

MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

S5-210

6ES5095-8MC03

S5-95U COMPACT CONTROLLER

Applicable product family: SIMATIC S5 automation systems

OFFICIAL SOURCE

6ES5095-8MC03.pdf

The following pages are selected from the supplied manufacturer document and retain their original page content.

SIMATIC S5

**S5-90U/S5-95U
Programmable Controller**

System Manual

EWA 4NEB 812 6115-02b

Edition 03

STEP ® SINEC ® and SIMATIC ® are registered trademarks of Siemens AG.
LINESTRA® is a registered trademark of the OSRAM Company.
Subject to change without prior notice.

The reproduction, transmission or use of this document or its contents is not permitted without express written authority. Offenders will be liable for damages. All rights, including rights created by patent grant or registration of a utility model or design, are reserved.

Copyright© **Siemens AG 1994**

Introduction	
System Description	1
Technical Description	2
Installation Guidelines	3
Start-Up and Program Tests	4
Diagnostics and Troubleshooting	5
Addressing and Access to I/Os	6
Introduction to STEP 5	7
STEP 5 Operations	8
Integrated Blocks and Their Functions	9
Onboard Interrupt Inputs	10
Onboard Counter Inputs	11
Analog Value Processing	12
Integral Real-Time Clock (only in the S5-95U)	13
Communication via SINEC L1 LAN	14
Module Spectrum	15
Function Modules	16
Appendices	A/B/C/ D/E/F
Index	

Contents

	Page
How to Use This System Manual	xv
 1 System Description	 1 - 1
 2 Technical Description	 2 - 1
2.1 Programmable Controller Design - without External I/Os	2 - 1
2.1.1 Design of the S5-90U	2 - 1
2.1.2 Design of the S5-95U	2 - 3
2.2 Internal Electrical Configuration	2 - 5
2.2.1 Internal Electrical Configuration of the S5-90U	2 - 5
2.2.2 Internal Electrical Configuration of the S5-95U	2 - 6
2.3 Principle of Operation of the PLCs	2 - 7
2.3.1 Functional Units	2 - 7
2.3.2 Peculiarities of the PLCs	2 - 10
 3 A Installation Guidelines	 3 - 1
3.1 Mounting the PLC	3 - 1
3.2 Mounting the PLCs with External I/Os	3 - 5
3.2.1 Mounting the S5-90U with External I/Os	3 - 5
3.2.2 Mounting the S5-95U with External I/Os	3 - 7
3.2.3 How to Plug External I/O Modules into the Bus Units	3 - 9
3.2.4 Multi-Tier Expansion	3 - 11
3.2.5 Cabinet Mounting	3 - 13
3.3 Wiring	3 - 15
3.3.1 Connection Methods	3 - 15
3.3.2 Connecting the Power Supply to the S5-90U	3 - 19
3.3.3 Connecting the Power Supply to the S5-95U	3 - 19
3.3.4 Connecting the Onboard I/Os of the S5-90U	3 - 20
3.3.5 Connecting the Onboard I/Os of the S5-95U	3 - 22
3.3.6 Connecting External I/Os	3 - 24
3.4 Electrical Configuration with External I/Os	3 - 25
3.4.1 Electrical Configuration of the S5-90U with External I/Os	3 - 25
3.4.2 Electrical Configuration of the S5-95U with External I/Os	3 - 27
3.4.3 Connecting Non-Floating and Floating Modules	3 - 30

