
SIEMENS
SIMATIC S5
BUS MODULE
6ES5 700-8MA11
MADE IN GERMANY
LISTED 74D7
IND. CONT. EQ.
SIEMENS
SIMATIC S5
6ES5 482-8MA13
DIGITAL

16.6.2 Data Transfer

The data is transmitted via the I/O bus. Four bytes are used. Examples of data transfer are shown in section 16.6.6.

Transfer from the Programmable Controller to the Counter Module (PIQ)

The control program transfers two setpoints to the counter module by means of transfer operations.

Table 16-1. Sending Data from the Programmable Controller to the Counter Module

Byte 0	Byte 1	Byte 2	Byte 3
Setpoint 1		Setpoint 2	
High-order byte	Low-order byte	High-order byte	Low-order byte

Transfer from the Counter Module (PII) to the Programmable Controller

The counter module transfers the diagnostic byte and the current counter status. In the control program, this data can be read in by means of load operations and then evaluated.

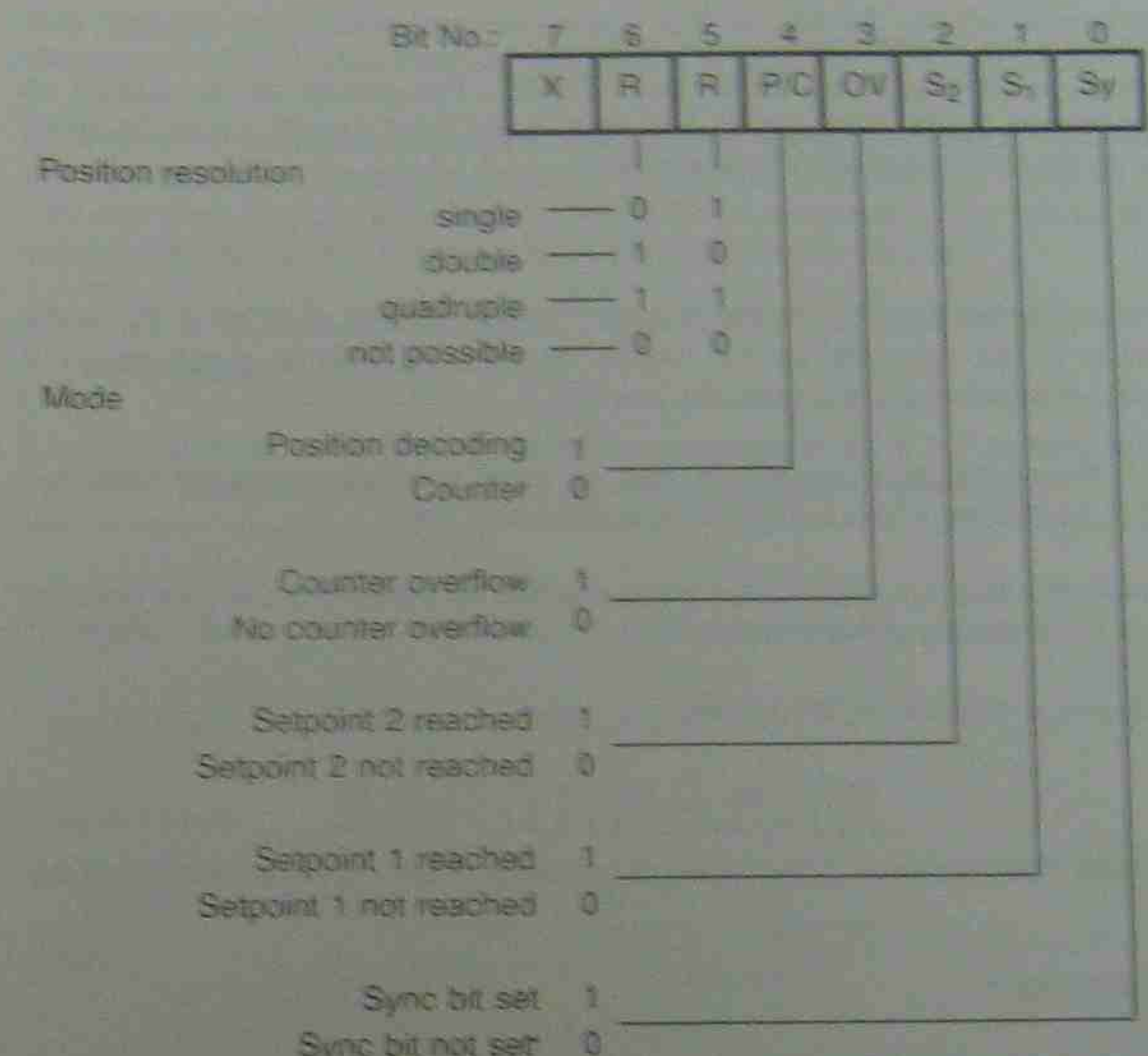
Table 16-2. Sending Data from the Counter Module to the Programmable Controller

