SIMATIC S5

Second Serial Interface of the S5-95U Programmable Controller

Manual

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Introduction

The S5-95U programmable controller with second serial interface can communicate with other devices via interface-specific functions.

In order to be able to use the performance capability of the second serial interface of the S5-95U (SI2) in full, the user requires detailed information.
This Product Manual describes all functions which are possible at the second serial interface of the S5-95U (SI2). It represents a supplement to the S5-90U/S5-95U System Manual. We assume therefore that you have the S5-90U/S5-95U System Manual.

For information concerning both the S5-95U with SI2 and the S5-95U basic device, e.g. ″installation guidelines″, ″startup and program testing″, refer to the S5-90U/ S5-95U System Manual. At corresponding locations in the Product Manual, reference is made to sections in the System Manual.

Experience in installation and startup of electrotechnical plants is not necessary but helpful in order to work successfully with this Product Manual.

On the following pages, you will find information which should facilitate handling of the Product Manual.

Description of contents

- Section 1
  This introductory section provides an overview of the devices that can be connected to the second serial interface of the S5-95U. You will learn which communications mechanism you should use for your specific application and which special features are to be considered if devices are connected to both serial interfaces of the S5-95U.

- Sections 2, 3 and 4
  In these sections, the different communications mechanisms are explained in detail by way of examples.

- Appendices
  The appendices contain overviews for regular use, such as all DB1 parameters for SI2 and additional information for the ″system expert″, e.g. where the individual parameters are entered in the system data area.

To make the startup phase of your system as short as possible, we recommend using this Product Manual in the following way:

Read Section 1 since it tells you which communications mechanism is best suited to your application
Read the relevant section on ″communications″ (2, 3 or 4).

Conventions

The uniformity of the S5-90U/S5-95U System Manual and the Product Manual ″Second Serial Interface of the S5-96U Programmable Controller″ is assured.
All conventions which are listed in the introduction to the System Manual apply to this Product Manual. Please refer to the System Manual.

For definitions of the terms ″Warning″, ″Danger″, ″Caution″ and ″Note″ please see the ″Safety-Related Guidelines for the User″ at the end of this introduction.

Courses

SIEMENS offers extensive training opportunities for SIMATIC S5 users.
For more detailed information please contact your Siemens office.

Reference material

Reference material is listed in the S5-90U/S5-95U System Manual, Appendix E.

Information on the range of devices available for an S5-95U programmable controller is provided in the following catalogs:

- ST 52.1 ″SIMATIC S5-90U, S5-95U and S5-100U Programmable Controllers ET 100U Electronic Terminator″
- ST 52.3 ″SIMATIC S5-115U, S5-115H and S5-115F Programmable Controllers″
- ST 54 ″SIMATIC S5-135U and S5-155U Programmable Controllers″
- ST 59 ″SIMATIC S5 Programmers″
- ST 80 ″COROS Control and Process Monitoring Systems″
- IPC 10 ″SICOMP Industrial PCs System Units and Standard Peripherals″
- IPC 12 ″SICOMP Industrial PCs Communications and Process Peripherals″
- PR 30 ″SICOMP M Computer-Systems″
- MOBY-I ″MOBY-I Identification System″
- MP 66 ″TELEPERM M Automation Systems AS 235, AS 235 H and AS 235 K″

Other components and modules (e.g. CPs and SINEC L1) are described in separate manuals. These sources of information will be referred to in the relevant sections of this manual.

Sheets for corrections/suggestions are included at the end of this manual. Please enter your suggestions for improvement, additions and corrections in these sheets and return them to us. In this way, you enable us to improve the next edition.

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.
Quialified 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.

Figures

Tables

1 Description of the System

This section contains information on the following:
- Performance range and the advantages which the second serial interface offers to you
- Devices you can connect to the second serial interface
- Criteria according to which you can determine the ″correct″ communications mechanism for your specific application
- Features of the communications mechanisms
- Special features to be considered when operating two serial interfaces
- Display and control elements of the PLCs and the assignment of the SI2 interface.

The flexibility of a logic control is of great importance for the productivity of a manufacturing plant.
To achieve a high degree of flexibility, complex control functions can be distributed among several devices.
This means
- You obtain small and handy units. You can easily configure, commission, diagnose, modify, operate and monitor the overall process
- You have a better control of your plant because when one unit fails, the remaining system can continue to work.

When distributing the control functions among several devices, the information flow between the individual devices must be guaranteed in order
- to exchange data between individual programmable controllers,
- to monitor, operate and control manufacturing plants centrally,
- to be able to compile management information (e.g. production and stock data).

For these reasons, the S5-95U programmable controller with two serial interfaces has been developed as a variant of the S5-95U basic unit.

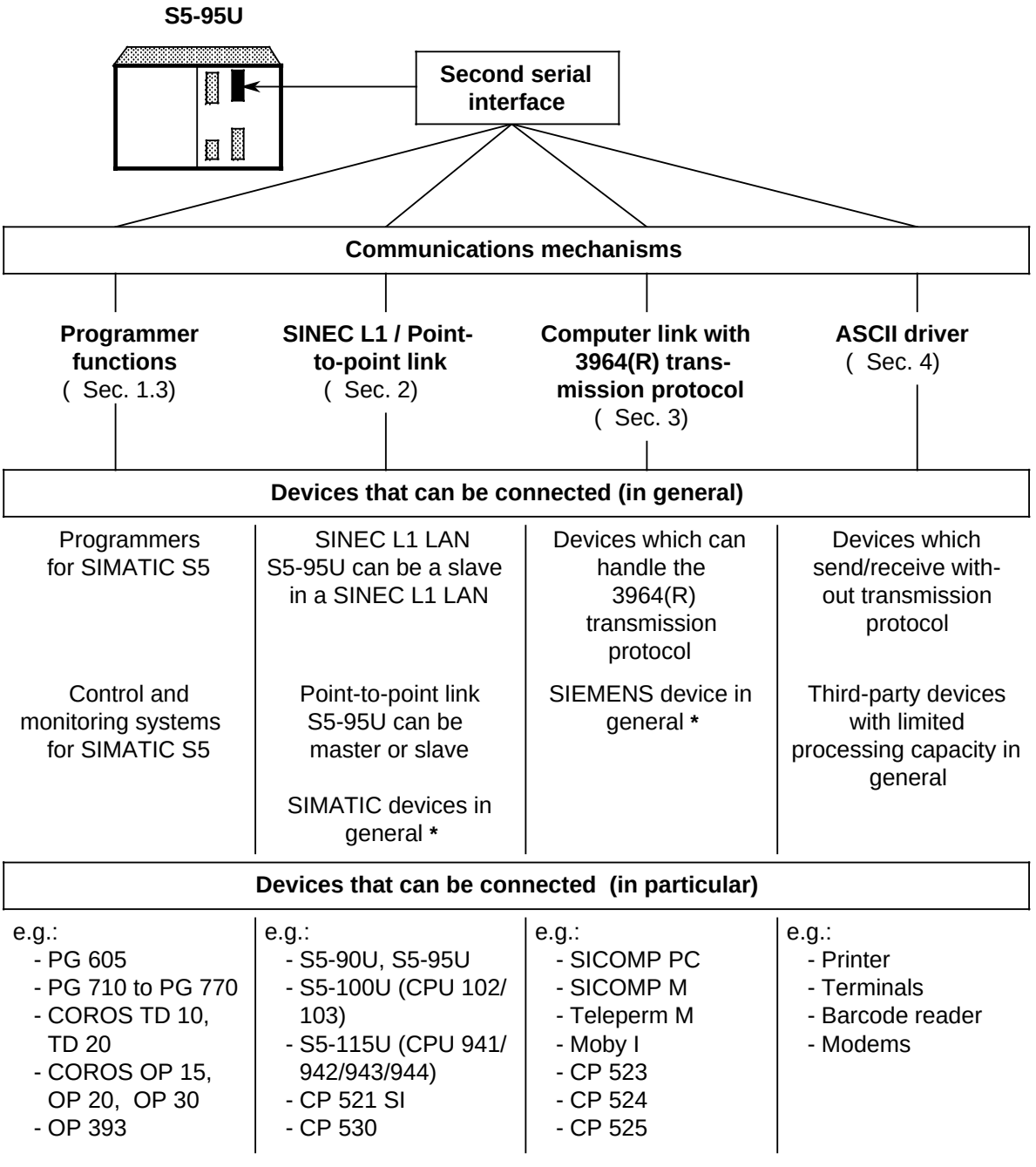
The second serial interface provides the following communication possibilities:
- Communication via the SINEC L1 local area network (LAN)
- Point-to-point link (SINEC L1 protocol)
- Computer link with the 3964(R) transmission protocol
- ASCII driver, e.g. for visualization of process sequences
- Programmer functions for operator control and monitoring of processes

The second serial interface offers the following advantages:
- Parallel operation of programmer and operator panel at the S5-95U is possible
- Parallel operation of programmer/operator panel and SINEC L1 at the S5-95U (slave) is possible
- Parallel operation of programmer/operator panel and interfacing with a further partner is possible via:
  - Point-to-point link (SINEC L1 protocol)
  - Computer link with 3964(R) transmission protocol
  - ASCII drivers
- Low-cost interface to a further PLC (SIMATIC S5) via point-to-point link
  e.g. S5-95U with S5-100U (CPU 102); no CP required
- Simple connection to SIEMENS devices via computer link
  e.g. S5-95U with SICOMP PC
- Simple connection to third-party devices via ASCII driver
  e.g. connection of a barcode reader to an S5-95U

1.1 Possible Applications of the S5-95U with Second Serial Interface

The following overview shows you:

- which devices/systems can communicate with the S5-95U via the second serial interface of the S5-95U and
- which communications mechanism for which node can be used in the S5-95U.



***** On account of the widespread use of SINEC L1, numerous third-party manufacturers offer device interfaces for SINEC L1 and/or 3964(R) transmission protocol.

Figure 1-1 Device Configurations

Selection of communications mechanism

The optimum communications mechanism for all communication partners is not determined by the device configuration alone. Thus it is possible to use the point-to-point link, the computer link or the ASCII driver for PLCs and CPs as communication partners of the S5-95U.

These three communications mechanisms are therefore compared in the following table
(Table 1-1).
You can decide by means of the table which are the important criteria for your specific application and consequently, which communications mechanism you use.

Table 1-1 Criteria for Selecting the Communications Mechanism

Selection Criteria		Point-to-P. Link w. SINEC L1 Protocol	3964(R) Computer link	ASCII Driver
Interface with	SIMATIC PLC	Yes	Possible	Possible
	SIEMENS Device	Possible	Yes	Possible
	Third-Party Device	Possible	Possible	Yes
Maximum Number of Net Data per Request		64 bytes	1024 bytes	1024 bytes
Safe Data Transmission Ensured by Protocol		Yes	Yes	No
Flexible Transmission Format can be used*		No	Yes	Yes

***** e.g. transmission rate, data format and parity (Section 3; 4)

The following overview (Table 1-2) contains the main characteristics of all communications mechanisms supported by the SI2 interface.

Table 1-2 Characteristics of the Communications Mechanisms

Communications Mechanism	Features
Programmer Functions	• PLC is programmed with programmer or process functions in the PLC are monitored with operator panel • Programmer functions are especially suitable for startup of PLCs and input and output of messages • An operator panel can be permanently connected to Si1 or SI2, a serial interface remains free for a programmer.
SINEC L1 / Point-to-Point Link	• The S5-95U can access the SINEC L1 LAN via SI1 or SI2. • Point-to-point link making use of the SINEC L1 protocol is possible (1 S5-95U+1 communication partner), for this purpose, no CP 530 is necessary. • Safe process data transmission • Data volume per request: 64 bytes
3964(R) Computer Link	• Bidirectional data communication with protocol protection mechanism (in two directions) • The LAN must be able to process the 3964(R) protocol • Safe process data transmission • Data volume per request: Maximum of 1024 bytes
ASCII Driver	• Bidirectional data communication without protocol-dependent error detection and correction functions • Flexible transmission format can be set, resulting in easy adaptation to the LAN • The ASCII driver is especially suitable for visualization of process sequences and input/output of messages • Data volume per request: Maximum of 1024 bytes

1.2 Range of Functions of the Two Serial Interfaces

You can connect programmers and operator panels at both serial interfaces.
The entire range of functions of the interfaces is listed in Table 1-3. The program execution period may be extended when connecting a programmer, operator panel or SINEC L1 to the SI1 or SI2 interface (for scan on-load times of the PLC, see Appendix E).

> **Note**
>
> If a function is not parameterized in DB1, the driver number "00_H" is automatically written in the system data during startup of the PLC (Appendix B, system data word 46); i.e. you can operate a programmer or operator panel at the SI2 interface immediately after the restart of the PLC.

Table 1-3 Overview of the Functions Possible at SI1 and SI2 interfaces

Programmer Function Designation	Abbreviation	Possible at SI1	Possible at SI2
Input block	INPUT	X	X
Output block	OUTPUT	X	X
Test	**TEST**		
Program test	PROG TEST	-	-
END program test	END TEST	-	-
Signal status display	STATUS	X	-
PLC functions	**PC FCT**		
PLC restart	START	X	X
PLC STOP	STOP	X	X
Compress	COMPRESS	X	X
STATUS variable	STAT VAR	X	X
Force	FORCE	-	-
Force variable	FORCE VAR	X	X
PLC information	**PC INFO**		
Output addresses	OUTP ADDR	X	X
Memory configuration	MEM CONF	X	-
System parameter	SYSPAR	X	X
Block stack	BSTACK	X	-
Interrupt stack	ISTACK	X	X

Table 1-3 Overview of the Functions Possible at Interfaces SI1 and SI2 (Continued)

Programmer Function **Designation**	**Abbreviation**	**Possible at SI1**	**Possible at SI2**
Auxiliary functions	**AUX FCT**		
Transfer	TRANSFER	X	X
Delete	DELETE	X	X
Directory	DIR	X	X
Function		**Possible at SI1**	**Possible at SI2**
Operator panel function		X	X
SINEC L1 slave		X	X
Point-to-point link	Master	-	X
	Slave	X	X
3964(R) computer link		-	X
ASCII driver		-	X

Concurrent use of interfaces SI1 and SI2 with programmer/operator panel functions

There are restrictions on the concurrent use of the two interfaces SI1 and SI2.
Certain requests of a programmer/operator panel to the other interface are not possible depending on the status (activity) of an interface.

If this occurs, the function is aborted by the operating system of the CPU at the relevant interface. The following error message appears: ″AS function disabled: current function″.
This message draws your attention to the fact that a function which blocks the requested function is currently being executed on the other interface.

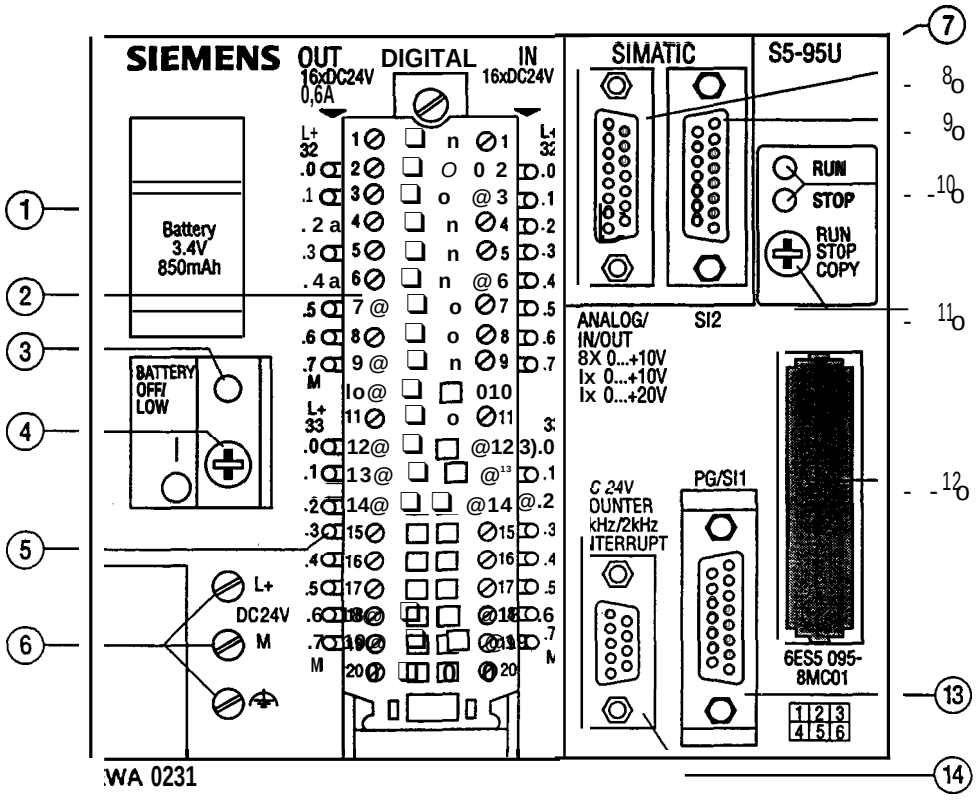
Example: If ″TEST STATUS″ runs at SI1, ″INPUT BLOCK″ is not possible at SI2.

At the SI2 interface, **no programmer/operator panel function** is possible if one of the following functions is activated:

- Point-to-point link,
- Computer link
  or
- ASCII driver.

1.3 Configuration of the PLC and Assignment of the Second Serial Interface

The figure below **shows all displays, controls and interfaces of the S5-95U (6ES5095-8MC01).**

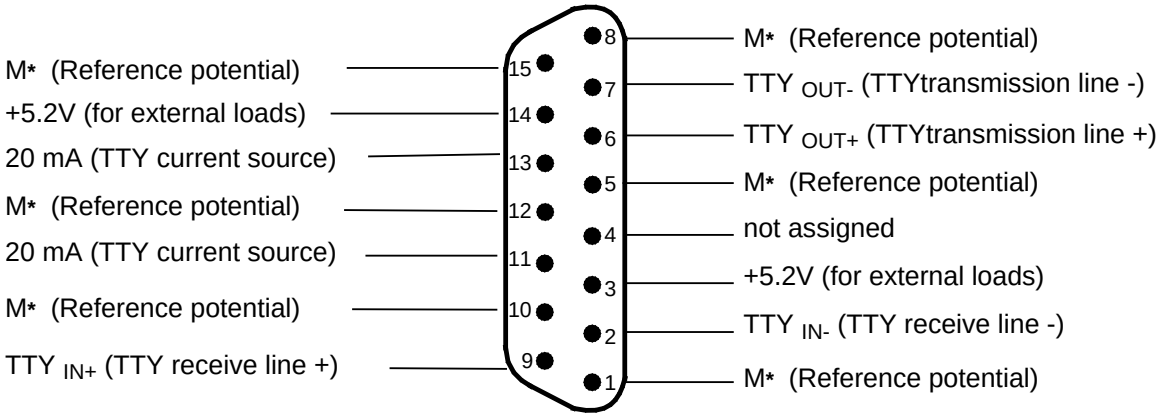


(1) **Battery compartment**
(2) Front connector for digital inputs (I 32.0 . . . I 33.7) and for digital outputs (Q 32.0 . . . Q 33.7)
(3) Battery low LED
(4) On/off switch
(5) LEDs **for digital inputs and outputs**
(6) **Terminals for connecting the** power supply
(7) Cable connector **for S5-1OO modules**
(8) **Interface for analog inputs (IW 40 . . . IW 54) and for analog outputs (QW 40)**
(9) **Second serial interface**
(10) **RUN/STOP LEDs: green LED → RUN; red** LED → STOP
(11) RUN/STOP/COPY SWITCH
(12) Receptacle for **user submodule: E(E)PROM**
(13) **Interface for PG,** PC, OP or SINEC L1 LAN
(14) Interface **for interrupt inputs (1 34.0 . . . 34.3) and for counter inputs (IW 36, IW 38)**

Figure 1-2 S5-95U LEDs, Controls and Interfaces

The second serial interface is non-floating. The cables are connected to a 15-pin sub D socket.

Assignment of the 15-pin sub D socket:



* M ≙ M internal (still available at interface SI1)

Figure 1-3 Pin Assignments of the Second Serial Interface of the S5-95U

Figures

Tables

2 Point-To-Point Link with SINEC L1 Protocol

This section covers the following:

- Possible communication partners for the S5-95U
- How to connect communication partners to the SI2 interface
- Data communication via point-to-point link
- Parameter assignment of the PLC
- Product Manuals where you can find further information on the point-to-point link
- Structure of the PLC program for the point-to-point link (example).

The SINEC L1 protocol is SIMATIC-specific and is therefore used for networking SIMATIC components. In the meantime, there is also a range of third-party devices which also have the SINEC L1 protocol.

SINEC L1 LAN and S5-95U as a communication partner

SINEC L1 is a LAN for linking SIMATIC S5 PLCs; it works according to the master/slave principle.
A single PLC called master handles all coordination and monitoring of data traffic in the LAN as well as the through-switching and monitoring of programming functions on the bus. All other PLCs automatically become slaves.