	Page
3.5 Wiring Arrangement, Shielding and Measures against Electromagnetic Interference	3 - 33
3.5.1 Running Cables Inside and Outside a Cabinet	3 - 33
3.5.2 Running Cables Outside Buildings	3 - 34
3.5.3 Equipotential Bonding	3 - 35
3.5.4 Shielding Cables	3 - 36
3.5.5 Special Measures for Interference-Free Operations	3 - 37
 4 Start-Up and Programmer Functions	 4 - 1
4.1 Operating Instructions	4 - 1
4.1.1 Programmable Controller Operator Panel	4 - 1
4.1.2 Operating Modes	4 - 2
4.1.3 Performing an Overall Reset of the Programmable Controller	4 - 3
4.2 Starting Up a System	4 - 4
4.2.1 Suggestions for Configuring and Installing the Programmable Controller	4 - 4
4.2.2 Steps for Starting Up the Programmable Controller	4 - 5
4.3 Loading the Program into the PLC	4 - 8
4.3.1 Loading the Program Automatically	4 - 8
4.3.2 Loading the Program Manually	4 - 9
4.4 Saving a Program	4 - 10
4.4.1 Saving a Program to a Memory Submodule	4 - 10
4.4.2 Function of the Back-Up Battery	4 - 11
4.5 Programmer Functions	4 - 11
4.5.1 Overview of Programmer Functions	4 - 12
4.5.2 Peculiarities of the Programmer Functions for the S5-90U and S5-95U	4 - 13
4.5.3 Performance Characteristics When Using the Programmer Interface	4 - 13
 5 Diagnostics and Trouble Shooting	 5 - 1
5.1 Diagnostic Byte	5 - 1
5.2 LED Error Display	5 - 3
5.3 Interrupt Analysis Using the Programmer	5 - 4
5.3.1 "ISTACK" Analysis Function	5 - 4
5.3.2 Meanings of the ISTACK Displays for Errors Occurring During Restart and Program Execution	5 - 7
5.3.3 Meanings of the ISTACK Displays in the Case of Errors During Copying the Program	5 - 8

	Page
5.4 Program Errors	5 - 9
5.4.1 Determining an Error Address	5 - 9
5.4.2 Program Tracing with the "BSTACK" Function	5 - 10
5.5 Faults in the External I/Os	5 - 12
5.6 System Parameters	5 - 13
5.7 The PLC does not Enter the "RUN" Mode	5 - 13
6 Addressing and Access to I/Os	6 - 1
6.1 Addressing the Onboard I/Os	6 - 1
6.2 Addressing the External I/Os	6 - 2
6.2.1 Slot Numbering	6 - 2
6.2.2 Digital Modules	6 - 5
6.2.3 Analog Modules	6 - 7
6.2.4 Function Modules	6 - 8
6.3 Process Image and Access to I/Os	6 - 9
6.3.1 Access to I/Os During Cyclic Program Execution	6 - 11
6.3.2 Access to I/Os During Time-Controlled Program Execution (for S5-95U only)	6 - 13
6.4 Calculating the Scan Time and Response Time	6 - 15
6.5 Start-Up with/without External I/Os and Parameterization of Internal Timers (S5-95U only)	6 - 23
7 Introduction to STEP 5	7 - 1
7.1 Writing a Program	7 - 1
7.1.1 Methods of Representation	7 - 1
7.1.2 Operand Areas	7 - 2
7.2 Program Structure	7 - 3
7.2.1 Linear Programming	7 - 3
7.2.2 Structured Programming	7 - 4

