
HIMA
SMART
SAFETY.
Manual
HIQuad X®
F-COM 01

Contact

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Table of Contents

1 Introduction

This manual describes the technical characteristics of the module and its use. It provides information on how to install, start up and configure the module in SILworX.

1.1 Structure and Use of the Document

The content of this manual is part of the hardware description of the HIQuad X programmable electronic system.

This manual contains the following main chapters:

- Introduction
- Safety
- Product description
- Start-up
- Operation
- Maintenance
- Decommissioning
- Transport
- Disposal

Additionally, the following documents must be taken into account:

Document	Content	Document no.
HIQuad X system manual	Hardware description of the HIQuad X system	HI 803 211 E
HIQuad X safety manual	Safety functions of the HIQuad X system	HI 803 209 E
Communication manual	Description of communication and protocols	HI 801 101 E
SILworX online help (OLH)	Instructions on how to use SILworX	-
SILworX first steps manual	Introduction to SILworX	HI 801 103 E

Table 1: Additional Applicable Manuals

The current manuals can be obtained upon request by sending an e-mail to: documentation@hima.com. Registered customers can download the product documentation from the HIMA Extranet.

1.2 Target Audience

This document is aimed at the planners, design engineers and programmers of automation systems as well as the persons authorized to start up, operate and maintain the devices and systems concerned. Specialized knowledge of safety-related automation systems is required.

1.3 Writing Conventions

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

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	Parameters and system variables, references.
`Courier`	Literal user inputs.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references are hyperlinks even if they are not particularly marked. When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notices and operating tips are particularly marked.

1.3.1 Safety Notices

Safety notices must be strictly observed to ensure the lowest possible risk.

The safety notices are represented as described below.

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

The signal words have the following meanings:

- Warning indicates hazardous situations which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situations which, if not avoided, could result in minor or modest injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ SIGNAL WORD

Type and source of risk!

Consequences arising from non-observance.

Risk prevention.

NOTICE

Type and source of damage!

Damage prevention.

1.3.2 Operating Tips

Additional information is structured as presented in the following example:

i	The text giving additional information is located here.

Useful tips and tricks appear as follows:

TIP	The tip text is located here.

2 Safety

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

The product is operated with SELV or PELV. No imminent risk results from the product itself. Use in the Ex zone is only permitted if additional measures are taken.

2.1 Intended Use

HIQuad X components are designed for assembling safety-related controller systems.

When using the components in the HIQuad X system, comply with the following general requirements.

2.1.1 Environmental Requirements

All the environmental conditions specified in this manual must be observed when operating the HIQuad X system. The environmental requirements are listed in the product data.

2.1.2 ESD Protective Measures

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace components.

NOTICE

Damage to the HIQuad X system due to electrostatic discharge!

- **When performing the work, make sure that the workspace is free of static, and wear a grounding strap.**
- **If not used, ensure that the components are protected from electrostatic discharge, e.g., by storing them in their packaging.**

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 system from operating safely is permitted.

3 Product Description

The F-COM 01 communication module is intended for use in the programmable electronic system (PES) HIQuad X.

A maximum of 2 communication modules can be used in the slots foreseen in the base rack of the H41X system and a maximum of 10 communication modules are permitted in the H51X system. The permitted slots are specified in Chapter 4.1.1.

The module is used to communicate with external systems via standard and safety-related protocols. To this end, the protocol licenses and interfaces required for configuring the communication module are selected in the SILworX programming tool.

Refer to the HIMA website and the HIQuad X safety manual (HI 803 209 E) for more information on the standards used to test and certify the module and the HIQuad X system.

3.1 Supported Protocols

For details on the supported standard protocols, refer to the communication manual (HI 801 101 E).

3.2 Safety Function

No safety function is performed by the communication module.

3.2.1 Response in the Event of a Fault

If faults occur, the module enters the temporary STOP_ERROR state. The module is then rebooted and restarted from the INIT state.

No process data is exchanged with external communication partners in the STOP_ERROR state. No process data is transferred to the process module.

3.3 Scope of Delivery

The module is delivered with no additional accessories.

3.4 Variants Designation

The following table shows the variants of the F-COM modules:

Designation	Remark
F-COM 01	Without coating
F-COM 01, coated	With protective coating

Table 2: Variants Designation for the F-COM Modules

3.5 Type Label

The type label specifies the following important details:

- Product name
- Mark of conformity
- Part no.
- Serial number
- Hardware revision index (HW-Rev.)
- Operating system revision index (OS-Rev.)
- Ex specifications (if applicable)
- Production year (Prod-Year:)