Byte 0	Byte 1	Byte 2	Byte 3
Irrelevant	Diagnostic byte	Actual value	
		High-order byte	Low-order byte

- **Diagnostic Byte (Byte1)**

The diagnostic byte is byte 1 of the first input word. Byte 0 has no significance. The diagnostic byte provides information on the following items.

- Preset position resolution
- Preset mode
- The reaching of setpoints
- Signal status of the sync bit for position decoding



X = irrelevant

* If the sync bit is not set, a reference point approach must be implemented before operation can continue in the "Position decoding" mode.

Figure 16-16. Diagnostic Byte

16.6.3 Functional Description of the Counter Mode

In the operation mode "Counter", the module works as a "port-controlled" up-counter and counts the positive edges of the counting pulses while the enable input is high. If the counter reaches a preselected setpoint, the respective output is then enabled.

Initial Settings

On the operating mode switch, make the following selections.

- "Counter" (C)
- Counting pulse signal level (5 V or 24 V)

The position of the switches for the position resolution is irrelevant.
For this operation, you need a counting pulse sensor (e.g., BERO). The pulses can be applied as 5-V differential signals according to RS 422A (up to 500 kHz) or as 24-V signals (up to 25 kHz). The sensor is connected to the sub-D interface of the module.

Loading Setpoints

The control program can transfer two setpoints to the module. These setpoints must be in the range of 0 to 65,535. The transfer of the setpoints via the module depends on whether the "setpoint 1 (setpoint 2) reached" bit is set in the diagnostic byte (S1 and S2).

If the bit is not set, which means the existing setpoint has not been reached or has not been exceeded, the new setpoint is transferred immediately and is immediately valid.

If the bit is set, which means the existing setpoint has been reached or exceeded, the new setpoint is valid only after a positive edge occurs at the enabled input.

If you do not specify a setpoint, a setpoint of "0" applies.

Enabling the Counter

The signal state of the enable input (terminal 3 on the terminal block) determines the function of the counter.

A **positive edge** at the enable input:

- Sets the counter to 0
- Resets the diagnostic bits for "setpoint reached"
- Resets the outputs
- Enables the counter

> **Note**
>
> The enable input should be set to "1" only after the setpoint has been transferred. Otherwise, the outputs are enabled automatically when the first positive edge occurs.

Disabling the Counter

A **negative edge** at the enable input disables the counter. The outputs, diagnostic bits, and the counter are not reset. You can continue reading the current count. A positive edge at the enable input resets the outputs and the diagnostic bytes.

Reaching the Setpoints - Setting the Outputs - Resetting the Outputs

If setpoints have been preselected and the counter is enabled, the module counts the positive edges at the counter input. The count is incremented by "1" with every leading edge.

After setpoint 1 has been reached, output Q 0 is enabled. At the same time, status bit S1 is set.
After setpoint 2 has been reached, output Q 1 is enabled. At the same time, status bit S2 is set.

As long as the enable input is active, the counter counts the pulses. After the enable command has been cancelled, the counter is disabled. The actual value remains constant.
You can read the current count in the STEP 5 program. The actual value is displayed as an unsigned whole number and must lie in the range of 0 to 65,535.

> **Note**
>
> If no setpoint is preselected, the respective value "0" is assigned. The corresponding output is enabled with the positive edge of the enabled input.

