Programmable Systems

The H41q and H51q System Families

Data Sheet / Operating Instructions
for Module
F 8627(X)

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Industrial Automation

HI 800 265 FEA

Caution

The safety-related H41q/H51q systems as described in this manual can be used for several different purposes. The knowledge of regulations and the technically perfect transfer carried out by qualified staff are prerequisites for the safe installation, start-up and for the safety during operation and maintenance of the H41q/H51q systems.

In case of unqualified interventions into the automation devices, de-activating or bypassing safety functions, or if advices of this manual are neglected (causing disturbances or impairments of safety functions), severe personal injuries, property or environmental damage may occur for which we cannot take liability.

Important Notes

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All listed modules are CE certified and meet the requirements of the EMC Guideline of the European Community.

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The prices shown in a special list are valid ex works, packing charges excluded. The prices are subject to change.

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ModbusF 8627/F 8627X

F 8627X:Ethernet module

F 8627X Communication Module for Ethernet-Communication
Application in H41q/H51q PES (beginning with OS 41q/51q V7.0-7 (9906)).
Appertaining ELOP II Function block: HK-COM-3

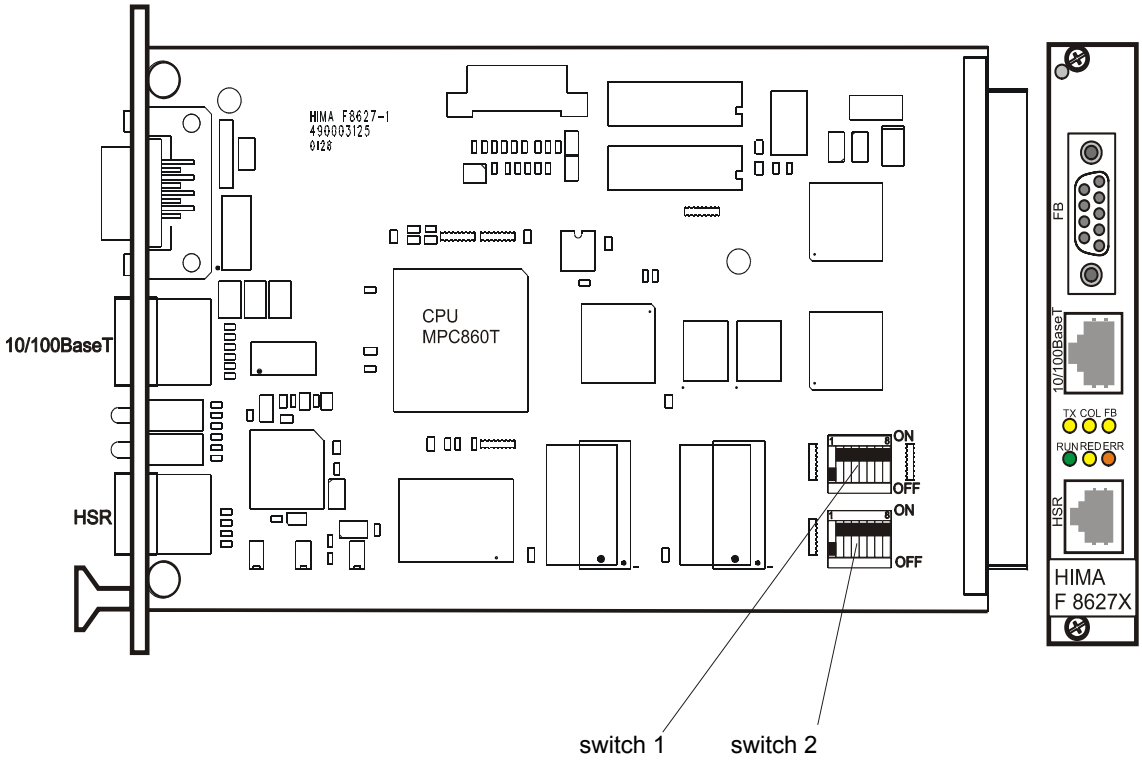


Figure 1: Communication module F 8627X

1 Technical data

Processor	32 bit Motorola CPU MPC860T with integrated RISC communication controller
Operating voltage	5 V
Current consumption	1 A
Space required	3 HU (units high), 4 SU (units wide)
Ethernet Interface	10BaseT or 100Base TX according to the IEEE 802.3 standard, connection via an RJ-45 plug.
HSR Interface	High-speed serial communication interface to the redundant HSR (High Speed Redundancy) communication module. Connection via an RJ-12 plug with BV 7053.
Serial Interface	The serial interface FB is not used.
Diagnostic Display	6 LEDs for display diagnostic during operation.
DIP switches	2 DIP switches for setting the module functions.

2 Functions of F 8627X

2.1 General

A H41q/H51q controller can simultaneously exchange via an F 8627X non safety-related data with a HIMA OPC server and safety-related data via safe**ethernet**. In this case, the F 865xX central module ensures safety.

Beginning with operating system version 4.x, the F 8627X supports the functions "Modbus TCP slave" and "ELOP II TCP". The ELOP II TCP connection provides a fast data exchange between a PADT (PC) and the F 865xX central module.

Note The F 8627X has the same functions as the F 8627 and is compatible with it. The new functions are only supported in an F 8627**X** with operating system V4.x or higher.

2.2 Operating system versions

Overview of the operating system versions which can be loaded into the F 8627X.
The F 8627X is delivered with operating system version 4.x

Operating system version	Properties/Mode
From OS version 2.x	• HIPRO-S Mode • A maximum of 31 HIMA PES can communicate with each other in a safety-related manner. • A PES can communicate with a maximum of 4 HIMA OPC servers (see also Table 10, “Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S,” on page 19).

From OS version 3.x	• Compatible to OS version 2.x
	• HIPRO-S-DIRECT Mode
	  • No more than 99 safe**ethernet** members can be configured in the total network. An individual PES can have 63 safe**ethernet** communication partners.
	  • In HIPRO-S-DIRECT mode the number of OPC servers can be set via switch from 0 up to 14 (see also Table 10, “Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S,” on page 19).

From OS version 4.x (only F 8627X)	• Compatible with OS versions 2.x and 3.x • A PES can communicate as a Modbus TCP slave via Port 502 and Port 8896. • ELOP II TCP connection between a PADT (PC) and F 8627X. **System environment required for F 8627X** • Central module F 865xX, OS version (05.34) or higher • ELOP II, version 4.1 Build (6118) or higher

Table 1: F 8627X operating system versions

2.3 Compatibility of the operating system versions

Communication modules having different operating system versions may operate within one rack, even if the communication modules are interconnected redundantly or communicate with one another via Ethernet.
Observe that the used functions of a communication module are supported by the respective operating system (see Table 1).

Note Observe the application guidelines and settings of the F 8627X in Chapter 6.

2.3.1 Ethernet communication between F 8627X and F 8625

Check the following Ethernet communication settings between F 8627X and F 8625:

- If the F 8627X is directly connected with a F 8625 (using a "cross over" Ethernet cable without a switch), then "Autonegotiation" must be activated on the F 8627X (switch S2/3 to „ON“).
- The DIRECT Mode on the F 8627X must be switched off (set switch S1/7 to "OFF").
- "Passive mode" may only be used (set switch S1/8 to "OFF") if also activated on the communication partners.

2.3.2 Redundant interconnection in an H41q/H51q controller

The following table shows the operating systems for the redundant interconnection of the communication modules (CM) F 8627X and F 8627X/F 8625 and the settings that must be considered.

CM1	CM2	Properties/Settings
F 8625 OS V1.x	F 8627X from OS V2.x up to OS V4.x	The "DIRECT Mode" on the F 8627X module must be switched off (switch S1/7 to „OFF“).
F 8627X from OS V2.x up to OS V4.x	F 8627X from OS V2.x up to OS V4.x	The used functions must be supported by the used OS versions (see Table 1).

Table 2: Redundant interconnection of the communication modules

Note The "passive mode" and the "DIRECT mode" may only be activated if activated on the redundant communication module.

Note For redundant interconnection it is recommended to use communication modules of the same type with the same operating system.

2.4 Replacing an F 8627X

An F 8627X must never be removed from a redundant operation without a special procedure.
Before removing an F 8627X, its fixing screws must be completely loosened and freely movable. Remove the module from the bus board by pushing the ejection lever (front label) top down and quickly removing in an upward motion to ensure faulty signals are not triggered within the system.
To attach the module, place it on the terminal block and press it inwards as far as it will go. This action should be performed quickly to ensure that faulty signals are not triggered within the system.

2.4.1 Operation of the ejection lever

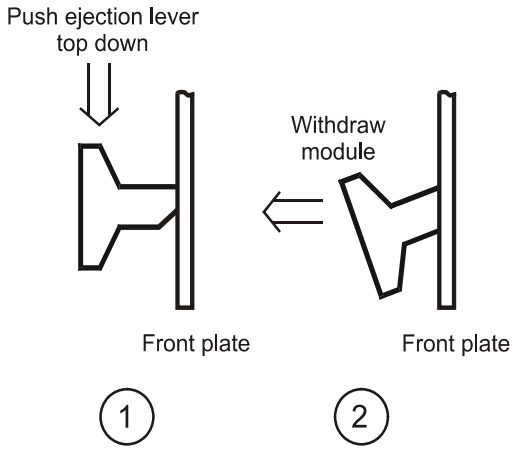


Figure 2: Operation of the ejection lever

2.4.2 Procedure for exchanging a redundant F 8627X in a redundant H41q/H51q controller

Make sure that you connect the Ethernet cable to the Ethernet socket (10/100BASE-T) and the HSR cable to the HSR socket (HSR).
The respective connectors must be pressed in until they snap into their sockets.

1. Unplug communication cable (Ethernet).
2. Corresponding central module (e.g. F 8650X) with operating system
   - Version below (05.34): remove the central module!
   - Version beginning with (05.34): erase application program manually to deactivate the central module (see operation system manual "Erasing the application program")
3. Unplug HSR cable BV 7053 (if used).
4. Remove communication module F 8627X.
5. Check the new F 8627X
   - Check the DIP-switch settings
     (see chapter 4 and compare to the exchanged F 8627X).
   - Check whether if the operating system (see sticker on the F 8627X) supports the used functions!
6. Plug the new communication module F 8627X.
7. Plug the HSR cable BV 7053 (if required).
8. Corresponding central module (e.g. F 8650X) with operating system
   - Version below (05.34): plug the central module!
   - Version beginning with (05.34): push the button "Ack" to activate the central module (see operation system manual "Self-Education")
9. Wait until the LED "RUN" on the F 8627X lights continiously.
10. Plug the communication cable (Ethernet).

Note

The ARP entry on the PADT (PC) must be deleted if the new F 8627X has the **same IP address** as the old F 8627X.
If the new F 8627X has the same IP address it cannot be connected to the PADT (PC).

Example: Delete the ARP entry of an F 8627X with
IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC)
- Enter the command **arp -d 192.168.0.67**.

3 Diagnostic LEDs on module front

3.1 Top row LEDs on module front

TX	COL	FB	Operating status
ON	-	-	Send LED of Ethernet communication
-	ON	-	Collision on the Ethernet segment
-	-	OFF	No display (always OFF)

Table 3: Top row LEDs on module front

3.2 Bottom row LEDs on module front

RUN	RED	ERR	Operating status
ON	-	OFF	Ethernet communication protocol active
Flashing	-	OFF	Ethernet communication protocol inactive
-	ON	OFF	Communication to redundant communication module active. **Note** The redundancy LED is OFF if DIRECT Mode (switch 1/7 ON) or Mono (switch S2/2 ON) is enabled. This applies also in case of a redundant connection via HSR cable.
Flashing	-	Flashing	Booting of the communication module
ON	-	Flashing	Beginning with OS version 4.x User Error / Configuration Error • Res-ID and ID are not equal • Ethernet communication protocol inactive, even if the communication module is in RUN status.
OFF	-	ON	Fatal error in communication module. Module must be replaced.
OFF	-	Flashing 3-times	Saving the error code in Flash-EPROM (required for repair purposes) ***Do not unplug communication module!***

Table 4: Bottom row LEDs on module front

4 Functions of the switches

4.1 Functions of switch 1 (S1)

S1	ON	OFF	Description
1	10 ms	0 ms	The "Timeout" is the timeframe within which the receiver must acknowledge receiving packets from the transmitter. It is set via the switches S1/1-5. Standard value: 10 ms (switch 1/1-5 "OFF"). Switches S1/1-5 can be combined by the user. 10 ms must be added for each combination of switches. HIPRO-S-DIRECT must be activated (switch 1/7 "ON").
2	20 ms	0 ms	
3	40 ms	0 ms	
4	400 ms	0 ms	
5	1000 ms	0 ms	
6	ID_IP ON	ID_IP OFF	For OS versions < 4.x no function (See also Chapter 5.2.3) ID_IP ON The bus station number (ID) which is set on the F 865xX central module via switches (S1 1-7) is used as Res-ID if no Res-ID could be determined from the loaded user program. ID_IP OFF The bus station number (ID) which is set on the F 865xX central module via switches (S1 1-7) is never used for the Res-ID.
7	DIRECT Mode enabled	DIRECT Mode disabled	HIPRO-S-DIRECT Mode must be activated if more than one bus configuration is required. HIPRO-S-DIRECT is supported beginning with the F 8627X OS version 3.x.
8	Passive Mode disabled	Passive Mode enabled	The Passive Mode controls the communication to the HIMA OPC server. Passive Mode enabled: The Token Passing between the F 8627X to the HIMA OPC servers is disabled. The HIMA OPC servers cyclically exchange data with the F 8627X, independent of the token owner. Passive Mode disabled: The Token Passing between the F 8627X and the HIMA OPC servers is enabled. The HIMA OPC servers only exchange data with the F 8627X if they have the Token.