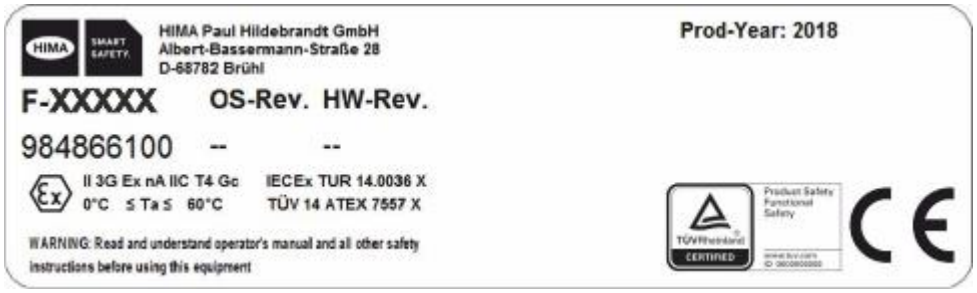


Figure 1: Sample Type Label

3.6 Structure

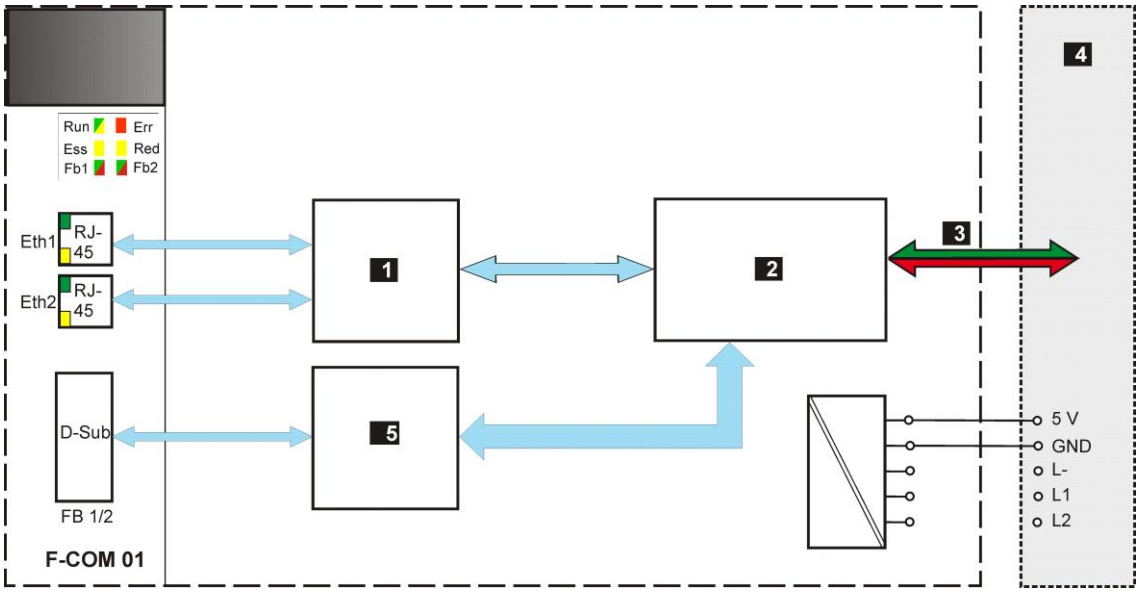
Functional units of the module:

- Non-safety-related processor system
- Ethernet switch
- Ethernet and fieldbus interfaces on the connector board.

LEDs on the indicator panel displaying the status, see Chapter 3.6.2.

3.6.1 Block Diagram, Functional Units

The following block diagram illustrates the structure of the module.



1 Ethernet switch (external communication)
2 Processor system
3 System bus A and system bus B
4 Backplane PCB
5 Protocol converter, galvanically separated

Figure 2: Block Diagram

3.6.2 Processor System

The non-safety-related processor system controls and monitors the external communication. The communication and processor modules internally exchange the process data via the redundant system bus.

Operating system and error code history are stored in a non-volatile memory and can be read in SILworX via the diagnostic function.

3.6.3 Ethernet Switch

Integrated Ethernet switch to configure different networks.

3.6.4 Ethernet Interfaces

The communication module is equipped with two Ethernet switch ports connected to the Ethernet interface of the processor system via an integrated Ethernet switch.

Ethernet interface	
Ports	2
Transmission standard	10BASE-T/100BASE-Tx, Half and full duplex
Autonegotiation	Yes
Autocrossover	Yes
Connection socket	RJ-45
IP address	Freely configurable[1)]
Subnet mask	Freely configurable[1)]
Supported protocols	safe**ethernet** Standard protocols
[1)] The general rules for assigning IP addresses and subnet masks must be adhered to.	

Table 3: Ethernet Interface Properties

i Ensure that no loops result from the network wiring. Data packets may only reach a controller over a single path.

3.6.5 Fieldbus Interfaces

Users can configure the fieldbus interface transmission standards in SILworX using the corresponding protocol editor. The pins for the FB1and FB2 interfaces of the F-COM 01 module are automatically assigned once this configuration has been loaded into the controller.

Fieldbus interfaces	
Number	1 (2 FB interfaces in one D-sub connector)
Transmission standard	Configurable via the SILworX configuration.
Connection socket	D-sub connector, 9 poles
Operating data	5 V galvanically separated, ≤ 100 mA (short-circuit-proof)
Supported protocols	The fieldbus protocols must be enabled via a license key or can be operated in demo mode for a limited period of time. For further details on the fieldbus protocols, refer to the communication manual (HI 801 101 E).

Table 4: Fieldbus Interface Specifications

i Wiring, bus termination:

- Observe the corresponding fieldbus standard when connecting the fieldbus interfaces.
- Use the bus terminations to terminate the fieldbuses on their physical ends.
- Only shielded cables may be connected to the 9-pole D-sub connector. The shield is connected to the rack housing.

3.6.5.1 RS422

One RS485 (RS422) cable must be used, see Chapter 4.6.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	RxD-A	Receive data A
4	TxD-A	Send data A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	RxD-B	Receive data B
9	TxD-B	Send data B

Table 5: Pin Assignment of the FB1 Interface with RS422

3.6.5.2 RS485 with RTS

One RS485 cable must be used, see Chapter 4.6.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	RXD/TXD-A	Receive/send data A
4	CNTR-A	Control signal A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	RXD/TXD-B	Receive/send data B
9	CNTR-B	Control signal B

Table 6: Pin Assignment of the FB1 Interface with RS485 (with RTS)

3.6.5.3 Twice RS485 (without RTS)

One (two) RS485 cable must be used, see Chapter 4.6.

