SIMATIC S5

SINEC L2 Interface of the S5-95U Programmable Controller

Manual

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How to Use This Manual

The S5-95U programmable controller with SINEC L2 interface can communicate with SIMATIC S5 controllers and other control devices via the SINEC L2 bus system.

To use the SINEC L2 interface to its full capacity, you need detailed information.

This manual contains descriptions for installing and operating the following programmable controllers as SINEC L2 stations:

- S5-95U, Order No. 6ES5 095-8MB01
- S5-95U, Order No. 6ES5 095-8MB02

The manual does not provide information on the performance of other controllers on the L2 bus. Only special features of the S5-95U pertaining to data interchange with the CP 5430 communications processor are mentioned.

Experience in configuring and starting up bus-type LANs is helpful, though not necessary, to work with this manual successfully.

This section is intended to make it easier for you to use the manual.

Contents of This Manual

- Chapter 1
  This chapter provides an overview of the applications, performance capabilities, operation principle, basic terminology, and transmission physics of the SINEC L2 bus system. This chapter characterizes the possible types of data transmission and specifies and explains the selection criteria for special applications.
- Chapter 2
  This chapter specifies the installation procedures that you should follow to ensure that your S5-95U controller functions properly as a station on the SINEC L2 bus.
- Chapter 3
  This chapter summarizes information that you need to start up your S5-95U controller as a station on the SINEC L2 bus. You will also discover how to recognize faults in the controller and find out what tests and diagnostics are available to you.
- Chapters 4, 5, 6, 7 and 8
  These chapters use examples to describe the various types of data transmission in detail.
- Chapter 9
  This chapter shows you how to implement programmer functions over the LAN.
- Appendices
  The appendices contain two types of information. On the one hand, you will find brief information for regular use (e.g., all the DB1 parameters); on the other hand, you will find additional information of interest to network experts (e.g., concerning the SAPs).

Each chapter begins with a brief explanation of its contents. By reading the first section of a chapter, you can determine whether the information in the chapter is important to you.

Conventions

The "S5-90U/S5-95U System Manual" and the SINEC L2 Manual - Interface of the S5-95U Programmable Controller" observe the same conventions.
All the conventions listed at the beginning of the System Manual apply also to this manual. Please refer to that Manual. Your attention is also drawn to the "Safety-Related Guidelines for the User" on page xi at the end of this chapter.

Courses

Siemens offer a wide range of training courses for SINEC users.
For more information, please contact

- Informations- und Trainings-Center für Automatisierungstechnik
  AUT 959 Kursbüro
  Postfach 21 12 62
  76181 Karlsruhe
  Federal Republic of Germany
  Tel.: (Nat. access code) 721 595-2917
  or
- Your nearest Siemens representative

Reference Material

This manual contains a comprehensive description of the SINEC L2 interface of the S5-95U programmable controller. The following manuals etc. contain more detailed information on topics that are handled only briefly here:

SINEC L2 Local Area Network
CP 5430
Order No. 6GK1 970-5AA00-0AA0

SINEC
L2/L2F0 Manual
Order No. 6GK1 970-5CA00-0AA0

Installation Guidelines:
Installing the SINEC L2 Local Area Network
Order No. AR 463-2-220

PROFIBUS Standard (DIN 19245)
Beuth-Verlag; Berlin 1988

Bender, Klaus: Profibus
Hauser-Verlag; Munich 1990

Kafka, Gerhard: Grundlagen der Datenkommunikation;
Datacom-Fachbuchreihe; Pulheim 1989.
(available in German only)

Stöttinger, Klaus H.: Das OSI-Referenzmodell;
Datacom-Fachbuchreihe; Pullheim 1989.
(available in German only)

There are correction forms at the end of this manual. Please use them to indicate any corrections, additions or suggestions you might have in the way of improvement that will benefit the next edition of the manual.

Safety-Related Guidelines for the User

This document provides the information required for the intended use of the particular product. The documentation is written for technically qualified personnel.

Qualified personnel as referred to in the safety guidelines in this document as well as on the product itself are defined as follows.

- System planning and design engineers who are familiar with the safety concepts of automation equipment.
- Operating personnel who have been trained to work with automation equipment and are conversant with the contents of the document in as far as it is connected with the actual operation of the plant.
- Commissioning and service personnel who are trained to repair such automation equipment and who are authorized to energize, de-energize, clear, ground, and tag circuits, equipment, and systems in accordance with established safety practice.

Danger Notices

The notices and guidelines that follow are intended to ensure personal safety, as well as protect the products and connected equipment against damage.

The safety notices and warnings for protection against loss of life (the users or service personnel) or for protection against damage to property are highlighted in this document by the terms and pictograms defined here. The terms used in this document and marked on the equipment itself have the following significance.

Danger

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

contains important information about the product, its operation or a part of the document to which special attention is drawn.

Proper Usage

Warning

- The equipment/system or the system components may only be used for the applications described in the catalog or the technical description, and only in combination with the equipment, components, and devices of other manufacturers as far as this is recommended or permitted by Siemens.
- The product will function correctly and safely only if it is transported, stored, set up, and installed as intended, and operated and maintained with care.

1 System Description

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Tables

1 System Description

In this chapter, you will learn the following:

- The applications that the SINEC L2 network is suited for
- The performance capabilities that the SINEC L2 network is equipped with
- The operation principle of the SINEC L2 network
- The explanation of important basic terminology and parameters
- The types of data transmission that are possible and which criteria you use to select them
- The transmission physics that can be used

1.1 Communications in Industry

In today’s modern production control systems, the installations for process automation operate in an information network that can be organized into several hierarchy levels, as illustrated in Figure 1-1.

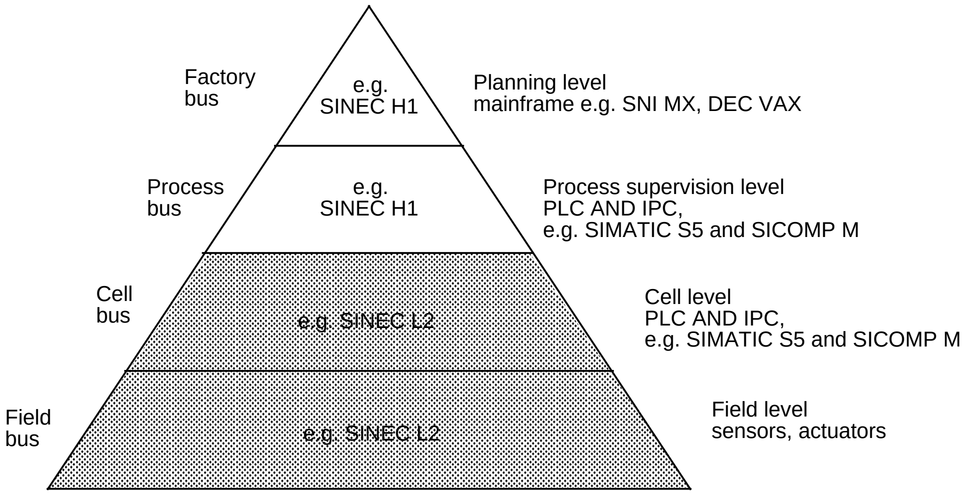


Figure 1-1. Hierarchy Levels in the Computer-Integrated Automation Network

The following sections explain the different tasks of each of the hierarchy levels.

Definitions

- Planning Level
  This is where you plan orders, production strategies and production guidelines, and where the information from the production process is monitored.

- Process Control Level
  This is where you decide how the production will take place and how the function groups will be coordinated.

- Cell Level
  This level receives requests from the process control level. It consists, as a rule, of assembly cells. Each assembly cell is controlled by at least one programmable controller.

- Field Level
  This is where the field devices such as sensors and actuators are. The task of these units is to make the exchange of information between control and technical process possible.

Communication Tasks Required from the Different Networks

The requirements for the planning and process control level networks differ from the requirements for the cell and field level networks as follows:

- Communication in the planning and control levels
  - Large amounts of data (range >100 bytes)
  - Often no time-critical requirements
  - Electromagnetic compatibility requirements matched to office environment (with additional specific measures, also for industrial environment)
  - Large network expansion
  - Large number of stations
  - Higher connection costs acceptable

- Communication in the cell and field levels
  - Smaller amounts of data (range <100 bytes)
  - Time-critical requirements (real-time requirements)
  - High electromagnetic compatibility requirements (industrial environment)
  - Small network expansion
  - Small number of stations (range <100)
  - Low connection costs

The SINEC L2 network is optimally adapted to the requirements of the cell and field levels”.

1.2 The SINEC L2 Local Area Network

The SINEC L2 LAN is based on the PROFIBUS Standards (DIN 19245).
PROFIBUS (**PRO**cess **FI**eld **BUS**) is the German process and field bus standard that is defined in the PROFIBUS Standards (DIN 19245). This standard sets up functional, electrical and mechanical characteristics for a bit-serial field network. The purpose of these standardization efforts is to be able to network programmable controllers and field devices of different manufacturers without expensive adapters. Therefore, you have the ability to mix and match components from different manufacturers, and to have them communicate with each other via the SINEC L2 network as long as the components meet the PROFIBUS Standard. The SINEC L2 network services of the S5-95U use part of the services defined in the PROFIBUS Standards.

In order to be able to use S5-95U programmable controllers as SINEC L2 stations, you need one of the following two items:

- The RS 485 bus terminal that connects SINEC L2 stations via the terminal cable with the bus cable that connects the individual bus terminals with each other.
- The SINEC L2 bus connector with bus cable that connects stations with each other.

Figure 1-2 represents a bus segment using SINEC L2 bus connectors.

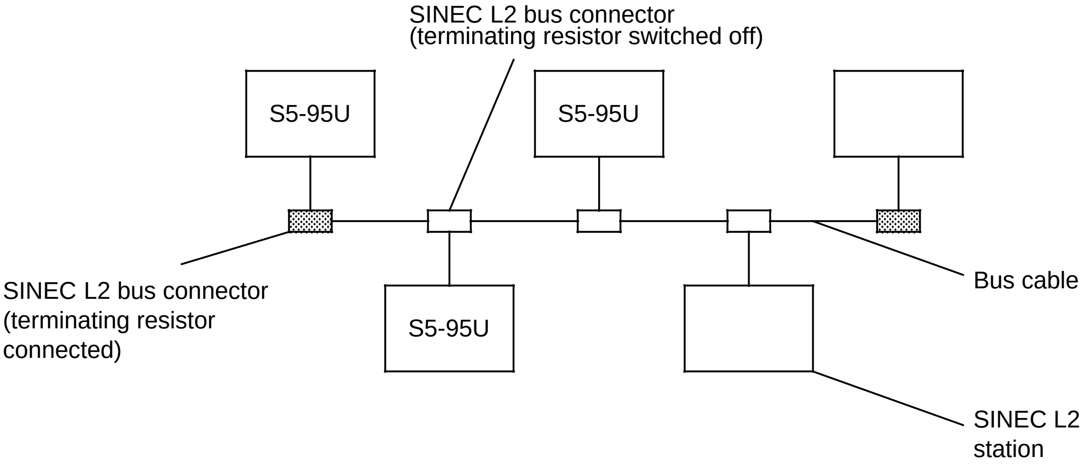


Figure 1-2. Bus Segment

In order to communicate, each station must observe certain rules:

- There must be a rule for who is allowed to transmit via the common bus cable at a given time (section 1.3 “Procedure for Accessing the Bus”).
- A common language must exist between two stations (section 1.5 “Types of Data Transmission”).
- The electrical features of the stations must match each other (section 1.6 “Bus Physics”).

1.3 Procedure for Accessing the SINEC L2 Network

The following section discusses the basic mode of operation of the SINEC L2 network. The goal of this section is to make you familiar with terms that you will need to configure the S5-95U as a station and to assign parameters in the S5-95U.

An essential aspect of the network is the access procedure. On the SINEC L2, there are two types of stations with different access rights: active stations and passive stations.

Active Stations

- Are allowed, when they have the right to transmit data to other stations
- Are allowed to request data from other stations

Passive Stations

- Are allowed to exchange data with an active station only after being requested to do so by the latter.

Whether a station is active or passive depends on the respective unit. Simple field units such as motor control units are as a rule passive; smart units such as programmable logic controllers, on the other hand, are active.
The S5-95U can be a passive as well as an active station on the network. This is possible by setting parameters.

Station Address

Each station on the bus has a station address that you can assign by setting parameters.

Token / Right to Transmit

So that all active stations do not try to access the bus at the same time, an active station that is ready to transmit has to wait until it receives the right to access the bus. The station receives this right through a special frame, the token frame. The structure of the token frame and how its transmission is controlled will not be discussed here (refer to the PROFIBUS Standard, DIN 19245).

It is important for you to know the following:

- The token frame (and the permission to access) automatically goes from one station to the next one (according to the ascending sequence of the station addresses).

- The token frame is passed on in the logical ring: The station with the highest address passes the token frame on to the station with the lowest address. For each active station there is one token rotation cycle between token frame transmitting and token frame receiving **.**

A network normally contains several active and several passive stations. Figure 1-3 shows a network with three active and three passive L2 stations.

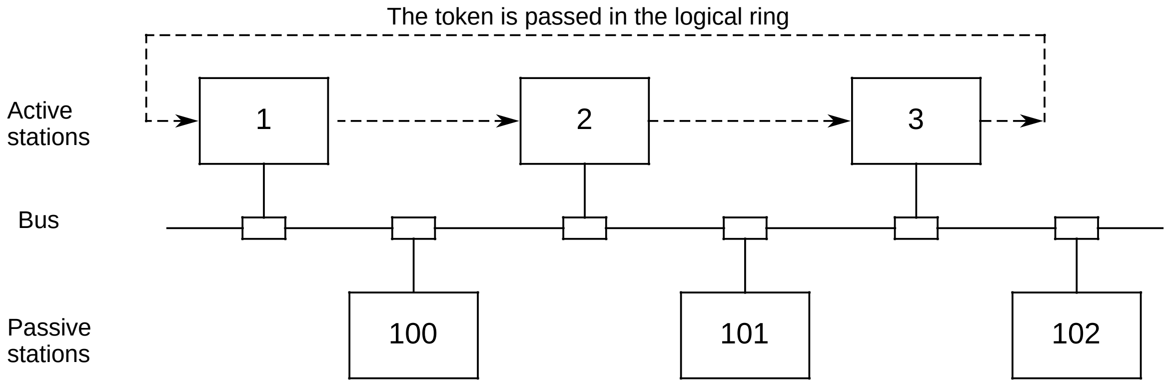


Figure 1-3. Bus Accessing Procedure

Explanations for Figure 1-3:

- The token frame is passed only from an active station to another.
  Stations 1, 2 and 3 are active. The token frame is passed on as follows:
  1 2 3 1 2 ...
- One token cycle includes passing the token three times:
  1 2 3 1.
- Stations 100, 101 and 102 are passive.
- Stations addresses 0, 4 to 99, and 103 to 126 are not assigned.
- Active stations can be assigned addresses in the range 1 to 31.
- Passive stations can be assigned addresses in the range 1 to 126.
- It is not absolutely necessary to assign the station addresses in ascending order.

Based on the mode of operation of the SINEC L2, two special cases can be deduced:

1) If only one station is active and all others are passive, the bus functions according to the master-slave principle.
2) If all stations are active, a token passing procedure is present.

Target Rotation Time

A token cycle takes a certain amount of time. You must set the maximum permissible token cycle time as target rotation time (target rotation time in DB1, TRT parameter).
Even the transmission of large amounts of data must conform to the target rotation time set in DB1.
In order to conform to this time, the SINEC L2 uses the following principle.

Time Management of the Network

Each active station measures the time in which it was not in the possession of the token. This time is the station’s “real” rotation time, i.e., the time used up by the other stations. The station compares this measured time with the previously set target rotation time.
The processing of the frame to be transmitted depends on the results of this comparison and on the priority of the message frames as follows:

The preset priority of the message frames is low for the standard connection (chapter 4), PLC-to-PLC connection (chapter 6) and cyclic I/O (chapter 7). Only for layer 2 access can you decide whether the message frame is to be given high or low priority.

Possible results of the comparison between the rotation time measured (the "real" rotation time) and the target rotation time:

1) The "real" rotation time is shorter than the target rotation time.
   Result: All send and receive jobs in the queue are executed until the target rotation time has been reached or the jobs in the queue have been processed; first the message frames with high priority, then the message frames with low priority.

2) The "real" rotation time is longer than the target rotation time.
   Result: Only one more message frame with high priority is transmitted. The message frames with low priority are not transmitted until the "real" rotation time is shorter than the target rotation time in the following token cycles.

This is shown in Figures 1-4 and 1-5.

Each station measures the “real” rotation time and calculates the difference between target rotation time and “real” rotation time (= **token hold time**). During this time, a station can transmit: first, the frames with high priority, then the frames with low priority. When the token hold time is used up, the station must pass the token to the next station.

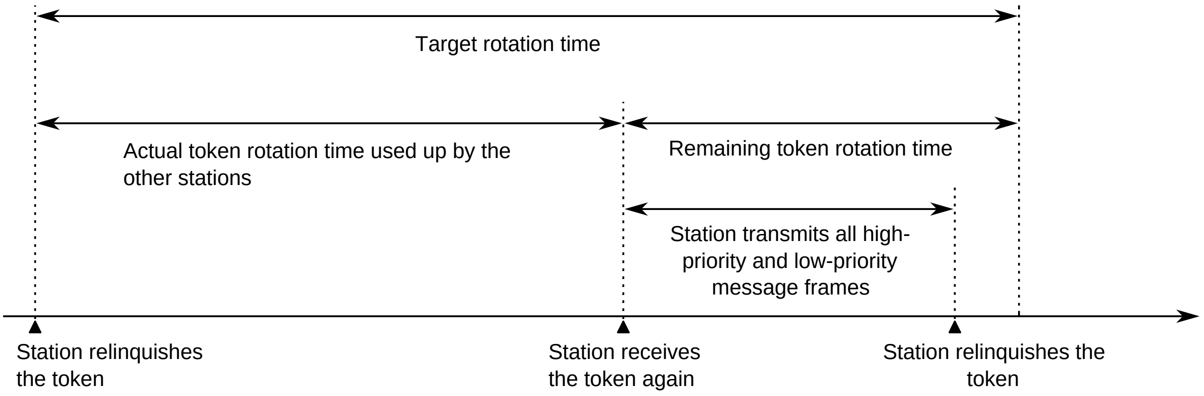


Figure 1-4. Distribution of the Target Rotation Time (1)

If the transmitter has no token hold time at its disposal (see Figure 1-5), it can only transmit one frame with high priority before is has to pass the token.

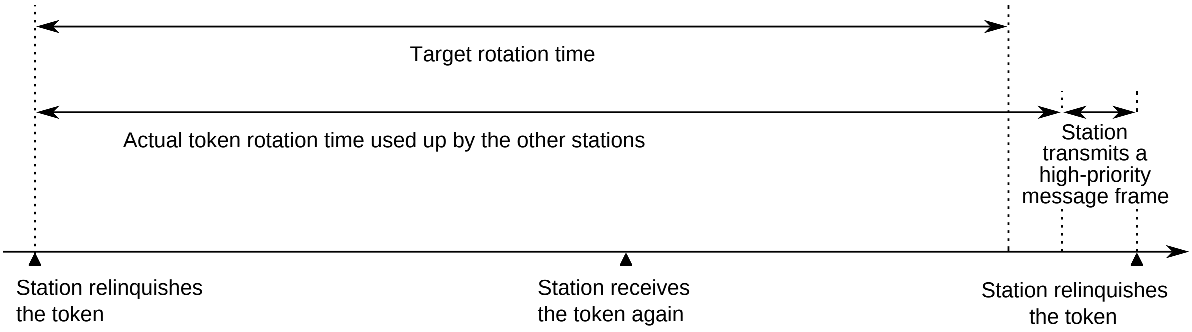


Figure 1-5. Distribution of the Target Rotation Time (2)

Broadcasting

Broadcasting is when an active station sends a message frame to all active and passive stations.

Multicasting

Multicasting is when an active station sends a message frame to several active and passive stations.

1.4 Assigning Parameters for the L2 Interface of the S5-95U

You assign the parameters for the L2 interface in DB1, in the parameter block with block ID “SL2:”. Irrespective of the type of data transmission you select, you must assign certain parameters (basic parameters) in DB1. The basic parameters affect only the procedures for accessing the network (see section 1.3) and not the communication mechanisms. DB1 has default settings for the basic parameters that you can use or change according to the task to be performed.

The default DB1 is illustrated in Figure 1-6.

```
  0:     KS  ='DB1 0BA: AI 0 ; 0BI:    ';
 12:     KS  ='  ; 0BC: CAP N      CBP ';
 24:     KS  ='N      ;#SL1: SLN 1  SF ';
 36:     KS  ='DB2  DW0   EF DB3  DW0  ';
 48:     KS  ='  CBR FY100      CBS FY1';
 60:     KS  ='01      PGN 1  ;# SDP: N';
 72:     KS  ='T 128 PBUS N ; TFB: OB13';
 84:     KS  =' 100    ; #CLP: STW MW10';
 96:     KS  ='2        CLK DB5  DW0   ';
108:     KS  ='  SET 3  01.10.91 12:00:';
120:     KS  ='00    OHS 000000:00:00  ';
132:     KS  ='  TIS 3 01.10. 12:00:00 ';
144:     KS  ='   STP Y SAV Y  CF 00   ';
156:     KS  ='    #SL2: TLN 0   STA AKT';
168:     KS  =' BDR 500    HSA 10  TRT ';
180:     KS  ='5120    SET 0   ST 400  ';
192:     KS  ='SDT 1 12  SDT 2 360   SF';
204:     KS  =' DB6  DW0   EF DB7  DW0 ';
216:     KS  ='  KBS MB62  KBE MB63  ; ';
228:     KS  ='#  END ';
```

Parameters for S5-95U functions described in the S5-90U/S5-95U system manual

Basic parameters

Parameters for type of data transmission (Chapters. 4, 6, 7 and 8)

Figure 1-6. DB1 with the Default Parameters

The basic parameters and their ranges are listed and explained in the following Table.

Table 1-1. DB1 Basic Parameters

Parameter	Argument	Significance
Block ID: SL2:		**SINEC L2**
TLN	n	Own station address
STA	AKT/PAS	Own station status
BDR	p	Baud rate
HSA	q	Highest L2 station address on bus
TRT	m	Target rotation time
SET	s	Set-up time
ST	t	Slot time
SDT 1	u	Shortest delay time
SDT 2	v	Longest delay time
Argument	**Permissible Range**	**Explanation**
n	1 to 126	Station address, including 1 to 31 active S5-95U stations
AKT/PAS	-	AKT = active, PAS = passive
p	9.6; 19.2; 93.75; 187.5; 500; 1500	Baud rate in kBaud
q	1 to 126	Station addresses
m	256 to 1048320	Bit time units*
s	0 to 494	Bit time units*
t	50 to 4095	Bit time units*
u	11 to 255	Bit time units*
v	35 to 1023	Bit time units*

* One bit time unit is the time its takes to transmit one bit (reciprocal value of Baud rate)
The arguments s, t, u, and v depend on Baud rate (see Table 1-3)

Table 1-2 shows which basic parameters are relevant for active and passive stations.

Table 1-2. Relevant Basic Parameters for the S5-95U as an Active/Passive Station

Parameter	TLN	STA	BDR	HSA	TRT	SET	ST	SDT 1	SDT 2
S5-95U active	x	x	x	x	x	x	x	x	x
S5-95U passive	x	x	x				x	x	

Rules for Setting the Basic Parameters

- TLN 0 (default) is not allowed for the S5-95U as L2 station (TLN 0 is reserved for a programmer). You must change the value for TLN 0, otherwise the programmable controller stays in the STOP mode.
- Do not delete any relevant parameters, otherwise the PLC will stay in the STOP mode! Delete any irrelevant parameters (in the case of passive S5-95Us).
- The following basic parameters must be the same for all stations in the SINEC L2 network: BDR, HSA, TRT, SET, ST, SDT 1 and SDT 2. Always take the basic parameters of the slowest station! The slowest station is the station with the longest slot time in the SINEC L2 network.

  Example: Communications between the CP 5410, S5-95U and CP 5430-0: preset baud rate 187.5 kbaud. The CP 5430-0 with 400 bit time units has the longest slot time (default value). Set the basic parameters of the CP 5430-0 (187.5 kbaud) for all stations (see Table 1-5).

Communications with S5-95Us (homogeneous S5-95U networks)

Define the arguments of the BDR, SET, ST, SDT 1 and SDT 2 basic parameters for the S5-95U programmable controllers in DB1 (see Table 1-3).

Table 1-3. Defining the Basic Parameter Arguments for S5-95U PLCs

Baudrate in kbaud Basic parameters in bit time units	9.6	19.2	93.75	187.5	500	1500
SET	0	0	0	0	0	60
ST	73	76	99	170	400	1000
SDT 1	12	12	12	12	12	150
SDT 2	40	60	80	150	360	980

Example: Define the baud rate as 187.5 kbaud in DB1. This gives the other basic parameters as follows: SET 0 ST 170 SDT 1 12 SDT 2 150.

Bit time unit

You must specify certain parameters, e.g. the target rotation time, in bit time units. To calculate the times in milliseconds from the bit time units, use the following formula:

$$\text{Time (in milliseconds)} = \frac{\text{Number of bit time units}}{\text{Baud rate (in kbits/s)}} \left(\text{e.g., time} = \frac{\text{1 bit time unit}}{\text{9.6 kbits/s}} = \text{0.104 ms} \right)$$

Procedure for Assigning Parameters in DB1 and the S5-95U

A default DB1 is integrated in the operating system of the S5-95U programmable controller. DB1 contains default values for parameters, including those for data exchange by means of SINEC L2.
Load the default DB1 in your programmer (function: transfer; source: PC; destination: FD (PG)).

Look for the SINEC L2 parameter block. The block ID is "SL2:".

The SINEC L2 parameter block is enclosed in comment characters (#). The programmable controller cannot interpret the SL2: parameter block in this form (Figure 1.6). Overwrite the comment characters that appear before the block ID (SL2:) and after the last SINEC L2 parameter with a blank.

Enter the parameters according to your specifications (for basic parameters and parameters for the desired communications services, see chapters 3, 4, 6, 7 and 8) **in one coherent block** after the block ID.
Make sure you follow the general rules for assigning parameters. Refer to the S5-90U/S5-95U Programmable Controller System Manual, section 9.1.4.

Transfer the changed DB1 to the S5-95U. The default DB1 is overwritten with the changed DB1.

If you now switch from STOP to RUN mode, the S5-95U accepts the new parameters. If the BF LED lights up (Table 3-1), you must switch from POWER OFF to POWER ON (mode selector at RUN and backup battery inserted) on the S5-95U to transfer DB 1.

Refer to Appendix A for the following information:

- The procedure for reading the DB1 parameter assignment error code and its interpretation
- The explanations to the SET, ST, SDT 1, and SDT 2 parameters. (It is not absolutely necessary to know the meaning of these parameters.)
- The procedure for setting (calculating) the target rotation time (TRT) depending on the baud rate (BDR)

Communications with the CP 5410 and/or CP 5430-1

You must set the same basic parameters BDR, SET, ST, SDT 1 and SDT 2 for the S5-95U, CP 5410 and CP 5430-1.
Define the arguments of the BDR, SET, ST, SDT 1 and SDT 2 basic parameters as shown in Table 1-4:

- for the S5-95U in DB1
- for the CP 5410
- for the CP 5430-1

Table 1-4. Defining the Arguments of the Basic Parameters for the S5-95U in Conjunction with the CP 5410 and/or CP 5430-1

Baud rate in kbaud Basic parameters in bit time units	9.6	19.2	93.75	187.5	500	1500
SET	1	1	1	1	1	60
ST	80	80	190	380	1000	3600
SDT 1	12	12	12	12	12	150
SDT 2	40	60	80	150	360	980

Example: Define the baud rate as 187.5 kbaud in DB1. This gives the other basic parameters as follows: SET 1 ST 380 SDT 1 12 SDT 2 150.

Communications with Other SIMATIC Devices, e.g. the CP 5412 or CP 5430-0

You must set the same basic parameters BDR, SET, ST, SDT 1 and SDT 2 for the S5-95U and the other SIMATIC device.
Define the arguments of the BDR, SET, ST, SDT 1 and SDT 2 basic parameters as shown in Table 1-5:

- for the S5-95U in DB1
- for the other SIMATIC device

Table 1-5. Basic Parameter Arguments for the S5-95U in Conjunction with Other SIMATIC Devices

Baud rate in kbaud Basic parameters in bit time units	9.6	19.2	93.75	187.5	500	1500
SET	10	15	45	80	80	80
ST	100	170	240	400	1000	3000
SDT 1	12	15	45	80	80	150
SDT 2	60	65	200	360	360	980

Example: Define the baud rate as 187.5 kbaud in DB1. This gives the other basic parameters as follows: SET 80 ST 400 SDT 1 80 SDT 2 360.

1.5 Types of Data Transmission for the S5-95U

There are different types of data transmission that allow for an optimal adaptation to specific needs. The types of data transmission can be divided into two groups:

- Procedure for communications between active station and active station
  - Standard connection
  - PLC to PLC connection
  - Cyclic I/O (only possible between S5-95Us)
  - Layer 2 access
- Procedure for communications between an active station and a passive station
  - Cyclical I/O
  - Standard connection (broadcasting from active to passive nodes only)
  - Layer 2 access

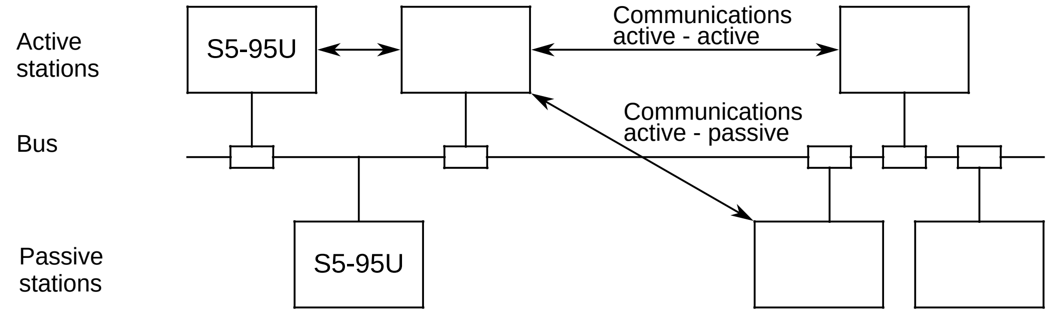


Figure 1-7. Data Transmission Types

The types of data transmission differ from each other by the following:

- The management
- The communications process (implicit/explicit communications*)
- The stations that are to be connected (active/passive stations)
- The kind of data that is to be transmitted or received (e.g. single bytes or data blocks)

Depending on your application, you need to decide on the following issues:

- Should the S5-95U be a passive or an active station on the bus?
- Which type of data transmission do I select?

You will find the answers to these questions below.

---

* implicit communication: The communication is automatic; it is not triggered in the user program.
explicit communication: The communication timing is triggered in the user program.

- Is my S5-95U to be a passive or active station on the LAN?

  An active station receives the token (permission to send). When they have the token, active stations can send data to other stations.
  A passive station does not receive the token. Consequently, passive stations can only exchange data with an active station when they are requested to do so by that station.

  An S5-95U should, if possible, be a passive station on the LAN since token management on an active station takes time and increases the LAN's response time.

- Which type of data transmission should I choose?

  You will find the answer to this question
  - in Table 1-6 (recommended types of data transmission)
  - in Table 1-7 (comparison of the characteristics of the various types of data transmission)
  - in Tables 1-8 and 1-9 (which type of data transmission is to be recommended for which station)

Table 1-6. Recommended Types of Data Transmission

Type of Data Transmission	...generally recommended for:
Standard connection	Porting existing programs from SINEC L1 to SINEC L2.
PLC-to-PLC connection	Communications between two active stations.
Cyclic I/O	Communications between active and passive stations.
Layer 2 access	Communications with non-SIMATIC devices which cannot exchange data via the standard connection, PLC-to-PLC connection and cyclic I/O.

Table 1-7 lists the characteristics of the various types of data transmission to help you select the best type for your specific application.

Table 1-7. Characteristics of the Various Types of Data Transmission

Characteristics		**Standard Connection**	**PLC-to-PLC Connection**	**Cyclic I/O (ZP)**	**Layer 2 Access**
Communications	**explicit**	Via send and receive mailboxes	Via L2-SEND FB and L2 RECEIVE FB		Via L2-SEND FB and L2-RECEIVE FB
	implicit			Automatic, without being initiated by the user program	
Amount of data		1 to 242 bytes per job	1 to 242 bytes per job	ZP master: Input range 0 to 128 DW Output range 0 to 128 DW ZP slave: Input range 0 to 121 DW Output range 0 to 121 DW	0 to 242 bytes per job
Send and receive data may be located		In the flag area or in the data area	In the flag area or in the data area	In the data area	In the flag area or in the data area
Parallel processing of several send and receive jobs		No	Yes; one send job and one receive job in parallel per communications partner	Non-applicable*	Yes; 23 random jobs in parallel

* Since no job is requested by the user in the case of implicit communications

Table 1-8 contains the following for S5-95Us as active stations:

- Recommendations for the choice of type of data transmission to suit the communications partner
- The data transmission modes with which broadcasting and multicasting are possible.

Table 1-8. Types of Data Transmission for S5-95Us as Active Stations

Active S5-95Us* / **Type of Data Transm.**		**Standard Connection**	**PLC-to-PLC Connection**	**Cyclic I/O**	**Layer 2 Access**
Communications with	**another active S5-95U**	yes	yes	possibly	no
	a passive S5-95U	no	no	yes	no
	an active device of other manufacture	no	possibly	possibly	yes
	a passive device of other manufacture	no	no	yes	yes
Broadcasting	**Send**	yes	no	no	no
	Receive	yes	no	no	no
Multicasting	**Send**	no	no	no	yes
	Receive	no	no	no	yes

***** All types of data transmission (standard connection, PLC-to-PLC connection, cyclic I/O and layer 2 access) can be programmed/used in parallel.

Table 1-9 contains the following for S5-95Us as passive stations:

- Recommendations for the choice of type of data transmission to suit the communications partner
- The types of data transmission with which broadcasting and multicasting are possible.

Table 1-9. Types of Data Transmission for S5-95Us as Passive Stations

Type of Data Transm. **Passive S5-95Us***		**Standard Connection**	**PLC-to-PLC Connection**	**Cyclic I/O**	**Layer 2 Access**
Communications with	**an active S5-95U**	no	no	yes	yes
	another passive S5-95U	no	no	no	no
	an active device of other manufacture	no	no	yes	yes
	a passive device of other manufacture	no	no	no	no
Broadcasting	**Send**	no	no	no	no
	Receive	yes	no	no	no
Multicasting	**Send**	no	no	no	no
	Receive	no	no	no	yes

***** All types of data transmission (standard connection, PLC-to-PLC connection, cyclic I/O and layer 2 access) can be programmed/used in parallel.

Selecting the Types of Data Transmission to Suit the Hardware Configuration

Except in a few cases, you will still not be able to make a final decision as to which type of data transmission to use based solely on the information found in Tables 1-8 and 1-9: if, for example, the amount of data to be expected is not clear.

Typical partial configurations of a SINEC L2 network are illustrated in Figures 1-8 and 1-9.

These partial configurations correspond to the situations encountered most frequently in the industry. They are presented here according to the frequency of their occurrences (high to low). In the chapters dealing with the individual types of data transmission (see chapters 4, 6, 7 and 8), these typical partial configurations are the basis for the examples for assigning parameters and programming with the S5-95U.

1. Communications between two S5-95Us

PLC-to-PLC connection

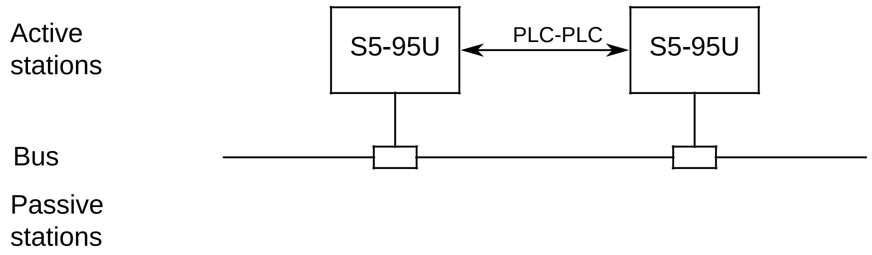


Figure 1-8. PLC-to-PLC Connection between Active S5-95Us

Cyclic I/O (ZP)

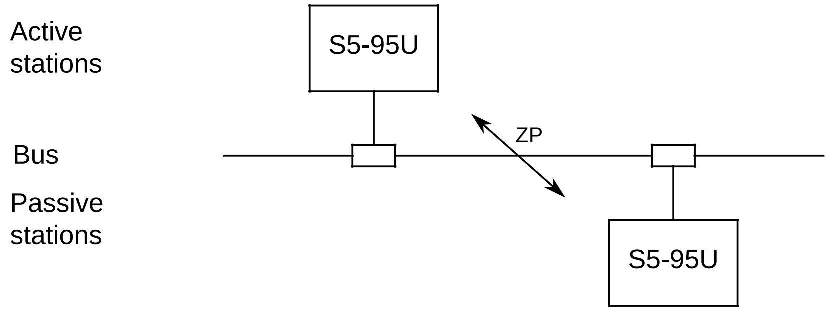


Figure 1-9. Cyclic I/O between an Active and a Passive S5-95U

Standard connection (SC)

To be recommended only if existing programs are to be ported from SINEC L1 to SINEC L2.

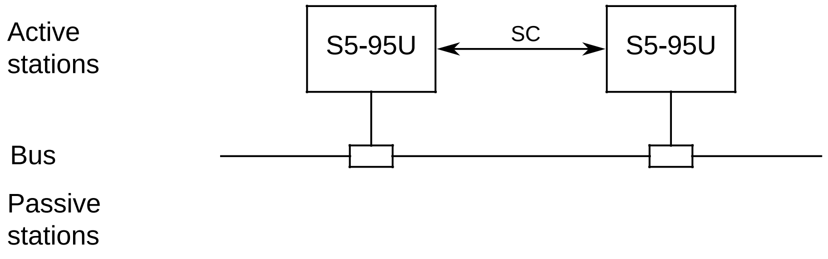


Figure 1-10. Standard Connection for Porting Programs from SINEC L1 to SINEC L2

2. Communications between an S5-95U and a Device of Other Manufacture (station that is not an S5-95U)

PLC-to-PLC connection

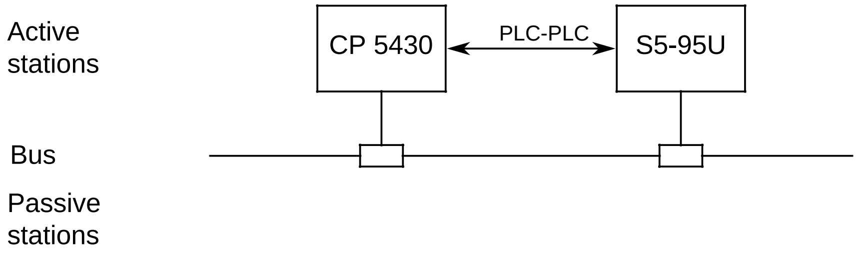


Figure 1-11. PLC-to-PLC Connection between an Active CP 5430 and an Active S5-95U

Cyclic I/O (ZP)

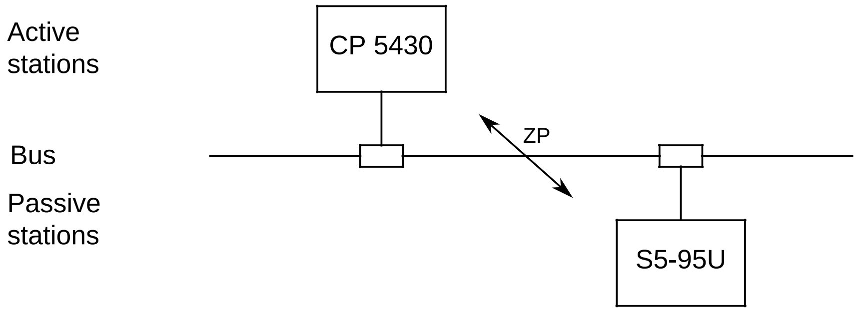


Figure 1-12. Cyclic I/O between an Active CP 5430 and a Passive S5-95U

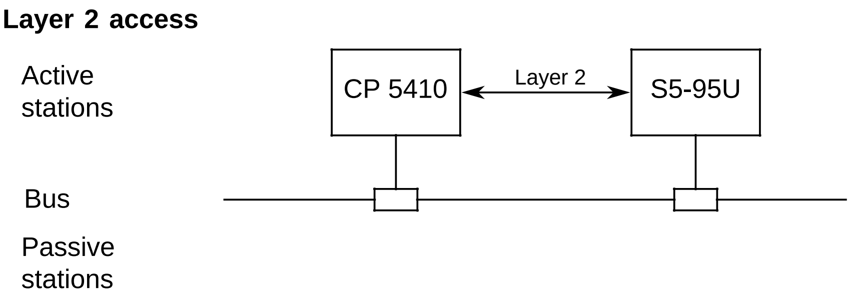


Figure 1-13. Layer 2 Access between an Active CP 5410 and an Active S5-95U

1.6 Physical Bus Characteristics and Installation Techniques for the SINEC L2 Network

You can connect the S5-95U programmable controllers to SINEC L2 networks using two different types of transmission technologies:

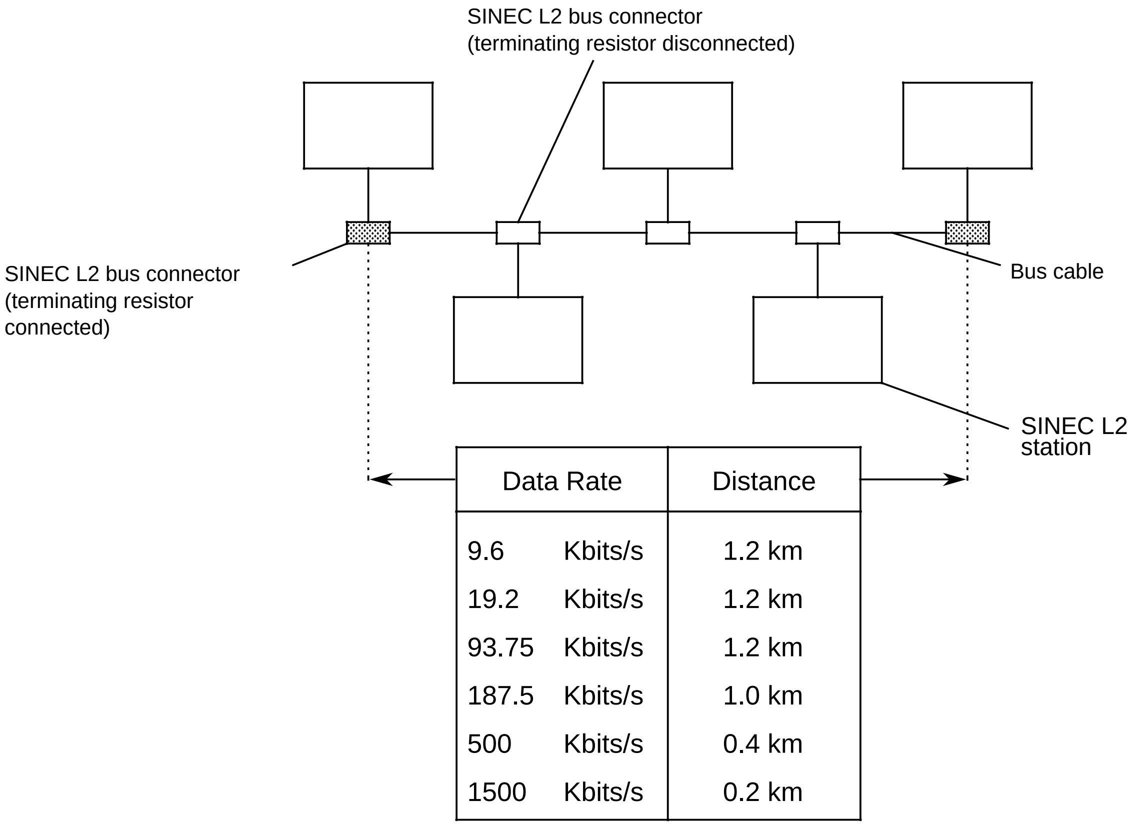
- RS 485 transmission technology
  (advantages: interference-proof due to difference signals, and economical)
- Fiber optic transmission technology
  (advantages: no EMC problems, electrical isolation between the stations, larger network expansion capability as with the RS 485)

Refer to the SINEC L2/L2FO Network Manual for detailed information about transmission technologies.

1.6.1 RS 485 Transmission Technology

Physical bus characteristics and related distances

A SINEC L2 network consists of one or more bus segments.
Figure 1-14 shows a SINEC L2 segment with RS 485 technology.



Data Rate		Distance
9.6	Kbits/s	1.2 km
19.2	Kbits/s	1.2 km
93.75	Kbits/s	1.2 km
187.5	Kbits/s	1.0 km
500	Kbits/s	0.4 km
1500	Kbits/s	0.2 km

Figure 1-14. SINEC L2 Bus Segment with RS 485 Technology

You can link the bus segments by repeaters. Figure 1-15 shows a SINEC L2 network with RS 485 technology. The terminology is explained later on.

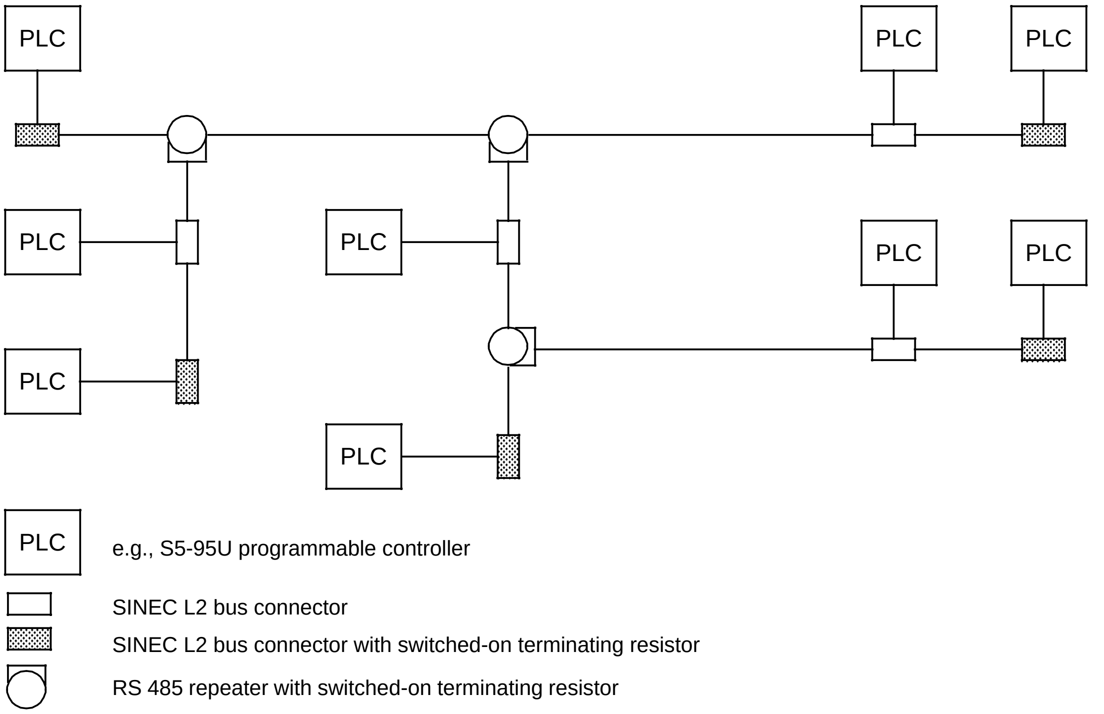


Figure 1-15. SINEC L2 Network with RS 485 Technology

The conditions for installing the network are as follows:

- You can connect a maximum of 127 stations (TLN 0 is reserved for a programmer).
- A maximum of 32 bus loads is permitted per segment (a bus load is either a station or a repeater).
- You can connect a maximum of 7 repeaters in series.

Table 1-7 shows the possible distances between stations calculated on the basis of the expansion of a bus segment and of the condition specified above that a maximum of 7 repeaters is allowed between two stations.

Table 1-10. Distance Table for RS 485 Technology

Baud Rate in Kbits/s	**Number of Segments Connected in Series**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
9.6; 19.2; 93.75	1.2 km	2.4 km	3.6 km	4.8 km	6.0 km	7.2 km	8.4 km	9.6 km
187.5	1.0 km	2.0 km	3.0 km	4.0 km	5.0 km	6.0 km	7.0 km	8.0 km
500	0.4 km	0.8 km	1.2 km	1.6 km	2.0 km	2.4 km	2.8 km	3.2 km
1500	0.2 km	0.4 km	0.6 km	0.8 km	1.0 km	-	-	-

⚠

Caution

In extensive networks, the potential difference between two stations may be more than ± 7 V. In such a case, take the necessary equipotential bonding measures, otherwise the SINEC L2 interface will be destroyed.

Installation Techniques

SINEC L2 Bus Connector

The SINEC L2 bus connector can be used to connect the two-wire, shielded bus cable with the S5-95U. It is the most economical and the easiest to install of the various connectors. The bus connector is available in the following two designs:

- L2 bus connector with degree of protection IP 20 without connector for a programmer (shown in Figure 1-16)
- L2 bus connector with degree of protection IP 20 with connector for a programmer

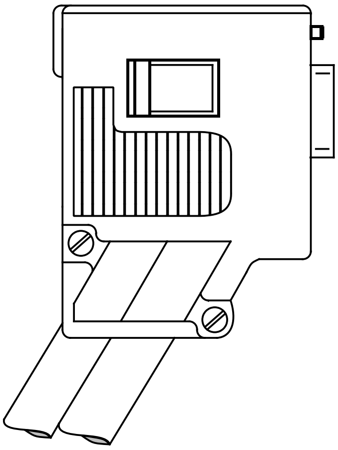


Figure 1-16. L2 Bus Connector with Degree of Protection IP 20 without Connector for a Programmer

Bus Terminals

The bus terminal with RS 485 transmission technology has the same function as the SINEC L2 bus connector. It is an alternative to the SINEC L2 bus connector. The only difference is the installation technique. The bus terminal snaps onto the mounting rail, thus providing tension release.

Table 1-11. SINEC L2 Bus Terminals

Bus Terminal	Cable Length (m / ft)	Order Number
RS 485	1.5 / 4.9 3.0 / 9.8	6GK1 500-0AA00 6GK1 500-0AB00
RS 485/PG	1.5 / 4.9	6GK1 500-0DA00

Bus Cable for SINEC L2

You need a two-wire, shielded, twisted cable as bus cable, that has the technical specifications listed in Table 1-9.