Example: Setpoints S1 = 2 and S2 = 4 are entered into the counter

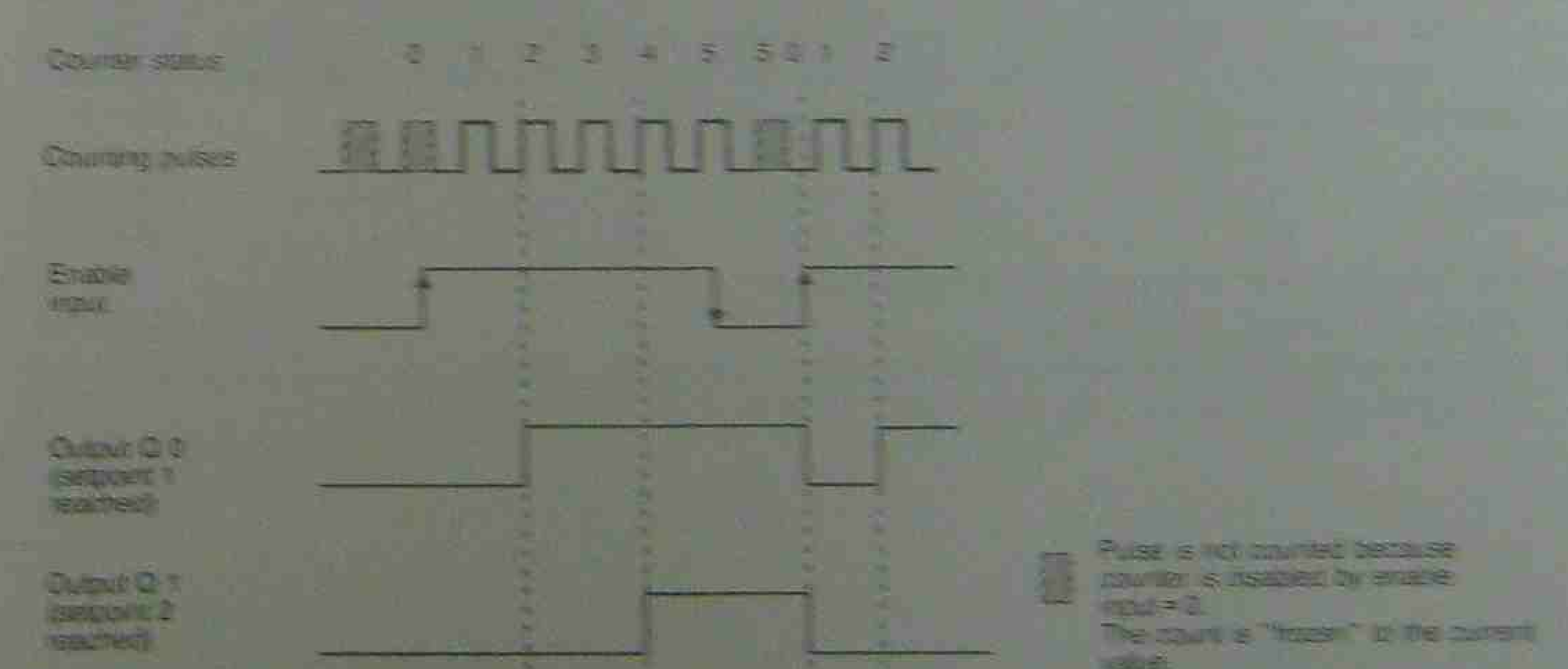


Figure 16-17. Switching the Outputs Dependent on the Status of the Counter and the Enable Input

When the programmable controller goes from RUN to STOP, outputs Q 0 and Q 1 are reset.

Performance during Overflow

If the enabled counter exceeds the counter range limit 65,535 the following actions occur.
- Bit 3 (overflow) in the diagnostic byte is set to "1" and
- The outputs and diagnostic bits for "setpoint reached" are disabled, but they remain unchanged

The counting function continues. Thus the actual value is constantly updated.
You can continue to read all data from the module in the STEP 5 program.
- The updated count
- The status of the outputs at the time of the overflow (This status remains unchanged until the overflow bit is reset.)
- The set overflow bit

After an overflow, the counter can be reset by one of the following actions.
- A positive edge at the enable input
- An overall reset of the programmable controller (STOP to RUN mode)

> **Note**
>
> After a cold restart of the programmable controller, the outputs are disabled. These outputs can be enabled via a positive edge to the enable input.

16.6.4 Functional Description of the Position Decoder

In the operation mode "position decoder" the module works as an up-counter/down-counter and counts the pulses of the connected position encoder. Because of the phase offset of the two decoder signals A and B, the counter determines the counting direction. If the counter reaches a preselected setpoint, the respective output is then turned on.