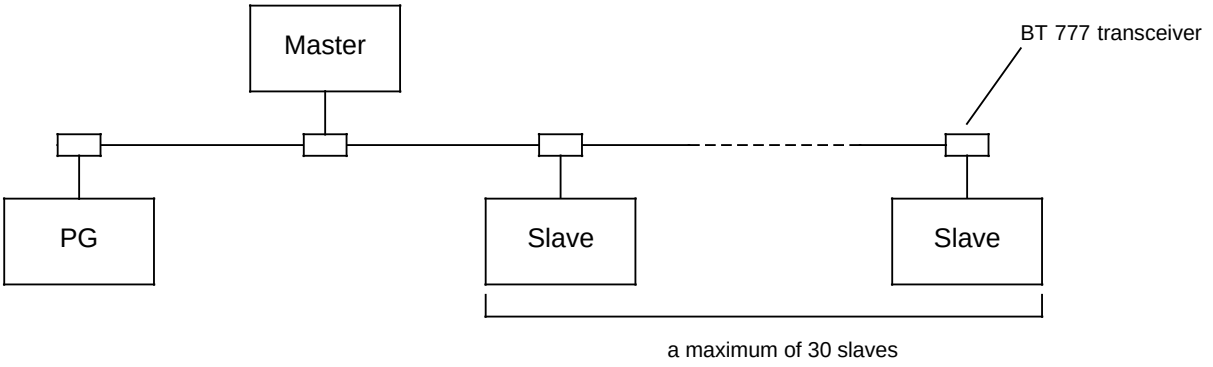


Figure 2-1 Structure of a SINEC L1 LAN

Special features of the S5-95U as node:
- The S5-95U can only be a slave on the SINEC L1 LAN.
- Both serial interfaces SI1 and SI2 have slave capability (however not both at the same time).

For further information on the SINEC L1 LAN, please refer to the SINEC L1 LAN Manual.

Point-to-point link with SINEC L1 protocol and S5-95U as a communication partner

The point-to-point link is a special case of SINEC L1 communication. A SINEC L1 LAN is reduced to two nodes.
Data, logic control and error detection and correction data can only be exchanged between two communication partners.
The communication partners are not equal, there is one (point-to-point) master and one (point-to-point) slave. The slave can only send data after a request from the master.

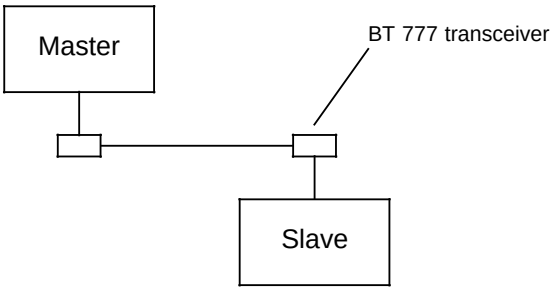


Figure 2-2 Structure of a Point-To-Point Link with BT 777 Transceiver

Restrictions as compared to a SINEC L1 LAN:
- Communication possible with exactly one slave
- In the point-to-point link, a programmer cannot be connected additionally.

Special features of the S5-95U in a point-to-point link:
- The S5-95U is master for the communication partner. Only the SI2 interface has master capability.
- The S5-95U can be slave for the communication partner. Both serial interfaces have slave capability.

For cost saving, one can renounce the BT 777 transceiver if both communication partners are linked via a special cable (direct cable).

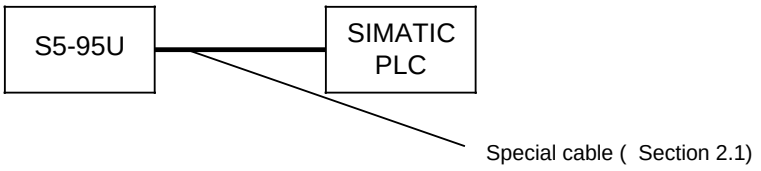


Figure 2-3 Structure of a Point-To-Point Link with Direct Cable

Data transmission and parameter assignment always correspond to SINEC L1 communication via the SI1 interface of the S5-95U (Section 2.2).

As a communication partner in the point-to-point link, you can use the following modules
(Table 2.1).

Table 2-1 Communication Partners in the Point-To-Point Link

Applications of the S5-95U	Communication Partners (master)	
S5-95U is slave	**S5-95U**	with 2 serial interfaces
	CP 521 SI	
	S5-115U	with CPU 943/944 with 2 serial interfaces
	CP 530	
S5-95U is master	**Communication Partners (slave)**	
	S5-100U	with CPU 102/103
	S5-90U / 95U / 101U	
	CP 521 SI	
	S5-115U	with CPU 941/942/943/944
	CP 530	

Proceed as follows for startup of the S5-95U:

Link the S5-95U with the communication partner via the SI2 interface (Section 2.1).
Parameterize the point-to-point link in DB1 of the S5-95U (Section 2.2).
Enter the PLC program into the programmer (example Section 2.4).
Transfer DB1 and the PLC program to the S5-95U.
Switch the mode selectors of the S5-95U and the communication partner from STOP to RUN.
Also note Section 4.2 ″Starting Up a System″ in the S5-90U/ S5-95U System Manual.

2.1 Conection of Nodes in a Point-To-Point Link

A link can be set up in two ways:

- Via a bus cable with transceivers (BT 777, S5-90U/S5-95U System Manual, Section 14)
  or
- via a direct cable (Figure 2-4, 2-5). Use a 4-core, shielded cable with a cross-section of at least 0.14 mm². We recommend the 707-1 bus cable 707-1(Order number Appendix D).

Linking point-to-point master (TTY active) with point-to-point slave (TTY passive)

Cable length: < 100 m

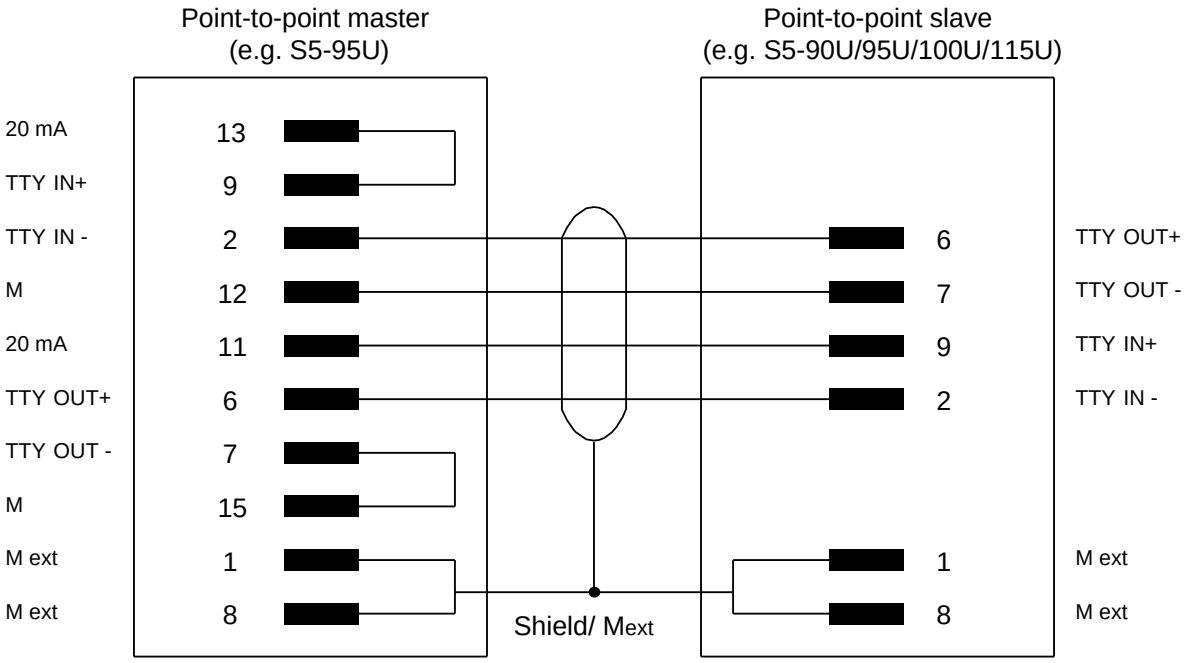


Figure 2-4 Pin Assignments Point-To-Point Master (TTY Active) - Point-To-Point Slave (TTY Passive)

Linking the S5-95U as master with the CP 521 SI (TTY passive) as slave (TTY active)

Cable length: < 100 m

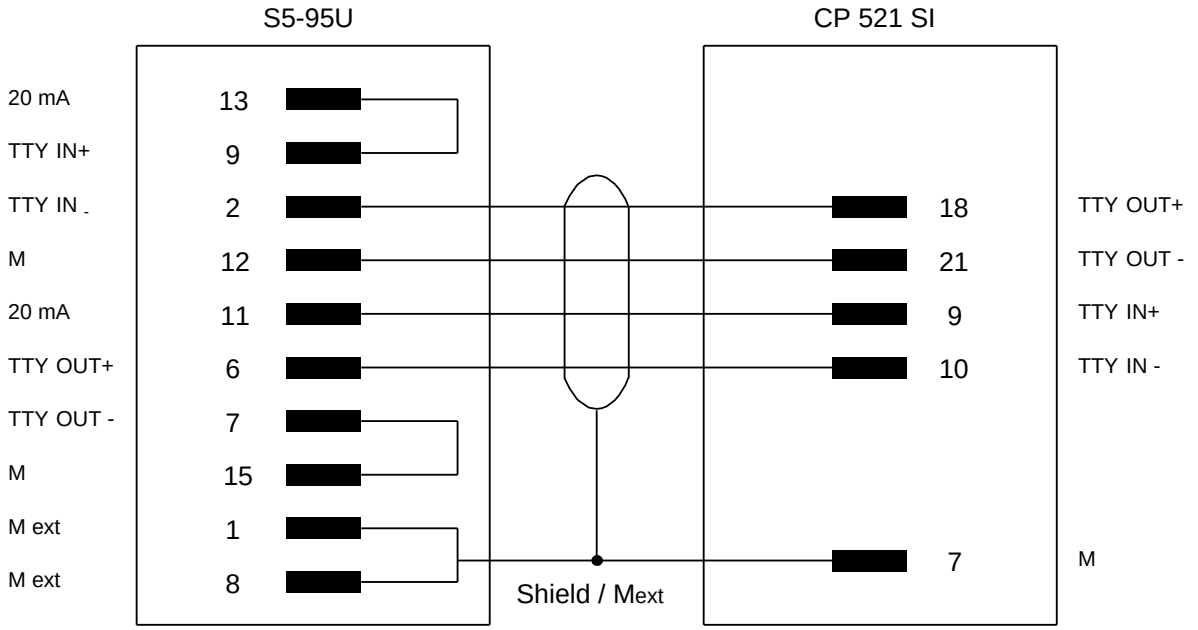


Figure 2-5 Pin Assignments S5-95U (TTY Active) - CP 521 SI (TTY Passive)

Note

If the wiring is incorrect, the SI2 interface can be destroyed.

2.2 Data Traffic and DB1 Parameter Assignment in a Point-To-Point Link

As in the case of the SINEC L1 LAN, data traffic is handled via send and receive mailboxes, which are accessed by the PLC program via load and transfer operations (S5-90U/S5-95U System Manual, Section 14.3).
The operating system of the CPU controls data transfer and stores this information in two coordination bytes. The two bytes can be read and evaluated by the PLC program.
The structure of the coordination bytes is described in the next section.

For the point-to-point link, you determine the parameters in the ″SL1:″ (SINEC L1) of DB1. The parameters for the point-to-point link correspond to the SINEC L1 parameters for the SI1 interface.
For the point-to-point link, the parameter ″slave number″ can also be set to ″0″ for the S5-95U (master function, possible only at interface SI2). The partner is then identified as slave 1.

Caution: The parameter blocks for the ASCII driver (ASC:) and the computer link (RKT:) must remain enclosed between comment characters! Only one communication possibility can ever be parameterized for the second serial interface.

Please refer to the S5-90U/S5-95U System Manual, Section 14.2, for the parameter assignment of DB1. In Section 2.4, you will find a complete program example of an S5-95U configured as a master.
In Appendix A, you will find an overview of the DB1 parameter ranges.

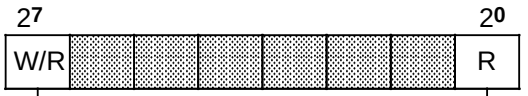
Note

As long as the SI2 interface is parameterized as a point-to-point link, no other functions are possible at the SI2 interface (e.g. programmer/operator panel).

2.3 Coordination Bytes in a Point-To-Point Link

The ″receive″ and ″send″ coordination bytes control data traffic between the partners. The meaning of the bits in the coordination bytes is explained below.

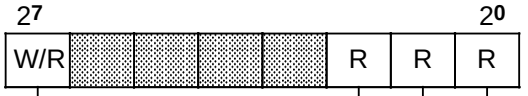
″Send″ coordination byte (KBS) (flag byte or high-order byte in the data word)



Error
0: No error
1: Send error during last data transfer

SEND-ERL (send permission)
0: Program can access send mailbox. Operating system has no access.
1: Operating system sends data from the send mailbox to the bus. Program has no access.

″Receive″ coordination byte (KBE) (flag byte or high-order byte in the data word)



Error
0: No error
1: Receive error during last data transfer

Slave-AUS
0: Normal operation
1: Partner failed

LAN RUN
0: SINEC L1 LAN is in STOP mode
1: SINEC L1 LAN is in RUN mode

EMPF-ERL (receive permission)
0: Program can fetch data from the receive mailbox. Operating system has no access.
1: Operating system can transfer data from the bus to the receive mailbox. Program has no access.

Irrelevant bits
R: Read Only (bit may only be read)
W/R: Write / Read (bit may be read and overwritten)

Figure 2-6 Structure of the Coordination Bytes

The coordination bytes, the send mailbox and the receive mailbox are parameterized at the SI1 interface in DB1 as in the case of SINEC L1 (see S5-90U/S5-95U System Manual, Section 14).

2.4 Program Example of Point-To-Point Link

In this section, the structure of a PLC program for a point-to-point link is explained in detail.

Example:
The program example can be used for any communication partner both as point-to-point master and slave.
The example can be used for an S5-95U as point-to-point master if slave number 0 is parameterized in DB1 and destination number 1 is used in FB100 for transmission (following program example).
The example can be used for an S5-95U as a point-to-point slave if slave number 1 is parameterized in DB1 and destination number 0 is used in FB100 for transmission.
The S5-95U is to receive data from the communication partner and send data to the communication partner.

Proceed as follows:

Establish the ready state at the communication partner (parameterized as slave 1).
Switch the S5-95U on and carry out ″PLC overall reset″ (PLC mode: STOP).
Parameterize the point-to-point link in DB1 of the S5-95U as described below.
Program the individual blocks as described below.
Transfer DB1 and the PLC program to the S5-95U.
Switch the mode selector of the PLC to RUN.

For the program structure of the program example please refer to the following diagram (Figure 2-7).

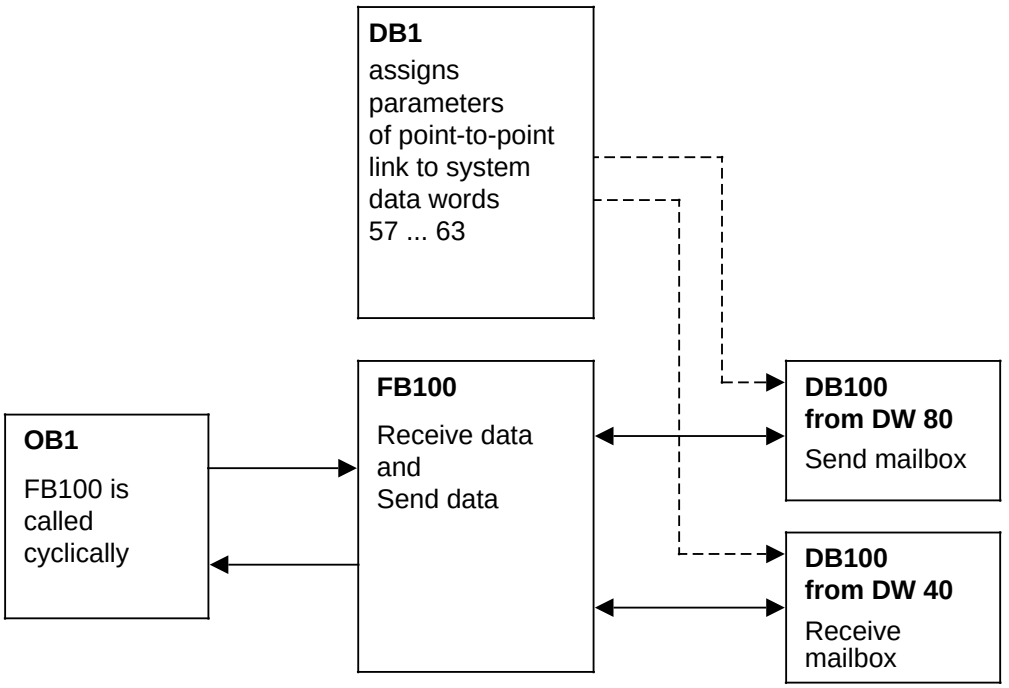


Figure 2-7 Program Structure Point-To-Point Link

DB1 STL	Description
: : 24: KS ='N ; SL1: SLN 0 SF '; 36: KS ='DB100DW80 EF DB100DW40 '; : 48: KS =' KBE MB61 KBS MB6'; 60: KS ='2 PGN 1 ; SDP: N'; 72:	Slave number: 0 (PLC is master); Send mailbox: DB100 from DW 80; Receive mailbox: DB100 from DW 40; ”Receive” coordination byte: FY 61; ”Send” coordination byte: FY 62; PG bus number: 1 (irrelevant for p. to p. link)

OB1 STL	Description
:AN I 0.0 :R F 99.0 :A I 0.0 :AN F 99.0 :S F 99.0 :S F 1.0 : :JU FB 100 NAME :P-Z-P : :BE	Pulse edge evaluation I 0.0 Positive-going edge at I 0.0 Set send initiation bit for point-to-point link Send and receive via point-to-point link

FB100 STL	Description
NAME :P-Z-P :C DB 100 : :O F 61.7 :JC =M001 : : :L DL 40 :T FY 40 :L DR 40 :T FY 41 : :L KF +1 :T FW 254 :L KF +41 :T FW 252 : M003 :DO FW 252 :L DW 0 :DO FW 254 :T DW 0 :	 Open send and receive mailbox KBE bit 7=1 ”No new data received” Jump to ”Send data” Receive data ========== Evaluate frame length and source if necessary Default settings of index scratch flags for copying the frame from the receive mailbox into the user area In the example, all 32 data words (DW 41 to DW 72) are copied into the user area DB100, DW 1 to DW 32

FB100 AWL (continued)	Description
:L KF +72	
:L FW 252	Scan to determine whether all 32 DW have
:!=F	already been copied
:JC =M002	then jump to receive mailbox enable
:L FW 252	otherwise, data word numbers are
:ADD KF +1	incremented by 1
:T FW 252	
:L FW 254	
:ADD KF +1	
:T FW 254	
:JC =M003	and next data word is copied
:	
M002 :AN F 61.7	Enable receive mailbox again for
:S F 61.7	new frame
:	
M001 :	Send data
	==========
:AN F 1.0	if no request to send,
:BEC	end
:	
:O F 1.1	if transmitting disabled or
:O F 62.7	if send request active then
:JC =M004	jump to pulse edge evaluation ”Send ready”
:	
:AN F 1.1	Disable transmission since the send mailbox
:S F 1.1	must not be changed during transmission
:L KY 64.1	Enter frame length (here = 64 bytes) and
:T DW 80	destination number (here = 1 for slave 1) in
:	1st DW of the send mailbox
:	Net data must be entered in DW 81 to DW 112
:	at this point.
:AN F 62.7	
:S F 62.7	Enable transmitting in the KBS and
:R F 1.2	reset edge auxiliary flag
M004 :	Pulse edge evaluation ”Transmission terminated”
:AN F 62.7	if KBS bit 7 changes from 1 to 0 and
:AN F 1.2	edge auxiliary flag is not set,
:= F 1.3	Edge ”Transmission terminated”
:U F 1.3	in case of negative edge,
:S F 1.2	set auxiliary flag again
:	
:A F 1.3	If transmission terminated and
:AN F 62.0	no errors have occurred during transmission,
:R F 1.0	reset send initiation bit,
:R F 1.1	reenable transmission
:	
:A F 1.3	If transmission terminated and
:A F 62.0	errors have occurred during transmission,
:R F 1.1	enable transmission for repeat
:BE	

Figures

Tables

3 Computer Link with 3964(R) Transmission Protocol

This section covers the following:

- Possible communication partners for the S5-95U
- How to connect communication partners to the SI2 interface
- Data traffic via computer link
- Parameter assignment of the PLCs
- PLC program for the computer link (example)
- 3964(R) transmission protocol.

The 3964(R) transmission protocol is SIEMENS-specific and is therefore ideal for the connection of SIEMENS devices. In the meantime, there is also a range of third-party devices which offer the 3964(R) transmission protocol.

The computer link with 3964(R) transmission protocol is used for the connection of two communication partners. The communication partners are equal, i.e. each partner can send data without a request from the other partner.

The computer link with 3964(R) transmission protocol is only possible via the second serial interface of the S5-95U (SI2).

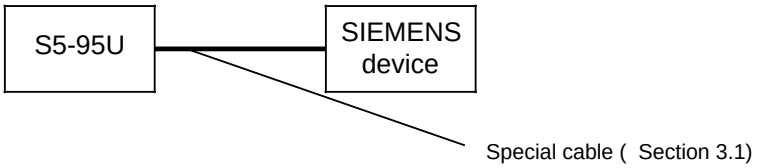


Figure 3-1 Node in a Computer Link with 3964(R) Transmission Protocol

Note

You can also interface SIMATIC components via a computer link, e.g. two S5-95U PLCs. However, in general it is more favorable to link SIMATIC components via a point-to-point link (Section 2).

A number of conventions must be agreed upon for a data transmission procedure: codes, modes, transmission rates and the sequence of transmission.

