position is = 0.	CU Position is either connected or not set.
16#10002	Incorrect position of the central module: the CU Position is > 2.	The range of values for CU Position was exceeded.
16#10003	The central module is missing: CU1 or CU2 does not exist.	Correct the value of CU Position , or insert the central module.
16#10010	Incorrect position of the COM module: The COM Position is = 0.	COM Position is either connected or not set.
16#10020	Incorrect position of the COM module: The COM Position is > 5.	The range of values for COM Position was exceeded.
16#10030	The COM module is missing.	Correct the value of COM Position , or insert the COM module.
16#10100	Illegal function: The Function input is > 4.	The range of values for Function was exceeded.
16#10200	Illegal function for the Ethernet module.	The configured function is not possible with the selected COM module (e.g., OPC with PROFIBUS DP module).
16#10300	Illegal channel-specific configuration.	In a channel-specific configuration, I3, I4, I5 must not be used.
16#20100	Invalid operating system loaded.	The COM module is loaded with an operating system that is not suitable for HIPRO-S V2.
	Connection-specific configuration error	

Code	Description	Remark
16#30000	The Resource Name input does not match the configured HIPRO-S V2 communication partner.	Verify the entry at the Resource Name input.
16#30001	Connection-specific configuration configured. The Function input is ≠ 5.	For a connection-specific configuration, this input must be set to 5.
16#30002	Connection-specific configuration configured. The inputs COM Position (1, 2, 3, 4, 5) CU Position (1, 2) are ≠ 0.	The inputs COM Position (1, 2, 3, 4, 5) CU Position (1, 2) must be set to 0.
16#30003	Illegal value at the I3 input.	To enable HIPRO-S V2, this input must be set to 1! Otherwise 0.
16#30004	Illegal bit list at the I5 input.	To enable the communication modules, check the bit list at the I5 input!
16#30005	Multiple assignment in connection-specific configuration.	No unique assignment of the connection-specific instance to the corresponding HIPRO-S V2 connection. More than one connection-specific instance available for the same connection.
16#0F0000	Invalid resource name.	Check the ASCII characters inserted in ARRAY [0..7]!
16#100000	Preview bit as bit mask.	Inconsistent parameter settings of the inputs detected during the preview test. Preview bit is set 1.

6 HIPRO-S V2 Connection between HIQuad and HIMax

In this example, a HIPRO-S V2 connection is created between a HIQuad and a HIMax controller.



6.1 Adjusting HIQuad Controllers for HIPRO-S V2

The current operating system, \geq BS41q/51q V7.0-8 BS (08.17), must be loaded in the central module of the HIQuad controller.

6.1.1 F 8627X Switch Settings

The operating system of the communication module need not be changed. Modbus TCP and OPC can still be used simultaneously with HIPRO-S/ HIPRO-S V2.

- F 8627X Ethernet module channel 1 (switch 2/1 = ON).
- F 8627X Ethernet module channel 2 (switch 2/1 = OFF).
- Direct Mode (switch 1/7 = ON) must be activated on both F 8627X.

6.1.2 HIQuad Resource Name for HIPRO-S/HIPRO-S V2

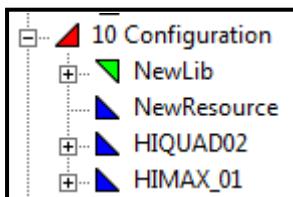
The HIQuad resource name must be exactly 8 characters long, the two last characters must be numbers (e.g., HIQUAD02).

The address is assigned as known so far over the last two digits of the resource name. The IP address range of 192.168.0.X is retained.

- For Ethernet module channel 1 (switch 2/1 = ON)
Host address = (the last two digits of the resource name) * 2 + 1
- For Ethernet module channel 2 (switch 2/1 = OFF)
Host address = (the last two digits of the resource name) * 2 + 2

6.2 Configuration in ELOP II

The configuration is started in ELOP II with the creation of a HIPRO-S connection between two ELOP II resources. One of the two resources serves as a proxy resource in ELOP II, which is actually configured in the SILworX project.



At the end of the configuration process in ELOP II, all the relevant HIPRO-S/ HIPRO-S V2 data of the proxy resource must be exported to an XML file using the ELOP II tool LCxmlExport. Once the XML file has been imported to SILworX, the ELOP II HIPRO-S/ HIPRO-S V2 variables can be assigned to global variables in the SILworX resource.

6.2.1 Creating the Proxy Resource as Normal ELOP II Resource

A normal resource (in this example: for HIMax) used as proxy resource is created in ELOP II.

To create the HIMax proxy resource

- Open the ELOP II project in which the HIMax proxy resource should be created.
- Right-click **Configuration** and select **New, Resource**.
A new resource (HIMax proxy resource) is added.
- Right-click **Resource** and select **New, Type Instance**.
- Select the **Rename** function in the resource context menu (HIMax proxy resource) and enter a unique name. The resource names must be exactly 8 characters long, the two last characters must be numbers (e.g., HIMax_01).

