

SIMATIC S5

S5-95F
Programmable controller

Manual

EWA 4NEB 812 6220-02

Edition 01

Introduction

Please read the introduction carefully. You will then find it easier to use the manual and this will save time.

The S5-95F is a failsafe programmable controller for the lower and mid performance ranges. It is for use wherever safety is the first priority and where potential dangers must be avoided. In order to use the controller to its best advantage you require detailed information.

In this manual we have attempted to present the necessary information as completely and as well organized as possible. Certain information is repeated in various chapters so that you do not have to leaf through the manual to find what you need.

On the following pages of this introduction you will find information that will make it easier for you to use the manual. This section explains how the manual is organized.

Contents

- **Hardware Description (Chapters 1, 2, 3)**
These chapters describe the controller: how it fits into the SIMATIC S5 family of programmable controllers, how it functions, and how you install and connect it.
- **Startup Information (Chapters 4, 5, 6)**
These chapters summarize the information you need to start up your programmable controller.
- **The Programming Language and Blocks for the S5-95F (Chapters 7, 8, 9)**
These chapters describe the structure, operations, and structuring aids of the STEP 5 programming language and the function of the integral blocks.
- **Functions of the S5-95F (Chapters 10, 11, 12, 13)**
Each of these chapters contains a complete description of a particular function, from wiring to programming (subjects include: integral clock, analog value processing, interrupt processing, SINEC L1).
- **Diagnostics and Troubleshooting (Chapters 14, 15)**
These chapters describe the diagnostics and test means available to remedy hardware and software faults.
- **High-availability Failsafe Controller with S5-95F (Chapter 16)**
This chapter describes the hardware configuration and the parameterization of the integral function block for linking two S5-95Fs.
- **Example (Chapter 17)**
A simple example illustrates how easy it is to set up and initialize an S5-95F control system.

- Rules for Failsafe Applications (Chapter 18)
This chapter is a brief repetition of the above topics. It is also intended to serve as a reference and to simplify system acceptance.
- Module Spectrum (Appendix A)
This chapter contains the technical specifications of the S5-95F and information on the modules that you can use to expand your controller.
- Overviews (Appendices B through D)
In these chapters you will find not only dimension drawings and a complete list of operations but also guidelines for handling electrostatic sensitive devices (ESD Guidelines).
- Prototype Test Certification (Appendix E)
Certificates on prototype tests can be obtained from us on request.
Please direct inquiries to the address specified in Appendix E.

You will find correction pages at the end of the manual. Use them to indicate any corrections, additions or suggestions for improvement you might have. Send these suggestions to us. They will help us to improve the next edition of this manual.

Conventions

This system manual is organized in menu form to make it easier for you to find information. This means the following:

- Each chapter is marked with printed tabs.
- At the front of the system manual is an overview page that lists the title of each chapter. Following this page, you will find a table of contents.
- At the beginning of each chapter is a table of contents for that chapter. Each chapter has three level headings that are numbered. The fourth level heading is not numbered but appears in **boldface type**.
- Pages, figures, and tables are numbered separately for each chapter. On the back of the table of contents for each chapter you will find a list of the figures and tables that appear in that chapter.

This system manual employs the following specific structuring devices:

- Specific terms have characteristic abbreviations (e.g. programmer is PG). Appendix A contains a list of abbreviations.
- Footnotes are marked with a raised number (e.g. "1"), or a raised asterisk (" *") . You will find the corresponding explanations in the lower margin of the page or under a figure or table if the footnotes appears in one of these.
Lists are designed with bullets (• as in this particular listing) or with hyphens (-).
Procedures are marked with black triangles () and must be performed in the sequence presented.
- Cross references are indicated as follows:
(see section 7.3.2)
There are no references to specific page numbers.
- Dimensions in drawings are indicated in millimeters and inches.

Especially important information appears in framed boxes such as the following:



Warning

You will find definitions for the terms "Note", "Safety Note", "Caution", and "Warning" in the Safety-Related Guidelines for the User at the end of the introduction.

Scope of this Manual

This manual contains a detailed description of our S5-95F system with basic units 6ES5 095-8FB01, version 1. The necessary COM 95F parameter assignment software is described in a separate manual.

The predecessor units 6ES5 095-8FAxx are described in the S5-95F manual with the Order No. 6ES5 998-1MFxx. Also please observe the additional product information.