The pin assignment does not comply with the standard, since two interfaces are connected to one plug.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	RxD1/TxD1-A	First receive/send data A
4	RxD2/TxD2-A	Second receive/send data A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	RxD1/TxD1-B	First receive/send data B
9	RxD2/TxD2-B	Second receive/send data B

Table 7: Pin Assignment of the FB1 and FB2 Interface with two RS485 (without RTS)

i The assignment Table 6 is active upon reload completion on FB1 with RS485 (with RTS).
The assignment Table 8 is active upon reload completion on FB2 with RS485 (without RTS).

3.6.5.4 FB2 with RS485 (without RTS)

One RS485 cable must be used, see Chapter 4.6.

The pin assignment does not comply with the standard.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	-	-
4	RxD2/TxD2-A	Second receive/send data A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	-	-
9	RxD2/TxD2-B	Second receive/send data B

Table 8: Pin Assignment of the FB2 Interface with RS485 (without RTS)

3.6.5.5 PROFIBUS DP Slave

One PROFIBUS DP cable must be used, see Chapter 4.6.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	RXD/TXD-A	PROFIBUS DP receive/send data A
4	CNTR-A	Control signal A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	RXD/TXD-B	PROFIBUS DP receive/send data B
9	CNTR-B	Control signal B

Table 9: Pin Assignment of the FB1 Interface with PROFIBUS DP Slave

3.6.5.6 PROFIBUS DP Slave and RS485

The pin assignment does not comply with the standard, since two interfaces are connected to one plug.

One PROFIBUS DP cable must be used for PROFIBUS DP slaves. One RS485 cable must be used for RS485, see Chapter 4.6.

Pin	Signal	Description
1	-	Not used
2	5 V	Fieldbus supply decoupled via diode
3	PROFIBUS DP RXD/TXD-A	PROFIBUS DP receive/send data A
4	RS485 RxD1/TxD1-A	Receive/send data A
5	DGND	Data transmission potential (ground to 5 V)
6	5 V	Fieldbus supply
7	-	Not used
8	PROFIBUS DP RXD/TXD-B	PROFIBUS DP receive/send data B
9	RS485 RxD1/TxD1-B	RS485 receive/send data B

Table 10: Pin Assignment of the FB1/2 Interface with PROFIBUS DP Slave and RS485

3.6.6 Indicators

The following figure shows the front view of the processor module: The indicators consist of LEDs located on the front plate.

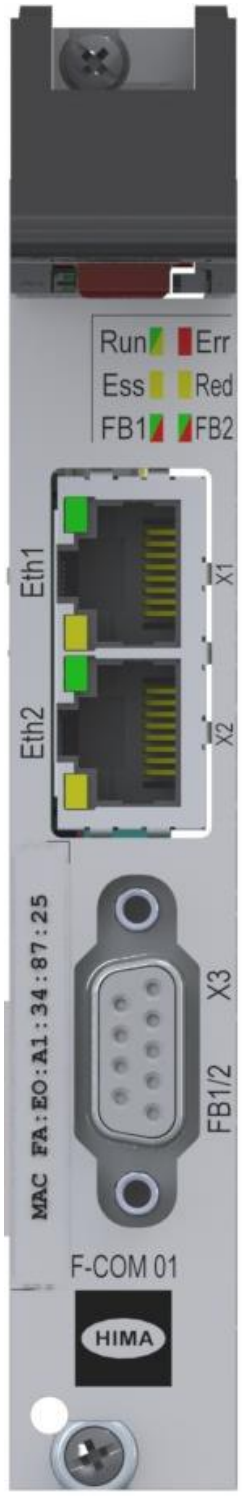


Figure 3: Front View with LEDs, Ethernet Ports and Fieldbus Interface

Additionally, the front plate includes two Ethernet ports, one fieldbus interface and a label with the MAC address.

The LEDs indicate the operating state of the communication module. All LEDs should be considered together. The LEDs on the module are divided into the following groups:

- System status indicators (Run, Err)
- Redundancy indicators (Ess, Red)
- Fieldbus interface indicators (FB1/2)

When the supply voltage is connected, an LED test is performed and all LEDs are briefly lit.

Definition of blinking frequencies

The following table defines the blinking frequencies of the LEDs:

Definition	Blinking frequencies
Blinking1	Long (600 ms) on, long (600 ms) off
Blinking2	Short (200 ms) on, short (200 ms) off, short (200 ms) on, long (600 ms) off
Blinking-x	Ethernet communication: Blinking synchronously with data transmission

Table 11: Blinking Frequencies of LEDs

3.6.6.1 System Status Indicators

The LEDs of the system status indicators are located above the channel indicators.

LED	Color	Status	Description
RUN	Green	On	Module in the RUN state, normal operation.
	Yellow	On	▪ Module state: STOP / VALID CONFIGURATION ▪ The emergency loader is active.
		Blinking1	The module is in one of the following states: ▪ STOP / INVALID CONFIGURATION ▪ STOP / LOADING OS ▪ INIT / out of group ▪ LOCKED
Err	Red	On	System warning, for example: ▪ No license for additional functions (e.g., communication protocols), test mode. ▪ Temperature warning
		Blinking1	System error, for example: ▪ Internal module faults detected by self-tests, e.g., hardware or voltage supply faults. ▪ System configuration error. ▪ Error while loading the operating system. ▪ The emergency loader is active.
		Off	No faults detected.

Table 12: System Status Indicators

3.6.6.2 Redundancy Indicators

The LEDs are located below the module status indicators.