The address is assigned as known so far over the last two digits of the resource name. The IP address range of 192.168.0.X is retained.

- For Ethernet channel 1: Host address = (the last 2 digits of the resource name) * 2 + 1
- For Ethernet channel 2: Host address = (the last 2 digits of the resource name) * 2 + 2

To create HIBUS

Create HIBUS in the configuration and add the partner.

- Right-click *Configuration* and select the **Properties** context menu function.
- In the *Properties* dialog box, select the **Busses** tab.
- Click the **Add** button. The *Add Communication System* appears.
- Enter a unique name for HIBUS in the *Name* field.
The default name for the communication system is already *HIBUS*.
- Click **OK** to confirm. The *Edit HIBUS* dialog box appears.
- Create the HIBUS participants in the *Participants* tab (in this example: HIQUAD02 and HIMax_01).
The *Parameter* tab is not relevant for HIPRO-S/ HIPRO-S V2.
- Click **OK** to confirm.

To assign the PES master a resource

- Select **Properties** from the context menu of the resource (in this example: HIMax 01).
- In the *Properties* dialog box, select the **HIPRO-S** tab.
- Click the **Add** button. The *Resource* dialog box appears.

- In the *Resource* field, select the controller on which the PES master is running (in this example: *HQUAD02*).
- In the *PES Master* field, select **Master** (in this example: *HQUAD02*).
- Select **HIPRO-S V2** in the *Signature Mode* field.
- Click **OK** to confirm.

To assign the HIPRO-S variables

- Open the structure tree for the resource (in this example: *HIMax_01*) and double-click **Program** to open the FBD Editor.
- Right-click a free field in the Object Panel of the FBD Editor and select **New**. The *Variable Declaration* dialog box appears.
- Declare the variables in the *Variables* tab:
 - Enter a unique name in the *Name* field.
 - Define the type of variable in the *Declaration* field.
- In the *HIPRO-N/S* tab, *HIPRO-S* area, determine the import and export processes with the partner resource.
- Click **OK** to confirm.

To configure the HK-COM-3 function block

In the ELOP II user program, a connection-specific HK-COM-3 instance must be configured for each HIPRO-S V2 connection. For further information, see Chapter 5 .

- In the structure tree, open the **ELOP II LIB** and drag the **HK-COM-3** function block onto a free field in the user program.
- In this example, the HK-COM-3 input must be set up as follows:

Parameter	Type	Description
CU Position (1, 2)	UINT	This input must be set to 0 or remain empty!
COM Position (1, 2, 3, 4, 5)	UINT	This input must be set to 0 or remain empty!
Enable Con- figuration	BOOL	Set the input to TRUE to enable the current configuration.
Function	UINT	Set the input to 5 for safety-related communication via HIPRO-S V2.
Resource Name	ARRAY [8 BYTE]	Enter the <i>Resource Name</i> for the HIPRO-S V2 communication partner in the ARRAY (in this example: <i>HIMax_01</i>), see Chapter 5.3.5 .
E3	UINT	Set the HIPRO-S V2 <i>Enable</i> input to 1 .
E4	UINT	Align the <i>Production Rate</i> with the consumption rate of the slow com-

Parameter	Type	Description
		munication partner.
E5	UINT	Used communication modules enabled.
I6	UINT	Statistics reset due to change 0>1>0 .

- Save the user program.

To generate the code and perform the verification

- Generate code for both resources, the real HIQuad controller and the proxy resource (in this example: HIMax_01).
- Take the messages in the code generator logbook into account and correct potential errors.
- Select **PES Master** from the context menu of Configuration.
- To verify the connection, click **Cross-Reference** in the *PES Master* dialog box.
- The cross-reference list displays the destination and source of the variables and the errors or faults.
- Click **Close** to close the dialog box.
- **Exit ELOP II!**

6.2.2 Exporting the Data of the Proxy Resource from ELOP II

The data of the proxy resource configured in ELOP II must be exported to an XML file. This XML file can then be imported to SILworX to establish the HIPRO-S connection for the HIMatrix controller.

To export to an XML file

- From the ELOP II Control Center, select and start the **ELOP II Command Prompt**.
- Call `LCxmlExport ConfigurationPath/MyRessource.L2R` to start the export process.
The configuration file is saved as *.xml in the configuration directory of the verified resource. For further details on the ELOP II tool, see the ELOP II Control Center.

6.3 Configuration in SILworX

6.3.1 Creating a HIPRO-S V2 Object

- Open the SILworX project in which the ELOP II proxy resource should be created.
- Right-click **Resource** and select **New, HIPRO-S**.
A new HIPRO-S object is created.