	Page
7.3 Block Types	7 - 6
7.3.1 Organization Blocks (OBs)	7 - 8
7.3.2 Program Blocks (PBs)	7 - 10
7.3.3 Sequence Blocks (SBs; only for S5-95U)	7 - 10
7.3.4 Function Blocks (FBs)	7 - 10
7.3.5 Data Blocks (DBs)	7 - 15
7.4 Processing Blocks	7 - 17
7.4.1 Changing Programs	7 - 17
7.4.2 Changing Blocks	7 - 17
7.4.3 Compressing the Program Memory	7 - 17
7.5 Number Representation	7 - 18
8 STEP 5 Operations	8 - 1
8.1 Basic Operations	8 - 1
8.1.1 Boolean Logic Operations	8 - 2
8.1.2 Set/Reset Operations	8 - 7
8.1.3 Load and Transfer Operations	8 - 10
8.1.4 Timer Operations	8 - 15
8.1.5 Counter Operations	8 - 25
8.1.6 Comparison Operations	8 - 30
8.1.7 Arithmetic Operations	8 - 31
8.1.8 Block Call Operations	8 - 33
8.1.9 Other Operations	8 - 38
8.2 Supplementary Operations	8 - 39
8.2.1 Load Operation (only for the S5-95U)	8 - 40
8.2.2 Enable Operation (only for the S5-95U)	8 - 41
8.2.3 Bit Test Operations (only for the S5-95U)	8 - 42
8.2.4 Digital Logic Operations	8 - 44
8.2.5 Shift Operations	8 - 48
8.2.6 Conversion Operations	8 - 50
8.2.7 Decrement/Increment (only for the S5-95U)	8 - 52
8.2.8 Disable/Enable Interrupt	8 - 53
8.2.9 DO Operation (only for the S5-95U)	8 - 54
8.2.10 Jump Operations	8 - 56
8.2.11 Substitution Operations (only for the S5-95U)	8 - 58
8.3 System Operations (only for the S5-95U)	8 - 64
8.3.1 Set Operations (only for the S5-95U)	8 - 64
8.3.2 Load and Transfer Operations	8 - 64
8.3.3 Arithmetic Operation (only for the S5-95U)	8 - 67
8.3.4 Other Operations (only for the S5-95U)	8 - 68

	Page
8.4 Condition Code Generation	8 - 69
8.5 Sample Programs	8 - 71
8.5.1 Momentary-Contact Relay (Edge Evaluation)	8 - 71
8.5.2 Binary Scaler (Binary Divider)	8 - 71
8.5.3 Clock (Clock-Pulse Generator)	8 - 73
9 Integrated Blocks and Their Functions	9 - 1
9.1 Integrated Organization Blocks (OBs)	9 - 1
9.1.1 Cyclic Program Execution (OB1)	9 - 2
9.1.2 Interrupt-Driven Program Execution (OB3)	9 - 3
9.1.3 Time-Controlled Program Execution (OB13; for S5-95U only)	9 - 3
9.1.4 Restart Processing (OB21, OB22)	9 - 5
9.1.5 Retriggering the Scan Time (OB31; for S5-95U only)	9 - 6
9.1.6 Procedure after Battery Failure (OB34; for S5-95U only)	9 - 7
9.1.7 OB251 PID Algorithm (for S5-95U only)	9 - 8
9.2 Integrated Function Blocks (FBs)	9 - 20
9.2.1 Code Converter : B4 - FB240 -	9 - 20
9.2.2 Code Converter : 16 - FB 241-	9 - 21
9.2.3 Multiplier : 16 - FB242 -	9 - 22
9.2.4 Divider : 16 - FB243 -	9 - 23
9.2.5 Reading of Analog Values (FB250)	9 - 24
9.2.6 Output of Analog Values (FB251)	9 - 24
9.3 Integrated Sequence Block 2 (SB2)	9 - 24
9.4 Integrated Data Block 1 (DB1)	9 - 25
9.4.1 Parameter Blocks	9 - 26
9.4.2 Rules to Observe When Generating DB1	9 - 27
9.4.3 Transferring DB1 Parameters to the Programmable Controller	9 - 30
9.4.4 Procedure for Parameterizing the PLC	9 - 30
9.4.5 How to Recognize and Correct Parameter Errors	9 - 31
10 Onboard Interrupt Inputs	10 - 1
10.1 Setting Parameters for Interrupt Inputs in DB1	10 - 1
10.2 Interrogating the Cause for an Interrupt in the Diagnostic Byte	10 - 2
10.3 Interrupt Priority	10 - 4
10.4 Calculating Interrupt Reaction Times	10 - 7