LED	Color	Status	Description
Ess	Yellow	On	At least one non-redundant fieldbus protocol is configured.
		Blinking1	A fieldbus protocol configured for redundant operation is not operating redundantly.
		Off	▪ All fieldbus protocols configured for redundant operation are operating redundantly. ▪ No non-redundant fieldbus protocols are running.
Red	Yellow	On	All fieldbus protocols configured for redundant operation are operating redundantly to the partner module.
		Blinking1	▪ Synchronization ▪ The redundant partner of at least one redundant fieldbus protocol is missing.
		Off	No redundant fieldbus protocol is configured.

Table 13: Redundancy Indicators

3.6.6.3 Fieldbus Indicators

The LEDs of the fieldbus indicators are labeled *Fieldbus*.

LED	Color	Status	Description
FB1…2	Green	On	The meaning depends on the fieldbus protocol.
		Blinking-x	The meaning depends on the fieldbus protocol.
	Yellow	On	The emergency loader is active.
	Off	Off	No activity, fieldbus not operating.
Fault	Red	Blinking1	Fieldbus fault of the bus (e.g., the slave is not present or faulty response), depending on the fieldbus protocol (minimum blinking duration 5 s).
		Off	No fieldbus fault.

Table 14: Fieldbus Indicators

3.6.6.4 Ethernet Indicators

The LEDs of the Ethernet indicators are labeled *Ethernet*.

LED	Color	Status	Description
Eth 1…2	Green	On	Communication partner connected. No communication detected on interface.
		Blinking-x	Communication detected on interface.
		Blinking1	IP address conflict detected. All Ethernet indicator LEDs are blinking.
		Off	No communication partner connected.
H/F/Col 1…2	Yellow	On	Full duplex operation on Ethernet line.
		Blinking-x	Collisions detected on Ethernet line.
		Blinking1	IP address conflict detected. All Ethernet indicator LEDs are blinking.
		Off	Half duplex operation on Ethernet line.

Table 15: Ethernet Indicators

3.7 Product Data

General	
Current consumption	0.8 A at 5 VDC
Microprocessor	PowerPC 405EP
Protection class	Protection class III in accordance with IEC/EN 61131-2.
Ambient temperature	0...+60 °C
Transport and storage temperature	-40...+70 °C
Humidity	Max. 95 % relative humidity, non-condensing
Pollution	Pollution degree II in accordance with IEC/EN 60664-1
Altitude	< 2000 m
Degree of protection	IP20
Dimensions	4 HP
Weight	Approx. 270 g

Table 16: Product Data

4 Start-Up

The communication module is started up by inserting the communication module into a permissible base rack slot, see Chapter 4.1.1.

If the base rack is already operating, the communication module adopts the operating state.

If the base rack is not operating, connect the supply voltage.

4.1 Mounting

Observe the following points when mounting the module:

- The module is intended for use within a HIQuad X base rack. For further information on how to structure the base rack, refer to the corresponding system documentation.
- Only operate the processor module in the permissible slot, see Chapter 4.1.1.
- Only operate the module with forced cooling (fan rack).
- Modifications or extensions to the system wiring must be performed by personnel with knowledge of ESD protective measures.

NOTICE

Electrostatic discharge!

Failure to comply with these instructions can destroy the module.

- **Make sure that the workspace is free of static and wear a grounding strap.**
- **If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.**

- Effects due to EMC influences:

  Exposing the module to environmental influences other than those specified in the manual may lead to malfunctions or even the destruction of the module.

NOTICE

Damage to the controller or system malfunction possible!

Only expose the modules to permissible environmental influences, see Chapter 3.7.

4.1.1 Slots Permitted for the Communication Module

The following points must be observed when assigning the slots to the communication modules, including the Hardware Editor:

- In the H41 system, a maximum of 2 communication modules can be used in slots 14 and 15 of the base rack (F-BASE RACK 02).
- In the H51 system, a maximum of 10 communication modules can be used in slots 12 through 21 of the base rack (F-BASE RACK 01).

4.2 Mounting and Removing the Module

This chapter describes how to mount and remove a module.

The following points must be adhered to when mounting and removing modules:

- Strictly observe the following instructions when removing and reinserting the modules of the HIQuad X system.
- Quickly disconnect the modules from the backplane to avoid faulty signals in the system that could cause its shutdown.
- Only use the module in the designated slot.

i HIMA cannot be made liable for consequential loss caused by improperly removing and reinserting the modules.

NOTICE

Damage to bus and power sockets due to module jamming!

Failure to comply with these instructions can damage the controller.

Always insert the modules in the racks carefully.

Tools:

- Screwdriver, cross PH1

i The first of the three MAC addresses is affixed on the front plate of the F-COM 01 module. The two following MAC addresses always include a number increasing by 1.
Example: MAC FA:EO:A1:34:87:**25**, MAC FA:EO:A1:34:87:**26**, MAC FA:EO:A1:34:87:**27**!

Installation:

1. Pull back as far as possible the fastening screws on the module's front plate.
2. Insert the module into the guiding rail of the intended slot and push it in the rack as far as it can go.
3. Push the red release button bottom up to unlock the extractor handle.
4. With your thumbs, press the module carefully, but quickly inwards as far as it can go to ensure that no faulty signals are triggered within the system.
5. Press the extractor handle down until it snaps into position.
6. Tighten the fastening screws (max. 0.35 Nm).
7. If provided, insert the Ethernet and fieldbus cables.

► The module is mounted.