- The name of the objects LOCAL and REMOTE must be adjusted.
To this end, the object names must be identical with the resource names in ELOP II.
LOCAL = rename in HIMAX_01
REMOTE = rename in HIQUAD02

6.3.2 Importing an XML File to SILworX

- In the structure tree, select **HIPRO-S, Local** and open the context menu.
- Select **Update Connection** from the context menu.
A dialog box for importing an XML file with the extension *.xml appears.
- Select the configuration file created in the ELOP II project, and click **OK**.

To open the remote object

- Select **HIPRO-S V2, Local, Remote** from the Object Panel and right-click **Remote**.
- Select **Edit** from the context menu to open the remote object of the HIPRO-S V2 connection.

To connect process variables

To add the process variables in the editor of the HIPRO-S connection.

- Select the **Process Variables** tab.
- Select the **Input Signals** area.
- In the Object Panel, select a global variable and drag it onto the input signal to be connected and located in the **Input Signals** area.
- Repeat this step for further variables.
- Select the **Output Signals** area.

- In the Object Panel, select a global variable and drag it onto the output signal to be connected and located in the **Output Signals** area.
- Repeat this step for further variables.

To verify the HIPRO-S connection

- In the structure tree, select **Resource, HIPRO-S** and open the context menu.
- Select **Verification** from the context menu, and click **OK** to confirm.
- Thoroughly verify the messages contained in the logbook and correct potential errors.



Recompile the resource configuration with the HIPRO-S connection, and load it to the controllers to ensure that the new configuration is available for communication with HIMax.

7 Upgrading HIQuad from HIPRO-S to HIPRO-S V2

Safety-related communication via HIPRO-S V2 meets the current requirements for SIL 3 applications in accordance with the standards IEC 61508 and IEC 61784-3.

This section describes what need to be considered when upgrading HIQuad controllers to HIPRO-S V2.

Prior to loading the new operating system, V7.0-8 BS (8.17) or higher, ensure that the user program does not contain any HK-COM-3 instance that could create a connection-specific configuration. Such a HK-COM-3 instance is usually not contained in an existing project since the *Resource Name* input had no function so far.

When running in the previous HIPRO-S mode of operation, the new operating system V7.0-8 BS (08.17) or higher is fully compatible with the HIPRO-S protocol of the previous HIQuad operating systems. This is required if communication with the partner controller should run over HIBUS (controlled by an PES master). In such cases, both controllers must run in the previous mode of operation.

7.1 HIPRO-S V2 Switch Settings on the F 8627X Communication Module

No restrictions for F 8627X modules with operating system V3.x and higher. HIPRO-S, HIPRO-S V2, Modbus TCP and OPC may be used simultaneously.

- F 8627X Ethernet module channel 1 (switch 2/1 = ON).
- F 8627X Ethernet module channel 2 (switch 2/1 = OFF).
- Direct Mode (switch 1/7 = ON) must be activated on the F 8627X Ethernet modules.

7.2 Transition Phase when Upgrading from HIPRO-S to HIPRO-S V2

During the upgrade, mixed communication occurs between two HIQuad controllers with HIPRO-S and HIPRO-S V2 messages. The HIQuad controller that was upgraded to HIPRO-S V2 sends HIPRO-S V2 messages and receives HIPRO-S messages from the HIQuad controller running with the previous mode of operation.

Only after HIPRO-S V2 was enabled and is active on both HIQuad controllers, the upgrade to HIPRO-S V2 is complete in both communication directions.

When connections are re-established, both partner controllers must be running in the same mode of operation. Inhomogeneous modes of operations may only apply to running connections for a short transition time during the upgrade.



If after the upgrade from HIPRO-S to HIPRO-S V2, HIPRO-S V2 is disabled on one side, communication is interrupted.

7.3 Rules for Upgrading HIPRO-S to HIPRO-S V2

In HIQuad controllers with redundant central module, the operating system can be upgraded during operation. The new operating system of the central module, \geq V7.0-8 BS (8.17), is configured by default for using the mode of operation compatible with HIPRO-S.

Only when the new mode of operation for HIPRO-S V2 has been enabled on both controllers, the HIPRO-S V2 protocol can be processed in both communication directions. The following points must be observed:

- Both HIQuad controllers of an existing HIPRO-S communication connection must be loaded with the current operating system V7.0-8 BS (8.17) or higher.
- Note that additional time requirements must be met in the new mode of operation for HIPRO-S V2 to guarantee seamless communication during the upgrade to HIPRO-S V2. Whether these time requirements such as the *Maximum Response Time* are complied with, depends on the cycle times of both communication partners and the latency of the transport channel. In general, these time values cannot be reliably predicted.
- The transport channel must be functional in both directions.
- The response time for a connection must be less than or equal to: $2 * \text{Monitoring Time} (\text{Receive Timeout})$.