Compatibility of basic units 6ES5 095-8FB01 and 6ES5 095-8FAxx

6ES5 095-8FB01 basic units are compatible to predecessor units 6ES5 095-8FAxx. Please note, however, that systems consisting of S5-95Fs must always have two identical basic units (the two basic units must have the same Order No. and the same revision level).

Changes with Regard to Programmable Controller 6ES5 095-8FAxx

Please note that the functionality of basic units 6ES5 095-8FB01 is more extensive than that of the preceding units.

The principle differences between an S5-95F programmable controller with basic units 6ES5 095-8FB01 and its predecessor are as follows:

- 2-out-of-3 evaluation for failsafe digital inputs (see Chapter 9.2.1)
- Integrated function blocks for connecting operator panels and text displays with recording function in failsafe mode (see Chapter 9.2.2)
- New (subunit-specific) short-circuit test for lines to failsafe digital inputs (see Chapter 4.2.2)
- Failsafe analog value processing (see Chapter 11.7)
- Establishment of high-availability failsafe control via DI/DQ link (see Chapter 16)
- Shorter execution and response times through the use of a new processor (see Appendix C)
- Shorter off-times when testing the failsafe digital outputs (see Chapter 4.3)
- Failsafe speed monitoring (see Chapter 4.5)

Training

SIEMENS offers a wide range of training courses for SIMATIC S5 users. Contact your Siemens representative for more information.

1 S5-95F Failsafe Mini PLC

The SIMATIC S5 system family offers programmable controllers in all performance classes, from the mini PLC to the high-end PLC.

For your failsafe-oriented applications you can choose between the modular S5-115F and the compact S5-95F. Both have been prototype-tested by the Bavarian Technical Inspectorate (TUEV Bayern), and both meet a number of safety standards which are listed in the prototype test certificate.

Additional tests and certifications are available for the S5-95F from the Institute for Industrial Safety of the Statutory Industrial Accident Insurance (BIA), the Swiss Institute for Industrial Safety (SUVA), the Professional/Trade Association (BG), the Federal Bureau of Railways (EBA), and from Underwriters Laboratories (UL). A summary of applications and their safety regulations is presented in Chapter 1.1.

A copy of the prototype test certificate as well as copies of the certificates of approval can be obtained from us on request (see Appendix E).

The following approvals/authorizations were granted for the S5-95F for failsafe applications:

- Safety classes 2 to 5 in conformity with the manual published by the German Technical Inspectorate
- Safety Integrity Levels 1 to 3 in conformity with IEC 65A (Sec) 123
- Quality levels 1 to 6 in conformity to DIN V 19250
- Quality levels for signalling systems of the German Federal Railways (Deutsche Bahn) in conformity with Mue 8004
- Quality levels in conformity with UL 1998

The quality levels to DIN V 19250 can be compared with the Safety Integrity Level in accordance with IEC 65A (Sec) 123, Fig. 7 of the normative Annex A (see Table 1-1).

TUEV Safety Classes

The German Technical Inspectorate (TUEV) has arranged the requirements laid down in the regulations into five safety classes, with the strictest requirements in class 1. It should be noted that the safety class is not necessarily an indication of the risk involved in the areas of application in question.

Integrity Level to IEC 65A (Sec) 123 (05.92)

Safety Integrity distinguishes between classes 1 to 4, with the lowest requirements in class 1. Safety Integrity can be defined as follows:

Safety Integrity is the likelihood of a safety-related system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time.

1.3 S5-95F Programming and Parameterization Software

Programming Instead of Wiring

Conventional controls using relays or contactors are hardwired. Their functions are implemented by wiring the switching elements. If the control task changes, time-consuming modifications of the wiring have to be made.

With the S5-95F, the sensors and actuators are connected to the programmable controller. The control task is written in a program where the only thing you do is to evaluate the signal states of the sensors and actuators connected. Modification of functions, testing and startup are thus simplified considerably.

STEP 5 Programming Language

This language enables the first-time user to become quickly familiar with PLC technology. All SIMATIC S5 PLCs, including the S5-95F, can be programmed using the STEP 5 language. STEP 5 is easy to comprehend and makes developing of programs user-friendly, flexible and economical.