Difference between the 3964 and 3964R transmission protocols:

The 3964R transmission protocol differs from the 3964 transmission protocol by a block check character (BCC) generated and sent at the end of a transmitted data block. This block check character forms the vertical parity across all transmitted bits of a block with the same significance.
Advantage as compared to 3964 transmission protocol: Data transmission with the 3964R transmission protocol is safer.

Section 3.6 explains in detail the procedure of data transmission with the 3964(R) transmission protocol. For startup of the S5-95U, this knowledge is not necessary.

The following devices are suitable **communication partners for the S5-95U**:

- SICOMP PC
- SICOMP M (computer system)
- Teleperm M (process control system)
- MOBY-M (identification system)
- SIMATIC communication partners (e.g. CP 523, CP 525, S5-95U with two serial interfaces)

> **Note**
>
> If the computer link is activated, no other functions are possible at the SI2 interface (e.g. programmer/operator panel, ASCII driver).

Proceed as follows for startup of the S5-95U:

Link the S5-95U with the communication partner via the SI2 interface (Section 3.1).
Establish Data Set Ready on the communication partner.
Parameterize the computer link in DB1 of the S5-95U (Section 3.2).
Write the PLC program into the programmer (for an example Section 3.5).
Transmit DB1 and the PLC program into the S5-95U.
Switch the mode selector of the S5-95U from STOP to RUN.

Also note Section 4.2 ″Startup of a system″ in the S5-90U/S5-95U System Manual.

3.1 Connection of Communication Partners in a Computer Link

The communication partners are linked via a direct cable. Use a 4-core, shielded cable with a cross-section of at least 0.14 mm^2. We recommend the 707-1 bus cable (Order number Appendix D).

Linking the S5-95U (TTY active) with any communication partner (TTY passive)

Cable length: < 100 m

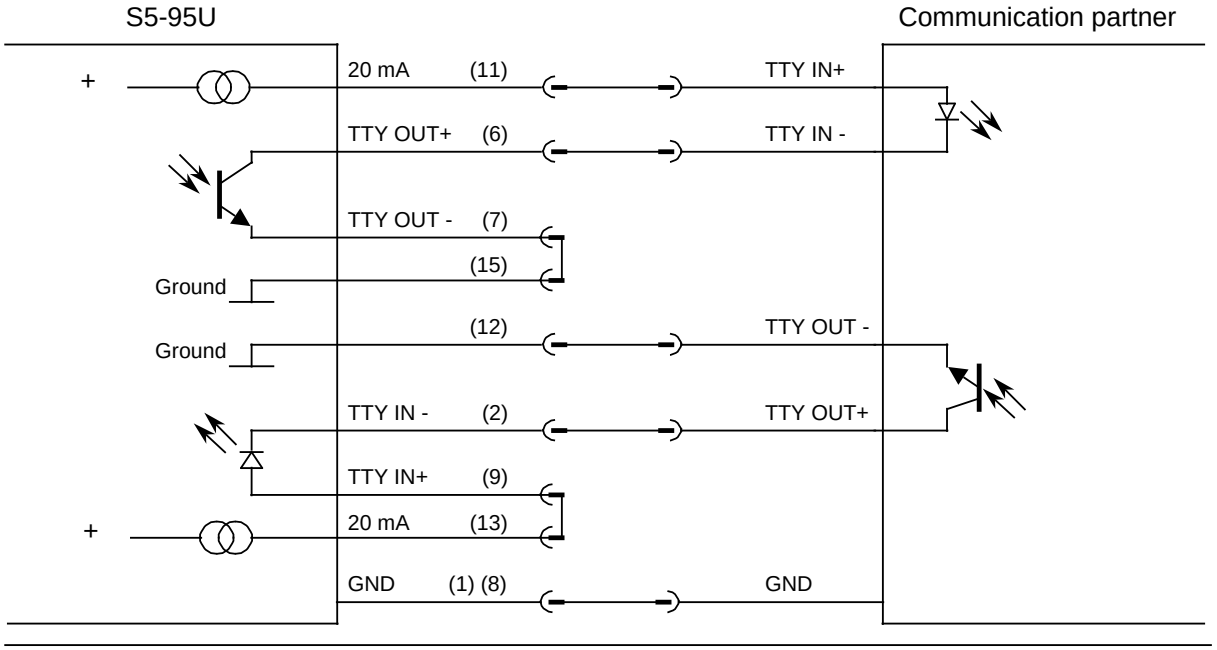


Figure 3-2 Pin Assignments S5-95U (TTY Active) - any Communication Partner (TTY Passive)

> **Note**
>
> If wiring is incorrect, the SI2 interface can be destroyed.

Linking S5-95U (TTY passive) with any communication partner (TTY active)

Cable length: see technical data of the node

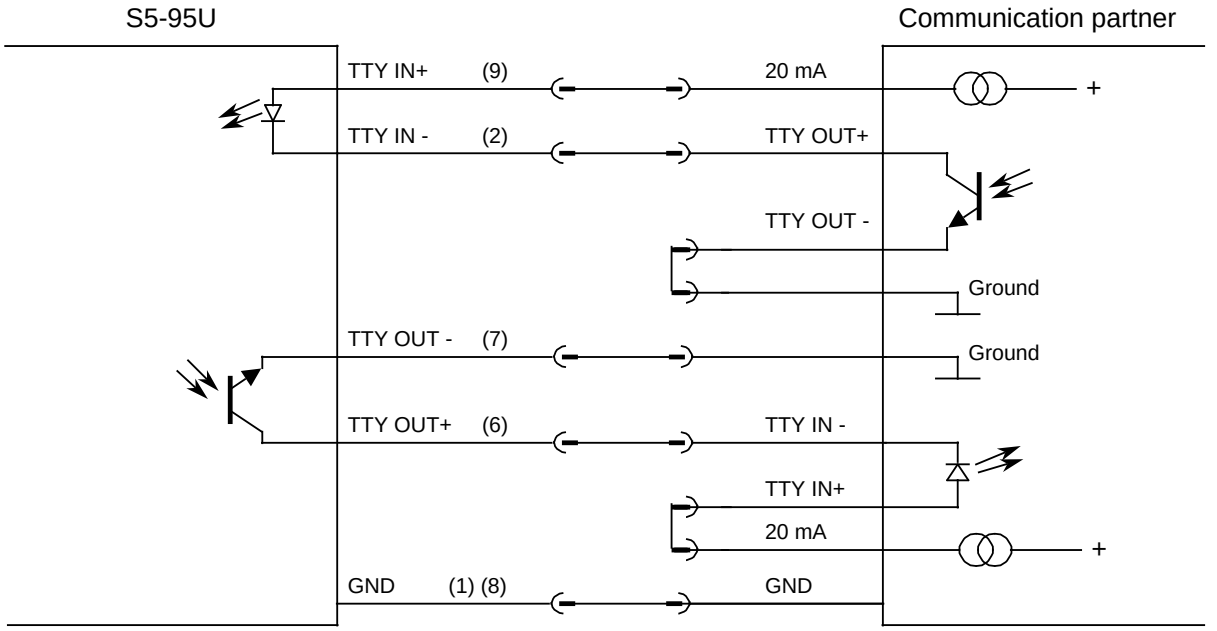


Figure 3-3 Pin Assignments of S5-95U (TTY Passive) - any Communication Partner (TTY Active)

Linking the S5-95U (TTY active) with the CP 523 (TTY passive)

Cable length: < 100 m

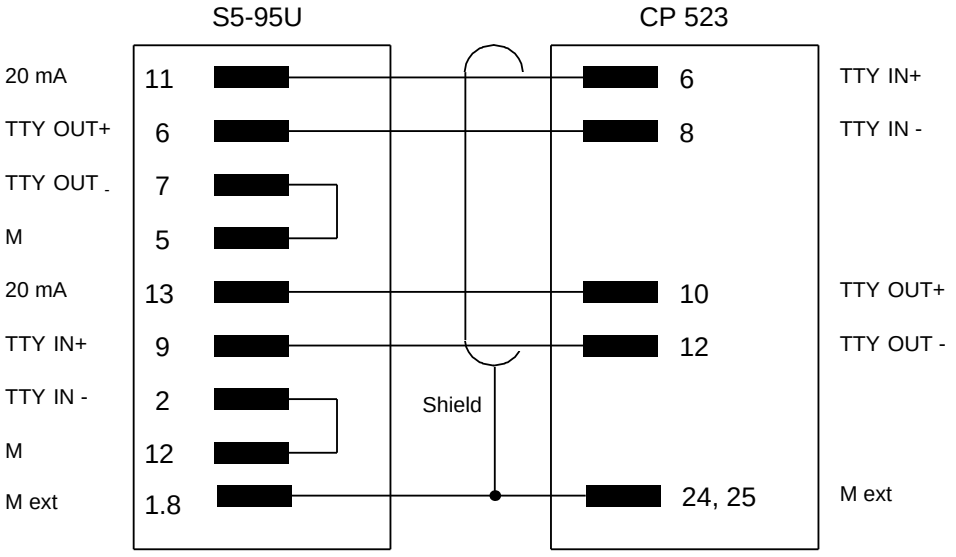
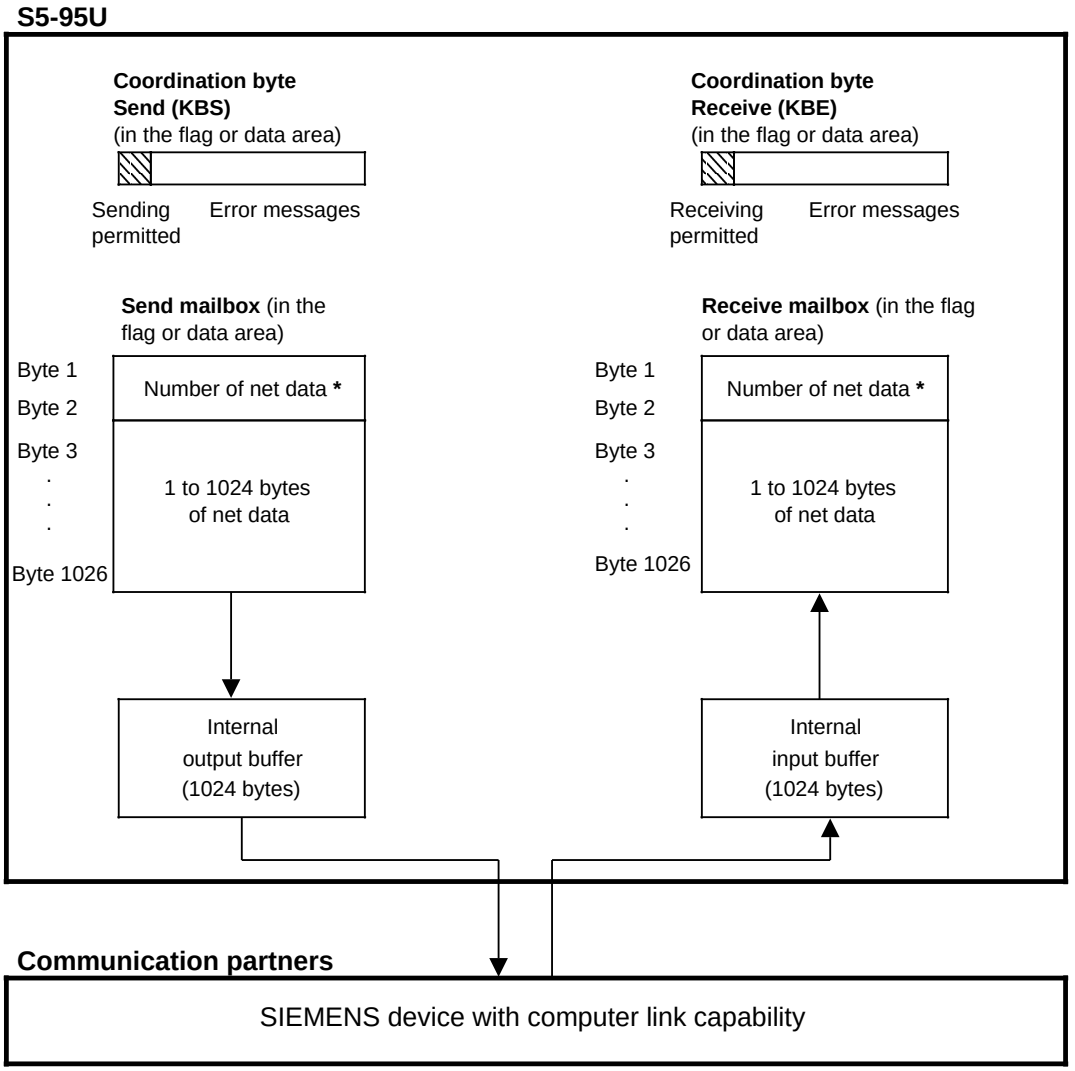


Figure 3-4 Pin Assignments of the S5-95U (TTY Active) - CP 523 (TTY Passive)

3.2 Data Traffic via Computer Link

Figure 3-5 describes the principle of operation of the computer link in a schematic diagram.



* Byte 1-^most significant half; Byte 2-^least significant half

Figure 3-5 Functional Model of a Computer Link

Data can be transmitted in both directions:

- Send direction
  Data included in the send mailbox (SF) (e.g. contents of a DBx) are buffered in an output buffer and then sent to the other communications partner.
- Receive direction
  The communication partner sends data to interface SI2 of S5-95U. The data is buffered in the input buffer and written into the receive mailbox (EF) on initiation by the PLC program.

The send and receive mailboxes may be located in the same data block or flag area.

Characteristics of send and receive mailboxes:

- In the first word of the send mailbox, the length of the data block to be sent must be specified (in bytes). The data block length (word 1) is not transmitted. The remaining words of the send mailbox are available for the data to be sent.

- In the first word of the receive mailbox, the computer link automatically enters the number of bytes received, followed by the receive data.

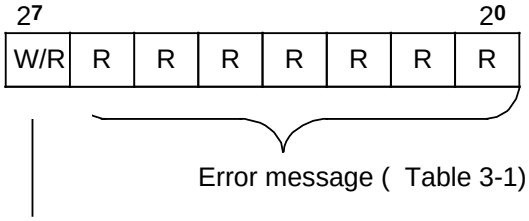
The location of the send and receive mailboxes can be parameterized in DB1 (Section 3.4).

3.3 Coordination Bytes for a Computer Link

The computer link monitors data traffic and writes status and error messages in two different bytes, the ″send″ (KBS) and ″receive″ (KBE) coordination bytes.

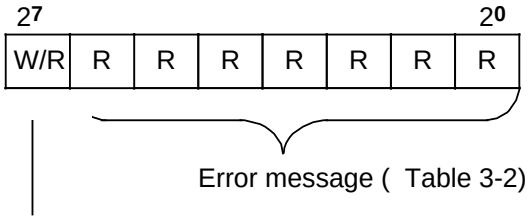
The following diagram shows the structure of the two coordination bytes.

″Send″ coordination byte (KBS) (flag byte or high-order byte in data word)



Sending permitted
Set by the user and reset by the computer link when the send procedure is terminated. The send procedure is activated by a positive-going edge at this bit.

″Receive″ coordination byte (KBE) (flag byte or high-order byte in data word)



Receiving permitted
Set by the user and reset by the computer link after receiving data either with or without errors.

R: Read Only (bit may only be read)
W/R: Write / Read (bit may be both read and overwritten)

Figure 3-6 Structure of the Coordination Bytes

Note

The bits in the coordination bytes can be set or reset by the operating system after any instruction and independently of the PLC cycle. This means that multiple scanning of the coordination bit within a program cycle may lead to different results. (Important when evaluating pulse edges!)

The error messages are listed and explained in the following tables.

Error messages in the ″send″ coordination byte

Table 3-1 Error Messages in the ”Send” Coordination Byte

Assignment	Meaning	Response
09_H	Negative acknowledgement of receiver at connection cleardown	Data invalid for receiver
$0B_H$	Negative acknowledgement of receiver at connection buildup	Data not sent
$0D_H$	Parameterizing error	Data not sent
$0F_H$	Send procedure aborted by receiver	Data invalid for receiver
11_H	No send mailbox available	Data not sent
13_H	Length exceeds output buffer size	
15_H	Timeout at connection buildup	
17_H	Timeout at connection cleardown	Data invalid for receiver
19_H	Initialization conflict, both partners have high priority	Data not sent
$1B_H$	Break	Send procedure aborted
$1D_H$	Initialization conflict, both partners have low priority	Data not sent

Error messages in the ″receive″ coordination byte

In a receive request, various errors may occur, which are assigned different priorities by the computer link. The KBE always contains the error which has the highest priority in the last receive attempt. In Table 3-2, the highest priority has the value 0 and the lowest is assigned the value 6.

Table 3-2 Error Messages in the ”Receive” Coordination Byte

Assignment	Meaning	Priority	Response
03_H	Parity error	5	Data rejected
05_H	Frame with length 0	6	
07_H	Input buffer full	2	
09_H	Too many frames received (more than 100 frames)	2	Data valid but the following frames have been rejected
$0B_H$	Frame longer than receive mailbox	0	Data rejected
$0D_H$	DLE was not duplicated or no ETX after DLE*	3	
$0F_H$	Receive mailbox not available	0	
11_H	STX error; handshaking did not start with STX **	3	
13_H	DT character delay time error	4	
15_H	BWT block wait time error	2	
17_H	Check sum error	5	
$1B_H$	Break	1	

* DLE and ETX are control characters for connection buildup and cleardown (DLE = Data Link Escape, ETX = End of Text). The procedure automatically duplicates this data item to make sure that a data item having the same code as a control character (DLE in this case), is recognized as data by the procedure.
The control character sequence DLE - ETX is fixed to ensure a proper connection cleardown.

** STX is the control character for extablishing the link with the other node (STX = Start of Text).

The position of the coordination bytes is to be parameterized in DB1 (Section 3.4).

3.4 Parameterizing the Computer Link in DB1

To facilitate parameterizing, DB1 has default settings and is loaded in the PLC.
If you load the default DB1 from the PLC into the programmer after an overall reset and display it on the screen, it has the following structure:

```
  0:     KS  ='DB1 OBA: AI 0 ; OBI:    ';
 12:     KS  ='   ; OBC: CAP N     CBP ';
 24:     KS  ='N      ;#SL1: SLN 1  SF ';
 36:     KS  ='DB2  DW0   EF DB3  DW0  ';
 48:     KS  ='  KBE MB100      KBS MB1';
 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  =' ; # #RKT: PAR DB202DW0 ';
168:     KS  ='   SF DB203DW0   EF DB204';
180:     KS  ='DW0   KBS MB104      KBE';
192:     KS  =' MB105      MOD 1  BDR  ';
204:     KS  ='9600 PRTY EVEN DF 1  DT ';
216:     KS  ='220    PRI HIGH TIO 2000';
228:     KS  ='    BWT 4000    TTE 6    ';
240:     KS  ='TTS 6   ;#  #ASC:  PAR  ';
252:     KS  ='DB202DW0   SF DB203DW0  ';
264:     KS  =' EF DB204DW0   KBS MB104';
276:     KS  ='      KBE MB105      MOD';
288:     KS  =' 1 BDR 9600 PRTY EVEN   ';
300:     KS  ='DF 0 DT 100    ML 64   ;';
312:     KS  =' # END  ';
```

Default parameters of computer link

Figure 3-7 DB1 with Default Parameters

The parameters for the computer link are assigned in the parameter block with the block designation ″RKT:″ (grey background).
The parameter block for the computer link is enclosed between comment characters (#) and is thus not interpreted by the PLC. You should therefore overwrite with a blank the comment character preceding the block designation ″RKT″: and the comment character following the last computer link parameter.

Note: The ASCII parameter block (″ASCII″) must remain enclosed between comment characters! Only one communication procedure at a time can be parameterized for the second serial interface.

The procedures for input, modification and transmission of DB1 are described in detail in the S5-90U/S5-95U System Manual, Section 9.1.3.

The following table (Table 3-3) lists all parameters for the computer link with their permissible ranges. The parameters are also clearly explained.

DB1 parameters for the computer link

You specify the following in DB1:
- Position of the parameter set for the computer link
- Positions of send mailbox, receive mailbox, ″send″ and ″receive″ coordination bytes
- Mode number
- Parameter set for computer link.

Table 3-3 Computer Link, DB1 Parameters

Parameter	Argument	Permissible Range	Meaning
Block Identifier: RKT:			**Computer Link with Second Interface**
PAR [1]			Position of ***PAR***ameter set
SF	DBxDWy	x= 2 ... 255	Position of send mailbox (beginning)
EF	or	y= 0 ... 255	Position of receive mailbox (beginning)
KBS	MBz	z= 0 ... 255	Position of ″send″ coordination byte
KBE			Position of ″receive″ coordination byte
MOD	n	n= 1, 2	″***MOD***e number″
			Parameter set for computer link:
BDR	m	m= 200; 300; 600; 1200; 2400; 4800;9600	″***B***au***D R***ate″ transmission rate in bit/s
PRTY	p	p= E(VEN); O(DD); M(ARK); S(PACE); N(ONE)	″***P***a***R***i***TY***″
DF	q	q= 0 ... 5, 7, 8	″***D***ata ***F***ormat″
DT	s [2]	s= 10 ... 655330	″***D***elay ***T***ime″ Character delay time in ms
PRI	r	r= H(IGH); L(OW)	″***PRI***ority″
TIO	t [2]	t= 20 ... 655340	″***TI***me ***O***ut″ in ms
BWT	u [2]	u= 30 ... 655350	″***B***lock ***W***ait ***T***ime″Block waiting period in ms
TTE	v	v= 1 ... 255	″***T***ries ***T***o ***E***rrect″ Number of buildup
TTS	w	w= 1 ... 255	

[1] The ”PAR” parameter must precede the parameter set for the computer link in the ”RKT:” parameter block.
[2] Specify in 10 ms steps.

