SIEMENS

SINEC

CP 5430 TF with COM 5430 TF, CP 5431 FMS with COM 5431 FMS

Volume 1 of 2

6GK1970-5AB01-0AA1 C79000-G8976-C048 Release 02

SIEMENS

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SIEMENS

SINEC

CP 5430 TF/CP 5431 FMS with COM 5430 TF/COM 5431 FMS

Description C79000-B8976-C060/02

Note

We would point out that the contents of this product documentation shall not become a part of or modify any prior or existing agreement, commitment or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Siemens. Any statements contained in this documentation do not create new warranties or restrict the existing warranty.We would further point out that, for reasons of clarity, these operating instructions cannot deal with every possible problem arising from the use of this device. Should you require further information or if any special problems arise which are not sufficiently dealt with in the operating instructions, please contact your local Siemens representative.

General

WARNING !

!

This device is electrically operated. In operation, certain parts of this device carry a dangerously high voltage.

Failure to heed warnings may result in serious physical injury and/or material damage.

Only appropriately qualified personnel may operate this equipment or work in its vicinity. Personnel must be thoroughly familiar with all warnings and maintenance measures in accordance with these operating instructions.

Correct and safe operation of this equipment requires proper transport, storage and assembly as well as careful operator control and maintenance.

Personnel qualification requirements

Qualified personnel as referred to in the operating instructions or in the warning notes are defined as persons who are familiar with the installation, assembly, startup and operation of this product and who posses the relevant qualifications for their work, e.g.:

– Training in or authorization for connecting up, grounding or labelling circuits and devices or systems in accordance with current standards in saftey technology;
– Training in or authorization for the maintenance and use of suitable saftey equipment in accordance with current standards in safety technology;
– First Aid qualification.

1 Introduction

The manual for the CP 5430 TF and CP 5431 FMS is divided into two volumes. This volume, Volume 1 of the manual describes the PROFIBUS (PROcess FIeld BUS) communication available with the two CPs. Differences in communication and performance are pointed out in the appropriate chapters. The communications processors are configured with COM 5430 TF/COM 5431 FMS under SINEC-NCM.

PROFIBUS is a bus system for applications in automation engineering in areas closely associated with the process and allows easy implementation of bus interfaces. With the PROFIBUS, SIMATIC S5 programmable controllers, programmers, AT-compatible PCs and other control systems and, of course, PROFIBUS-compatible devices from various manufacturers can be networked.

The CP 5430 TF is used to connect SIMATIC S5 programmable controllers to the SINEC L2/L2FO local area network and complies with the PROFIBUS standard (DIN 19245) Part 1 /1/. The range of performance described in Volume 2 extends the functions of the CP by the services described in the TF standard for SINEC TF. The CP 5430 TF also provides the L2-DP (distributed I/Os) service.

The CP 5431 FMS communications processor is used to connect programmable controllers of the SIMATIC S5 range to the local area network SINEC L2/L2FO and complies with the PROFIBUS standard (DIN 19245) both in Part 1 and Part 2 /10/ as an active station on the bus (PROFIBUS multivendor network). The CP 5431 FMS also provides the L2-DP (distributed I/Os) service.

SINEC L2-DP is the Siemens implementation of DIN E19245 Part 3 PROFIBUS-DP /11/. The L2-DP protocol uses a subset of the functions specified in DIN 19245 Part 1 for layers 1 and 2 and supplements these for the special applications in distributed I/Os.

The performance of the CP 5431 FMS described in Volume 2 extends the functions of the CP by the services described in the FMS standard.

The network is configured with COM 5430 TF/COM 5431 FMS under SINEC NCM (Network and Communication Management). The configuration tool can be run on the PG 710, 730, 750 and 770 under the S5-DOS/ST operating system.

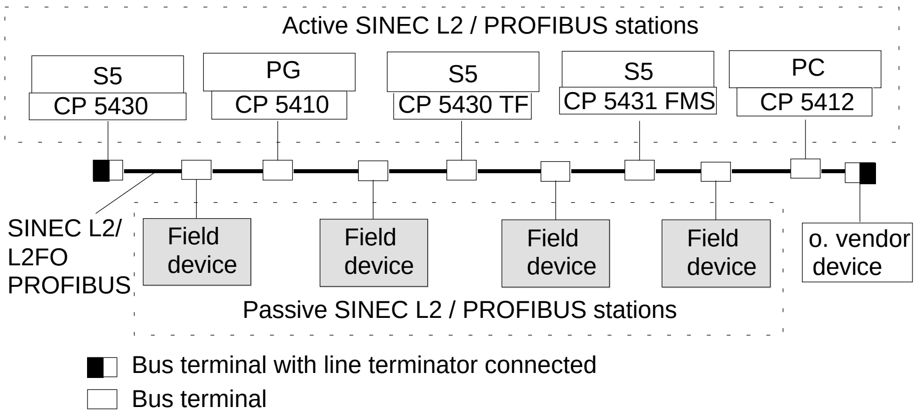


Fig. 1.1 Example of PROFIBUS L2 Configuration

The handling of the communications protocols for layers 1 and 2 described in this volume is microprocessor-controlled. The host system is therefore relieved of specific communications tasks.

To allow a wide range of applications, the PROFIBUS communications system provides the user system with a variety of services for open communication.

The information in this manual is intended for the following users:

➢ The planner and designer of a communications network

➢ Programmers of communications relations

➢ Customers wishing to use SINEC L2/L2FO in the SIMATIC S5 system

General symbols:

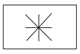
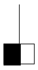
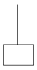
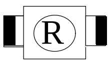
	Active star coupler
	Twisted pair
	Bus terminal (terminating resistor connected)
	Bus terminal (terminating resistor disconnected)
	Data Terminal Equipment
	Fiber optic cable
	Optical bus terminal
	SF repeater adapter
	RS 485 repeater

Table 1.1 Symbols for SINEC L2/L2FO

✔ This character indicates an activity or operation for you to perform.

☞ This symbol highlights **special features** and **dangers**.

mm The dimensions in diagrams and scale drawings are specified in millimeters.

Requirements of the user

To understand the examples, you should have the following:

- ➢ Knowledge of programming with STEP 5
- ➢ Basic knowledge of the use of handling blocks (HDBs). The description of the HDBs can be found in the manual for your programmable controller or in separate descriptions of the programmable controllers.

Training offer

Siemens provides SINEC users with a comprehensive range of training opportunities.

For more detailed information contact

Informations- and Trainings-Center
für Automatisierungstechnik

AUT 6 Kursbüro
Postfach 21 12 62
76181 Karlsruhe
Germany

or your local Siemens office.

Order numbers for the products mentioned in this manual can be found in the current catalogs.

To help you find your way through this manual (Volume 1) the remainder of this section outlines the chapters briefly.

Chapter 2
System Overview
This chapter supports you when structuring your network and provides an overview of the standards, techniques, devices and structure of the PROFIBUS-compatible network SINEC L2/L2FO. You will also find general information about different topologies, functions and network planning and design of the SINEC L2/L2FO bus system.

Chapter 3
Fundamentals of the Model
This chapter provides an introduction to the communications model by explaining terminology and inter-relationships and illustrates the interface to the SIMATIC S5 user.

Chapter 4
Technical Description and Installation Guidelines for the CP 5430 TF/CP 5431 FMS
This chapter describes in detail the hardware of the CP 5430 TF/CP 5431 FMS (technical data, interfaces, operating statuses, memory modules) and also deals with PG connections and the module slots in various PLCs.

Chapter 5
Selecting the Type of Communication
This chapter helps you to select the type of communication for your specific task by briefly outlining the essential characteristics of different types of communication. The detailed descriptions of the possible types of communication can then be found in Chapters 7 to 11 in Volume 1 and for the FMS or TF services in Volume 2. Each chapter contains a specific description of the basics and of configuration.

Chapter 6
Basics of Configuration with NCM
This chapter contains an introduction to working with SINEC NCM and COM 5430 TF/COM 5431 FMS. It is intended to familiarize you with the basics of configuring, i.e. how to use general guidelines and the basic configuration screens and their application.

Chapter 7
S5-S5 Communication
This chapter describes the communication with handling blocks on pre-configured S5-S5 links between active SIMATIC S5 programmable controllers.

Chapter 8
Free Layer 2 (FL2) Communication
This chapter describes the data exchange with handling blocks using the layer 2 access of the CP.
The free layer 2 access allows communication with passive and/or non-Siemens PROFIBUS stations which also have free layer 2 access.

Chapter 9
Global I/Os (GP) Communication
This chapter describes event-driven data transmission using the global I/Os (GP) via the I/O area of the SIMATIC S5 programmable logic controller.

Chapter 10
Cyclic I/Os (only CP 5430 TF)
This chapter describes the cyclic data exchange to normally passive field devices using the cyclic I/Os service (ZP) via the I/O area of the SIMATIC S5 programmable controller.

Chapter 11
Distributed I/Os (DP) Communication
This chapter describes the cyclic communication with standard DP slave stations via the I/O area of the SIMATIC S5 programmable controller.

Chapter 12
FMA Services
This chapter describes the different types of communication including a detailed description of the basics and the configuring procedure. At the end of each section there is an example to illustrate the type of communication.

Chapter 13
Clock Services
This chapter describes the data formats for the time of day and explains how the clock master and clock slave roles function.

Chapter 14
Documentation and Test
This chapter contains a description of the test and documentation functions referred to in earlier chapters

Chapter 15
Utilities
The "bus selection" utility is described in this chapter. This tool is used to create paths that can be activated using the menu command Bus Selection.

You can also use this tool to modify the memory module size and with the CP 5430 TF, you can convert databases of the CP 5430 to new databases.

Chapter 16
Using the Application Examples
This chapter describes the general procedure for the application examples.

Chapter 17
Appendix
Here, you will find important information you require regularly, for example the significance of error messages, basic calculations for important bus parameters, notes on the simultaneous use of different types of data transmission etc.

Chapter A and B
Abbreviations and Index
The list of abbreviations will help you considerably when working with this manual since you can check the meaning of unknown abbreviations quickly. You can use the index to find a term quickly.

Chapter C
Further Reading
This section lists publications and manuals dealing with related aspects (marked in the text with **/x/**).

Volume 2 of the CP 5431 FMS manual explains the range of functions of the FMS protocol architecture.
The user interface to the corresponding FMS services is described for SIMATIC S5.
It provides you with the following information:

➢ Handling
Acyclic communication or
Cyclic communication on the basis of FMS

➢ Documentation and Test

➢ Request Editor

Volume 2 of the CP 5430 TF manual explains the range of communication with layer 7 (application layer). It describes the user interface to the corresponding SINEC technological functions (TF) for SIMATIC S5 and for TF configuration.

This volume provides important information for:

➢ Detailed configuration of the communications processor under TF and how to configure communication objects (variables, domains etc.)

➢ Operating the interfaces supported by the CP under TF

➢ This volume also introduces the additional packages belonging to the functional range of the COM system program for menu-guided support of the TF client interface with the Request Editor. ❑

2 System Overview

The performance of control systems is no longer simply determined by the programmable controllers but also to a great extent by the accessory equipment. Apart from plant visualization, operating and monitoring this also means a high-performance communications system.

Distributed automation systems are being used increasingly in production and process automation. This means that a complex control task is divided into smaller "handier" subtasks with distributed control systems. As a result, efficient communication between the distributed systems is an absolute necessity.

Such distributed structures have, for example, the following advantages:

➢ Independent and simultaneous start-up of individual sections of plant

➢ Smaller, clearer programs.

➢ Parallel processing by distributed automation systems with the following results:
- shorter reaction times
- reduced load on the individual processing units

➢ Supervisory controllers can handle additional diagnostic and logging functions

➢ Increased plant availability since the failure of a substation does not stop the whole plant

A comprehensive, high-performance communications system is a must for a distributed plant structure.

With SINEC, Siemens provides an open heterogeneous communications system with various local area networks (LANs) for industrial environments. The SINEC communications system is based on national and international standards according to the ISO/OSI reference model.

LANs form the basis of the communications system and can be implemented

- electrically
- optically
- as an electrical/optical combination.

2.1 SINEC Overview

SINEC (SIEMENS Network Architecture for Automation and Engineering) is the name of the communications network for SIEMENS programmable controllers, process computers workstations and personal computers.

SINEC includes the following:

- ➢ The communications network comprising the transmission medium, link and transmission components and the appropriate transmission technique.
- ➢ Protocols and services for data transmission between the devices mentioned above.
- ➢ The modules of the automation system or computer providing the link to the communications network (communications processor "CP").

To handle the variety of tasks in automation engineering SINEC provides different communications networks to suit the particular situation.

The topology of rooms, buildings, factories and complete company complexes and the prevalent environmental conditions mean different requirements. The networked automation components also make different demands on the communications system.

To meet these various requirements, SINEC provides the following communications networks complying with national and international standards:

- ➢ SINEC H3,
  a high-speed optical network (FDDI standard).
- ➢ SINEC H1/H1FO,
  a communications network using baseband technology according to IEEE 802.3 with the CSMA/CD medium access technique operating on The following media:

- triaxial cable (50 Ω)

- fiber-optic cable

- twisted pair

➢ SINEC L2/L2FO,
a communications network for the cell and field area according to PROFIBUS with hybrid medium access techniques token bus and master-slave operating on

  - twisted pair

  - fiber-optic cable

The various communications networks can be used either independently of each other or in different combinations as required.

2.2 The PROFIBUS-Compatible Network SINEC L2/L2FO

Within the open, heterogeneous SINEC communications system, SINEC L2/L2FO is the network for the cell and field area, intended particularly for industrial environments.

The SINEC L2 network complies with the German process and field bus standard PROFIBUS DIN 19245.

SINEC L2 is the **electrical** network based on a shielded, twisted pair.

The optical network **SINEC L2FO** (FO = fiber-optic) is the **optical version** of SINEC L2, i.e. the data transmission between two components (DTE = data terminal equipment) is on fiber-optic cables.

SINEC L2/L2FO has the following characteristics:

- ➢ Low installation costs
- ➢ High flexibility in its communications options, i.e. open communication by using standards
- ➢ A variety of possible network topologies using repeaters

The SINEC L2/L2FO bus system can be used in a variety of areas of application, e.g.

- ➢ Process engineering
- ➢ Production engineering
- ➢ Mechanical engineering
- ➢ Power engineering
- ➢ Building automation

The following devices could be connected to each other via a SINEC L2/L2FO network:

- SIMATIC programmable controllers, S5-95U, S5-115U, S5-115H, S5-135U, S5-150U, S5-155U and S5-155H
- PCs
- Motor protection and control devices capable of communication (e.g. SIMOCODE)
- Measuring transducers
- Actuators
- Field controllers
- PROFIBUS-compatible programmable controllers (PLC and CNC)
- Local operating, monitoring and programming devices

2.2.1 Standards

SINEC L2 is based on the reference model of the International Standards Organization ISO for "Open System Interconnection" (OSI, Fig. 2.1). The aim of this model is the connection of devices from different manufacturers via a common "communications system".

The area of application of SINEC L2 bus systems ranges from simple field bus applications to the networking of production cells (cell bus). In keeping with this broad area of application, three protocol standards are available with SINEC L2:

- **SINEC L2-TF** (technological functions)
  is suitable for cell networking and allows communication with higher SINEC H1 networks. /2/ /13/

- **SINEC L2-FMS** (field bus message specification)
  is a version intended for networking in the field area with devices of different manufacturers which comply with Part 2 of DIN 19245. /10/ /12/

- **SINEC L2-DP** (distributed I/Os)
  is for the fast connection of distributed I/O systems and corresponds to DIN E19245 Part 3 PROFIBUS-DP. /11/

All three versions use the PROFIBUS link protocol, i.e. Part 1 of DIN 19245 /1/. All three protocols can be operated simultaneously on a SINEC L2 bus system, however, communication is only possible between stations with the same protocol structure.

SIMATIC S5 provides the following connections for these three protocol standards:

➢ The SINEC L2-TF connection with the CP 5430 TF

➢ The SINEC L2-FMS connection with the CP 5431 FMS

➢ The SINEC L2-DP connection with the IM308 B and the CP 5430 TF/CP 5431 FMS.

This manual (Volume 1) describes the common functions of the CP 5430 TF/CP 5431 FMS (layer 2). The layer 7 communication of the TF services on SINEC L2 is described in Volume 2 for each module separately.

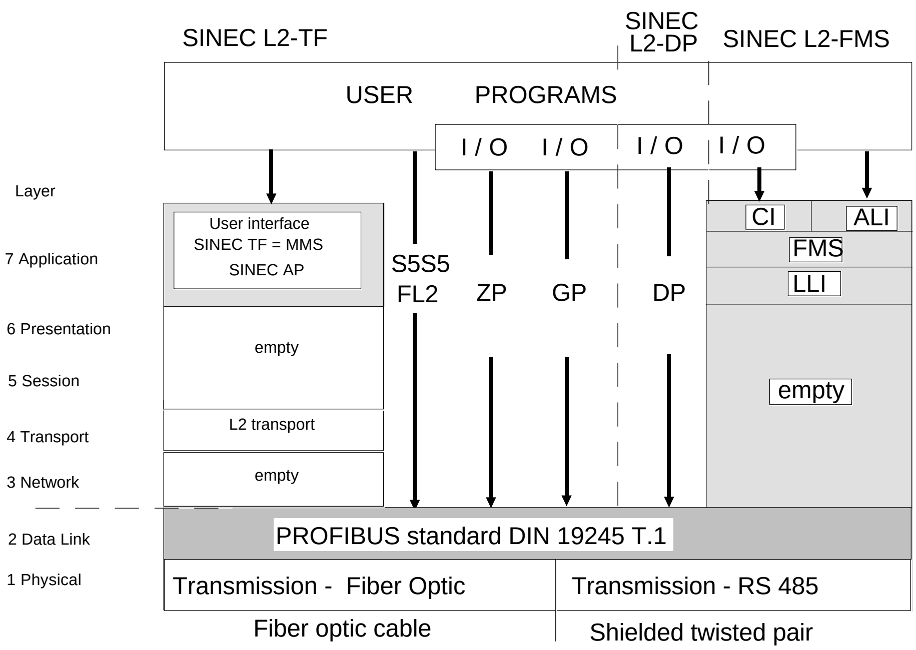


Fig. 2.1 Layered Structure with SINEC L2/L2FO

The ISO/OSI reference model is divided into 2 different areas:

➢ Transport-oriented layers: 1 - 4

➢ Application-oriented layers: 5 - 7

In SINEC L2/L2FO the lower layers 1 (physical layer) and 2 (data link layer) comply with the PROFIBUS standard DIN 19245 Part 1. SINEC L2 supports various transmission techniques (layer 1):

➢ RS-485 transmission technique (complying with the PROFIBUS standard) /4/

➢ Fiber-optic transmission technique

The medium access control technique (layer 2) in SINEC L2/L2FO is a hybrid technique operating according to the

➢ Token bus principle for "active stations"

and the

➢ Master-slave principle between "active" and "passive" stations.

Layer 2 provides the standardized FDL interface "Fieldbus Data Link" for the higher layers. Frames can be processed on this interface with two different priorities (high, low).

L2 transport as layer 4 provides functions such as segmentation, link establishment and link termination.

Explanations of the layer 2 communication model for SIMATIC S5 are in Chapter 3 of this manual (Volume 1) in Chapter 3.

Explanations of the FMS model for SIMATIC S5 are in Volume 2 of the manual for the CP 5431 FMS.

Explanations of the TF communications model for SIMATIC S5 are in Volume 2 of the manual for the CP 5430 TF.

2.2.2 Network Access Technique

The medium access technique in SINEC L2/L2FO complies with the token bus technique for active stations and master-slave technique for passive stations as stipulated in DIN 19245 Part 1.

Active stations

- ➢ can send data to other stations without being requested to
- ➢ can request data from other stations.

Passive stations

- ➢ can only send data after a request from an active station.

Whether or not a station is active or passive depends on the particular device. Simple field devices, e.g. motor controllers are usually passive, "intelligent" devices such as programmable controllers, on the other hand, are normally active. Many devices can be assigned an active or passive role. The CP 5430 TF/CP 5431 FMS can only be assigned parameters as an active station.

The access technique is not dependent on the transmission medium.
Fig. 2.2 illustrates the hybrid technique with active and passive stations. This is explained briefly below:

- ➢ All active stations form the logical token ring in a fixed order, each active station being aware of the other stations and their order in the logical ring.
- ➢ The token (right to transmit) is passed from active station to active station. The following applies to all active stations: a token rotation takes place between transmitting the token and receiving it again.

➢ Every active station "knows" the addresses of the other active stations. An active station checks the address area between itself and the next active station cyclically, this is known as the GAP address area. With this check, the station recognizes whether an active or passive station has been included in the ring or whether a passive station has been removed.
The GAP update factor specifies the interval at which an active station checks its complete GAP address area. When a new station is added to the ring, it receives the token immediately.

➢ When a station has the token, it can transmit providing its token holding time has not elapsed. The token holding time is calculated according to a special method each time the token is circulated and indicates how long the station is permitted to keep or hold the token. If the token holding time has already elapsed when the token is received, the station can nevertheless transmit one high-priority frame.

➢ If an active station has the token and if links to passive stations have been configured, these passive stations are then polled (e.g. read values) or data is transmitted to them (e.g. transfer of a setpoint).

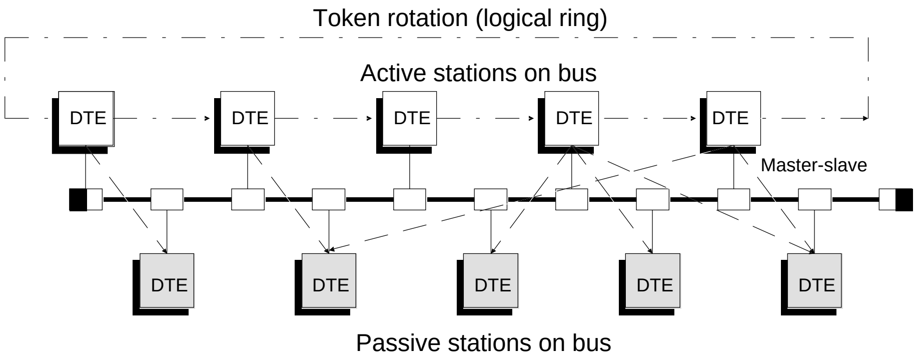


Fig. 2.2 Principle of the SINEC L2 Hybrid Access Technique

Within the token mechanism for the active stations, various procedures are defined for the following special situations:

➢ Initializing the logical token ring

➢ Duplication of the token

➢ Loss of the token

➢ Addition or deletion of an active station in the logical ring

The way in which the SINEC L2/L2FO network functions results in two special cases:

1. When only **one station is active** and **all others are passive**, the bus operates on a **master-slave principle**.

2. When **all stations are active** the technique is **token passing**.

A token rotation takes a certain amount of time. The maximum permitted rotation time must be programmed and is known as the target rotation time.

Even when there is a large amount of data traffic, the set target rotation time must be kept to. To keep within this time, SINEC L2/L2FO uses a principle explained below.

Each station measures the actual token rotation time and calculates the difference between the target rotation time and the actual rotation time (= token holding time). During this time, the station can transmit (first the frames with high priority and then the frames with low priority). Once the token holding time has elapsed, the token must be passed on.

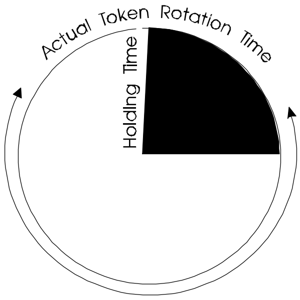


Fig. 2.3 Distribution of the Target Rotation Time (1)

If the transmitter has very little or no token holding time available, (Fig. 2.4) it can only send one high priority frame before it is forced to pass on the token.

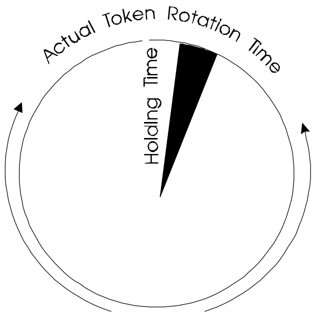


Fig. 2.4 Distribution of the Target Rotation Time (2)

2.2.3 Transmission Techniques

With SINEC L2/L2FO there are two different transmission techniques available (RS-485, FO) for two different transmission media (twisted pair or fiber-optic cable). The SINEC L2/L2FO communications processors (CPs) generally support both transmission techniques (refer to the manuals for the specific CPs). The transmission technique is selected along with the SINEC L2/L2FO bus terminal type.

2.2.3.1 Transmission According to RS-485

The transmission technique RS-485 corresponds to symmetrical data transmission with NRZ coding according to the USA standard EIA RS-485 /4/. The PROFIBUS standard DIN 19245 Part 1 stipulates RS-485 as transmission technique version 1 on a twisted pair transmission medium. The maximum length of a bus segment depends on the data rate and the cable used.

RS-485 has the following electrical characteristics:

Topology	bus, terminated at both ends by its characteristic impedance; connecting cables to SINEC L2 station max. 3 m.
Medium:	shielded, twisted pair characteristic impedance: 160 Ω loop impedance: 110 Ω operating capacitance: 30 nF/km attenuation: 0.9 dB/100 m (200 kHz) wire cross section: 0.34 mm^2
Data rate (dr):	9.6 / 19.2 / 93.75 / 187.5 / 500 / 1,500 Kbps
Cable length (per bus segment):	1,200 m for dr <= 93.75 Kbps 1,000 m for dr = 187.5 Kbps 400 m for dr = 500.0 Kbps 200 m for dr = 1,500.0 Kbps

(only when using the SINEC L2 bus cable)
Various cables are available from Siemens for SINEC L2

Number of stations: max. 32 per bus segment
max. 127 per network when using repeaters

The SINEC L2 bus terminal is used to structure the network. The bus terminals can be connected to any standardized L2 connector (9-pin sub-D socket). The pin assignment of the terminal connector corresponds to the PROFIBUS standard. When supplied, the bus terminal is fitted with a cable for connection to the CP 5430 TF/CP 5431 FMS communications processor.

☞ **For disturbance-free operation with the terminator connected, the bus terminal requires the 5 V supply voltage from the DTE. The DTE at the end of the bus must be switched on.**

2.2.3.2 Transmission with Fiber Optic Cables (FO)

The fiber-optic version of SINEC L2 is implemented by an active star coupler and optical bus terminals. Owing to the physical characteristics of the fiber-optic cable, SINEC L2FO is structured as a star network.

The data terminal equipment DTEs (e.g. SIMATIC S5 programmable controllers) are connected to the modules of the active star coupler in point-to-point links (star) via the bus terminals and glass or plastic fiber-optic cables.

The length of these point-to-point links depends on the data rate and can be up to 1400 m long with the SINEC L2FO standard cable 62.5 / 125 µm. Several active star couplers can be cascaded to form more complex networks (greater number of DTEs, branched networks, wider spread). The number of active star couplers that can be connected in series, however, is reduced at higher data rates.

A point-to-point link between 2 SINEC L2FO bus terminals (without an active star coupler) is possible.

Characteristics of the fiber-optic technique:

- long distance between two DTEs when star couplers are cascaded (max. 17 x 1.4 km = 23.8 km at dr = 187.5 kbps[1)]
- immune to electromagnetic interference
- terminal equipment electrically isolated
- supports glass and plastic fiber-optic technology.

The fiber-optic transmission technique has the following characteristics:

Topology:	star network with active star couplers as central components
Medium:	glass fiber-optic cable 62.5/125 µm multimode graded index optional 50/125 µm or 100/140 µm multimode graded index fiber-optic cable plastic fiber-optic cable 980/1000 µm step index
Data rate (dr):	9.6 / 19.2 / 93.75 / 187.5 / 500 / 1.500 Kbps
Cable length:	0...1.400 m [1)] for all data rates listed
Cascading depth	23.8 km at 187.5 Kbps [1)] (max. 16 star couplers in cascade) 8.4 km at 500 Kbps [1)] (max. 5 star couplers in cascade) 4.2 km at 1.500 Kbps [1)] (max. 2 star couplers in cascade)
No. of stations:	max. 16 per star coupler max. 127 per network

1) When using the SINEC L2FO standard fiber 62.5 / 125 µm

For more information about fiber-optic cables, refer to Fundamentals, Cable Technology /5/, VDI/VDE 3692 page 2 /6/ and the SINEC L2/L2FO Network Manual /9/.

2.3 Network Topology

2.3.1 Topology of an Electrical SINEC L2 Network for the RS-485 Technique

In an electrical SINEC L2 network, the bus cable is a shielded, twisted pair (SINEC L2 bus cable). The characteristic impedance is 160 ohms. All the stations are connected to the SINEC L2 bus cable using SINEC L2 bus terminals. Each SINEC L2 bus segment must be terminated at both ends. This line terminator is integrated in each bus terminal and is connected in the two bus terminals at the end of the cable.

Fig. 2.5 illustrates the typical structure of a SINEC L2 network for RS-485. The SINEC L2 topology is a linear bus. By using the SINEC L2 repeater, several SINEC L2 bus segments can be connected together extending the SINEC L2 bus system length and increasing the number of stations.

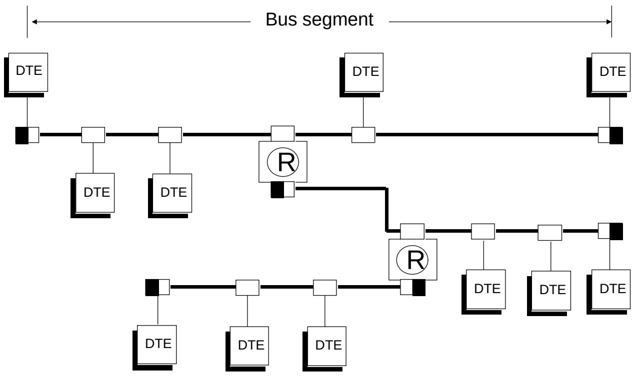


Fig. 2.5 Topology of SINEC L2 for RS-485

RS-485 allows 32 connections (bus terminals or repeaters) per bus segment. The maximum length of a segment depends on the data rate used. The following table (2.1) lists the upper limits for a SINEC L2 bus cable.

Data rate	Max. segment length
9.6 Kbps	1.200 m
19.2 Kbps	1.200 m
93.75 Kbps	1.200 m
187.5 Kbps	1.000 m
500.0 Kbps	400 m
1,500 Kbps	200 m

Table 2.1 Upper Limits of the Data Rate

Using the repeater as a structuring element, SINEC L2 bus systems can be implemented in rows and tree structures.

2.3.2 Topology of an Optical SINEC L2FO Network

Using an active star coupler (AS 501) several stations can be connected together in a star network (Fig. 2.6).The connection between the DTE and the active star coupler or between active star couplers is a plastic fiber-optic cable (980/1000 µm) or glass fiber-optic cable (62.5/125 µm).The maximum distance between a DTE and the active star coupler determines the maximum distance of 2800 m between any two DTEs. By cascading star couplers, the maximum distance is increased by a further 1400 m with each active star coupler. Apart from the star coupler, modular fiber-optic components are available under the name 'optical link module' (OLM) for glass and plastic fibers.

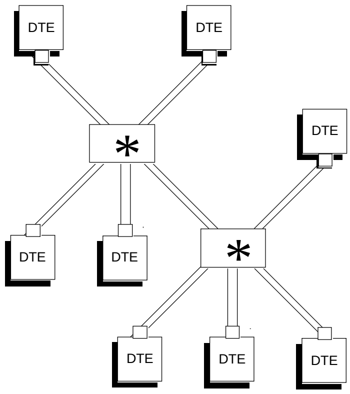


Fig. 2.6 Star Couplers with DTEs

By connecting two DTEs directly with a fiber-optic cable, an optical point-to-point link can be implemented. No active star coupler is required. The maximum distance between DTEs with glass fiber-optic cables is 1,400 m (Fig. 2.7).

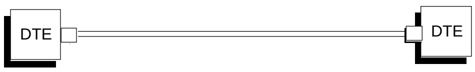


Fig. 2.7 DTEs in a Point-to-Point Link

2.3.3 Topology of a Combined Electrical / Optical SINEC L2/L2 FO Network

Using a SINEC L2 RS-485 repeater with an SF optical repeater adapter, an electrical L2 network (RS-485) can be connected to the active star coupler of an optical L2 network (see Fig 2.8). It is also possible to connect two electrical L2 networks optically by means of repeaters with optical repeater adapters (for interconnecting optical links, see Fig. 2.9). In these optical point-to-point links, no active star coupler is required.

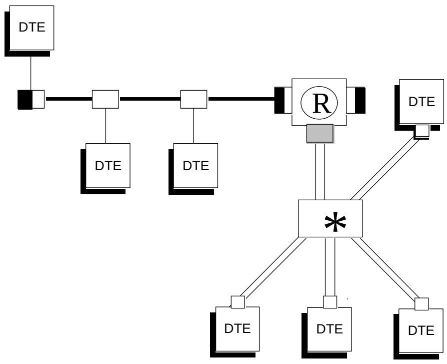


Fig. 2.8 Repeater Connected to Optical Star Coupler with DTEs

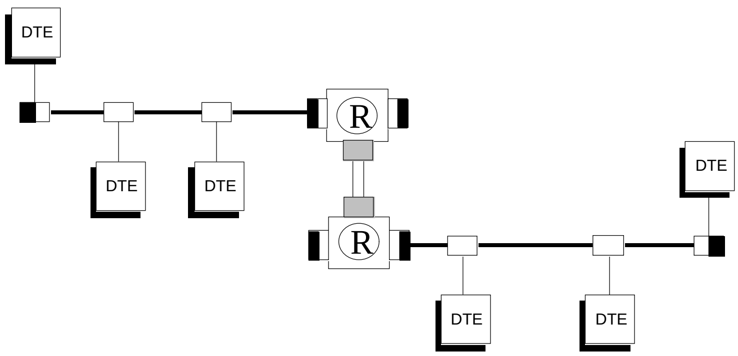


Fig. 2.9 Interconnecting Optical Link

To connect a SINEC L2 repeater to an active star coupler using an SF optical repeater adapter, the maximum distance of 1400m applies just as for a direct optical connection between two repeaters using SF optical repeater adapters.

2.4 Configuring the Network

2.4.1 Configuring a SINEC L2 Network for RS-485

When configuring a purely electrical network the following values are important:

➢ max. segment length

➢ max. number of stations

➢ max. length of the connecting cables

➢ cascading rules for SINEC L2 repeaters.

Fig. 2.5 shows the typical structure of a SINEC L2 network for RS-485, comprising several segments connected by repeaters.

Owing to the frequency-dependent attenuation of the cable, the maximum segment length depends on the data rate. Table 2.1 shows the maximum segment lengths for a SINEC L2 bus cable.

Number of stations
The maximum number of addressable stations with SINEC L2 (and PROFIBUS DIN 19245) is 127. A maximum of 32 stations are possible per bus segment (stations and repeaters).

Connecting cables
The segment lengths indicated here can only be achieved when certain frequency-dependent capacitances caused by the connecting cables to the stations are not exceeded. It may be necessary to reduce the total length of the connecting cables. (see Table 2.2).

The following connecting cables are permitted for the data rates listed:

Data rate	Max. number of connectable RS-485 bus terminals with 1.5 m connecting cables	Max. number of connectable RS-485 bus terminals with 3 m connecting cables
9.6 Kbps	32	32
19.2 Kbps	32	32
93.75 Kbps	32	32
187.5 Kbps	32	25 *
500 Kbps	20 *	10 *
1500 Kbps	6 *	3 *
*These values apply to version 1 of the RS-485 bus terminal. On request, there is a different version of the bus terminal which has no connecting cables, allowing a larger number to be connected.		

Table 2.2 Data Rate and Connecting Cables

☞ **Make sure that at data rates 187.5 Kbps, 500 Kbps or 1500 Kbps the total length of the connecting cables does not exceed 75 m, 30 m or 10 m respectively.**

Cascading rules for repeaters

The permitted cascading depth depends on the data rate. At 1500 Kbps, a maximum of four and at lower rates a maximum of seven repeaters can be cascaded. A repeater causes a delay of approximately 1.5 bit times. This delay time which is dependent on the data rate must also be taken into account when calculating the slot time (refer also to Chapter 6).

2.4.2 Configuring a SINEC L2FO Network

When planning a SINEC L2FO network the following parameters are important:

- ➢ maximum signal attenuation/attenuation calculation
- ➢ cascading rules

You will find detailed information about planning a SINEC L2FO network in the SINEC L2/L2FO Network Manual /9/. Further reading /7/8/. ❑

NOTES

3 Fundamentals of the Model

To understand the procedure and to be able to work with the system, the user must be familiar with the model and the terminology. This chapter first explains the architecture, then the communications model and its terminology and finally the simulation on programmable controllers.

To keep the explanation of terminology clear, some general terms are explained in the appendix.

The basic aims of the communication described in this volume are as follows:

➢ Simple data exchange via layer 2 (ISO/OSI),

➢ Limited volume of transmitted and received data to improve performance,

➢ Simple handling.

This model includes two basic types of communication:

➢ Implicit communication is handled in the SIMATIC PLC by means of I/O bytes, consisting of the distributed I/Os (DP) cyclic I/Os (ZP) and global I/Os (GP). Implicit communication is controlled by the communications processor (CP).
The **exceptions** in this case are the cycle-synchronized communication modes of the DP, ZP and GP. Here, handling blocks are used for synchronization.
The cyclic I/Os (ZP) mode is only possible with the CP 5430 TF.

➢ Explicit communication is handled in the SIMATIC PLC by the handling blocks within the system, consisting of S5-S5, FMA and free layer 2 communication.

3.1 ISO/OSI Reference Model for Communication

To obtain a structured architecture, the communications tasks were divided into seven layers (refer to Fig. 3.1). Each device (station) within the network has the same structure. The layers are hierarchical and each layer provides a series of services to the next higher layer. With each service, the executing layer of the local station communicates with the peer layer of the remote station (logical data exchange). This communication uses a virtual link with a protocol for the specific layer.

LAYER		TASK
7	Application Layer	Interface to application process, provides basic functions
6	Presentation Layer	Negotiation of the coding of the data to be transmitted, transformation of local into transfer syntax
5	Session Layer	Control of the communication, Synchronization
4	Transport Layer	Non network-dependent transport service flow control, fragmentation, separation of application from the transport links
3	Network Layer	Routing of traffic within the network, establishment and termination of links
2	Data Link Layer	Distribution, flow control, error detection and correction
1	Physical Layer	Transmission and reception of unstructured bit streams, electrical representation of signals

(shaded) relevant for CP communication in this volume

Fig. 3.1 The Seven Layers of the ISO/OSI Reference Model

3.2 Architecture <-> OSI Environment

The architecture of the CP 5430 TF is illustrated in Fig. 3.2, that of the CP 5431 FMS in Fig. 3.3, (refer also to Fig. 2.1). The components are briefly explained after the figures.

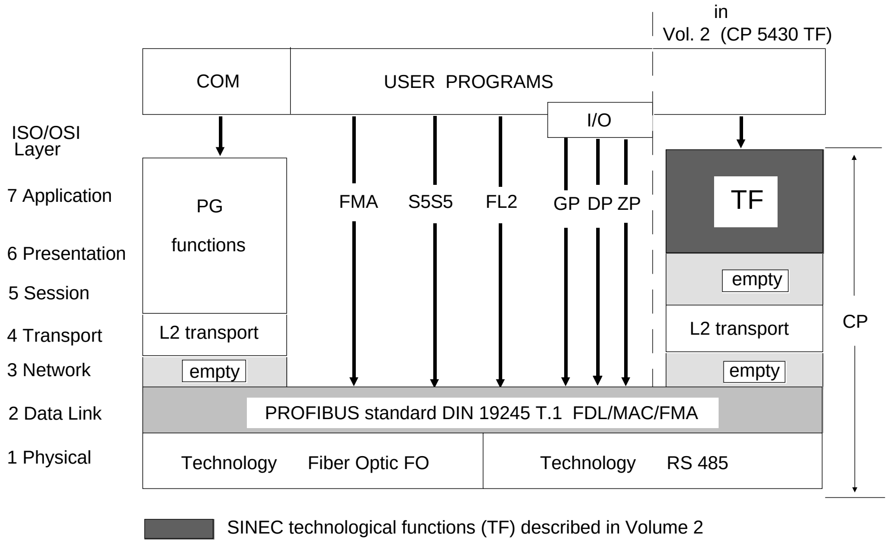


Fig. 3.2 Protocol Architecture of the CP 5430 TF

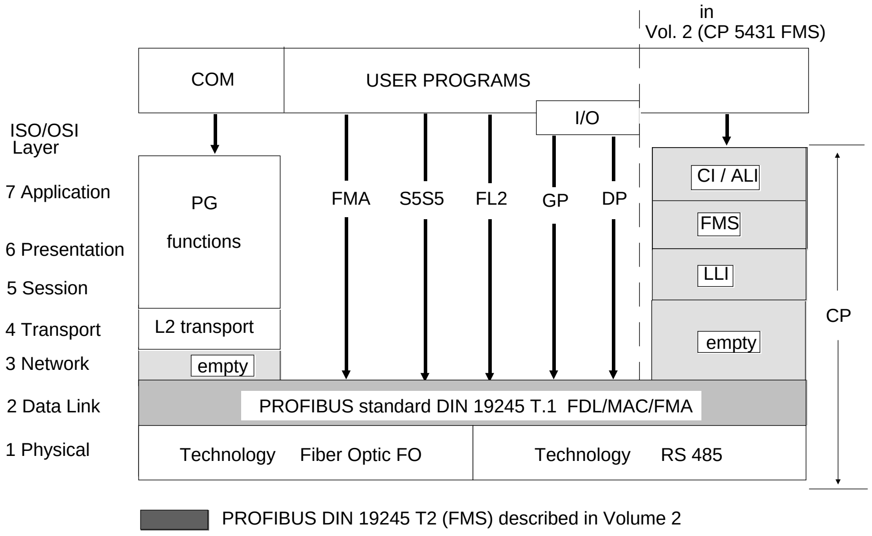


Fig. 3.3 Protocol Architecture of the CP 5431 FMS

Key:

S5-S5: SIMATIC S5 PLC-PLC communication (Chapter 7)

FL2: Free layer 2 communication (Chapter 8)

GP: Global I/Os (Chapter 9)

ZP: Cyclic I/Os (Chapter 10) CP 5430 TF

DP: Field bus management layer (Chapter 11) CP 5430 TF/CP 5431 FMS

FMA: Field bus management layer (Chapter 12)

FDL: Field bus data link
the services belonging to layer 2 are also known as FDL
(field bus data link) services

LLI:	Lower layer interface (Volume 2) CP 5431 FMS
FMS:	Fieldbus messaging specification (Volume 2) CP 5431 FMS
ALI:	Application layer interface (Volume 2) CP 5431 FMS
CI:	Cyclic interface (Volume 2) CP 5431 FMS
MAC:	Media access control
L2-Transport:	Transport layer
TF:	Technological functions (Volume 2) CP 5430 TF
PG functions:	Used for the following:
	- loading/deleting the CP
	- executing COM functions
	- bus selection
	- test functions
COM:	Used to configure and assign parameters to the CP

3.2.1 Communications Model

This section is intended to introduce you to the communications world and to provide explanations of the model and terminology to establish the relationship between theory and practice.

In terms of communication, an application process includes all the programs, resources and tasks not assigned to a communication layer. These include, for example, operating systems, real application processes, application programs and communication drivers.

3.2.1.1 Relationship between Application Processes

There are logical relationships between application processes which are used to exchange information. These communication relations must all be established before data exchange begins. An application process can participate in communication via communication end points. One or more communication end points are assigned on a fixed basis and uniquely to an application process. These are addressed by the application process using local communication references (address of the communication end point). The communication references are specific to a device. Between two application processes, there are one or more communication relationships which are uniquely assigned to communication end points (see Fig. 3.4).

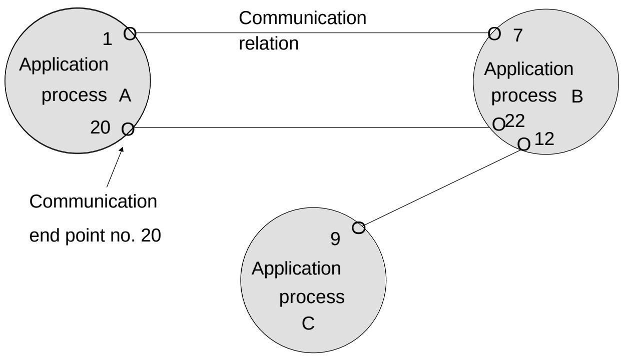


Fig. 3.4 Relationship Between Application Processes

3.2.1.2 Logical Data Exchange

FDL services are available for issuing jobs. Jobs are transferred via the specified communication relations (logical channels as connection) to the communication partner in PDUs.

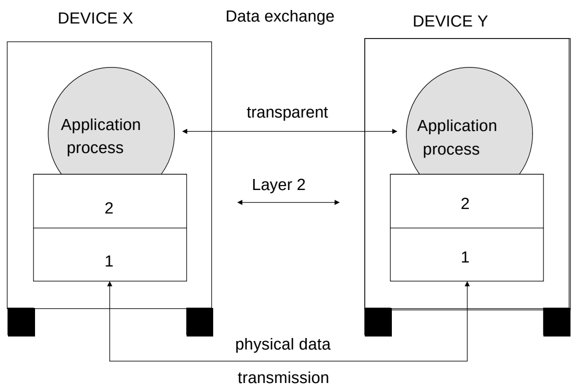


Fig. 3.5 Logical Data Exchange

To the user, it appears as if the application processes exchange data directly. In fact, the data are passed down from layer 2 on one side, transmitted on the physical medium and passed up again to layer 2 through the communications layers.

3.2.2 Communication Relations

From the point of view of the user, communication with the application processes of the communication partner takes place on logical channels. These logical channels to the communication partners are defined in the configuration phase.

For each communication relationship the following information is stored:

- address of the remote station
- local and remote service access point

The communications start and end point of a logical channel between two stations on the bus is known as a Service-Access Point (SAP). A SAP is a further address criterion in addition to the station address. You must specify a SAP number for each channel to be able to use layer 2 services.

3.2.2.1 Addressing Model for Explicit Communication (for S5-S5, free layer 2 and FMA)

An interface to the user process is specified for SIMATIC S5 by the interface number and job number.

In the CP itself, a job is identified and managed using only the job number (Fig. 3.6).

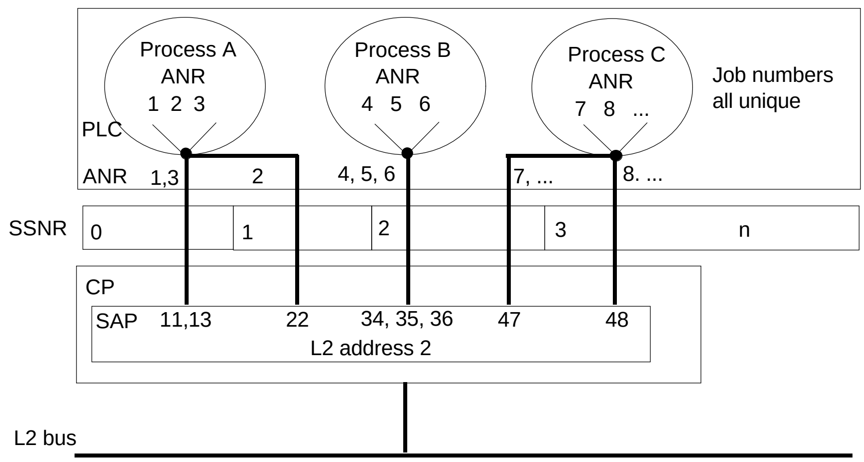


Fig. 3.6 Addressing Model for Communication on the CP

The assignment of the job number to the SAP must be unique both (local and remote). When configuring the CP 5430 TF/CP 5431 FMS, the communication relations to other stations must be specified.

3.2.2.2 Addressing Model for Implicit Communication (GP, DP ZP)

In data transmission using implicit communication via L2, the data exchange is handled via the I/O area of the SIMATIC PLC.
All I/O bytes via which you want to send and all I/O bytes via which you want to receive must be assigned to the appropriate I/O protocol by configuring the I/O areas in COM.

In GP (global I/Os) communication, I/O bytes are assigned to global objects of the GP during configuration.

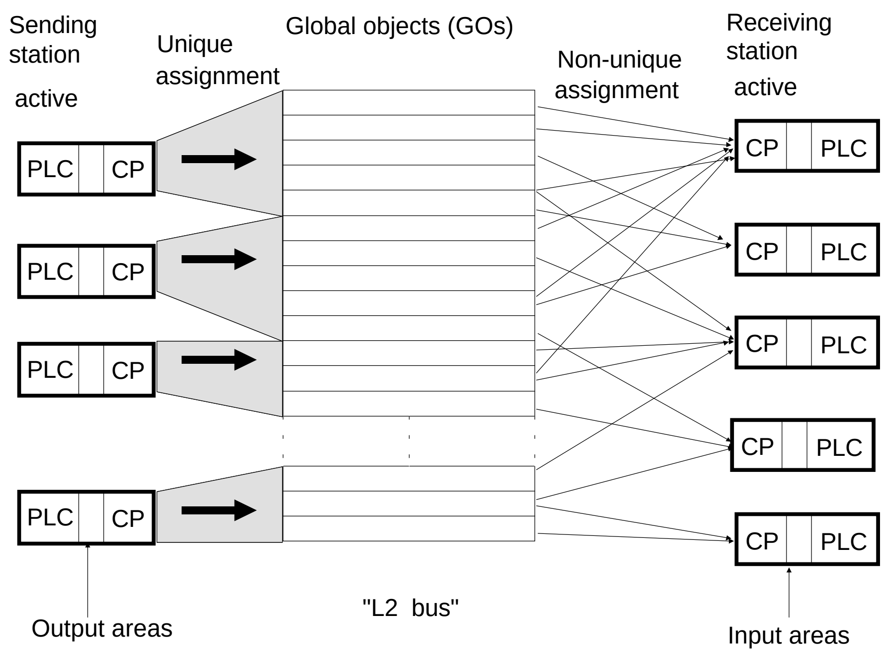


Fig. 3.7 Addressing Model for Communication with GP

Sending and receiving stations must be active. Both functions, sending and receiving are possible in one station.
Communication is via global objects which form the connection (the "bus").

In ZP (cyclic I/Os) communication (CP 5430 TF), I/O areas of certain passive stations are assigned by configuring their L2 address and the remote SAP.

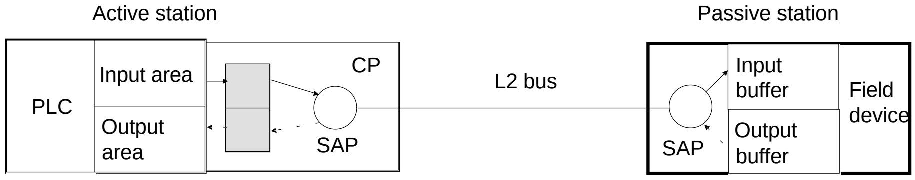


Fig. 3.8 Addressing Model for Communication with ZP

In DP (distributed I/Os) communication, I/O areas of certain passive stations are assigned simply by configuring their L2 address.

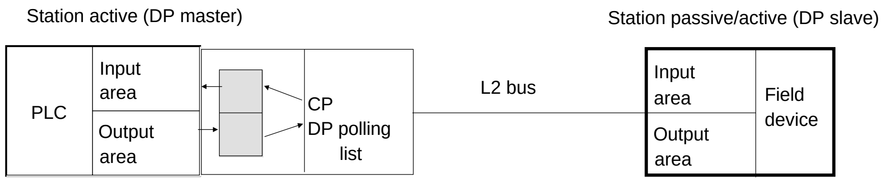


Fig. 3.9 Addressing Model for Communication with DP

3.3 Application Interfaces of Layer 2 Communication

In this model, as already mentioned, there are two basic types of communication:

Explicit communication using the existing handling blocks:

- S5-S5 communication
- Free layer 2 communication
- FMA services.

Implicit communication using I/O bytes:

- Global I/Os (GP)
- Cyclic I/Os (ZP) with the CP 5430 TF
- Distributed I/Os (DP).

3.3.1 Explicit Communication

3.3.1.1 S5-S5 Communication

With this type of communication, the CP generates frames from the data records of the SIMATIC S5 PLC which meet the requirements of the PROFIBUS standard (Part 1). The services of the first layer and the FDL-SDA (send data with acknowledge) service of the second layer of the ISO/OSI reference model are used. Communication between SIMATIC S5 PLCs is achieved using HDBs via S5-S5 links. The job numbers 1 to 32 are available for transmit jobs via layer 2 and 101 to 132 for receive jobs. The links to be established between the maximum 32 active stations on SINEC L2 (static SAP relationships), can be configured with the aid of the COM. The size of the frames is restricted to a maximum of 128 bytes.

With this type of data transmission, you do not need to know about PDU structure or service IDs, since the CP does the encoding. To control communication with the SIMATIC S5 PLC, it is necessary to check and evaluate the status words of the HDB during the communication.

The basic sequence of communication via S5-S5 links is described in Chapter 7 .

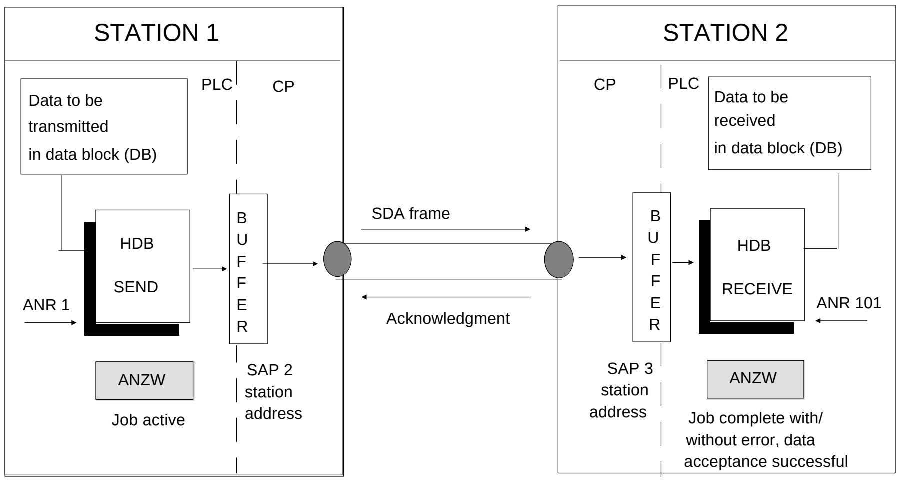


Fig. 3.10 Handling an S5-S5 Link

3.3.1.2 Free Layer 2 Communication with FDL Services

For communication with passive or active and heterogeneous stations on the SINEC L2 bus, the CP provides a free access to layer 2.

With this type of data transmission, it is valuable to understand the services of layer 2 of the model.

The layer 2 firmware of the CP provides various services for reliable data transmission which you can use in the control program. In concrete terms, this means that you request layer 2 services for data transfer and evaluate confirmations (including error messages) made available by this layer in the control program. You must also evaluate layer 2 indications when a frame is received by the CP.

The FDL services specified in PROFIBUS (DIN 19245/1) and implemented in the CP for data transmission are as follows:

- FDL_DATA.-req/-ind/-conf (SDN service)
- FDL_DATA_ACK.-req/-ind/-conf (SDA service)
- FDL_DATA_REPLY.-req/-ind/-conf (SRD service)
- FDL_SEND_UPDATE.-req/-ind/-conf (RPL_UPD_S)
- FDL_REPLY_UPDATE.-req/-ind/-conf (RPL_UPD_M).

You use these services provided by the layer 2 firmware of the CP in your STEP 5 control program by calling handling blocks which refer to job buffers. The job buffer (PDU) must be completed by the user. The first 8 bytes ("header") of the job buffer to be transferred contain control information for the layer 2 firmware. The receiver can evaluate the first 8 bytes of the received block of data as status information (this also includes error messages).

With the data transmission services SDA, SDN and SRD, the CP 5430 TF/CP 5431 FMS uses the control information from the header of the block of data to "pack" the data in a frame which can then be transmitted via the SINEC L2 bus. The remaining 242 bytes are available for the user data when transmitting and receiving.

The basic procedure for communication with the free layer 2 access is described in Chapter 8.

The job numbers ANR 134 to ANR 186 are available for these layer 2 functions.

3.3.1.3 Fieldbus Management with FMA Services

The FMA services are provided on the CP 5430 TF/CP 5431 FMS for service and information purposes. The execution of an FMA service corresponds to that of an FL2 service. The following reading (passive) FMA services are available to the user on the CP:

- ➢ FDL_READ_VALUE
- ➢ LSAP_STATUS
- ➢ FDL_LIFE_LIST_CREATE_LOCAL
- ➢ FDL_IDENT
- ➢ FDL_READ_STATISTIC_CTR
- ➢ FDL_READ_LAS_STATISTIC_CTR.

To start an FMA service, the job buffer (8 byte "header") must be transferred to layer 2. The data for the job are then returned in the confirmation.

The basic procedure for the FMA services using FL2 access is described in Chapter 12. The special job number ANR 200 is available for these management functions.

3.3.2 Implicit Communication

If you use implicit communication, the communications processor (CP) controls the communication. The types of communication in DP, ZP and GP in which communication is synchronized with the cycle and for which handling blocks are used to update information are exceptions.

The difference between GP and DP/ZP is as follows:

- GP is used for communication only between active stations

- DP/ZP is used for communication between an active and a passive station.

- DP data exchange is only controlled by one master (polling).

3.3.2.1 Global I/Os (GP)

The term "global I/Os" means that part of the I/O area is not used by I/O modules but for global data exchange between SIMATIC PLCs. Global data exchange involves the CP sending the entire changed output area assigned to the global I/Os and cyclically updating the entire input area assigned to the global I/Os with the received data once again. The global I/O area is in the I/O area of the controller and is also used by the PLC program. The address areas are processed with STEP 5 operations. The mode can either be synchronized with the cycle or free. With the cycle-synchronized mode, a CP-HDB must be called at the checkpoints required by the user to ensure the consistency of inputs and outputs. This HDB also triggers a group job for data transmission.

An important characteristic of global I/Os is that changes in the data bytes are recognized and only the changes transmitted.

This data transmission is suitable for the transfer of single bytes between active SIMATIC S5 programmable controllers.

The CP 5430 TF/CP 5431 FMS uses the SDN transmission service to transmit the data "packed" in a frame via the SINEC L2 bus.

The basic procedure for this communication is explained in Chapter 9.

3.3.2.2 Cyclic I/Os (ZP), only with CP 5430 TF

The demanding requirements of cyclic communication for automation functions of a field device cannot be met by direct HDB calls. Instead of cyclic HDB calls, the CP 5430 TF also provides the POLL or cyclic I/Os service.

The term "cyclic I/Os" means that part of the I/O area is not used by I/O modules, but rather for cyclic data exchange between SIMATIC programmable controllers and passive stations. "Cyclic data exchange" involves the CP 5430 TF transmitting the entire output area assigned to the cyclic I/Os and updating the entire input area assigned to the cyclic I/Os with the received data cyclically. The cyclic I/O area is in the I/O area of the controller and is also used by the PLC program. The address areas are processed with STEP 5 operations. The mode can either be synchronized with the cycle or free. With the cycle-synchronized mode, a CP-HDB must be called at the checkpoints required by the user to ensure the consistency of inputs and outputs. This HDB also triggers a group job for data transmission.

ZP data transmission is suitable for communication between SIMATIC S5 PLCs and field devices. Field devices are passive stations which cannot access the bus themselves and must then be constantly or cyclically polled by active L2 stations.

The CP 5430 TF uses the SRD transmission service to send data to the slave stations on the SINEC L2 bus.

The basic procedure for this communication is described in Chapter 10

3.3.2.3 Distributed I/Os (DP)

Data transmission using L2-DP (distributed I/Os) provides a standardized interface for communication between SIMATIC S5 PLCs and field devices (DP slave), with the PROFIBUS DP protocol complying with DIN E19245 Part 3.

Data transmission with DP is simple to implement.
The programming and handling is reduced to a minimum for the user. When using the DP service, part of the I/O area of the PLC is occupied by the connected DP slaves. The CP 5430 TF/CP 5431 FMS structures the I/O bytes used in the direction of the CPU.
This means that access by the user program to the I/O bytes used by L2-DP is acknowledged by the CP 5430 TF/CP 5431 FMS.
Using the L2-DP protocol, the CP 5430 TF/CP 5431 FMS exchanges the input and output data assigned to the individual DP slaves cyclically.

The basic sequence of this communication is described in Chapter 11.❑

4 Technical Description and Installation of the CP 5430 TF/CP 5431 FMS

4.1 Technical Description

4.1.1 Communications Processor CP 5430 TF/CP 5431 FMS

The elements of the CP 5430 TF/CP 5431 FMS important for operation can be seen in Fig. 4.1.
The description of the indicators and interfaces can be found on the following page.

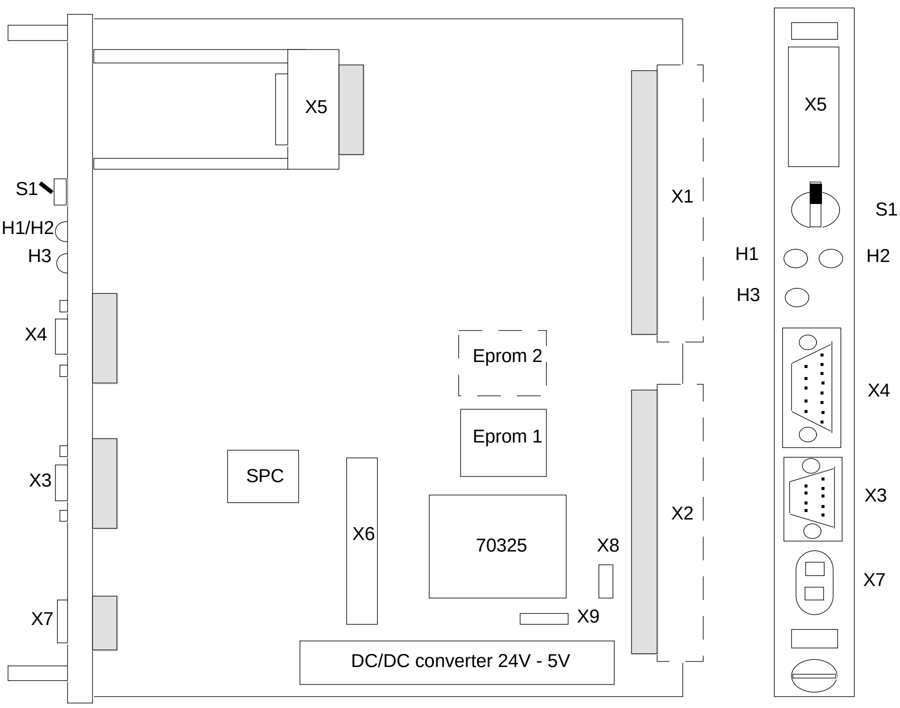


Fig. 4.1 Design of the CP 5430 TF/CP 5431 FMS

Explanation of Fig. 4.1:

Mode indicator

H1 : RUN (refer to Table 4.1)

H2 : STOP (refer to Table 4.1)

H3 : CP-FAULT (refer to Table 4.2)

Mode selector switch:

S1 : STOP/RUN (refer to Table 4.1)

Interfaces:

X1 : backplane connector (refer to Table 4.3)

X2 : backplane connector (refer to Table 4.3)

X3 : L2 interface (refer to Table 4.4)

X4 : PG interface (AS511) (refer to Table 4.5)

X5 : slot for memory submodule

X6 : medium connector (intended for extensions)

X7 : L2FO interface, provides FO link for plastic fiber optic cable

X8 : test jumper

X9 : test jumper

Eprom 1/2:

contains the firmware for the CP 5430 TF/CP 5431 FMS

4.1.1.1 Mode Indicators (RUN and STOP LEDs)

Table 4.1 explains the significance of the RUN and STOP LEDs

Mode changes

The mode can change in a variety of situations. Fig. 4.2 illustrates the factors causing a particular change.

FROM	Actions	TO
STOP	- Set STOP/RUN switch on front panel of CP 5430 TF/ CP 5431 FMSto RUN. - Trigger PG function "START CP" (only when mode switch is set to RUN). During the STOP -> RUN transition, all pending jobs are deleted.	RUN
NOT SYNCHRON	Synchron HDB call in a start-up OB of the programmable controller; STOP/RUN switch on the front panel of the CP 5430 FMS set to RUN.	RUN
RUN	- Set START/STOP switch on front panel of the CP from RUN to STOP. - trigger PG function "stop CP".	STOP
NOT SYNCHRON	- Set START/STOP switch on front panel of the CP from RUN to STOP. - Trigger PG function "stop CP".	STOP
RUN or STOP	Only after power outage: - the programmable controller is in the STOP mode or - No SYNCHRON HDB in start-up OB	NOT SYNCHRON

Fig. 4.2 Mode Changes

LED	Status of the CP 5430 TF/ CP 5431 FMS	Meaning
Green RUN LED lit, red unlit	RUN	- All types of data transmission are possible, both from the CPU control program and via PG bus functions. - The memory submodule of the CP 5430 TF/CP 5431 FMS can be read, but not written to.
Red STOP LED lit, green unlit	STOP	- HDB data exchange between CP and CPU via the backplane bus blocked (evaluation of the PAFE error message possible: refer to Section 7.3.2 or 8.1.3). - CP can be assigned parameters via AS 511 interface (memory submodule can be written to). - Data exchange via PG bus function possible, management services possible.
Green RUN LED ***and*** red STOP LED lit	NOT SYNCHRON	- No data transmission possible (data exchange with the CPU via the backplane bus blocked). - CP cannot be assigned parameters via the AS 511 interface. - The memory submodule of the CP 5430 TF/CP 5431 FMS can be read but not written to. Cause: HDB SYNCHRON run incorrectly. Remedy: call HDB SYNCHRON.
Neither green RUN LED **nor** STOP LED lit		Cause: - POWER OFF - CP not correctly plugged in. - Fault indicated by the fault LED (refer to Table 4.2). Result: no data transmission possible (data exchange with the CPU via the backplane bus blocked).

Table 4.1 Meaning of the LEDs

The START /STOP response

The CP is a slave processor system in the S5 rack and must therefore follow the START/STOP response of the master (here the PLC). After switching on the power supply, the CP runs through a hardware test program. Following this, it sets up a management block in the non-backed up RAM area for every job defined in the module card for internal program management. It then waits for the start signal from the PLC. In this idle status, all the programs which process the system tasks or operate the PG interface are released, however, data exchange with the PLC or with the bus system is blocked.

The STOP status is defined as follows:

➢ The system programs and the PG interface are enabled.

➢ The virtual links remain established, or continue to be established.

➢ Data transfer on the bus system and interfaces to the PLC are blocked.

The RUN status is defined as follows:

➢ All the programs of the CP and interfaces to the PLC are enabled.

➢ The PG interface is enabled and all ONLINE PG functions can be performed (exception: changing the database).

➢ Data transfer is enabled and can be monitored with the COM test functions.

The CP runs through a warm restart whenever the status changes from STOP to RUN and from RUN to STOP and to RUN again (resynchronization by repeatedly activating the START/STOP switch on the PLC). All previously established links are cleared and then re-established. All buffered data on the CP is lost during this status change

With the COM functions START CP and STOP CP, the PG can also set the START or STOP request. A STOP status triggered with the START/STOP switch can only be changed with the START/STOP switch.

4.1.1.2 Fault LED

The fault LED is lit permanently or flashes when the firmware of the CP detects an error (refer to Table 4.2).
Note: when the CP fault LED flashes/is lit, the RUN and STOP LEDs are irrelevant!

LED	Meaning
Fault LED flashes	- No data transmission possible (data exchange with the CPU via the backplane bus blocked). - Parameters can be assigned on the AS 511 interface. - Data exchange using PG bus functions not possible. - User module detected as invalid during start-up. - Management services remain possible. Possible causes: - memory submodule fault/error - firmware and configuration not compatible The COM test functions provide further diagnostic tools (refer to Section 12.2).
flashes 2x	Too many links programmed.
flashes 3x	Memory problem (not enough resources) ot incomplete database (OB1 missing)
flashes 4x	SAP configuration incorrect (e.g. configured twice).
flashes 5x	Incorrect bus parameters.
flashes 6x	Incorrect application associations (layer 7).
flashes 7x	DP slave parameter assignment error
CP fault LED lit	Hardware fault.

Tabelle 4.2 Meaning of the Fault LED

4.1.2 Data Exchange between the CPU and CP 5430 TF/CP 5431 FMS

The following section explains how the CP 5430 TF/CP 5431 FMS receives data for transmission from the CPU and how it passes on data it has received to the CPU.

The following programmable controllers of the SIMATIC S5 family are supported:

➢ S5-115U with CPU 942, 943, 944, 941B, 942B, 943B, 944B, 945

➢ S5-115H

➢ S5-135U (single and multiprocessor system) with CPU 922, 928, 928B

➢ S5-155U (single and multiprocessor system) with CPU 922, 928, 928B, 946/947, 948

➢ S5-155H.

Depending on the type of data transmission, the CPU and CPs in the same PLC exchange data in different ways:

➢ Using the I/Os

➢ Using job buffers and the dual-port RAM

Data exchange via I/Os

With data transmission using GP/DP/ZP (refer to Chapters 9 and 10 and 11) the data exchange takes place using the I/O address area. Depending on the address, this area in the STEP 5 control program can either be addressed via the process image of inputs and outputs (PII and PIQ) or directly.

☞ **This data exchange is only possible using the base interface number of the CP (see Fig. 4.3). R In the multiprocessor mode, data exchange via I/Os is only possible with CPU 1 (other CPUs have no access to the base interface).**

Data exchange using the job buffers of the dual-port RAM

With S5-S5 data transmission and free layer 2 access (refer to Chapters 7 and 8) data is exchanged using the dual-port RAM of the CP 5430 TF/CP 5431 FMS. All data and functions passing through the dual-port RAM of the CP 5430 TF/CP 5431 FMS must be provided by handling blocks from the point of view of the control program.

The principle of the PLC-CP link

The interface between CPs and the PLC is a dual-port RAM (DPR) which is organized in the same way in all S5 CPs. The CP 5430 TF/CP 5431 FMS has four such DPR interfaces so that in multiprocessor PLCs each central processing unit (CPU) can communicate with the CP independently of the others. The STEP 5 user program controls the CP via the DPR using handling blocks (HDBs). The STEP 5 user cannot access CPs directly (without using handling blocks). The following system calls (i.e. HDBs) are available:

➢ SEND transfer data to the CP

➢ RECEIVE receive data from the CP

➢ RESET ALL warm restart on the module

➢ CONTROL request the status of a job

➢ SYNCHRON start up and synchronize the PLC and CP

All these handling blocks must be assigned an interface number and a job number (SYNCHRON only requires an interface number).

The job number (ANR) identifies both a task on the CP and in the PLC. On the CP, the job number also involves a parameter set which defines the assignment to a virtual circuit, the data direction and the priority class.

The interface number (SSNR) consists of the base interface number and the page number of the CP.

For the data exchange between the CP 5430 TF/CP 5431 FMS and the PLC-CPU a 4 Kbyte dual-port RAM (DPR) is available which is divided into 4 pages each of 1 Kbyte.

In the address area of the CPU, the memory area $F400_H$ ... $F7FF_H$ (1 Kbyte) is available for addressing the dual-port RAM of CPs/IPs with page addressing. To allow more than one CP/IP to use this memory area to exchange data with a CPU, the page numbers must not overlap. To ensure a unique assignment, the pages as seen by the PLC are numbered from 0 to 255.
The CP 5430 TF/CP 5431 FMS always occupies 4 pages, beginning with the page number assigned to it with the "base interface number" parameter. For this reason, the base interface number beginning at 0 can only be set in steps of 4 (0, 4, 8, 12, ..., 248).
The grouping of pages into four for the CP is only necessary with the multiprocessor PLCs to prevent the page numbers overlapping which would result in double addressing (refer to Fig. 4.3).

In the multiprocessor PLCs, the assignment of CPU and page number is as illustrated in Fig. 4.3.

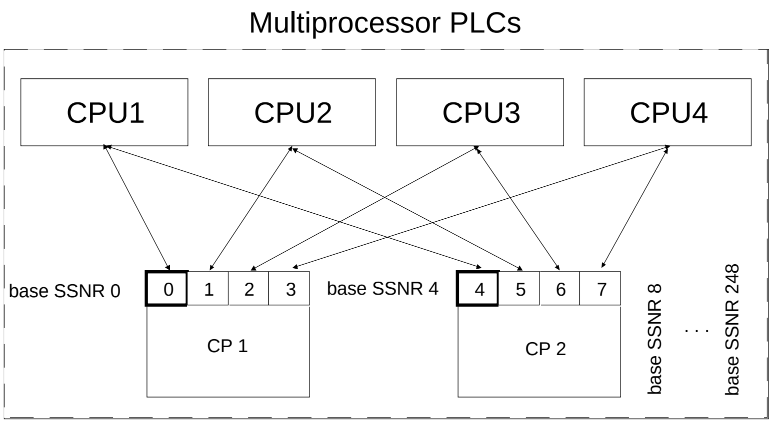


Fig. 4.3 Interface Addressing with a Multiprocessor PLC

For monoprocessor PLCs, it makes sense to use only the base interface number (refer to Fig. 4.4).

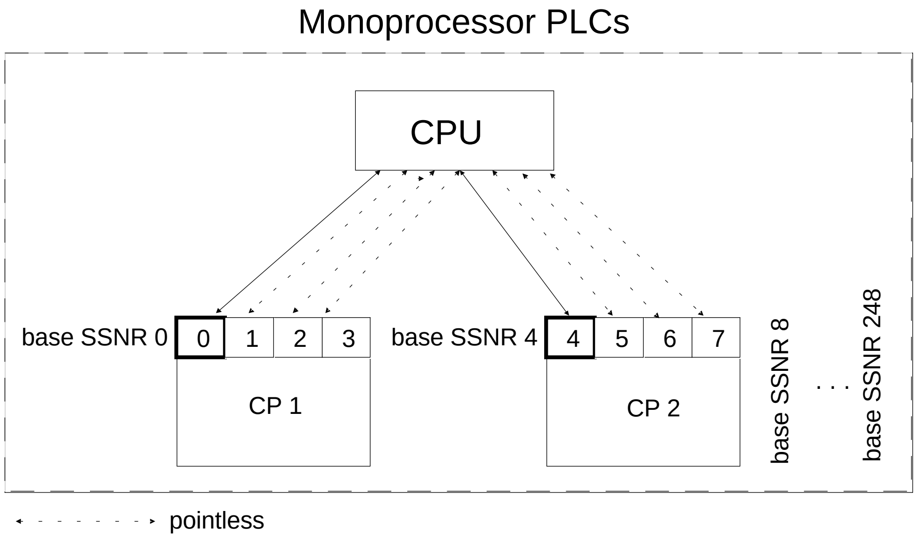


Fig. 4.4 Interface Addressing with a Monoprocessor PLC

The link between the STEP 5 user program and a particular action on the CP is the SSNR/ANR combination. To prevent the system reacting incorrectly, an ANR must only be assigned once per connected CP. Fig. 4.5 illustrates the relationship between a STEP 5 user program and the parameter set on the CP.

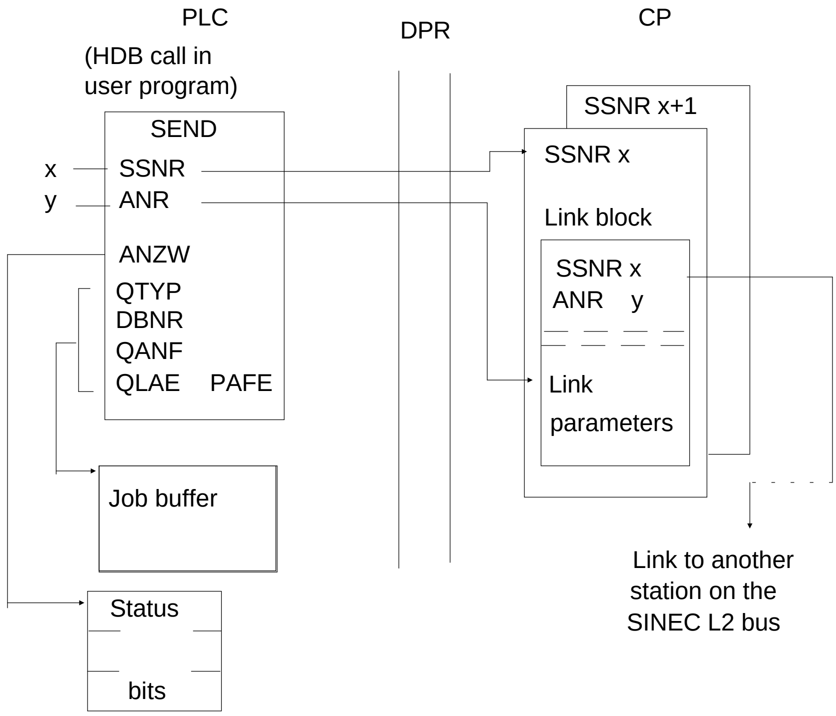


Fig. 4.5 Assignment: Calls in the User Program -> Parameter Lists on the CP

☞ **For more details about handling blocks for the individual PLCs (particularly when the blocks are integrated in the operating system) refer to the descriptions of the relevant programmable controllers**

4.1.2.1 Hardware Monitoring (Watchdog)

If an error occurs in the module which cannot be corrected by the firmware, the hardware monitoring (watchdog) responds and resets the module (cold restart).

4.1.3 Technical Data of the CP 5430 TF/CP 5431 FMS

4.1.3.1 Interfaces

PG interface:	TTY max. 1 km long transmission protocol Siemens AS 511 9.6 Kbps
L2 interface:	RS 485
L2FO interface:	Plastic HP duplex

☞ **The L2FO interface and the 9-pin RS 485 connector must never be both connected at the same time. If the L2FO interface is not being used, it must be closed with the rubber plug supplied. Light falling on the receiver diode can cause disturbances.**

4.1.3.2 Operating and Environmental Conditions

Type of protection:	IP00
Permitted ambient temperature:	0 ... 55 °C
Permitted storage temperature:	- 40 ... + 70 °C
Humidity class:	F complying with DIN 40040 (15 ... 95 % no condensation at 25 °C)
Operating altitude:	up to approx. 3,000 m above sea level

4.1.3.3 Mechanical and Electrical Data

Current consumption:	
5 V	typically 450 mA
24 V	typically 70 mA for RS 485
Power loss:	1.9 W for RS 485 5.3 W at 5V2/500 mA
Back-up current:	typically 20 pA
Vibration:	10 ... 57 Hz 0.15 mm; 57 ... 150 Hz 2 g complying with IEC 68-2-6
Electrical isolation:	no
Weight of the module	approx. 0.4 kg
Weight of the memory submodule:	approx. 0.1 kg
Card size:	double Eurocard format (160 x 233.4 mm)
Front panel width:	20.32 mm (1 1/3 standard slot)

4.1.3.4 Logical Characteristics

Static RAM 384 Kbytes

DPR 4 Kbytes, 4 pages each 1024 bytes

EPROM 384 Kbytes (maximum)

4.1.3.5 Performance Data CP 5430 TF

S5-S5

Maximum number of links:	32
Maximum amount of data:	128 bytes per job

Free Layer 2

Maximum number of links:	32 (55 without S5-S5)
Maximum amount of data:	242 bytes per job

ZP (cyclic I/Os)

Max. polling list entries:	128
Maximum number of job:	242 bytes per ZP slave (max., however 256 bytes in total)
Maximum number of outputs:	242 bytes per ZP slave (max. however 256 bytes in total)

GP (global I/Os)

Maximum number of GP objects:	2048 throughout the network
Maximum number of inputs:	256 bytes per station
Maximum number of outputs:	64 bytes per station
Maximum number of stations:	32

If ZP and GP are used together, a maximum of 256 inputs and 256 outputs can be used.

DP (distributed I/Os)

Number of DP slaves per master:	32
Maximum number of inputs:	242 bytes per DP slave (max. however 256 bytes in total)
Maximum number of outputs:	242 bytes per DP slave (max. however 256 bytes in total)

TF (technological functions)

Maximum no. of application associations	24 for PDU size 512 bytes
Maximum PDU size:	9999 bytes
Maximum number of configurable variables:	800
of which max. 242 defined variables per scope	242 VMD-specific 242 domain-specific 242 per application association
Maximum name length:	32 bytes

Simultaneous operation of DP, GP and ZP is not possible.

The total number of SAPs (links) required for S5-S5/free layer 2 and TF must not exceed 55.