Table 5: Functions of switch 1 (S1)

4.2 Functions of switch 2 (S2)

S2	ON	OFF	Description
1	Ethernet Channel 1	Ethernet Channel 2	F 8627X allocation to the Ethernet channel 1 or Ethernet channel 2.
2	Mono	Redundant	Wiring of the modules (Not used in HIPRO-S-DIRECT Mode)
3[1)]	Auto-negotiation On	Auto-negotiation Off	Automatic adaptation of transmission rate (10/100 MBit/s) and duplex mode if is Switch S2/3 is ON.
4	100 MBit/s	10 MBit/s	The switch position of switch is only relevant if switch S2/3 (auto-negotiation) is OFF.
5[1) 2)]	Full duplex	Half duplex	The switch position of switch is only relevant if switch S2/3 (auto-negotiation) is OFF. Simultaneous sending and receiving if switch S2/5 is ON. Note on full-duplex operation: In network topologies where hubs are used, hubs must be replaced by full-duplex switches (hubs are not full-duplex capable).
6	2 OPC server	0	Beginning with the F 8627X OS version 3.x, the number of HIMA OPC servers (0 to 14) must be set via switches. Switches S2/6-8 can be combined by the user. If HIPRO-S-DIRECT is not active the number of HIMA OPC servers is four. For determining the Node Ids and IP addresses for the configuration of HIMA OPC server, see Chapter 6.8.1.4 and Chapter 6.10.1.5.
7	4 OPC server	0	
8	8 OPC server	0	

Table 6: Functions of switch 2 (S2)

1) Beginning with OS versions 3.x, only the transmission rate is automatically adapted when "Autonegotiation On" (S2/3 ON) is set. The duplex mode must be set using switch S2/5.

2) Beginning with OS versions 3.x, autonegotiation must be activated at the communication partner (e.g. switch) if full duplex (S2/5 ON) is set on the F 8627X . Not observing these settings can lead to communication problems.

Note Beginning with OS version 4.x, an F 8627X with the settings "Autonegotiation Off" (S2/3 OFF) and "full duplex" (S2/5 ON) may not operate with a communication partner (e.g. switch) with Autonegotiation activated.
Since these settings are allowed for OS version V3.x and below, they must be checked and, if necessary, adapted when upgrading to OS version V4.x or higher. Not observing these settings can lead to communication problems.

5 Ethernet connection via the F 8627X

5.1 Determining the F 8627X IP address

For all OS versions the F 8627X IP address is determined from the resource name of the loaded user program.
The IP address is composed of the network address and the host address. The default network address is **192.168.0**.
The last byte of the IP address 192.168.0.x is the host address and is calculated as follows:

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

Note

The resource name **must** have eight characters and the last two characters (Res-ID) **must** be numbers!
IDs allowed:

DIRECT Mode ON (switch 1/7 ON)
Res-ID: 1 up to 99
DIRECT Mode OFF (switch 1/7 OFF)
Res-ID: 1 up to 64

The ethernet module does not change to RUN status, if the Res-ID > 64 and the DIRECT Mode is deactivated.

Important for safe**ethernet**:
If more than 30 communication partners are configured, several bus configurations must be created in ELOP II, since a bus configuration in ELOP II supports no more than 31 participants.

Example:
Resource name MT200_**33**, module channel 1 (switch 2/1 = ON)
Host address: 33 ∗ 2 + 1= 67; IP address = 192.168.0.**67**

Resource name MT200_**33,** module channel 2 (switch 2/1 = OFF)
Host address: 33 ∗ 2 + 2 = 68; IP address = 192.168.0.**68**

F 8627X settings upon delivery
IP address 192.168.0.63 (switch 2/1 ON) or 192.168.0.64 (switch 2/1 OFF).
Switch ID_IP is deactivated (switch 1/6 OFF).

5.2 ELOP II TCP connection to the central module (CM)

Via the PADT (PC), the user can establish an ELOP II TCP connection to the F 865xX central module via the F 8627X.
The ELOP II TCP connection provides a fast data exchange between a PADT and the F 865xX central module.

Res-ID: The Res-ID is identical to the last two numbers of the resource name.

ID: The ID is set via DIP switches 1 to 7 on the F 865xX central module.

5.2.1 Requirements for a ELOP II TCP connection

- F 865xX central module OS version (05.34) or higher
- ELOP II, version 4.1 build (6118) or higher
- F 8627X Ethernet module OS version 4.x or higher
- HSR cable in redundant systems

5.2.2 Connection of ELOP II PADT (PC) to F 8627X

A PADT can only connect to a H41q/H51q via a single F 8627X on the H41q/H51q (even in cases of redundancy).
The selected F 8627X transfers the telegrams to the associated F 865xX central module and via the HSR cable (BV 7053) to the redundant F 8627X and the associated F 865xX central module.
The HSR cable between the two redundant F 8627X enables the communication to both central modules as well as the "Reload" of a redundant H41q/51q.

Note For ELOP II TCP connection, any free IP address for the PADT may be used. If the PADT IP addresses and the F 8627X are located in the same subnet, a routing entry for the subnet of the F 8627X is not required on the PADT (see also Chapter 5.2.6.1).

Note Carefully check that no other participant (e.g. H41q/H51q, OPC server or PC) has the same IP address, as this could cause communication problems. Next time, when expanding communication, please consider the H41q/H51q and the OPC server IP-addresses.

5.2.3 Create ELOP II TCP connection to a H41q/H51q

Perform the following settings on the H41q/H51q:

- Activate the ID_IP (switch 1/6 ON) on the F 8627X .
- Set channel 1 or channel 2 on the Ethernet module F 8627X (see chapter 5.1).
- Set the redundant channel (if available) on the redundant Ethernet module F 8627X (see chapter 5.1).
- Make sure that a proper operating system OS Version (05.34) or higher is loaded in the F 865xX central modules.
- Set the same number for the "ID" on the F 865xX central module (DIP switches, see F 865xX865xX data sheet), which is used as Res-ID in the resource name (last two digits of the resource name).

If necessary, delete the User Program of the Central Module F 865xX
If a user program with a wrong resource name (e.g. no or wrong Res ID) exists in the F 865xX, no ELOP II TCP connection can be established.
Delete the user program with the wrong resource name, so that the F 8627X can be determine the IP address from the F 865xX ID settings (DIP switches 1-7).

Note Please refer to the manual "Functions of the operating system BS41q/ H51q (HI 800 105)" for further information about "Erasing the user program".

Perform the following Settings in ELOP II

- Create a resource, having a name from which the required IP address can be determined (see chapter 5.1).
- In the dialog "cabinet layout" add the F 8627X module icons for the documentation of the cabinet allocation.

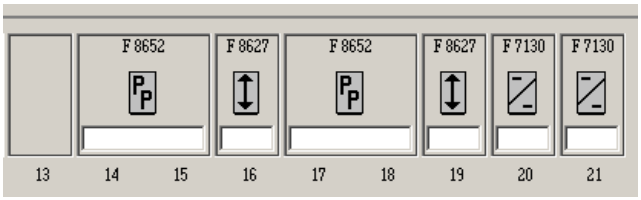


Figure 3: Cabinet Layout

- Open the context menu of the resource and select *Properties.*

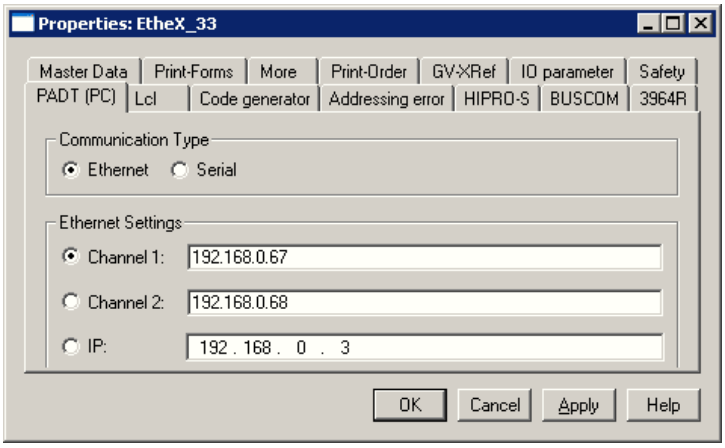


Figure 4: ELOP II dialog "Properties"

- Open the tab *PADT (PC)* and select the communication type *Ethernet*.
- Select one of the IP addresses *channel1* or *channel2* which are determined by ELOP II. By this the F 8627X connected to the PADT is selected.
- Click "OK" to close the "Properties" dialog with "OK".

Load the User Program into the H41q/H51q

- Connect the selected F 8627X with the PADT corresponding to a connection from chapter 5.2.5.

Note In case of a redundant H41q/H51q, make sure that the HSR cable (BV 7053) is plugged; otherwise there is no access available to the redundant central module F 865xX.

- Open the context menu of the resource and select *Control Panel*.

If a connection has been established, "OK" appears in the field "Communication".

- Load the user program into the central module(s) F 865xX using "Download/ Reload".
- Start the H41q/H51q controller.

In case of problems with the ELOP II TCP communication see also chapter 5.2.6.

5.2.4 Upgrade of a H41q/H51q to ELOP II TCP without system stop

Preconditions
A H41q/H51q controller may change to ELOP II TCP without a system stop if the following conditions are fulfilled:

- The conditions for a ELOP II TCP connection are fullfilled (see chapter 5.2.1).
- A suitable operating system OS version (05.34) or higher must be loaded in the central module(s) F 865xX.
- In the F 865xX a user program must exist having a resource name, from which the F 8627X can determine an IP address.
- On all F 865xX the same number for the ID must be set, which is used as Res ID in the resources name. For the reading of the ID, see manual "functions of the operating system BS41q/H51q" (HI 800 105).

Installation of the F 8627X module
For installation of the F 8627X Consider chapter 2.4.

- On all F 8627X activate the ID_IP (switch 1/6 ON).
- Set channel 1 or channel 2 on the Ethernet module F 8627X (see chapter 5.1).
- Set the redundant channel (if available) on the redundant Ethernet module F 8627X (see chapter 5.1).
- Replace the existing modules F 8627 by F 8627X, by which the ELOP II TCP connection is carried out. If no F 8627X modules were used previously, then plug the F 8627X into the specified module slot.

Perform the following Settings in ELOP II

- Open the resource context menu and select *Properties.*
- Open the tab *PADT (PC)* and select the communication type *Ethernet*.
- Select one of the IP addresses *channel1* or *channel2* that are determined by ELOP II. By this the F 8627X connected to the PADT is selected.
- Click "OK" to close the "Properties" dialog with "OK".

Load the User Program into the H41q/H51q

- Connect the selected F 8627X to the PADT corresponding to a wiring from chapter 5.2.5.

Note In case of a redundant H41q/H51q, make sure that the HSR cable (BV 7053) is plugged; otherwise no access possible to the redundant central module F 865xX.

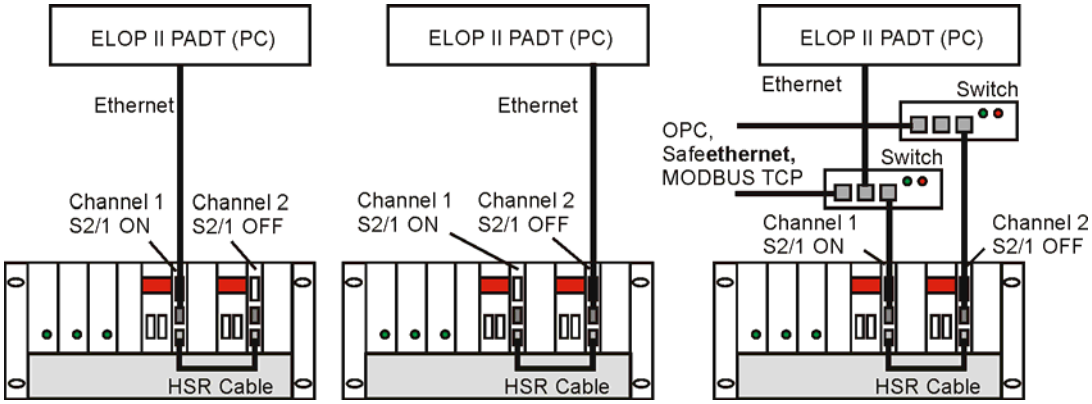
- Open the context menu of the resource and select *control panel*.
  If a connection has been established, "OK" appears in the field "Communication"

In case of problems with the ELOP II TCP communication see also chapter 5.2.6.

5.2.5 ELOP II TCP connections to H41q/H51q controllers

ELOP II, OPC and safe**ethernet** can operate on the same network.
Certain restrictions apply to HIPRO-S and OPC (see Table 9 and Table 10 in Chapter 6).
If the PADT and the H41q/H51q controller are directly connected with one another, a "cross over" Ethernet cable is required.

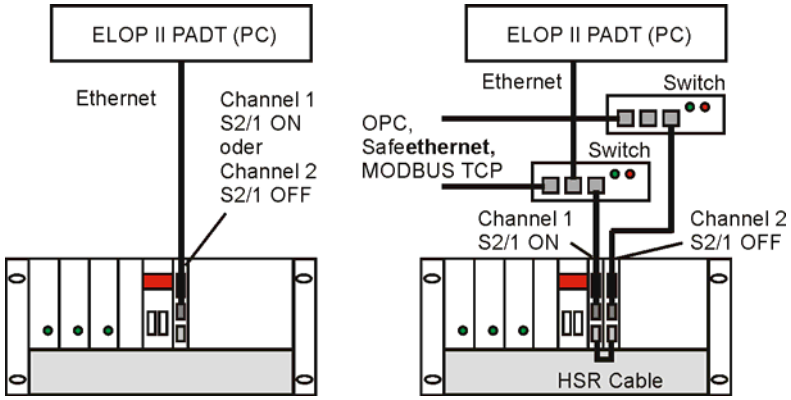
5.2.5.1 ELOP II TCP connections to redundant H41q/H51q controllers



The PADT can establish a connection to the H41q/H51q

- only via channel 1 (left figure).
- only via channel 2 (middle figure).
- only via channel 1 (right figure).

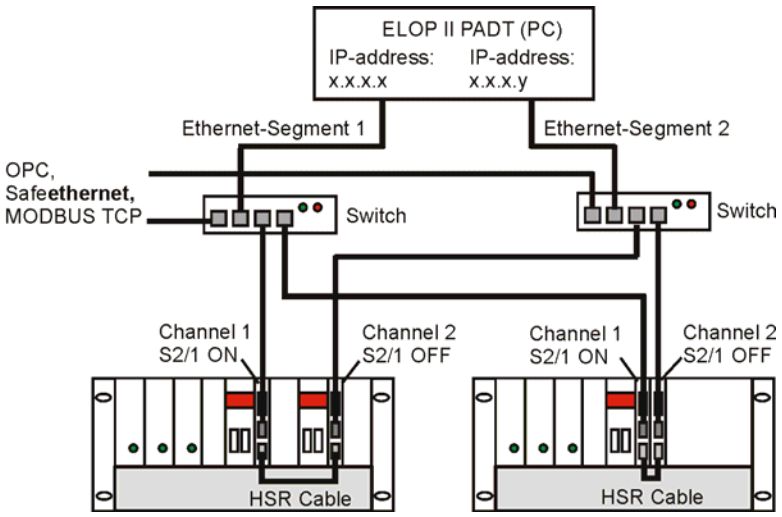
5.2.5.2 ELOP II TCP connections to mono H41q/H51q controller



The PADT can establish a connection to the H41q/H51q

- either via channel 1 or via channel 2 ,depending on F 8627X switch 2/1 (left figure).
- only via channel 1 (right figure).