Settings

Set the following items on the operating mode switch.
- "Position decoding" (PD) function
- The desired position resolution (single, double, or quadruple)
- The signal level of the counting pulses (5 V or 24 V)

Connect the sub-D interface female connector to an incremental position encoder that has to deliver the following signals.
- Two counting pulses offset by 90 degrees
- A reference pulse

The pulses can be supplied as 5-V differential signals according to RS 422 (up to 500 kHz) or as 24-V DC signals.

Connect a switch to the enable input. This switch must deliver a 24-V signal. In the same way, the reference pulse has to deliver a 24-V signal to the reference input.

Position Resolution

- Counter capacity
  The 16-bit up-down counter permits a resolution of 65,536 units between -32768 and +32767. The traversing range depends on the resolution of the position encoders.

- Pulse evaluation
  The counting pulses, which are offset by 90 degrees, can be subjected to single, double, or quadruple evaluation. The necessary setting is made on the operating mode switch (see section 16.6).

The accuracy of the traversing path increases accordingly if double or quadruple pulse evaluation is used. However, the traversing range then available is reduced by the factor 2 or 4.

Table 16-3. Pulse Evaluation

	Single Evaluation	Double Evaluation	Quadruple Evaluation
Counting pulse A Counting pulse B			
Count	0 1	0 1 2	0 1 2 3 4

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Example:

A rotary incremental position encoder produces 1000 pulses per revolution.

The spindle has a pitch of 50 mm/revolution. The position encoder therefore produces 1000 pulses for a traversing path of 50mm (1 revolution).
The resolution of the encoder is therefore 50 mm/1000 pulses.

The counter can handle up to 65536 pulses. With the above resolution, the following traversing ranges are obtained:

Table 16-4. Example for a Traversing Range

Pulse evaluation	Single	Double	Quadruple
Traversing range	3.25 m (10.7 ft.)	1.625 m (5.3 ft.)	0.81 m (2.7 ft.)
Distance travelled/ pulse	50 µm	50 µm	50 µm

Loading Setpoints

In the STEP 5 program, two setpoints can be transferred to the module. These setpoints must lie between -32768 and +32767.

The acceptance of the setpoints by the module depends on whether the "setpoint 1 (setpoint 2) reached" bit has been set in the diagnostic byte.

If the bit is not set, which means the existing setpoint is not reached or not exceeded, the new setpoint is immediately accepted and is immediately valid.

If the bit is set, which means the existing setpoint is reached or exceeded, the new setpoint is not valid until a positive edge occurs at the enable input.

If you do not specify a setpoint, a setpoint of "0" applies.

Synchronization of the Actual Value Detection (Reference Point Approach)

The synchronization of the actual value detection is necessary after "power-up" and after a counter overflow.

Synchronization performs the following functions.

- The count (actual value) is set to "0" and
- The **SYNC bit** (bit 0 in the diagnostic bit) is **set** after "power-up"
  or
- The **overflow bit** (bit 3 in the diagnostic byte) is **reset** after an overflow

Prerequisites for a Synchronization

- The reference signal
  The sensor for the reference signal is connected to terminals 7 and 8 of the terminal block. Synchronization is enabled with the **leading edge** (0 to 1) at terminal 8. If the signal was already on "1" when the module was switched on, then the reference signal must be turned off to restart the synchronization.
  If the reference signal lies in the normal traversing range, the actual value will be constantly resynchronized by the reference signal. To prevent the unwanted resynchronizing, you have to mask out the reference signal after the first reference point approach.

- Traversing path after a positive edge of the reference signal
  After the reference signal has been reached, the module has to recognize a **positive traversing path** (up-counting) while the reference signal is still active (1). This means, you have to input the reference signal with increasing actual value to synchronize the module.

- Reference pulse
  The reference pulse is generated by the position encoder at least once per revolution.
  The **first reference pulse** that the module recognizes after a leading edge of the reference signal synchronizes the module. This is also valid if, after the first positive traversing path, the direction is changed and a reference pulse is encountered (see Figure 16-20). If, during post synchronization, the reference point is again passed, then you have to mask out the reference signal after the synchronization reference point approach to avoid resynchronizing the module.