4.1.3.6 Performance data of the CP 5431 FMS

ALI

Number of links:	32
Number of variables (indexes):	approx. 256
Maximum length of a variable:	233 bytes
Maximum PDU size:	241 bytes (data: 233 bytes)
Link attributes:	master-master and master-slave (without slave initiative) No connectionless services

CI

Number of links:	32
Maximum PDU size:	32 bytes
Maximum number of inputs:	232 bytes per CI slave (max. however 256 bytes in total)
Maximum number of outputs:	232 bytes per CI slave (max. however 256 bytes in total)

DP (distributed I/Os)

Maximum number of DP slaves per Master:	32
Maximum number of inputs:	242 bytes per DP slave (max. however 256 bytes in total)
Maximum number of outputs:	242 bytes per DP slave (max. however 256 bytes in total)

GP (global I/Os)

Maximum number of GP objects:	2048 throughout the network
Maximum number of inputs:	256 bytes per station
Maximum number of outputs:	64 bytes per station
Maximum number of stations:	32

If CI and GP are used together, a maximum of 256 inputs and 256 outputs can be used.

☞

1. The specifications for CI only apply when no ALI links are programmed (MMAC, MSAC).

2. The sum of ALI and CI links must not exceed 48.

3. The number of possible ALI links (MMAC, MSAC) can be reduced by the following:

the number of CI links

the number of job numbers per communication reference

the number of entries in the "access to variables" field of the communication references (Get OL).

4. Simultaneous operation of DP and CI is not permitted.

5. Simultaneous operation of GP and CI is not possible.

4.1.3.7 Interface Assignments

This section specifies the electrical interfaces of the CP 5430 TF/CP 5431 FMS (refer to Tables 4.3 - 4.5). The interfaces are as follows:

- ➢ Backplane connector X1/X2
- ➢ L2 interface socket X3
- ➢ PG interface socket X 4

X1	D	B	Z	X2	D	B	Z
Pin no.	Signal name	Signal name	Signal name	Pin no.	Signal name	Signal name	Signal name
2	-	M5	P5	2	-	M5	P5
4	UBATT	-	-	4	-	-	-
6	ADB12	ADB0	-	6	-	-	-
8	ADB13	ADB1	$\overline{\text{MEMR}}$	8	-	-	-
10	ADB14	ADB2	$\overline{\text{MEMW}}$	10	-	-	-
12	ADB15	ADB3	$\overline{\text{RDY}}$	12	-	-	-
14	$\overline{\text{IRA}}$	ADB4	DB0	14	-	-	$\overline{\text{NAU}}$
16	$\overline{\text{IRB}}$	ADB5	DB1	16	-	-	-
18	$\overline{\text{IRC}}$	ADB6	DB2	18	-	-	-
20	$\overline{\text{IRD}}$	ADB7	DB3	20	-	-	-
22	-	ADB8	DB4	22	TxD	-	-
24	-	ADB9	DB5	24	-	-	-
26	-	ADB10	DB6	26	-	$\overline{\text{RxDs}}$	-
28	ODSI	ADB11	DB7	28	-	-	-
30	-	BASP	-	30	-	-	M24
32	-	M5	-	32	-	M5	P24

Table 4.3 Pinout Table of the Backplane Connectors X1 and X2

L2 interface socket X3 (RS 485)

X3			occ. with
Pin no.	Signal name	PROFIBUS designation	RS 485
1	PE	Protective earth	yes
2	SIL	-	-
3	RxD/TxD-P	Data line - B	yes
4	RTS (AG)	Control - A	yes
5	M5V2	Data ref. potential	yes
6	P5V2	Power supply +	yes
7	BATT	-	-
8	RxD/TxD-N	Data line - A	yes
9	RTS (PG)	Control - B	-

Table 4.5 Pinout Table of the L2 Interface Socket X3

PG interface socket X4

X4	
Pin no.	Signal name
1	M-EXT (external ground))
2	TTY_{IN-}
3	-
4	P24
5	MASSE (internal ground))
6	TTY_{OUT+}
7	TTY_{OUT-}
8	M-EXT (external ground))
9	TTY_{IN+}
10	M24
11	20 mA (control source for transmitter))
12	MASSE (internal ground)
13	20 mA (control source for receiver))
14	Master poll
15	MASSE (internal ground))

Table 4.4 Pinout Table of the PG Interface Socket X4

4.2 Memory Submodules

4.2.1 Memory Submodule Types for the CP 5430 TF/CP 5431 FMS

To store the parameter data in the CP 5430 TF/CP 5431 FMS, the following memory submodule types can be used:

Type of submodule	Type	Memory capacity
EPROM NMOS/CMOS	376	16Kbytes x 8
EPROM NMOS/CMOS	376	32Kbytes x 8
EPROM NMOS/CMOS	376	64Kbytes x 8
RAM	377	16Kbytes x 8
RAM-Modul	377	32Kbytes x 8
RAM	377	64Kbytes x 8

Table 4.6 Memory Submodules Available for the CP 5430 TF/CP 5431 FMS

4.3 Installation Guidelines

4.3.1 Basic Configuration

Fig. 4.6 illustrates the minimum configuration of a SINEC L2 bus system.

- Communications processor CP 5430 TF/CP 5431 FMS
- Bus terminal with terminal cable
- Bus cable

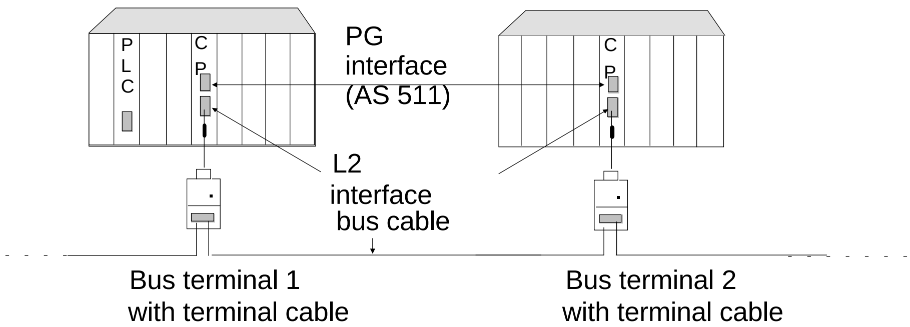


Fig. 4.6 SINEC L2 Components

4.3.1.1 CP 5430 TF/CP 5431 FMS Slots in the various PLCs

The CP 5430 TF/CP 5431 FMS communications processor is designed as a board in double Eurocard format. The front panel is 1 1/3 standard slots wide.

The CP 5430 TF/CP 5431 FMS can be used in the CP slots of the PLCs listed in Section 4.1.2.

The module is supplied in a compact design and can be operated without a fan. If the module is to be inserted in the S5-115U, an adapter casing is required.

☞ **Modules must only be inserted or removed when no voltage is applied. The rules for working with electrostatically sensitive devices (ESD guidelines) must be adhered to.**

Depending on the range of performance and the configuration of the control system, there are several subracks available for the central controller (CC) (S5 115U) and for expansion units (EU).

The slot assignments in SIMATIC PLCs are as follows:

SIMATIC S5 115U

Central controllers:

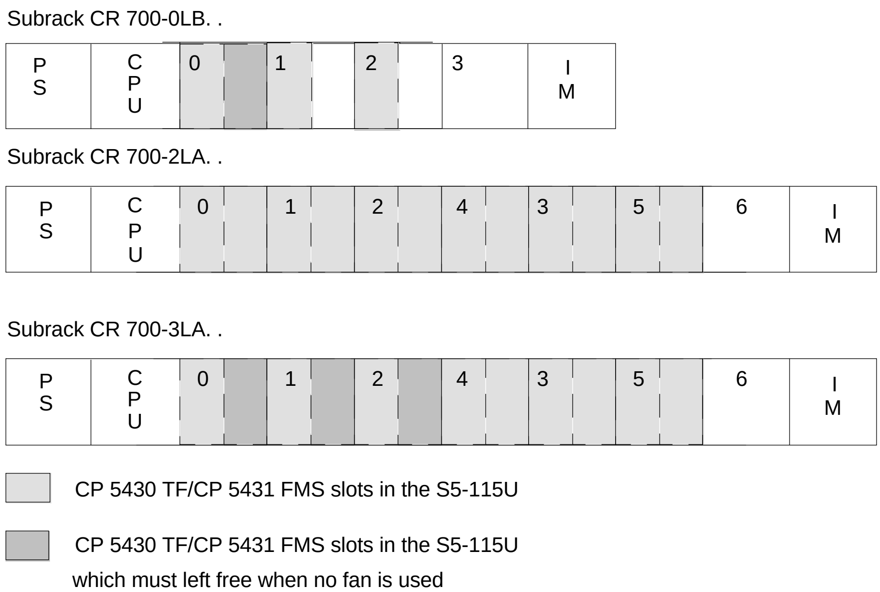


Fig. 4.7 Slots for the CP 5430 TF/CP 5431 FMS in the S5-115U 115U

Expansion unit (EU):

Subrack ER 701-3LA..

PS	0	1	2	3	4	5	6	7	IM

Subrack ER 701-3LH..

PS	0	1	2	3	4	5	6	7	IM

Fig. 4.9 Slots for the CP 5430 TF/CP 5431 FMS in the Expansion Unit ER 701-3L

SIMATIC S5-135U

Central controller

3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163

without interrupt line

Fig. 4.8 Slots for the CP 5430 TF/CP 5431 FMS in the Central Controller CC 135U

SIMATIC S5-155U
Central controller:

3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163

without interrupt line

Fig. 4.10 Slots for the CP 5430 TF/CP 5431 FMS in the Central Controller CC 155U

In the S5 155U, in certain situations (Manual S5-155U) further slots may be available for the CP

Expansion unit EU 185U:

3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163

Fig. 4.11 Slots for the CP 5430 TF/CP 5431 FMS in the Expansion Unit EU 185U

Expansion unit EU 186U:

3	19	35	51	67	83	99	115	131	147	163

Fig. 4.12 Slots for the CP 5430 TF/CP 5431 FMS in the Expansion Unit EU 186U

SIMATIC S5-135U/155U

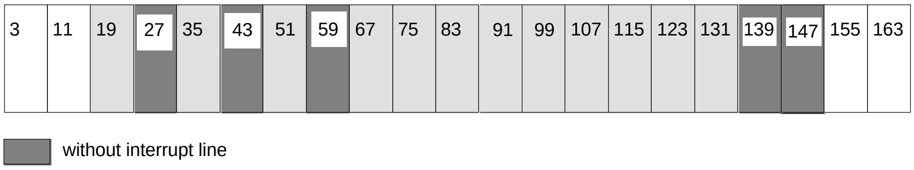


Fig. 4.13 Slots for the CP 5430 TF/CP 5431 FMS in the Central Controller CC 188U

4.4 Ways of Connecting PGs on the SINEC L2 Bus

With the following L2 communications processors you can connect a PG or a PC/AT directly to a bus terminal and therefore to the L2 bus.

Product name	Application	Functions
CP 5410-S5DOS/ST	PG 730 / 750 / 770 with STEP5/ST	PG functions via SINEC L2/L2FO
CP 5410-S5DOS/MT	PG 730 / 750 / 770 with STEP5/MT	PG functions via SINEC L2/L2FO
TF-NET 5412/MSDOS, Windows	PG 730 / 750 / 770 AT-compatible PCs with MSDOS or WINDOWS	FDL functions (layer 2) TF functions (layer 7)

Table 4.14 Possible Connections

Connection of PGs to programmable controllers with CPs is possible in various ways depending on the configuration and application.

The simplest case is direct connection of the PG to the CP (refer to Fig. 4.15).

If there are several CPs in one rack as for example in the multiprocessor PLC S5-135U, the modules can be connected using the PG-MUX 757.

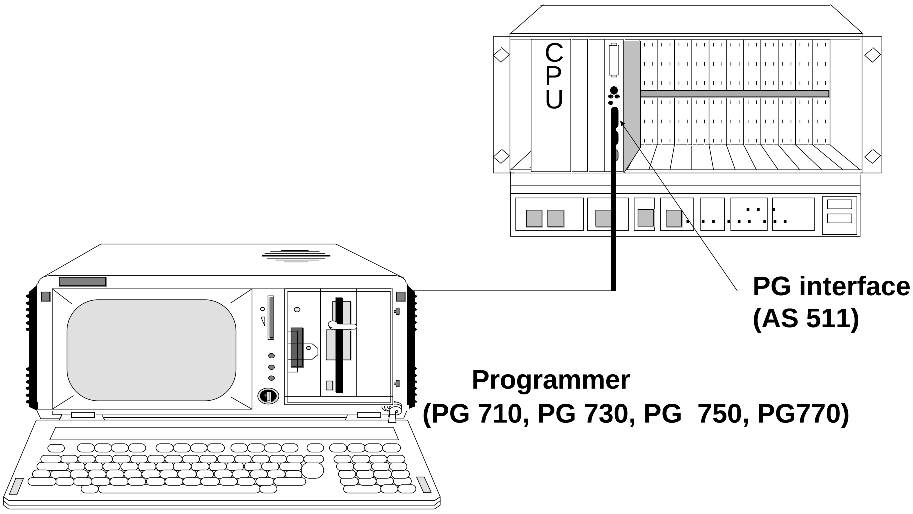


Fig. 4.15 Direct Connection from the PG to the CP

If several PLCs are networked with one SINEC L2 bus system, you can also program the CPUs via the bus. In practice, this means that a centrally installed PG, e.g. in a control room, can reach all the PLCs connected to the bus system.

With the SINEC L2 bus system, the following programmers can be used: PG 710, PG 750, PG 730 and PG 770. The PGs are operational when they are connected using the PG interface (AS 511) of the CP 5430 TF/CP 5431 FMS.
If you want to connect a PG 730, 750 or 770 directly to the bus, the products shown in Table 4-14 must be used.

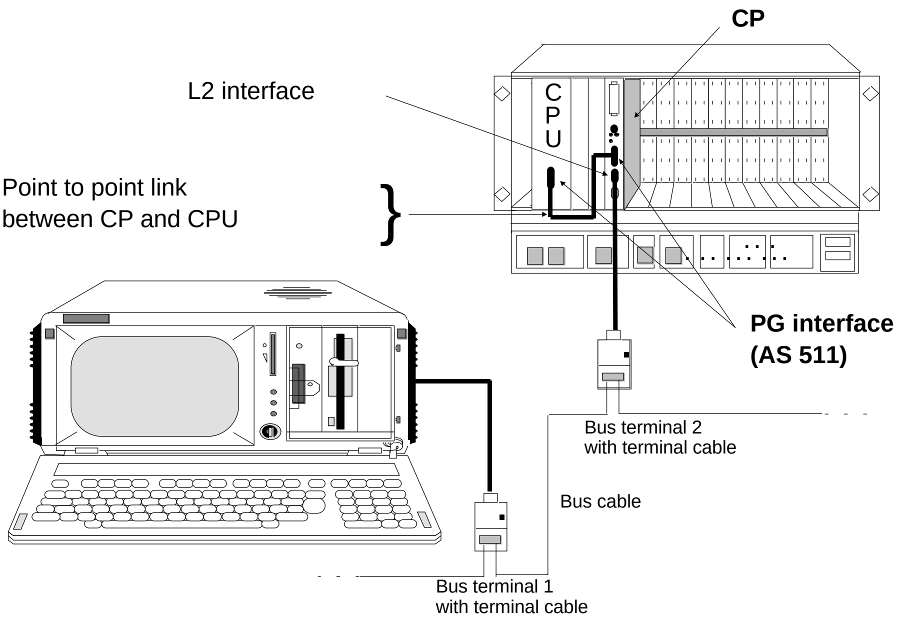


Fig. 4.16 Communication Path PG/CPU on the SINEC L2 Bus System

4.4.1 Structure and Functions of the Bus Terminal

Bus terminals connect a CP 5430 TF/CP 5431 FMS, CP 5412 or a CP 5410 to the SINEC L2 bus. As the end terminal, they also function as the terminator of the bus segment (refer to Chapter 2).

4.4.2 Example of Transmission with RS 485 Bus Terminals

The RS 485 bus terminal connects devices with a SINEC L2 interface and which use the RS 485 transmission technique to the SINEC L2 bus. If the bus terminal is the last station on the SINEC L2 bus, a terminating resistor can be switched in (switch setting "bus terminated"). These bus terminals are suitable for all data rates.

One version of the RS 485 bus terminal has a PG/OP interface (see Fig. 4.17). This bus terminal allows the connection of PGs and OPs to the bus without additional wiring.

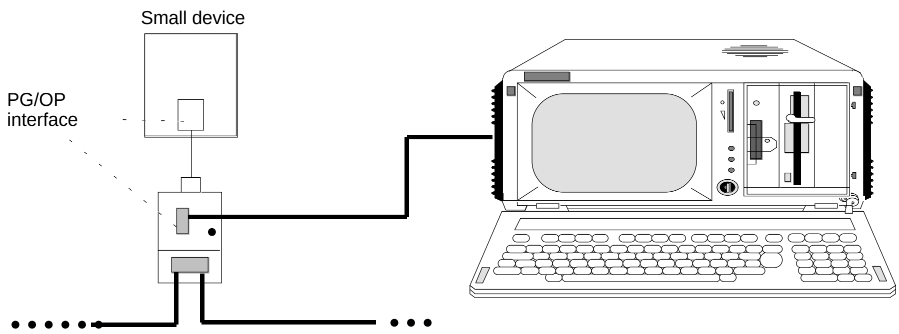


Fig. 4.17 Bus Terminal with PG/OP Interface

Connecting cable for bus terminals with a PG/OP interface

Fig. 4.18 shows the connecting cable between the PG/OP interface of the RS 485 bus terminal and the interface of the CP 5410 (PG).

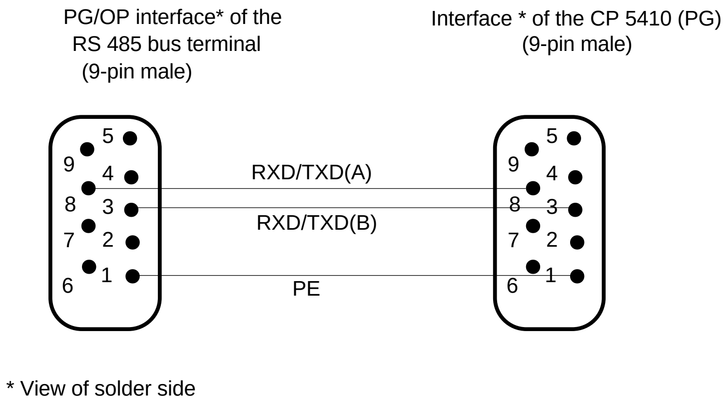


Fig. 4.18 Cable Between PG/OP Interface and CP 5410

You can order a specially prepared connection cable for bus terminals with a PG/OP interface (refer to the SINEC catalog for the order number).❑

5 Selecting the Type of Communication

Chapter 3 explained that there are various mechanisms available for data transmission that can, in practical terms, be divided into five different types as follows:

- ➢ Data transmission with HDBs on links (S5-S5)
- ➢ Data transmission with HDBs by direct access to layer 2 services (FL2)
- ➢ Data transmission with global I/Os (GP)
- ➢ Data transmission with cyclic I/Os (ZP) with the CP 5430 TF
- ➢ Data transmission with distributed I/Os (DP)

This chapter contains basic information about the different types of communication to help you select the type of data transmission most suitable for your applications.

Criteria influencing the selection of the type of data transmission are as follows:

- ➢ Speeds necessary for the data transmission (performance)
- ➢ Size of the messages
- ➢ Number and type of communications partners
- ➢ Monitoring mechanisms
- ➢ Priority of the transmission

Section 5.6 provides a brief overview of SINEC TF. Volume 2 of the CP 5430 TF manual contains the complete description of communication with SINEC TF and the services available.

Chapter 5.7 provides a brief overview of SINEC FMS. In Volume 2 (CP 5431 FMS), you will find the complete description of communication with SINEC FMS and the services available.

5.1 Data Transmission with HDBs (S5-S5)

Data transmission with HDBs on configured links is suitable for the transmission of related blocks of data up to 128 bytes long between active SIMATIC S5 programmable controllers.

This type of communication has the following characteristics:

➢ The data transmission is via S5-S5 links configured in the PLC program and triggered by HDBs.

➢ The station relationship is a 1 : 1 relationship between two stations: station 1 (PLC<->CP) -----> (CP<->PLC) station 2.

➢ The data structures to be transmitted are related blocks of data of 1 to 128 bytes.

➢ The PLC cycle time load as transmitter and receiver is high compared with implicit communication (GP/ZP/DP).

➢ The L2 service used is SDA.

➢ The priority of the L2 frame can be selected: L (low) / H (high) / I (high with interrupt).

Special features:

A frame with the priority I (interrupt) can trigger an interrupt in the remote PLC.

5.2 Data Transmission with HDBs (Free Layer 2 Access)

This type of data transmission is suitable for communication between SIMATIC S5 programmable controllers and remote PROFIBUS compatible automation or field devices. SIMATIC S5 programmable controllers can also communicate with each other with this type of data transmission, although for this situation, data transmission via S5-S5 links is much easier to handle (refer to Chapter 7).

With data transmission by direct access to layer 2 services, you can transmit or receive blocks of data with a length of maximum 242 bytes.

This type of communication has the following characteristics:

➢ The data transmission is by direct access to layer 2 services after being triggered by an HDB in the PLC program.

➢ The station relationship is a 1 : 1 relationship or a 1 : n relationship between stations: station (PLC<->CP)----->(CP<->PLC) or non-S5 device station.

➢ The data structures to be transmitted are related blocks of data of 1 to 242 bytes.

➢ The PLC cycle time load as transmitter and receiver is high compared with implicit communication (GP/ZP/DP).

➢ The L2 service used is SDA, SDN, SRD, RPL_UPD_S, RPL_UPD_M. Depending on the type of service selected, various security mechanisms accompany the data transmission.

➢ The priority of the L2 frame is selectable (L (low) / H (high)).

5.3 Data Transmission with Global I/Os (GP)

Data transmission with global I/Os (I/O interface) is suitable for communication between SIMATIC S5 PLCs. The data transmission using global I/Os is suitable for the transmission of single bytes between active SIMATIC S5 programmable controllers. Data with the following characteristics can be transmitted:

- ➢ Small volumes of data
- ➢ Time-critical data
- ➢ Data with few changes.

This type of communication has the following characteristics:

- ➢ The data transmission takes one of the two following forms:
  - – synchronized with the cycle, triggered by the PLC program using the I/Os (the PLC determines when the data transmission takes place), or
  - – free, initiated by the CP using the I/Os (the CP determines when the data transmission takes place).
- ➢ The station relationship is a 1 : n relationship :
  1 station (PLC<->CP) -----> n stations (CP<->PLC).
- ➢ The priority of the L2 frame is H (high).
- ➢ The data structures to be transmitted are as follows: for all stations there are a maximum of 2048 GP bytes (GPB 0...GPB 2047) available (per station a maximum of 64 GP output bytes and 256 GP input bytes).

Special features:
With this type of communication, the base interface is always used. Data is only transmitted when the status of bytes has changed. If you use GP, global objects must also be configured on the CP as well as the input/output bytes.

☞ **Configured I/O bytes must not overlap the addresses of inserted I/O cards.**

5.4 Data Transmission with Cyclic I/Os (ZP) (CP 5430 TF)

Data transmission with cyclic I/Os is suitable for communication between SIMATIC S5 PLCs and PROFIBUS compatible field devices. The field devices are passive stations that cannot access the bus themselves and must normally be polled cyclically by active L2 stations.
The "cyclic I/Os (ZP)" type of data transmission is easy to use, i.e. far less programming is required compared with the other types of data transmission, for example the "free layer 2 access" (Chapter 8).

This type of communication has the following characteristics:

➢ The data transmission takes one of the two following forms:

- synchronized with the cycle, triggered by the PLC program using the I/Os (the PLC determines when the data transmission takes place)

  or

- free, initiated by the CP using the I/Os (the CP determines when the data transmission takes place).

➢ The station relationship is a 1 : 1 relationship:
station (PLC<->CP) <-----> station

➢ The data structures to be transmitted are related blocks of data of 1 to 242 bytes.

Special features:
With this type of communication, the base interface is always used.

5.5 Data Transmission with Distributed I/Os (DP)

Data transmission via L2-DP (distributed I/Os) provides a standardized interface for communication between SIMATIC S5 PLCs and field devices (DP slaves).

Data transmission with DP is simple to handle.
For the user, the programming and handling is reduced to a minimum. When using the DP service, part of the I/O area of the PLC is occupied by the connected DP slaves with the CP modeling the I/O bytes towards the CPU. This means that access by the user program to the I/O bytes used for L2-DP is acknowledged by the CP.
Using the L2-DP protocol, the inputs and outputs assigned to the individual DP slaves are exchanged cyclically by the CP (see Chapter 11).

This type of communication has the following characteristics:

- ➢ Data transmission uses one of the following two methods:
  - – Synchronized with the cycle, determined by the STEP 5 control program.
  - – Free, initiated by the CP (no influence by the STEP 5 control program).
- ➢ The CP can only be operated as DP master of class 1 on the SINEC L2 bus.
- ➢ The L2-DP interface of the CP operates according to the PROFIBUS standard DIN E 19254, Part 3.

Special features:
With this type of communication, the base interface is always used.

5.6 Communication with TF (CP 5430 TF)

Owing to its complexity, TF communication is discussed in detail in Volume 2 (CP 5430 TF). This section simply provides an overview of the services available and their advantages. For more information about the model and programming, refer to Volume 2 (CP 5430 TF).

The SINEC technological functions (TF) form the application protocol (layer 7 ISO/OSI) for communication in a heterogeneous automation network with the CP. They provide the user with services to allow problem-free interaction between different automation components (e.g. PLC, NC controls, robots, open-loop controllers, PCs, mini-computers and host computers etc.). TF services also allow the exchange of information (messages) using a standard language. In contrast to data-oriented protocols in which "pure bits" are transmitted, in message-oriented protocols contents are transmitted. The standardization is intended to permit the implementation of open systems, reducing the time and expense required for the software engineering. A further advantage is the monitoring of the application association.

The basis on which the TF services are defined is the international standard for application protocols in the area of industrial automation:
ISO 9506, MMS (Manufacturing Message Specification).

The uniform, standardized language for exchange of information has the following advantages:

➢ The use of TF services for the exchange of information makes the job of the programmer much easier. The protocol "disguises" the specific characteristics of the end system behind a standardized, uniform representation of the system and the data. This means that negotiations between programmers regarding system structures and methods of representation are no longer necessary. The programmer can concentrate on implementing his own particular tasks

➢ The simple integration of components of other manufacturers is made possible by TF.

➢ The protocol is independent of the underlying communication system: SINEC L2, SINEC H1 or SINEC MAP. This provides flexibility in program development (the system grows with the requirements of the user) and also means a reduction of training costs.

- ➢ Bridges can be implemented without problems.
- ➢ By using TF, the time and expense of software development can be greatly reduced.

Advantage of using the TF infrastructure

- ➢ Increased reliability with logical acknowledgment of messages.
- ➢ Chronological and logical monitoring of the TF jobs.

TF services:

- ➢ **Variable services:** To ensure continuity despite different end systems, the data is simulated on variable objects.
- ➢ **Application association management:** To manage communication relations between applications.
- ➢ **VMD services:** To obtain information about the programmable logic controller.

Further functions::

- ➢ **Clock services:** To synchronize the time of day throughout the network.

5.7 Communication with FMS (CP 5431 FMS)

FMS communication is discussed in detail in Volume 2 (CP 5431 FMS). Here, there is only a overview of the services available. For further information about the model and configuring, refer to Volume 2 (CP 5431 FMS).

SINEC L2-FMS (Fieldbus Messaging Specification), is the version for application with the completely standardized PROFIBUS.
The interface of the CPs to FMS can be divided into the following:

- Cyclic interface (CI)
- Application layer interface (ALI)

➢ Data transfer with cyclic communication (using CI)

This type of communication is always suitable when values only need to be written or read cyclically. The jobs to be processed cyclically are specified during configuration. Only the variable values are exchanged between the PLC and CP. The CP creates the appropriate FMS-PDUs automatically.

➢ Data exchange with acyclic communication (using ALI)

☞ **This type of communication is advantageous when the services used and the time they are used is controlled by the user program. Job buffers containing a job description and possibly also data are exchanged between the PLC and CP. The PDU is created based on the content of the job buffer.**❑

NOTES

6 Basics of Configuration with NCM

To configure the CP you require the corresponding software package COM 5430 TF/COM 5431 FMS, simply called COM from now on, which can be run on all PGs with S5-DOS Stage VI (or higher) or on PC/ATs with S5-DOS Stage VI. The COM under SINEC **NCM** (**N**etwork and **C**ommunication **M**anagement) allows menu-controlled programming of all the required parameters for the CP. A distinction is made between parameters which do not depend on the type of data transmission (basic configuring) and parameters which depend on the selected type of data transmission. The documentation and test functions are explained in Chapter 14.

This chapter introduces you to the basics of configuring, configuring the individual types of data transmission is discussed in the chapters dedicated to the specific type.

To familiarize you with handling the software package, the following topics are introduced in this chapter:

➢ The structure of SINEC NCM and how to work with it.

➢ The structure of the COM screens and how to use them.

➢ The procedure for installing the software package.

➢ The structure and procedure for basic programming.

➢ The transfer of files to/from the CP or PLC and the required preparations.

6.1 SINEC NCM

To make it easier to handle the increasing number of different configuring and test tools, SINEC COM products now have the management interface SINEC NCM. SINEC NCM is the menu manager which unites the COMs of completely different end systems under one user interface.

The SINEC NCM user interface has the following characteristics:

➢ Configuring is made more understandable and clearer by the method of representation.

➢ The menu guidance is based on the SAA standard with keyboard shortcuts and cursor operation (mouse operation from S5-DOS/ST Stage VI onwards).

➢ Settings made in the project currently being worked on are saved in their up-to-date status and are reconstructed when you return to the project.

➢ Operation and input with various COMs is standardized.

➢ Specially selected hierarchical steps provide an easy overview.

6.1.1 The Keyboard

Functions are executed using standard keys or key combinations.

The following list shows the assignment of the most commonly used COM functions to the keys on the PG/PC keyboard.

COM functions	**Keyboard**
Paging, searching for files backwards	<Arrow up> or one of the function keys "page-1" "line-1" or mouse click on the function key
Paging, searching for files forwards	<Arrow down> or one of the function keys "page+1" "line+1" or mouse click on the function key
Return or abort	<ESC> or break key mouse click on "End" field in the upper right corner of the input screen
Enter	<F7> or enter key mouse click on F7
Selection, i.e. possible parameters are displayed for selection	<F8> mouse click on F8
Help, i.e. input fields now have direct help texts for the user	<HELP> (PG) SHIFT F8
Delete the information displayed on the screen	<DEL>

☞ **Other key assignments may be possible depending on the PC/PG you are using.**

6.1.2 Menu Structure and Operation

This chapter briefly explains the structure, functions and operation of SINEC NCM.

The user interface is designed so that a menu bar is displayed in which you can see all the function groups as a menu item, which provides for programming and testing. The bottom edge of the screen contains the help line, in which a specific help text is available for each pull-down menu item (explanation see Fig. 6.1). The area between the menu bar and the help line is for the user dialog. Here, the pull-down menu items, help texts, special windows etc. are displayed.

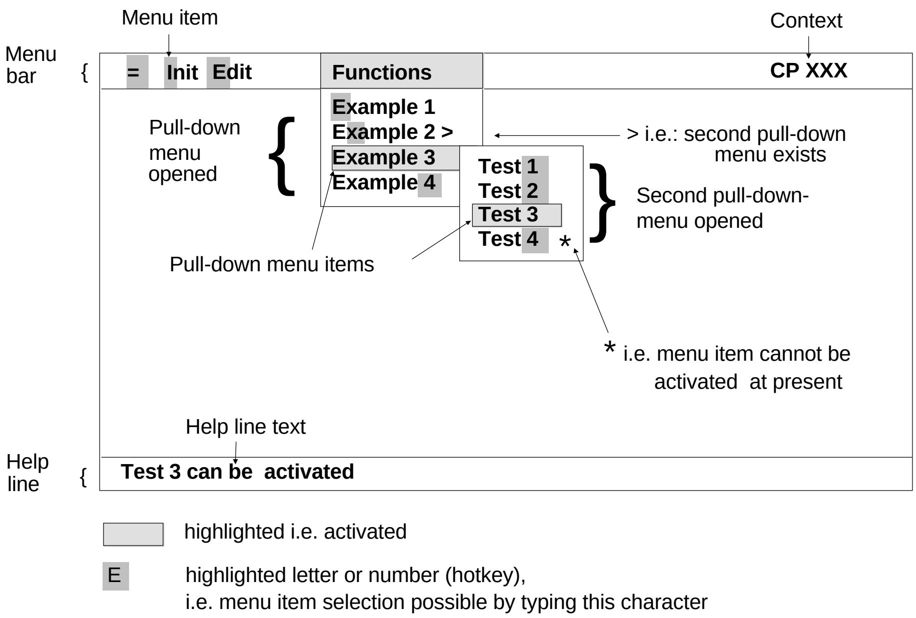


Fig. 6.1 SINEC NCM Screen Layout

➢ Explanation of the menu bar and the individual pull-down menus.

From the menu bar you can obtain all the menu items. The menu items in the menu bar represent a group of functions. The pull-down menu items represent the operations or commands used to activate the individual COM function screens. The NCM selection menu is no longer visible when a COM function screen has been activated by a pull-down menu item.

If you select a pull-down menu item marked with an arrow tip (>), you obtain a further pull-down menu in which you can select other pull-down menu items.

Pull-down menu items marked with an asterisk (*) are disabled.

➢ Selecting pull-down menu items (i.e. commands):

When you select a menu item in the menu bar with the arrow keys, you automatically open the corresponding pull-down menu. After this, you select a menu item with the arrow keys and then press <enter>. To activate a menu point you can also use the keyboard shortcut, i.e. the highlighted letter in the menu item title. You can, for example, select the Edit menu from the menu bar with <E> and the Init command from the pull-down menu with <I>. You can terminate every action with the <ESC> key and return to the previous menu. After you activate the item, the corresponding COM screen is opened. Once you have completed work with the screen, you return to SINEC NCM.

➢ From S5-DOS/ST Stage VI onwards, you can also select menu items with the mouse. In this case, you select menu items with the mouse pointer. The actions are activated with the suitable keyboard operation or by pressing the left mouse button.

6.1.3 COM Screen Layout and Operation

The COM software is operated exclusively via screens and softkey menus. The softkey menus display the possible branches and functions that can be triggered by the function keys F1 to F8.

The four cursor keys (arrow keys left, right, up, down) are used to position the cursor within a screen. The input fields in the screens are completed using the ASCII keyboard. The OK key validates the string you have input.

The cancel or ESC key returns you to the previous screen or aborts the currently active function.

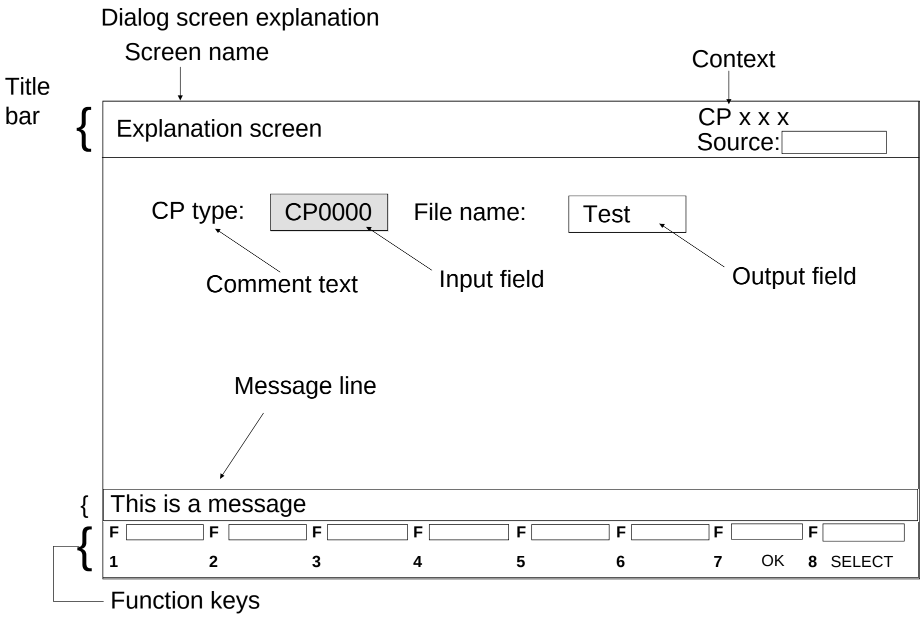


Fig. 6.2 Screen Layout

The line on the screen above the softkeys is the message line. Here, the PG displays warnings, errors, operating instructions etc. A message remains displayed until you press a key.

Screen title bar:

Screen name:	Description of the path in abbreviated form, e.g. "Init Edit"
Context:	Screens specific to the CP: name of the CP otherwise SINEC NCM
Source:	Module file/bus parameter file/path name

Message line:

Current messages are described in the line above the softkeys (warnings, errors, operating instructions etc.). A message remains displayed until you press a key.

Keys:

Function keys F1 to F8 for activating functions.

General information about input:

Highlighted field:	If the input field is displayed in inverse video, modifications or inputs can be made. You can delete the input fields character by character by using the special key "crossed out zero".
Field not highlighted:	This is purely a display field.

General notes on operation:

➢ You can only make inputs or changes in highlighted fields selected with the cursor positioning keys.

➢ To obtain a list of possible selections, press F8 (Select).

➢ After you have made your selection with the cursor keys you can enter it with <CR> or the OK key.

➢ With the help key on the PG and SHIFT F8 on the PC, you can obtain a help text explaining your selection.

➢ Once you have processed a screen completely and want to enter the data, press F7 or the enter key to transfer the data to the database displayed as the "source".
<ESC> discards your entries and aborts the function.

6.1.4 Special Windows

These windows are used by NCM to provide help and information and are displayed automatically or after selecting a pull-down menu item of the INFO menu item '='.

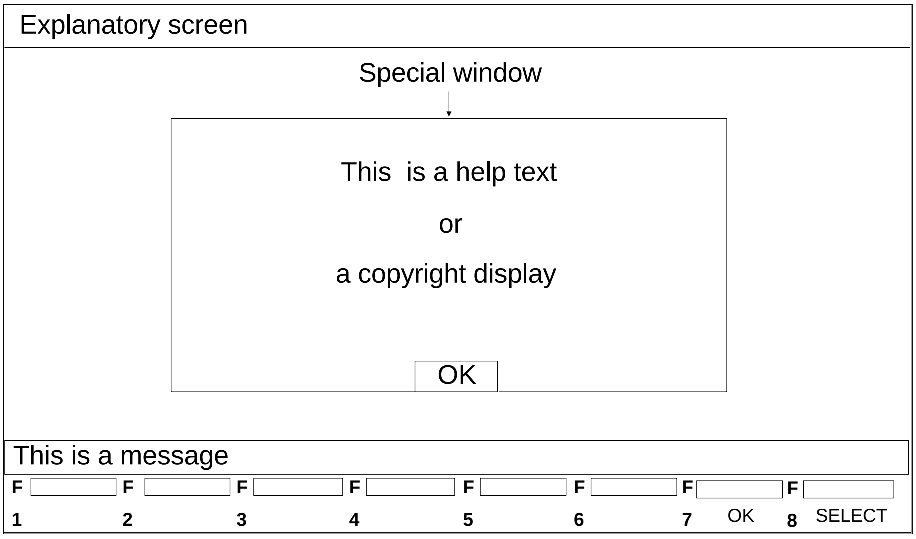


Fig. 6.3 Special Window

6.2 Installation and Start

Free working memory capacity of at least 590 Kbytes is required to use SINEC NCM.

Make sure that you have enough free space on the hard disk. You should make approximately 1.2 Mbytes of hard disk available per COM (see the Readme file). When you install the COM under MS-DOS, the installation tool checks that there is sufficient space.

Procedure:

✔ Start the operating system.

✔ Insert the COM diskette in a floppy disk drive.

✔ Change to your installation diskette e.g.: >A.

✔ Activate the installation routine on the installation diskette, e.g.: >install c:\SINEC i.e.: the software is installed from drive A: to drive C:\SINEC in the SINEC directory. The directory (in this example SINEC) must already exist.

☞ **Protect the files you have transferred from being accidentally overwritten.**

✔ Call the command interpreter (KOMI) with >S5, then press the <insert> or <OK> key.

- Selecting the package under S5 DOS stage V
  Activate SINEC NCM in the KOMI screen with the "package selection" key <F1> (or <Insert> or OK) (for more detailed information, refer to the S5-DOS manual).
- Selecting the package under S5 DOS stage VI
  Under the "OTHERS" menu item, you can navigate to the COM 5430/5431 directory. If you selected the correct path, the COM can be started with the OK key.

After activating SINEC NCM, a window displaying the copyright appears and after acknowledging this window you can begin working with SINEC NCM.

☞ **Please remember that the databases configured in the following sections are stored in the default working directory under S5 DOS stage VI.**

6.3 General Guidelines for Working with your Software

When designing your bus system, follow the procedure outlined below:

➢ Find out how many PLCs and field devices are required for your application. Assign the L2 station addresses carefully since renaming the L2 station addresses once you have configured them is time consuming.

➢ All the configuration data should be stored in one file, i.e. whenever possible, work "OFFLINE FD" with the PG hard disk.

Creating user files
As already mentioned, the CP 5430 TF/CP 5431 FMS has a receptacle for a memory submodule. These submodules can be RAMs or EPROMs. Depending on the particular submodule, 16 Kbytes to 64 Kbytes of memory are available (for memory submodules refer to Section 4.2). The CP expects to find the description of a link and the general parameters (user data) in this memory submodule.

For the system-wide identification (S5 system) of submodules, there is a system identification block (Edit -> CP Init: SYSID).

There are two ways of configuring (making entries/modifications) in the Init -> Edit screen:

OFFLINE FD: you create the blocks on disk and transfer the created parameter set directly to a RAM submodule using the transfer function Transfer -> CP Database Transfer -> FD -> CP. The transfer function is only possible when the CP is in the STOP mode (Transfer -> Start CP/Stop CP) or when the switch on the CP is set to STOP.
The transfer (blowing) of the parameter set to an EPROM submodule is also possible with the transfer function Transfer -> CP Database Transfer -> FD -> EPROM. An EPROM must be plugged into the EPROM interface.

ONLINE CP: you create the blocks directly on the CP. Modifying and transferring blocks is only permitted in the stop mode of the CP (Transfer -> Start CP/Stop CP or switch on the CP set to STOP):

With ONLINE, you select the ONLINE functions of the COM. It is assumed that the PG is connected directly to a CP or to a remote bus station via a bus selection path (bus selection utility). The selected ONLINE functions basically provide the same possibilities as with the OFFLINE functions on the hard disk. The content of the submodule is organized as follows:

SYSID	System identification block: identifies the submodule uniformly in the S5 System	
Subfield 1	Sub fields e.g.:	
	Network parameters	(UB)
Subfield 2	Peripheral block	(UB/PB)
.	Layer 2 link block	(PB)
.	Layer 7 link block	(VBs)
Subfield n	Variables block (CP 5431 TF/5431 FMS)	(OB)

Fig. 6.4 Organization of the Memory Submodule

Centralized loading via the bus system
If the SYSID block is entered ("original initialization of the CP with the COM via the PG interface of the CP"), a central PG can set up a PG link via a bus path to the CP and transport the remaining parameter sets to the CP.

Modifying blocks
If you want to modify existing blocks already contained in the memory submodule of the CP (transfer functions in Section 6.6), proceed as follows:

✔ Transfer the blocks from the CP/EPROM to the database file (Transfer -> CP Database Transfer -> CP -> FD or Transfer -> CP Database Transfer -> EPROM -> FD).

✔ Modify the block.

✔ Transfer the block back to the CP/EPROM (Transfer -> CP Database Transfer -> FD -> CP or Transfer -> CP Database Transfer -> FD -> EPROM).

6.4 Overview of Basic Configuration

To provide you with an overview of the structure and procedures involved in configuration, these aspects are explained in more detail in this section which is then followed by an example.

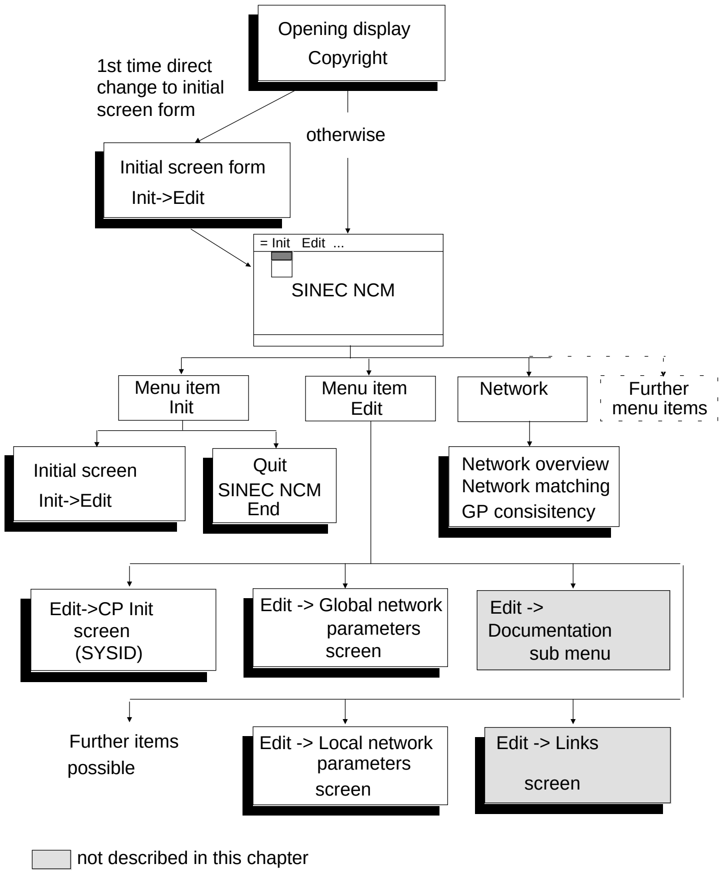


Fig. 6.5 Basic Structure of Configuring

The menu items introduced in the following sections and the screens connected with them should be processed in the hierarchical order illustrated in Fig. 6.5.

When you first call SINEC NCM, the screen Init -> Edit appears automatically. Unless this screen is filled out correctly and completely, you cannot proceed any further. Once you exit SINEC NCM with a correct initialization screen, you no longer automatically obtain this screen and can only select it from a menu, for example to change the CP type and to load a different COM.

The following sections provide information about the layout of the screens that must be completed for each type of data transmission.

When the copyright window appears, press any key to change to the menu.

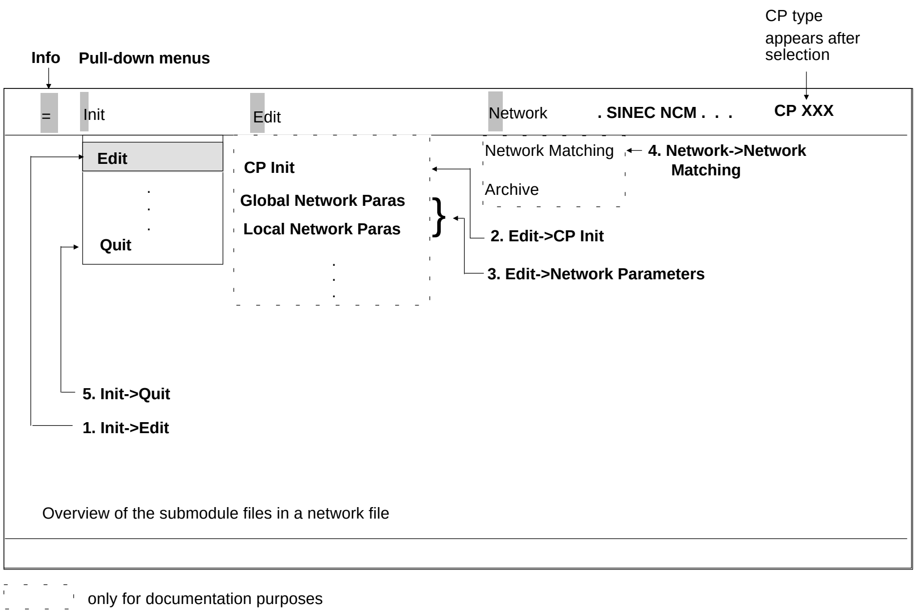


Fig. 6.6 Part of a SINEC NCM Menu

The following numbering refers to Fig. 6.6.

1. Init -> Edit "CP TYPE and project database name"
   Basic initialization screen whose data are automatically saved in a file. If you call up SINEC NCM again, the last defined values are entered in all the input fields.

2. Edit -> CP Init basic initialization (SYSID) block
   Here you program the system parameters which describe the general allocation of the CP to a programmable controller. The parameters also provide information about the firmware and software version of the CP.

3. Edit -> Global/Local Network Parameters "network parameters/network initialization"
   Here you can specify the network parameters. These include various processing times and the highest L2 station address. The COM screen proposes values which you can correct if you require.

   In the global network parameters screen you can define all the bus parameters for all stations on the network. These bus parameters can be transferred to all the databases belonging to the network using Network -> Network Matching. The global network parameters screen is only supported OFFLINE. It is advisable to define all the network stations first and then finally to edit and match the global network parameters.

   The local network parameters screen allows you to edit the bus parameters for a specific station (e.g. optimization) OFFLINE or to change the bus parameters ONLINE.

4. Network -> Network Matching
   With "Network -> Network Matching" you can transfer the bus parameters edited in the global network parameters screen to all the databases belonging to the network (refer also to point 3).

Since the connections depend on the type of data transfer which means that different screens can exist, these screens are explained in the individual chapters for the corresponding types of data transfer.

The menu item Transfer and its commands are explained in Section 6.6.

The remaining menu items are dealt with in separate chapters.

6.5 Screens for Basic Configuration

6.5.1 Editing

When you first call SINEC NCM, you are requested to select a CP type in the Init-Edit screen. Using the selection function, you can select the required CP type from a list. The name of the module then appears in the title line. You can then only exit this screen when all the required parameters have been set or you abort the function with <ESC>. The settings made in the screen for the COM belonging to the CP you have selected are stored in a configuration file and read in when you activate SINEC NCM again.

A module file (database file) is set up for each CP module. This contains all the parameters for operating the CP.

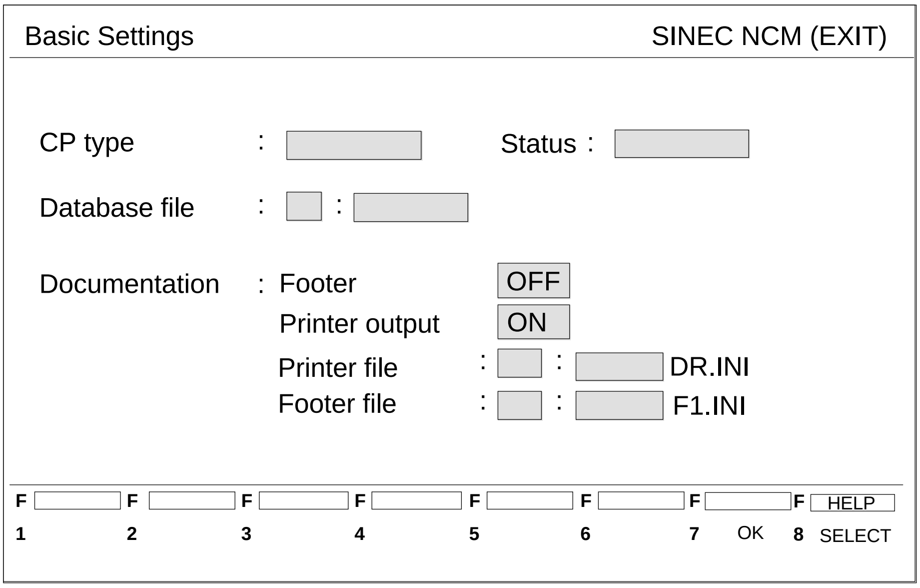


Fig. 6.7 Init -> Edit Screen

Input fields:

CP type: Here, you can choose between the various CPs integrated in SINEC NCM:
(possible selections: e.g. CP 5430 TF, CP 5431 FMS, CP 5412, CP 5470)

Status: The status decides whether the next executable functions are performed:
(possible selections: ONLINE CP, OFFLINE FD) description in Section 6.3

Database file: Format: drive : database

- Drive: Here, you specify the drive you want to work with. If you press F8 the possible drives are displayed.

- Database: You can specify any string (except for the first character) to assign a name to the database of a CP (module file). Each CP module has its own module file set up on the data diskette. This contains all the parameters for operating the CP. If files already exist and you press the F8 selection key, the directory is searched for appropriate entries and the files displayed for selection. You can change this name, however, the first letter must be an "O" for the CP 5430 TF or a "Q" for the CP 5431 FMS (possible selections: alphanumeric characters and the period).
Under S5 DOS stage 6, the database files are saved in the working directory. You can change the working directory in the S5 stage 6 presets screen.

Documentation:

Footer:	With this you decide whether you want a footer printed out at the end of each page (refer to footer file, possible selections: ON/OFF).
Printer output:	Controls the output either only on the screen or on the printer and screen (possible selections: ON/OFF).
Printer file:	Format: drive : printer file
- Drive:	Here, you specify the drive you want to work with. If you press F8 the possible drives are displayed.
- Printer file:	In this file, you specify printer parameters that can be created with the S5-DOS utility "printer file" (possible selections: alphanumeric characters and the period).
Footer file:	Format: drive : footer file
- Drive:	Here, you specify the drive you want to work with. If you press F8 the possible drives are displayed.
- Footer file:	If you want printouts with a footer, the footer file must be specified. The footer is created with the "footer editor" utility (possible selections: alphanumeric characters and the period).

With "Printer output OFF/ON" the printout is switched on or off. With "Footer OFF/ON" the printout of a footer at the end of a page is switched on or off. If you want to print with a footer you must specify the footer file.

☞ **You must first enable the drives you want to work with as default drives in the S5-KOMI.**

Function keys

F7 OK	The "OK" function key enters the data. If the module file does not yet exist it is set up after confirmation.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

Other keys:

(PC with stage V) BACKSPACE (PC with stage VI) SHIFT F8 (PG) HELP:	Displays a help text
RETURN ENTER INSERT:	The values in the help window are entered in the input field.
ESC:	Aborts the function - returns you to the basic screen of the menu.

6.5.2 CP Init

The SYSID block edited with this screen contains all the initialization parameters of the CP which are only adopted during system start-up, i.e. at the transition from STOP to RUN or following power up. Modifications or new entries in the SYSID block are therefore allowed only in the STOP mode. Some parameters are processed in the SYSID block, others are only used for management functions in the COM.

The SYSID block has the following tasks:

➢ Uniform identification and assignment of the module within the SIMATIC S5 system with SINEC L2.

➢ Transfer of parameters which define certain responses of the module.

➢ Display of the firmware version of the module.

When you set up a new module file, the screen is automatically displayed for entering the **Submodule size** and **Base SSNR**.

Select Edit -> CP Init to call the COM screen. The screen is structured as shown below::

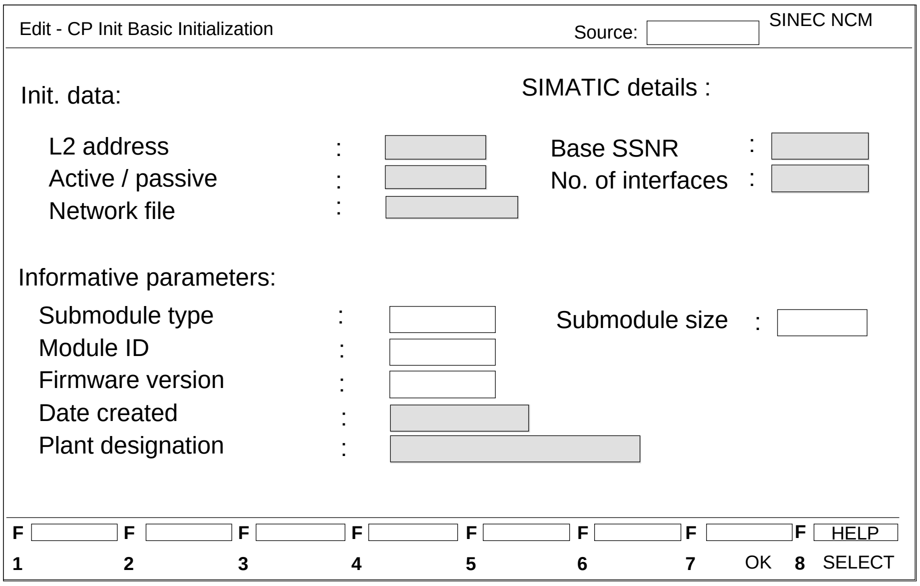


Fig. 6.8 Edit -> CP Init Screen

Input fields:

Init. data:

L2 address	Any station address is possible but must be unique on the bus (range of values: active stations on the bus 1 to 126).

Active / passive The CP 5430 TF/CP 5431 FMS must be active.

Network file Here, the local system is assigned to a network. The network is managed independently of the database. As the default, the name of the last network processed is displayed. The assignment to a network is necessary to establish a consistent bus parameter field in all the databases belonging to the network using the menu item Network -> Network Matching.

(Range of values: alphanumeric characters and the period format: xxxxxNCM.NET, only the characters in the name marked with x are freely selectable. If you type in more characters, a message is displayed.)

SIMATIC details:

Base SSNR: The value corresponds to the address of page 0 (range of values: 0 to 248 in steps of 4).

No. of interfaces: This parameter specifies how many interfaces (pages) can be addressed. (Range of values: 1 to 4)

Informative parameters:

Submodule size: Memory capacity of the submodule in Kilobytes (range of values: 16, 32, 64).
Example: "Submodule type: EPROM Submodule size: 32 Kb".
Recommended submodule size:
16 Kbytes for PLC links and for access to layer 2 services
64 Kbytes for TF applications

☞ **You can change the submodule size with the appropriate utility (see Section 15.2)**

Date created: Date (max. 8 ASCII characters)

Plant designation: Designation of the plant (possible selections: ASCII characters).

Output fields

Submodule type: This parameter is updated in the online mode and is used to display the read submodule type. The following memory types are allowed: "RAM", "EPROM".

Module ID: The module ID is entered by the firmware when an upload is performed. The COM enters the expected module ID.

Online:
specific hardware ID entered by the firmware.

Offline:
entry based on the module type.

Firmware version: Firmware version in the form "V X.YZ".

Function keys

F7 OK	The "OK" function key enters the data. If the module file does not yet exist it is set up after confirmation.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.5.3 Network Parameters

If you do not make entries in the network parameter screens, the COM automatically enters the default values.

The network parameters are fundamental to the functioning of the whole network and the individual stations. When configuring the network parameters the following distinction is made:

➢ configuring global network parameters

➢ configuring local network parameters.

The "Global network parameters" screen allows you to edit the bus parameters belonging to a network. These bus parameters are stored in a file with the extension ".BPB". The screen can only be selected in the OFFLINE mode. The edited parameters can be included in all the OFFLINE databases belonging to the network using the function Network -> Network Matching. The network matching ensures the consistency of the network.

The "Local network parameters" screen allows you to edit station-oriented bus parameters. Local editing is useful for optimization.

☞ **Remember that any input that is not compatible with the network can reduce the performance of your network.**

The parameters are only adopted on the CP during system start-up; i.e. during the transition from the STOP to the RUN mode or after power up. Parameters can therefore only be modified with the CP in the STOP mode.

6.5.3.1 Global Network Parameters

In this screen you can modify the bus parameters for the whole network. The screen is divided into three logical areas, as follows:

➣ Cumulative topology data

➣ Bus parameters

➣ Bus parameter data.

The first two areas contain information for calculating the default bus parameter values. With F1 <Calculate>, you can obtain these default values. The modified parameters are entered in the local databases with the Network -> Network Matching function.

Select Edit -> Global network parameters to call the COM screen. The screen has the following layout:

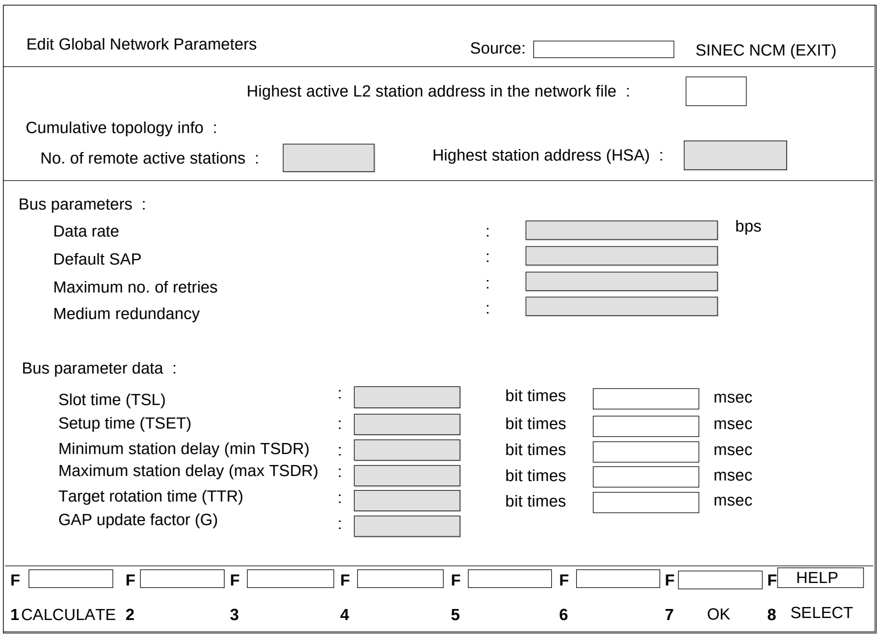


Fig. 6.9 Edit -> Global Network Parameters Screen

Input fields

Cumulative topology info:

No. of remote active stations	The number of active stations not included in the topology file. These are normally stations of other manufacturers. This parameter is required to calculate the bus parameter field. (Range of values: 0..(HSA (number of configured active stations.))
Highest station address (HSA):	Highest Station Address, specifies the highest station address of an active station in the bus system. Addresses for passive stations can be higher than the HSA (range of values: highest active address in the network .. 126).

Bus parameters:

Data rate:	Data rate on the bus (range of values: 9.6 Kbps, 19.2 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps and 1.5 Mbps).
Default SAP:	If an L2 frame is received without a destination SAP number, the CP automatically selects the default SAP.
Maximum no. of retries	Call repetition counter for unsuccessful transmission. It specifies how often a call is repeated by the initiator when no correct acknowledgment frame has been received (range of values: 1 to 8).
Medium redundancy:	(Range of values: no redundancy)

Bus parameter data:

Slot time (TSL):	Monitoring time during which the transmitter (initiator) of a frame waits for an acknowledgment from the responder. When this time elapses, transmission is repeated according to the "maximum no. of retries" value (range of values: 80 to 4095 bit times, however at least 2 ms!).(see Table 6.1).

Setup time (TSET): Minimum "dead time" between the reception of an acknowledgment before sending a new call frame by the initiator (range of values: 1 to 255 bit times*) (see Table 6.1).

Minimum station delay (min TSDR): (Minimum protocol processing time)
A remote responder must not send an acknowledgment of a received call frame until this time has elapsed. The smallest time between receiving the last bit of a frame before sending the first bit of the next frame (range of values: 0 to 255 bit times*) (see Table 6.1).

Maximum station delay (max. TSDR): (Maximum protocol processing time)
An initiator must wait at least this time after transmitting before sending a further call frame. The largest time between receiving the last bit of a frame to transmitting the first bit of the next frame (range of values: 1 to 1024 bit times*) (see Table 6.1).

Target rotation time (TTR): Preset target rotation time within which the token must pass round the logical ring. When the token is received, this time is constantly compared with the actual token rotation time already elapsed. This comparison decides whether and which frames can be sent by the station (refer also to Section 2.2.2) (range of values: 3000 to 1048575 bit times*). This time must be matched to the requirements of the bus system (for calculation, see Appendix).

GAP update factor (G): After the time "G * TTR" has elapsed, a free address area between two active stations (GAP) is checked by the station with the lower address to see whether a further station wishes to enter the logical ring (range of values: 1 to 100).
You must match this factor to the requirements of the bus system. (see Table 6.1).

* Bit time
This is the time required to transmit a bit (reciprocal of the data rate in bps). The unit "bit time" has the advantage that the parameters are not dependent on the transmission speed used.
To calculate the time in milliseconds from the number of bit time units, use the following formula:
time (in milliseconds) = number of the bit time units / transmission rate (in Kbps).

Function keys

F1 CALCULATE	This key triggers the calculation of the bus parameter databased on the information.
F7 OK	The "OK" function key enters the data. If the module file does not yet exist it is set up after confirmation.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.5.3.2 Local Network Parameters

In this screen, you can edit the bus parameters of the local database for special optimization. The local database can be either a file or be on the CP (online). The parameters can be freely edited. In the offline mode, a locally edited file is declared as local. If network matching is later performed, the user is informed that this file has been specially edited. Before overwriting the bus parameters with the global bus parameters you must confirm your intention.

☞ **Remember that any input that is not compatible with the network can reduce the performance of your network.**

Select Edit -> Local Network Parameters to call the COM screen. The screen has the following layout:

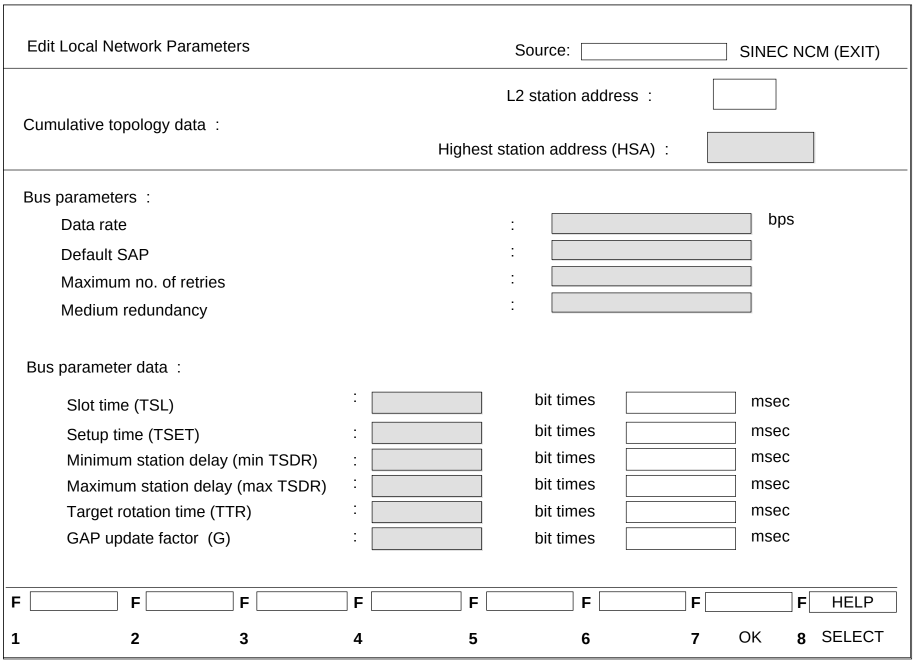


Fig. 6.10 Edit -> Local Network Parameters Screen

Input fields:

Highest station address (HSA): Highest station address, specifies the highest station address of an active station in the bus system. Addresses for passive stations can be higher than the HSA (range of values: highest active address in the network .. 126).

Bus parameters:

Data rate: Data rate on the bus (range of values: 9.6 Kbps, 19.2 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps and 1.5 Mbps).

Default SAP: When an L2 frame is received without a destination SAP number, the layer 2 firmware automatically selects the default SAP.

Maximum no. of retries: Call repetition counter for unsuccessful transmission. It specifies how often a call is repeated by the initiator when no correct acknowledgment frame has been received (range of values: 1 to 8).

Medium redundancy: (Range of values: no redundancy)

Bus parameter data:

Slot time (TSL): Monitoring time during which the transmitter (initiator) of a frame waits for an acknowledgment from the responder. When this time elapses, transmission is repeated according to the "maximum no. of retries" value (range of values: 80 to 4095 bit times, however at least 2 ms!) (see Table 6.1).

Set-up time (TSET): Minimum "dead time" between the reception of an acknowledgment before sending a new call frame by the initiator (range of values: 1 to 255 bit times*) (see Table 6.1).

Minimum station delay (min TSDR): (Minimum protocol processing time) A remote responder must not send an acknowledgment of a received call frame until this time has elapsed. The smallest time between receiving the last bit of a frame before sending the first bit of the next frame (range of values: 0 to 255 bit times*) (see Table 6.1).

* Bit time
This is the time required to transmit a bit (reciprocal of the data rate in bps). The unit "bit time" has the advantage that the parameters are not dependent on the transmission speed used.
To calculate the time in milliseconds from the number of bit time units, use the following formula:
time (in milliseconds) = number of the bit time units / transmission rate (in Kbps).

Maximum station delay (max. TSDR):	(Maximum protocol processing time) An initiator must wait at least this time after transmitting before sending a further call frame. The largest time between receiving the last bit of a frame to transmitting the first bit of the next frame (range of values: 1 to 1024 bit times*) (see Table 6.1).
Target rotation time (TTR):	Preset target rotation time within which the token must pass round the logical ring. When the token is received, this time is constantly compared with the actual token rotation time already elapsed. This comparison decides whether and which frames can be sent by the station (refer also to Section 2.2.2) (range of values: 3000 to 1048575 bit times). This time must be matched to the requirements of the bus system (for calculation, see Appendix).
GAP update factor (G):	After the time "G * TTR" has elapsed, a free address area between two active stations (GAP) is checked by the station with the lower address to see whether a further station wishes to enter the logical ring (range of values: 1 to 100). You must match this factor to the requirements of the bus system. (refer to Table 6.1).

* Bit time:
This is the time required to transmit a bit (reciprocal of the data rate in bps). The unit "bit time" has the advantage that the parameters are not dependent on the transmission speed used.
To calculate the time in milliseconds from the number of bit time units, use the following formula:
time (in milliseconds) = number of the bit time units / transmission rate (in Kbps).

Output field:

L2 station address	The station address was assigned in the Init screen.

Function keys:

F7 OK	The "OK" function key enters the data. If the module file does not yet exist it is set up after confirmation.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

Guidelines for network parameter values:
The network parameters depend on the number of active stations, the characteristics of the end systems and the data rates. The bus parameters are calculated in the global network parameters screen according to the following values:

Baud rate (Kbps)	9.6	19.2	93.75	187.5	500	1500
Slot time	100	170	240	400	1000	3000
Setup time	10	15	45	80	60	80
Minimum station delay	12	15	45	80	80	150
Maximum station delay	60	65	200	360	360	980
Gap factor (G)*	2	4	6	20	30	50

Table 6.1 Network Parameters (suggested values)

The calculation of the target rotation time (TTR) is explained in the appendix.

6.5.4 Network Functions

Under the main menu item Network, you can call all the functions for the network. sind.

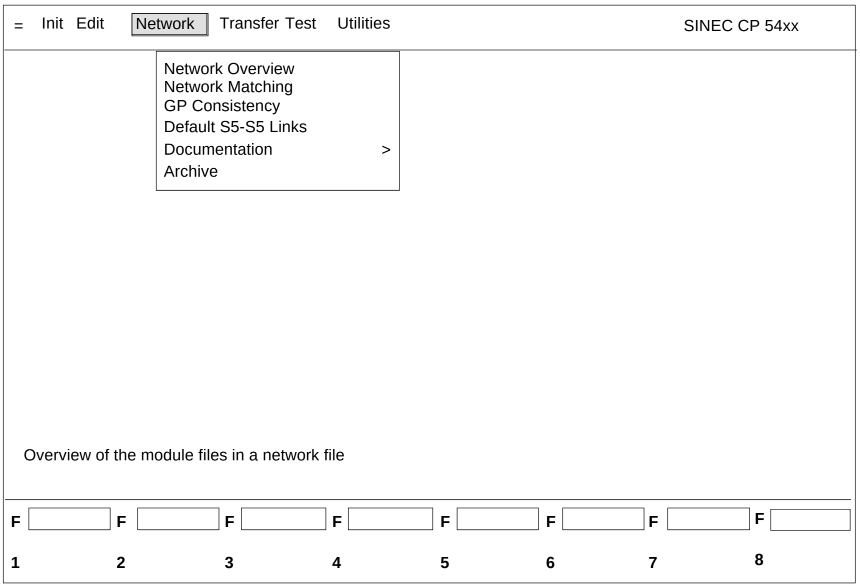


Fig. 6.11 Network Screen

☞ **The network file assigned to a database file is selected in the "Edit -> CP Init" screen.**

6.5.4.1 Network Overview

The network overview displays all the database files belonging to a network (i.e. nodes) in a list. By selecting a node, you can start the required COM.

Network - Network Overview SINEC-NCM (EXIT)
Source: NETZ1NCM.NET

No. of stations: 3 Highest station address (HSA): 31

Node name / database file	L2 address	Type
Q11	11	CP 5431
Q21	21	CP 5430
Q11	17	DPSLAVE

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
PAGE +	PAGE -						HELP
LINE +	LINE -			DELETE		OK	SELECT

Fig. 6.12 Network overview Screen

Output field:

Source: Displays the selected network file

No. of stations: Here, the number of all the passive and active stations belonging to a network is displayed.

Highest station address With global network parameters, the highest set station address is displayed.

Node name/ database file: List of all the database files assigned to the selected network file.

L2 address: Bus address of the station

Bus station type: CP or DP slave

Function keys:

SHIFT F1 PAGE +	Page one page down
SHIFT F2 PAGE -	Page one page up
F1 LINE +	Page one line down
F2 LINE -	Page one line up
F5 DELETE	Delete database file
F7 OK	Start the selected COM
F8 SELECT	Select a new network file

6.5.4.2 Network Matching

In the global network parameters screen you can define all the bus parameters for all stations on the network. These bus parameters can be transferred to all the databases belonging to the network using Network -> Network Matching. The global network parameters screen is only supported OFFLINE. It is advisable to define all the network stations first and then finally to edit and match the global network parameters.

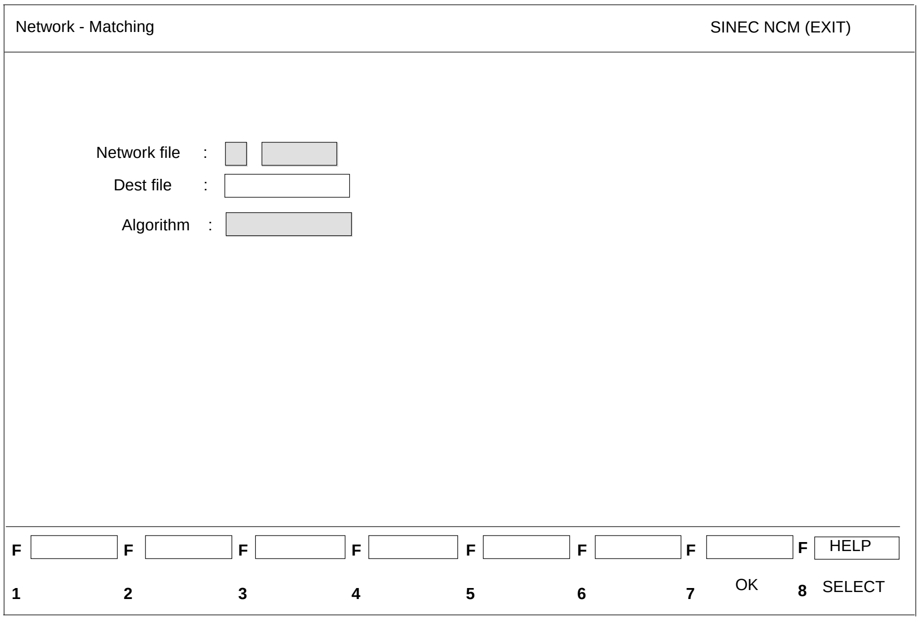


Fig. 6.13 Network Matching Screen

Input field:

Network file: Format: drive : network file name

- Drive: Here, you specify the drive you want to work with. You can display possible drives with F8.

- Network file: Here, a network file is displayed whose name was assigned in the Edit -> CP Init screen and which contains bus parameters created with Edit network parameters. As default, the name of the last processed network is displayed (possible selections: alphanumeric characters and the period, format: xxxxxNCM.NET only the characters in the name marked with x are freely selectable. If you type in more characters, a message is displayed.)

Algorithm This parameter specifies the algorithm according to which the bus parameters are written into the databases of the network.
Currently only "STANDARD" is supported.
STANDARD:
The bus parameter field is adopted from the Global Bus Parameters screen and written into the databases.

Output field

Dest. file Here, all the databases are displayed that are assigned to the network and in which the network parameters will be inserted.

Function keys

F7 OK	The "OK" function key enters the data.

☞ **If the local network parameters of a CP database file have been edited (in the local network parameters screen), a message to this effect is displayed (Bus parameters edited locally, overwrite?). The bus parameter field of this database can then be overwritten with the global bus parameters (function key F1).or you can retain the locally edited data (function key F3).**

F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.5.4.3 GP Consistency

This function starts a consistency check of the global I/Os within a network file. If the check detects that GP output bytes overlap, an error message is displayed. You can now decide whether the GP output byte will be deleted in station A or B or whether the function should be canceled.
The GP input bytes are also checked in the same way. If an unreferenced GP input byte is found (i.e. not assigned to a GP output), you will be asked whether or not to delete the entry or whether a remote active station is involved.

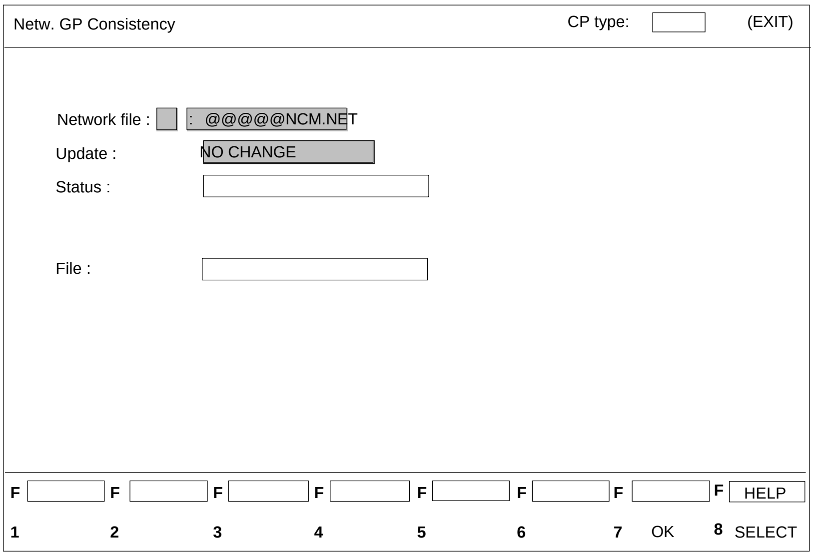


Fig. 6.14 GP Consistency Screen

Input field:

Network file: Format: Drive : Network file name

- Drive: Here, you specify the drive you want to work with. You can display possible drives with F8.

- Network file:	As default, the name of the last network you worked on is displayed.
Update:	Range of values: **CYCLE SYNCHRONIZED:** All configuration settings are set to cycle synchronized. **FREE:** All configuration settings are set to free. **NO CHANGE:** No changes are made.

Output field:

Status:	Displays the status of the consistency check.
File:	Displays the name of the database file being checked for consistency.