5.2.5.3 ELOP II TCP connection to H41q/H51q controllers via a redundant network



The PADT can establish a connection to the H41q/H51q systems via ethernet segment 1 or ethernet segment 2.
A routing entry for each ethernet module of the PADT is required (see also chapter 5.2.6).

Others possibilities of the ELOP II TCP wiring shown above are not authorized and can cause problems!

Only communication modules of the same type may be connected to one another using the HSR cable (the connection between F 8627X and F 8628X is not permitted).

5.2.6 If ELOP II TCP communication can not be established

First check

- If ELOP II TCP wiring was correctly performed
  (see Chapter 5.2.5.1 to Chapter 5.2.5.3) and
- the F 865xX ID (DIP switches 1-7) and the ressources RES-ID are identical.

Note A H41q/H51q PES can only communicate with a single PADT.
If the user accesses the same PES using a second PADT, he can establish a connection to this PES by repeatedly pushing the button "Initialize communication".
Then the connection to the first PADT is disconnected and the message "2. PADT (PC) connected to the PES" is displayed in the control panel's "Communication" field.

5.2.6.1 Is the PADT (PC) network card located in the same subnet?

1. Determining the IP address of the PADT(PC) network

- In MS-Windows, open the settings of the PADT network connections from the PADT.
- Select the network card used for connecting to the F 8627X.
- Select properties of the internet protocoll.
  - If the network card is not located in the same F 8627X subnet "**192.168.0.x**", follow step 2 for creating a connection.
  - If the network card is located in the same subnet but no connection is available, check the connection using the function "Ping" specified in Chapter 5.2.6.3.

2. Establishing a network connection between a PC and an F 8627X, if they are located in different subnets.

- First method: Change the IP address of the PC network card in use
  - In the properties of the TCP/IP connection, enter a free IP address which is located in the same subnet as the F 8627X "**192.168.0.**x".

- Second method: Create a routing entry to the F 8627X on the PC
  - Start the "Dos Shell" on the PC.
  - Enter the following command:
    route add [IP address F 8627X] mask 255.255.255.255 [IP address PC]

Note To ensure the routing entry remains permanent (e.g. after the PC is restarted), use the **-p** parameter with the route command.
Example: **route -p add**.
Check if the routing entry for connecting the PC network card to the F 8627X is correct by using the command **route print**.

  - Start the ELOP II control panel to establish a connection to the F 8627X.

5.2.6.2 Connection problem after exchanging an F 8627X

The ARP entry on the PC must be deleted if the new F 8627X has the **same IP address** as the old F 8627X.
Otherwise the new F 8627X with the same IP address cannot be connected to the PADT (PC).

Example: Delete the ARP entry of an F 8627X with the
IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC).
- Enter the command **arp -d 192.168.0.67**.

5.2.6.3 Check the connection to the F 8627X using "Ping"

- Start the "Dos Shell" on the PADT (PC).
- Enter the command **Ping 192.168.0.x**.
- Messages generated by "Ping":
  - Ethernet connection is OK : "Reply from 192.168.0.x: bytes = 32 time < 4ms...."
    If ELOP II connection is available check the resource settings in ELOP II.
  - Ethernet connection is not OK: "Request timed out."
    Check the wiring, routing entrie etc.

Note If all steps described in this chapter have been followed and the F 8627X does not respond, check if other participants can be accessed using the PC's netword card.

5.2.6.4 The F 8627X determines its IP address in accordance with the following priorities

1. The IP address is determined from the Resource ID (Res-ID) of the user program that is loaded in the F 865xX.
   The Res-ID of the user program always has a higher priority than the F 865xX ID settings (DIP-switch 1-7).
2. The IP address is determined from the F 865xX ID settings (DIP switches 1-7), if the Res-ID cannot be determined from the current user program's resource name and switch ID_IP is activated on the F 8627X (switch 1/6 ON).
3. IP address of the "Basic Configuration"
   If no IP address can be determined using the Res-ID or ID (switch 1/6 OFF) as described in the first two cases, the last IP address determined on this F 8627X is used.

6 Communication via the F 8627X

This chapter describes the F 8627X communication types and the required settings.
ELOP II TCP and Modbus TCP can be operated in conjunction with any of the exisiting communication types (OPC, HIPRO-S and HIPRO-S-DIRECT).

Note If the HIPRO-S-DIRECT Mode is activated (see 6.5.4) the HSR-Communication for the Modbus TCP slave via Port 8896 is deactivated (no redundancy).

6.1 Network Ports Used for Ethernet Communication

UDP Ports	Use
6011, 6031, 6032	Program ComEth (only for diagnosis)
6005, 6010, 6012	HIPRO-S (DIRECT) and OPC via ethernet

Table 7: Network Ports (UDP Ports) in Use

TCP Ports	Use
6034	Programming and operation with ELOP II TCP
502	Modbus (directly access to the central module via F 8627X)
8896	Modbus (access of the process data image from the F 8627X)

Table 8: Network Ports (TCP Ports) in Use

6.2 Overview

The following tables provide a quick overview of the communication type properties that can be set for the F 8627X as well as the conditions that must be fulfilled to do so.

HIPRO-S	HIPRO-S-DIRECT
F 8625 / F 8627 / F 8627X all OS versions	F 8627, beginning with OS version 3.x F 8627X
DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode On Switch 1/7 (ON)
Token passing	No token passing
No more than 64 safe**ethernet** members can be configured in the entire network.	No more than 99 safe**ethernet** members can be configured in the entire network.
One PES may have no more than 30 safe**ethernet** communication partners.	A PES can have no more than 63 safe**ethernet** communication partners.

Table 9: Overview of the HIPRO-S (DIRECT) communication via the F 8627X

HIPRO-S	HIPRO-S-DIRECT
Timeout fixed to 16 ms	Timeout adjustable 10 ms up to 1480 ms Switch S1/1-5
Communication between each PES and any other PES (HIPRO-S dummies might be required)	Not required
Ethernet network with low load: Only HIMA PES or HIMA OPC servers	An existing Ethernet network can be used if the require-ments[1)] are fullfilled.
Hub/Switch	Switch
HSR cable required for redundancy	HSR cable is required for ELOP II TCP and Modbus TCP (Port 502)
Half/Full-Duplex	Full-Duplex

Table 9: Overview of the HIPRO-S (DIRECT) communication via the F 8627X

1) Requirements for using an existing Ethernet network for the HIMA PES with F 8627X

- Network may only contain switches
- Full-Duplex (no collisions)
- Sufficient bandwidth for transmission
- Calculating the timeout with the delay time induced by active network components (e.g. switches, gateways) taken into account.

OPC without Passive Mode	OPC with Passive Mode	OPC with Passive Mode + HIPRO-S-DIRECT
F 8625 from version 1.x F 8627 / F 8627X from version 2.x on	F 8625 from version 1.13 F 8627 / F 8627X from version 2.x on	F 8627 / F 8627X from version 3.x on
DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode On Switch 1/7 (ON)
Passive Mode Off Token passing to a HIMA OPC server Switch 1/8 (ON)	Passive Mode On No token passing to an HIMA OPC server Switch 1/8 (OFF)	If "DIRECT Mode Off" switch 1/7 is activated (ON), the F 8627X's settings remain "Passive Mode On".
Deactivate the Passive Mode in the HIMA OPC server.	Activate the Passive Mode in the HIMA OPC server.	Activate the Passive Mode in the HIMA OPC server.
Number of HIMA OPC servers fixed to 4	Number of HIMA OPC servers fixed to 4	Up to 14 OPC servers can be used Switch S2/6-8
Monitoring Time for HIMA OPC server: fixed to 16 ms	Monitoring Time for HIMA OPC server: fixed to 16 ms	Monitoring Time for HIMA OPC server: fixed to 6 seconds
The F 8625 / F 8627(X) communicates with an OPC server via BUSCOM variables.	The F 8625 / F 8627(X) communicates with an OPC server via BUSCOM variables.	The F 8627(X) communicates with an OPC server via BUS-COM variables.

For communicating with a HIMA OPC server without Passive Mode, HIPRO-S variables must be sent from each PES to all other PES (one data direction is sufficient) to ensure token passing. HIPRO-S dummyies may have to be configured.	HIPRO-S variables **must not** be defined when communicating with a HIMA OPC server in passive mode (otherwise OPC without passive mode). F 8625: from V. 1.13 F 8627(X): from V. 2.x No restrictions/specifications for HIPRO-S variables. F 8625: from V. 1.17 F 8627 / F 8627X: from version 3.x on	No restrictions/specifications for HIPRO-S variables.
Hub/Switch	Switch	Switch
HSR cable required for redundancy	HSR cable required for redundancy	HSR cable is required for ELOP II TCP and Modbus TCP (Port 502)
Half/Full-Duplex	Full-Duplex	Full-Duplex

Table 10: Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S

The simultaneous use of both an F 8621A coprocessor module for safety-related communication and an F 8627X communication module for Ethernet communication is not allowed.

6.3 Application guidelines and notes

- The requirements of the IEEE 802.3 standards must be met.
- The cycle time of the communication partners' central module may differ up to factor 4.
- The entire transmission network must ensure a transmission rate of 10 MBit/s or 100 MBit/s.
- To ensure a deterministic data exchange for safety-related communication, a load-free Ethernet segment must be connected to the HIMA communication modules.
  If this is not possible, a specified time response can not be guaranteed on the Ethernet segment. This may result in a safety shutdown because of exceeded monitoring time.
- No connection between the redundant Ethernet segments is required.
- The HSR cable BV 7053 is required for redundancy in HIPRO-S, OPC and Modbus TCP.
- The HSR cable between both redundant F 8627X functionally replace "Y-cable" BV 7049 when ELOP II TCP is connected to a PADT (PC).
- Replacing a communication module (see Chapter 2.4).
- Should the Ethernet segment not be available to HIMA communication modules, the following IP address cannot be used otherwise:
  192.168.0.3 up to 192.168.0.130 (up to OS version 3.x)
  192.168.0.3 up to 192.168.0.200 (from OS version 3.x on)
- All single communication module connections must be connected to the same logical Ethernet segment.
- Communication modules belonging to one PES and having the same module number must be connected to different Ethernet segments.

The F 8627X automatically accesses all HIPRO-S data, configured in the PES. This may cause problems, if a F 8621A simultaneously operates as PES master in the same PES.
In this case, the function block HK-COM-3 must deactivate the HIPRO-S communication via the F 8627X or the F 8621A configuration must change over to HIPRO-N.

6.4 Ethernet possible connections

All connected Ethernet components must meet the requirements specified in the application guidelines!
The Ethernet segments may always have a redundant structure. If a HIPRO-S is used, the HSR cable BV 7053 must be plugged in between the redundant communication modules F 8627X (via HSR interface).
The HSR cable BV 7053 is also required for the redundant Modbus TCP and ELOP II TCP connection (see chapter 5.2).

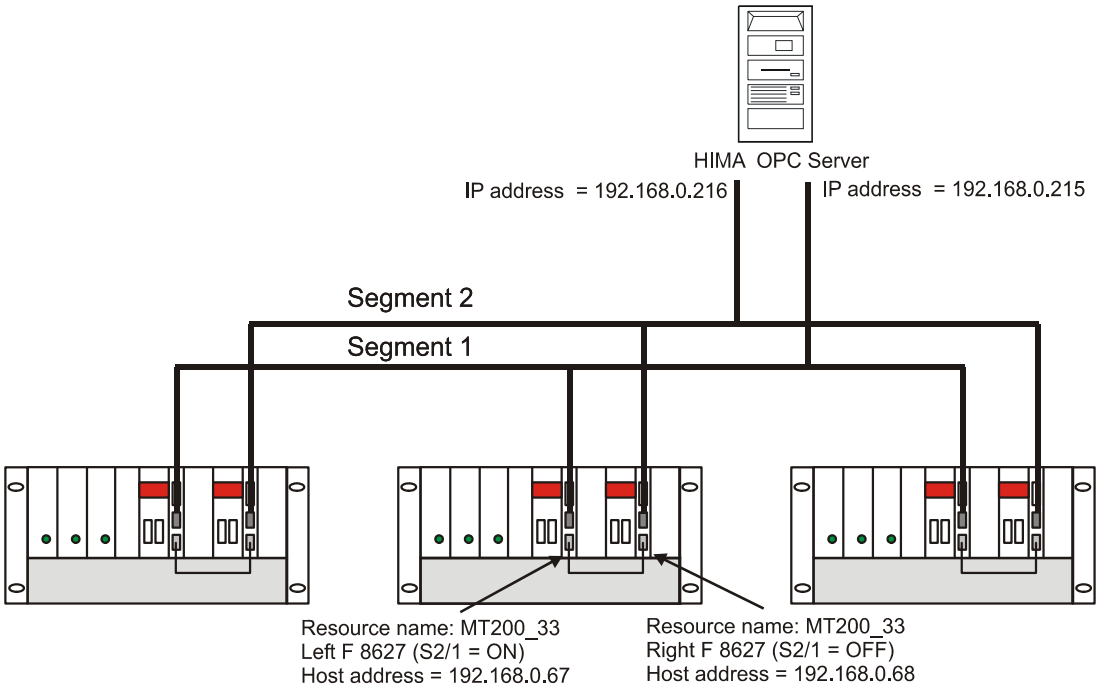


Figure 5: Redundant connection via 2 segments

For a "truly" redundant connection, an own network segment is required for each channel. All F 8625/27 (and PC network cards) with odd IP addresses (e.g. 192.168.0.67) must be attached to segment 1 and all F 8625/27 with even IP addresses to segment 2 (see Chapter 5.1).