Removal:

1. If present, remove the Ethernet and fieldbus cables.
2. Completely release the fastening screws from the module.
3. Push the red release button bottom up to unlock the extractor handle.
4. Completely push the extractor handle upwards to rapidly separate the module from the backplane. This avoids faulty signals in the system.
5. Press the extractor handle down once again until it snaps into position.
6. Remove the module from the rack holding it by the extractor handle.

► The module is removed.

4.3 Configuring the Module in SILworX

The module is configured in the Hardware Editor of the SILworX programming tool.

To evaluate the system parameters in the user program, they must be assigned to global variables. Perform this step in the Hardware Editor using the module's detail view.

The Ethernet interfaces are configured in the detail view of the COM module.

i Communication loss!

With an inappropriate Ethernet parameter setting, the processor or communication module might no longer be reachable. Reset the module!

The following tables present the system parameters for the module in the same order as in the SILworX Hardware Editor.

TIP A scientific calculator such as the Windows® calculator with the corresponding view can be used to convert hexadecimal values to bit strings.

4.3.1 The **Module** Tab

The **Module** tab contains the following parameters:

Designation	Description
Name	Module name.
Activating Max. µP Budget for HH Protocol	▪ Activated: Use CPU load limit for safe**ethernet** from the *Max. µP Budget for HH Protocol [%]* field. ▪ Deactivated: Do not use the CPU load limit for safe**ethernet**. Default setting: Deactivated
Max. µP Budget for HH Protocol [%]	Module's maximum CPU load that can be used for transporting the safe**ethernet** data packets of the safety-related processor module. i The maximum load must be distributed among all the implemented protocols that use this communication module.
IP Address	IP address of the Ethernet interface. Default value: 192.168.0.99
Subnet Mask	32-bit address mask to split up the IP address into network and host address. Default value: 255.255.252.0
Standard Interface	Activated: The interface is used as standard interface for system login. Default setting: Deactivated
Default Gateway	IP address of the default gateway. Default value: 0.0.0.0

Designation	Description
ARP Aging Time [s]	A COM module stores the MAC addresses of the communication partners in a MAC/IP address assignment table (ARP cache). The MAC address remains stored in the ARP cache if messages from the communication partner are received within 1x...2x *ARP Aging Time*. The MAC address is erased from the ARP cache if no messages from the communication partner are received within 1x...2x *ARP Aging Time*. The typical value for the *ARP Aging Time* in a local network ranges from 5...300 s. The contents of the ARP cache cannot be read out. Range of values: 1...3600 s Default value: 60 s **Note:** If routers or gateways are used, the *ARP Aging Time* must be adjusted (increased) due to the additional time required for two-way transmission. If the *ARP Aging Time* is too low, the MAC address of the communication partner is erased from the ARP cache and communication is delayed or interrupted. For an efficient performance, the ARP Aging Time value must be greater than the receive timeout set for the protocols in use.
MAC Learning	*MAC Learning* and *ARP Aging Time* are used to set how quick the Ethernet switch should learn the MAC address. The following settings are possible: ▪ Conservative (recommended): If the ARP cache already contains MAC addresses of communication partners, these are locked and cannot be replaced by other MAC addresses for at least 1 *ARP Aging Time* and a maximum of 2 *ARP Aging Time* periods. This ensures that data packets cannot be intentionally or unintentionally forwarded to external network subscribers (ARP spoofing). ▪ Tolerant: When a message is received, the IP address contained in the message is compared to the data in the ARP cache and the MAC address stored in the ARP cache is immediately overwritten with the MAC address from the message. The *Tolerant* setting must be used if the availability of communication is more important than the authorized access to the controller. Default setting: Conservative

Designation	Description
ICMP Mode	The Internet Control Message Protocol (ICMP) allows the higher protocol layers to detect error states on the network layer and optimize the transmission of data packets. Message types of Internet Control Message Protocol (ICMP) supported by the CPU module: ▪ No ICMP Responses All the ICMP commands are deactivated. This ensures a high degree of safety against potential sabotage that might occur over the network. ▪ Echo Response If Echo Response is activated, the module responds to a ping command. It is thus possible to determine if a module can be reached. Safety is still high. ▪ Host Unreachable If an UDP telegram is received on an UDP port that the module did not open, the module returns *Destination unreachable / Port unreachable* (ICMP Type 3 / Code 3). ▪ All Implemented ICMP Responses All ICMP commands are activated. This allows a more detailed diagnosis of network malfunctions. Default setting: Echo Response

Table 17: Configuration Parameters, **Module** Tab

4.3.2 The **Routings** Tab

The **Routings** tab contains the routing table. A maximum of 8 routing entries are possible.

Designation	Description
Name	Designation of the routing settings.
IP Address	Target IP address of the communication partner (with direct host routing) or network address (with subnet routing). Range of values: 0.0.0.0...255.255.255.255 Default value: 0.0.0.0
Subnet Mask	Define the target address range for a routing entry. 255.255.255.255 (with direct host routing) or subnet mask of the addressed subnet. Range of values: 0.0.0.0...255.255.255.255 Default value: 255.255.252.0
Gateway	IP address of the gateway to the addressed network or Ethernet interface index (currently only 0.0.0.1 allowed for interface 1). Range of values: 0.0.0.0...255.255.255.255 Default value: 0.0.0.1

Table 18: Routing Parameters

4.3.3 The **Ethernet Switch** Tab

The **Ethernet Switch** tab contains the following parameters:

Designation	Description
Name	Name of the port (Eth1, Eth2) as printed on the housing; per port, only one configuration may exist. Range of values: 1...2
Speed [MBit/s]	10: Data rate 10 MBit/s 100: Data rate 100 MBit/s Autoneg: Automatic baud rate setting. Default value: Autoneg
Flow Control	Full duplex: Simultaneous communication in both directions. Half duplex: Communication in one direction. Autoneg: Automatic communication control. Default value: Autoneg
Autoneg also with Fixed Values	The *Advertising* function (forwarding the speed and flow control properties) is also performed if the parameters *Speed* and *Flow Control* have fixed values. This allows other devices whose ports are set to *Autoneg* to detect the setting of the F-COM ports. Default setting: Activated.
Limit	Limit the inbound multicast and/or broadcast packets. Off: No limitation. Broadcast: Limit broadcast packets (128 kBit/s) Multicast and Broadcast: Limit multicast and broadcast packets (1024 kBit/s) Default value: Broadcast

Table 19: Ethernet Switch Parameters

4.3.4 The **VLAN** Tab (Port-Based VLAN)

For configuring the use of port-based VLAN.

For each port of a switch, the user can define to which other ports of the switch received Ethernet frames may be sent to.

The table in the VLAN tab contains entries through which the connection between two ports can be set to *active* or *inactive*.

Name	Eth1	Eth2
Eth1		
Eth2	Active	
COM	Active	Active

Table 20: VLAN Tab

Default setting: All connections between ports are set to *Active*

4.3.5 The **Mirroring** Tab

Mirroring is used to configure whether the module should duplicate Ethernet packets on a given port such that they can be read from a device connected to that port, e.g., for test purposes.

The following parameters define how a given port should work:

Off	This port does not participate in the mirroring process.
Egress	Outgoing data of this port are duplicated.
Ingress	Incoming data of this port are duplicated.
Ingress/Egress	Incoming and outgoing data of this port are duplicated.
Dest Port	Duplicated data are sent to this port.

Default setting: Off.

If Mirroring is configured, exactly one port must be selected as the target.

4.3.6 Network Ports in Use for Ethernet Communication

UDP ports / use

123	SNTP (time synchronization between PES and remote I/O, PES and external devices).
502	Modbus salve (can be changed by the user).
6010	safe**ethernet** and OPC
8001	Configuration of the remote I/Os using the PES.
8000	Programming and operation with SILworX

TCP ports / use

502	Modbus salve (can be changed by the user).

i All ports listed above are destination ports. The source ports of the communication modules are variable and cannot be affected.

The ComUserTask can use any port if it is not already used by another protocol and is not included in the list of the network ports in use.

4.4 Technical Characteristics of RS485 Transmission

The following table presents the basic technical features of the RS485 transmission that is used for the PROFIBUS DP.

Element	Description
Network topology	Linear bus, active bus termination on both ends
Medium	Shielded, twisted pair wires
Connectors	9-pole D-sub connector. Refer to Chapter 3.6.5 for details on the pin assignment.
Number of bus subscribers for each segment	32 subscribers in every segment, without repeaters[1)]
Total number of bus subscribers for each bus	1 Modbus master, 3 repeaters[1)] 121 Modbus slaves
Max. length of a bus segment	1200 m for each segment
Max. length of the bus	4800 m, 4 segments with 3 repeaters[1)]
Max. baud rate	115200 Bit/s

[1)] The maximum number of bus subscribers in the segment decreases by 1 for each repeater used. This means that a maximum of 31 subscribers may be operated on the segment. According to the standard, a total of three repeaters may be used so that a maximum of 121 Modbus slaves may be connected per serial interface on a Modbus master.

Table 21: Properties of the RS485 Transmission

The cable length specified in Table 22 depends on the baud rate selected.

Baud rate	Cable length for each segment	RS485	PROFIBUS DP
300 Bit/s	1200 m	X	-
600 Bit/s	1200 m	X	-
1200 Bit/s	1200 m	X	-
2400 Bit/s	1200 m	X	-
4800 Bit/s	1200 m	X	-
9600 Bit/s	1200 m	X	X
19200 Bit/s	1200 m	X	X
38400 Bit/s	1200 m	X	-
45450 Bit/s	1200 m	-	X
57600 Bit/s	1200 m	X	-
62500 Bit/s	1200 m	X	-
76800 Bit/s	1200 m	X	-
93750 Bit/s	1200 m	-	X
115200 Bit/s	1200 m	X	-
187500 Bit/s	1000 m	-	X
500000 Bit/s	400 m	-	X
1.5 MBit/s	200 m	-	X
3 MBit/s	100 m	-	X
6 MBit/s	100 m	-	X
12 MBit/s	100 m	-	X