Function keys:

F7 OK	Starts the GP consistency check
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.5.4.4 Default S5-S5 Links

This menu item allows simple configuration of an S5-S5 link. Default links are generated between all the systems on the network according to the following pattern:

- local SAP (SSAP) corresponds to the remote station address +1
- remote SAP (DSAP) corresponds to the local station address +1
- send job number (ANR Send) corresponds to the remote station address
- receive job number (ANR receive) corresponds to the local station address +100

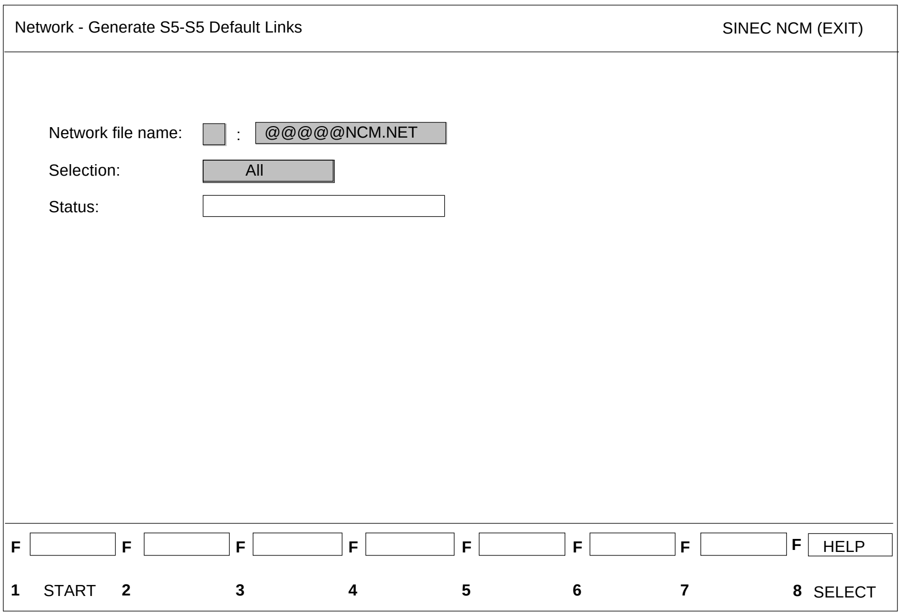


Fig. 6.15 S5-S5 Default Links Screen

Input field:

Network file:	Format: Drive : Network file name
- Drive:	Here, you specify the drive you want to work with. You can display possible drives with F8.
- Network file name:	As default, the name of the last network you worked on is displayed.
Selection:	**All:** S5-S5 links are generated for all databases in the network file. **CP 5430:** Only the default S5-S5 links for CP 5430 database files are generated. **CP 5431:** Only the default S5-S5 links for CP 5431 database files are generated.

Output field:

Status:	Displays the status of the currently active default S5-S5 function.

Function keys:

F1 START	Generates default links
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.5.4.5 Network Documentation

This function provides you with global network documentation of the various services.

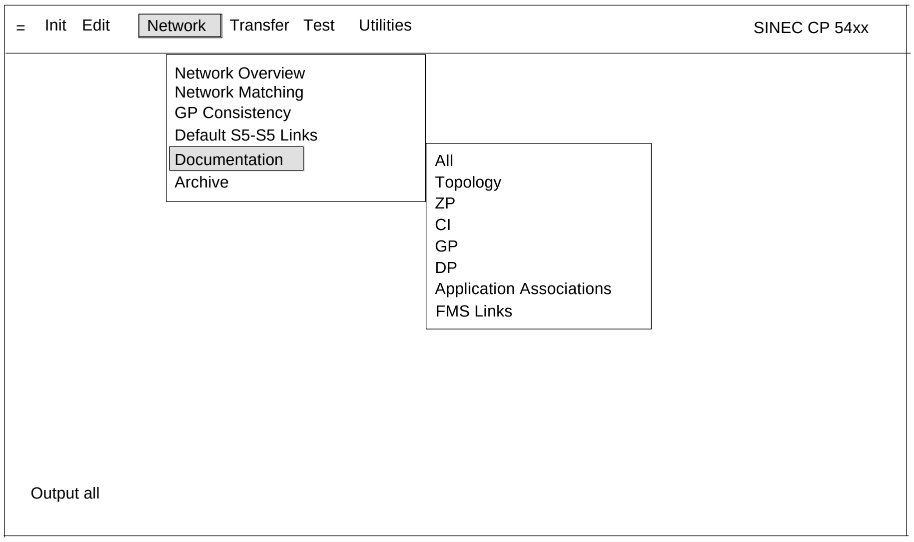


Fig. 6.16 Network Documentation Screen

After selecting the required documentation filter, you change to the network documentation (documentation filter) screen and can start your documentation.

The following documentation filters are available:

All:	complete documentation of the network (starting with the network overview list).
Topology:	output of the network overview list.
ZP:	output of the ZP configuration (CP 5430 TF) incl. I/O area.
CI:	output of the CI configuration (CP 5431 FMS) incl. I/O area.
GP:	output of the GP configuration (CP 5430 TF/CP 5431 FMS) incl. I/O area.
DP:	output of the DP configuration (CP 5430 TF/CP 5431 FMS) incl. I/O area.
Application Associations:	output of the SINEC application association configuration of all CP 5430 TF stations.
FMS Links.:	output of the FMS links of all CP 5431 FMS stations.

6.5.4.6 Archiving

With this function, you can archive a whole network on disk. .

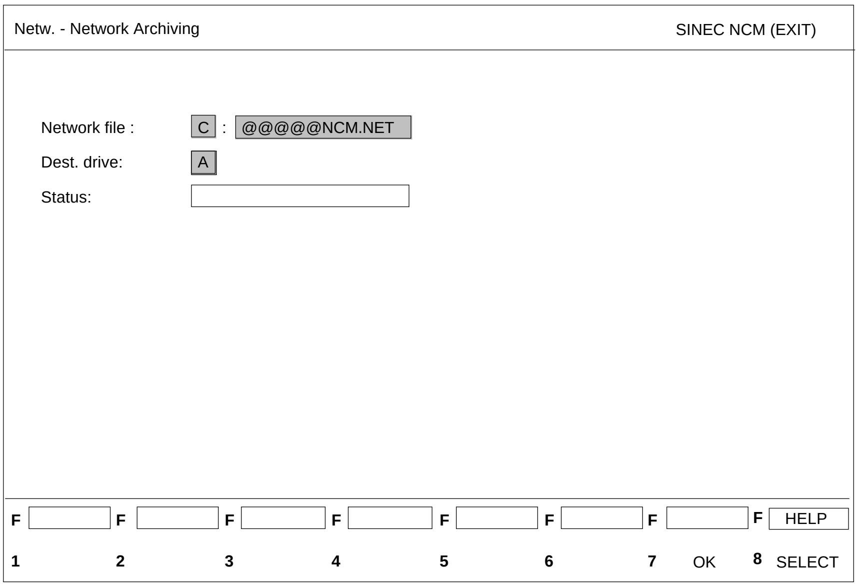


Fig. 6.17 Archiving Screen

Input field:

Network file: Format: Drive : Network file name

- Drive: Here, you specify the drive you want to work with. You can display possible drives with F8.

- Network file name: Name under which the network file will be archived.

Dest drive: All S5 drives except for the currently selected drive of the network file can be specified.

Output field:

Status:	Displays the status of the currently active archiving function.

Function keys:

F7 OK	Starts the archiving
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.6 Transfer Functions

Using the transfer functions, a parameter set, e.g. a submodule file of a CP created locally can be transferred. The commands start, stop and delete are used. In addition to this, it is possible to transfer data from one file to another and to transfer files to the PLC. When transferring from a memory submodule to hard disk, the parameter Submodule type is automatically set to "EPROM" in the SYSID block, regardless of the actual type of submodule. When transferring from a diskette or hard disk to a memory submodule, the Submodule type parameter is automatically matched to the current type of memory submodule.

After selecting the Transfer function in the menu bar, the menu items shown in Fig. 6.18 appear in the pull-down menu.

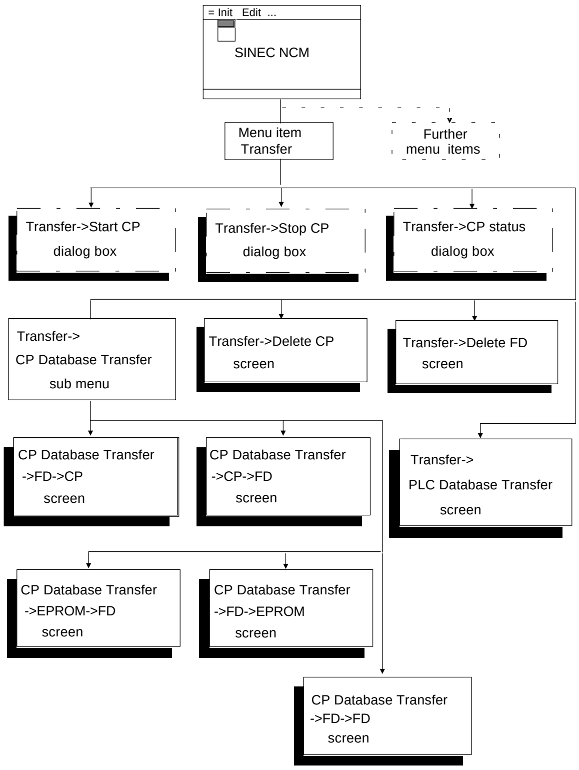


Fig. 6.18 NCM Menu Transfer Function

In the ONLINE mode, the transfer is between the hard disk (= FD) and the memory submodule of the CP. If the memory submodule is an EPROM, only transfer from EPROM to diskette is possible ONLINE.

6.6.1 Start CP / Stop CP / CP Status

The CP recognizes the modes RUN and STOP. The RUN mode is the normal operating status of the CP. In this mode, it is not possible to modify the database. It is only possible to read from the CP. In contrast, in the STOP mode, the CP can be written to. For this reason, before using the functions "Transfer -> FD -> CP" or "Transfer -> Delete CP", the CP must be switched to the STOP mode. The CP can be stopped directly with the START/STOP switch or by a COM function.

The following functions are available:

➢ Start CP

➢ Stop CP

➢ CP status.

The functions can be activated directly from the NCM menu and logically belong to the "Transfer" menu item.

6.6.1.1 Start CP

Select **Transfer -> Start CP** to call the function. This function switches the CP to the RUN mode. A dialog box which you can exit by pressing a key or clicking with the mouse informs you whether the function was successful or not.

6.6.1.2 Stop CP

Select **Transfer -> Stop CP,** to call the function. This function changes the CP to the STOP mode. A dialog box which you can exit by pressing a key or clicking with the mouse informs you whether the function was successful or not.

6.6.1.3 CP Status

Select **Transfer -> CP Status,** to call the function. This function allows you to inquire about the CP status. The status or an error message is displayed in a dialog box which you can exit by pressing a key or clicking with the mouse.

6.6.2 Delete CP

With the delete CP command, you can delete the content of a RAM submodule. To prevent you deleting data accidentally, this command must be confirmed.

Select **Transfer -> Delete CP** to call the COM screen. The screen has the following layout:

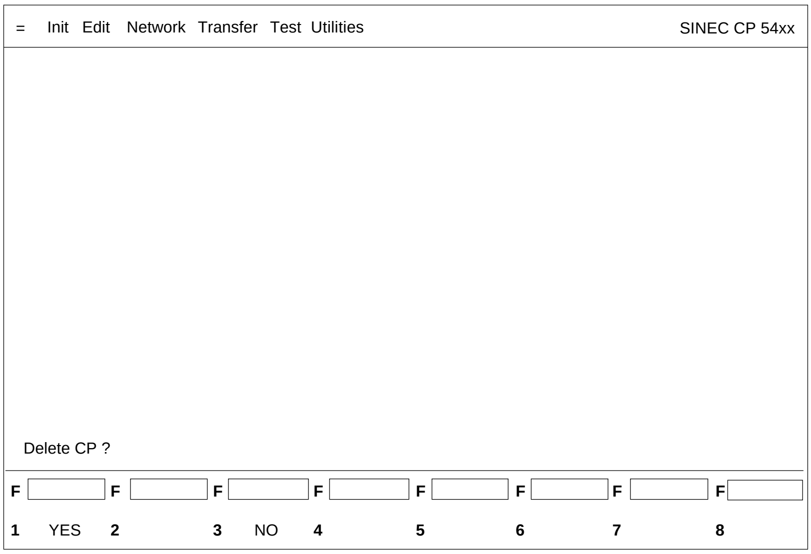


Fig. 6.19 Transfer -> Delete CP Screen

In the message line, the prompt: Delete CP? appears to which you respond using the function keys.

Function keys:

F1 YES	CP will be deleted.
F3 NO	CP contents are retained.

6.6.3 Delete FD

With the Delete FD command you can delete the contents of a database file. To prevent data being accidentally deleted, this command must be confirmed.

Select **Transfer -> Delete FD** to call the COM screen. The screen has the following layout:

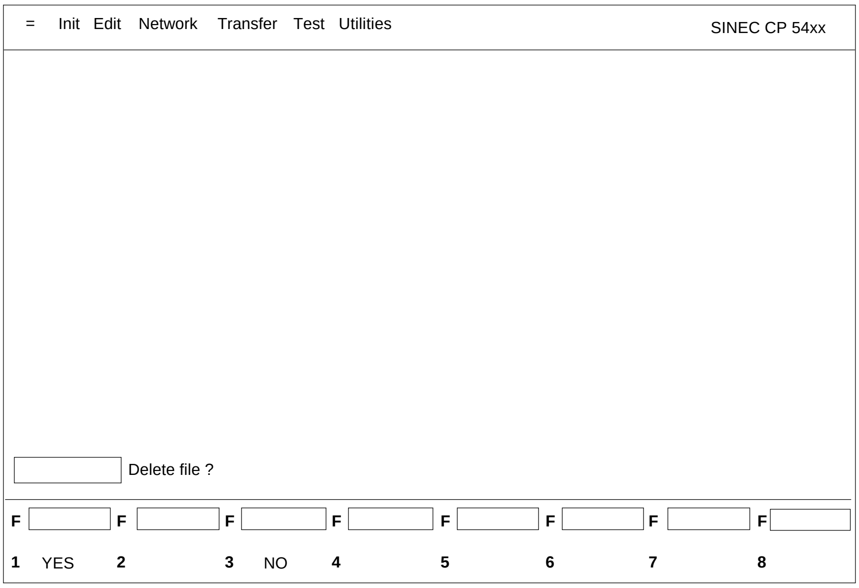


Fig. 6.20 Transfer -> Delete FD Screen

The following prompt appears in the message line: drive: source file name: Delete file?, to which you can respond with the function keys.

Function keys:

F1 YES	Source file will be deleted.
F3 NO	Source file is retained.

6.6.4 CP Database Transfer

Select **Transfer -> CP Database Transfer,** to change to the submenu.

6.6.4.1 FD -> CP

Submodule files created OFFLINE are transferred to the CP. The PG must, however, be connected ONLINE (via the PG interface or the bus) with the CP at the time of the transfer. There must be a RAM submodule inserted in the CP. As the submodule file, the database file specified in the Init -> Edit screen is used. Select **CP Database Transfer -> FD -> CP,** to call the COM screen. The screen has the following layout:

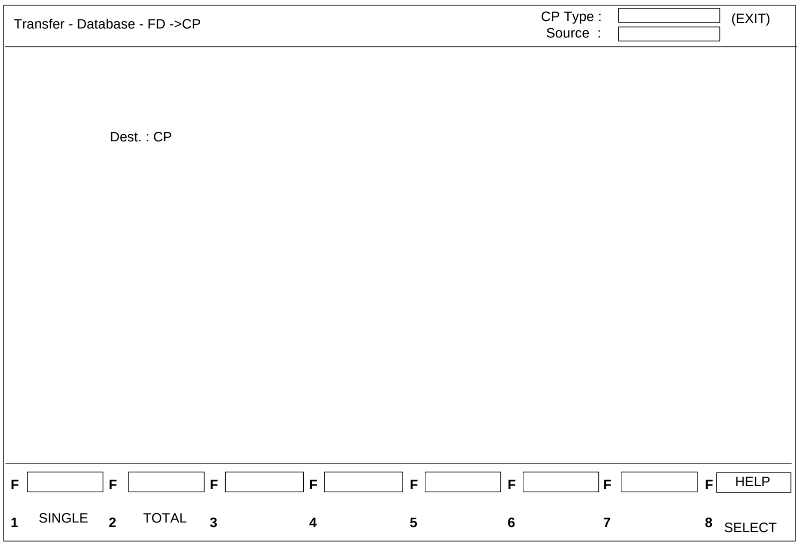


Fig. 6.21 Database Transfer -> FD -> CP Screen

The COM asks whether single blocks or all blocks are to be transferred. If the network belonging to the database is inconsistent, a warning is displayed. If you acknowledge the message, the function is continued. You can abort the function with ESC

Function keys:

F1 SINGLE	The blocks are transferred singly to the CP. For the meaning of the individual blocks refer to Fig. 6.27/6.28 in this chapter.
F2 TOTAL	The blocks are all transferred to the CP.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

☞ **Make sure that the size of the RAM submodule matches the submodule size set with "Edit CP Init" (Fig. 6.8).**

6.6.4.2 CP -> FD

The submodule files are transferred from the CP to FD. The PG must, however, be ONLINE with the CP at the time of the transfer. The default destination file is the database file specified in the Init -> Edit screen. Select **CP Database Transfer -> CP -> FD,** to call the COM screen. The screen has the following layout:

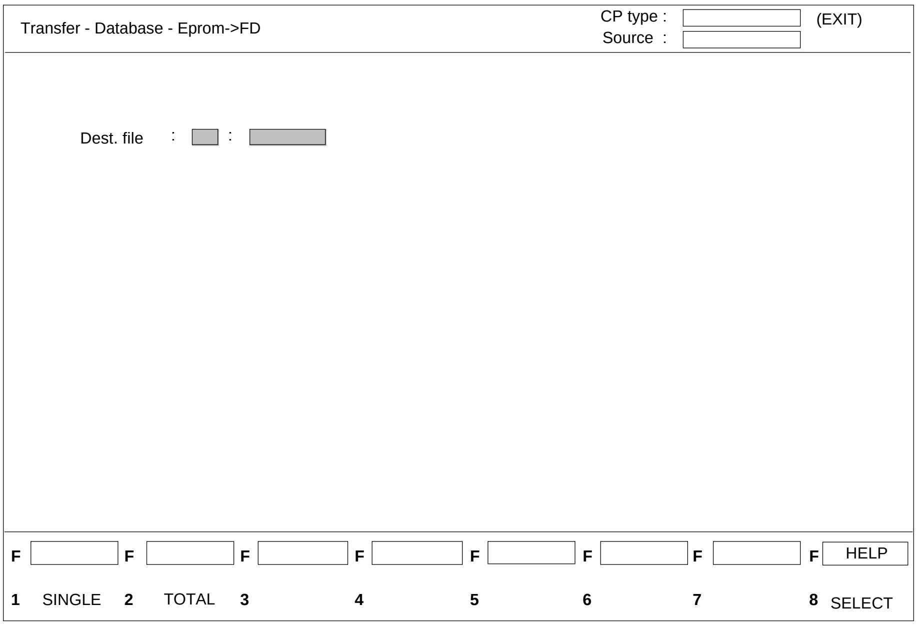


Fig. 6.22 CP Database Transfer -> CP -> FD Screen

If the file already exists, a message appears in the message line asking you whether you want to delete the file on the destination station by overwriting it.

Output fields:

Dest. file	This is the file in which the database from the CP is stored.

Function keys:

F1 SINGLE	The blocks are transferred singly to the CP. For the meaning of the individual blocks refer to Fig. 6.28 in this chapter.
F2 TOTAL	The blocks are all transferred to the destination file.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.6.4.3 FD -> EPROM

The data records on FD (diskette or hard disk) are written directly to the EPROM (blown). Select **CP Database Transfer -> FD -> EPROM** to call the COM screen. The screen has the following layout:

Input fields:

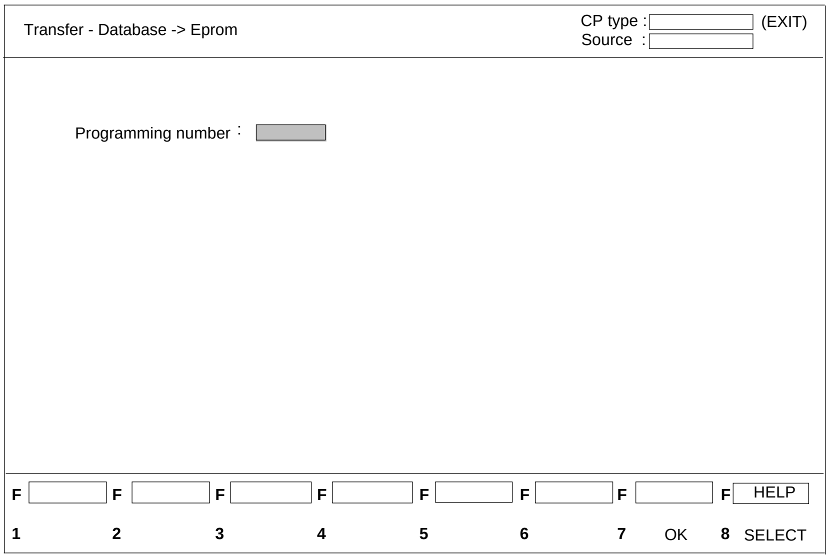


Fig. 6.23 CP Database Transfer -> FD -> EPROM Screen

Programming number: Here, you enter the programming number of the EPROM type you are using. You can select this from the NCM selection menu.

☞ **Make sure that the EPROM type matches the programming number. If the assignment is wrong, the EPROM submodule is destroyed.**

You should also make sure that the size of the EPROM matches the submodule size preset in "Edit CP Init" (Fig. 6.8).

Function keys:

F7 OK	The data are transferred to the EPROM.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.6.4.4 EPROM -> FD

The data records on the EPROM are copied directly to the default database file. Select **CP Database Transfer -> EPROM -> FD** to call the COM screen. The screen has the following layout:

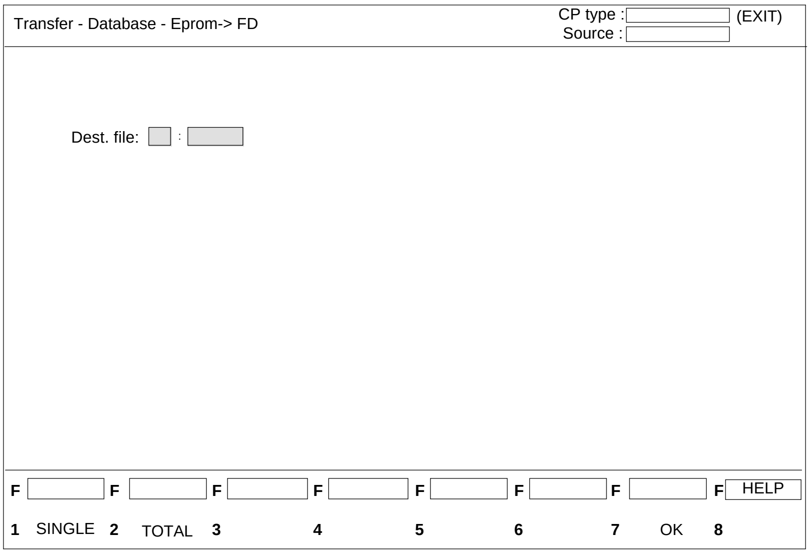


Fig. 6.24 CP Database Transfer -> EPROM -> FD Screen

If the file already exists, a message appears in the message line asking you whether you want to delete the file on the destination station by overwriting it.

Output fields

Dest. file	This is the file in which the database from the EPROM is stored.

Function keys:

F7 OK	All the data are read from the EPROM and stored in the destination file.

6.6.4.5 FD -> FD

This function is used to duplicate the source in the destination file. Select **CP Database Transfer -> FD -> FD** to call the COM screen. The screen has the following layout:

Fig. 6.25 Database Transfer -> FD -> FD Screen

If the file already exists, a message appears in the message line asking you whether you want to delete the file on the destination station by overwriting it.

Input fields:

Dest. file	Here, you specify the drive (e.g. A: for floppy disk or B: for a hard disk) and the name of the destination file (possible values drive: "A" to "Z", file name: alphanumeric characters and the period).

Function keys:

F1 SINGLE	The data are read from the EPROM into the destination file in blocks. Refer to Figs. 6.27 and 6.28 in this chapter for the meaning of the individual blocks.
F2 TOTAL	All the data are read from the EPROM and stored in the destination file.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

6.7 Link Configuration

This menu item is available in all SINEC NCM COMs but the screen layout differs depending on the protocol or type of data transmission and is therefore described in the relevant chapters.

6.8 Basic Configuration

For basic configuring, the software package COM 5430 TF/COM 5431 FMS is used under SINEC NCM.

The screens required for basic configuration are provided by SINEC NCM as illustrated in Fig. 6.26.

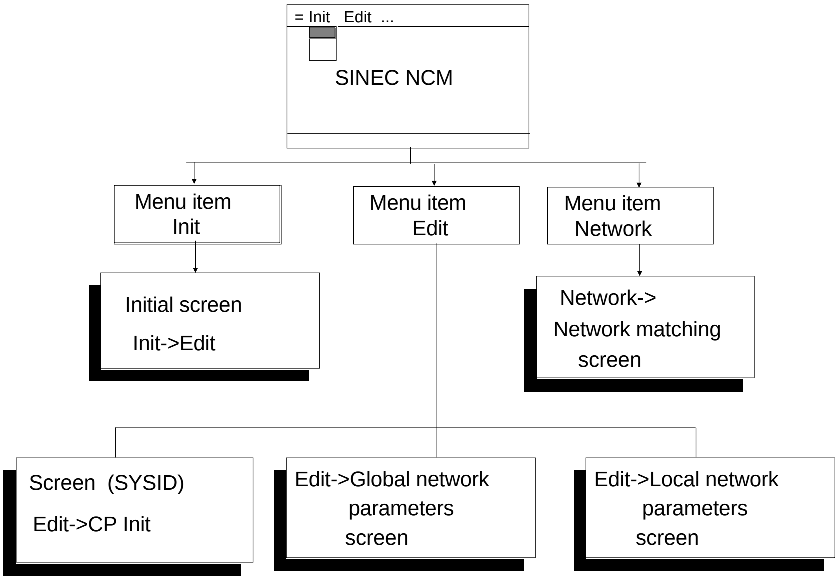


Fig. 6.26 Basic Configuration

General Procedure:

During configuration, the following must be done for each station:

➢ A database file must be assigned in the Init -> Edit screen per station and the status OFFLINE entered.

➢ The Edit -> CP Init screen must be completed, i.e.:

  – assignment of an L2 address
  – setting of the base interface
  – entering of a valid network file for each station on the bus
  – entry of the plant designation and the date created (optional)

➢ In the Edit -> Global network parameters screen:

  – entry of the highest station address (HSA)
  – entry of the "bus parameters"
  – entry of the "bus parameter data"

The global network parameters only need to be entered once, since they are automatically available to the other stations when the network file is entered.

Once these data have been entered for every station in the network, the network matching function is then required to match the global network parameters. This is performed with the menu item (Network -> Network Matching).
Other global network functions are described in Section 6.5.4.

6.8.1 Block Overview CP 5430 TF

Block	Meaning
PB1	Link list for S5-S5 links
PB2	GP inputs
PB3	GP outputs
PB4	ZP list
PB7	DP list
OB2	SAP list for FL2 access
OB3	Start I/O area I/Os list
OB5	Variable description VMD
OB6	Configuration parameters
OB8	Network data return reference
VB 0...X	TF data link block
UB1 (UL1)	Initialization block (bus parameter field)

Fig. 6.27 Block Overview CP 5430 TF

6.8.2 Block Overview CP 5431 FMS

Block	Meaning
PB1	Link list for S5-S5 links
PB2	GP inputs
PB3	GP outputs
PB5	ZI list
PB7	DP list
OB2	SAP list for FL2 access
OB3	Start I/O area I/Os list
OB5	Variable description VMD
OB8	Network data return reference
VB 0...X	FMS data link block
UB1 (UL1)	Initialization block (bus parameter field)

Fig. 6.28 Block Overview CP 5431 FMS

❑

NOTES

7 Data Transmission Using Configured S5-S5 Links

This chapter describes how to transmit data using handling blocks via configured S5-S5 links. The following aspects are explained:

- ➢ The applications for which this type of data transmission is suitable.
- ➢ The principles of this type of data transmission.
- ➢ What is meant by "links" between the stations on the bus.
- ➢ How to assign parameters for these "links" and configure the CP 5430 TF/CP 5431 FMS modules using COM 5430 TF/COM 5431 FMS (example Section 7.3).
- ➢ The structure of STEP 5 programs for this type of data transmission (example Section 7.3).
- ➢ How to recognize and clear errors.

Areas of application for data transmission with HDBs via configured S5-S5 links

This type of data transmission is suitable for transmitting blocks of data of up to 128 bytes between active SIMATIC S5 programmable controllers.

7.1 Basics of Data Transmission with HDBs on Configured S5-S5 Links

The following applies for the CP 5430 TF/CP 5431 FMS:

The firmware of the module generates frames from the data records of the SIMATIC S5 PLC which meet the requirements of the PROFIBUS standard. The services of the first and second layers of the ISO/OSI reference model are used.

You should understand the following points:

➢ What is meant by S5-S5 links and what are the characteristics of such links?

➢ How is data transmission via such links controlled?

Characteristics of the S5S5 link

➢ S5-S5 links allow reliable data exchange between two SIMATIC PLCs using the SEND and RECEIVE handling blocks.

➢ The start and end points of an S5-S5 link are service access points (SAPs).

➢ An SAP manages the link and provides the application process with services for data transmission.

➢ 64 SAPs are defined, of which the SAPs 2 to 54 are available for this type of transmission.

➢ The links between the PLCs created with COM 5430 TF/COM 5431 FMS use SAPs 2 to 54. Each SAP can be assigned a particular send or receive job number (refer to Table 7.1). The number of possible SAPs may be restricted if other types of data transmission are used.

➢ An S5-S5 link must be assigned the priority "Low", "High" or "Interrupt" (refer to Section 7.2.1).

Link to station with L2 address	via LSAP no.	with SEND-ANR	and RECEIVE-ANR
1	2	1	101
2	3	2	102
3	4	3	103
. .	. .	. .	. .
31	32	31	131

Table 7.1 SAP-ANR (Job Numbers) - Assignment Proposed by COM

☞ **Make sure there can be no overlapping of job numbers and LSAPs for FMS links. COM 5431 FMS does not check this automatically.**

Checking data transmission in the control program

If frames are transmitted by a PLC, the PLC expects an acknowledgment. This acknowledgment can either be positive or negative and simply indicates whether or not the frame arrived at the communications partner. The acknowledgment provides information about the processing status of the frame and can be evaluated by the updated status word (ANZW) of the HDBs CONTROL/SEND/RECEIVE.

The status word (refer to Section 7.1.2) informs you about the following:

➢ The status of a job

➢ The data management

➢ Any errors which may have occurred

7.1.1 Sequence of the Data Transmission

Figs. 7.1 to 7.3 are schematics showing how the relevant bits of the ANZW change during correct or incorrect data transmission. The transmitting L2 station is defined as "local", the receiving L2 station as "remote".

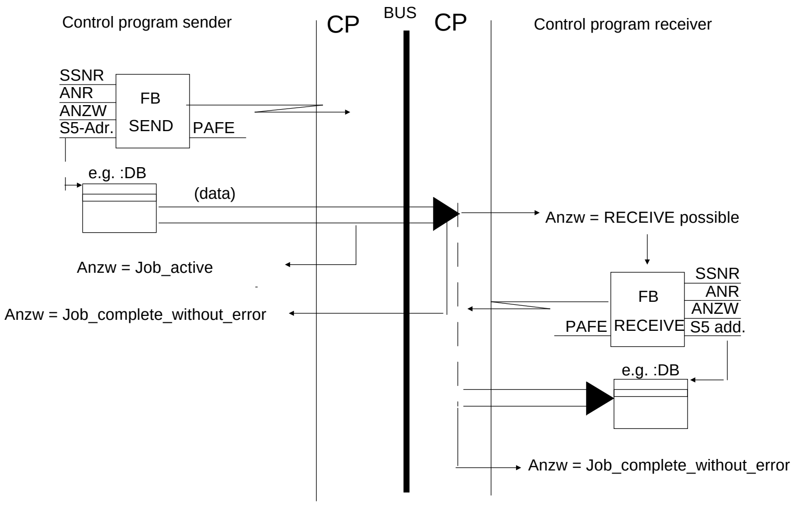


Fig. 7.1 Job Processing - No Error Occurred

ANZW local	ANZW remote	Meaning
0004_H		Previous job complete without error
0002_H		Job active (data being sent)
0008_H		Job complete with error
	0001_H	Receive possible (data can be fetched from the CP)
	0005_H	Previous job complete without error and RECEIVE possible

Table 7.2 Changes in the Status Word During Job Processing

If errors occur during the data transmission, the acknowledgment may be from either the remote or local CP depending on the error.

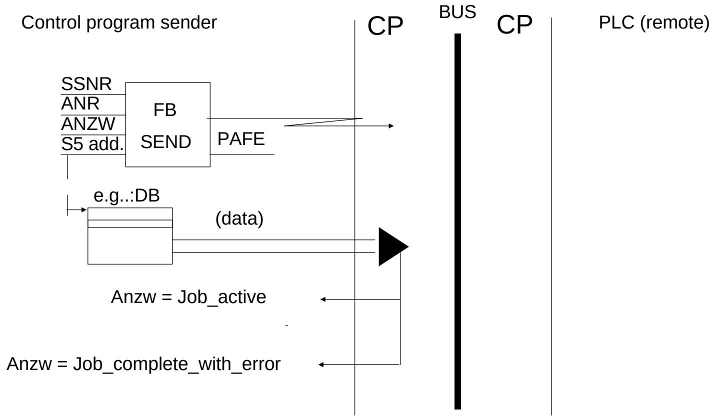


Fig. 7.2 Job Processing with Error Message from Local CP

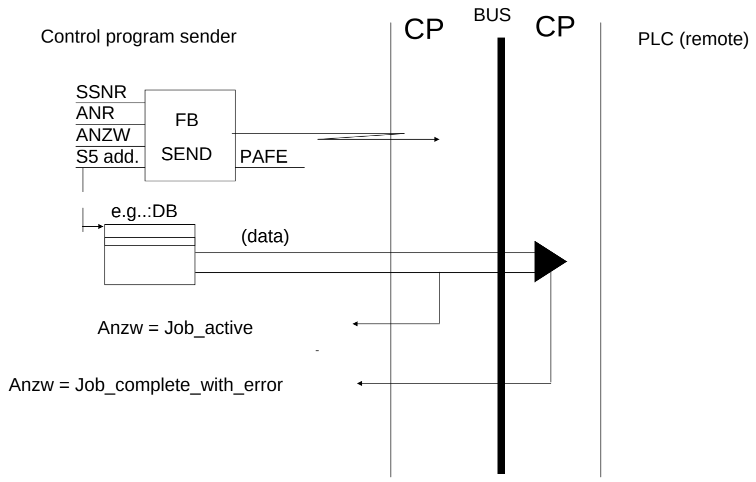


Fig. 7.3 Job Processing with Error Message from Remote CP

7.1.2 Checking with ANZW and PAFE

The status word is part of a double word specified in the calling HDB. The second part of the double word is formed by the length word which indicates how much data has already been transferred for the current job.
Following synchronization, the status words of all the HDBs (ANR) assigned parameters with COM 5430 TF/COM 5431 FMS contain the value 0008_H. If the ANR used is incorrectly or not configured in the COM, the ANZW has the value $0F0A_H$.

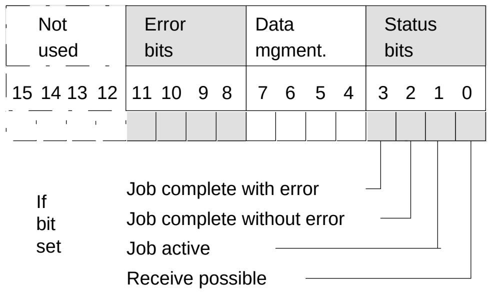


Fig. 7.4 Structure of the Status Word, here: Status Bits

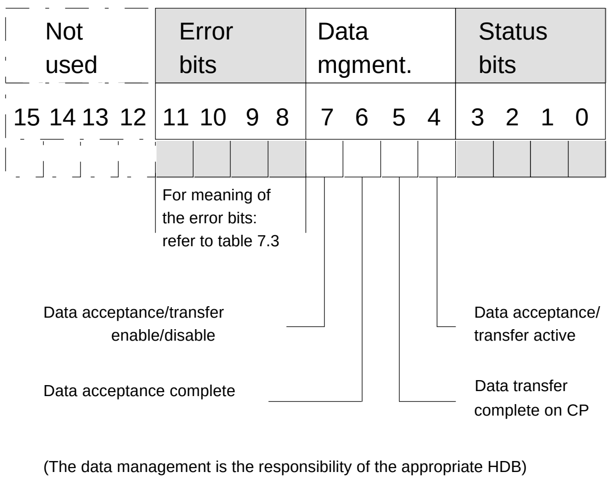


Fig. 7.5 Structure of the Status Word, here: Data Management

Bits 8 -11	Meaning of the error bits
0_H	No error. If bit 3 "job complete with error" is nevertheless set, this means that the CP has set up the job again following a cold restart or RESET.
1_H	Wrong type specified in block call (QTYP/ZTYP).
2_H	Memory area does not exist (e.g. not initialized).
3_H	Memory area too small. The memory area specified in the HDB call (parameters Q(Z)TYP, Q(Z)ANF, Q(Z)LAE) is for too small for the data transmission.
4_H	Timeout (QVZ). Acknowledgment from the memory cell is absent during data transfer. Remedy: check and if necessary replace the memory submodule or check and correct the source/destination parameters.
5_H	Incorrect parameters assigned to status word. The parameter "ANZW" was specified incorrectly. Remedy: correct the parameter or set up the data block correctly in which the ANZW is to be located.
6_H	Invalid source/destination parameter. Parameter ID "NN" or "RW" was used or the data length is too small (=0) or longer than 128 bytes. Remedy: use the correct Q(Z)TYP parameter; "NN" and "RW" are not allowed for this type of data transmission. Check the data length.
7_H	Local resources bottleneck. There are no data buffers available for processing the job. Remedy: retrigger the job, reduce the CP load.
8_H	Remote resources bottleneck. No free receive buffer on the remote CP. Remedy: in the remote PLC, accept "old" data with the receive HDB, in the transmitting PLC repeat the transmit job.

Table 7.3 Error Bits (bits 8...11) in Status Word

Bits 8 -11	Meaning of the error bits
9_H	Remote error. The remote CP has acknowledged the job negatively because e.g. the SAP assignment is incorrect. Remedy: reassign parameters for the link.
A_H	Connection error. The sending PLC or receiving PLC is not connected to the bus. Remedy: switch systems on/off or check bus connections.
B_H	Handshake error. The HDB processing was incorrect or the HDB monitoring time was exceeded. Remedy: start the job again.
C_H	System error. Error in the system program. Remedy: inform Siemens service.
D_H	Disabled data block. The data transmission is or was disabled during the HDB processing.
E_H	Free
F_H	Link or ANR not specified. The job is not defined on the CP. Remedy: program the job (link) or correct the SSNR/ANR in the HDB call.

Table 7.4 Error Bits (bits 8..11) in Status Word (continued)

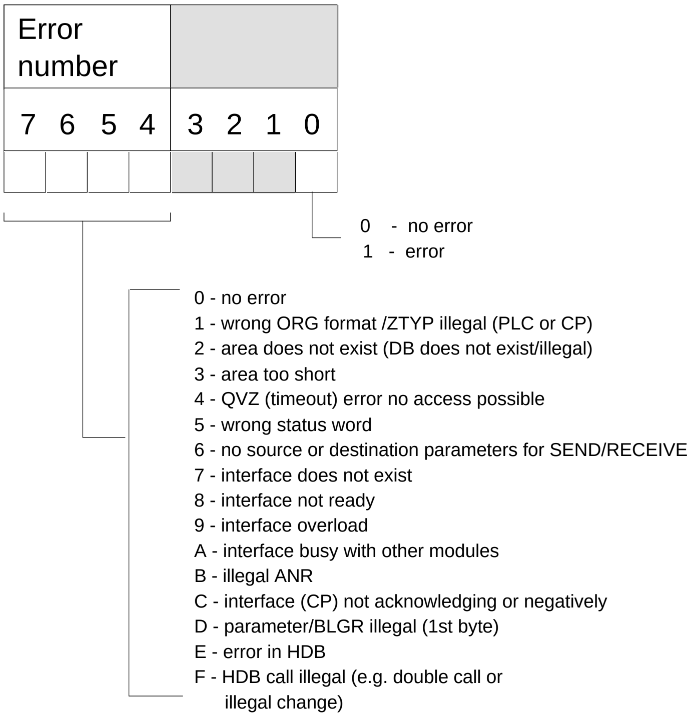


Fig. 7.6 Structure of the Parameter Assignment Error Byte "PAFE"

The **parameter assignment error byte** (PAFE) informs you about various parameter assignment errors. When assigning parameters for the individual blocks, you specify the address at which this information can be called. The meaning of the individual bits is explained in Fig. 7.6

7.2 Configuring

To assign parameters for S5-S5 functions, the software package COM 5430 TF/COM 5431 FMS is used under SINEC NCM.

The screen forms required in addition to the basic initialization screen forms for assigning parameters are provided by SINEC NCM as shown in Fig. 7.7:

➢ Link editor

➢ Documentation and test functions.

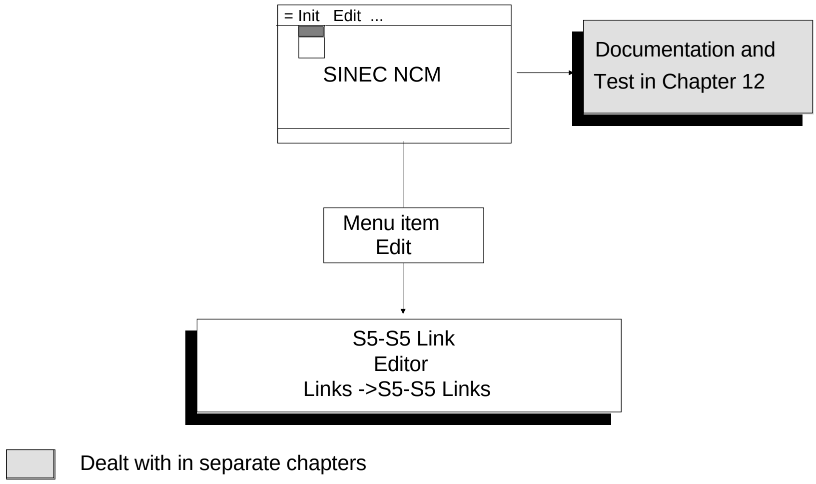


Fig. 7.7 S5-S5 Parameter Assignment

General procedure:

To implement a simple task (transferring data from PLC 1 to PLC 2 via pre-configured links with HDBs) the following procedure is required:

➢ The links between the PLCs must be configured (as mentioned in the general guidelines). For planning the link, refer to Characteristics of the S5-S5 Link (Section 7.2.1).

➢ Assigning parameters to the individual CP modules. This involves creating the SYSID and INIT blocks (refer to Chapter 6).

➢ Configuring the links between the PLCs. This involves creating the link blocks (refer to Section 7.1) according to the planned task.

➢ Programming the CPUs of the PLCs according to the task. This involves HDBs, OBs, FBs and DBs.

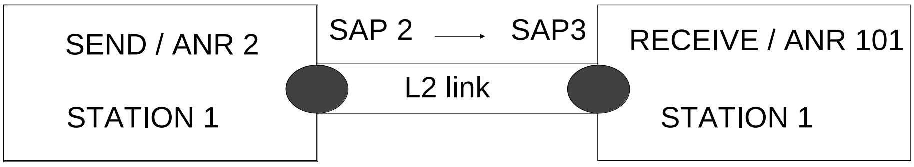


Fig. 7.8 Schematic Representation of a Link Between 2 Stations

7.2.1 Configuring S5-S5 Links

With the link editor of the COM 5430 TF/COM 5431 FMS software package you assign parameters for the links between two stations on the bus. You can also generate default S5-S5 links valid throughout the network (refer to Section 6.5.4.4).

These links are either saved in a submodule file (offline mode) or written directly to the CP submodule or modified there (online mode). This means that submodule files created offline can also be loaded on the CP or that the contents of the CP submodule can be saved in a file.

Select Edit -> Links -> S5-S5 Links to call the following screen. The screen is structured as follows:

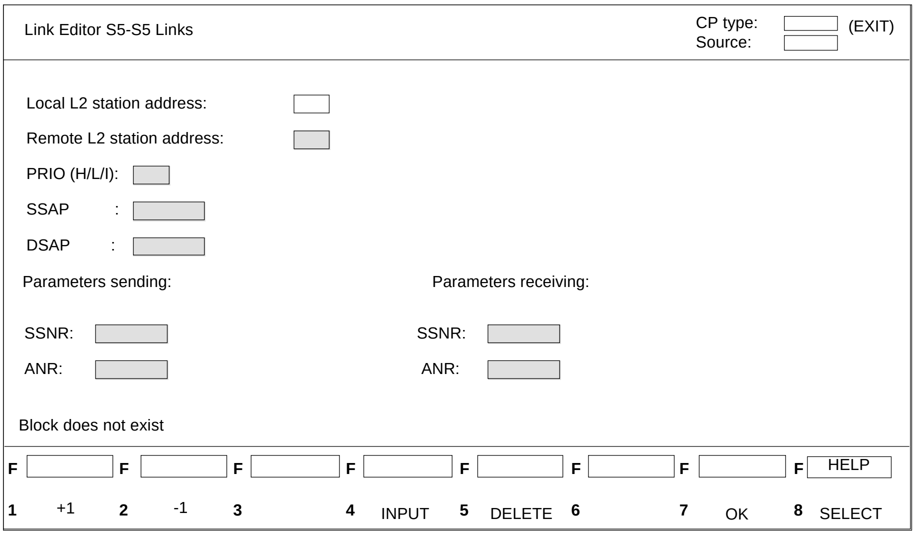


Fig. 7.9 S5-S5 Links Configuration Screen

Input fields

Remote L2 station address	Here, you enter the address of the remote station (range of values: 1 .. 31)
PRIO (H/L/I):	Specifies the priority of the jobs. The default is "LOW". (Possible entries: "LOW", "HIGH" "Interrupt").

"LOW": frames with this priority are normal frames. After receiving the token, and if there is sufficient token holding time, frames with low priority are sent.

"High": frames with this priority are given preference during data exchange. This means that if an L2 station has no more token time available when it receives the token, it can still transmit a high priority frame.

"Interrupt": these frames are handled just like high priority frames during data exchange. They also trigger an interrupt in the receiving PLC (IR-A/B/C/D).

SSAP:	Local (Source) Service Access Point. (range of values: 2 .. 33). **Make sure you exclude the possibility of overlapping with LSAPs for FMS links.**
DSAP:	Remote (Destination) Service Access Point. (range of values: 2 .. 33, 56). **Make sure you exclude the possibility of overlapping with LSAPs for FMS links.**
Parameters sending/receiving:	Parameters for the local station for transmitting and receiving are entered here.
SSNR:	Interface number, corresponds to the number of the CPU and therefore forms the CPU-CP interface. (range of values 0..3).
ANR:	Job number via which the job is triggered. (range of values transmitting :1..32, range of values receiving :101..132). **Make sure you exclude the possibility of overlapping with job numbers (ANR) for FMS links.**

Output fields

Local L2 station address:	L2 address currently being processed.

Function keys:

F1 +1	Page forwards through the links for several S5-S5 links.
F2 -1	Page backwards through the links for several S5-S5 links.
F4 INPUT	Prepare next input.
F5 DELETE	Delete the input link.
F7 OK	Enter the data in the link block.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

7.3 Example of a Program for an S5-S5 Link

The aim of the example is to set up a communication system that allows simple control of the activity on a SINEC L2 bus system. It should be possible to formulate the basic information required to set up and operate a SINEC L2 bus system and to control the activity on the bus system. The example illustrates how to program the CPU and assign parameters for the CP as well as triggering and checking the data transmission.

You should have worked through Chapters 3 to 6 of this manual and be familiar with the handling blocks and STEP 5.

Hardware and software requirements

The following hardware is necessary:

- ➢ Two SIMATIC S5 programmable controllers (PLC 1: S5-155U and PLC 2: S5-115U)
- ➢ One CP 5430 TF or CP 5431 FMS per PLC
- ➢ One EPROM or RAM submodule per CP 5430 TF or CP 5431 FMS
- ➢ One RS 485 bus terminal per CP
- ➢ SINEC L2 bus cable
- ➢ At least one PG 710, PG 730, PG 750 or PG 770, or PC

The following software packages are also required:

- COM 5430 TF/COM 5431 FMS under SINEC NCM
- PG software for STEP 5 programming
- Appropriate handling blocks for the PLCs
- Diskette with the example program.

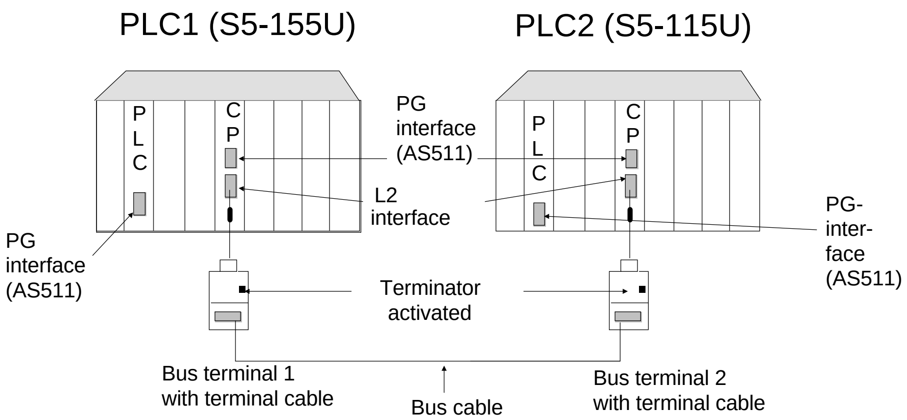


Fig. 7.10 Schematic Representation of the Hardware Components

7.3.1 Outline of the Task

Data from PLC 1 will be transmitted via configured links using HDBs to PLC 2 and data will be transmitted via configured links using HDBs from PLC 2 to PLC 1. The following tasks must be performed in the individual PLCs:

PLC 1

➢ DW 1 is incremented in DB 10.

➢ After incrementing DW 1, this is transmitted to PLC 2 using the handling block SEND.

➢ HDB SEND is assigned the values ANR = 2 and SSNR = 0.

➢ PLC 1 has the L2 address 1.

➢ The data word received from PLC 2 is stored in DB 12 DW 1.

➢ HDB RECEIVE is assigned values ANR=102 and SSNR=0.

PLC 2

- ➢ DW 1 is incremented in DB 20.
- ➢ After DW 1 has been incremented in DB 20, this is transmitted to PLC 1 using HDB SEND.
- ➢ HDB SEND is assigned the values ANR=1 and SSNR=4.
- ➢ PLC 2 has the L2 address 2.
- ➢ The data sent from PLC 1 are received in PLC 2 and stored in DB 22.
- ➢ HDB RECEIVE is used for this. The HDB is assigned the values A-NR=101 and SSNR=4.

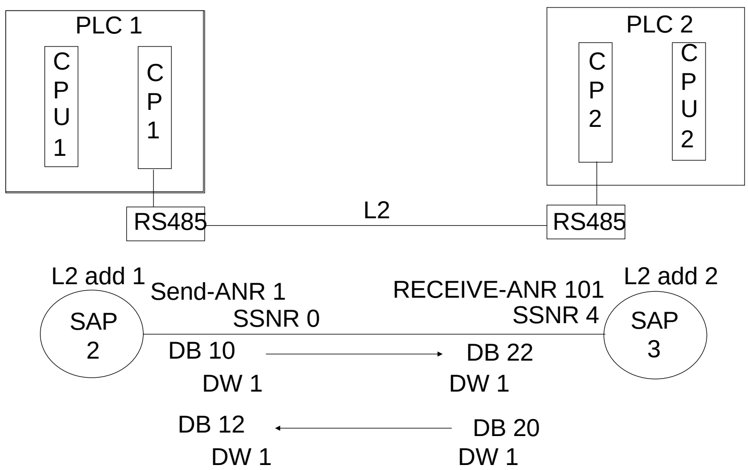


Fig. 7.11 System Configuration for the Example of Data Transmission with HDBs

7.3.1.1 Program for PLC 1 (S5-155 U)

When the PLC starts up, the CP interface is synchronized with the SYNCHRON handling block.

PLC 1 increments data word DW 1 in DB10 and then transmits it to PLC 2. Once the job is completed, i.e. the status of the ANZW is "complete without error", the data word is incremented again and transmitted to PLC 2.

Transmission is triggered in PLC 1 with a SEND HDB. This is called in FB 2. Before each SEND call, the data bytes of DW 1 are incremented in DB 10. This takes place in FB 1. The function blocks and FB 2 are called in OB 1.

Before triggering a new send job, the following statuses must be checked:

➢ Has the corresponding DW been incremented (F2.0 =1)?

➢ Is the previous SEND job complete (F11.1 = 0) and free of error (F 11.2 =1)?

➢ Has no parameter assignment error occurred (F15.0 = 0)?

In addition to this, PLC 1 receives a DW from PLC 2 which must be written to DW 1 in DB 12.

If the status of ANZW FW 110 in FB 102 is "receive possible", the RECEIVE HDB is called and the receive word stored in the DB.

➢ Is "RECEIVE possible" (F111.0=1)?

➢ Has no parameter assignment occurred (F115.0=0).

7.3.1.2 Program for PLC 2 (S5-115 U)

The CP interface of PLC 2 must also be synchronized during start-up using the SYNCHRON handling block. The SYNCHRON calls must therefore be programmed for the PLC used in blocks OB 21 (for manual warm restart) and OB 22 (warm restart following power down).

The synchronization is triggered and checked in FB 111 STARTUP (not a standard FB). If an error occurs, a flag bit is set which can be evaluated by the user program.

The transmit trigger in PLC 2 uses a SEND HDB. This is called in FB 10. Before each SEND call, the data bytes must be incremented. This occurs in FB 20. Function blocks FB 1 and FB 2 are called in OB 1.

The data transmitted by PLC 1 are received in PLC 2 using the RECEIVE handling block. This HDB is called in FB 101.

7.3.2 Transferring the Configuration Data for the CP 5430 TF/CP 5431 FMS and the STEP 5 User Program

To be able to implement the practical example for S5-S5 communication, follow the procedure outlined below (and refer to Chapter 16):

➢ Transfer the following COM 5430 TF/COM 5431 FMS database files to the CPs you are using:

When using the CP 5430 TF under the network file AGAGONCM.NET

- for station 1 OAGAG.155
- for station 2 OAGAG.115.

When using the CP 5431 FMS under the network file AGAGQNCM.NET

– for station 1 QAGAG.155

– for station 2 QAGAG.115.

➢ Transfer the following STEP 5 files to the programmable controllers you are using:

– For PLC 1 (S5-155U) the file AGAGT1ST.S5D

– For PLC 2 (S5-115U) the file AGAGT2ST.S5D.

7.3.3 Monitoring the Data Transmission

The data transmission can be monitored best by using two PGs. Connect one PG to one CPU and display the data blocks, the status word (ANZW) and the parameter assignment error byte (PAFE) with which the data transmission can be monitored. The following table lists the blocks, flag words and flag bytes relevant for checking this example.

	PLC 1	PLC 2
DB transmitted/received data	DB 10 (DW 1) DB 12 (DW 1)	DB 20 (DW 1) DB 22 (DW 1)
ANZW		
FB 120 SEND	FW 10	
FB 121 RECEIVE	FW 110	
FB 244 SEND		FW 20
FB 245 RECEIVE		FW 210
PAFE		
FB 120 SEND	FY 15	
FB 121 RECEIVE	FY 115	
FB 244 SEND		FY 25
FB 245 RECEIVE		FY 215

Table 7.5 DB Transmitted and Received Data, Status Words and PAFE Codes

The data words in the DBs must change in rapid succession. If this is not the case, there is a transmission or parameter assignment error and the type of error can be found by evaluating the ANZW and PAFE bits.

Section 7.1.2 explains the significance of the bits in ANZW and PAFE. These bytes must be continuously evaluated to check the data transmission and to be able to localize and remedy any errors which may occur. ❑

8 Data Transmission by Direct Access to Layer 2 Services

This chapter explains the following aspects:

- ➢ The devices and applications for which "data transmission by direct access to layer 2 services" is suitable.
- ➢ How this type of data transmission functions.
- ➢ How this "link" is configured with COM 5430 TF/COM 5431 FMS and how to assign parameters for the CP 5430 TF/CP 5431 FMS module (example program in Section 8.4).
- ➢ The STEP 5 programs for this type of data transmission (example program in Section 8.4).
- ➢ How to detect and remedy errors.

Areas of application for data transmission by direct access to layer 2 services

This type of data transmission is suitable for communication between two SIMATIC S5 programmable controllers and remote PROFIBUS compatible programmable controllers or field devices. SIMATIC S5 programmable controllers can also communicate with each other with this type of data transmission; however, for this situation, data transmission via S5-S5 links is easier to implement (refer to Chapter 7).

With data transmission by direct access to layer 2 services you can transmit or receive blocks of data with a maximum length of 242 bytes.

8.1 Basics of Data Transmission using Layer 2 Services

The following applies to the CP 5430 TF/CP 5431 FMS:

The firmware of the modules generates S5 frames from the data records of the SIMATIC S5 PLC which comply with the requirements of the PROFIBUS standard. The services of the first and second layer of the ISO/OSI reference model are used. The services of layer 2 are also known as FDL (Fieldbus Data Link) services. The terms used are explained in the model or in the appendix.

What you need to know

➢ Which layer 2 services are available for data transmission?

➢ How do you use these services for data transfer?

➢ How does this type of data transmission function and how is it used correctly?

➢ How to handle and check data transmission using these services from the point of view of the control program.

8.1.1 FDL Services implemented in a CP 5430 TF/CP 5431 FMS for Data Transmission

The layer 2 firmware of the CP 5430 TF/CP 5431 FMS provides various services for reliable data transmission which can be used in the control program. In concrete terms this means that the control program can request layer 2 data transmission services and can evaluate confirmations (and error messages) made available by this layer. You must also evaluate indications from layer 2 when a frame is received by the CP.

SDA (Send Data with Acknowledge):	Data is sent to the remote station and this acknowledges reception.
SDN (Send Data with No Acknowledge):	Data is sent to the remote station but this does not acknowledge reception.
SRD (Send and Request Data):	Data is sent to the remote station and at the same time data is requested from it. The requested data must already be prepared by the remote station in a transfer buffer.
RPL_UPD_S (RePLy-UPDate-Single):	With this service the transfer buffer is filled with data to be fetched by the communications partner using the SRD service. Once the data have been fetched, the buffer is empty.
RPL_UPD_M (RePLy-UPDate -Multiple):	With this service the transfer buffer is filled with data to be fetched by the communications partner using the SRD service. The data are not deleted after they have been fetched (they remain available until they are overwritten).

You use these services provided by the layer 2 firmware of the CP 5430 TF/CP 5431 FMS in the STEP 5 control program by programming handling block calls.

Using the services for the actual data transfer

The data to be transmitted (max. 242 bytes "net data") and the received data (also max. 242 bytes) should be stored in a data block; it can, however, also be stored in the flag area.

The data to be transmitted and received is always preceded by an 8 byte header containing control and status information for the layer 2 firmware. When calculating the memory required for transmitted and received data (parameters QLAE or ZLAE when calling a handling block) these 8 bytes must be taken into account. The data including the header form the general interface for calling the services, known as the "job buffer". The action is triggered by an application program via the job buffer. The job buffers are transferred to the interface module via the dual-port RAM using the standard handling blocks. The job buffer itself is used to transfer the parameters for correct execution of the service on the interface module. Job buffers must always be in the data block area or in the extended data block area and are restricted to a maximum length of 250 bytes. Each job buffer consists of a header and a data .

Fig. 8.1 illustrates the basic structure of a job buffer. The description of the header is in the key to the figure. The user must create the job buffer for specific services.

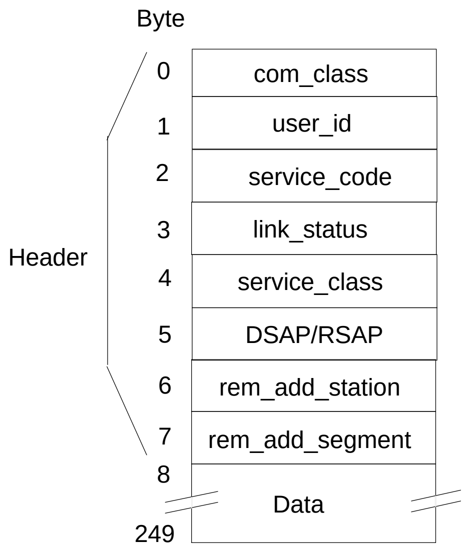


Fig. 8.1 Structure of the Header with a Job Buffer to be Sent/Received

Description of the parameters in the header

com_class: 1 byte, format: KH
FDL request $=00_H$ in transmit buffer:
Service request to layer 2
FDL confirmation$=01_H$ in receive buffer:
Acknowledgment from layer 2 after FDL request
FDL indication $=02_H$ in receive buffer:
Indicates that the data was received.

user_id: 1 byte, format: KH
Freely assignable ID which is returned unchanged with a confirmation. In an indication the value is "0". With the user_id it is possible to establish a unique assignment between request and confirmation.

service_code: 1 byte, format: KH
This identifies the type of service requested for the transmitting job buffer:

$SDA=00_H$
$SDN=01_H$
$SRD=03_H$
$RPL\_UPD\_S=06_H$
$RPL\_UPD\_M=07_H$

This identifies the type of service provided by layer 2 for the received job buffer.

$SDA=00_H$
$SDN=01_H$
$SRD=03_H$
only with FDL confirmation:
$RPL\_UPD\_S=06_H$
$RPL\_UPD\_M=07_H$
only with FDL indication:
$SDN\_MULTICAST=7F_H$

link_status: 1 byte, format: KH
Table 8.1 describes the link_status for a confirmation
Table 8.2 describes the link_status for an SRD indication

service-class: 1 byte, format: KH
Service class specifies the priority of the service
Low = 00_H
High = 10_H

DSAP/RSAP: 1 byte, format: KH
When transmitting, number of the destination SAP coded in hexadecimal (default SAP = FF_H)

When receiving, number of the remote SAP, coded in hexadecimal (default SAP = FF_H)

rem_add_station: 1 byte, format: KH
When transmitting, this indicates the station address of the receiver station, coded in hexadecimal.

When receiving, this indicates the station address of the transmitting station, coded in hexadecimal.

rem_add_segment: byte, format: KH
Logical segment address, FF_H always entered (at present, no other segments can be addressed)

Data: 241 bytes, format: KH
When transmitting, the data to be transmitted are entered here

When receiving, this contains the received data (only with indication and SRD confirmation)

Value of link_status	Abbreviation PROFIBUS	Meaning
SDA		
00_H 01_H 02_H 03_H 11_H 12_H	OK UE RR RS NA DS	positive acknowledgment, service executed. positive acknowledgment, remote user/FDL interface error positive acknowledgment, resources of the remote FDL controller not available. service or rem_add on remote SAP not activated. no reaction (Ack./Res.) from the remote station. local FDL/PHY not in the logical token ring or not connected to bus.
SDN		
00_H 12_H	OK DS	positive acknowledgment, transfer of data by local FDL/PHY controller completed. local FDL/PHY not in the logical token ring or not connected to bus.
SRD		
08_H $0A_H$ 01_H 02_H 03_H 09_H $0C_H$ $0D_H$ 11_H 12_H	DL DH UE RR RS NR RDL RDH NA DS	positive acknowledgment, reply data low exist. positive acknowledgment, reply data low exist. positive acknowledgment, remote user/FDL interface error. positive acknowledgment, resources of the remote FDL controller not available. service or rem_add on remote SAP not activated. positive acknowledgment, resources of the remote FDL controller not available. reply data (low) exist, but negative acknowledgment for transmitted data, 09_H (NR). reply data (high) exist, but negative acknowledgment for transmitted data , 09_H (NR). no reaction (Ack./Res.) from the remote station. local FDL/PHY not in the logical token ring or not connected to bus.
REPLY_UPDATE_SINGLE/REPLAY_UPDATE_MULTIPLE		
00_H 12_H	OK LR	positive acknowledgment, data area loaded. response resource currently being used by MAC.
SDA/SDN/SRD/REPLY_UPDATE_SINGLE/REPLAY_UPDATE_MULTIPLE		
10_H 15_H	LS IV	service on local SAP not activated. invalid parameters in the request header.

Table 8.1 Meaning of the Values in Byte 3 (link_status) in the Confirmation Header

Value of link_status	Abbreviation PROFIBUS	Meaning
SRD (Indication)		
20_H	LO	in this SRD exchange, the reply was with low priority data.
21_H	HI	in this SRD exchange, the reply was with high priority data.
22_H	NO_DATA	in this SRD exchange, no reply data were sent

Table 8.2 Meaning of the Values in Byte 3 (Link Status) in the Indication Header

8.1.2 How Data Transmission by Direct Access to Layer 2 Services Functions

The first 8 bytes of the block of data to be transmitted (in the header) contain control information for the layer 2 firmware. The receiver can also evaluate the first 8 bytes of the received block of data as status information (e.g. error messages (link_status)).

With the data transmission services SDA, SDN and SRD, the CP 5430 TF/CP 5431 FMS uses the control information from the header of the data to "package" the transmitted data in a frame which is then transmitted by the SINEC L2 bus.

The basic sequence of communication via the free layer 2 access is illustrated in Fig. 8.2.

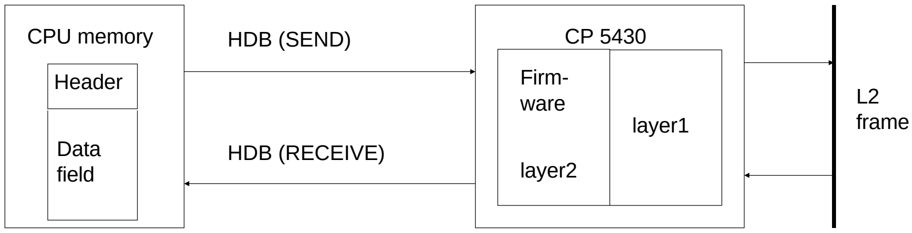


Fig. 8.2 Basic Sequence of Communication using Free Layer 2 Access

The link to communication end points is via so-called channels. To communicate via the free layer 2 access, a link must be configured using "channels" with the link editor (Section 8.3.1).

Characteristics of the free channels

The communication start and end point of a channel between two stations on the bus is known as a service access point (SAP). An SAP is a further address criterion in addition to the station address. As already mentioned in the model, a channel (SAP) is addressed by a job number (ANR). An SAP number must be specified for each channel to be able to use layer 2 services (refer to Fig. 8.3). The assignment of ANR and local SAP is made when configuring with the COM.

☞ **Make sure that any possibility of overlapping with SAPs used for DP is excluded.**

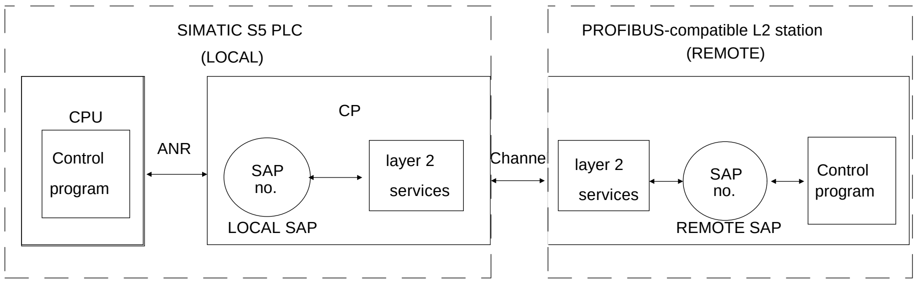


Fig. 8.3 Access to Layer 2 Services via Service Access Points (SAPs)

With the link editor you specify the following:

➢ The interface number

➢ The assignment between:

- SEND/RECEIVE job numbers ANR (range: 134 to 186). The same ANR is used both for transmitting and receiving.
- Number of the local service access point (SAP; range 2...54, 56)

➢ Priority of the link.

With the link editor, the link parameters of the **local** station can be selected.

The missing information must be stored in the header of the corresponding data package; this includes the following:

➢ DSAP (destination SAP) of the remote station

➢ Address of the remote station

➢ Required layer 2 service (SDA, SDN or SRD).

☞ **The firmware of the CP 5430 TF/CP 5431 FMS activates all the specified SAPs for the services SDA, SDN and SRD (both for the initiator and responder functions). The L2 address range of the remote station is not restricted.**

Once the "channels" have been assigned parameters with the link editor for every L2 station with a CP 5430 TF/CP 5431 FMS that is intended to communicate via the free layer 2 access, the required data transfer must be coordinated in the control program.

8.1.3 Handling the Individual Data Transmission Services from the Point of View of the Control Program

The SEND block can be used to transfer an FDL request. FDL confirmations or FDL indications are accepted in the PLC with a RECEIVE HDB. Via the bits in the status word which can be updated with the CONTROL block, the SEND or RECEIVE HDBs can be controlled.

The status word contains information about the status of a job, information about data management and error bits. In the figures illustrating the sequence of the control program (refer to Figs. 8.7 to 8.11) the change in the status word (ANZW) is always visible.

8.1.4 Checking the Data Transmission in the Control Program using ANZW and PAFE

If messages are sent by a PLC, the PLC expects an acknowledgment. This acknowledgment can be either positive or negative and simply indicates whether the frame arrived at the communications partner or not. The acknowledgment provides information about the processing status of the frame and can be evaluated from the updated status word (ANZW) of the CONTROL/SEND/RECEIVE HDBs.

The status word informs you about the following:

- the status of the job
- the data management
- any errors

Following synchronization, the status words of all the links (ANR) assigned parameters with COM 5430 TF/COM 5431 FMS contain the value 0008_H. If the link was not defined, the ANZW has the value $0F0A_H$

The status word is part of a double word defined by the parameter ANZW in the HDB call. The second part of the double word is the length word which indicates how many data have already been transferred for the current job. The structure of the status word is basically identical to that for S5-S5 communication, however, it is handled differently.

Structure of a status word

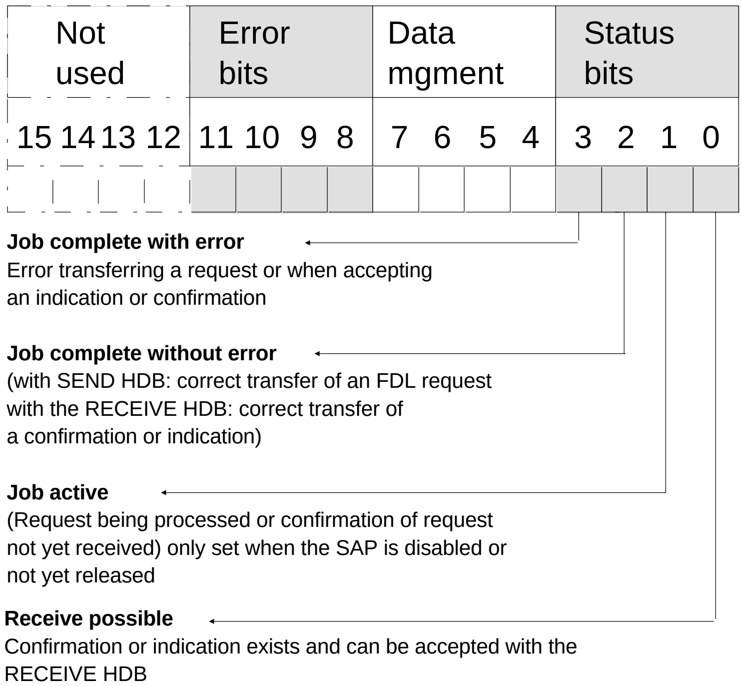


Fig. 8.4 Structure of the Status Word, here: Status Bits

☞ **Apart from the status word, you must also evaluate the "link_status" byte from the confirmation header (or indication header of an SRD indication) in the control program. The significance of the information in the "link_status" byte (or in the indication header of an SRD indication) can be seen in Table 8.1/8.2.**

If the bit "job complete with error" is set in the status bits, the "error bits" provide the coding of the cause. With the "channels" only the PLC error is indicated (error numbers 1 to 6). Errors processing an FDL request are transferred with the corresponding confirmation. The error number 15 ($0F_H$) is set by the CP when the corresponding SAP was not enabled. With this number, the bits "job complete with error" and "job active" are also set (ANZW $0F0A_H$). The way in which this data transmission is handled between two SIMATIC PLCs can be seen in Figs. 8.7 to 8.11. Before these figures, there is an explanation of the sequence of the transmission. Figs. 8.7 to 8.11 also take into account the status bits in the status word (e.g. ANZW....1H" means "RECEIVE possible").

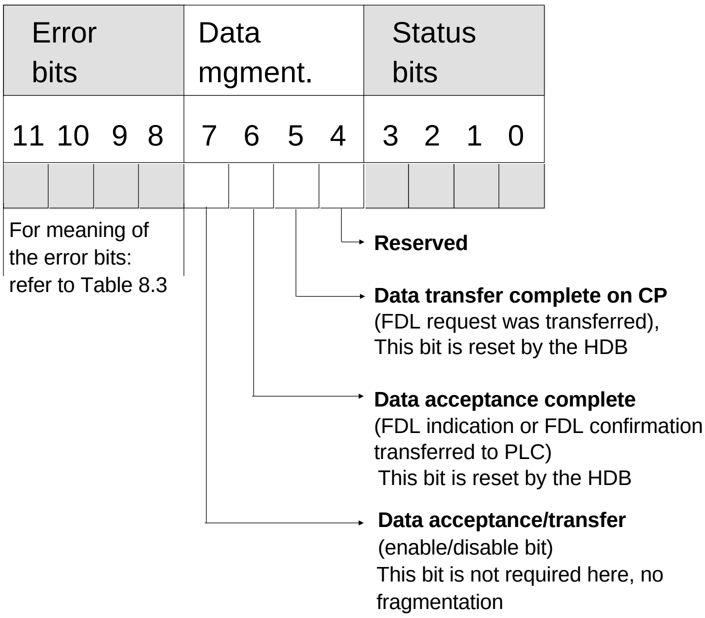


Fig. 8.5 Structure of the Status Word, here: Data Management

Bits 8-11	Meaning of the error bits
0	No error. If bit 3 "job complete with error" is nevertheless set, this means that the CP has set up the job again following a cold restart or RESET.
1	Wrong type specified in block call (QTYP/ZTYP).
2	Memory area does not exist (e.g. not initialized)
3	Memory area too small. The memory area specified in the HDB call (parameters Q(Z)TYP, Q(Z)ANF, Q(Z)LAE) is too small for the data transmission.
4	Timeout (QVZ). Acknowledgement from the memory cell is absent during data transfer. Remedy: check and if necessary replace the memory submodule or check and correct the source/destination parameters.
5	Incorrect parameters assigned to status word. The parameter "ANZW" was specified incorrectly. Remedy: correct the parameter or set up the data block correctly in which the ANZW is to be located.
6	Invalid source/destination parameter. Parameter ID "NN" or "RW" was used or the data length is too small (=0) or longer than 128 bytes. Remedy: use the correct Q(Z)TYP parameter; "NN" and "RW" are not allowed for this type of data transmission. Check the data length.
7	Local resource bottleneck. There are no data buffers available for processing the job. Remedy: retrigger the job, reduce the CP load.
B	Handshake error. The HDB processing was incorrect or the HDB monitoring time was exceeded. Remedy: start the job again.
C	System error ! Illegal service code service_code or error in system program. Remedy: check service_code or inform Siemens service.
D	Data field blocked! The data transmission is or was disabled during HDB execution (control bit disable/enable in status word set to disable).
E	free
F	Job or channel not programmed ! Programming error or incorrect HDB call (parameter SSNR/ANR). Remedy: program job number (ANR) as "free channel" (type:FREE) or correct SSNR/ANR for HDB call.

Table 8.3 Error Bits (bits 8..11) in the Status Word

Structure of the parameter assignment error byte

The parameter assignment error byte (PAFE) informs you about various parameter assignment errors. When you assign parameters to the individual blocks, you specify the address at which this information is available. The meaning of the individual bits is explained in Fig. 8.6.

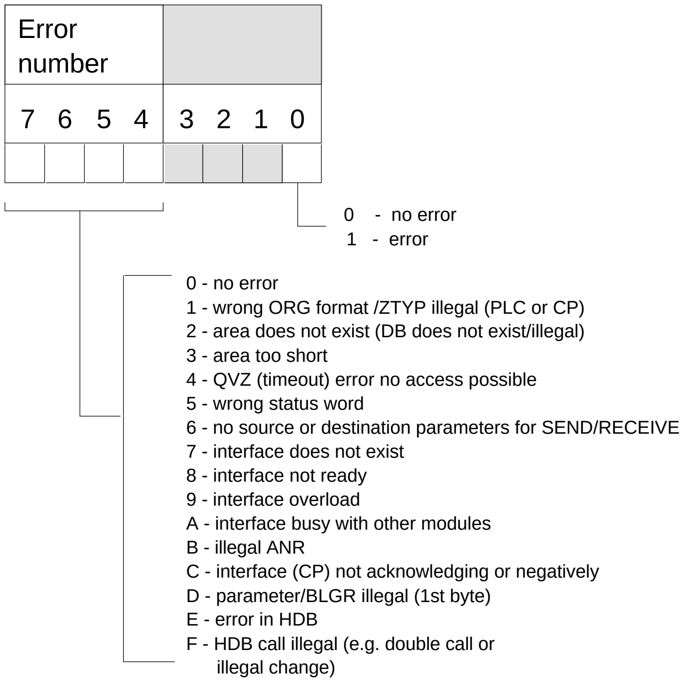


Fig. 8.6 Structure of the Parameter Assignment Error Byte "PAFE"

8.1.5 Sequence of the Data Transmission

To understand how the services are handled, the following section shows how a data exchange must be coordinated in the control program depending on the data transmission service used. It is assumed that the transmitter and receiver are SIMATIC PLCs which exchange data via the CP 5430 TF/CP 5431 FMS.

Data are transmitted with the SEND HDB, data and acknowledgments (confirmation, indication) are received with the RECEIVE HDB. To be able to monitor the data exchange, you must constantly evaluate the status word for this job.

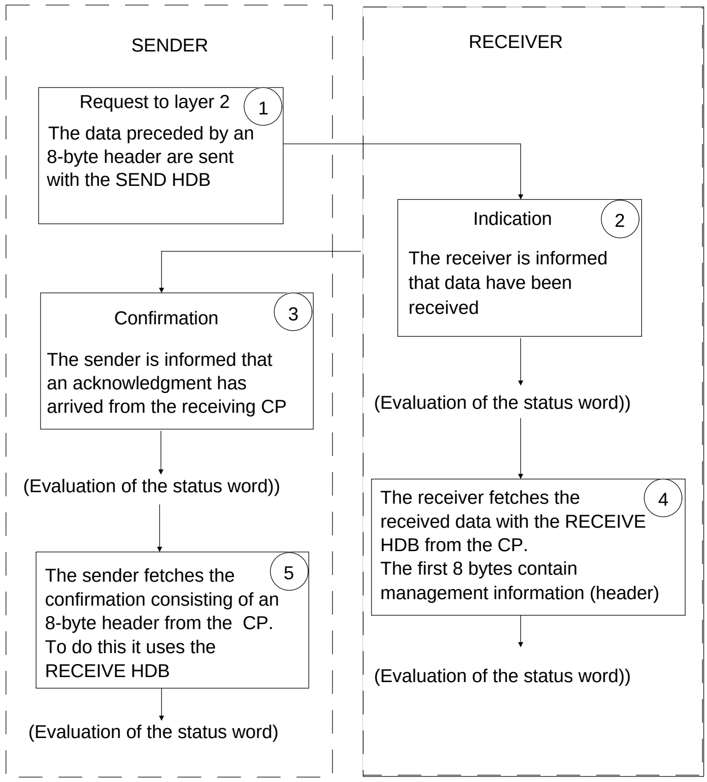
☞ **As long as an indication is waiting to be accepted by the PLC, the corresponding SAP does not have a receive buffer.**

Start-up OBs for SIMATIC S5 PLCs

You must call the SYNCHRON handling block for the interface number of the CP 5430 TF/CP 5431 FMS in the start-up OB.

Transmitting and receiving data with acknowledgment (service: SDA)

Sequence of the transmission



☞ **SEND and RECEIVE job numbers must match the programmed job numbers (link editor of the COM 5430 TF/COM 5431 FMS).**
If the link was not programmed with the link editor of COM 5430 TF/COM 5431 FMS, the job (triggering the SEND HDB) is blocked by the firmware of the CP (ANZW 0F0A$_H$)!