STEP 5 offers three different methods of representation:

- Statement list (STL)
Uses mnemonics for statements
- Control system flowchart (CSF)
Uses logic representation
- Ladder diagram (LAD)
Similar to a circuit diagram

Programming

Programming of the S5-95F means that the redundant structure is not taken into account (simulation of single-channel design).

This means that the 2-channel failsafe I/Os are addressed in the STEP 5 program only under one address.

Parameter Assignment

The man-machine interface (MMI) of the S5-95F is parameterized like a single-channel controller. The corresponding parameters are set in DB1 of the COM 95F parameterization software.

Parameter Assignment with COM 95F

The COM 95F parameterization software offers you a user-friendly, interactive operator interface. It simplifies

- Entering of system parameters
- Startup
- Error diagnostics
- On-site acceptance

Software Tools for Acceptance

A software-supported acceptance procedure has been developed to simplify system acceptance. It has been harmonized and agreed upon with the German Statutory Industrial Accident Insurance Institution (BG), the BG Institute for Industrial Safety (BIA) and the German Technical Inspectorate (TÜV). For this acceptance procedure, the following software must be installed on your programmer:

- STEP 5 basic package
- COM 95F software package (parameterization software and acceptance tool)
- KOMDOK software package, if you have an earlier version of the STEP 5 basic package than V 6.0.

The Major Characteristics of the S5-95F and S5-115F at a Glance

Table 1-3. The Major Characteristics of the S5-95F and S5-115F at a Glance

Characteristics	S5-95F	S5-115F
<u>Hardware</u>		
Subunit dimensions (W×H×D) in mm	145×135×146	482×302×210
Supply voltage	24 V DC	24 V DC
Digital inputs - Failsafe onboard DIs - Failsafe external DIs - Non-failsafe external DIs	16 max. 128 max. 320	- max. 1024 max. 1024
Digital outputs - Failsafe onboard DQs - Failsafe external DQs - Non-failsafe onboard DQs - Non-failsafe external DQs	8 max. 64 2×4 max. 320	- max. 1008 - max. 1008
Analog inputs - Failsafe external AIs - Non-failsafe external AIs	max. 16 max. 32	max. 64 max. 64
Analog outputs - Non-failsafe external AQs	max. 16	max. 64
Failsafe, onboard counter inputs	2	-
Interrupt inputs - Failsafe onboard interrupt DIs (OB2) - Failsafe onboard interrupt DIs (OB3) - Failsafe external interrupt DIs (OB2)	max. 4 max. 20 -	- - 8
Interfaces	PG/OP/TD/SINEC L1	PG/OP/SINEC L1
Connection to SINEC L1 and PROFIBUS	yes	yes
Failsafe point-to-point link	no	yes
<u>Software</u>		
User memory (1 statement corresponds to 2 bytes)	16 KB, 8 KB of which typ. for program	37 KB
Operating system runtime - Without external I/Os - With external I/Os	25 ms 25 ms+2 ms per bus module	approx. 80 ms
Run time of operating system	approx. 50 ms	approx. 80 ms
Execution time for 1024 binary statements	2 ms	2 ms
Number of flags - Retentive	2048 512	2032 -
Number of counters - Retentive	128 8	128 -
Number of timers	128	128
Program organization - Structured programming - Process interrupt handling - Time-controlled program processing - PID controller (non-failsafe)	yes yes yes yes	yes yes yes yes

A.1.1 Programmable Controller

Technical Specifications AG S5-95F

(6ES5 095-8FB01)