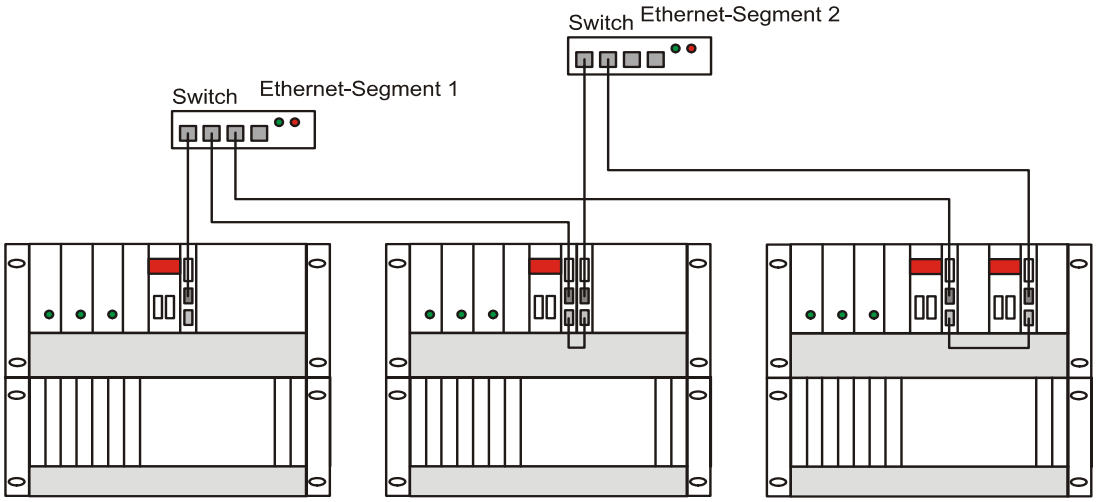


Figure 6: Possible PES connections

Figure 6: shows all possible PES connections.

- Left: Single PES on one Ethernet segment (each switch is an independent Ethernet segment).
- Centre: Single PES with two communication modules on both Ethernet segments.
- Right: PES with two communication modules on both Ethernet segments.

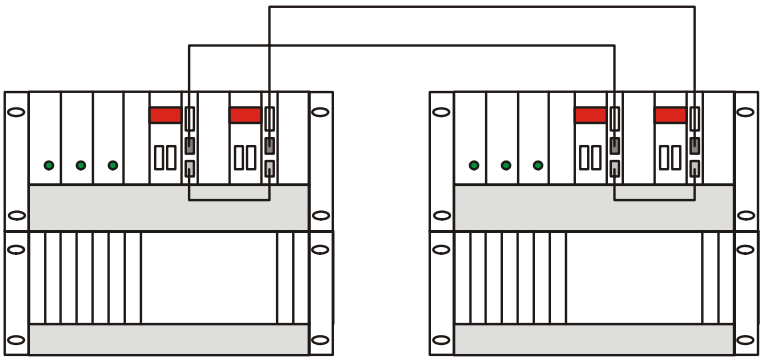


Figure 7: Interconnection of two PES

When two PES are interconnected together (Figure 7), no switch is required. Both 10BaseT or 100BaseTX interfaces of the communication modules are directly connected by a special cross-over cable (with twisted wires).

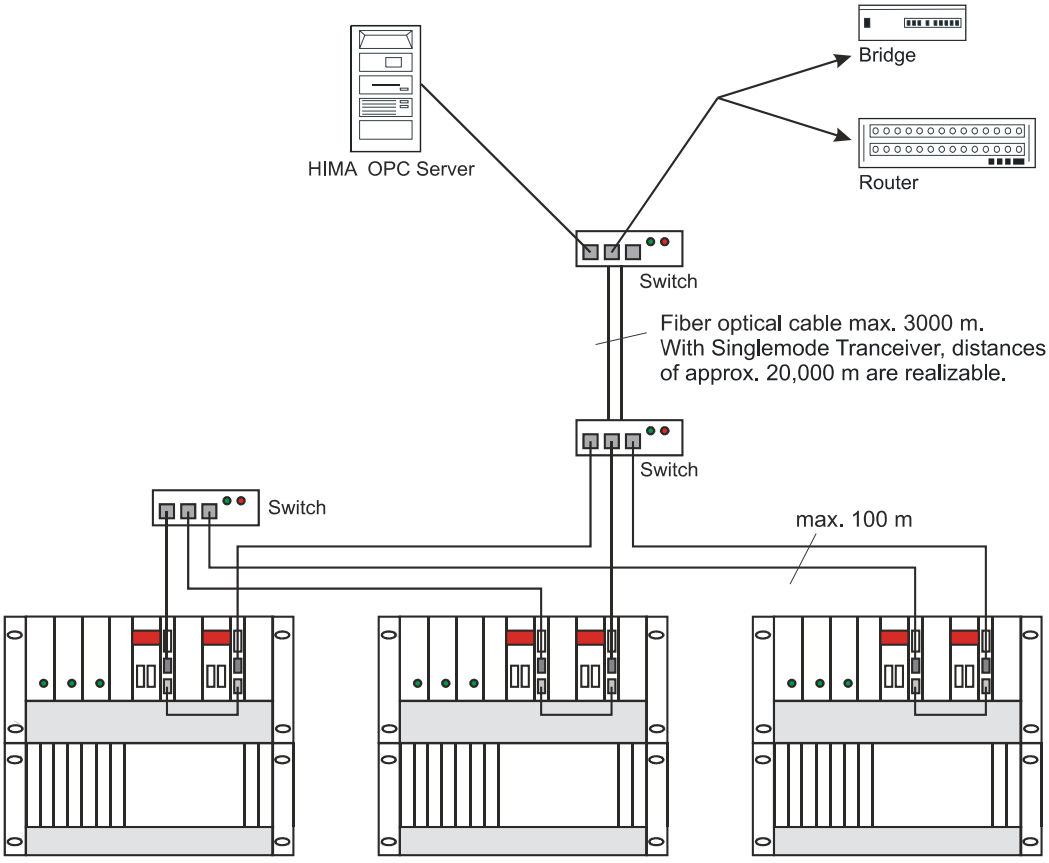


Figure 8: Redundant interconnection with switches

In Figure 8, three PES are completely redundantly interconnected via two switches.
A third switch is connected to the redundantly interconnected PES via a redundant fibre optic connection (the fibre optic interface is integrated in the switch). An HIMA OPC server and further Ethernet components are connected to the third switch.

6.5 Modbus TCP slave

Requirements for the Modbus TCP slave

- F 865xX central module, beginning with OS version (05.34)
- F 8627XEthernet module, beginning with OS version 4.x

A Modbus TCP slave is active if

- BUSCOM variables are existing
- the F 8627X is in RUN mode (RUN-LED on the F 8627X is lighting continuosly)
- the associated F 865xX central module is in RUN or MONO operating mode

The serial Modbus slave is still supported (serial interface RS 485 on the F 865xX central module).

The Modbus TCP slave IP address is the F 8627X IP address (see chapter 5.1).
A Modbus TCP master can access the Modbus TCP slave in the H41q/H51q via the ports 502 and 8896.

- Via F 8627X port 502, the F 865xX central module operates as a Modbus TCP slave with the known functions (see manual "Functions of the operating system" HI 800 105).
- Via F 8627X port 8896, the F 8627X operates as a Modbus TCP slave with further Modbus function codes.

Both ports 502 and 8896 share the possible Modbus TCP connections in according with the principle First Come, First Serve.

The following table shows three possible equipment configuration variants of H51q and how many Modbus TCP master can access the F 865xX central module.

Variants	F 865xX	associated F 8627X	Max. number of Modbus master
1	1 x CU1	1	4
	1 x CU2	1	4
2	1 x CU1	2	8
	1 x CU2	2	8
3	1 x CU1	5 (maximum equipment)	20
	1 x CU2	5 (maximum equipment)	20

Table 11: Variants for Modbus master access the H51q

Note Up to 40 Modbus TCP masters can access the H51q controller. However, a maximum number of 16 Modbus TCP master is recommended (see variant 2 in Table 11).

Partitioning of the BUSCOM address range in the Modbus TCP slave (H41q/H51q)
All variables which should be sent via the Modbus TCP slave must be created as BUSCOM variables using ELOP II.
While configuring the Modbus communication, the user must ensure that separate address ranges are used for BUSCOM Import Variables for each Modbus master; otherwise, the acceptance of the data sent by a Modbus TCP master cannot be guaranteed.

The following figure shows an example, how the BUSCOM import address range of the H41q/ H51q can be partitioning for the Modbus TCP masters.

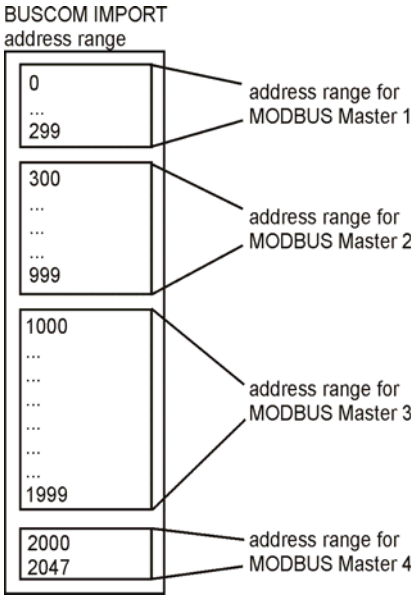


Figure 9: Partitioning of the BUSCOM Import address range for the Modbus TCP Master

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Note In case of port 8896, the BUSCOM variables are mapped into the process data image of the F 8627X. The Modbus TCP master must therefore access the BUSCOM variables using the identity numbers (see chapter 7).
To avoid further dividing the BUSCOM variable address ranges into BOOL and WORD areas, we recommend creating BUSCOM variables of type WORD only. This helps maintain a more simple overview.

6.5.1 Polling intervall of the Modbus TCP slave

The polling interval is the interval in which the Modbus TCP slave is polled by the Modbus master. The polling interval is registered within the Modbus master.

Note The polling interval of the Modbus TCP slaves should be selected depending on the cycle time of the F 865x central module.

$t_{Poll} = CT + n * 15ms$

CT: Maximum cycle time (ms) of the central module in status RUN (it is displayed on ELOP II control-panel).
n: Number of Modbus masters polling the Modbus slave
15ms: Process time per request in which the Modbus masters should give to the F 865xX central module.

Note Please read the cycle time under full communication load again and check whether the maximum cycle time "CT" has increased. An adaption of t_{Poll} may be necessary.

6.5.2 Redundant Modbus communication

To ensure a redundant Modbus communication, the Modbus master must be redundantly connected to the Modbus slave (see Chapter 5.2.5.3).
To ensure the redundant Modbus communication between a H41q/H51q PES and a Modbus master, the following two methods are possible:

Cable redundancy
Under all circumstances, Modbus communication only takes place via a single ethernet channel. If the Modbus master no longer receives a responding telegram on the active channel, it can switch to the other channel and continue exchanging data. The Modbus master can thus switch to the redundant channel if a network segment fails (e.g. broken ethernet cable or a faulty switch).

Redundancy with two "Peer to Peer" connections
In this case, the Modbus master in use must possess the function to establish two independent Modbus "Peer to Peer" connections to the Modbus slave's two F 8627X.
The same data are then transmitted over both ethernet connections to the two F 8627X simultaniosly.
The user must ensure that separate BUSCOM address ranges are used for each Ethernet channel transmitting the redundant BUSCOM variables (see figure below).

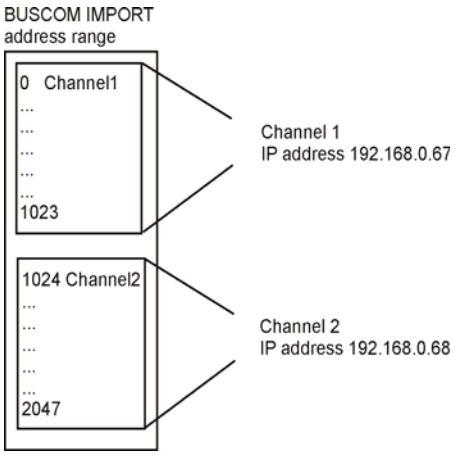

Figure 10: Partitioning of the BUSCOM Import address range for the redundant BUSCOM variables

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Note In case of port 8896, the BUSCOM variables are mapped into the F 8627X process data image. The Modbus TCP master must therefore access the BUSCOM variables using the identity numbers (see Chapter 7).

The logic of the user program must ensure, that the user program always processes the most current data record of the channel.

A monotonically increasing sequence number, incremented by the Modbus TCP master, can serve e.g. as a criterion for determining how up-to-date the BUSCOM variables in the separate address ranges are.

Figure 10 shows an example, in which the sequence number is registered in the BUSCOM variables Channel1 and Channel2, respectively.

6.5.3 Connection via port 502

Via F 8627X port 502, the F 865xX central module operates as a Modbus TCP slave and can be directly reached.
The BUSCOM Variables can be accessed via the BUSCOM adresses configured in ELOP II.
The Modbus slave on the central module provides the Modbus function codes, as described in the manual "Functions of the operating system" HI 800 105.

Note The events query and the synchronization of the central module (CM) software clock is only possible via TCP server port 502.
The HSR communication for a Modbus TCP slave via port 502 is independent of the HIPRO-S-DIRECT mode.

The F 8627x and F 865xX react to a Modbus request via port 502 as follows:

- If the F 8627X is in mono operation mode (i.e. no HSR connection to a second F 8627X), then the F 8627X must have a connection to the F 865xX, which in turn must be in RUN status to answer a Modbus request with the corresponding Modbus response.
- If two F 8627X are operating redundantly (i.e. HSR connection to a second F 8627X), then one of the two redundant F 8627X must have a connection to its associated F 865xX, which in turn must be in RUN or MONO status to answer a Modbus request with the corresponding Modbus response.

If the Modbus request cannot be passed on to an F 865xX, the F 8627X sends the error code 0x0B back to the Modbus master.

Note Processing each Modbus Request increases the cycle time for the F 865xX central module. To avoid increasing the cycle time too much, the F 8627X limits the minimal polling interval per Modbus master to 50 ms.

Using port 502, if the recommended polling interval "t_{Poll}" is ignored, the Modbus communication may behave as follows:

- Should the same master send other Modbus request within 50 ms, other Modbus requests from the same master are received within 50 ms after a Modbus request, the F 8627X transfers last Modbus-Request from this master to the F 865xX central module, if:
  - the central module is not processing a Modbus request from this master and
  - 50 ms are expired.
- As long as the F 865xX is processing a MODUBUS request from a master, it will only accept another Modbus request from this master after a minimum of 400 ms.
- In case of a new connection, the first request is passed on to the F 865xX after $\geq$ 50 ms.