The parameter settings in the S5-95U and the other communication partner must be identical except for the parameter ″PRI″ (priority). Opposite priorities must be set in the communication partner and the S5-95U to avoid initialization conflicts (Section 3.6).
Note: If you have specified a DB after the ″PAR″ parameter in DB1, you have to generate this DB before switching the PLC from STOP to RUN.

Mode number for computer link (MOD)
Two modes are available for the type of data transmission.
Table 3-4 shows the meanings of the individual mode numbers.

Table 3-4 Meanings of the Mode Numbers

Mode	Meaning	Default in DB1:
1	No block check character is sent at the end of a transmitted data block (3964).	X
2	A block check character (BCC) is sent at the end of a transmitted data block (3964R).	

Parameter set for computer link (PAR)
The defaults necessary for data exchange are entered in the parameter set.

The following is to be specified in DB1:
- Data block / flag byte to include the parameter set (in DBx, from DW y onwards)
- All parameters of the parameter set (Table 3-3).

Access to parameterization data (Figure 3-8):
- The DB1 interpreter stores the parameters **"PAR",** "SF", "EF", "KBS", "KBE" and "MOD" in the system data from system data word 48 onwards (Appendix B).
- The DB1 interpreter stores the parameters of the parameter set in the DBx defined in the system data, starting from DWy.
- The driver for the computer link in the operating system of the PLC accesses the parameterization data as described in Figure 3-8.

Section 3.5 includes an example DB1 and the associated parameter set DB.

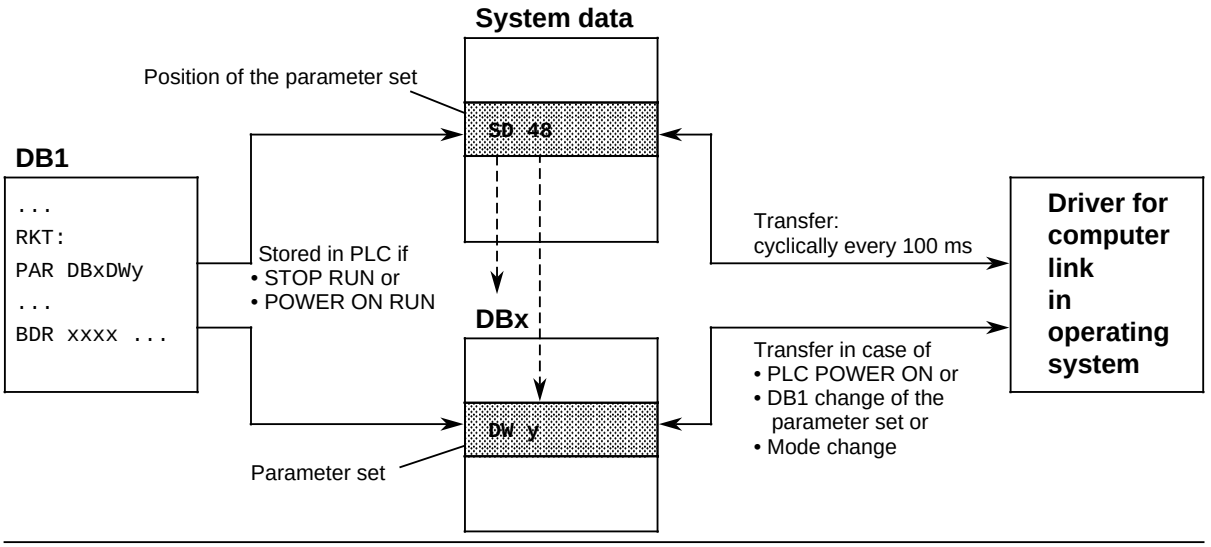


Figure 3-8 Access to Parameterization Data in a Computer Link

Parity (PRTY)
Five types of parity are available.

Table 3-5 Meanings of the Types of Parity

Parity	Meaning	Default in DB1:
EVEN	**Even parity** The parity bit is set to ensure that the sum of the data bits (including parity bit) with signal state ″1″ is even.	X
ODD	**Odd parity** The parity bit is set to ensure that the sum of the data bits (including parity bit) with signal state ″1″ is not even.	
MARK	The parity always has signal state **″1″**.	
SPACE	The parity always has signal state **″0″**.	
NONE	**No parity check** The signal state of the parity bit is meaningless. Parity is not checked when the block is received; during sending, however, it is always set to ″1″.	

Data format and character frame (DF)
Characters are transmitted between the S5-95U and the communication partner in either a 10-bit or 11-bit character frame. Within these character frames, you can use either 7 or 8 data bits.

Table 3-6 Character Frames and Sequence of Bits Transmitted in a Computer Link (Depending on Data Format)

Arguments of the DB1 ″DF″ (data format)	Character frame	Parity	Sequence and Number of Bits on the Line				Default in DB1:
			Start Bit	Data Bits	Parity Bit	Stop Bits	
0	11 bits	E/O/M/S/N *	1	7	1	2	
1	11 bits	E/O/M/S/N *	1	8	1	1	X
2	11 bits	Setting irrelevant	1	8	-	2	
3	10 bits	Setting irrelevant	1	7	-	2	
4	10 bits	E/O/M/S/N *	1	7	1	1	
5	10 bits	Setting irrelevant	1	8	-	1	
7 as data format 0	11 bits	E/O/M/S/N *	1	7	1	2	
8 as data format 1	11 bits	E/O/M/S/N *	1	8	1	1	

***** cf. Table 3-3

Character delay time (DT)
This is the maximum permissible time interval between receiving two characters (character delay time). Only those characters with a delay shorter than the specified time are recognized as valid characters and transmitted in a frame to the CPU.
In DB1, ″DT 220″ is set as default, i.e. the character delay time is 220 ms.

Table 3-7 Character Delay Time Depending on the Transmission Rate in a Computer Link

Transmission Rate in bit/s	200	300	600	1200	2400	4800	9600
Minimum Adjustable Character Delay Time in ms	510	310	170	90	50	30	20

Priority (PRI)
If both devices make a send request at the same time, the low-priority device postpones its send request. For data transmission with the 3964(R) transmission protocol, one device must be assigned high priority (″HIGH″ or ″H″) and the other device low priority (″LOW″ or ″L″). ″PRI HIGH″ is in DB1 the default.

Timeout (TIO)
The maximum time interval that may elapse between transmission of the respective control characters in a connection buildup and cleardown without an error message being issued. Please note the following ratios when setting the times:
Character delay time < timeout < block waiting period!
In DB1 ″TIO 2000″ is the default in DB1, i.e. the timeout is 2000 ms.

Block waiting period (BWT)
Relevant for receiving frames if block check characters (BCC) are used for sending and receiving (for 3964R).
If the character delay time has been exceeded, the data block that has been sent repeatedly must arrive at the receiver within the block waiting period. Please note the following ratios when setting the times: Character delay time < timeout < block waiting period!
In DB1, ″BWT 4000″ is the default, i.e. the block waiting period is 4000 ms.

Number of buildup attempts (TTE)
Number of attempts to build up a connection.
In DB1, ″TTE 6″ is the default, i.e. after a total of 6 failed attempts, the procedure is aborted and the connection buildup error is entered in the ″send″ coordination byte (Table 3-1).

Number of send attempts (TTS)
Number of attempts to send data.
In DB1, ″TTS 6″ is the default, i.e. after 6 failed attempts to transmit data properly, the send procedure is aborted.
Reason for discontinuation of the procedure: either parity check error or BCC error (Table 3-2).

3.5 Sample Program for Computer Link

This section deals with the structure of a PLC program for transmitting data via a computer link.

Example:
This example describes the program of an arbitrary communication partner. In can be used for an S5-95U for which high priority is set in DB1 and a communication partner for which low priority is set.

The data to be transmitted is stored in data words DW 1 to DW 5 of DB207. A data block length of 10 bytes must therefore be entered in DB207.

Proceed as follows:

Establish the ready state at the communication partner.
Switch the S5-95U on and carry out an overall reset of the PLC (PLC in STOP).
Parameterize the computer link in DB1 of the S5-95U as described below.
Program the individual blocks as described below.
Do not forget to generate the relevant DB for the position of the parameter set!
Transfer DB1 and the PLC program to the S5-95U.
Set the mode selector of the PLC to RUN.

The structure of this sample program is shown in the diagram below (Figure 3-9).

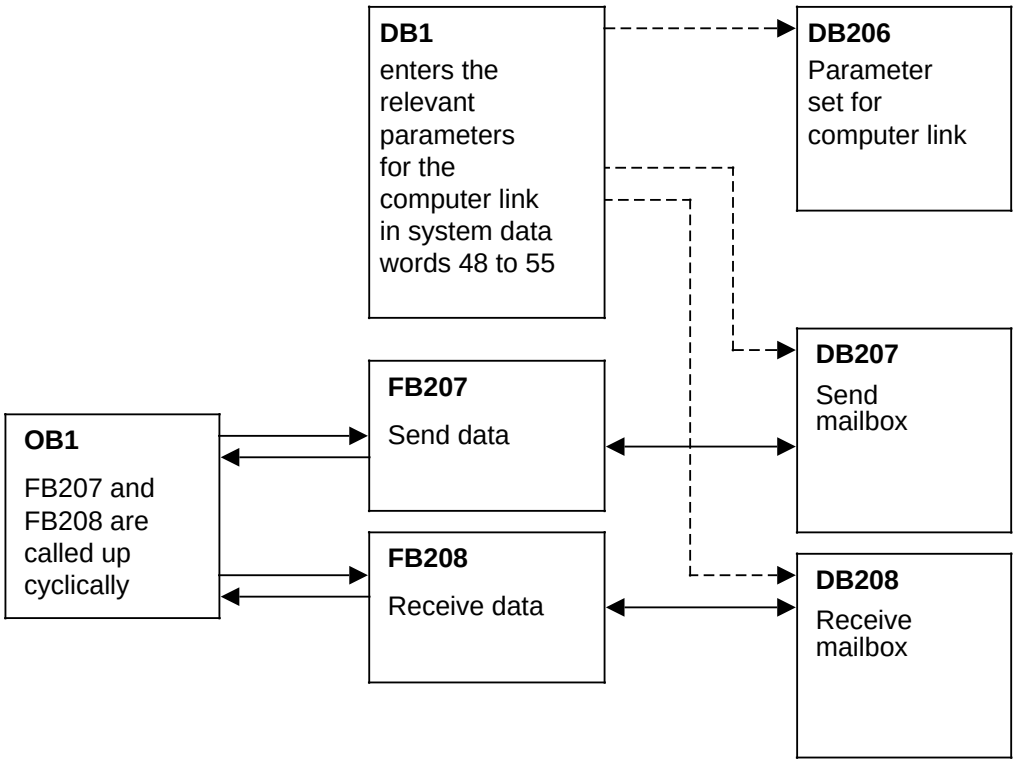


Figure 3-9 Program Structure of a Computer Link

DB1 STL	Description
: :	
156: KS =' ; # RKT: PAR DB206DW0 ';	Parameter set is in DB206 from DW 0 onwards
168: KS =' SF DB207DW0 EF DB208';	Send mailb.: DB207 from DW0; Rec. mailb.: DB208
180: KS ='DW0 KBS MB100 KBE';	from DW 0; ”send” coordination byte: FY 100;
192: KS =' MB101 MOD 2 BDR ';	”Receive” coordination byte: FY 101;
204: KS ='9600 PRTY EVEN DF 8 DT ';	Mode No.: 2; transmission rate: 9600 bit/s;
	Parity:even; data format: 8; char. delay time
216: KS ='220 PRI HIGH TIO 2000';	betw. 2 characters: 220 ms; Priority: high;
	timeout: 2000 ms; block waiting time: 4000 ms;
228: KS =' BWT 4000 TTE 6 ';	max. number of buildup attempts: 6;
240: KS ='TTS 6 ; #ASC: PAR ';	max. number of send attempts: 6
262:	

The parameter set for the computer link is written in DB206 by the DB1 interpreter. In this example, DB206 is as follows:

DB206 STL	Description
0: KF = +00008;	Transmission rate: 8 = 9600 bit/s
1: KF = +00000;	Parity: 0 = even
2: KF = +00008;	Data format: 8 = 8 bits per character
3: KF = +00001;	Priority: 1 = high
4: KF = +00022;	Character delay time between 2 characters: 22 x 10 ms
5: KF = +00200;	Timeout: 200 x 10 ms
6: KF = +00400;	Block waiting time: 400 x 10 ms
7: KF = +00006;	max. number of buildup attempts: 6
8: KF = +00006;	max. number of send attempts: 6
9:	

OB 1 STL	Description
:JU FB 207	SEND
NAME :SENDEN	
:	
:JU FB 208	RECEIVE
NAME :EMPFANG	
:BE	

FB207 STL	Description
NAME :SENDEN	
:C DB 207	Open send mailbox
:O F 100.7	End if currently sending or
:ON I 0.0	if no send request present
:BEC	(Enable sending at I 0.0)
:	
:A F 100.0	Error during last send procedure?
:JC PB 1	Then error evaluation in PB1
:	
:	Prepare send mailbox
:L KF +10	10 bytes are to be sent
:T DW 0	(1st word in send mailbox)
:	
:L DW 1	Modify send data
:ADD KF +1	
:T DW 1	
:	
:AN F 100.7	Send initiation
:S F 100.7	
:BE	

FB208 STL	Description
NAME :EMPFANG	
:C DB 208	Open receive mailbox
:A F 101.7	End if no data has been
:BEC	received.
:	
:A F 101.0	Error during receiving?
:JC PB 2	Then error evaluation in PB2
:	
:	Evaluate receive mailbox
:L DW 0	Evaluate length received
:T QW 0	
:L DW 1	Evaluate date received
:T QW 2	
:	
:AN F 101.7	Re-enable receive mailbox
:S F 101.7	
:BE	

3.6 The 3964(R) Transmission Protocol

The following explanations are not required for starting up the S5-95U. The protocol will be described simply for the sake of explaining the DB1 parameter settings (e.g. mode number, data format Table 3-4, 3-6).

Unlike protocol-free data transmission procedures, the 3964(R) procedure requires a protocol. This means that the actual data to be transmitted must be enclosed between two control characters.

The 3964(R) driver ensures comparatively safe data transmission since the receiver must first signal its readiness to receive to the transmitter (connection buildup) and confirm receipt of data after data transmission. The 2964R transmission protocol offers an even higher degree of safety by sending an additional block check character.

The 3964(R) driver interprets the following control characters:

- DLE (10_H) Data Link Escape
- STX (02_H) Start of Text
- NAK (15_H) Negative Acknowledgement
- ETX (03_H) End of Text

During parameter assignment, you may also decide whether data frames are to be sent with or without block check characters. Block check characters (BCC) increase the safety of data transmission. Depending on whether you wish to transmit data with or without block check characters, the 3964R or 3964 transmission procedure should be used.

- Data transmission with block check characters: 3964R
- Data transmission without block check characters: 3964

Protocol data

The 3964 and 3964R transmission protocols control data flow between the programmable controller and a communication partner.

The data to be sent must be written into the send buffer of the S5-95U. This data is sent together with the 3964 or 3964R transmission protocol to the communication partner. If necessary, the send procedure is repeated by the transmission protocol. Errors that cannot be eliminated are entered in a coordination byte.

Data received from the communication partner connected are written in receive buffers. If the data was received without error, it can be fetched by the CPU for further processing.

The 3964 and 3964R transmission protocols are asynchronous, bit-serial transmission procedures. All parameter settings must be identical in both communication partners with the exception of **priority**.

Control characters and net data are transmitted via the interface lines. To make sure that every character can be recognized by the receiver and transmission can be monitored for errors, the transmitted data is preceded/followed by additional bits. The character frame is parameterized in DB1 by means of ″DF″ (data format).

Example of a character frame:

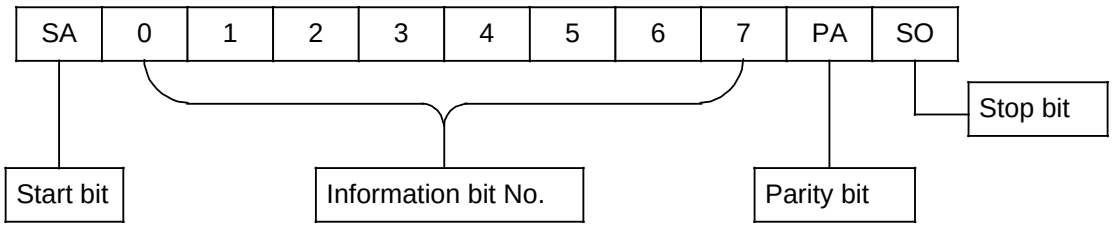


Figure 3-10 Example of an 11-Bit Character Frame

In the **3964R transmission protocol**, a **block check character (BCC)** is sent at the end of each data block. The block check character is the even longitudinal parity (XOR gating of all data bytes) of a block that is sent or received. Parity generation starts with the first net data byte (1st byte of the frame) after connection buildup and ends with the DLE ETX character after connection cleardown.

Sending

For **building up a connection**, the PLC sends the **STX** (start of text) **control character**. If the communication partner * responds with the DLE (Data Link Escape) character before the timeout has elapsed, the transmission protocol switches to send mode. If the communication partner responds with NAK (Negative Acknowledgement), any other character (except DLE) or the timeout elapses without any response, the connection buildup has failed. After a total of 6 ** failed attempts, the procedure is aborted and the connection buildup error entered in coordination byte KBS.

If the connection buildup is successful, the net data in the send buffer is sent to the communication partner at the selected transmission speed. The communication partner supervises the intervals between the incoming characters. The interval between two characters may not exceed the **character delay time*****.

Each DLE control character available in the buffer is sent as two DLE characters (**DLE duplication**), i.e. the data item (10_H) is sent twice.

After transmission of the buffer contents, the PLC adds the following characters as end-of-text characters:

- 3964 transmission protocol: **DLE ETX**
- 3964R transmission protocol: **DLE ETX BCC**

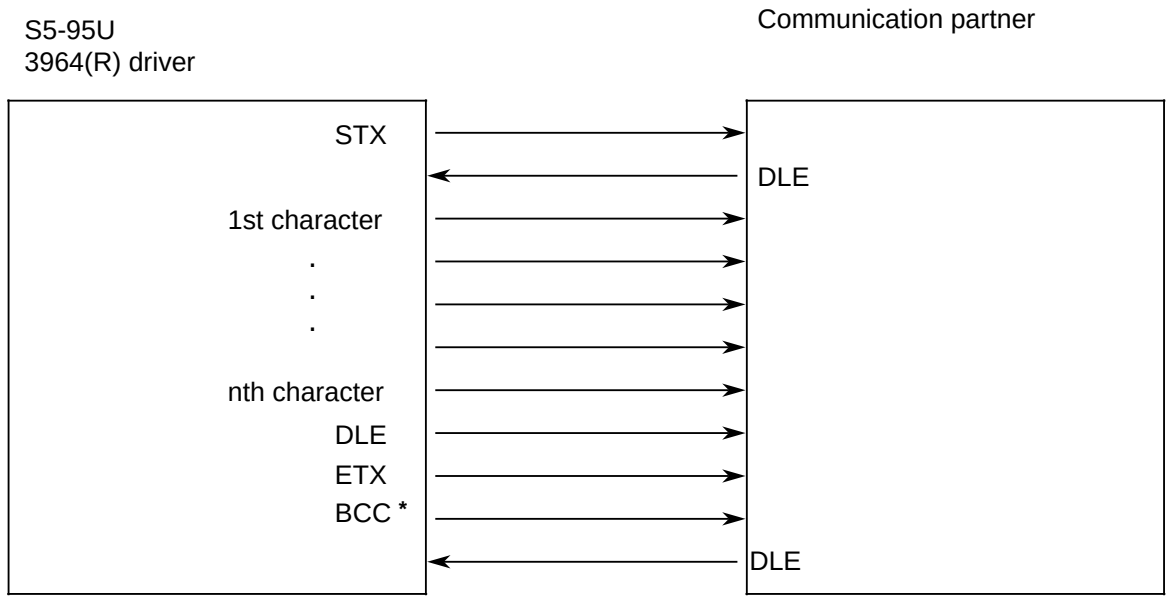
The PLC waits for an acknowledgement. If the communication partner sends the DLE character within the timeout, the data block has been received without any error.

If the communication partner responds with NAK, any other character or the timeout elapses without any response, the PLC starts sending again by means of STX (connection buildup). After a total of 6 failed attempts ** to send the data block, the PLC discontinues the procedure, enters an error message in the KBS and sends a NAK character to the communication partner.

If the communication partner sends the NAK character during a send procedure, the PLC aborts the procedure and repeats it in the manner described above. In the case of another character, the PLC initially waits for the character delay time to elapse and sends a NAK to set the communication partner to the idle state ****. Then the PLC starts sending again by means of a connection buildup (STX).

***** Default value in DB1: 2000 ms
****** Default value in DB1, other values may also be parameterized
******* Default value in DB1: 220 ms (depending on transmission rate)
******** i.e. the 3964(R) driver is currently not executing any send request and the node is waiting for the PLC to establish a connection.

Example of an error-free send procedure:



* BCC only in the 3964R transmission protocol

Figure 3-11 Error-Free Communication During Sending

Receiving

In the idle state, the 3964(R) driver does not process any send request and the PLC waits for the communication partner to establish a connection.