Table 22: Cable Length According to the Baud Rate for RS485 and PROFIBUS DP

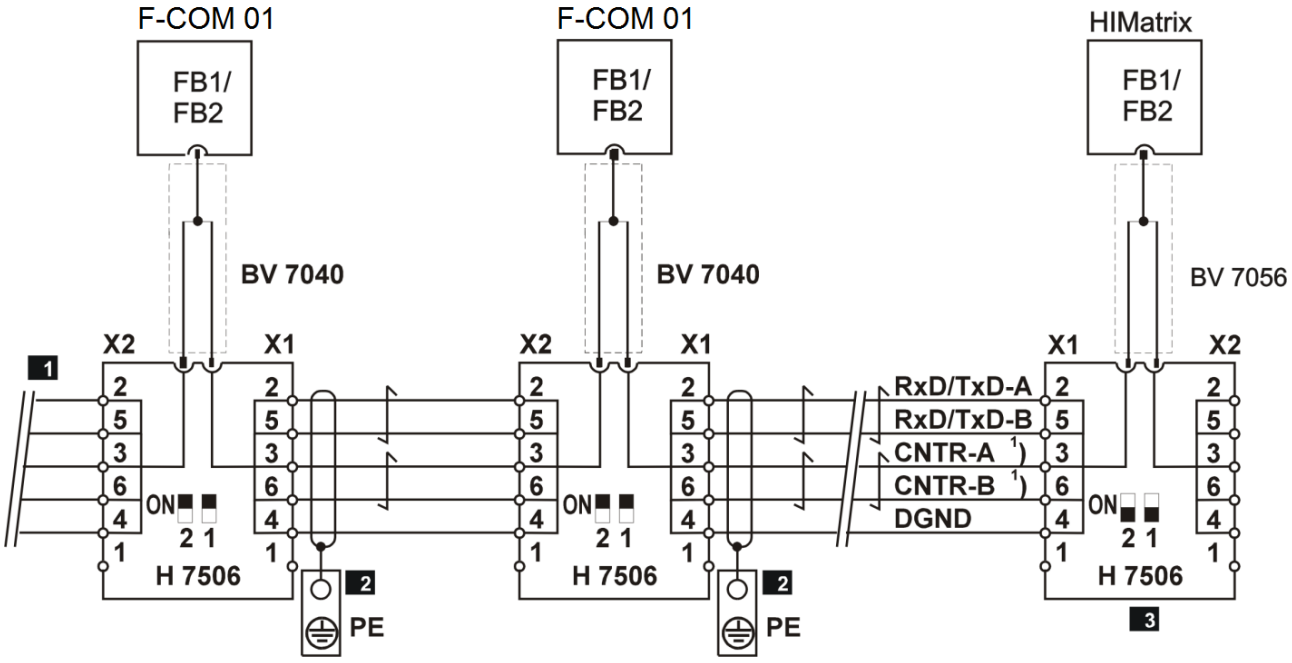
i The cable length may be increased by using bidirectional repeaters. A maximum of three repeaters may be connected between two subscribers. In doing so, a cable length of 4.8 km may be achieved.

For time-critical applications, HIMA recommends connecting no more than 32 bus subscribers. For non-time-critical applications, up to 126 subscribers (with repeaters) may be used.

4.5 RS485 Bus Topology

The following picture shows the structure of an RS485 bus topology using HIMA components. H 7506 are used as bus terminals. The total bus length may not exceed 1200 m. A repeater such as the H 7505[1)] must be used for long distances. A total of 3 repeaters may be used. The bus may thus have a maximum extension of 4800 m.

The time until the information from a slave is available on a master increases by the number of slaves on the bus. The more slaves are connected to the bus, the worse the system response time will become.



1 Additional controllers

2 Protective conductor terminal, USLKG4 YE/GN

3 H 7506 switch position (bus termination)

Figure 4: RS485 Bus Topology

[1)] If fiber optic cable/RS485 converters are used in the bus, the H 7505 must not be used (no automatic switching of data direction).

i Equipotential bounding should be used if the bus is extended over larger distances.

At transmission rates ≥ 1.5 MBit/s, branch lines must be strictly avoided. For this reason, use suitable bus connector plugs only.

4.5.1 H 7506 Terminal Assignment

The following table shows the terminal assignment of the HIMA H 7506 bus terminal. The HIMA BV 7040 cable connects the H 7506 to the FBx fieldbus interface of the controller.

X1/X2	Color	Description
1	-	-
2	WH	RxD/TxD-A, data cable
3	GN	CNTR-A, control line for repeater
4	GY	DGND
5	BN	RxD/TxD-B, data cable
6	GE	CNTR-B, control line for repeater

Table 23: Terminal Assignment for H 7506

i Refer to the HIMA website for more information on this topic and on additional HIMA RS485 components.

4.5.2 Bus Connection and Bus Termination

The incoming and outgoing data cables can be directly connected in the bus connector plug. This avoids branch lines and the bus connector plug can be plugged in to and out from the field device at any time without interrupting the data traffic.

The IEC 61158 standard recommends using a 9-pole D-sub connector. Depending on the degree of protection of the field device, other slots, which are not occupied, may be used.

Figure 5 shows the pin assignment of the 9-pole D-sub connector. The bus connection to the field device is implemented as a socket.

The PROFIBUS DP bus connection includes a resistor combination that ensures a defined rest potential on the bus cable. The resistor combination is integrated in the PROFIBUS DP bus connector plugs and can be activated via bridges or switches.

Additionally, stations at which the bus terminates should provide 5 V at pin 6.

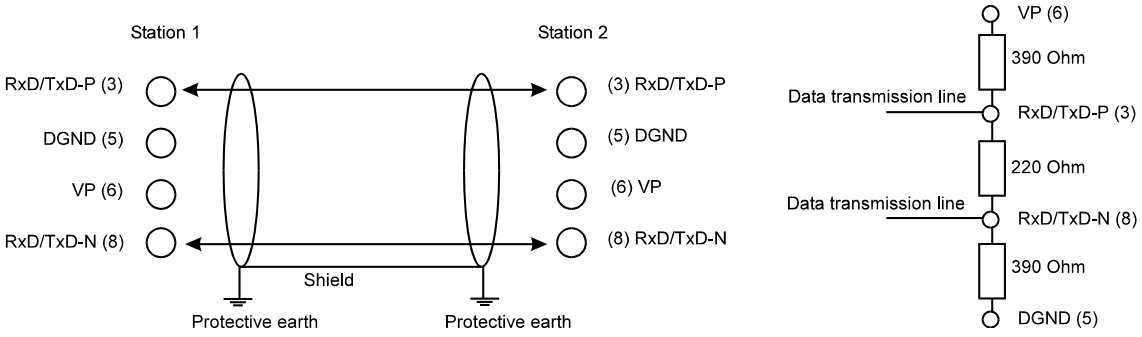


Figure 5: Bus Connection and Bus Termination, Pin Assignment of the Fieldbus Interface

4.6 Communication Cable Requirements

For communication connections running within a control cabinet, the minimum cross-section of patch cables must be 0.2 mm².