The following three figures illustrate different possibilities for a reference traversing path:

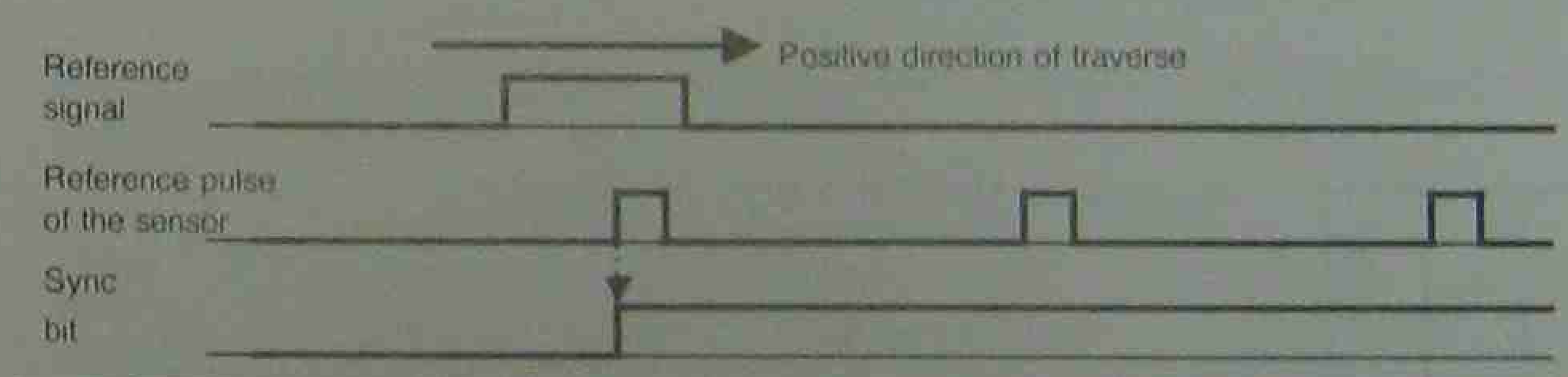

Figure 16-18. Position of the Reference Point (SYNC Bit = 1) within the Reference Signal Range

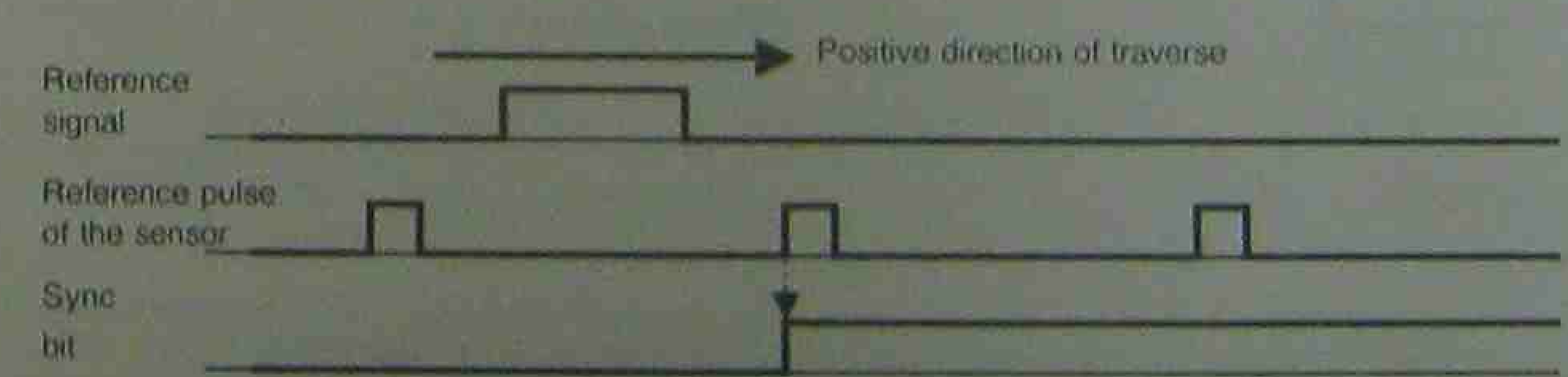

Figure 16-19. Position of the Reference Point (SYNC Bit = 1) after the Reference Signal