If the PLC receives any character (except STX) in the idle state, it waits for the character delay time to elapse and then sends a NAK character.

If the PLC receives the STX character from the communication partner and if the receive buffer is not full, the PLC responds with DLE. Incoming characters are then written in the receive buffer. If two successive DLE characters are received, only one of them is transferred into the receive buffer.

After each receive character, the receiver waits for the next character during the specified character delay time. If the character delay time elapses without a character being received, the NAK character is sent to the communication partner.

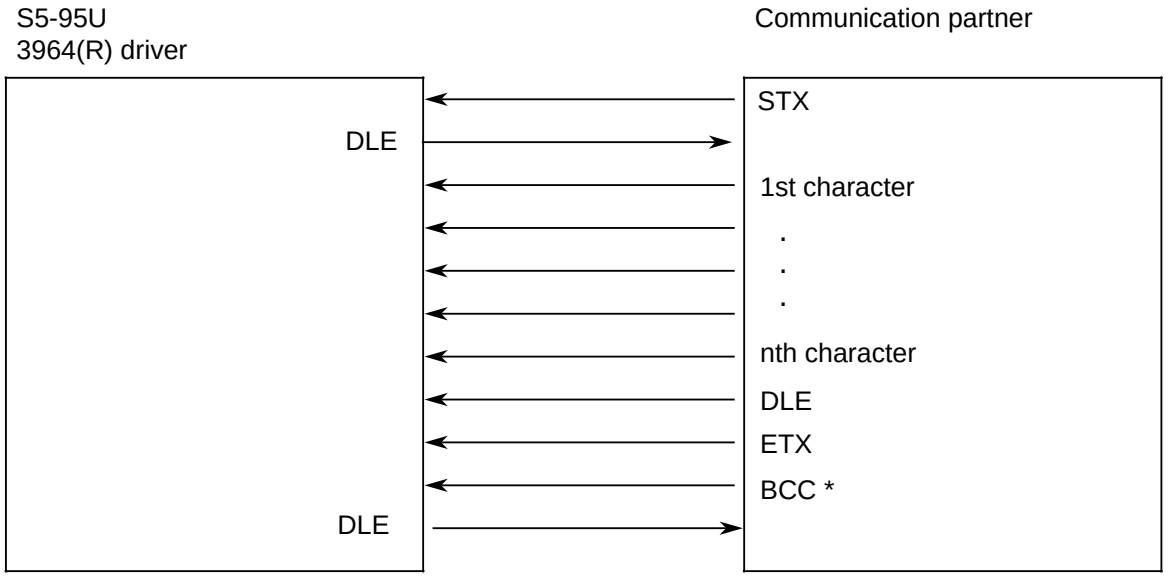
The PLC terminates the receive procedure in one of the following ways depending on whether it uses the 3964 or 3964R transmission protocol:

- 3964 transmission protocol (i.e. without BCC):
  If the PLC recognizes the character sequence DLE ETX, it stops receiving and sends DLE to the communication partner for correctly receiving a block (or NAK in case of an error).

- 3964R transmission procedure (i.e. with BCC):
  If the PLC recognizes the character sequence DLE ETX BCC, it stops receiving. It compares the block check character (BCC) received with the longitudinal parity it has generated. If the block check character is correct and no other receive error has occurred, the PLC sends a DLE. If the BCC is invalid, NAK is sent to the communication partner. Then the communication partner will expect a repetition of the procedure. If the block cannot be received without any error even after a total of 6 attempts * or if the communication partner does not repeat the procedure within the block waiting period of 4 s*, the PLC aborts the receive procedure.

If transmission errors occur during receiving (character lost, frame error, parity check error), receiving is continued until connection cleardown and then NAK is sent to the communication partner. The communication partner waits for a repetition according to the procedure described above.

Example of an error-free receive procedure:

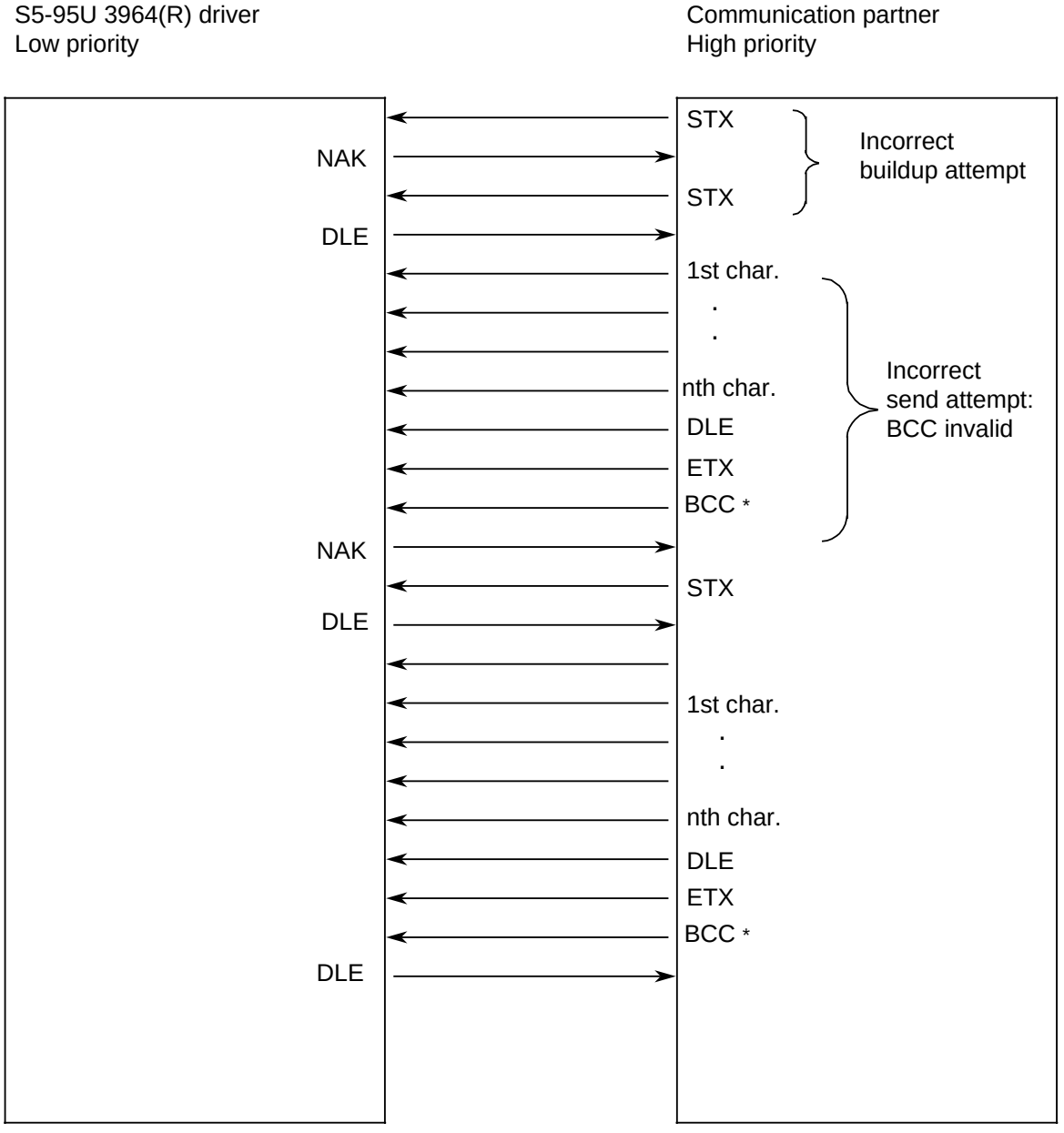


* BCC only in 3964**R** transmission protocol

Figure 3-12 Error-Free Communication During Receiving

***** Default value in DB1, other values can also be parameterized

Example of incorrect data transmission:



***** BCC only with 3964**R** transmission protocol

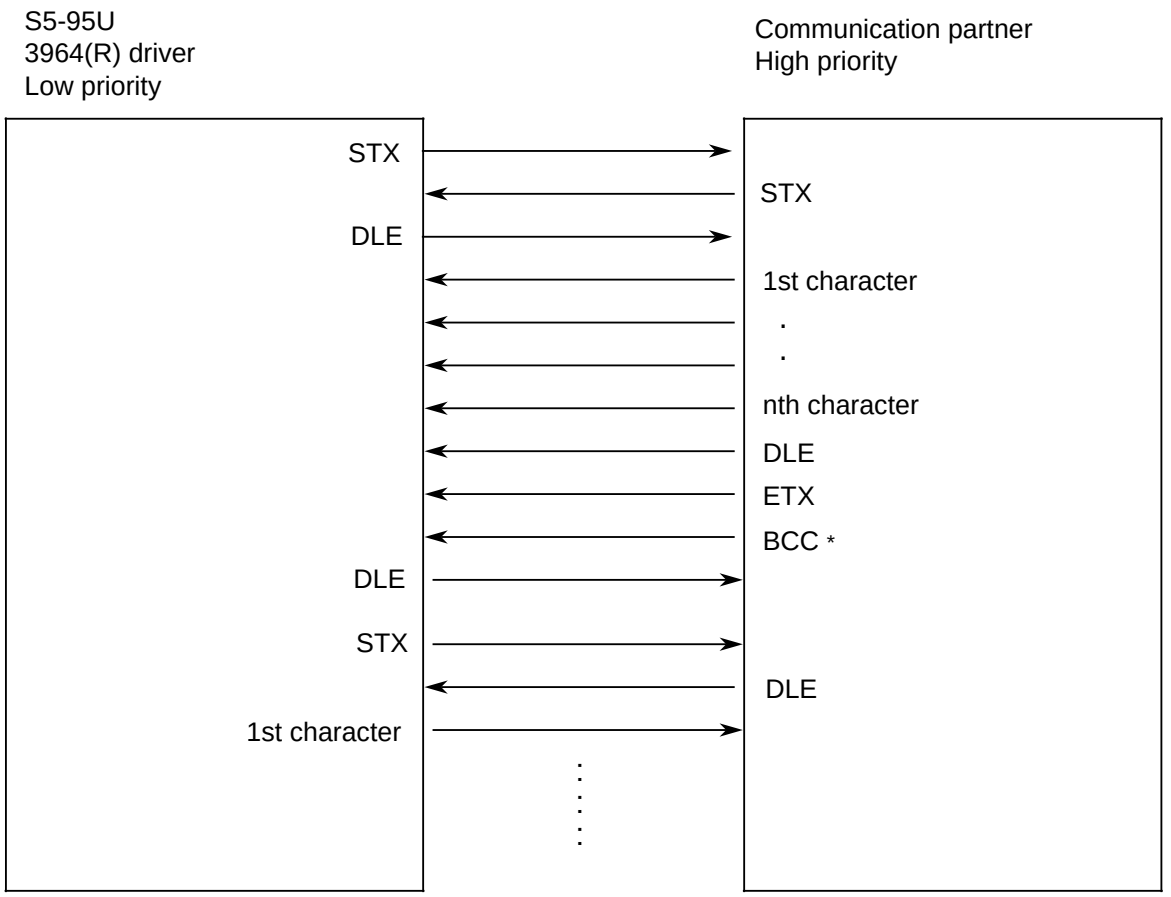
Figure 3-13 Incorrect Data Transmission

Initialization conflict

An initialization conflict occurs if a communication partner does not respond with DLE or NAK to the send request (STX character) of the other communication partner within the specified timeout and sends an STX character instead. This means that both communication partners want to send at the same time. The device with low priority will then postpone its send request and responds with the DLE character. The device with high priority sends the data as described above. After connection cleardown, the device with low priority can make a send request.

The ″PRI″ (priority) parameter must be set when parameterizing the 3964(R) driver in DB1. Make sure to assign different priorities to the devices.

Solving an initialization conflict (example):



***** BCC only with 3964**R** transmission protocol

Figure 3-14 Solving an Initialization Conflict

Protocol errors

The transmission protocol recognizes errors caused by the communication partner and errors caused by line faults.

In both cases, the send or receive procedure is repeated. If the data block cannot be sent or received even after the maximum number of repetitions (or if another error occurs), the transmission protocol stops sending or receiving. A specific error number is entered in the coordination byte and the PLC enters the idle state.

Figures

Tables

4 ASCII Driver

This section covers the following:

- Possible communication partners for the S5-95U
- How to connect communication partners to the SI2 interface
- Data traffic via the ASCII driver
- Parameter assignment of the PLC
- PLC program for the ASCII driver (example).

The ASCII driver is ideal for communication between an S5-95U and a third-party device since data transmission does not comply with any standardized protocol such as the computer link with 3964(R) transmission protocol. The ASCII driver therefore offers a comparatively low degree of data integrity. Flexible setting of the transmission format is possible with the ASCII driver and the S5-95U can therefore easily be adapted to the communication partner.

The ASCII driver is used for interfacing two communication partners. The communication partners are equal, i.e. every partner can send data independently without any request from the other partner.
The ASCII driver can only function over the second serial interface of the S5-95U (SI2).

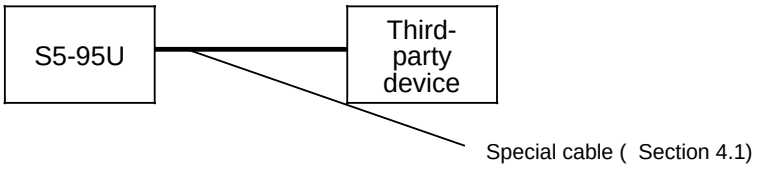


Figure 4-1 Communication Partners if the ASCII Driver is Used

The ASCII driver is especially suitable for visualization of process sequences, e.g. for output of message texts on a printer.
The following devices can be used as communication partners for the S5-95U:

- Various printers (e.g. PT 88, DR 210, DR 211)
- Terminals
- Barcode reader
- PC

> **Note**
>
> If the ASCII driver is activated, no other functions are possible at the SI2 interface (e.g. programmer/operator panel).

Proceed as follows for startup of the S5-95U:

Link the S5-95U with the communication partner via the SI2 interface (Section 4.1).
Select Data Set Ready on the communication partner.
Parameterize the ASCII driver in DB1 of the S5-95U (Section 4.2).
Enter the PLC program in the programmer (example Section 4.5).
Transfer DB1 and the PLC program to the S5-95U.
Switch the mode selector of the S5-95U from STOP to RUN.

Also note Section 4.2 ″Starting up a System″ in the S5-90U/S5-95U System Manual.

4.1 Connection of Communication Partners when Using the ASCII Driver

The communication partners are linked via a direct cable. Use a 4-core, shielded cable with a cross-section of at least 0.14 mm^2. We recommend the 707-1 bus cable (Order number Appendix D).

Linking the S5-95U (TTY active) with any communication partner (TTY passive)

Cable length: < 100 m

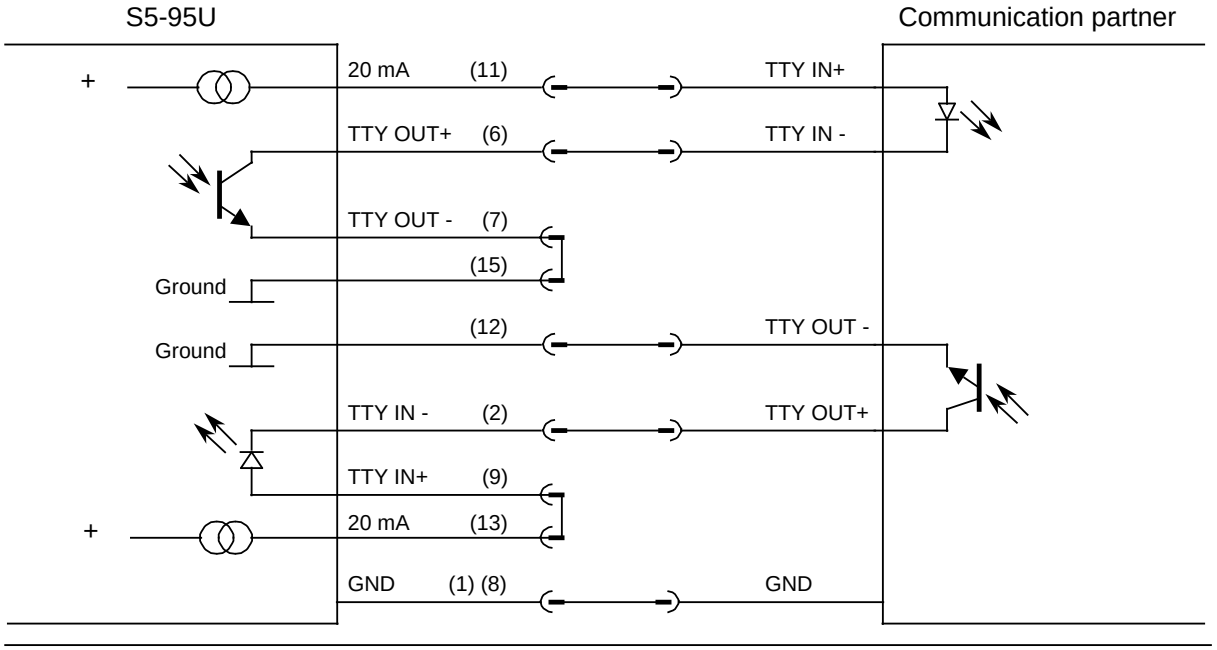


Figure 4-2 Pin Assignments S5-95U (TTY Active) - Any Communication Partner (TTY Passive)

> **Note**
>
> Incorrect wiring may cause destruction of the interface block.

Linking the S5-95U (TTY passive) with any communication partner (TTY active)

Cable length: see technical specifications of the communication partner

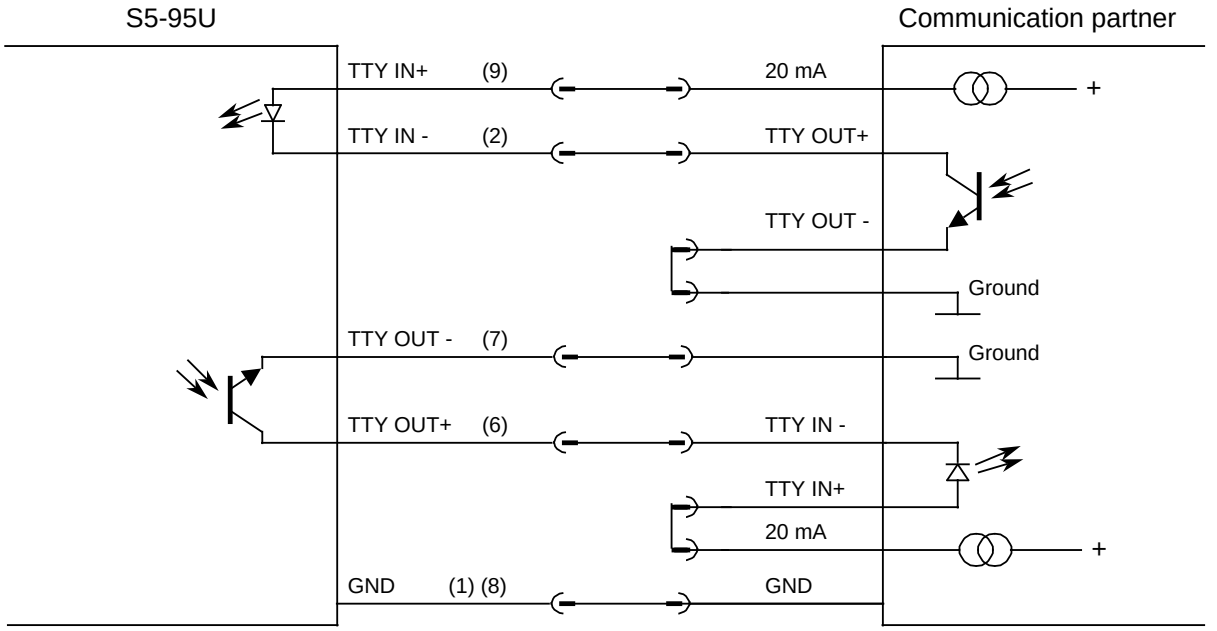


Figure 4-3 Pin Assignments S5-95U (TTY Passive) - Any Communication Partner (TTY Active)

Linking the S5-95U (TTY passive) via printer cable with printer DR 211 (TTY active)