Dimensions and Weight		Output current	
Dimensions WxHxD (in mm)	145×135×146	- from V 1	1 A
(in in.)	5.7 × 5.3 × 5.7	- from V 2	0,65 A
Weight - S5-95F	approx. 1.5 kg (3.3 lbs.)	Short-circuit protection	electronic
Internal Technical Specifications		Class of protection	Class I
Memory capacity - internal RAM 16 KB, 8 KB for control program - EPROM submodule Clock - accuracy t_g ±1 s/day at 25 °C (77 °F) - variation due to temp. change t_A 0 to 60 °C (32 to 140 °F) Execution time - per binary operation approx. 1.2 µs Cycle monitoring time - defined via hardware approx. 680 ms - programmable via software 10 to 2550 ms Flags 2048 (512 retentive) Timers number/range 128; 0.01 to 9990 s Counters number/range 128; 0 to 999 (8 retentive) Inputs/outputs (onboard) Digital inputs, failsafe 16 Digital outputs - failsafe 8 - single-channel 2×4 Interrupt inputs, failsafe 4 Counter inputs, failsafe 2 External I/O modules Digital modules max. 32 Analog modules max. 8 Permissible blocks Organization blocks 1, 2, 3, 13, 21, 22, 31, 34, 37, 251 Program blocks 0 to 255 Function blocks 0 to 255 - integrated 240 to 243, 250 to 252, and 255 Sequence blocks 0 to 255 Data blocks 1 to 255 - reserved 1, 252 to 255 Operation set approx. 140		Floating	no
		Back-up battery	Lithium battery (3.4 V/850 mAh)
		- life expectancy	min. 1 year
		- service life (at 25 °C/77° F)	approx. 5 years
		Power loss of the module	typ. 12 W
		Specific Onboard I/O Specifications	
		For digital inputs:	
		Floating	yes
		- isolated in groups of	16
		- Isolation voltage	max. 60 V DC against shield
		Input voltage	
		- rated value	24 V
		- at "0" signal	- 30 V to +5 V DC
		- at "1" signal	+13 V to +30 V DC
		Input current	
		- at "0" signal	<1.5 mA (Input zero-signal current, 2-wire BERO)
		- at "1" signal	<6.5 mA (at 30 V)
		Delay time	
		- from "0" to "1"	typ. 2.5 ms
		- from "1" to "0"	typ. 2.0 ms
		Cable length unshielded	max. 200 m (660 ft.)
		For digital outputs	
		Floating	yes
		- isolated in groups of	16
		- Isolation voltage	max. 60 V DC against shield
		Load voltage L+	
		- rated value	24 V DC
		- permissible range (including ripple)	20 to 30 V DC
		Output current for "1" signal	
		in horiz. mounting position at 0 to 40° C with L + 24 V DC	
		- failsafe outputs	max. 2.0 A
		- single-channel outputs	max. 0.5 A
		in horiz. mounting position at 40 to 60° C with L + 24 V DC	
		- failsafe outputs	max. 1.5 A
		- single-channel outputs	max. 0.5 A
		in horiz. mounting position at 40 to 60° C with L + 30 V DC	
		- failsafe outputs	max. 1.0 A
		- single-channel outputs	max. 0.5 A
		in vert. mounting position at 0 to 40° C with L + 30 V DC	
		- failsafe outputs	max. 1.0 A
		- single-channel outputs	max. 0.5 A

For digital outputs (continued): Total current (simultaneity factor) - failsafe outputs 100 % - single-channel outputs 100 % Lamp load - failsafe outputs - source output max. 4 W - sink output max. 10 W - single-channel outputs max. 10 W Residual current for "0" signal max. 50 µA Output voltage - for "0" signal max. 0.5 V (at 6k ohms load resistance) - for "1" signal max. L+ minus 0.5 V max. M plus 0.5 V Short-circuit protection for failsafe outputs - source output electronic - sink output thermoelectronic Short-circuit protection for single-channel outputs thermoelectronic Overload withstand capability - failsafe outputs no - single-channel outputs no Polarity reversal protection - for failsafe outputs no - for single-channel outputs no Restriction of the inductive circuit interruption (internal) - for failsafe outputs to - 11 V - for single-channel outputs to - 16 V Switching frequency - resistive load max. 100 Hz - inductive load max. 2 Hz Direct digital output control possible Paralleling of outputs - failsafe outputs possible when outputs are de-coupled by a diode - single-channel outputs each 0.5 A Cable length, unshielded max. 200 m (660 ft.) Current consumption from 24 V - failsafe outputs (all outputs "0") 50 mA - single-channel outputs (all outputs "0") 20 mA	Counter inputs Floating yes Input voltages and currents as for digital inputs (see Specific Onboard I/O Specifications) Delay time - from "0" to "1" typ. 1 ms - from "1" to "0" typ. 1 ms Counter frequency* - counter A: max. 900 Hz - counter B: max. 900 Hz Pulse duration 1.4 ms Cable length (shielded) 100 m For interrupt inputs Floating yes Input voltages and currents as for digital inputs (see Specific Onboard I/O Specifications) Delay time - from "0" to "1" typ. 1 ms - from "1" to "0" typ. 1 ms Pulse duration* 2 ms Cable length (shielded) 100 m (330 ft.)
---	---