Table 1-12. Technical Specifications of the Bus Cable

Feature	Specification
Surge impedance	approx. 135 to 160 (f= 3 - 20 MHz)
Loop resistance	115 /km
Effective capacitance	30 nF/km
Attenuation	0.9 dB/100 (f= 200 kHz)
Permissible core cross section	0.3 mm^2 to 0.5 mm^2
Permissible cable diameter	8 mm ± 0.5 mm

The SINEC L2 standard cable matches these specifications (order number for indoor bus cable: 6XV1 830-0AH10, for buried bus cable: 6XV1 830-3AH10).

RS 485 SINEC L2 Repeater

Use the RS 485 SINEC L2 Repeater for the following tasks:
- To link individual SINEC L2 bus segments
- To add branches to your network
- To regenerate electrical signals on the network cables.

Each repeater that is connected to a bus segment limits the maximum possible number of stations (32) by one for this bus segment. For example, when connecting two repeaters to a segment, you can connect only 30 stations.

Two types of RS 485 SINEC L2 repeaters are available:

- For nominal voltage operation 24 V DC with external power supply (degree of protection IP 20)
- For nominal voltage operation 24 V DC with external power supply (degree of protection IP 65)

1.6.2 Fiber Optics Transmission Technology

Physical Bus Characteristics

Figure 1-17 shows an example of a SINEC L2FO network configured as a fiber optic star network with cascading stars. The star centers are active star couplers AS 501.

The technical terms will be explained in the section that follows.

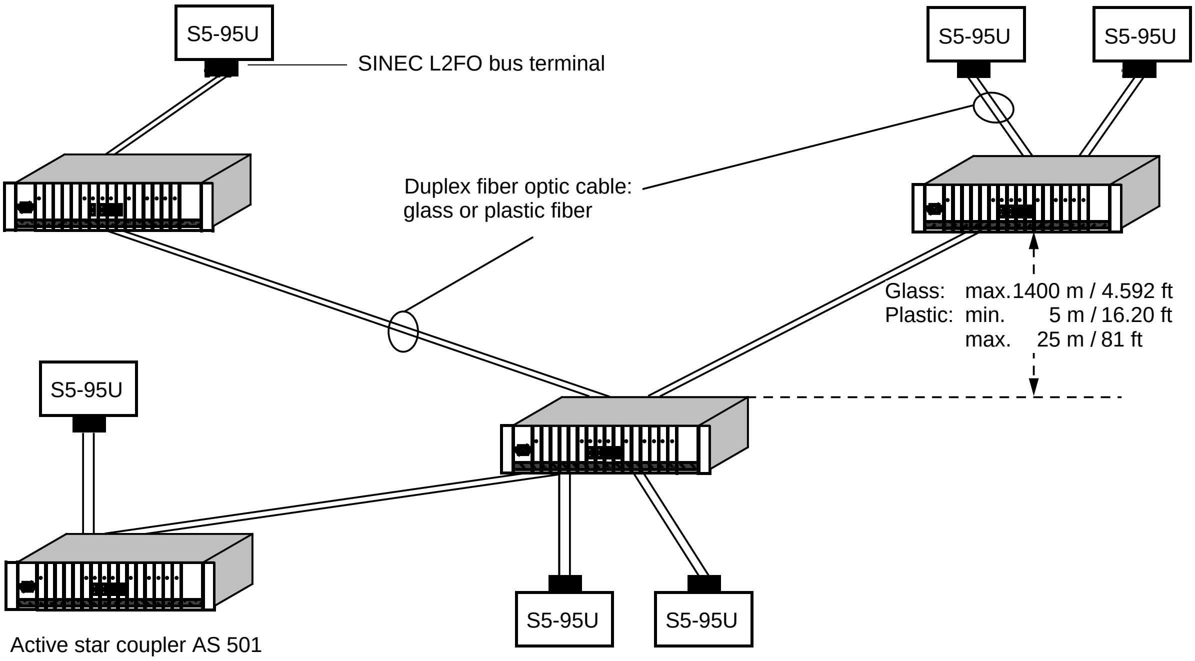


Figure 1-17. SINEC L2 Network with Fiber Optic Cable

You can also link two S5-95U programmable controllers point to point directly via a fiber optic cable, i.e., without using an active star coupler AS 501, as shown in Figure 1-18.

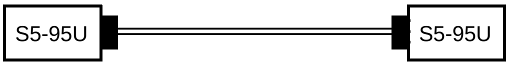


Figure 1-18. Point to Point Link via a Fiber Optic Cable

The conditions for installing the network are as follows:

- You can connect a maximum of 127 stations (TLN 0 is reserved for a programmer).
- You can connect a maximum of 16 active star couplers between two stations.

Table 1-13 shows the possible distances between to stations calculated on the basis of the values specified in Figure 1-17 and the condition specified above that a maximum of 16 active star couplers is allowed between two stations.

Table 1-13. Distance Table for Glass Fiber Optic Cable Technology

Baud Rate in Kbits/s	**Number of Active Star Couplers**								
	1	**2**	**3**	**4**	**5**	**6**	**7**		**16**
9.6; 19.2; 93.75; 187.5	1.4 km	2.8 km	4.2 km	5.6 km	7.0 km	8.4 km	9.8 km	....	23.8 km
500	1.4 km	2.8 km	4.2 km	5.6 km	7.0 km	8.4 km	-		-
1500	1.4 km	2.8 km	4.2 km	-	-	-	-		-

Installation Techniques

SINEC L2FO Bus Terminal SF-B/PF-B

The SINEC L2FO Bus Terminal SF-B/PF-B converts electrical signals into optical signals for the L2FO network and vice versa.

You can plug the optical bus terminal directly onto the 9-pin D-type female connector of the S5-95U. There are two different versions for different fiber optic cable media:

- The SINEC L2FO bus terminal SF-B for glass fiber optic cables
- The SINEC L2FO bus terminal PF-B for plastic fiber optic cables

Figure 1-19. SINEC L2FO Bus Terminal SF-B/PF-B

SINEC L2FO Active Star Couplers AS 501 A and 501 B

Due to the physical properties of fiber optic cables, you must configure the SINEC L2FO as a star network. The central point of this star is the SINEC L2FO active star coupler AS 501 A or AS 501 B.

Use an active star coupler for the following tasks:

- To regenerate the optic level
- To add branches to your SINEC L2FO network (star points)

Design of the SINEC L2FO active star coupler:

- 16 plug-in modules maximum
- OPM module (Optical Plastic fiber one-port Module)
- OSM (Optical Silica fiber one-port Module)

The active star coupler is available in two versions:

- AS 501 A with single power supply 120 V/240 V AC
- AS 501 B with redundant power supply 120 V/240 V AC

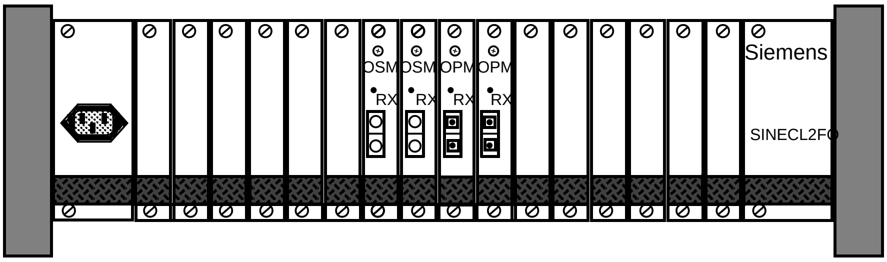


Figure 1-20. SINEC L2FO Active Star Coupler AS 501

1.6.3 Mixed Configuration of RS 485 and Fiber Optics Transmission Technology

You can configure networks with combined RS 485 and fiber optics transmission technologies by using the SINEC L2FO repeater adapter.
Figure 1-21 is an example of this type of configuration.

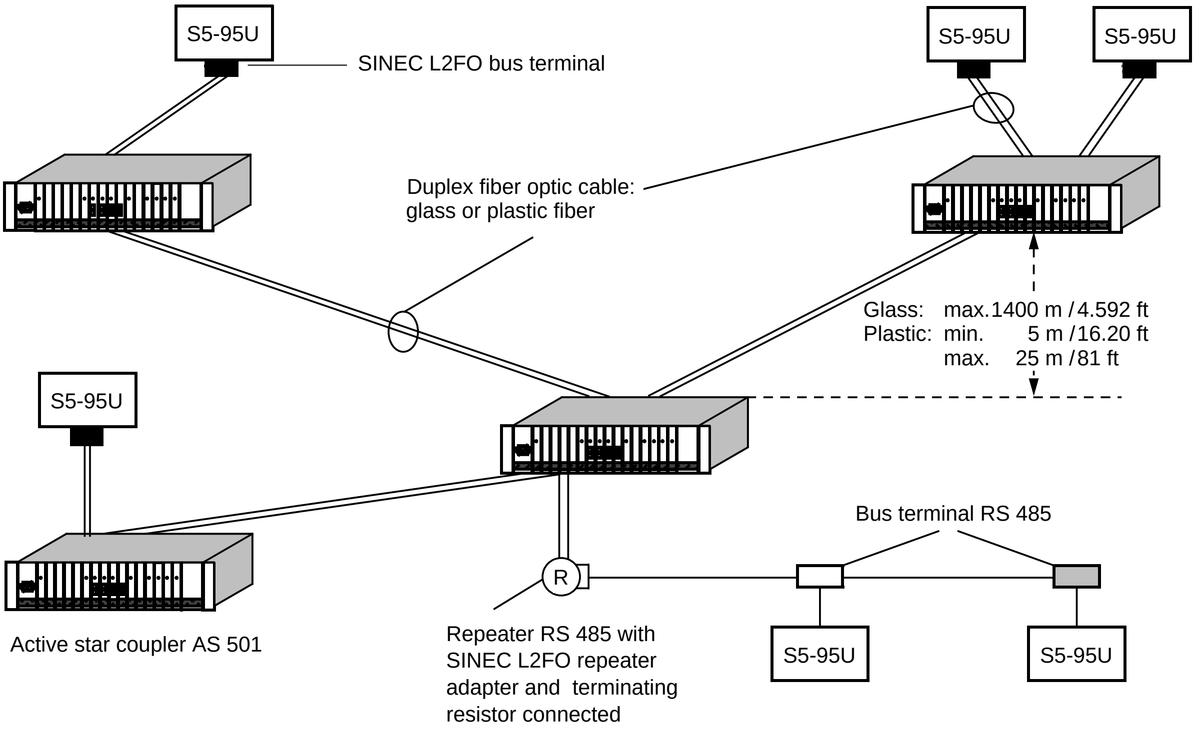


Figure 1-21. Mixed Configuration with RS 485 and FO Transmission Technology

You can also link two SINEC L2 networks of the RS 485 technology type directly via a fiber optic cable without using an active star coupler as shown in Figure 1-22.

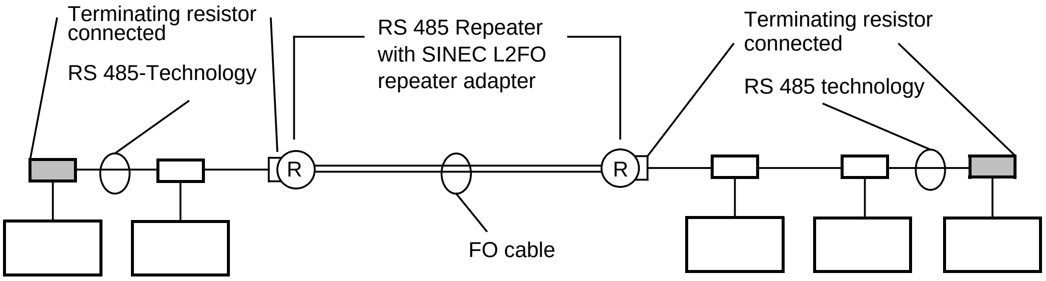


Figure 1-22. Two SINEC L2 Networks of the RS 485 Technology Linked via Fiber Optic Cable

SINEC L2FO SF Repeater Adapter for L2 Repeater

The SINEC L2FO SF repeater adapter converts electrical signals of the network into optical signals for the L2FO network.

Design of the SINEC L2FO SF repeater adapter (see also Figure 1-23):

- You can plug the SF repeater adapter directly onto the 15-pin D-type female connector of an L2 repeater
- Connection only to a glass fiber optic cable

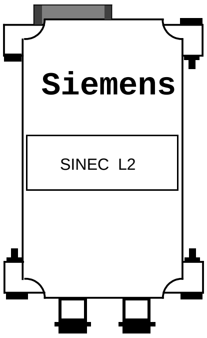


Figure 1-23. SINEC L2FO SF Repeater Adapter for L2 Repeater

2 Installation Guidelines

Figures

Tables

2 Installation Guidelines

This chapter contains suggestions and rules for configuring and installing the S5-95U as a SINEC L2 bus station. The S5-90U/S5-95U System Manual discusses installation guidelines for all versions of the S5-95U, such as mechanical installation and wiring. You should use this chapter together with the installation guidelines discussed in the system manual.

Note

Refer to the *SINEC L2/L2FO Network Manual* for additional information about installation techniques.

2.1 Basic Configuration

Figure 2-1 illustrates the main components of a SINEC L2 in RS 485 and S5-95U installation technology. The main components are as follows:

- The S5-95U programmable controllers with a SINEC L2 interface
- The SINEC L2 bus connector with the bus cable

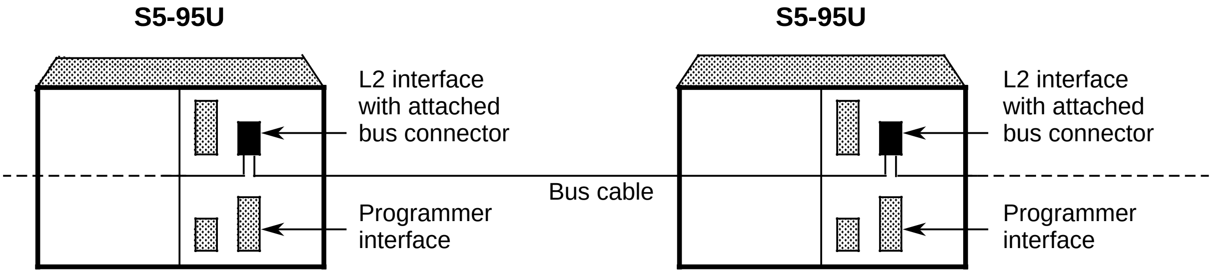


Figure 2-1. SINEC L2 Components

Note

The bus terminal can replace the bus connector (See section 1.6.1). All of the references in section 2.2 are to the bus connector because it is the most economical and simplest connection method.

2.2 Installing a SINEC L2 Bus Segment

This section explains how to install a SINEC L2 bus segment. A bus segment consists of the following components:

- The bus cable
- The SINEC L2 bus connector or the SINEC L2 RS 485 bus terminal
- The SINEC L2 station, e.g., an S5-95U programmable controllers with SINEC L2 interface

Mounting the Bus Cable on the SINEC L2 Bus Connector

You must mount the bus cable on the SINEC L2 bus connector to connect an S5-95U to the SINEC L2 bus.

Perform the following steps to establish the connection.

Lay out the cable and cut it.
Open the connector housing by loosening the housing screws.
Remove the housing cover.
Mount the bus cable as shown in Figure 2-3.
If required, switch on the terminating resistor.
Close the connector housing.
Now you can plug the SINEC L2 bus connector to the SINEC L2 interface of the S5-95U.
You can remove the connector without interfering with bus operation.

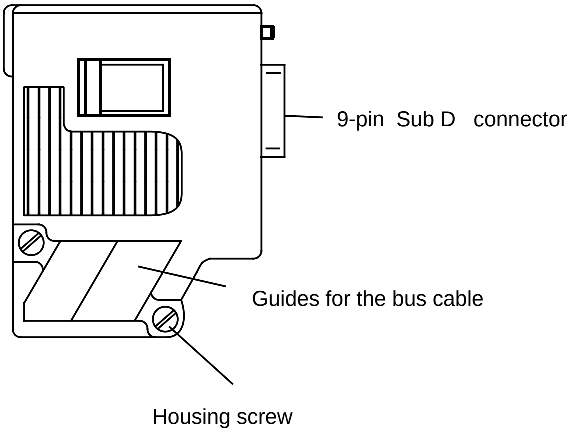
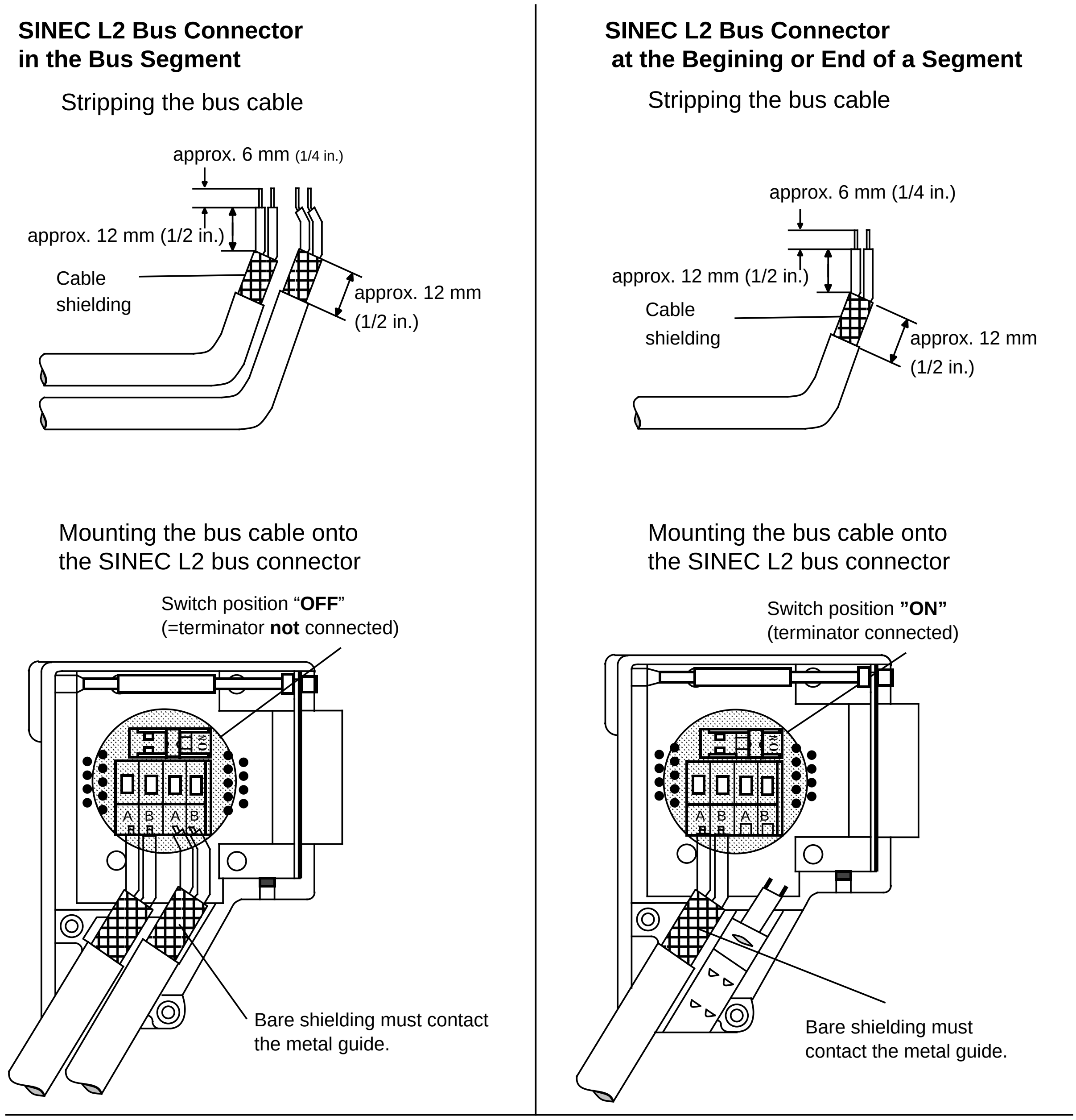


Figure 2-2. SINEC L2 Bus Connector with Degree of Protection IP 20

Note

When mounting the bus cable onto the SINEC L2 bus connector, make sure the data line connected to terminal A of one bus connector (Figure 2.3) is also jumpered with terminal A of the other.
Analogously, the B terminals of the two bus connectors must also be interconnected (Figure 2.3).



SINEC L2 Bus Connector in the Bus Segment

SINEC L2 Bus Connector at the Begining or End of a Segment

Figure 2-3. Cutting the Bus Cable, Stripping the Insulation, and Connecting the SINEC L2 Bus Connector

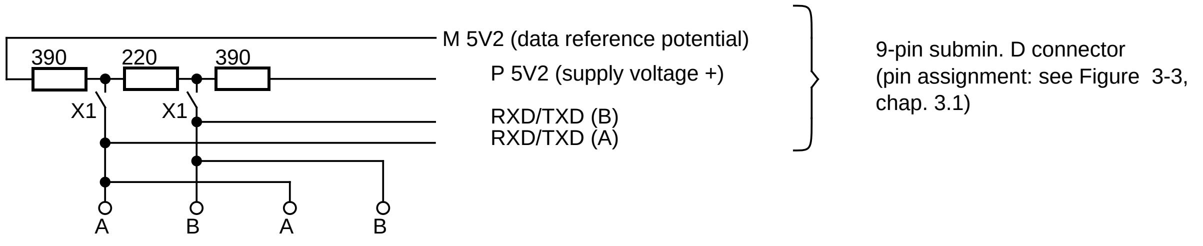


Figure 2-4. Circuit diagram of the SINEC L2 Bus Connector

2.3 Linking Bus Segments with the L2 Repeater

2.3.1 Electrical Design of the SINEC L2 Repeater RS 485

Voltage Potentials for a Correct EMC Installation of the L2 Repeater

- Bus segment 1 and bus segment 2 are electrically isolated from each other.
- Bus segment 2 and the power supply have a common reference potential.
- The reference potential (M terminal) and the protective ground conductor (PE terminal) are **not** connected to one another.
- All the shield clamps are connected to the protective ground conductor (PE terminal) at the factory. The clamps for the power supply and bus segment 2 are connected internally to the PE terminal. The connection between bus segment 1 and the PE terminal can be removed (remove connecting plate between bus segments 1 and 2).
- Terminal C (“C” stands for common) is not needed to connect the two-wire SINEC L2 bus cable.

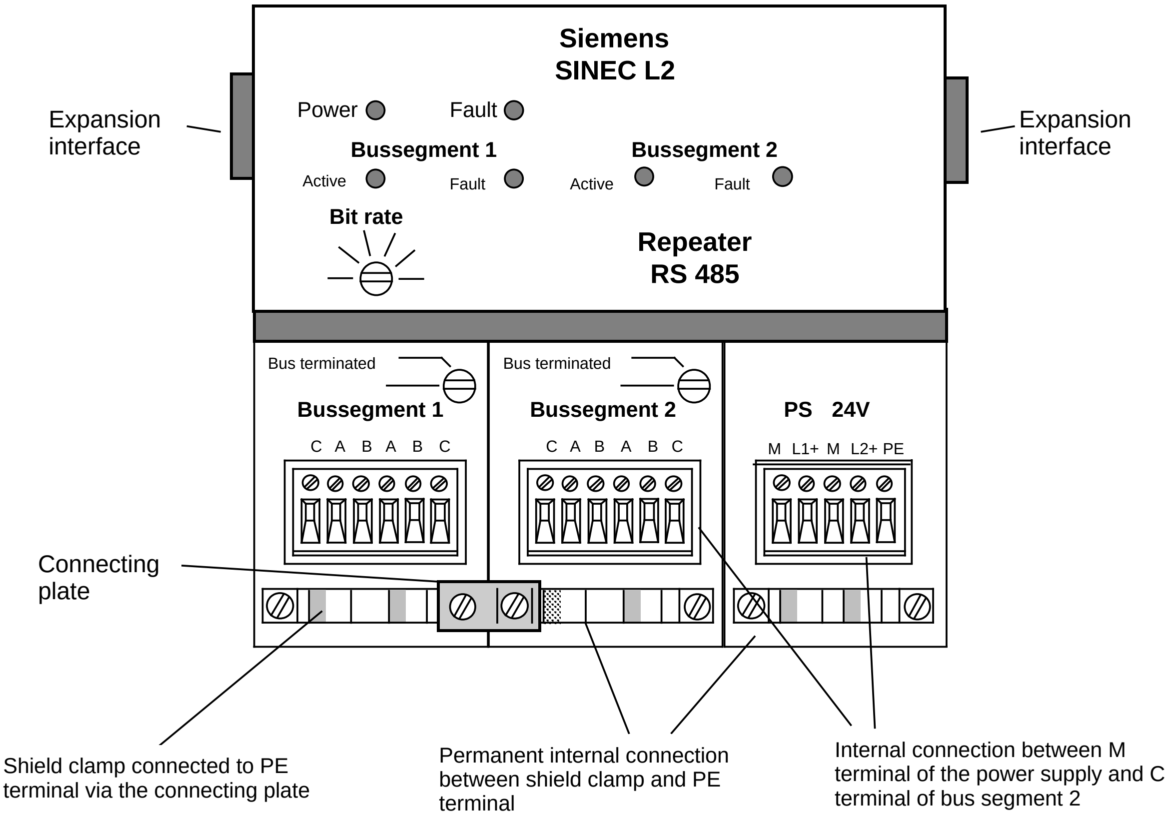


Figure 2-5. Voltage Potentials for the SINEC L2 Repeater RS 485

Grounding Methods

Installation on a standard mounting rail	Ground the standard mounting rail
Installation on a metal plate of a cabinet or on a wall	Connect the protective ground clamp of the repeater to the grounding rail using the shortest cable possible (cross section 1.5 mm^2, approximately AWG 16)

Reasons for Removing the Connecting Plate

Connecting both ends of the shield of the SINEC L2 bus cable to protective ground provides good noise suppression for high frequency ranges. It is the recommended method.

Note

Potential differences between the grounding points can cause an equalizing current to flow on the shield connected on both sides that exceeds the capacity of the shield. In that case, provide an equipotential bonding line.

Connecting only one end of the shield to protective ground should be the exception. It provides damping only of low-frequency noises. Choose this method only if you cannot provide an equipotential bonding line.

Remove the connecting plate between the shield clamps of segments 1 and 2. This opens the connection to the protective ground conductor.

⚠ Warning

When the connecting plate between segment 1 and segment 2 is removed, electric shock-hazard voltages 40 V can be present at the cable clamp of bus segment 1. Make sure you provide appropriate contact protection.

2.3.2 Connecting the Supply Voltage

To connect the supply voltage (+24 V DC) to the screw-type terminal block, use a two-wire or three-wire, shielded cable and prepare the shielding as follows (see Figure 2-6):

- Remove the insulation completely.
- Connect the shielding to the shield clamp of the repeater using the broadest connection surface as possible.
- Connect the shielding at the power supply end to the protective ground conductor.

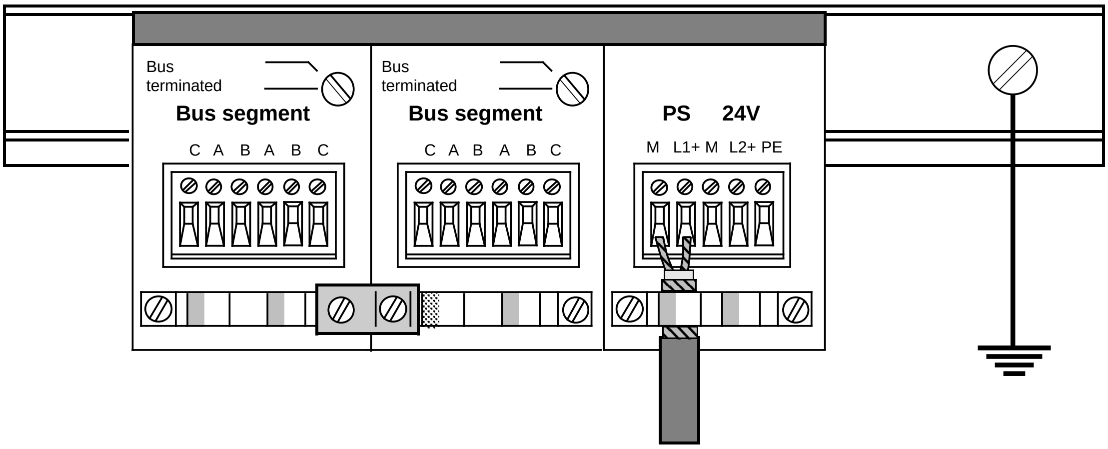


Figure 2-6. Connecting the Supply Voltage to the L2 Repeater

2.3.3 Connecting Bus Segments

This section explains how you connect bus segments to the L2 repeater. Note that you must terminate a segment at both ends (i.e., when the terminators are connected, the bus is terminated).

Repeater at Segment End
Figure 2-7 shows the connection of two segments to a repeater.

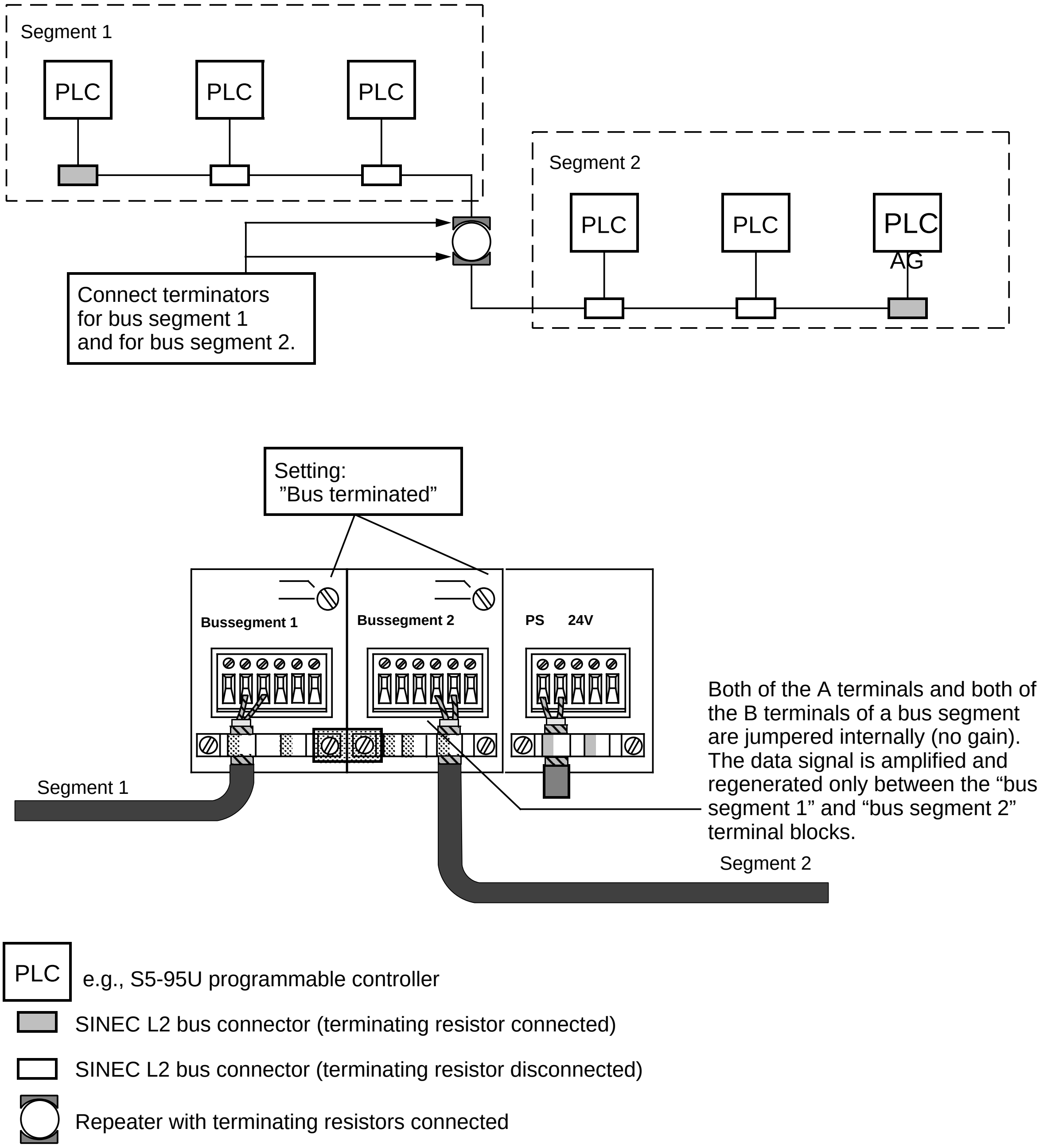
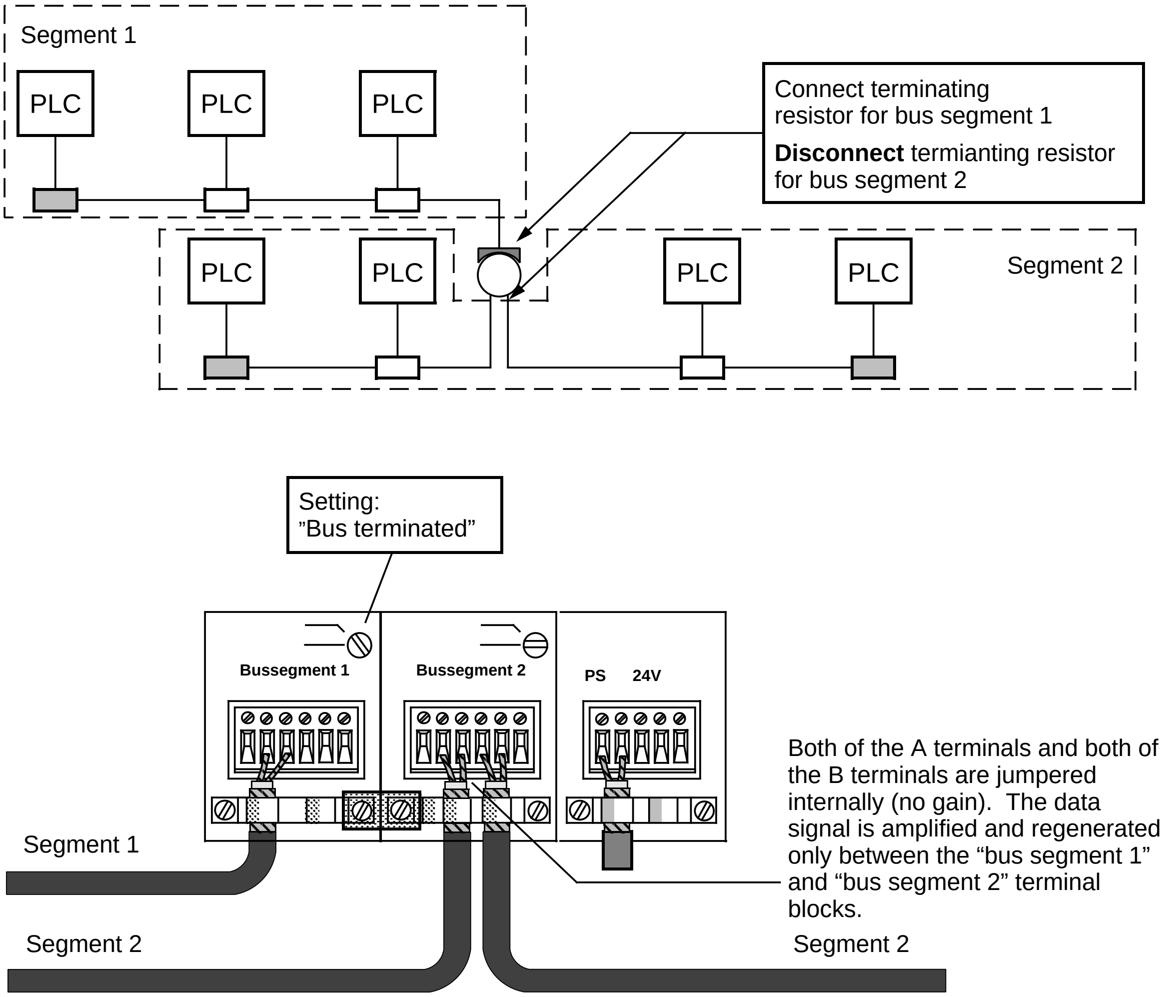


Figure 2-7. Connecting Two Bus Segments to Screw-Type Terminals of the L2 Repeater (1)

Repeater in Segment



Connect terminating resistor for bus segment 1

Disconnect termianting resistor for bus segment 2

Setting:
”Bus terminated”

Both of the A terminals and both of the B terminals are jumpered internally (no gain). The data signal is amplified and regenerated only between the “bus segment 1” and “bus segment 2” terminal blocks.

PLC e.g., S5-95U programmable controller

▨ SINEC L2 bus connector (terminating resistor connected)

▭ SINEC L2 bus connector (terminating resistor disconnected)

◯ Repeater with one terminating resistor connected

Figure 2-8. Connecting Two Bus Segments to Screw-Type Terminals of the L2 Repeater (2)

2.4 Routing Cables

Routing the Bus Cable
When routing the bus cable indoors, observe the limiting conditions listed in Table 2-1 (d_O = outer diameter).

Table 2-1. Limiting Conditions for Routing Cables Indoors

Feature	Limiting Condition
Bending radius when bending once	80 mm (3.1 in.) ($10 \cdot d_O$)
Bending radius when bending more than once	160 mm (6.3 in.) ($20 \cdot d_O$)
Permissible temperature range for routing cables	- 5 °C to+50 °C (+23 °F to+122 °F)
Temperature range for storing and operating	- 30 °C to+65 °C (-22 °F to+149 °F)

Do not twist, stretch, or crush cables when routing them.

When routing the bus cable outdoors, observe the general regulations regarding lightning and grounding.

Lightning protection
If cables for SIMATIC S5 devices are to be laid outdoors, both indoor and outdoor lightning protection should be provided.

Outside buildings, cables should be laid
- in steel conduits grounded at both ends or
- in concrete cable ducts with continuous armouring.

Install these elements where the cable enters the building.

Note

Look at each system individually to determine the measures necessary to protect it against lightning. Please address your questions to your local Siemens representative.

3 Start-Up, Tests, and Diagnostics

Figures

Tables

3 Start-Up, Tests, and Diagnostics

This chapter describes how to start up an S5-95U programmable controller as a SINEC L2 local area network station.

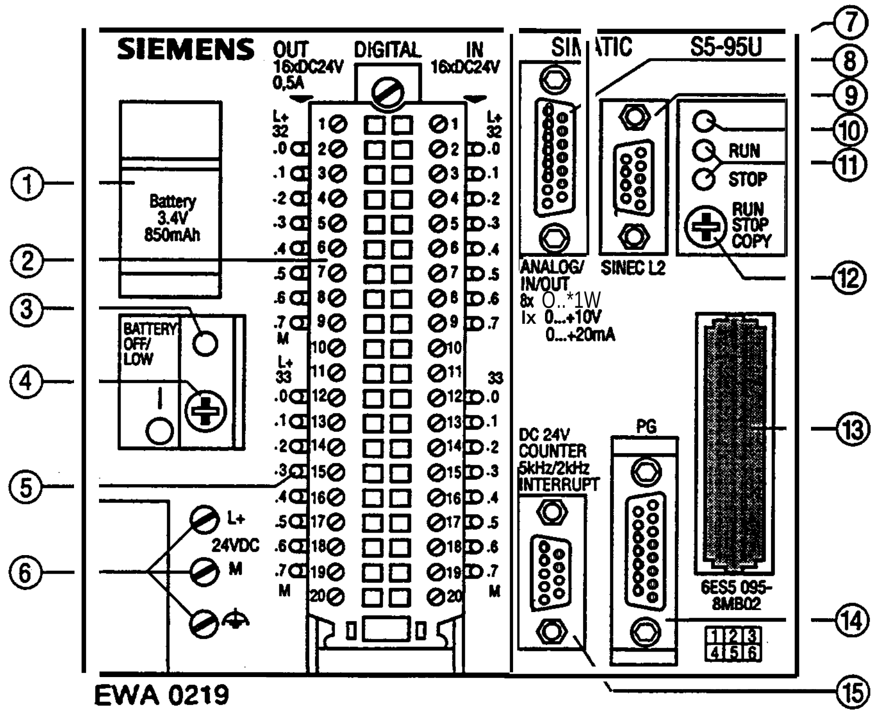
The first part of this chapter provides information on design and operating mode of the S5-95U with SINEC L2 interface. It also answers the following questions:

- What is the start-up sequence of the S5-95U with SINEC L2 interface?
- How do I start up the programmable controller as a SINEC L2 station?
- What tests should I conduct during start-up?

The second part of this chapter describes how errors are indicated on the programmable controller and which service and diagnostic functions (FMA services) are provided. Each FMA service is described individually and is followed by programming examples.

3.1 Design and Mode of Operation of the Programmable Controller

Figure 3-1 shows all the displays, operator controls and interfaces of the S5-95U (Order No. 6ES5095-8MB@



① Battery compartment

② Front panel connector for digital inputs (1 32.0 to 133.7) and for digital outputs (Q 32.0 to Q 33.7)

③ Battery low LED

④ ON/OFF switch

⑤ LED display for digital inputs and outputs

⑥ Terminals for connecting the power supply

⑦ Cable connector for S5-100U modules

⑧ Interface for analog inputs (IW 40 to IW 54) and for analog outputs (QW 40)

⑨ Interface for SINEC L2 bus

⑩ SINEC L2 bus fault LED

⑪ RUN/STOP LEDs: The green LED indicates the “RUN” mode, the red LED indicates the “STOP” mode.

⑫ RUN/STOP/COPY switch

⑬ Receptacle for an EPROM or EEPROM memory submodule

⑭ Interface for a PG, PC, OP or SINEC L1 bus

⑮ interface for interrupt inputs (1 34.0 to 34.3) and for counter inputs (IW 36, IW 38)

Figure 3-1. S5-95U LEDs, Controls, and Interfaces of the S5-95U

Operating the Programmable Controller with a SINEC L2 Interface
Figure 3-2 shows the operating principle of a programmable controller with the SINEC L2 interface.

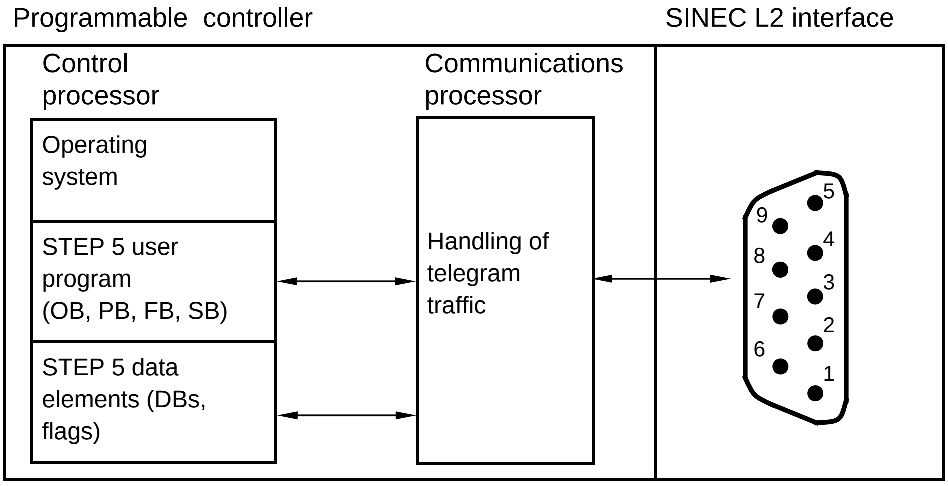


Figure 3-2. Operating Principle of an S5-95U with the SINEC L2 Interface

Communications Processor
The communications processor handles the frame traffic via the SINEC L2 network in parallel with the control processor.

The communications processor has the following tasks:

- Receive frames that are used for network management, e.g., token frames, via SINEC L2
  - Interpret the frame
  - Trigger adequate reactions
- Receive frames that contain data via SINEC L2
  - Interpret the frame
  - Store the data in STEP 5 data elements
- Transmit frames that are used for network management, e.g., token frames, via SINEC L2
- Transmit frames that contain data via SINEC L2
  - retrieve the data from STEP 5 data elements
  - pack the data into frames and transmit

SINEC L2 Interface
9-pin subminiature D female connector as specified in the *PROFIBUS Standards*.

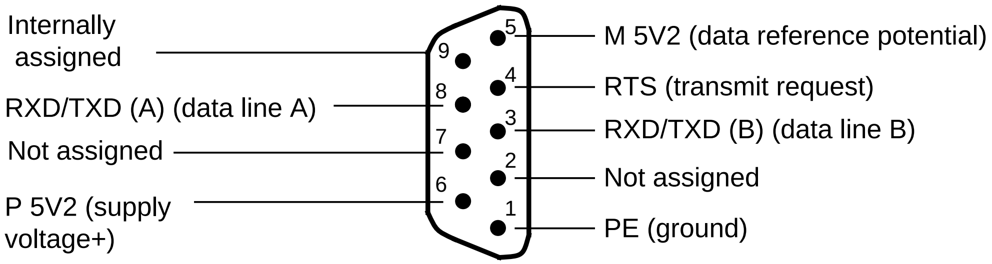
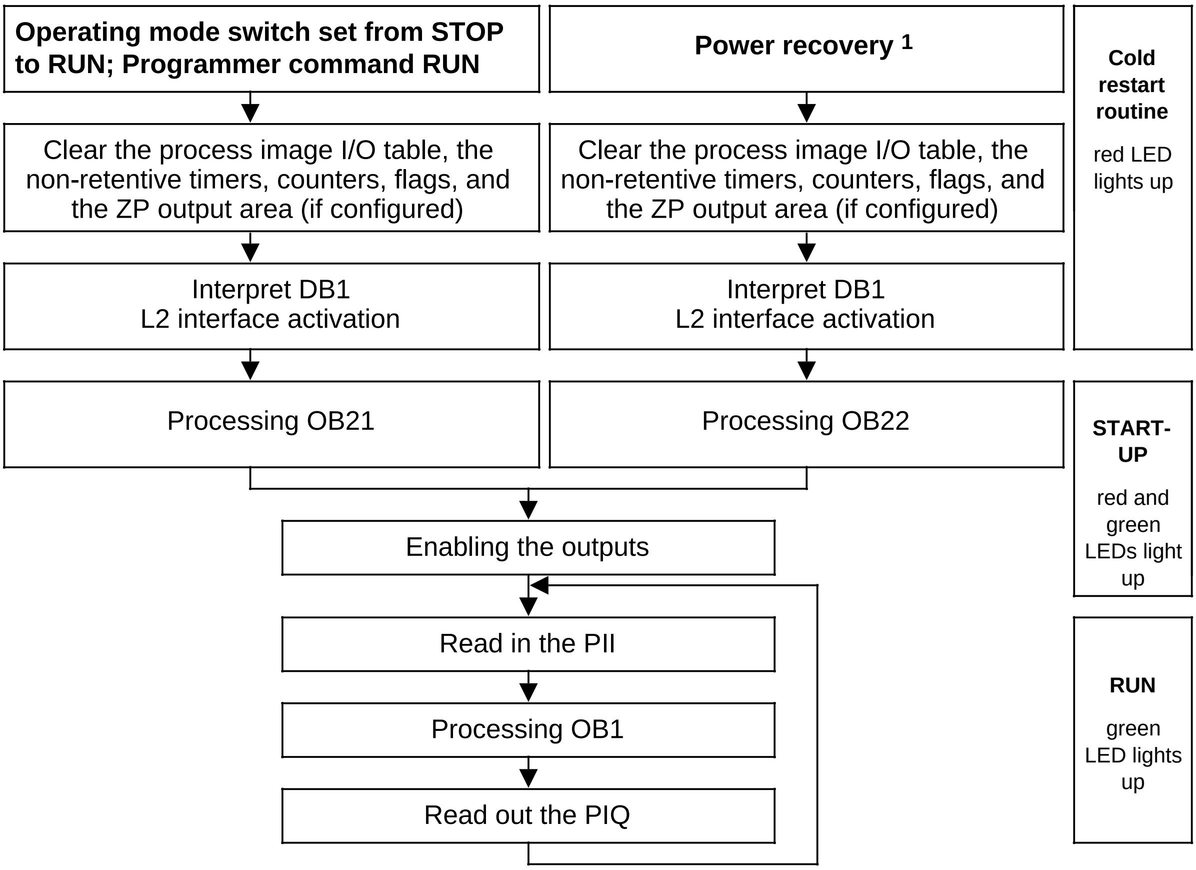


Figure 3-3. Pin Assignment for the SINEC L2 Interface of the S5-95U

3.2 START-UP Sequence

In the START-UP sequence, the communications processor is activated before the START-UP OBs are processed, as illustrated in Figure 3-2.



[1] This is the procedure if the programmable controller was in the "RUN" mode when the power went off, if the mode switch was still on RUN when the power was restored, and if the battery was inserted. If the battery was not inserted, you must insert a memory submodule containing the valid blocks.

Figure 3-4. Start-Up Sequence at Power ON/Switch from STOP to RUN

When the **S5-95U is in the STOP mode**, only the cyclical I/O (ZP) and the programmer functions are supported.

When the mode is switched from **STOP TO RUN after a modification of the SL2 parameters in DB1**, the status bytes for SINEC L2 communication are reset on the CPU side, and running jobs are deleted (communications processor is reset)

When the mode is switched from **STOP TO RUN without a modification of the SL2 parameters in DB1**, the status bytes for SINEC L2 communication remain on the CPU side, and processing of running jobs continues.

3.3 Starting Up a System

The following section contains suggestions for configuring and starting up a system containing programmable controllers.

3.3.1 Suggestions for Configuring and Installing the Equipment

The equipment is often used as a component in a larger system. The suggestions contained in the following warning are intended to help you install your programmable controller safely.

Warning

- Adhere to any safety and accident-prevention regulations applicable to your situation and system.
- If your system has a permanent power connection (stationary equipment) that is not equipped with an isolating switch and/or fuses that disconnect all poles, install either a suitable isolating switch or fuses in the building wiring system. Connect your system to a ground conductor.
- Before start-up, if you have units that operate using the main power supply, make sure that the voltage range setting on the equipment matches the local main power voltage.
- When using a 24-V supply, make sure you provide proper electric isolation between the main supply and the 24-V supply. Use only power supplies manufactured according to IEC 364-4-41 or HD 384.04.41 (VDE 0100, part 410).
- Fluctuations or deviations of the supply voltage from the rated value may not exceed the tolerance limit specified in the technical data. If they do, functional failures or dangerous conditions can occur in the electronic modules or equipment.
- Take suitable measures to make sure that programs that are interrupted by a voltage dip or power failure resume proper operation when the power is restored. Make sure that dangerous operating conditions do not occur even momentarily. If necessary, force an EMERGENCY OFF.
- EMERGENCY OFF devices must be in accordance with EN 60204/IEC 204 (VDE 0113) and be effective in all operating modes of the equipment. Make certain to prevent any uncontrolled or undefined restart when the EMERGENCY OFF devices are released.
- Install power supply and signal cables so that inductive and capacitive interference can not affect the automation functions.
- Install your automation system and its operative components so as to prevent unintentional operation.
- Automation equipment can assume an undefined state in the case of a wire break in the signal lines. To prevent this, take the proper hardware and software safety measures when linking the inputs and outputs of the automation equipment.