Length of the printer cable: < 1000 m

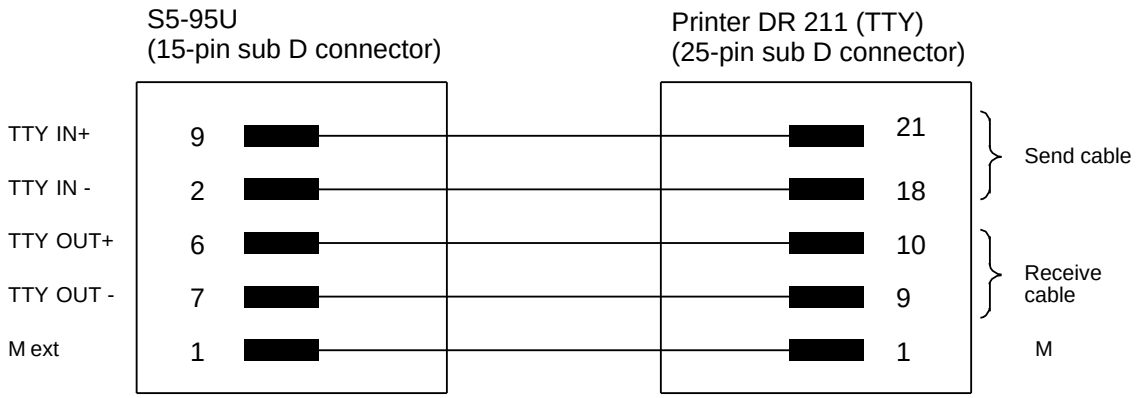
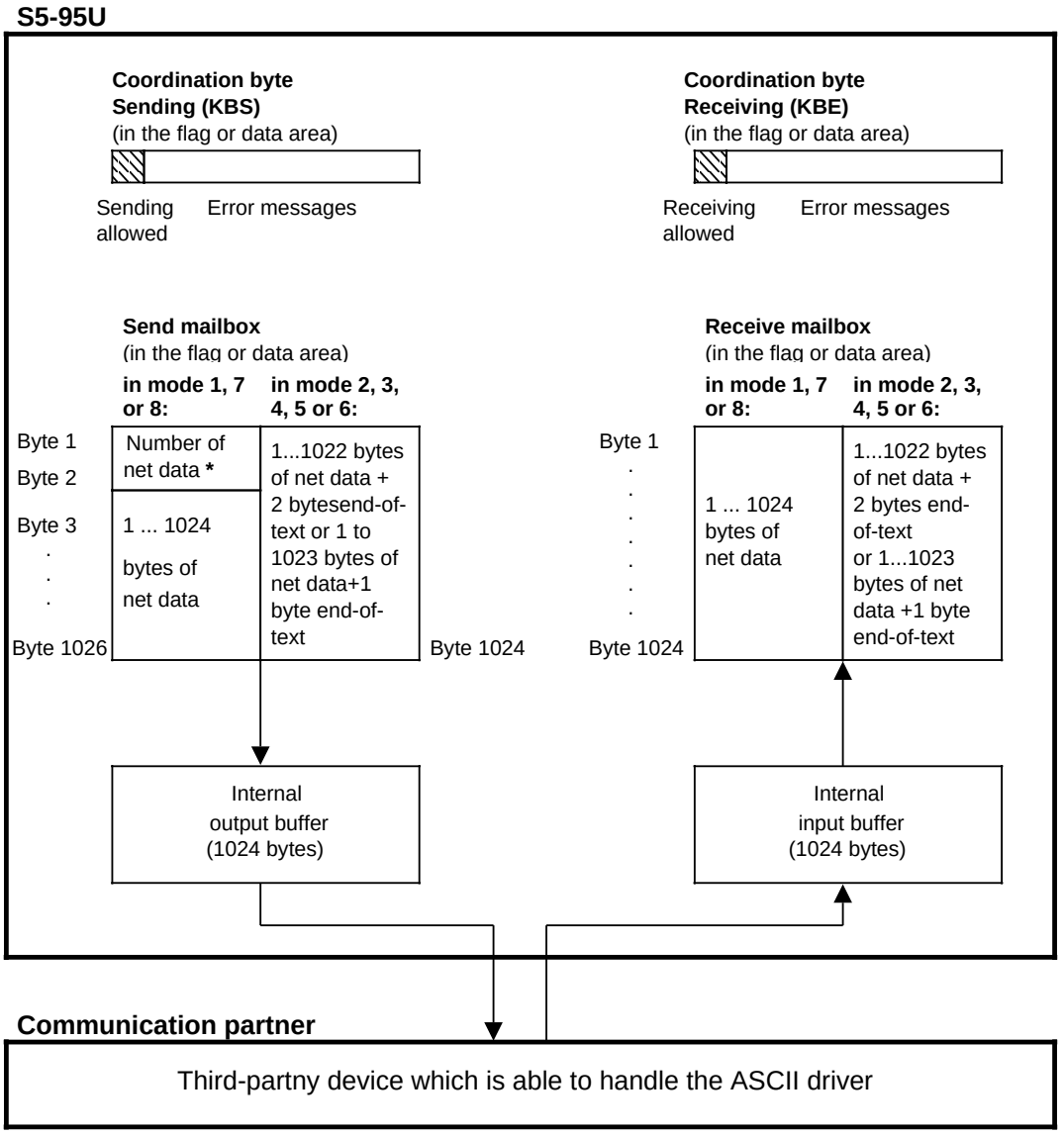


Figure 4-4 Pin Assignments of the Printer Cable (Example)

4.2 Data Traffic with the ASCII Driver

Figure 4-5 shows the principle of operation of the ASCII driver in schematic form.



* Byte 1-^High-order part; Byte 2-^Low-order part

Figure 4-5 Functional Model of the ASCII Driver

Data traffic is possible in one or two directions:

- Sending
  Data available in the send mailbox (SF) (e.g. contents of a DB) are buffered in an output buffer and from there sent to the communication partner.

- Receiving

  The communication partner sends data to the SI2 interface of the S5-95U in ASCII code. The data is buffered in the input buffer and stored in the receive mailbox (EF) after initiation through the PLC program.

e.g.:
- An S5-95U sends data to a printer. (Data traffic in one direction)
- An S5-95U receives data from a barcode reader. (Data traffic in one direction)
- An S5-95U receives and sends data to a terminal (screen+keyboard). (Data traffic in 2 directions)

Characteristics of send mailbox and receive mailbox:

- Send mailbox and receive mailbox can be stored in a data block or in the flag area.

- 1024 bytes of the input buffer are available in all modes (Section 4.4).

- In those modes in which the characters XON, XOFF, RUB OUT are interpreted when received, the ASCII driver can receive data and/or frames even after it has sent an XOFF character to the communication partner. In this case, the ASCII driver receives data until the input buffer is full or it receives frames until the maximum possible number of frames is reached.
  Example of a ″borderline case″:
  If a received frame is 1024 bytes long and the ASCII driver consequently sends XOFF, characters which were received by the communication partner after transmitting XOFF cannot be buffered any more.

- In mode 1, 7 or 8 (Section 4.4), you must specify the amount of data to be sent (in bytes) in the first word of the send mailbox.

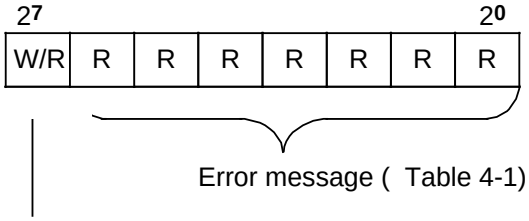
You parameterize the position of send mailbox and receive mailbox in DB1 (Section 4.4).

4.3 Coordination Bytes for Use of the ASCII Driver

The ASCII driver monitors data traffic and stores status and error messages in two bytes, the ″send″ (KBS) and ″receive″ (KBE) coordination bytes.

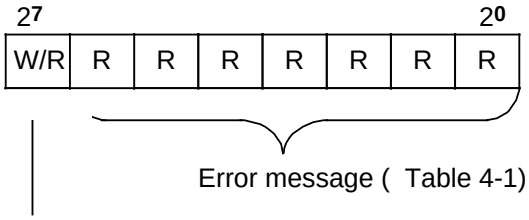
The following display shows the structure of the two coordination bytes.

″Send″ coordination byte (KBS) (flag byte or high-order byte in the data word)



Sending allowed
Is set by the user and reset by the ASCII driver when the send procedure in terminated.
If a positive-going edge occurs in this bit, the send procedure is activated.

″Receive″ coordination byte (KBE) (flag byte or high-order byte in the data word)



Receiving allowed
Is set by the user and reset by the ASCII driver after receiving with or without errors.

R: Read Only (bit may only be read)
W/R: Write / Read (bit may be read and overwritten)

Figure 4-6 Structure of the Coordination Bytes

> **Note**
>
> The bits in the coordination bytes can be set and/or reset by the operating system after every instruction irrespective of the PLC scan cycle. That is, a repeated scan of a coordination bit in a program cycle can lead to different results. (Caution during pulse edge evaluation!)

The different error messages are listed and explained in the following table.

Table 4-1 Error Messages in the Coordination Bytes

	Assignment	Meaning	Response
KBS	07_H	Output buffer is full	Data rejected
	$0D_H$	Parameterizing error	
	11_H	Send mailbox not available	
	13_H	Frame is too long	
	$1B_H$	Break	
KBE	01_H	Character delay time exceeded	Data valid until time exceeded
	03_H	Parity error	Data rejected
	05_H	Receiving after XOFF	
	07_H	Input buffer full	
	09_H*	Too many frames received	Data valid, subsequent frames rejected
	$0B_H$	Frame is larger than receive mailbox	Data rejected
	$0F_H$	Receive mailbox is not available	
	$1B_H$	Break	

***** In the case of bit 7 KBE=0 (receiving not possible because e.g. the PLC is in STOP mode), up to 100 frames can be stored in the input buffer (a maximum of +1024 bytes).

You parameterize the position of the coordination bytes in DB1 (Section 4.4).

4.4 Parameterizing the ASCII Driver in DB1

In order to simplify parameterizing, the DB1 with default parameters is already integrated in the PLC. If you load the default DB1 from the PLC into the programmer after an ″overall reset″ and display it on the screen, it has the following structure:

```
  0:     KS  ='DB1 OBA: AI 0 ; OBI:    ';
 12:     KS  ='   ; OBC: CAP N     CBP ';
 24:     KS  ='N      ;#SL1: SLN 1  SF ';
 36:     KS  ='DB2  DW0   EF DB3  DW0  ';
 48:     KS  ='  KBE MB100      KBS MB1';
 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  =' ; # #RKT: PAR DB202DW0 ';
168:     KS  ='  SF DB203DW0   EF DB204';
180:     KS  ='DW0   KBS MB104      KBE';
192:     KS  =' MB105      MOD 1  BDR  ';
204:     KS  ='9600 PRTY EVEN DF 1  DT ';
216:     KS  ='220    PRI HIGH TIO 2000';
228:     KS  ='   BWT 4000    TTE 6    ';
240:     KS  ='TTS 6   ;# #ASC:  PAR  ';
252:     KS  =' DB202DW0   SF DB203DW0  ';
264:     KS  =' EF DB204DW0   KBS MB104';
276:     KS  ='       KBE MB105      MOD';
288:     KS  =' 1 BDR 9600 PRTY EVEN   ';
300:     KS  =' DF 0 DT 100    ML 64  ;';
312:     KS  =' # END  ';
```

Default parameter for ASCII driver

Figure 4-7 DB1 with Default Parameters

The parameters of the ASCII driver are assigned with the ″ASC:″ blocking designation in the parameter block (in Figure 4-7, grey shaded).

The ASCII parameter block is enclosed between comment characters (#) and is not interpreted by the PLC in this form. For this reason, overwrite with a blank the comment character preceding the ″ASC:″ block designation and following the last ASCII parameter.

Caution: The parameter block for the computer link (RKT:) must remain enclosed between comment characters! Only one communication possibility can be parameterized for the second serial interface.

The procedure for the entering, changing and transmitting of the DB1 is explained in detail in the S5-90U/S5-95U System Manual, Section 9.1.3.

The following table (Table 4.2) shows all parameters for the ASCII driver with their value ranges. The parameters are then explained.

DB1 parameters for the ASCII driver

In DB1, you specify the position of the ASCII parameter set, the position of the send mailbox, receive mailbox and coordination bytes, the mode number and the ASCII parameter set.
The parameter settings in the S5-95U and in the communication partner must be identical.
Caution: If you specified a DB after the ″PAR″ parameter in DB1, this DB must be generated before you switch the PLC from STOP to RUN.

Table 4-2 ASCII Driver, DB1 Parameters

Parameter	Argument	Permissible Value Range	Meaning
Block Identification: ASC:			**ASCII Driver at Second Serial Interface**
PAR [1]			Position of the ASCII-***PAR***ameter
SF	DBxDWy	x= 2 ... 255	Position of the send mailbox (beg. of SF)
EF	or	y= 0 ... 255	Position of the receive mailbox (beg. of SF)
KBS	MBz	z= 0 ... 255	Position of the send coordination byte
KBE			Position of the receive coordination byte
MOD	n	n= 1 ... 8	″***MOD***e number″ ASCII mode number
			ASCII parameter set:
BDR	m	m= 200; 300; 600; 1200; 2400; 4800;9600	″***B***au***D R***ate″ transmission rate bit/s
PRTY	p	p= E(VEN); O(DD); M(ARK);S(PACE) N(ONE)	″***P***a***R***i***TY***″ Parity
DF	q	q= 0 ... 5, 7, 8	″***D***ata ***F***ormat″ data format
WCR	r [2]	r= 0 ... 2550	″***W***ait time after ***C***arriage ***R***eturn″ in ms
WLF	r [2]	r= 0 ... 2550	″***W***ait time for ***L***ine ***F***eed″ in ms
WFF	r [2]	r= 0 ... 2550	″***W***ait time for ***F***orm ***F***eed″ in ms
DT	s [2]	s= 10 ... 655350	″***D***elay ***T***ime″ character delay time in ms
ML	t	t= 0 ... 1024	″***M***ail ***L***ength″ frame length in bytes (only optional for ″ME″)
ME	u v	u= 0 ... 255 v= 0 ... 255	″***M***ail ***E***nd″ end-of-text (only optionally for ″ML″)
SLF	J/N/Y	-	″***S***uppress ***LF***″
LPP	w	w=1 ... 255	″***L***ines ***P***er ***P***age″ Number of lines per page
LM	x	x= 0 ... 255	″***L***eft ***M***argin″ Width of left margin in char.
PN	z	z= O(BEN); T(OP); U(NTEN);B(OTTOM)	″***P***age ***N***umber″ Position of page number
HD1 [3]	<string>	a maximum of 120 alphanumeric characters	
HD2 [3]	<string>		″***H***ea***D***er 1″
FT1 [3]	<string>		″***H***ea***D***er 2″
FT2 [3]	<string>		″***F***oo***T***er 1″
			″***F***oo***T***er 2″

[1] The ”PAR” parameter must be in front of the ASCII set of parameters in the ”ASC:” parameter block.
[2] Specify in 10 ms increments.
[3] The order of the parameters ”HD1”, ”HD2”, ”FT1” and ”FT2” must be adhered to in the parameter block. The DB1 interpreter automatically inserts a ”CR” after every header and/or footer.

ASCII mode number (MOD)

You can define the type of data traffic by means of the mode number (1 ... 8).

Two protocol types can be distinguished:

- Non-interpreting mode (mode no. 1, 2, 3)
  Data is exchanged without XON/XOFF protocol.
- Interpreting mode (mode no. 4 ...8)
  Data is exchanged with XON/XOFF protocol. When the signal state of the bit ″receiving allowed″ changes, the ASCII driver sends:
  - XOFF at the falling edge or
  - XON at the rising edge.

Table 4-3 shows the meanings of the individual mode numbers. The definitions of the DB1 parameters ″ML″ or ″ME″ in Table 4-3 serve as an example. All parameters of the permissible range of values are valid (Table 4-2).

Table 4-3 Meaning of the Mode Number

Mode	Meaning	Definition of the ML/ME Parameters
1	Transmitting n bytes; n* must be specified in the first word of the send mailbox. Receiving m bytes; m** is specified in the ASCII parameter set.	ML 64
2	Transmitting or receiving data until the end-of-text character defined in the parameter set (low-order byte) is sent or received. The end-of-text character is transferred.	ME 0 13
3	Transmitting or receiving data until the two end-of-text characters defined in the parameter set are sent or received. The two end-of-text characters are transferred. End of text is only recognized if the character defined in the high-order byte is sent or received prior to the character defined in the low-order byte.	ME 13 10
4	As mode 2 but ASCII characters are interpreted when received: RUB OUT : Delete last character XON : Continue to send XOFF : Abort transmission and wait for XON	ME 0 13
5	As mode 3 but ASCII characters are interpreted when received: RUB OUT : Delete last character XON : Continue to send XOFF : Abort transmission and wait for XON	ME 13 10

* n is variable when sending
** m is fixed in the case of the receiver

Table 4-3 Meaning of the Mode Number (Continued)

Mode	Meaning	Definition of the ML/ME Parameters
6	Output on printer. Send the send mailbox until an end-of-text character defined in the set of parameters (low-order byte) is reached. The end-of-text character is not sent. Only XON/XOFF can be received. These signals are then also interpreted.	ME 0 4
7	Output on printer. Send n bytes; n must be specified in the first word of the send mailbox. n is not sent. Only XON/XOFF can be received. These signals are then also interpreted.	ML 64
8	As mode1; additionally, the following ASCII characters interpreted when received: RUB OUT*** : Delete last character XON : Continue to send XOFF : Abort sending and wait for XON	ML 64

*** If the frame received with a length of m bytes contains a RUB OUT character, the amount of data entered in the receive mailbox is reduced accordingly and the character delay time is triggered error message 01 in KBE.

Assignment ASCII code hexadecimal decimal:

RUB OUT	$7F_H$	127_D
XON	11_H	17_D
XOFF	13_H	19_D
CR	$0D_H$	13_D
LF	$0A_H$	10_D
FF	$0C_H$	12_D
EOT	04_H	04_D
ETX	03_H	03_D

ASCII parameter set (PAR)

The principle of operation of the ASCII driver can be parameterized in the ASCII parameter set.
You specify the following in DB1:

- Data block/flag byte in which the parameter set should lie (in the DBx, from DW y onwards) and
- all parameters of the set (Table 4-2).

Access to parameterization data (Figure 4-8):

- The DB1 interpreter defines the parameters **"PAR",** "SF", "EF", "KBS", "KBE" and "MOD" in the system data from system data word 48 onwards (Appendix B).
- The DB1 interpreter defines the parameters of the set from DW y onwards of the DBx defined in the system data.
- The ASCII driver in the operating system of the PLC accesses the parameterization data as described in Figure 4-3.

Section 4.5 describes an example DB1 and the corresponding parameter set DB.

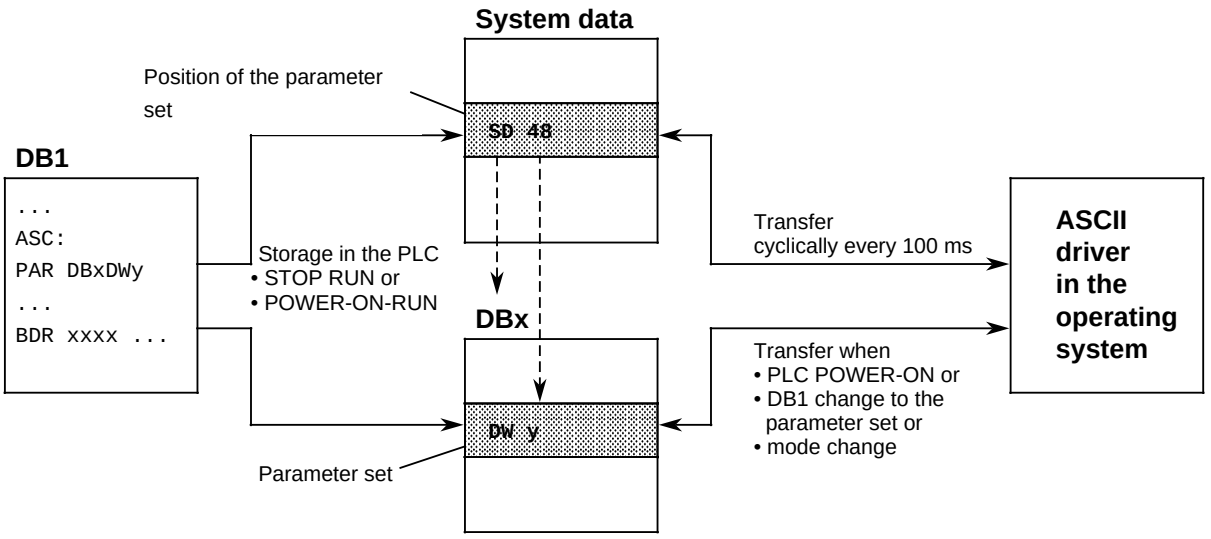


Figure 4-8 Access to the Parameter Assignment Data for the ASCII Driver

You must define the individual parameters of the parameter set in the DB1 depending on the mode selected. Table 4-4 gives an overview of the relevant parameters for the various modes. The specifications of Table 4-4 should be regarded as an example; the permissible value ranges for the DB1 parameters are included in Table 4-2.
The default values in DB1 are defined for mode number 1.

Table 4-4 ASCII Set of Parameters

DB1 Parameter	Definition in DB1, Depending on Mode (Example)							
	1	2	3	4	5	6	7	8
BDR (transmission rate)	9600	9600	9600	9600	9600	9600	9600	9600
PRTY (parity)	EVEN	EVEN	EVEN	EVEN	EVEN	EVEN	EVEN	EVEN
DF (data format) [1]	0	0	0	0	0	1	1	0
WCR (CR waiting time) [2]	X	X	X	X	X	0	0	X
WLF (LF waiting time) [2]	X	X	X	X	X	0	0	X
WFF (FF waiting time) [2]	X	X	X	X	X	0	0	X
DT (character delay time when receiving)	100	100	100	100	100	X	X	100
ML (frame length)	64	X	X	X	X	X	64	64
ME (end-of-text)	X	0 13	13 10	0 13	13 10	0 4	X	X
SLF (suppress LF)	X	X	X	X	X	J	J	X
LPP (lines per page)	X	X	X	X	X	72	72	X
LM (left margin)	X	X	X	X	X	10	10	X
PN (page number)	X	X	X	X	X	U	U	X
HD1, HD2, FT1, FT2 (headers / footers) [3]	X	X	X	X	X	CR	CR	X

X = not relevant
[1] Meaning of data format 0 ... 8: Table 4-6
[2] When sending
[3] The DB1 interpreter autromatically separates headers and footers (max. length 120 characters each) by means of CRs in the parameter set DB. If no headers or footers are specified, CR is entered four times in the parameter set DB.

Parity (PRTY)
You can choose from five types of parity.