HIMA recommends upgrading HIPRO-S to HIPRO-S V2. This may affect the availability of a HIPRO-S connection.

7.4 Upgrade Blockade due to the Operating System's Protective Function

The operating system upgrade to HIPRO-S V2 is blocked if a connection with empty process data telegram is detected on a communication direction.

The HIPRO-S V2 operating system is blocked as a protective function to ensure that the availability of running process data communications is not compromised.

This protective function is necessary since process data communication in HIPRO-S V2 running in the new mode of operation is only successful if process data transfer is possible in both directions.

Whether the new operating system mode has been blocked is reported to the O2 output of the HK-COM-3 function block. The previous mode of operation is retained even if the new one has been enabled.

Other causes for a blockage include faulty configuration settings of the HK-COM-3 function block such as missing communication enabled for individual connections or Ethernet modules. Otherwise, the transport medium (cables, switches, etc.) must be checked.

8 Glossary

This glossary is organized alphabetically and provides explanations of specialized terms and abbreviations used at different levels of the present document.

B

BUSCOM

The operating system of the HIQuad is designed to allow communication with third-party systems. The variables to be transferred, e.g., for Modbus, should be declared as BUSCOM in the variable declaration.

C

Central Module

The user program and safety functions of the HIQuad controllers are processed on the central module.

The central modules, which simultaneously process the same programs, operating systems and user programs, are composed of two microprocessors, each with its own RAM. A comparator continuously compares the data on the busses between the two microprocessors and their memories.

COM

Communication module

E

ELOP II

ELOP II is the programming tool in accordance with IEC 61131-3 to be used for HIQuad controllers.

The user program is created with ELOP II and contains the application-specific functions to be performed by the automation device. ELOP II is also used to configure the operating system functions. A code generator translates the user program into a machine code. ELOP II uses a serial interface or Ethernet to transfer this machine code to the flash EPROM of the automation device central module.

F

Fieldbus Interfaces

The fieldbus interfaces on the central modules of the HIQuad system are suitable for connection to the serial HIBUS. The serial HIBUS enables HIQuad controllers to be operated with the HIPRO-S protocol. HIPRO-S V2 protocol is not suitable for serial communication!

H

HIBUS

HIBUS is used to establish the bus connection among HIQuad controllers or between HIQuad controllers and PADT (programming and debugging tool).

HIPRO is the protocol implemented for data transfer among HIMA PES. The protocols for communication among PES are based on the master-slave principle.

Each bus participant is identified by a bus station number, which may be preset by the user. A maximum of 31 logical bus stations may operate on a bus, either as master or slave.

HIPRO-S or HIPRO-S V2 must be used for safety-related communication.

HIPRO-S

The HIPRO-S protocol is used for safety-related communication between two or several HIQuad controllers. Ethernet or the serial HIBUS serves as transmission media.

HIPRO-S is programmed with ELOP II. The resources with which safety-related data is to be exchanged, must be specified in each resource. The variables to be exchanged are defined in the Variable Declaration Editor of the program instance.

HIPRO-S V2

Safety-related communication via HIPRO-S V2 meets the current requirements for SIL 3 applications in accordance with the standards IEC 61508 and IEC 61784-3.

HIQuad

HIQuad refers to the safety-related automation devices, H41q, H41qc and H51q. These devices can be used in applications up to SIL 3 (IEC 61508), Cat. 4 or Pl e (ISO 13849-1).

I

IEC

International electrotechnical commission

P

PES

Programmable electronic system

PES Master

The PES master is required for safety-related and non-safety-related data transfer via the serial HIBUS.

For HIPRO-S / HIPRO-S V2 data transfer, the PES master need be generated, but no longer be loaded. The PES master cross-reference in ELOP II ensures comfortable verification of the connection.

S

safeethernet

Safety-related protocol in accordance with SIL 3 for HIMax and HIMatrix controllers.

SIL

Safety integrity level in accordance with IEC 61508.

SILworX

SILworX is the programming tool in accordance with IEC 61131-3 to be used for HIMax and HIMatrix controllers.

9 HIMA Service, Training and Hotline

To deepen users knowledge of ELOP II and SILworX, HIMA holds specific training course in accordance with the current seminar program.

For further information, refer to the HIMA website at www.hima.de or www.hima.com.

Refer to the following table for any question, concern or suggestion related to the programming tool.

HIMA Hotline Phone	+49 6202 709 - 255 (or 258) for questions about ELOP II +49 6202 709 - 185 for questions about SILworX
Fax	+49 6202 709 - 199
E-mail	hotline@hima.com

For questions about specific topics or to locate the appropriate HIMA contact person, use the contact form provided on our website www.hima.com.

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