SIMATIC S5

Second Serial Interface of the S5-95U Programmable Controller

Manual

EWA 4NEB 812 6095-02a

Edition 02

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).

1 Description of the System

1.1 Possible Applications of the S5-95U with Second Serial Interface . . . . . 1 - 2

1.2 Range of Functions of the Two Serial Interfaces . . . . . 1 - 5

1.3 Configuration of the PLC and Assignment of the Second Serial Interface . . . . . 1 - 7

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.

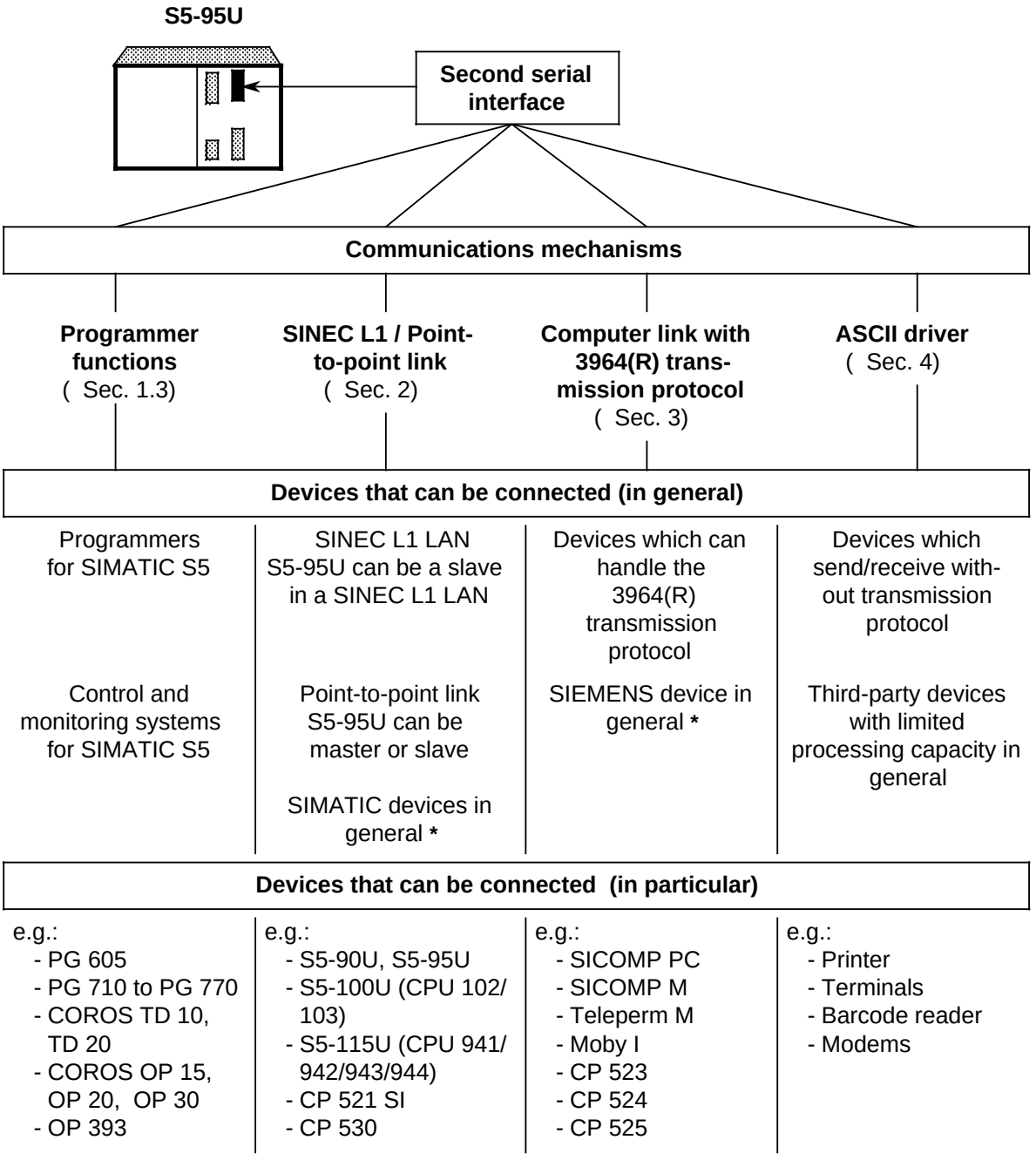
The second serial interface provides the following communication possibilities:
- Communication via the SINEC L1 local area network (LAN)
- Point-to-point link (SINEC L1 protocol)
- Computer link with the 3964(R) transmission protocol
- ASCII driver, e.g. for visualization of process sequences
- Programmer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