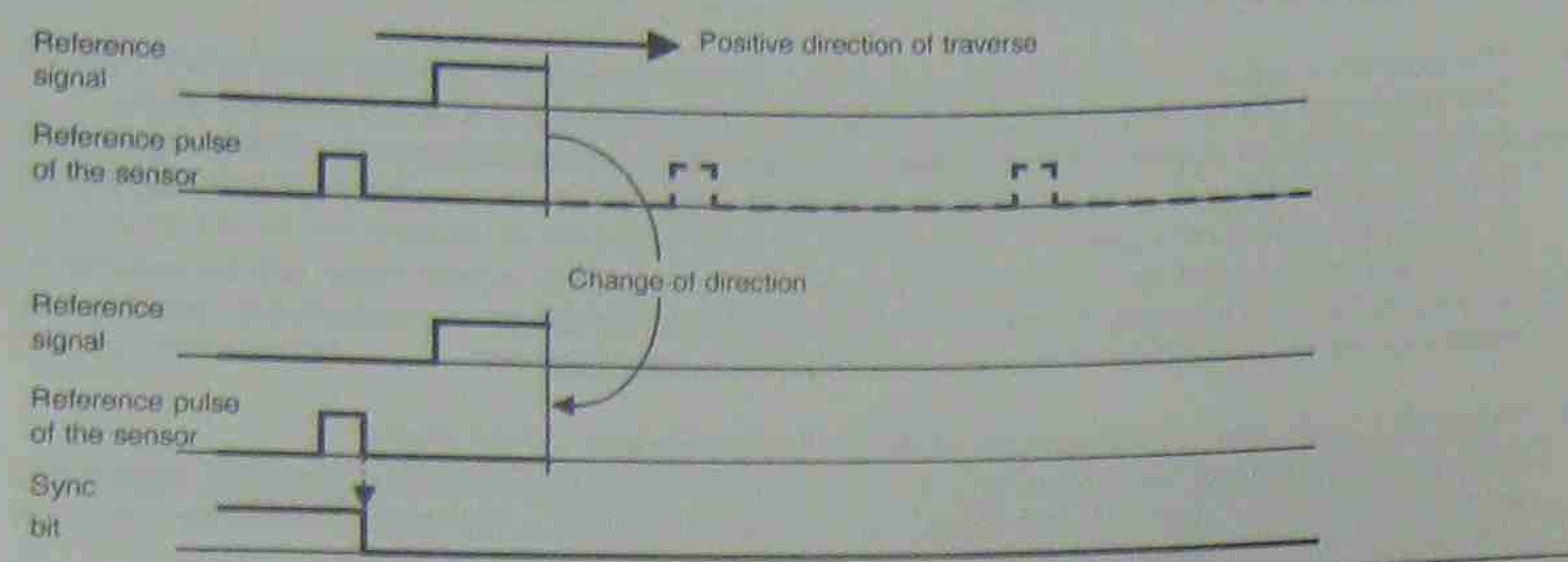

Figure 16-20. Position of the Reference Point (SYNC Bit = 1) during a Reversal of Direction before Reaching the Reference Pulse in a Positive Direction

Example:

Transporting objects from point A to point B on a conveyor belt.
A rotary position encoder is used, together with a BERO proximity switch as reference transmitter. The conveyor belt is marked at a definite point. As soon as this mark comes within the range of the BERO, the BERO produces a reference signal.

Following the reference point approach, the enable input is set via a digital output module.