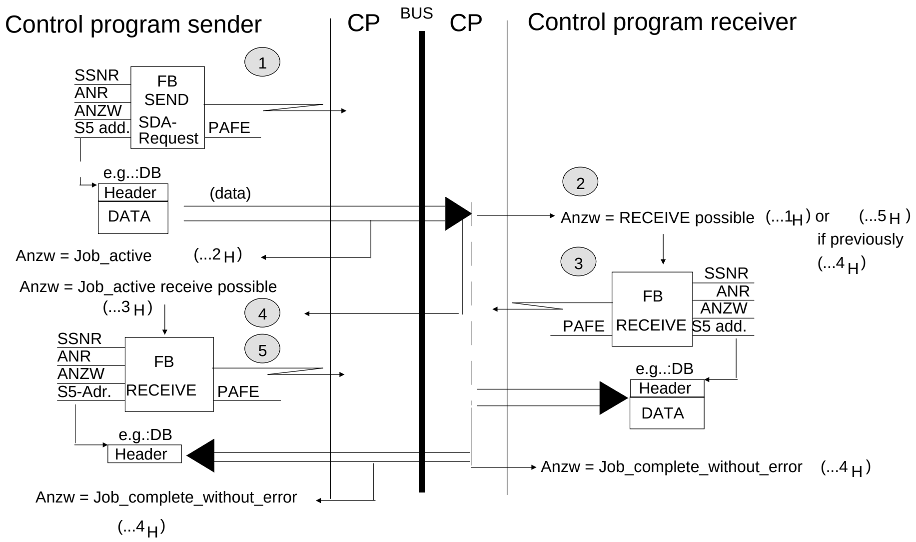
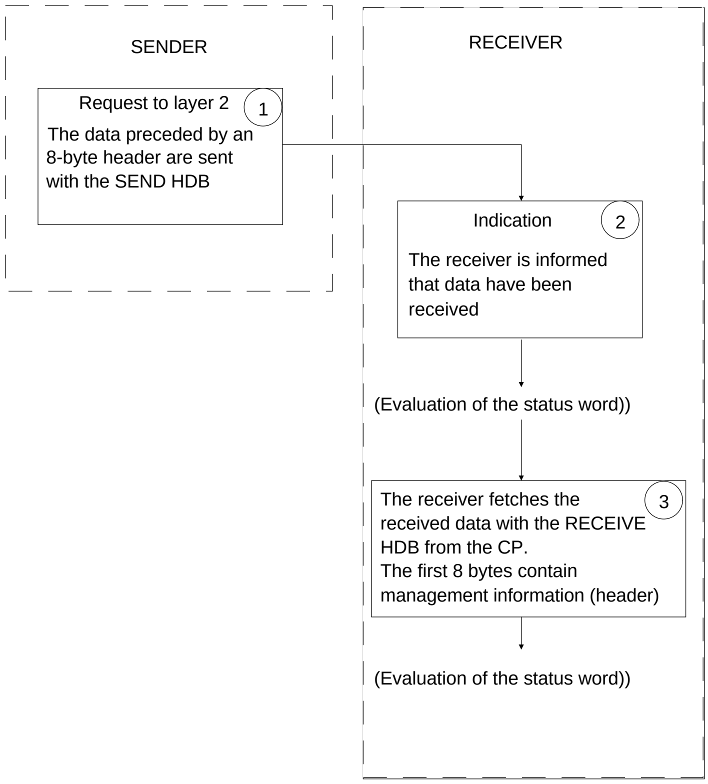


Fig. 8.7 Transmitting and Receiving Data with Acknowledgment (Service SDA)

Transmitting and receiving data without acknowledgment (service: SDN)

Sequence of the transmission



☞ **In contrast to the SDA service, the sender does not receive an acknowledgment from the receiver CP with the SDN service, but simply an acknowledgment from its own local CP.**

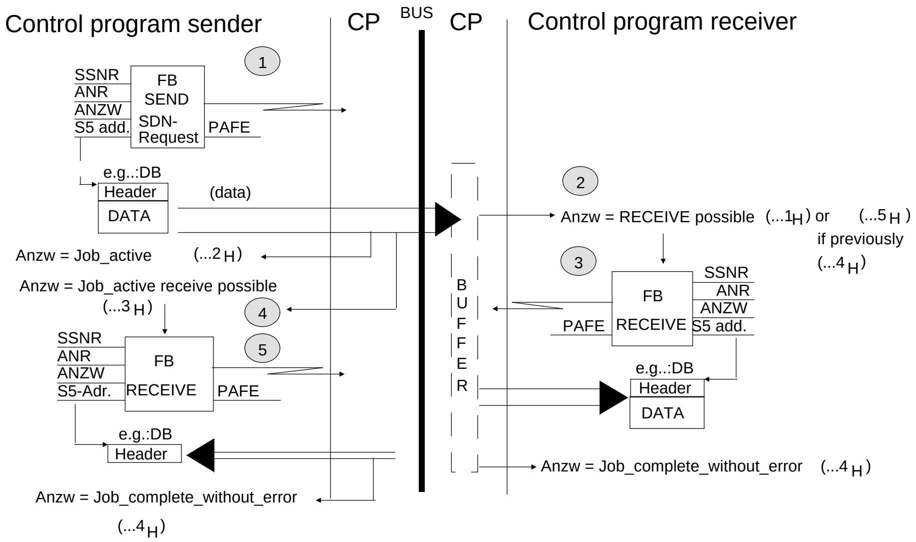


Fig. 8.8 Transmitting and Receiving Data without Acknowledgment (Service: SDN)

Transmitting data with request to receiver to return data (service: SRD)

Sequence of the transmission:
Before the sender requests data from the receiver, the receiver must prepare the requested data in a CP buffer (responder function). The receiver either uses the "reply update single (RPL_UPD_S)" or the "reply update multiple (RPL_UPD_M)" service.

The RPL_UPD_S service prepares the requested data once. After the requesting station has read the data from the buffer the buffer is empty and must be filled again with an RPL_UPD_S service. The user is informed that the data have been fetched in the SRD indication (link_status). If the requesting station finds an empty buffer, it is informed by an error message in the confirmation header (link_status).

With the RPL_UPD_M service, the data remain in the buffer until the buffer is overwritten. This means that the data can be read out more than once.

How the data are written to the buffer:

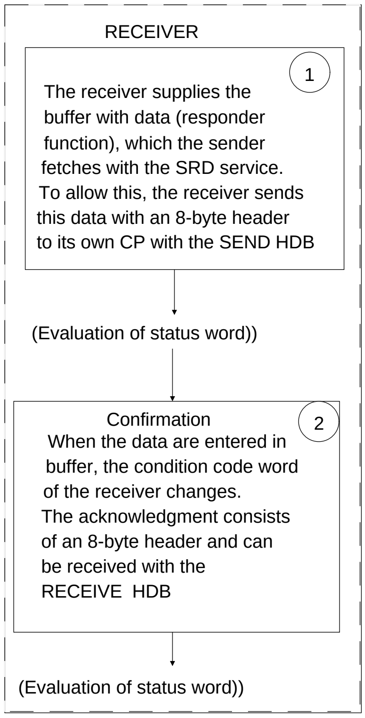


Fig. 8.9 RPL_UPD_S service

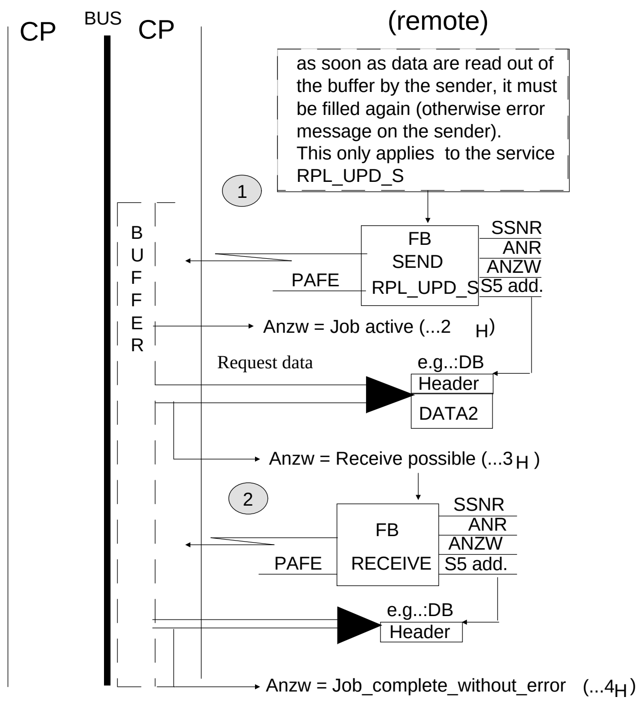
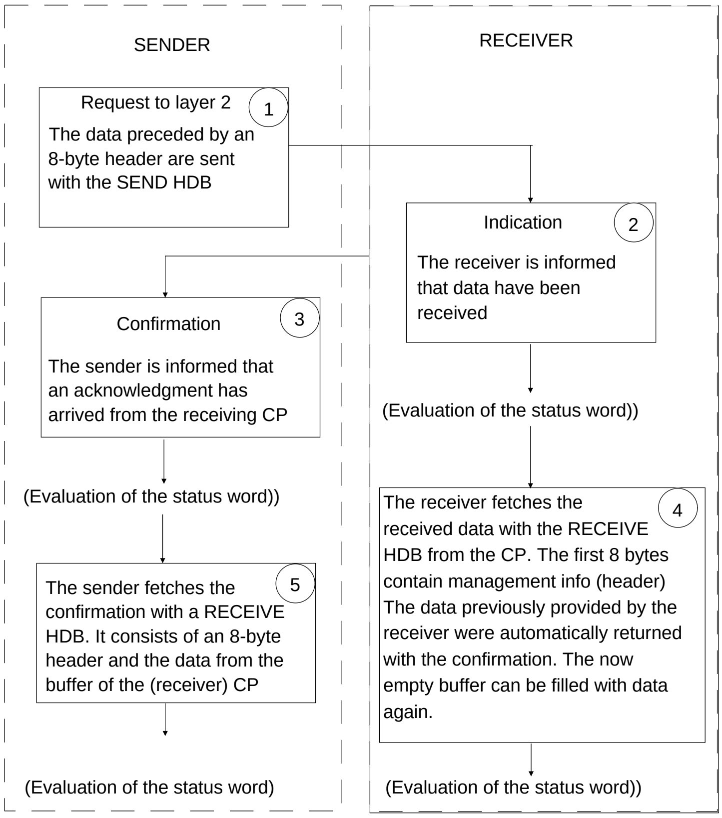


Fig. 8.10 RPL_UPD_S service (continued)

Once the requirements for the SRD service are met, the sender can transmit data to the receiver and fetch the data from the receiver's buffer. Fig. 8.11 is the logical continuation of the procedure outlined in Fig. 8.10.



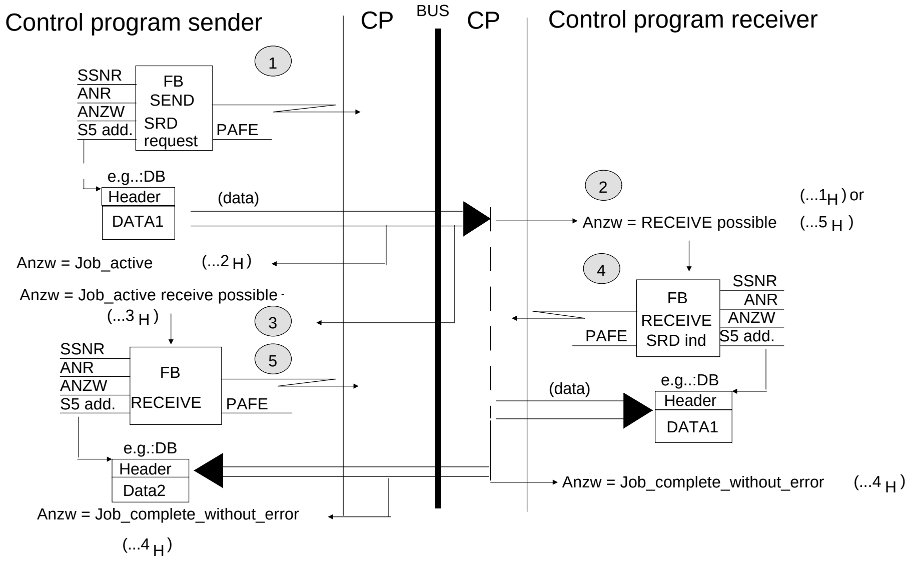


Fig. 8.11 Transmitting Data with Request for Receiver to Return Data (SRD)

Special case: requesting data (service: SRD with 0 bytes of data to be transmitted)

Sequence of the transmission

If the sender does not have data to transmit to the receiver, but only wants to request data from the receiver, use the SRD service with 0 bytes of data to send. The terms "sender" and "receiver" are retained even if the "sender" has no data to transmit, but only requests data.
The "receiver" transfers the requested data to the buffer using the "reply update single (RPL_UPD_S)" service or the "reply update multiple (RPL_UPD_M)" service. How the data are transferred to the buffer and handled in the buffer has already been described above. The sequence is illustrated schematically in Figs. 8.10 and 8.11 with the special feature that in Fig. 8.11 there are no data to be transmitted with the SRD request (data 1 = 0).

8.2 Transmitting Multicast Messages by Direct Access to Layer 2 Services

If the transmitted data are intended for several stations simultaneously (using layer 2 services) you must use the following procedure:

➢ Program the same (local) SAP number (range 2..54) for each receiver of the multicast message.

➢ Create the (request) header for the block of data to be transmitted, as follows:

Byte	
0	....
1	....
2	service_code =01_H (SDN)
3	....
4	....
5	DSAP/RSAP=no. of the SAP programmed for each receiver
6	rem_add_station = $7F_H$ (global address)
7	....

The station address $7F_H$ is a global address for this application. Multicast to all stations is only possible when the same (local) SAP is set up for every L2 station and this SAP is entered as the DSAP/RSAP in the request header of the sender. Fig. 8.12 illustrates which stations receive an SDN frame with DSAP/RSAP 10 and address $7F_H$.

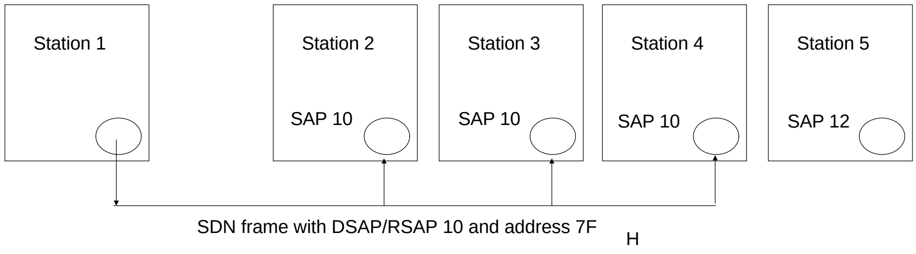


Fig. 8.12 Sending Multicast Messages with the SDN Service

Another way of sending multicast messages to all stations is to use the default SAP. This SAP which can be programmed with the Init editor of the COM 5430 TF software package has the following function:
All receive messages with DSAP/RSAP information are automatically assigned to the default SAP by the layer 2 firmware. To reach all stations on the bus you must simply follow the procedure below:

➢ Assign a default SAP (range: 2..54) to each station

➢ Assign byte 2 (service_code) the value 01_H (service: SDN)

➢ Make sure that the sender generates a frame without DSAP/RSAP information. To do this, enter the value FF_H in byte 5 of the request header (DSAP/RSAP)

and

➢ Enter the value $7F_H$ (global address) in byte 6 (rem_add_station) of the request header

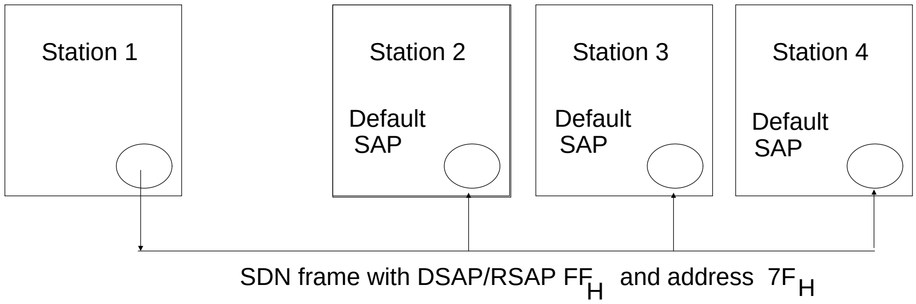


Fig. 8.13 Receiving Multicast Messages using the Default SAP

Fig. 8.13 illustrates how all the stations assigned a default SAP in the range 2..54 can receive a multicast frame.

☞ **COM 5430 TF/COM 5431 FMS automatically assigns the same default SAP number to all CP 5430 TF/CP 5431 FMS stations.**

8.3 Configuring

The software package COM 5430 TF/COM 5431 FMS is used under SINEC NCM to configure free layer 2 communication.

The screens required for configuration are provided by SINEC NCM as shown in Fig. 8.14:

➢ Link editor

➢ Documentation and test functions

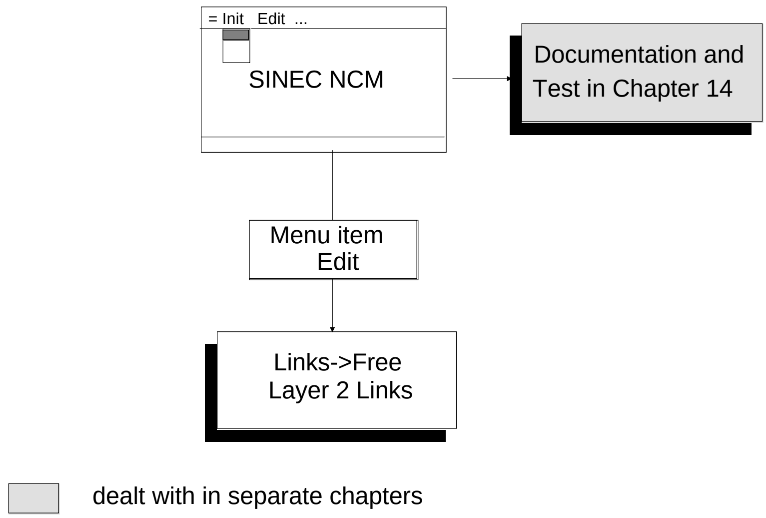


Fig. 8.14 Free Layer 2 Configuration

General procedure:

To implement a simple task (transferring data from PLC 1 to the remote device via pre-programmed links with HDBs) the following procedure is required:

➢ The links between the PLC and remote device must be programmed (as mentioned in the general guidelines). For planning the link, refer to Characteristics of the S5-S5 Link.

➢ Assigning parameters to the CP module. This involves creating the SYSID block (refer to Chapter 6)

➢ Configuring the links between the PLC and the remote device.

➢ Programming the CPUs of the PLCs i.e. HDBs, OBs, FBs and DBs and creating the frames with service-specific headers (refer to Section 8.1) according to the planned task..

8.3.1 Configuring Free Layer 2 Links

With the link editor of the COM 5430 TF/COM 5431 FMS software package you assign parameters for the links between two stations on the bus.

These links are either stored in a submodule file (offline mode) or written directly to the CP submodule or modified there (online mode).

This means that submodule files created offline can also be loaded on the CP or that the contents of the CP submodule can be saved in a file.

Select Edit -> Links -> Free layer 2 Links to call the following screen. The screen is structured as follows:

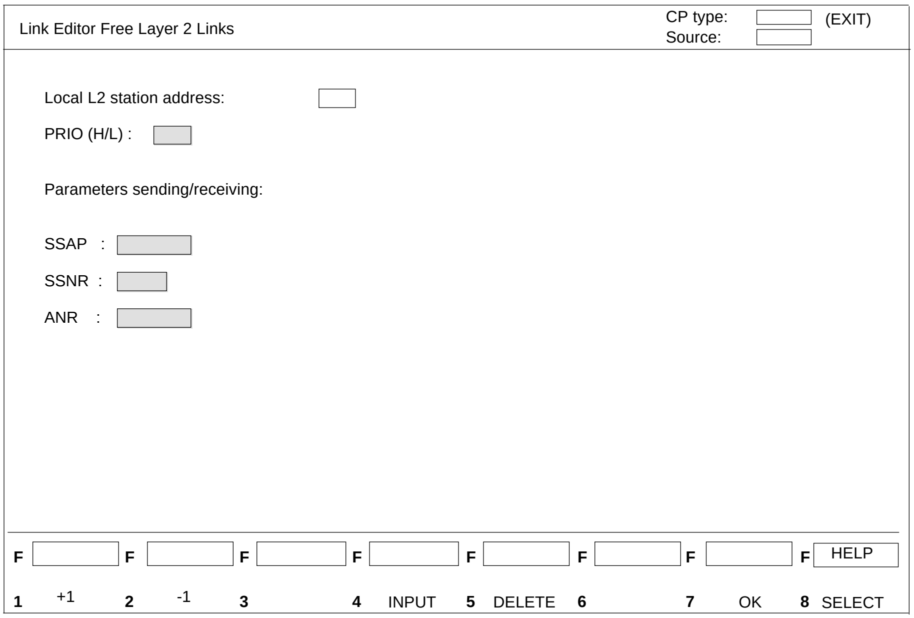


Fig. 8.15 Layer 2 Link Configuration Screen

Output fields

L2 station address: L2 address you are currently working with

Input fields

PRIO (H/L): Specifies the priority of the jobs. The default is "LOW". (Possible entries:: "**L**OW", "**H**IGH").

Parameters sending/receiving: Send or receive parameters are entered here.

SSAP: Local Service Access Point (range of values: 2 - 54, 56).

SSNR: Interface number corresponding to the PLC DPR page number and therefore forming the CPU-CP interface. The interface number must be uniform for all jobs via a link. It can therefore only be entered in the first field and is automatically repeated for further parallel services (range of values: 0..3).

ANR: Job number via which the job is triggered. (Range of values: 134 .. 186)

Function keys

F1 +1	Page forwards through the links for several free layer 2 links
F2 -1	Page backwards through the links for several free layer 2 links
F4 INPUT	Prepare next input.
F5 DELETE	Delete the input link.
F7 OK	Enter the data in the link block.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

8.4 Example of a Layer 2 Link

This section describes how two stations can be configured with COM 5430 TF/COM 5431 FMS to be able to exchange data via direct access to layer 2 services.

You should have worked through Chapters 3 to 6 of this manual and be familiar with the handling blocks and STEP 5.

Hardware and software requirements

The following hardware is necessary:

- ➢ Two SIMATIC S5 programmable controllers (PLC 1: S5-155U and PLC 2: S5-115U)
- ➢ One CP 5430 TF or CP 5431 FMS per PLC
- ➢ One RAM submodule per CP 5430 TF or CP 5431 FMS
- ➢ One RS 485 bus terminal per CP
- ➢ SINEC L2 bus cable
- ➢ At least one PG 710, PG 730, PG 750 or PG 770, or PC

The following software packages are also required:

- ➢ COM 5430 TF or COM 5431 FMS under SINEC NCM
- ➢ PG software for STEP 5 programming
- ➢ Appropriate handling blocks for the PLCs
- ➢ Diskette with the example programs.

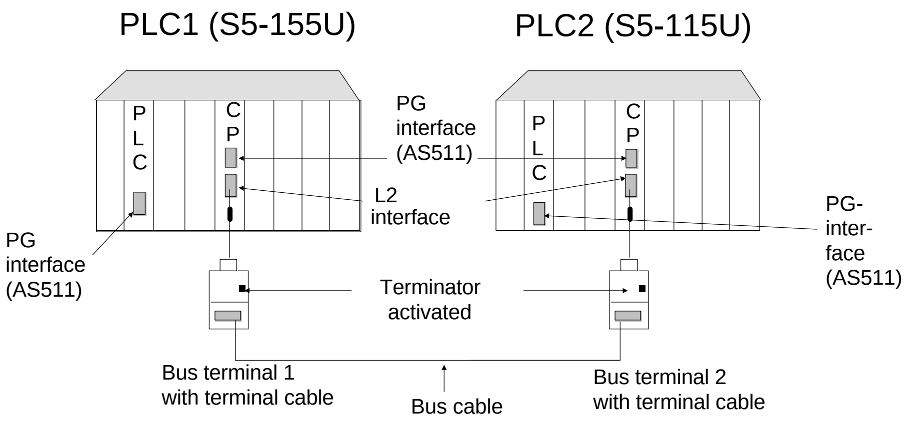


Fig. 8.16 System Structure with all Hardware Components

8.4.1 Program Description

Two SIMATIC programmable controllers with the L2 addresses 1 and 2 are to exchange data via the SINEC L2 bus. The transmitted and received data will be written to data blocks (DB).

Station 1, an S5 155U PLC, uses SAP 2 as the service access point. For station 2, an S5 115U PLC, SAP 3 has been selected.
The data exchange uses an SRD service on station 1 and an RPL_UPD_S service on station 2.

8.4.1.1 Program for PLC 1

During the PLC start up, the CP interface is synchronized with the SYNCHRON handling block.

Four data words will be sent from PLC 1 to PLC 2. At the same time, four data words will be requested from PLC 2 (SRD). PLC 2 transfers the requested data to a buffer using an RPL_UPD_S job.

The data (request) are transmitted with the SEND HDB, the receive data and "acknowledgments" (confirmations/indication) are received with the RECEIVE HDB.

To be able to monitor the data exchange, you must evaluate the status word for this job continuously. The status word contains information about the status of the job, information about data management and error codes.

8.4.1.2 Program for PLC 2

PLC 2 receives 4 data words. At the same time, 4 data words are requested by PLC 1 and are transmitted or transferred to the buffer (RPL_UPD_S).

8.4.2 Transferring the Configuration Data for the CP 5430 TF/CP 5431 FMS and the STEP 5 User Program

To be able to implement the practical example for free layer 2 communication, follow the procedure outlined below (and refer to Chapter 16):

➢ Transfer the following COM 5430 TF/COM 5431 FMS database files to the CPs you are using:

When using the CP 5430 TF under the network file LAY2ONCM.NET

- for station 1 OLAY2T1.155
- for station 2 OLAY2T2.115

When using the CP 5431 FMS under the network file LAY2QNCM.NET

- for station 1 QLAY2T1.155
- for station 2 QLAY2T2.115

➢ Transfer the following STEP 5 files to the programmable controllers you are using:

- For PLC 1 (S5-155U) the file LAY2T1ST.S5D
- For PLC 2 (S5-115U) the file LAY2T2ST.S5D.❑

9 Data Transmission with Global I/Os

This chapter explains the following:

- ➢ The applications for which data transmission with global I/Os is suitable.
- ➢ How this type of data transmission functions.
- ➢ How to assign parameters for the CP 5430 TF/CP 5431 FMS for this type of transmission when programmable controllers exchange data via the global I/Os (GP).
- ➢ How to use this type of data transmission based on an example including a STEP 5 program (example in Section 9.3).

Areas of application:

Communication with global I/Os is only allowed via the base interface number base SSNR!

Data transmission with global I/Os (I/O interface) is suitable for communication between SIMATIC PLCs.

Data transmission with global I/Os is suitable for the transmission of single bytes using high priority broadcast frames between active SIMATIC S5 programmable controllers. Data with the following characteristics may be considered for this type of communication.

- ➢ Small volumes of data
- ➢ Time-critical data
- ➢ Data which does not change constantly

This, for example, might include control commands, messages, measured values and analog values.

An important characteristic of the global I/Os is that changes in the data bytes are recognized and only these changes transmitted. The changed data bytes are then transmitted more quickly compared with data transmission using HDBs (refer to Chapter 7).

The term "global I/Os" means that part of the I/O area is not used by I/O modules but for global data exchange between SIMATIC PLCs. Global data exchange involves the CP sending the entire changed output area assigned to the GP and updating the entire input area assigned to the GP with the received data once again cyclically. You can use these I/Os as normal inputs and outputs. The address areas are processed with STEP 5 operations.

The mode can either be **synchronized with the cycle** or **free**. With the cycle-synchronized mode, an HDB must be called at the checkpoints required by the user to ensure the consistency of inputs and outputs.

Ideally with the global I/Os, you should transmit data which change rarely relative to the target rotation time (the rate of change should be a multiple of the target rotation time). If, however, the data bytes to be transmitted change constantly (compared with the target rotation time), the advantage of minimum bus load, the main characteristic of GP, is lost.

☞ **Simultaneous use of GP and DP is not possible.**

9.1 Basics of Data Transmission with Global I/Os

This section describes the functions of the global I/Os from the point of view of the CPU control program.

- Data exchange via I/Os
- How the data transmission functions
- Updating the I/Os with GP

In data transmission with global I/Os the data exchange takes place using the I/Os of the SIMATIC PLC, as follows:

- The data for transmission are assigned to the output area of the I/Os in the control program.
- The received data are stored in the input area of the I/Os.
- Transmitted and received data can be processed with STEP 5 operations.

The term "global I/Os" conveys the fact that part of the I/O area of a programmable controller is not assigned "locally" to the corresponding input and output modules but is "globally" available to all programmable controllers on the L2 bus.

- **Data for transmission via the output area**
- **Received data via the input area**

All I/O bytes via which you want to transmit and all I/O bytes via which you want to receive must be designated as I/Os. To do this, you reserve I/O areas of each station taking part in the GP communication for GP using the COM.

- ➢ Each output I/O byte via which you want to transmit must be assigned to a "global object" (GO). A GO is a global I/O byte (GPB).
- ➢ The GOs are numbered.
- ➢ Each input I/O byte via which you want to receive, must also be assigned to a GO.

A GO always consists of the following:

- ➢ One I/O output byte for one sender and
- ➢ One or more I/O input bytes for the receivers

The way in which areas are reserved for the GP and how I/O bytes are assigned to global objects is described in Section 9.2.

➢ **Configuring I/O areas for GP**

The GP frames automatically have the priority "high" for the CP 5430 TF/CP 5431 FMS; i.e. the CP 5430 TF/CP 5431 FMS gives priority to a GP frame.

Functions:

By configuring with the GP station editor, the CP becomes the "distributor".

Transmission on the CP:

- ➢ The output data of the PLC are read out.
- ➢ All values changed since the last time the output data were read out are detected.
- ➢ All changed values including object information is packed into change frames.
- ➢ The frame is transmitted as a broadcast to all GP stations.

Receiving: on the CP

➢ A frame containing changes is received.

➢ Locally configured objects are filtered out of the frame.

➢ All the filtered values are entered in the input area of the PLC.

Fig. 9.1 is a schematic representation of transmission and reception using the "global I/Os area". A byte to be transmitted from station 1 is written to output byte 7 (PY 7). The global I/Os byte 10 (GPB 10) is assigned to PY 7. The transmitted byte is received at station 2 as input byte 1 (PY 1) because PY 1 is assigned to GPB 10 in this station.

PY 7 of station 1 is therefore in a sense directly "wired" to PY 1 of station 2 via GPB 10.

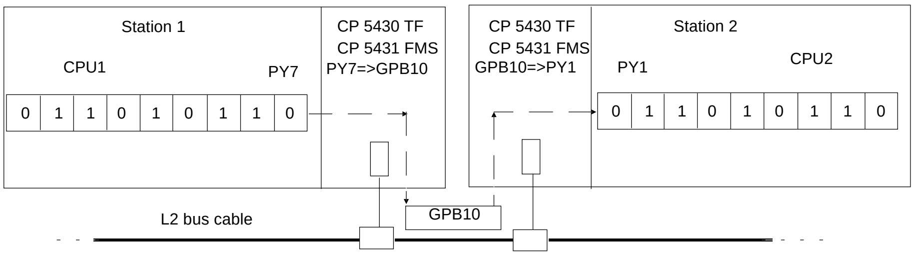


Fig. 9.1: Transmitting and Receiving Using the Global I/O Area

Each station which assigns GPB 10 to an input byte as shown in the previous example is also the receiver of this byte.

Updating the input and output bytes of the global I/Os

The times at which the CP 5430 TF/CP 5431 FMS updates the **GP bytes to be transmitted** are either

➢ **FREE** mode: decided by the CP (the STEP 5 control program has no influence) or

➢ **CYCLE-SYNCHRONIZED** mode: decided by the control program using a send handling block call with job number 210.

The times at which the CP 5430 TF/CP 5431 FMS transfers the **received GP bytes** to the CPU input area are also either

➢ **FREE** mode: decided by the CP (or influenced by the STEP 5 control program) or

➢ **CYCLE-SYNCHRONIZED** mode: decided by the control program using a RECEIVE handling block call with job number 211.

Consistency of the input and output bytes of the GP

➢ **FREE** mode: guaranteed consistency of **one** byte.

➢ **CYCLE-SYNCHRONIZED** mode: guaranteed consistency over the whole area.

Special features

➢ **CYCLE-SYNCHRONIZED** mode: when a GP station fails, the input bytes assigned to this station are reset on the other stations (to the value 0). Notes on the calculation of this "switch off time" can be found in the appendix of this manual.

If the PLC changes from the RUN to the STOP mode, its GP output bytes are reset (to the value 0). Since the CP 5430 TF/CP 5431 FMS registers this change, each of these bytes which previously had a value other than "0" is transmitted with the value "0".

The FREE and CYCLE-SYNCHRONIZED modes are now explained in more detail.

Send GP (free)

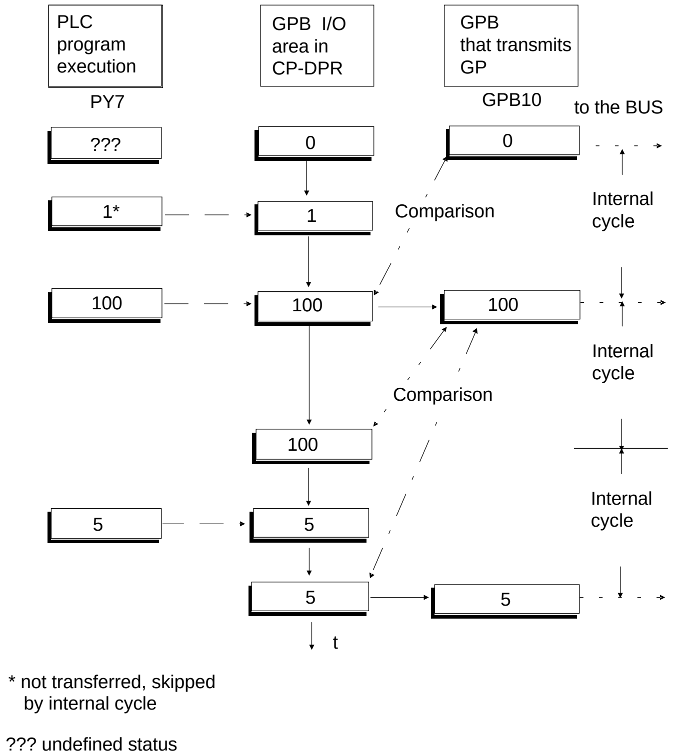


Fig. 9.2: How the Mode Transmit FREE Functions

Explanation of Fig. 9.2:
In the free mode, there is no synchronization with the PLC cycle. The consistency of the I/Os can therefore only be guaranteed for one byte. The time at which the output byte is evaluated (i.e. the new/old comparison) is determined solely by the CP (e.g. after sending the previous GP frame). In the free mode, a cycle overflow of the PLC cannot be detected. A cycle overflow means that the data of a PY were updated at least twice by the control program before the GP was able to perform a "new/old" comparison.

In the PLC program, the control program changes the output byte to be transmitted (PY 7).

In the CP cycle, the CP checks all (GP) output bytes for changes (new/old comparison) and transmits only the GP bytes whose values have changed since the last comparison.

Result: the CP 5430 TF/CP 5431 FMS only sends a GP byte when its value has changed between two consecutive "new/old" comparisons.

The value of the GP byte at the time of the new/old comparison is decisive. If, in the meantime, a bit has changed its value more than once, but has returned to its original value when the next comparison is made, these changes are not recognized. Information about calculating the "reaction times" of the global I/Os in the FREE mode can be found in the appendix of this manual.

Receive GP in the free mode

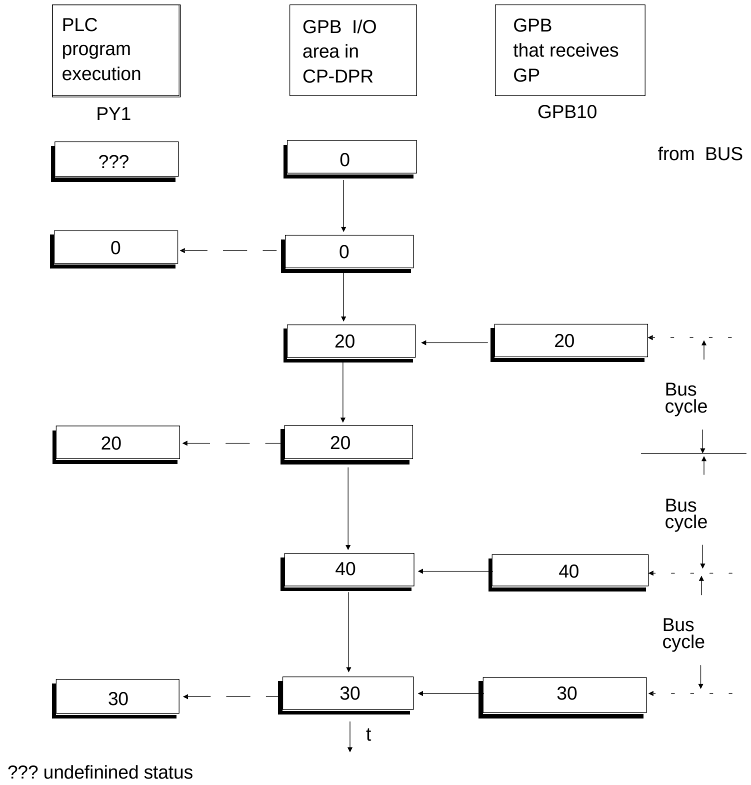


Fig. 9.3: How the Mode Receive FREE Functions

Explanation of Fig. 9.3:
When a frame containing changes is received, the data are entered in the DPR independently of the PLC cycle. This means that the consistency of the received data, just as with sending, can only be guaranteed for one byte. In the free mode, a cycle overflow cannot be detected by the bus. A cycle overflow means that the data of a PY from the bus were updated at least twice before the control program was able to evaluate the PY data.

➢ In the bus cycle, GP bytes are only received when the data have changed on the sender.

➢ In the PLC, the control program evaluates the received input byte (PY 1).

The value of the GP byte at the time the control program accesses it in the PLC is decisive. If data is received several times between two accesses by the PLC, only the current value is passed on to the control program. All intermediate values are lost.

Essential features of the FREE mode:

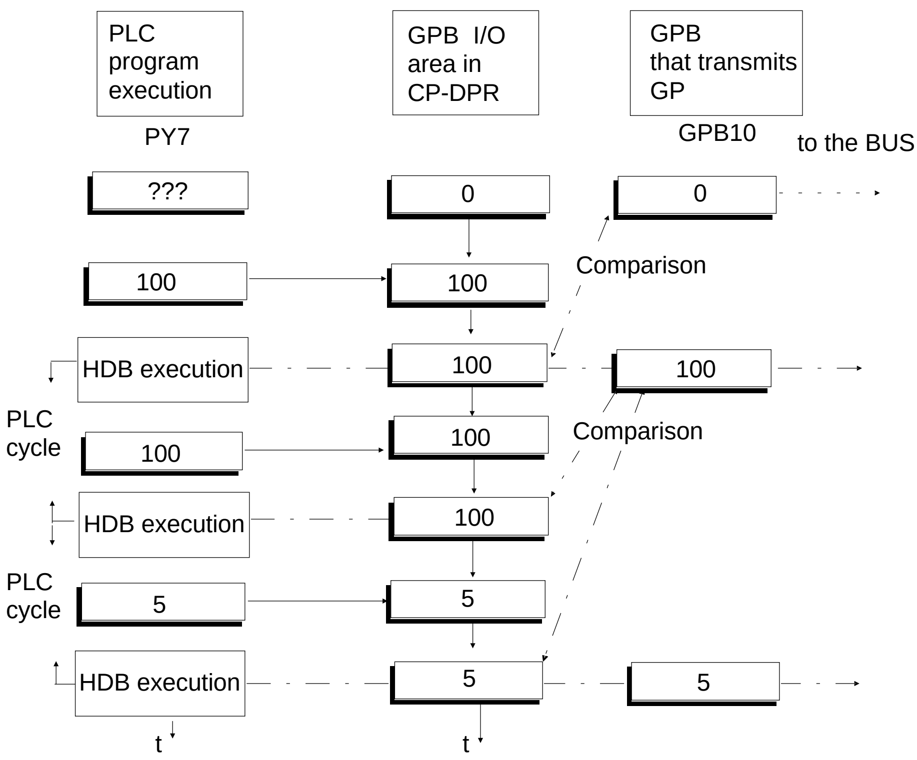
➢ Minimum cycle load (corresponds to the cycle load that would occur simply by plugging in the corresponding input/output modules.

➢ Minimum load on the CP 5430 TF/CP 5431 FMS.

➢ Simple programming (single handling block call; HDB SYNCHRON during start-up).

☞ **If GP bytes need to be transferred together because they form a logical unit (e.g. a control parameter requiring a word), the FREE update mode must under no circumstances be selected. With this mode, there is no guarantee that the GP bytes which belong together are actually transferred together. The receiver would then process inconsistent values.**

Transmit GP cycle-synchronized



??? undefined status

Fig. 9.4: How the Mode Transmit CYCLE-SYNCHRONIZED Functions

Explanation of Fig. 9.4:
In the cycle-synchronized mode, the consistency of the I/O bytes of a PLC cycle is guaranteed. The output byte is only transferred to the CP at the cycle checkpoint (HDB execution) of the PLC. The cycle checkpoint must be made known to the CP by a handling block.

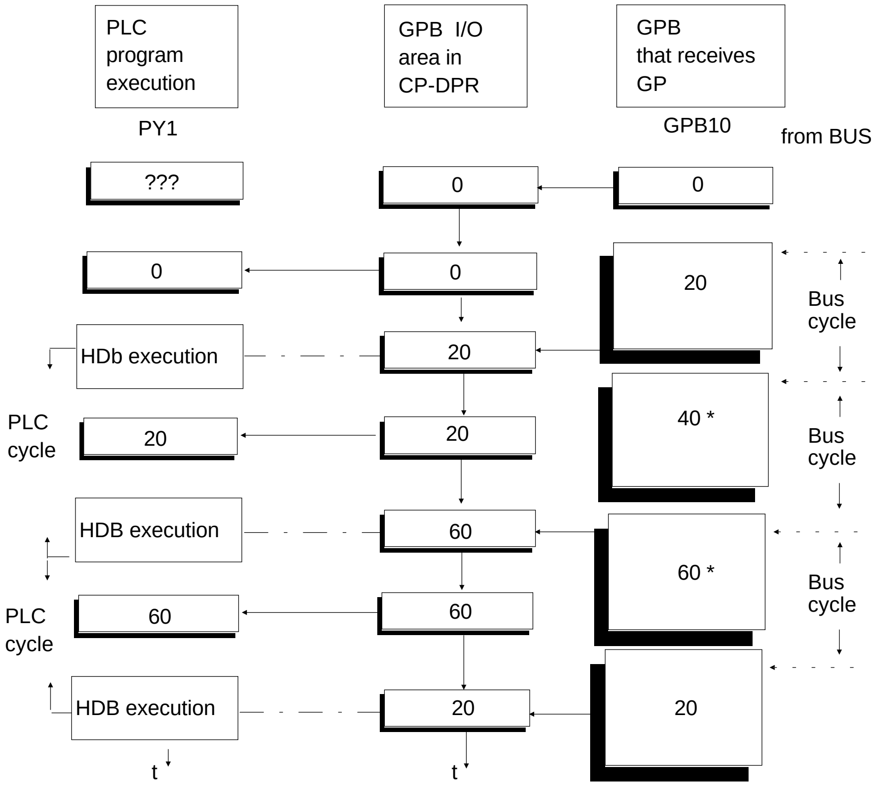
- ➢ The PLC control program changes the output byte to be transmitted (PY 7).

- ➢ At the point when the HDB is executed, the CP 5430 TF/CP 5431 FMS rechecks all the (GP) output bytes for changes (new/old comparison) and only transmits the GP bytes which have changed since the last "new/old" comparison.

Result: the CP 5430 TF/CP 5431 FMS only transmits a GP byte in the cycle-synchronized mode, when its value has changed between two consecutive new/old comparisons.

The value of the GP byte at the time of the new/old comparison which you decide in the control program (by means of an HDB send call with job number 210) is decisive. If a byte changes its value several times but has returned to its original value at the time of the "new/old" comparison, these changes are not detected.

Receive GP (cycle-synchronized)



* cycle overrun is entered in the station list
??? undefined status

Fig. 9.5: How the Mode Receive CYCLE-SYNCHRONIZED Functions

Explanation of Fig. 9.5:
The consistent acceptance of the input byte by the CP takes place at the cycle checkpoint. The cycle checkpoint must be made known to the CP with a handling block.

➢ At the point when the HDB is executed, all changed PYs are entered in the DPR by the CP. Once the HDB has been executed, the PLC can access this current data of the PY.

➢ The PLC control program accepts the received input byte (PY 1).

The value of the GP byte at the time of the HDB execution (HDB receive call with job number 211) is decisive. If a GP byte has changed its value several times between two HDB executions, the current value is accepted. This cycle overflow is indicated in the GP station list by the bus.

☞ **With short PLC cycle times (< 50 ms) the HDB SEND/RECEIVE calls with job numbers 210/211 may extend the PLC cycle time. The load on the CP 5430 TF/CP 5431 FMS may also increase so that the transmission times of the global I/Os deteriorate. If you have short PLC cycle times, make sure that the time between two HDB calls is greater than 50 ms (e.g. by programming HDB SEND/RECEIVE calls with job numbers 210/211 in every nth PLC cycle).**

Sequence of the data transmission

The start-up OBs have the following task with the global I/Os data transmission mode;

➢ They must synchronize the CP 5430 TF/CP 5431 FMS interface.

➢ They can make sure that the PLC only starts up when certain or all stations are ready to transmit and receive (i.e. when there are no GP error messages).

➢ If you have selected the CYCLE-SYNCHRONIZED update mode, the complete GP should be received at the end of a start-up OB.

The SEND synchronization point is indicated by the SEND-HDB (ANR 210). The parameter QTYP must be assigned the value "NN". DBNR, QANF, QLAE are irrelevant. The ANZW should be assigned to a data or flag word. The RECEIVE synchronization point is indicated by the RECEIVE HDB (ANR 211). The remaining assignment of parameters to the HDBs is the same as for the SEND synchronization point.

The following figure (Fig. 9.6) illustrates one way of integrating the HDBs in the cold or warm restart branch of the PLC.

(OB 20, OB21, OB 22)

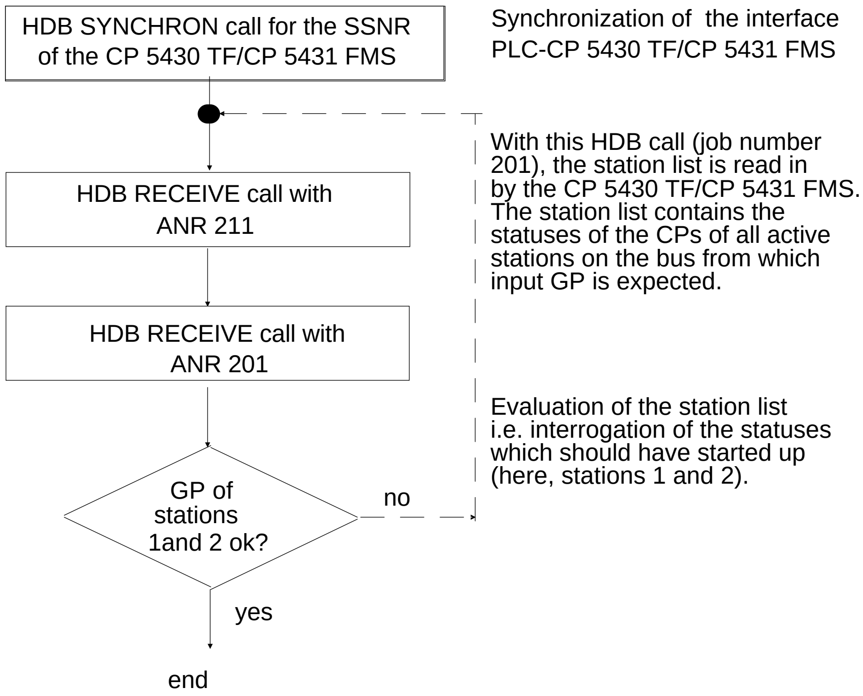


Fig. 9.6: HDBs in the Cold or Warm Restart Branch of the PLC

Both in the cold restart branch (OB 20) and in the warm restart branch (OB 21/22) each CP interface to be used later must be synchronized (SYNCHRON HDB). From the cold restart branch, the PLC operating system branches directly to the first cycle checkpoint. The process image of the inputs (PII) is read in for the first time at this point. The first RECEIVE synchronization point for the CP 5430 TF/CP 5431 FMS is therefore already in the cold restart branch. At this point (i.e. at the end of OB 20) the CP can also be monitored to check that the GP image is complete. For this purpose, the CONTROL HDB can be integrated and called in a loop repeatedly until the CP no longer signals an error in the GP image using the control status word.

Cyclic operation

The cyclic program has the following structure for all stations in the CYCLE SYNCHRONIZED update mode:

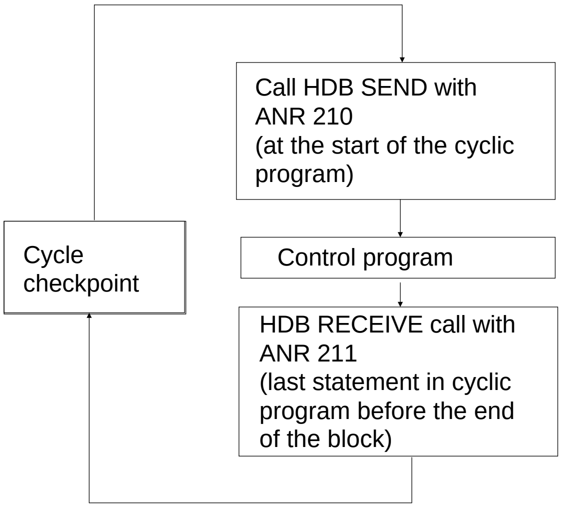


Fig. 9.7: Structure of the Cyclic Program for all Stations

In cyclic operation, the SEND synchronization point is immediately at the start of OB 1; the RECEIVE synchronization point at the end of the PLC cycle. The division into a SEND and a RECEIVE synchronization point is necessary, since the CP must make the received GP bytes available to the PLC before the PLC cycle control point and on the other hand the CP can only process the GP output byte after output of the PIQ.

If one of the SIMATIC S5 PLCs **fails**, the switch off safety strategy for I/O signals is used for the "global I/Os". If a PLC stops, all outputs and therefore all GP output bytes sent by this PLC are set to zero. This means that these GP bytes are automatically sent to all other receiving stations. The failure of a complete station (e.g. caused by a power failure) can be detected by the CP 5430 TF/CP 5431 FMS using ANR 201.

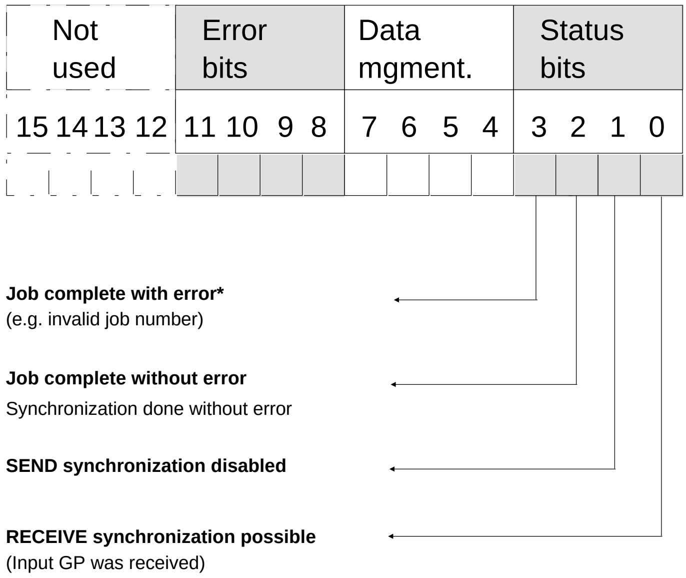
Possibilities of error detection

- ➢ Group error message in ANZW (RECEIVE ANR 210)
- ➢ Reading the station list (ANR 201).

Error statuses within the bus system including GP processing are written to the station list. Using a cyclic CONTROL call and a RECEIVE handling block call, the user program can read out the station list. In the status byte for GP processing (ANR = 210) an error which occurs in the GP processing is indicated as a "group error message" so that the station list must only be read out in case of an error. If the cycle-synchronized processing mode is set, "cycle overflow" is also entered in the station list. A cycle overflow can occur when changes in the GP output bytes cannot be transmitted owing to a lack of bus capacity (PLC cycle is faster than the bus token cycle). The failure of a GP transmitter is also indicated in the station list. The station list can be read out with ANR 201 using the RECEIVE block.

9.1.1 Checking the Data Transmission with ANZW and the GP Station List

Structure of the status word with HDB SEND (ANR 210) and RECEIVE (ANR 211):



* Bit 3 of the status bits is not connected with the error bits (8..11).
When bit 3 is set, the error is not specified by the error bits. All the errors listed in table 7.3 are possible.

Fig. 9.8: Structure of the Status Word, here: Status Bits

Bits 8... 11 (error bits) are group error messages; more detailed information about the errors that have occurred in GP processing can be obtained from the GP station list.

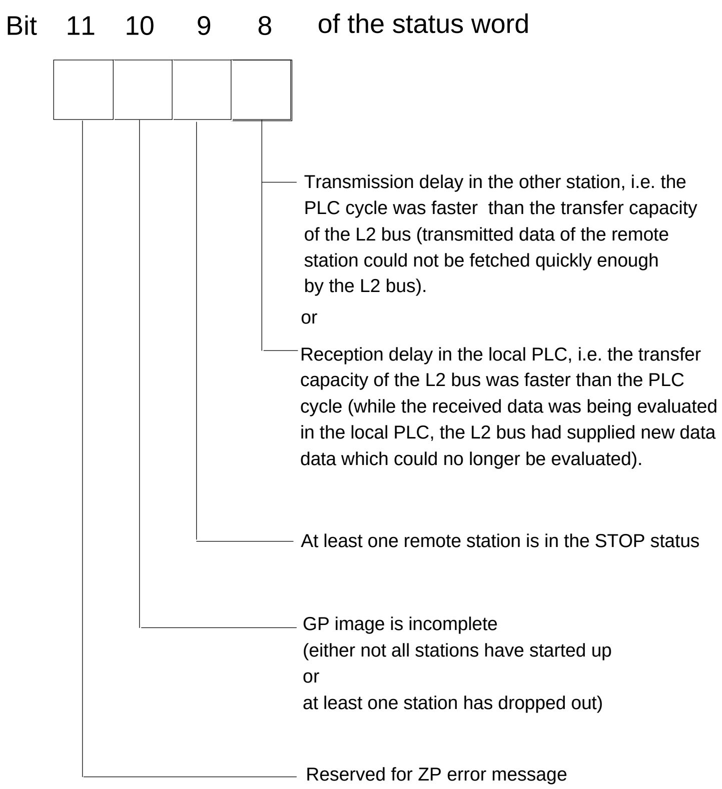


Fig. 9.9: Meaning of the Error Bits in the Status Word

☞ **If there is a group error message, bit 3 of the error status word is not set!**
If a station has failed, the corresponding GP input I/O bytes on the other stations are automatically reset by the CP 5430 TF/CP 5431 FMS (to value 0). This also applies to the start-up!

Evaluation of the GP station list (HDB RECEIVE with ANR 201)

Each CP 5430 TF/CP 5431 FMS which receives global I/Os manages an internal GP station list. This has a length of 32 bytes.
Each of these 32 bytes provide information about the operating statuses of all active L2 stations (maximum 32 stations) connected via global objects to the stations which evaluate the station list.

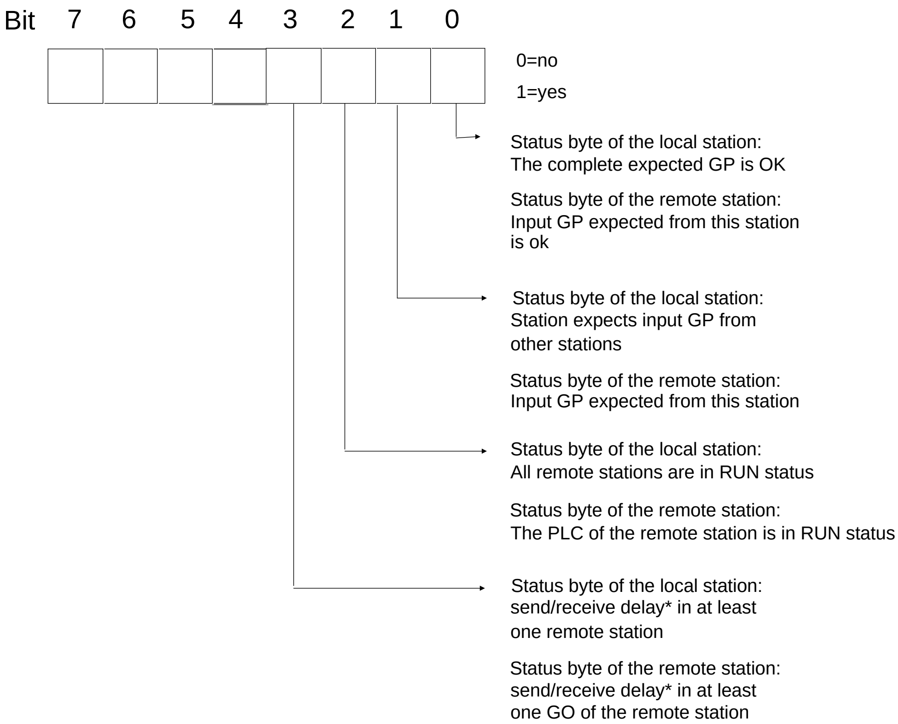
Table 9.1 illustrates the structure of the GP station list, Fig. 9.10 the structure of a status byte. You can read the GP station list with the HDB RECEIVE (ANR 201).

Byte no	Status byte from stations
0	status byte station 1 (L2 station address 1)
1	status byte station 2 (L2 station address 2)
...	
31	status byte station 32 (L2 station address 32)

Table 9.1: Structure of the GP Station List

You can only evaluate the station list when HDB RECEIVE (with ANR 201) was executed without an error.
If no GP input byte was defined, the value "A_H" is entered in the status bit of the status word for this job.

Fig. 9.10 takes this difference into account in the explanation of the individual bits of the status byte:



*With send/receive delay, GOs have changed more often than they could be sent or received (intermediate values can be lost)

Fig. 9.10: Structure of a Status Byte in the Station List

A further distinction must be made as to the mode (FREE or CYCLE-SYNCHRONIZED) in which the station list is evaluated, as follows:

➢ **FREE:**
the station list is updated continuously by the CP.

- **CYCLE-SYNCHRONIZED:**
  the station list is updated by the CP at the point when the HDB RECEIVE with job number 211 is called in the control program (GP receive).

9.2 Configuring

The PG package SINEC NCM with COM 5430 TF/COM 5431 FMS is used to configure the functions.

The screens you require for programming are provided by SINEC NCM as shown in Fig. 9.11.

➢ I/O areas

➢ GP editor

➢ Documentation and test

➢ GP consistency

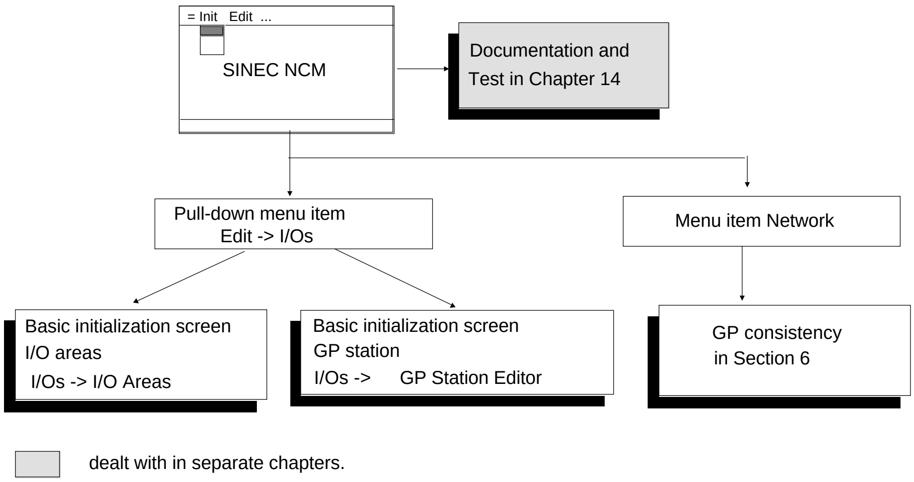


Fig. 9.11: GP Configuration

9.2.1 I/O Areas CP 5430 TF

The assignment of input and output areas in the SIMATIC PLC is made for the global I/Os in a screen.

If you specify areas for ZP at the same time, you require only three limits for the input and output areas since one limit is always implicitly specified.

☞ **Simultaneous use of GP and DP is not possible.**

Select Edit -> I/Os -> I/O Areas to call the following screen. The screen has the following structure:

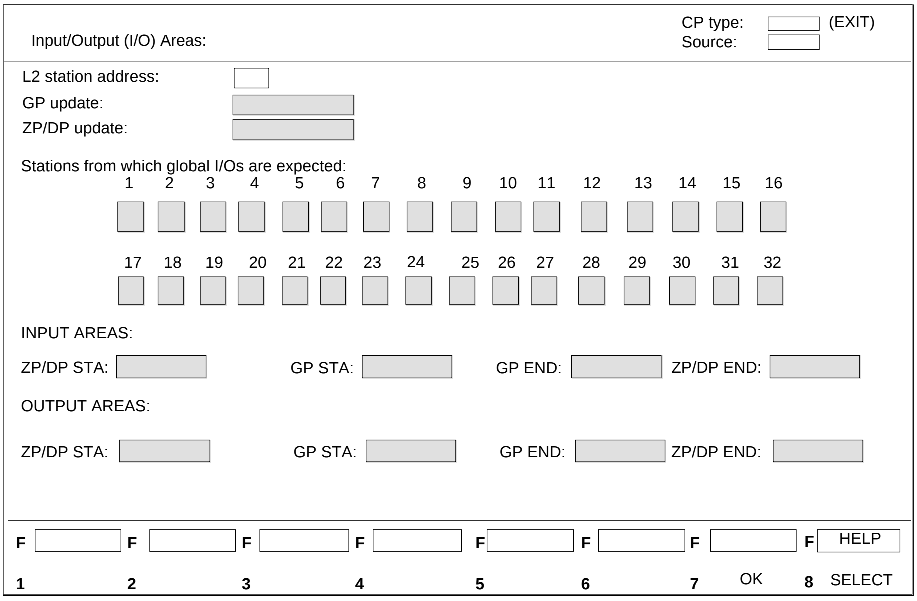


Fig. 9.12: Screen for Assigning Input/Output Areas CP 5430 TF

Input fields:

GP senders: All the stations from which GP bytes are expected must be marked with "X".
Recommendation: only enter an X for the stations from which GP data are expected, otherwise the bus load is increased.

Update**:** **Cycle-synchronized:** update at the cycle checkpoint by the HDB.
Free: implicit update of the I/O areas by the CP.

Input areas

GP STA: Beginning of the (continuous) input area for the GP.
(Range of values PY 0 .. 254, OY 0 .. 254)

GP END: End of the (continuous) input area for the GP.
(Range of values PY 1 .. 255, OY 1 .. 255)

Output areas

GP STA: Beginning of the (continuous) output area for the GP.
(Range of values PY 0 .. 254, OY 0 .. 254)

GP END: End of the (continuous) output area for the GP.
(Range of values PY 1 .. 255, OY 1 .. 255)

Output fields:

L2 station address: The address of the currently addressed station is displayed.

Function keys:

F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

☞ **The input or output area must always begin with an even byte number and must always end with an odd byte number.**

The fields remain empty if no input or output areas are required for the GP.

If you make errors in the entries, these are rejected by the COM. After you press the OK key, an error message appears in the message line.

If you want to reserve areas for the cyclic I/Os (ZP), remember the following when you are reserving areas:

➢ The area for the "global I/Os" (i.e. the area shared by all stations involved) can be a maximum of 2048 bytes long (GPB0 to GPB2047).

➢ Per station, a maximum of 64 bytes can be used as output GPs. These 64 output bytes must be a continuous block in the P or O extended input and output area.

➢ Per station, a maximum of 256 bytes can be used as input GPs. These bytes can also only be located as a continuous block in the P or O extended input and output area.

- ➢ GP and ZP/DP input areas must not overlap.
- ➢ GP and ZP/DP output areas must not overlap.
- ➢ The reserved input area for GP and ZP/DP must not include gaps.
- ➢ The reserved output area for GP and ZP/DP must not include gaps.
- ➢ The input area per station for GP and ZP/DP together must not exceed a maximum of 256 bytes.
- ➢ The output area per station for GP and ZP/DP together must not exceed a maximum of 256 bytes, of which a maximum of 64 bytes are reserved for GP.

Input and output I/O areas can be selected independent of each other (refer to Fig. 9.12). They can be shifted "up" or "down".

☞ **The I/O area reserved for the GP and ZP/DP must not be used by other I/O modules.**
An online modification of the GP or ZP/DP area only becomes effective after the CP 5430 TF has gone through power off/power on.

9.2.2 I/O Areas CP 5431 FMS

The assignment of input and output areas in the SIMATIC PLC is made for the global I/Os in a screen.

If you specify areas for ZI at the same time, you require only require three limits for the input and output areas since one limit is always implicitly specified.

Simultaneous use of GP and DP is not possible.

Select Edit -> I/Os -> I/O areas to call the following screen. The screen has the following structure:

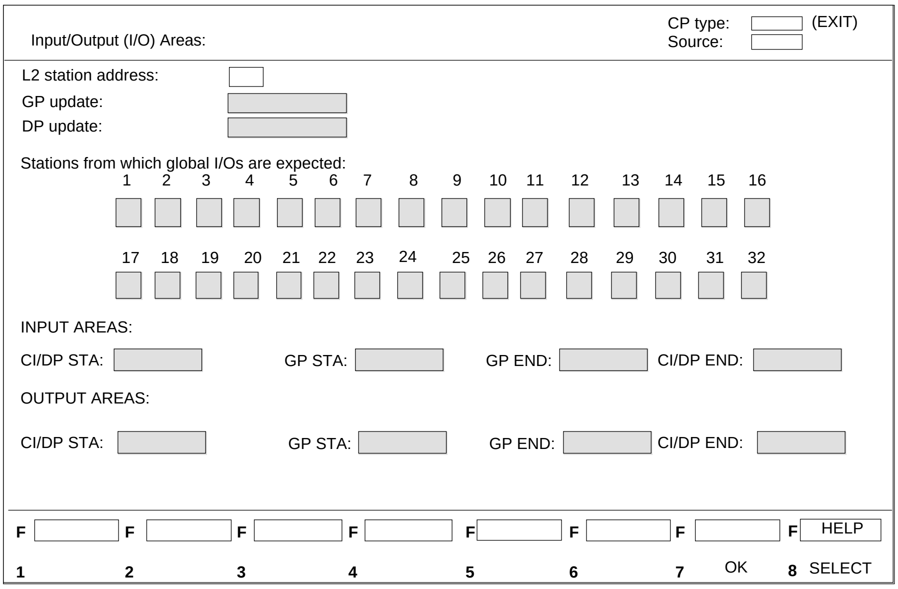


Fig. 9.13 Screen for Assignning Input/Output Areas CP 5431 FMS

Input fields:

GP senders: All the stations from which GP bytes are expected must be marked with "X".
Recommendation: only enter an X for the stations from which GP data are expected, otherwise the bus load is increased.

Update**:** **Cycle-synchronized:** update at the cycle checkpoint by the HDB.
Free: implicit update of the I/O areas by the CP.

Input areas

GP STA: Beginning of the (continuous) input area for the GP.
(Range of values PY 0 .. 254, OY 0 .. 254)

GP END: End of the (continuous) input area for the GP.
(Range of values PY 1 .. 255, OY 1 .. 255)

Output areas

GP STA: Beginning of the (continuous) output area for the GP.
(Range of values PY 0 .. 254, OY 0 .. 254)

GP END: End of the (continuous) output area for the GP.
(Range of values PY 1 .. 255, OY 1 .. 255)

Output fields:

L2 station address: The address of the currently addressed station is displayed.

Function keys:

F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

☞ **The input or output area must always begin with an even byte number and must always end with an odd byte number.**

The fields remain empty if no input or output areas are required for the GP.

If you make errors in the entries, these are rejected by the COM. After you press the OK key, an error message appears in the message line.

If you want to reserve areas for the cyclic interface (ZI), remember the following when you are reserving areas:

➢ The area for the "global I/Os" (i.e. the area shared by all stations involved) can be a maximum of 2048 bytes long (GPB0 to GPB2047).

➢ Per station, a maximum of 64 bytes can be used as output GPs. These 64 output bytes must be a continuous block in the P or O extended input and output area.

➢ Per station, a maximum of 256 bytes can be used as input GPs. These bytes can also only be located as a continuous block in the P or O extended input and output area.

➢ GP and ZI/DP input areas must not overlap.

➢ GP and ZI/DP output areas must not overlap.

➢ The reserved input area for GP and ZI/DP must not include gaps.

➢ The reserved output area for GP and ZI/DP must not include gaps.

➢ The input area per station for GP and ZI/DP together must not exceed a maximum of 256 bytes.

➢ The output area per station for GP and ZI/DP together must not exceed a maximum of 256 bytes, of which a maximum of 64 bytes are reserved for GP.

Input and output I/O areas can be selected independent of each other (refer to Fig. 9.13). They can be shifted "up" or "down".

☞ **The I/O area reserved for the GP and ZI/DP must not be used by other I/O modules.**
An online modification of the GP or ZI/DP area only becomes effective after the CP 5431 FMS has gone through power off/power on.

9.2.3 Editor for Global I/Os

Once you have reserved the input/output areas for the global I/Os, you must assign the individual inputs and outputs of the stations to objects of the global I/Os (abbreviation GO) using the GP editor. These GOs are global I/O bytes (GPB).

Select Edit -> I/Os -> GP station editor to call the following screen. The screen has the following structure:

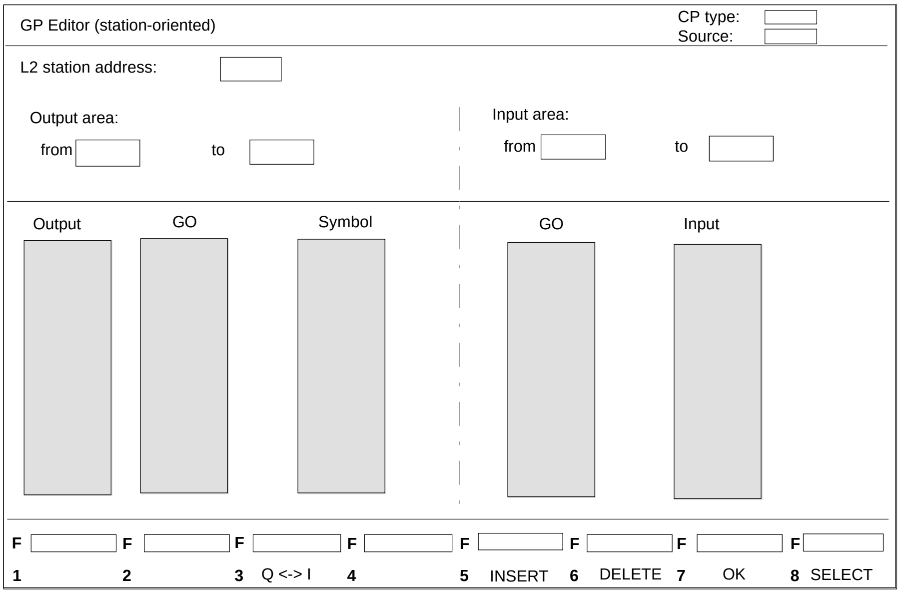


Fig. 9.14: Screen for GP Editor

Output fields:

L2 station address: The address of the currently addressed station is displayed.

Input/output area: Here, the I/O area is displayed in which the variables to be programmed will be simulated.
From: the first byte of the block in the I/O area
To: the last byte of the block in the I/O area
(Range of values: area programmed in the I/O area.)

Input fields:

Output: Output byte to be transmitted. (Range of values PY 0 .. 254, OY 0 .. 254).

GO: Global object or "global I/O byte" (GPB). (Range of values 0 .. 2047).

Symbol: Symbolic ID of the GO (Range of values 8 ASCII characters).

Input: Input byte to be read in. (Range of values PY 0 .. 254, OY 0 .. 254).

Function keys:

F3 Q<->I	Change between inputs and outputs.
F5 INSERT	An empty line is inserted at the current cursor position.
F6 DELETE	Deletes the line marked by the cursor in the input or output area.
F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.

F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

9.3 Example of Data Transfer with Communication using Global I/Os

The following example describes an application with cycle-synchronized global I/Os.

Hardware and software requirements

The following hardware is necessary:

➢ Three SIMATIC S5 programmable controllers (PLC 1: S5-155U and PLC 2: S5-115U and PLC 3: S5-135U)

➢ One CP 5430 TF/CP 5431 FMS per PLC

➢ One RAM submodule per CP 5430 TF/CP 5431 FMS

➢ One RS 485 bus terminal per CP

➢ SINEC L2 bus cable

➢ At least one PG 710, PG 730, PG 750 or PG 770, or PC

The following software packages are also required:

- COM 5430 TF/COM 5431 FMS under SINEC NCM
- PG software for STEP 5 programming
- Appropriate handling blocks for the PLCs
- Diskette with the example program.

9.3.1 Program Description

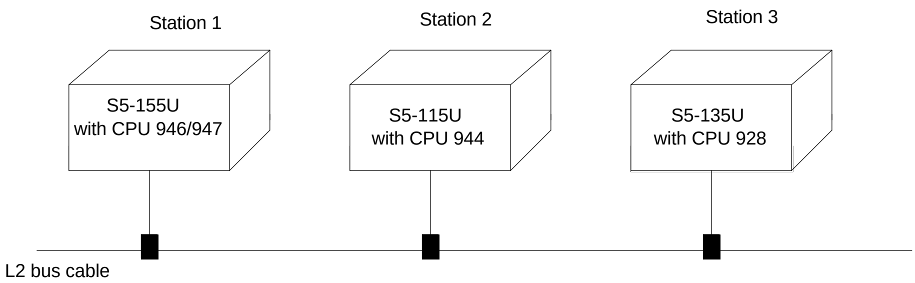


Fig. 9.15: Example of Global I/Os (System Configuration)

Three programmable controllers (S5-155U, S5-115U and S5-135U) of a manufacturing unit are to be connected via the SINEC L2 bus (-> Fig. 9.14).

The distribution of the tasks is as follows:

PLC	Bus station number	Task
S5-155U	1	"head control" - Sends program selection number and control commands for both manufacturing subunits 1 and 2 (bus stations 1 and 2) - Receives acknowledgement and position messages from the manufacturing subunits
S5-115U	2	"manufacturing subunit 1" - Acknowledges the control commands received from the head control - Signals positions and faults to the head control - Signals faults to manufacturing subunit 2
S5-135U	3	"manufacturing subunit 2" - Acknowledges the control command received from the head control - Signals positions and faults to the head control - Signals faults to manufacturing subunit 1

Table 9.2: Distribution of Tasks in the "Manufacturing Unit" Example

The following specification of the transmitted and received data includes the assignment of the I/O bytes (PY) to the global I/O bytes (GB).

Bus stn. no.	Input/output bytes used for data transmission	Assignment: input and output words to global I/Os	
1	QB PY 2 -Send the control commands to stations 2 and 3 QB PY 3 -Send the program selection (number) to stations 2 and 3	PY 2 -> GPB 10 PY 3 -> GPB 11	output GP
	IB PY 2 -Receive the ack. from station 2 IB PY 3 -Receive the position and fault message from station 2	PY 2 <- GPB 100 PY 3 <- GPB 101	input GP
	IB PY 4 -Receive the ack. from station 3 IB PY 5 -Receive the position and fault messages from station 3	PY 4 <- GPB 102 PY 5 <- GPB 103	input GP
2	IB PY 10 -Receive the control commands from station 1 IB PY 11 -Receive the program selection from station 1 IB PY 12 -Receive the fault messages from station 3	PY 10 <- GPB 10 PY 11 <- GPB 11 PY 12 <- GPB 122	input GP
	QB PY 20 -Send the ack. to stn. 1 QB PY 21 -Send the position and fault messages to station 1 QB PY 22 -Send the fault messages to station 3	PY 20 -> GPB 100 PY 21 -> GPB 101 PY 22 -> GPB 22	output GP
3	IB PY 110 -Receive the control commands fromstation 1 IB PY 111 -Receive the program selectionl from station 1 IB PY 112 -Receive the fault messages from Station 2	PY 110 <- GPB 10 PY 111 <- GPB 11 PY 112 <- GPB 22	input GP
	QB PY 120 -Send the ack. to station 1 QB PY 121 -Send the position and fault messages to station 1 QB PY 122 -Send the fault messages to station 2	PY 120 -> GPB 102 PY 121 -> GPB 103 PY 122 -> GPB 122	output GP

Table 9.3: Specification of the Transmitted and Received Data and the Assignment to GP

In Figs. 9.16 to 9.20 you can see that the I/O input and output bytes of the three stations in the manufacturing unit are practically directly connected or "wired" to each other by the GP.

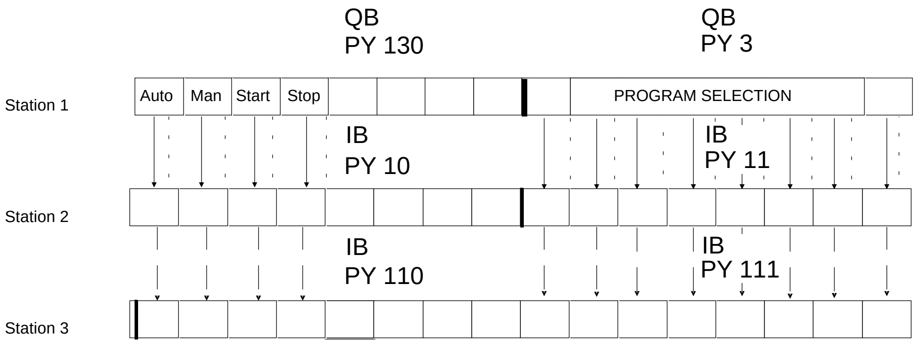


Fig. 9.16: Station 1 Sends Control Commands and Program Selection to Stations 2 and 3

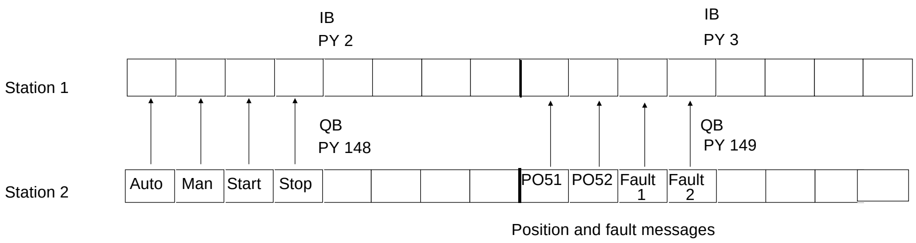


Fig. 9.17: Station 2 Sends Acknowledgment, Position and Fault Messages to Station 1

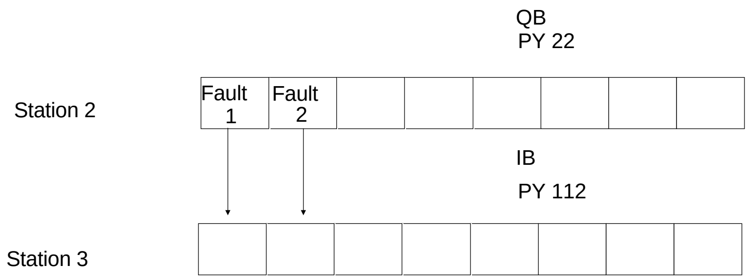


Fig. 9.19: Station 2 Sends Fault Messages to Station 3

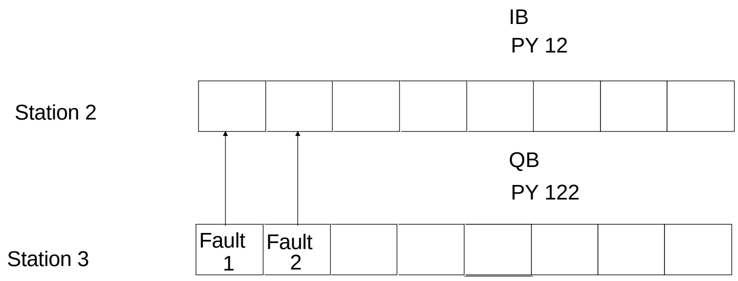


Fig. 9.18: Station 3 Sends Fault Messages to Station 2

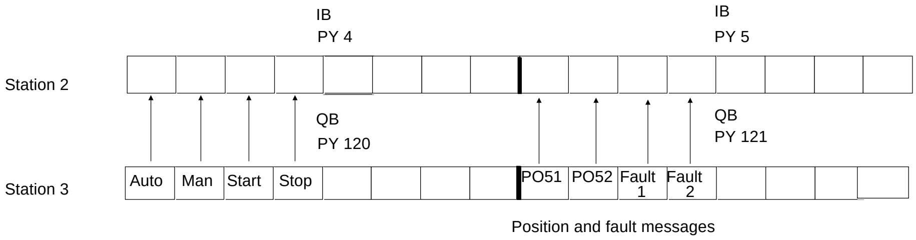


Fig. 9.20: Station 3 Sends Acknowledgment, Position and Fault Messages to Station 1

9.3.1.1 Start-up Response

During a PLC "cold restart" the various PLCs process the following start-up OBs:

Start-up OB Device	OB 20	OB 21	OB 22
S5-115U		Cold restart after STOP-RUN transition (manual)	Cold restart after power down (automatic)
S5-135U S5-155U	Cold restart (manual)	Warm restart (manual)	Warm restart (automatic)

Table 9.4: Start-Up OBs for the Various Programmable Controllers

The start-up OBs have the following task with the global I/Os data transmission mode;

➢ They must synchronize the CP 5430 TF/CP 5431 FMS interface.