Note If the Modbus master is only connected to one F 8627X on the H41q/ H51q, the Modbus master must always be connected to the F 8627X plugged into the left F 865xX via an Ethernet cable.
This ensures that the data written most recently from the Modbus master are also reflected in the data currently being processed by the user program.

6.5.4 Connection via port 8896

The Modbus TCP master accesses the process data image from the F 8627X via port 8896. In this case, the F 8627X is an active Modbus TCP slave and relieves the burden on the F 865xX.
On port 8896, the BUSCOM variables are mapped into the F 8627X's process data image. For this reason, the Modbus TCP master must access the identity numbers resulting from the process data mapping (see Chapter 7).

The WORD and BOOL variables are located in a common memory area on the F 8627X.
In case of port 8896, a Modbus telegram for WORD can access the address range of the WORD and BOOL variables.
The user must pay attention to correctly interpret the variable types of reading and writing data.

Note Modbus function codes 2, 4, 23 and 43 are supported by port 8896.
HK-COM 3 function block must allow the not safety-related data exchange via Modbus TCP. The address mapping of the BUSCOM variables into the F 8627X is described in Chapter 7.

Note If port 502 is not used in the H41q/H51q controller, the polling interval for port 8896 can be set to $t_{Poll} \geq CT$.

F 8627X reacts to a Modbus request via port 8896 as described below:

- If the F 8627X is in mono operation mode (i.e. no HSR connection to a second F 8627X), then the Modbus TCP slave on the F 8627X must be active to answer a Modbus request with the corresponding Modbus response.
- If two F 8627X are operating redundantly (i.e. HSR connection to a second F 8627X), then the Modbus TCP slaves must be active on one of the two redundant F 8627X to answer a Modbus request with the corresponding Modbus response.

If the Modbus request cannot be passed to an active Modbus TCP slave, the F 8627X sends the error code 0x0B back to the Modbus master.

Note HSR communication for a Modbus TCP slave via port 8896 is only possible if both F 8627X are operating in redundant mode (DIP-switch 2/2 OFF) and the HPRO-S-DIRECT mode is deactivated (DIP-switch 1/7 OFF).

Via Modbus TCP port 8896, the F 8627X supports the following function codes:

Function	Code	Type	Description
Read Coils	01	BOOL	Reads several variables (BOOL) from the slave's import or export area (same range as code 02).
Read discrete Inputs	02	BOOL	Reads several variables (BOOL) from the slave's export area.
Read Holding Registers	03	WORD	Reads several variables of any type from the slave's import or export area (same range as code 04).
Read Input Registers	04	WORD	Reads several variables of any type from the slave's export area.
Write Single Coil	05	BOOL	Writes one single variable (BOOL) in the slave's import area.
Write Single Register	06	WORD	Writes one single variable (WORD) in the slave's import area.
Write Multiple Coils	15	BOOL	Writes several variables (BOOL) in the slave's import area.
Write Multiple Registers	16	WORD	Writes several variables of any type in the slave's import area.
Read/Write Multiple Registers	23	WORD	Writes and reads several variables of any type in and from the slave's import area.
Read Device Identification	43	x[1)]	Transmits the slave's identification data to the master.

1) Note about the Modbus Function: Read Device Identification (43)

The HIMA Modbus slave supplies identification data to the master and supports the following Object-Ids:

Basic:
0x00 VendorName "HIMA Paul Hildebrandt GmbH + Co KG"
0x01 ProductCode "<Serial Number>"
0x02 MajorMinorRevision "<CU-OS Key 0x23ad CRC 0x-------- / COM Vx.y CRC>"

Regular:
0x03 VendorUrl "http://www.hima.com"
0x04 ProductName "HIQuad"
0x05 ModelName "<RessourceTyp>" z.B. "F 8627X"
0x06 UserApplicationName "<Buchst00>" resource name from ELOP projekt

Extended:
0x80 CPU OS version/CRC "< CU-OS Key 0x23ad CRC 0x-------->"
0x81 CPU OSL version/CRC deliver the error code 2 (Invalid Data)
0x82 CPU BL version/CRC deliver the error code 2 (Invalid Data)
0x83 COM OS version/CRC "<Vx.y / 0x234adcef>"
0x84 COM OSL version/CRC deliver the error code 2 (Invalid Data)
0x85 COM BL version/CRC deliver the error code 2 (Invalid Data)
0x86 Configuration-CRC "<Data-version 0x13ac / Area-version 0x13ac / Code-version 0x13ac / Run-version 0x13ac>"

The following ReadDevice ID Codes are supported:
(1) Read Basic device identification (stream access)
(2) Read regular device identification (stream access)
(3) Read extended device identification (stream access)
(4) Read one specific identification object (inidividual access)

For further information about Modbus TCP, refer to "Modbus Application Protocol Specification" www.modbus.org.

Note The function codes 03, 04 and 16 support data type Word (2 bytes) and any other data types. The interpretation of the two Modbus master request parameters (start address, number) is done as follows:
Start address describes the index of the first variable to be transmitted.
Number determines the size of the area to be transmitted:
2*number bytes must be transmitted, provided the area ends directly at a variable boundary.

6.5.5 Error codes

Error code	Description
0x01 (Invalid Code)	If Modbus TCP master sends a telegram with an unknown function code, Modbus TCP slave responds with error code 0x01 (invalid code).
0x02 (Invalid Data)	If Modbus TCP master's telegram does not match with the Modbus TCP slave's configuration (e.g. the request telegram does not end "even" at a variable border), Modbus TCP slave responds with error code 0x02 (invalid data).
0x03 (Invalid Value)	If Modbus TCP master sends a telegram with faulty values (e.g. length field), Modbus TCP slave respons with error code 0x03 (invalid value).
0x0B	No reply for a Modbus Request is possible. In case of Port 502 No F 865xX central module is reachable. In case of Port 8896 No active Modbus TCP slave on the F 8627X is reachable. Note: The function code "0x0B" is based on a gateway function. Please refer to the Modbus specification at page modbus.org

6.6 HIPRO-S

HIPRO-S is a safe communication via the HIPRO-S variables configured in the PES.
In the HIPRO-S Mode, the Ethernet bus access control is done by token passing. This mode provides operation with a hub and avoids collisions on the network.

No more than 31 safe**ethernet** members can be configured in the entire network.
One PES can have up to 30 safe**ethernet** communication partners since a bus configuration in ELOP II supports a maximum of 31 communication partners.
All communication partners must be configured in the same bus configuration.
A PES can communicate with maximal 4 HIMA OPC servers. The number of communication partners is not reduced by the number of configured HIMA OPC servers.

The communication modules for HIPRO-S must be configured in ELOP II and via the DIP switches.

- Switch 2/1 sets the module numbers, which corresponds to the attached Ethernet segment (see Table 6 and Figure 5).
- Switch 2/2 set a mono or redundant interconnection of the communication module group (see Table 6 and Figure 5).

6.6.1 Notes for creating HIPRO-S user program

While creating the user program, the following points should be considered:

- In ELOP II, a resource name must have eight characters, the last two of which must be numbers (see Chapter 5.1.)
- With HIPRO-S, safety-related communication must be set up such that **each PES** has configured a safety-related data exchange **with all other PES** (i.e. exchange of dummy data if no other user data are exchanged).
  The direction of the data exchange can be freely selected.
- To check the HIPRO-S configuration, the PES master program should be compiled, but not loaded into the master. Potential errors can be corrected.
- Via the system variables, the diagnosis of the safety-related communication can be evaluated in the user program.
- ELOP II's function block HK-COM-3 can be used to project and monitor the F 8627X.
- The monitoring time "MT/MTe" for HIPRO-S connections must be calculated (Chapter 6.8).

6.7 HIPRO-S-DIRECT

Like HIPRO-S, HIPRO-S-DIRECT is a safety communication via the HIPRO-S variables configured in the PES. This mode can only be used with switches.
HIPRO-S-DIRECT mode allows a faster exchange of data than HIPRO-S mode.

No more than 99 safe**ethernet** members can be configured in the entire network.
One PES can have up to 63 safe**ethernet** communication partners.
If more than 30 communication partners are configured, several bus configurations must be created in ELOP II since a bus configuration in ELOP II supports a maximum of 31 bus participants.

The number of HIMA OPC servers can be set from 0 to 14. The number of HIPRO-S communication partners is not reduced by the number of configured HIMA OPC servers.
If HIPRO-S-DIRECT mode is active (switch 1/7 "ON"), switch S1/8 "passive mode" no longer influences communication. For this reason, "passive mode" must also be activated on the HIMA OPC servers.

The communication modules for HIPRO-S must be configured in ELOP II and via DIP-switches

- Switch 2/1 sets the module number which corresponds to the attached Ethernet segment (see Table 6 and Figure 5).
- Set switch 1/7 (Table 5 on page 7) to "ON" to activate the HIPRO-S-DIRECT mode.
- Switches 1/1 to 1/5 (Table 5 on page 7) set the "Timeout" for the answer of the communication partner.

Switch 1	Timeout
	10 ms
	20 ms
	30 ms
	40 ms
	50 ms
	60 ms
	70 ms
	80 ms
	400 ms
	1000 ms

Legend:

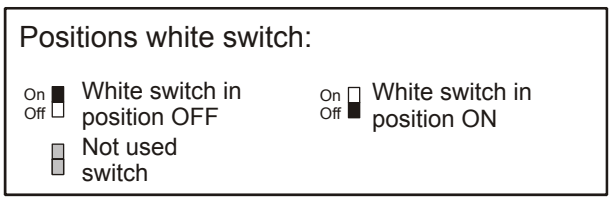


Table 12: Settings of switch 1 (S1)

Note All communication partners must be connected via switches. Consider the delay time of the used switches. If the delay time is higher than 5 ms, "Time-out" for the answer of the communication partners must be configured via switches (S1/1-5) on each F 8627X.

- F 8627X redundancy mode is fixed to MONO in the HIPRO-S-DIRECT operating mode, independently of the position of switch 2/2. The HSR cable connection is not required for HIPRO-S-DIRECT communication.
- The number of HIMA OPC servers (0, 2, 4, 6, 8, 10, 12 or 14) can be set via switches 2/6 to 2/8 (see Table 6).

6.7.1 Notes for creating HIPRO-S-DIRECT's user program

While creating the user program, the following points must be considered:

- In ELOP II, the resource name must have eight characters, the last two of which must be numbers (see Chapter 5.1.)
- The exchange of dummy data is not required.
- If more than 31 communication members are required, they can be configured in several bus configurations. A communication partner must be configured in all bus configurations in which its communication partners are configured (see Chapter 6.9).
- To check the HIPRO-S configuration, the PES master program should be compiled, but not loaded into the master. Potential errors can be corrected.
- Via the system variables, the diagnosis of the safety-related communication can be evalutated in the user program.
- ELOP II's function block HK-COM-3 can be used to project and monitor the F 8627X.
  In this case, a distinction differ between safe and non-safe communication can be made. (see ELOP II Online Help).
- The monitoring time "MT/MTe" for HIPRO-S connections must be calculated (Chapter 6.8).

6.8 Calculating the monitoring time for HIPRO-S/ HIPRO-S DIRECT connections

The monitoring time for HIPRO-S/ HIPRO-S-DIRECT connections is used for monitoring the update of HIPRO-S import variables at regular intervals.
The relevant factor is the safety time of the overall plant. If no imported safety-related variables are written within the defined period of time, they are set to 0 in the PES.
The monitoring time of the HIPRO-S/ HIPRO-S-DIRECT connections is set in the dialog window *Properties->HIPRO-S* of the corresponding target resource and must not be confused with the monitoring time of each PES.

Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

If the monitoring time provided by the authority exceeds or is equal to **13200 ms**, the user can set the monitoring time of the HIPRO-S or HIPRO-S-DIRECT connections to **13200 ms** in the target resource. This value corresponds to the monitoring time, which is sufficient for the maximum size of a bus configuration (HIPRO-S with 31 or HIPRO-S-DIRECT with 64 members).

6.8.1 Calculation method and formulas

Step 1: Determining the maximum Ethernet transmission time (T_{max})
To calculate the monitoring time, the maximum Ethernet transmission time of the HIPRO-S data T_{max} must be determined.

T_{max} for HIPRO-S communication
$T_{max} = (NP^2 + NP + 100)$ ms
If T_{max} < 600 ms than T_{max} must set to 600 ms.

NP: Number of PES communication partners + 4 OPC servers which are fixed configured in HIPRO-S mode.
T_{max}: Maximum Ethernet transmission time of the HIPRO-S Data.

T_{max} for HIPRO-S-DIRECT communication
$T_{max} = T_{DIP}$

T_{DIP}: Set value of the Timeout for HIPRO-S-DIRECT (Chapter 6.7) via switch 1/1-5.
T_{max}: Maximum Ethernet transmission time of the HIPRO-S-DIRECT data.

Step 2: Calculating the Watchdog Time

- $\mathbf{WD_{Source(Target)} = CT * 1.7}$ for H41q/H51q (F 8650 up to F 8653)
- $\mathbf{WDe_{Source(Target)} = CT * 1.5 + D * 5.5}$for H41qe/H51qe (F 8650E/X up to F 8653E/X)

$WD(e)_{Target}$: Watchdog time (ms) for the target resource
$WD(e)_{Source}$:Watchdog time (ms) for the source resource
CT: Maximum cycle time (ms) of the central module in RUN operation mode (is displayed in the ELOP II control panel).
D: Data size in kByte "Data Size (without SI Data)" (is displayed by the ELOP II Compiler).

Step 3: Calculating the monitoring time MT/MTe

Calculating the monitoring time MT for H41q/H51q

$$\mathbf{MT = 2 * WD_{Source} + 2 * T_{max} + 2 * WD_{Target}}$$

MT: Monitoring time (HIPRO-S connection)
WD_{Target}: Watchdog time (ms) for the target resource
WD_{Source}: Watchdog time (ms) for the source resource
T_{max}: From "Step 1".

Calculating the monitoring time MTe for H41qe/H51qe

$$\mathbf{MTe = 2 * WDe_{Source} + 2 * T_{max} + 2 * WDe_{Target}}$$

MTe: Monitoring time (HIPRO-S connection)
WDe_{Target}: Watchdog time (ms) for the target resource
WDe_{Source}: Watchdog time (ms) for the source resource
T_{max}: From "Step 1".