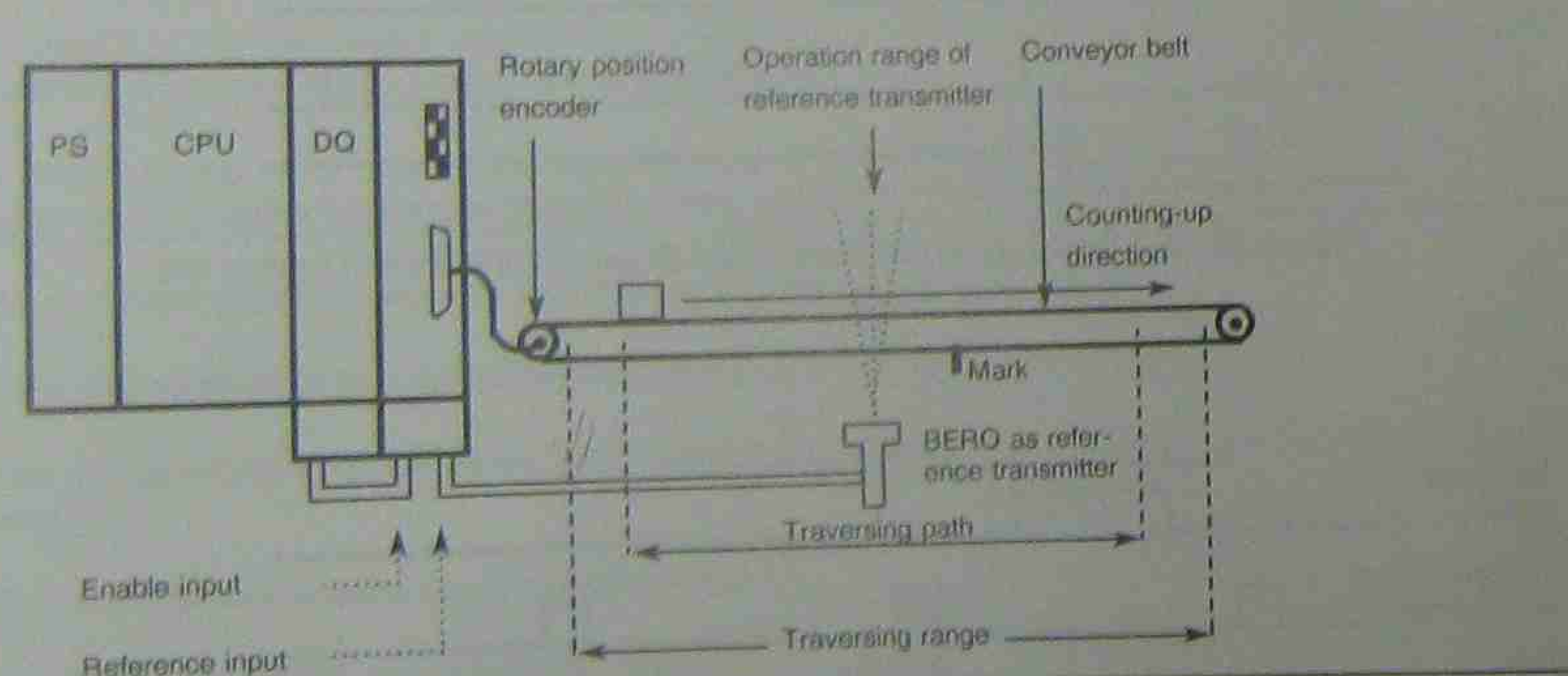

Figure 16-21. Schematic of a Reference Point Approach Operation

Starting the Counter

The counter is reset and started by setting the SYNC bit in the diagnostic byte during the reference point approach operation. The active pulses are counted according to the rotation direction of the position encoder. The count value is incremented during a positive count direction, and decremented during a negative count direction.

Enabling the Outputs - Reaching the Setpoints - Resetting the Outputs

The two outputs are enabled for switching by a positive pulse edge at the enable input.

An output and the associated diagnostic bit "setpoint reached" are set if all of the following statements are true.

- The position decoder was synchronized (SYNC bit = 1 and overflow bit = 0).
- The enable signal (terminal 3 on the terminal block) is set to "1" signal.
- The actual value corresponds to the selected setpoint.
  - The setpoint can be reached in the up-count or down-count direction.