➢ They can make sure that the PLC only starts up when certain or all stations are ready to transmit and receive (i.e. when there are no GP error messages).

➢ If you have selected the CYCLE-SYNCHRONIZED update mode, the complete GP should be received at the end of a start-up OB.

For the "manufacturing unit" example, the three stations should have different start-up responses:

Station No.	Start-up response
1 S5-155U (head control)	The controller should always start up even if there is a GP error message such as PLC STOP, voltage OFF, no bus connection to the manufacturing subunits 1 and 2.
2 S5-115U (manufacturing subunit 1)	The controller should always start up when the head control is active, i.e. when there are no GP error messages for station 1. GP error messages for manufacturing subunit 2 are ignored.
3 S5-135U (manufacturing subunit 2)	This controller must only start up when both the head controller and the manufacturing subunit 1 are running, i.e. there are no GP error messages.

Table 9.5: Description of the Start-up Response for the Stations of the Manufacturing Unit

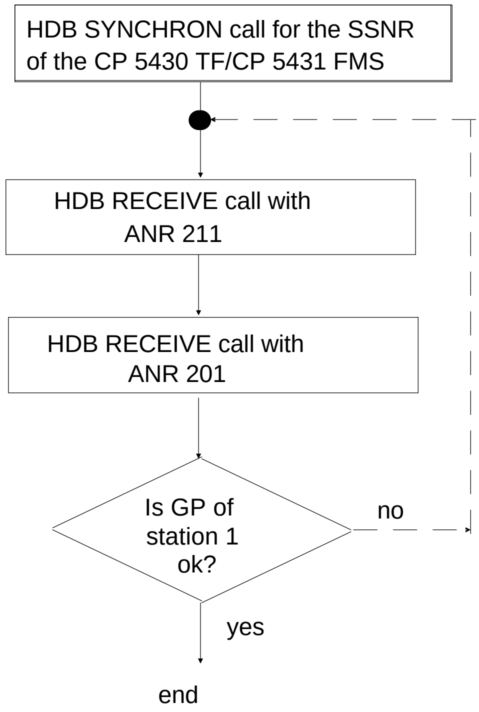
As a result of the conditions listed above, the following start-up variations are required:

Station 1:
(OB 20, OB21, OB22)

HDB SYNCHRON call for the SSNR of the CP 5430 TF/CP 5431 FMS

Fig. 9.21: Start-up Response of Station 1 (Manufacturing Unit)

Station 2:
(OB 20, OB21)



Synchronization of the interface PLC-CP 5430 TF/CP 5431 FMS

Job number 211 causes the first reception of the GP, i.e. inputs and station list are updated (only necessary in the CYCLE-SYNCHRONIZED mode)

With this HDB call (job number 201) the station list is read in by the CP 5430 TF/ CP 5431 FMS. The station list contains the statuses of the CPs of all active stations from which input GP is expected. The structure of the station list is explained following this figure.

Evaluation of the station list i.e. interrogation of the statuses of all stations which should have started up.

Fig. 9.22: Start-up Response of Station 2 (Manufacturing Unit)

Station 3:
(OB 20, OB21, OB 22)

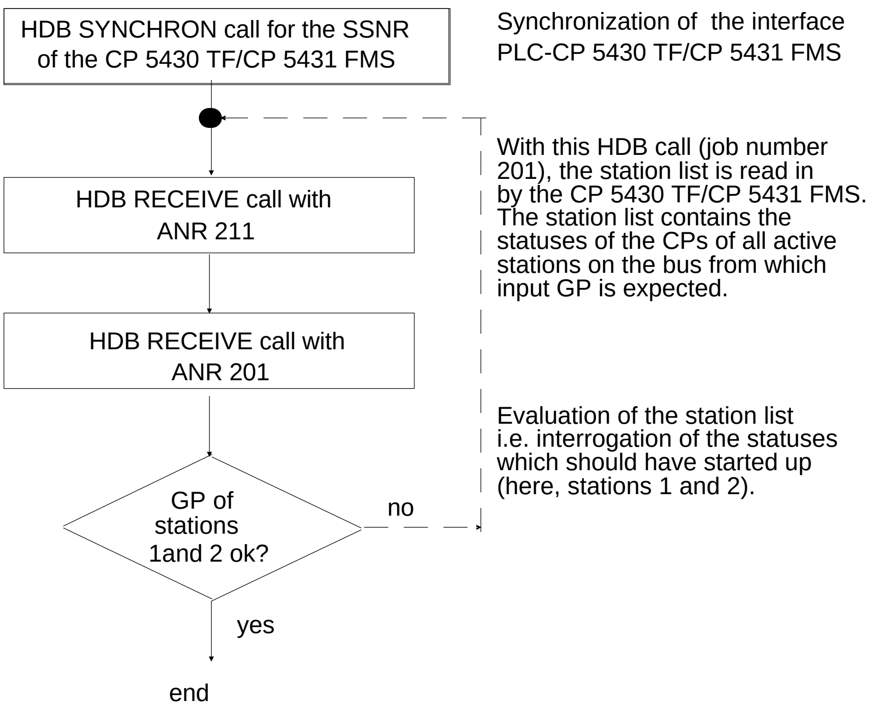


Fig. 9.23: Start-up Response of Station 3 (Manufacturing Unit)

9.3.1.2 Cyclic Mode

The cyclic program has the following structure in all stations for the CYCLE-SYNCHRONIZED update mode.

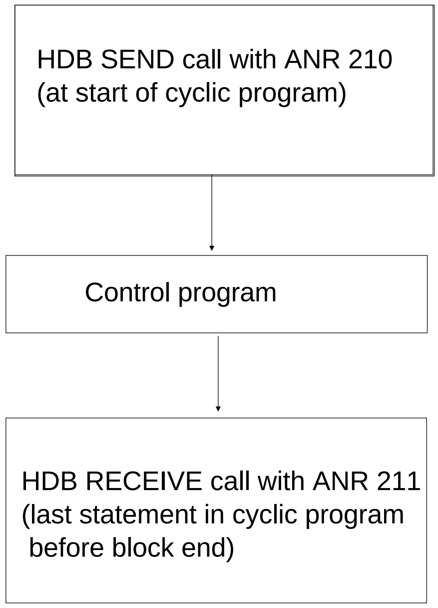


Fig. 9.24: Structure of the Cyclic Program (OB 1) for all Stations. (Manufacturing Unit)

9.3.2 Transferring the Configuration Data for the CP 5430 TF/CP 5431 FMS and the STEP 5 User Program

To be able to implement the practical example for communication using global I/Os, follow the procedure outlined below (and refer to Chapter 16):

➢ Transfer the following COM 5430 TF/COM 5431 FMS database files to the CPs you are using:

When using the CP 5430 TF under the network file GPO@@NCM.NET

- for station 1 OGPTLN1.155
- for station 2 OGPTLN2.115
- for station 3 OGPTLN3.135.

When using the CP 5431 FMS under the network file GPQ@@NCM.NET

- for station 1 QGPTLN1.155
- for station 2 QGPTLN2.115
- for station 3 QGPTLN3.135.

➢ Transfer the following STEP 5 files to the programmable controllers you are using:

- For PLC 1 (S5-155U) the file GP155UST.S5D
- For PLC 2 (S5-115U) the file GP115UST.S5D
- For PLC 3 (S5-135U) the file GP135UST.S5D.❑

Notes

10 Data Transmission with Cyclic I/Os (CP 5430 TF)

This chapter contains the following information:

- ➢ The devices and applications for which data transmission with cyclic I/Os (ZP) is suitable.
- ➢ How this type of data transmission functions.
- ➢ How to assign parameters to the CP 5430 TF for this type of data transmission when an S5 programmable controller is to exchange data with a field device (example in Section 10.3).
- ➢ The STEP 5 program for this example.

Applications for data transmission with cyclic I/Os (ZP)

The high, cyclic communications demands for the automation function of a field device cannot be met with direct HDB calls. Instead of cyclic HDB calls, the CP 5430 TF therefore provides the cyclic I/Os service.

Data transmission with cyclic I/Os is suitable for communication between SIMATIC S5 PLCs and field devices. Field devices are passive stations on the bus which cannot access the bus themselves and must be constantly (normally cyclically) polled by active L2 stations.

The main feature of data transmission with cyclic I/Os (ZP) is that it is easy to use, i.e. it involves far less programming compared with other types of data transmission, for example "free layer 2 access" (refer to Chapter 8).

The term "cyclic I/Os" means that part of the I/O area is not used by I/O modules but rather for the cyclic data exchange between SIMATIC programmable controllers and passive stations on the bus. "Cyclic data exchange" means that the CP 5430 TF sends the whole of the output area assigned for ZP cyclically and updates the whole input area assigned for ZP with the received data. You can use these virtual I/Os as proper inputs or outputs. These addressed areas are processed normally with STEP 5 commands. The mode is cycle-synchronized or free. With the CYCLE-SYNCHRONIZED mode, an HDB must be called at the checkpoints required by the user to ensure the consistency of inputs and outputs. This HDB also serves to trigger a group job for data transmission.

The volume of data to be transmitted with ZP should be small.

This would, for example, include control commands, messages, measured values and analog values.

☞ **Simultaneous use of ZP and DP is not possible**

10.1 Basics of Data Transmission with Cyclic I/Os (ZP)

When you have specified a SIMATIC S5 PLC with a CP 5430 TF as being an active station, you can program data transmission with "cyclic I/Os" for this PLC and exchange (poll) data with PROFIBUS-compatible field devices. The communication between the SIMATIC S5 PLC and field device functions according to the master slave method.

This section describes the functions of the cyclic I/Os from the point of view of the CPU control program

In data transmission with cyclic I/Os the data exchange takes place via the I/Os of the SIMATIC PLC, as follows

Communication using cyclic I/Os is only permitted using the base interface number (base SSNR).

➢ The data for transmission are assigned to the output area of the I/Os in the control program.

➢ The received data are stored in the input area of the I/Os.

➢ Transmitted and received data can be processed with STEP 5 operations.

   – **Data for transmission via the output area**

   – **Received data via the input area**

All I/O bytes via which you want to transmit and all I/O bytes via which you want to receive must be designated as cyclic I/Os. To do this, you program I/O areas using COM 5430 TF (refer to section 10.2).

Configuring I/O areas for ZP

Fig. 10.1 illustrates the basic function of the cyclic I/Os. The field device (slave) can only be addressed by the CP 5430 TF when it knows both the L2 address and the corresponding service access point (SAP) of this field device. Both the L2 address of the slave and the SAP number must be specified using the ZP editor of the COM 5430 TF software package.

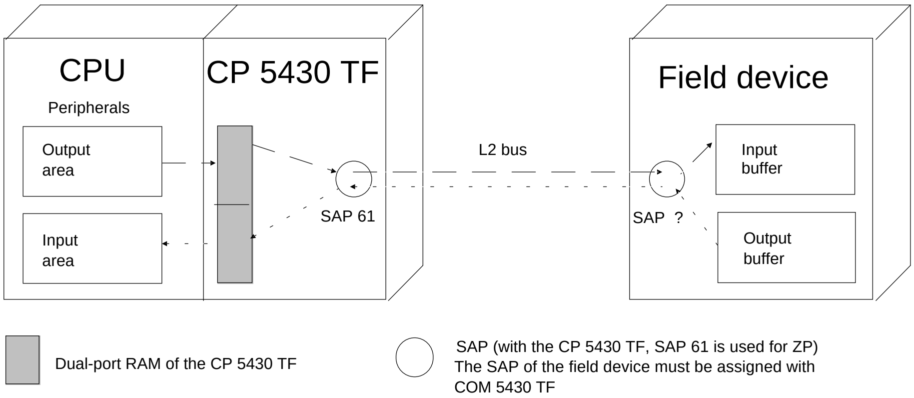


Fig. 10.1: Outline of the Functions of Cyclic I/Os

The CP 5430 TF becomes the "distributor" after it is configured with the ZP editor. It performs the following functions:

- receives the trigger for data transmission via an HDB or CP internal cycle
- reads the ZP output area of the CPU
- allocates the L2 address and destination SAP to the corresponding field device
- "packs" all the output bytes belonging together in frames
- sends these frames to the addressed field devices and at the same time requests reply frames from these field devices

- receives the reply frames and assigns them to the configured ZP input bytes of the CPU

The following information is important:

- With field devices, different data (e.g. programming data in contrast to signal data) can be assigned to different SAPs.
- ZP transmits and receives exclusively using SAP number 61.
- ZP uses the PROFIBUS layer 2 service SRD (send and request data) for data transmission.
- The frames of the cyclic I/Os always have low priority. This means that when there is a large volume of traffic on the bus from other stations with higher priority, it cannot be guaranteed that ZP frames are transmitted during a token rotation.
- if ZP is to transmit via the default SAP, SAP61 must be set as the default SAP

Updating the input and output areas of the cyclic I/Os

The times at which the CP 5430 TF updates the **ZP bytes to be transmitted** are either

- **FREE** mode: decided by the CP (the STEP 5 control program has no influence) or
- **CYCLE-SYNCHRONIZED** mode: decided by the control program using a send handling block call with job number 210.

The times at which the CP 5430 TF transfers the **received ZP bytes** to the CPU input area are also either

- **FREE** mode: decided by the CP (not influenced by the STEP 5 control program) or
- **CYCLE-SYNCHRONIZED** mode: decided by the control program by means of a RECEIVE handling block call with job number 211.

Consistency of the input and output bytes of the ZP

➢ **FREE** mode: guaranteed consistency of **one** byte.

➢ **CYCLE-SYNCHRONIZED** mode: guaranteed consistency over the whole area.

☞ **The ZP update points depend on the communication via the L2 bus. Communication between the CP 5430 TF and passive stations is constant (cyclic) and not dependent on handling block calls (SEND/RECEIVE with ANR 210/211).**

Special features
If a passive station fails, the input bytes assigned to this station are reset (to the value 0). If the PLC changes from the RUN to the STOP mode, its ZP output bytes are also reset so that the value "0" is transmitted. This is also the reaction during start-up.

The following pages describe the FREE and CYCLE-SYNCHRONIZED modes; how to set these modes with COM 5430 TF is described in the example.

Procedure with the FREE mode: master transmits to slave

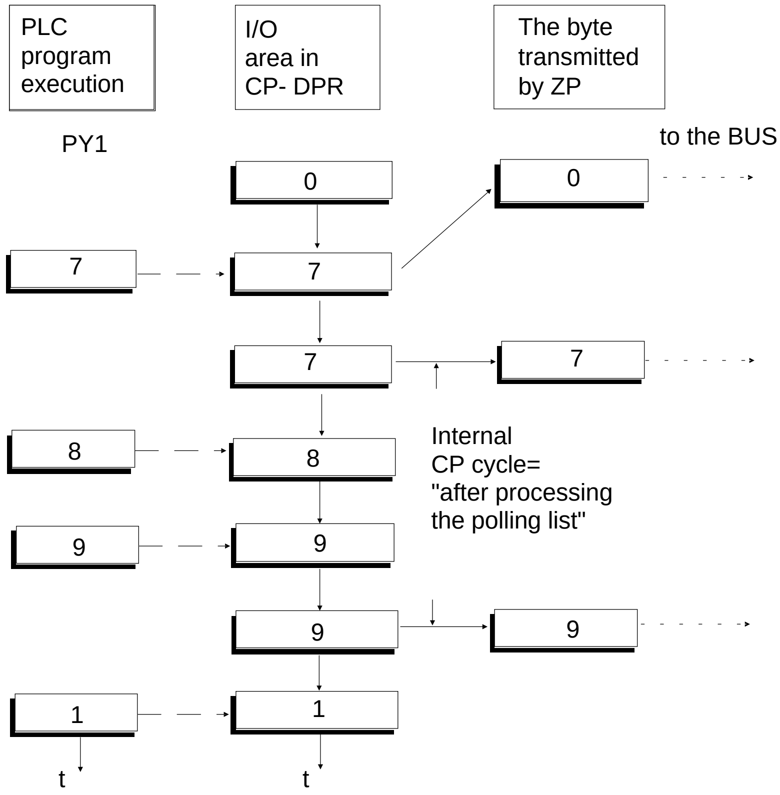


Fig. 10.2: How the FREE Mode Functions: Master Transmits to Slave

Explanation of Fig. 10.2:

- The control program modifies the output byte to be transmitted (PY 1).
- In the CP cycle, the CP 5430 TF transmits the whole of the output area assigned to ZP. In the FREE mode, the CP cycle determines the point at which the data is transmitted.

In the FREE mode, the time when the CP 5430 TF transmits the ZP output bytes is not fixed.

Procedure with the FREE mode: master receives from slave

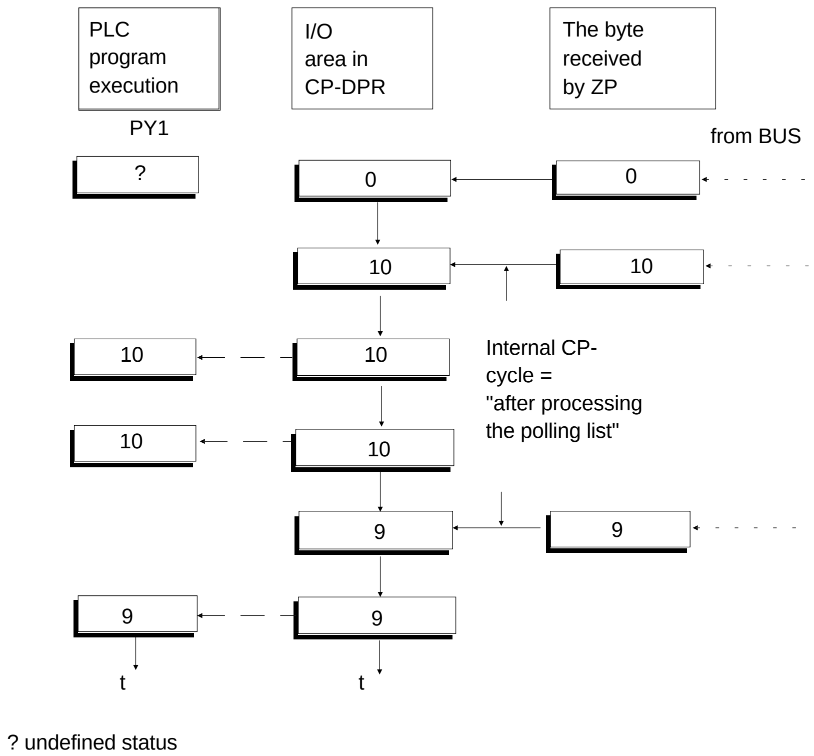


Fig. 10.3: FREE Mode: Master Receives from Slave

Explanation of Fig. 10.3:

➢ The byte received by ZP is transferred to the I/O area of the DPR within the internal CP cycle.

➢ The control program can then work with these values under PY1.

☞ **If ZP bytes need to be transferred together because they form a logical unit (e.g. a control parameter requiring a word), the FREE update mode must under no circumstances be selected. With this mode, there is no guarantee that the ZP bytes which belong together are actually transferred together. The receiver (PLC or slave) would then process inconsistent values.**

Essential features of the FREE mode:

➢ Minimum cycle load (corresponds to the cycle load that would occur simply by plugging in the corresponding input/output modules.

➢ Minimum load on the CP.

➢ Simple programming (single handling block call; HDB SYNCHRON during start-up).

Procedure with the CYCLE-SYNCHRONIZED mode: master transmits to slave

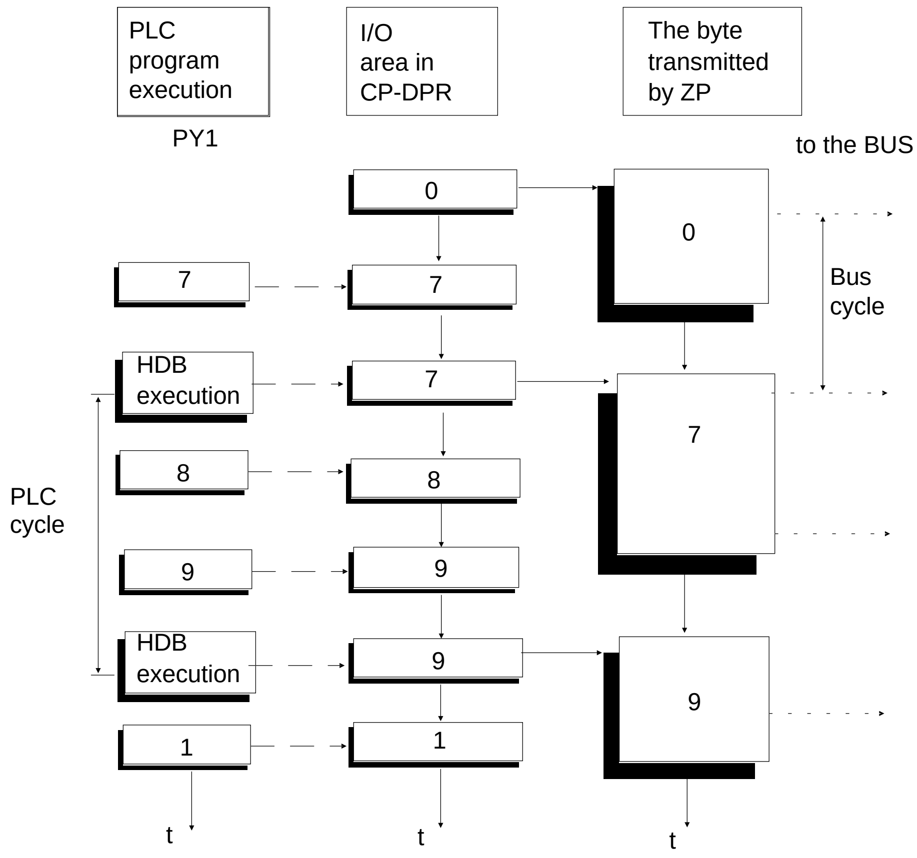


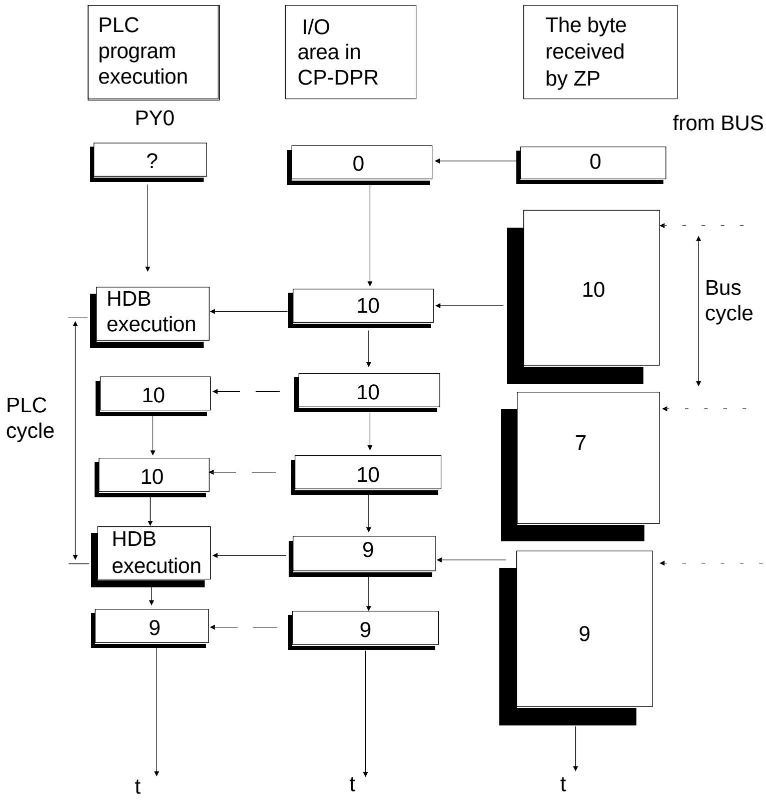
Fig. 10.4: CYCLE-SYNCHRONIZED Mode: Master Transmits to Slave

Explanation of Fig. 10.4:

➢ The control program changes the output byte to be transmitted (PY1).

➢ At the point when the HDB is executed, the CP 5430 TF transmits all the output bytes assigned to the ZP. In contrast to the FREE mode, you determine this point in time in the control program by means of an HDB SEND call with job number 210.

Procedure with the CYCLE-SYNCHRONIZED mode: master receives from slave



? undefined status

Fig. 10.5: CYCLE-SYNCHRONIZED Mode: Master Receives from Slave

Explanation of Fig. 10.5:

➢ The byte received by ZP is transferred to the I/O area of the DPR at the point determined by the execution of the HDB.

➢ The control program can then work with these values under PY0.

The advantage of the CYCLE-SYNCHRONIZED mode is that the time at which the ZP is sent or received is fixed in the control program.

To ensure that the ZP input area of the CPU is also updated at a defined point in time, an HDB RECEIVE with job number 211 must be called in the control program, normally at the end of the cyclic control program.

To ensure that the ZP output area of the CPU is also updated at a defined point in time, an HDB SEND with job number 210 must be called in the control program, normally at the start of the cyclic control program.

☞ **With short PLC cycle times (< 50 ms) the HDB SEND/RECEIVE calls with job numbers 210/211 may extend the PLC cycle time. The load on the CP 5430 TF may also increase so that the transmission times of the global I/Os deteriorate.**

If you have short PLC cycle times, make sure that the time between two HDB calls is greater than 50 ms (e.g. by programming HDB SEND/RECEIVE calls with job numbers 210/211 in every nth PLC cycle).

The normal safety philosophy of SIMATIC control systems, resetting all the output bytes if the PLC stops and clearing the input bytes belonging to an I/O device if this fails, is also used here. The total number of GP and ZP I/O bytes processed by the CP must not exceed 256 input or output bytes, but can be assigned to the P or O areas (O area only with S5 135U, S5 150U and S5 155U).

Sequence of the data transmission

The start-up OBs have the following task with the cyclic I/Os data transmission mode;

➢ They must synchronize the CP 5430 TF interface

➢ They can make sure that the PLC only starts up when certain or all stations are ready to transmit and receive (i.e. when there are no ZP error messages)

➢ If you have selected the CYCLE-SYNCHRONIZED update mode, the complete ZP should be received at the end of a start-up OB

The SEND synchronization point is indicated by the SEND-HDB (ANR 210). The parameter QTYP must be assigned the value "NN". DBNR, QANF, QLAE are irrelevant. The ANZW should be assigned to a data or flag word. The RECEIVE synchronization point is indicated by the RECEIVE HDB in the "direct mode" and ANR 211. The remaining assignment of parameters to the HDBs is the same as for the SEND synchronization point.

The following figure (Fig. 10.6) illustrates one way of integrating the HDBs in the cold or warm restart branch of the PLC.
(OB 20, OB21, OB 22)

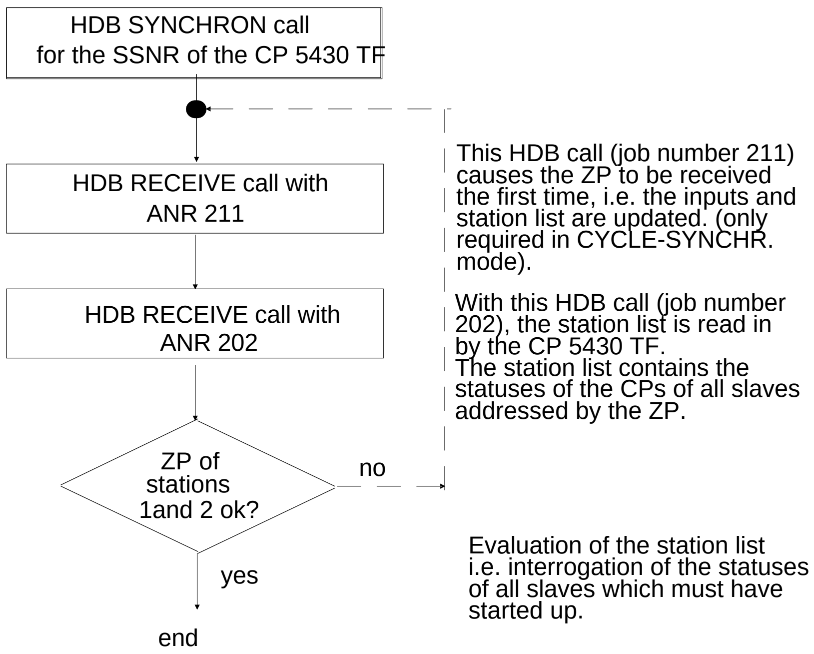


Fig. 10.6: HDBs in Cold or Warm Restart of the PLC

Both in the cold restart branch (OB 20) and in the warm restart branch (OB 21/22) each CP interface to be used later must be synchronized (SYNCHRON HDB). From the cold restart branch, the PLC operating system branches directly to the first cycle checkpoint. The process image of the inputs (PII) is read in for the first time at this point. The first RECEIVE synchronization point for the CP 5430 TF is therefore already in the cold restart branch.

After the warm restart (OB21/22) the PLC cycle is resumed at the point at which it was interrupted. The old PII is still valid for the remainder of the PLC cycle and is only updated at the next PLC cycle checkpoint. If a check of the ZP image is required with a warm restart, the control HDB should be called in a loop at the end of OB21/22 until the status word contains no further relevant error bits.

Cyclic operation

The cyclic program has the following structure for all stations in the CYCLE SYNCHRONIZED update mode:

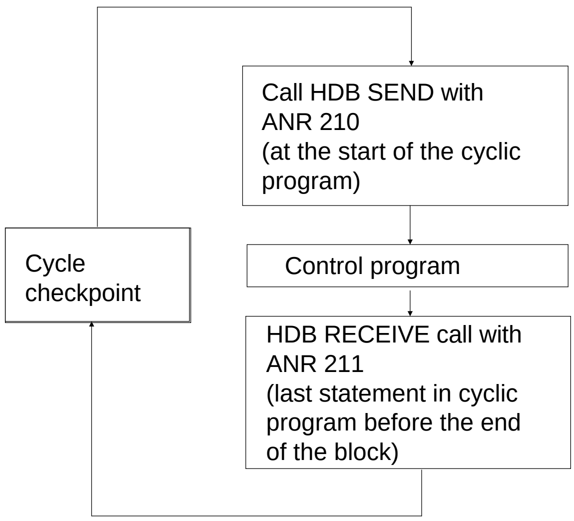
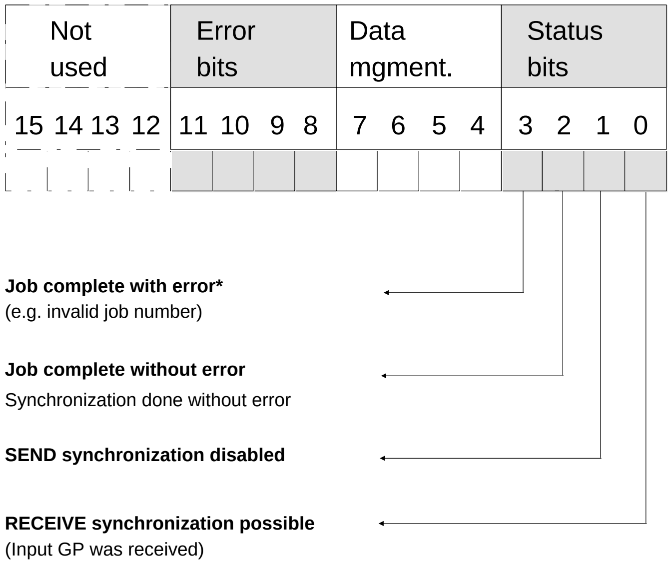


Fig. 10.7: Structure of the Cyclic Program

In cyclic operation, the SEND synchronization point is immediately at the start of OB 1; the RECEIVE synchronization point at the end of the PLC cycle. The division into a SEND and a RECEIVE synchronization point is necessary, since the CP must make the received ZP bytes available to the PLC before the PLC cycle control point and on the other hand the CP can only process the ZP output byte after the PIQ has been output.

10.1.1 Checking the Data Transmission with ANZW and the ZP Station List



* Bit 3 of the status bits is not connected with the error bits (8..11).
When bit 3 is set, the error is not specified by the error bits. All the errors listed in table 7.3 are possible.

Fig. 10.8: Structure of ANZW for HDB SEND (ANR 210) and RECEIVE (ANR 211), here: Status Bits

☞ **If there is a group error message, bit 3 of the status word (status bit) is not set.**

Error bits for the RECEIVE-HDB (ANR 211)

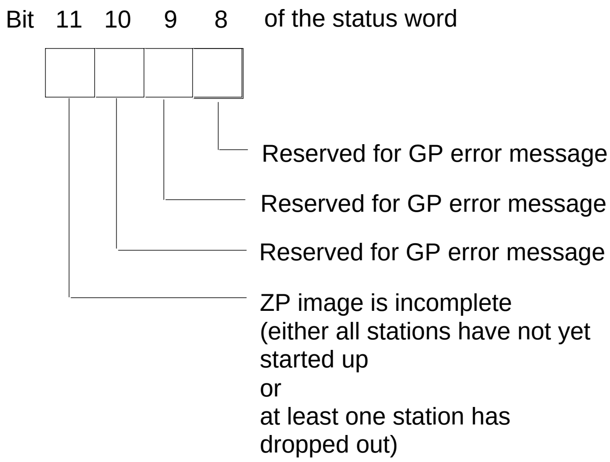


Fig. 10.9: Error Bits in RECEIVE HDB (ANR 211)

Error bits of the ZP station list (ANR 202)

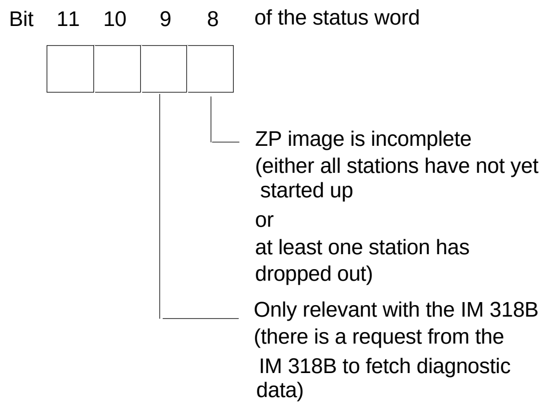


Fig. 10.10: Error Bits of the ZP Station List

Structure of the ZP station list

The station list has a length of 16 bytes, with each bit assigned to a station address.

All stations configured for ZP and which respond correctly are marked with "0". Stations not responding correctly or from which a diagnosis request exists (only with IM318B) are marked with a "1" in the station list.

The last bit in the station list is irrelevant, since the permitted station addresses on the L2 bus are in the range from 0 to 126.

Byte	0								1								2 - 14	15							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0
Station address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 119	120							127

Fig. 10.11: Structure of the ZP Station List

Error bits and updating the station list during data transmission:

During start-up, the station list is initialized with "0". After the RECEIVE HDB has been executed the first time, all stations which do not respond correctly are marked with bit value "1". Note: the RECEIVE HDB is only released when the complete polling list has been run through once.

As long as one station does not respond correctly, the corresponding group error message is set both in the status word of the RECEIVE HDB (ANR 211) and in the status word of the ZP station list (ANR 202).

As soon as a station responds correctly, it is cleared from the station list and the bit in the station list is set to "0".

If an error occurs, (one or more links not in the data transfer phase), the ZP station list can be read out at any point. If all the links are functioning correctly in the data transfer phase, the RECEIVE HDB for the ZP station list is disabled.

A further distinction must be made as to the mode (FREE or CYCLE-SYNCHRONIZED) in which the station list is evaluated, as follows:

FREE:
the station list is updated continuously by the CP.

CYCLE-SYNCHRONIZED:
the station list is updated by the CP at the point when the HDB RECEIVE with job number 211 is called in the control program (ZP receive)

10.2 Configuring

The PG package SINEC NCM with COM 5430 TF is used to configure the functions.

The screens you require for configuring are provided by SINEC NCM as shown in Fig. 10.12.

➢ I/O areas

➢ ZP editor

➢ Documentation and test

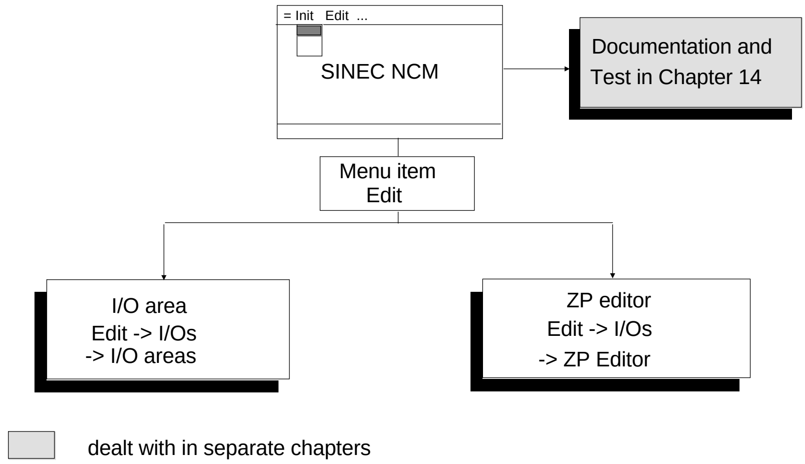


Fig. 10.12: Configuring Cyclic I/Os

10.2.1 I/O Areas

Input and output areas of the SIMATIC PLC for cyclic I/Os are assigned in a screen.

If you also specify areas for GP, you only require three area limits for the input and output areas since one limit is always specified implicitly.

☞ **Simultaneous use of ZP and DP is not possible**

Select Edit -> I/Os -> I/O areas to call the following screen. The screen has the following structure:

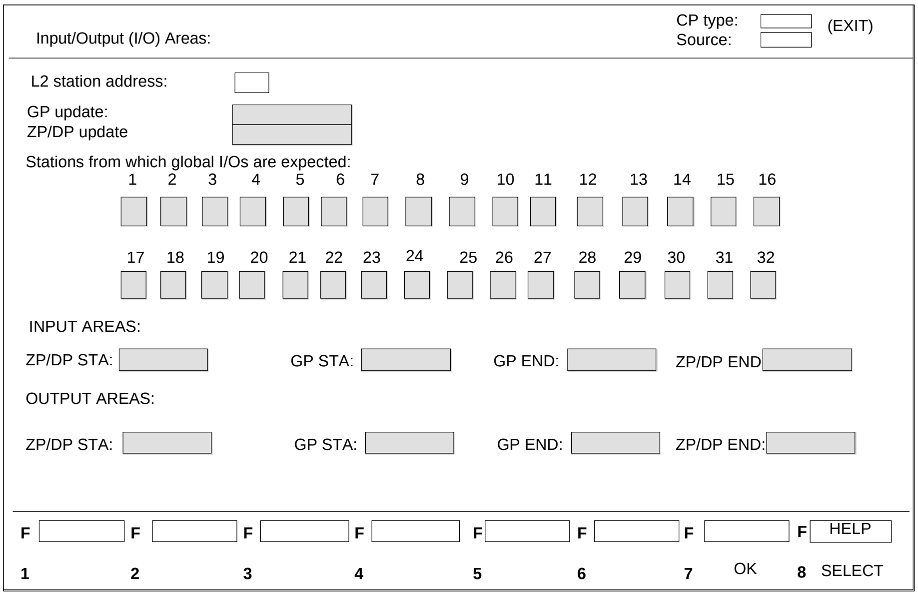


Fig. 10.13: Screen for Assigning I/O Areas (CP 5430 TF)

Input fields:

Update**:**	**Cycle-synchronized:** update at the cycle checkpoint by the HDB. **Free:** implicit update of the I/O areas by the CP.

Input areas

ZP/DP STA:	Beginning of the (continuous) input area for the cyclic I/Os. (Range of values PY 0 .. 254, OY 0 .. 254)
ZP/DP END:	End of the (continuous) input area for the cyclic I/Os. (Range of values PY 1 .. 255, OY 1 .. 255)

Output areas

ZP/DP STA:	Beginning of the (continuous) output area for the cyclic I/Os. (Range of values PY 0 .. 254, OY 0 .. 254)
ZP/DP END:	End of the (continuous) output area for the cyclic I/Os. (Range of values PY 1 .. 255, OY 1 .. 255)

Output fields:

L2 station address:	The address of the currently addressed station is displayed.

Function keys:

F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

☞ **The input or output area must always begin with an even byte number and must always end with an odd byte number.**

The fields remain empty if no input or output areas are required for the cyclic I/Os.

The input area/output area for ZP must not exceed a maximum of 256 bytes.

If you want to reserve areas for the global I/Os (GP), remember the following when you are reserving areas:

➢ GP and ZP input areas must not overlap.

➢ GP and ZP output areas must not overlap.

➢ The reserved input area for GP and ZP must not include gaps.

➢ The reserved output area for GP and ZP must not include gaps.

➢ The input area per station for GP and ZP together must not exceed a maximum of 256 bytes.

➢ The output area per station for GP and ZP together must not exceed a maximum of 256 bytes, of which a maximum of 64 bytes are reserved for GP.

☞ **The I/O area reserved for the GP and ZP must not be used by other I/O modules.**
An online modification of the GP/ZP area only becomes effective after the CP 5430 TF has gone through power off/power on.

10.2.2 ZP Editor

Once you have reserved the input/output areas for cyclic I/Os, you must now assign part of the reserved area to each field device (slave) using the ZP editor.

Select Edit -> I/Os -> ZP editor to call the following screen. The screen has the following structure:

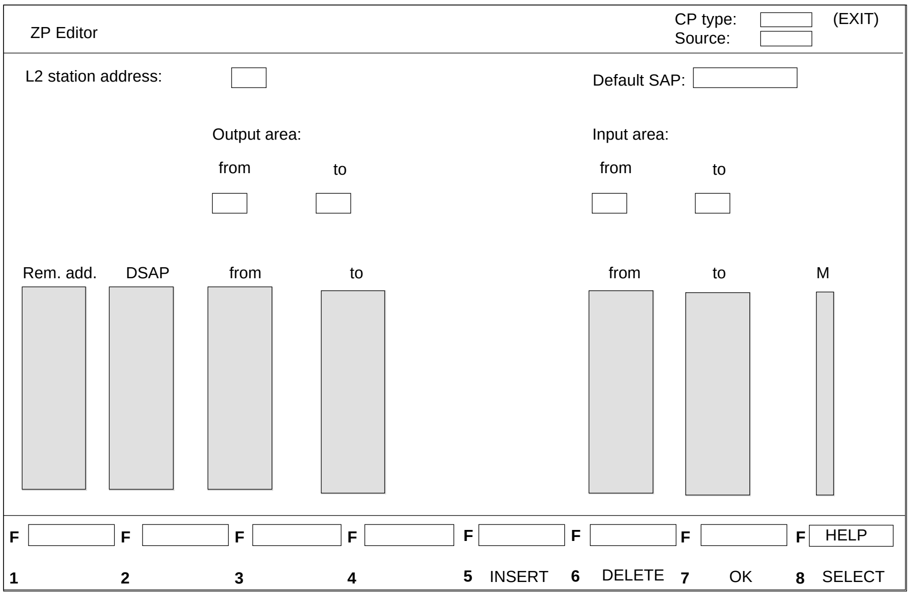


Fig. 10.14: "ZP Editor" Screen

Input fields

rem. add: In this column, you specify the L2 address of the slave station.

DSAP: The SAP of the slave station must also be specified. (Range of values: 2 .. 64, empty = default SAP)

Output area
If you intend to define an output block for the corresponding slave on the DSAP, this block of continuous bytes is specified here.

from: The first byte of the output block.

to: The last byte of the output block.

It is possible to assign the output areas more than once using a different L2 address.

Input area
If an input block is intended, it is defined here. Multiple assignment is, however, not possible.

from: The first byte of the input block.

to: The last byte of the input block.

M: Here, the number of entries in the internal polling list is specified. This also specifies the priority of the link (range of values: default 1, otherwise 1...4).

Output fields:

L2 station address: The L2 station address of the station for which inputs and outputs are to be assigned to a slave station.

Input/output area
Here, the I/O area in which the variables to be configured will be simulated, is displayed.

Default SAP: Here, the specified default SAP is displayed (refer to Section 6.5.3 network parameters). If the CP 5430 TF is to transmit via the default SAP with ZP, the default SAP must be set to SAP number 61.

from: The first byte of the block.

to: The last byte of the block.
(range of values in I/O area, configured area).

Function keys:

F5 INSERT	An empty line is inserted at the current cursor position.
F6 DELETE	Deletes the line marked by the cursor in the input or output area.
F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

☞ **After saving and reading out the input/output areas, the entries are displayed in descending order of priority (M).**

10.3 Example of using the Cyclic I/Os

The following example describes an application using cycle-synchronized cyclic I/Os.

Hardware and software requirements

The following hardware is necessary:

➢ Two SIMATIC S5 programmable controllers (PLC 1: S5-115U and PLC 2: S5-95U)

➢ One CP 5430 TF

➢ One RAM submodule per CP

➢ Two RS 485 bus terminals

➢ SINEC L2 bus cable

➢ At least one PG 710, PG 730, PG 750 or PG 770, or PC

The following software packages are also required:

➢ COM 5430 TF under SINEC NCM

➢ PG software for STEP 5 programming

➢ Appropriate handling blocks for the PLCs

➢ Diskette with the example programs.

10.3.1 Program Description

Two programmable controllers (S5-115U and S5-95U) must be linked via the SINEC L2-BUS.

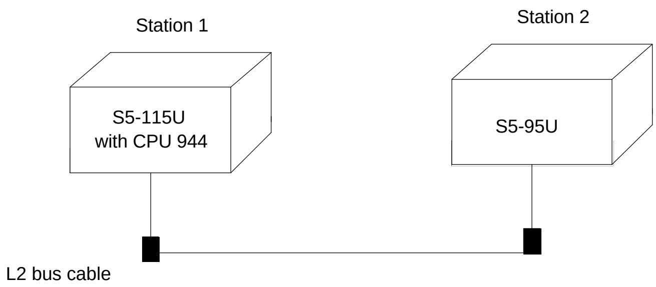


Fig. 10.15: Programmable Controllers

For the example, a simple data exchange of two bytes in both communications directions has been selected. PLC 1 sends changing data to PLC 2. In PLC 2, these data are returned to PLC 1.

Station number	Inputs and outputs used for data transmission	
1	PY 10 - transmit I/Os PY 11 - transmit I/Os PY 12 - receive I/Os PY 13 - receive I/Os	output ZP output ZP input ZP input ZP
2	PY 100 DW 1 transmitted word DW 10 received word	output ZP input ZP

Table 10.1: Specification of the Transmitted and Received Data and Assignment to ZP

10.3.1.1 Program for PLC 1

When a PLC starts up, the CP interface must be synchronized using a SYNCHRON HDB.
PLC 1 sends DW 10 of DB 100 to PLC 2 and fetches the DW 1 of DB 100.

10.3.1.2 Program for PLC 2 (S5-95U)

PLC 2 receives the ZP from PLC 1 via DW 10 in DB 100. FB 150 transfers the received DW 10 to DW 1 of DB 100 and therefore sends it back to PLC 1.

Assignment of DB 1 parameters of the S5 95U for L2

SL2	->	L2 parameters
STA 2	->	own L2 address
STA PAS	->	station is passive
BDR 187.5	->	transmission rate 187.5 Kbps
SDT 1 12	->	smallest station delay 12 bit times
ST 380	->	slot time 380
ZPDB 100	->	transmit and receive DB of the ZP, DB 100
ZPSS FY 100	->	status byte of the ZP (FY 100)
ZPSA DW 1-1	->	output area of the ZP (DW 1)
ZPSE DW 10-10	->	input area of the ZP (DW 10)

```
DB 1                C:DZP95UST.S5D

0 :   KS =  "DB 1                          ";
12:   KS =  "SL2: STA 2 STA PAS            ";
24:   KS =  "BDR 187.5 SDT 1 12            ";
36:   KS =  "ST 380                        ";
48:   KS =  "ZPDB DB100 ZPSS FY 100        ";
60:   KS =  "ZPSA DW 1 DW 1                ";
72:   KS =  "ZPSE DW 10 DW 10;             ";
84:   KS =  "ERT: ERR DB 255 DW ;1         ";
96:   KS =  "END                           ";
108:
```

Table 10.2: DB 1

10.3.2 Transferring the Configuration Data for the CP 5430 TF and the STEP 5 User Program

To be able to implement the practical example for communication using cyclic I/Os, follow the procedure outlined below (and refer to Chapter 16):

➢ Transfer the following COM 5430 TF database file to the CP 5430 you are using:

– under the network file ZP@@@NCM.NET, the file OZPTLN1.115

➢ Transfer the following STEP 5 files to the programmable controllers you are using:

– For PLC 1 (S5-115U) the file ZP115UST.S5D

– For PLC 2 (S5-95U) the file ZP95U@ST.S5D❑

11 Data Transmission with Distributed I/Os

With the distributed I/Os system SINEC L2-DP, you can use a large number of distributed I/O modules and field devices in close proximity to the process.

Distributed means that there can be large distances between your programmable controller and the I/O and field devices which can be bridged by a field bus or (twisted pair or fiber optic).

This chapter describes the functions of the DP from the point of view of the CPU control program.

Data exchange with distributed I/Os (DP) is handled via the I/O area of the SIMATIC PLC:

- In the control program, the data for transmission are assigned to the output area of the I/Os.
- The received data are stored in the input area of the I/Os.

All I/O bytes via which you want to send data and all I/O bytes via which you want to receive data must be marked as DP. You do this by configuring the I/O areas in COM 5430 TF/COM 5431 FMS (see Section 11.6.1).

This chapter describes the following:

➢ How data transmission with DP functions.

➢ Configuring the data exchange with the connected DP slaves.

➢ Diagnostics using the control program.

The distributed I/Os system SINEC L2-DP consists of active and passive stations on the bus.

Active stations (masters) are:

- the programmable controllers
  S5-115U/H, S5-135U, S5-150U, S5-155U/H with the master modules IM308-B and CP 5430 TF/CP 5431 FMS
- PCs or PGs with the appropriate interface card
- programmable controllers of other manufacturers

Passive stations (slaves) are, for example:

- ET200U-DP
- S5-95U L2-DP
- OP 15/20
- DP slaves of other manufacturers

Data transmission using L2-DP (distributed I/Os) provides a standardized interface for communication between SIMATIC S5 PLCs and field devices (DP slaves).

Data transmission using DP is particularly easy to handle.
Programming and handling is reduced to a minimum for the user. When using the DP service, distributed I/Os can be used as if they were modules plugged into a central controller. With DP, part of the I/O area of the PLC is occupied by the connected DP slaves with the CP modeling the I/O bytes used in the direction of the CPU.
This means that access by the user program to the I/O bytes used for L2-DP, is acknowledged by the CP in place of the distributed I/Os.
Using the L2-DP protocol, the inputs and outputs assigned to the DP slaves are exchanged cyclically be the CP (see Fig. 11.1).

ONLINE test and diagnostics with the COM 5430 TF/COM 5431 FMS package are described in Section 14.2.4 .

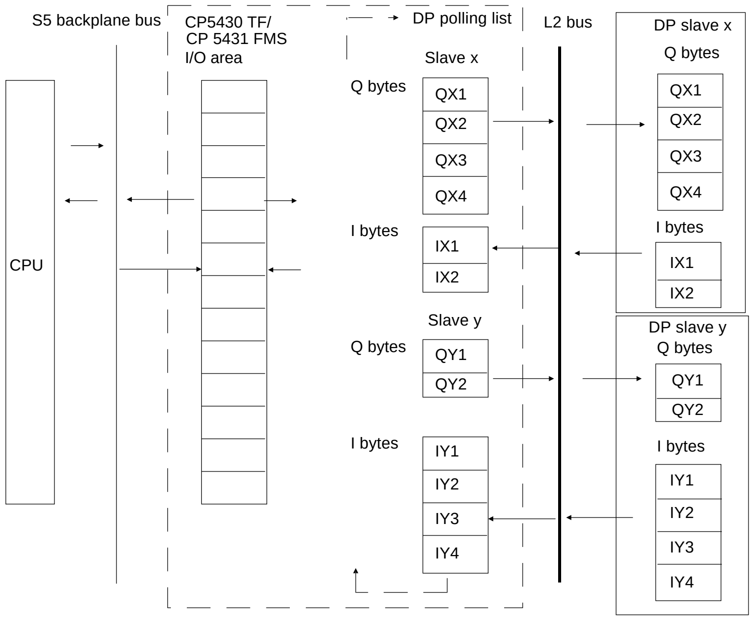


Fig. 11.1 How the Data Transmission between CPs and DP Slaves Functions

☞ **Simultaneous use of GP/ZP and DP is not possible.**
Simultaneous use of GP/CI and DP is not possible.

11.1 Basics of SINEC L2-DP

SINEC L2-DP is the Siemens implementation of the DIN E19245 Part 3 PROFIBUS-DP.
The L2-DP protocol uses the functions specified in DIN 19245 Part 1 for layers 1 and 2, and supplements these for the special requirements of distributed I/Os.
The data exchange in a pure SINEC L2-DP bus system is characterized by the master- (active station on the bus) slave (passive station on the bus) relationship. The main purpose of such a SINEC L2-DP bus system is fast data exchange between the master (PLC) and the distributed slave stations (for example, I/Os of the ET200U station).

Because the L2-DP protocol is based on Part 1 of the PROFIBUS standard and the hybrid bus access method it specifies, it also possible to operate MASTER - MASTER communication in addition to the L2-DP MASTER -SLAVE communication.

With SINEC L2-DP/PROFIBUS-DP the following configurations are possible:

➢ Communication function of the DP MASTER class 1
The class 1 MASTER polls the slaves assigned to it cyclically and handles the configured data exchange using its requester and responder functions.

➢ Communication function of the DP MASTERS, class 2
In SINEC L2-DP/PROFIBUS, a programming, diagnostic or management device used for diagnostic and service functions is known as a class 2 MASTER.

➢ Communication with other active PROFIBUS devices functioning according to the standard DIN 19245 Part 1 and 2 on the bus. These configurations are suitable for applications with low to middle requirements in terms of system reaction times .

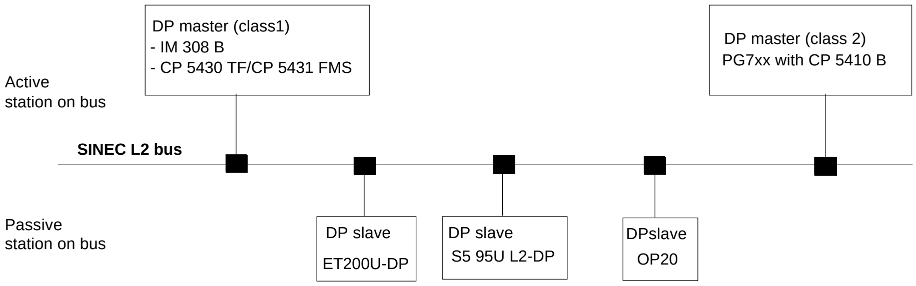


Fig. 11.2 Bus Configuration with a SINEC L2-DP Application to PROFIBUS Standard

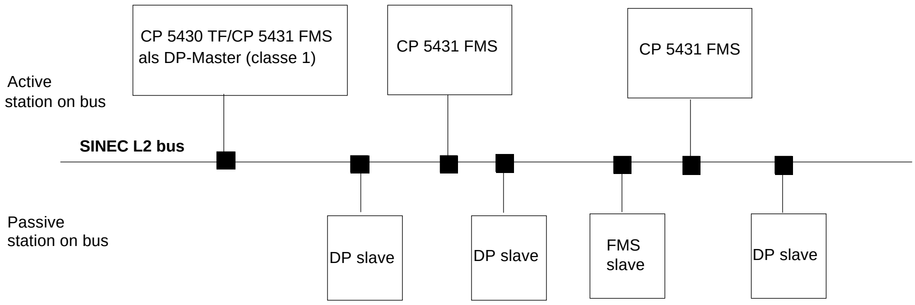


Fig. 11.3 Bus Configuration with SINEC L2-DP in a Multi-Master Application

11.1.1 The SINEC L2-DP Interface for the CP 5430 TF/CP 5431FMS

Characteristics of the SINEC L2-DP interface of the CP 5430 TF/ 5431 FMS:

➢ The CP can only be operated as DP master, class 1 on the SINEC L2 bus.

➢ The L2-DP interface of the CP functions in accordance with the PROFIBUS standard DIN E19254, Part 3.

The L2-DP interface can be operated parallel to the FMS interface (CP 5431 FMS) or to the TF interface (CP 5430 TF) (combined applications).

11.2 CP 5430 TF/CP 5431 FMS L2-DP Functions

The following SINEC L2-DP functions are implemented on the CP 5430 TF/CP 5431 FMS:

- ➢ Assignment of parameters to the DP slave (Set_Prm_Request)
  Using this function, the connected DP slave is assigned parameters during the start up or restart phase of the DP system.

- ➢ Reading out configuration data of a DP slave (Get_Cfg_Request)
  This function allows configuration data to be read from a DP slave.

- ➢ Configuration of a DP slave (Chk_Cfg_Request)
  Using this function, the configuration data are transferred to the DP slave .

- ➢ Productive data exchange (Data_Exchange_Request)
  This function handles the cyclic I/O data exchange between the DP master (class 1) and the DP slaves assigned to it.

- ➢ Send control command to the DP slave (Global_Control_Request)
  This allows specific control commands to be sent to the DP slaves.

- ➢ Read DP slave information (Slave_Diag_Request)
  This function allows the diagnostic data of a DP slave to be read out.

- ➢ Read master diagnostic data information (Get_master_Diag_Response)
  Using this function the diagnostic data stored on the CP (DP master, class 1) belonging to the DP slaves assigned to it can be read by a DP master (class 2).

With the exception of the functions that the user can execute using HDB calls

– read DP slave diagnostic information and

– send control command to DP slave,

all the functions listed above run automatically on the CP when the L2-DP service is activated.

Type of service: DP slave service	Type of service: DP master service	CP 5430 TF/CP 5431 FMS as: Requester	CP 5430 TF/CP 5431 FMS as: Responder	Layer 2 service used	SSAP used	DSAP used
Data_Exchange		X		SRD	Default SAP *	Default SAP *
Slave_Diag		X		SRD	62	60
Set_Prm		X		SRD	62	61
Chk_Cfg		X		SRD	62	62
Global_Control		X		SDN	62	58
	Get_Cfg	X		SRD	62	59
	Get_Master_Diag		X	SRD	54	54

* As default SAP, SAP 61 must be configured in the COM Network Parameters screen (see Section 6.5.3).

Table 11.1 DP Functions Supported by the CP and Their SAP Assignment

11.3 Communication Between the DP Master and the DP Slave Station

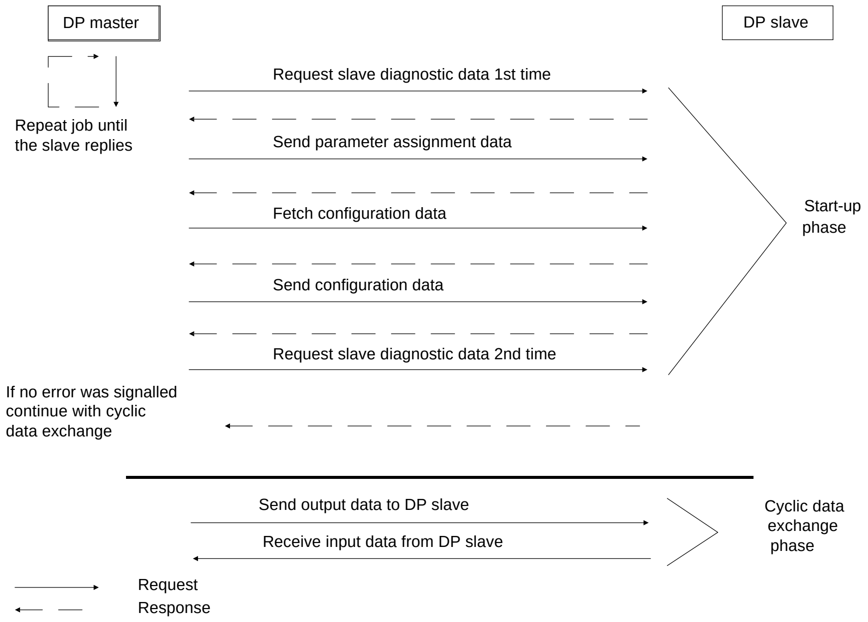


Fig. 11.4 Communication between DP Master CP 5430 TF/CP 5431 FMS and DP Slave

During the start-up phase, the CP checks whether the DP slave station is operational by fetching diagnostic data.
This job is repeated (controlled cyclically using the DP polling list) until the slave responds with the requested diagnostic data. If the received diagnostic data do not indicate any further errors, the DP slave is then assigned parameters and configured.
If no error is signaled after the second request for diagnostic data, the CP changes to the mode "cyclic data exchange" with the DP slave.

11.4 Basics of Data Transmission Using the DP Service of the CP

This section describes the functions of the DP service from the point of view of the CPU control program.

With data transmission using L2-DP, the data exchange is handled via the I/O area of the SIMATIC PLC.

This means the following:

➢ The transmitted data are transferred to the CP by the control program with STEP-5 commands directly or using the operating system function PIQ (Output process image of the outputs).

➢ The received data are fetched from the CP by the control program with STEP-5 commands directly or using the operating system function PII (Update process image of the inputs).

All the I/O bytes you want to use for sending and for receiving must be identified as DP I/Os when the I/O areas are configured in the COM.

Communication with distributed I/Os is only permitted using the base interface number (base SSNR) .

☞ **Simultaneous use of DP and GP is not possible**

11.5 Updating the Input and Output Areas with the DP Service

Depending on the selected mode, the CP distinguishes between two times when the DP output bytes for transmission can be accepted:

- ➢ FREE mode: decided by the CP (the STEP 5 control program has no influence)
- ➢ CYCLE-SYNCHRONIZED mode: decided by the control program using a send handling block call with job number 210.

Depending on the selected mode, the CP distinguishes between two times when the DP input bytes **received** can be transferred:

- ➢ FREE mode: decided by the CP (not influenced by the STEP 5 control program)
- ➢ CYCLE-SYNCHRONIZED mode: decided by the control program using a RECEIVE handling block call with job number 211.

11.5.1 Consistency of the Input and Output Bytes with the DP Service of the CP

The consistency of the DP I/O bytes depends on the selected mode.

- ➢ FREE mode: guaranteed consistency of only one byte for the I/O DP area.
- ➢ CYCLE-SYNCHRONIZED mode: The data of the whole I/O DP area is consistent. Whenever you want to work with consistent I/O areas, for example, when using the analog I/Os in the ET200U, you must select the CYCLE-SYNCHRONIZED mode.

11.5.2 How the FREE Mode Functions

The following diagram illustrates how the FREE mode functions for output bytes.

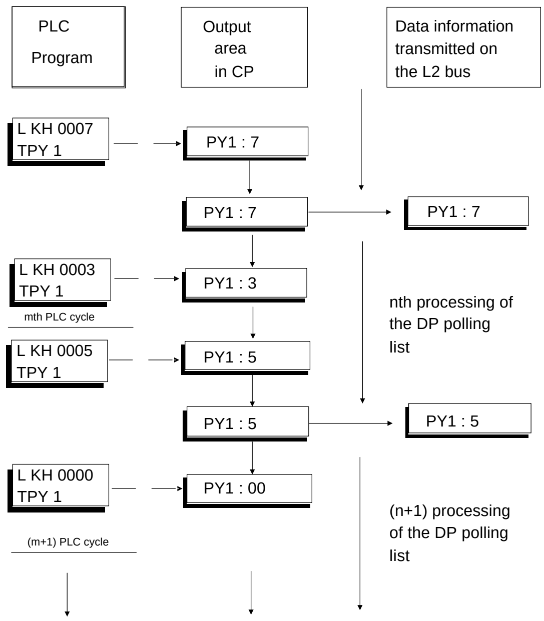


Fig. 11.5 CP 5430 TF/CP 5431 FMS Sends to L2-DP Slave

Explanation of Fig. 11.5:

The output byte information to be transmitted is transferred to the output area of the CP by the user program.
This takes place, either at the end of the PLC cycle using the "PIQ output or by direct I/O access.

In the FREE mode, the DP polling list processing cycle alone decides when the data in the output area of the CP are accepted for transmission on the L2 bus.

The following diagram illustrates how the FREE mode functions for input bytes.

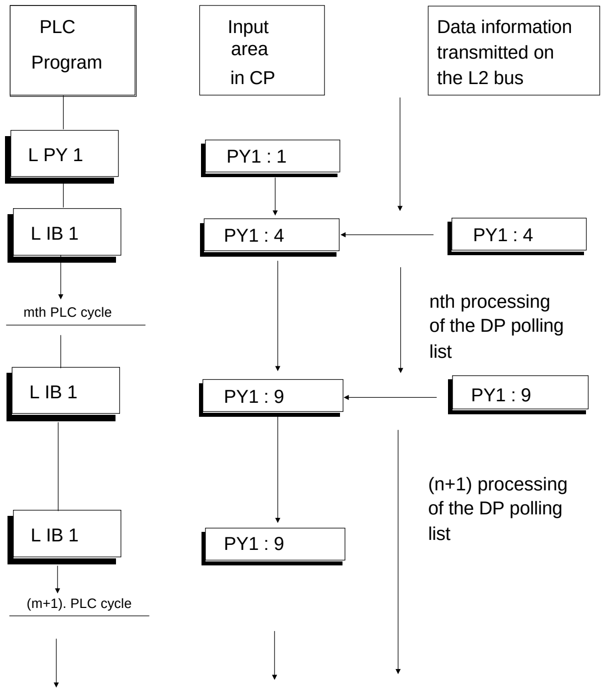


Fig. 11.6 CP 5430 TF/CP 5431 FMS Receives from L2-DP Slave

Explanation of Fig.11.6:

The input byte information received from the L2 bus when processing the DP polling list, is transferred to the input area of the CP after each DP data exchange is completed.
Following the "update PII" function at the beginning of each CPU program cycle or using direct access (for example, LPY) to the input bytes, the received data can be processed further in the user program.

In the FREE mode, the DP polling list processing cycle of the CP alone decides when the data received from the L2 bus are transferred to the input area of the CP.

☞ **If DP bytes need to be transferred together (e.g. analog values/counted values with word or double word length), the FREE update mode must under no circumstances be selected. With this mode, there is no guarantee that the DP bytes which belong together are actually transferred in one frame.**

Essential features of the FREE mode:

➢ Minimum cycle load (corresponds to the cycle load that would occur simply by plugging in the corresponding input/output modules..

➢ Minimum load on the CP, since no HDB calls are required for communication.

➢ Simple programming of data exchange (single handling block call; HDB SYNCHRON for the CP during start-up of the PLC).

11.5.3 How the CYCLE-SYNCHRONIZED Mode Functions

The following diagram illustrates how the CYCLE-SYNCHRONIZED mode functions for output bytes.

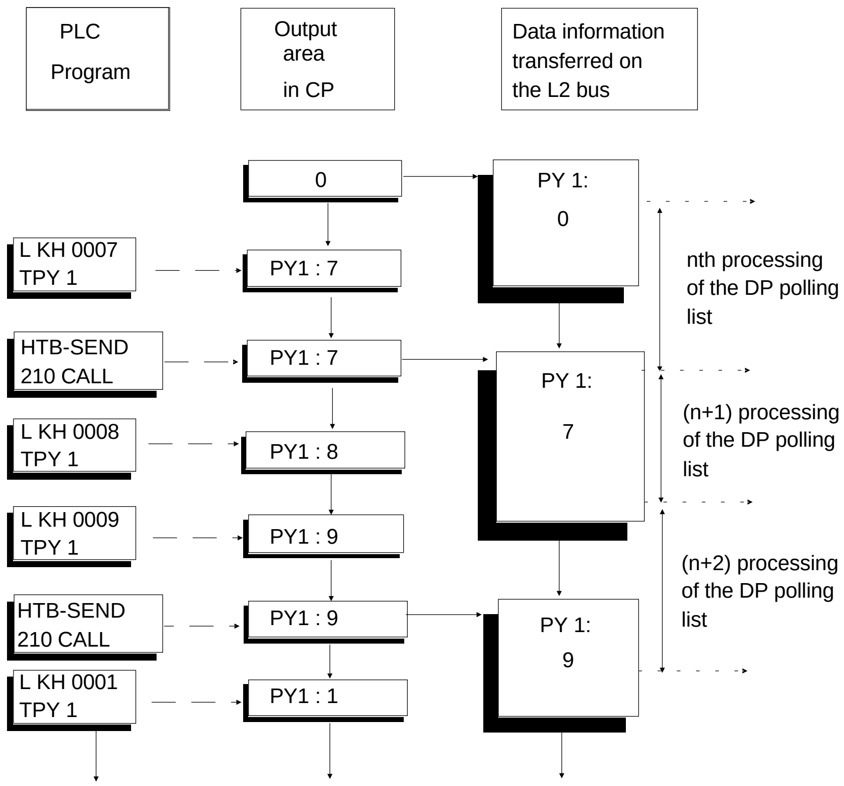


Fig. 11.7 CYCLE-SYNCHRONIZED Mode: Master Sends to Slave

Explanation of Fig. 11.7:

The output byte information to be transmitted is transferred to the output area of the CP by the user program.
This transfer is made at the end of the PLC cycle using the "output PIQ" function, or as shown in the diagram, by direct I/O access.

In the CYCLE-SYNCHRONIZED mode, all the data located in the output area of the CP are accepted and buffered when the HDB send 210 is called. At the beginning of the next DP polling list cycle, this data is transmitted to the connected DP slaves.

The following diagram illustrates how the CYCLE-SYNCHRONIZED mode functions for input bytes.

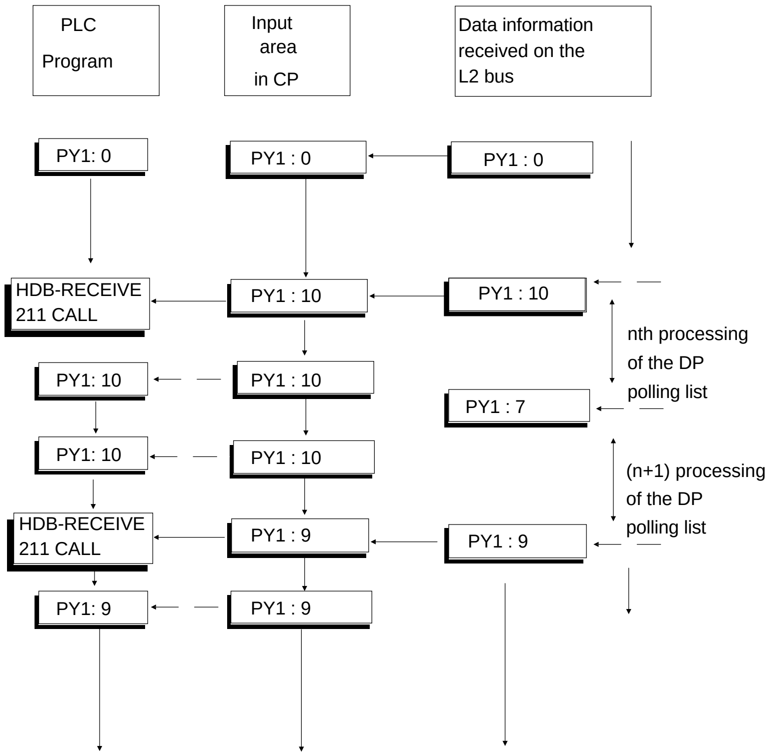


Fig. 11.8 CYCLE-SYNCHRONIZED Mode: Master Receives from Slave

Explanation of Fig. 11.8:

The input byte information received from the L2 bus when processing the DP polling list is buffered by the CP after it completes the DP polling list cycle and transferred completely to the input area of the CP with the next HDB RECEIVE 211 call. After the "update PII" function at the beginning of every program cycle of the CPU or by means of direct access (for example, LPY) to the input bytes, the received data can be further processed in the user program.

In the CYCLE-SYNCHRONIZED mode, you as user decide when the DP input and output data is accepted or transferred by the CP by calling the HDB checkpoints SEND 210/RECEIVE 211.

As can be seen in Figs. 11.9 and 11.10, in the CYCLE-SYNCHRONIZED mode for DP, the processing of the DP polling list and the calls for the HDB checkpoints (PLC cycle) are independent of each other.

☞ **The processing of the DP polling list in the CYCLE-SYNCHRONIZED mode is only started after the first call of one of the HDB checkpoints (SEND 210/RECEIVE 211).**

Relationship between the HDB SEND 210 call and DP polling list cycle

The information transferred to the output area of the CP with the HDB SEND 210 call, is only transferred to the bus as allowed by the processing of the DP polling list.

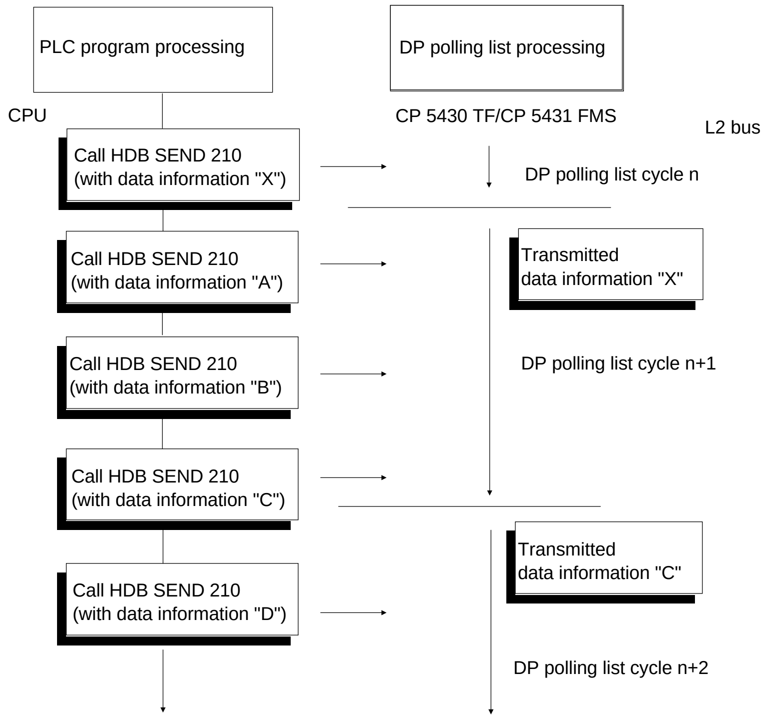


Fig. 11.9 Relationship Between HDB SEND 210 Call and DP Polling List Cycle

Relationship between the HDB RECEIVE 211 call and the DP polling list cycle

The data information received during the processing of the DP polling list is only transferred to the input area of the CP at the end of the polling cycle.

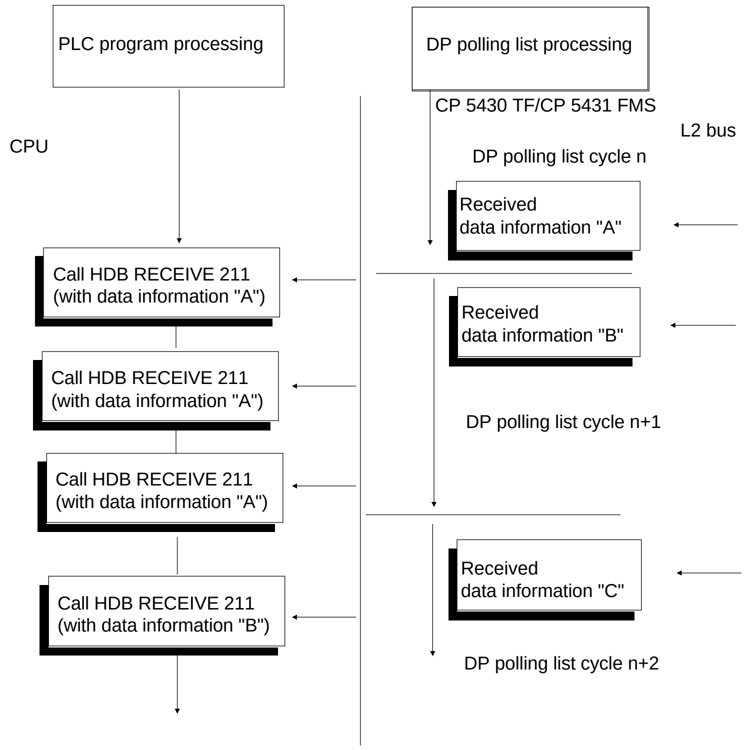


Fig. 11.10 Relationship Between HDB RECEIVE 211 Call and DP Polling List Cycle

The DP update times are in no way connected to the communications taking place on the L2 bus.
The data exchange with the L2-DP service between the CP and the L2-DP slaves is constant (cyclic according to the DP polling list entry) regardless of the call cycle of the handling blocks SEND 210 and RECEIVE 211. To start the DP polling list processing in the CYCLE-SYNCHRONIZED mode, at least one HDB checkpoint (SEND 210/RECEIVE 211) must be called.

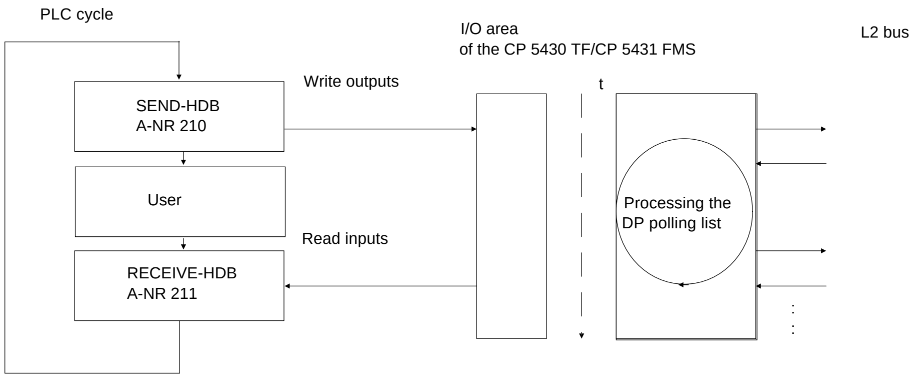


Fig. 11.11 Function of the CYCLE-SYNCHRONIZED Mode

Using the status word bits 8 - 11 of the HDB checkpoint, diagnostic information can be analyzed.

11.6 Configuring

The PG package SINEC NCM with COM 5430 TF/COM 5431 FMS is used to configure the DP functions.

The screens you require for configuring are provided by SINEC NCM as shown in Fig. 10.12.