* without connection of a programmer, operator panel, text display or SINEC L1

B Dimension Drawings

B.1 S5-95F Programmable Controller

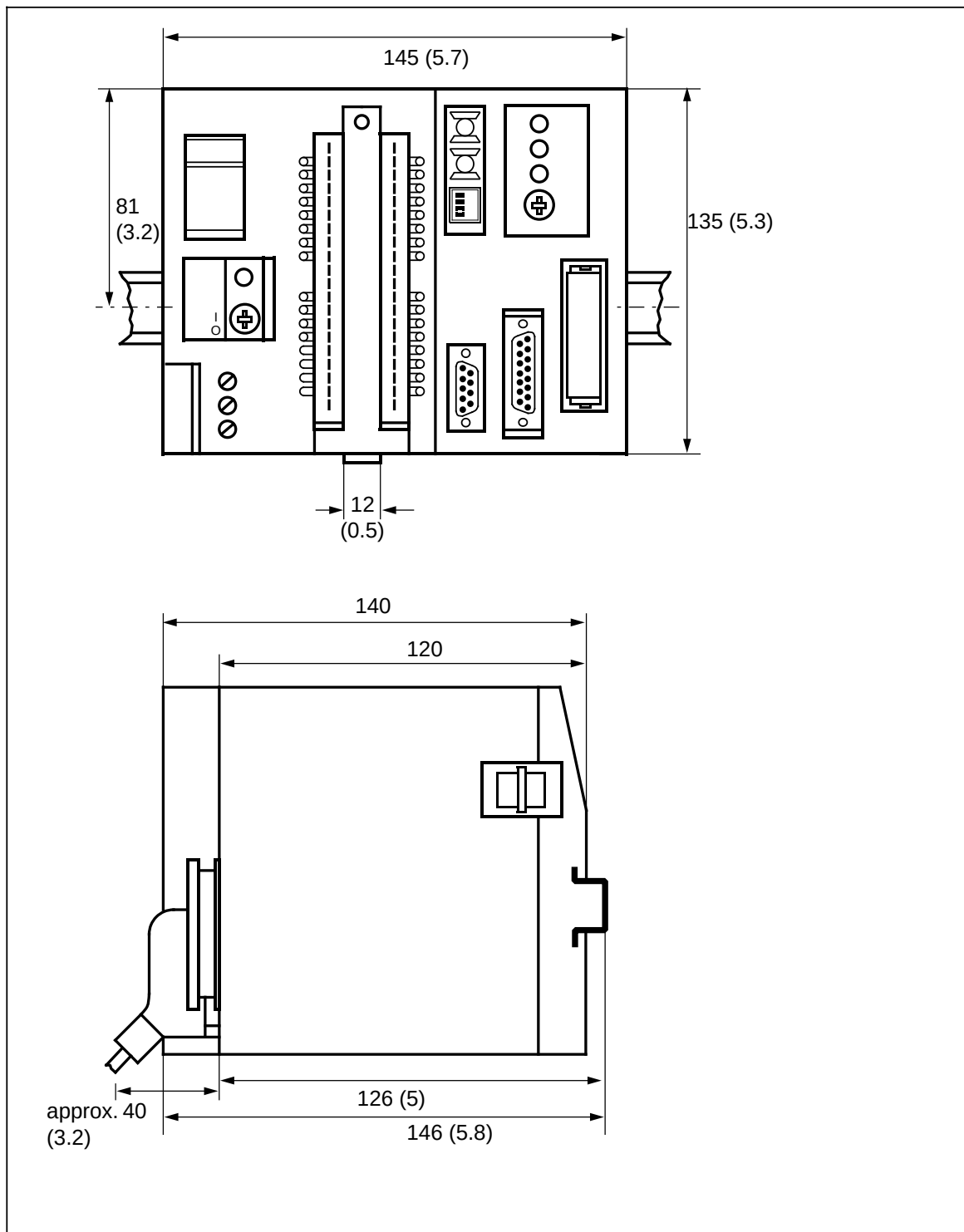


Figure B-1. Dimension Drawing of the S5-95F