	Page
11 Onboard Counter Inputs	11 - 1
11.1 Setting Parameters for Counter Inputs in DB1	11 - 3
11.2 Programming the Reaction to Interrupts in OB3	11 - 4
11.3 Scanning the Actual Counter Status	11 - 5
11.4 Entering the Comparison Value and Resetting the Counter	11 - 5
11.5 Cascading Counters (with the S5-95U only)	11 - 7
11.6 Calculating the Counter Frequency Limit	11 - 9
12 Analog Value Processing	12 - 1
12.1 Reading in Analog Values	12 - 2
12.1.1 General Representation of Analog Input Values	12 - 3
12.1.2 Reading in and Scaling an Analog Value -FB250-	12 - 5
12.1.3 Time Required for Reading and Accuracy of the Analog Value Read in	12 - 7
12.1.4 Using Analog Inputs of the S5-95U as Additional Digital Inputs	12 - 8
12.2 Output of Analog Values	12 - 9
12.2.1 General Representation of Analog Output Values	12 - 9
12.2.2 Outputting Analog Values -FB251-	12 - 10
12.2.3 Time Required for Output and Accuracy of the Analog Value Output	12 - 12
12.3 Example: Analog Value Processing with FB250 and FB251	12 - 14
13 Integral Real-Time Clock (only in the S5-95U)	13 - 1
13.1 Function	13 - 1
13.2 Structure of the Clock Data Area	13 - 2
13.3 Structure of the Status Word and How to Scan it	13 - 5
13.4 Backup of the Hardware Clock	13 - 7

	Page
13.5 Setting Parameters in DB1	13 - 8
13.5.1 Setting the Clock in DB1	13 - 10
13.5.2 Setting the Prompt Time in DB1	13 - 10
13.5.3 Setting the Operating Hours Counter in DB1	13 - 11
13.5.4 Entering the Clock Time Correction Factor in DB1	13 - 11
13.6 Programming the Integral Real-Time Clock in the User Program	13 - 12
13.6.1 Reading and Setting the Clock	13 - 12
13.6.2 Programming the Prompt Function	13 - 16
13.6.3 Programming the Operating Hours Counter	13 - 21
13.6.4 Entering the Clock Time Correction Factor	13-26
14 Communication via SINEC L1 LAN	14 - 1
14.1 Connection of the Programmable Controllers to the L1 Bus Cable	14 - 1
14.2 Basic Principle of Data Interchange	14 - 2
14.3 Parameterization of the PLC for Data Interchange in DB1	14 - 3
14.4 Sending Data	14 - 5
14.5 Receiving Data	14 - 7
14.6 Program Example	14 - 9
15 Module Spectrum	15 - 1
15.1 General Technical Specifications	15 - 3
15.2 Power Supply Modules	15 - 4
15.3 Bus Units	15 - 6
15.4 Interface Modules	15 - 8
15.5 Digital Modules	15 - 11
15.5.1 Digital Input Modules	15 - 13
15.5.2 Digital Output Modules	15 - 23
15.5.3 Digital Input/Output Modules	15 - 34
15.6 Analog Modules	15 - 36
15.6.1 Analog Input Modules	15 - 37
15.6.2 Analog Output Modules	15 - 92

	Page
16 Function Modules	16 - 1
16.1 Comparator Module	16 -1
16.2 Timer Module	16 -4
16.3 Simulator and Simulator Module	16 -7
16.3.1 Simulator only for the S5-90U	16 -7
16.3.2 Simulator Module	16 -8
16.4 Diagnostic Module	16 -10
16.5 Counter Module 2×0 to 500 Hz	16 -13
16.6 Counter Module 25/500 kHz	16 -18
16.6.1 Installation Guidelines	16 -21
16.6.2 Data Transfer	16 -26
16.6.3 Functional Description of the Counter Mode	16 -28
16.6.4 Functional Description of the Position Decoder	16 -30
16.6.5 Entering New Setpoints for the Counter and Position Decoder	16 -39
16.6.6 Addressing	16 -40
16.7 IP 262 Closed-Loop Control Module	16 -42
16.8 IP 263 Positioning Module	16 -46
16.9 IP 264 Electronic Cam Controller Module	16 -50
16.10 IP 265 High Speed Sub Control	16 -53
16.11 IP 266 Positioning Module	16 -53
16.12 IP 267 Stepper Motor Control Module	16 -56
16.13 CP 521 SI Communications Processor	16-63
16.14 CP 521 BASIC Communications Module	16-66