➢ Assignment/reservation of the I/O areas required for the DP service

➢ Assignment of parameters to the DP slaves to be addressed

➢ Entry of the DP polling list in the DP editor

➢ Documentation and Test

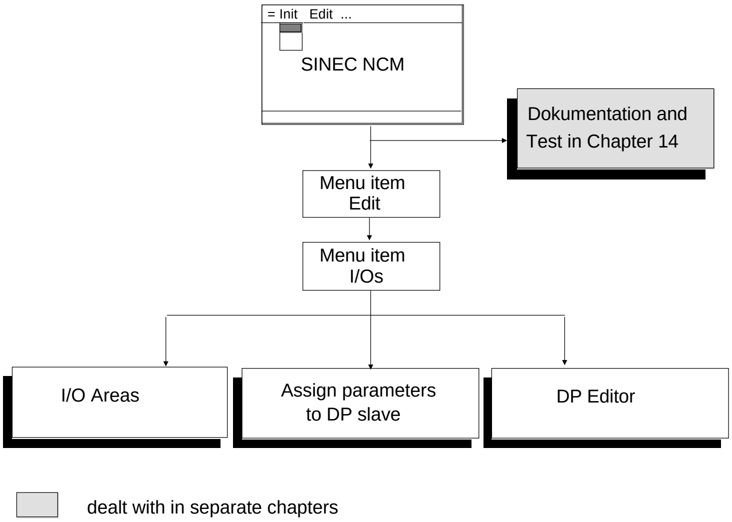


Fig. 11.12 DP Configuration

☞ **When you transfer a database CP->FD, the DP slaves configured in the database are not entered in the network table. The DP slaves can be entered by entering the lines individually in the DP editor (Section 11.6.3).**

11.6.1 I/O Areas

The I/O areas used with the DP service are selected in the I/O area editor screen.

☞ **Simultaneous use of GP/ZP and DP is not possible**
Simultaneous use of GP/CI and DP is not possible.

The I/O area editor is different for the CP 5430 TF and CP 5431 FMS.

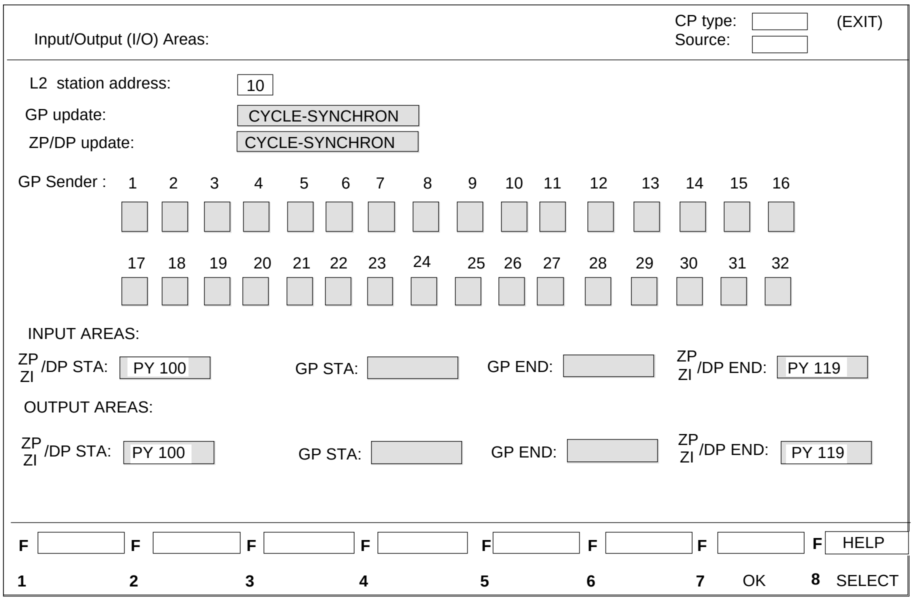


Fig. 11.13 Input/Output Areas Screen

In the DP Update (CP 5431 FMS) or ZP/DP Update (CP 5430 TF), you select when the I/O between the CPU and CP are updated.

Cycle-synchronized: Updating at the call points of the HDBs SEND 210 and RECEIVE 211 (cycle checkpoint). The DP polling list processing is only started after the first HDB checkpoint has been called (SEND 210/RECEIVE 211).

Free:	The point at which the I/O areas are updated is decided by the CP.

Input areas:

(CP 5431 FMS) CI/DP STA: (CP 5430 TF) ZP/DP STA:	Beginning of the (continuous) input area for the distributed I/Os. Range of values: PY0-254, OY0-254. Only even addresses allowed.
(CP 5431 FMS) CI/DP END: (CP 5430 TF) ZP/DP END:	End of the (continuous) input area for the distributed I/Os. Range of values: PY1-255, OY1-255. Only odd addresses allowed..

Output areas:

(CP 5431 FMS) CI/DP STA: (CP 5430 TF) ZP/DP STA:	Beginning of the (continuous) output area for the distributed I/Os. Range of values: PY0-254, OY0-254. Only even addresses allowed.
(CP 5431 FMS) CI/DP END: (CP 5430 TF) ZP/DP END:	End of the (continuous) output area for the distributed I/Os. Range of values: PY1-255, OY1-255. Only odd addresses allowed.

Output fields:

L2 station address:	The bus address of the station of the currently selected database is displayed here.

Function keys:

F7 OK	The "OK" key enters the data. If the module file does not yet exist, it is set up when you confirm the entries.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

☞ **The input or output area must always begin with an even byte number and must always end with an odd byte number.**

Note:

The fields remain empty if no input or output areas are required for the distributed I/Os.

The input area/output area for DP must not exceed a maximum of 256 bytes.

☞ **The I/O area reserved for the DP must not be used for I/O modules! Online modification of the DP area is only recognized by the CP after POWER OFF/POWER ON!**

11.6.2 Assigning Parameters to DP Slaves

For each DP slave to be addressed with the DP service, parameters must be assigned using the screen "Edit->I/Os->DP Slave Parameters". This information such as "Slave L2 address" and "Slave Vendor Identification", is required later separately for each DP slave during data exchange. 32 DP slaves can be assigned.

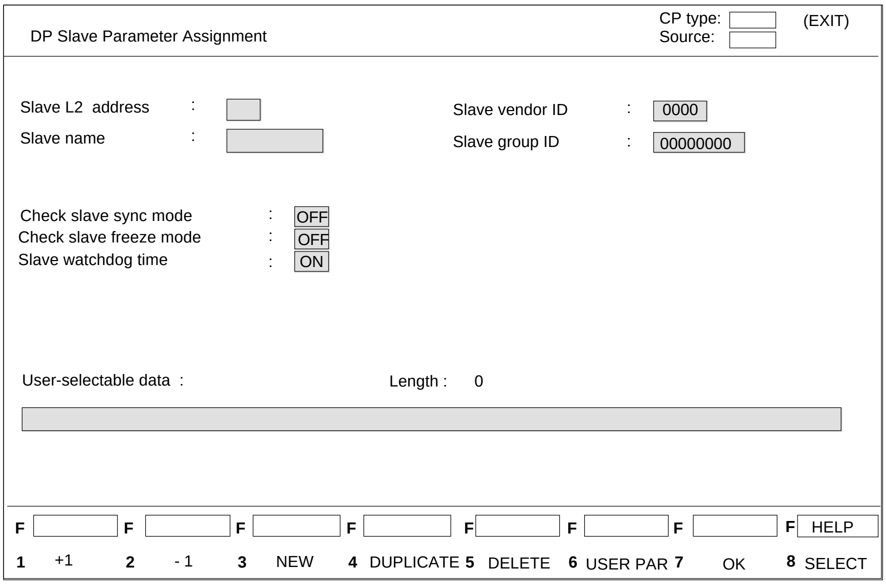


Fig. 11.14 DP Slave Parameter Assignment Screen

DP slave parameter assignment can only be called when no CI (CP 5431 FMS) or ZP (CP 5430 TF) has been configured and an I/O area has been reserved for DP.

Once you have entered more than 25 bytes of user assigned data, the symbol ">" appears at the end of the field. To enter more than 25 bytes, you must change to the next screen User-Specific Parameters by selecting F6 USER PAR.

The second slave parameter screen (Fig. 11.14) selected with F6 USER PAR.

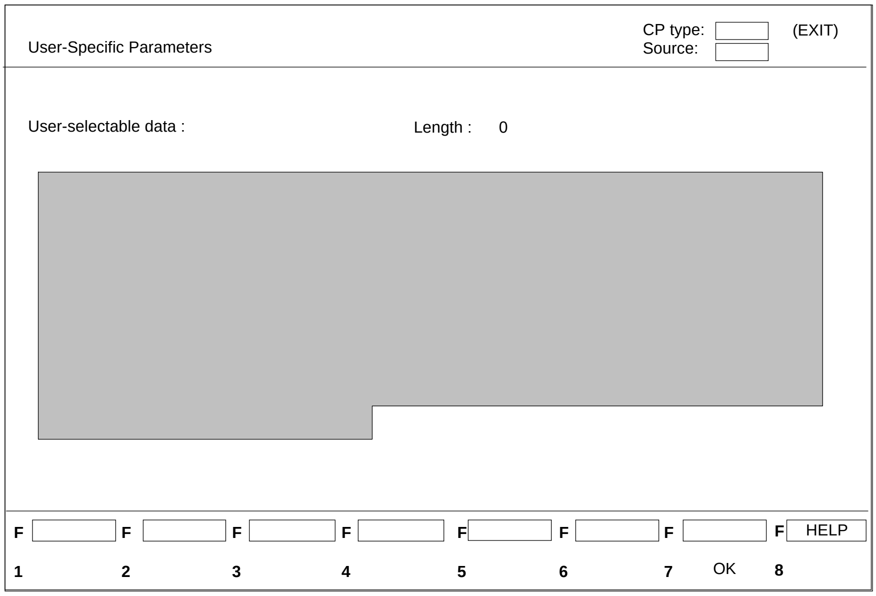


Fig. 11.15 DP Slave Parameter Assignment Screen II

Input fields:

Slave L2 address: Here, you enter the L2 bus address of the DP slave (Range of values: 1-124).

Slave vendor ID: Here, the four-digit vendor identification listed in the device documentation of the slave must be entered for the DP slave.

Slave group ID: The group identifier specified here is only relevant when jobs will be processed using the global control function with Sync/Unsync or Freeze/Unfreeze.

The group identifier makes it possible to distinguish the following 8 groups.

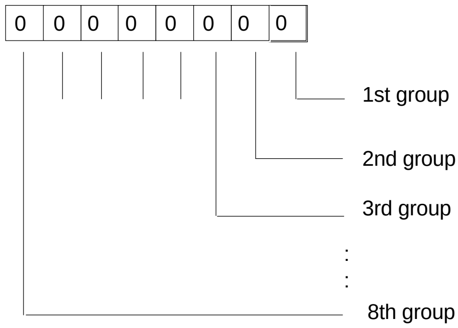


Fig. 11.16 Group Identifier Structure

If no group identifier was specified at the HDB call for the global control job (all bits set to "0"), the global control job is sent and executed by all DP slaves capable of the Sync and/or freeze mode.

If the group identifier is not zero, the conditions for execution are as follows:

- Sync and/or freeze mode must be supported by the DP slave.
- At least one group of the global control job and of the group identifier must match.

Slave name: Here, it is possible to assign up to 10 ASCII characters long to the slave for documentation purposes.

Check slave sync mode/ Check slave freeze mode: If you select the ON mode here, the CP checks whether or not the slave supports the Sync. or Freeze jobs using the parameter assignment frame during start up.

Slave watchdog time:	With this parameter, you decide whether or not the slave operates on the L2-DP bus with watchdog monitoring ON or watchdog monitoring OFF. The monitoring time itself is set only once in the DP editor screen and applies to all connected DP slaves. The watchdog monitoring on the DP slave is used to monitor the DP master. Each time a frame is received from the DP master, the watchdog monitoring is restarted in the DP slave. If the master fails, this is recognized by the DP slave after the monitoring time elapses and the slave changes to a safe state (for example, all outputs are reset).
User-selectable data:	In this field (which can also be selected in the next screen with F6 USER PAR) you can specify the user-specific data contained in the device documentation provided this is permitted for the DP slave. From 0 to 235 bytes (0: none) of user assignable data can be specified.

Output fields:

Length:	Here, the length of the user-specific data entered is displayed in bytes.

Function keys:

F6 USER PAR	Change to the next screen to enter the user-specific parameters.
F7 OK	The OK function key enters the data.

F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key.

Once a slave has had parameters assigned with F7 OK, the following function keys are available in the screen:

F1 +1	Page forwards in the DP slave parameters (only if more than one DP slave has had parameters assigned).
F2 -1	Page backwards in the DP slave parameters (only if more than one DP slave has had parameters assigned).
F3 NEW	Assign parameters to new DP slave . All the input fields in the screen are deleted or display default values.
F4 DUPLICATE	Duplicate DP slave parameter assignment for new DP slave. With the exception of the slave L2 address, slave name and input/output areas (in the DP editor Section 11.6.3), all the values entered for the open DP slave are adopted .
F5 DELETE	All the parameters of the selected DP slave are deleted.

11.6.3 DP Editor

Once you have reserved the input/output areas for distributed I/Os and have entered the parameter data for the slaves to be addressed, you must now assign part of the required I/O area of the CP to each DP slave using the DP editor.

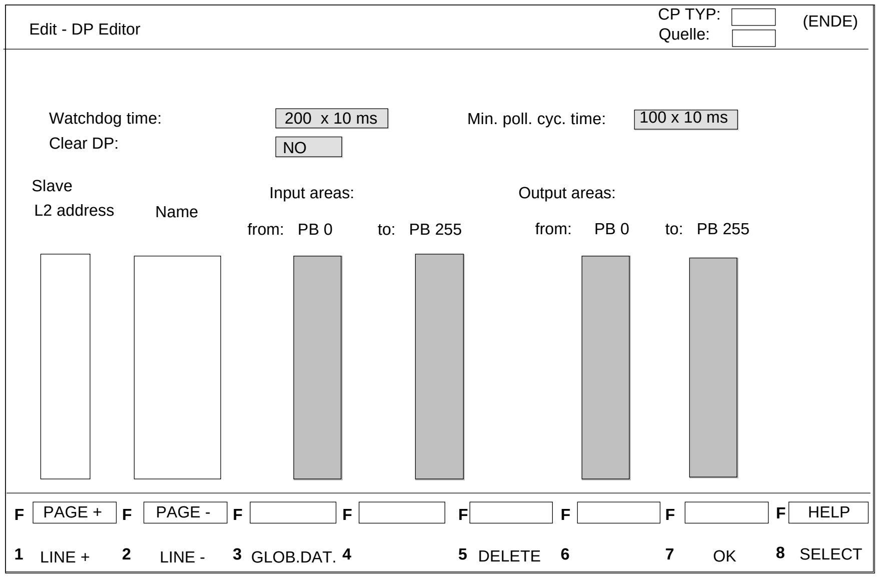


Fig. 11.17 DP Editor Screen

The DP editor can only be called when at least one DP slave has been configured.

The fields, Watchdog time, Min. polling cycle time and Clear DP can only be modified after selecting function key F3 GLOB.DAT. With F3 LIST, you exit this modification mode.

Input fields:

Input areas: Here, you assign the input bytes of the configured DP slaves to the reserved input area of the CP.
The permitted range of values is from one byte (from PYxxx to PYxxx, xxx = same address) to the I/O byte limit specified in the I/O area editor for the I area (up to a maximum of 242 bytes). If the DP slave does not have an I area, these fields remain empty. Multiple assignment for different DP slave stations is not possible.

Output areas: Here, the output areas of the configured DP slaves are assigned to the Q area of the CP.
The permitted range of values is from one byte (from PYxxx to PYxxx, xxx = same address) to the I/O byte limit specified in the I/O area editor for the Q area (up to a maximum of 242 bytes). If the DP slave does not have a Q area, these fields remain empty. Multiple assignment for different DP slave stations is not possible.

Watchdog time: The time specified here is the timeout value for all DP slaves with activated watchdog monitoring ("DP slave parameter assignment" screen).

The watchdog monitoring time, transferred to the DP slave during the start-up phase in the parameter assignment frame is used to monitor the DP master. Each time a frame is received from the DP master, the watchdog monitoring is restarted in the DP slave.
If the master fails, this is recognized by the DP slave after the monitoring time elapses and the slave changes to a safe state (for example, all outputs are reset).
The time set here, is directly related to the token rotation and the processing time of the DP polling list.

Min. polling cycle time:

Here you select the time intervals at which the DP polling list is processed.
Once all the jobs in the DP polling list have been executed, the processing of the DP polling list is only restarted after this cycle time has elapsed.

Setting the times:

For the configured times:
- Minimum polling cycle time
- Highest min. slave interval
- Watchdog time

of the slaves, the following four conditions must be met:
(1) Min polling cycle time >= 2 x highest min.. slave interval
(2) 10 ms <= min. Polling cycle time <= (watchdog-time - 30 ms)
(3) Watchdog time <= 9900 ms
(4) Watchdog time must be divisible by 100.

The configured min. polling cycle time is also checked by the CP to make sure that the CP can operate correctly with the time.

The minimum value depends directly on the number of active slaves and corresponds to the lowest min. polling cycle time. If you select a value below this when configuring, the error LED flashes to indicate a DP slave parameter assignment error (see Section 4.1.1.2).

Note:
- All three times apply to all slaves!
- The I/O list for the configured slaves can be re-called with (F3) LIST.

Highest min. slave interval	The time specified here is the highest value of the minimum slave interval of all DP slaves to be processed using the DP polling list.
	The min. slave interval of a DP slave is the time the slave requires to process the last polling frame received. Following this, the slave is ready to receive the next polling frame. The value of the min. slave interval can be found in the documentation for the particular slave.
Clear DP:	**Yes:** The output data of the CPU are only transferred when all the DP slaves are in the cyclic data transfer phase. Otherwise, all the output data are sent as "0". **No:** The output data of the CPU are transferred as soon as the slave is in the cyclic data transfer phase.

Output fields:

L2 address and name:	Here, all the configured L2-DP slaves are listed with their bus address and name.

Function keys:

F1 LINE +	Move display one line forwards.
SHIFT F1 PAGE +	Move display one page forwards.
F2 LINE -	Move display one line backwards.
SHIFT F2 PAGE -	Move display one page backwards.

F3 GLOB.DAT.	Change to the fields watchdog monitoring time, min. Polling cycle time and clear DP.
F5 DELETE	Delete the input and output areas of a L2-DP slave.
F7 OK	With the OK function key, you enter the data. If the module file does not yet exist it is created after you press this key.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select values from the list with the cursor keys and enter them in the field with the return key

This function key appears only after you press the function key F3 GLOB.DAT.:

F3 LIST	Change to the I/O area entries for the DP slaves.

Assignment of the DP I/O areas to the I/O modules in the slave

The following rules apply:

➢ The selected I (input) area is assigned to the input modules beginning at the left without gaps.

➢ The selected Q (output) area is assigned to the output modules beginning at the left without gaps.

ET200U-DP example of a configuration

The following I/O assignments were made with the help of the COM for the ET200U-DP station 10 described below:

I/O area editor:
DP-mode: cycle-synchronized
Input area DP STA: PY100 Input area DP-END: PY107
Output area DP STA: PY80 Output area DP-END: PY85

DP-Editor:
Station 10, Input area: PY100 to 107/Output area PY80 to PY85

ET200U-DP Station 10	PS	IM 318B	DQ 440	DQ 441	DI 422	AQ 470	DI 430	DI 421	AI 464 1)	empty
Occupied address area (bytes)			1	1	2	4	1	1	4	
I peripheral byte address assignment					PY100 PY101		PY102	PY103	PY104 PY105 2) PY106 PY107 2)	
Q peripheral byte address assignment			PY80	PY81		PY82 PY83 2) PY84 PY85 2)				

1) Number of channels used can be selected
In this case 2.

2) The bytes be handled in the user program
as being word size (e.g. PY82 and PY83 = PW82).
This is only guaranteed in the "cycle-synchronized" mode

Table 11.2 ET200U-DP Example of a Configuration

11.6.4 Example of using the DP service

The following example describes the use of the cycle-synchronized DP.

Task:

Three ET200U-DP station are to be connected to a programmable controller (S5 115U) as distributed I/Os using the DP service.

The ET200U-DP stations have the following data:

Vendor identification:	8008H
Sync mode:	OFF
Freeze mode:	OFF
Watchdog:	ON

1. L2 station

L2 bus address:	20
I inputs:	3xDI each with 8 bits
Q outputs:	2xDQ each with 8 bits

2. L2 station

L2 bus address:	21
I inputs :	2xDI each with 8 bits
Q outputs:	1xDQ each with 8 bits

3. L2 station

L2 bus address:	22
I inputs:	1xDI each with 8 bits
Q outputs:	1xDQ each with 8 bits

The distributed I/O bytes will be assigned to the input addresses from PY100 and the output byte addresses from PY108 .

L2 bus address	I/O bytes of the ET200U-DP station	CP 5431
20	3 x DI 2 x DQ	PY100-102 PY108-109
21	2 x DI 1 x DQ	PY103-104 PY110
22	1 x DI 1 x DQ	PY105 PY111

Table 11.3 L2 I/O Assignment

This means a DP input area from PY100 - PY105 and a DP output area from PY108 - PY111 must be reserved in the I/O area editor!

Configuring with COM 5430 TF/COM 5431 FMS

To assign parameters to the CP 5430 TF/CP 5431 FMS for the DP service, several steps are required:

- ➢ First, the basic configuration of the CP must be specified. This is described in detail in Chapter 6.
- ➢ After the basic configuration, the input/output area for the I/Os used must be specified.
- ➢ Using "DP slave parameter assignment", you specify the parameters for each DP slave to be addressed.
- ➢ Finally, in the "DP editor" screen, the I/Os intended for data exchange must be assigned to the individual DP slaves.

To be able to use the practical example of the DP service, proceed as follows (see also Chapter 16).

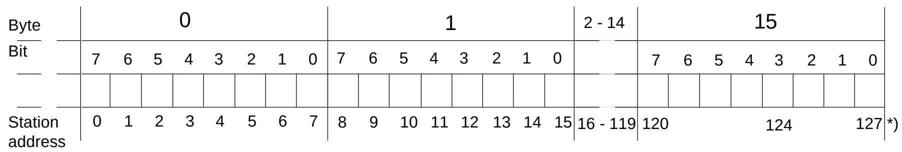
- ➢ Transfer the following COM 5430 TF/COM 5431 FMS database file to the CP you are using.
  - – When using the CP 5430 TF under the network file DPO@@NCM.NET the file ODPTLN1.115.
  - – When using the CP 5431 FMS under the network file DPQ@@NCM.NET, the file QDPTLN1.115.
- ➢ Transfer the STEP 5 file DP115UST.S5D to the PLC you are using (S5-115U). The example files are on the COM application file diskette.

11.7 L2-DP Diagnostics with the User Program

11.7.1 Overview

To allow you to monitor the data exchange with the configured DP slaves from the user program, the CPs provide the following functions:

➢ Read out DP station list
The DP station list provides information about the status of all slaves and has a length of 16 bytes (128 bits). Each bit of the station list corresponds to one of the possible bus addresses of a DP slave station.



*) The first and last two bits in the station list are not relevant, since the permitted station address on the L2 bus must be in the range 1-125

Fig. 11.18 Structure of the DP Station List

Meaning of the bits

Bit code	Meaning
0	Station is in the cyclic data transfer phase or the station address is not assigned.
1	Station is not in the cyclic data transfer phase

All the bits of the DP slave stations, for which there was no configuration in the DP editor, (-> no input/output areas configured), are identified with "0". These DP slave stations are known as passive DP stations and are ignored in the station list.

This also applies to DP stations with which cyclic data exchange is running free of error.

For all DP slave stations not in the cyclic data transfer phase, the DP station bit is set to "1"
This is the case when the DP slave station does not acknowledge on the bus or is not yet completely initialized.

When a DP station is first initialized, the DP station bit is kept at "0" during the initialization.

➢ Read out DP diagnostic list
The DP diagnostic list indicates whether there are any new diagnostic data from the DP slaves and has a length of 16 bytes (128 bits).
Each bit of the DP diagnostic list corresponds to one of the possible bus addresses of the DP slave stations.

Byte	0								1								2 - 14	15							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0
Station address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 119	120				124			127 *)

*) The first and last two bits in the station list are not relevant, since the permitted station address on the L2 bus must be in the range 1-125

Fig. 11.19 Structure of the DP Diagnostic List

Meaning of the bits

Bit coding	Meaning
0	Station does not exist or there are no new diagnostic data .
1	There are new diagnostic data .

All the bits of the DP slave stations for which there are no new diagnostic data or which are not configured and all the passive stations are identified by "0" in the diagnostic list.

If there are new diagnostic data from a DP station, the DP station diagnostic bit is set to "1".

When the DP station is first initialized, the DP diagnostic bit is set to zero.

The new diagnostic data reported by the slave can be requested from the slave using the function "single diagnostics".

➢ Read out DP slave single diagnostics
With this function, further diagnostic data about the specific slave can be requested.
The information provided consists of the following:

The general DP slave diagnostic data:

- Station status 1 - 3
- Master address (address of the DP-master (class 1), which assigned parameters to the DP slave).
- Vendor ID of the DP slave.

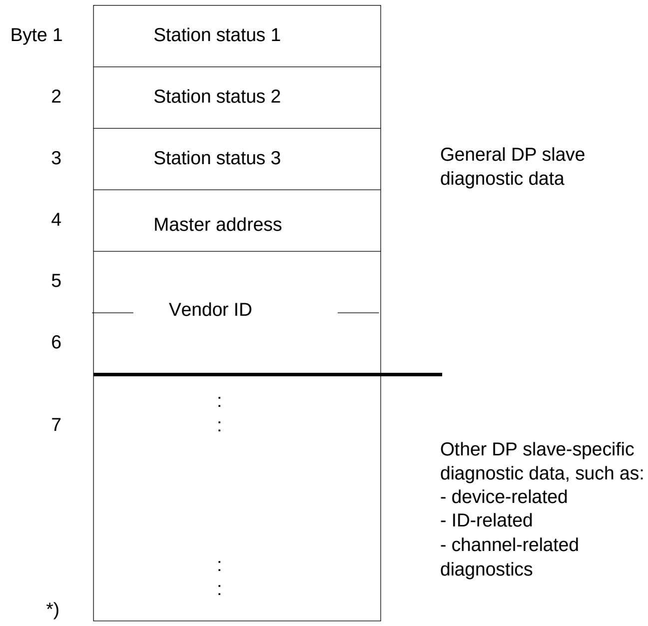
The extended DP slave diagnostic data:

– Device-related diagnostics
  (Vendor and device-specific diagnostic data)

– ID-related diagnostics
  (Configuration-dependent listing of the I/O channels).
  All I/O channels for which diagnostics are available are marked.

– Channel-related diagnostics
  (reason for diagnosed channels).

Structure of the diagnostic data according to the DP standard



*) can be extended to max. 242 bytes

Fig. 11.20 Structure of the Single DP Slave Diagnostic Data

11.7.2 Examples of Practical Applications

11.7.2.1 Reading out the DP station list

Whenever the cyclic data exchange is disturbed with at least one DP slave station, the DP station list can be read out with the HDB call RECEIVE A-NR: 202.

If there is no fault/error, i.e. all DP slave stations are in the cyclic data transfer phase, the HDB RECEIVE 202 call is blocked with the ANZW bit "Receive possible".

DP Group messages with HDB Receive 202 ANZW

The DP ANZW bits 8-11 of the HDB Receive job 202 create the following DP group message:

Bit 11 10 9 8 of ANZW/A-NR: 202

Bit 8:

0 = no error, all the configured DP slaves are in the data transfer phase

1= at least one DP slave is not in the data transfer phase

Cause of error, what to do:
To find out which slave(s) is affected, you must read out the DP station list using HDB-RECEIVE A-NR: 202.

Possible causes of a group message are;

- DP slave, does not reply on the bus (not connected, switched off)

Bit 9:

0 = there are no new diagnostic data for DP slave

1= there are diagnostic data for a DP slave

Cause of error, what to do:
To find out which slave(s) is affected, you must use the special service "DP station diagnostic list" HTB-A-NR: 209, to read out the diagnostic list

Using the special service "Read single DP slave diagnostic data", HTB-A-NR: 209, it is possible to obtain an accurate error analysis for every slave.

Bit 10:

0 = cyclic global control job not sent

1= cyclic global control job sent

Bit 11:

0 = no timeout occurred during processing of the DP polling list

1= a timeout occurred during processing of the DP polling list

The selected monitoring time for processing the polling list was exceeded.

Possible causes of this error message:
- problems on the bus
- delayed DP polling list processing due to parallel processing of other acyclic services on the CP.

Fig. 11.21 DP Group Messages Using the HDB Receive 202 ANZW

To update the group messages bits 8 - 11 in the ANZW of the HDB job 202, it is sufficient to call HDB-CONTROL A-NR: 202.

Programming example of reading out the DP station list and updating DP group messages

FB202 "STAT-LIS" makes all DP group messages available by means of bit formal operands.
If a slave leaves the cyclic data transfer phase, the DP station list is read and saved in data block DB202 from DW0 onwards.

Description of the FB202 "STAT-LIS" formal operands:

STAF	:	DP station failed
DIAG	:	New DP diagnostic data exist
ZYGC	:	Cyclic global control job active
TOUT	:	Timeout processing the DP polling list

Function block FB202 with the corresponding data block DB202 for use in a CPU of the S5-115U series is in the STEP 5 file STATIOST.S5D on the COM/application example diskette.

11.7.3 Reading Out the DP Diagnostic List

The message that a slave has new diagnostic data causes the corresponding bit in the DP diagnostic list to be set to "1". As soon new diagnostic data exist for at least one connected slave, this is indicated in the group status ANZW HDB/A-NR202 (DP station list) bit 9.

Using the HDB special service, A-NR209, the diagnostic list can be read out. When the diagnostic list is read out by the user program, the currently set diagnostic message bits and the group diagnostic status bits are reset on the CP.

The DP diagnostic list can always be read out regardless of group bit 9 (HDB job 202).

Example of a program for reading out the DP diagnostic list

The following figure shows the sequence of the HDB special service A-NR 209 for reading out the DP diagnostic list.

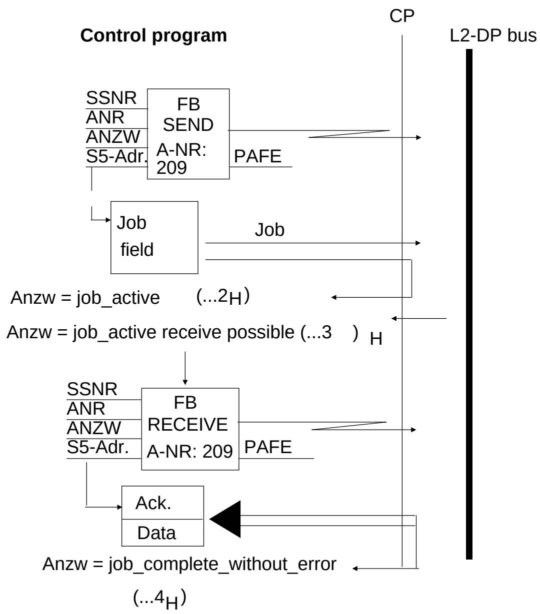


Fig. 11.22 Sequence of HDB Special Service, A-NR: 209 for Read Out DP Diagnostic List

Explanation of Fig. 11.22:

The "DP diagnostic list" special service is triggered with SEND A-NR: 209 and acknowledged with RECEIVE A-NR: 209. The acknowledgment is made with the local CP data.

Structure of the job field "DP diagnostic list"

Byte	Value	Meaning
1st byte	04	Length of the job field in bytes
2nd byte	01	*Job type* Diagnostics request
3rd byte	01	*Diagnostics type* DP station diagnostics list
4th byte		not occupied with this function

Fig. 11.23 Structure of the Job Field "DP Diagnostic List"

Structure of the Acknowledgment field for "DP diagnostic list"

Byte	Field	Meaning
1st byte	Length in bytes	- with negative ack. -> 2 - with positive ack. -> 18
2nd byte	Acknowledgment	00 hex ok 01 hex syntax error in job field 02 hex error in HDB handling 0B hex CP job cannot be executed, since the DP polling list processing is in the STOP mode
3rd byte	Diagnostics list	DP station diagnostics list for stations 1 - 125
: :	: :	
18th byte		

Fig. 11.24 Structure of the Acknowledgment for "DP Diagnostic List"

Example of programming for reading out the DP diagnostic list

FB209 "DIAG-LIS" requests the diagnostic list from the CP with the special service HDB A-NR. 209 and enters it in DB209 from DW4 onwards (incl. acknowledgment).

Function block FB 209 signals that the job has been done by resetting the assigned trigger bit "ANST".

Function block FB 209 with the corresponding data block 209, for use in a CPU of the S5-115U series is in the STEP 5 file DIAG@@ST.S5D on the COM/Application examples diskette.

11.7.4 Request Single DP Station Diagnostic Data

With the special service "single DP station diagnostics", you can request DP slave-specific diagnostic data from a slave connected to the bus.

The diagnostic data of a single DP slave, can be requested from a DP slave at any time regardless of the "New diagnostic data" message in the DP diagnostic list .

En entry in the DP diagnostic list indicating that new diagnostic data exist is deleted when the diagnostic data are read.

11.7.5 Example of a Program for Requesting Single DP Station Diagnostics

The following figure shows the sequence of the HDB special service, A-Nr: 209 single DP station diagnostics.

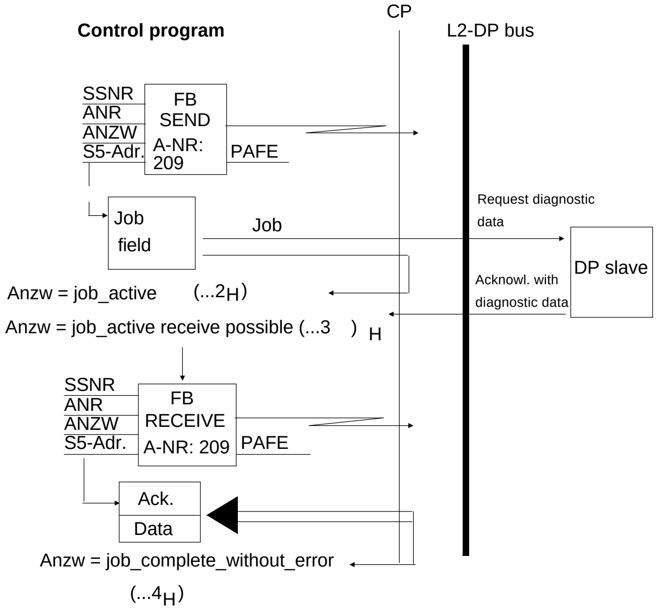


Fig. 11.25 Sequence of HDB Special Service, A-Nr: 209 for Single DP Station Diagnostics

Explanation of Fig. 11.25:

The special service "single DP station diagnostics" is triggered with SEND A-NR: 209 and acknowledged with RECEIVE A-NR: 209.
It is acknowledged with the diagnostic data requested from the DP slave.

Structure of the job field "single DP station diagnostics"

1st byte	04	Length of job field in bytes
2nd byte	01	*Job type* Diagnostics request
3rd byte	02	*Type of diagnostics* Single DP diagnostics
4th byte	03	Station address (e.g. 3)

Fig. 11.26 Structure of the Job Field "Single DP Station Diagnostics"

Structure of the acknowledgment field for "single DP station diagnostics"

1st byte	Length in bytes	- with negative acknowl. -> 2 - with positive acknowl. 8 - 244
2nd byte	Acknowledgment	00 hex ok 01 hex syntax error in job field 02 hex error in HDB handling 03 hex CP not in logical ring 04 hex slave station not configured 05 hex slave nor replying (failed) 0A hex DP slave configuration error detected by master when configuring the DP slave 0B hex DP polling list processing is in the STOP mode
3rd byte	Station status byte 1	Structure of thestation status bytes
4th byte	Station status byte 2	
5th byte	Station status byte 3	
6th byte	Master address	Bus address of the DP master, which assigned parameters to the slave
7th byte 8th byte	Ident_number	Vendor ID, dependent of DP slave type
9th byte	Extended diagnostics	DP slave-specific diagnostic information
34th byte *		

* can be extended up to 244 bytes

Fig. 11.27 Structure of the Acknowledgment Field for "Single DP Station Diagnostics"

Causes of errors in the acknowledgment $0A_H$ "DP slave configuration error detected by DP master when configuring the DP slave" are as follows:

– Configured I/O area for the DP slave does not match the DP slave I/O configuration or

– DP slave works with consistent I/O areas, but the free mode is configured on the CP.

Structure of the station status bytes

Station status byte 1

Bit no.	Meaning	Explanation
7	Master_Lock	The DP slave was assigned parameters by a different DP master. This bit is set by the CP (DP master) when the master address in the byte is not FFH and not the CP bus address.
6	Parameter_Fault	The last parameter frame received contained an error.
5	Invalid_Slave_ Response	This bit is set by the CP (DP master) when no plausible response was received from the slave.
4	Not_Supported	The requested functions are not supported by the DP slave
3	Ext_Diag Ext_Status-Message	Bit = 1 means: slave-specific diagn. data exist. Bit = 0 means: slave signals own status, with or without extended diagnostic information.
2	Slv_Cfg_Chk_Fault	Configuration data received from master do not match the configuration expected in the DP slave.
1	Station_Not_Ready	The DP slave is not ready for the data exchange.
0	Station_Non_Existent	The DP slave does not reply on the bus. This bit is set by the CP (DP master).

Table 11.4 Station Status Byte 1

Station status byte 2

Bit no.	Meaning	Explanation
7	Deactivated	This bit is set by the CP (DP master) when the DP slave no longer exists in the DP pollin list.
6	Reserved	
5	Sync_Mode	Set by the DP slave after receiving sync command.
4	Freeze_Mode	Set by the DP slave after receiving freeze command.
3	WD_On	Watchdog on (response monitoring) DP slave is active (bit = "1").
2	Status_From_Slv	The slave sets this permanently to "1".
1	Stat_Diag	Static diagnostics If this bit is set, the DP master must fetch diagnostic data from the DP until the DP slave can make valid network data available so that this bit can be reset.
0	Prm_Req	This bit is set by the DP slave when it has new parameters assigned and must be configured.

Table 11.5 Station Status Byte 2

If bit 1 and bit 0 are set at the same time, bit 0 has the higher priority.

Station status byte 3

Bit no.	Meaning	Explanation
7	Ext_Diag_Data _Overflow	If this bit is set, there is more diagnostic information than specified in the extended diagnostic data.
6 - 0	reserved	

Table 11.6 Station Status Byte 3

Structure of the byte "master address"

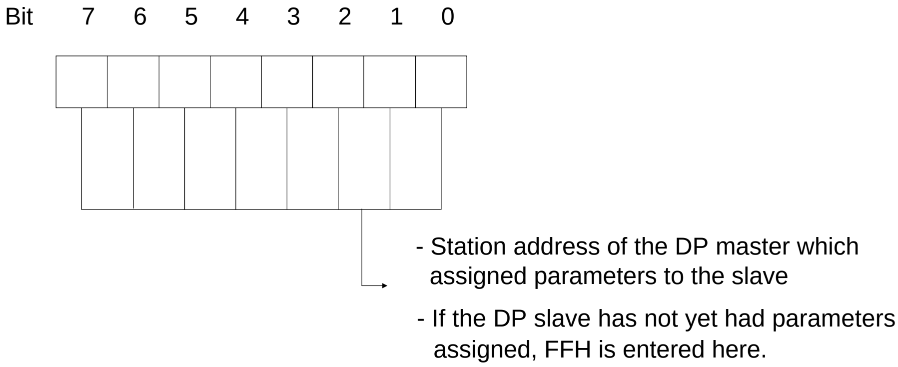


Fig. 11.28 Structure of the "Master Address" Byte

"Ident_Number" bytes

These two bytes contain the vendor ID for exact identification of a DP slave type.

Structure of the extended DP slave diagnostics

The extended DP slave diagnostics is divided into 3 groups depending on the DP slave device type and type of error signaled.

- ➢ Device-related diagnostics
- ➢ ID-related diagnostics and
- ➢ Channel-related diagnostics.

In contrast to device-related diagnostics in which general diagnostic data are stipulated depending on vendor and device type, the structure of the ID-related diagnostic data and channel-related data is stipulated in the DP-standard DIN E19245 Part 3 .

The three diagnostic groups are distinguished by the header or identification bytes. The order of the groups is unimportant. Each group can also occur more than once.

Device-related diagnostics

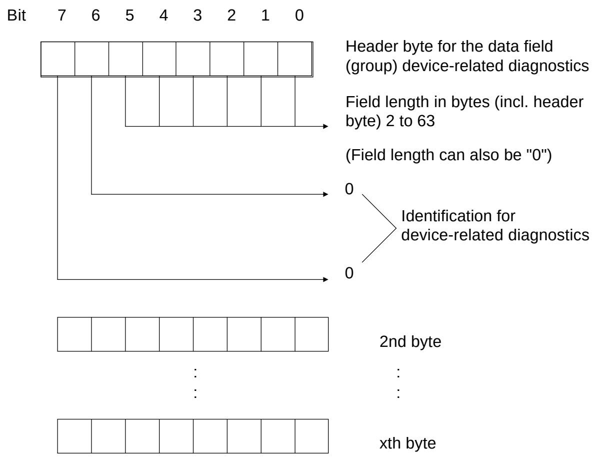


Fig. 11.29 Structure of the Header Byte for Device-Related Diagnostics

The evaluation of the device-related diagnostics can be found in the documentation for the device. This information varies from vendor to vendor.

ID-related diagnostics

In ID-related diagnostics, the list following the header byte contains a bit reserved for every configured module (ID).
This list indicates the ID number for which diagnostic data exist (bit "1").

The list of ID-related diagnostics is rounded up to a byte boundary. Non-configured modules are indicated by "0".

1st byte of the data field of ID-related diagnostics

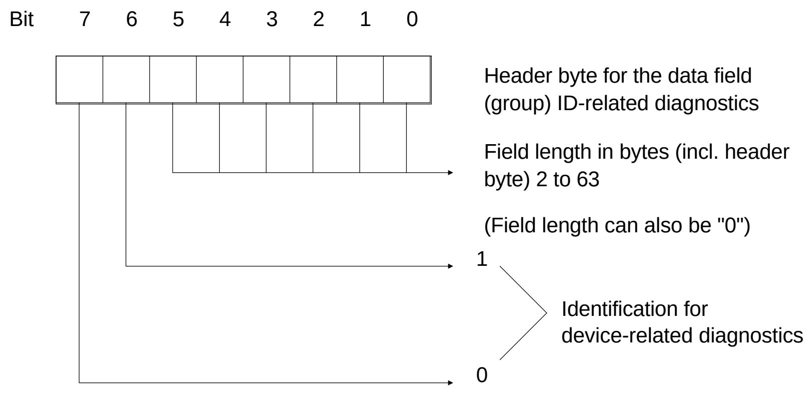


Fig. 11.30 Structure of the Header Byte for ID-Related Diagnostics

2nd byte of the data field of ID-related diagnostics

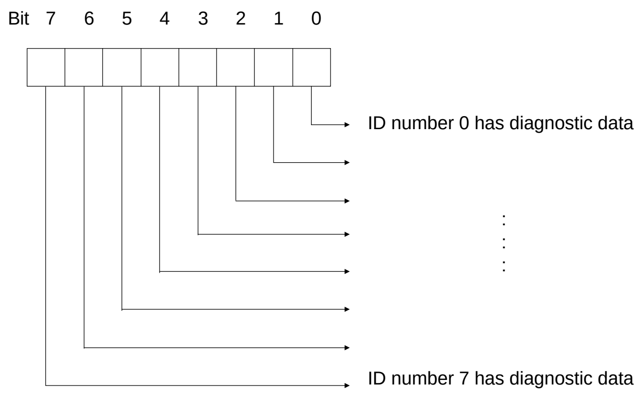


Fig. 11.31 Structure of the Field of ID-Related Diagnostics Byte 2

3rd byte of the data field of ID-related diagnostics

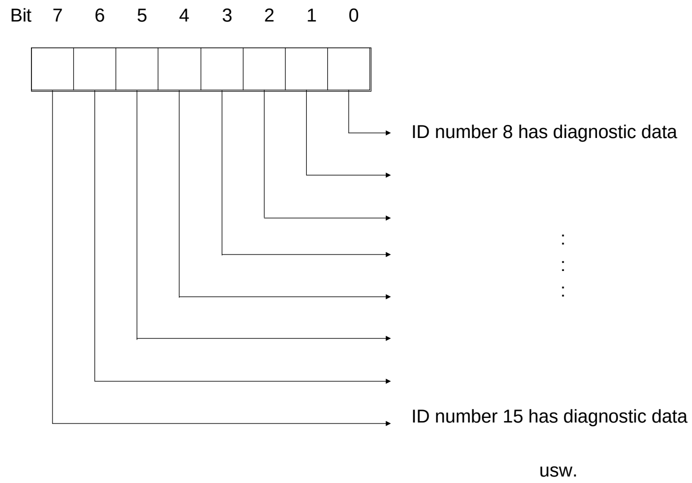


Fig. 11.32 Structure of the Field of ID-Related Diagnostics Byte 3

Channel-related diagnostics

Part of a module is known as channel.
The order of the diagnosed channels and the reason for diagnostics are each entered in three bytes in the data field for channel-related diagnostics.

1st byte of the channel-related diagnostics

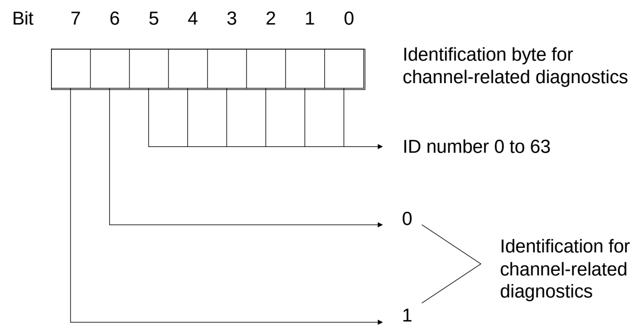


Fig. 11.33 Channel-Related Diagnostics Byte 1

2nd byte of the channel-related diagnostics

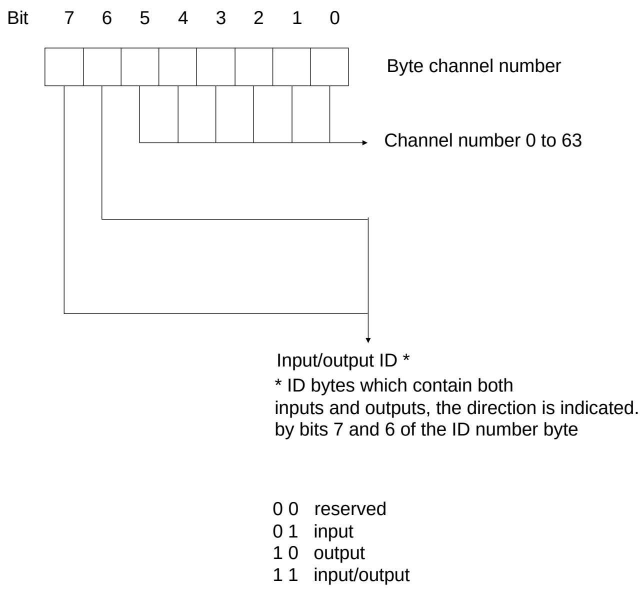
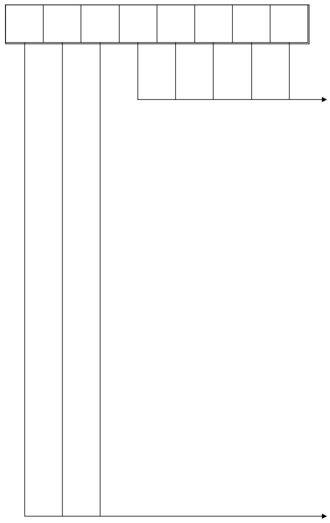


Fig. 11.34 Channel-Related Diagnostics Byte 2

3rd byte of the channel-related diagnostics

Bit 7 6 5 4 3 2 1 0



Byte for error and channel type

Error type
00000 reserved
00001 short circuit
00010 undervoltage
00011 overvoltage
00100 overload
00101 overtemperature
00110 line break
00111 upper limit exceeded
01000 lower limit exceeded
01001 error
01010 reserved
:
:
01111 reserved
10000 vendor-specific
:
:
11111 vendor-specific

channel type
000 reserved
001 bit
010 2 bits
011 4 bits
100 byte
101 word
110 2 words
111 reserved

Fig. 11.35 Channel-Related Diagnostics Byte 3

Example: Structure of a complete data field "extended diagnostics"

Bit	7	6	5	4	3	2	1	0	
	0	**0**	0	0	0	0	1	1	**Device-related diagnostics**
	2 bytes vendor-specific								Meaning explained in in DP slave documentation.
	diagnostic data								
	0	**1**	0	0	0	1	0	0	**ID-related diagnostics**
							1		-> ID number 1 with diagn.
					1				-> ID number 11 with diagn.
		1							-> ID number 23 with diagn.
	1	**0**	0	0	0	0	1	0	**Channel-related diagnostics** with ID number 1
	0	0	0	0	0	1	0	0	Channel 4
	0	0	1	0	0	0	0	1	Short circuit, channel organized in bits
	1	**0**	0	0	1	0	1	1	**Channel-related diagnostics** with ID number 11
	0	1	0	0	0	1	0	1	Channel 5, input
	0	0	1	0	0	1	1	0	Line break, channel organized in bits
	1	**0**	0	1	0	1	1	1	**Channel-related diagnostics** with ID number 23
	1	0	0	0	1	1	0	0	Channel 12, output
	1	0	1	0	0	1	1	1	Upper limit exceeded, organized in words

Fig. 11.36 Structure of a Complete Data Field "Extended Diagnostics"

Example of a program for read single DP slave diagnostics

Functions block FB 208 "EINZ-DIA" requests the diagnostic data of a single DP slave using the CP 5430 TF/CP 5431 FMS special service HDB A-NR 209. The corresponding DP slave station number is transferred to the function block with the formal operand "STAT".
FB 208 signals that the job has been done by resetting the FB trigger bit "ANST".

Function block FB208 with the corresponding data block 208, for use in a CPU of the S5 115U series can be found in the STEP 5 file EINZELST.S5D on the COM/application example diskette.

11.8 Sending Control Commands to the DP Slave

Using the special HDB A-NR: 209, the "Global_Control" DP service can be used to send various control commands to the DP slaves.

These Global_Control jobs can be used, for example, to synchronize the I/O data from some or all of the connected DP slaves .
In general, the following rules apply for sending Global_Control jobs:

➢ A DP slave only accepts control commands from the master that assigned parameters to it and configured it.

➢ By using the "group identifier" (see COM function DP slave parameter assignment, Section 11.6.2) it is possible to control commands:

- to a particular DP slave (single)
- to certain groups of DP slaves (multicast), or
- to all connected DP slaves (broadcast)

Global_control jobs are not acknowledged on the L2 bus, i.e. the reception of a global_control frame is not confirmed by the DP slaves .
At the handling block-user program level for the special HDB A-NR: 209 there is only a confirmation in the job acknowledgment field indicating that the global_control frame was sent.

11.8.1 Function of the Control Commands - Sync and Unsync

Sync

The output data last received with the "Sync" control command are output by the DP slave and frozen.
All the output data received after this are ignored until the next Sync control command or the control command "Unsync" is received.

Unsync

The control command "Unsync" cancels the function of the control command "Sync".

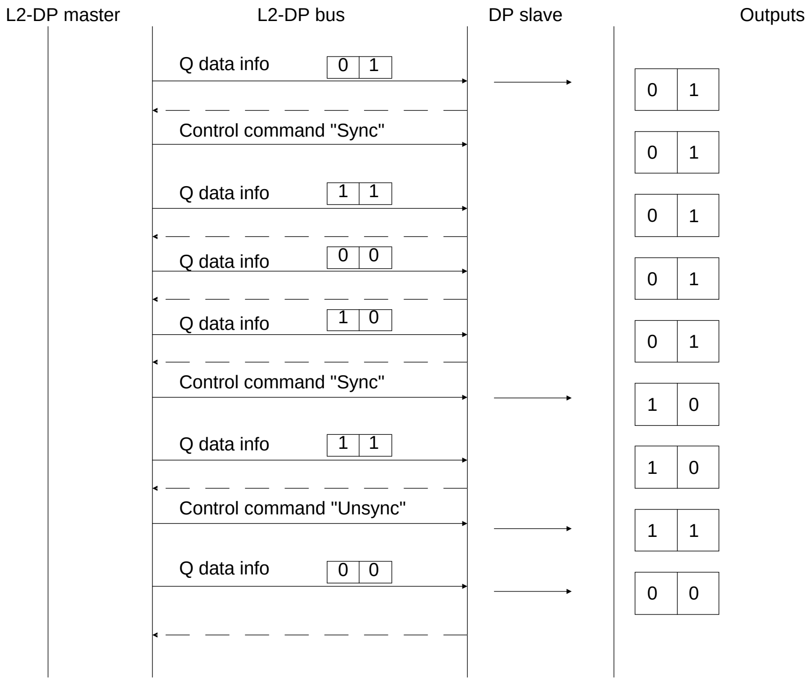


Fig. 11.37 Function of the Control Commands - Sync and Unsync

11.8.2 Function of the Control Commands - Freeze and Unfreeze

Freeze

When the control command "Freeze" is received, the current statuses of the inputs are read in by the DP slave and frozen.
The frozen input data are transferred to the L2-DP master during cyclic transfer until the next "Freeze" control command or the control command "Unfreeze" is received.

Unfreeze

Cancels the function of the control command "Freeze".

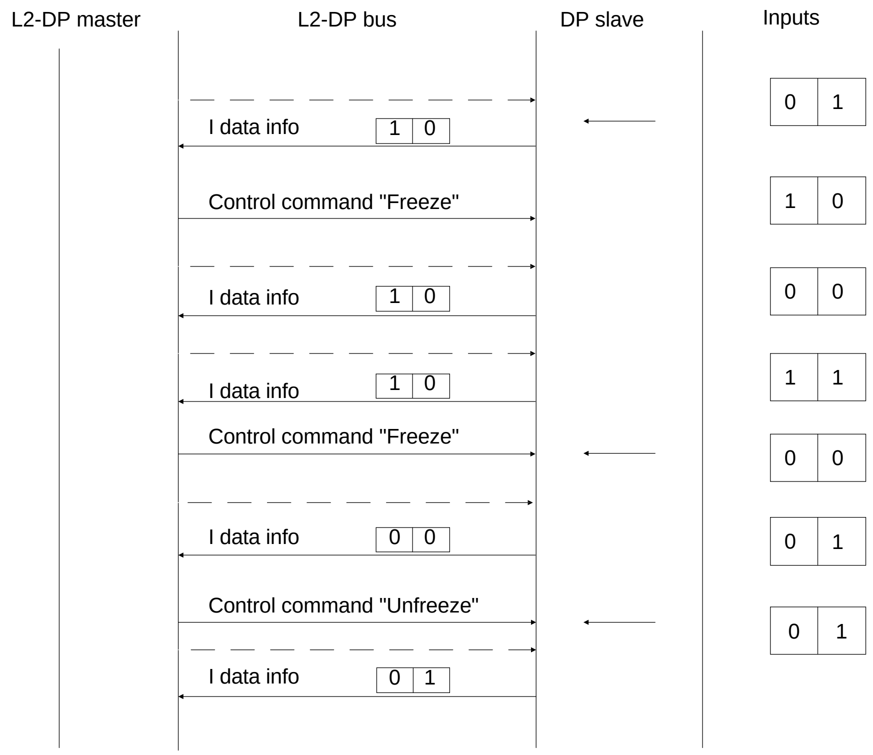


Fig. 11.38 Function of the Control Commands - Freeze and Unfreeze

11.8.3 Cyclic and Acyclic Transmission of Global_Control Commands

When a control command is sent with the special HDB A-NR: 209, the CPs distinguish between the two job types in the transferred job field:

➢ Acyclic transmission of control commands

➢ Cyclic transmission of control commands

Acyclic transmission of control commands
With the job type, "acyclic transmission", the CPs send the required control command once at the end of a DP polling list cycle.

If any of the DP slaves relevant for the control command job are not in the cyclic data transfer phase with the CPs, the job is not executed and is acknowledged negatively.

Cyclic transmission of control commands
In contrast to the "acyclic transmission" of control commands, in the job type "cyclic transmission", once the control command has been activated, it is sent by the CPs at the end of every DP polling list cycle (Unsync, Unfreeze).

The cyclic transmission of a control command is terminated by sending a new control command.

Sending control commands with the job type "cyclic transmission" is only possible when the mode "cycle-synchronized" was selected during configuration of the I/O areas with the COM package.

If any of the DP slaves relevant to the control command job are not in the cyclic data transfer phase with the CPs when the job field is transferred, the job is acknowledged negatively when it is transferred to the CP or may be deactivated later.

A cyclic global control job that only deactivates the mode Sync and /or Freeze is converted to a cyclic control job. The requirement for this is a Group ID other than "0".

Checking the cyclic control command job

The cyclic transmission of global control commands can be monitored using the group status bit of the ANZW HDB A-NR: 202 (DP station list).

The bit has the following significance:

bit 10 = "1" Global_Control command is sent cyclically.

"0" The cyclic transmission of Global_Control commands is not active (has been deactivated).
Here, there are two different situations:
a) no Global_Control command was sent with the job type cyclic transmission.
b) at least one of the DP slave stations relevant for the job is no longer in the cyclic data transfer phase with the CP.

☞ **The cyclic transmission of Global_Control and control commands must be activated again by the PLC.**

Program example of sending a control command to a DP slave

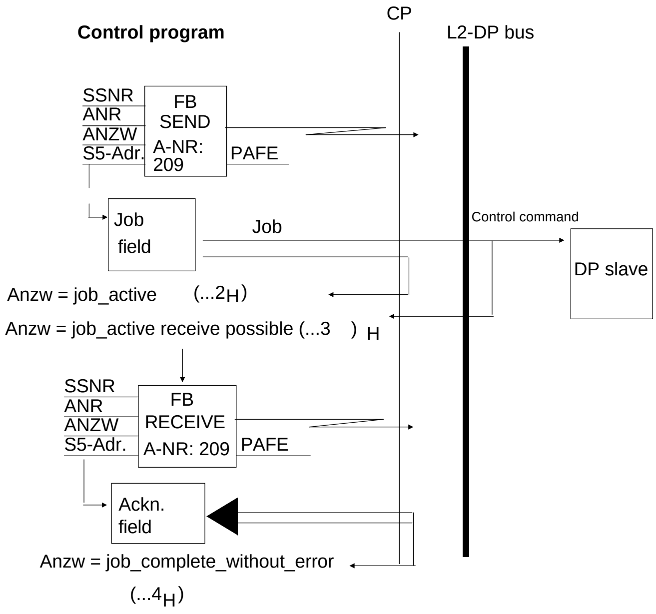


Fig. 11.39 Sequence of HDB Special Service A-NR: 209 for Global_Control

Explanation of Fig. 11.39:

The special service to send "Global_Control commands" to the DP slave is triggered with SEND A-NR: 209 (job field transferred) and acknowledged locally by the CP with RECEIVE A-NR: 209.

Structure of the job field "send control command"

1st byte	04 hex	Length of job field in bytes	
2nd byte	Job type	02 hex acyclic synchronization job 03 hex cyclic synchronization job	
3rd byte	Control command	Bit 7 = reserved = 0 Bit 6 = reserved = 0 Bit 5 = Sync Bit 4 = Unsync Bit 3 = Freeze Bit 2 = Unfreeze Bit 1 = not used = 0 Bit 0 = reserved = 0	Function table for the bits Sync/Unsync and Freeze/Unfreeze
4th byte	Group identifier	As assigned with COM in the DP slave parameter assignment or 00 Hex as general broadcast frame	

Fig. 11.40 Structure of the Job Field of "Send Control Command"

Control Command Byte

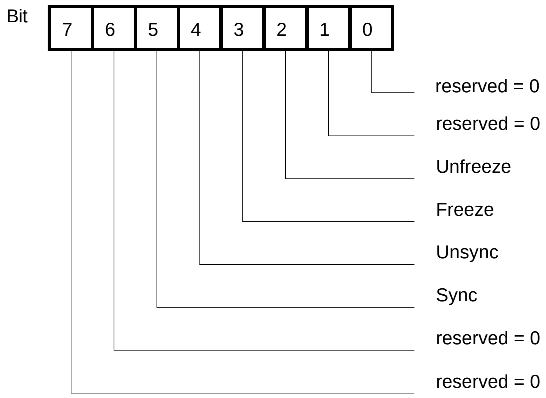


Fig. 11.41 Function Table for Control Command Byte

Structure of the acknowledgment field for "send control command"

1st byte	02 hex	Length in bytes
2nd byte	Acknowledgment	00 hex OK 01 hex syntax error in job field 02 hex error in HDB handling 06 hex slave stations not all in the data transfer phase 07 hex cyclic control command not possible because "Free" mode is set. 08 hex illegal command code 09 hex no DP slave with the relevant group identifier is active. 0B hex job cannot be executed because DP polling list processing is in the STOP mode

Fig. 11.42 Structure of the Acknowledgment Field for "Send Control Command"

Meaning of the bits for Un-/Sync and Un-/Freeze

bit 2 or 4	bit 3 or 5	Meaning
0	0	No function
0	1	Function is activated
1	0	Function is deactivated
1	1	Function is deactivated.

11.8.4 Special Job "STOP DP polling list processing"

Using the special job "STOP DP polling list processing" with special HDB A-NR: 209, you can stop the cyclic processing of the DP polling list.

Polling list processing is continued again as soon as a new cycle checkpoint is sent with HDB SEND 210 or RECEIVE 211.

The following rules apply to sending the special job "STOP DP polling list processing":

➢ The special job "STOP DP polling list processing" is only effective in the "cycle-synchronized" DP mode.

➢ The stop job only takes effect at the end of a DP polling list cycle.

➢ Polling list processing is continued by calling the cycle check HDBs (SEND 210 or RECEIVE 211).

➢ As long as DP polling list processing is in the STOP mode, it is not possible to send Global_Control commands or to read the diagnostic list.

➢ When DP polling list processing is resumed with the cycle check HDBs, the connected DP slaves are assigned new parameters and reconfigured.

Sequence of the special service "STOP DP polling list processing"

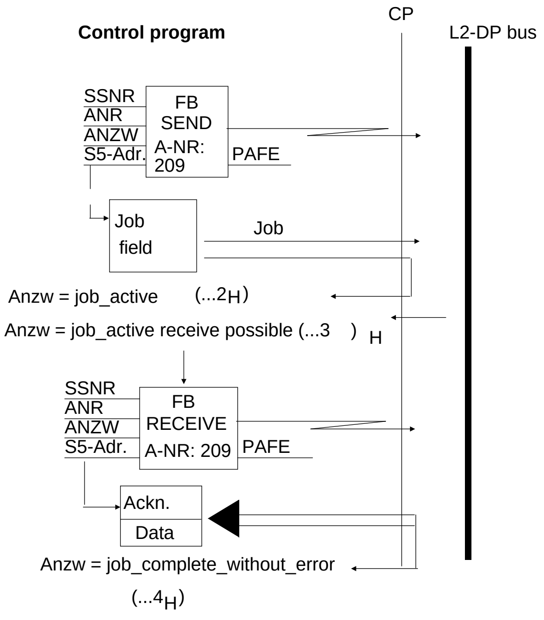


Fig. 11.43 Sequence of the Special Service "STOP DP Polling List Processing"

Explanation of Fig. 11.43:

The special service "STOP DP polling list processing" is triggered with the SEND A-NR: 209 and acknowledged locally by the CP with RECEIVE A-NR: 209.

Structure of the job field "STOP DP polling list processing"

1st byte	04	Length of the job field in bytes
2nd byte	04	Job type: STOP-DP polling list processing
3rd byte		Not used with this function
4th byte		Not used with this function

Fig. 11.44 Structure of the Job Field "STOP DP Polling List Processing"

Structure of the acknowledgment field for "STOP DP polling list processing"

1st byte	Length in bytes	always 2 bytes
2nd byte	Acknowl.	00 hex ok 01 hex syntax error in job field 07 hex stop DP polling list processing not possible, because the DP "Free" mode is set. 0B Hex stop DP polling list processing unnecessary DP polling list processing already in the STOP mode.

Fig. 11.45 Structure of the Acknowledgment Field for "STOP DP Polling List Processing"

❑

12 Service and Diagnostic Functions on the SINEC L2 Bus using FMA Services

This chapter describes the administrative fieldbus management (FMA) services available to you as the user and the corresponding parameters.

The chapter informs you of the following:

- What is understood by FMA services
- Why FMA services are used
- Which FMA services are relevant for the SINEC L2 bus system
- How FMA services are called
- How the corresponding request and confirmation frames are structured.

Requirements for understanding this chapter are as follows:

- Knowledge of the PROFIBUS standard (DIN 19245, Part 1)
- Knowledge of data transmission by direct access to layer 2 services.

12.1 Use and Types of FMA Service

The fieldbus management (FMA) organizes the initialization, monitoring and error handling between the FMA user and the logical functions in layers 1 and 2.

The management therefore serves as mediator between the local user and layers 1 and 2. Service requests which may be specified by the management are passed on to layers 1 or 2 and the user of the FMA services receives an acknowledgement with a confirmation.

The FMA services permitted for the SINEC L2 bus system allow diagnosis of all the systems belonging to the bus and their links.

When using the FMA services and the clock function at the same time, the following feature of the CP must be noted:

☞ **If the CP is the clock master on the L2 bus <u>and</u> if an FMA service is triggered at the same time, this can lead to delays in the transmission of the cyclic time of day frame.**

To avoid dangerous plant states in the bus system, only the following reading (passive) FMA services are permitted with the CP 5430 TF/CP 5431 FMS:

Services	Function
FDL_READ_VALUE	Reading the current bus parameters.
LSAP_STATUS	Reading the status values of an SAP.
FDL_LIFE_LIST_CREATE_LOCAL	Creating the current overview of all the systems connected to the bus system by means of station-internal information.
FDL_IDENT	Reading the identification of the local or a remote station on the SINEC L2 bus system.
FDL_READ_STATISTIC_CTR	Reading the station-oriented statistical information.
FDL_READ_LAS_STATISTIC_CTR	Reading the bus-oriented statistical information.

Table 12.1 FMA Services

The following table lists some of the characteristics of the individual services.

Characteristics of the FMA services / FMA services	FMA service can be used when CP 5430 TF: CP 5431 FMS:		FMA service requests info from CP 5430 TF: CP 5431 FMS:		For the FMA service the following bytes in the FMA header are relevant:							
	active	passive	local	remote	0	1	2	3	4	5	6	7
FDL_READ_VALUE	X		X		X		X					
LSAP_STATUS	X		X	X	X		X			X	X	
FDL_LIFE_LIST_CREATE_LOCAL	X		X		X		X					
FDL_IDENT	X		X	X	X		X				X	
			X		X		X				X	
FDL_READ_STATISTIC_CTR	X		X		X		X					
FDL_READ_LAS_STATISTIC_CTR	X		X		X		X					

Table 12.2 Characteristics of the FMA Services

Before using the FMA services, you must perform the following tasks for the CP 5430 TF/CP 5431 FMS:

➢ create the SYSID block

➢ assign parameters for the required HDBs SYNCHRON, CONTROL, SEND or RECEIVE

➢ set up a data block with the request header and space for the confirmation.

The creation of the SYSID block is described in detail in Chapter 6.

12.2 Fundamentals of using the FMA Services

The request for an FMA service by the CP 5430 TF/CP 5431 FMS and the transfer of the confirmation to the CPU of the PLC is the responsibility of the handling blocks SEND and RECEIVE.

For FMA services, use job number ANR 200 when calling the HDBs SEND and RECEIVE.

If an FMA service is requested, the following procedure is executed:

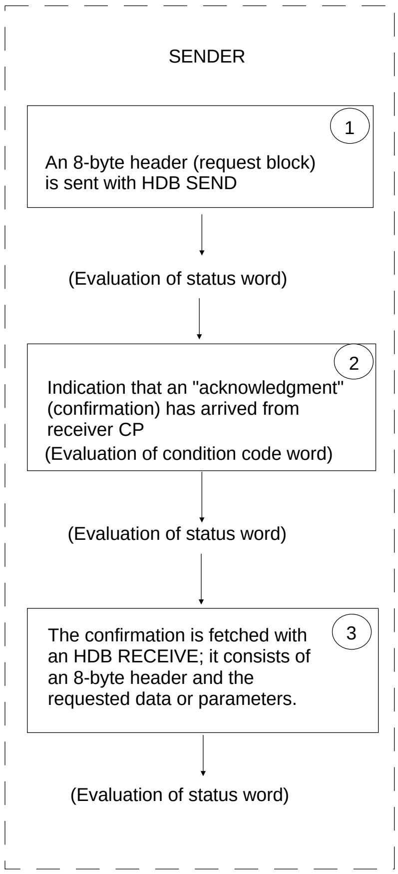


Fig. 12.1 Schematic Sequence of the FMA Services

A distinction is made between local and remote FMA services

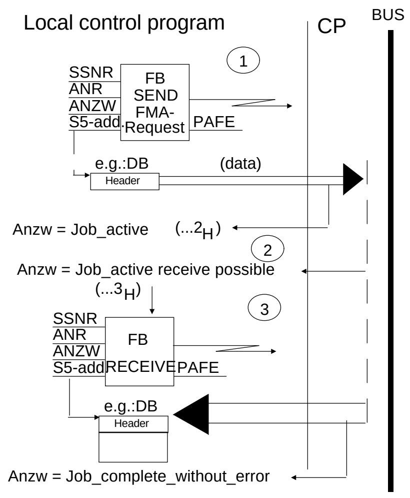


Fig. 12.2 Schematic Sequence of an FMA Service (local)

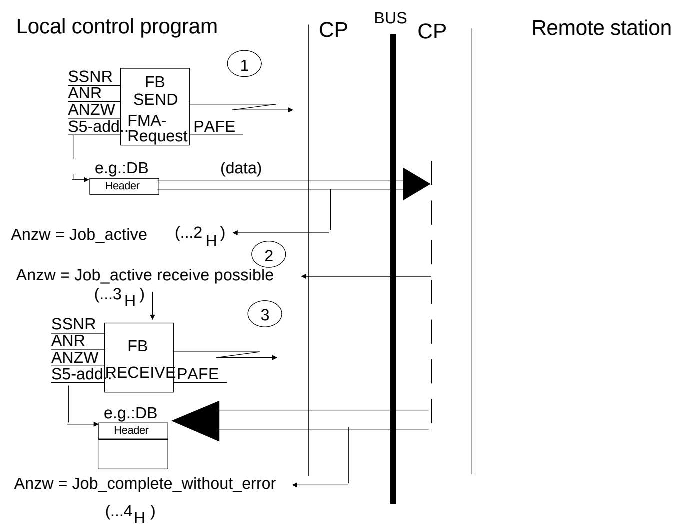


Fig. 12.3 Schematic Sequence of an FMA Service (remote)

An FMA request consists of an 8-byte header. Depending on the service, the confirmation consists of a maximum of 250 bytes, of which the first 8 bytes are occupied by the confirmation header (FMA header).

Fig. 12.4 shows the structure of a block of data to be transmitted or received. The designations of the header bytes are taken from the PROFIBUS standard.

The FMA header contains the following parameters which are not completely evaluated by all functions.

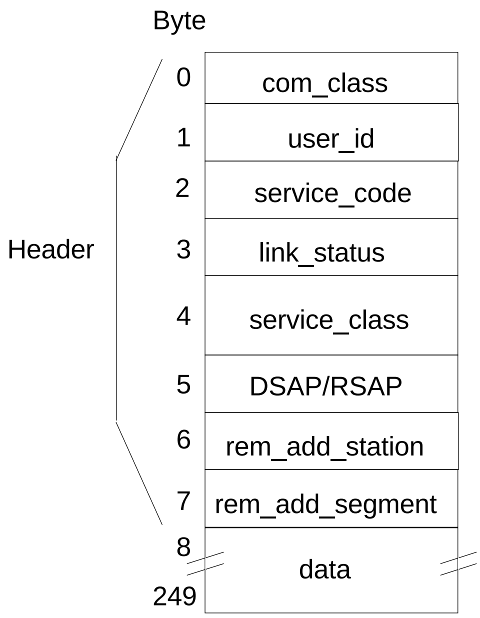


Fig. 12.4 Structure of the FMA Header for Request and Confirmation

Storing the request header and confirmation data

The data to be transferred (8 bytes) and the received data (max. 250 bytes) should be stored in a data block. Correct storage of the header information in a DB (see Fig. 12.4) is necessary for error-free use of an FMA service. It is advisable to provide enough space for the confirmation data in the same DB.

Note

The following rules apply to FMA services:

➢ If parameters occupy two bytes (one word) the order in which these bytes are stored in the data word of a data block is important:

- left data (DL): low byte of the parameter
- right data (DR): high byte of the parameter.

The header bytes are explained as necessary in the service descriptions starting in Section 12.3.

The program example is described in detail for the FMA service FDL_READ_VALUE. Setting up the DB is also illustrated as comprehensively as the user program.

The user program for the other FMA services has an analogous structure. The only difference is that a different DB must be called with parameters assigned for the particular service (e.g. service_code).

Controlling the data exchange

To be able to control the data exchange between the CPU and CP 5430 TF/CP 5431 FMS, you must evaluate the **status word** (ANZW) for this job. The condition contains information about the status of the job, information about data management and error bits (refer to Figs. 12.5/12.6).

The figures illustrating the sequence of the control program (refer to Figs. 12.2/12.3) illustrate the changes in the status word.

Not used				Error bits				Data mgment.				Status bits			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Job complete with error
Error transferring a request or when accepting an indication or confirmation

Job complete without error
(with SEND HDB: correct transfer of an FMA request with the RECEIVE HDB: correct transfer of a confirmation)

Job active
(Request being processed or confirmation of request not yet received)

Receive possible
Confirmation exists and can be accepted with the RECEIVE HDB

Fig. 12.5 Structure of the Status Word, here: Status Bits

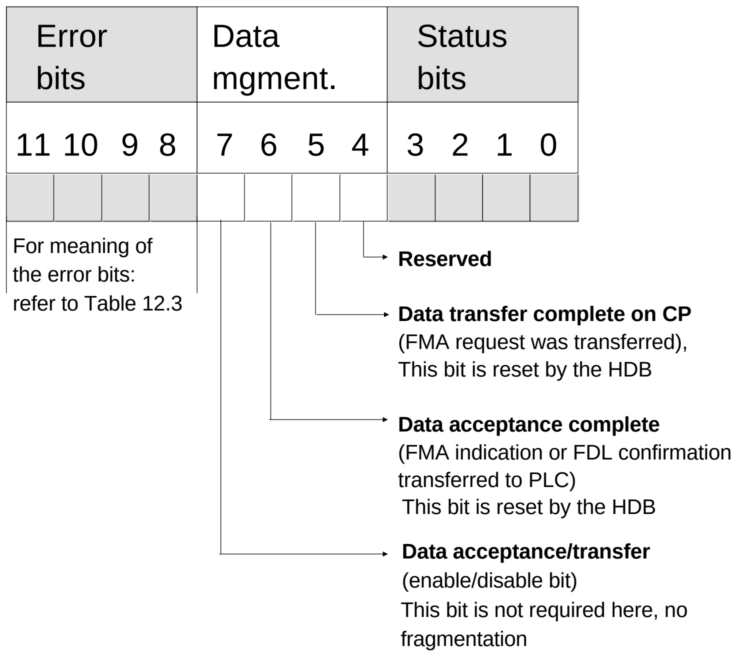


Fig. 12.6 Structure of the Status word, here: Data Management

Bits 8-11	Meaning
0_H	No error If bit 3 "job complete with error" is nevertheless set, this means that the CP has set up the job again following a cold restart or RESET.
1_H	Wrong type specified in block call (QTYP/ZTYP).
2_H	Memory area does not exist (e.g. not initialized)..
3_H	Memory area too small. The memory area specified in the HDB call (parameters Q(Z)TYP, Q(Z)ANF, Q(Z)LAE) ist for too small for the data transmission.
4_H	Timeout (QVZ). Acknowledgement from the memory cell is absent during data transfer. Remedy: check and if necessary replace the memory submodule or check and correct the source/destination parameters.(types AS, PB and OY specified).
5_H	Incorrect parameters assigned to status word. The parameter "ANZW" was specified incorrectly. Remedy: correct the parameter or set up the data block correctly in which the ANZW is to be located. (DB-No. and DB length).
6_H	Invalid source/destination parameter. Parameter ID "NN" or "RW" was used or the data length is too small (=0) or longer than 128 bytes. Remedy: use the correct Q(Z)TYP parameter; "NN" and "RW" are not allowed for this type of data transmission.
7_H	Local resource bottleneck. There are no data buffers available for processing the job. Remedy: retrigger the job, reduce the CP load.
B_H	Handshake error. The HDB processing was incorrect or the HDB monitoring time was exceeded. Remedy: start the job again.
C_H	System error. Error in the system program. Remedy: inform Siemens service
D_H	Disabled data block. The data transmission is or was disabled during the HDB processing. (control bit disable/ enable in status word disable).
E_H	Free
F_H	Job or "channel not programmed. programming error or wrong (SSNR/ANR). Remedy: program ANR as "channel" (FREE) or correct SSNR/ANR in HDB call

Table 12.3 Error Bits (bits 8...11) in the Status Word

The **parameter assignment error byte** (PAFE) must also be evaluated in the control program. It informs you about various parameter assignment errors. When you assign parameters to the individual blocks, you specify the address at which this information is available. The meaning of the individual bits is explained in Fig. 12.7.

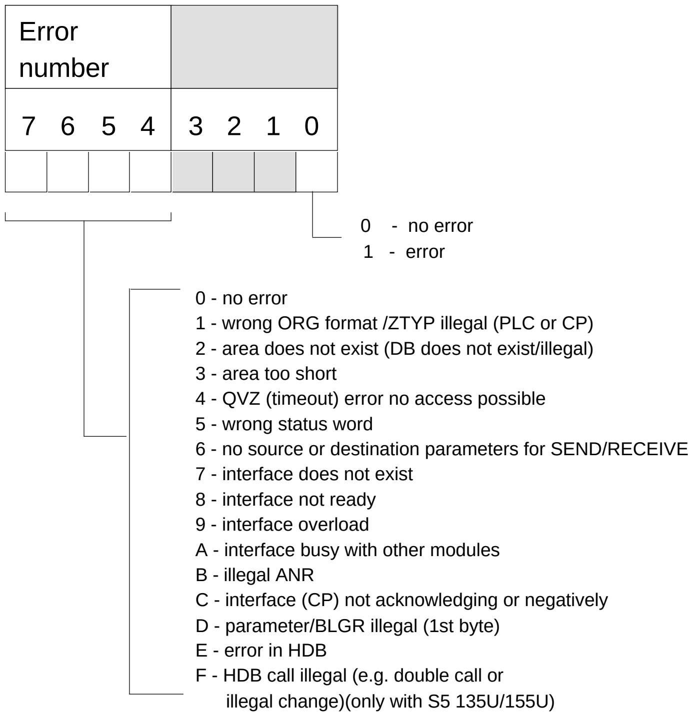


Fig. 12.7 Structure of the Parameter Assignment Error Byte "PAFE"

12.3 FDL_READ_VALUE

This service allows the FMA user to read out the current bus parameters of the local station.

12.3.1 FDL_READ_VALUE_Request

For the structure of the FDL_READ_VALUE request you must enter the following parameters in the header:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00$_H$**
user_id	1st byte: freely assignable ID, which is returned unchanged with a confirmation (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_READ_VALUE=0B$_H$**
link_status / service_class/ SAP number/ rem_add_station/ rem_add_segment	3rd-7th byte: irrelevant

The arrangement of the data in a DB from which they can then be read by the HDB SEND is explained in more detail in Section 12.9.1.

12.3.2 FDL_READ_VALUE_Confirmation

In the FDL_READ_VALUE confirmation, the values for the header and bus parameters are stored as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_READ_VALUE=0B$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.4)
service_class/ SAP number/ rem_add_station/ rem_add_segment	4th-7th byte: irrelevant
Bus parameter block	from 8th byte: (refer to Table 12.5)

The storage of the block data in a DB by HDB RECEIVE is described in detail in Section 12.9.1.

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with the FMA service FDL_READ_VALUE:

Value of link_status	Abbrev. PROFIBUS	Meaning
		FDL_READ_VALUE
00_H	OK	Positive acknowledgment: service executed, bus parameters read
15_H	IV	Negative acknowledgment: "...RESET" currently active or no receive buffer

Table 12.4 link_status Message for FDL_READ_VALUE Confirmation

The reaction in the user program when this message is received is not fixed.