Table 4-5 Meaning of the Parity

Parity	Meaning	Default in DB1:
EVEN	**Even parity** The parity bit is set in such a way that the sum of the data bits (inclusive of parity bit) is even at signal state ″1″.	X
ODD	**Odd parity** The parity bit is set in such a way that the sum of the data bits with signal state ″1″ (inclusive of parity bit) is odd.	
MARK	The parity bit always has signal state ″1″.	
SPACE	The parity bit always has signal state ″0″.	
NONE	**No parity check** The signal state of the parity bit is meaningless. The parity is not checked when received; however, it is always set to ″1″ during transmission.	

Data format and character frame (DF)
The characters are transmitted between the S5-95U and the communication partner in a 10-bit and/or 11-bit character frame. Within these character frames, you can select either 7 or 8 data bits.

Table 4-6 Character Frames and Order of the Bits on the Line for the ASCII Driver (Depending on the Data Format)

Arguments of the DB1 Parameter ″DF″ (Data Format)	Character Frame	Parity	Sequence and Number of Bits on the Line				Default in DB1:
			Start Bit	Data Bits	Parity Bit	Stop Bit	
0	11 bits	E/O/M/S/N *	1	7	1	2	X
1	11 bits	E/O/M/S/N *	1	8	1	1	
2	11 bits	Setting irrelevant	1	8	-	2	
3	10 bits	Setting irrelevant	1	7	-	2	
4	10 bits	E/O/M/S/N *	1	7	1	1	
5	10 bits	Setting irrelevant	1	8	-	1	
7 as data format 0	11 bits	E/O/M/S/N *	1	7	1	2	
8 as data format 1	11 bits	E/O/M/S/N *	1	8	1	1	

***** cf. Table 4-2

Example of a character frame:

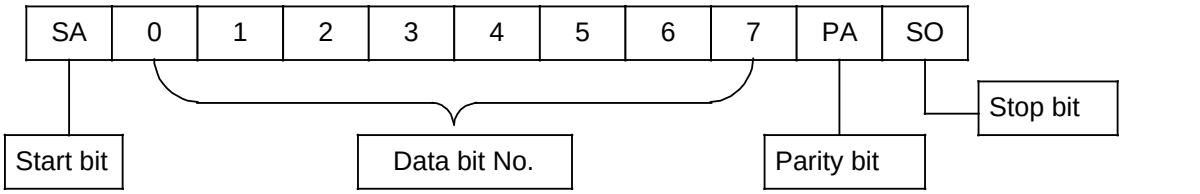


Figure 4-9 Example of an 11-Bit Character Frame

Waiting times CR, LF, FF (WCR, WLF, WFF)
The DB1 parameter ″WCR″ specifies the waiting times for the transition to the next line for a printer.
The DB1 parameter ″WLF″ specifies the waiting time for feeding the paper of a printer to the beginning of the next print line.
The setting of the DB1 parameter ″SLF ″ can be selected in such a way that the printer paper is not fed up to the beginning of the next print line.
The DB1 parameter ″WFF″ specifies the waiting period for the page feed for a particular printer.

Character delay time (DT)
It is the maximum time interval between receiving of two characters (character delay time). Only those characters are recognized as valid and transmitted as a frame to the CPU whose delay is shorter than the defined time.
In DB1. ″DT 100″ is preset, i.e. the character delay time is 100 ms.

Table 4-7 Character Delay Time for ASCII Driver Depending on the Transmission Rate

Transmission Rate in bit/s	200	300	600	1200	2400	4800	9600
Min. Adjustable Character Delay Time in ms	510	310	170	90	50	30	20

If you have set a smaller value in DB1 than the one specified in Table 4-7, the ASCII driver automatically sets the minimum adjustable character delay time.

Frame length (ML)
The DB1 parameter ″ML″ (frame length) is relevant for the non-interpretive mode (mode No. 1, 2, 3) of the ASCII driver when receiving data frames.
In the interpreting mode, the receive frames must have a fixed length. In DB1, ″ML 64″ is preset, i.e. frames of a maximum length of 64 bytes can be received.
Please ensure that the same frame length is parameterized in the S5-95U and in the communication partner.

End-of-text identifier (ME)
You can parameterize either one or two end-of-text characters for sending data frames with variable length. You limit the length of the respective data frame by means of the end-of-text characters selected. You can send or receive a maximum length of 1024 bytes. For the end-of-text, there is no default in DB1 since the parameter can only be set optionally to ″ML″ (frame length).
Please make sure that the same end-of-text is parameterized in the S5-95U and in the node.

Suppress LF (SLF)
The driver requires the LF control characters in the send mailbox for the correct placement of the headers and footers. A double line feed is achieved if your printer automatically carries out an ″LF″ (line feed) at every ″CR″ (carriage return) and an ″LF″ character is additionally transmitted within the frame.
In order to prevent the double ″LF″ you can suppress the output of the LF control character to the printer through the parameter assignment ″SLF J″.

Number of lines per page (LPP)
For the correct placement of the headers and footers the transmitted lines are counted internally by the driver by means of the ″LF″ xharacter.

Width of left margin (LM)
You can define a left margin for the text lines (not for headers and footers) in DB1 (with blanks). The driver sends the number of blanks according to the character combination ″CR″ and ″LF″. The charactrer combination must be specified in the send mailbox.

Position of the page number (PN)
You place the page number either on the third line (″PN O″) or on the third last line (″PN U″) of the respective page.

Headers and footers (HD1, HD2, FT1, FT2)
The text for the headers and footers must be included in quotes (″). Control characters in KS format must be entered as follows:
$hh (″dollar sign″ and hexadecimal code of the control character).

4.5 Program Example for the ASCII Driver

In this section, the structure of a PLC program for the ASCII driver is explained.

Example:
The program generates a message list for output on the DR 211 printer. It automatically initiates a printout in 2-second intervals.

Proceed as follows:

Connect the DR 211 printer to SI2 of the S5-95U via the respective cable (Figure 4-4).

Switch on the printer and set the printer parameters in the menu at the printer.
Only the printer parameter blocks in which you must change the default parameters are represented below (bold); parameters to be set are printed in italics:

TECHNICAL LIST:

LINE CONTROL	
PAPER COMMAND	*PAPER COMMAND + CR*
LINE OVERFLOW	*CR + LF*
CR	*CR*
LF	*LF*
INTERFACE SETTING	
SERIAL INTERFACE	
RECEIVE BUFFER	*17 KB*
DATA BITS	*7 BIT*
PARITY	*EVEN*
STOP BITS	*2 STOP BITS*
BAUD RATE	*9600*
PRINTER STATUS	*ON LINE*
ESCAPE CHARACTER	*ESC*
VERTICAL SPACING	
VERTICAL SPACING	*1/72 INCH*

USER LIST:

LANGUAGE	
MENU LANGUAGE	*GERMAN*
PRINT DENSITY	
CHARACTER PITCH	*10 CPI*
WIDE FONT	*NO*
CHARACTER REPRESENTATION	
NATIONAL CHARACTER SET	*0* (for ASCII)
LINE SPACING	*6 LPI*
PAPER FORMAT	
FORM LENGTH (INCH)	*12*
LINE LENGTH (1/10 INCH)	*136*

Switch printer to on-line (simply follow the menu of the printer).

Activate the S5-95U and carry out a ″PLC overall reset″ (PLC mode STOP).

Parameterize the ASCII driver in DB1 of the S5-95U as described below.

Program the individual blocks as described below.
Do not forget to generate the DB for the parameter set!

Transfer DB1 and the PLC program to the S5-95U.

Switch the mode selector of the PLC to RUN.

See the following diagram for the structure of the program example (Figure 4-10).

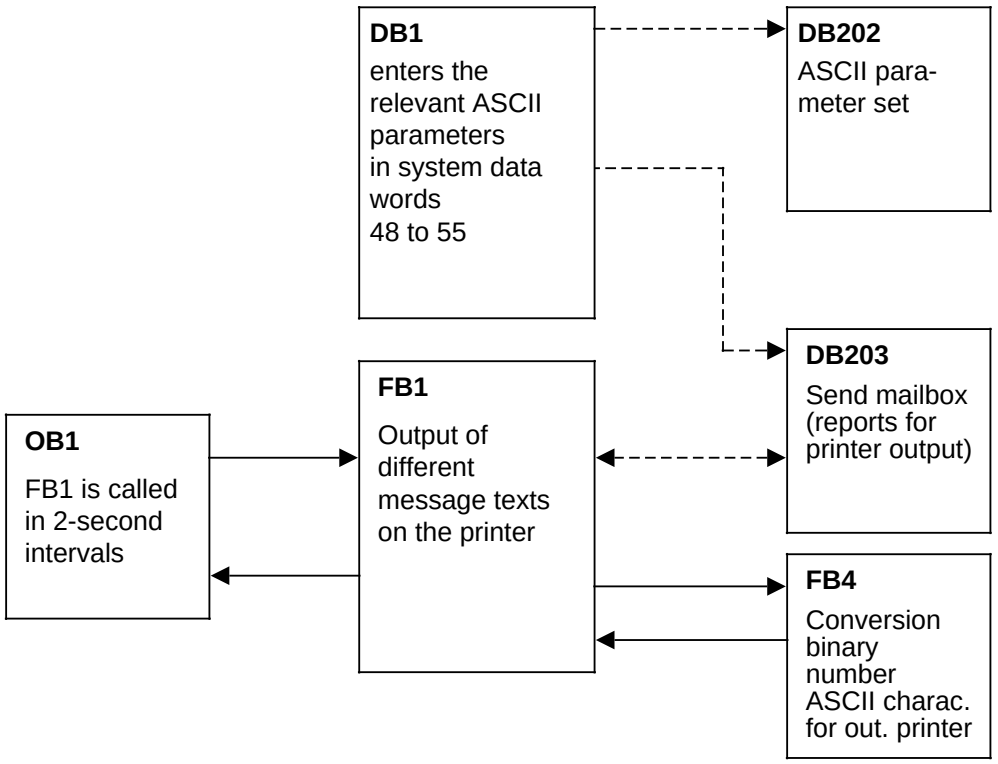


Figure 4-10 Program Structure of the ASCII Driver

DB1 AWL	Erläuterung
: 240: KC ='TTS 6 ;# #ASC: PAR '; 252: KC ='DB202DW0 SF DB203DW0 '; 264: KC =' EF DB204DW0 KBS MB200'; 276: KC =' KBE MB201 MOD'; 288: KC =' 6 BDR 9600 PRTY EVEN '; 300: KC ='DF 0 DT 2 ME 0 4 '; 312: KC =' SLF N LPP 6'; 324: KC ='6 LM 5 PN U HD1 ” ME'; 336: KC ='SSAGE LIST: PLC $3AS5$5F'; 348: KC ='95U$5FASCII$5FTREIBER” '; 360: KC =' HD2 ”=========='; 372: KC ='========================'; 384: KC ='========================'; 396: KC ='====================” '; 408: KC =' FT1 ”*************'; 420: KC ='*********************<SE'; 432: KC ='ITE>*********************'; 444: KC ='*********************” '; 456: KC =' FT2 ” '; 468: KC =' EXAMPLE PLC 95U-SI-ASC'; 480: KC ='II-DRIVERINTERFACE '; 492: KC =' ” ; :	ASCII set of parameters lies in DB202 from DW 0 onwards. Send mailbox: DB203 from DW0: Receive mailbox: DB204 From DW 0 onwards; 'Send' coordination byte: FY 200; 'Receive' coordination byte: FY 201 ASCII mode No: 6; Transmission rate: 9600 bit/s Parity: even; Data format: 0; Character delay time between 2 characters: 20 ms End-of-text identifier:”EOT”; Suppress LF: No Lines per page: 66: Left margin: 5 characters; Page specification: bottom; Header line 1 Header line 2 Footer 1 Footer 2

OB1 AWL	Description
: :UN M 0.0 :L KT 200.0 :SE T 0 :U T 0 := M 0.0 : :U M 0.0 :U E 0.0 :SPB FB 1 NAME :PRINT : :BE	 Call of FB1 in 2-second intervals and enable if printing

The FB1 example function block is used for printing out reports stored in the DB203 send data block.
A printer output is initiated at every call of the function block and resetting of send initiation bit (KBS bit 7). Here, the number output in the message text is incremented by 1 for every FB run.
The FB4 function block is used for conversion of the binary message number into ASCII representation.

FB1 STL	Description
NAME :PRINT	FB for printout of a message
:A DB 203	Open send mailbox DB
:	
:U F 200.7	KBS bit: ”Send” (printing out)
:JC = END	
:	
:L FW 202	Increment the number of the message
:ADD KF +1	printout for the example by 1
:T FW 202	
:	
:JC FB 4	Call of conversion FB
NAME :DU>ASCII	
DUAL : FW 202	Source binary number
A-TH : DW 14	ASCII representation T/H (thousands/hundreds)
A-ZE : DW 15	ASCII representation Z/E (tens/units)
	Data words to be updated in the send DB
:	
:L FW 204	Increment the number of the error text
:ADD KF +2	for the example by 2
:T FW 204	
:JC FB 4	Call of conversion FB
NAME :DU>ASCII	
DUAL : FW 204	
A-TH : DW 38	Data words to be updated
A-ZE : DW 39	in send DB
:	
:AN F 200.7	KBS bit 7
:S F 200.7	Initiate printout
:	
END :BE	

FB4 STL	Description
NAME :DU>ASCII	Converter Binary number to ASCII number
BEZ :DUAL E/A/D/B/T/Z: E BI/BY/W/D: W	
BEZ :A-TH E/A/D/B/T/Z: A BI/BY/W/D: W	
BEZ :A-ZE E/A/D/B/T/Z: A BI/BY/W/D: W	
:L KB 0	Delete auxiliary register
:T FW 240	
:T FW 242	
:T FW 244	Residual value register
:	
:L =DUAL	Load binary number (area 0-9999)
:L KF +9999	
:>F	
:BEC	
:TAK	
SUBT :L KF +1000	Evaluation of thousands
:>=F	
:JC =TAUS	Jump to processing thousands
:TAK	
SUBH :L KF +100	Evaluation of hundreds
:>=F	
:JC =HUND	Jump to processing hundreds
:TAK	
SUBZ :L KF +10	Evaluation of tens
:>=F	
:JC =ZEHN	Jump to processing tens
:JU =EINE	Jump to processing units
:	
TAUS :-F	
:T FW 244	
:L FY 240	
:ADD KF +1	
:T FY 240	Increment thousands count register
:TAK	
:JU =SUBT	Jump to processing thousands
:	
HUND :-F	
:T FW 244	
:L FY 241	
:ADD KF +1	
:T FY 241	Increment hundreds count register
:TAK	

FB4 STL (continued)	Description
:JU =SUBH : ZEHN :-F :T FW 244 :L FY 242 :ADD KF +1 :T FY 242 :TAK :JU =SUBZ : EINE :TAK :T FY 243 : :L KH 3030 :L FW 240 :OW :T =A-TH :TAK :L FW 242 :OW :T =A-ZE :BE	Jump to processing hundreds Increment tens count register Jump to processing tens Write units count register

DB202 is written by the DB1 interpreter with the ASCII parameter set.
For this example, DB202 is as follows:

DB202 STL	Description
0: KF = +00008; 1: KF = +00000; 2: KF = +00000; 3: KH = 0000; 4: KH = 0000; 5: KH = 0000; 6: KF = +00002; 7: KH = 0004; 8: KH = 0001; 9: KF = +00066; 10: KF = +00005; 11: KH = 0055; 12: KS =' MESSAGE LIST: PLC :S5_'; 24: KS ='95U_ASCII_TREIBE';	Transmission rate: 8=9600 bit/s Parity: 0=even parity Data format 0 Waiting time after CR: (none) Waiting time after LF: (none) Waiting time after FF: (none) Character delay time between 2 chars: 2 x 10 ms End-of-text character: ”EOT” = 04_H Suppress LF: NO Lines per page: 66 Left margin: 5 characters Page number at bottom = 55_H Header line 1

DB202 STL (continued)	Explanation
32: KH = 520D;	52_H = R ; $0D_H$ = CR
33: KS ='========================';	Header 2
45: KS ='========================';	
57: KS ='========================';	
69: KS ='========';	
73: KH = 0D2A;	$0D_H$ = CR ; $2A_H$ = *
74: KS ='************************';	Footer 1
86: KS ='*********<SEITE>********';	
98: KS ='************************';	
110: KS ='********';	
114: KH = 0D20;	$0D_H$ = CR ; 20_H = Blank
115: KS =' EXAMPLE';	Footer 2
127: KS =' PLC 95U-SI-ASCII-DRIVER';	
139: KS ='INTERFACE ';	
150: KH = 0000;	
151: KH = 0000;	

Send data block DB203 with message text for printer output:

DB203 STL	Description
0: KH = 0D0A;	Control character: CR ; LF
1: KH = 1B5B;	Select 1/17 character pitch for
2: KH = 3477;	control characters.
3: KS ='Process message No.: ';	Message text
13: KH = 1B30;	Control character: Underline ON
14: KS ='0067';	Number of message printout (used by FB4)
16: KH = 1B39;	Control character: Underline OFF
17: KS =' *** >';	Message text
21: KH = 1B30;	Control character: Underline ON
22: KS =' A C H T U N G B R E N';	Message text with variables from 4
34: KS =' N E R 0134 A U S G E F';	
46: KS ='A L L E N ! ';	
53: KH = 1B39;	Control character: Underline OFF
54: KS ='< ';	Message text
55: KH = 200D;	SPACE and CR
56: KH = 1B5B;	Select 1/10 character pitch for
57: KH = 3177;	control characters.
58: KH = 0A04;	LF and end-of-text character EOT (DB202)
59: KH = 0000;	
60:	

Appendices

A DB1 Parameters, DB1 Parameterizing Errors

A DB1 Parameters, DB1 Parameterizing Errors

Parameter	Argument	Permissible Range	Meaning
Block Identifier: SL1:			**SINEC L1/Point-to-Point Link**
SLN	p	p=0, 1 ... 30	″***SL***ave***N***umber″
SF	DBxDWy	x=2 ... 255	Position of the send mailbox (start of SF)
EF	or	y=0 ... 255	Position of the receive mailbox (start of EF)
KBE	MBz	z=0 ... 255	Position of the receive coordination byte
KBS			Position of the send coordination byte
PGN	p	p=1 ... 30	***P***ro***G***rammer bus ***N***umber [1]
Block Identifier: RKT:			**Comput. Link w. Second Serial Interface**
PAR [2]			Position of ***PAR***ameter set
SF	DBxDWy	x= 2 ... 255	Position of the send mailbox (start of SF)
EF	or	y= 0 ... 255	Position of the receive mailbox (start of EF)
KBS	MBz	z= 0 ... 255	Position of the send coordination byte
KBE			Position of the receive coordination byte
MOD	n	n= 1, 2	″***MOD***e number″ mode number
			Parameter set - computer link:
BDR	m	m= 200; 300; 600; 1200; 2400; 4800;9600	″***B***au***D R***ate″ Transmission rate in bit/s
PRTY	p	p= E(VEN); O(DD); M(ARK); S(PACE); N(ONE)	″***P***a***R***i***TY***″ parity
DF	q	q= 0 ... 5, 7, 8	″***D***ata ***F***ormat″
DT	s [3]	s= 10 ... 655330	″***D***elay ***T***ime″ Character delay time in ms
PRI	r	r= H(IGH); L(OW)	″***PRI***ority″
TIO	t [3]	t= 20 ... 655340	″***TI***me ***O***ut″ in ms
BWT	u [3]	u= 30 ... 655350	″***B***lock ***W***ait ***T***ime″ in ms
TTE	v	v= 1 ... 255	″***T***ries ***T***o ***E***rect″ numb. of buildup attempts
TTS	w	w= 1 ... 255	″***T***ries ***T***o ***S***end″ number of send attempts

[1] A programmer bus number is required if programmer functions are to be transmitted via the SINEC L1 LAN.
Caution: If the slave number is also ”0” the communication partner has master function. In this case, no programmer/operator panel function is possible at SI2 interface, the parameter is irrelevant.
In the case of overall reset of the PLC via programmer bus, the PG bus number is retained.

[2] The parameter ”PAR” must be in front of the parameter set - computer link in the ”RKT:” parameter block

[3] Specify in 10 ms steps.

Parameter	Argument	Permissible range	Meaning
Block identification: ASC:			**ASCII Driver at Second Serial Interface**
PAR [1]			Position of ASCII-***PAR***ameter set
SF	DBxDWy	x= 2 ... 255	Position of the send mailbox (start of SF)
EF	or	y= 0 ... 255	Position of the receive mailbox (start of EF)
KBS	MBz	z= 0 ... 255	Send position of the coordination byte
KBE			Receive position of the coordination byte
MOD	n	n= 1 ... 8	″***MOD***e number″ ASCII mode number
			ASCII parameter set
BDR	m	m= 200; 300; 600; 1200; 2400; 4800;9600	″***B***au***D R***ate″ transmission rate in bit/s
PRTY	p	p= E(VEN); O(DD); M(ARK);S(PACE) N(ONE)	″***P***a***R***i***TY***″
DF	q	q= 0 ... 5, 7, 8	″***D***ata ***F***ormat″
WCR	r [2]	r= 0 ... 2550	″***W***ait time after ***C***arriage ***R***eturn″ in ms, during transmitting
WLF	r [2]	r= 0 ... 2550	″***W***ait time for ***L***ine ***F***eed″ in ms, during transmitting
WFF	r [2]	r= 0 ... 2550	″***W***ait time for ***F***orm ***F***eed″ in ms, during transmitting
DT	s [2]	s= 10 ... 655350	″***D***elay ***T***ime″ Character delay time in ms
ML	t	t= 0 ... 1024	″***M***ail ***L***ength″ Frame length in bytes (only alternatively to ″ME″)
ME	u v	u= 0 ... 255 v= 0 ... 255	″***M***ail ***E***nd″ End-of-text identifier (only alternatively to ″ML″)
SLF	J/N/Y	-	″***S***uppress ***LF***″
LPP	w	w=1 ... 255	″***L***ines ***P***er ***P***age″
LM	x	x= 0 ... 255	″***L***eft ***M***argin″ Width of left margin
PN	z	z= O(BEN); T(OP); U(NTEN);B(OTTOM)	″***P***age ***N***umber″ Position of page number
HD1 [3]	<string>	a maximum of 120 alphanumeric characters	″***H***ea***D***er 1″
HD2 [3]	<string>		″***H***ea***D***er 2″
FT1 [3]	<string>		″***F***oo***T***er 1″
FT2 [3]	<string>		″***F***oo***T***er 2″

[1] The ”PAR” parameter must be in front of the ASCII parameter set in the ”ASC:” parameter block.
[2] Specify in 10 ms steps.
[3] The order of the parameters ”HD1”, ”HD2”, ”FT1” and ”FT2” must be adhered to in the parameter block. The DB1 interpreter inserts a ”CR” automatically after every header and footer.