3.3.2 Prerequisites for Starting Up the S5-95U as a SINEC L2 Station

We assume that the S5-95U is to be connected as a station **to an already existing SINEC L2 local area network**.

Minimum hardware requirement:

- One S5-95U programmable controller
- One EPROM/EEPROM memory submodule or a back-up battery
- One bus connector or one bus terminal
- One programmer with monitor

Figure 3-5 shows the location of the connectors on the S5-95U.

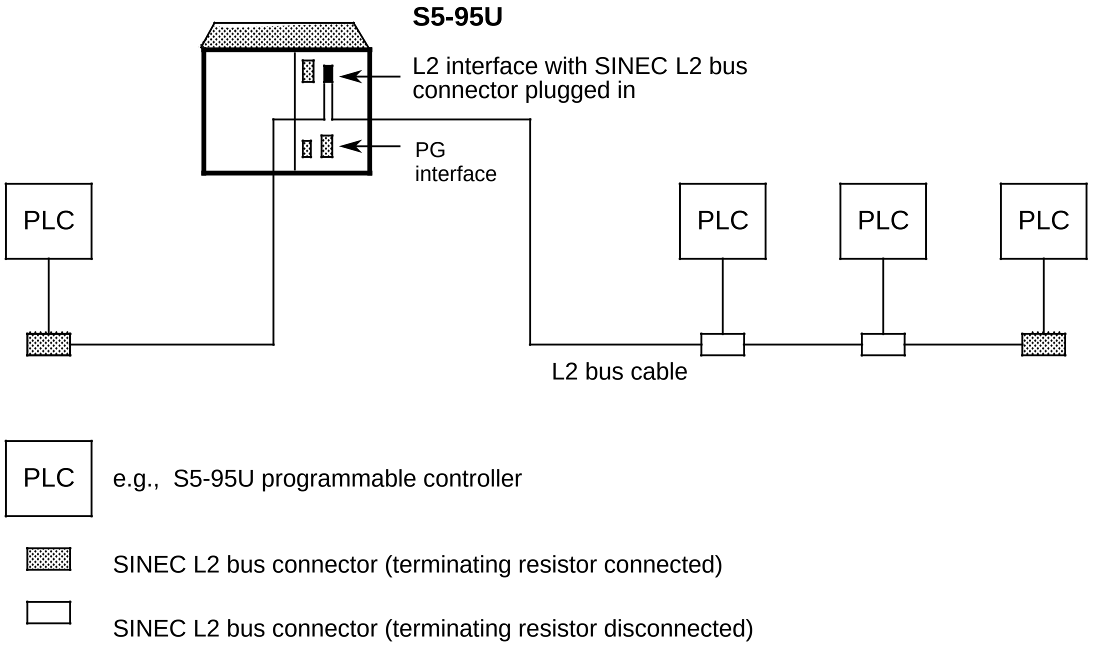


Figure 3-5. Connecting the L2 Interface of the S5-95U to the Local Area Network

Parameter Assignments Required in DB1:

- You have set the basic parameters in DB1 (see section 1.4).
- You have set the parameters for the desired data transmission type(s).
  Section 1.5 provides information for the selection of the data transmission types.
  The specific chapters provide information for assigning parameters for each specific data transmission type (Standard Connection: chapter 4; PLC to PLC: chapter 6; Cyclic I/O: chapter 7; layer 2 accesses: chapter 8).

3.3.3 System Startup Diagnostics and Procedures

BF LED fault display

The BF (Bus Fault) LED lights up when

- the firmware of the S5-95U detects a fault, or
- if the communications processor integrated in the S5-95U is not activated.

Table 3-1. Interpretation of the BF LED Display

BF LED	Meaning	Cause	Corrected DB1 is transferred to the PLC:
Lights up	Communications processor is not activated	There is no SL2 parameter block in DB1 or it is enclosed by comment characters (#)	after STOP-RUN or POWER OFF - POWER ON on the PLC
	Communications processor has been assigned the wrong parameters PLC remains in STOP mode	SL2 parameter block in DB1 contains errors	after POWER OFF - POWER ON on the PLC
	LAN bus fault (can only occur if the S5-95U is connected to the LAN)	Fatal internal fault or basic parameters are not consistent over the entire network, e.g. TLN (station address) has been allocated twice (LAN bus fault Table 3-10)	after POWER OFF - POWER ON on the PLC

Note

If you start up the S5-95U with the default DB1, the communications processor will not be activated and the BF LED will light up.

Test Possibilities during Start-Up

The S5-95U provides the two following types of diagnostics functions:

- Functions for the general diagnostics of the SINEC L2 bus
- Functions for diagnostics of the specific data transmission types (standard connection, PLC-to-PLC, cyclic I/O, layer 2 services)

The functions for diagnostics of the different data transmission types are explained in the corresponding chapters.
The functions for the general diagnostics of the SINEC L2 bus are explained in the following:

List All the Operative Active Stations of the Network
FMA service LAS_LIST_CREATE (see section 3.4.5)

Find Out the Status of a Remote Station
FMA service FDL_STATUS (see section 3.4.6)
You can find out whether another station is operative and passive or active.

Calculate the Remaining Token Hold Time When Receiving the Token
FMA service TIME_TTH_READ (see section 3.4.8)
You can find out whether the set target rotation time is optimal (TRT parameter in DB1).

Locate Errors
FMA service MAC_EVENT (see section 3.4.9)
Examples of errors that can be located using this service:

- Two stations have the token (double token).
- A station address has been assigned twice.
- There is a short-circuit on the bus cable.

Startup Procedure for the SINEC L2 station

Proceed as follows to start up the SINEC L2 station:

Start up the PLC without the SINEC L2 interface (as described in the S5-90U/S5-95U System Manual, chapter 4).
Start up the SINEC L2 interface as shown in the flowchart of Figure 3-6.

Prerequisite: The SINEC L2 bus connector is not plugged into the interface port on the PLC.

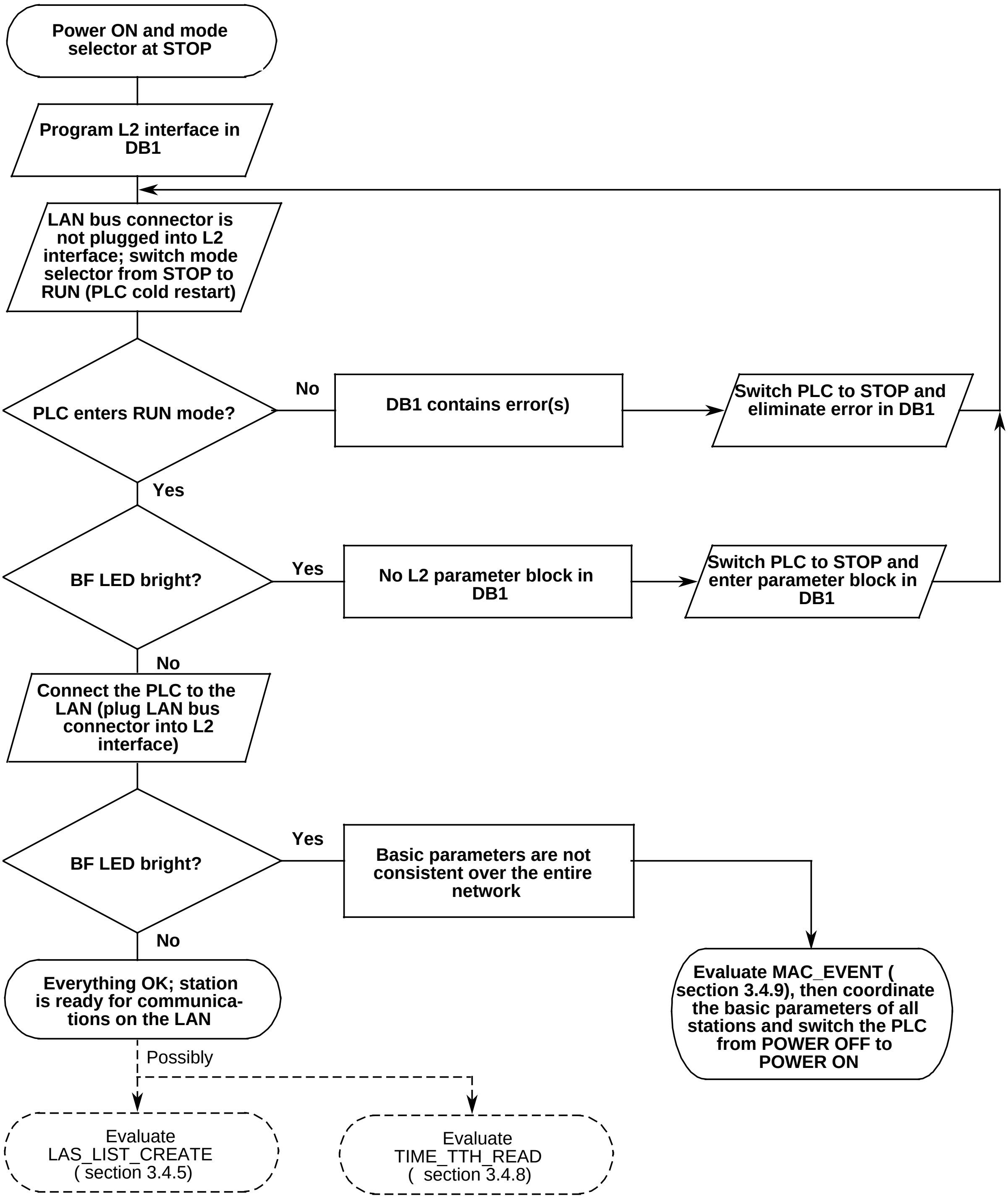


Figure 3-6. Checklist Flowchart for Starting Up a System

3.4 FMA Services

This section provides you with the following information:

- What is meant by FMA services
- Why FMA services are used
- Which FMA services are relevant for the L2 interface of the S5-95U
- How FMA services are called up

The prerequisites for understanding this section are:

- Knowledge of STEP 5 programming
- Knowledge of how to handle the L2-SEND and L2-RECEIVE function blocks (see chapter 5)

These special functions give you access to the management services. FMA stands for Field bus MAnagement. FMA services serve to monitor both the network and the local stations.
The FMA services make it possible to diagnose all of the network stations.
The communications processor evaluates the data collected from the stations.

3.4.1 Principle of Operation

- A service request is sent to the communications processor by means of integral function block FB L2-SEND (FB252) .
- If the FMA service requests information from another station (only FMA service FDL_STATUS)
  - The communications processor scans the status of the other station .
  - The other stations replies .
- The system waits for a reply (confirmation) to arrive from the communications processor.
  In the meantime the control processor processes the user program. This way the waiting time does not cause any additional cycle delay.
- The user program indicates that a confirmation has arrived from the communications processor.
- The confirmation is fetched by means of integral function block FB L2-RECEIVE (FB253) .

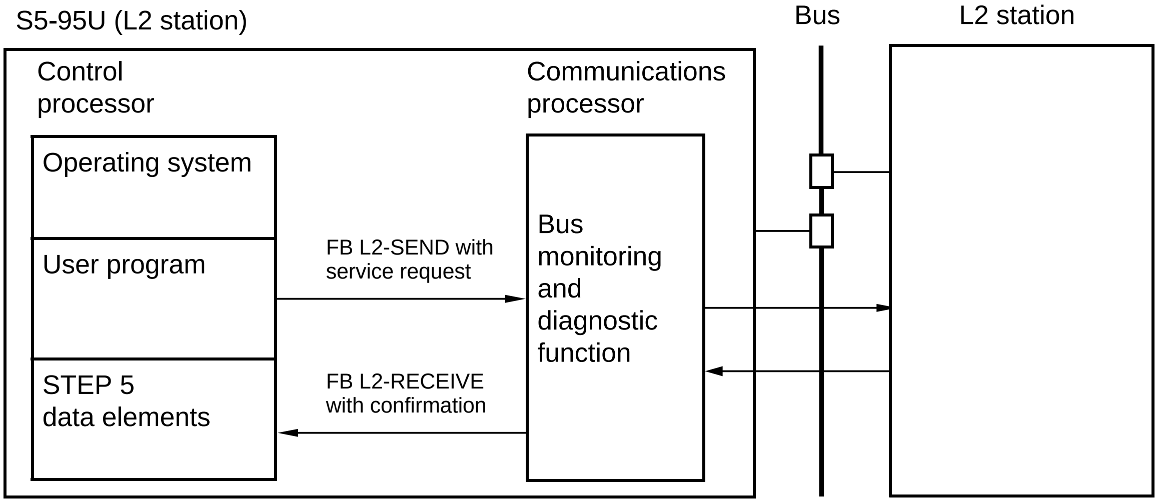


Figure 3-7. Principle of Operation of the Programmable Controller with SINEC L2 Interface

An FMA request consists of an 8-byte header. The confirmation, depending on the service, consists of a maximum of 58 bytes. Bytes 0 to 7 are assigned to the confirmation header; the requested data start with byte 8.
Figure 3-8 shows the structure of a service request and of a confirmation. The designations in the header blocks are taken from the PROFIBUS Standards.

The FMA headers contain the following parameters. Not all parameters are completely evaluated for all functions.

Service Request

Byte	
0	**com_class** **FMA_Request=00_H** (service request)
1	**user_id** Freely assignable ID. That ID is returned unchanged in the confirmation.
2	**service_code** Type of service requested
3	irrelevant
4	irrelevant
5	irrelevant
6	**rem_add_station*** Address of destination station (hexadecimal)
7	irrelevant

Confirmation

Byte	
0	**com_class** **FMA_Confirmation=01_H** (acknowledgment from firmware following FMA_Request)
1	**user_id** ID assigned in the FMA_Request
2	**service_code** Type of service provided by the layer 2 firmware
3	**link_status** OK message, or error message; indicates the success or failure of the previous service request
4	irrelevant
5	irrelevant
6	**rem_add_station*** Address of destination station (hexadecimal)
7	irrelevant
8 ⋮ 57	Data

***** Required only by FMA service FDL_STATUS

Figure 3-8. Structure of the FMA Headers for Request and Confirmation

Storing the Request Header and the Confirmation Data

Store the transmit data and the received data in the flag area or the data area.
The maximum length of the confirmation (header + data) is 58 bytes. Because of the rather large maximum amount of data contained in a confirmation, we recommend choosing only the data area. We also recommend storing request and confirmation in the same data block.

3.4.2 The Types of FMA Services

The L2 interface of the S5-95U permits only the FMA services listed in Table 3-2.

Table 3-2. FMA Services Possible with the L2 Interface of the S5-95U

FMA Service	Function
LAS_LIST_CREATE	Read out the list of all the active stations on the network.
FDL_STATUS	Read the status of another station (e.g., “Station is passive”; or “Station is active and in the token ring”).
READ_VALUE	Read the updated bus parameters (e.g., TLN, BDR, TRT).
TIME_TTH_READ	Read the token hold time still available when receiving the token.
MAC_EVENT	Read out an event message (e.g., “cable short-circuit”).

Some of the **characteristics** of the individual FMA services are summarized in Table 3-3.

Table 3-3. Characteristics of FMA Services

FMA Service Characteristics	FMA Service Can Be Used if the S5-95U is		FMA Request Necessary?
FMA Service	Active	Passive	
LAS_LIST_CREATE	X		X
FDL_STATUS	X		X
READ_VALUE	X	X	X
TIME_TTH_READ	X		X
MAC_EVENT	X	X	

As a **prerequisite** to using FMA services you must perform the following actions on the relevant programmable controller:

- Define job number ANR=200 for calling up the L2-SEND and L2-RECEIVE function blocks, and define the location of a status byte in DB1.
- Set parameters for the L2-SEND and L2-RECEIVE function blocks.
- Set up a data block for the service request and for the confirmation.

Section 3.4.3 describes how to assign parameters in DB1. Chapter 5 describes how to assign parameters for L2-SEND and L2-RECEIVE.

3.4.3 Assigning Parameters in DB1 for the FMA Services

The default settings of DB1 do not enable the FMA services. To activate the FMA services, set the following parameters in DB1:

- The job number A-NR=200 (200 is reserved for FMA services)
- The location of a status byte (STB) for FB L2-SEND and FB L2-RECEIVE.

The status byte displays the status of the transmit or receive jobs and informs you of possible errors. Section 5.4 explains in detail the structure and the evaluation of the STB. The STB parameter settings provide you with access to all the FMA services described in section 3.6.2, except MAC_EVENT. If you want to use MAC_EVENT, you must specifically activate this service in DB1.

Figure 3-9 shows DB1 with parameter settings for all FMA services.
The procedures to set and modify parameters in DB1 and to transfer DB1 are described in detail in section 1.4.

```
156:     KS  ='    SL2: TLN 1   STA AKT';
168:     KS  =' BDR 500    HSA 10  TRT ';
180:     KS  ='5120    SET 0   ST 400  ';
192:     KS  ='SDT 1 12  SDT 2 360     ';
204:     KS  ='STB 200  MB200 FMAE Y   ';
 :
 :
```

Figure 3-9. DB1 with Parameter Settings for All FMA Services

Table 3-4 shows the parameters to use for FMA services.

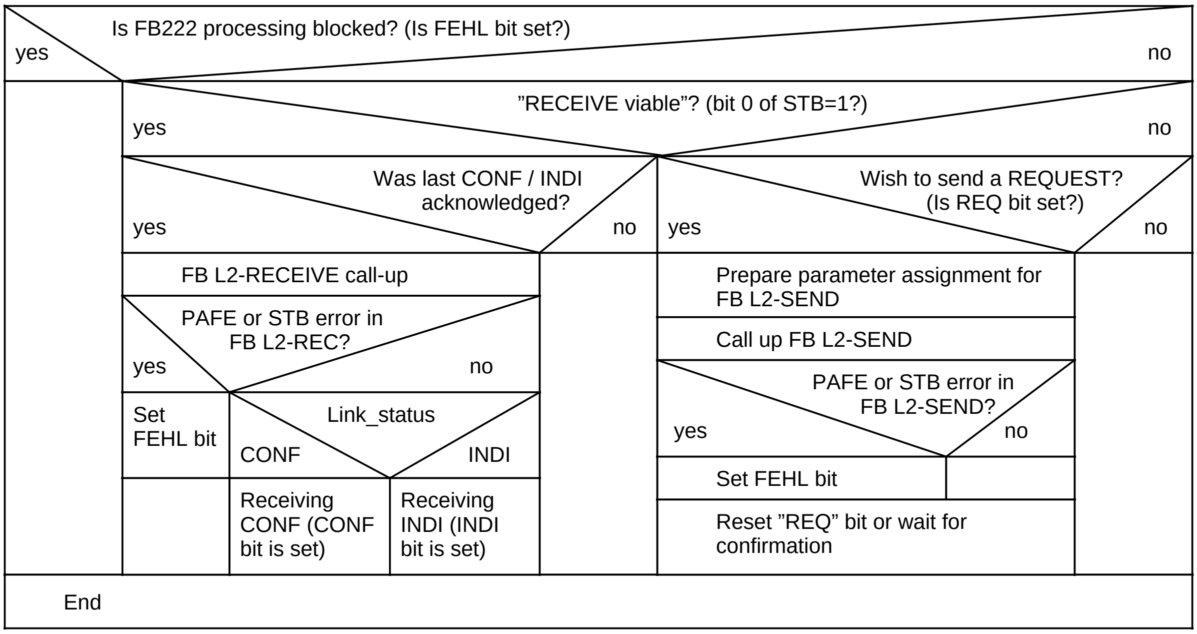
Table 3-4. DB1 Parameters for the FMA Services

Parameter	Argument	Significance
Blockkennung: SL2:		**SINEC L2**
STB	200 MBx	Location of status byte for FMA services Job number A-NR=200
FMAE	J/Y/N	Activate FMA service MAC_EVENT
Argument	**Permissible Range**	**Explanation**
200 MBx	1 ... 253	Job number, flag byte
J/Y/N	—	Is FMA service activated? j/J = ja; y/Y = yes; n/N = nein

3.4.4 Managing of all FMA Services with FB222

FB222 (named AG95/FMA) allows you, with a minimum of programming, to initiate and monitor FMA jobs, and to react to them. You program FB222 once for a given S5-95U. FB222 can be used for all the FMA services.

Structure the control program for the FMA services as shown in Figure 3-10.



Significance of the FB222 Parameters:

REQ **Input parameter bit**
Setting this bit triggers the request job with the service code specified in the CODE parameter. You set the REQ bit before the FB222 call-up. FB222 resets the REQ bit after the job has been triggered or if an error has occurred.

CODE **Input parameter word**
Left byte = station address of the remote station (valid only for FMA service FDL_STATUS, service_code 22_H)
Right byte = service_code
You transfer the service code and, with service code 22_H, the address of the remote station for the request job (triggered by parameter REQ).

CONF **Output parameter bit** (CONF=1 for all FMA services except MAC_EVENT)
FB222 tells you that a confirmation was received. You can evaluate the received data in the receive area of data block DB200. FB222 sets bit CONF. You must reset bit CONF after evaluation of the received data.

INDI **Output parameter bit** (INDI=1 for FMA service MAC_EVENT)
FB222 tells you that an indication was received. You can evaluate the received data in the receive area of data block DB200. FB222 sets bit INDI. You must reset bit INDI after evaluation of the received data.

FEHL **Output parameter bit**
FB222 tells you that a parameter assignment error or a status byte error has occurred. FB222 sets the bit. You must reset the bit after you have evaluated it.

FB222	Explanation
SEGMENT 1 0000	
NAME : AG95/FMA	
DES : REQ I/Q/D/B/T/C: I BI/BY/W/D: BI	
DES : CODE I/Q/D/B/T/C: I BI/BY/W/D: W	
DES : CONF I/Q/D/B/T/C: Q BI/BY/W/D: BI	
DES : INDI I/Q/D/B/T/C: Q BI/BY/W/D: BI	
DES : FEHL I/Q/D/B/T/C: Q BI/BY/W/D: BI	
0008 : C DB 200	Call up DB for received data.
000A :	
000C : A =FEHL	End if processing of FB222 is blocked.
000E : BEC	
0010 :	
0012 : AN F 200.0	If STB bit ‘Receive viable’ is not set,
0014 : JC =REQ	jump to request program section.
0016 :	Did you acknowledge receiving
0018 : O =CONF	the last confirmation or
001A : O =INDI	the last indication?
001C : BEC	End here if no acknowledgment.
001E :	
0020 : JU FB 253	
0022 NAME : L2-REC	
0024 A-NR : KY O,200	Job number for FMA services is 200.
0026 QTYP : KS DB	Receive data are in a data block,
0028 DBNR : KY 0,200	DB number is 200,
002A QANF : KF +9	starting with data word DW9,
002C QLAE : KF -1	“wildcard length”.
002E : O F 200.3	If STB bit ‘Job completed with error’ is set,
0030 : O F 255.0	or if parameter assignment error is present,
0032 : S =FEHL	output error code
0034 : BEC	
0036 :	***************************************
0038 :	Confirmation or indication was received.
003A :	
003C : L DL 9	Load com_class.
003E : L KH 001	Check that confirmation is received.
0040 : !=F	
0042 : S =CONF	Code: confirmation was received
0044 : BEC	
0046 : S =INDI	Code: indication was received
0048 : BEU	
004A :	***************************************
004C REQ :	Request program section
004E : AN =REQ	if no request job is in progress
0050 : BEC	

(continued)

FB222 (continued)	Explanation
`0052       :`	Prepare indirect parameter setting.
`0054       :`	Load parameters for FB L2-SEND in DB1.
`0056       : L    KF +200`	A-NR
`0058       : T    DW   0`	
`005A       : L    KS DB`	QTYP
`005C       : T    DW   1`	
`005E       : L    KY 0,200`	DBNR
`0060       : T    DW   2`	
`0062       : L    KF +5`	QANF
`0064       : T    DW   3`	
`0066       : L    KF +4`	QLAE
`0068       : T    DW   4`	
`006A       :`	
`006C       : L    =CODE`	Enter service_code in data field for the request job.
`006E       : T    DL   6`	
`0070       :`	
`0072       : SRW       8`	Enter station number of receiver station
`0074       : T    DL   8`	in data field for request job (only for FMA service
`0076       :`	FDL_STATUS).
`0078       : AN   F 200.1`	STB bit ‘Job in progress‘ is not set.
`007A       : JC   FB 252`	Jump to L2-SEND.
`007C  NAME : L2-SEND`	Indirect parameter setting of L2-SEND.
`007E  A-NR :      KY 0,0`	
`0080  QTYP ;      KS YY`	
`0082  DBNR :      KY O,200`	Parameters for L2-SEND are stored in data block DB200,
`0084  QANF :      KF +0`	starting with data word DW0.
`0086  QLAE :      KF +0`	
`0088       : O    F 200.3`	If STB bit ‘Job completed with error’ is set or
`008A       : O    F 255.0`	if a parameter assignment error is present,
`008C       : S    =FEHL`	set bit FEHL.
`008E       : RB   =REQ`	Reset REQ trigger bit.
`0090       : BEC`	
`0092       :`	
`0094       : RB   =REQ`	Reset REQ trigger bit.
`0096       :`	
`0098       : BE`	

The chapter for each particular FMA service describes how you call up FB222 from OB1.

3.4.5 Reading Out a List of All Active Stations on the Network (LAS_LIST_CREATE)

The LAS_LIST_CREATE (List of Active Stations) service delivers a list of all active stations on the network up to HSA.
The creation of this list does not burden the bus (local service).

Figure 3-10 shows the structure of the LAS_LIST_CREATE request and confirmation blocks.

Structure the LAS_LIST_CREATE request block as follows:

Byte	*Request Block*
0	**com_class** **FMA-Request=00$_H$** (service request)
1	user_id Freely assignable ID. That ID is returned unchanged in the confirmation.
2	**service_code** Type of service requested **LAS_LIST_CREATE=1B$_H$**
3-7	irrelevant

The data are stored in the LAS_LIST_CREATE confirmation block as follows:

Byte	*Confirmation Block*
0	**com_class** **FMA-Confirmation=01$_H$** (acknowledgment from firmware following FMA_Request)
1	**user_id** ID assigned in the FMA_Request
2	**service_code** Type of service provided: **LAS_LIST_CREATE = 1B$_H$**
3	**link_status**
4-7	irrelevant
8	***Status byte for station 00***
9	***Status byte for station 01***
	....
HSA+8	***Status byte for station with HSA***

▨ Relevant parameters

Figure 3-10. Structure of the LAS_LIST_CREATE Request and Confirmation Blocks

link_status

Table 3-5. link_status Messages for the LAS_LIST_CREATE Confirmation

link_status-Meldung	**Significance**
00$_H$	ok (okay): Positive confirmation, LAS was read out
15$_H$	iv (invalid): Errorr, local station is passive, service is impossible

The status bytes of the stations are located in the **confirmation block** as shown in Figure 3-10.

7	6	5	4	3	2	1	0	
0	0	0	0	0	0	0	1	1_H=Station does not exist or is passive
0	0	0	0	0	0	1	0	2_H=Station active, waiting for the token
0	0	0	0	0	1	0	0	4_H=Station active (connected)

Figure 3-11. LAS_LIST_CREATE Status Bytes

Calling Up FB222 and Storing the Data with FMA Service LAS_LIST_CREATE

OB1	Explanation
`:            :`	
`:            :`	
`0008       : L         KH 001B`	Load service_code into the ACCUM and transfer to FW2
`0009       : T         FW 2`	
`000A       : SPJU      FB 222`	(see section 3.4.4)
`000B   NAME: AG95/FMA`	
`000C    REQ: F  1.0`	If FMA service is required, bit must be set.
`000D   CODE: FW 2`	Enter type of service requested (here: $1B_H$)
`000E   CONF: F  1.1`	FB222 message: confirmation was received
`0010   INDI: F  1.2`	irrelevant
`0011   FEHL: F  1.3`	FB222 message: error occurred in PAFE or STB
`.           .`	
`.           .`	
`0030       : BE`	

DB200	Explanation
	****REQUEST block****
`6:   KH = 1B00;`	service_code / irrelevant
`7:   KY = 000,000;`	irrelevant / irrelevant
`8:   KY = 000,000;`	irrelevant / irrelevant
	****CONFIRMATION****
`9:   KH = 0100;`	com_class / user_id
`10:   KH = 1B00;`	service_code / link_status
`11:   KY = 000,000;`	irrelevant / irrelevant
`12:   KY = 000,000;`	irrelevant / irrelevant
`13:   KM = 00000001 00000100;`	status station 00 / status station 01
`14:   KM = 00000100 00000001;`	status station 02 / status station 03
`15:   KM = 00000001 00000001;`	status station 04 / status station 05
`16:   KM = ......`	......

3.4.6 Reading the Status of Another Station (FDL_STATUS)

The FDL_STATUS service delivers information about the status of another station on the network (remote service).

Structure the FDL_STATUS request block as follows:

Byte	*Request Block*
0	**com_class** **FMA-Request=00$_H$** (service request)
1	user_id Freely assignable ID. That ID is returned unchanged in the confirmation.
2	**service_code** Type of service requested: **FDL_STATUS=22$_H$**
3	irrelevant
4	irrelevant
5	irrelevant
6	**rem_add_station** **Address of target station** (TLN=1 to 126)
7	irrelevant

The data are stored in the FDL_STATUS confirmation block as follows:

Byte	*Confirmation Block*
0	**com_class** **FMA-Confirmation=01$_H$** (acknowledgment from firmware following FMA_Request)
1	**user_id** ID assigned in the FMA_Request
2	**service_code** Type of service provided: **FDL_STATUS = 22$_H$**
3	**link_status**
4-5	irrelevant
6	**rem_add_station** **Address of target station** (TLN=1 to 126)
7	irrelevant
8	***Status byte for remote station***

▨ Relevant parameters

Figure 3-12. Structure of the FDL_STATUS Request and Confirmation Blocks

link_status

Table 3-6. link_status Messages for the FDL_STATUS Confirmation

link_status Message	**Significance**
00$_H$	ok (okay): Positive confirmation, FDL_STATUS was read out
15$_H$	iv (invalid): The following errors may have occurred: - Local station is passive, service is not possible - Target station address is own address - Target station address is higher than 126

The status information may be contained in byte 8 of the **confirmation block** as shown in Figure 3-12.

7	6	5	4	3	2	1	0	
0	0	0	0	1	0	0	0	8_H= remote station is passive
0	0	0	0	0	0	0	1	1_H= no acknowledgement from remote station
0	0	0	0	0	0	1	0	2_H= remote, active station ready to be connected
0	0	0	0	0	1	0	0	4_H= remote, active station is connected

Figure 3-13. Status Byte of FDL_STATUS

Calling Up FB222 and Storing the Data with FMA Service FDL_STATUS

OB1	Explanation
. .	
0008 : L KH 0222	Load address of target station (here: TLN 2) and service_code in ACCUM and transfer to flag word FW2 (see section 3.4.4)
0009 : T FW 2	
000A : JU FB 222	
000B NAME: AG95/FMA	
000C REQ: F 1.0	If FMA service is requested, bit must be set.
000D CODE: FW 2	Enter type of service requested (here: 22_H)
000E CONF: F 1.1	FB222 message: confirmation was received
0010 INDI: F 1.2	irrelevant
0011 FEHL: F 1.3	FB222 message: error occurred in PAFE or STB
. .	
. .	
0030 : BE	

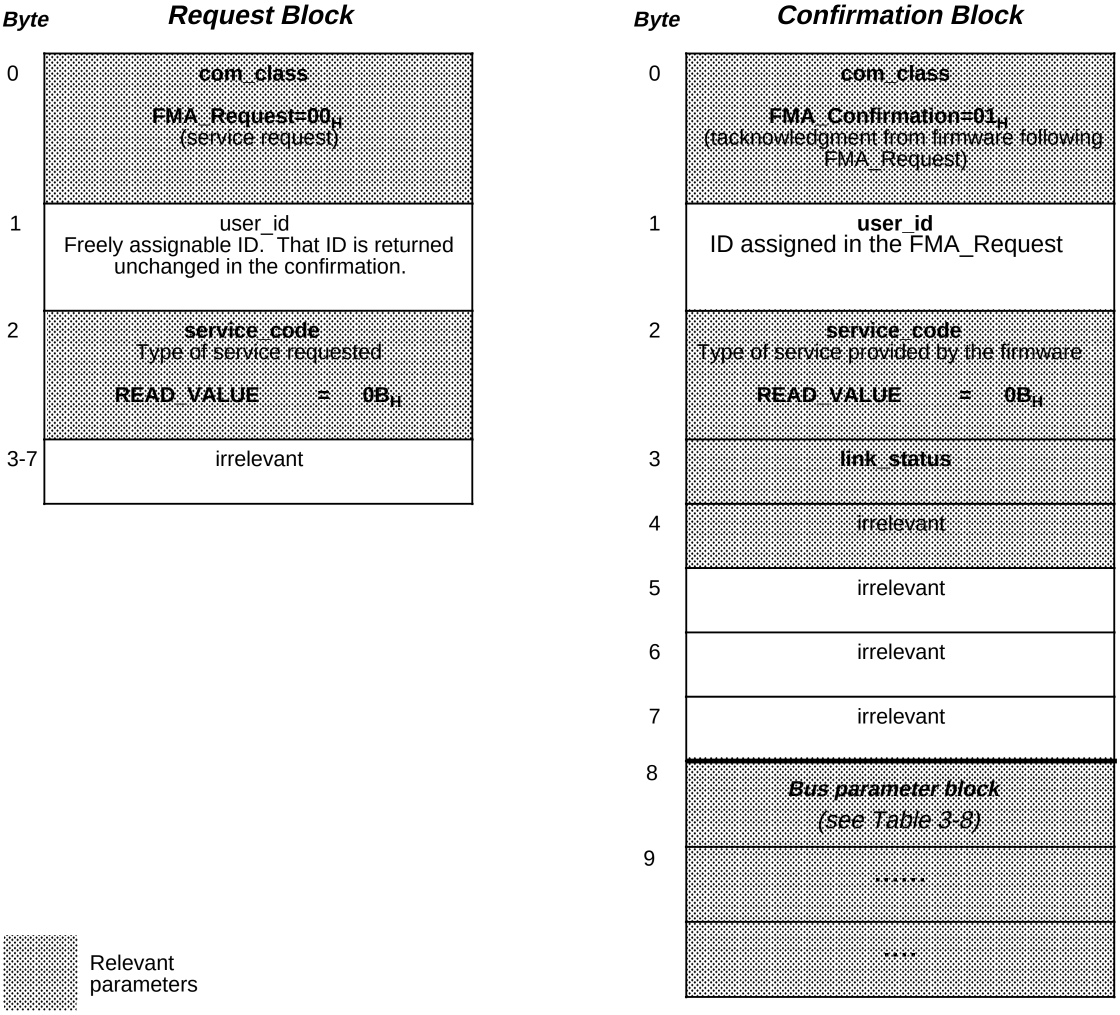
DB200	Explanation
	****REQUEST block****
6: KH = 2200;	service_code / irrelevant
7: KY = 000,000;	irrelevant / irrelevant
8: KY = 002,000;	address of target station (here: 2) / irrelevant
	****CONFIRMATION****
9: KH = 0100;	com_class / user_id
10: KH = 2200;	service_code / link_status
11: KY = 000,000;	irrelevant / irrelevant
12: KY = 002,000;	address of target station (here: 2) / irrelevant
13: KM = 00001000 00000000;	status of remote station (here: station 2 is passive) / . . .
14: KM = ...	....

3.4.7 Reading Updated Bus Parameters (READ_VALUE)

The READ_VALUE service allows you to read out the updated bus parameters of the local station.

Structure the READ_VALUE request block as follows:

The data are stored in the READ_VALUE confirmation block as follows:



Request Block

Byte	
0	**com_class** **FMA_Request=00$_H$** (service request)
1	user_id Freely assignable ID. That ID is returned unchanged in the confirmation.
2	**service_code** Type of service requested **READ_VALUE = 0B$_H$**
3-7	irrelevant

Confirmation Block

Byte	
0	**com_class** **FMA_Confirmation=01$_H$** (tacknowledgment from firmware following FMA_Request)
1	**user_id** ID assigned in the FMA_Request
2	**service_code** Type of service provided by the firmware **READ_VALUE = 0B$_H$**
3	**link_status**
4	irrelevant
5	irrelevant
6	irrelevant
7	irrelevant
8	***Bus parameter block*** *(see Table 3-8)*
9	......
	....

▨ Relevant parameters

Figure 3-14. Structure of the READ_VALUE Request and Confirmation Blocks

link_status

Table 3-7. link_status Messages for the READ_VALUE Confirmation

link_status Message	**Significance**
00$_H$	ok (okay): Positive acknowledgement, service was executed, bus parameters were read out

Table 3-8 lists the parameters, their meanings and their permissible range of values of the bus parameter block for the STB display 'Job completed without error' (see detailed explanation of the parameters in section 1.4).

Table 3-8. Bus Parameter Block Values for a READ_VALUE Confirmation

Byte	Parameter	Significance	Value Range / Code
8	tln (byte)	Address of the local station	active stations 0 to 31 passive stations 0 to 126
9	sta (word)	Type of the local station	00H=passive 01H=active
10	hsa (byte)	Highest active station address	1 to 126
11	bdr (byte)	Baud rate	0 = 9.6 KBaud 1 = 19.2 KBaud 2 = 93.75 KBaud 3 = 187.5 KBaud 4 = 500 KBaud 5 = 1.5 MBaud
12 to 15	trt (double word)	Target rotation time In this time, the token should have been passed once to every active station.	256 to 1 048 320 bit times
16 & 17	st (word)	Slot time (initiator waits for reply frame)	34 to 4095 bit times
18 & 19	set (byte)	Set-up time	0 to 494 bit times
20 & 21	STD1 (word)	Minimum station delay time	11 to 255 bit times
22 & 23	STD2 (word)	Maximum station delay time	35 to 1023 bit times
24	rtr* (byte)	Number of call-up retries to a remote, non-replying station	1 to 8 Default in the S5-95U: 1
25	gap* (byte)	Gap update factor	2 to 255 in multiples of the target rotation time Default in the S5-95U: 20

** Bus parameters irrelevant for S5-95U user (for further explanations of the bus parameters, refer to PROFIBUS Standards DIN 19245)*

Calling Up FB222 and Storing the Data with FMA Service READ_VALUE

OB1	Explanation
: :	
0008 : L KH 000B	Load service_code in ACCUM and transfer to flag word
0009 : T FW 2	FW2
000A : JU FB 222	(see section 3.4.4)
000B NAME: AG95/FMA	
000C REQ: F 1.0	If FMA service is requested, bit must be set.
000D CODE: FW 2	Enter type of service requested (here: $0B_H$)
000E CONF: F 1.1	FB222 message: confirmation was received
0010 INDI: F 1.2	irrelevant
0011 FEHL: F 1.3	FB222 message: error occurred in PAFE or STB
. .	
. .	
0030 : BE	

DB200	Explanation
	****REQUEST Block****
6: KH = 0B00;	service_code / irrelevant
7: KH = 0000;	irrelevant / irrelevant
8: KH = 0000;	irrelevant / irrelevant
	****CONFIRMATION Block****
9: KH = 0100;	com_class / user_id
10: KH = 0B00;	service_code / link_status
11: KH = 0000;	irrelevant / irrelevant
12: KH = 0000;	irrelevant / irrelevant
	****Bus Parameter Block****
13: KY = 002,001;	tln / sta
14: KH = 0A04;	hsa / bdr
15: KH = 0000	trt (high word)
16: KH = 1400	trt (low word)
17: KH = 0190;	st
18: KH = 0000;	set
19: KY = 000,012;	sdt 1
20. KH = 0190;	sdt 2
21: KY = 001,020;	rtr / gap
22: KY = ..	..

3.4.8 Reading Out Available Token Hold Time When Receiving the Token (TIME_TTH_READ)

The TIME_TTH_READ service gives you the available token hold time when receiving the token. It is very useful in the start-up phase for setting the target rotation time.
If the available token hold time moves towards zero, you must assign a higher value to the target rotation time. Since the available token hold time fluctuates, you should read it out several times at short intervals and calculate its mean value.

Structure the TIME_TTH_READ request block as follows:

Byte	***Request Block***
0	**com_class** **FMA-Request=00$_H$** (service request)
1	user_id Freely assignable ID. That ID is returned unchanged in the confirmation.
2	**service_code** Type of service requested: **TIME_TTH_READ=23$_H$**
3-7	irrelevant

The data are stored in the TIME_TTH_READ confirmation block as follows:

Byte	***Confirmation Block***
0	**com_class** **FMA-Confirmation=01$_H$** (acknowledgment from firmware following FMA_Request)
1	**user_id** ID assigned in the FMA_Request
2	**service_code** Type of service provided: **TIME_TTH_READ=23$_H$**
3	**link_status**
4-7	irrelevant
8	***Remaining token hold time **** *(high word)*
9	***Remaining token hold time **** *(low word)*

▨ Relevant parameters

***** The values for the remaining token hold time can be in the range of 0 to 1 048 320 bit times.

Figure 3-15. Structure of the TIME_TTH_READ Request and Confirmation Blocks

link_status

Table 3-9. link_status Messages for the TIME_TTH_READ Confirmation

link_status Message	**Significance**	
00$_H$	ok (okay):	Positive acknowledgement, rest token hold time was read out
15$_H$	iv (invalid):	Error, local station is passive, service is impossible

Calling Up FB222 and Storing the Data with FMA Service TIME_TTH_READ

OB1	Explanation
`:          :`	
`0008       :   L      KH 0023`	Load service_code in ACCUM and transfer to flag word FW2 (see section 3.4.4)
`0009       :   T      FW 2`	
`000A       :   JU     FB 222`	
`000B   NAME:   AG95/FMA`	
`000C    REQ:   F  1.0`	If FMA service is requested, bit must be set.
`000D   CODE:   FW 2`	Enter type of service requested (here: 23_H)
`000E   CONF:   F  1.1`	FB222 message: confirmation was received
`0010   INDI:   F  1.2`	irrelevant
`0011   FEHL:   F  1.3`	FB222 message: error occurred in PAFE or STB
`.          .`	
`.          .`	
`0030       :   BE`	

DB200	Explanation
	****REQUEST Block****
`6:   KH = 2300;`	service_code / irrelevant
`7:   KY = 000,000;`	irrelevant / irrelevant
`8:   KY = 000,000;`	irrelevant / irrelevant
	****CONFIRMATION****
`9:   KH = 0100;`	com_class / user_id
`10:   KH = 2300;`	service_code / link_status
`11:   KY = 000,000;`	irrelevant / irrelevant
`12:   KY = 000,000;`	irrelevant / irrelevant
`13:   KH = 0000;`	remaining token hold time, high word
`14:   KH = 0200;`	remaining token hold time, low word

3.4.9 Reading Out the Event Message (MAC_EVENT)

This FMA service is for reading out fault events. It is useful for testing during start-up.

Principle of Operation (represented in Figure 3-16)

- Errors recognized by the communications processor (e.g., double token, frame errors) are indicated automatically. There is no need for a service request.
- A pending error indication is displayed in the status byte (STB) at job number A-NR 200.
- An error indication is fetched by means of integral FB L2-RECEIVE (FB253) via job number A-NR 200 .

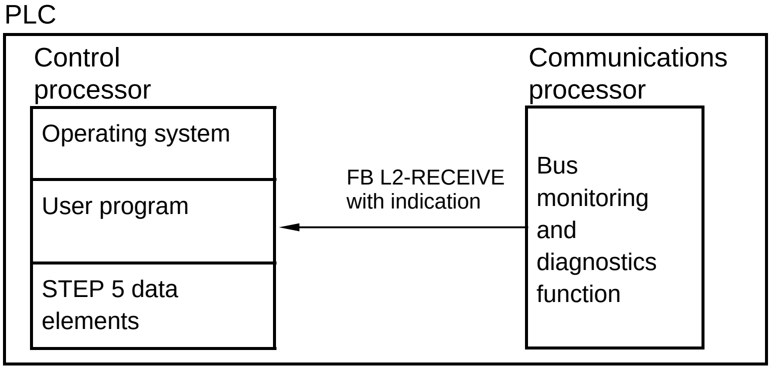


Figure 3-16. Sequence Principle of FMA service MAC_EVENT

The indication consists of a maximum of 58 bytes. Bytes 0 to 7 are assigned to the header. The error indications are stored in the sequence of their occurrence starting with byte 8 (up to 50 errors can be recorded). Figure 3-17 shows the structure of the MAC_EVENT indication block.

The parameter values are stored in the MAC_EVENT indication block as follows:

Byte	***Indication Block***
0	▨ **com_class** **FMA_Indication=02_H** (event indication)
1	irrelevant
2	▨ **service_code** Type of service provided: **MAC-EVENT=20H**
3-7	irrelevant
8	▨ ***Event parameter block*** (see Table 3-10)
9	▨ ......

▨ Relevant parameters

Figure 3-17. Structure of the MAC_EVENT Indication Block

Table 3-10 lists the possible error codes.

Table 3-10. Event Parameter Message in Indication Block

Error Code	Significance/Cause	Remedy
01_H	Double token (e.g., when two logical rings have been linked together, or bus cable has been interrupted)	Temporary error (repairs itself)
02_H	No bus activity within monitoring time T_{to} (ring start-up, or temporary loss of token)	Temporary error (repairs itself)
03_H	No bus synchronization within monitoring time T_{syni}	Temporary error (repairs itself)
04_H	L2 processor overload	Temporary error (repairs itself)
05_H	Station is connected, but its HSA is too low compared to the other	Temporary error (repairs itself)
06_H	Receive frame problems	Temporary error (repairs itself)
21_H	Transmit frame problems caused by hardware (module) fault or faulty bus	Replace module eventually
22_H	LAS useless	Temporary error (repairs itself)
23_H	Station is connected, but there is another station with the same	Temporary error (repairs itself)
24_H	Station is not connected yet, its HSA is too low compared to the other	Change HSA in DB1 (must be the same for all stations on
25_H	Temporary token loss	Temporary error (repairs itself)
26_H	Frame error	Temporary error (repairs itself)
27_H ... 30_H	Protocol error or protocol monitoring error	Check L2 basic parameters in DB1 for baud rate compatibility
41_H	Station is not connected yet, there is another station with the same station number	Change TLN parameter in DB1, switch PLC OFF and ON
$B2_H$	Only for active stations: station was not accepted in the network within the monitoring time	Check DB1 parameters and hardware configuration and, if necessary, change them (TRT must be the same for all stations on the network, HSA too low, cable short-circuit etc.) switch PLC OFF and ON
42_H ... $B1_H$, $C0_H$ ... FF_H	Serious internal error	Cannot be done by the user; contact your nearest Siemens representative

If temporary errors occur often in your network, check the network configuration. The errors could be caused by hardware problems on the network, such as faulty cables, bus connectors, etc.

Calling Up FB222 and Storing the Data with FMA Service MAC_EVENT

OB1	Explanation
. .	
000A : JU FB 222	(section 3.4.4)
000B NAME: AG95/FMA	
000C REQ: F 1.0	irrelevant
000D CODE: FW 2	irrelevant
000E CONF: F 1.1	irrelevant
0010 INDI: F 1.2	FB222 message: indication was received
0011 FEHL: F 1.3	FB222 message: error occurred in PAFE or STB
. .	
. .	
0030 : BE	

DB200	Explanation
	****INDICATION-Block****
9: KH = 0200;	com_class / irrelevant
10: KH = 2000;	service_code / irrelevant
11: KY = 000,000;	irrelevant / irrelevant
12: KY = 000,000;	irrelevant / irrelevant
13: KH = 0122;	error code (see Table 3-10)
14: KH = ...	....

4 Data Transmission Using a Standard Connection

Figures

Tables

4 Data Transmission Using a Standard Connection

This chapter provides you with the following information:

- How this type of data transmission functions in principle
- How to set parameters for the programmable controllers
- How to program with STEP 5 for this type of data transmission (examples)

4.1 Features of a Standard Connection

- The standard connection is particularly appropriate for:
  - The transmission of large quantities of data (242 bytes)
  - A homogeneous networking of S5-95U programmable controllers

  Communication with other devices, such as with the CP 5430-1 (Order no. 6GK1 543-0AA01), is also possible.
- Active and passive L2 stations can participate on the network.
- There are two ways to transmit data:
  - Any active L2 station can transmit to any other active station.
  - Any active L2 station can transmit simultaneously to all other connected active and passive stations (broadcast, see section 4.6).
- Active stations must have a transmitter or receiver number. This number is the L2 station address used to address the stations. A station address must be within the range of 1 to 31. A station address may be assigned only once on the network.
- Programmable controller parameters are set in data block DB1 to enable data exchange.

Figure 4-1 shows a possible hardware configuration for the standard connections described in section 1.5. All of the examples used in sections 4.2 through 4.5 refer to this configuration.

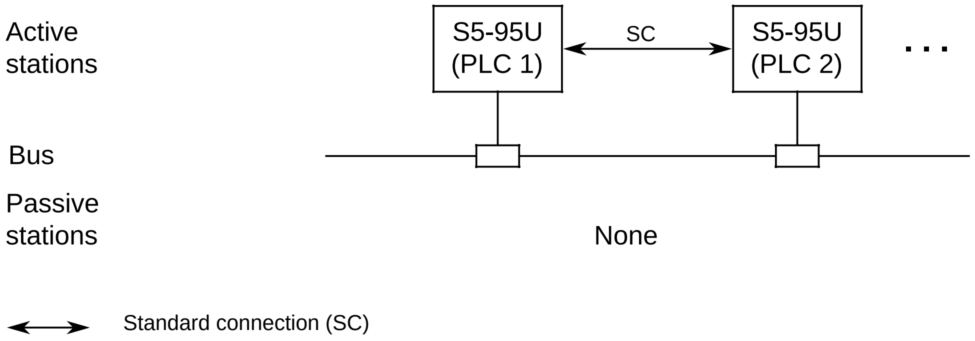


Figure 4-1. Example of a Hardware Configuration for a Standard Connection

Principle of Operation

For this type of communication you need to define the following once:

- The send mailbox (SF) that contains the transmit data (maximum 242 bytes).
- The send coordination byte (CBS) that coordinates between user program and SINEC L2.
- The receive mailbox (RM) that contains the received data (maximum 242 bytes).
- The receive coordination byte (CBR) that coordinates between user program and SINEC L2.