Structure of the bus parameter block (see also network parameters):

Parameter	Meaning	Range of values/Code
hsa (byte)	Highest station address	2 to 126 (display of the value set in the Init block)
loc_add._station (byte)	Address of the local station	1 to 126
station_typ (word)	Active / passive	00_H = passive 01_H = active
baud_rate (word)	Baud rate	00_H = 9.6 Kbps 01_H = 19.2 Kbps 02_H = 93.75 Kbps 03_H = 187.5 Kbps 04_H = 500 Kbps 07_H = 1.5 Mbps
medium_red (word)	Redundancy	00_H = not redundant
retry_ctr	Number of retries	01_H = once 02_H = twice
default_sap (byte)	Default SAP if no SAP specified	2 to 54, 57, 61
network_connection_sap (byte)	Number of network connection SAP	0 (not used)
tsl (word)	Slot time	2^0 to 2^{16} -1 bit time unit
tqui (word)	Modulator quiet time	reserved
tset (word)	Setup time	0 to 2^{16} bit time unit
min_tsdr (word)	Min. station delay time	2^0 to 2^{16} -1bit time unit
max_tsdr (word)	Max. station delay time	2^0 to 2^{16} -1bit time unit
ttr (Doppelwort)	Target rotation time	2^0 to 2^{24} -1 bit time unit
g (byte)	GAP update factor	1 to 100
in_ring_desired (word)	Request to enter ring	true = 1(im low byte) false = 0
physical_layer (word)	Physical bus characteristics	00_H = RS 485 / FO

Table 12.5 Values of the Bus Parameter Block for FDL_READ_VALUE Confirmation

12.4 LSAP_STATUS

This service allows the FMA user to read out the services and functions assigned to a particular SAP of a remote or local station.

Services

- SDA
- SDN
- SRD
- CSRD (not possible for CP 5430 TF/CP 5431 FMS)

Functions

- Initiator
- Responder
- Initiator and Responder
- Service not activated

12.4.1 LSAP_STATUS_Request

The LSAP_STATUS request block must be structured as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00_H**
user_id	1st byte: freely assignable ID, which is returned unchanged with a confirmation. (optional)
service_code	2nd byte: format KH, type of service requested: **LSAP_STATUS=19_H**
link_status / service_class/	3rd-4th byte: irrelevant
RSAP	5th byte: format: KH, Range of values of the remote SAP no.: (0 .. 63)
rem_add_station	6th byte: format KH Range of values of the station address: (0 .. 126)
rem_add_segment	7th byte: format KH, irrelevant

The arrangement of the data in a DB from which they can then be read by the HDB SEND is explained in more detail in Section 12.9.2.

12.4.2 LSAP_STATUS Confirmation

The values for the header and LSAP status are stored as follows in the LSAP_STATUS confirmation:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service requested: **LSAP_STATUS=19$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.6)
service_class	4th byte: irrelevant
RSAP	5th byte: format KH, remote SAP number
rem_add_station	6th byte: format KH, station number of sender
rem_add_segment	7th byte: irrelevant
access_station	8th byte: station access restrictions
access_segment	9th byte: segment access restrictions
LSAP status (The arrangement may be different with other devices)	10th byte: Status_SDA 11th byte: Status_SDN 12th byte: Status_SRD 13th byte: Status_CSRD

The storage of the data in a DB by HDB RECEIVE is illustrated in detail in the example in Section 12.9.2.

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with the FMA service LSAP_STATUS

Value of link_status	Abbrev. PROFIBUS	Meaning
00H	OK	Positive acknowledgment, status was read
	RS	LSAP not activated on the remote FDL controller
	NA	No plausible reaction (ack/res) from remote station
	DS	Local FDL/PHY not in logical token ring or is disconnected from the bus line
	NR	Negative acknowledgment, reply data (L_sdu) not available on the remote FDL controller
15H	IV	Negative acknowledgment: - "FDL_RESET" currently active - invalid parameter in the application block - passive station (with remote request) - other FMA service currently active (MAC)

Table 12.6 link_status Message for LSAP_STATUS Confirmation

The reaction in the user program to receiving this message is not fixed.

The status bytes of the service descriptions are structured as follows:

Bit	7	6	5	4	3	2	1	0
	Role_in_service				Service_type			

Fig. 12.8 Structure of the LSAP_STATUS Byte

The entries in the right or left nibble have the following significance:

Service_type	Bit	3	2	1	0	Enabled service
		0	0	0	0	SDA enabled
		0	0	0	1	SDN enabled
		0	0	1	1	SRD enabled
		0	1	0	1	CSRD enabled
Role_in_service	Bit	7	6	5	4	SAP function for the enabled services
		0	0	0	0	Initiator
		0	0	0	1	Responder
		0	0	1	0	Initiator and Responder
		0	0	1	1	Service not activated

Table 12.7 Meaning of the Status Byte Entries

12.5 FDL_LIFE_LIST_CREATE_LOCAL

This service supplies status information about all active stations and all passive stations located in the GAP area of the service requesting station.

To provide the status information, no information is requested from remote station, i.e. the bus is not subjected to extra load by this service.

12.5.1 FDL_LIFE_LIST_CREATE_LOCAL Request

The FDL_LIFE_LIST_CREATE_LOCAL request block must be structured as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00_H**
user_id	1st byte: freely assignable ID, which is returned unchanged with the confirmation (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_LIFE_LIST_CREATE_LOCAL=$1B_H$**
link_status / service_class/ SAP number/ rem_add_station/ rem_add_segment	3rd-7th byte: irrelevant

The arrangement of the data in a DB from which they can then be read by the HDB SEND is explained in more detail in Section 12.9.4.

12.5.2 FDL_LIFE_LIST_CREATE_LOCAL Confirmation

The values for the header and station status are stored as follows in the FDL_LIFE_LIST_CREATE_LOCAL confirmation:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service provided: **FDL_LIFE_LIST_CREATE_LOCAL=1B$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.9)
service_class/ SAP number/ rem_add_station rem_add_segment	4th-7th byte: irrelevant
Status bytes	8th byte: status byte station (STA) 00 9th byte: status byte station (STA) 01
(hsa+8th byte):	status byte station (STA) hsa

The storage of the status data in a DB by the HDB RECEIVE is illustrated in detail in the example (Section 12.9.4).

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with this FMA service:

Value of link_status	Abbrev. PROFIBUS	Meaning
		FDL_LIFE_LIST_CREATE_LOCAL
00_H	OK	Positive acknowledgment, life list was created
	IR	Resources of the local FDL controller not available or not adequate (no life list buffer)
15_H	IV	Negative acknowledgement: - "FDL_RESET" currently active - passive station - another FMA service currently active

Table 12.8 link_status Message for FDL_LIFE_LIST_CREATE_LOCAL Confirmation

The reaction of the user program to receiving this message is not fixed.

The confirmation block contains status bytes of the active stations and passive stations located in the GAP area of the service requesting station. The status bytes are structured as follows:

Byte val.	Meaning
10	Station does not exist
20	Station active and ready
30	Station active
00	Station passive

Fig. 12.9 FDL_LIFE_LIST_STATUS Byte

12.6 FDL_IDENT

With this service, identification information can be requested from a station connected to the bus. This can involve both the local or a remote station.

The identification contains the manufacturers name, the PROFIBUS interface module type, the hardware and software versions.

12.6.1 FDL_IDENT Request

The FDL_IDENT request block must be structured as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00$_H$**
user_id	1st byte: freely assignable ID, which is returned unchanged with the confirmation (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_IDENT=1C$_H$**
link_status / service_class/ SAP number	3rd-5th byte: irrelevant
rem_add_station	6th byte: format: KH:, **Range of values of the station address: (0 .. 126)**
rem_add_segment	7th byte: irrelevant

The arrangement of the data in a DB from which they can then be read by the HDB SEND is explained in more detail in Section 12.9.5.

12.6.2 FDL_IDENT Confirmation

The values for the header and station Ident parameters are stored in the FDL_IDENT confirmation as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service provided: **FDL_IDENT=1C$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.10)
service_class/ SAP number	4th-5th byte: irrelevant
rem_add_station	6th byte: format: KH: Number of the station: (0 .. 126)
rem_add_segment	7th byte: irrelevant
Ident bytes	8th byte: LE1 (length byte 1) 9th byte: LE2 (length byte 2) 10th byte: LE3 (length byte 3) 11th byte: LE4 (length byte 4) 12th byte: hardware version (12+LE1) byte: controller PROFIBUS interface module (12+LE1+LE2) byte: vendor name (12+LE1+LE2+LE3) byte: software release max. 200th byte

The storage of the status data in a DB by the HDB RECEIVE is illustrated in detail in the example (Section 12.9.5).

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with this FMA service:

Value of link_status	Abbrev. PROFIBUS	Meaning
		FDL_IDENT
00_H	OK	Positive acknowledgment, Ident was read
11_H	NA	No plausible reaction (ack/res) from remote station)
12_H	DS	Local FDL/PHY not in logical token ring or disconnected from the bus line
09_H	NR	Negative acknowledgment for IDENT data since not available on remote controller
	LR	Resources of the local FDL controller not available or inadequate
15_H	IV	Negative acknowledgment: - "FDL_RESET" currently active - passive station - other FMA service currently active.

Table 12.9 link_status Message for FDL_IDENT Confirmation

The reaction in the user program to receiving this message is not fixed.

12.7 FDL_READ_STATISTIC_CTR

This service is used to read station-oriented statistical information. In the appropriate bytes, counters indicate how often certain statuses occurred in the bus system. The counters are set to 0 at each cold restart and whenever they are read. This means that the values always relate to a defined period. If the counters overflow, this is not indicated. When the upper limit is reached, the counters stop.

12.7.1 FDL_READ_STATISTIC_CTR Request

The FDL_READ_STATISTIC_CTR request block must be structured as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00$_H$**
user_id	1st byte: freely assignable ID, which is returned unchanged with the confirmation (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_READ_STATISTIC_CTR=1D$_H$**
link_status / service_class/ SAP number/ rem_add_station/ rem_add_segment	3rd-7th byte: irrelevant

The arrangement of the block data in a DB from which they can then be read by the HDB is explained in detail in the example (refer to Section 12.9.6).

12.7.2 FDL_READ_STATISTIC_CTR Confirmation

The values for the header and station statistics parameters are stored in the FDL_READ_STATISTIC_CTR as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service provided: **FDL_READ_STATISTIC_CTR=1D$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.10)
service_class/ SAP number/ rem_add_station/ rem_add_segment	4th-7th byte: irrelevant
Statistics parameters field	from 8th byte: (refer to Table 12.11)

The storage of the status data in a DB by the HDB RECEIVE is illustrated in detail in the example (Section 12.9.6).

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with this FMA service:

Value of link_status	Abbrev. PROFIBUS	Meaning
		FDL_READ_STATISTIC_CTR
00_H	OK	Positive acknowledgment: service executed, statistics read
15_H	IV	Negative acknowledgment: "..._RESET" currently active or no receive buffer or no statistics buffer exists

Table 12.10 link_status Message for FDL_READ_STATISTIC_CTR Confirmation

The reaction of the user program to receiving this message is not fixed.

The values in the statistics block provide information about how often the following processing statuses occurred:

Parameter	Meaning
invalid_start_delimiter_ctr	Received frame with invalid start delimiter
invalid_fcb_fcv_ctr	Received frame with invalid FCB/FCV.
invalid_token_ctr	Token frame: - does not match LAS - DA and SA > bus_parameter.hsa.
collision_ctr	Unexpected response frame
wrong_fcs_or_ed_ctr	Received frame with wrong FCS or ED.
frame_error_ctr	- Gap in received frame - Receive buffer too short
char_error_ctr	- Serial error (framing, parity, overrun error) - Invalid start delimiter - Frame with invalid SD2 header - Wrong FCS or ED.
retry_ctr	Frame repetition
start_delimiter_ctr	Received frame with valid start delimiter (=reference)
stop_receive_ctr	Reception aborted, because: - receive buffer too short - invalid start delimiter - collision - duplicate address - invalid DA, SA, DAE, SAE or LE - wrong fcs or ed - SD1, SD2, SD3 received in LISTEN_TOKEN
send_confirmed_ctr	Number of transmitted "confirmed" requests
send_sdn_ctr	Number of transmitted SDN requests.

Table 12.11 Info in the Statistics Parameter Block for FDL_READ_STATISTIC_CTR Confirmation

12.8 FDL_READ_LAS_STATISTIC_CTR

This service is used to read bus-oriented statistical information. In the appropriate bytes, counters indicate how often certain statuses occurred in the bus system. The counters are set to 0 at each cold restart and whenever they are read. This means that the values always relate to a defined period. If the counters overflow, this is not indicated. When the upper limit is reached, the counters stop.

12.8.1 FDL_READ_LAS_STATISTIC_CTR Request

The FDL_READ_LAS_STATISTIC_CTR request block must be structured as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL request =00$_H$**
user_id	1st byte: freely assignable ID, which is returned unchanged with the confirmation (optional)
service_code	2nd byte: format KH, type of service requested: **FDL_READ_LAS_STATISTIC_CTR=1E$_H$**
link_status / service_class/ SAP number/ rem_add_station/ rem_add_segment	3rd-7th byte: irrelevant

The arrangement of the block data in a DB from which they can then be read by the HDB is explained in detail in the example (refer to Section 12.9.7).

12.8.2 FDL_READ_LAS_STSTISTIC_CTR Confirmation

The values for the header and statistical data are stored in the FDL_READ_LAS_STATISTIC_CTR confirmation as follows:

com_class	0. byte: format KH, service request to layer 2 here: **FDL confirmation =01$_H$**
user_id	1st byte: ID assigned with FDL request (optional)
service_code	2nd byte: format KH, type of service provided: **FDL_READ_LAS_STATISTIC_CTR=1E$_H$**
link_status	3rd byte: format KH, OK or error message (refer to Table 12.13)
service_class**/** SAP number/ rem_add_station/ rem_add_segment	4th-7th byte: irrelevant
Statistics parameter block	from 8th byte: (refer to Table 12.13)

The storage of the status data in a DB by the HDB RECEIVE is illustrated in detail in the example (Section 12.9.7).

The parameter link_status of the confirmation indicates the success or failure of the previous FMA request.

The following messages can occur with this FMA service:

Value of link_status	Abbrev. PROFIBUS	Meaning
		FDL_READ_LAS_STATISTIC_CTR
00_H	OK	Positive acknowledgment: service executed, statistics read.
15_H	IV	Negative acknowledgment: "..._RESET" currently active or no receive buffer or passive station.

Table 12.12 link_status Message for FDL_READ_LAS_STATISTIC_CTR Confirmation

The reaction of the user program to receiving this message is not fixed.

The statistics provide information about the number of token rotations and the number of received tokens in the individual active stations.

Parameter	Meaning
las_cycle_ctr	Number of token rotations (reference)
station x	Number of received tokens station x
station y	Number of received tokens station y
. .	. .
station z	Number of received tokens station z

Table 12.13 Info in the Statistics Block for FDL_READ_LAS_STATISTIC_CTR Confirmation

12.9 Examples

The program example is described in detail for the FMA service FDL_READ_VALUE. Setting up the DB is also illustrated as comprehensively as the user program.

The user program for the other FMA services has an analogous structure. The only difference is that a different DB must be called with parameters assigned for the particular service (e.g. service_code).

12.9.1 Program Example for the FDL_READ_VALUE Service

For this example, DB 140 is set up to store the request and confirmation data.

The following parameters must be specified for the FMA service FDL_READ_VALUE:

com_class : 00_H = request
service_code : OB_H = FDL_READ_VALUE

After accepting the confirmation block with the HDB RECEIVE, the values are entered in the DB and can then be processed further by the user program.

Word	DB 140	Explanation
0:	KH = 0000;	***Request-Header****
1:	KY = 000,000	com_class / user_id
2:	KY = 011,000	service_code / no significance
3:	KY = 000,000	no significance
4:	KY = 000,000	no significance
5:	KH = 0000;	****Confirmation-Header****
6:	KY = 000,000	com_class / user_id
7:	KY = 000,000	service_code / link_status
8:	KY = 000,000	no significance/no significance
9:	KY = 000,000	no significance/no significance
10:	KY = 000,000	hsa / loc_add.station
11:	KH = 0000;	station_type
12:	KH = 0000;	baud_rate
13:	KH = 0000;	medium_red
14:	KH = 0000;	retry
15:	KY = 000,000	default_sap / network_con._sap
16:	KH = 0000;	tsl (slot-time)
17:	KH = 0000;	tqui (modulator quiet time)
18:	KH = 0000;	tset (set-up time)
19:	KH = 0000;	min_tsdr (min. station delay)
20:	KH = 0000;	max_tsdr (max. station delay)
21:	KH = 0000;	ttr (target rotation time)
22:	KH = 0000;	ttr (target rotation time)
23:	KY = 000,000	g (gap_up) / in_ring_desired
24:	KY = 000,000	in_ring_desired / physical_Layer
25:	KY = 000,000	physical_Layer / no significance
26:	KY = ..	.....
27:	KY = ...	.....

Table 12.14 DB 140

The user program is structured as follows:
After evaluating the ANZW, to determine whether a previous job is still active, the request is sent. If no PAFE occurs and the SEND job is completed, the ANZW is checked to determine whether a confirmation has been received. If this is the case, this is transferred with HDB RECEIVE to the CPU and the parameters can be processed in the user program or evaluated as a check. An error check has already been performed with ANZW, PAFE and link_status.

FB140	Explanation
Segment 1 Name: READ-Val DECL:ANST I/Q/D/B/T/C: I BI/BY/W/D: BI	 FMA service read_value "OBH"
0008 : 0009 : 000A : 000B : 000C : 000D : JU FB 123 000E Name: CONTROL 000F SSNR: KY 0,0 0010 A-NR : KY 0,200 0011 ANZW: FW 140 0012 PAFE: FY 145	FMA read_value REQUEST and CONFIRMATION ************************************** read status for FMA job job number for FMA service
0013 : 0014 : 0015 : AN =ANST 0016 : O F 141.1 0017 : JC =CONF	************************************** transmit trigger for FMA service ANZW job active jump to receive confirmation
0018 : 0019 : 001A : 001B : JC FB 120 001C Name: SEND 001D SSNR: KY 0,0 001E A-NR : KY 0,200 001F ANZW: FW 140 0020 QTYP : KS DB 0021 DBNR : KY 0,140 0022 QANF : KF +1 0023 QLAE : KF +4 0024 PAFE : FY 144 0025 : 0026 : O F 141.3 0027 : O F 144.0 0028 : BEC	 ************************************** FMA-REQUEST_SEND job number for FMA function FMA-REQ header is in DB 140 from DW 1 onwards REQUEST length is 4 words ANZW error PAFE with last SEND?

Table 12.15 FB 140 (part 1 of 3)

FB 140 (continued)	Explanation
0029 :	
002A : RB =ANST	reset transmit trigger
002B :	
002C :	***************************************
002D CONF:	
002E :	
002F : A F 141.0	ANZW-CONFIRMATION received?
0030 : BEC	
0031 :	
0032 : JC FB 121	FMA-CONFIRMATION-RECEIVE
0033 Name : RECEIVE	
0034SSNR : KY 0,0	
0035 A-NR : KY 0,200	job number for FMA service
0036 ANZW: FW 140	
0037 ZTYP : KS DB	FMA confirmation to be stored in
0038 DBNR: KY 0,140	DB 140
0039 ZANF : KF +6	from DW 6
003A ZLAE : KF -1	"joker length"
003B PAFE: FY 146	
003C :	
003D :	evaluation whether RECEIVE activated
003E : O F 141.3	ANZW error
003F : O F 146.0	PAFE-error
0040 : BEC	
0041 :	

Table 12.16 FB 140 (part 2 of 3)

FB 140 (continued)	Explanation
0042 :	***************************************
0043 :	
0044 :	evaluation of link_status
0045 : C DB 140	
0046 :	
0047 : L KB 0	status "ok"
0048 : L DR 1.1	load FMA link_status
0049 : ! = F	
004A : BEC	program end here if
004B :	confirmation link_status positive
004C :	
004D :	***************************************
004E :	
004F :	user program for evaluation
0050 :	of FMA-CONFIRMATION error
0051 :	message
0052 :	
0053 :	**************************************
0054 :	
0055 : BE	

Table 12.17 FB 140 (part 3 of 3)

12.9.2 Program Example for the LSAP_STATUS Service

For the example, DB 141 is set up to store the request and confirmation data.
The following parameters must be specified for the FMA service LSAP_STATUS.

com_class	00_H	=	request
service_code	19_H	=	LSAP_STATUS
Remote SAP no.	30_H	=	dest SAP
rem_add_station	$0A_H$	=	address of the receiver
rem_add-segment	FF_H	=	irrelevant, always enter FF_H

After accepting the confirmation block with the HDB RECEIVE, the values are entered in the DB and can then be processed further by the user program.

DB 141	Explanation
0: KH = 0000;	**** REQUEST_HEADER******
1: KY = 000,000	com_class / user_id
2: KY = 025,000	service_code / no significance
3: KY = 000,061	no significance / remote SAP-Nr.
4: KY = 002,255	no significance / rem_add_segment
5: KH = 0000;	******CONFIRMATION*******
6: KY = 000,000	com_class / user_id
7: KY = 000,000	service_code / link_status
8: KY = 000,000	no significance / remote SAP-Nr.
9: KY = 000,000	rem_add_station/ rem_add_segment
10:KM = 00000000 00000000	statusbyte 1 / statusbyte 2
11:KM = 00000000 00000000	Status SDA / Status SDN
12:KM = 00000000 00000000	Status SRD / Status CSRD
13:KH = 0000;	
14:KH = 0000;	
15:KH = 0000;	

Table 12.18 DB 141

The structure of the user program for sending the request and receiving the confirmation is exactly as described for the FMA service FDL_READ_VALUE (refer to Section 12.9.1). The differences simply result from using a different DB for storing the request or confirmation block.

☞ **Remember that when reading a remote station of a different manufacturer, the position of the status bytes in the data field may be different.**

For the CP 5430 TF/CP 5431 FMS, the positions of the status bytes are as described in the manual.

12.9.3 Program Examples for the FDL_LIFE_LIST_CREATE_REMOTE Service

This service is not implemented

12.9.4 Program Example for the FDL_LIFE_LIST_CREATE_LOCAL Service

For the example, DB 143 is set up to store the request and confirmation data.

The following parameters must be specified for the FMA service FDL_LIFE_LIST_CREATE_LOCAL:

com_class	:	00	=	request
service_code	:	$1B_H$	=	FDL_LIFE_LIST_CREATE _LOCAL

After accepting the confirmation block with the HDB RECEIVE, the values are entered in the DB and can then be processed further by the user program.

DB 143	Explanation
0: KH = 0000;	**** REQUEST_HEADER******
1: KY = 000,000	com_class / user_id
2: KY = 027,000	service_code / no significance
3: KY = 000,000	no significance / no significance
4: KY = 000,000	no significance / no significance
5: KH = 0000;	******CONFIRMATION*******
6: KY = 000,000	com_class / user_id
7: KY = 000,000	service_code / link_status
8: KY = 000,000	no significance / no significance
9: KY = 000,000	no significance / no significance
10:KM = 00000000 00000000	Status TN 00 / Status TN 01
11:KM = 00000000 00000000	Status TN 02 / Status TN 03
12:KM = 00000000 00000000	Status TN 04 / Status TN 05
13:KM = ...	.....
14:KM = ...	.....
15:KM = ...	.....
16:KM = ...	.....
17:KM = ...	.....

Table 12.19 DB 143

The structure of the user program for sending the request and receiving the confirmation is exactly as described for the FMA service FDL_READ_VALUE (refer to Section 12.9.1). The differences simply result from using a different DB for storing the request or confirmation block.

12.9.5 Program Example for the FDL_IDENT Service

For the example, DB 144 is set up to store the request and confirmation data.

The following parameters must be specified for the FMA service FDL_IDENT:

com_class	:	00_H	=	request
service_code	:	$1C_H$	=	FDL_IDENT
rem._add._station	:	$0A_H$	=	address of the receiver

After accepting the confirmation block with HDB RECEIVE, the values are entered in the DB and can be read out.

DB 144	Explanation
0: KH = 0000;	**** REQUEST_HEADER******
1: KY = 000,000	com_class / user_id
2: KY = 028,000	service_code / no significance
3: KY = 000,000	no significance / no significance
4: KY = 002,000	rem_add_station / no significance
5: KH = 0000;	******CONFIRMATION*******
6: KY = 001,000	com_class / user_id
7: KY = 028,000	service_code / link_status
8: KY = 000,000	no significance / no significance
9: KY = 002,000	rem_add_station / no significance
10:KH = 0000;	ident buffer (LE1/LE2)
11:KH = 0000;	(LE3/LE4)
12:KS = ' ';	....
13:KS = ' ';	....
14:KS = ' ';	....

Table 12.20 DB 144

Example of DB 144 with identification data of the station:

DB144	Explanation
0: KH = 0000;	**** REQUEST_HEADER******
1: KY = 000,000	com_class / user_id
2: KY = 028,000	service_code / no significance
3: KY = 000,000	no significance / no significance
4: KY = 002,000	rem_add_station / no significance
5: KH = 0000;	******CONFIRMATION*******
6: KY = 001,000	com_class / user_id
7: KY = 028,000	service_code / link_status
8: KY = 000,000	no significance / no significance
9: KY = 002,000	rem_add_station / no significance
10:KH = 020A;	Length byte 1; Length byte 2
11:KS = ????;	Length byte 3, Length byte 4
15:KH = 3232;	
16:KS = ????;	CP 5430 TF
23:KH = ????;	Siemens AG
24:KS = ????;	V x.y
27:KH = ????;	
28:KS = ????;	
32:KS = ????;	
33:KH = 0101;	
34:KH = 0101;	
35:KH = 0101;	
36:KH = 0101;	
37:KH = 0101;	
38:KH = 0101;	
39:KH = 0101;	
40:KH = 0101;	
41:KH = 0101;	
42:KH = 0101;	
43:KH = 0101;	
44:KH = 0101;	

Table 12.21 DB 144

The structure of the user program for sending the request and receiving the confirmation is exactly as described for the FMA service FDL_READ_VALUE (refer to Section 12.9.1). The differences simply result from using a different DB for storing the request or confirmation block.

12.9.6 Program Example for FDL_READ_STATISTIC_CTR Service

For the example, DB 145 is set up to store the request and confirmation data.

The following parameters must be specified for the FMA service FDL_READ_STATISTIC_CTR:

com_class	:	00_H	=	request
service_code	:	$1D_H$	=	FDL_READ_STATISTIC_CTR

After accepting the confirmation block with HDB RECEIVE, the values are entered in the DB and can be read out.

DB 145	Explanation
0: KH = 0000;	**** REQUEST_HEADER******
1: KY = 000,000	com_class / user_id
2: KY = 029,000	service_code / no significance
3: KY = 000,000	no significance /no significance
4: KY = 010,000	no significance / no significance
5: KH = 0000;	******CONFIRMATION*******
6: KY = 000,000	com_class / user_id
7: KY = 000,000	service_code / link_status
8: KY = 000,000	no significance / no significance
9: KY = 000,000	no significance/ no significance
10:KH = 0000;	invalid_start_delimiter_ctr
11:KH = 0000;	invalid_fcb_fcv_ctr
12:KH = 0000;	invalid_token_ctr
13:KH = 0000;	collision_ctr
14:KH = 0000;	wrong_fcs_or_ed_ctr
15:KH = 0000;	frame_error_ctr
16:KH = 0000;	char_error_ctr
17:KH = 0000;	retry_ctr
18:KH = 0000;	start_delimiter_ctr
19:KH = 0000;	
20:KH = 0000;	stop_receive_ctr
21:KH = 0000;	
22:KH = 0000;	send_confirmed_ctr
23:KH = 0000;	
24:KH = 0000;	send_sdn_ctr
25:KH = 0000;	
26:KH = 0000;	

Table 12.22 DB 145

The structure of the user program for sending the request and receiving the confirmation is exactly as described for the FMA service FDL_READ_VALUE (refer to Section 12.9.1). The differences simply result from using a different DB for storing the request or confirmation block.

12.9.7 Program Example for FDL_READ_LAS_STATISTIC_CTR Service

For the example, DB 146 is set up to store the request and confirmation data.

The following parameters must be specified for the FMA service:

FDL_READ_LAS_STATISTIC_CTR:

com_class	:	00_H	=	request
service_code	:	$1E_H$	=	FDL_READ_LAS_STATISTIC_CTR

After accepting the confirmation block with HDB RECEIVE, the values are entered in the DB and can be read out.

DB 146	Explanation
0: KH = 0000; 1: KY = 000,000 2: KY = 030,000 3: KY = 000,000 4: KY = 000,000 5: KH = 0000; 6: KY = 000,000 7: KY = 000,000 8: KY = 000,000 9: KY = 000,000	**** REQUEST_HEADER****** com_class / user_id service_code / no significance no significance / no significance no significance / no significance ******CONFIRMATION******* com_class / user_id service_code / link_status no significance / no significance no significance / no significance
10:KH = 0000; 11:KY = 000,000; 12:KH = 000,000; 13:KH = 000,000; 14:KH = 000,000; 15:KH = 000,000;	las_cycle_ctr (reference) 1st act. station / 2nd act. station 3rd act. station / 4th act. station : : :
1x:KH = 000,000;	nth act. station

Table 12.23

The structure of the user program for sending the request and receiving the confirmation is exactly as described for the FMA service FDL_READ_VALUE (refer to Section 12.9.1). The differences simply result from using a different DB for storing the request or confirmation block. ❑

13 Clock Services

The CP 5430 TF/CP 5431 FMS clock function is implemented by a clock chip and clock software that uses the clock chip (clock task).

There are two basic clock functions:

1. The clock keeps the time on the CP 5430 TF/CP 5431 FMS within the absolute limits of accuracy described in the technical data. This clock continues to run during a power down as long as the battery voltage is present.

2. The clock can also be used to synchronize synchronization frames so that all the CP 5430 TF/CP 5431 FMS modules connected to the SINEC L2 network and involved in synchronization have a relative deviation of 20 ms from each other. The transmitter of the clock message must be the CP 5430 TF/CP 5431 FMS.

The clock message has a fixed format for SINEC which corresponds to the TF standard (refer to Fig. 13.1). The transmitter has SAP 55 reserved for transmitting the time of day message. The user does not need to assign parameters to this, since the clock software does this automatically.

When using the FMA services and clock function at the same time, remember the following special feature of the CP:

☞ **If the CP is the active time transmitter (clock master) on the L2 bus <u>and</u> an FMA service is triggered at the same time, this may lead to the cyclic transmission of the time of day being delayed.**

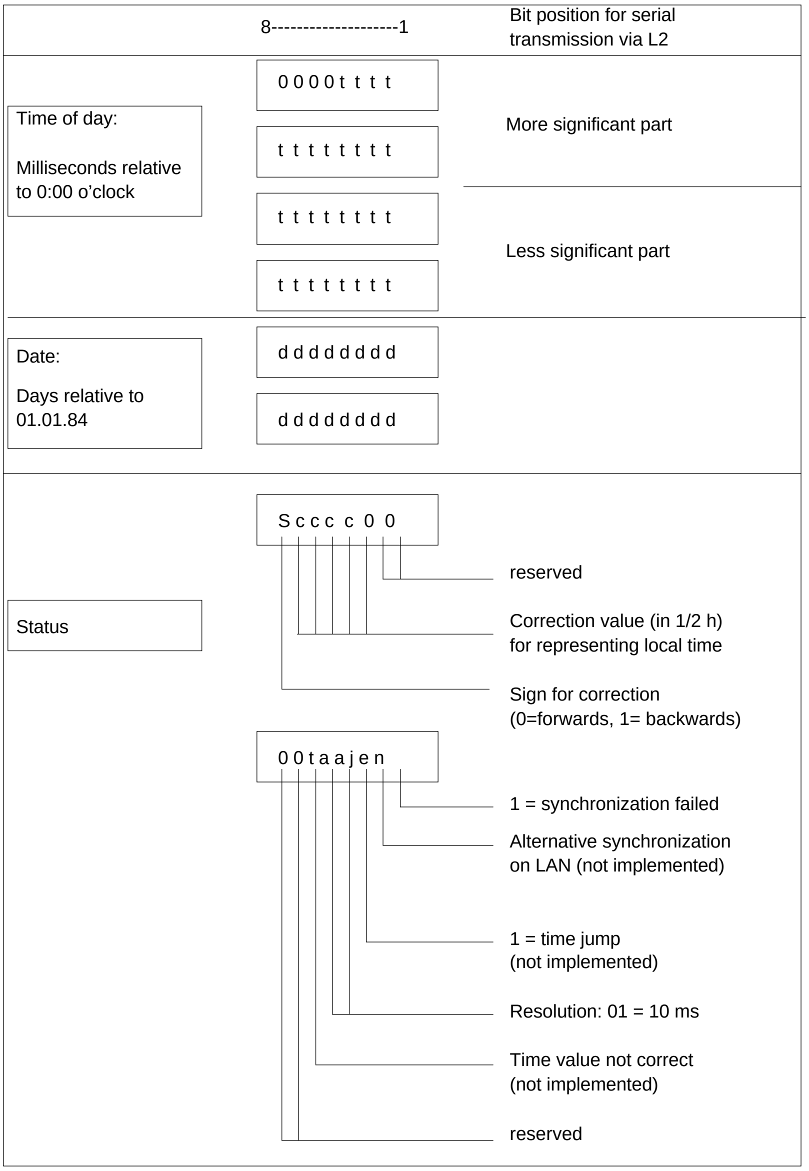


Fig. 13.1 Representation of Time and Status on the Bus

13.1 Network Topology, Clock Master/Slave Functions

Within a SINEC L2 network, all the CP 5430 TF/CP 5431 FMSs can execute clock functions. The aim is to achieve network-wide clock synchronization.

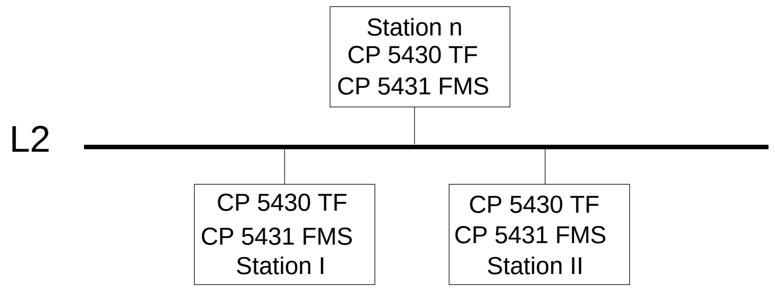


Fig. 13.2 Network Topology

The synchronization can be performed by **one** selected CP 5430 TF/CP 5431 FMS.

The station that transmits the clock synchronization frames is known as the "clock master".

In this case, all other stations are "clock slaves".

The CP 5430 TF/CP 5431 FMS can take over the functions of the clock master if programmed accordingly.

The transmission of clock frames can be selected within a range between 1 and 60 seconds. The value used by COM 5430 TF/CP 5431 FMS as the default value is 10 s. This means that all slaves expect a synchronization frame from the clock master after a maximum of 10 s. Otherwise, the clock slaves attempt to take over the clock master function (only the highest priority clock slave station is successful, provided this is programmed as DYNAMIC CLOCK MASTER in COM 5430 TF/CP 5431 FMS).

The order of priority in which the stations take over the clock master function is selected when the station address is assigned.

The station address is defined as the L2 address:

Based on the L2 address, a time is stipulated after which the station attempts to become clock master.

The following terms are important:

➢ Delay Time,
corresponds to the L2 address in seconds.

➢ Update Time,
selected time interval for transmitting clock synchronization frames.

➢ Undefined Time
sum of the delay time and update time.

By taking the L2 address as the delay time, a priority is established for stations attempting to take over the clock master functions.

Example:
the following table shows which station takes over the clock master function and if this fails, which station will replace it.

	Status	Dyn. Master	Delay Time
Master possible	Master	Y	03
	Slave	Y	07
	Slave	Y	08
	Slave	Y	10
	Slave	Y	12
	Slave	Y	13
Master not possible	Slave	N	18
	Slave	N	21
	Slave	N	01
	etc.		!=!

Priority assigned based on the delay time

☞ **Since in L2 the individual station addresses must be different from each other, the delay times cannot overlap.**

This concept ensures that there is always clock synchronization within the network.

13.2 How the Clock Functions

The clock can have the following statuses:

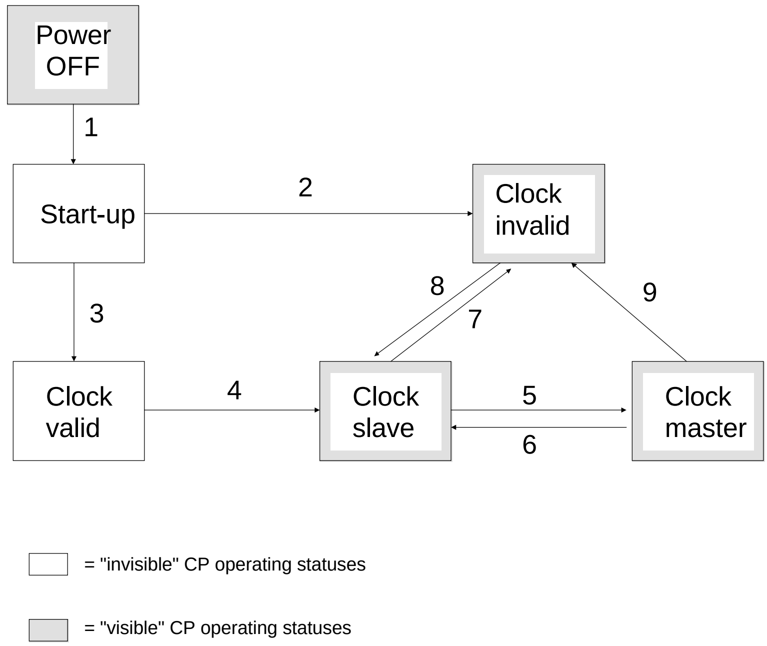


Fig. 13.3 Clock Statuses

Description of the status transitions

1. When the CP starts up, the hardware clock of the CP 5430 TF/CP 5431 FMS is checked.

2. The status of the hardware clock was recognized as invalid. The clock must be reset.

3. The status of the hardware clock was recognized as valid, i.e. the hardware clock has already been set.

4. If during the CP start-up the clock is recognized as valid, the CP automatically assumes the "clock_slave" status.

5. During the undefined time, no synchronization frame was received. The CP therefore attempts to take over the clock master function.

6. The current clock master has received a synchronization frame from a higher priority CP 5430 TF/CP 5431 FMS. The station once again assumes the status of clock slave.

7. The CP with the clock slave status recognizes an invalid time (e.g. defective hardware clock).

8. This status change is possible after receiving a valid clock frame from the clock master from the PG or from the PLC.

9. The CP with the clock master status recognizes an invalid time (e.g. defective hardware clock).

13.3 Several CP 5430 TF/CP 5431 FMS Modules on a SINEC L2 Bus

Dynamic clock masters can be configured on an L2 bus. The L2 address determines which CP 5430 TF/CP 5431 FMS assumes the clock master function. A double definition is not possible.

The clock is programmed in the Edit->Clock_Init screen.

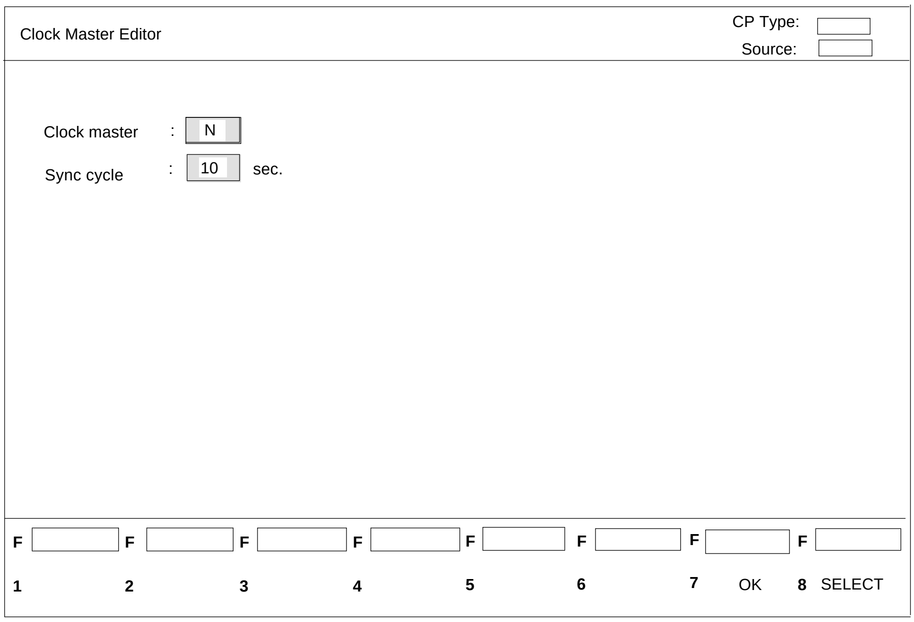


Fig. 13.4 Edit -> Clock Init Screen

The values entered in the screen correspond to the defaults.

Clock master (Y/N):

Y The CP 5430 TF/CP 5431 FMS can become the clock master if it has the highest priority and can transmit clock synchronization frames.

N The CP 5430 TF/CP 5431 FMS receives synchronization frames if they exist in the L2 network.

Sync cycle: 10 (sec) default

If the CP 5430 TF/CP 5431 FMS is the clock master, it sends clock synchronization frames to the SINEC L2 network at the time intervals specified above.

Possible values: 1 - 60 sec.

F7 OK	The data edited in the screen are entered as the current data.
F8 SELECT	Activating this key displays a selection list for each input field that cannot be freely edited. Values can be selected in the list using the cursor keys and entered directly in the input field with the return key.

13.3.1 Setting and Reading the Time in the Programmable Controller

The CP 5430 TF/CP 5431 FMS has the job number 218 available for processing the time.

A SEND with this job number writes the CP's time, a RECEIVE, reads the CP's time.

These services are possible on the synchronized CP interfaces using the standard HDBs for the PLC.

☞ **When the CP starts up, internal test functions can lead to a waiting time of 1 second before the clock can be read out reliably from the PLC.**

To provide the time for the programmable controller, the following representation is used:

Data format of the time in a DB of the PLC (S5 155 U format)

	15 12	11 8	7 4	3 0
DW n:	tens sec	units sec	1/10 sec	1/100 sec
DW n+1:	tens hr	units hr	tens min	units min
DW n+2:	tens day	units day	weekday	0
DW n+3:	tens year	units year	tens month	units month
DW n+4:			correction value	

Possible values (hexadecimal):

1/100	seconds:	0...9
1/10	seconds	0...9
units	seconds	0...9
tens	seconds	0...5
units	minutes	0...9
tens	minutes	0...5
units	hours	0...9
tens	hours	0...1 / 0...2 bit 15 = 1: 24-hour format bit 14 = 0: AM bit 15 = 1: PM
Weekday		Mo...Su = 0...6
units	days	0...9
tens	days	0...3
units	months	0...9
tens	months	0...1
units	years	0...9
tens	years	0...9

Correction value:
The correction value corresponds formally to the correction value for representing the local time (refer to Fig. 13.1) from the SINEC clock frames
Bit 0...5 deviation in 1/2 hour 0..24
Bit 7 sign 0 = plus (+) / 1 = minus (-)

The following identifiers are possible replies to a "**set time**" job from the PLC.

Reply (decoded IDs)	**Identifier**	**Meaning**
OK, no error	00_H	Command could be executed without error.
Protocol error	01_H	Time is invalid (was not set etc.).
System error	$0E_H$	System error (e.g. invalid command).
Hardware clock	$0F_H$	Hardware clock has failed.

The following identifiers are possible as the reply to a "**read time**" job of the PLC.

Reply	Identifier	Meaning
System error	$0E_H$	System error (e.g. with invalid command).
Hardware clock	$0F_H$	Hardware clock has failed.
Clock_Master	06_H	CP is clock master and executes this function.
Clock_Slave	07_H	CP is clock slave.
Clock_Slave, + invalid	08_H	Station has an invalid clock chip, clock must be reset.
Clock_Slave, + asynchronous	09_H	Station not receiving clock frame.
Slave, >master	$0B_H$	CP is clock slave; prepare for master function.
Master,>slave	$0A_H$	CP is clock master; prepare for slave function.
Subst synchron	$0C_H$	CP is synchronized by a CP 5430 TF/CP 5431 FMS.

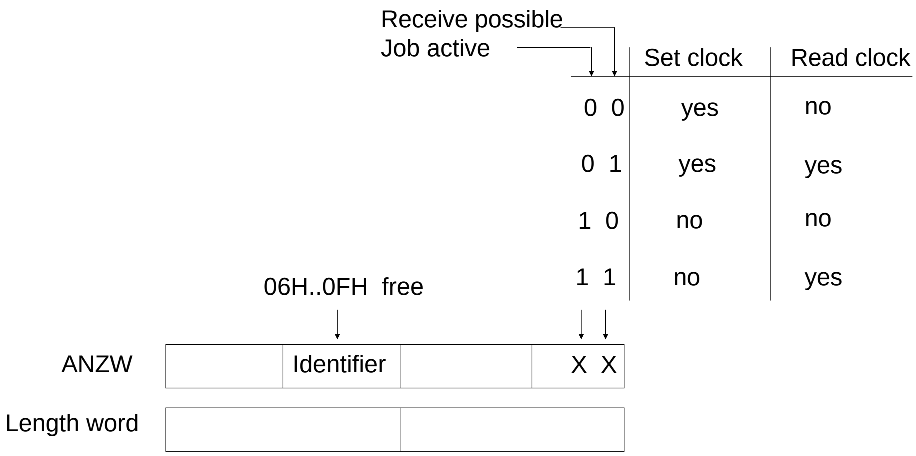


Fig. 13.5 ID in the Status Word of the Handling Blocks (HDBs)

When the CP is starting up, the lower two bits of the status word are set to "set clock" and "read clock" not possible. During normal operation, these bits are set according to the CP clock status.

After the HDB has been run through successfully (Receive or Send), the number of accepted or transferred data is entered in the length word.

13.4 Setting and Reading the Time with COM 5430 TF/CP 5431 FMS

Using COM 5430 TF/CP 5431 FMS, it is possible to both set the hardware clock of the CP 5430 TF/CP 5431 FMS as well as to read the current time cyclically.

The clock can only be read when it is in one of the following statuses:

- Clock master
- Clock slave substitute sync
- Clock slave asynchronous
- Slave > master
- Master > slave.

The time can be set in the following statuses:

- Clock master
- Clock slave substitute sync
- Clock slave invalid

In the NCM menu, the following screen can be called under the menu item Utilities -> Clock Functions.

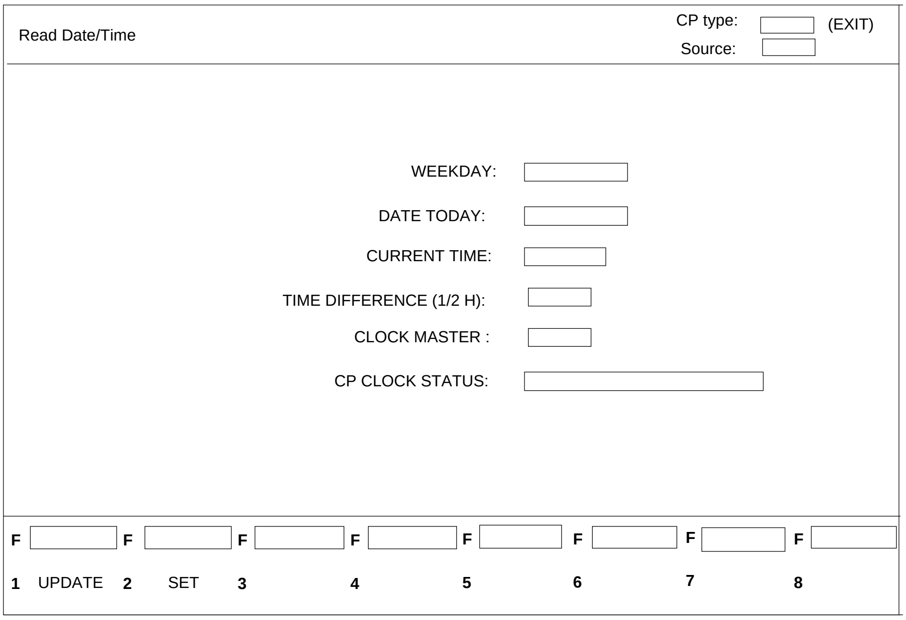


Fig. 13.6 Clock Functions Screen

A clock read frame is then sent to the selected CP 5430 TF/CP 5431 FMS.

The screen is completed with the received data and functions are available depending on the CP clock status.

When reading the time, an ID byte is supplied to the CP protocol which provides information about the current status of the clock chip. The decoded IDs are entered in the field "CP clock status".

F1 UPDATE	The PG requests the time cyclically. The CP clock status is also updated.

F2 SET	The time can only be set when the CP status is "master clock" or "clock_slave_asynchronous" or when the clock chip of the CP 5430 TF/CP 5431 FMS is marked as invalid.

Displays in the COM 5430 TF/CP 5431 FMS screen

WEEKDAY:	MONDAY - SUNDAY
DATE TODAY:	e.g. 29. 10. 1993 The data can be set within the limits 01.03.1984 to 31.12 2083.
CURRENT TIME:	e.g. 15:23:43
TIME DIFF-ERENCE (1/2 H):	"+" or "-" and range between 0 and 24
CLOCK MASTER:	Indicates whether the current CP 5430 TF/CP 5431 FMS is the clock master or is a clock slave.
CP CLOCK STATUS:	**CLOCK MASTER** the clock sends synchronization frames **CLOCK SLAVE** the clock receives synchronization frames **CLOCK SLAVE,+ INVALID** the clock must be set **CLOCK SLAVE,+ ASYNCHR** clock does not receive synchronization frames **SLAVE <--> MASTER** clock status change **TRANSMITTER ASYNCHR** time transmitter is itself asynchronous **SUBST SYNCHRON** the clock is synchronized from a CP 5430 TF/CP 5431 FMS **SYSTEM ERROR** an internal error has occurred **HW CLOCK FAILURE** hardware clock has failed

13.5 Restrictions / Tips

The time should be read or set by the programmable controller (with RECEIVE) at a time interval > 10 ms.

a) The hardware clock of the CP 5430 TF/CP 5431 FMS itself only has a resolution of 10 ms.

b) By reading or setting the clock too quickly (cyclically) PLCs, the CP 5430 TF/CP 5431 FMS can be influenced to such an extent that the module is disabled for other activities.

To avoid loading the SINEC L2 bus with unnecessary time frames, a synchronization time greater than 10 seconds should be selected.

To ensure that the CP functions correctly, the following points must be taken into account:

➢ The cycle time for synchronization frames on every CP 5430 TF/CP 5431 FMS must be the same. The default cycle time is 10 seconds (can be modified in the Clock Init screen).

➢ At least one dynamic clock master must be configured.

13.6 Accuracy

The hardware clock of the CP 5430 TF/CP 5431 FMS has a maximum deviation of 11.94 s/day or 8.3 ms/min. This deviation is based on a calculation involving the quartz inaccuracy and temperature fluctuation.

➢ Absolute accuracy
The absolute accuracy of the clock chip on the CP 5430 TF/CP 5431 FMS is in the worst case +/- 11.94 sec per day.

For this reason, it is necessary to compensate for this deviation in the CP 5430 TF/CP 5431 FMS hardware clock by receiving synchronization frames.

The time is kept on the hardware clock of the CP 5430 TF/CP 5431 FMS with a resolution of 10 ms.

To achieve a system-wide clock accuracy in the programmable controllers, a time difference of 20 ms must not be exceeded. This is achieved by time of day synchronization.

➢ Relative accuracy
If the times on the SINEC H1 relative to each other should not deviate by more than 20 ms, the relationship between the Ethernet address (ID) and cycle time of the synchronization frame must be borne in mind.

Once it is running, if the CP sends a synchronization frame, the following deviations are possible providing the CP is only functioning as clock master.

Cycle time	1 sec	10 sec	60 sec
Deviation	0.28 ms/s	2.77 ms/10s	16.6 ms/min

Table 13.1 Accuracy

If the CP is in a transitional status, i.e. it has not received a synchronization frame, and is attempting to become master, then depending on the L2 address, larger deviations are possible (refer to Table 13.2). The bus parameters are not included in these calculations. Depending on the real CP load and parameter settings, greater deviations in the accuracy may be possible.

L2 address	Cycle time and resulting deviations in the time of day		
	1 s	10 s	60 s
1	0.55 ms/s	3.04 ms/10s	16.58 ms/min
2	0.83 ms/s	3.32 ms/10s	16.86 ms/min
:	:	:	:
10			19.38 ms/min
11			19.66 ms/min
:	:	:	:
20		8.36 ms/10s	
21		8.64 ms/10s	
:	:	:	:
30	8.67 ms/s		
31	8.95 ms/s		

Table 13.2 Status Transitions

❑

NOTES

14 Documentation and Testing

The screens required for documentation or testing are provided by SINEC NCM as listed in Fig. 14.1 and Fig. 14.2.

14.1 Documentation Functions

To give you the opportunity of producing lists with your programming, the following documentation and print functions are integrated.

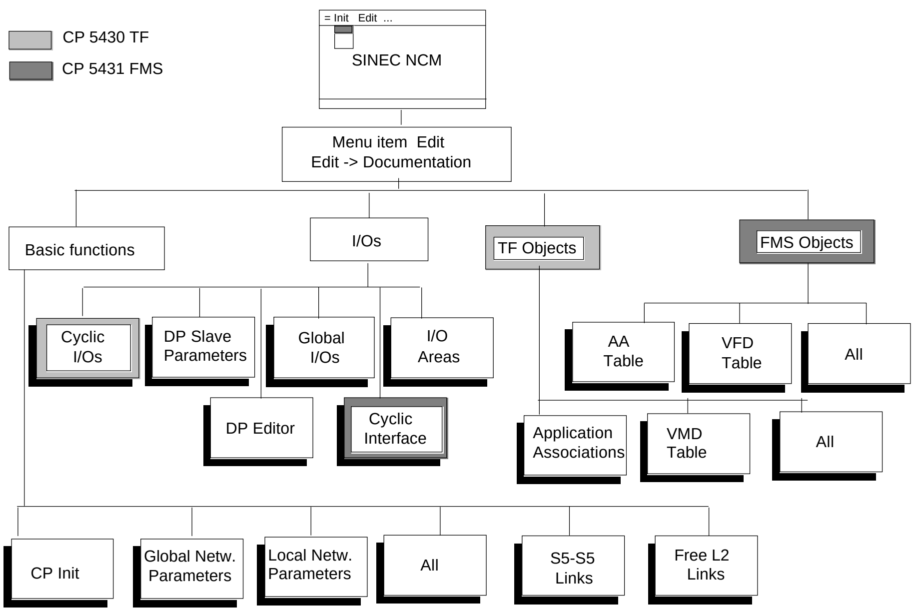


Fig. 14.1 Menu Structure Documentation

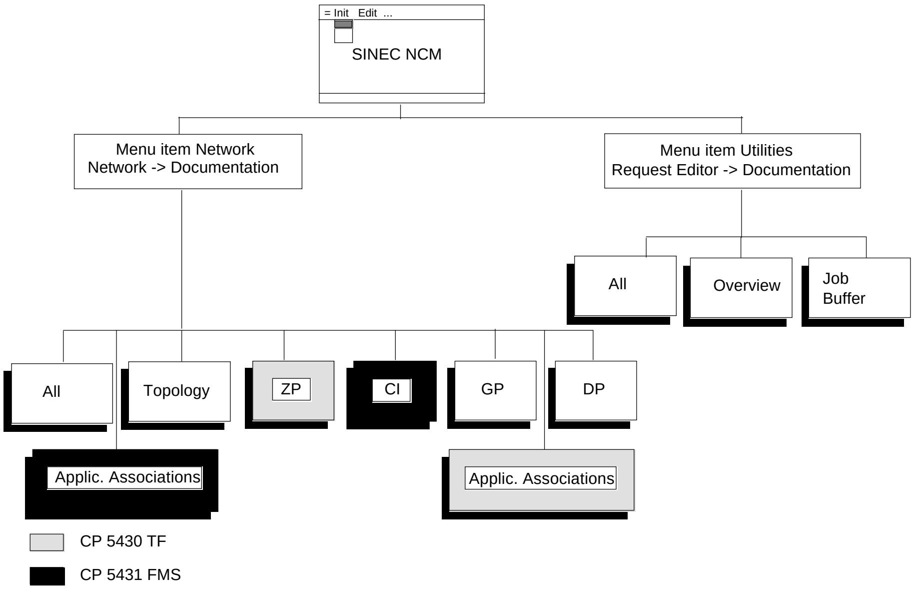


Fig. 14.2 Menu Structure Network Documentation

With footer on/off in the "Init -> Edit" screen (Chapter 6, Fig. 6.7) you can specify a footer file in which you saved a footer for the printout using the S5-DOS footer editor.

With "Printer output on/off" in the screen (Chapter 6, Fig. 6.7) you can decide whether to output solely on the screen or on both printer and screen.

☞ **Make sure that your printer is switched on.**

To activate the documentation functions, select the appropriate menu item in the documentation menu in SINEC NCM.

14.2 Test

Suitable test and diagnostic tools are particularly important when installing SINEC L2 networks. For this reason, the software package COM 5430 TF/COM 5431 FMS under SINEC NCM provides a number of test functions.

To allow you to test your configuration, the test and diagnostic functions shown in Fig. 14.3 were integrated in

- S5-S5/free layer 2
- GP (global I/Os)
- ZP (cyclic I/Os) (only with CP 5430 TF)
- DP (distributed I/Os)
- FMA

The TF/FMS test functions are described in Volume 2.

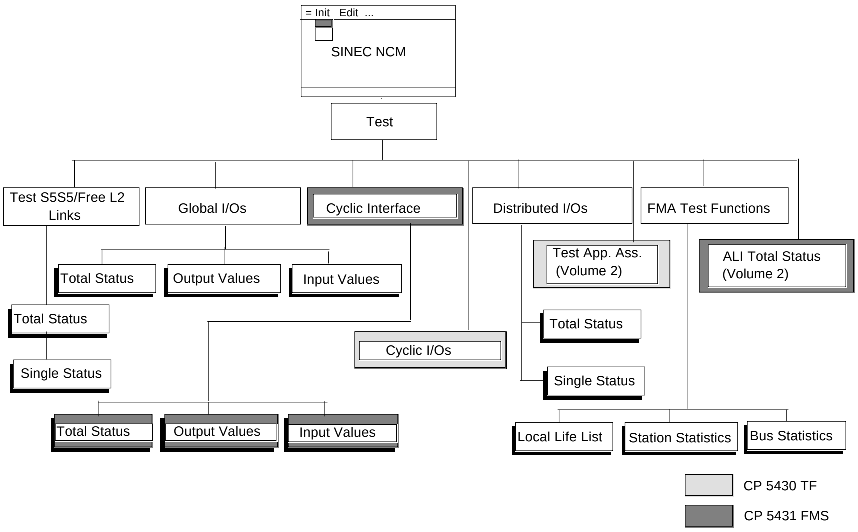


Fig. 14.3 Menu Structure Test

☞ **With the test functions, only the data exchange between the PLC and CP via the S5 backplane bus is monitored. The data transmission from the CP on the L2 bus cannot be checked with the test functions (to check this traffic, use the SINEC L2 bus monitor "SCOPE L2"). If PLC or bus errors occur, COM 5430 TF/COM 5431 FMS uses the various messages contained in the status word (ANZW) of the handling blocks and the link_status of the confirmation header.**

14.2.1 S5-S5/ Free L2 - Test Functions

With the S5-S5 / free L2 link test functions, you can determine the status of individual parts of the system during communication and localize any errors that are detected.

14.2.1.1 Total Status

The screen has the following structure (examples of parameters):

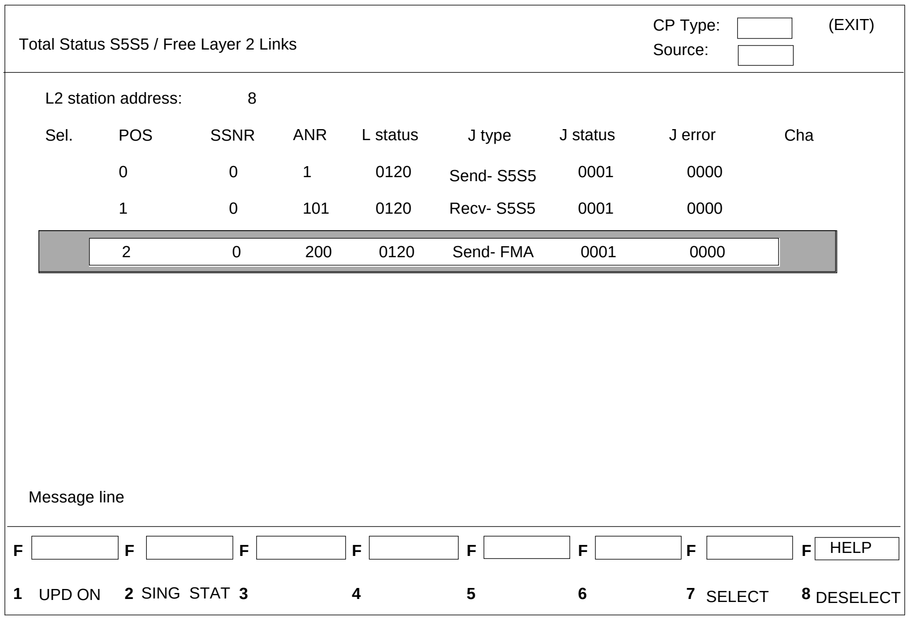


Fig. 14.4 Total Status Screen

Output fields:

L2 station address	Station, with which the test functions are performed.
Sel:	Indicates a selection.
POS:	Number of the link.
SSNR:	Page number via which the communication between the CP and PLC is handled.
ANR:	Job number, identifies the configured links.
L status:	Link status displayed coded in hex (see Table 14.1).

J type:	Job type: the following job types can be distinguished: SEND - S5-S5 RECV - S5-S5 SEND - FL 2 RECV - FL 2 SEND - FMA RECV - FMA
J status:	Job status (see Table 14.2).
J error:	Job error with S5-S5/free layer 2 communication.
Cha:	Indicates a status change with " * " .

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F2 SING STAT	Changes to the single status of the link shown on a gray background.
F7 SELECT	Select the lines marked by the cursor.
F8 DESELECT	Undo the selections.

Link statuses

Based on the link statuses, you can see the current status of a configured link.

Hex value	ID	Meaning
0120_H	LINK_LAYER_2	Layer 2 link is established.
0180_H	CANNOT_EST	Layer 2 link cannot be established.

Table 14.1 Link Statuses

Job status

Hex	Meaning
0000_H	Initial status, no current job exists
0001_H	No job processing at preset
0021_H	Await-Indication Request field sent to layer 2.
0022_H	Data being transferred to PLC
0023_H	CP waiting for transfer of an indication.
0024_H	Error in indication transfer (FL2).
0025_H	Error in the indication (S5-S5) -> Await-Request field to layer 2.
0026_H	Incorrect request field transfer with send direct
0031_H	Request field transfer to layer 2.
0032_H	CP waiting for request trigger from PLC
0033_H	CP waiting for transfer of a confirmation.
0034_H	Error in confirmation transfer (FL2).
0035_H	Error in the confirmation (S5-S5) -> CP expects new trigger.
0036_H	Incorrect data acceptance with receive direct (S5-S5).

Table 14.2 Job Statuses

Errors in S5-S5/free layer 2 communication

Error ID	Meaning
0000_H	No error
0001_H	Wrong block type for SEND-DIRECT.
0002_H	Memory area does not exist on PLC
0003_H	Memory area too small
0004_H	Timeout
0005_H	Error in status word
0006_H	Data too long or short for S5-S5 and FL2.
0007_H	No local resources
0008_H	No remote resources.
0009_H	Remote error
$000A_H$	Link error
$000C_H$	System error

Table 14.3 Errors in S5-S5/Free Layer 2 Communication

14.2.1.2 Single Status

The screen with the example parameters has the following structure:

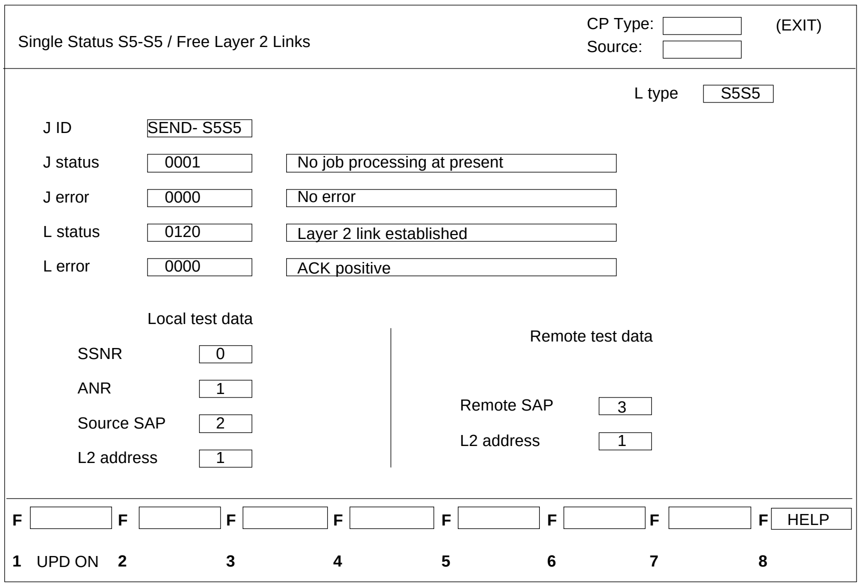


Fig. 14.5 Single Status Screen

Output fields:

L type: Link type:
"S5-S5" : S5-S5 link
"FDL" : free layer 2 link
"FMA" : FMA link
"DEFAULT" : link via default SAP

J type: Representation of the job in text form.
SEND - S5-S5
RECV - S5-S5
SEND - FL 2
RECV - FL 2
SEND - FMA
RECV - FMA

J status:	Job status. Presentation of the action coded (see Table 14.2) and in text form.
J error:	Job error in S5-S5/free layer 2 communication (see Table 14.3) and in text form.
L status:	Displays the link status coded (hexadecimal) (refer to Table 14.1) and in text form.
L error:	Link error FDL error message (see Table 14.4).
SSNR:	Page via which the PLC and CP communicate.
ANR:	Job number. Identifies the configured link
Source SAP/ Remote SAP:	Configured SAP; local or remote.
L2 address:	L2 addresses of the local and remote station.

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.

FDL error messages

These error messages are returned as the link status in the acknowledgment (Confirmation).

ID	link_status	Meaning
L2_LST_OK	0x0000	ack. positive
L2_LST_UE	0x0001	rem. user interface error
L2_LST_RR	0x0002	no remote resources
L2_LST_RS	0x0003	rem service or SAP error
L2_LST_DL	0x0008	resp. data low available
L2_LST_NR	0x0009	no resp. data rem.
L2_LST_DH	0x000a	resp. data high available
L2_LST_RDL	0x000c	neg. ack., resp. data low available
L2_LST_RDH	0x000d	neg. ack., resp. data high available
L2_LST_LS	0x0010	service not allowed locally
L2_LST_NA	0x0011	no reaction from rem. station
L2_LST_DS	0x0012	local station not in ring
L2_LST_NO	0x0013	neg. ack., function-dependent
L2_LST_LR	0x0014	no local resources
L2_LST_IV	0x0015	invalid parameter in request
L2_LST_LO	0x0020	low resp. data send
L2_LST_HI	0x0021	high resp. data send
L2_LST_NO_DA TA	0x0022	no data resp. data send

Table 14.4 FDL Error Messages

14.2.2 GP Test Functions

With the GP test functions, the user can determine the statuses of individual parts of the system and localize any errors from the PG.

14.2.2.1 Total Status of the GP Jobs

The total status of the GP jobs provides you with an overview of all or some of the data transmission statuses. The status job requests the statuses of the station from the point of view of the local station.
Up to 32 stations and their statuses can be displayed in two columns. The local station is highlighted. Other functions are explained with the softkeys.

The screen has the following layout:

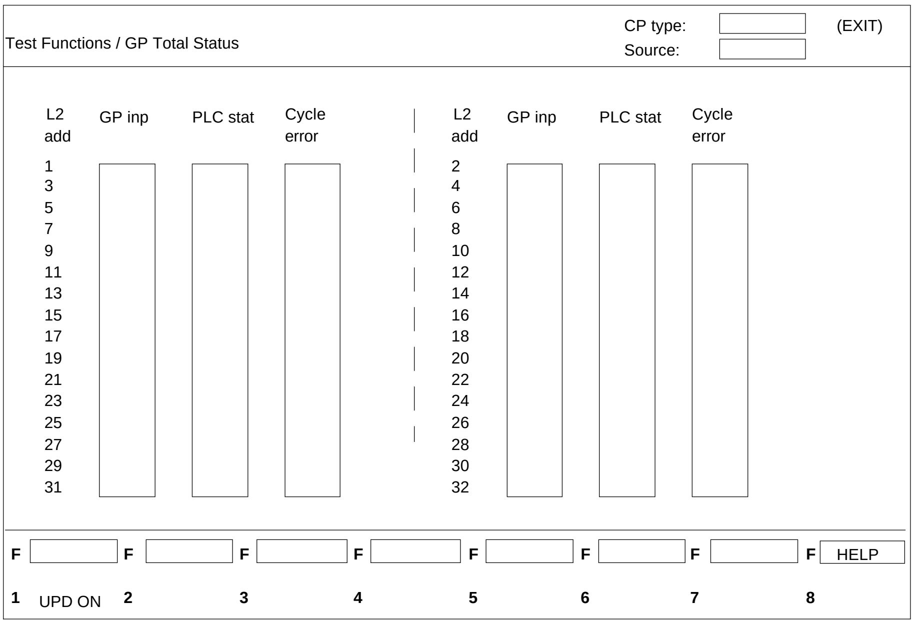


Fig. 14.6 GP-Total Status

Output fields:

L2 add:	Here, the L2 addresses of the master stations in the logical ring are displayed.
GP inp:	"X" indicates all the stations from which GP input bytes are expected.
PLC stat:	Indicates the PLC status. The status can only be RUN or STOP.
Cycle errors:	A data delay is indicated by "X".

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.

14.2.2.2 Display of the GP Output Values

The GP output values are displayed as bytes in ascending order.

The screen with the example parameters has the following structure:

Test Functions / GP Outputs — CP type: — Source: — (EXIT)

L2 station address: 2 — Status of GP: RUN

Sel.	Pos.	Output	GO	Symbol	Value	
	0	PY20	GPY 100		KH= 0	KM= 0000 0000
	1	PY21	GPY 101		KH= 0	KM= 0000 0000

F1	F2	F3	F4	F5	F6	F7	F8
UPD ON	STOP	START	STEP			SELECT	HELP / DESELECT

Fig. 14.7 GP Output Values

Output fields:

L2 station-address: The L2 address of the master station is displayed here.

Status of GP: Indicates the current status of the GP. The status can only be RUN (GP active) or STOP (GP was stopped).

Sel: Indicates with an asterisk that a line is selected.

Pos: Line index.

Output: Physical assignment of the output bytes of this station.

GO: Global Object or object name of the output.

Symbol: Symbolic name of the output.

Value Value of the output in KH (hexadecimal) and KM (bits).

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F2 STOP	With this key, you can send a stop message to the GP. The output values are then no longer updated. The status field then changes to STOP.
F3 START	With this key, you can send a start message to the GP. The output values are then no longer updated. The status field then changes to RUN.
F4 STEP	With this key, you can update the GP output bytes once. The status field then changes to STOP.
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the outputs screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.

F8 DESELECT	With this key, you can cancel the selection made with F7.

With the page up and page down keys you can page through the lines of the screen if they cannot all be displayed.

14.2.2.3 Display of the GP Input Values

The GP input values are displayed as byes in ascending order. The screen has the following layout:

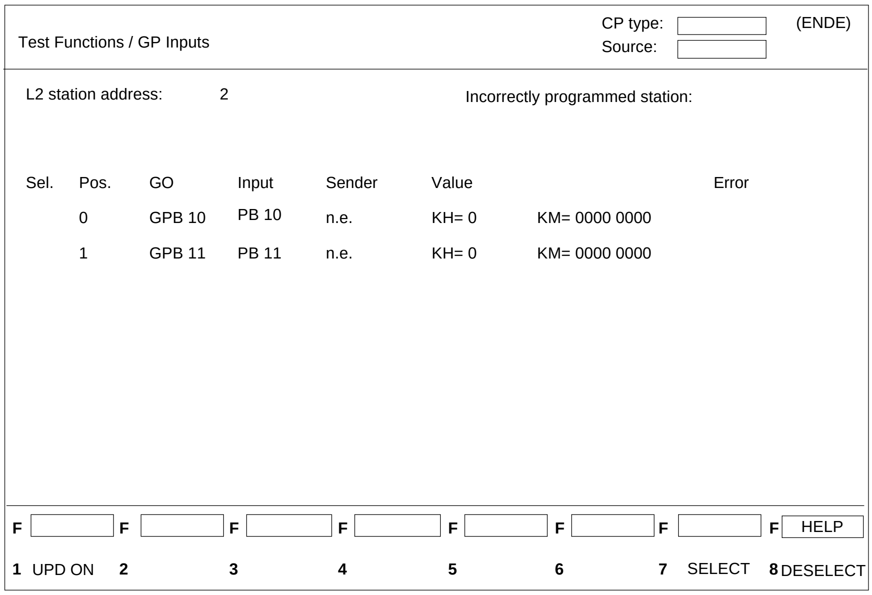


Fig. 14.8 GP Input Values

Output fields:

L2 station address:	The L2 address of the master station is displayed here.
Incorrectly programmed station:	Here, the first station is displayed that sent an incorrect GP byte.

Sel:	Indicates with an asterisk that a line is selected.
Pos:	Line index.
GO:	Global object or object name of the input.
Input:	Physical assignment of the input bytes of this station.
Sender:	L2 address of the GP sender. A GP byte, that has not yet been received cannot be assigned to a sender and is marked as n.e. (non-existent).
Value:	Value of the input in KH (hexadecimal) and KM (bits).
Error:	"X" indicates that a GP byte was received from two different stations.

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the input values screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.
F8 DESELECT	With this key, you can cancel the selection made with F7.

With the page up and page down keys you can page through the lines of the screen if they cannot all be displayed.

14.2.3 ZP Test Functions (CP 5430 TF)

With the ZP test functions you can determine the status of individual parts of the system during communication and localize any errors that are detected on the PG.

14.2.3.1 Total Status of the ZP Jobs

The total status of the ZP Jobs is displayed in the form of lists. The screen has the following structure:

Test Functions / ZP Total Status   CP Type: [ ] Source: [ ]   (EXIT)

L2 station address: 1

Sel.	Pos.	Rem. add.	DSAP	Output area from	to	Input area from	to	M	Status
	0	60	44			PB 8	PB 8	4	FO

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
UPD ON	INPUTS	OUTPUTS				SELECT	DESELECT
							HILFE

Fig. 14.9 ZP Total Status

Output fields:

L2 station address: The L2 address of the master station is displayed here.

Sel: Indicates with an asterisk that the line is selected.

Pos:	Display position. links are displayed in ascending order (0-255).
rem. add.:	Address of the remote station.
DSAP:	Remote SAP of the configured link.
Output area:	Physical output area of a ZP link.
Input area:	Physical output area of a ZP link.
M:	Specifies how often a station is entered in the polling list.
Status:	Provides the status of the selected station (hexadecimal) (see Table 14.4 and Table 14.5).

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F2 INPUTS	This calls the screen for the inputs of the currently selected link. Using the cursor keys, you can select a line with the inverse bar and examine it more closely.
F3 OUTPUTS	This calls the screen for the outputs of the currently selected link. Using the cursor keys, you can select a line with the inverse bar and examine it more closely.
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the input values screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.
F8 DESELECT	With this key, you can cancel the selection made with F7.

ID	Status	Meaning
ZP_ERR_START	0x00F0	Start-up ID
ZP_ERR_DIAG_REQ	0x00F1	Diagnostics request from ET200U
ZP_ERR_INP_TOO _LONG	0x00F3	Input area> receive_len of frame
ZP_ERR_I_FRA_TOO _LONG	0x00F4	Input area < receive_len of frame

Table 14.5 ZP Internal Errors

14.2.3.2 Display of the ZP Output Values

The ZP output values are displayed as byes in ascending order. The screen has the following layout:

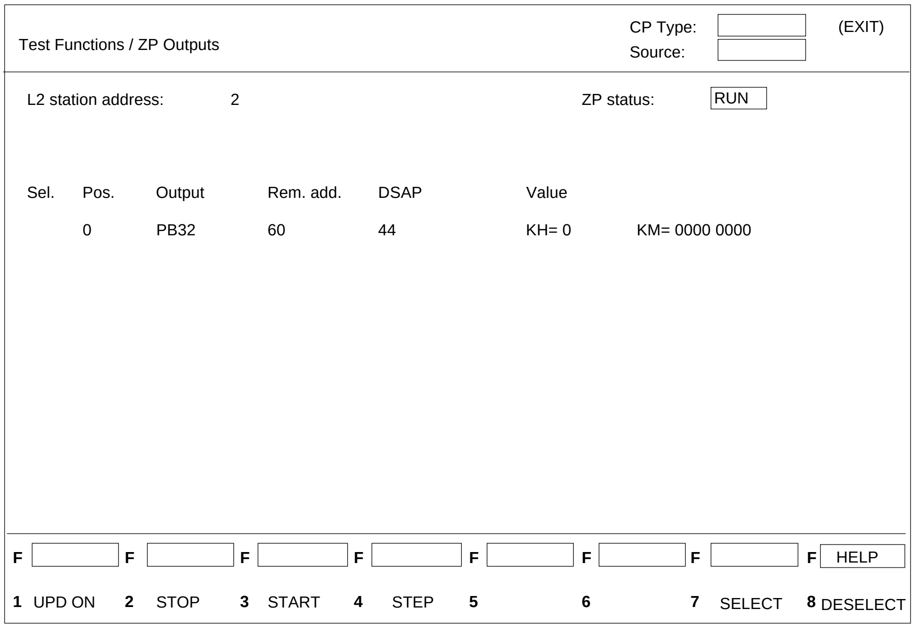


Fig. 14.10 ZP Outputs

Output fields:

L2 station address — Here, the L2 address of the local station is displayed.

ZP status: — Displays the current status of the ZP. The status can only be RUN (ZP active) or STOP (ZP was stopped).

Sel: — Indicates with an asterisk that the line is selected.

Pos: — Line index

Output:	Physical assignment of the output bytes of this station.
Rem. add:	Remote L2 address or address of the remote station.
DSAP:	Remote SAP of the configured link.
Value	value of the output in KH (hexadecimal) and KM (bits).

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F2 STOP	With this key, you can send a stop message to the ZP. The output values are then no longer updated. The status field then changes to STOP.
F3 START	With this key, you can send a start message to the ZP. The output values are then no longer updated. The status field then changes to RUN.
F4 STEP	With this key, you can update the ZP output bytes once. The status field then changes to STOP.
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the outputs screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.

F8 DESELECT	With this key, you can cancel the selection made with F7.

With the page up and page down keys you can page through the lines of the screen if they cannot all be displayed.

14.2.3.3 Display of the ZP Input Values

The GP input values are displayed as byes in ascending order. The screen has the following layout:

Test Functions / ZP Inputs — CP type: — Source: — (EXIT)

L2 station address: 2

Sel.	Pos.	Input	Rem. add.	DSAP	Value	
	0	PB36	60	44	KH= 0	KM= 0000 0000
	1	PB37	60	44	KH= 0	KM= 0000 0000
	2	PB38	60	44	KH= 0	KM= 0000 0000

F1	F2	F3	F4	F5	F6	F7	F8
UPD ON						SELECT	HELP DESELECT

Fig. 14.11 ZP Inputs

Output fields:

L2 station-address:	The L2 address of the master station is displayed here.
Sel:	Indicates with an asterisk that a line is selected.
Pos:	Line index.
Input	Physical assignment of the input bytes of this station.
Rem. add	Address of the remote station.

DSAP: Remote SAP of the configured link.

Value: Value of the input in KH (hexadecimal) and KM (bits).

Function keys:

F1 UPD ON	Using this key, you can update the content of the screen. Pressing this key activates the automatic, cyclic updating of the screen data, pressing it again deactivates the automatic updating.
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the input values screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.
F8 DESELECT	With this key, you can cancel the selection made with F7.

With the page up and page down keys you can page through the lines of the screen if they cannot all be displayed.