Step 4: Setting up the calculated monitoring time
The calculated monitoring time MT or MTe must set in the dialog window *Properties -> HIPRO-S* of the target resource.

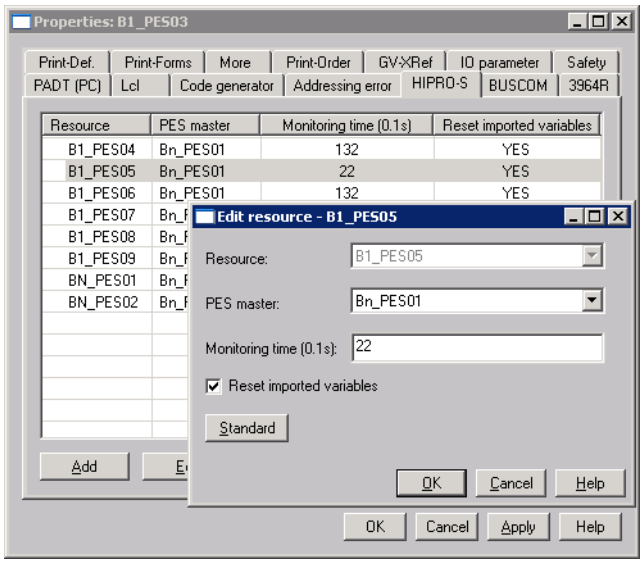


Figure 11: Configuration of the HIPRO-S connections

Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

6.8.2 Example for calculating the monitoring time

Calculating of the monitoring time for a H41qe/H51qe with HIPRO-S and 20 communication partners.

Step 1: Calculating the maximum transmission time "T_{max}"
20 communication partners + 4 HIMA OPC server (fixed configuration)
-> **NP = 24**
$T_{max} = NP^2 + NP + 100$
$T_{max} = 576 + 24 + 100$
$T_{max} = 700$ ms

Note In HIPRO-S-DIRECT mode, T_{max} is not calculated but it must be set up via DIP switches 1/1-5 (see Chapter 4.1).

Step 2: Calculating the HIPRO-S source/target resource

Calculating the Watchdog Time WDe_{Source} from the source resource

- Note the maximum PES cycle time "**CT**" in RUN status, which is displayed on the ELOP II control panel of the HIPRO-S source-resource (e.g. **100 ms**).
- Note the datasize "**D**" in kByte "Data Size (without SI Data)" from the source-resource, which is displayed by the ELOP II Compiler (e.g. **2 kByte**).
- Calculate the Watchdog Time "**WDe_{Source}**" for the source-resource
  $WDe_{Source} = CT * 1.5 + D * 5.5$
  $WDe_{Source} = 100 * 1.5 + 2 * 5.5$
  $WDe_{Source} = 161$ ms

Calculating the Watchdog Time WDe_{Target} from the target resource

- Note the maximum PES cycle time "**CT**" in RUN status, which is displayed on the ELOP II control panel of the HIPRO-S target-resource (e.g. **150 ms**).
- Note the datasize "**D**" in kByte "Data Size (without SI Data)" from the target-resource, which is displayed by the ELOP II Compiler
  (e.g. **1.5 kByte**).
- Calculate the Watchdog Time "**WDe_{Target}**" for the target-resource
  $WDe_{Target} = CT * 1.5 + D * 5.5$
  $WDe_{Target} = 150 * 1.5 + 1.5 * 5.5$
  $WDe_{Target} = 233.25$ ms -> 234 ms

Step 3: Calculating monitoring time "MTe"

- $MTe = 2 * WDe_{Source} + 2 * T_{max} + 2 * WDe_{Target}$
  $MTe = 2 * 161 + 2 * 700 + 2 * 234$
  MTe = 2190 ms -> 2200 ms

Step 4: Set the calculated monitoring time "MTe" in the target-resource

- Open the dialog window "Properties" using the context menu *Properties -> HIPRO-S* of the target-resource.
- Select the source-resource in the list of HIPRO-S communication partners and click the button *EDIT*.
- Set the monitoring time "**MTe**" in the dialog window "Edit resource".

Calculating the monitoring time "**MTe**"

- for each of the 20 communication partners in this target-resource.
- for each of the 20 communication partners in its own resource.

Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

6.9 Example of "Bus configuration with 64 resources"

In this example 64 resources are configured and partitioned into three bus configurations.
Both resources "B*n*_PES01" and "B*n*_PES02" are configured for each bus and provide a gateway between the three bus configurations.
The bus configuration is identical for the communication versions "MONO" and "Double MONO". When "Double MONO" is used, a second F 8627X communication module with the corresponding DIP switch settings must be plugged into the redundant module slot for each communication partner.

Note Respect the guidelines and application notes for configuring the Ethernet Segments (Chapter 6.3).

6.9.1 Function description of bus configuration

- The resources "B*n*_PES01" and "B*n*_PES02" are created in all three bus configurations. The resources "B*n*_PES01" and "B*n*_PES02" can thus exchange data with any other configured resource.
- In the bus configuration "BUS 1", the resources "B1_PES03" up to "B1_PES31" can communicate directly with each other.
- In the bus configuration "BUS 2", the resources "B2_PES32" up to "B2_PES60" can communicate directly with each other.
- In the bus configuration "BUS 3", the resources "B3_PES61" up to "B3_PES64" can communicate directly with each other
- If data from different bus configurations must be exchanged between resources, the data must be sent via the gateway resources "B*n*_PES01" and "B*n*_PES02".

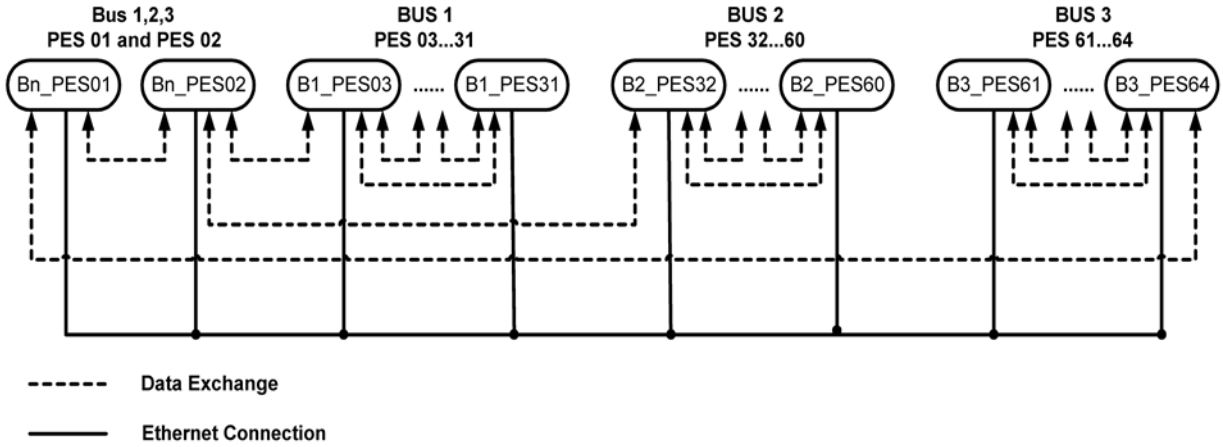


Figure 12: "MONO" bus configuration with HIPRO-S-DIRECT

Note All communication partners must be connected via switches. Consider the delay time of the used switches. If the delay time is higher than 5 ms, "Time-out" for the answer of the communication partners must be configured via switches (S1/1-5) on each F 8627X.

6.9.2 Setting up the bus configuration in ELOP II

The user should be familiar with the programming tool **ELOP II** and HIMA H41q/H51q PES. Refer to the manual "First steps ELOP II" and the ELOP II Online Help for further information.

Note All resources must be created in the same configuration (here "Config"). Consider also the notes about parameterizing the HIPRO-S-DIRECT mode and generating the user program (Chapter 6.7).

Create the following resources in the configuration "Config":

- "B*n*_PES01" and "B*n*_PES02"
- "B1_PES03" to "B1_PES31"
- "B2_PES32" to "B2_PES60"
- "B3_PES61" to "B3_PES64"

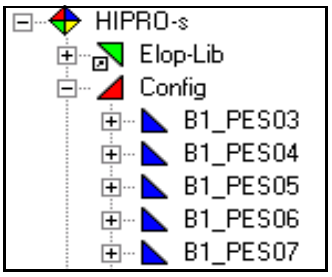


Figure 13: 64 resources in the configuration "Config"

In the application program of each resource, use the software function block HK-COM-3 for configuring and monitoring the F 8627X.

- The HK-COM3 must be assigned as described in the following table:

Input	Value
CU-Slot (1,2)	1
COM-Slot (1,2,3,4,5)	1
Enable Configuration	TRUE/FALSE
Function	0, 1 or 3

- In the user program, HK-COM3's outputs are used for monitoring.

Create and configure the three busses (see Table 13, Table 14, Table 15):

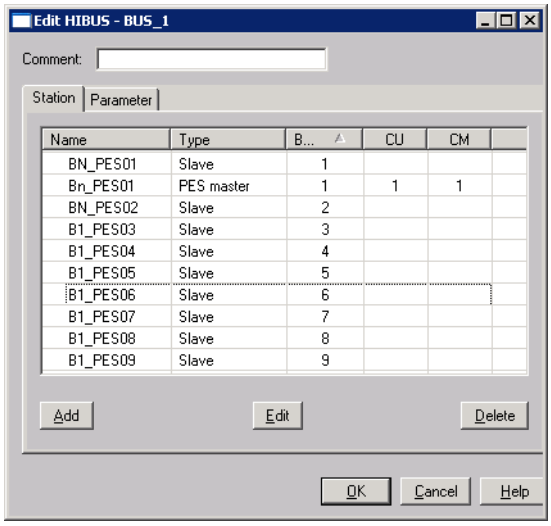


Figure 14: Configuration of BUS 1 in ELOP II

BUS 1 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B*n*_PES01	PES master	1	1	1	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B1_PES03	slave	3			29
"	"	"	"	"	
B1_PES31	slave	31			

Table 13: Configuration of BUS 1

BUS 2 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B*n*_PES02	PES master	2	1	2	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B2_PES32	slave	3			29
"	"	"	"	"	
B2_PES60	slave	31			

Table 14: Configuration of BUS 2

BUS 3 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B3_PES61	PES master	3	2	2	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B3_PES61	slave	3			4
"	"	"	"	"	
B3_PES64	slave	6			

Table 15: Configuration of BUS 3

In each resource, define the communication partners (resources), with which HIPRO-S data are to be exchanged.
Determine and set the monitoring time for the communication partners (see Chapter 6.8).

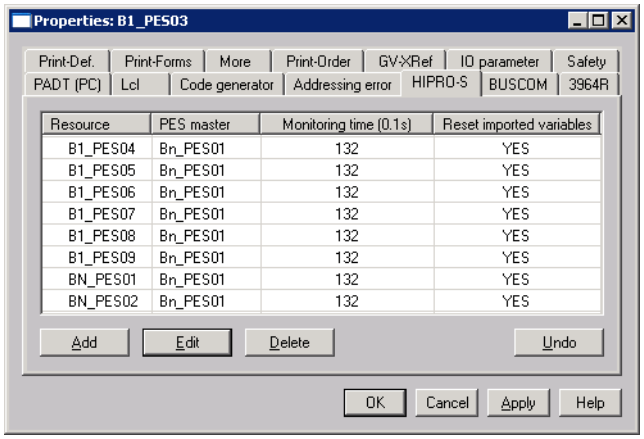


Figure 15: HIPRO-S communication partners of the resource

Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

In ELOP II, define the HIPRO-S variable which should be used for the HIPRO-S communication:

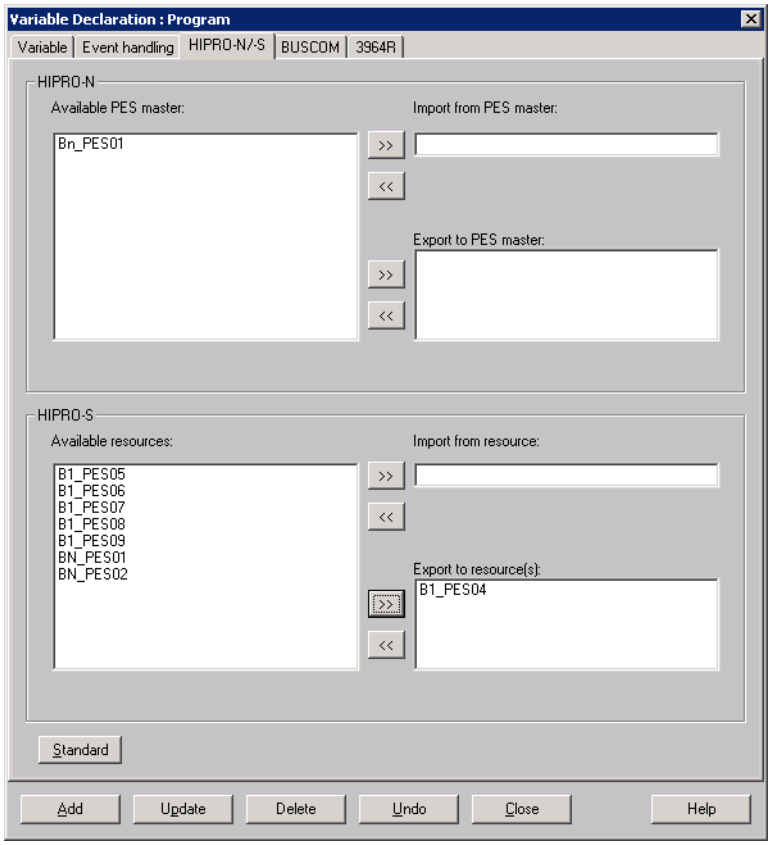


Figure 16: Configuration of a HIPRO-S variable in ELOP II

Note To verify the HIPRO-S-DIRECT configuration, the PES master program should be compiled, but not be loaded into the master. Potential errors can thus be corrected.

6.10 Communication with HIMA OPC Server (BUSCOM)

The F 8627X communicates with an OPC server via the non safety related BUSCOM variables.

Note The F 8627X OPC communication is only possible with a HIMA OPC server.

6.10.1 F 8627X configuration

The F 8627X is configured in ELOP II and via DIP switches.

In ELOP II, the resource name under ELOP II must have eight characters, the last two of which must be numbers. The numbers must be unique to avoid collisions while determining the communication module's IP address (see Chapter 5.1).