The coordination bytes are stored in the flag area. The send and receive mailboxes are usually stored in a data block. Figure 4-2 illustrates a standard connection.

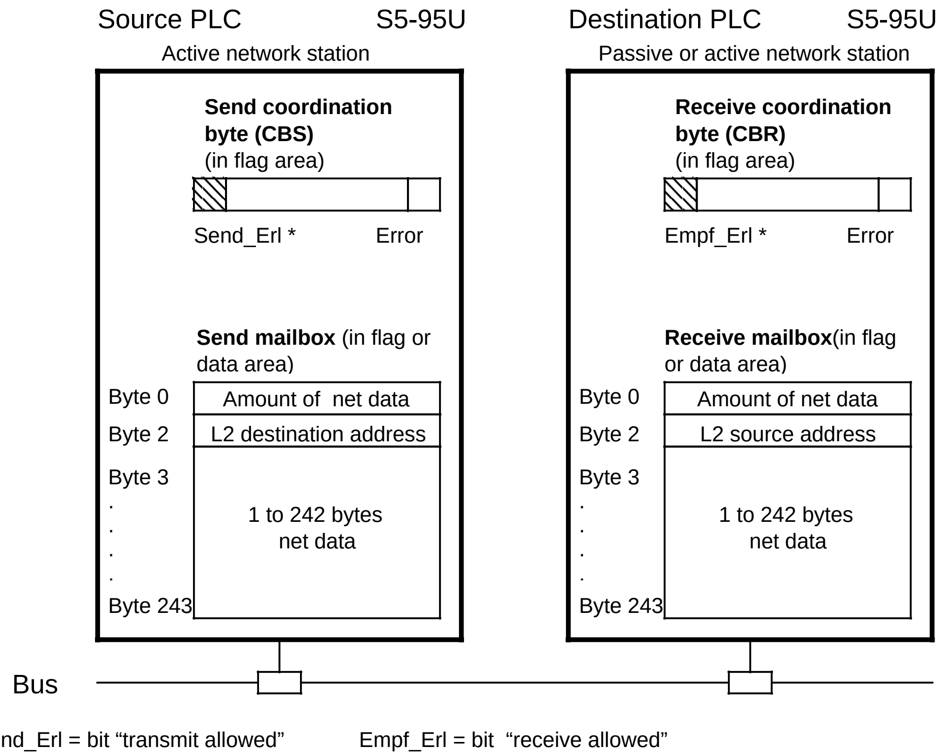


Figure 4-2. Functional Diagram of a Standard Connection

Explanations to Figure 4-2:

If you want to transmit a message, write to the send mailbox: Enter in the send mailbox the amount of data to transmit (amount of net data) and the receiver’s address (L2 destination address), and then store the message (net data). Then grant the permission to transmit in send coordination byte (set bit “Send_Erl”).

The S5-95U sends the message to the addressed receiver via the bus.

After the message has arrived at the receive mailbox, bit “Empf_Erl ” (receive allowed) is reset in the receive coordination byte. The received data are available for evaluation in the receive mailbox.

To restore the receive readiness, empty the receive mailbox, and set bit “Empf_Erl ” in the receive coordination byte.

4.2 Assigning Parameters in DB1 of the S5-95U for Data Exchange with Standard Connections

You assign the following parameters in DB1:

- The location of the send mailbox (SM).
- The location of the receive mailbox (RM).
- The location of the send coordination byte (CBS).
- The location of the receive coordination byte (CBR).

SF, EF, CBS, and CBR are used with the L2 bus of the S5-95U the same way as with the SINEC L1 bus. Refer to chapter 14 of the *S5-90U/S5-95U Programmable Controller System Manual* for additional information.

DB1 with the default parameters for standard connections is represented in Figure 4-3.

The procedure for parameterizing, modifying and transferring the DB1 parameter block is described in detail in section 1.4.

```
156:     KS  ='   #SL2: TLN 0   STA AKT';
168:     KS  =' BDR 500    HSA 10  TRT ';
180:     KS  ='5120    SET 0   ST 400  ';
192:     KS  ='SDT 1 12  SDT 2 360   SF';
204:     KS  =' DB6  DW0   EF DB7  DW0 ';
216:     KS  ='  KBS MB62  KBE MB63  ; ';
228:     KS  ='#  END ';
```

Basic parameters (see section 1.4)

Default parameters for standard connection

Figure 4-3. DB1 with the Default Parameters for Standard Connections

DB1 Parameters for Standard Connections

Table 4-1. DB1 Parameters for Standard Connections

Parameter	Argument	Significance
Block ID: SL2:		**SINEC L2**
Parameters for Standard Connection		
SF EF KBS KBE	DBxDWy or MBz DBxDWy or MBz MBh MBh	Location of the send mailbox Location of the receive mailbox Location of the send coordination byte Location of the receive coordination byte
Argument	**Permissible Range**	**Explanation**
MBh DBx DWy MBz	1 to 63 2 to 255 0 to 255 0 to 254	Flag byte Data block Data word Flag byte

Example: Two S5-95U programmable controllers are to communicate using a standard connection.

Table 4-2. Setting Parameters for Standard Connections

DB1 PLC 1	Explanation
`156:     KS  ='    SL2: TLN 1   STA AKT';`	L2 basic parameter (see section 1.4)
`168:     KS  =' BDR 500    HSA 10  TRT ';`	
`180:     KS  ='5120    SET 0   ST 400  ';`	
`192:     KS  ='SDT 1 12  SDT 2 360   SF';`	SF (SM) = DB6, starting with DW 0; EF (RM) = DB7, starting with DW 0; KBS (CBS) = MB (FB) 62; KBE (CBR) = MB (FB) 63
`204:     KS  =' DB6  DW0   EF DB7  DW0 ';`	
`216:     KS  ='  KBS MB62  KBE MB63    ';`	
. . .	
DB1 PLC 2	
`156:     KS  ='    SL2: TLN 2   STA AKT';`	
`168:     KS  =' BDR 500    HSA 10  TRT ';`	L2 basic parameter (see section 1.4)
`180:     KS  ='5120    SET 0   ST 400  ';`	
`192:     KS  ='SDT 1 12  SDT 2 400   SF';`	
`204:     KS  =' DB8  DW0   EF DB9  DW0 ';`	SF (SM) = DB8, starting with DW 0; EF (RM) = DB9, starting with DW 0; KBS (CBS) = MB (FB) 60; KBE (CBR) = MB (FB) 61
`216:     KS  ='  KBS MB60  KBE MB61    ';`	
. . .	

The remaining sections of chapter 4 provide detailed information on how to control transmitting and receiving data.

4.3 Transmitting Data

There are two prerequisites for transmitting data:

- The parameters for the locations of SF and CBS are set in data block DB1 (see section 4.2).
- The transmit data, additional information (length of the transmit data ("net data"), and the station address of the receiver) have been transferred to the send mailbox.

Figure 4-4 shows which information must be stored in which send mailbox location.

Example: Send mailbox in the **flag area** (starting with flag byte 0)

FY 0	"Net data" length in bytes (1 to 242)
FY 1	*Receiver's address*
FY 2	1st data item
FY 243	242nd data item

Example: Send mailbox in the **data block** (starting with data word DW0)**--**

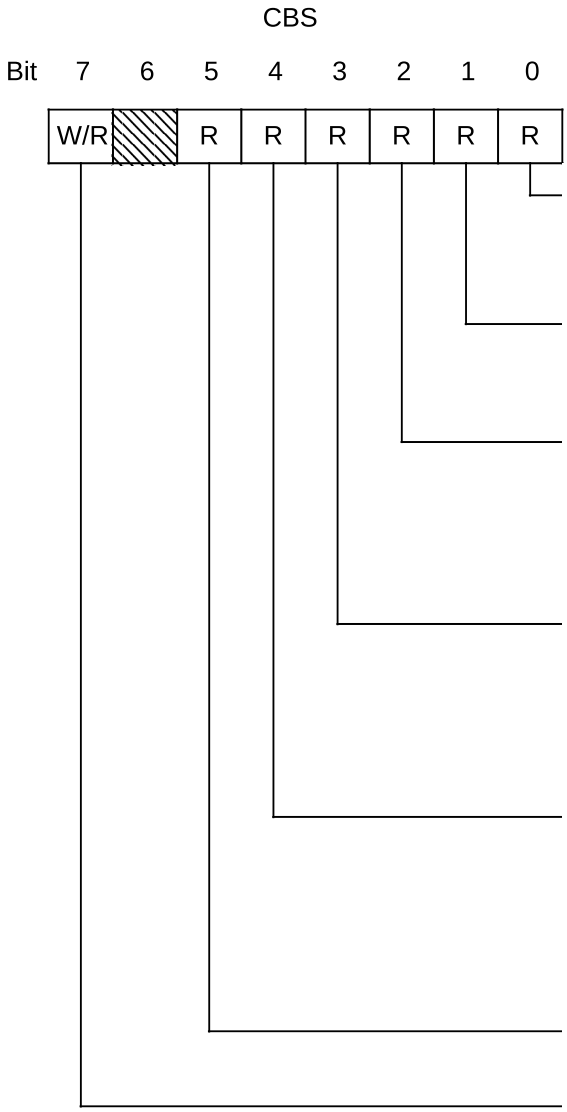
	DL	DR
DW 0	"Net data" length in bytes (1 to 242)	Receiver's address*
DW 1	1st data item	2nd data item
DW 121	241st data item	242nd data item

* 1 to 31 = L2 station address (active stations)
255 = Broadcasting (to all active and passive stations, see section 4.6)

Figure 4-4. Structure of the Send Mailbox for a Standard Connection

Structure of the Send Coordination Byte (CBS)

Figure 4-5 shows the structure of the send coordination byte (CBS).



0: No error during the last data transmission
1: Error during the last data transmission (Bits 1 to 5 describe the cause for an error in more detail.)

0: The destination programmable controller acknowledges correctly.
1: The destination programmable controller does not acknowledge.

0: No error
1: Send mailbox error (either the DB is not available or the send mailbox is too small), or there is a parameter assignment error in the send mailbox (either the “length of net data” or the “L2 destination address” is incorrect).

0: The destination PLC is in the RUN mode.
1: The destination PLC is in the STOP mode. PLC STOP is recognized only if the destination station is an S5-95U and if the connection has been configured correctly. (It does not work with broadcasting.)

0: No negative acknowledgment
1: Negative acknowledgment; either one of the following:
- Receiver’s receive mailbox not empty
- Connection not configured on
- Bus error (hardware fault)
- Addressed station is passive

0: The L2 interface is not overloaded.
1: The L2 interface is overloaded.

0: The user program can process the send mailbox. (The operating system has no access to the send mailbox.)
1: The send mailbox is enabled to transmit. (The user program has no access to the send mailbox.)

R: Read only
W/R: Write / Read
▨ Reserved bit

Warning

If you write bit 6 of CBS, undefined conditions can occur in the network.
Bit 6 is not available to the user.

Figure 4-5. Structure of the Send Coordination Byte (CBS) for a Standard Connection

4.4 Receiving Data

Prerequisites for receiving data:

You have set the parameters for the location of the receive mailbox (RM) and receive coordination byte (CBR) in data block DB1 (see section 4.2). Figure 4-6 shows where information is stored when it is received.

Example**:** The receive mailbox is in the **flag area** (starting with flag byte 0)

FY 0	"Net data" length in bytes (1 to 242)
FY 1	Transmitter's address*
FY 2	1st data item
FY 243	242nd data item

Example**:** The receive mailbox is in the **data block** (starting with data word DW0)

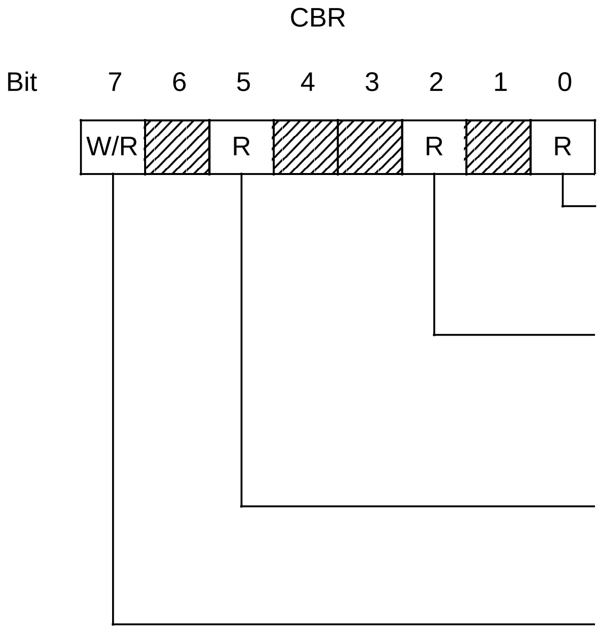
	DL	DR
DW 0	"Net data" length in bytes (1 to 242)	Transmitter's address*
DW 1	1st data item	2nd data item
DW 2	3rd data item	4th data item
DW 121	241st item	242nd item

* 1 to 31 = L2 station address (active stations)

Figure 4-6. Structure of the Receive Mailbox for a Standard Connection

Structure of the Receive Coordination Byte (CBR)

Figure 4-7 shows the structure of the receive coordination byte (CBR).



Bit 0:
- 0: No error
- 1: Error during the last data transmission (Bits 2 and 5 describe the error cause in more detail.)

Bit 2:
- 0: No error
- 1: Receive mailbox error (The DB is not available.) Received data stay stored. A new receive request can transfer the received data to the receive mailbox once the error has been corrected.

Bit 5:
- 0: The L2 interface is not overloaded.
- 1: The L2 interface is overloaded.

Bit 7:
- 0: The user program can access the receive mailbox. (The operating system has no access to the receive mailbox.)
- 1: The operating system can accept data in the receive mailbox. (The user program has no access to the receive mailbox.)

R:	Read only
W/R:	Write / read
▨	Reserved bit

Warning

If you write in bit 6 of CBS, the bus might enter an undefined state.
Bit 6 is not available to the user.

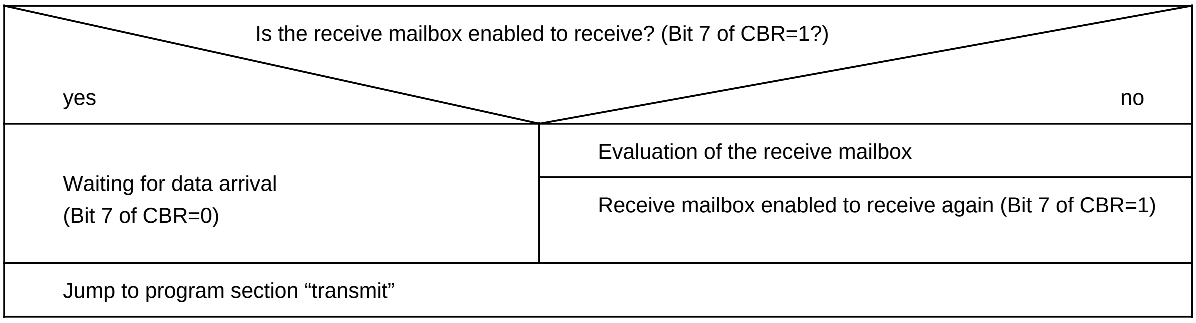
Figure 4-7. Structure of the Receive Coordination Byte (CBR) for a Standard Connection

4.5 Programming Example for Data Transmission via a Standard Connection

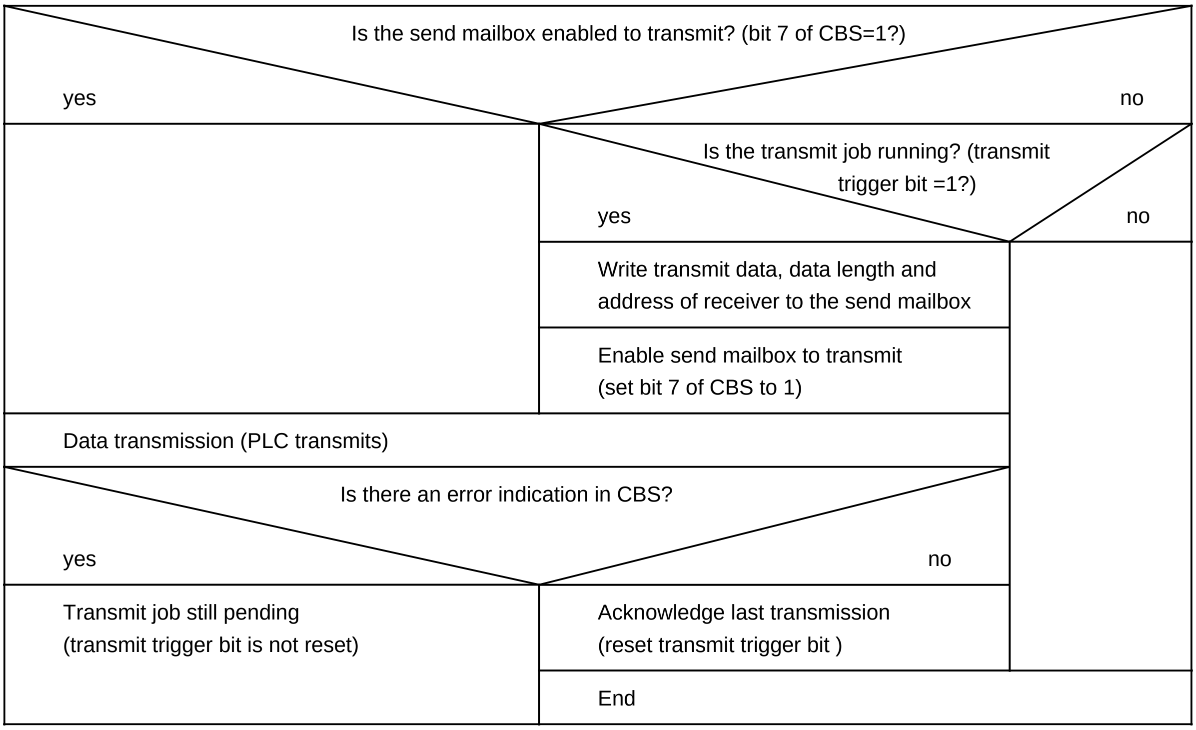
This section explains the structure of the control program in the following example:

Programmable controller 1 is to receive data from programmable controller 2 and to transmit data to programmable controller 2. Refer to section 4.1 for the description of the hardware configuration.

The control program in FB1 for receiving data is structured as illustrated below.



The control program in FB1 for transmitting data is structured as illustrated below.



Programmable Controller 1

Proceed as follows:

Assign parameters in DB1 of programmable controller 1 as described in section 4.2.
Program the individual blocks as described in the following section.
Transfer blocks DB1, OB1, DB6, and DB7 to programmable controller 1.

Cyclical Program for Station 1 (Programmable Controller 1)

The following was set in DB1:

- Send mailbox is in DB6 starting with data word DW0.
- Receive mailbox is in DB7 starting with data word DW0.
- Send coordination byte is in flag byte FY62.
- Receive coordination byte is in flag byte FY63.

OB1 for PLC 1	Explanation
`NETZWERK 1            0000`	
`0000       :`	
`0001       : JU       FB 1`	Transmit to station 2.
`0002  NAME : L2-STAND`	
`0003  ANST : F 50.0`	Transmit trigger bit, has to be set by user program, (is reset after the transmit job is completed)
`0004  ZIEL : KF 2`	Station 2
`0005  LAEN : KF 4`	Frame length of transmit data: 4 bytes
`0006       : BE`	

FB1 for PLC 1	Explanation
`Netzwerk 1            0000`	
`NAME  :    L2-STAND`	L2 standard connection
`BEZ   :    ANST       E/A/D/B/T/Z: E`	`BI/BY/W/D: BI`
`BEZ   :    ZIEL       E/A/D/B/T/Z: D`	`KM/KH/KY/KS/KF/KT/KC/KG: KF`
`BEZ   :    LAEN       E/A/D/B/T/Z: D`	`KM/KH/KY/KS/KF/KT/KC/KG: KF`
`0008       : U        F 63.7`	If receive mailbox enabled to receive,
`0009       : JC       = M001`	jump to ‘SEND’ program section.
`000A       : A        DB 7`	Open receive mailbox data block
`000B       :`	
`000C       :`	==
`000D       :`	Program section for evaluation of received data
`000E       :`	
`000F       :`	==
`0010       :`	
`0011       : UN       F 63.7`	CBR bit ”Enable receive”
`0012       : S        F 63.7`	Enable RM to receive
`0013       :`	

FB1 for PLC 1 (continued)	Explanation
0014 M001:	
0015 : ON = ANST	If transmit trigger bit is 0 or
0016 : O F 62.7	send mailbox is enabled to transmit, or
0017 : O F 71.2	transmit disabling bit is set,
0018 : JC = M002	jump to edge evaluation ‘Job completed’.
0019 :	
001A : A DB 6	Open send mailbox data block
001B :	Prepare transmit job:
001C : LW = LAEN	Enter net data length (bytes)
001D : T DL 0	and
001E : LW = ZIEL	enter destination address.
001F : T DR 0	
0020 :	
0021 : AN F 62.7	CBS bit ‘Enable transmit’
0022 : S F 62.7	Send mailbox enabled to transmit
0023 : S F 71.2	set transmit disabling bit,
0024 : R F 71.0	reset edge auxiliary flag.
0025 :	
0026 M002 :	
0027 : A F 71.2	Edge evaluation ‘Job completed’
0028 : AN F 62.7	
0029 : AN F 71.0	
002A : = F 71.1	
002B : A F 71.1	
002C : S F 71.0	
002D : A F 62.7	
002E : R F 71.0	
002F :	
0030 : A F 71.1	If job was completed and
0031 : AN F 62.0	there was no error in the last data transmission,
0032 : R F 71.2	reset transmit disabling bit,
0033 : RB = ANST	reset transmit trigger bit.
0034 :	
0035 : A F 71.1	If job was completed and
0036 : A F 62.0	there was an error in the last data transmission,
0037 : R F 71.2	reset transmit disabling bit.
0038 : BE	

Programmable Controller 2

Proceed as follows:

Assign parameters in the DB1 of programmable controller 2 as described in section 4.2.
Program the individual blocks as described in the following section.
Transfer blocks DB1, OB1, DB8, and DB9 to programmable controller 2.

Cyclical Program for Station 2 (Programmable Controller 2)

The following was set in DB1:

- Send mailbox is in DB8 starting with data word DW0.
- Receive mailbox is in DB9 starting with data word DW0.
- Send coordination byte is in flag byte FY60.
- Receive coordination byte is in flag byte FY61.

OB1 for PLC 2	Explanation
`SEGMENT 1             0000`	
`0000       :`	
`0001       : JU       FB 1`	Transmit to station 1.
`0002  NAME : L2-STAND`	
`0003  ANST : F 50.0`	Transmit trigger bit, has to be set by user program, (is reset after the transmit job is completed)
`0004  ZIEL : KF 1`	Station 1
`0005  LAEN : KF 4`	Frame length of transmit data: 4 bytes
`0006       : BE`	

FB1 for PLC 2	Explanation
`SEGMENT 1             0000`	
`NAME  :    L2-STAND`	L2 standard connection
`DES   :    ANST       I/Q/D/B/T/Z: E  BI/BY/W/D: BI`	
`DES   :    ZIEL       I/Q/D/B/T/Z: D  KM/KH/KY/KS/KF/KT/KC/KG: KF`	
`DES   :    LAEN       I/Q/D/B/T/Z: D  KM/KH/KY/KS/KF/KT/KC/KG: KF`	
`0008       : A        F 61.7`	If receive mailbox enabled to receive,
`0009       : JC       = M001`	jump to ‘SEND’ program section.
`000A       : A        DB 9`	Open receive mailbox data block
`000B       :`	
`000C       :`	==
`000D       :`	Program section for evaluation of received data
`000E       :`	
`000F       :`	==
`0010       :`	
`0011       : AN       F 61.7`	CBR bit ‘Enable receive’
`0012       : S        F 61.7`	Enable RM to receive
`0013       :`	

FB1 for PLC 2 (continued)	Explanation
`0014   M001:`	
`0015       : ON      = ANST`	If transmit trigger bit is 0, or
`0016       : O       F 60.7`	send mailbox is enabled to transmit, or
`0017       : O       F 71.2`	transmit disabling bit is set,
`0018       : JC      = M002`	jump to edge evaluation ‘Job completed’.
`0019       :`	
`001A       : C       DB 8`	Open send mailbox data block
`001B       :`	Prepare transmit job:
`001C       : LW      = LAEN`	Enter net data length (bytes)
`001D       : T       DL 0`	and
`001E       : LW      = ZIEL`	enter destination address.
`001F       : T       DR 0`	
`0020       :`	
`0021       : AN      F 60.7`	CBS bit ‘Enable transmit’
`0022       : S       F 60.7`	Send mailbox enabled to transmit
`0023       : S       F 71.2`	set transmit disabling bit,
`0024       : R       F 71.0`	reset edge auxiliary flag.
`0025       :`	
`0026  M002 :`	
`0027       : A       F 71.2`	Edge evaluation ‘Job completed’
`0028       : AN      F 60.7`	
`0029       : AN      F 71.0`	
`002A       : =       F 71.1`	
`002B       : A       F 71.1`	
`002C       : S       F 71.0`	
`002D       : A       F 60.7`	
`002E       : R       F 71.0`	
`002F       :`	
`0030       : A       F 71.1`	If job was completed and
`0031       : AN      F 60.0`	there was no error in the last data transmission,
`0032       : R       F 71.2`	reset transmit disabling bit,
`0033       : RB      = ANST`	reset transmit trigger bit.
`0034       :`	
`0035       : A       F 71.1`	If job was completed and
`0036       : A       F 60.0`	there was an error in the last data transmission,
`0037       : R       F 71.2`	reset transmit disabling bit.
`0038       : BE`	

Switch both programmable controllers from STOP to RUN. The programmable controllers accept the parameter values of both DB1 data blocks.

Check the data transmission. This is done best with a programmer: Connect each programmable controller to a programmer and display the data blocks and the coordination bytes.

Refer also to section 3.3 “Starting up a System”.

Appendix E gives you information on cycle delay times in the programmable controllers due to data transmission.

4.6 Broadcast Request (“Transmit to All”)

“Broadcasting” means that one active station transmits a message to all active and all passive stations.

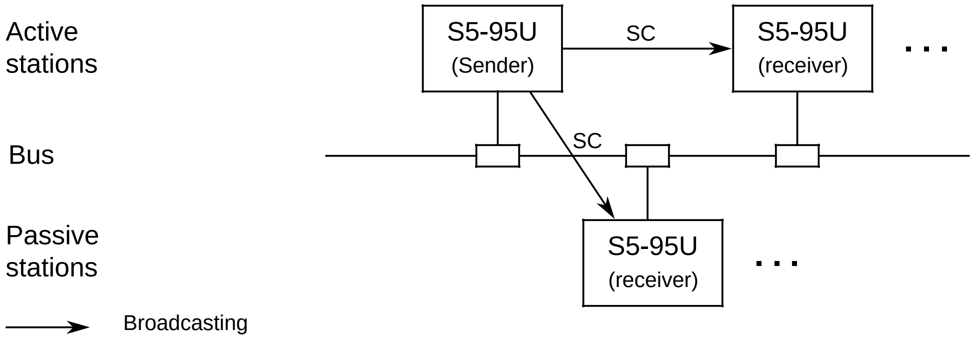


Figure 4-8. Example of a Hardware Configuration for a Broadcast

The **sender's** prerequisites for broadcast transmission are as follows:

- The parameters for the locations of CBS and SF are set in data block DB1 (see section 4.2).
- Send data and additional information are transferred to the send mailbox.
- The receiver’s address “255” (hexadecimal) for a **broadcast** is entered in byte 2 of the send mailbox (see section 4.3).

The **receiver**’s prerequisites for broadcast transmission are as follows:

- In an active station: At least CBR and RM are set up.
- In a passive station: Only CBR and RM are set up.

Note

Bits 1, 3, and 4 in the CBS (see section 4.3) are not relevant for broadcast jobs because the receiver does not acknowledge broadcast transmissions.

5 Integral Standard Function Blocks L2-SEND and L2-RECEIVE

Figures

Tables

5 Integral Standard Function Blocks L2-SEND and L2-RECEIVE

The L2-SEND (FB252) and L2-RECEIVE (FB253) standard function blocks are already integrated in the S5-95U operating system.
FB L2-SEND transports information from the control processor of the S5-95U to the communications processor of the S5-95U.
FB L2-RECEIVE transports information from the communications processor of the S5-95U to the control processor of the S5-95U (section 5.1).

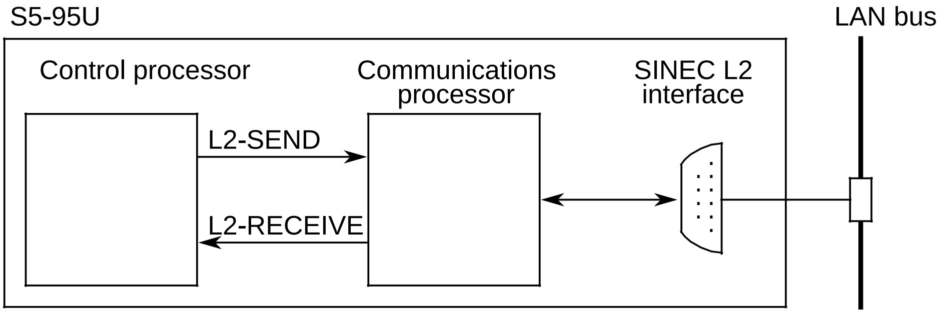


Figure 5-1. Information Transport with the L2-SEND and L2-RECEIVE Function Blocks

The standard function blocks manage the following communications (Figure 5-1) services:

- Transmitting and receiving by means of PLC to PLC connections (chapter 6)
- Service functions and diagnostic functions with FMA services (chapter 3)
- Fetching the ZP slave life list with cyclic I/O (chapter 7)
- Transmitting and receiving via layer 2 access (chapter 8)

Standard function blocks offer you the following advantages:

- They do not occupy any memory locations in the user memory.
- They have short run times.
- They do not require any STEP 5 timers or STEP 5 counters.
- Their processing cannot be interrupted (e.g., by interrupts).
- They can be called up from any other block (OB, PB, FB, SB).

Cycle delay times in the programmable controllers caused by standard function blocks are described in Appendix E.

5.1 Parameters for L2-SEND and L2-RECEIVE

Function blocks L2-SEND and L2-RECEIVE use the parameters listed in Tables 5-1 and 5-2.

Table 5-1. A List of Parameters Used by L2-SEND (FB252)

Designation	Significance
A-NR :	Job number
QTYP :	Type of data source
DBNR :	Data block number
QANF :	Data block start address of source data area
QLAE :	Length of source data

Table 5-2. A List of Parameters Used by L2-RECEIVE (FB253)

Designation	Significance
A-NR :	Job number
ZTYP :	Type of data destination
DBNR :	Data block number
ZANF :	Data block start address of destination data area
ZLAE :	Length of destination data

The job number specifies the following:

- The type of communication service (as listed in Table 5-3)
- With PLC to PLC connection:
  - in L2-SEND, to which station the data are transmitted
  - in L2-RECEIVE, from which station the received data were transmitted.
- With layer 2 accesses
  - in L2-SEND, which layer 2 access is used for sending data
  - in L2-RECEIVE, which layer 2 access is used for receiving data

Table 5-3 Allocation of the Job Numbers

Job Number	Allocated to Type of Communication
1 to 31	Transmitting and receiving via PLC to PLC connections
33 to 54, 64	Transmitting the request and fetching the confirmation using the layer 2 access
133 to 154, 164	Fetching the indication when using layer 2 access
200	Service and diagnostics functions with FMA services
202	Fetching the ZP slave life list for ZP master with cyclic I/O

The formal operands that have to be specified when the standard function blocks are used are explained in Tables 5-4 and 5-5.

Table 5-4. Formal Operands: Significance of the Parameters Used with L2-SEND (FB 252)

Parameter	Significance
`A-NR: KY x, y`	Parameter x is irrelevant. The y parameter represents the job number; y = 1 to 31, 33 to 54, 64, 200
`QTYP: KS xx`	xx=DB, FY for a direct parameter setting xx=YY for an indirect parameter setting
`DBNR: KY 0, y`	The data block number containing the data to be transmitted y = 2 to 255 (y is irrelevant if the start of the source data area QANF is in the flag area)
`QANF: KF x`	Start of the source data area (DW number or FY number) x = 0 to 255 (DW) or x = 0 to 254 (FY)
`QLAE: KF x`	Length of the source data area (DW: words; FY: bytes) x = 1 to 125 (DW) or x = 1 to 250 (FY)

Table 5-5. Formal Operands: Significance of the Parameters Used with L2-RECEIVE (FB 253)

Parameter	Significance
`A-NR: KY x, y`	Parameter x is irrelevant. The y parameter represents the job number; y = 1 to 31, 33 to 54, 164, 133 to 154, 164, 200, 202
`ZTYP: KS xx`	xx=DB, FY for a direct parameter setting xx=YY for an indirect parameter setting
`DBNR: KY 0, y`	The data block number to contain the received data y = 2 to 255 (y is irrelevant if the start of the destination data area ZANF is in the flag area)
`ZANF: KF x`	Start of the destination data area (DW number or FY number) x = 0 to 255 (DW) or x = 0 to 254 (FY)
`ZLAE: KF x`	Length of the destination data area (DW or FY) (DW: words; FY: bytes) x = -1 “wildcard length” As much data is accepted as the transmitter delivers.

5.2 Direct and Indirect Parameter Settings for the L2 Function Blocks

You can set parameters either directly or indirectly for the L2-SEND and L2-RECEIVE function blocks.

The advantage of indirect parameter settings: you can assign new parameters to the standard function blocks from the STEP 5 program. The parameters are then located as a parameter list in a data block.

Table 5-6 is an example of direct parameter settings for the L2-SEND function block. Table 5-7 is an example of indirect parameter settings for the L2-SEND function block.

Table 5-6. An Example of Direct Parameter Settings for the L2-SEND Function Block

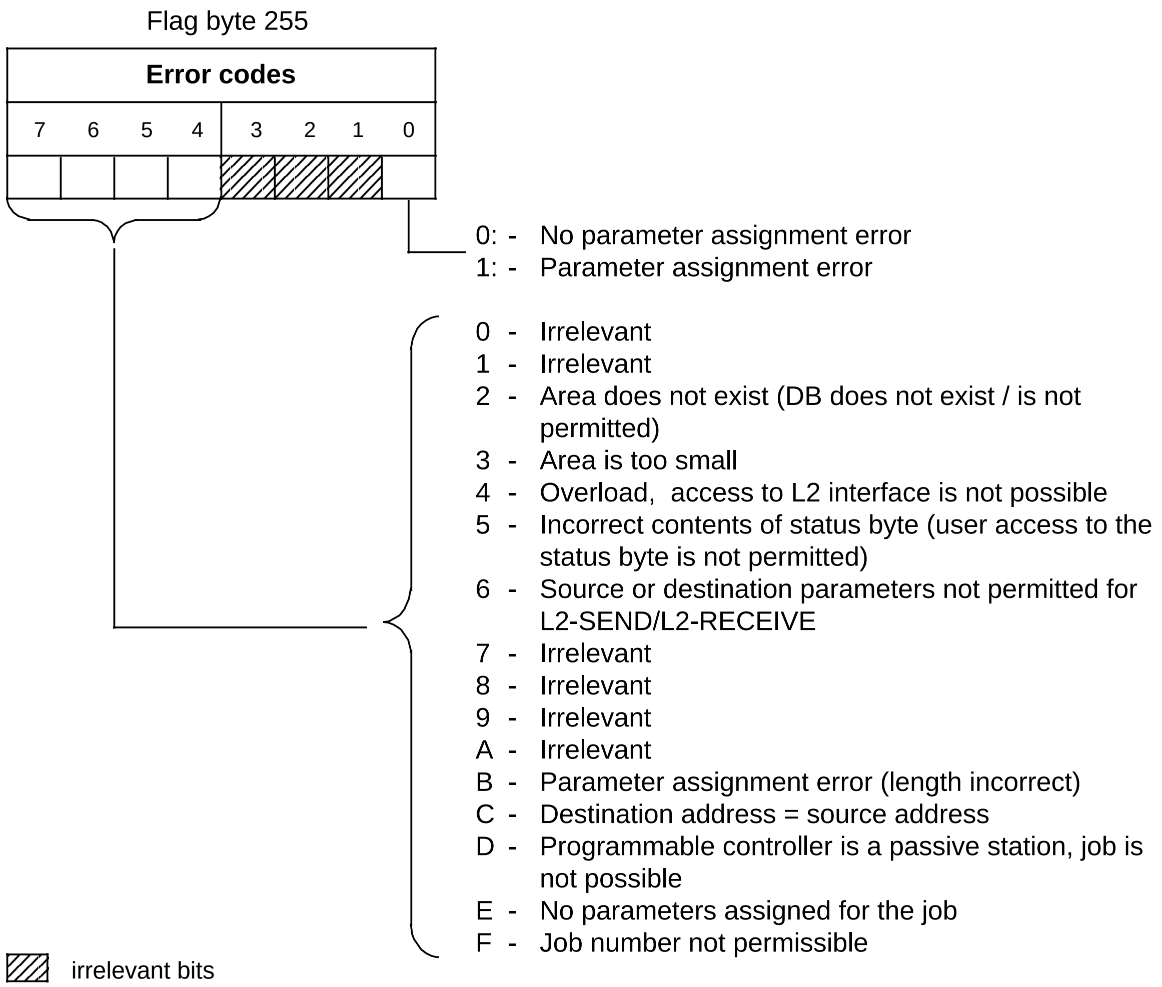
Direct Parameter Settings			Explanation
JU		FB 252	
NAME	:	L2-SEND	
A-NR	:	KY 0,5	Data are sent to station 5.
QTYP	:	KS DB	The data to be sent are located
DBNR	:	KY 0,9	in data block DB9
QANF	:	KF +10	starting with data word DW10.
QLAE	:	KF +33	Net data length is 33 words.

Table 5-7. An Example of Indirect Parameter Settings for the L2-SEND Function Block

Indirect Parameter Settings			Explanation
JU		FB 252	
NAME	:	L2-SEND	
A-NR	:	KY 0,0	Irrelevant
QTYP	:	KS YY	ID for indirect parameter assignment
DBNR	:	KY 0,10	The parameters for the job are located in data block
QANF	:	KF +14	DB10 beginning with data word DW14.
QLAE	:	KF +0	Irrelevant
DB		10	
DW 14		KY 0,17	Data are sent to station 17.
DW 15		KS DB	
DW 16		KY 0,8	The data to be sent are located in data block DB8
DW 17		KF +22	starting with data word DW22.
DW 18		KF +45	Net data length is 45 words.

5.3 Parameter Assignment Error Byte (PAFE)

The **parameter assignment error byte (PAFE)** indicates errors made when assigning parameters for L2-SEND and L2-RECEIVE. **Flag byte 255** is reserved as the parameter assignment error byte. You can scan the PAFE in the control program and program the reactions to errors that occur.



0: - No parameter assignment error
1: - Parameter assignment error

0 - Irrelevant
1 - Irrelevant
2 - Area does not exist (DB does not exist / is not permitted)
3 - Area is too small
4 - Overload, access to L2 interface is not possible
5 - Incorrect contents of status byte (user access to the status byte is not permitted)
6 - Source or destination parameters not permitted for L2-SEND/L2-RECEIVE
7 - Irrelevant
8 - Irrelevant
9 - Irrelevant
A - Irrelevant
B - Parameter assignment error (length incorrect)
C - Destination address = source address
D - Programmable controller is a passive station, job is not possible
E - No parameters assigned for the job
F - Job number not permissible

▨ irrelevant bits

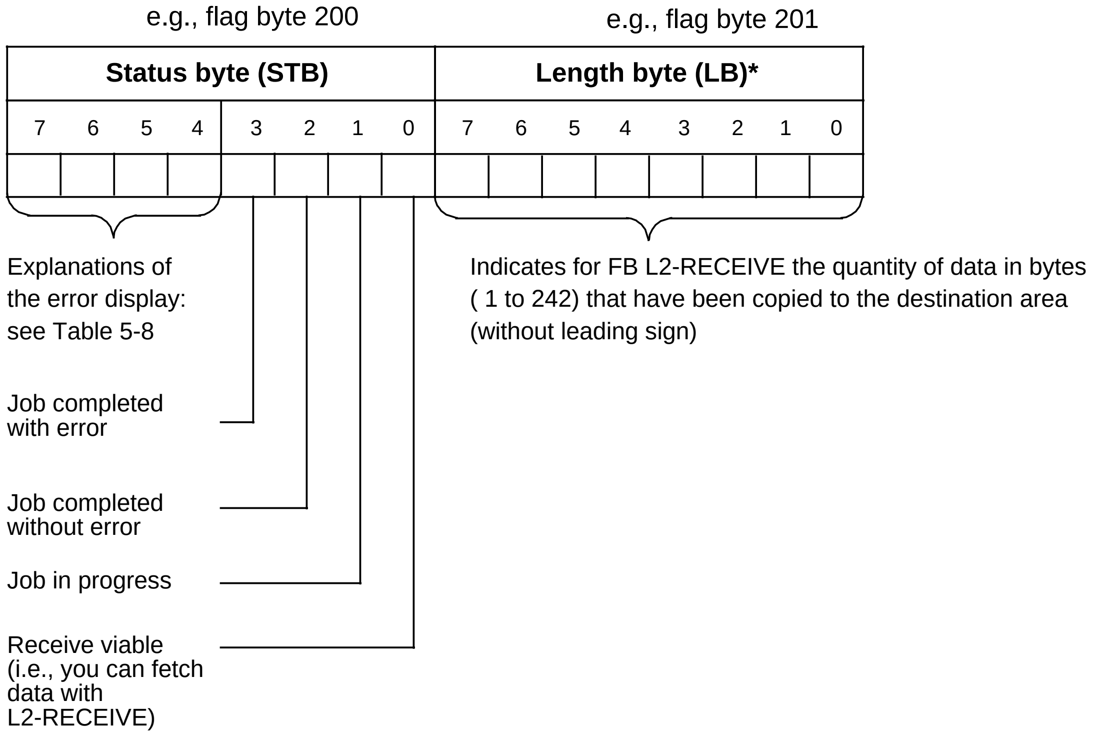
Figure 5-2. Structure of the PAFE Parameter Assignment Error Byte

Note

It is possible to overwrite PAFE in the STEP 5 program. We do not recommend that you do if you want to keep programming clear. After call-up of L2-SEND or L2-RECEIVE, PAFE may have been written to with error indications so you need to scan it in the STEP 5 program.

5.4 Status Byte

The status byte (STB) is used to control the data transmission using L2-SEND and L2-RECEIVE. You need to evaluate the status byte in order to monitor the data exchange between the control processor of the S5-95U and the communications processor of the S5-95U. The status byte indicates errors and the status of a job and informs you about data management.
Define the location of the status byte in DB1..



* With FBs L2-RECEIVE, the flag byte immediately following the status byte is reserved for the length byte.
It is not available to the user.

Figure 5-3. Structure of the Status Byte

Warning

If you write in the status byte, undefined states can occur during job processing.
You may only read the status byte.

Note

In the case of the FMA services (section 3.4), the error codes 7_{hex} to C_{hex} in bits 4 to 7 of the status byte do not exist for L2-RECEIVE.

Table 5-8. Error Codes in the Status Byte (Bits 4 to 7)

Value of Bits 4 to 7 in STB (hexadecimal)	Significance of the Error Codes
0	**No error**
4	**Overload, access to L2 interface is not possible**
7	**Local medium busy** No data buffer is available for processing the job. Remedy • Retrigger the job after a waiting period. • Reconfigure to decrease the L2 load.
8	**Remote medium busy** No input buffer is available for the job on the remote programmable controller (still occupied by the previous job input). Remedy: • Use L2-RECEIVE to accept the "old" data in the remote programmable controller. • Repeat the transmit job in the transmitting programmable controller.
9	**Remote error** The remote programmable controller acknowledges the job negatively, for example because the SAP assignment is incorrect (Appendix B). Remedy: Reconfigure (correct) the connections.
A	**Connection error** The transmitting programmable controller or the receiving programmable controller is not connected to the bus. Remedy: Switch the systems on or connect the systems and test the bus connections.
C	**The remote programmable controller is in the STOP mode** Recognition of PLC STOP works only with the PLC to PLC connection and then only if the destination station is an S5-95U and if the destination station was configured properly.

6 Data Transmission Using PLC-to-PLC Connections

Figures

Tables

6 Data Transmission Using PLC-to-PLC Connections

This chapter provides you with the following information:

- How this type of data transmission functions in principle
- How to communicate with the CP 5430 communications processor
- How to set parameters for the programmable controllers
- How to program with STEP 5 for this type of data transmission (examples)

6.1 Features of the PLC-to-PLC Connections

- You use PLC-to-PLC connections to connect active stations.
- You can set parameters in DB1 for a maximum of 31 PLC-to-PLC connections.
- You use the integral function blocks L2-SEND and L2-RECEIVE to communicate via PLC-to-PLC connection. L2-SEND and L2-RECEIVE are described in detail in chapter 5.
- For L2-SEND you need to specify the following parameters:
  - The destination programmable controller as the job number
    The job number is identical to the destination station address on the SINEC L2 network.
  - The data to transmit
- For L2-RECEIVE you need to specify the following parameter:
  - The source programmable controller as the job number.
    (The job number is identical to the source station address on the SINEC L2 network.)
- Please note that
  - a specific status byte ‘Transmit’ STBS belongs to L2-SEND and each of the job numbers
  - a specific status byte ‘Receive’ STBR belongs to L2-RECEIVE and each of the job numbers
- You can transmit or receive a maximum of 242 bytes of data per job.
- You can transmit in parallel to several stations.
- You can receive in parallel to several stations.
- You can transmit faster using PLC-to-PLC connections than using standard connections.

Figure 6-1 shows a possible hardware configuration (section 1.5) for the PLC-to-PLC connections. All examples in section 6.3 refer to PLC 1 and PLC 2 in this configuration.

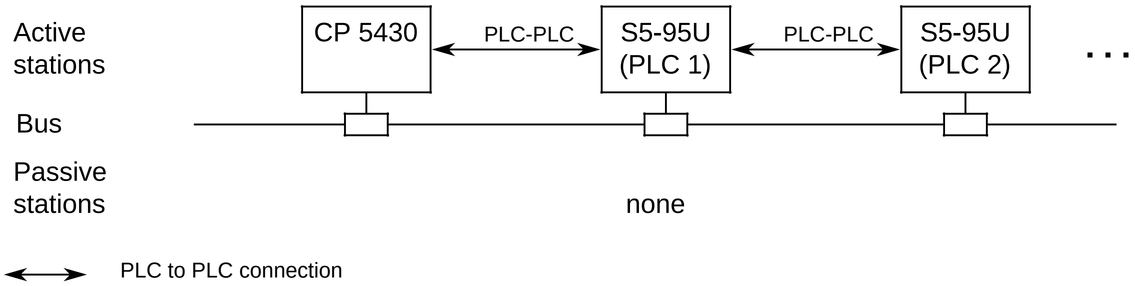


Figure 6-1. Example: Hardware Configuration for PLC-to-PLC Connection

Principle of Operation

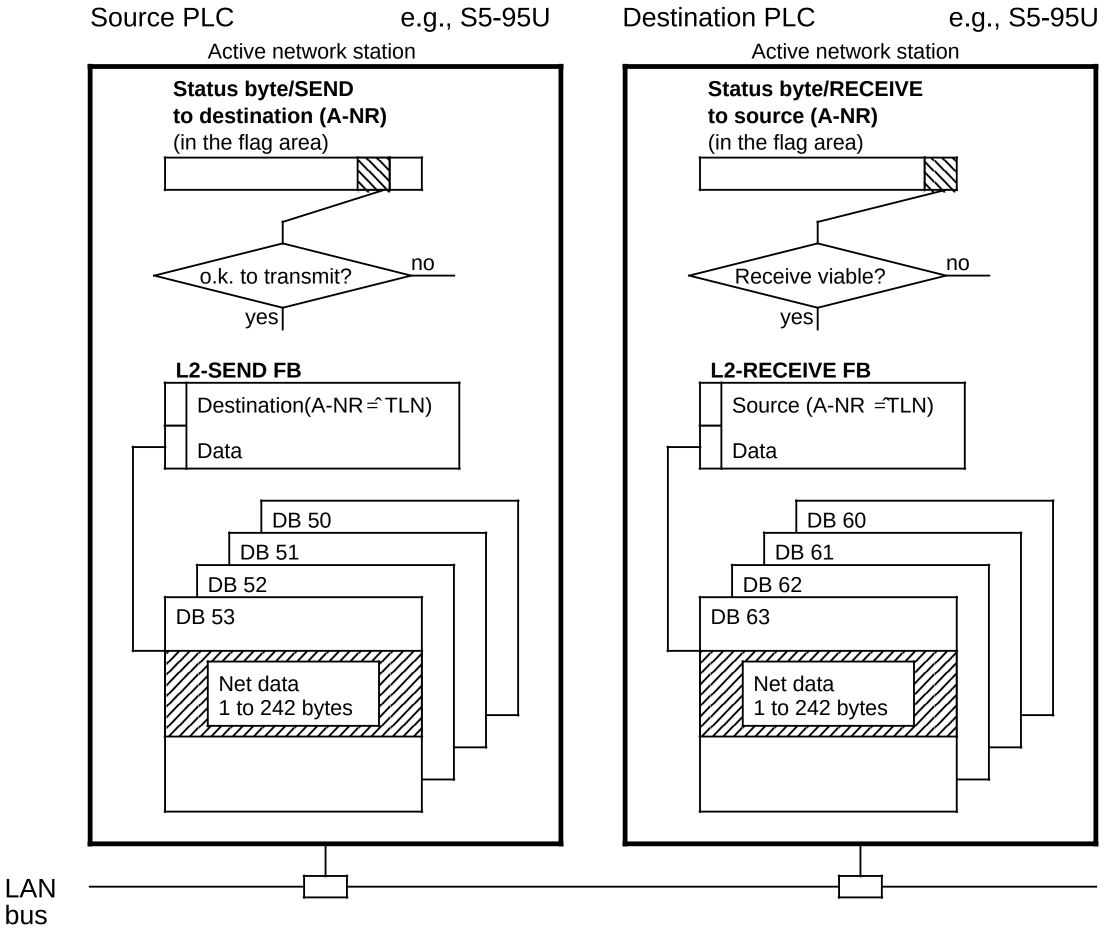


Figure 6-2. Functional Diagram of a PLC-to-PLC Connection

Explanations to Figure 6-2:
When there are no more jobs running on the PLC-to-PLC connection, the 'send' status byte indicates that it is okay to transmit. L2-SEND is called up from the user program. L2-SEND receives the following information from the parameter assignment:

- where to send the data (job number)
- where the net data are stored

The net data are transmitted to the addressed receiver via the network. At the receiver, a bit in status byte ‘Receive’ indicates that the data arrived. The receiver can fetch the data by means of L2-RECEIVE.