DB1 parameterizing error

You can read DB1 parameterizing errors as error codes. For this purpose, you must define in the ″ERT:″ DB1 parameter block where the error code is to be stored (in the flag area or in a data block).
The error code which is listed in the following table is in the left-hand byte.
In the right-hand byte ″13_H″ is entered as error location for RKT: parameter block - computer link or ″14_H″ for ASC: ASCII parameter block.
In Section 9.1.2 of the S5-90U/S5-95U System Manual, entry of the parameter ″ERT:″ is described in detail.

Error Code of the DB1 Interpreter (Left-Hand Byte in DW or FW)	**Meaning**
5_H	Block designation syntax error
6_H	Violation of upper or lower limit in an argument
10_H	DB does not exist
11_H	Insufficient space in the parameterized DB or the FY
70_H	Header or footer is too long
71_H	Error in the control character
72_H	Incorrect order of the headers or footers
73_H	Parameter ″PAR″ is incorrect or does not exist or not in front of the parameter set in the DB1
74_H	For time specifications in 10 ms steps: Number cannot be divided by 10
75_H	Parameters ″ML″ **and** ″ME″ have been parameterized (only alternatively)
The following error messages may also occur but they cannot be assigned to any parameter block, i.e. ″FF″ is stored as error location in the right-hand byte.	
1_H	End-of-text error or comment error or syntax error in headers and footers
2_H	

Section 9.1.5 of the System Manual contains all further parameterizing errors which can occur in the S5-95U.

B Positions of the Parameters in the System Data Area of the PLC, ASCII Code

B Positions of the Parameters in the System Data Area of the PLC, ASCII Code

The DB1 enters the parameters you have selected in system data words 48 to 63.
The following tables tell you which system data word includes which parameter and which absolute address is occupied.
For programming and startup of your system by means of DB1, this information is not necessary.

System Data Word	High-Order Byte	Low-Order Byte	Absolute Address
SD 46	Driver number (Tab. ″Assignment of SD 46″)	Error check backs (Tab. ″Assignment of SD 46″)	5D5C
Position of the Parameters for the Computer Link or the ASCII Driver:			
SD 48	Parameter set Data identifier[1]	Parameter set Flag byte or DB No.[2]	5D60
SD 49	Parameter set Data word No.[3]	Send mailbox Data identifier[1]	5D62
SD 50	Send mailbox Flag byte or DB No.[2]	Send mailbox Data word No.[3]	5D64
SD 51	Receivew mailbox Data identifier[1]	Receive mailbox Flag byte or DB No.[2]	5D66
SD 52	Receive mailbox Data word No.[3]	KBS Data identifier[1]	5D68
SD 53	KBS Flag byte or DB No.[2]	KBS Data word No.[3]	5D6A
SD 54	KBE Data identifier[1]	KBE Flag byte or DB No.[2]	5D6C
SD 55	KBE Data word No.[3]	Mode number	5D6E

[1] $4D_H$ (KH) or ″F″ (KS) for flag area, 44_H (KH) or ″D″ (KS) for data block

[2] Flag byte No. 0...255 or data block No. 2...255

[3] Only relevant for data block

System Data Word	High byte	Low byte	Absolute Address
Position of the Parameters for SINEC L1 / Point-to-Point Link:			
SD 57	Programmer bus number[4] (1...30)	Slave number (0, 1...30)	5D72 5D73
SD 58	KBE Data identifier[1]	KBE Flag byte or DB No.[2]	5D74 5D75
SD 59	KBE Data word No.[3]	KBS Data identifier[1]	5D76 5D77
SD 60	KBS Flag byte or DB No.[2]	KBS Data word No.[3]	5D78 5D79
SD 61	Send mailbox Data identifier[1]	Send mailbox Flag byte or DB No.[2]	5D7A 5D7B
SD 62	Send mailbox Data word No.[3]	Receive mailbox Data identifier[1]	5D7C 5D7D
SD 63	Receive mailbox Flag byte or DB No.[2]	Receive mailbox Data word No.[3]	5D7E 5D7F

1 $4D_H$ (KH) or ”F” (KS) ffor flag area, 44_H (KH) or ”D” (KS) for data block

2 Flag byte No. 0...255 or data block No. 2...255

3 Only relevant for data block

4 A programmer bus number is required if PG functions are to be transmitted via the SINEC L1 LAN.
Caution: If the slave number is in low-order byte ”0”, the communication partner has master function. In this case, no programmer/operator panel function is possible at SI2 interface; the parameter is irrelevant!
In the case of overall reset of the PLC via the programmer bus, the programmer bus number is retained.

Assignment of system data word 46:

Byte	Assignment	Meaning
High-order byte	00_H	Programmer/operator panel and SINEC L1 mode
	01_H	ASCII driver
	02_H	Driver for 3964(R) computer link
Low-order byte		**Error Checkbacks**
	10_H	KBS not available
	20_H	KBE not available
	40_H	KBS and KBE not available

Default for ASCII driver and computer link without parameterization of DB1 and parameter set

Both the ASCII driver and the computer link offer default values for the parameter set.

Under the following circumstances, the defaults are accepted:

- You have entered ″01_H″ or ″02_H″ (drive number for ASCII driver / computer link) in the high-order byte of the system data word by means of the PLC program.
- You have not programmed the position of the parameter set or you have programmed it incorrectly in the system data (e.g. DB is not available)

The position of the parameter set (in the flag area or data block) is determined in system data words 48 and 49.

Default of the ASCII parameter set:

The defaults for the ASCII driver are valid for the DR 211 printer (mode 6).

Word	Meaning	Range of Values	Default Depending on Mode							
			1	2	3	4	5	6	7	8
0	Transmission rate	2 200 bit/s 3 300 bit/s 4 600 bit/s 5 1200 bit/s 6 2400 bit/s 7 4800 bit/s 8 9600 bit/s	8	8	8	8	8	8	8	8
1	Parity	0 even 1 odd 2 mark (″1″) 3 space (″0″) 4 none	0	0	0	0	0	0	0	0
2	Data format	0 ... 5, 7, 8	0	0	0	0	0	1	1	0
3	CR waiting time *	0 ... $00FF_H$ x 10 ms	x	x	x	x	x	0	0	x
4	LF waiting time *	0 ... $00FF_H$ x 10 ms	x	x	x	x	x	0	0	x
5	FF waiting time *	0 ... $00FF_H$ x 10 ms	x	x	x	x	x	0	0	x
6	Character delay time (when receiving)	1 ... $FFFF_H$ x 10 ms	10	10	10	10	10	x	x	10

X = Not relevant

* During transmitting

Word	Meaning	Range of Values	Default, Depending on Mode							
			1	2	3	4	5	6	7	8
7	End-of-text character/number of receive characters		64	<CR>	<CR> <LF>	<CR>	<CR> <LF>	<EOT>	None	64
8	Suppress LF	0/1 yes/no	x	x	x	x	x	0	0	x
9	Lines per page	1 ... 255	x	x	x	x	x	72	72	x
10	Left margin	0 ... 255	x	x	x	x	x	10	10	x
11	Page number	o/u top/bottom	x	x	x	x	x	u	u	x
12 . . .	Header ** footer	Header 1 Header 2 Footer 1 Footer 2	x	x	x	x	x	CR CR CR CR	CR CR CR CR	x

x = Not relevant

** The contents of the individual headers and footers (max. length 120 characters each) must be separated by CRs in any case if the headers and footers have not been defined in DB1.

Default of the set of parameters for computer link:

Word	Meaning	Range of Values	Default
0	Transmission rate	2 200 bit/s 3 300 bit/s 4 600 bit/s 5 1200 bit/s 6 2400 bit/s 7 4800 bit/s 8 9600 bit/s	8
1	Parity	0 even 1 odd 2 mark (″1″) 3 space (″0″) 4 none	0
2	Data format	0...5, 7, 8	1
3	Priority	0 low 1 high	1
4	Character delay time	1... 65535×10ms	22
5	Timeout	1... 65535×10ms	200
6	Block waiting time	1... 65535×10ms	400
7	Number of buildup attempts	1... 255	6
8	Number of send attempts	1... 255	6

ASCII code

Hexadecimal	ASCII	Hexadecimal	ASCII	Hexadecimal	ASCII	Hexadecimal	ASCII
00	NUL	20	SP	40	@	60	,
01	SOH	21	!	41	A	61	a
02	STX	22	″	42	B	62	b
03	ETX	23	#	43	C	63	c
04	EOT	24	$	44	D	64	d
05	ENQ	25	%	45	E	65	e
06	ACK	26	&	46	F	66	f
07	BEL	27	´	47	G	67	g
08	BS	28	(	48	H	68	h
09	HT (TAB)	29	)	49	I	69	i
0A	LF	2A	*	4A	J	6A	j
0B	VT	2B	+	4B	K	6B	k
0C	FF	2C	,	4C	L	6C	l
0D	CR	2D	-	4D	M	6D	m
0E	SO	2E	•	4E	N	6E	n
0F	SI	2F	/	4F	O	6F	o
10	DLE	30	0	50	P	70	p
11	DC1 (XON)	31	1	51	Q	71	q
12	DC2 (TAPE)	32	2	52	R	72	r
13	DC3 (XOFF)	33	3	53	S	73	s
14	DC4 (TAPE)	34	4	54	T	74	t
15	NAK	35	5	55	U	75	u
16	SYN	36	6	56	V	76	v
17	ETB	37	7	57	W	77	w
18	CAN	38	8	58	X	78	x
19	EM	39	9	59	Y	79	y
1A	SUB	3A	:	5A	Z	7A	z
1B	ESC	3B	;	5B	[	7B	{
1C	FS	3C	<	5C	\	7C	|
1D	GS	3D	=	5D	]	7D	
1E	RS	3E	>	5E		7E	} (ALT MODE)
1F	US	3F	?	5F	-	7F	DEL (RUB OUT)

C List of Abbreviations

C List of Abbreviations

Interface-specific abbreviations	Description
ASC	DB1 block identification for ASCII drivers
BCC	Block check character
BDR	DB1 parameter: Transmission rate
BWT	DB1 parameter: Block Wait Time
CP	Communications processor
DF	DB1 parameter: Data format
DLE	ASCII character: Data Link Escape
DT	DB1 parameter: Delay Time (character delay time)
EF	DB1 parameter: Position of the receive mailbox
EOT	ASCII character: End of transmission
ETX	ASCII character: End of text
FT1	DB1 parameter: Footer 1
FT2	DB1 parameter: Footer 2
HD1	DB1 parameter: Header 1
HD2	DB1 parameter: Header 2
KBE	DB1 parameter: Position of the ″receive″ coordination byte
KBS	DB1 parameter: Position of the ″send″ coordination byte
LM	DB1 parameter: Left Margin (width of the left margin)
LPP	DB1 parameter: Lines Per Page (number of lines per page)
ME	DB1 parameter: Mail End (end-of-text)
ML	DB1 parameter: Mail Length (frame length)
MOD	DB1 parameter: Mode number
NAK	ASCII character: Negative Acknowledgement
Point-to-point link	Point-to-point link
PAR	DB1 parameter: Position of the parameter set
PGN	DB1 parameter: Programmer bus number
PN	DB1 parameter: Page Number (position of the page number)
PRI	DB1 parameter: Priority
PRTY	DB1 parameter: Parity
RKT	DB1 block identifier for computer link with 3964(R) transmission protocol
RUB OUT	ASCII character: Delete last character
SF	DB1 parameter: Position of send mailbox

Interface-specific abbreviations	Description
SI1	First serial interface (also programmer interface)
SI2	Second serial interface
SL1	DB1 block idientifier SINEC L1
SLF	DB1 parameter: Suppress LF
SLN	DB1 parameter: Slave number
SS	Interface
STX	ASCII character: Start of text
TIO	DB1 parameter: Timeout
TTE	DB1 parameter: Tries To Erect (number of buildup attempts)
TTS	DB1 parameter: Tries To Send (number of send attempts)
TTY active	The 20 mA power source of the device supplies the current for the interface.
TTY passive	The 20 mA power source of the device supplies no current for the interface.
WCR	DB1 parameter: Wait time after Carriage Return
WFF	DB1 parameter: Wait time for Form Feed
WLF	DB1 parameter: Wait time for Line Feed
XOFF	ASCII character: Abort sending and wait for XON
XON	ASCII character: continue to send

D Accessories and Order Numbers

D Accessories and Order Numbers

		Order numbers
S5-95U programmable controller with two serial interfaces		6ES5 095-8MC01
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
″Second Serial Interface of the		
S5-95U Programmable Controller″ Product Manual	German	6ES5 998-8MC11
	English	6ES5 998-8MC21
	French	6ES5 998-8MC31
	Spanish	6ES5 998-8MC41
	Italian	6ES5 998-8MC51
SINEC L1 Manual	German	6ES5 998-7LA11
	English	6ES5 998-7LA21
	French	6ES5 998-7LA31
	Spanish	6ES5 998-7LA41
	Italian	6ES5 998-7LA51
707-1 Bus cable		6ES5 707-1AA00

E Technical Data, Scan On-Load Times of the PLC When Using the Second Serial Interface

E Technical Data, Scan On-Load Times of the PLC When Using the Second Serial Interface

Climatic environmental conditions
S5-90U/S5-95U System Manual

Mechanical environmental conditions
S5-90U/S5-95U System Manual

Electromagnetic compatibility, noise immunity
S5-90U/S5-95U System Manual

Specifications for IEC/VDE safety
S5-90U/S5-95U System Manual

Internal technical data
S5-90U/S5-95U System Manual

Power supply (internal)

Input voltage

- Nominal value	24 V DC
- Permissible range	20 ... 30 V

Current consumption at 24 V

- for the PLC	typ.	240 mA
- External I/Os for max. config.	typ.	1.1 A

Output voltage

- U 1 (for external I/O)	+9 V
- U 2 (for serial interfaces)	+5.2 V

Output current

- from U 1	1 A
- from U 2 (total)	0.65 A
Short-circuit protection for U 1, U 2 (programmer)	Yes, electronic

Galvanic isolation **No**

Protection class **I class**

Backup barrery S5-90U/S5-95U System Manual

Specific data onboard I/O
S5-90U/S5-95U System Manual

Specific data of the second serial interface

Main processor	80C537
Communications processor	80C32
Bus	Shielded cable
Interface	TTY
Transmission mode	Bit-serial, asynchronous
Data format	10 -bit/ 11-bit character frames (1 startbit, 7 or 8 data bits, 1 parity bit, 1 or 2 stop bits)

Specific data of the interface (continued)

Possible transmission rates
(adjustable in DB1)

- for programmer functions; SINEC L1; point-to-point link (SINEC L1 protocol): 9600 bit/s

- for computer link with 3964(R) transmission protocol; ASCII driver: 200 bit/s, 300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s

Communications mechanisms

Programmer functions

SINEC L1

- Station status	Slave
- Data quantity per request	1 ... 64 bytes

Point-to-point link (SINEC L1 protocol)

- Data quantity per request	1 ... 64 bytes

Computer link with 3964(R) transmission protocol

- Data quantity per request	1 ... 1024 bytes

ASCII driver

- Data quantity per request	1 ... 1024 bytes

Integrated blocks

Integrated organization blocks

- OB1	Cyclic program scanning
- OB3	Interrupt-driven program scanning
- OB13	Time-controlled program scanning
- OB21	Restart program scanning (manual cold restart)
- OB22	Restart program scanning (power restore)
- OB31	Cycle trigger
- OB34	Battery failure
- OB251	PID control algorithm

Integrated function blocks

- FB240	Code converter: BCD4 after 16 bits fixed point
- FB241	Code converter: 16 bits fixed point to BCD4
- FB242	Multiplier: 16 bit fixed point
- FB243	Devider: 16 Bit fixed point
- FB250	Read in analog value
- FB251	Output analog value

Interrupt reaction time

The interrupt reaction time increases by a maximum of 2.3 ms for all functions that are executable at the SI2 interface (exception: ″Compress block″ programmer function; Calculation of interrupt reaction times S5-90U/S5-95U System Manual, Section 10.3) .
The total interrupt reaction time T_{Itot} (up to 1st STEP 5 operation in OB3) is calculated as follows:

$$\mathbf{T_{Itot} = T_{Ibas} + T_{ISI1} + T_{ISI2}}$$

T_{Itot} = Total interrupt reaction time
T_{Ibas} = Basic reaction time
T_{ISI1} = Interrupt reaction time at SI1
T_{ISI2} = Interrupt reaction time at SI2

Example: If an OP is connected to SI1 and a programmer to SI2, the total interrupt reaction time is as follows: T_{Itot}= 0.6 ms* + 0.4 ms* + 1 ms= 2 ms

* Values taken from: S5-90U/S5-95U System Manual, Section 10.3, Table 10-8

PLC scan cycle load

In the case of programmer/operator panel functions:
For current programmer/operator panel functions, the scan on-load time is function-dependent and can therefore not be specified universally.

S5-95U as SINEC L1 slave or point-to-point slave/master:
PLC scan cycle load depends on the number of bus cycles during the PLC scan cycle. The bus cycle is asynchronous to the PLC scan cycle.

In order to define the PLC scan cycle load you must
1. Compute the PLC load time per bus cycle
2. Compute the time for a bus cycle (to estimate the percentage by which the PLC scan time increases as a result of SINEC L1 communications)

1. Compute PLC load time

$$\frac{\textbf{PLC load time}}{\textbf{Bus cycle}} = x \cdot T_B^* + T_{REA}^{**} + T_{REC} + T_S$$

x = Number of frames in a bus cycle
T_B = Basic load time (must always be accounted for, i.e. irrespective of whether the slave is addressed or not): 1ms per SINEC L1 frame
T_{REA} = Slave response time, PLC addressed as slave (irrespective of whether net data available) : 1.5 ms
T_{REC} = Receive time in the case of reception of max. net data (64 bytes) : 1 ms
T_S = Send time in the case of transmission of max. net data (64 bytes): 1 ms

* For S5-95U used as a point-to-point master: T_B=1.5 ms per SINEC L1 frame.
** For S5-95U as point-to-point master T_{REA} is omitted in the equation.

Example: S5-95U is SINEC L1 slave
Number of frames = 15
Net data ″receive″ = 64 bytes
Net data ″send″ = 64 bytes

$$\frac{\text{PLC load time}}{\text{Bus cycle}} = 15 \cdot 1\text{ ms} + 1.5\text{ ms} + 1\text{ ms} + 1\text{ ms} = 18.5\text{ ms}$$

2. Compute time for a bus cycle

The time for one bus cycle (cycle time T_C in ms) can be calculated by means of the following equation:

$$T_C = (20 + L_m \cdot 1.8 + L_s \cdot 1.8 + t_Q) \cdot n$$

T_C = Bus cycle time for n nodes for identical frame lengths (m) master slave
for identical frame lengths (s) slave master
L_M = Number of bytes in the case of the master
L_s = Number of bytes in the case of the slave
t_Q = 20 ms, for internode communication only (i.e. slave sends data to other slave)
n = Number of slaves (n=1 is always valid in the case of point-to-point link)

For S5-95U as point-to-point master, the following equation is valid in the range
100 ms T_C 280 ms.

Example: S5-95U is SINEC L1 slave
Number of bytes in the case of the master = 64 bytes
Number of bytes in the case of the slave = 64 bytes
Number of slaves = 15

T_C=(20+64 bytes·1.8+64 bytes·1.8)·15
T_C=3756 ms

$$\frac{\text{PLC load time}}{\text{Bus cycle time}} = \frac{18.5 \text{ ms}}{3756 \text{ ms}} = 0.005$$

The PLC scan time increases by 0.5% on account of SINEC L1 communication at the SI2 interface provided the PLC scan cycle is just as long as the bus cycle. For short PLC scan cycles, the load resulting from SINEC L1 communication is not evenly distributed.

In the case of computer link/ASCII driver:
When sending, the first load occurs within 100 ms, i.e. the send request is recognized by the driver in the operating system of the PLC (32 bytes are copied by the send mailbox into the internal output buffer).

When receiving, the first load occurs when the KBE bit ″Receiving permitted″ is set and receive data are available.

Further loads occur both during sending and receiving at intervals of approx. 10 ms.
The number of loads depends on the data quantity:
- Worst case für 1 ... 32 bytes = 1 ms
- Worst case für 1024 bytes = 32·1 ms

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