While configuring the communication with a HIMA OPC server, pay particular attention to the Passive mode (see Chapter 6.10.1.1 to Chapter 6.10.1.3).

6.10.1.1 Passive mode disabled (switch S1/8 "ON")

The token passing between the F 8627X and the HIMA OPC servers is active.

- If the Passive Mode is disabled on the F 8627X, it must also be disabled on the HIMA OPC s+ervers.
- With HIPRO-S, safety-related communication must be set up such that **each PES** has configured a safety-related data exchange **with all other PES** (i.e. exchange of dummy data if no other user data are exchanged). The direction of the data exchange can be freely selected.
  This procedure is used because all Ethernet nodes must be known in each PES within SafeEthernet to ensure communication within the network (token passing).

6.10.1.2 Passive mode enabled (switch S1/8 "OFF")

In this mode the F 8627X's behavior is passive and HIMA OPC server polls it in certain time intervals.
The token passing between the F 8627X and the HIMA OPC servers is disabled.

- The Passive mode may be only activated on a F 8627X, if HIMA OPC server also supports it (HIMA OPC server version 3.2.0 and higher).
- The Passive Mode can also be activated, if safety-related communication for the F 8627X module is configured.

Note If HIPRO S DIRECT mode is active (switch 1/7 "ON"), switch S1/8 "passive mode" no longer influences communication. For this reason, "passive mode" must also be activated on the HIMA OPC servers.

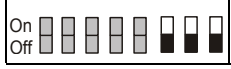
6.10.1.3 Benefits of passive mode

- If safety-related communication will not be performed via the F 8627X, then safety-related dummy variables need not be defined between the PES during configuration.
- It is now possible to have simultaneously a safety-related communication (via AG master F 8621A or a second F 8625/27) and non safety-related communication to a HIMA OPC server in one PES since no more dummy variables are needed for communicating with the HIMA OPC server.
- An overload of the PC running the HIMA OPC server can be prevented in cases in which the number of available communication partners is too small (e.g. due to frequent token holding caused by the short token cycle).

Note Hubs may not be used in Passive mode. Switches are recommended.

6.10.1.4 Numbers of HIMA OPC server and determination of the node Id

- HIPRO-S mode (S1/7 "OFF"): Fixed to four HIMA OPC servers.
  Node Ids of the HIMA OPC servers are 107 to 110.
- HIPRO-S-DIRECT mode (S1/7 "ON"):
  Switches 2/6-8 set the number of HIMA OPC servers with which the F 8627X can exchange BUSCOM variables.
  A range of node Id's is available for the number of HIMA OPC servers selected via switch 2 (see Table 16).
- The Node Id is required for configuring the HIMA OPC server (see manual "HIMA OPC server 3.0 Rev. 2").

Switch 2	Number of HIMA OPC server	Node Id
	0	-
	2	107 and 108
	4	107 up to 110
	6	107 up to 112
	8	107 up to 114
	10	107 up to 116
	12	107 up to 118
	14	107 up to 120

Legend:

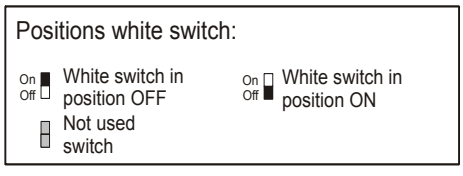


Table 16: Settings of switch 2 (S2)

6.10.1.5 Determining the IP address of the OPC Server network card

The IP address is composed of the network address and the host address. The default network address is 192.168.0.
The last byte of the IP address 192.168.0.x is the host address and it is calculated from the Node Id as specified below:

Host address = Node Id * 2 + 1 (For IP address Segment 1)
Host address = Node Id * 2 + 2 (For IP address Segment 2)

The following IP addresse are resulting from the calculation (see Table 17).

Node Id	IP Address Segment 1	IP Address Segment 2
107	192.168.0.215	192.168.0.216
108	192.168.0.217	192.168.0.218
109	192.168.0.219	192.168.0.220
110	192.168.0.221	192.168.0.222
111	192.168.0.223	192.168.0.224
112	192.168.0.225	192.168.0.226
113	192.168.0.227	192.168.0.228
114	192.168.0.229	192.168.0.230
115	192.168.0.231	192.168.0.232
116	192.168.0.233	192.168.0.234
117	192.168.0.235	192.168.0.236
118	192.168.0.237	192.168.0.238
119	192.168.0.239	192.168.0.240
120	192.168.0.241	192.168.0.242

Table 17: Mapping of IP addresses to node Id's

The IP address must be set in the properties of the network card of the PC running the HIMA OPC server.

6.10.2 Configuring of the BUSCOM variables in ELOP II

The F 8627X communicates with an OPC server via the BUSCOM variables, which must be created in ELOP II by the user.
The BUSCOM variables created in ELOP II can be exported into a text file, which in turn can be directly imported into the HIMA OPC server for configuration.

6.10.2.1 Address range of the BUSCOM variables

The address of the BUSCOM variables are calculated as follows
Base address + Relative address =BUSCOM address.

Note The base address' settings are located in the resource's properties. In the "BUSCOM" tab, the user can set the base address separately for Import, Export and Import/Export; however, using the standard base address settings is recommended.

The following address ranges can be used for BUSCOM variables:

BUSCOM variables	Address range (Base address+ relative address)
BOOL	0 up to 2047 or 4096 up to 8191
UINT (WORD, INT, SINT, USINT)	0 up to 2047 or 4096 up to 8191

Table 18: Address range of the BUSCOM variables

Note Select one of the two address ranges for the BUSCOM variables. If this is not possible, please contact the HIMA support.

Addresses for the BUSCOM variables can be allocated automatically or manually, but each address is allocated with reference to the base address.

6.10.2.2 Manually assigning the address for BUSCOM variables

By activating the function "set relative address" in the dialog located "Variable Declaration", set the address must be assigned manually. The base address is displayed above the input field. An overview of all used addresses can be found selecting in the *context menu of the resource->documentation->Res docu (generated)*.

Note The user should assign the address for the BUSCOM variables, manually to avoid a reorganization of the addresses (address shift) after adding new BUSCOM variables.

6.10.2.3 Automatically assigning the address for BUSCOM variables

Deactivate the function "set relative address" located in the dialog "Variable Declaration".
The automatic address assignment of the BUSCOM variables is arranged in alphabetical order on the basis of the variable name.
An overview of all used addresses can be found selecting the *context menu of the resource->documentation->Res docu (generated)*.

Once new BUSCOM variables have been added, a *not reloadable code* must always be generated to allow the addressing to be reconfigured.

6.10.3 Example of a configuration in ELOP II for the communication with a HIMA OPC-Server

Define the BUSCOM variables used for the OPC communication:

- Select one of the following properties to determine the communication direction of the BUSCOM variables:

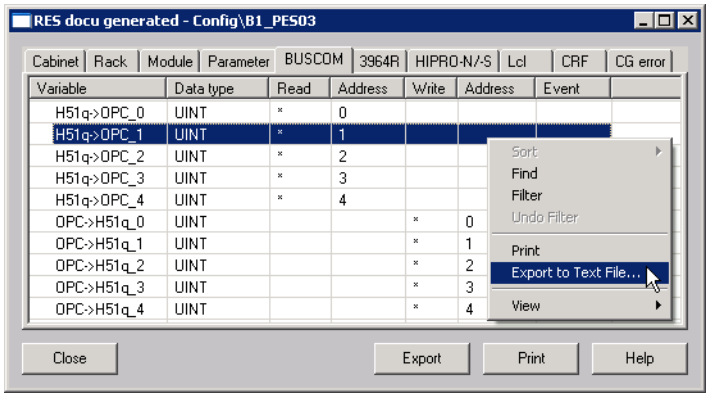
Export:	read by HIMA OPC server
Import:	written by HIMA OPC server
Import/Export:	both written and read by HIMA OPC server

Create the BUSCOM resources' list for HIMA OPC server:

- Open the resource's context menu and select *Documentation*.
- Select the submenu function *RES-Docu (generated)* to open the dialog "Res-Docu (generated)".
- Select the tab "BUSCOM" located in the dialog "Res-Docu (generated)".
- Right click on the BUSCOM variable line, to open the export context menu.
- Select *Export to Text File.*

Note Consider that no filters are set during the export!

- Save the file with the extension **.txt* on a storage medium (server, floppy disk), which the HIMA OPC server can read.



Read: To be read by the HIMA OPC server

Write:To be written by the HIMA OPC server

Figure 17: Dialog "Res-Docu (generated)"

The generated BUSCOM list appears as seen in Figure 18 and can be used by the HIMA OPC server without any changes.

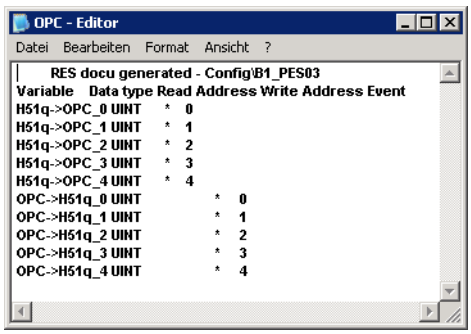


Figure 18: BUSCOM list for the HIMA OPC server

7 Address mapping of the BUSCOM variables

7.1 Data types of BUSCOM variables

Overview, how the BUSCOM variables are represented and stored.

ELOP II (variable data types)	Process data mapping on the F 8627X	Size of data types on the F 8627X and F 865xX
BOOL	BOOL	1 Byte
WORD (WORD INT UINT)	WORD	2 Bytes

Table 19: Data type definitions

All 2 Byte data types configured in ELOP II as BUSCOM variables are transmitted as WORD. 1 Byte data types (e.g. Byte, SINT) must be packed into BUSCOM variables of data type WORD (e.g. with the function blocks "Pack" and "Unpack") such that they can be transmitted.

7.2 BUSCOM address of the F 865xX central module

The user can set-up the BUSCOM Addresses of the BUSCOM variables by specifying the base and relative addresses in ELOP II.

The addresses of the BUSCOM variables are calculated on the central module F 865xX as follows:

Base address + Relative address = BUSCOM address

The relative address must be set such that the BUSCOM address is located in the same range as the corresponding base address (see Table 20).

Note The base address' settings are located in resource's properties. In the "BUSCOM" tab, the user can set the base address separately for Import, Export and Import/Export; however, using the standard base address settings is recommended.

The BOOL and WORD variables are stored within the import and export areas of the F 865x E/X and further seperated into 0 and 1 areas.

Ranges	BOOL (BUSCOM address)	WORD (BUSCOM address)
Import range 0 (Base address 0000)	0000 to 2047	0000 to 2047
Import range 1 (Base address 4096)	4096 to 8191	4096 to 8191
Export range 0 (Base address 0000)	0000 to 2047	0000 to 2047
Export range 1 (Base address 4096)	4096 to 8191	4096 to 8191

Table 20: BUSCOM variable ranges in the F 865xX central module

7.3 Mapping of the BUSCOM variables on the F 8627X

To transmit the BUSCOM variables, they are mapped from the F 865xX central module to the F 8627X communication module.
The BUSCOM variables from the F 865xX are copied into two memory areas located in the F 8627X internal memory.
The memory areas EV and IV reflect the export and the import variables respectively. In the memory area, a BUSCOM variable is described by its identity number.

Note This scheme for converting BUSCOM variables (on the F 865xX) into identity numbers (on the F 8627X) is used for WORD as well as for BOOL variables.

Consider at Modbus Port 8896, that you neither reading nor writing with a Modbus telegram beyond the address range of a variable type (see also Chapter 6.5.4)

7.3.1 Example 1

In this example the **WORD** variables in the export area 0 (on the F865xX) start with the BUSCOM address 0 and are mapped to the memory area EV (on the F 8627X) with the identity number 0.
The identity numbers of the WORD variables in memory area EV are in ascending order up to the last WORD variable (identity number 110) from export area 0.

In this example, the **BOOL** variables in export area 0 (on the F 865xX) start with BUSCOM address 0 and are mapped to memory area EV (on the F 8627X) beginning with identity number 111, which follows the last identity number of the WORD variables (i.e. 110).
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (indentity number 150) from export area 0.

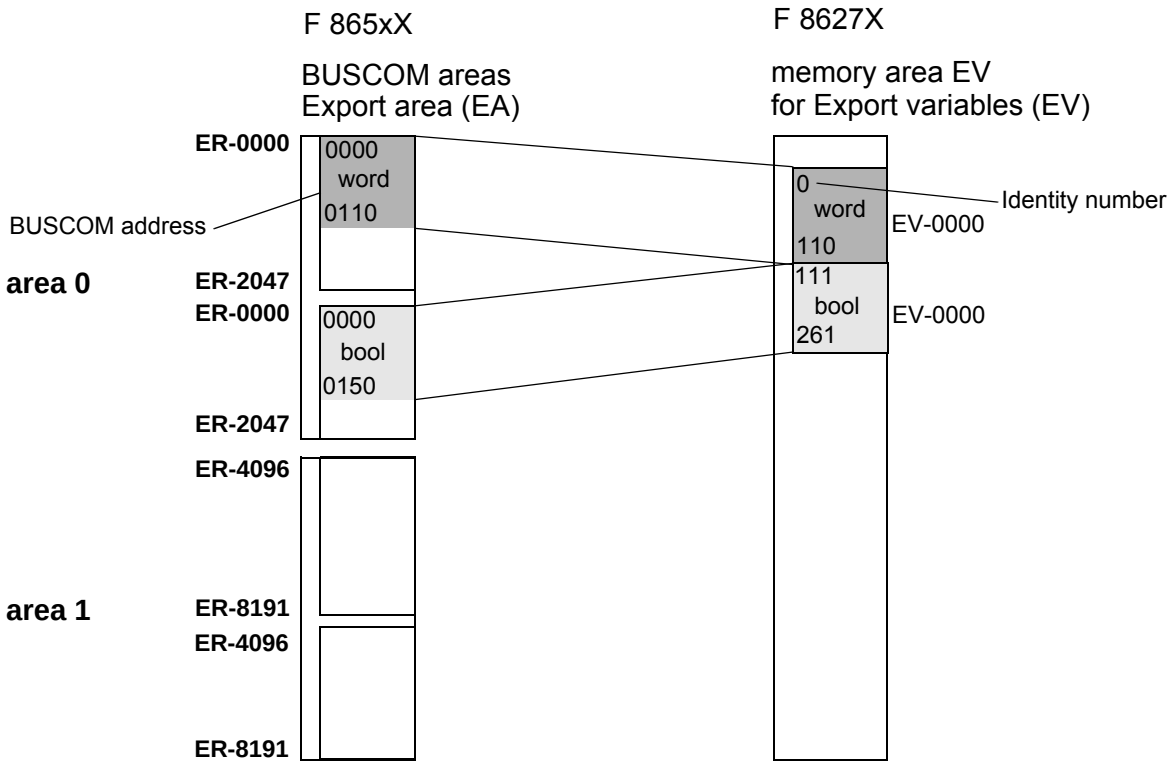


Figure 19: Mapping of WORD- and BOOL-variables from export area 0

7.3.2 Example 2

In this example the **BOOL** variables in the export area 0 (on the F865xX) start with the BUSCOM address 0 and mapped to the memory area EV (on the F 8627X) with the identity number 0.
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (identity number 100) from export area 0.