Communicating with the CP 5430 Communications Processor

If you want to connect other SIMATIC S5 controllers (S5-115U, S5-135U, S5-155U) to the network, you can use the CP 5430 communications processor (see Figure 6-1).
You configure the desired PLC-to-PLC connection in DB1 of the S5-95U, and program function blocks L2-SEND and L2-RECEIVE. For this PLC-to-PLC connection, configure the default connection in the CP 5430. The CP 5430 can communicate with the S5-95U using its data handling blocks SEND and RECEIVE.

When making entries in the COM 5430-VERB editor screen, note the following:

- You must enter the job number configured in DB1 of the S5-95U in the SEND/RCV-ANR (local parameters) column. The job number corresponds to the station address of the partner station (section 6.2).
- SAP (local parameter) = station address of the partner station + 1 (Appendix B for an explanation and definition of the SAP numbers in the case of the S5-95U)
- The "Remote Parameters" columns are irrelevant for an S5-95U as communications partner.

You will find additional information on the connection of the CP 5430 to the SINEC L2 network in the ”SINEC L2 Local Area Network, CP 5430 with COM 5430” Manual, order number 6GK1 970-5AA00-0AA0.

6.2 Assigning Parameters in DB1 of the S5-95U for Data Exchange with PLC-to-PLC Connections

There are no default settings in DB1 for the PLC-to-PLC connections. You assign the parameters in data block DB1 for the following items:

- The station to which the data is to be sent and from which the data is to be received
- The location of the status byte for the function blocks FB L2-SEND and FB L2-RECEIVE for each connection desired

All status bytes must be in the flag byte area. The status of transmit or receive jobs is displayed in the status byte, as well as possible errors. The structure and the evaluation of status bytes are discussed in detail in section 5.4. For function block FB L2-RECEIVE, the flag byte following the status byte is always reserved for the length byte. The length byte tells how many bytes of data were received. You have only reading rights to the length bytes.

Figure 6-3 shows how the DBs, STBs, and L2 FBs work together for data transmission in a programmable controller.

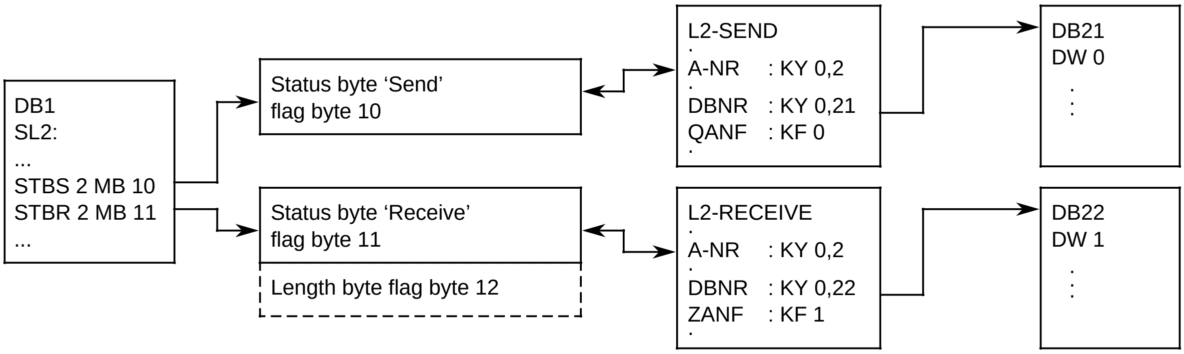


Figure 6-3. Diagram: Data Transmission Using PLC-to-PLC Connections

Table 6-1 is a configuration aid for assigning job numbers in DB1.
Create such a table in your planning phase.
How to read the table: Job number A-NR = station address TLN of the communication partner.
Example: PLC 1 transmits with A-NR 2 to PLC 2;
PLC 1 receives with A-NR 2 from PLC 2 etc.

Table 6-1. Configuring Job Number n in DB1

Transmit Receive	PLC 1 transmits to...	PLC 2 transmits to...	PLC 3 transmits to...	PLC 4 transmits to...
PLC 1 receives from...		ANR 1 ANR 2	ANR 1 ANR 3	ANR 1 ANR 4
PLC 2 receives from...	ANR 2 ANR 1		ANR 2 ANR 3	ANR 2 ANR 4
PLC 3 receives from...	ANR 3 ANR 1	ANR 3 ANR 2		ANR 3 ANR 4
PLC 4 receives from...	ANR 4 ANR 1	ANR 4 ANR 2	ANR 4 ANR 3	

The procedures to set and modify parameters in DB1 and to transfer DB1 are described in detail in section 1.4.

DB1 Parameters for PLC-to-PLC Connections

Table 6-2. DB1 Parameters for PLC-to-PLC Connections

Parameter	Argument	Significance
Block ID: SL2:		**SINEC L2**
STBS	n MBx	Job number and location of status byte ‘Transmit
STBR	n MBy	Job number and location of status byte ‘Receive’
Argument	**Permissible Range**	**Explanation**
n	1 to 31	Job number
MBx	1 to 254	Flag byte
MBy	1 to 253	Flag byte*

* The next flag byte is reserved as length byte

Example: Two S5-95U are to communicate with each other.

Table 6-3. Assigning Parameters for PLC-to-PLC Connections

DB1 for PLC 1	Explanation

`156:     KS  ='    SL2: TLN 1   STA AKT';`
`168:     KS  =' BDR 500    HSA 10  TRT ';`
`180:     KS  ='5120    SET 0   ST 400  ';`
`192:     KS  ='SDT 1 12  SDT 2 360     ';`
	L2 basic parameters (see section 1.4 for explanation)

`204:     KS  ='STBS 2 MB10 STBR 2 MB11 ';` . . .	Transmitting from station 1 to station 2, STB ‘Transmit’ is in MB10. Receiving from station 2, STB ‘Receive’ is in MB11 (MB12 is reserved as length byte)
DB1 for PLC 2	

`156:     KS  ='    SL2: TLN 2   STA AKT';`
`168:     KS  =' BDR 500    HSA 10  TRT ';`
`180:     KS  ='5120    SET 0   ST 400  ';`
`192:     KS  ='SDT 1 12  SDT 2 360     ';`
	L2 basic parameter (see section 1.4 for explanation)

`204:     KS  ='STBS 1 MB21 STBR 1 MB22 ';`	Transmitting from station 2 to station 1, STB ‘Transmit’ is in MB21. Receiving from station 1, STB ‘Receive’ is in MB22 (MB23 is reserved as length byte)

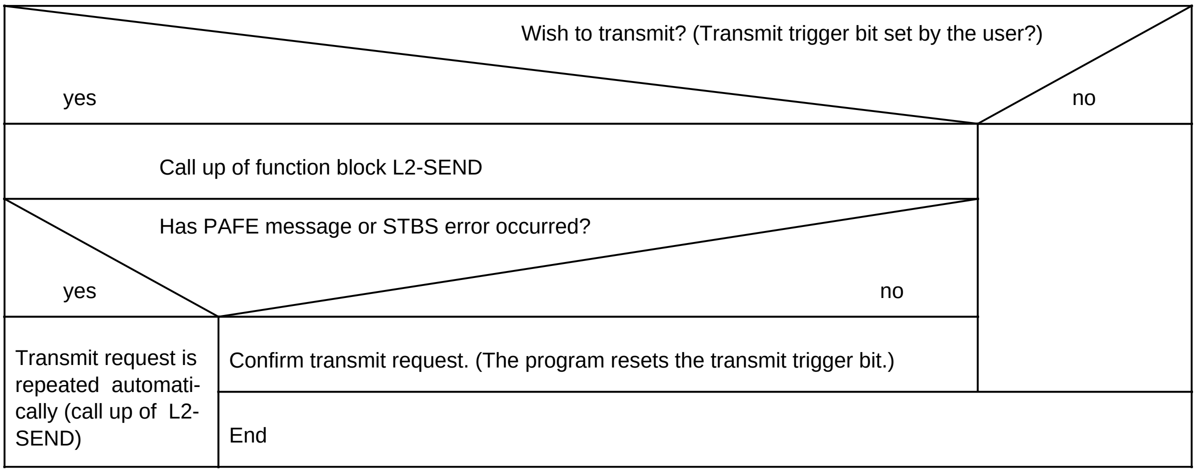
After you have completed assigning the parameters, you have to set up the control program for the data exchange. The procedure for doing this is discussed in the next sections.

6.3 Programming Example for Data Transmission via PLC-to-PLC Connections Using Standard Function Blocks

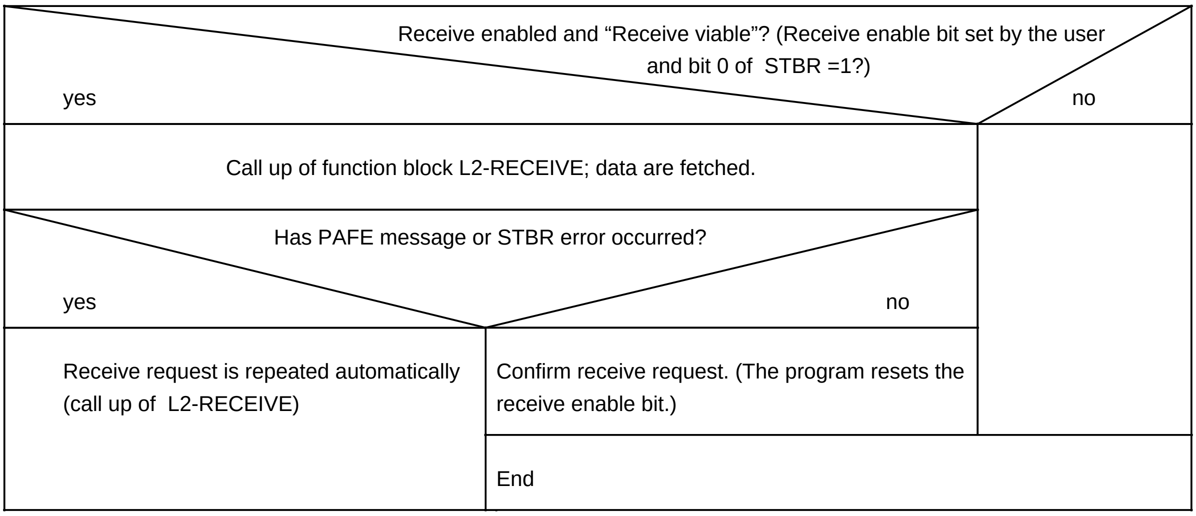
This section explains the structure of the control programs for two programmable controllers.

Example:
PLC 1 and PLC 2 are to exchange data with one another, i.e., they will transmit and receive. Refer to section 6.1 for the description of the hardware configuration.

The control program in FB105 for transmitting data is structured as illustrated below.



The control program in FB15 for receiving data is structured as illustrated below.



Programmable Controller 1

Proceed as follows:

Assign parameters in DB1 of programmable controller 1 as described in section 6.2.
Program the individual blocks as described in the following section.
Transfer blocks DB1, OB1, FB5, FB105, DB21 and DB22 to programmable controller 1.

Cyclical Program for Station 1 (Programmable Controller 1)

Programmable controller 1 is to transmit data to programmable controller 2 and to receive data from programmable controller 2.
Function block L2-SEND triggers the data transmission in programmable controller 1. L2-SEND is called up in function block FB5 of programmable controller 2.
Function block L2-RECEIVE triggers the data reception. L2-RECEIVE is called up in function block FB105. FB5 and FB105 are called up in organization block OB1. The transmit data are stored in data block DB21. The received data are stored in data block DB22. Status byte ‘Send’ is flag byte FY10. Status byte ‘Receive’ is flag byte FY11.

Significance of the Parameters for FB5 and FB105:

ANST:	Input Parameter Bit ('Send' initiation bit) A request to transmit is triggered by bit ANST. You set bit ANST. When the job is completed without error, FB5 resets bit ANST. If initiation of a request to send ends with an error message in STBS or PAFE, the request to send is repeated automatically.
EMPF:	Input Parameter Bit ('Receive’ enable bit) Receiving is enabled by bit EMPF. You set bit EMPF. When the job is completed without error, FB105 resets bit EMPF. If receiving ends with an error message in STBR or PAFE, the receive procedure is repeated automatically.

OB1 for PLC 1	**Explanation**
NETZWERK 1 0000	
0000 :	
0001 : JU FB 5	Send to station 2
0002 NAME : S 1=>2	
0003 ANST : F 5.0	'Send' initiation bit
0004 :	
0005 : JU FB 105	Receive from station 2
0006 NAME : R 1<=2	
0007 EMPF : F 6.0	‘Receive’ enable bit
0008 :BE	

FB5 for PLC 1	**Explanation**
`Segment 1            0000`	
`NAME   :    S 1=>2`	Transmitting from station 1 to station 2
`DES    :    ANST       I/B/D/B/T/Z: I BI/BY/W/D: BI`	
`0009        :`	Edge evaluation
`000A        :`	“Job completed without error” via
`000B        :`	STBS = flag byte FY10
`000C        : A        F 10.2`	STBS bit “Job completed without error”
`000D        : AN       F 20.0`	Edge auxiliary flag.
`000E        : =        F 20.1`	Edge flag “Job completed”
`000F        :`	
`0010        : A        F 10.2`	If “Job completed without error”,
`0011        : =        F 20.0`	set edge auxiliary flag.
`0012        :`	
`0013        : A        F 20.1`	If “Job completed“ and
`0014        : AN       F 20.7`	no parameter assignment error is present,
`0015        : RB       =ANST`	reset send initiation bit,
`0016        : R        F 20.5`	reset send disabling bit.
`0017        :`	
`0018        : A        =ANST`	If Send initiation bit is set and
`0019        : AN       F 20.5`	send disabling bit is not set,
`001A        : R        F 20.0`	reset edge auxiliary flag.
`001B        :`	
`001C        : JC       FB 252`	Call-up of FB L2-SEND
`001D  NAME  : L2-SEND`	
`001E  A-NR  : KY 0,2`	Send to station 2
`001F  QTYP  : KS DB`	Send data are stored in a data block,
`0020  DBNR  : KY 0,21`	DB number is 21,
`0021  QANF  : KF + 0`	starting with data word DW0.
`0022  QLAE  : KF + 3`	Three words are to be sent (DW0 to DW2).
`0023        : A        F 255.0`	Note parameter assignment error message.
`0024        : =        F 20.7`	
`0025        :`	
`0026        : A        F 10.1`	If STBS bit “Job in progress” is set,
`0027        : =        F 20.5`	set send disabling bit.
`0028        : BE`	

FB105 for PLC 1	**Explanation**
Netzwerk 1	
NAME : R 1<=2	Station 1 receives from station 2
DES : EMPF I/Q/D/B/T/Z: I BI/BY/W/D: BI	
000A : ON =EMPF	If receiving is not enabled or
000B : ON F 11.0	if STBR bit “Receive viable” is not set,
000C : BEC	end here.
000D :	
000E : JU FB 253	Call-up of FB L2-RECEIVE
000F NAME : L2-REC	
0010 A-NR : KY 0,2	Receiving from station 2
0011 ZTYP : KS DB	Received data are stored in a data block,
0012 DBNR : KY 0,22	DB number is 22,
0013 ZANF : KF +1	starting with data word DW1.
0014 ZLAE : KF -1	“Wildcard length”
0015 : AN F 255.0	If there is no parameter assignment error message
	and STBR bit “Job completed with error” is not
0016 : AN F 11.3	set, “Job completed with error” is not set,
0017 : RB =EMPF	reset receive enable bit.
0018 :	
0019 : BE	

DB21 for PLC 1	**Explanation**	
0: KY = 000,000;	Send area to PLC 2	byte 1 +2
1: KY = 000,000;	Send area to PLC 2	byte 3 +4
2: KY = 000,000;	Send area to PLC 2	byte 5 +6
3: KH = 0000;		

DB22 for PLC 1	**Explanation**	
0: KH = 0000;		
1: KY = 000,000;	Receive area from PLC 2	byte 1+2
2: KY = 000,000;	Receive area from PLC 2	byte 3+4
3: KY = 000,000;	Receive area from PLC 2	byte 5+6
.		
.		
.		

Programmable Controller 2

Proceed as follows:

Assign parameters in the DB1 of programmable controllers 2 as described in section 6.2.
Program the individual blocks as described in the following section.
Transfer blocks DB1, OB1, FB1, DB21 and DB22 to programmable controller 2.

Cyclical Program for Station 2 (Programmable Controller 2)

Programmable controller 2 is to transmit data to programmable controller 1 and to receive data from programmable controller 1.
Function block L2-SEND in programmable controller 2 triggers the data transmission.
L2-SEND is called up in function block FB5 of programmable controller 1.
Function block L2-RECEIVE triggers the data reception in programmable controller 2.
L2-RECEIVE is called up in function block FB105.
FB5 and FB105 are called up in organization block OB1. The transmit data are stored in data block DB21. The received data are stored in data block DB22. Status byte ‘Send’ is flag byte 21. Status byte ‘Receive’ is flag byte 22.

Significance of the Parameters for FB5 and FB105:

ANST: Input Parameter Bit (trigger bit ‘Transmit’)
A transmit request is triggered by bit ANST. You set bit ANST. When the job is completed without error, FB5 resets bit ANST. If triggering of a transmit request ends with an error message in STBS or PAFE, the transmit request is repeated automatically.

EMPF: Input Parameter Bit (enable bit ‘Receive’)
Receiving is enabled by bit EMPF. You set bit EMPF. When the job is completed without error, FB105 resets bit EMPF. If receiving ends with an error message in STBR or PAFE, the receive procedure is repeated automatically.

OB1 for PLC 2	Explanation
`SEGMENT 1             0000`	
`0000       :`	
`0001       : JU       FB 5`	Transmit to station 1.
`0002 NAME  : S 2=>1`	
`0003 ANST  : F 5.0`	Trigger bit ‘Transmit’
`0004       :`	
`0005       : JU       FB 105`	Receive from station 1
`0006 NAME  : R 2<=1`	
`0007 EMPF  : F 6.0`	Enable bit 'Receive'
`0008       :BE`	

FB5 for PLC 2	**Explanation**
`SEGMENT 1           0000`	
`NAME  :    S 2=>1`	Transmitting from station 2 to station 1
`DES   :    ANST       I/Q/D/B/T/Z: I BI/BY/W/D: BI`	
`0009       :`	Edge evaluation
`000A       :`	"Job completed without error" via
`000B       :`	STBS = flag byte FY21
`000C       : A        F 21.2`	STBS bit "Job completed without error"
`000D       : AN       F 42.0`	Edge auxiliary flag
`000E       : =        F 42.1`	Edge flag "Job completed"
`000F       :`	
`0010       : A        F 21.2`	If "Job completed without error",
`0011       : =        F 42.0`	set edge auxiliary flag.
`0012       :`	
`0013       : A        F 42.1`	If "Job completed" and
`0014       : AN       F 42.7`	no parameter assignment error is present,
`0015       : RB       =ANST`	reset send initiating bit,
`0016       : R        F 42.5`	reset send disabling bit.
`0017       :`	
`0018       : A        =ANST`	If send initiating bit is set and
`0019       : AN       F 42.5`	send disabling bit is not set,
`001A       : R        F 42.0`	reset edge auxiliary flag.
`001B       :`	
`001C       : JC       FB 252`	Call-up of FB L2-SEND
`001D  NAME : L2-SEND`	
`001E  A-NR : KY 0,1`	Send to station 1
`001F  QTYP : KC DB`	Send data are stored in a data block,
`0020  DBNR : KY 0,21`	DB number is 21,
`0021  QANF : KF + 0`	starting with data word DW0.
`0022  QLAE : KF + 3`	Three words are to be sent (DW0 to DW2).
`0023       : A        F 255.0`	Note parameter assignment error message.
`0024       : =        F 42.7`	
`0025       :`	
`0026       : A        F 21.1`	If STBS bit "Job in progress" is set,
`0027       : =        F 42.5`	set send disabling bit.
`0028       :`	
`0029       : BE`	

FB105 for PLC 2	Explanation
SEGMENT 1	
NAME : S 2<=1	Station 2 receives from station 1
DES : EMPF I/Q/D/B/T/Z: I BI/BY/W/D: BI	
000A : ON =EMPF	If receiving is not enabled or
000B : ON F 22.0	if STBR bit “Receive viable” is not set,
000C : BEC	end here.
000D :	
000E : JU FB 253	Call-up of L2-RECEIVE
000F NAME : L2-REC	
0010 A-NR : KY 0,1	Receiving from station 1
0011 ZTYP : KS DB	Received data are stored in a data block,
0012 DBNR : KY 0,22	DB number is 22,
0013 ZANF : KF +1	starting with data word DW1.
0014 ZLAE : KF -1	“Wildcard length”
0015 : AN F 255.0	If there is no parameter assignment error message
0016 : AN F 22.3	and STBR bit “Job completed with error” is not
0017 : RB =EMPF	set, reset enable bit ‘Receive’.
0018 :	
0019 : BE	

DB21 for PLC 2	Explanation
0: KY = 000,000;	Send area to PLC 1 Bytes 1 +2
1: KY = 000,000;	Send area to PLC 1 Bytes 3 +4
2: KY = 000,000;	Send area to PLC 1 Bytes 5 +6
3: KH = 0000;	

DB22 for PLC 2	Explanation
0: KH = 0000;	
1: KY = 000,000;	Receive area from PLC 1 Bytes 1+2
2: KY = 000,000;	Receive area from PLC 1 Bytes 3+4
3: KY = 000,000;	Receive area from PLC 1 Bytes 5+6
.	
.	
.	

Switch both programmable controllers from STOP to RUN.
Check the data transmission. This is done best with a programmer: Connect each programmable controller to a programmer and display the data blocks, the status bytes, and the parameter assignment error byte.

Refer also to section 3.3 “Starting up a System”.
Appendix E gives you information on cycle delay times in the programmable controllers due to data transmission.

7 Data Transmission Using Cyclic I/O

Figures

Tables

7 Data Transmission Using Cyclic I/O

This chapter provides you with the following information:

- How this type of data transmission functions in principle
- How to set parameters for the programmable controllers
- How to program with STEP 5 for this type of data transmission (examples)

7.1 Features of Cyclic I/O

- Data transmission with cyclic I/O (ZP) is appropriate for the frequent transmission of small amounts of data between active S5-95Us and passive S5-95Us or field devices. Extensive programming is not required.
- A ZP station that scans other ZP stations is called a **ZP master**. A ZP master is always an active station on the SINEC L2 network.
  A ZP station that is scanned by a ZP master is called a **ZP slave**. A ZP slave is generally a passive station on the SINEC L2 network. Exception: a ZP slave S5-95U can be either an active or a passive station on the SINEC L2 network.
  The following devices can be ZP masters:
  - an active S5-95U
  - a CP 5430

  The following devices can be ZP slaves:
  - an active S5-95U
  - a passive S5-95U
  - a field device

  Settings in DB1 determine master/slave status of an S5-95U.
- Each ZP master can service a maximum of 32 ZP slaves. Several ZP masters can request data in parallel from a ZP slave.
- A reserved data block (ZP DB) is responsible in the S5-95U for the word-by-word data exchange. The cyclic I/O input area (ZPE) and cyclic I/O output area (ZPA) for the respective stations are defined in data block ZP DB.
  In the ZP master, the ZPE and the ZPA can each accept a maximum of 128 data words. In the ZP slave, the ZPE and the ZPA can each accept a maximum of 121 data words.
  The input data and output data are available without requiring a request to transmit or a request to receive in the control program.
  You set the parameters for the ZP DB and for the ZP areas in DB1.
- Status bytes (STBs) are available to control the cyclic I/O. ou set the parameters for the location of the STBs in DB1.

Principle of Operation

A reserved data block (ZP DB) is responsible in the S5-95U for the word-by-word data exchange. The cyclic I/O input area (ZPE) and cyclic I/O output area (ZPA) for the respective stations are defined in data block ZP DB.

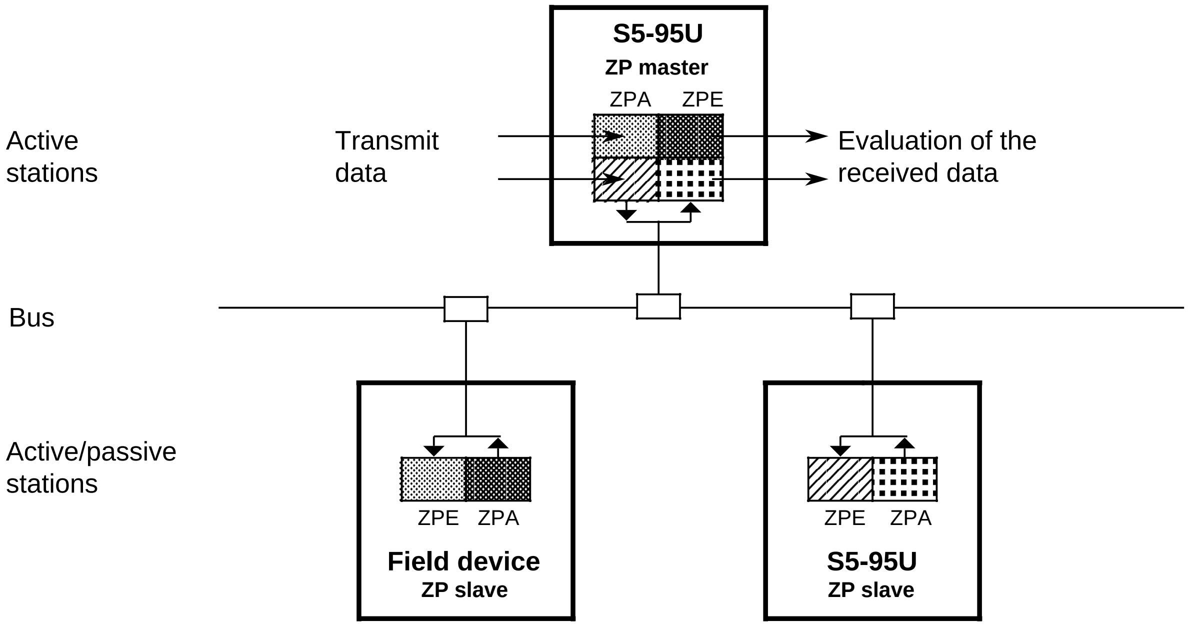


Figure 7-1. Functional Diagram of Cyclic I/O

Explanations to Figure 7-1:
The boxes filled with a pattern represent the data areas (same pattern = same data area).
The user program writes the transcript data to the ZPA of the ZP master . The transmit data are transmitted automatically to the respective ZP slaves and written to their ZPE .
At the same time, the contents of the ZP slave's ZPA are transmitted to the corresponding ZPE of the ZP master where the user program can evaluate them.
The ZP master creates a ZP slave life list containing all the states of the ZP slaves that the ZP master scans.

Note

You may read and write the complete ZPA.
You may only read out the ZPE.

Updating the Cyclic I/O Input Area and Output Area

There is an exchange of ZP data (ZPA, ZPE, and ZP status bytes) between the control processor and the communications processor at every cycle control point in the programmable controller's CPU program cycle.
The communications processor transmits ZP data cyclically via the network independently of the ZP cycle control point of the programmable controller’s CPU operating system.
There is complete data consistency for ZPA and ZPE.

SAP Number

A ZP slave can be addressed only if the ZP master knows both the ZP slave address and its appropriate service access point (SAP).
You set the parameters for the ZP slave address and the ZP slave's SAP number in DB1 of the ZP master.
If you are using an S5-95U as a ZP slave, the SAP number is 61: **You must set the SAP parameter in DB1 of the ZP master to 61.**
If you are using a field device as a ZP slave, you can set the SAP parameter in DB1 of the ZP master from 0 to 62. Refer to Appendix B for more detailed explanations and for a list of all SAP numbers used with S5-95U programmable controllers.

Restart sequence when:

- **powering up the PLC or**
- **switching the PLC from STOP to RUN following a "PLC overall reset" or**
- **switching the PLC from STOP to RUN after modification of the SL2 parameter block in DB1**

Before executing the restart OBs (OB21/OB22), ZPA and ZPE are assigned the default value "0" in the ZP-DB. Bit 7 "ZP slave failure" or bit 7 "ZP master failure"in the STB is set (section 7.3).

Restart sequence when:

- **switching the PLC from STOP to RUN without modification of the SL2 parameter block in DB1**

ZPA is assigned the default value ”0” in the ZP DB before execution of the restart OB (OB21). The input data presently available from the LAN are written to the ZPE in the ZP DB.

ZP Safety Function

When the programmable controller goes from RUN to STOP, ZPA and ZPE stay unchanged in the ZP DB.
When the programmable controller is in the STOP mode, the value “zero” is sent as ZP output data.
If a ZP slave fails, the ZP input bytes assigned to it in the ZP master are reset to 0. If a ZP master fails, the ZP input bytes assigned to it in the ZP slave are reset to 0.
You can read out the status of all the ZP slaves by means of the ZP slave life list (see section 7.3)

Communication with the CP 5430 Communications Processor

The CP 5430 communications processor is required when S5-95U programmable controllers communicate via cyclic I/O (ZP) with the SIMATIC S5-115U to S5-155U controllers. The CP 5430 functions as the ZP master. The S5-95U functions as the ZP slave. Section 7.2 describes how to set the parameters for the S5-95U.

> You must enter the input/output areas and the SAP 61 as the destination into the ZP editor screen of COM CP 5430.

Refer to the SINEC L2 CP 5430 Operating Guide for additional information about the CP 5430.

7.2 Assigning Parameters in DB1 of the S5-95U for Data Exchange with Cyclic I/O

DB1 does not have default settings for ZP. Assign the following parameters:

- The ZP output area ZPA where the transmit data are located
- The ZP input area ZPE where the receive data are located
- The location of the status bytes

You must assign parameters in DB1 for the location of one status byte (STB). All status bytes must be in the flag area. The status byte indicates the status of the cyclic I/O and possible errors.

You can assign parameters in DB1 of the ZP master for a status byte that will allow you to get the ZP slave life list. Section 7.3 describes the structure of the status bytes and explains the ZP slave life list.

You set parameters for a ZP data block (ZP DB) in DB1. Figure 7-2 illustrates how DB1, the STBs , and ZP DB work together in a ZP master.

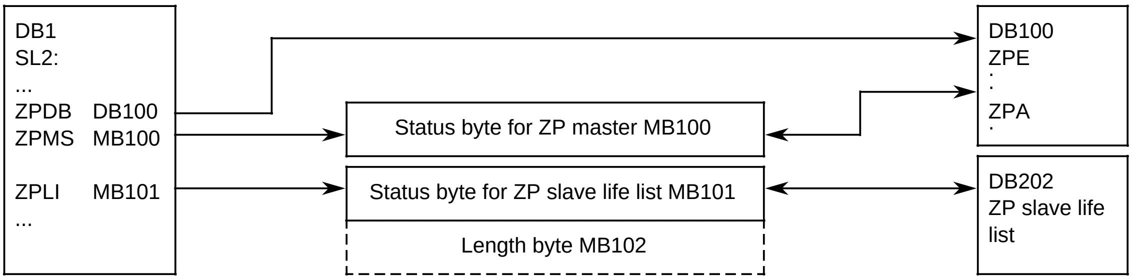


Figure 7-2. Diagram: Data Transmission Using Cyclic I/O

Both the entire ZP input area and the entire ZP output area of an S5-95U must be in **one area** without gaps in the ZP data block. The same ZPA or even data words from the ZPA of a ZP master can be specified for different ZP slaves.

Figures 7-3 and 7-4 illustrate this requirement with an example for a ZP master and an example for a ZP slave.

Examples:

ZP DBx for ZP Master

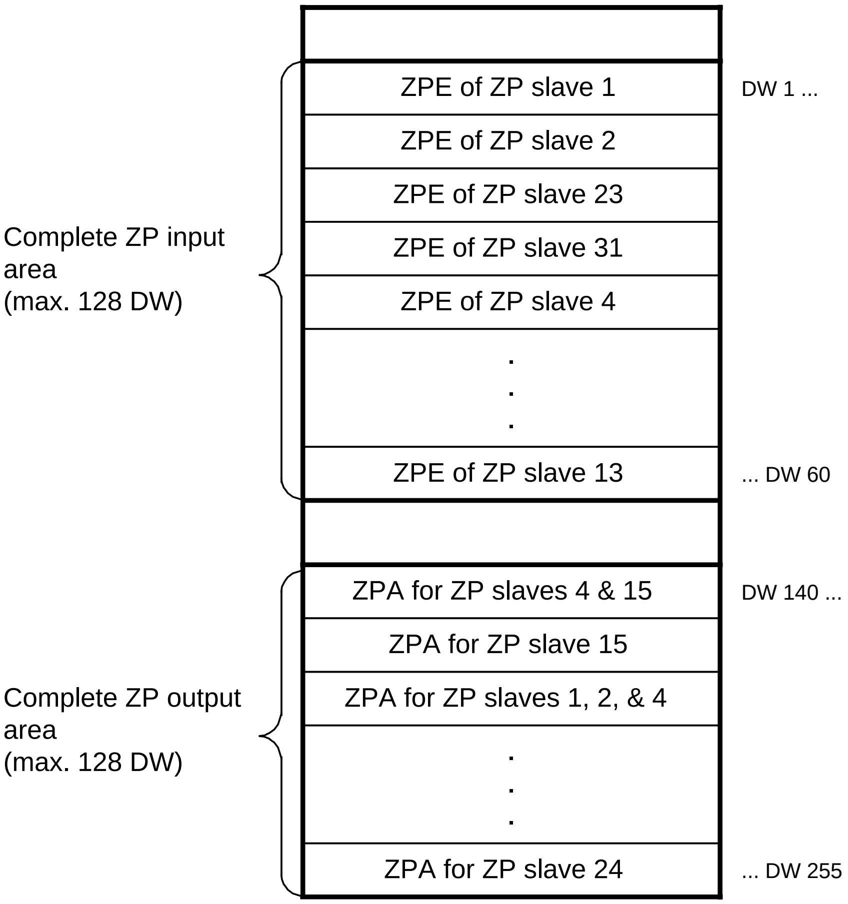


Figure 7-3. Division of the DB Reserved for Cyclic I/O (ZP) in the S5-95U (Example for ZP Master)

ZP DBx for ZP Slave

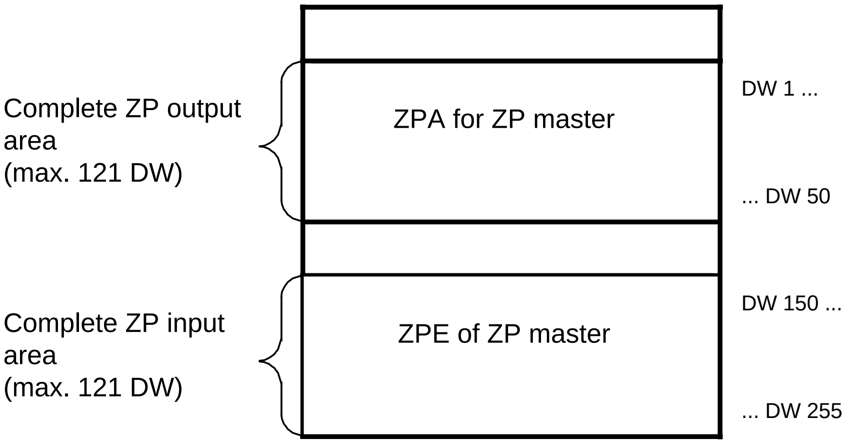


Figure 7-4. Division of the DB Reserved for Cyclic I/O (ZP) in the S5-95U (Example for ZP Slave)

The procedures to set and modify parameters in DB1 and to transfer DB1 are described in detail in section 1.4.

DB1 Parameters for Cyclic I/O

Table 7-1. DB1 Parameters for Cyclic I/O

Parameter	Argument	Significance
Block ID: SL2:		**SINEC L2**
Parameters for ZP Master Function:		
ZPDB	DBx	Reserved data block for cyclic I/O
ZPMS	MBy	Status byte (STB) for ZP master
ZPM	a b DWc DWd DWe DWf	ZP master/slave connection (max. 32 connections can be programmed)
ZPLI	MBz	Status byte (STB) for ZP slave life list
Argument	**Permissible Range**	**Explanation**
a	1 to 126	ZP slave station address
b	0 to 62	L2 SAP of ZP slave (if S5-95U is ZP slave, enter 61
DWc or X	0 to 255	ZPA lower limit; data word; X for “non defined”
DWd or X	0 to 255	ZPA upper limit; data word; X for “non defined”
DWe or X	0 to 255	ZPE lower limit; data word; X for “non defined”
DWf or X	0 to 255	ZPE upper limit; data word; X for “non defined”
DBx	2 to 255	Data block
MBy	1 to 254	Flag byte
MBz	1 to 253	Flag byte
Parameters for ZP Slave Function:		
ZPDB	DBx	Reserved DB for cyclic I/O
ZPSS	MBz	Status byte (STB) for ZP slave
ZPSA	DWa DWb	ZP slave output area
ZPSE	DWc DWd	ZP slave input area
Argument	**Permissible Range**	**Explanation**
DWa or X	0 to 255	ZPA lower limit; data word; X for “non defined”
DWb or X	0 to 255	ZPA upper limit; data word; X for “non defined”
DWc or X	0 to 255	ZPE lower limit; data word; X for “non defined”
DWd or X	0 to 255	ZPE upper limit; data word; X for “non defined”
DBx	2 to 255	Data block
MBz	1 to 254	Flag byte

* The next flag byte is reserved as length byte.

Example: Four S5-95Us are to communicate using cyclic I/O. Programmable controller 1 is the ZP master, programmable controllers 40, 41 and 42 (all of them passive) are the ZP slaves. Some of the default parameters (represented shaded in Table 7-2) in DB1 need to be modified.

Table 7-2. Assigning Parameters for Cyclic I/O

DB1 Parameters for PLC 1 (ZP Master)

```
156:     KS  ='    SL2: TLN 1   STA AKT';
168:     KS  =' BDR 1500   HSA 1   TRT ';
180:     KS  ='5120    SET 60  SDT 1 15';
192:     KS  ='0 SDT 2  980 ST 1000    ';
204:     KS  ='ZPDB DB100 ZPMS MB100   ';
216:     KS  ='ZPLI MB101 ZPM 40 61    ';
228:     KS  ='DW1 DW10 DW101 DW110    ';
240:     KS  ='ZPM 41 61               ';
252:     KS  ='DW11 DW20 DW111 DW120   ';
264:     KS  ='ZPM 42 61               ';
276:     KS  ='DW21 DW30 DW121 DW130   ';
.
.
.
```

Explanation

L2 basic parameters (see section 1.4 for explanation);
ZP DB for the ZP master is DB100;
STB for the ZP master is FY100;
STB for the ZP slave life list is FY101;
For station 40: L2 SAP 61,
ZPA= DW 1 to DW 10,
ZPE= DW 101 to DW 110;
For station 41: L2 SAP 61,
ZPA=DW 11 to DW 20,
ZPE= DW 111 to DW 120;
For station 42: L2 SAP 61, ZPA=
DW 21 to DW 30, ZPE=DW 121 to DW 130

DB1 Parameters for PLC 40 (ZP Slave)

```
156:     KS  ='    SL2: TLN 40  STA PAS';
168:     KS  =' BDR 1500  SDT 1 150    ';
180:     KS  =' ST 1000                ';
192:     KS  ='ZPDB DB100 ZPSS MB100   ';
204:     KS  ='ZPSA DW1 DW10           ';
216:     KS  ='ZPSE DW11  DW20         ';
.
.
.
```

Explanation

L2 basic parameters (see section 1.4 for explanation);

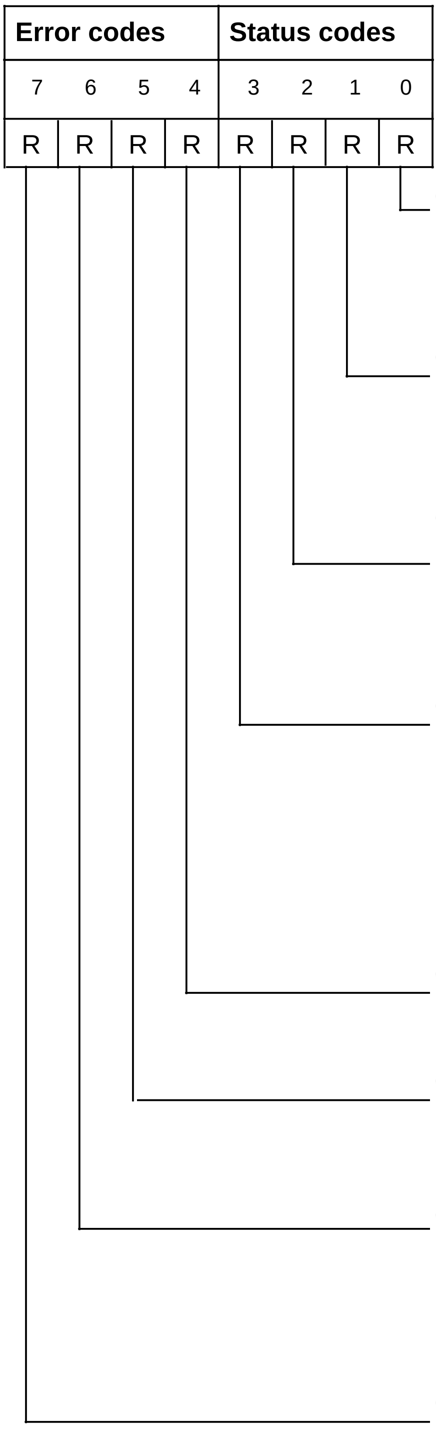
ZP DB for the ZP slave is DB100;
STB for the ZP slave is MB100;
ZPA=DW 1 to DW 10;
ZPE=DW 11 to DW 20

Change parameters in the DB1s of PLC 41 and PLC 42 as you did for PLC 40.

7.3 Controlling Data Transmission in the Control Program

Each ZP master and each ZP slave is provided with a status byte to control cyclic I/O. The status byte indicates the ZP status and any errors that may have occurred.
The ZP master also creates a ZP slave life list that can be fetched by FB L2-RECEIVE (with job number A-NR 202). An additional status byte is necessary for this. See section 5.4 for information on the structure of the status byte for FB L2-RECEIVE.
You can scan the status bytes (STB) in the control program and program reactions to possible errors. You have already set the parameters for the location of the status bytes in data block DB1 (section 7.2).

Status Byte for the ZP Master



Error codes				**Status codes**			
7	6	5	4	3	2	1	0
R	R	R	R	R	R	R	R

0: No ZPE cycle overflow
1: ZPE cycle overflow:
new ZP input data are available in DB ZP from all ZP slaves although the CPU could not yet take over the previous ZP input data .

0: No ZPA cycle overflow
1: ZPA cycle overflow:
The CPU has provided new ZP output data from the ZP DB to the communications processor although previous ZP output data could not yet be transmitted via the bus.

0: All ZP slaves transmitted the programmed number of ZP input data.
1: At least 1 ZP slave did not transmit the programmed number of ZP input data.
- If too many data were sent, the rest is discarded.
- If too few data were sent, the rest is filled up with “0”.

0: ZP bus cycle is presently running.
1: A complete ZP bus cycle ended at the last ZP control point (before this OB1 cycle) (scanning of all the programmed ZP slaves by the ZP master):
- The newest ZP input data are available from all programmed ZP slaves and
- the ZP slave life list was updated in the communications processor.

Bit 3 stays set for one PLC-CPU program cycle.

0: ZP data in ZP DB and ZP slave life list are valid.
1: ZP data in ZP DB and ZP slave life list are temporarily invalid; previous ZP output data are being transmitted via the bus.

0: No ZP DB error
1: Programmed ZP DB is not available or ZP DB is too small; ZP image in ZP DB is invalid, ZP output data “0” are being transmitted via the bus.

0: No ZP configuration error
1: One error minimum has occurred in at least one ZP slave:
- SAP not activated or parameter settings incorrect.
- ZP slave has insufficient or no receiving resources;

ZP slaves concerned are entered on ZP slave life list and their ZP input area is set in ZP DB to “0”.

0: All ZP slaves okay
1: At least one ZP slave has failed, is still in the start-up phase or ZP master is still in the start-up phase; concerned ZP slaves are entered in ZP slave life list and their ZP input area in ZP DB is set to “0”.

R = Read only

Figure 7-5. Structure of the Status Byte (STB) for the ZP Master

ZP Slave Life List

The ZP master (S5-95U) creates a ZP slave life list that contains the status of of every ZP slave scanned by the ZP master. The remaining entries in the list are zeros.

There is an entry in the ZP slave life list when the ZP master scans the ZP slave and either a ZP configuration error (STB bit 6) or a ZP slave failure (STB bit 7) occurs.

The ZP slave life list contains 16 bytes. The state of every ZP slave is represented in bits 1 to 126. Bit 0 and bit 127 are irrelevant (=0).

You can fetch the ZP slave life list using FB L2-RECEIVE and store it as a consistent area (no gaps) in the flag area or in a data block.

Example: ZP slave life list is located in the flag area starting with flag byte FY2

		1	**2**	**3**	**4**	**5**	**6**	**7**	**TLN of the ZP slave**
Flag byte FY2	▨	0/	0/	0/	0/	0/	0/	0/	Status of the ZP slave
	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	Bit

	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**TLN of the ZP slave**
Flag byte FY3	0/	0/	0/	0/	0/	0/	0/	0/	Status of the ZP slave
	3.7	3.6	3.5	3.4	3.3	3.2	3.1	3.0	Bit

Example: ZP slave life list is located in data block starting with data word DW2

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**TLN of the ZP slave**
DW2	▨	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	0/	Status of the ZP slave
	2.15	2.14	2.13	2.12	2.11	2.10	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	Data

Status 0: ZP slave is okay or is not scanned by this ZP master

Status 1: a “ZP configuring error” or a “ZP failure” occurred with this ZP slave

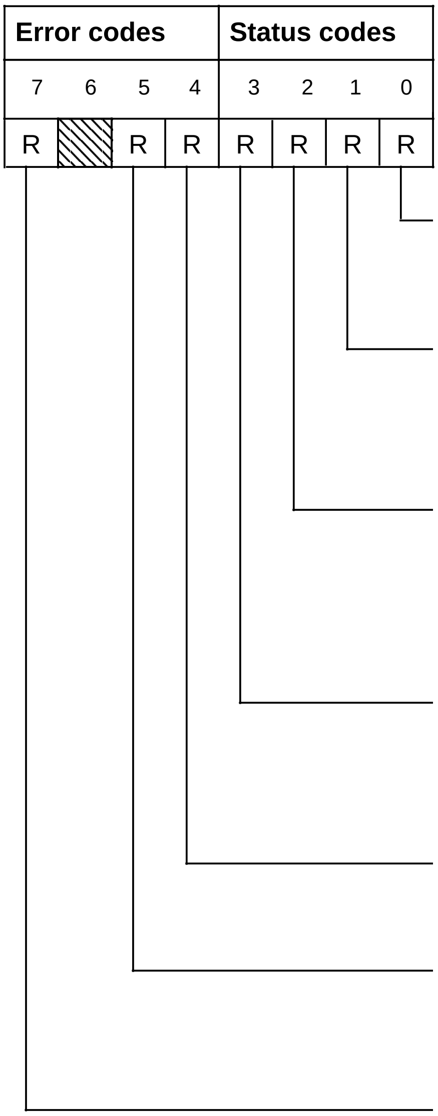
▨ Bit for station 0 is irrelevant (=0)

Figure 7-6. Structure of the ZP Slave Life List

You can fetch the ZP slave life list using **FB L2-RECEIVE with job number A-NR 202**. For this purpose, you need an additional STB for the ZP master (refer to section 5.4 for information on the structure of the STB of FB L2-RECEIVE). You assign STB parameters in DB1 under parameter ZPLI (see section 7.2).

The ZP slave life list can be fetched only if, in the corresponding STB, bit “Receive viable” is set. Bit “Receive viable” is set only if an error occurred at least in one of the ZP slaves.

Status Byte for the ZP Slave:



Error codes				**Status codes**			
7	6	5	4	3	2	1	0
R	▨	R	R	R	R	R	R

0: No ZPE cycle overflow
1: ZPE cycle overflow:
New ZP input data are available in ZP DB from ZP master although the CPU could not yet take over previous ZP input data.

0: No ZPA cycle overflow
1: ZPA cycle overflow:
The CPU has provided new ZP output data from the ZP DB to the communications processor although previous ZP output data could not yet be preprocessed for the bus.

0: The ZP master transmitted the programmed number of ZP input data.
1: The ZP master did not transmit the programmed number of ZP input data:
- If too many data were sent, the rest is discarded.
- If too few data were sent, the rest is filled up with “0”.

0: ZP bus cycle is presently running.
1: A ZP bus cycle ended at the last ZP control point (before this OB1 cycle) (scanning of the ZP slave by the ZP master):
- The newest ZP input data are available from the ZP master.
Bit 3 stays set for one PLC-CPU program cycle.

0: ZP data in ZP DB are valid.
1: ZP data in ZP DB are temporarily invalid; previous ZP output data are being transmitted via the bus.

0: No ZP DB error
1: Programmed ZP DB is not available or ZP DB is too small; ZP image in ZP DB is invalid, ZP output data “0” are transmitted via the bus.

0: The ZP master is okay.
1: The ZP master has failed, is still in the start-up phase (ZP slave was not scanned within a certain “access time”) or the ZP slave is still in the start-up phase; the complete ZPE in ZP DB is set to “0”.

R: Read only

▨ Irrelevant bit (=0)

Figure 7-7. Structure of the Status Byte (STB) for the ZP Slave

ZP Slave Watchdog

The S5-95U as a ZP slave has a watchdog. If the ZP slave is not scanned cyclically within the "response time" by a ZP master, bit 7 "ZP master failure" is set in the ZP slave status byte and the entire ZPE in ZP DB is set to zero.

Table 7-3 lists the ZP slave "response time" for the S5-95U calculated from the Baud rate at a given slot time.