14.2.4 DP Test Functions

With the DP Test Functions you can find out the statuses on individual DP slaves and the DP master ONLINE and to localize any errors.

14.2.4.1 DP Total Status

The test function total status of the DP jobs displays a list of the communications statuses of all configured DP slaves. The screen has the following layout:

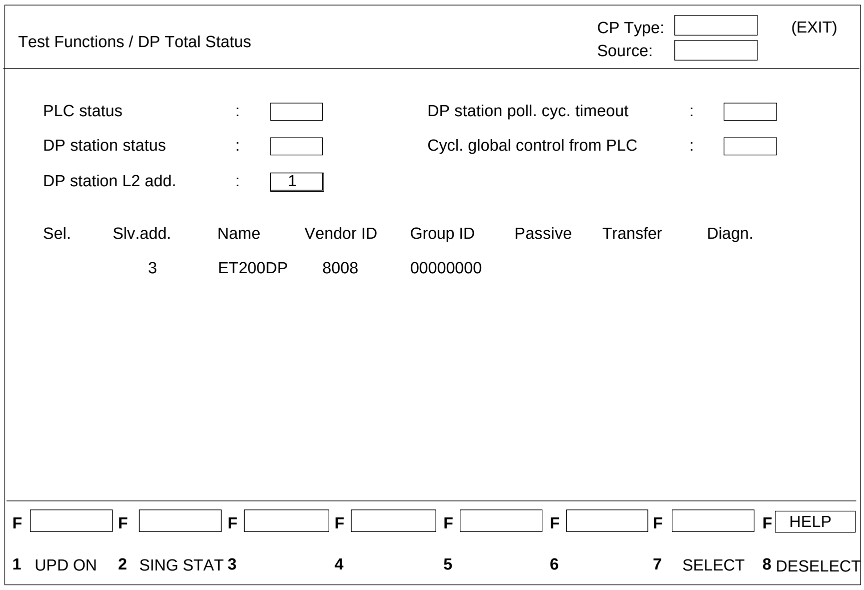


Fig. 14.12 DP Total Status

Output fields:

PLC status: Indicates the PLC status. The status can only be RUN or STOP.

DP station status:	Local DP master mode with the following meaning: RUN: DP polling list is processed. STOP: DP polling list is not processed. Clear: DP polling list is processed, all output data bytes are sent with the value "0".
DP station L2 add:	Bus address of the DP master (CP).
DP station poll. cyc. timeout:	An asterisk indicates that the DP polling list could not be processed in the set time.
Cycl. global control from PLC:	An asterisk indicates that a cyclic global_control control command is currently being processed.
Sel:	Indicates with an asterisk that a line is selected.
Slave address:	Bus address of the DP slave.
Name:	The names of the DP slaves specified in parameter assignment are displayed here.
Vendor ID:	The configured vendor identifier of the DP slave is shown here.
Group ID:	The group ID of the DP slave specified in parameter assignment is displayed here.
Pass.:	An asterisk here indicates that there is no parameter assignment for this slave (neither an input nor output area was specified in the DP editor).
Transfer:	An asterisk here indicates that this slave is in the cyclic data transfer phase with the master.
Diagn.:	An asterisk here indicates that there are new diagnostic data from the slave.

Function keys:

F1 UPD ON	This key switches on automatic cyclic updating of the screen data.
F1 UPD OFF	This key switches off automatic cyclic updating of the screen data.
F2 SING-STAT	This key branches to the screen for the DP single status. The selection criterion is the cursor position (inverse bar).
F7 SELECT	Using this key, or the enter key, you can select lines from the complete list of the outputs screen by marking them with the inverse bar controlled by the cursor keys. These selected lines are then the only lines displayed after pressing the update key F1. You exit this mode with the ESC key.
F8 DESELECT	With this key, you can cancel the selection made with F7.

14.2.4.2 DP Single Status

The screen for the test function "DP single status", which can be called in the total status screen, has the following layout:

Test Functions / DP Single Status — CP type: — Source: — (EXIT)

Data being updated - CP in RUN

Slave L2 address	:	3	PLC status	:	
Slave name	:	ET200DP	DP station status	:	
Master L2 address	:		DP station L2 address	:	1
Vendor ID	:	8008	DP station in ring	:	
Group ID.	:	00000000	DP station - slave	:	pass.

Station diagnos.:

StationNonExistent	:	StaticDiag	:	ParameterRequest	:
StationNotReady	:	ExtStatusMessage	:	ParameterFault	:
InvalidSlaveResponse	:	ExtDiagMessage	:	SlaveConfigCheckFault	:
ServiceNotSupported	:	ExtDataOverflow	:	MasterConfigCheckFault	:
MasterLock	:	SyncMode	:	SlaveDeactivated	:
WatchdogOn	:	FreezeMode	:	StatusFromSlave	:

Device diagn.:

No diagnostic data received

F1	F2	F3	F4	F5	F6	F7	F8
UPD ON		ID&C DIAG					HELP

Fig. 14.13 DP Single Status

Output fields:

Slave L2 address: Station address of the DP slaves.

Slave name: The name of the DP slave specified in parameter assignment is displayed here.

Master L2 address: Station address of the DP master, which assigned parameters to and configured the DP slave.

Vendor ID:	The configured vendor ID or (if possible) the vendor ID sent by the slave is displayed here.
Group ID:	The group ID of the DP slave specified in parameter assignment is displayed here.
PLC status:	The mode of the PLC is displayed here (RUN/STOP).
DP station status:	Local DP master mode with the following meaning: RUN: DP polling list is processed. STOP: DP polling list is not processed. Clear: DP polling list is processed, all output data bytes are sent with the value "0".

DP Status	Poll active slaves	Q data: PLC -> Slaves	I data: Slaves-> PLC
STOP	no	no	no
CLEAR	yes	yes, Q data= zero	yes
RUN	yes	yes	yes

DP station L2 address:	Bus address of the DP master station (CP), on which you have just selected the single status function.
DP station in ring:	yes/no: indicates whether or not the DP master station (CP), on which you have just selected the single status function is in the logical ring.
DP station slave:	active/passive, indicates whether the DP slave was configured with (-> active) or without I/Os (-> passive) in the DP editor.
Station diagn.:	For the meaning of the bits, refer to Section 11.7 "Single DP Slave Diagnostics").
Master Config Check Fault:	An asterisk here indicates that the DP master of the DP slave detected a configuration error during the initialization phase. Possible causes are: - configured I/O area for the slave does not match the

DP slave I/O configuration

- DP slave works with consistent I/O areas, but the free mode is configured on the CP.

Device diagn.:	Here, the general DP slave device-specific diagnostic messages are displayed, see documentation of the DP slave).

As soon as ID and/or channel-related diagnostic information exists, this is indicated by COM.
After stopping the DP single status updating with F1, you can branch to the ID and channel-related diagnostics with F3 "ID&C DIAG".

Function keys:

F1 UPD ON	This key switches on automatic cyclic updating of the screen data.
F1 UPD OFF	This key switches off automatic cyclic updating of the screen data.
F3 ID&C DIAG	This key branches to the ID and channel-related diagnostics.

14.2.5 FMA Test Functions

These test functions are used to read out the Layer 2 statistics.

14.2.5.1 Local Life List

This screen contains a list of all the active and passive stations on SINEC L2.

The screen has the following structure:

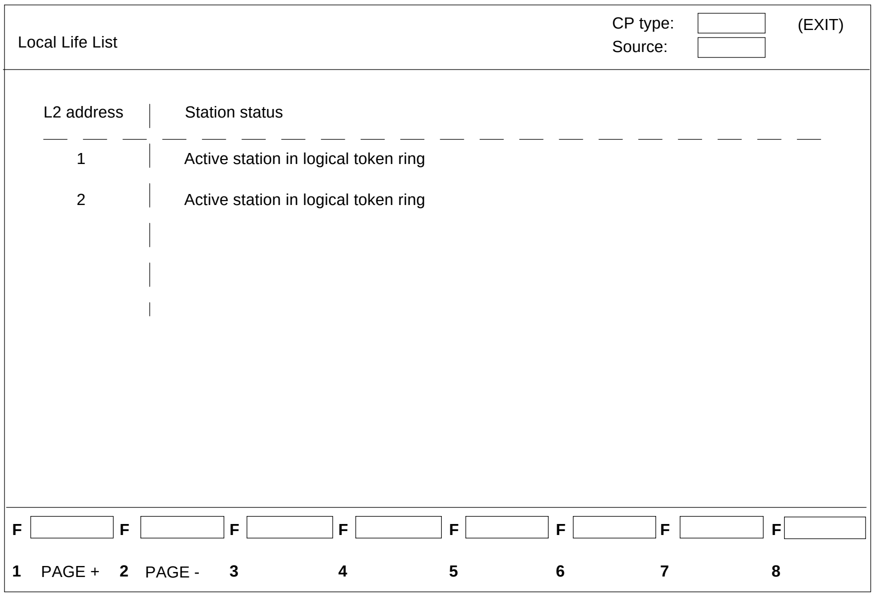


Fig. 14.14 Local Life List

Output fields:

L2 address: The L2 addresses of all the stations in the logical ring are displayed.

Station status: Possible entries: "active station in the logical token ring" or "passive station in the logical token ring".

Function keys:

F1 PAGE +	Page one page forwards.
F2 PAGE -	Page one page backwards.

14.2.5.2 Station-oriented Statistics

This screen contains station-related statistical information.

The screen has the following structure:

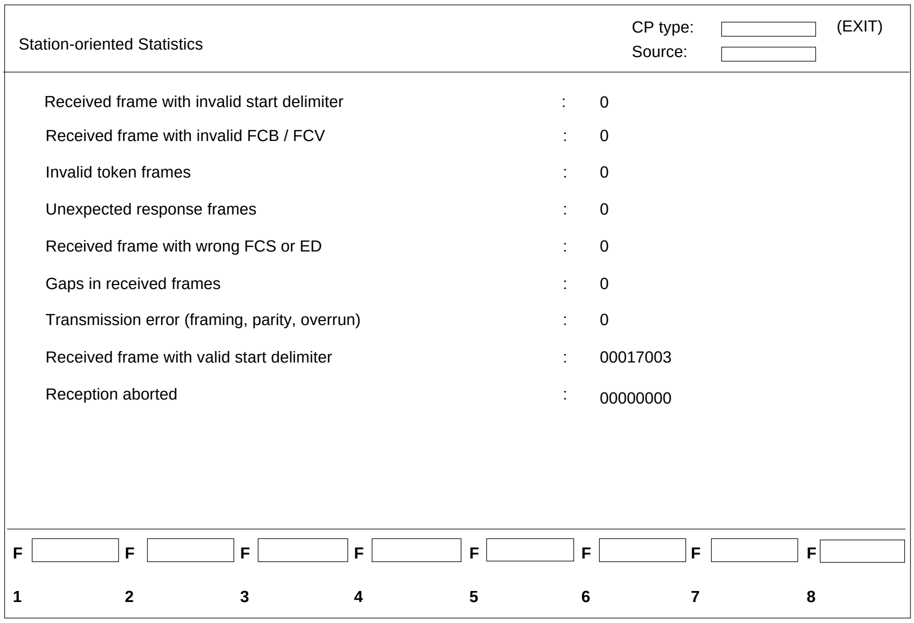


Fig.: 14.15 Station-oriented Statistics

Output fields:

Counted values about station statuses.

14.2.5.3 Bus-oriented Statistics

This screen contains bus-oriented statistical information to allow assessment of the bus response.

The screen has the following layout:

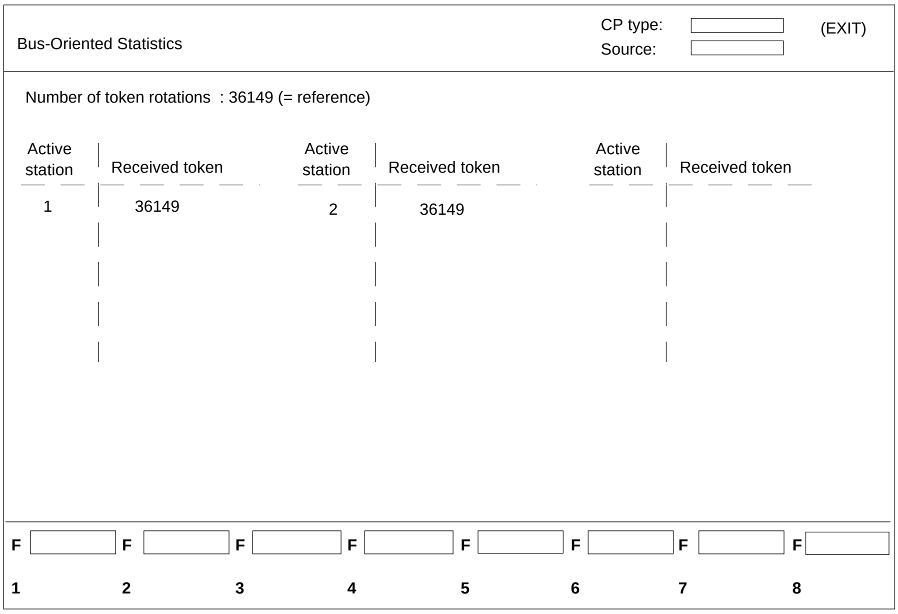


Fig.: 14.16 Bus-oriented Statistics

Output:

Counted values about statuses that occurred on the bus. ❑

NOTES

15 Utilities

The following figure is an overview of all the utilities available under the Utilities menu item. The individual utilities are described in this chapter.

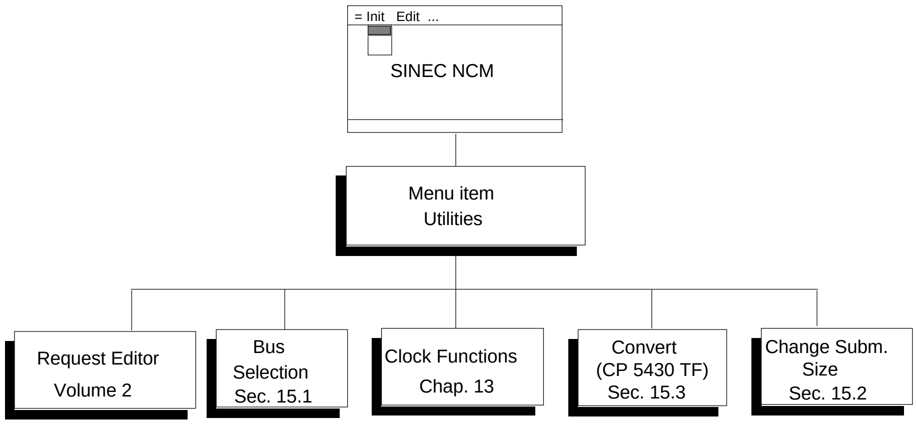


Fig. 15.1 Overview of the Utilities

15.1 PG Functions on the SINEC L2 Bus

The PG functions on the SINEC-L2 Bus allow you to obtain, monitor and configure stations (CPs, CPUs) in the network topology from a central PG.

A link from a PG to the required station is known as a path. Using this path, all the normal programming functions can be executed as if a direct point-to-point link existed. The selected devices or CPs on the path are known as nodes.

There are basically two ways of configuring a path.

The PG has only one AS 511 interface:

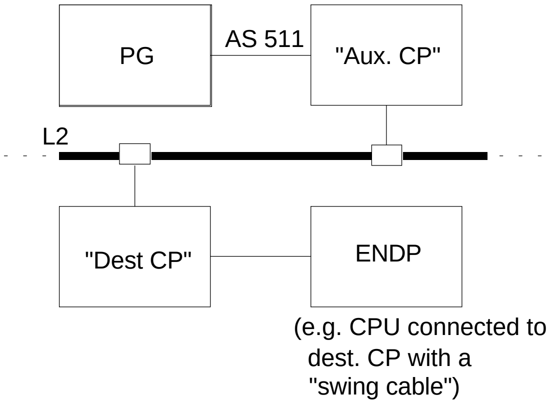


Fig. 15.2 PG via AS 511 (Path_1)

☞ **If the end point is an S5-95U with a SINEC L2 interface and there is no other station on the bus, it may not be possible to establish the path on the PG interface.**

The PG has an internal L2 interface:

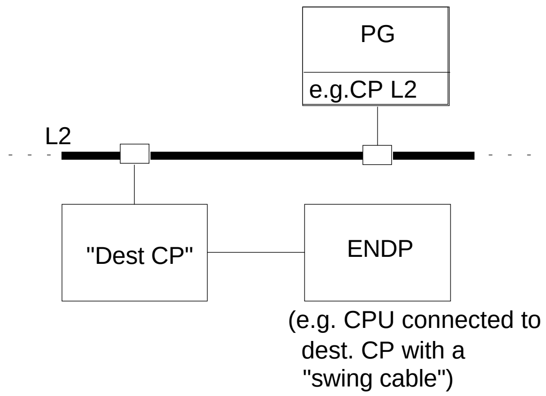
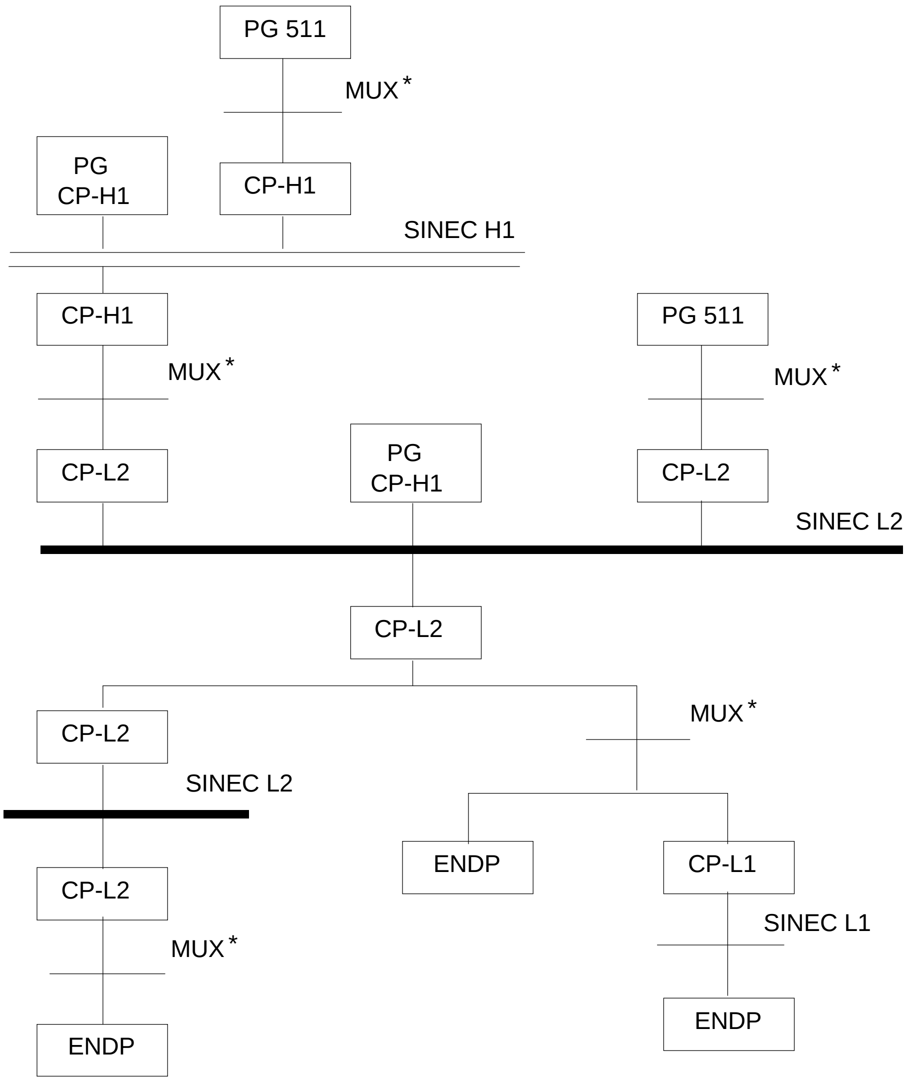


Fig. 15.3 PG via Internal L2 Interface (Path_2)

This path (see Fig. 15.2,15.3), symbolized by the path name can be used to monitor the selected station and if necessary to reconfigure it using the appropriate software packages (COM, LAD/CSF/STL).

The two paths shown here are examples that can be extended and modified to fit other topologies. It is, for example, possible to implement gateways between H1 and L2 networks (see Fig. 15.4).

Before you can use a path, you must first edit it using a suitable tool (Bus selection). This utility can be obtained both under SINEC NCM as well as under the normal S5 interface (KOMI).



MUX* In the diagram, this is an alternative to a direct connection, however, the maximum number of MUX levels is two.

Fig. 15.4 Overview of the Paths Possible on SINEC L2

15.1.1 Bus Selection - Creating Paths in Path Files

To be able to obtain remote active stations on the SINEC L2 bus with the PG, the "BUS SELECTION" utility is available under the SINEC NCM menu item. This provides tools with which you can edit paths and store them in a path file. Selecting a remote station via the L2 bus is only possible with S5-DOS from Stage VI onwards.

In the BUS SELECTION utility, you edit a dedicated link from a PG to the required station.

You can then activate this path to the required station under the menu item Init in the Path selection screen.

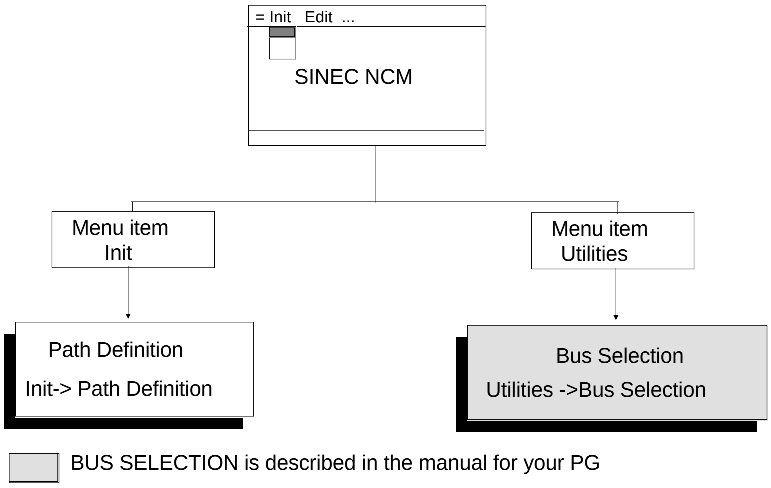


Fig. 15.5 Menu Structure of the PG Functions on the Bus

You can edit the paths with the corresponding station addresses both in the OFFLINE and ONLINE mode of the programmer. In the OFFLINE mode, the PATH is stored in the PATH FILE on diskette or hard disk, i.e. you edit the PATH on the screen and store it on diskette or hard disk. You can only activate a PATH in the ONLINE mode by calling up a PATH from diskette or hard disk or by activating the PATH you have just edited.

With the TERMINATE command of this utility, or by calling a different PATH, you can terminate a dedicated link again.

Example of a Path::
PG-->COR/MUX-->CP 5430 TF-->CP 5430 TF-->COR/MUX-->ENDP

15.1.2 Editing a Path

The method of editing a path is described in the manual for your PG under the utility "BUS SELECTION". Here, the procedure for the paths represented in Figs. 15.2 and 15.3 will be illustrated.

Path_1: (PG via AS511)

✔ Set the AS 511 interface in the PG

✔ Call the bus selection package

✔ Specify the path name and path file (this combination later selects the node in the application programs e.g. LAD/CSF/STL, NCM)

✔ Edit and store the path

✔ Check the path by attempting to activate it

Path_2: (PG via internal L2 interface)

✔ Set the L2 interface in the PG

✔ Call the bus selection package

✔ Specify the path name and path file

✔ Edit and store the path

✔ Check the path

- Activate the path only as far as the internal L2 interface module.
- Check and if necessary match the internal SYSID.
  The set bus parameters of the internal L2 interface module must not collide with the bus parameters of the external L2 CPs (e.g. data rate).
- Activate the remaining nodes of the path.

15.1.3 Activating the Edited Path

Before activating a path starting from a CP L2, the local (SYSID) parameters of the CP L2 must be matched to the L2 bus parameters.

How is the PATH activated?

An edited path can be activated as follows:

➢ In the NCM menu under menu item Init->Path selection (>screen: INIT PATH DEFINITIONS).

➢ In an S5 program package intended for path selection.

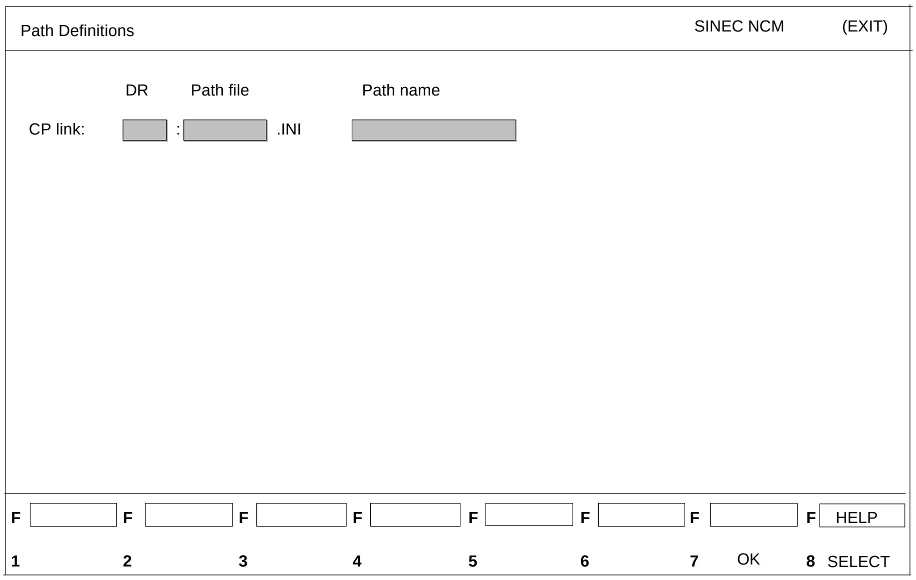


Fig. 15.6 Screen for Activting a Path

By activating a path, the link is established to a remote station.

The screen for Init->Path selection has the following structure

Input fields:

CP link /Path file:	Format: drive: file Drive Here, you must specify the drive you wish to work with. If you press F8, possible drives are displayed for selection. Path file Paths with different path names can be stored in this PATH FILE. A path file can contain up to 100 different paths. The path files are all of the type AP.INI (range of values: max. 6 ASCII characters).
Path name:	Each edited PATH in the path file is assigned a path name which you supply here in order to select the required PATH. (Range of values: max. 19 ASCII characters, first character must be a letter.)

☞ **If a path name is entered in the corresponding field, online operation is not possible via the AS 511 interface.**

☞ **Once a path name has been entered, it is stored by SINEC NCM even if the PG is switched off.**

Function keys:

F7 OK	The "OK" key enters the data.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key

15.2 Change Submodule Size

You can change the submodule size (16/32/64 bytes) using the menu item with this name in the Utilities menu.

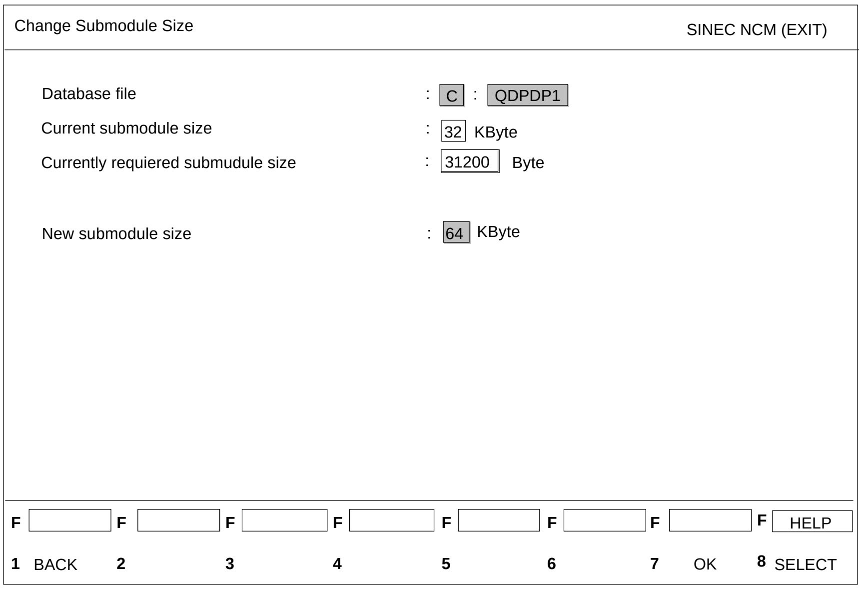


Fig. 15.7 Change the Submodule Size

Input fields:

Database file: Format: drive: database

- Drive: Here, you specify the drive with which you want to work. Press F8 to display a list of drives for selection.

- Database: All existing CP 5430/5431/5412 databases

New submodule size: Possible entries 16/32/64 Kbytes

Output fields:

Current sub-module size:	Memory capacity of the submodule in Kbytes (values: 16/32/64)
Currently required submodule size	Memory requirements of the currently selected database file in bytes; (minimum submodule size)

Function keys:

F1 BACK	With the BACK function, you can reverse the change. The old submodule size is selected again.
F7 OK	Starts the conversion to the new submodule size.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.

15.3 Convert CP 5430 Database old - new (CP 5430 TF)

The CP 5430 TF has its own menu item under "Utilities" with which you can convert old CP 5430 databases to new ones.

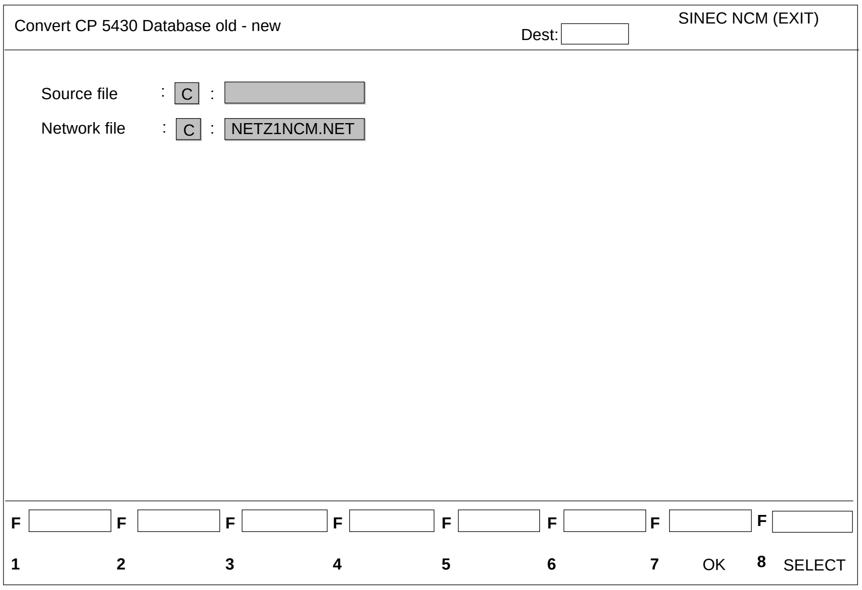


Fig. 15.8 Convert CP 5430 Database old - new Screen

Input fields:

Source file: Format: drive: source file name

- Drive: Here, you specify the drive with which you want to work. Press F8 to display a list of drives for selection.

- Source file name: Database file name of a database created with COM 5430 (A0).

Network file:	Format: drive: network file name
- Drive:	Here, you specify the drive with which you want to work. Press F8 to display a list of drives for selection.
- Network file name:	Destination network file where the new database will be saved. The new database name is displayed in the "Dest:" output field and matches that specified with "Init -> Edit". The database file specified for conversion must be new.
F7 OK	This function key starts the conversion.
F8 SELECT	If you press this key, a selection list is displayed with possible entries for fields which cannot be edited freely. Select entries from the list with the cursor keys and enter them in the field with the return key.❑

NOTES

16 Working with the Application Examples

On the COM 5430 TF/COM 5431 FMS diskette, you will find all the COM and STEP 5 user files required to work through the application examples.

The application examples were written for RAMs on both the CPs and the CPUs.

The following general procedure is recommended for working with the example programs:

➢ Delete the CPUs and switch to the STOP mode.

➢ In the SIMATIC S5 package, select the preset ON and select the program file you want to work with.

➢ Transfer all the blocks from FD to the CPUs.

➢ Switch the CPs you are using to STOP with the mode selector switch.

➢ Call the COM and select the required database file on diskette in the menu item "INIT -> EDIT".

➢ Transfer the database files to the CP with menu item "TRANSFER -> CP Database Transfer -> FD -> CP" and the key F2 TOTAL.

➢ Switch the CPs to RUN.

➢ Once the configuration data have been transferred to the CPs, you must switch the power off and on again so that the CPs accept the new configuration (SSNR, I/O area being used).

➢ Switch the CPUs of the programmable controllers to RUN.

The following list include all the COM and STEP 5 files required for the application examples:

List of example programs for the CP 5430 TF:

S5-S5
AGAGT1ST.S5D
AGAGT2ST.S5D
OAGAG.115
OAGAG.155
AGAGONCM.NET
AGAGONCM.BPB

LAYER2
LAY2T1ST.S5D
LAY2T2ST.S5D
LAY2ONCM.NET
LAY2ONCM.BPB
OLAY2T1.155
OLAY2T2.115

GP
OGPTLN1.155
OGPTLN2.115
OGPTLN3.135
GP115UST.S5D
GP155UST.S5D
GP135UST.S5D
GPO@@NCM.NET
GPO@@NCM.BPB

DP
DIAGNOST.S5D
STATIOST.S5D
EINZELST.S5D
ODPTLN1.115
DP115UST.S5D
DPO@@NCM.NET
DPO@@NCM.BPB

ZP
OZPTLN1.115
ZP115UST.S5D
ZP95U@ST.S5D
ZP@@@NCM.NET
ZP@@@NCM.BPB

TF
TF115UST.S5D
OTFTLN1
OTFTLN2
TF@@@NCM.NET
TF@@@NCM.BPB

List of example programs for the CP 5431 FMS:

S5-S5
AGAGT1ST.S5D
AGAGT2ST.S5D
QAGAG.115
QAGAG.155
AGAGQNCM.NET
AGAGQNCM.BPB

LAYER2
LAY2T1ST.S5D
LAY2T2ST.S5D
LAY2ONCM.NET
LAY2ONCM.BPB
QLAY2T1.155
QLAY2T2.115

GP
QGPTLN1.155
QGPTLN2.115
QGPTLN3.135
GP115UST.S5D
GP155UST.S5D
GP135UST.S5D
GPQ@@NCM.NET
GPQ@@NCM.BPB

DP
DIAGNOST.S5D
STATIOST.S5D
EINZELST.S5D
QDPTLN1.115
DP115UST.S5D
DPQ@@NCM.NET
DPQ@@NCM.BPB

FMS
FERTIGST.S5D
LAGER@.ST.S5D
QFERTIG.TN1
QLAGER.TN2
QZIBEIS.TN1
FMS2@NCM.NET
FMS2@NCM.BPB
ZIBEISST.S5D
FMS1@NCM.NET
FMS1@NCM.BPB❑

17 Appendix

17.1 Job Numbers for the CP 5430 TF

ANR	HDB
0	Send or Receive All
1 - 32	Send via Layer 2
33 - 96	Send or Receive via L2 Transport (TF)
97 - 100	Disabled
101-132	Receive via Layer 2 (S5S5 link)
133	Disabled
134-186	Free access to Layer 2
187-199	Disabled
200	FMA services
201	Read out the GP station list
202	Read out the ZP station list
203	Fileserver associations
205	Local jobs (PI, domain)
206-209	Disabled
210	Synchronization GP/ZP/DP output byte
211	Synchronization GP/ZP/DP input byte
212-217	Disabled
218	Transfer or receive the time of day
219-223	Disabled
224-255	Does not exist

Table 17.1 Overview of the Job Numbers for the CP 5430 TF

SAP	Use	ANR
0	Disabled	------------
1	Disabled	------------
2 . . . 33	These SAPs are normally used for S5S5. Their use for free layer 2 access or FMS application associations is possible as long as the memory limits are kept to (total number of links); double use of a SAP must, however, be avoided.	1 - 32 Send S5S5 link 101-132 Receive S5S5 link
34 . . . 53	These SAPs are normally used for free layer 2 access. If they are not used for this purpose, they can be used for FMS application associations. (Caution: make sure the SAPs are only used by one service!)	134-185 Free layer 2 access 134-199 FMS application associations
54	DP master class 2 response	
55	Clock function	218 Read/set clock
56	S5-95 standard link	206-209 free 212-217 free 219-223 free 200 FMA services 201 Read out GP station list
57	Free	
58	Polling SAP for cyclic FMS application association	ANR not assigned to a service
59	Reserved for PG links	
60	Reserved for GP broadcast	
61	Default SAP for DP	
62	Reserved for GP Request frame and for DP slave services	
63	Disabled	

Table 17.2 Assignment of the SAPs to the ANR for the CP 5431 FMS

17.2 Job Numbers for the CP 5431 FMS

ANR	HDB
0	Send or Receive All
1 - 32	Send via layer 2 (S5S5) *
33 - 100	FMS application associations
101-132	Receive über Layer 2 (S5S5 link) *
133	FMS application associations
134-186	Free access to layer 2 *
187-199	FMS application associations
200	FMA services
201	Read out the GP station list
202	Read out the ZI station list/DP station list
203-208	Disabled
209	DP- special services
210	Synchronization GP/DP output byte
211	Synchronization GP/DP input byte
212-217	Disabled
218	Transfer/receive the time of day
219-223	Disabled
224-255	Does not exist

Table 17.3 Overview of the Job Numbers for the CP 5431 FMS

* These job numbers can also be used for FMS application associations. Make sure, however that there are no double assignments. The ANR is assigned either to an S5S5 link or a free layer 2 link or and FMS application association.

SAP	Use	ANR
0	Disabled	------------
1	Disabled	------------
2 . . . 33	These SAPs are normally used for S5S5. Use as "free channels" is only possible when less than the maximum number of links have been defined.	1 - 32 Send S5-S5 link 101-132 Receive S5-S5 link
34 . . . 53	These SAPs are not used by the system program of the CP 5430 TF and are available as "free channels" . - free layer 2, PG access (caution, make sure there is not double assignment!)	33 - 96 Application associations 97 -100 free 134-186 Free Layer 2 access
54	DP master class 2 response	
55	Clock function	218 clock function
56	S5-95 standard link	187-199 free 206-209 free 212-217 free 219-223 free 200 FMA services 201 read out GP station list 202 read out ZP station list
57	Free	
58	Free	
59	Reserved for PG- links	-----------
60	Reserved for GP broadcast	210 synch. GP/ZP output bytes
61	Reserved for ZP/DP	210 synch. GP/ZP/DP output bytes 211 synch. GP/ZP/DP input bytes
62	Reserved for GP request frame	211 synch. GP/ZP input bytes
63	Disabled	224-255 not defined

Table 17.4 Assignment of the SAPs to the ANR for the CP 5430 TF

17.3 SAP - Job Number Assignment

Before you can work with free channels, the SAPs involved must be configured with the free layer 2 links.

While the dual-port RAM sizes are limited to 128 bytes for the predefined S5S5 links, data units of up to 256 bytes can be exchanged using "free channels". This allows transmission of blocks of data with a maximum length of 242/256 bytes. The first 8 bytes of these 256 bytes are used for the header.

17.4 Overview of the Error Messages

The error messages are listed here to provide you with an overview.

17.4.1 Messages in the status word for predefined S5S5 links, free layer 2 and FMA

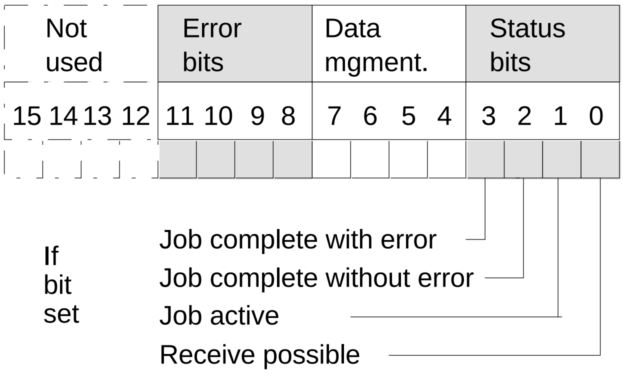


Fig. 17.1 Structure of the Status Word here: Status Bits

Bits 8 -11	Meaning of the error bits
0_H	No error. If bit 3 "job complete with error" is nevertheless set, this means that the CP has set up the job again following a cold restart or RESET.
1_H	Wrong type specified in block call (QTYP/ZTYP).
2_H	Memory area does not exist (e.g. not initialized).
3_H	Memory area too small. The memory area specified in the HDB call (parameters Q(Z)TYP, Q(Z)ANF, Q(Z)LAE) is for too small for the data transmission.
4_H	Timeout (QVZ). Acknowledgment from the memory cell is absent during data transfer. Remedy: check and if necessary replace the memory submodule or check and correct the source/destination parameters.
5_H	Incorrect parameters assigned to status word. The parameter "ANZW" was specified incorrectly. Remedy: correct the parameter or set up the data block correctly in which the ANZW is to be located.
6_H	Invalid source/destination parameter. Parameter ID "NN" or "RW" was used or the data length is too small (=0) or longer than 128 bytes. Remedy: use the correct Q(Z)TYP parameter; "NN" and "RW" are not allowed for this type of data transmission. Check the data length.
7_H	Local resources bottleneck. There are no data buffers available for processing the job. Remedy: retrigger the job, reduce the CP load.
8_H*	Remote resources bottleneck. No free receive buffer on the remote CP. Remedy: in the remote PLC, accept "old" data with the receive HDB, in the transmitting PLC repeat the transmit job.

Table 17.5 Error Bits (Bits 8..11) in the Status Word (continued in Table 17.6)

Bits 8 -11	Meaning of the error bits
9_H*	Remote error. The remote CP has acknowledged the job negatively because e.g. the SAP assignment is incorrect. Remedy: reassign parameters for the link.
A_H*	Connection error. The sending PLC or receiving PLC is not connected to the bus. Remedy: switch systems on/off or check bus connections.
B_H	Handshake error. The HDB processing was incorrect or the HDB monitoring time was exceeded. Remedy: start the job again.
C_H	System error. Error in the system program. Remedy: inform Siemens service.
D_H	Disabled data block. The data transmission is or was disabled during the HDB processing.
E_H	Free
F_H	Link or ANR not specified. The job is not defined on the CP. Remedy: program the job (link) or correct the SSNR/ANR in the HDB call.
* only applies to S5-S5 links. With free layer 2 and FMA jobs, the errors are identified in greater detail by the link_status in the confirmation header	

Table 17.6 Error Bits (Bits 8..11) in the Status Word (continued from Table 17.5)

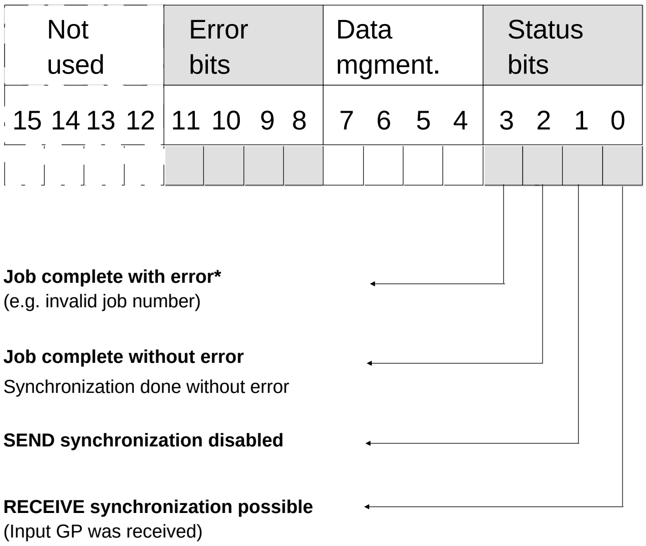
The following table lists the Profibus error IDs (link_status) modeled on the S5-S5 error messages.

PROFIBUS	Meaning	ANZW error ID
00 OK	No error	0 No error
01 VE	Negative acknowledgment	9 Remote error
02 RR	Remote resources not available	8 Resources remote
03 RS	Remote SAP not defined	9 Remote error
10H LS	Station not defined	C System error
11H NA	No reaction from station	A Link error
12H DS	Station not in ring	A Link error
15H IV	Invalid parameter	C System error

Table 17.7 Profibus Error ID (link_status)

17.4.2 Global I/Os - Error Bits

Structure of the status word for HDB SEND (ANR 210) and RECEIVE (ANR 211)



* Bit 3 of the status bits is not connected with the error bits (8..11).
When bit 3 is set, the error is not specified by the error bits. All the errors listed in table 7.3 are possible.

Fig. 17.2 Structure of the status word, here: Status Bits

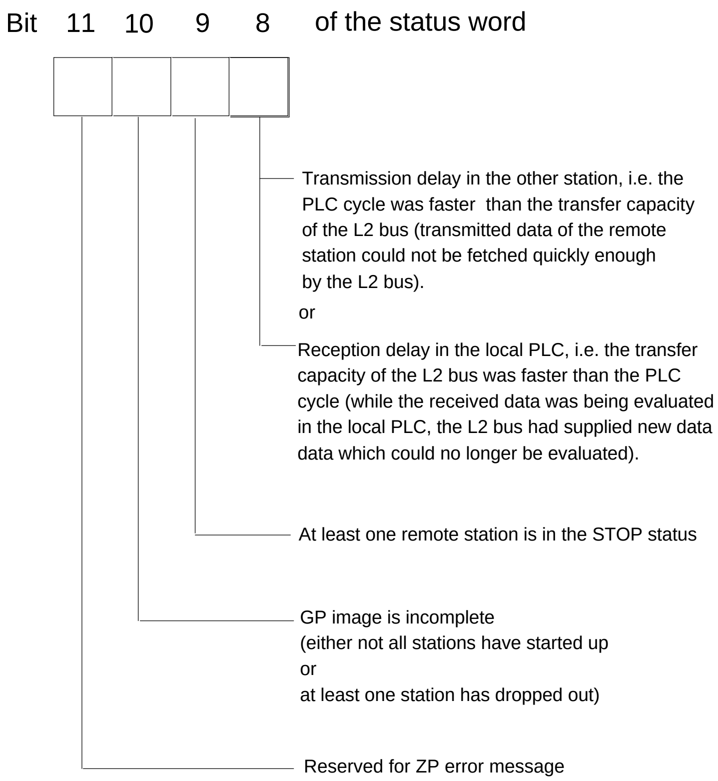


Fig. 17.3 Meaning of the Error bits in the Status Word in RECEIVE

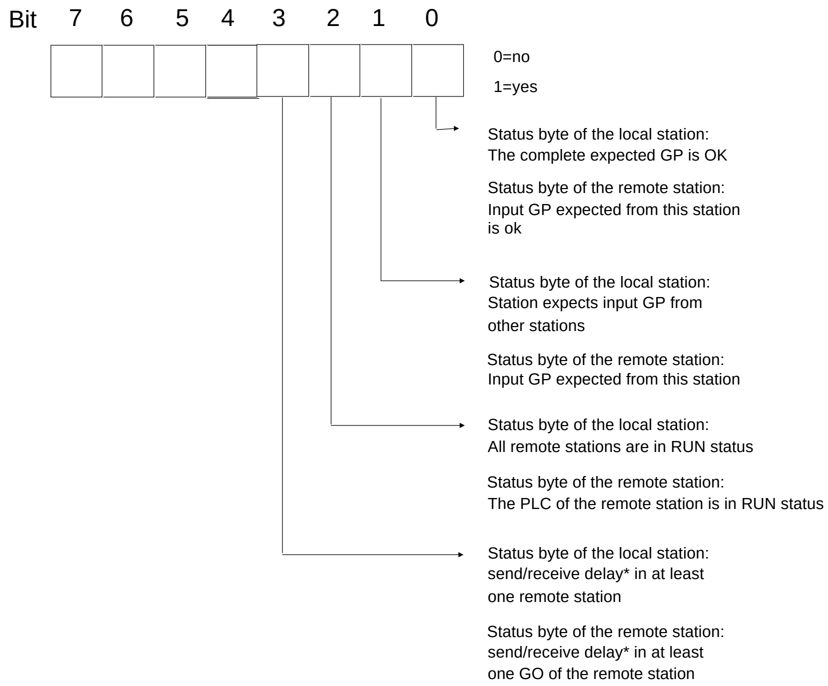
Evaluation of the GP station list (HDB RECEIVE with ANR 201)

Every CP that receives global I/Os manages a GP station list internally. This list is 32 bytes long.
Each of the 32 bytes provides information about the status of an active L2 station (max. 32 stations) using global objects with which the stations evaluating the station list are "connected".

Byte no.	Status byte of the stations
0	Status byte station 1 (L2 station address 1)
1	Status byte station 2 (L2 station address 2)
...	
31	Status byte station 32 (L2 station address 32)

Table 17.8 Structure of the GP Station List

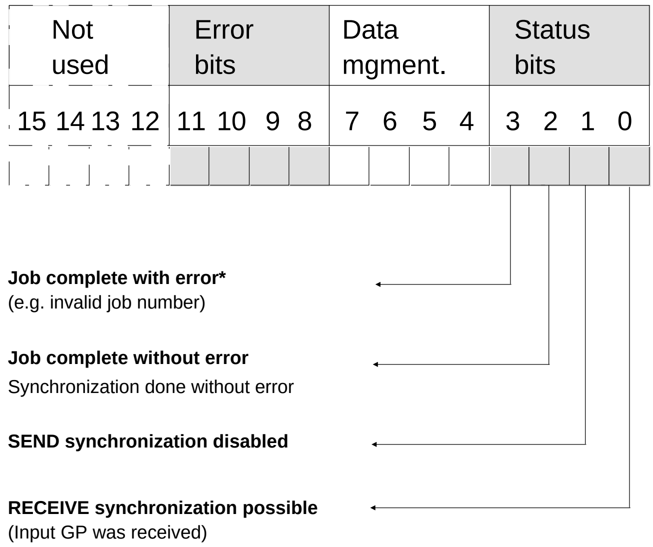
Explanation of the individual bits of the status byte:



*With send/receive delay, GOs have changed more often than they could be sent or received (intermediate values can be lost)

Fig. 17.4 Structure of a Status Byte of the Station List

17.4.3 Cyclic I/Os Error Messages



* Bit 3 of the status bits is not connected with the error bits (8..11).
When bit 3 is set, the error is not specified by the error bits. All the errors listed in table 7.3 are possible.

Fig. 17.5 Structure of Status Word HDB SEND (ANR210) and RECEIVE (ANR 211), Status Bits

Error bits for RECEIVE-HDB (ANR 211)

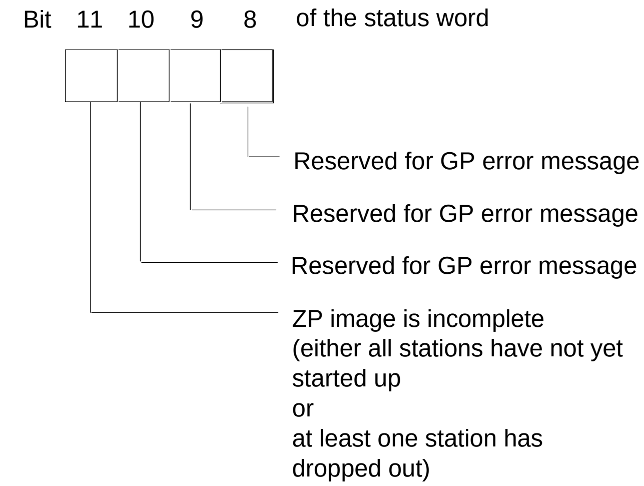


Fig. 17.6 Error Bits in RECEIVE-HDB (ANR 211)

Error bits for the ZP station list (ANR 202)

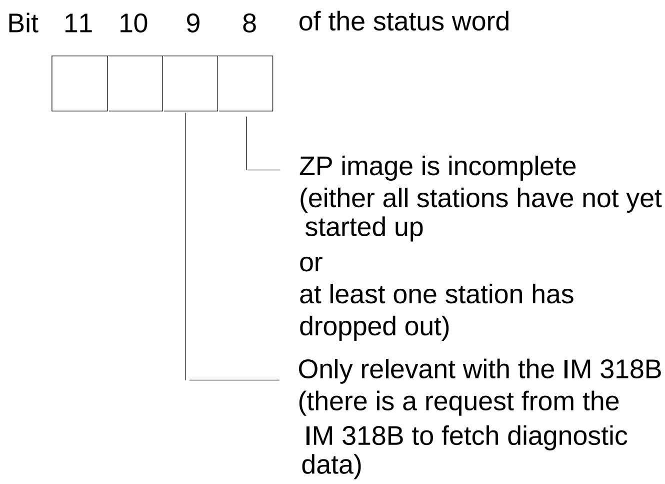


Fig. 17.7 Error Bits of the ZP Station List

Structure of the ZP station list (ANR 202)

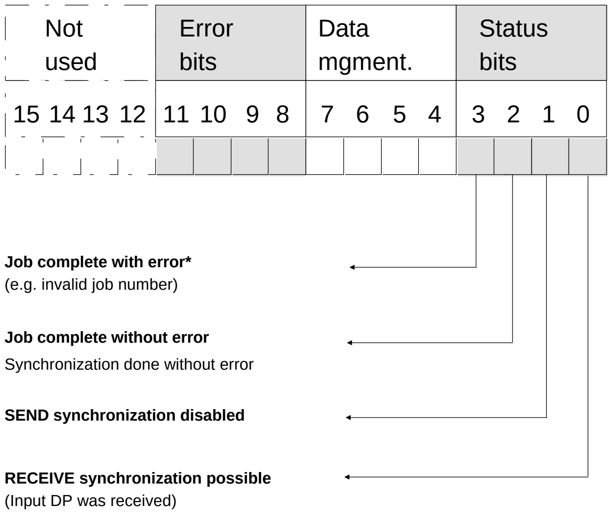
The station list has a length of 16 bytes, with each bit assigned to a station address.

Byte	0								1								2 - 14	15							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0
Station address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 119	120							127

Fig. 17.8 Structure of the ZP Station List

17.4.4 DP Error Displays

Structure of the status word for HDB SEND (ANR 210) and RECEIVE ANR 211).



* Bit 3 of the status bits is not connected with the error bits (8..11).
When bit 3 is set, the error is not specified by the error bits. All the errors listed in table 7.3 are possible.

Fig. 17.9 Structure of the Status Word, here: Status Bits

DP group messages of the DP station list

The DP ANZW bits 8-11 of job 202 provide the following DP group message:

Bit 11 10 9 8 of ANZW/A-NR: 202

0 = no error, all the configured DP slaves are in the data transfer phase
1= at least one DP slave is not in the data transfer phase

Cause of error, what to do:
To find out which slave(s) is affected, you must read out the DP station list using HDB-RECEIVE A-NR: 202.

Possible causes of a group message are;

- DP slave, does not reply on the bus (not connected, switched off)

0 = there are no new diagnostic data for DP slave
1= there are diagnostic data for a DP slave

Cause of error, what to do:
To find out which slave(s) is affected, you must use the special service "DP station diagnostic list" HTB-A-NR: 209, to read out the diagnostic list

Using the special service "Read single DP slave diagnostic data", HTB-A-NR: 209, it is possible to obtain an accurate error analysis for every slave.

0 = cyclic global control job not sent
1= cyclic global control job sent

0 = no timeout occurred during processing of the DP polling list
1= a timeout occurred during processing of the DP polling list

The selected monitoring time for processing the polling list was exceeded.

Possible causes of this error message:
- problems on the bus
- delayed DP polling list processing due to parallel processing of other acyclic services on the CP.

Fig. 17.10 The ANZW Bits 8-11 of Job 202

Structure of the DP station list (ANR 202)

The DP station list has a length of 16 bytes (128 bits). Each bit of the DP station list corresponds to one of the possible station addresses on the bus of the DP slave stations.

Byte	0								1								2 - 14	15								
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0	
Station address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 119	120				124			127	*)

*) The first and last two bits in the station list are not relevant, since the permitted station address on the L2 bus must be in the range 1-125

Fig. 17.11 Structure of the DP Station List

Structure of the DP diagnostic list (ANR 209)

The DP diagnostic list has a length of 16 bytes (128 bits). Each bit of the DP diagnostic list corresponds to one of the possible station addresses on the bus of the DP slave stations.

Byte	0								1								2 - 14	15								
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0	
Station address	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 119	120				124			127	*)

*) The first and last two bits in the station list are not relevant, since the permitted station address on the L2 bus must be in the range 1-125

Fig. 17.12 Structure of the DP Diagnostics List

Meaning of the acknowledgment messages for special job ANR 209

Acknowledgment:

00 Hex	No error
01 Hex	Syntax error in job field.
02 Hex	Error in HDB handling.
03 Hex	CP not in logical token ring.
04 Hex	Slave station not configured.
05 Hex	Slave not responding (failed).
06 Hex	Slave station not in data transfer phase
07 Hex	CP not in cycle-synchronized mode
08 Hex	Global_Control: mode not allowed
09 Hex	Global_Control: no active slave selected
0A Hex	CP check of slave configuration detected error
0B Hex	DP STOP status
0C Hex	Global_Control: acyclic Global_Control

17.5 Overview of the FMA Services

		Relevant bytes in the request field			
You want to....	.. then use the service	FDL request (byte 0)	Service code (byte 2)	SAP no. (byte 5)	rem add station (byte 6)
Read current bus parameters	FDL_READ_VALUE	00_H	OB_H (= 11)	_____	______
Read status values of an SAP	LSAP_STA-TUS	00_H	19_H (= 25)	2...63	0...126
Obtain an overview of all stations con-nected to the bus (query the local sta-tions)	FDL_LIFE_LIST_CREATE_LOCAL	00_H	$1B_H$ (= 27)	_____	______
Read identification of a station	FDL_IDENT	00_H	$1C_H$ (= 28)	______	0...126
Read station-oriented statistics	FDL_READ_STATISTIC_CTR	00_H	$1D_H$ (= 29)	______	______
Read station-oriented statistics	FDL_READ_LAS_STATISTIC_CTR	00_H	$1E_H$ (= 30)	______	______

Table 17.9 Overview of the FMA Services

Byte	Field to be sent (request)	Byte	Field received (Confirmation/Indication)
0	com_class FDL request=00 (service request to layer 2)	0	com_class FDL confirmation = 01H (acknowledgment from layer 2 firmware after FDL request) or FDL Indication = 02H (data received)
1	user_id Freely assigned ID that is returned unchanged in the confirmation	1	user_id Identifier assigned in an FDL request (only relevant for confirmation; with indication the value is "0")
2	service_code Type of requested service: SDA = 00_H SDN = 01_H SRD = 02_H RPL_UPD_S = 06_H RPL_UPD_M = 07_H	2	service_code Type of service provided by the layer 2 firmware SDA = 00_H / SDN = 01_H SRD = 32_H Only with FDL confirmation: RPL_UPD_S = 06_H RPL_UPD_M = 07_H Only with FDL indication: SDN_MULTICAST = $7F_H$
3	link_status only relevant for confirmation relevant	3	link_status (see table 17.11)
4	service_class (priority) Low = 0_H, High = 1_H	4	service_class (priority) Low = 0_H, High = 1_H
5	DSAP/RSAP Number of the destination SAP (default SAP = FF_H)	5	DSAP/RSAP Number of the remote SAP (=Source-SAP) (default SAP = FF_H)
6	rem_add_station station address of the receiving station	6	rem_add_station station address of the receiving station
7	rem_add_segment logical segment address; always enter FF_H	7	rem_add_segment logical segment address; always enter FF_H

Table 17.10 Structure of the Confirmation/Indication/Request Header

Value of link_status	Abbreviation PROFIBUS	Meaning
		SDA
00_H	OK	Positive-acknowledgment, service executed.
01_H	UE	Negative-acknowledgment, remote user/FDL interface error.
02_H	RR	Negative-acknowledgment, resources of remote FDL controller not available.
03_H	RS	Service or rem_add on remote SAP not activated.
11_H	NA	No reaction (Ack./Res.) from remote station.
12_H	DS	Local FDL/PHY not in logical ring or disconnected from the bus.
		SDN
00_H	OK	Positive acknowledgment, transmission of data from local FDL/PHY controller completed.
12_H	DS	Local FDL/PHY not in logical token ring or disconnected from the bus.
		SRD
08_H	DL	Positive acknowledgment, reply data low exist.
$0A_H$	DH	Positive acknowledgment, reply data high exist .
01_H	UE	Negative acknowledgment, remote user/FDL interface error.
02_H	RR	Negative acknowledgment, resources of the remote FDL controller not available.
03_H	RS	Service or rem_add on remote SAP not activated.
09_H	NR	Negative acknowledgment, resources of the remote FDL controller not available.
$0C_H$	RDL	Reply data (low) exist but negative acknowledgment of transmitted data 09_H (NR).
$0D_H$	RDH	Reply data (high) exist but negative acknowledgment of transmitted data, 09_H (NR).
11_H	NA	No reaction (Ack./Res.) from remote station.
12_H	DS	Local FDL/PHY not in the logical ring or disconnected from the bus.
REPLY_UPDATE_SINGLE/REPLY_UPDATE_MULTIPLE		
00_H	OK	Positive acknowledgment, data area loaded.
12_H	LR	Response resource being used by MAC.
SDA/SDN/SRD/REPLY_UPDATE_SINGLE/REPLY_UPDATE_MULTIPLE		
10_H	LS	Service not activated on local SAP.
15_H	IV	Invalid parameter in request header.

Table 17.11 Meaning of the Values in byte 3 (link_status) in the Confirmation Header

17.6 Calculation of the Target Rotation Time (TTR)

The TTR is dependent to a great extent on the data rate and the number of active stations (NAS).

17.6.1 Overview

Parameter	Explanation
Retry-Counter	Number of attempts to re-transmit when transmission unsuccessful.
Slot-Time*	Wait to recieve time (or wait for reaction time). This is the time the sender(initiator) of a request has to wait until the addressed station reacts. It does not matter whether the frame is a message or the token frame. Range: 1....65535 bit times
Setup-Time	"Dead time": this is the maximum time between an event (e.g. reception of characters or end of an internal monitoring time) and the reaction to the event. Range: 1....255 bit times
Minimum Station Delay*	Minimum time between receiving the last bit of a frame and sending the first bit of the next frame. Range: 1....255 bit times
Maximum Station Delay*	Maximum time between receiving the last bit of a frame and sending the first bit of the next frame. Range: 1....255 bit times
Target Rotation Time *	Preset token rotation time. This time is compared with the actual token rotation time that has elapsed when the token is received. The result of the comparison decides whether and which frames can be sent by the station. Range: 1....16777215 bit time units*. You must select this time to match the requirements of the bus system.

* Times are entered as bit times. This is the time required to send one bit (reciprocal of the data rate in bps)

Table 17.12 Overview: INIT Parameters

Parameter	Explanation
GAP Update Factor	The address area between the local station address of an active station and the address of the next active station is known as the GAP. The GAP addresses are checked cyclically to obtain the status of stations in the GAP address area ("not ready", "ready" or "passive"). If the status is "ready", the station is a new active station and the token is passed to it. The GAP update factor "G" is a factor for calculating the time = (G*TTR) after which the station with the lower address checks whether a further station is requesting to enter the ring. Range 1 to 100 You must select this factor to match the requirements of your bus system.
HSA (highest L2 station address)	Range: 2....126.
Default SAP	If an L2 frame is received without a destination SAP number, the layer 2 firmware automatically selects the default SAP. If you want to use FDL services, you must select the number of the default SAP in the range 2 to 54, since the FDL service only only accesses these DAPs.
Bus characteristics	RS 485

* Times are entered as bit times. This is the time required to send one bit (reciprocal of the data rate in bps)

Table 17.13 Overview: INIT Parameters (continued)

Orientation values for the INIT parameters

Recommended default parameters:

Data rate (in Kbps))	9.6	19.2	93.75	187.5	500	1500
Slot Time	100	170	240	400	1000	3000
Setup Time	10	15	45	80	60	80
Minimum Station Delay	12	25	45	80	80	150
Maximum Station Delay	60	65	200	360	360	980

The next sections explain how to do the following,

- calculate the target rotation time
- select the GAP update factor
- the effects of the HSA setting "HSA" (highest station address).

Assuming that you have used the recommended default INIT parameters, the target rotation time can be calculated relatively accurately for

- S5-S5 links
- Data transmission with direct access to layer 2 services.

Proceed as follows to calculate the required target rotation time:

- ➢ Work out the maximum possible number of frames from all stations that can occur in one token rotation distinguishing between the different types of frame (e.g. SDN, SDA frames). Frames on predeifined S5-S5 links count as SDA frames.
- ➢ Calculate the "worst case" target rotation time using Table 17.13. You must then add 11 bit time units for every data byte to the basic overhead from the table (BTU).
- ➢ Then multiply the "worst case" target rotation time by the correction factor 0.6.

	Data rate in Kbps					
Type of frame	9.6	19.2	93.75	187.5	500	1500
Token (LAS<3)	88	97	195	320	750	2700
Token (LAS>3)	88	97	195	320	215	450
GAP	165	195	410	690	1650	4950
SDN	195	160	270	450	850	1950
SDA	215	225	295	465	1100	3150
SRD	345	295	430	610	1300	3150

Table 17.14 Basic Overheads of the Frames Relative to the Data Rate (in BTU)

Selecting the GAP update factor:

The GAP update factor decides how many token rotations take place before all the active stations check their GAP area.
If you require a low bus load, select a high GAP update factor. Stations that have dropped out of the ring and wish to re-enter it are registered later in this case.
If, on the other hand, you want such stations to be included in the ring as soon as possible, then select the GAP update factor as small as possible. This increases the bus load (more frames due to additional GAP frames).

The more stations connected to the bus, the lower the relative load caused by GAP frames. If the station addresses and HSA are selected optimally, a GAP update factor on 1 can be selected.

Example of calculating the target rotation time (TTR) with the following bus configuration:

Three stations are connected to the SINEC L2 bus:

Addresses:	1, 2 and 3
HSA:	3
GAP update factor:	1
Data rate (in Kbps):	187.5

Volume of frames:

station 1:	1 SDN frame with 10 bytes of transmitted data
station 2:	1 SDN frame with 10 bytes of transmitted data
station 3:	1 SDN frame with 10 bytes of transmitted data
	1 SRD frame with 20 bytes of transmitted data and 10 bytes of received data.

Calculation of the volume of frames and time required:

Type of frame	Number	Overheads from column 187,5 Kbps Table 17.13	Result (in BTU)
Token	3 (stations)	x 320	960
GAP	1 (GAP upd.)	x 690	690
SDN	3 (SDN with 10 bytes transmitted data)	x (450 + 10 (bytes) x 11 BTU)	1680
SRD	1 (SRD with 30 bytes transmitted and received data)	x (610 + 30 (bytes) x 11 BTU)	940
The total is the "worst-case" target rotation time			4270

From this you can select the target rotation time:

4270 ("worst-case" target rotation time) x 0.6 (correction factor) = **2562** BTU (target rotation time)

Optimizing the target rotation time:

➢ Assign the station addresses in ascending order (1, 2, ..)

➢ The selected HSA should be the same as the highest station address on the L2 bus.

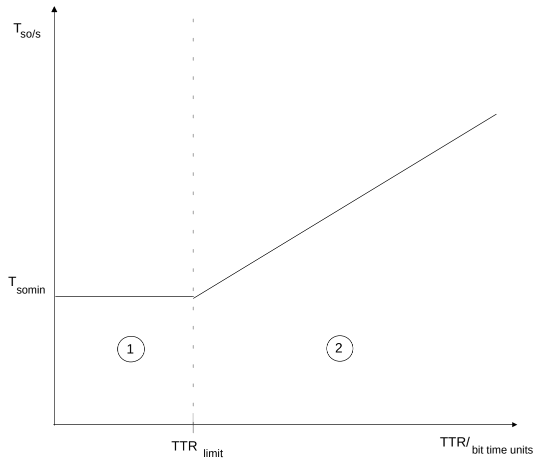
17.7 Calculating the Switch-off and Reaction Times of the Global I/Os

Calculation of the switch-off times T_{so} for the free and cycle-synchronized modes

The CP 5430 TF/CP 5431 FMS "registers" the failure of a station only after the switch-off time T_{so} has expired. After this time, the CP resets the GP inputs, i.e. the input bytes assigned to this station are set to the value "0". The time T_{so} depends on the following

- the selected target rotation time and
- the selected data rate.

The diagram shows the switch-off time T_{so} (in seconds) as a function of the target rotation time (TTR; in bit time units).



Explanation of areas 1 and 2 :

1 If TTR is less than TTR_{limit}, the CP switches off the failed station at the latest after time T_{somin} has elapsed

2 If TTR is greater than TTR_{limit} there is a linear relationship according to the equaiton (TTR in bit time units, data rate in bps, T_{so} in seconds):

$$T_{so} = \frac{24}{\text{data rate}} * TTR$$

Fig. 17.13 Switch-off Time T_{so} (in seconds) as Function of the Target Rotation Time

The shape of the curve is similar for all data rates; it always consists of areas 1 and 2.
The curves for different data rates differ in

- The position of the "dog-leg" separating areas 1 and 2.

and

- The angle of the curve in area 2.

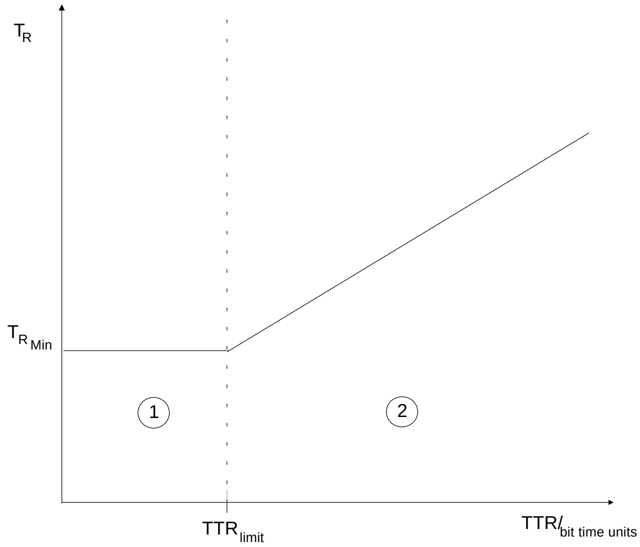
The switch-off times (in seconds) for the different data rates can be calculated based on the following table (BTU=bit time units):

Data rate	Switch-off time in area 1	Switch-off time in area 2
9.6 Kbps	TTR_{limit} = 317 BTU	
	TTR< 317 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR > 317 BTU: >T_{so} = 0.0025xTTR(s)
19.2 Kbps	TTR_{limit} = 590 BTU	
	TTR< 590 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR> 590 BTU: >T_{so} = 0.00125xTTR(s)
93.75 Kbps	TTR_{limit} = 4125 BTU	
	TTR< 2883 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR> 2883 BTU: >T_{so} = 0.000256xTTR(s)
187.5Kbps	TTR_{limit} = 8250 BTU	
	TTR< 5766 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR> 5766 BTU: >T_{so} = 0.000128xTTR(s)
500 Kbps	TTR_{limit} = 15375 BTU	
	TTR< 15375 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR> 15375 BTU: >T_{so} = 0,.0005xTTR(s)
1.5 Kbps	TTR_{limit} = 46125 BTU	
	TTR< 46125 BTU: >$T_{so} = T_{somin}$ = 0.8 s	TTR> 46125 BTU: >T_{so} = 0,.0002xTTR(s)

Table 17.15 Switch-off times (in seconds) for the Different Data Rates

Calculation of the reaction time T_R of the global I/Os

In the CYCLE-SYNCHRONIZED mode, the time interval between HDB SEND (RECEIVE) calls in the control program determines the reaction times of the global I/Os.
In the FREE mode, you can calculate the minimum time interval between two consecutive "changed value frames" (the CP sends only data whose values have changed!).
This minimum interval, called the "reaction time" (T_R) is a function of the data rate and the selected target rotation time (TTR).



Explanation of areas 1 and 2 :

1 If TTR is less than TTR_{limit} , the CP sends changed GP output bytes at the latest after a reaction time T_{RMin} .

2 If TTR is greater than TTR_{limit}, there is a linear relationship according to the following equation (TTR in bit time units, data rate in bps, T_R in seconds):

$$T_R = \frac{4}{\text{data rate}} * TTR$$

Fig. 17.14 Reaction Times T_R

The shape of the curve is similar for all data rates; it always consists of areas 1 and 2.
The curves for different data rates differ in

- The position of the "dog-leg" separating areas 1 and 2.

and

- The angle of the curve in area 2.

The reaction times (in milliseconds) for the different data rates can be calculated based on the following table.

Data rate	Switch-off time in area 1	Switch-off time in area 2
9.6 Kbps	TTR_{limit} = 3177 BTU	
	TTR< 317 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR > 317 BTU: >T_R = 0.417xTTR(ms)
19.2 Kbps	TTR_{limit} = 590 BTU	
	TTR< 590 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR> 590 BTU: >T_R = 0.208xTTR(ms)
93.75 Kbps	TTR_{limit} = 2883 BTU	
	TTR< 2883 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR> 2883 BTU: >T_R = 0,043xTTR(ms)
187.5 Kbps	TTR_{limit} = 5766 BTU	
	TTR< 5766 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR> 5766 BTU: >T_R = 0.021xTTR(ms)
500 Kbps	TTR_{limit} = 15375 BZE	
	TTR< 15375 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR> 15375 BTU: >T_R = 0.008xTTR(ms)
1.5 Mbps	TTR_{limit} = 46125 BTU	
	TTR< 46125 BTU: >$T_R = T_{RMin}$ = 132 ms	TTR> 46125 BTU: >T_R = 0.003xTTR(ms)

Table 17.16 Reaction Times (in milliseconds) for the Different Data Rates

Example:

You have set a TTR of 4000 BTU at a data rate of 187.5 Kbps. Based on the table this means:
Switch-off time T_{so} = T_{somin} = 1.06 s
Reaction time T_R = T_{RMin} = 132 ms

Now increase the TTR to 10,000 BTU at the same data rate.
Result:
Switch-off time T_{so} = 0.000128xTTR(s) = 1.28 s
Reaction time T_R = 0.016xTTR(ms) = 160 ms. ❑

A Abbreviations

Abbreviations

A

ALI	Application Layer Interface
ANR	Job number (for handling blocks)
ANZW	Status word
AP	Automation protocol layers 5 to 7 of the ISO/OSI reference model
AS	Active star coupler
AS 511	511 interface, protocol for the communication between PLC and PG
ASCII	American Standard Code of Information Interchange

B

B	Block
BCD	Binary coded decimal
BE	Block end

C

CC	Central controller
CI	Cyclic interface
CIM	Computer Integrated Manufacturing
COM	Abbreviation for programming software for SIMATIC S5 CPs

COR	Coordination module
CP	Communications Processor
CPU	Central Processing Unit
CSF	Control System Flowchart, graphical representation of automation tasks with symbols
CSMA/CD	Carrier sense multiple access with collision detect

D

DA	Destination Address
DB	Data block
DCE	Data Communication Equipment
DIN	Deutsches Institut für Normung (German Standards Institute)
DIR	Directory of data medium and files
DMA	Direct Memory Access
DOS	Operating system
DP	Distributed I/Os
DPR	Dual Port RAM
DTE	Data Terminal Equipment
DW	Data word (16 bits)
DX	Extended data block

E

EG/EU	Expansion unit
EIA	Electronic Industries Association
EPROM	Erasable Programmable Read Only Memory
ET 200	Electronic Terminal 200

F

F	Flag bit
FB	Function block
FD	Floppy Disk (data medium)
FD	Flag double word
FDDI	Fiber Distributed Data Interface
FDL	Fieldbus Data Link (subfunction of layer 2)
FDL2	Free layer 2 communications
FlexOs	Multitasking operating system
FMA	Fieldbus Management Layer
FMS	Fieldbus Message Specification (complying with PROFIBUS)
FO	Fibre Optic
FW	Flag word
FY	Flag byte

G

GO	Global Object
GP	Global I/Os
GPW	Global Peripheral Word
GPY	Global Peripheral Byte
GRAPH 5	Software package for planning and programming sequence controllers

H

HDB	Handling blocks
HSA	Highest Station Address

I

IB	Input byte
IEC	International Electronics Commission
IEEE	Institution of Electrical and Electronic Engineers
IP	Intelligent peripheral module
ISO	International Standardization Organization
IW	Input word

K

KOMI	Command interpreter

L

LAD	Ladder Diagram, graphical representation of the automation task with symbols of a circuit diagram

LAN	Local Area Network
LB	Link block
LED	Light Emitting Diode
LEN	Length of a block
LLC	Logical Link Control
LLI	Lower Layer Interface
LSB	Least Significant Bit

M

MAC	Medium Access Control
MAP	Manufacturing Automation Protocol
MMS	Manufacturing Message Specification

N

NCM	Network and Communication Management

O

OB	Organization block
OSI	Open System Interconnection
OW	Word from the extended I/Os
OY	Byte from the extended I/Os

P

PAFE	Parameter assignment error
PB	Program block

PC	Personal Computer
PCI	Protocol Control Information (for coordinating a protocol)
PCP/M-86	Operating system Personal CP/M-86
PDU	Protocol Data Unit (frames consisting of PCI and SDU)
PG	Programmer
PI	Program invocation
PI	Process image
PII	Process image of the inputs
PIQ	Process image of the outputs
PLC	Programmable controller
PNO	PROFIBUS user organization
PRIO	Priority
PROFIBUS	PROcess Field BUS
PW	Peripheral word
PY	Peripheral byte

Q

QB	Output byte
QW	Output word

R

RAM	Random Access Memory

RLO	Result of logic operation (code bits)
RS	Recommended Standard
RS 485	EIA standard (multipoint capability) standard for electrical data transmission

S

S5-S5	Special type of communication PLC with PLC
SA	Source Address
SAP	Service Access Point. Logical interface points on the interface between the layers via which the PDUs are exchanged between service users.
SB	Sequence block
SDA	Send Data with Acknowledge
SDN	Send Data with No Acknowledge
SDU	Service Data Unit. Information about the service used and the user data contained within it.
SINEC	Siemens network architecture for coordination and engineering
SINEC AP	SINEC automation protocol
SINEC H1	SINEC bus system for industrial applications based on CSMA/CD
SINEC H1FO	SINEC bus system for industrial applications based on CSMA/CD with fiber optics
SINEC H3	SINEC bus system for industrial applications based on FDDI

SINEC L2	SINEC bus system for industrial applications based on PROFIBUS
SINEC L2-FO	SINEC bus system for industrial applications based on PROFIBUS with fiber optics
SINEC L2-FMS	SINEC bus system for industrial applications based on PROFIBUS with the FMS protocol
SINEC L2-DP	SINEC bus system for industrial applications based on PROFIBUS with the DP protocol
SINEC L2TF	SINEC bus system for industrial applications based on PROFIBUS with the TF protocol
SINEC TF	SINEC technological functions
SRD	Send and Request Data
SSNR	Interface number
STEP 5	Programming language for programming programmable controllers of the SIMATIC S5 range
STL	Statement List, STEP 5 method of representation as a series of mnemonics of PLC commands (complying with DIN 19239)
Sub-D	Subminiature D (connector)
SYM	Symbolic addressing
SYSID	Block for system identification
S5-KOMI	S5 command interpreter
S5-DOS/MT	S5 operating system based on FlexOS

T

TF	Technological functions
TSAP	Transport Service Access Point
TSAP-ID	Transport Service Access Point Identifier
TSET	Set-up time
TSDR	Station delay
TSL	Slot-time
TTR	Target rotation time
TPDU	Transport Protocol Data Unit (size of the block of data transferred by the transport system)
TSDU	Transport Service Data Unit (size of the block of data transferred to the transport system with a job for transportation via a transport relation)
TSEL	Transport selector, term used as an alternative for TSAP-ID

V

VB	Code for application association-specific and abbreviation (code) for data link block.
VFD	Virtual Field Device
VMD	Virtual Manufacturing Device

Z

ZP	Cyclic I/Os

Notes

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C Further Reading

/1/ N.N.:
PROFIBUS Standard DIN 19245, Part 1
Beuth-Verlag Berlin 1988

/2/ Siemens:
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Order No. 6GK1971-1AB00-0AA0 German
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EIA RS 485 Standard

/5/ G. Mahlke, P. Gössig.:
Lichtwellenleiterkabel: Grundlagen, Kabeltechnik
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ISBN 3-8009-1501-4, 2Auflage 1988

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/13/ Siemens:
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Order no. refer to latest SINEC Catalog
Siemens AG 07/94❑