In this example, the **BOOL** variables in export area 1 (on the F 865xX) start with BUSCOM address 4096 and are mapped to memory area EV (on the F 8627X) beginning with identity number 101, which follows the last identity number of the BOOL variables (i.e. 100).
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable 4196 from export area 1.

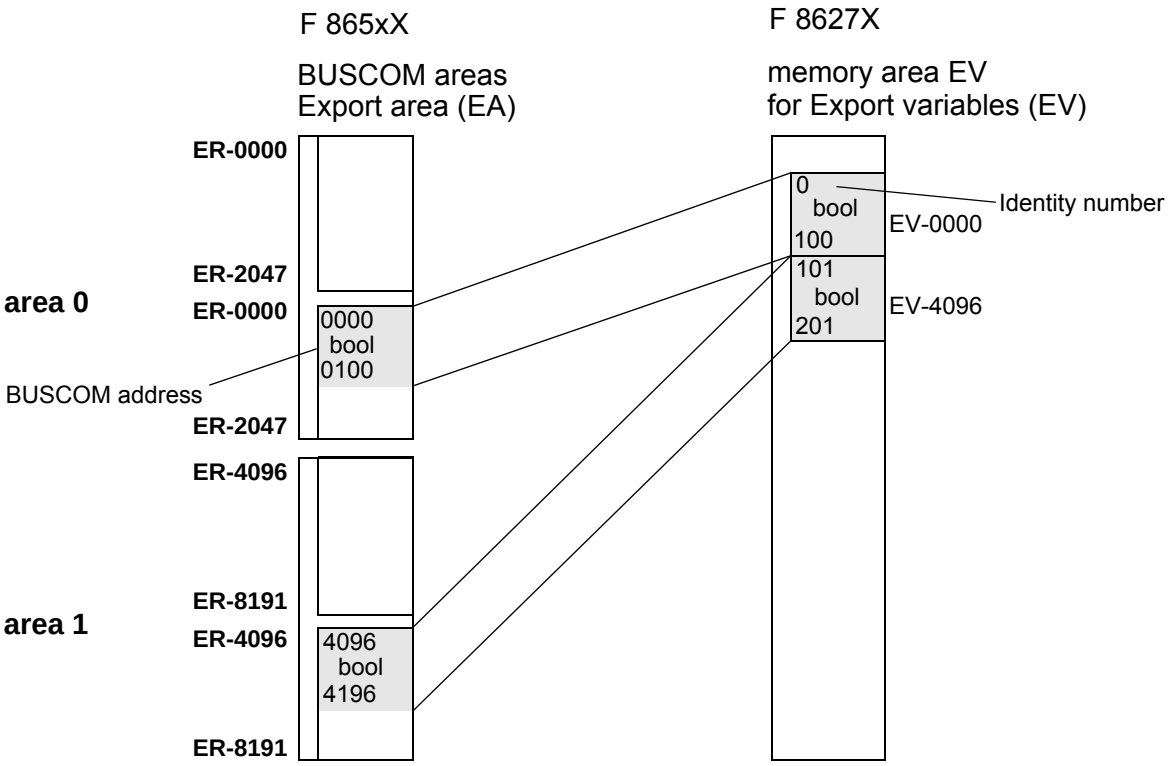


Figure 20: Mapping of BOOL-variables from export areas 0 and 1

7.3.3 Example 3

In this example, the **WORD** variables in export area 0 (on the F 865xX) start with BUSCOM address 1 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 1. The identity numbers of the WORD variables in memory area EV are in ascending order up to the last WORD variable (0110) from export area 0.
The unused BUSCOM address 0 is assigned a dummy variable and mapped to identity number 0 within memory area EV.

In this example, the **WORD** variables in export area 1 (on the F 865xX) start with BUSCOM address 4100 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 115. The identity numbers of the WORD variables in memory area EV are in ascending order up to the last
WORD variable (4200) from export area 1.
The unused BUSCOM addresses 4096 to 4099 are assigned dummy variables and mapped to identity numbers 111 to 114 within memory area EV.

In this example, the **BOOL** variables in export area 0 (on the F 865xX) start with BUSCOM address 0 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 216 which follows the identity number 215 of the last WORD variable from export area 0.
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (0100) from export area 0.

In this example, the **BOOL** variables in export area 1 (on the F 865xX) start with BUSCOM address 4096 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 317 which follows the identity number 316 of the last BOOL variable from export area 0.
The identity numbers of the BOOL variables in the memory area EV are ascending up to the last BOOL variable 4196 from the export area 1.

Note If BUSCOM variables do not start at the beginning of an area, this area is padded with dummy variables on the central module and also mapped on the communication module.

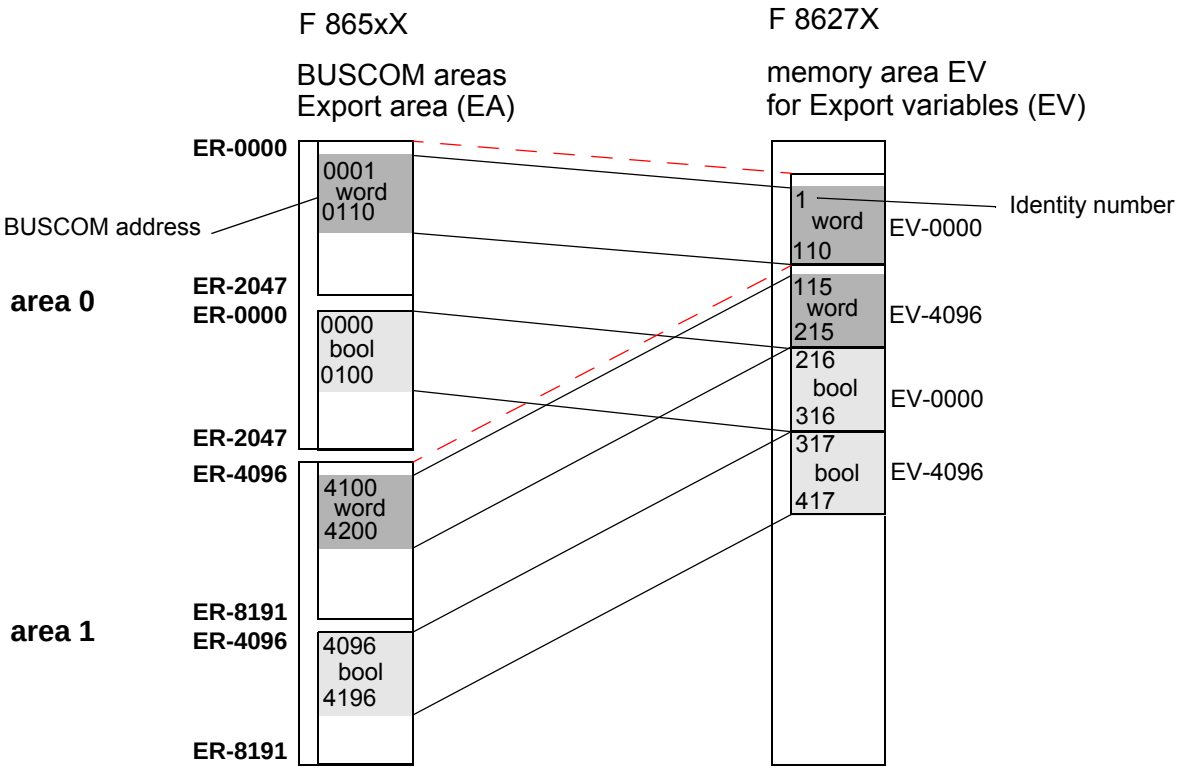


Figure 21: Mapping of WORD- and BOOL-variables from export areas 0 and 1

8 Replacing of the operating system

8.1 Upgrading/downgrading the operating system versions of the F 8627X

The following instructions describe the upgrade/downgrade the operation systems for the F 8627X module.

Upgrading/downgrading may only be performed by HIMA service engineers. It is recommended that the operating system is changed, e.g. in times of a shutdown of the plant.

8.1.1 Upgrading/downgrading from version 2.x

To upgrade/downgrade version 2.x, the operating system file with extension ***.flash** must be loaded.

When upgrading from version 2.x to another version, the user must ensure that only the correct operating system file is loaded into the corresponding module.
If the module F 8627X was loaded with any incorrect file, the functionality of the F 8627X is lost and can not be programmed any longer with the diagnostic dialog ComEth. In this case the module F 8627X must be programmed new by HIMA.

After upgrading to version 3.x and higher a protection mechanism is activated and only operating system files with extension ***.ldb** can be loaded.

8.1.2 Upgrading/downgrading from version 3.x and higher

To upgrade/downgrade version 3.x and higher, the operating system file with extension ***.ldb** must be loaded.

After downgrading to version 2.x, the protection mechanism preventing incorrect files from being loaded is no longer active!

8.2 Downloading the operating system into the F 8627X

The operating system for the F 8627X module is downloaded using the diagnosis dialog **ComEth**.

The connection between the **ComEth**'s control panel and the F 8627X Ethernet module should be closed, if **ComEth** is not used.
The connection to the **ComEth**'s diagnosis panel can remain.

Downgrading from version ≥ V4.x to version ≤ V3.x!
If the F 8627X is set to "Autonegotiation Off" (S2/3 OFF) and full duplex (S2/5 ON), then autonegotiation must be activated for all communication partners (e.g. switch) once the downgrade has been completed (see also Chapter 4.2).

Upgrading from version ≤ V3.x to version ≥ V4.x!
If the F 8627X is set to "Autonegotiation Off" (S2/3 OFF) and full duplex (S2/5 ON), then autonegotiation must be deactivated for all communication partners (e.g. switch) once the upgrade has been completed (see also Chapter 4.2).

- Start the ComEth diagnosis dialog and check in the error-state viewer that the
  - "main program version" is 0.8.0 or higher
  - "diagnostic text version" is 0.2.0 or higher.
- Select *Project->New* on the menubar of the ComEth diagnosis dialog, to create a new Project.
- Select *New Configuration* in the context menu of the new project, to create a new configuration.
- Select *New Resource* in the context menu of the new configuration, to create a new resource.
- Select *New F 8627X* in the context menu of the new resource, to create a new F 8627X in the new resource.
- Select *Properties* in the context menu of the new F 8627X, to open the dialog window "Properties".

Configure the input fields as follows:

- Enter any unique name for the F 8627X (e.g. CU1CM1) in the input field.
- In the input field "IP address", enter the IP address of the F 8627X module into which the operating system is to be loaded. For determining the IP address of the F 8627X module, (see Chapter 5.1).
- The view box "IP address PC" displays all IP addresses of the available PADT (PC) network cards. Select the IP address of the network card to be used for creating the connection to the F 8627X module.

Note

OS versions < V4.x
The PADT (PC) IP address must:

- be located in the same subnet as the F 8627X module.
- have an IP address in one of the following ranges:
  - from 192.168.0.201 to 192.168.0.214 or
  - from 192.168.0.243 to 192.168.0.254.

Exception: If the PADT (PC) is simultaneously used as an OPC server and already has own one of the OPC server IP addresses, it also can also use this IP address.

If several network cards are available on the PADT (PC), a corresponding routing entry must be set for the network card which is used for connection to the F 8627X.

OS versions ≥ V4.x
Any free IP address for the PADT may be used. If the PADT IP addresses of the PADT and the F 8627X are located in different subnets, a routing entry for the subnet of the F 8627X is required on the PADT (PC).

- Select *Control Panel* in the context menu of the new F 8627X to open the Control Panel.
- Select *PADT->Connect* in the control panel to create a connection to the F 8627X module.

The next step causes a communication loss, if no redundant F 8627X module exists or if the redundant module does not have any connection!

- Click the button *Stop Device* in the ComEth control panel, to set the F 8627X module into the STOP state (green RUN LED blinks).
- Select *Extra->OS Update* in the ComEth control panel to open the standard dialog for opening a file.
- Select and load the **proper** operating system for the upgrade/downgrade into the selected F 8627X module (see Chapter 8.1.1 and Chapter 8.1.2).

If the operating system download of the F 8627X was aborted, the F 8627X must **not** be removed!
Close the **ComEth** control panel and reopen it. Repeat the previous step to load the F 8627X operating system.

Note

After successfully downloading the F 8627X operating system, **the F 8627X module must be rebooted**. After rebooting the new operating system is started. Until then, the F 8627X operates using with the old operating system.

To reboot the F 8627X:

- Remove and replace the F 8627X module or
- select the function *Extra->Reboot Device* located in the ComEth Control Panel dialog.
- Check the upgrade/downgrade
- Select *PADT->Connect* in the control panel to create a new connection to the F 8627X module.
- Select the tab *version* and check that the OS version displayed is the same as the OS version of the Upgrade/Downgrade.
- If a redundant F 8627X module exists, follow the same procedure.

Note

The ARP entry must be deleted on the PADT (PC) if another F 8627X is to be loaded and has the **same IP address** as the F 8627X loaded immediately beforehand; otherwise, a connection cannot be opened to the newly loaded F 8627X with the same IP address.

Example: Delete the ARP entry of a F 8627X with the IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC)
- Enter the command **arp -d 192.168.0.67**.

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9 Recommended literature

[1] Safety Manual H41q/H51q
HIMA GmbH Bruehl, 2005: HI 800 013

[2] Functions of the Operating System H41q/H51q
HIMA GmbH Bruehl, 2005: HI 800 105

[3] Online Help in ELOP II
HIMA GmbH Bruehl, 2005

[4] First Steps ELOP II
HIMA GmbH Bruehl, 2001: HI 800 000

[5] HIMA OPC server 3.0 Rev. 2
HIMA GmbH Bruehl, 2004

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