Table 7-3. ZP Slave "Response Time" for the S5-95U Calculated from the Baud Rate at a Given Slot Time

Baud Rate	Slot-Time	ZP Slave "Response Time"
9.6 kBaud	73 bit time units*	6 s
19.2 kBaud	76 bit time units*	3 s
39.75 kBaud	99 bit time units*	0.654 s
187.5 kBaud	170 bit time units*	0.381 s
500 kBaud	400 bit time units*	0.207 s
1500 kBaud	1000 bit time units*	0.125 s

* One bit time unit is the time it takes to transmit one bit (reciprocal value of baud rate)

If you are using a slot time that differs from the ones listed in Table 7-3 (permissible range for slot time: 50 to 4095), you can calculate the "response time" with the following formula:

$$\mathbf{T_{response} = 140 \cdot (T_{slot} + 341) \cdot T_{bit}}$$

$T_{response}$ = ZP slave response time in seconds

T_{slot} = Slot time in bit time units

T_{bit} = Bit time units = $\frac{1}{bdr}$ in seconds

Minimum ZP slave response time:	100 ms	(i. e., if the calculated $T_{response}$ is < 100 ms, the minimum ZP slave response time is 100 ms)
Maximum ZP slave response time:	5 min	(i. e., if the calculated $T_{response}$ is >5 min, the maximum ZP slave response time is 5 min)

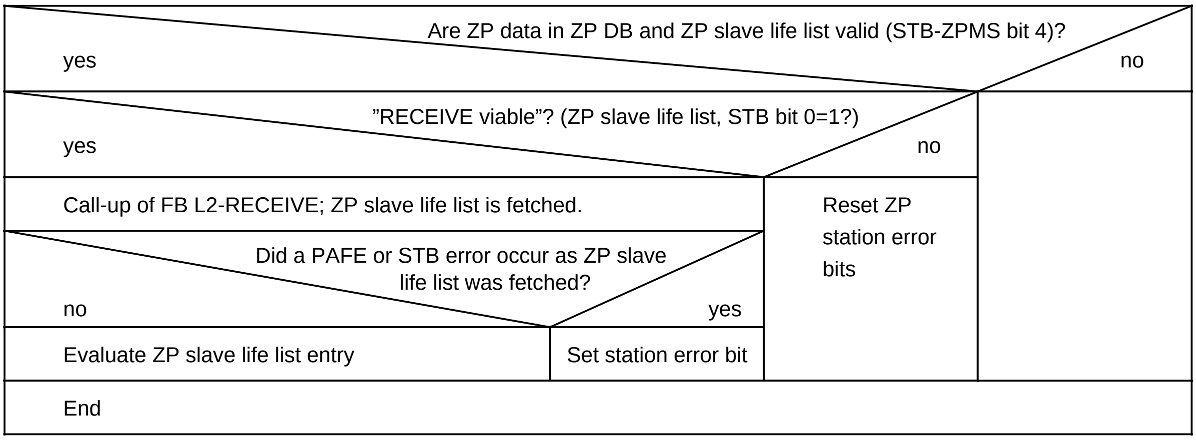
Tolerance: - 0% +20% $T_{response}$

7.4 Programming Example for Data Transmission via Cyclic I/O

This section explains the structure of the control programs for cyclic I/O.
The data are exchanged cyclically without request to transmit or request to receive: The data exchange is controlled within the control program only by the status byte.

Example:
An S5-95U (ZP master) is to supply data to three S5-95Us (ZP slaves, passive stations) and to receive data from them.

The control program in FB202 for ZP master is structured as illustrated below.



Cyclic Program for Station 1 (ZP Master)

In FB202, FB L2-RECEIVE scans the ZP slave life list for updated entries.
FB202 is called up from OB1.
The ZP slave life list is located in DB202. ZP DB for the ZP master is DB100. The status byte for the ZP slave life list is flag byte FY101. The status byte for the ZP master is flag byte FY100.

Proceed as follows:

Assign parameters for programmable controller 1 as the ZP master as described in section 7.2.
Program the individual blocks as described in the following section.
Transfer blocks OB1, FB202, DB202, and DB100 to programmable controller 1.

OB1 for PLC 2 (ZP Slave)	Explanation
`NETZWERK 1             0000`	
`0000       :`	
`0002       : JU       FB 202`	
`0004  Name : ZP-ST-LI`	
`0006  SL40 : F 4.0`	Station error bit, is set if PLC 2 (TLN 40) failed
`0008  SL41 : F 4.1`	Station error bit, is set if PLC 3 (TLN 41) failed
`000A  SL42 : F 4.2`	Station error bit, is set if PLC 4 (TLN 42) failed
`000C  FEHL : F 4.3`	Error when reading out ZP slave life list, indicated in STB/PAFE
`000E       : BE`	

FB202 for PLC 1 (ZP Master)	**Explanation**
SEGMENT 1 0000	
NAME : ZP-ST-LI	
DES : SL40 I/Q/D/B/T/Z: Q BI/BY/W/D: BI	
DES : SL41 I/Q/D/B/T/Z: Q BI/BY/W/D: BI	
DES : SL42 I/Q/D/B/T/Z: Q BI/BY/W/D: BI	
DES : FEHL I/Q/D/B/T/Z: Q BI/BY/W/D: BI	
0008 : A F 100.4	If ZP data in ZP DB and ZP slave life list are
000A : BEC	temporarily invalid, end here.
000C :	
000E : A F 101.0	If STB bit ‘Receive viable’ is set for ZP slave
0010 : JC =READ	life list, jump to ‘Read ZP slave life list’.
0012 :	
0014 : RB =SL40	Reset error bits of ZP stations
0016 : RB =SL41	
0018 : RB =SL42	
001A : RB =FEHL	
001C : BEU	
001E READ :	
0020 : JU FB 253	Call up L2-RECEIVE FB
0022 NAME : L2-REC	
0024 A-NR : KY 0,202	Read job number for ZP slave life list
0026 ZTYP : KS DB	ZP slave life list is located in a data block,
0028 DBNR : KY 0,202	DB number is 202,
002A ZANF : KF + 0	starting with data word DW0.
002C ZLAE : KF - 1	“Wildcard length”
002E : O F 101.3	If STB bit ‘Job completed with error’ is set ,
0030 : O F 255.0	or if there is a parameter assignment error
	message,
0032 : = =FEHL	set error bit.
0034 : BEC	
0036 :	
0038 : C DB 202	Evaluate ZP slave life list entry.
003A :	
003C : TB D 2.7	ZP slave life list bit for station 40; if list entry
003E : = =SL40	was updated, set station error bit.
0040 :	
0042 : TB D 2.6	ZP slave life list bit for station 41; if list entry
0044 : = =SL41	was updated, set station error bit.
0046 :	
0048 : TB D 2.5	ZP slave life list bit for station 42; if list entry
004A : = =SL42	was updated, set station error bit.
004C :	
004E : BE	

DB202 for PLC 1 (ZP Master)	Explanation
0: KM = 00000000 00000000;	**ZP slave life list**
1: KM = 00000000 00000000;	
2: KM = 00000000 **000**00000;	Status of : Station 40= D 2.7;
3: KM = 00000000 00000000;	Station 41= D 2.6;
4: KM = 00000000 00000000;	Station 42= D 2.5
5: KM = 00000000 00000000;	
6: KM = 00000000 00000000;	
7: KM = 00000000 0000000**0**;	Status of station 126= D 7.1

DB100 for PLC 1 (ZP Master)	Explanation
	********************************
1: KH = 1001;	
.	
.	ZP output area, ZP slave 40
.	
10: KH = 9B11;	
	********************************
11: KH = 1102;	
.	
.	ZP output area, ZP slave 41
.	
20: KH = 5310;	
	********************************
21: KH = 0011;	
.	
.	ZP output area, ZP slave 42
.	
30: KH = 0205;	
	********************************
.	
.	
.	
	********************************
101: KH = A011;	
.	
.	ZP input area, ZP slave 40
.	
110: KH = 10F2;	
	********************************
111: KH = 1100;	
.	
.	ZP input area, ZP slave 41
.	
120: KH = B000;	
	********************************
121: KH = 3F00;	
.	
.	ZP input area, ZP slave 42
.	
130: KH = 7A01;	
	********************************

Cyclical Program for Stations 40, 41, and 42 (ZP Slaves)

The structure of the programs is identical for the three ZP slaves. It is represented only once in the following section.
The status byte for the ZP slave is flag byte FY100. ZP DB for the ZP slave is DB100.

Proceed as follows:

Assign parameters for programmable controller 2 (station 40), programmable controller 3 (station 41), and programmable controller 4 (station 42) as ZP slaves as described in section 7.2. The only parameters you need to adapt specifically for each programmable controller are TLN (station number), ZPSA, and ZPSE.

Program the individual blocks as described in the following section.

Transfer blocks OB1 and DB100 to programmable controller 2 (station 40), programmable controller 3 (station 41), and programmable controller 4 (station 42).

OB1 for PLC 2 (ZP Slave)

```
SEGMENT 1            0000
0000       :
0001       : A       F 100.7
0002       : .
0003       : .
0004       : .
0005       : BE
```

Explanation

Monitoring of the ZP data exchange via STB bit
‘Error at ZP data exchange with
ZP master’
Specific reaction to error via
user program

DB100 for PLC 2 (ZP Slave)

```
 1:        KH  = A011;
           .
           .
           .
10:        KH  = 10F2;
11:        KH  = 1001;
           .
           .
           .
20:        KH  = 9B11;
```

Explanation

```
***********************************
```

ZP output area (ZP slave 40) to ZP master

```
***********************************
```

ZP input area from ZP master

```
***********************************
```

Set the operating mode switches of the ZP master and the three ZP slaves to RUN.

Check the data transmission. This is done best with a programmer: Connect each programmable controller to a programmer and display the data blocks and the status bytes.

Refer also to section 3.3 “Starting up a System”.
Appendix 5 gives you information on cycle delay times in the programmable controllers due to data transmission.

8 Data Transmission by Accessing Layer 2 Services

Figures

Tables

8 Data Transmission by Accessing Layer 2 Services

In this chapter, you will learn

- the basic principles underlying this type of transmission,
- how to assign the PLC's parameters, and
- what the STEP 5 programs for this type of transmission look like (examples).

The S5-95U with integral SINEC L2 interface has a control processor and a communications processor.

Certain parts of the communications section have defined designations.
The SINEC L2 transmission technology is referred to as "**layer 1**". The SINEC L2 interface of the S5-95U is implemented in RS 485 technology (section 1.6).
The operating system software of the communications processor is referred to as ”**layer 2**”. Some of these operating system programs (layer 2 services) can be invoked direct from the STEP 55 program.
The layer 2 services are also referred to as FDL (**F**ieldbus **D**ata **L**ink) services.

A layer 2 access must be activated before a layer 2 service can be invoked. You do this by assigning parameters in DB1 and programming a call in the control program. You can invoke several layer 2 services or invoke the same service more than once simultaneously. In this case, you must program several layer 2 accesses in DB1.

Data transmission by accessing layer 2 services is ideal for communications between S5-95Us and PROFIBUS-compatible programmable controllers or field devices that do not support the standard connection, PLC-to-PLC connection or cyclic I/O types of transmission.

S5-95U programmable controllers can also communicate with each other over layer 2 accesses, in which case the user-friendly standard connection, PLC-to-PLC connection or cyclic I/O types of transmission can be used (chapters 4, 6 and 7). Compared with the types of data transmission mentioned above, the programming overhead for layer 2 accesses is high.

8.1 Characteristic Features of Layer 2 Access Data Transmission

- Layer 2 accesses are used for communications between active stations or between active and passive stations.
- In DB1, you can program up to 23 layer 2 accesses for sending data and up to 23 layer 2 accesses for receiving data.
- You can send/receive up to 242 bytes of net data per job.
- You can send data in parallel over all configured layer 2 accesses.
- You can receive data in parallel over all configured layer 2 accesses.
- To communicate over configured layer 2 accesses, you need the integral standard function blocks L2-SEND and L2-RECEIVE (chapter 5).
- You must specify the following parameters for L2-SEND:
  - a job number to identify a particular layer 2 access
  - the data you wish to send
- You must specify the following parameters for L2-RECEIVE:
  - a job number to identify a particular layer 2 access
  - where the data received are to be stored.

Figure 8-1 shows a typical hardware configuration. The examples in section 8.3 refer to PLC 1 and PLC 2 in this configuration.

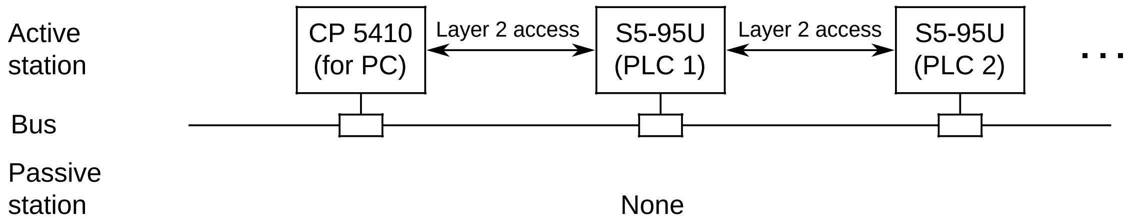


Figure 8-1. Example: Hardware Configuration Using Layer 2 Services

Principle of Operation

The principle of operation of layer 2 services is described in the following section, and the function model is shown in Figure 8-2.

The principle of operation of the various layer 2 services is explained in detail in the relevant sections of the manual (from section 8.5 onwards).

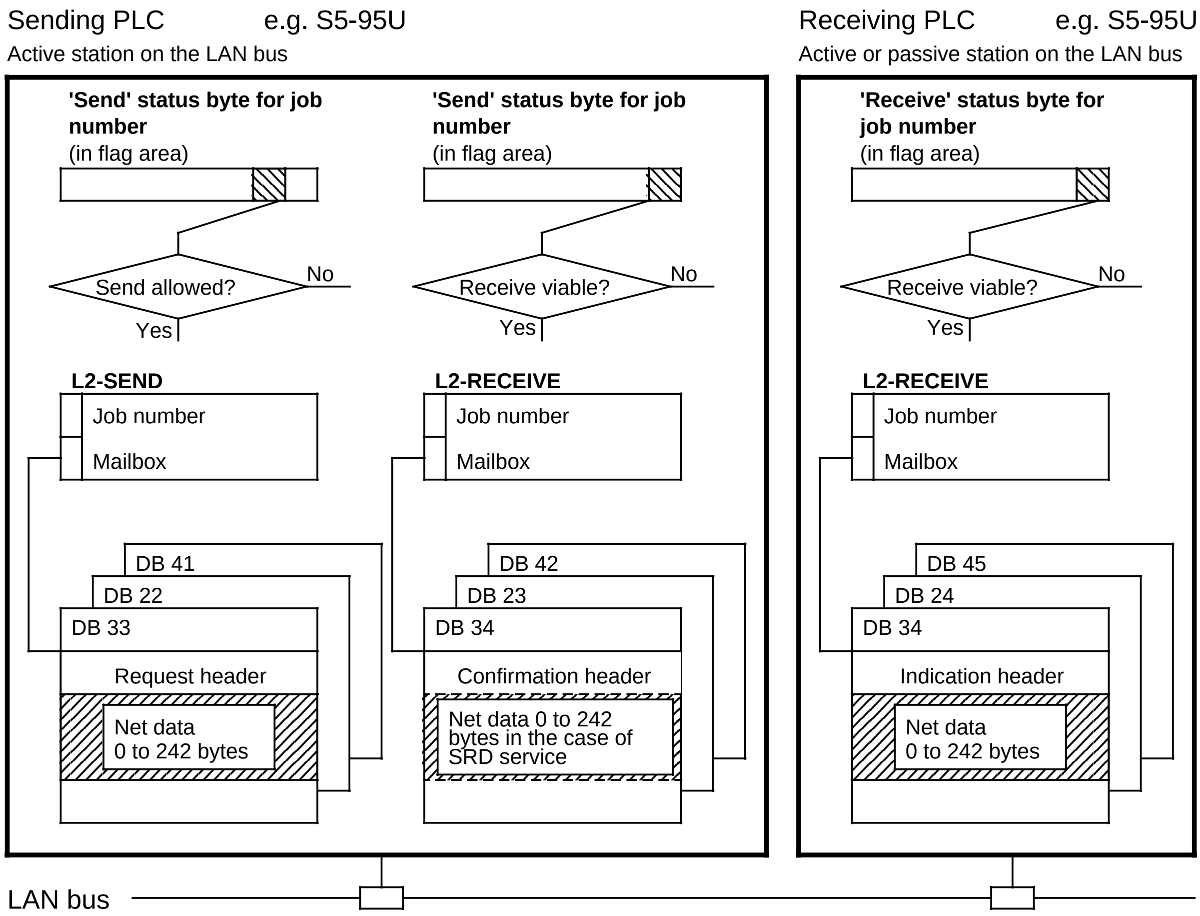


Figure 8-2. Function Model Using Layer 2 Services

Explanation of Figure 8-2:
If there are no longer any jobs being executed over a layer 2 access, the 'Send' status byte indicates that sending is permissible. L2-SEND is invoked in the STEP 5 program (request).

L2-SEND receives the following information in the parameters passed to it:

- Job number of the layer 2 access used (programmed in DB1)
- The mailbox in which an 8-bit header and the net data to be transmitted are located.

The net data are send to the addressed receiver over the LAN. At the receiver end, a bit in the 'Receive' status byte indicates that data have arrived. The data (in the form of an indication) are fetched from the receiver with L2-RECEIVE.

Each request is confirmed. The confirmation header indicates whether the job has been executed with or without error(s).
(In the case of the SRD service, the confirmation consists of the header and net data requested by the receiver.)
The "receive viable" bit is set in the 'Send' status byte of the transmitter. The confirmation is fetched with L2-RECEIVE.

Request, Indication and Confirmation

Request:
A layer 2 service is invoked from the STEP 5 program with a request. The request consists of the request header and the net data to be sent.

The request header is interpreted by the communications processor of the sending PLC. The request header defines the layer 2 service to be used and the destination to which the net data are to be sent.

Indication:
The receiver receives the net data in the form of an indication. The indication consists of the indication header and the net data received.

The indication header contains the following information on the data received:
- The layer 2 service used,
- The priority with which the data were sent, and
- The station from which the data were sent.

Confirmation:
The sender receives information on whether the layer 2 service has been executed correctly or with error(s) in the form of a confirmation.

In the case of the layer 2 SRD service (section 8.9), the confirmation consists of the confirmation header and the net data received.
For all other layer 2 services (sections 8.5 to 8.8), the confirmation consists only of an 8-byte confirmation header.

The confirmation header tells you whether the job has been executed correctly or with error(s), and, in the latter case, which error(s) has (have) occurred.

Section 8.2 contains a description of the types and characteristic features of the layer 2 services and the format of the various headers.

8.2 Types and Characteristic Features of the Layer 2 Services

You have the following layer 2 services at your disposal:

Table 8-1. Layer 2 Services of the L2 Interface of the S5-95U

Layer 2 Service	When Do You Use this Layer 2 Service?	Service can be Used if the S5-95U is		Description in Section
		Active	Passive	
SDA (Send Data with Acknowledge)	Active station sends data to **one** active or passive station.	X		8.5
SDN (Send Data with No Acknowledge)	Active station sends data to **one or more** active or passive stations.	X		8.6
RUP_SINGLE (Reply UPdate SINGLE)	Active or passive station holds data so that they can be fetched **once** by an active station.	X	X	8.7
RUP_MULTIPLE (Reply UPdate MULTIPLE)	Active or passive station holds data so that they can be fetched **several times** by one or more active stations.	X	X	8.8
SRD (Send and Request Data with Reply)	Active station sends data and/or fetches data from **one** active or passive station.	X		8.9

SAPs and Job Numbers

The communications processor has buffers for the data to be sent and the data received. These buffers are referred to as SAPs (**S**ervice **A**ccess **P**oints to layer 2)

An SAP is addressed by assigning it a number. You have the SAPs with the numbers 33 to 54 and 64 (default SAP) at your disposal for invoking layer 2 services. To enable a SAP to be referenced from the STEP 5 program, a layer 2 access must be configured for it. You define the SAP number in DB1 for this purpose (section 8.3)

The interaction between STEP 5 programs and SAPs is explained in Figure 8-3. Figure 8-3 is explained on page 8-7.

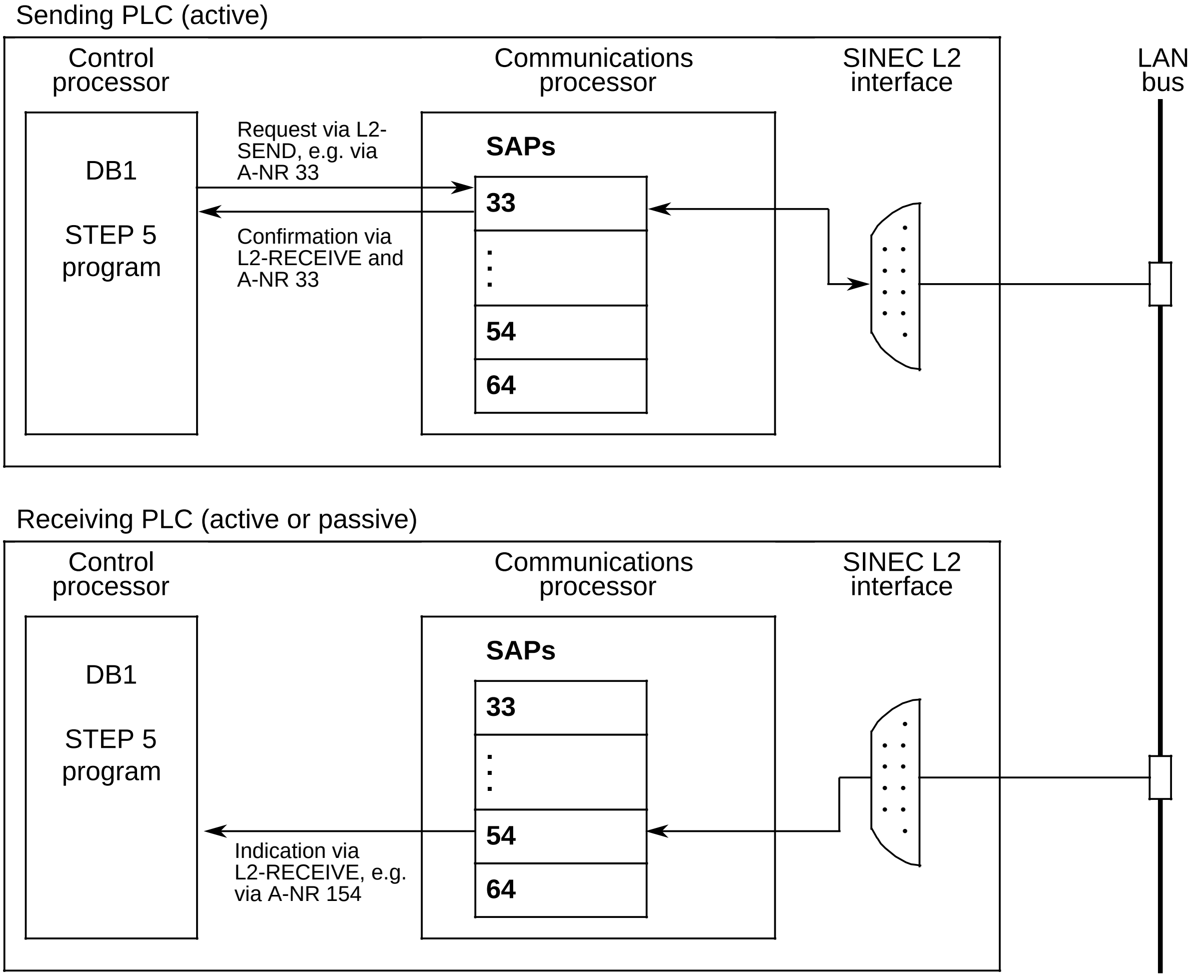


Figure 8-3. Using Job Numbers (A-NR) for Accessing Layer 2 Services via SAPs

Explanation of Figure 8-3:
A request is passed to SAP 33 from the STEP 5 program by L2-SEND.
Job number (A-NR) 33 indicates that L2-SEND accesses SAP 33.
In the case of a request, the following always applies: Job number = SAP number

The communications processor sends the net data of the request to the receiver and deposits them in the SAP. This SAP number (destination SAP) must be specified in the request header ("36_H" for SAP number 54 in the example). If you select the default SAP (SAP 64) as the destination SAP, you must specify "F_H" in the request header for SAP number 64.
The receiver can accept the indication (data received) from SAP 54 and write it into the STEP 5 program. L2-RECEIVE fetches the indication with job number 154.
In the case of an indication, the following always applies: Job number = SAP number + 100

The sender receives a confirmation via the layer 2 service processed. L2-RECEIVE fetches the confirmation with job number 33.
In the case of a confirmation, the following always applies: Job number = SAP number

You define the job numbers when assigning the parameters to L2-SEND and L2-RECEIVE (chapter 5)

Storing the Send and Receive Data

The frame to be sent (request) consists of the 8-byte header (bytes 0 to 7) and the net data of up to 242 bytes.

The following information must be entered in the request header by the STEP 5 program:

- The type of layer 2 service requested
  (SDA, SDN, SRD, RUP_SINGLE or RUP_MULTIPLE)
- The priority of the send message
  ("low" or "high";   Section 1.3 "Time Management of the Network")
- The SAP number of the receiver (= destination SAP)
- The address of the destination station

The communications processor confirms the request automatically. The confirmation header contains new information in the form of the link_status, which indicates whether the job has been carried out correctly or with error(s).
In the case of the layer 2 service SRD, the confirmation consists of the header and up to 242 bytes of net data.

The indication (frame received) consists of the 8-byte header (bytes 0 to 7) with the address of the source station and up to 242 bytes of net data.

Figure 8-4 shows the general structure of a request (frame to be sent), confirmation and indication (frame received), in each case with header. The designation of the header bytes conforms to the PROFIBUS standard.

Byte	Request	Byte	Confirmation	Byte	Indication
0	**com_class** **FDL_Request=00_H** (request for layer 2 service)	0	**com_class** **FDL_Confirmation=01_H** (Confirmation from layer 2 firmware following request)	0	**com_class** **Indication=02_H** (indication that data have been received)
1	**user_id** User-definable ID (echoed in a confirmation)	1	**user_id** ID assigned in connection with a request	1	irrelevant
2	**service_code** Type of service requested	2	**service_code** Type of service provided	2	**service_code** Type of service provided
3	irrelevant	3	**link_status** OK or error message; indicates success or failure of preceding request	3	irrelevant
4	**Bits 4 to 7** **service_class** Priority of send frame Bits 0 to 3 0	4	**Bits 4 to 7** **service_class** Priority of the send message Bits 0 to 3 0	4	**Bits 4 to** **service_class** Priority of receive frame Bits 0 to 3 0
5	**SAP No. of the receiver = destination SAP** (hexadecimal)	5	**SAP No. of the receiver = destination SAP** (hexadecimal)	5	**SAP No. of the sender = source SAP** (hexadecimal)
6	**rem_add_station** Address of the destination station (hexadecimal)	6	**rem_add_station** Address of the destination station (hexadecimal)	6	**rem_add_station** Address of source station (hexadecimal)
7	**rem_add_segment** Logical segment address; **always enter FF_H** (no other segments can be currently addressed)	7	**rem_add_segment** Logical segment address; **is always FF_H** (no other segments can be currently addressed)	7	**rem_add_segment** Logical segment address; **is always FF_H** (no other segments can be currently addressed)
8 ⋮ 249	**Send data** (0 to 242 bytes)	8 ⋮ 249	Receive data in connection with SRD service (0 to 242 bytes)	8 ⋮ 249	**Receive data** (0 to 242 bytes)

Figure 8-4. Request, Confirmation and Indication Structures

You can store the requests and indications (up to 250 bytes each) in the flag area or data area.
In view of the relatively large maximum amount of data, however, we advise you to use only the data area.
Section 8.5 describes the structure of requests, confirmations and indications for the special layer 2 services.

As a **prerequisite** for using layer 2 services, you must first

- specify an SAP number in DB1 (section 8.3)
- define two status bytes in DB1 (section 8.3)
- assign L2-SEND and L2-RECEIVE their parameters (section 8.3, chapter 5)
- create DBs for the request, the confirmation and the indication (from section 8.5 ff.).

8.3 Assigning the S5-95U Parameters for Data Communications

There is no default setting in DB1 for layer 2 accesses. You assign the following parameters in DB1:

- The location of a 'Send' status byte for L2-SEND and L2-RECEIVE with the corresponding SAP number.
- The location of a 'Receive' status byte for L2-RECEIVE with the corresponding SAP number.

All STBs must be in the flag area. The status byte flags the status of the send and/or receive job, and informs you of any errors (section 5.4).
The byte following the status byte is always reserved as the length byte. This byte indicates how many bytes of data have been received.

Defining the job numbers for a PLC (chapter 5):
Define a job number for the request and confirmation in L2-SEND.
Define a job number in L2-RECEIVE for the indication.
The following applies to a PLC: A-NR for request/confirmation = SAP number
A-NR for indication = SAP number + 100.

Table 8-2. Defining Job Numbers in the L2 FBs

Job	Send Job with L2-SEND	Fetch Confirmation with L2-RECEIVE	Fetch Indication with L2-RECEIVE
Job numbers in the L2 FBs	33	33	133
	34	34	134
	:	:	:
	54	54	154
	64	64	164

Figure 8-5 gives an example of the interaction of DBs, STBs and L2 FBs for data communications using layer 2 services.
In the example, the request is sent with L2-SEND and A-NR 48. The confirmation is fetched with A-NR 48 and L2-RECEIVE. The status byte for both jobs is FY 77. The indication is fetched with A-NR 149 and L2-RECEIVE; the status byte is FY 79.

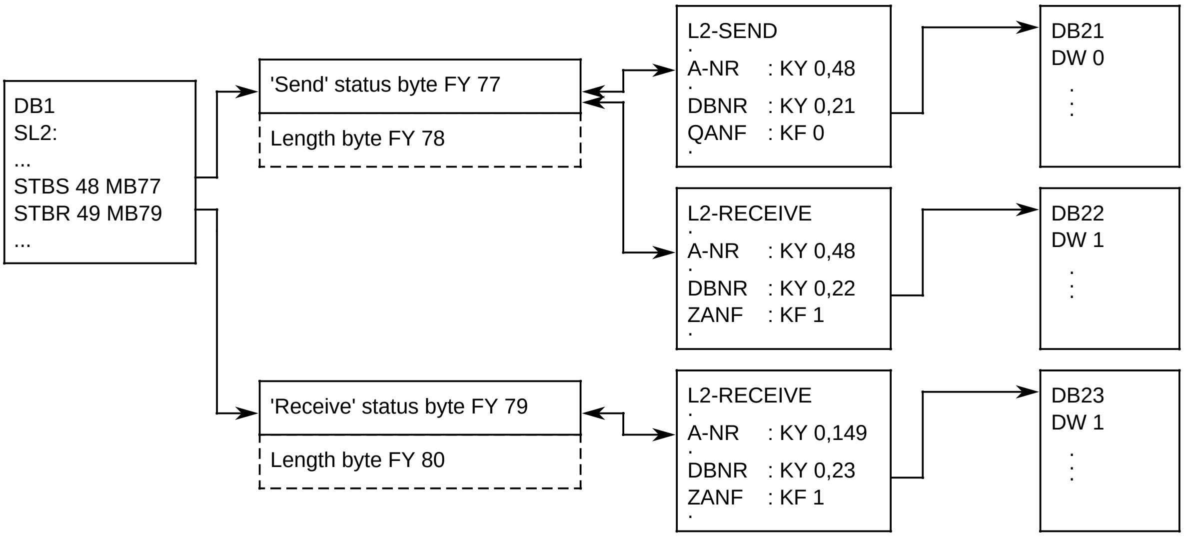


Figure 8-5. Schematic: Data Transmission Using Layer 2 Services

The procedures to follow for entering, modifying and transferring DB1 are described in detail in section 1.4.

DB1 Parameters for Layer 2 Services

Table 8-3. Layer 2 Services, DB1 Parameters

Parameter	Argument	Meaning
Block ID: SL2:		**SINEC L2**
STBS	n MBx	SAP number and location of the 'Send' status byte
STBR	n MBy	SAP number and location of the 'Receive' status byte
Argument	**Permiss. range**	**Explanation**
n MBx MBy	33 to 54, 64* 1 to 253 1 to 253	SAP number Flag byte** Flag byte**

* SAP 64 is the default SAP

** The next flag is reserved as length flag.
Retentive flags are also overwritten with 00_H on a cold PLC restart.

Example: Two S5-95Us communicating with each other using layer 2 services.

Table 8-4. Entering Parameters for Layer 2 Services

DB1 PLC 1

```
156:     KS  ='    SL2: TLN 1   STA AKT';
168:     KS  =' BDR 500    HSA 10  TRT ';
180:     KS  ='5120    SET 0   ST 400  ';
192:     KS  ='SDT 1 12  SDT 2 360     ';
204:     KS  ='STBS 48 MB77            ';
216:     KS  ='STBR 49 MB79            ';
 :
```

Explanation

Basic L2 parameters (for description see 1.4)

Sending via SAP No. 48, 'Send' STB = FY 77;
Receiving via SAP No. 49,
'Receive' STB = FY 79
(FY 78 and 80 are reserved as length bytes)

DB1 PLC 2

```
156:     KS  ='    SL2: TLN 2   STA AKT';
168:     KS  =' BDR 500    HSA 10  TRT ';
180:     KS  ='5120    SET 0   ST 400  ';
192:     KS  ='SDT 1 12  SDT 2 360     ';
204:     KS  ='STBS 48 MB77            ';
216:     KS  ='STBR 48 MB79            ';
 :
```

Basic L2 parameters (section 1.4)

Sending via SAP No. 48, 'Send' STB = FY 77;
Receiving via SAP No. 49,
'Receive' STB = FY 79
(FY 78 and 80 are reserved as length bytes)

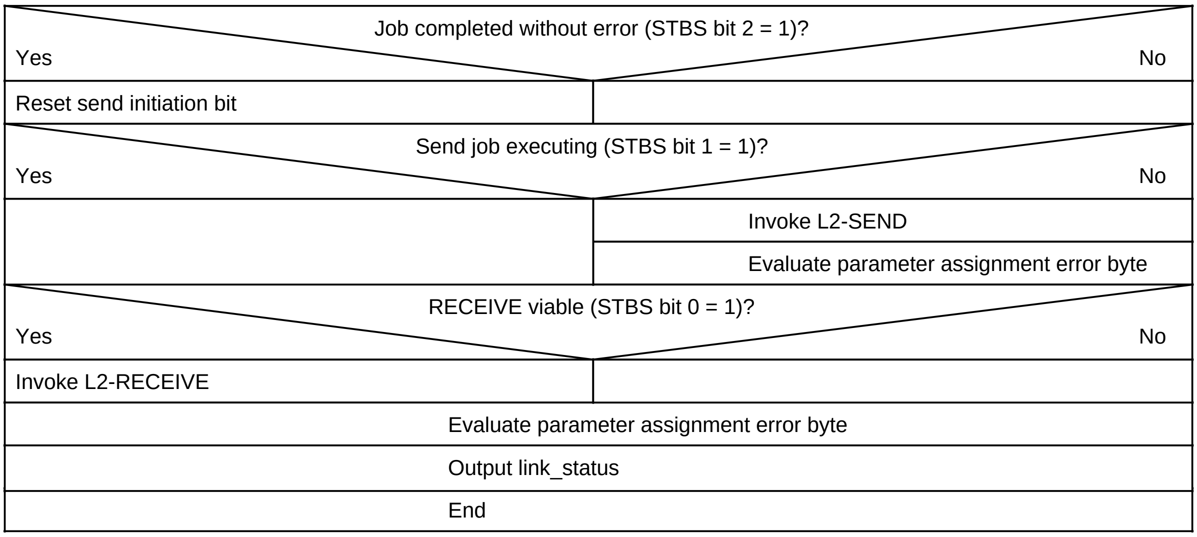
Once you have assigned the parameters, you must develop the control program for data communications. You will learn how to do this in the next section.

8.4 FBs for Managing All Layer 2 Services

FB223 and FB224 enable you to transmit data using layer 2 services with minimal programming overhead. You only need to program these FBs once for an S5-95U. The FBs can be used for all layer 2 services.

Structure of the Control Program for Sending the Request and Fetching the Confirmation in FB223

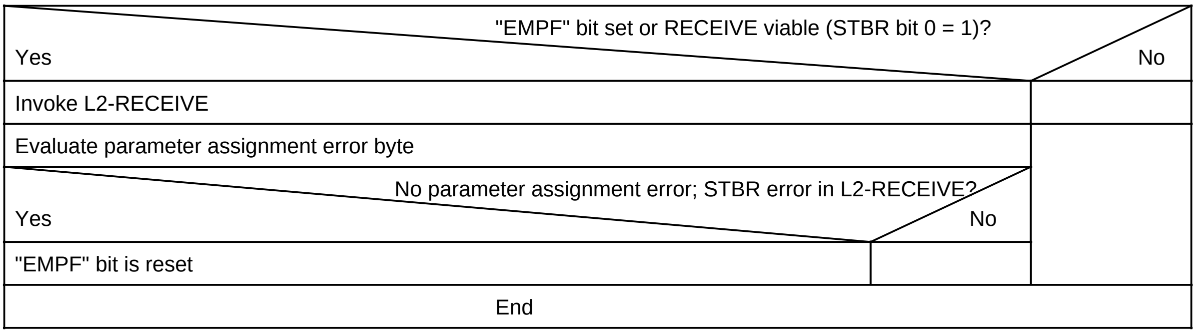
Prerequisites for executing FB223 according to the following schematic:
- You have programmed DB33 with header and send data.
- You have set the send initiation bit in OB1 and invoked FB223 (OB1 is shown in the various sections on the services, namely, 8.5 to 8.9).



You must evaluate the link_status once FB223 has executed.

Structure of the Control Program for Fetching the Indication in FB224

Prerequisites for executing FB224 according to the following schematic:
- You have generated DB34.
- You have set the "EMPF" bit in OB1 and invoked FB224 (OB1 is shown in the various sections on the services, namely, 8.5 to 8.9).



You must evaluate the link_status once FB224 has executed.

Meaning of the Parameters of FB223 and FB224:

”ANST”: **Input parameter bit**
The request job is initiated when this bit is set. Set the bit before invoking FB223. FB223 resets the bit once L2-SEND and L2- RECEIVE have executed without error.

”LSTA”: **Output parameter byte**
FB223 tells you the link_status of the confirmation. The link_status indicates the success or failure of the preceding request. You can evaluate the link_status in flag byte 9.

”EMPF”: **Input parameter bit**
This parameter enables receipt of an indication. Set this bit before invoking FB224. FB224 resets the bit once the indication has been received without error(s).

FB223	Explanation
`Segment 1         0000`	
`Name :SENDER`	Send FB for the SDA, SDN, SRD,
`Des  :ANST      I/Q/D/B/T/Z: I  BI/BY/W/D: BI`	RUP_SINGLE and RUP-MULTIPLE services
`Des  :LSTA      I/Q/D/B/T/Z: Q  BI/BY/W/D: BY`	
`     :`	The request DB is sent in this FB and the
`     :`	confirmation of the respective
`     :`	services fetched
`     :`	
`     :`	EDGE "Completed without error"
`     :A   F   77.2`	STBS "Job completed without error"
`     :AN  F   20.0`	Auxiliary edge flag
`     :=   F   20.1`	Edge "Job completed without error"
`     :`	
`     :A   F   77.2`	
`     :=   F   20.0`	
`     :`	
`     :A   F   20.1`	Edge "Job completed without error"
`     :RB  =ANST`	Reset send initiation bit
`     :`	
`     :A   =ANST`	Interrogation of send initiation bit
`     :AN  F   77.1`	STBS "Job executing"
`     :R   F   20.0`	Reset auxiliary edge flag
`     :`	
`     :`	
`     :JC FB 252`	Invoke L2-SEND
`Name :L2-SEND`	
`A-NR :    KY 0,48`	Job number for request = 48
`QTYP :    KS DB`	Send data are in
`DBNR :    KY 0,33`	DB33
`QANF :    KF +1`	starting at DW 1
`QLAE :    KF +8`	Send length: 8 words in this case
`     :`	Length = 8-byte header + net data
`     :`	(in the case of SRD without net data: 4 words)

FB223 (Cont.)	Explanation
`     :`	*****
`     :A   F  255.0`	Save parameter assignment error
`     :=   F   20.6`	byte for subsequent evaluation
`     :`	*****
`     :`	
`     :A   F   77.0`	If STBS "Receive viable" set
`     :JC FB 253`	Invoke L2-RECEIVE
`Name :L2-REC`	
`A-NR :    KY 0,48`	Job number for confirmation = 48
`ZTYP :    KS DB`	Data are in
`DBNR :    KY 0,33`	DB33
`ZANF :    KF +10`	starting at DW 10 (4-byte header)
`ZLAE :    KF -1`	
`     :`	*****
`     :A   F  255.0`	Save parameter assignment error
`     :=   F   20.7`	byte for subsequent evaluation
`     :`	*****
`     :C   DB  33`	Open working DB (DB33 in this case)
`     :`	
`     :L   DR  11`	Output link_status of the
`     :T   =LSTA`	confirmation
`     :`	
`     :BE`	

FB224	Explanation
`Segment 1         0000`	
`Name :EMPFANG`	Fetch indication
`Bez  :EMPF      I/Q/D/B/T/Z: I  BI/BY/W/D: BI`	
`     :`	Only the indications of layer 2 services are
`     :`	fetched in this FB
`     :`	
`     :ON  =EMPF`	If receive is not enabled or the
`     :ON  F   79.0`	STBR bit "Receive viable"
`     :`	is not set
`     :BEC`	End
`     :`	
`     :JC FB 253`	Invoke L2-RECEIVE
`Name :L2-REC`	
`A-NR :    KY 0,148`	Job number for indication = 148
`ZTYP :    KS DB`	Data are stored in DB
`DBNR :    KY 0,34`	DB34 in this case
`ZANF :    KF +10`	Data are stored starting at DW 10
`ZLAE :    KF -1`	″Wildcard length”
`     :`	*******
`     :A   F  255.0`	Save parameter assignment error
`     :=   F   20.7`	byte for subsequent evaluation
`     :`	*******
`     :AN  F  255.0`	If no parameter assignment error has
`     :AN  F   79.3`	occurred and STBR bit "Completed with
`     :RB  =EMPF`	error" is not set, reset receive enable
`     :`	
`     :BE`	

In the following sample programs for the various layer 2 services (sections 8.5 to 8.9), data are interchanged between two stations on the SINEC L2 LAN. Both stations are S5-95Us and have the station addresses TLN 1 and TLN 2.
The parameters to be assigned to the layer 2 accesses are listed in section 8.3, Table 8-4. It is assumed that you have already configured the DB1s.

Once you have completely developed your program for using a layer 2 service, **start up your PLC**.

Proceed as follows:

Switch the mode selector of the PLC to RUN.

Data transmissions are best checked by means of a programmer. Connect a programmer to each PLC and have it display the DBs, the status bytes and the parameter assignment error byte. (The format of the status bytes and parameter assignment error byte are shown in chapter 5.).

Read also section 3.3 "Starting Up a System".

Appendix E contains the cycle delay times of the PLC in connection with data transmissions.

8.5 Sending Data to a Station (SDA Service)

The SDA (**S**end **D**ata with **A**cknowledge) layer 2 service is used if an active station is to send data to an active or passive station.

Data transmission schematic (Figure 8-6):

The request (header + net data to be transmitted) in the flag or data area is sent with L2-SEND (= request an layer 2).
The 'Receive" status byte informs the receiver that an indication has arrived.
The receiver fetches the indication (header + net data received) with L2-RECEIVE.
The 'Send' status byte informs the sender that a confirmation has been transmitted.
The sender fetches the confirmation (= header) with L2-RECEIVE.

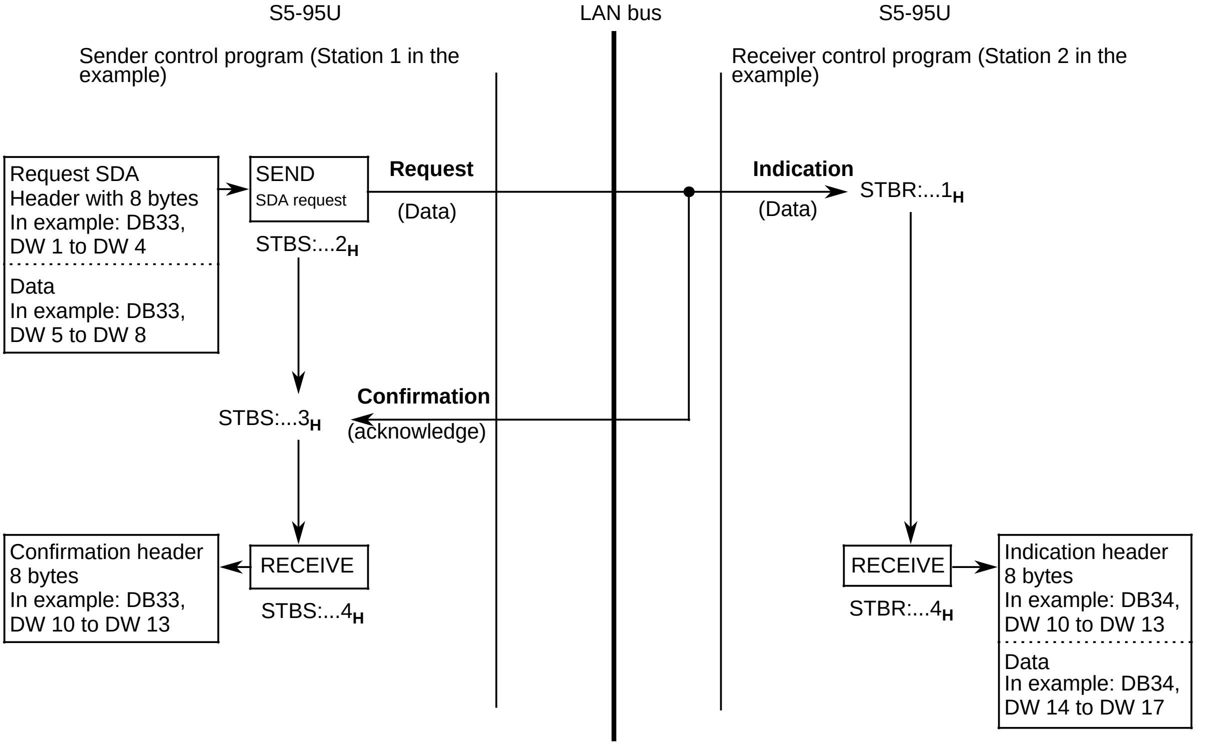


Figure 8-6. Sending and Receiving Data with Acknowledgement or Confirmation (SDA)

Figure 8-7 describes the structure of requests, confirmations and indications for the SDA service.

Byte	**Request**	*Byte*	**Confirmation**	*Byte*	**Indication**
0	**com_class** **FDL_Request=00_H**	0	**com_class** **Confirmation=01_H**	0	**com_class** **Indication=02_H**
1	user_id User-definable ID	1	user_id ID assigned in connection with a request	1	irrelevant
2	**service_code** Type of service requested **SDA=00_H**	2	**service_code** Type of service: **SDA=00_H**	2	**service_code** Type of service: **SDA=00_H**
3	irrelevant	3	**link_status** (Table 8-5)	3	irrelevant
4	**Bits 4 to 7 service_class Priority of send message low=0_H or high=1_H** Bits 0 to 3 0	4	**Bits 4 to 7 service_class Priority of the send message low=0_H or high=1_H** Bits 0 to 3 0	4	**Bits 4 to 7 service_class priority of receive frame low=0_H or high=1_H** Bits 0 to 3 0
5	**Destination SAP 0 to 62, FF (=default SAP 64)**	5	**Destination SAP 0 to 62, FF (=default SAP 64)**	5	**Source SAP 0 to 62, FF (=default SAP 64)**
6	**rem_add_station** **Address of the destination station (1 to 126)**	6	**rem_add_station** **Address of the destination station (1 to 126)**	6	**rem_add_station** **Address of source station (1 to 126)**
7	**rem_add_segment** Logical segment address; **always enter FF_H**	7	**rem_add_segment** Logical segment address; **is always FF_H**	7	**rem_add_segment** Logical segment address; **is always FF_H**
8 ⋮ 249	**Send data** **(0 to 242 bytes)**			8 ⋮ 249	**Receive data** **(0 to 242 bytes)**

▨ Must be specified by the user in the request header

Figure 8-7. Structure of Requests, Confirmations and Indications for the SDA Service

link_status Message in the Confirmation Header

Table 8-5. link_status Message for SDA

Value of link_status	Abbreviation (PROFIBUS)	Meaning
00_H	**ok**	**Positive acknowledgement, service executed**
01_H	ue	Negative acknowledgement; remote PLC is in STOP mode Prerequisite: Destination station is an S5-95U and the connection has been properly configured at the destination station
02_H	rr	Negative acknowledgement; resources of remote FDL control not available
03_H	rs	service_code or rem_add_station not activated at the remote station
11_H	na	No response from remote station or response not plausible
15_H	iv	- Illegal parameters in the request header or - Local station is passive or - Destination station is own station address or - If own SAP = default SAP*: destination SAP is not default SAP or - own SAP default SAP*: destination SAP is default SAP

* SAP 64 is defined as the default SAP.

Invoking FB223 for SDA

OB1 (Sending PLC)	Explanation
`:              :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the SDN service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :`	
`     :BE`	

Invoking FB224 for SDA

OB1 (Receiving PLC)	Explanation
`:            :`	
`     :JU FB 224`	Fetch indication (section 8.4)
`Name :EMPFANG`	
`EMPF :    F    0.1`	Enable receive
`     :`	
`     :`	
`     :BE`	

Storing Request and Confirmation at the Sender

DB33	Explanation
`0:     KH = 0000;`	****Request frame****
`1:     KY = 000,000;`	com_class / user_id
`2:     KY = 000,000;`	service_code / irrelevant
`3:     KY = 000,048;`	service_class/destination SAP
`4:     KY = 002,255;`	rem_add_station / rem_add_segm
`5:     KH = AAAA;`	Data bytes 1 and 2
`6:     KH = BBBB;`	Data bytes 3 and 4
`7:     KH = CCCC;`	Data bytes 5 and 6
`8:     KH = DDDD;`	Data bytes 7 and 8
`9:     KH = 0000;`	****Confirmation frame****
`10:    KY = 001,000;`	com_class / user_id
`11:    KY = 000,000;`	service_code / link_status
`12:    KY = 000,048;`	service_class / destination SAP
`13:    KY = 002,255;`	rem_add_station / rem_add_segm
`14:    KH = 0000;`	

Storing the Indication at the Receiver

DB34	Explanation
:	
`8:     KH = 0000;`	
`9:     KH = 0000;`	****Indication frame****
`10:    KY = 002,000;`	com_class / irrelevant
`11:    KY = 000,000;`	service_code / irrelevant
`12:    KY = 000,048;`	service_class / source SAP
`13:    KY = 001,255;`	rem_add_station / rem_add_segm
`14:    KH = AAAA;`	Receive data from sender
`15:    KH = BBBB;`	.
`16:    KH = CCCC;`	.
`17:    KH = DDDD;`	.
`18:    KH = 0000;`	

8.6 Sending Data to Several Stations (SDN)

The SDA (**S**end **D**ata with **N**o Acknowledge) layer 2 service is used if an active station is to send data to several active or passive stations (multicasting).