For communication connections running outside a control cabinet, the minimum cross-section of patch cables must be 0.5 mm². If necessary, installation cables with rigid cores must be used instead of patch cables with flexible cores.

Cables with the following characteristics are permitted for connecting to Ethernet or fieldbus interfaces:

- All the cables for Ethernet or fieldbus interfaces must withstand at least 500 bending cycles, if bending load is applied during the intended operating conditions.
- All the cables for Ethernet or fieldbus interfaces must withstand at least 25 bending cycles, if bending load is only applied during maintenance.
- All the cables for Ethernet or fieldbus interfaces must comply with UL94-V0.

4.6.1 Ethernet Cables

HIMA recommends using Ethernet patch cables with the following characteristics: Cat. 6, 600 MHz, RJ-45.

4.6.2 RS485 (RS422) Cables

As bus cables for RS485 (RS422), HIMA recommends using shielded twisted pair wires with the following characteristics:

Element	Description
Cable type	LiYCY 3 x 2 x 0.25 mm²
Wire cross-section	> 0.25 mm²
Impedance	100…120 Ω

Table 24: RS485 (RS422) Bus Cables

4.6.3 PROFIBUS DP Cables

As transmission medium, HIMA recommends only using PROFIBUS DP cables approved for PROFIBUS DP with the following parameters:

Parameter	Cable type A
Impedance	135…165 Ω
Capacitance	≤ 30 pF / m
Loop impendence	≤ 110 Ω / km
Wire diameter	> 0.64 mm
Wire cross-section	> 0.34 mm²

Table 25: Parameters of the PROFIBUS DP Cable Type A

Cable type A can be used for all transfer rates up to 12 MBit/s.

5 Operation

The module is operated within a HIQuad X base rack. No specific monitoring is required.

5.1 Handling

Direct handling of the module is not foreseen.

The module is operated, e.g., started or stopped, from within the PADT. For more details, refer to the SILworX documentation.

5.2 Diagnostics

LEDs on the front side of the module indicate the module state, see Chapter 3.6.2.

The communication module has a diagnostic memory that can be read using the PADT. The diagnostic memory can store up to 700 diagnostic messages for short-term diagnosis and 300 diagnostic messages for long-term diagnosis.

6 Maintenance

Defective modules must be replaced with a faultless module of the same type or with an approved replacement model.

Only the manufacturer is authorized to repair the module.

When replacing modules, observe the instructions specified in the system manual (HI 803 211 E) and safety manual (HI 803 209 E).

6.1 Maintenance Measures

In rare cases, the following measures are required for the communication module:

- Load the operating system, if a new version is required.
- Perform the proof test.

6.1.1 Loading the Operating System

HIMA is continuously improving the operating system of the module. HIMA recommends using system downtimes to load the current version of the operating system into the modules.

For detailed instructions on how to load the operating system, refer to the system manual (HI 803 211 E) and the online help. For loading the operating system, the communication module must be in the **STOP** state (displayed in SILworX). Otherwise, stop the communication module's system operation.

i The current version of the module is displayed in the SILworX Control Panel. The type label specifies the version when the module is delivered, see Chapter 3.3.

6.1.2 Proof Test

No proof test is required for the communication module since it does not perform any safety functions.

7 Decommissioning

To decommission the module, remove it from the base rack. For more details, refer to the Chapter *Mounting and Removing the Module*.

8 Transport

To avoid mechanical damage, the components must be transported in packaging.

Always store the components in their original product packaging. This packaging also provides protection against electrostatic discharge (ESD). Note that the product packaging alone is not sufficient for transport.

9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned hardware. Upon request, a disposal agreement can be arranged with HIMA.

All materials must be disposed of in an ecologically sound manner.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses
COM	Communication module
CRC	Cyclic redundancy check
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
ICMP	Internet control message protocol, network protocol for status or error messages
IEC	International electrotechnical commission
Interference-free	Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed interference-free if it does not distort the signals of the other input circuit. In terms of functional safety, the non-safety-related-module has no influence on the safety-related modules
MAC address	Media access control address, hardware address of one network connection
PADT	Programming and debugging tool (in accordance with IEC 61131-3), PC with SILworX
PE	Protective ground
PELV	Protective extra low voltage
PES	Programmable electronic system
R	Read: The system variable or signal provides a value, e.g., to the user program
R/W	Read/Write (column title for system variable/signal type)
Rack ID	Rack identification (number)
r_{PP}	Peak-to-peak value of a total AC component
SELV	Safety extra low voltage
SFF	Safe failure fraction, portion of faults that can be safely controlled
SIL	Safety integrity level (in accordance with IEC 61508)
SILworX	Programming tool for HIQuad X systems
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot addressing of a module
SW	Software
TMO	Timeout
W	Write, the system variable or signal receives a value, e.g., from the user program
Watchdog (WD)	Time monitoring facility for modules or programs If the watchdog time is exceeded, the module or program enters the error stop state
WDT	Watchdog time

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