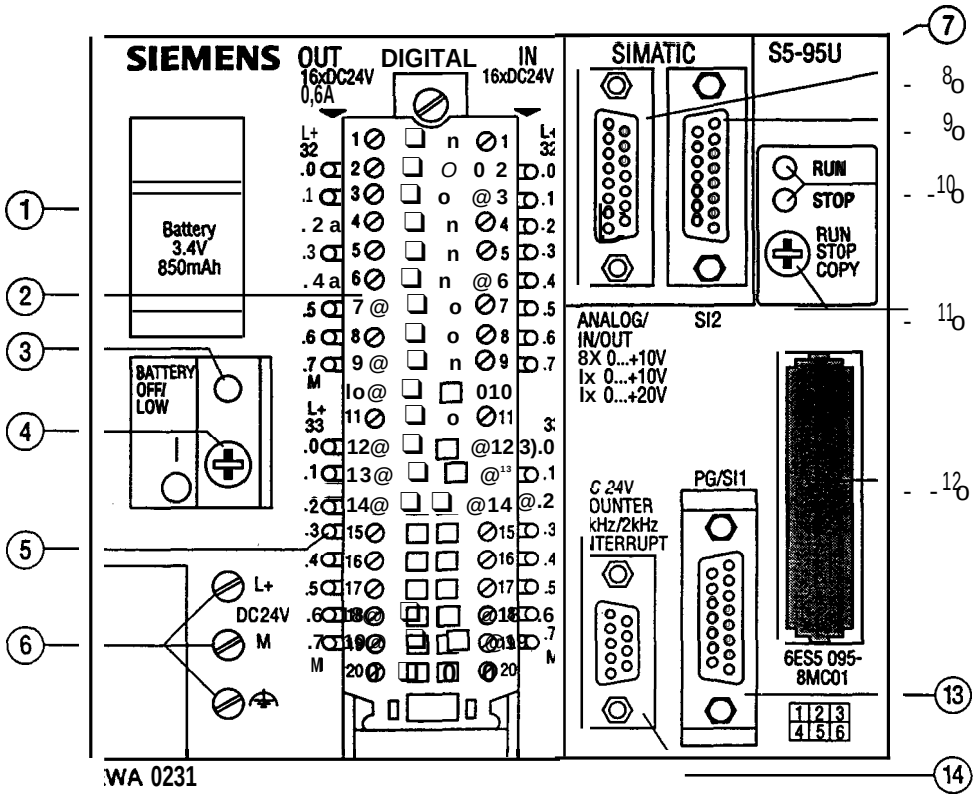
Example: If ″TEST STATUS″ runs at SI1, ″INPUT BLOCK″ is not possible at SI2.

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).**

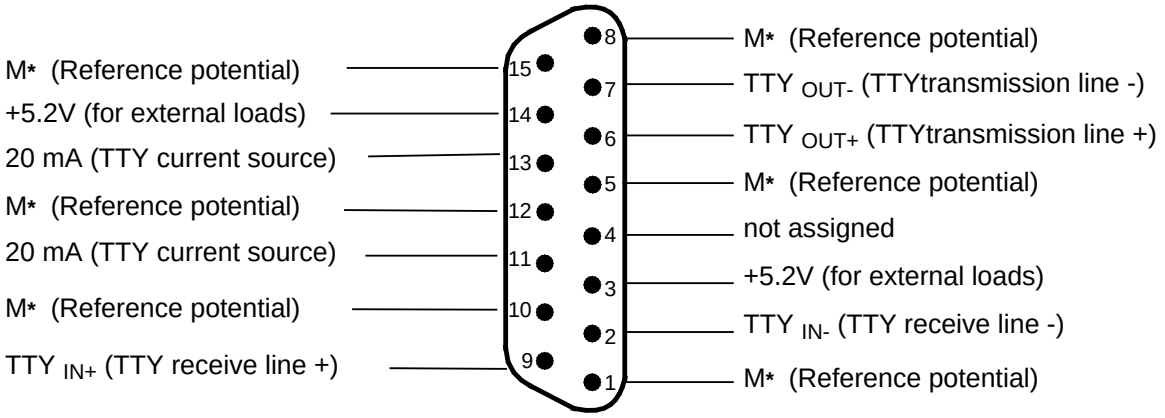


(1) **Battery compartment**
(2) Front connector for digital inputs (I 32.0 . . . I 33.7) and for digital outputs (Q 32.0 . . . Q 33.7)
(3) Battery low LED
(4) On/off switch
(5) LEDs **for digital inputs and outputs**
(6) **Terminals for connecting the** power supply
(7) Cable connector **for S5-1OO modules**
(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

2 Point-To-Point Link with SINEC L1 Protocol

2.1 Connection of Nodes in a Point-To-Point Link . . . . . 2 - 4

2.2 Data Traffic and DB1 Parameter Assignment in a Point-To-Point Link . . . . . 2 - 6

2.3 Coordination Bytes in a Point-To-Point Link . . . . . 2 - 7

2.4 Program Example of Point-To-Point Link . . . . . 2 - 8

Figures

2.1 Structure of a SINEC L1 LAN . . . . . 2 - 1
2.2 Structure of a Point-To-Point Link with BT 777 Transceiver . . . . . 2 - 2
2.3 Structure of a Point-To-Point Link with Direct Cable . . . . . 2 - 2
2.4 Pin Assignments Point-To-Point Master (TTY Active) - Point-To-Point Slave (TTY Passive) . . . . . 2 - 4
2.5 Pin Assignments S5-95U (TTY Active) - CP 521 SI (TTY Passive) . . . . . 2 - 5
2.6 Structure of the Coordination Bytes . . . . . 2 - 7
2.7 Program Structure Point-To-Point Link . . . . . 2 - 8

Tables

2.1 Communication Partners in the Point-To-Point Link . . . . . 2 - 3

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

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