Data can also be sent to one active or passive station with the SDN service. However, SDA is better suited for this (section 8.5).
SDN has the following disadvantage compared with SDA:
The confirmation received by the sender contains no information on whether the data have been correctly received or not. The sender only receives confirmation from its local communications processor that the data have been sent off properly.

Prerequisites for multicasting:

- You must assign the same receive SAP in the DB1s of all receiving stations (section 8.3).
- You must enter the global address for multicasting "127" in byte 6 of the request header.

Data transmission schematic (Figure 8-8):

The request (header + net data to be transmitted) in the flag or data area is sent with L2-SEND (request to layer 2).
The 'Receive" status byte informs all receivers that an indication has arrived.
Each receiver fetches the indication (header + net data received) with L2-RECEIVE.
The 'Send' status byte informs the sender that a confirmation has been transmitted.
The sender fetches the confirmation (= header) with L2-RECEIVE.

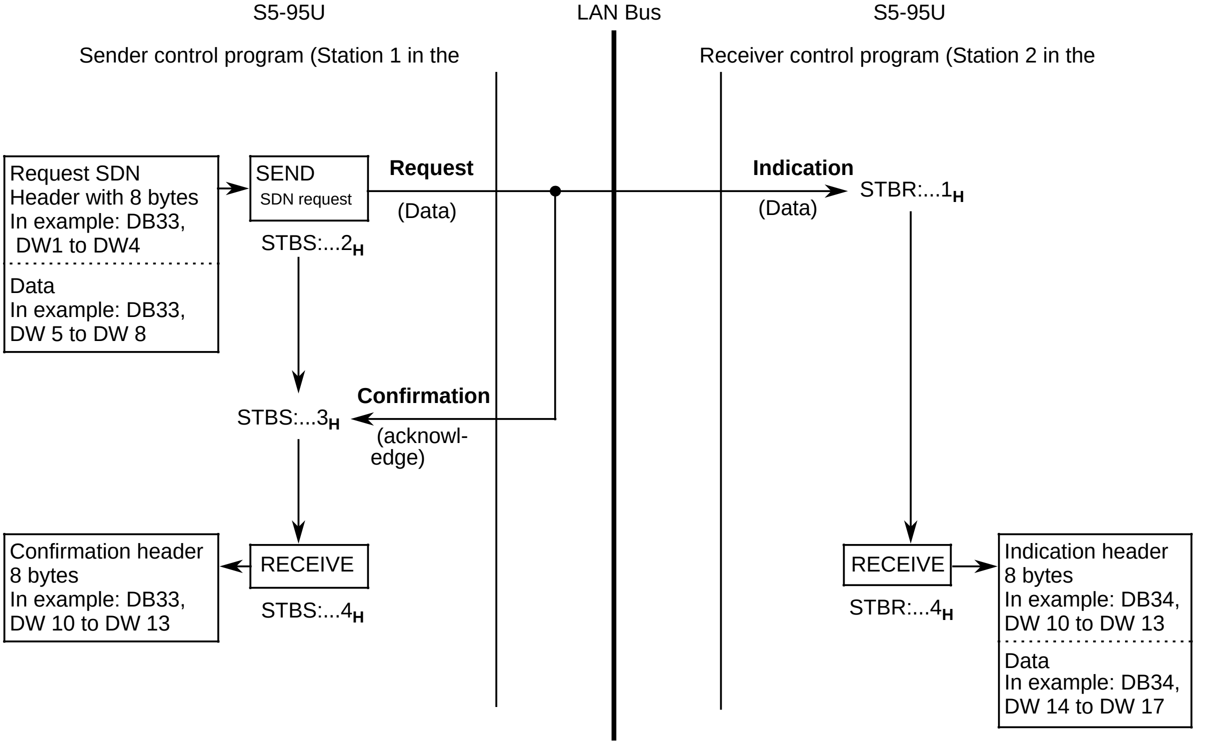


Figure 8-8. Sending and Receiving Data without Acknowledgement or Confirmation (SDN)

Figure 8-9 shows the request, confirmation and indication structures for the SDN service

Byte	**Request**	**Confirmation**	**Indication**
0	**com_class** **FDL_Request=00_H**	**com_class** **Confirmation=01_H**	**com_class** **Indication=02_H**
1	user_id User-definable ID	user_id ID assigned in connection with a request	irrelevant
2	**service_code** Type of service requested: **SDN=01_H**	**service_code** Type of service: **SDN=01_H**	**service_code** Type of service: **SDN=01_H or SDN $_{\text{Multicast}}$=$7F_H$**
3	irrelevant	**link_status** (Table 8-6)	irrelevant
4	**Bits 4 to 7 service_class Priority of send frame low=0_H or high=1_H** Bits 0 to 3 0	**Bits 4 to 7 service_class Priority of the send frame low=0_H or high=1_H** Bits 0 to 3 0	**Bits 4 to 7 service_class priority of receive frame low=0_H or high=1_H** Bits 0 to 3 0
5	**Destination SAP 0 to 62, FF (=default SAP 64)**	**Destination SAP 0 to 62, FF (=default SAP 64)**	**Source SAP 0 to 62, FF (=default SAP 64)**
6	**rem_add_station** **Address of the destination station (1 to 126 or 127 for multicast)**	**rem_add_station** **Address of the destination station (1 to 126)**	**rem_add_station** **Address of source station (1 to 126)**
7	**rem_add_segment** Logical segment address; **always enter FF_H**	**rem_add_segment** Logical segment address; **is always FF_H**	**rem_add_segment** Logical segment address; **is always FF_H**
8 ⋮ 249	**Send data** **(0 to 242 bytes)**		**Receive data** **(0 to 242 bytes)**

▨ Must be specified by the user in the request header

Figure 8-9. Structure of Requests, Confirmations and Indications for the SDN Service

link_status Message in the Confirmation Header

Table 8-6. link_status Messages for SDN

Value of link_status	Abbreviation (PROFIBUS)	Meaning
00_H	**ok**	**Positive acknowledgement; transmission of data from the sending (local) station completed**
15_H	iv	- Illegal parameters in the request header or - Local station is passive or - Destination station is own station address or - If own SAP = default SAP*: destination SAP is not default SAP or - If own SAP default SAP*: destination SAP is default SAP

* SAP 64 is defined as the default SAP.

Invoking FB223 for SDN

OB1 (Sending PLC)	Explanation
`:            :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the SDN service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :`	
`     :BE`	

Invoking FB224 for SDN

OB1 (Receiving PLC)	Explanation
`:            :`	
`     :JU FB 224`	Fetch indication (section 8.4)
`Name :EMPFANG`	
`EMPF :    F    0.1`	Enable receive
`     :`	
`     :`	
`     :BE`	

Storing Request and Confirmation at the Sender

DB33	Explanation
0: KH = 0000;	****Request frame****
1: KY = 000,000;	com_class / user_id
2: KY = 001,000;	service_code / irrelevant
3: KY = 000,048;	service_class/destination SAP
4: KY = 002,255;	rem_add_station / rem_add_segm
5: KH = AAAA;	Data bytes 1 and 2
6: KH = BBBB;	Data bytes 3 and 4
7: KH = CCCC;	Data bytes 5 and 6
8: KH = DDDD;	Data bytes 7 and 8
9: KH = 0000;	****Confirmation frame****
10: KY = 001,000;	com_class / user_id
11: KY = 001,000;	service_code / link_status
12: KY = 000,048;	service_class / destination SAP
13: KY = 002,255;	rem_add_station / rem_add_segm
14: KH = 0000;	

Storing the Indication at the Receiver

DB34	Explanation
:	
8: KH = 0000;	
9: KH = 0000;	****Indication frame****
10: KY = 002,000;	com_class / irrelevant
11: KY = 001,000;	service_code / irrelevant
12: KY = 000,048;	service_class / source SAP
13: KY = 001,255;	rem_add_station / rem_add_segm
14: KH = AAAA;	Receive data from sender
15: KH = BBBB;	.
16: KH = CCCC;	.
17: KH = DDDD;	.
18: KH = 0000;	

8.7 Holding Data for Fetching Once Only by a Station (RUP_SINGLE Service)

The RUP_SINGLE (**R**eply **UP**date **SINGLE**) service is used for holding data for fetching in an active or passive station. The data held can be fetched by an active station once only, using the SRD service (section 8.9).

Before the sender requests data from the receiver (SRD layer 2 service), the receiver must keep the data ready in an SAP.
The receiver uses either the RUP_SINGLE or RUP_MULTIPLE service to do this (section 8.8).
The RUP_SINGLE service holds the requested data ready for once-only fetching. If an active station requests data cyclically, this guarantees that it always receives new data.
Reason : Once the sender has read the data out of the SAP, the latter is empty. When the SAP is empty, i.e. no new data are yet pending, the sender receives a confirmation header (SRD layer 2 service).
New data are written into the SAP at the next RUP_SINGLE or RUP_MULTIPLE.

Data holding procedure for the receiver (Figure 8-10):

The request (header + net data to be held ready for fetching) in the flag or data area is sent with L2-SEND (request to layer 2).

The 'Send' status byte informs the receiver that a confirmation has been transmitted, and the receiver fetches the confirmation (= header) with L2-RECEIVE.

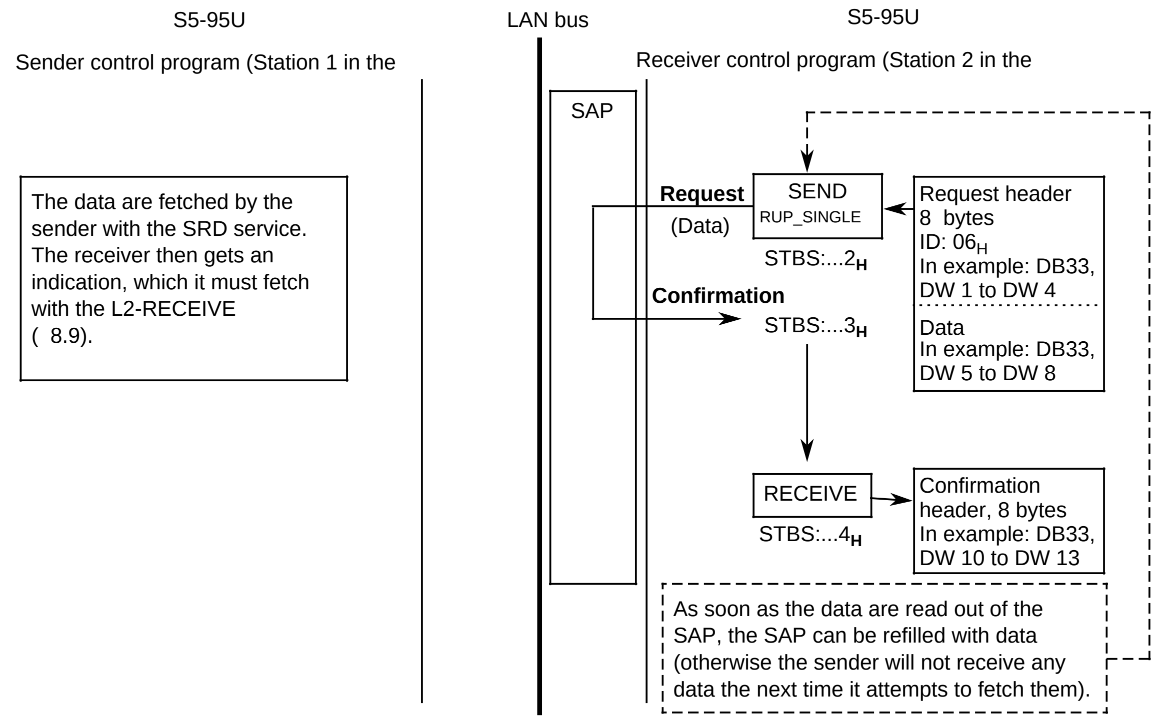


Figure 8-10. Holding Data Ready for Fetching with the RUP_SINGLE Service

Since the receiver sends data to itself with the RUP_SINGLE service, you must specify the same SAP in DB1 for sending and receiving (section 8.3). The destination SAP in the request header is irrelevant.
Figure 8-11 shows the request and confirmation structures for the RUP_SINGLE service.

Request

Byte		
0	▨ **com_class** **FDL_Request=00_H**	
1	user_id User-definable ID	
2	▨ **service_code** Type of service requested: **RUP_SINGLE=06_H**	
3	irrelevant	
4	▨ **Bits 4 to 7** **service_class** **Priority of send message** **low=0_H or high=1_H**	Bits 0 to 3 0
5	irrelevant	
6	irrelevant	
7	▨ **rem_add_segment** Logical segment address; **always enter FF_H**	
8 ⋮ 249	▨ **Send data** **(0 to 242 bytes)**	

Confirmation

Byte		
0	**com_class** **Confirmation=01_H**	
1	user_id ID assigned in connection with a request	
2	**service_code** Type of service: **RUP_SINGLE=06_H**	
3	**link_status** (Table 8-7)	
4	**Bits 4 to 7** **service_class** **Priority of the send message** **low=0_H or high=1_H**	Bits 0 to 3 0
5	irrelevant	
6	irrelevant	
7	**rem_add_segment** Logical segment address; **is always FF_H**	

▨ Must be specified by the user in the request header

Figure 8-11. Request and Confirmation Structures for the RUP_SINGLE Service

link_status Message in the Confirmation Header

Table 8-7. link_status Messages for the RUP_SINGLE Service

Value of link_status	Abbreviation (PROFIBUS)	Meaning
00_H	**ok**	**Positive acknowledgement; data area loaded**
06_H	no	Receive SAP not activated; receive SAP not equal to send SAP
14_H	lr	Response resource being used at the moment by MAC (temporary fault)
15_H	iv	Illegal parameters in the request header

Invoking FB223 and FB224 with the RUP_SINGLE Service in the Receiving PLC (holds data ready for fetching)

OB1 (Receiving PLC)	Explanation
`:            :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the RUP_SINGLE service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :JU FB 224`	Fetch INDICATION of the SRD service
`Name :EMPFANG`	
`EMPF :    F    0.1`	Enable receive
`     :`	
`     :`	
`     :BE`	

Invoking FB223 with the SRD Service in the Sending PLC (to fetch the data)

OB1 (Sending PLC)	Explanation
`:            :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the SRD service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :`	
`     :BE`	

Storing Request and Confirmation at the Receiver Using the RUP_SINGLE Service (holding data ready for fetching)

DB33	Explanation
`0:     KH = 0000;`	****Request frame, RUP_SINGLE service****
`1:     KY = 000,000;`	com_class / user_id
`2:     KY = 006,000;`	service_code / irrelevant
`3:     KY = 000,000;`	service_class / irrelevant
`4:     KY = 000,000;`	irrelevant / rem_add_segm
`5:     KH = 1111;`	Data bytes 1 and 2
`6:     KH = 2222;`	Data bytes 3 and 4
`7:     KH = 3333;`	Data bytes 5 and 6
`8:     KH = 4444;`	Data bytes 7 and 8
`9:     KH = 0000;`	***Confirmation frame, RUP_SINGLE service***
`10:    KY = 001,000;`	com_class / user_id
`11:    KY = 006,000;`	service_code / link_status
`12:    KY = 000,000;`	service_class / irrelevant
`13:    KY = 000,255;`	irrelevant / rem_add_segm
`14:    KH = 0000;`	

8.8 Holding Data Ready for Fetching Several Times Over by One or More Stations (RUP_MULTIPLE Service)

The RUP_MULTIPLE (**R**eply **UP**date **MULTIPLE**) service is used for holding data for fetching in an active or passive station. The data held can be fetched by an active station several times over, using the SRD service (section 8.9) ; from either one or several active stations.

Before the sender requests data from the receiver (SRD layer 2 service), the receiver must keep the data ready in an SAP.
The receiver uses either the RUP_SINGLE or RUP_MULTIPLE service to do this (section 8.8).
The RUP_MULTIPLE service ensures that the SAP keeps the requested data ready for fetching until the SAP is overwritten by a new RUP_SINGLE or RUP_MULTIPLE . The data in the SAP can therefore be read out several times.

If only one station is to fetch the data, this is also possible with the RUP_MULTIPLE service, but is better done with the RUP_SINGLE service.(section 8.7).
Reason: If the RUP_MULTIPLE service is used, the sender cannot distinguish between new data and data that have already been requested.

Data holding procedure for the receiver (Figure 8.12):

The request (header + net data to be held ready for fetching) in the flag or data area is sent with L2-SEND (request to layer 2).

The 'Send' status byte informs the receiver that a confirmation has been transmitted, and the receiver fetches the confirmation (= header) with L2-RECEIVE.

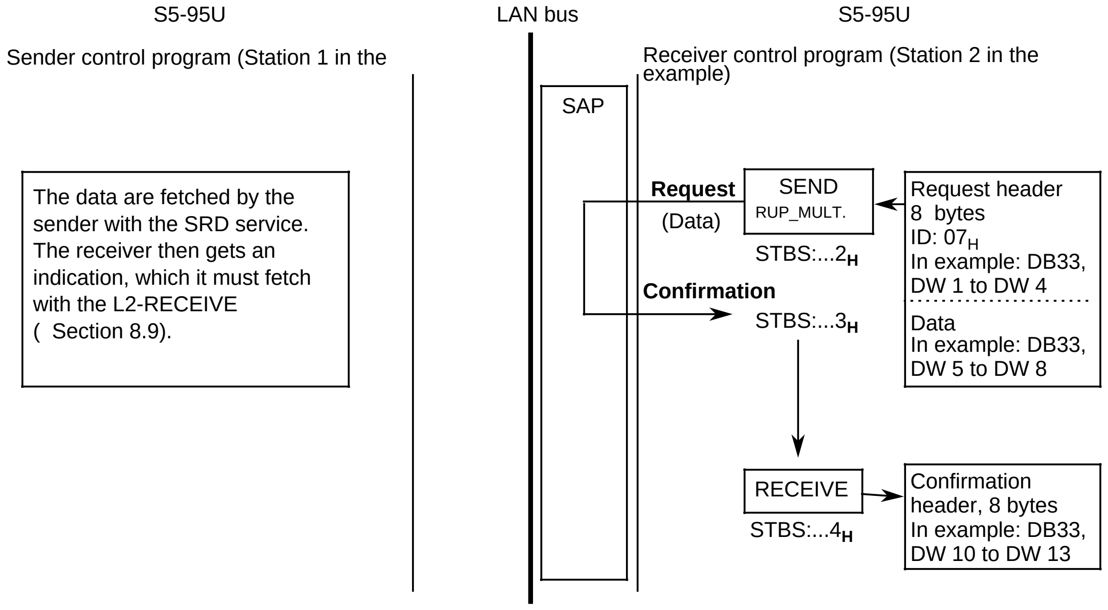


Figure 8-12. Holding Data Ready for Fetching with the RUP_MULTIPLE Service

Since the receiver sends data to itself with the RUP_MULTIPLE service, you must specify the same SAP in DB1 for sending and receiving (section 8.3). The destination SAP in the request header is irrelevant.

Figure 8-13 shows the request and confirmation structures for the RUP_MULTIPLE service.

Request

Byte		
0	**com_class** **FDL_Request=00$_H$**	
1	user_id User-definable ID	
2	**service_code** Type of service requested: **RUP_MULTIPLE=07$_H$**	
3	irrelevant	
4	**Bits 4 to 7** **service_class** **Priority of send frame** **low=0$_H$ or high=1$_H$**	Bits 0 to 3 0
5	irrelevant	
6	irrelevant	
7	**rem_add_segment** Logical segment address; **always enter FF$_H$**	
8 ⋮ 249	**Send data** **(0 to 242 bytes)**	

Confirmation

Byte		
0	**com_class** **Confirmation=01$_H$**	
1	user_id ID assigned in connection with a request	
2	**service_code** Type of service: **RUP_MULTIPLE=07$_H$**	
3	**link_status** (Table 8-8)	
4	**Bits 4 to 7** **service_class** **Priority of the send frame** **low=0$_H$ or high=1$_H$**	Bits 0 to 3 0
5	irrelevant	
6	irrelevant	
7	**rem_add_segment** Logical segment address; **is always FF$_H$**	

▨ Must be specified by the user in the request header

Figure 8-13. Request and Confirmation Structures for the RUP_MULTIPLE Service

link_status Message in the Confirmation Header

Table 8-8. link_status Messages for the RUP_MULTIPLE Service

Value of link_status	Abbreviation (PROFIBUS)	Meaning
00$_H$	**ok**	**Positive acknowledgement; data area loaded**
06$_H$	no	Receive SAP not activated; receive SAP not equal to send SAP
14$_H$	lr	Response resource being used at the moment by MAC (temporary fault)
15$_H$	iv	Illegal parameters in the request header

Invoking FB223 and FB224 with the RUP_MULTIPLE Service in the Receiving PLC (holds data ready for fetching)

OB1 (Receiving PLC)	Explanation
: :	
: :	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the RUP_MULTIPLE service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :JU FB 224`	Fetch INDICATION of the SRD service
`Name :EMPFANG`	
`EMPF :    F    0.1`	Enable receive
`     :`	
`     :`	
`     :BE`	

Invoking FB223 with the SRD Service in the Sending PLC (to fetch the data)

OB1 (Sending PLC)	Explanation
: :	
: :	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the SRD service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :`	
`     :BE`	

Storing Request and Confirmation at the Receiver Using the RUP_MULTIPLE Service (holding data ready for fetching)

DB33	Explanation
`0:     KH = 0000;`	****Request frame, RUP_MULTIPLE service****
`1:     KY = 000,000;`	com_class / user_id
`2:     KY = 007,000;`	service_code / irrelevant
`3:     KY = 000,000;`	service_class / irrelevant
`4:     KY = 000,000;`	irrelevant / rem_add_segm
`5:     KH = 1111;`	Data bytes 1 and 2
`6:     KH = 2222;`	Data bytes 3 and 4
`7:     KH = 3333;`	Data bytes 5 and 6
`8:     KH = 4444;`	Data bytes 7 and 8
`9:     KH = 0000;`	****Confirmation frame, RUP_MULTIPLE service****
`10:    KY = 001,000;`	com_class / user_id
`11:    KY = 007,000;`	service_code / link_status
`12:    KY = 000,000;`	service_class / irrelevant
`13:    KY = 000,255;`	irrelevant / rem_add_segm
`14:    KH = 0000;`	

8.9 Sending Data and Fetching Data from a Station (SRD Service)

The SRD (**S**end and **R**equest **D**ata with Reply) layer 2 service is used by an active station to send data to an active or passive station and/or fetch data from an active or passive station.

Prerequisite for data transmission:
You must hold data requested by the sender ready for fetching with the RUP_SINGLE
(section 8.7) or RUP_MULTIPLE layer 2 service (section 8.8)

Data transmission schematic (Figure 8-14):

The request (header + net data to be transmitted) in the flag or data area is sent with L2-SEND (request to layer 2).

The 'Receive" status byte informs the receiver that an indication has arrived.

The receiver fetches the indication (header + net data received) with L2-RECEIVE.

The 'Send' status byte informs the sender that a confirmation has been transmitted.

The sender fetches the confirmation (= header + net data requested by the receiver) with L2-RECEIVE.

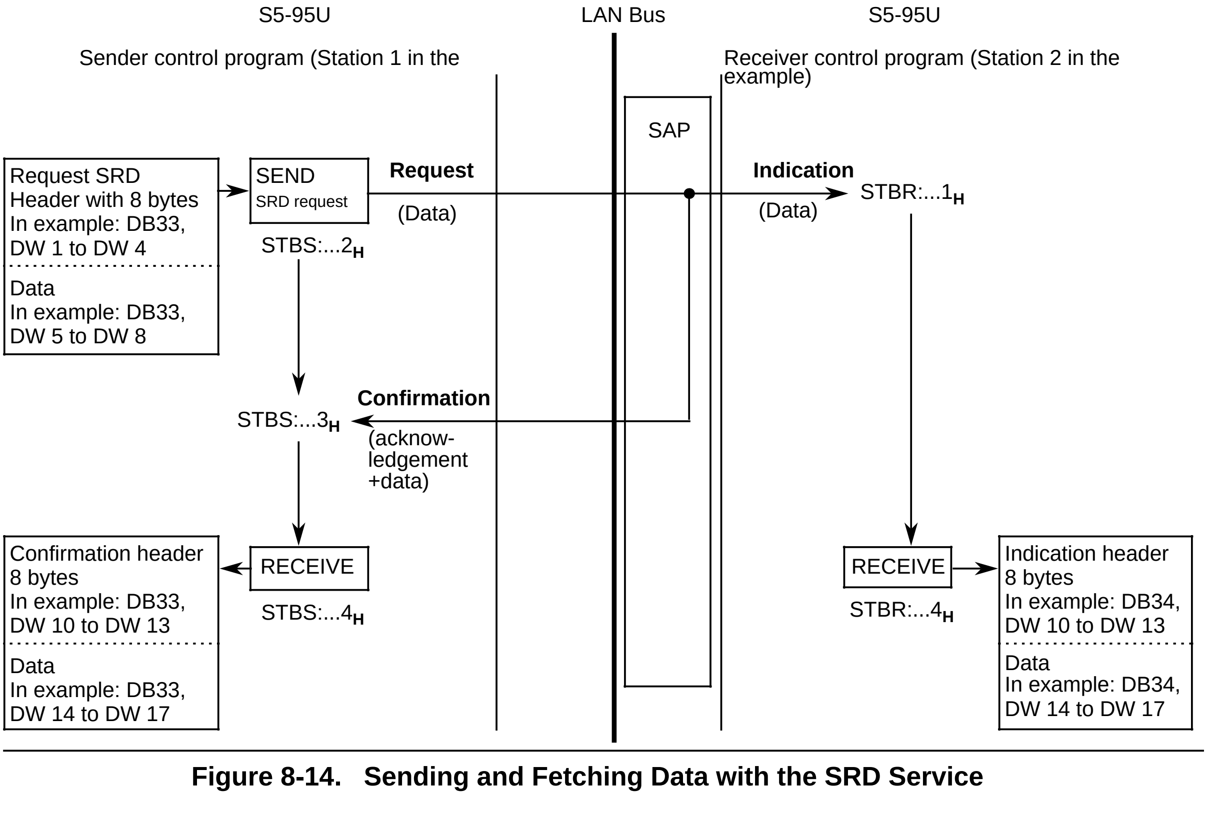


Figure 8-14. Sending and Fetching Data with the SRD Service

Requesting Data (SRD Layer 2 Service without Send Data)

If you do not want your sender to send any data to the receiver, but only request data from the receiver, use the special case of the "SRD without send data" layer 2 service.

Prerequisite for data transmission:
You must hold data requested by the sender ready for fetching with the RUP_SINGLE (section 8.7) or RUP_MULTIPLE layer 2 service (section 8.8).

Fetching the data by the sender (Figure 8-14):

The request (header + net data to be transmitted) in the flag or data area is sent with L2-SEND (request to layer 2).

The 'Receive" status byte informs the receiver that an indication has arrived.

The receiver fetches the indication (header) with L2-RECEIVE.

The 'Send' status byte informs the sender that a confirmation has been transmitted.

The sender fetches the confirmation (= header + net data requested by the receiver) with L2-RECEIVE.

Figure 8-15 shows the request confirmation and indication structures for the SRD service

Byte	**Request**	*Byte*	**Confirmation**	*Byte*	**Indication**
0	**com_class** **FDL_Request=00_H**	0	**com_class** **Confirmation=01_H**	0	**com_class** **Indication=02_H**
1	user_id User-definable ID	1	user_id ID assigned in connection with a request	1	irrelevant
2	**service_code** Type of service requested: **SRD=03_H**	2	**service_code** Type of service: **SRD=03_H**	2	**service_code** Type of service: **SRD=03_H**
3	irrelevant	3	**link_status** (Table 8-9)	3	**link_status** (Table 8-10)
4	**Bits 4 to 7 service_class Priority of send message low=0_H or high=1_H** Bits 0 to 3 0	4	**Bits 4 to 7 service_class Priority of the send message low=0_H or high=1_H** Bits 0 to 3 0	4	**Bits 4 to 7 service_class Priority of receive message low=0_H or high=1_H** Bits 0 to 3 0
5	**Destination SAP 0 to 62, FF (=default SAP 64)**	5	**Destination SAP 0 to 62, FF (=default SAP 64)**	5	**Source SAP 0 to 62, FF (=default SAP 64)**
6	**rem_add_station** **Address of the destination station (1 to 126)**	6	**rem_add_station** **Address of the destination station (1 to 126)**	6	**rem_add_station** **Address of source station (1 to 126)**
7	**rem_add_segment** Logical segment address; **always enter FF_H**	7	**rem_add_segment** Logical segment address; **is always FF_H**	7	**rem_add_segment** Logical segment address; **is always FF_H**
8 ⋮ 249	**Send data** **(0 to 242 bytes)**	8 ⋮ 249	**Data held ready by the receiver for fetching (0 to 242 bytes)**	8 ⋮ 249	**Receive data** **(0 to 242 bytes)**

▨ Must be specified by the user in the request header

Figure 8-15. Structure of Requests, Confirmations and Indications for the SRD Service

link_status Message in the Confirmation Header

Table 8-9. link_status Messages for the SRD Service

Value of link_status	Abbreviation (PROFIBUS)	Meaning
08_H	**dl**	**Positive acknowledgement for data sent; reply data with low priority available**
$0A_H$	**dh**	**Positive acknowledgement for data sent; reply data with high priority available**
09_H	**nr**	**Positive acknowledgement for data sent; negative acknowledgement for reply data**
01_H	ue	Negative acknowledgement; remote PLC is in the STOP mode Prerequisite: Destination station is an S5-95U and the connection has been properly configured at the destination station
02_H	rr	Negative acknowledgement; resources of the remote FDL control not available
03_H	rs	service_code or rem_add_station not activated at the remote station
11_H	na	No response from remote station or response not plausible
15_H	iv	- Illegal parameters in the request header or - Local station is passive or - Destination station is own station address or - If own SAP = default SAP*: destination SAP is not default SAP or - own SAP default SAP*: destination SAP is default SAP

* SAP 64 is defined as the default SAP.

link_status Message in the Indication Header

Table 8-10. link_status Messages (Indications) for the SRD Service

Value of link_status	Abbreviation (PROFIBUS)	Meaning
20_H	**lo**	**The reply to this SRD transaction was made with low-priority data**
21_H	**hi**	**The reply to this SRD transaction was made with high-priority data**
22_H	no_data	No reply data were transmitted in connection with this SRD transaction

Invoking FB223 for SRD

OB1 (Sending PLC)	Explanation
`:            :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the SRD service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :`	
`     :BE`	

Invoking FB223 and FB224 for the RUP_SINGLE and/or RUP_MULTIPLE Service in the Receiving PLC (to hold data ready for fetching)

OB1 (Receiving PLC)	Explanation
`:            :`	
`     :JU FB 223`	Send request and fetch confirmation (section 8.4)
`Name :SENDER`	
`ANST :    F    0.0`	Send initiation bit for the RUP_SINGLE and/or RUP_MULTIPLE service
`LSTA :    FY   9`	Flag byte contains the link_status of the confirmation
`     :`	
`     :JU FB 224`	Fetch INDICATION of the SRD service
`Name :EMPFANG`	
`EMPF :    F    0.1`	Enable receive
`     :`	
`     :BE`	

Storing Request and Confirmation at the Sender

DB33	Explanation
0: KH = 0000;	****Request frame****
1: KY = 000,000;	com_class / user_id
2: KY = 003,000;	service_code / irrelevant
3: KY = 000,048;	service_class / destination SAP
4: KY = 002,255;	rem_add_station / rem_add_segm
5: KH = AAAA;	Data bytes 1 and 2
6: KH = BBBB;	Data bytes 3 and 4
7: KH = CCCC;	Data bytes 5 and 6
8: KH = DDDD;	Data bytes 7 and 8
9: KH = 0000;	****Confirmation frame****
10: KY = 001,000;	com_class / user_id
11: KY = 003,000;	service_code / link_status
12: KY = 000,048;	service_class / destination SAP
13: KY = 002,255;	rem_add_station / rem_add_segm
14: KH = 1111;	Net data from the RUP_SINGLE and/or
15: KH = 2222;	RUP_MULTIPLE service
16: KH = 3333;	.
17: KH = 4444;	.
18: KH = 0000;	

Storing the Indication at the Receiver

DB34	Explanation
:	
:	
8: KH = 0000;	
9: KH = 0000;	****Indication frame****
10: KY = 002,000;	com_class / irrelevant
11: KY = 003,032;	service_code / link_status
12: KY = 000,048;	service_class / source SAP
13: KY = 001,255;	rem_add_station / rem_add_segm
14: KH = AAAA;	Receive data from the sender
15: KH = BBBB;	.
16: KH = CCCC;	.
17: KH = DDDD;	.
18: KH = 0000;	

9 Programmer Functions Over the SINEC L2 Network

Figures

Tables

9 Programmer Functions Over the SINEC L2 Network

This chapter will show you

- which programmer functions can be implemented over the SINEC L2 LAN for the S5-95U,
- how to establish the connection to a remote station from the programmer, and
- how to activate the connection.

You can operate the programmer as a station on the SINEC L2 LAN. Address TLN 0 is reserved for the programmer.

Prerequisites:
To program the S5-95U over the SINEC L2 LAN, you must assign the necessary SINEC L2 interface parameters in DB1.
At least the basic parameters must be in DB1. You will find tables of the basic parameters in section 1.4 of the manual. You must set these parameters in the S5-95U for the CP 5410 (PG 730/750/770 programmers) or CP 5412 (PG 685 programmer).
Important: Programmer functions over the SINEC L2 LAN can only be implemented for active S5-95Us. Station status "STA AKT" must therefore be specified as a basic parameter in DB1.
FMA services and the standard connection, PLC-to-PLC connection and cyclic I/O types of data transmission, and layer 2 services can also be configured in addition to the programmer functions.

Note:
If you switch the PLC from STOP to RUN following a "PLC overall reset", the SINEC L2 interface parameters are not set and the PLC cannot be programmed over the SINEC L2 LAN.

Reason: Following a "PLC overall reset" and a change from STOP to RUN mode, the default DB1 is again valid in the PLC. The SINEC L2 parameter block is within comment characters (#) in default DB1, and is therefore not interpreted by the PLC.

Remedy: Overwrite each comment character with a blank character; set the basic parameters (section 1.4); transfer the modified DB1 to the PLC, and switch the PLC from STOP to RUN mode.

To reach an S5-95U over the SINEC L2 LAN from the programmer, you must edit the corresponding path with the programmer's "Bus dialling" utility and store this path in a path file.
You can then activate the edited path for the particular station.

You need S5-DOS (version V and later) to select a remote station over the SINEC L2 LAN.
The following programmers can be operated currently as stations on the SINEC L2 LAN:

- PG 685 (together with CP 5412)
- PG 730 (together with CP 5410B or CP 5410B/FlexOS)
- PG 750 (together with CP 5410B or CP 5410B/FlexOS)
- PG 770 (together with CP 5410B or CP 5410B/FlexOS)

9.1 Programmer Functions

The S5-95U can only be operated as a programmer slave on the SINEC L2 LAN, i.e. you cannot

- implement programmer functions over the LAN at another station from the control program of an S5-95U,
- implement programmer functions at another station on the LAN through the programmer interface of an S5-95U.

Table 9-1 lists all the functions that can be implemented from a programmer over the SINEC L2 LAN.

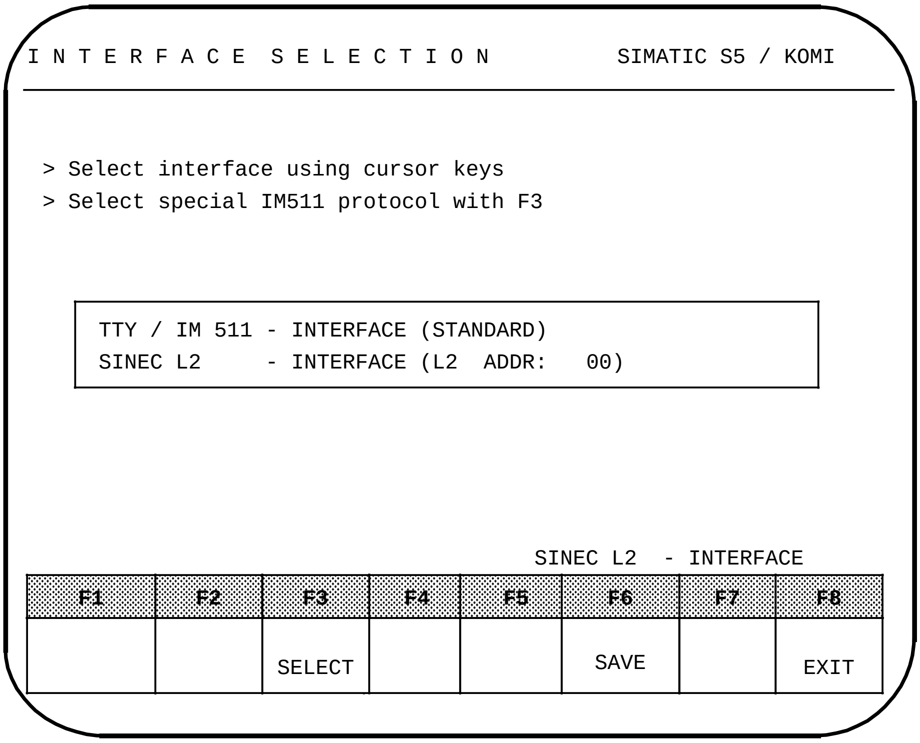
Table 9-1. Functions of a Programmer Operated as a SINEC L2 Station

Programmer Function	Mnemonic	Possible over the SINEC L2 LAN
Input block	INPUT	Yes
Output block	OUTPUT	Yes
Test	**TEST**	
Program test	PROGTEST	No
END program test	END TEST	No
Signal status display	STATUS	Yes
PLC functions	**PC FCT**	
Start PLC	START	Yes
Stop PLC	STOP	Yes
Compress	COMPRESS	Yes
Status variable	STAT VAR	Yes
Force I/O	FORCE	No
Force variable	FORCE VAR	Yes
PLC information	**PC INFO**	
Output addresses	OUTP ADDR	Yes
Memory configuration	MEM SIZE	Yes
System parameters	SYSPAR	Yes
Block stack	BSTACK	Yes
Interrupt stack	ISTACK	Yes
Help functions	**HELP**	
Save	SAVE	Yes
Delete	DELETE	Yes
Directory	DIR	Yes

9.2 Selecting the L2 Interface

You can select the SINEC L2 interface with the programmer's "INTERFACE SELECTION" function (key <F5> (INT) in the "PACKAGE SELECTION" screen. This screen lists only the interfaces you can select.

Press cursor key < > or < > in the "INTERFACE SELECTION" screen until the SINEC L2 interface appears in the message bar (Figure 9-1), and confirm with <F6> (SAVE):



```
INTERFACE SELECTION                 SIMATIC S5 / KOMI

 > Select interface using cursor keys
 > Select special IM511 protocol with F3

   TTY / IM 511 - INTERFACE (STANDARD)
   SINEC L2     - INTERFACE (L2  ADDR:   00)

                                    SINEC L2  - INTERFACE
```

Figure 9-1. "INTERFACE SELECTION" Screen

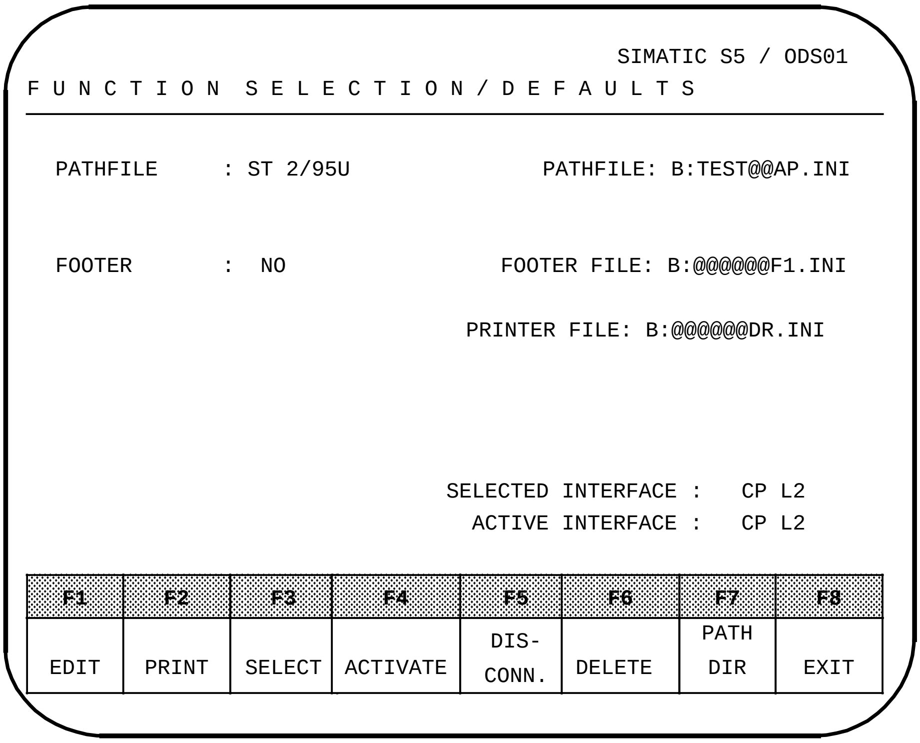
9.3 Entering Defaults

When you have confirmed your choice of interface, the "PACKAGE SELECTION" screen appears again.

Select the "FUNCTION SELECTION/DEFAULTS" screen with <F2> (UTILITY) and <F1> (BUS DIALLING).

Choose a name for the path you want to generate (e.g. "TN2/95PLC" for the S5-95U with station address 2 as endpoint of the path).

Choose names for the pathfile (e.g. C:TEST@@AP.INI), the footer file (if you want a footer) and the printer file (if you have defined printer parameters for the printer with the "PRINTER" utility).



```
                                                 SIMATIC S5 / ODS01
FUNCTION SELECTION/DEFAULTS

  PATHFILE     : ST 2/95U            PATHFILE: B:TEST@@AP.INI

  FOOTER       :  NO              FOOTER FILE: B:@@@@@@F1.INI

                               PRINTER FILE: B:@@@@@@DR.INI

                              SELECTED INTERFACE :   CP L2
                                ACTIVE INTERFACE :   CP L2
```

Figure 9-2. The "FUNCTION SELECTION/DEFAULTS" Screen of the "BUS DIALLING" Utility

Press <F1> (EDIT) to generate the path.

9.4 Editing a Path

Supposing you want to use a programmer connected direct to the SINEC L2 LAN to reach the station with LAN address 2. The endpoint of the path is to be the S5-95U with the station address 2. Figure 9-3 shows an example of how to edit the path (Figure 9-3) with the "LAN SELECT" utility.

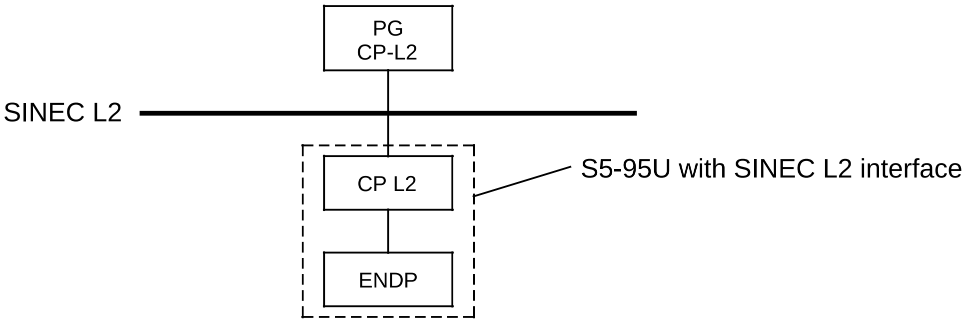
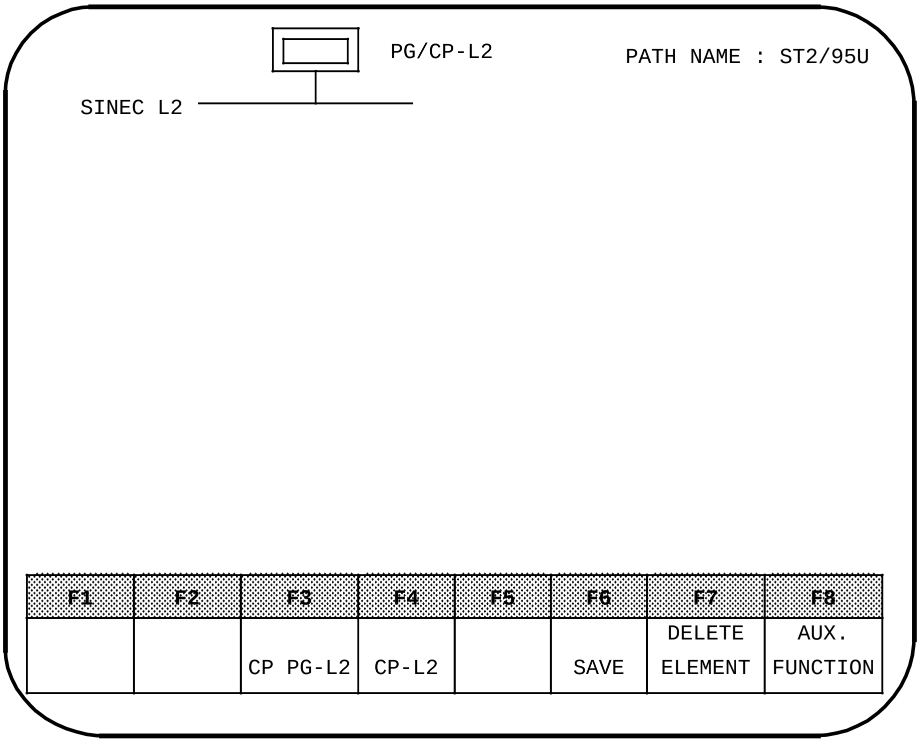


Figure 9-3. Path to be Edited with the "BUS DIALLING" Utility

Note

The "ENDP" control processor and "CP L2" communications processor are integrated in the S5-95U programmable controller (section 3.1, Figure 3-2).
You must therefore show the S5-95U as consisting of "CP L2" and "ENDP" as has been done in Figure 9-3.

Press key <F1> in the "FUNCTION SELECTION/DEFAULTS" screen. The following screen appears:



PATH NAME : ST2/95U

Figure 9-4. Screen for Editing a Path (1)

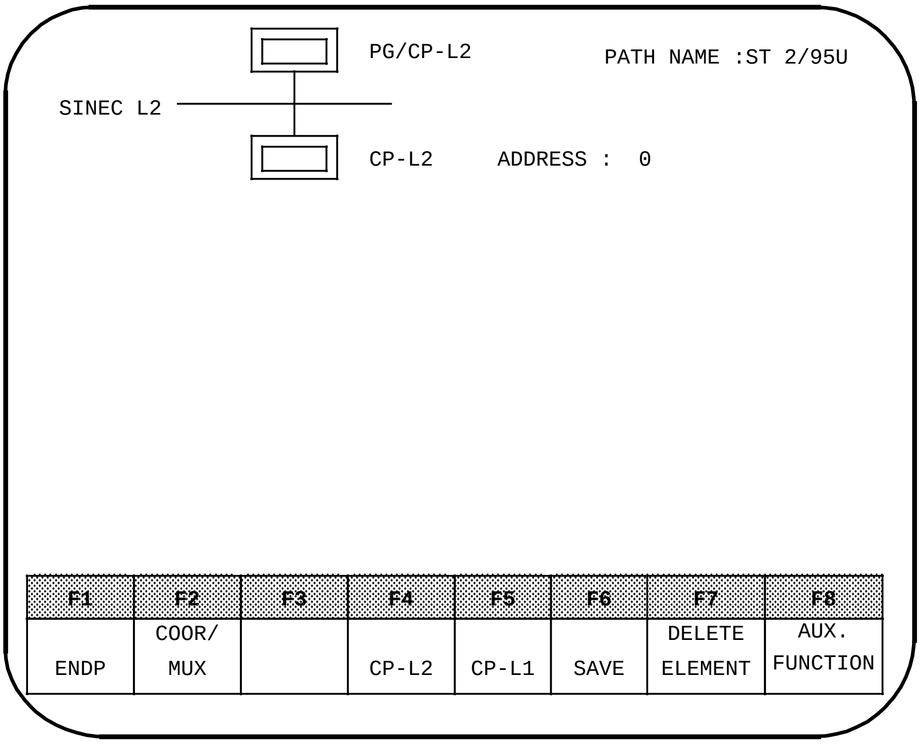
Press <F8> (AUX. FUNCTION) if you want to enter or modify the name of a program, symbol, printer or footer file.

Press <F4> (CP-L2) to proceed to the next path level.

Note

If you want to delete the element last entered by you in the path, press <F7>. This avoids having to delete the whole path if you have entered a wrong path element.

The screen changes to the following:



PATH NAME :ST 2/95U

ADDRESS : 0

Figure 9-5. Screen for Editing a Path (2)

Change the default address "0" in the entry field beside the symbol for CP-L2 to "2" in order to reach the S5-95U with the station address 2.

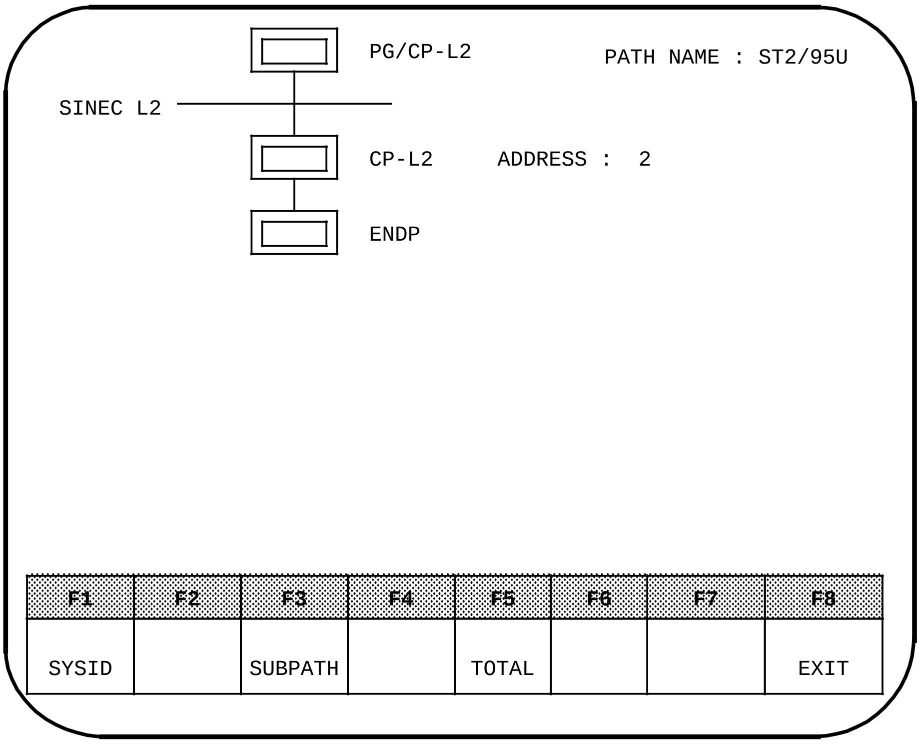
Press <F1> (ENDP) to complete the path.

