SIMATIC S5

S5-95F
Programmable controller

Manual

EWA 4NEB 812 6220-02

Edition 01

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 Guildelines 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 that that of the preceding units.

The principle differences between an S5-95F programmable controller with basic units 6ES5 095-8FB01 and its precedessor 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.

1.3 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
Hardware 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
Software 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

18.5 Memory Submodules for Safety Mode

The S5-95F operates in safety mode only when the user program is stored on an EPROM submodule. The table below lists the permissible memory submodules.

Table 18-3. Overview of EPROM Submodules

Submodule Type	Submodule Order No.	Capacity	Programming No.
EPROM	6ES5 375-0LA15	8 Kbytes	11
EPROM	6ES5 375-0LA21	16 Kbytes	12
EPROM	6ES5 375-0LA41	32 Kbytes	17
EPROM	6ES5 375-1LA15	8 Kbytes	411
EPROM	6ES5 375-1LA21	16 Kbytes	412
EPROM	6ES5 375-1LA41	32 Kbytes	417

Note

For operation with memory submodules you always requrietwo identical memory submodules. Make sure that both submodules have the same order number.

18.6 Function of the Backup Battery

A backup battery is absolutely necessary for S5-95F operation. The battery is required to maintain the contents of RAM if the power should fail and when the subunits are switched off.

The S5-95F monitors the state of its battery. If the battery charge falls below a certain value during operation, the S5-95F writes a message to the system event DB and subsequently processes OB34 at the beginning of every cycle. If the battery is not replaced within 72 hours, the S5-95F goes to STOP so as not to impair its failsafety.

As soon as the battery no longer has sufficient backup capacity, the yellow battery failure display at the front of the basic unit lights up. When the battery failure display is lit, you can only start the S5-95F by switching the power switch from OFF to ON and then switching from STOP to RUN.
For reasons of safety the S5-95F automatically performs an overall reset and copies the contents of the memory submodule into the internal RAM.

Replacing the Backup Battery

Do not wait until the S5-95F indicates that it is time to change the battery; simply replace it every year as a preventive measure.

Safety Note

Battery replacement while the PLC is at RUN is not allowed in installations which fall under the authority of BIA/BG. In all other installations, replacement of a battery while the PLC is at RUN is permitted only in conjunction with careful observation of the guidelines relating to electrostatic sensitive devices (see Appendix D).

A.1 General Technical Specifications for Failsafe Modules

Climatic Environmental Conditions	
Temperature	
Operating	
- horizontal design	0 to+60 °C (32 to 104 °F)
- vertical design	0 to+40 °C (32 to 104 °F) (Air-intake temperature, measured on the underside of the module)
Storage/transport	- 40 to+70 °C (-40 to 150 °F)
Temperature change	
- operating	max. 10 °C/h (50 °F/h)
- storage/transport	max. 20 °C/h (68 °F/h)
Relative humidity	to DIN 40040 15 to 95 % (indoor), non-condensing
Atmospheric pressure	
- operating	860 to 1060 hPa
- storage/transport	660 to 1060 hPa
Pollutants	
- SO_2	0.5 ppm, (rel. humidity 60 %, non-condensing)
- H_2S	0.1 ppm, (rel. humidity 60, non-condensing)

Mechanical Environmental Conditions	
Vibration	to IEC 68-2-6
- tested with	10 to 150 Hz, (const. ampl. 0.15 mm)
	57 to 150 Hz, (const. accel. 2 g)
Shock	to VDE 0116
- tested with	18 shocks (semisinusoidal 30 g/18 ms)
Free-fall	to IEC 68-2-31
- tested with	height of fall 50 mm

Emitted Electromagnetic Interference	
Radio interference level to EN 55011	Limit class A

Electromagnetic Compatibility (EMC) Noise Immunity	
Electrostatic discharge	to IEC 801-2 severity rating 3
- Test voltage	8 kV air discharge 6 kV contact discharge

Electromagnetic Compatibility (EMC) Noise Immunity	
Rated electromagnetic field test	to IEC 801-3, severity rating 3 field strength 10 V/m
Fast transient burst	to IEC 801-4, severity rating 3
Power supply lines	
- Supply voltage 24 V DC	2 kV
Signal lines	
- Analog input/output modules	1 kV
- Digital input/output modules for V 24 V	2 kV
Communications interfaces	1 kV
Surge impulse	to IEC 801-5, severity rating 3
HF current	to IEC 801-6, severity rating 3

IEC/VDE Safety Information	
Degree of protection	to IEC 529
- Type	IP 20
- Class	I to IEC 536
Insulation rating	to VDE 0160
- between electrically independent circuits **and** with circuits connected to a central grounding point	(05. 1988) to VDE 0160
- between all circuits **and** a central grounding point (standard mounting rail)	(05. 1988) to VDE 0160 (05. 1988)
Test voltage for a rated voltage V_{input} of the circuits (AC/DC)	Sine, 50 Hz
V_{input}=0 to 50 V	500 V
V_{input}=50 to 125 V	1250 V
V_{input}=125 to 250 V	1500 V

A.1.1 Programmable Controller

Technical Specifications AG S5-95F (6ES5 095-8FB01)

Dimensions and Weight

Dimensions WxHxD	(in mm)	145×135×146
	(in in.)	5.7 × 5.3 × 5.7
Weight - S5-95F	approx.	1.5 kg (3.3 lbs.)

Internal Technical Specifications

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

Power Supply (Internal)

Input voltage		
- rated value		24 V DC
- permissible range		20 to 30 V
Current consumption from 24 V		
- for the subunit	typ.	160 mA
- for full external I/O configuration	typ.	1 A
Output voltage		
- U 1 (for external I/O)		+9 V
- U 2 (for programmer)		+5.2 V
Output current		
- from V 1		1 A
- from V 2		0,65 A
Short-circuit protection		electronic
Class of protection		Class I
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 0 to 40° C with L + 30 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