Confirm the path parameters with <F6> (SAVE).

You have now completed and stored the path. You must now activate the subpath from the PG/CP-L2 to the L2 LAN to set the CP-L2's LAN parameters in the programmer.

Press <F4> (ACTIVATE) in the "FUNCTION SELECTION/DEFAULTS" screen.

The edited path appears on the monitor.



PATH NAME : ST2/95U

ADDRESS : 2

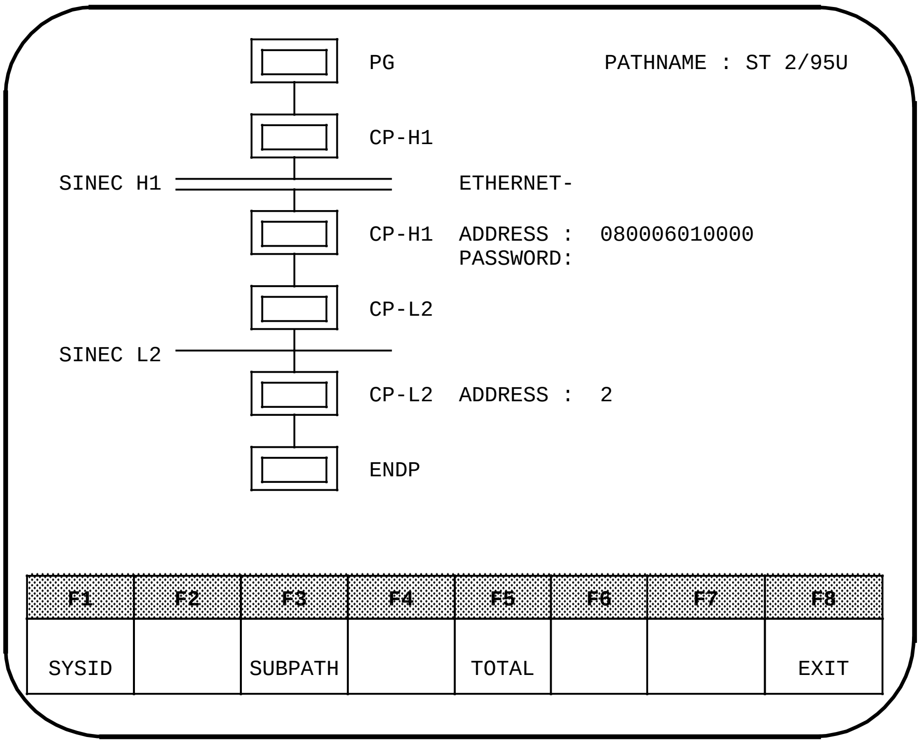
Figure 9-6. Screen for Activating a Path (1)

Activate the first path level by pressing <F3> (SUBPATH).

The activated subpath is then marked with an "* ", and "DIRECT PG LINK ESTABLISHED" appears in the message bar.

Press <F1> (SYSID) to match the local LAN parameters of the CP-L2 communications processor in the programmer to the L2 LAN parameters (basic L2 parameters) of the system (section 9.5).

You can also edit more complex paths.
For example, you can edit a path from a programmer on the SINEC H1 LAN to an S5-95U on the SINEC L2 LAN. Proceed exactly as described on the previous pages. The edited path will then appear as follows on your monitor:



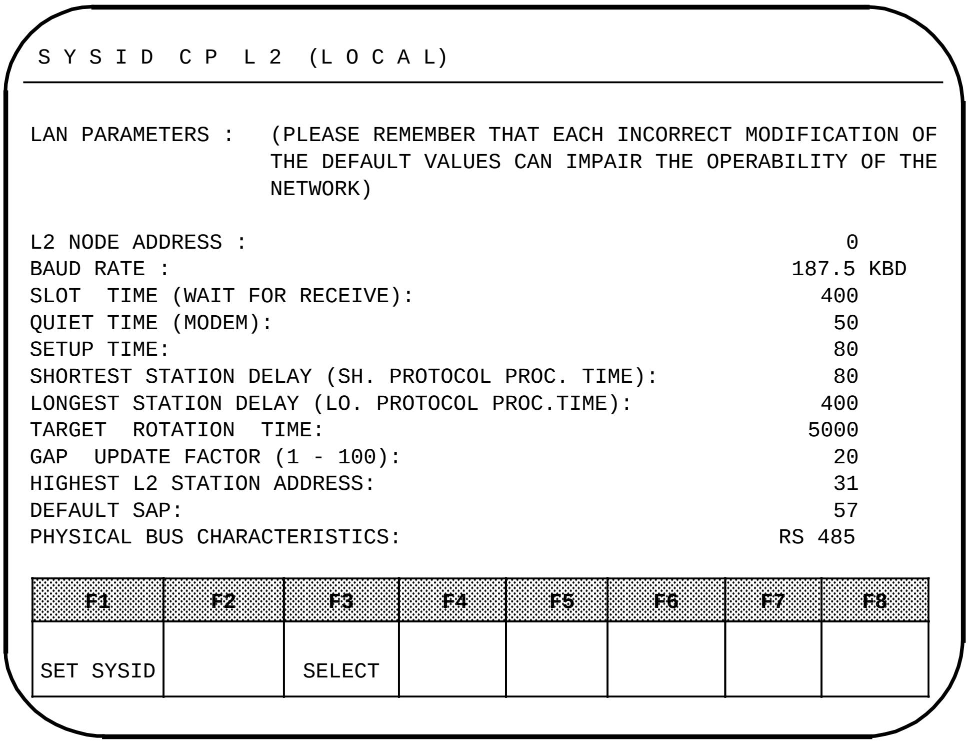
```
PG                PATHNAME : ST 2/95U

CP-H1

SINEC H1          ETHERNET-

CP-H1  ADDRESS :  080006010000
       PASSWORD:

CP-L2

SINEC L2

CP-L2  ADDRESS :  2

ENDP
```

F1	F2	F3	F4	F5	F6	F7	F8
SYSID		SUBPATH		TOTAL			EXIT

Figure 9-7. Screen for Activating a Path (2)

9.5 Setting the L2 Basic Parameters on the Programmer

The following display appears when you press <F1> (SET SYSID) in the "FUNCTION SELECTION/DEFAULTS" screen:



```
SYSID CP L2 (LOCAL)

LAN PARAMETERS :   (PLEASE REMEMBER THAT EACH INCORRECT MODIFICATION OF
                   THE DEFAULT VALUES CAN IMPAIR THE OPERABILITY OF THE
                   NETWORK)

L2 NODE ADDRESS :                                                 0
BAUD RATE :                                                   187.5 KBD
SLOT  TIME (WAIT FOR RECEIVE):                                  400
QUIET TIME (MODEM):                                              50
SETUP TIME:                                                      80
SHORTEST STATION DELAY (SH. PROTOCOL PROC. TIME):                80
LONGEST STATION DELAY (LO. PROTOCOL PROC.TIME):                 400
TARGET  ROTATION  TIME:                                        5000
GAP  UPDATE FACTOR (1 - 100):                                    20
HIGHEST L2 STATION ADDRESS:                                      31
DEFAULT SAP:                                                     57
PHYSICAL BUS CHARACTERISTICS:                                RS 485
```

Figure 9-8. "SYSID CP L2 (LOCAL)" Screen

The parameters shown are CP-L2 default parameters in the programmer, and must be matched to the basic L2 parameters of the system (Table 1-4, 1-5)!

Position the cursor to the parameter you want to change. You can select the baud rate and the physical bus characteristics with <F3>.

Press <F1> (SET SYSID) to confirm and save the parameters you have changed.

9.6 Activating an Edited Path

You must always match the basic L2 parameters of the CP-L2 to the basic L2 parameters of the system before activating a path starting at a programmer with an integral CP-L2 communications processor (section 9.5).

You can activate an edited path

- in the BUS DIALLING utility (FUNCTION SELECTION screen)
  or
- in an S5 program package with a path selection facility.

Activating a path establishes a communications link to a remote station.

Appendices

A DB1 Parameters, DB1 Parameter Assignment Errors, Calculation of Target Rotation Time

A DB1 Parameters, DB1 Parameter Assignment Errors, Calculation of Target Rotation Time

Parameter	Argument	Significance
Block ID: SL2:		**SINEC L2**
Basic Parameters for all Functions		
TLN	n	Own station address
STA	AKT/PAS	Own station status
BDR	p	Baud rate
HSA	q	Highest L2 station address on bus
TRT	m	Target rotation time
SET	s	Set-up time
ST	t	Slot time
SDT 1	u	Shortest delay time
SDT 2	v	Longest delay time
Argument	**Permissible Range**	**Explanation**
n	1 to 126	Station address, including 1 to 31 for active stations
AKT/PAS	-	
p	9.6; 19.2; 93.75; 187.5; 500; 1500	AKT = active, PAS = passive Baud rate in kbaud
q	1 to 126	
m	256 to 1,048,320	Station addresses
s	0 to 494	Bit time units*
t	50 to 4,095	Bit time units*
u	11 to 255	Bit time units*
v	35 to 1,023	Bit time units*
Parameters for FMA Services		
STB	200 MBx	Location of status byte for FMA services Job number A-NR=200
FMAE	J/Y/N	Activate FMA service MAC_EVENT
Argument	**Permissible Range**	**Explanation**
200 MBx	1 to 253	Job number, flag byte
J/Y/N	—	Is FMA service activated? j/J = ja; y/Y = yes; n/N = no
Parameter for Standard Connections		
SF	DBxDWy or MBz	Location of the send mailbox
EF	DBxDWy or MBz	Location of the receive mailbox
KBS	MBh	Location of the send coordination byte
KBE	MBh	Location of the receive coordination byte
Argument	**Permissible Range**	**Explanation**
MBh	1 to 63	Flag byte
DBx	2 to 255	Data block
DWy	0 to 255	Data word
MBz	0 to 254	Flag byte

Parameter	**Argument**	**Significance**
Block ID:	**SL2:**	**SINEC L2**
Parameters for PLC to PLC Connection		
STBS	n MBx	Job number and location of status byte ‘Transmit’
STBR	n MBy	Job number and location of status byte ‘Receive’
Argument	**Permissible Range**	**Explanation**
n	1 to 31	Job number
MBx	1 to 254	Flag byte
MBy	1 to 253	Flag byte**
Parameters for Cyclic I/O		
Parameters for ZP Master Function		
ZPDB	DBx	Reserved data block for cyclical I/Os
ZPMS	MBy	Status byte (STB) for ZP master
ZPM	a b DWc DWd DWe DWf	ZP master/slave connection (max. 32 connections can be programmed)
ZPLI	MBz	Status byte (STB) for ZP slave life list**
Argument	**Permissible Range**	**Explanation**
a	1 to 126	ZP slave station address
b	0 to 62	L2 SAP of ZP slave (if S5-95U is ZP slave, enter 61)
DWc or X	0 to 255	ZPA lower limit; data word; X for ”non defined”
DWd or X	0 to 255	ZPA upper limit; data word; X for ”non defined”
DWe or X	0 to 255	ZPE lower limit; data word; X for ”non defined”
DWf or X	0 to 255	ZPE upper limit; data word; X for ”non defined”
DBx	2 to 255	Data block
MBy	1 to 254	Flag byte
MBz	1 to 253	Flag byte
Parameters for ZP Slave Function		
ZPDB	DBx	Reserved DB for cyclical I/Os
ZPSS	MBz	Status byte (STB) for ZP slave
ZPSA	DWa DWb	ZP slave output area
ZPSE	DWc DWd	ZP slave input area
Argument	**Permissible Range**	**Explanation**
DWa or X	0 to 255	ZPA lower limit; data word; X for ”non defined”
DWb or X	0 to 255	ZPA upper limit; data word; X for ”non defined”
DWc or X	0 to 255	ZPE lower limit; data word; X for ”non defined”
DWd or X	0 to 255	ZPE upper limit; data word; X for ”non defined”
DBx	2 to 255	Data block
MBz	1 to 254	Flag byte

* A bit time unit is the time it takes to transmit one bit (reciprocal of the baud rate).

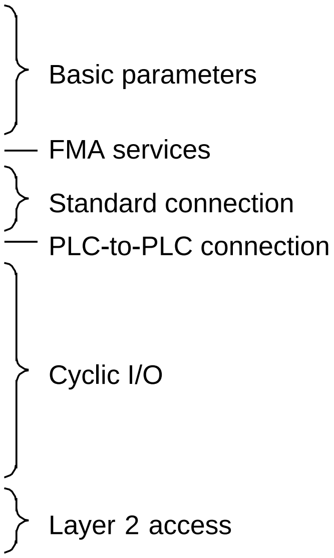
** The next flag byte is reserved as the length byte.

Parameter	Argument	Significance
Parameters for Layer 2 Accesses		
STBS STBR	n MBx n MBy	SAP number and location of the 'Send' status byte SAP number and location of the 'Receive' status byte
Argument	**Permissible Range**	**Explanation**
n MBx MBy	33 to 54, 64*** 1 to 253 1 to 253	SAP number Flag byte** Flag byte**

** The next byte is reserved as the length byte.
*** SAP 64 is the default SAP

Typical DB1 with all programmable SINEC L2 functions:

```
 :
 :
156:     KS  ='    SL2: TLN 1   STA AKT';
168:     KS  =' BDR 1500   HSA 1   TRT ';
180:     KS  ='5120    SET 60  SDT 1 15';
192:     KS  ='0 SDT 2  980 ST 1000    ';
204:     KS  ='STB 200  MB200 FMAE Y   ';
216:     KS  ='SF DB6  DW0   EF DB7  DW';
228:     KS  ='0   KBS MB62  KBE MB63  ';
240:     KS  ='STBS 2 MB10 STBR 2 MB11 ';
252:     KS  ='ZPDB DB100 ZPMS MB100   ';
264:     KS  ='ZPLI MB101 ZPM 40 61    ';
276:     KS  ='DW1 DW10 DW101 DW110    ';
288:     KS  ='ZPM 41 61               ';
300:     KS  ='DW11 DW20 DW111 DW120   ';
312:     KS  ='ZPM 42 61               ';
324:     KS  ='DW21 DW30 DW121 DW130   ';
336:     KS  ='STBS 48 MB77            ';
348:     KS  ='STBR 48 MB79            ';
360:     KS  =';  END ';
```



Relevant Basic Parameters for the S5-95U as an Active/Passive Station

Parameter	TLN	STA	BDR	HSA	TRT	SET	ST	SDT 1	SDT 2
S5-95U active	x	x	x	x	x	x	x	x	x
S5-95U passive	x	x	x				x	x	

Defining the Arguments of Basic Parameters for the S5-95U as a Function of the Baud Rate

Baudrate in kbaud / Basic parameters in bit time units	9.6	19.2	93.75	187.5	500 (Defaults in DB1)	1500
SET	0	0	0	0	0	60
ST	73	76	99	170	400	1000
SDT 1	12	12	12	12	12	150
SDT 2	40	60	80	150	360	980

Defining the Arguments of Basic Parameters for the S5-95U in Conjunction with the CP 5410 and/or CP 5430-1

Baudrate in kbaud / Basic parameters in bit time units	9.6	19.2	93.75	187.5	500	1500
SET	1	1	1	1	1	60
ST	80	80	190	380	1000	3600
SDT 1	12	12	12	12	12	150
SDT 2	40	60	80	150	360	980

Defining the Arguments of Basic Parameters for the S5-95U in Conjunction with Other SIMATIC Devices

Baudrate in kbaud / Basic parameters in bit time units	9.6	19.2	93.75	187.5	500	1500
SET	10	15	45	80	80	80
ST	100	170	240	400	1000	3000
SDT 1	12	15	45	80	80	150
SDT 2	60	65	200	360	360	980

Calculating the Target Rotation Time

Assuming that you have defined the SET, ST, SDT 1 and SDT 2 arguments as listed in the table entitled "Defining the Arguments of Basic Parameters for the S5-95U as a Function of the Baud Rate" on page A-4, you can calculate the target rotation time required for the following types of transmission:

- Standard connection
- PLC to PLC connection
- Cyclical I/O

Proceed as follows to calculate the target rotation time:

Determine the maximum possible number of frames for each different type of frame (for example, SDN or SDA frames)

Out of these data and using the following table and the explanations to the token frame, calculate the basic load. The values given in the table are specified in bit time units.

Add 11 bit time units to the basic load for every byte transmitted. The result is your worst-case target rotation time.

Type of Frame	Baud Rate in kbaud					
	9.6	19.2	93.75	187.5	500	1500
Token[1]	70	70	70	75	145	345
SDN[2]	170	190	210	230	480	1120
SDA[3]	180	185	190	230	425	1040
SRD[4]	270	270	270	280	500	1160

[1] Number of token frames = number of active stations on the SINEC L2 network

[2] SDN (Send Data with No acknowledge) = data transmission without acknowledgement;for standard connection (only broadcast)

[3] SDA (Send Data with Acknowledge) = data transmission with acknowledgement; for standard connection (not broadcast) and PLC to PLC connection

[4] SRD (**S**end and **R**equest **D**ata) = data transmission and data request with comfirmation ; for Cyclic I/O

An example of calculating the target rotation time can be found on the next pag

Example of Calculating the Target Rotation Time

Four active and two passive stations are connected to the SINEC L2 network.

TLN of the active stations:	1, 2, 3, and 4
TLN of the passive stations:	40, 41
HSA:	4
BDR:	500 kBaud
SET:	0
ST:	400 bit time units
SDT1:	12 bit time units
SDT2:	360 bit time units

Data traffic for

• Station 1:	ZP master	SRD frame with 4 bytes of transmit data to station 40: 2 bytes of received data from station 40; SRD frame with 10 bytes of transmit data to station 41; 10 bytes of received data from station 41
	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 2:
	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 3;
	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 4
• Station 2:	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 1
• Station 3:	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 1
• Station 4:	PLC to PLC conn.	SDA frame with 30 bytes of transmit data to station 1

Calculation of the basic frame load and the required time:

```
Token frames:                               4·145            =  580  bit times units
Station 1:  1·SRD with 6  bytes of net data   500+6·11         =  566  bit times units
            1·SRD with 20 bytes of net data   500+20·11        =  720  bit times units
            3·SDA with 30 bytes of net data   3·(425+30·11)    = 2265  bit times units
Station 2:  1·SDA with 30 bytes of net data   425+30·11        =  755  bit times units
Station 3:  1·SDA with 30 bytes of net data   425+30·11        =  755  bit times units
Station 4:  1·SDA with 30 bytes of net data   425+30·11        =  755  bit times units
                                           Sum (rounded up):   = 6400  bit times units
```

$$\textbf{Target rotation time to set:}\quad \textbf{6400 bit time units} \cdot \frac{\mathbf{1}}{\textbf{500 kBaud}} = \mathbf{12800\ \mu s}$$

Tip to optimize the target rotation time:

- Assign the station addresses in ascending order (1, 2, ...).

Explanation of the SET, ST, SDT1, and SDT2 Parameters

Parameter	Explanation
Set up time (SET)	"Dead time"; this is the time allowed to pass between the occurrence of an event (e.g., the receipt of a character or expiration of an internal timer) and the response to this event. Permissible range: 0 to 494 bit time units*
Slot time (ST)	Wait-to-receive time or wait-to-reply time; this is the length of time the transmitter of a frame must wait for the receiving station to respond. This is valid for a data frame as well as for a token frame. Permissible range: 50 to 4095 bit time units*
Shortest station delay time (SDT1)	Shortest protocol processing time; this is the shortest span of time between transmission(receipt) of the last bit of a frame and transmission (receipt) of the first bit of the next frame. Permissible range: 11 to 255 bit time units*
Longest station delay time (SDT2)	Longest protocol processing time; this is the longest span of time between transmission(receipt) of the last bit of a frame and transmission (receipt) of the first bit of the next frame. Permissible range: 35 to 1023 bit time units*

* One bit time unit is the time it takes to transmit one bit (reciprocal value of baud rate)

DB1 Parameter Assignment Errors

You can read out the DB1 parameter assignment errors as codes. All you need to do is to specify in DB1, parameter block "ERT:", where to store the error code (in the flag area or in a data block). The error code is in the left byte; "04_H" is in the right byte as the error location for SL2: SINEC L2 parameter block. Parameter assignment for "ERT:" is described in detail in section 9.1.2 of the *S5-90U/S5-95U* System Manual.

Error Code of DB1 Interpreter (left byte in data word or flag word)	Significance
3_H	Syntax error in block ID
4_H	Syntax error in parameter
5_H	Syntax error in argument, or value goes upside permissible
6_H	Value exceeds permissible range in an argument
7_H	Parameter combination not allowed
17_H	L2 interface not in working order
20_H	A flag byte has been assigned twice for the status bytes

Error Code of DB1 Interpreter (left byte in data word or flag word)	Significance
21_H	L2 basic parameter: TLN (station address) of an active station can be only 1 to 31
22_H	L2 basic parameter: TLN (station address) is higher than HSA (highest station address)
23_H	The connection has been configured to own station
24_H	PLC to PLC connection to a passive station is not possible; or, with standard connection, there is no send mailbox for a passive station.
25_H	FMA service MAC_EVENT has been activated (DB1 parameter FMAE y), but “STB 200” was not entered
26_H	L2 basic parameter: SET must be longer than SDT1 $\left(\text{SET} > \frac{\text{SDT 1 - 35}}{2}\right)$
27_H	No receive mailbox was specified for the standard connection
28_H	No send mailbox was specified for the standard connection
29_H	L2 basic parameter missing; all basic parameter must be present in DB1 parameter block “SL2:”.
30_H	There are several “SL2:” parameter blocks
31_H	L2 basic parameter: SDT2 must be (35+2 times SET)
32_H	L2 basic parameter: (ST - 15) must be SDT2
40_H	ZP master: no data block was specified in DB1 for ZP (ZP DB)
41_H	ZP master: ZP master was entered for a passive station
42_H	ZP master: ZP master has no ZP connection
43_H	ZP master: at least in one ZP connection the ZP slave address is wrong (ZP slave address=ZP master address)
44_H	ZP master: the ZP connection was assigned twice
45_H	ZP master: The ZPA (ZP output area) was not entered consistently (without gaps) in ZPDB
46_H	ZP master: length error in ZPA (ZP output area)
47_H	ZP master: The ZPE (ZP input area) was not entered consistently (without gaps) in ZPDB or overlaps.
48_H	ZP master: length error in ZPE (ZP input area)
49_H	ZP master: ZPA and ZPE overlap in ZP DB
52_H	ZP slave: no data block was specified in DB1 for ZP (ZP DB)
53_H	ZP slave: neither ZPA nor ZPE were specified in DB1
54_H	ZP slave: ZPA and ZPE overlap in ZP DB

B SAP Numbers / Job Numbers

B SAP Numbers / Job Numbers

This appendix contains information that you do not have to know to work with the S5-95U programmable controllers as SINEC L2 stations. This appendix is for the network expert who wants more details about the internal process of data transfer.

Definition of terms:
The job number carried by a frame running on the network helps the required station to identify and read in the frame. To achieve this, another parameter is provided, the SAP (**S**ervice **A**ccess **P**oint).

A mail carrier transporting a package to the receiver is in a situation similar to the message on the bus:

- The residence number (destination address) has to be identified.
- The correct residence door (=SAP) must be found in order to deliver the package (message).

The system automatically assigns the SAP numbers for the functions listed below.

SAP	Function/Explanation
0, 1	reserved
2 to 32	PLC to PLC connection via integrated standard function blocks L2-SEND and L2-RECEIVE.*
33 to 54	Layer 2 accesses
55	reserved
56	Standard connection
57 to 60	reserved
61	Cyclical I/O
62, 63	reserved
64 (default SAP)	Layer 2 accesses

***** The following applies to PLC-to-PLC connections:
SAP 2 means a PLC-to-PLC connection to station 1
:
SAP 32 means a PLC-to-PLC connection to station 31

The job number indicates the following:

- Which of the communications services is used (see table below)
- With PLC to PLC connections:
  - in L2-SEND, which station will receive the data
  - in L2-RECEIVE, which station transmitted the received data.
- With layer 2 accesses
  - in L2-SEND, which layer 2 access is used for the data to be sent
  - in L2-RECEIVE, which layer 2 access is used for the received data

Job Number	Used for
0	nothing
1 to 31	transmission (transmitting and receiving) via PLC to PLC connection
32	nothing
33 to 54, 64	sending the request and fetching the confirmation in the case of layer 2 accesses
55 to 63, 65 to 132	nothing
133 to 154, 164	fetching the indication in the case of layer 2 accesses
155 to 163, 165 to 199	nothing
200	service and diagnostics functions with FMA services
201	nothing
202	fetching the ZP slave life list for the ZP master with cyclic I/O
203 to 255	nothing

C List of Abbreviations/Glossary

C List of Abbreviations/Glossary

LAN-Specific Mnemonic	**Explanation**
A-NR	Parameter for FB L2-SEND and FB L2-RECEIVE: job number
AS	Active star coupler
BDR	DB1 parameter: SINEC L2, Baud rate (specifies the speed of the data transfer)
BF LED	Bus fault LED
CBR	DB1 parameter: SINEC L2, standard connection, location of the receive coordination byte
CBS	DB1 parameter: SINEC L2, standard connection, location of the send coord. byte
CP	Communications processor
DBNR	Parameter for FB L2-SEND and FB L2-RECEIVE: data block number (location of the source and destination data)
FMA	Field bus management
FMAE	DB1 parameter: SINEC L2, activate FMA service MAC_EVENT
FO	Fiber optics
FOL	Fiber optic link
GAP	For an active station: the address range from the own station address to the next active station address.
GP	Global I/O
HSA	DB1 parameter: SINEC L2, highest station address
LAS	List of active stations
LB	Length byte
OPM	Optical plastic module
OSM	Optical silica module
PAFE	Parameter assignment error byte
PROFIBUS	Process field bus
QANF	Parameter for FB L2-SEND: start address of source data area
QLAE	Parameter for FB L2-SEND: amount of source data
QTYP	Parameter for function block L2-SEND: type of source data
RM	DB1 parameter: SINEC L2, standard connection, receive mailbox location
SAP	Service access point
SC	Standard connection

LAN-Specific Mnemonic	**Explanation**
SDA	Send data with acknowledge
SDN	Send data with no acknowledge
SDT 1	DB1 parameter: SINEC L2, shortest station delay time
SDT 2	DB1 parameter: SINEC L2, longest station delay time
SET	DB1 parameter: SINEC L2, set-up time
SM	DB1 parameter: SINEC L2, standard connection, send mailbox location
SL2:	DB1 block ID for SINEC L2
SRD	Send and request data
ST	DB1 parameter: SINEC L2, slot time
STA	DB1 parameter: SINEC L2, station status
STB	Status byte
STBR	DB1 parameter: SINEC L2, PLC to PLC connection, location of the receive status byte
STBS	DB1 parameter: SINEC L2, PLC-PLC connection, location of the transmit status byte
TLN	DB1 parameter: SINEC L2, station address
TN	Station
TRT	DB1 parameter: SINEC L2, target rotation time
ZANF	Parameter for FB L2-RECEIVE: start address of the destination data area
ZLAE	Parameter for FB L2-RECEIVE: amount of source data
ZP	Cyclic I/O
ZP DB	DB1 parameter: SINEC L2, Cyclic I/O, data block for Cyclical I/Os
ZPA	Cyclic I/O output range (location of the send data)
ZPE	Cyclic I/O input range (location of the received data)
ZPLI	DB1 parameter: SINEC L2, cyclic I/O, status byte for the ZP slave life list
ZPM	DB1 parameter: SINEC L2, cyclic I/O, ZP master/slave relationship
ZPMS	DB1 parameter: SINEC L2, cyclic I/O, status byte for the ZP master
ZPSA	DB1 parameter: SINEC L2, cyclic I/O, ZP slave output range
ZPSE	DB1 parameter: SINEC L2, cyclic I/O, ZP slave input range
ZPSS	DB1 parameter: SINEC L2, cyclic I/O, ZP slave status byte
ZTYP	Parameter for FB L2-RECEIVE: type of destination data

Glossary

A	
Active star coupler	Resource for coupling fiber optic cables
Active station	When ready to send data, an active station may send data to, and request data from, other stations on the LAN
B	
Baud rate	Data transmission speed expressed as the number of bits transmitted per second (baud rate = bit rate)
Bit time unit	The time taken to transmit a bit (the reciprocal of the baud rate)
Bit-serial field bus system	Bus system used at the field level in integrated automation systems; information is transmitted in bit-serial mode over the bus cable
Broadcast	Data and information sent from an active station to all active and passive stations on the LAN
Bus	Common transmission path to which all stations are connected
Bus cable	Twisted-pair, shielded cable for connecting stations with each other
Bus connector	Resource for the direct interconnection of stations on the LAN
Bus terminal	Resource used for connecting a station to the bus cable
C	
Cell level	A hierarchical level in an integrated automation system: Receives production orders from the process supervision level; this level is generally represented by manufacturing cells, each of which is controlled by at least one PLC
Communications processor	That part of a PLC controlling message traffic over the SINEC L2 LAN parallel to the control processor
Confirmation	Acknowledgement of a service request
Coordination byte	Diagnostic byte for flagging error and coordination information when sending and/or receiving data over a standard connection
Cyclic I/O (ZP)	Cyclic data interchange between ZP master (generally active station) and ZP slaves (generally passive stations)
D	
Data transmission	Activity on the transmission link (bus or LAN cable)
E	
Explicit communications	The time at which communications take place is determined by the setting of an initiation bit in the user program
F	

Field device	A device, such as a sensor or actuator, permitting the exchange of information between the control system and the process
Field level	A hierarchical level in an integrated automation system; the interchange of information between the control system and the process is implemented by means of field devices, sensors and actuators
FMA services	Debugging and diagnostic services for monitoring the network and the local stations; implement network management functions to the PROFIBUS standard
FO transmission technology	Configuration of the SINEC L2 LAN using optical fiber conductors or waveguides (necessary in noisy environments)

G

GAP	Address area of the active station extending from its own address to that of the next active station

I

Implicit communications	Data communications over the LAN take place automatically and are not initiated by the user program
Indication	Indication of an event

L

LAN access method	Controls access to the transmission medium by the stations to guarantee the functional interchange of data master-slave method token passing method
Layer 2	Layer 2 of the ISO (International Organization for Standardization) 7-layer reference model for communications; in PROFIBUS terms, layer 2 is referred to as the Fieldbus Data Link (FDL)
Layer 2 services	Communications mechanisms provided to the user by the layer 2 firmware of the communications processor
Local station	Initiator of a communications link, either as a sending or requesting station
Longest station delay time	The longest time elapsing between sending or receiving the last bit of a frame and the sending or receiving of the first bit of the next frame

M

Master-slave method	LAN access method when there is only one station active and all other stations are passive; only the active station automatically has the right to send, while all passive stations can send data to an active station only when requested to do so by that station
Multicasting	Transmitting from an active station to a group of active and passive stations

O

Optical fiber link	Transmission medium employing fiber optic waveguides
P	
Parameter assignment error byte	Diagnostic byte for flagging possible errors when assigning parameters to the integral L2-SEND and L2-RECEIVE FBs
Passive station	A passive station may only exchange data with an active station when requested to do so by that station
Planning level	The hierarchical level in an integrated automation system at which production orders are planned, product strategy is established, production guidelines are defined and information from the production process is monitored
Process supervision level	The hierarchical level in an integrated automation system at which decisions are made concerning production procedures and the coordination of function groups
PROFIBUS	Process and field bus as defined in the PROFIBUS standard (DIN 19245). The standard specifies the functional, electrical and mechanical properties of this bit-serial field bus system
R	
Receive mailbox	Area in the data block (DB) or flag byte containing the data received from a data transmission
Receiver	remote station
Remote station	A responding station in a communications link as opposed to the initiating local station
Repeater	A resource for amplifying LAN bus signals and coupling LAN segments over great distances
Repeater adapter	A resource for a mixed configuration of RS 485 and FO transmission technologies
Request	A service request of the local station
RS 485 transmission technology	SINEC L2 LAN configuration involving shielded twisted- pair wires
S	
SAP	Service access point to layer 2
SDA	Send Data with Acknowledge: Data transmission service provided by layer 2 for acyclic send and request mode
SDN	Send Data with No Acknowledge: Data transmission service provided by layer 2 for acyclic send and request mode
Segment	The smallest functional unit of a LAN
Send mailbox	Area in a data block (DB) or flag byte containing the data to be transmitted
Sender	local station

Setup time	The time allowed to elapse between an event (e.g. receipt of a character or expiry of an internal monitoring time) and the response to that event ("dead time")
Shortest station delay	The shortest time elapsing between sending or receiving the last bit of a frame and sending or receiving the first bit of the next frame
SINEC L2	SINEC L2 local area network
SINEC L2 local area network	A bus-type LAN configuration consisting of one or more segments coupled together by repeaters; used for networking PROFIBUS-compatible PLCs and field devices at the cell and field levels
Slot time	Wait-to-receive time (or wait-to-reply time); the length of time the sender (initiator) of a frame must wait for the receiving station to respond. It is immaterial whether this is a message or data frame or a token frame.
SRD	Send and Request Data: Data transmission service provided by layer 2 for acyclic send and request mode
Star coupler	active star coupler
Station	Device/PLC capable of transmitting and receiving data via the LAN bus
Station address	Each station has an address (assigned to it as a parameter) to enable send and receive jobs to be uniquely assigned to it
Status byte	Diagnostic byte for flagging the status of a job and any errors in data transmission
Subminiature D connector	9-pin plug or male connector to DIN 41652
Subminiature D socket	9-pin socket or female connector to DIN 41652
T	
Target rotation time	The maximum permissible token rotation time
Terminating resistor	Resistance or resistance network used to match the line impedance of LAN cables; terminating resistors are always required at the end of the cable or segment
Terminator	terminating resistors
Token	A defined bit string ("assigned"/"unassigned") authorizing a station to send data over the LAN
Token hold time	The difference between the target rotation time and the token rotation time; the active station only has this time at its disposal for sending data over the LAN
Token passing method	Bus access method when all stations are active; the token (permission to send) is passed from one station to another while all stations are logically interconnnected

Token rotation cycle	The time that elapses between transmitting and receiving a token frame by an active station.
Token rotation time	The period, in the view of the active station, during which the station was not in the possession of the token
Transmission technology	RS485 transmission technology FO transmission technology
Types of data transmission	Transmission mechanisms enabling data transmission to be optimally adapted to the particular situation

Z

ZP input area	Area in a data block (DB) containing the data received in the case of cyclic I/O
ZP master	ZP station capable of interrogating other ZP stations
ZP output area	Area in a data block (DB) containing the data to be sent in the case of cyclic I/O
ZP slave	ZP station that can be interrogated by a ZP master
ZP slave life list	Diagnostic area in a data block (DB) or flag byte of the ZP master for flagging current ZP slave errors or faults

D List of Accessories and Order Numbers

D List of Accessories and Order Numbers

			Order Number
S5-95U programmable controller with SINEC L2 interface			6ES5 095-8MB02
S5-90U/S5-95U system manual	German		6ES5 998-8MA12
with User's Guide S5-90U and S5-95U	English		6ES5 998-8MA22
	French		6ES5 998-8MA32
	Spanish		6ES5 998-8MA42
	Italian		6ES5 998-8MA52
SINEC L2 interface for the S5-95U programmable controller manual			
	German		6ES5 998-8MB12
	English		6ES5 998-8MB22
	French		6ES5 998-8MB32
	Spanish		6ES5 998-8MB42
	Italian		6ES5 998-8MB52
Bus-Specific accessories for RS 485 transmission technology			
SINEC L2 bus connector IP 20			6ES5 762-1AA11
SINEC L2 bus connector IP 20 with PG socket			6ES5 762-1AA21
SINEC L2 bus terminal RS 485	1.5 m, approx.	5 ft	6GK1 500-0AA00
	3,0 m,	10 ft	6GK1 500-0AA00
SINEC L2 bus terminal RS 485 with attached PG interface	1.5 m,	5 ft	6GK1 500-0DA00
SINEC L2 repeater for nominal operating voltage 24 V, IP 20			6GK1 510-0AC00
SINEC L2 repeater for nominal operating voltage 24 V, IP 65			6GK1 510-0AD00
SINEC L2 bus cable (indoors)			6XV1 830-0AH10
SINEC L2 bus cable (buried)			6XV1 830-3AH10
Bus-Specific accessories for Fiber Optic transmission technology			
SINEC L2FO PF bus terminal for plastic FO cable			6GK1 500-1AA00
SINEC L2FO SF bus terminal for glass FO cable			6GK1 500-1AB00
Active star coupler AS 501 A			6GK1 501-0AA00
Active Star coupler AS 501 B			6GK1 501-0AB00
SINEC L2FO one-port module OPM			6GK1 501-1AA00
SINEC L2FO one-port module OSM			6GK1 501-1AB00
SINEC L2FO SF repeater adapter für glass FO cable			6GK1 510-1AA00
SINEC L2FO connecting cable plastic with HP connector	5 m, approx.	16 ft	6XV1 830-4AH50
	10 m,	33 ft	6XV1 830-4AN10
	15 m,	49 ft	6XV1 830-4AN15
	20 m,	66 ft	6XV1 830-4AN20
	25 m,	82 ft	6XV1 830-4AN25

E Technical Specifications; Cycle Delay Times of the PLC Caused by SINEC L2

E Technical Specifications; Cycle Delay Times of the PLC Caused by SINEC L2 Operations

Climatic Environmental Conditions

see *S5-90U/S5-95U System Manual*

Mechanical Environmental Conditions

see *S5-90U/S5-95U System Manual*

Electromagnetic Compatibility (EMC), Noise Immunity

see *S5-90U/S5-95U System Manual*

IEC-/VDE Information

see *S5-90U/S5-95U System Manual*

Internal Technical Specifications

see *S5-90U/S5-95U System Manual*

Worst Case PLC Delay Time caused by SINEC L2 Operation

- with standard connections	550 to 650 μs*
- with PLC to PLC conn. at every L2 FB call	500 to 650 μs*
- with cyclical I/Os when transferring ZP data at the ZP cycle control point	400 to 600 μs*

***** depending on the amount of data

Power Supply (Internal)

Input voltage		
- rated value		DC 24 V
- permissible range		20 to 30 V
Current consumption from 24 V		
- for the S5-95U	typ.	280 mA
- with full ext. I/O configuration	typ.	1.2 A
Output Voltage		
- V 1 (for external I/Os)		+9 V
- V 2 (for PG and SINEC L2 interface)		+5.2 V
Output Current		
- from V 1		1 A
- from V 2 (total)		0.65 A
- from V 2 for SINEC L2 interface		0.1 A
Short-circuit protection for V 1, V 2 (PG)		yes, electronic
Short-circuit/overvoltage protection for V 2 (SINEC L2 interface)		yes, fuse 250 mA, quick act.
Floating		**no**
Degree of protection		**class I**
Back-up battery		see *S5-90U/S5-95U System Manual*

Data Specific to Onboard I/Os

see *S5-90U/S5-95U System Manual*

Data Specific to SINEC L2

Main processor	80C537
Communications processor	V25+ with SPC (Siemens PROFIBUS controller)
Bus cable	two-wire, shielded, twisted cable

Data Specific to SINEC L2 (continued)

Interface	RS 485
Transmission type	bit-serial
Transmission protocol for layers 1 and 2 of the ISO-7 layer design	according to DIN 19245 part 1
Access procedure	
- between active stations	token passing, to DIN 19245, part 1
- between active and passive stations	master-slave, to DIN 19245, part 1
Number of stations	
- total (active and passive)	126
- active, max.	31
- for one segment, max.	31

Transmission rate	9.6	kBaud
(adjustable in DB1)	19.2	kBaud
	93.75	kBaud
	187.5	kBaud
	500	kBaud
	1500	kBaud

SINEC L2 Communications Services

Standard connections	
- amount of data per job	1 to 242 bytes
- accessible destination address (for transmitting)	1 to 31
- possible source address (for receiving)	1 to 31
- broadcast available	yes
PLC to PLC connections	
- amount of data per job	1 to 242 bytes
- accessible destination address (for transmitting)	1 to 31
- possible source address (for receiving)	1 to 31
- broadcast available	no
Cyclic I/O	
- ZP master	yes, for max. 32 ZP slaves
- ZP slave	yes
- amount of data for ZPE	0 to 128 DW (ZP master) 0 to 121 DW (ZP slave)
- amount of data for ZPA	0 to 128 DW (ZP master) 0 to 121 DW (ZP slave)
- accessible destination address (ZP master, for transmitting)	1 to 126
- possible source address (ZP slave, for receiving)	1 to 31
- Broadcast available	no

SINEC L2 Communications Services (Continued)

Layer 2 Services

- Amount of data per job	0 to 242 bytes
- Reachable destination address (when sending data)	1 to 126
- Possible source address (when receiving data)	1 to 126
- Number of layer 2 accesses	23 (SAP 33 to 54, 64)

- SDA	Active station sends data to an active or passive station
- SDN	Active station sends data to several active or passive stations
- RUP_SINGLE	Active or passive station holds data ready for fetching once only by an active station
- RUP_MULTIPLE	Active or passive station holds data ready for fetching by several active or passive stations
- SRD	Active station sends data and/or fetches data held ready for it from an active or passive station

FMA Services

- LAS_LIST_CREATE	local service (no additional bus load)
- MAC_EVENT	local service (no additional bus load)
- FDL_STATUS	remote service (additional bus load)
- READ_VALUE	local service (no additional bus load)
- TIME_TTH_READ	local service (no additional bus load)

Programmer Functions

Integral Blocks

Integral Organization Blocks

- OB1	cyclical program scanning
- OB3	interrupt-driven program processing
- OB13	time-controlled program processing
- OB21	start-up program processing (manual cold restart)
- OB22	start-up program processing (power recovery)
- OB31	cycle trigger
- OB34	battery failure
- OB251	PID control algorithm

Integral Function Blocks

- FB240	code converter: BCD4 to 16-bit fixed point
- FB241	code converter: 16-bit fixed point to BCD4
- FB242	multiplier: 16-bit fixed point
- FB243	divider: 16-bit fixed point
- FB250	reading in analog values
- FB251	outputting analog values
- FB252	L2-SEND
- FB253	L2-RECEIVE

Distance Table for RS 485 Technology:

Baud Rate in Kbits/s	Number of Segments Connected in Series							
	1	2	3	4	5	6	7	8
9.6; 19.2; 93.75	1.2 km	2.4 km	3.6 km	4.8 km	6.0 km	7.2 km	8.4 km	9.6 km
187.5	1.0 km	2.0 km	3.0 km	4.0 km	5.0 km	6.0 km	7.0 km	8.0 km
500	0.4 km	0.8 km	1.2 km	1.6 km	2.0 km	2.4 km	2.8 km	3.2 km
1500	0.2 km	0.4 km	0.6 km	0.8 km	1.0 km	-	-	-

⚠ **Caution**

In extensive networks, the potential difference between two stations may exceed ± 7 V. Should this be the case, make sure that the necessary equipotential bonding measures are taken, otherwise the SINEC L2 interface will be destroyed.

Distance Table for Glass Fiber Optic Cable Technology:

Baud Rate in Kbits/s	Number of Segments Connected in Series								
	1	2	3	4	5	6	7		16
9.6; 19.2; 93.75; 187.5	1.4 km	2.8 km	4.2 km	5.6 km	7.0 km	8.4 km	9.8 km	....	23.8 km
500	1.4 km	2.8 km	4.2 km	5.6 km	7.0 km	8.4 km	-		-
1500	1.4 km	2.8 km	4.2 km	-	-	-	-		-

Interrupt Response Time and PLC Cycle Delay Time

Increasing the interrupt response time
Since process interrupts cannot interrupt on-going SINEC L2 processing, the increase in the interrupt response time - worst case - corresponds to the cycle delay time caused by the current SINEC L2 function. In the case of programmer functions, the worst-case increase in the interrupt response time is 850 µs. (For calculation of the interrupt response times without SINEC L2 see S5-90U/S5-95U System Manual, section 10.3).

The table overleaf lists the worst-case times for PLC cycle delay times in connection with data transmission over the SINEC L2 LAN.

Type of Data Transmission	**Prerequisites**	**Amount of Data**	**When PLC Scan Cycle Loaded**	**PLC Cycle Delay Time as Sender or Receiver**
Standard connection	Sending and/or receiving is enabled	1 to 242 bytes	When sending: The PLC scan cycle is loaded when the send job is registered by the operating system (this takes place within 10 ms) When receiving: The PLC scan cycle is loaded when receive data has arrived at receive mailbox.	Worst case for 1 byte: 550 µs Worst case for 242 bytes: 650 µs
PLC-to-PLC connection/ layer 2 services	When sending: Send job is possible	1 to 242 bytes (PLC/PLC)/ 0 to 242 bytes (layer 2)	Every time an L2-FB is invoked (FB252, FB253)	When assigning parameters direct to the L2-FBs: worst case for 1 byte: 500 µs worst case for 242 bytes: 600 µs
	When receiving: Receive data are available			When assigning parameters indirectly to the L2-FBs: worst case for 1 byte: 550 µs worst case for 242 bytes: 650 µs
Cyclic I/O	Cyclic I/O is defined	ZP master: 1 to 128 words ZPA and/or 1 to 128 words ZPE ZP slave: 1 to 121 words ZPA and/or 1 to 121 words ZPE	When transferring the ZP data at the ZP cycle checkpoint (prior to the OB1 cycle)	Worst case for 1 word ZPA and 1 word ZPE: 400 µs Worst case for 128 words ZPA and 128 words ZPE: 600 µs

Programmer functions:
Programmer functions vary considerably regarding their influence on the cycle delay time and therefore no generally valid times can be specified.

F S5-95U Communications Matrix and Emulation of Types of Data Transmission on Layer 2 with the S5-95U

F S5-95U Communications Matrix and Emulation of Types of Data Transmission on Layer 2 with the S5-95U

The following overview lists the Siemens devices with which the S5-95U can communicate, as well as the respective data transmission connections and services.
The matrix represents only the present state of the art (08/93).

Device	Order No.	S5-95U, Order No. 6ES5 095-8MB12				
		Standard Conn.	PLC-PLC Conn.	ZP Master	ZP Slave	Layer 2 Services
S5-95U	6ES5 095-8MB21	x	x	x	x	
S5-95U	6ES5 095-8MB22	x	x	x	x	x
CP5430-0	6GK1 543-0AA00		x		x	x
CP5430-1	6GK1 543-0AA01		x		x	x
PC conn. FDL-NET5412/MS-DOS						x
TD10/220-5*	6AV3 010-1DK00					x
TD10/240-8*	6AV3 010-1EL00					x
TD20/240-8*	6AV3 020-1EL00					x
OP20/220-5*	6AV3 520-1DK00					x
OP20/240-8*	6AV3 520-1EL00					x
OP30/A*	6AV3 530-1RR00 6AV3 530-1RR20 6AV3 530-1RR01 6AV3 530-1RR21					x
OP30/B*	6AV3 530-1RR10 6AV3 530-1RR30 6AV3 530-1RR11 6AV3 530-1RR31					x
OP30/C*	6AV3 530-1RS31					x

* **Under development** (possible only with standard function block FB55 for the TD/OP link to SIMATIC S5, Order No. 6AV3 980-1AA21-0AX0 and over the SINEC L2 S5 module option, Order No. 6AV3 970-1XB30-0AA0)

Emulation of Types of Data Transmission for the S5-95U on Layer 2

Type of Data Transmission	**L2 Frame**	**Length of L2 Frame (in Net Data)**	**L2 SAPs (Default SAP not Permitted)**	**L2 Source Addresses**
Standard Connection	Send frame: • SDA low • SDN low for broadcasting Receive frame, active stations: • SDA low, • SDA high, • SDN low and SDN high permitted Receive frame, passive stations: • Only SDN low permitted	Send frame: • 1 to 242 bytes Receive frame: • 1 to 242 bytes permitted	When sending: • Local SAP = 56 • Remote SAP = 56 When receiving: • Local SAP = 56 • Remote SAPs, only 56 permitted	When receiving: • All source addresses permitted
PLC-PLC Connection	Send frame: • SDA low Receive frame: • Only SDA low permitted	Send frame: • 1 to 242 bytes Receive frame: • 1 to 242 bytes permitted	When sending: • Local SAP = destination address + 1 • Remote SAP = local address + 1 When receiving: • Local SAP = source address + 1 • All remote SAPs permitted	When receiving: • Only source address = local SAP - 1 permitted

Emulation of Types of Data Transmission for the S5-95U on Layer 2 (Continued)

Type of Data Transmission	L2 Frame	Length of L2 Frame (in Net Data)	L2 SAPs (Default SAP not Permitted)	L2 Source Addresses
ZP Master	Send frame of ZP master: • SRD low Response frame from ZP slave: • RESPONSE low and RESPONSE high permitted	Send frame of ZP master: • 0 to 242 bytes Response frame of ZP slave: • 0 to 244 bytes permitted	When sending: • Local SAP of ZP master = 61 • Remote SAPs of ZP slaves = 0 to 62 (configurable in DB1)	-
ZP Slave	Response frame of ZP slave: • RESPONSE low Receive frame from ZP master: • SRD low only permitted	Response frame of ZP slave: • 0 to 242 bytes Receive frame from ZP master: • 0 to 242 bytes permitted	When receiving: • Local SAP of ZP slave = 61 • Remote SAPs of ZP master = 0 to 62 permitted	When receiving: • All source addresses permitted
Layer 2 Services	Send frame: • SDA low/high • SDN low/high • SRD low/high Receive frame: • SDA low/high • SDN low/high • SRD low/high	Send frame: • 0 to 242 bytes Receive frame: • 0 to 242 bytes permitted	When sending: • Local SAP = 33 to 54, 64 (default SAP permitted) • All remote SAPs permitted When receiving: • Local SAP = 33 to 54, 64 (default SAP permitted) • All remote SAPs permitted	When receiving: • All source addresses permitted

Special Feature: If an S5-95U is in the STOP mode, receiving of a frame via the standard connection (not broadcasting) and the PLC-to-PLC connection (local SAP=56 and 2 to 32) is acknowledged on layer 2 with ”UE” (FDL/FMA 1/2-User Error) if the connection was properly configured in the local S5-95U.

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