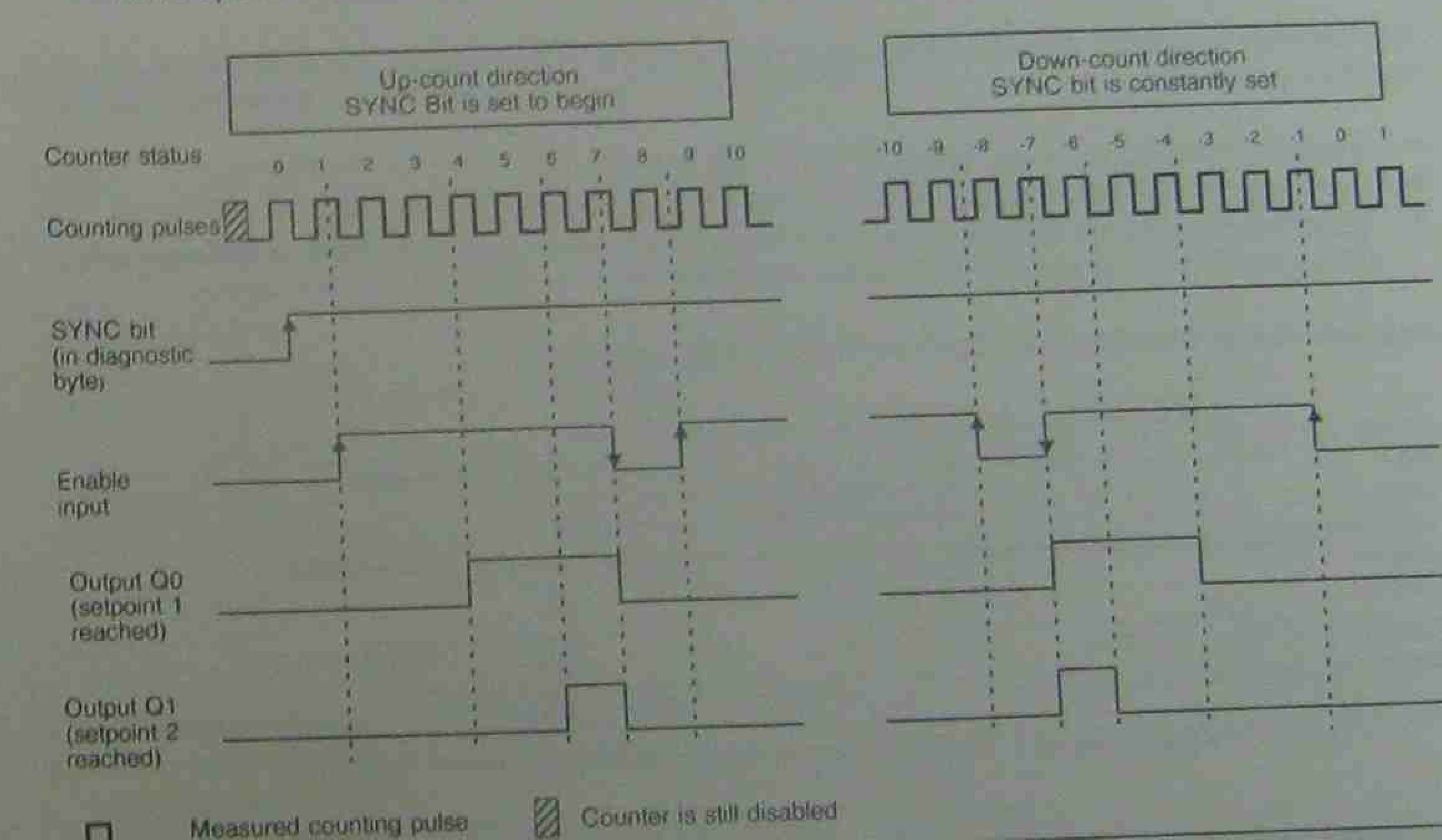

Figure 16-22. Enabling the Outputs - Reaching the Setpoints - Resetting the Outputs

After reaching setpoint 1, the output Q 0 is energized and the status bit S 1 is set. After reaching setpoint 2, the output Q 1 is energized and status bit S 2 is set.

As long as the enable input is active, the outputs are switchable through the module. If the enable command is cancelled, the outputs are switched off and the diagnostic bits are reset. The current actual value is still being measured and incremented or decremented depending on the direction of rotation.

You can read the current count in the STEP 5 program. The actual value is displayed as a signed whole number in two's complement and lies in the range - 32768 to + 32767.

Note

Before you enable the outputs to be switched on by setting the enable input to "1", make sure the following conditions exist.

1. Both setpoints were transferred.
2. The overflow bit = 0.
3. The SYNC bit = 1.

If you ignore these prerequisites, the outputs are switched on directly when the actual value = 0.

If the actual value = 0, the outputs are turned on.
The diagnostic bit and the output are reset with the "0" signal at the enable input. Outputs Q 0 and Q 1 are also reset when the programmable controller goes from RUN to STOP.

The following examples show the switching on of the output at the selected setpoint. Following are the three possibilities.

- Reaching the setpoint in the direction of a rising actual value
- Reaching the setpoint in the direction of a falling actual value
- Reaching the setpoint in the direction of a rising actual value, then a reversal of direction and a reapproaching of the setpoint in the opposite direction

Example 1: Approaching a Setpoint in Up-Count Direction

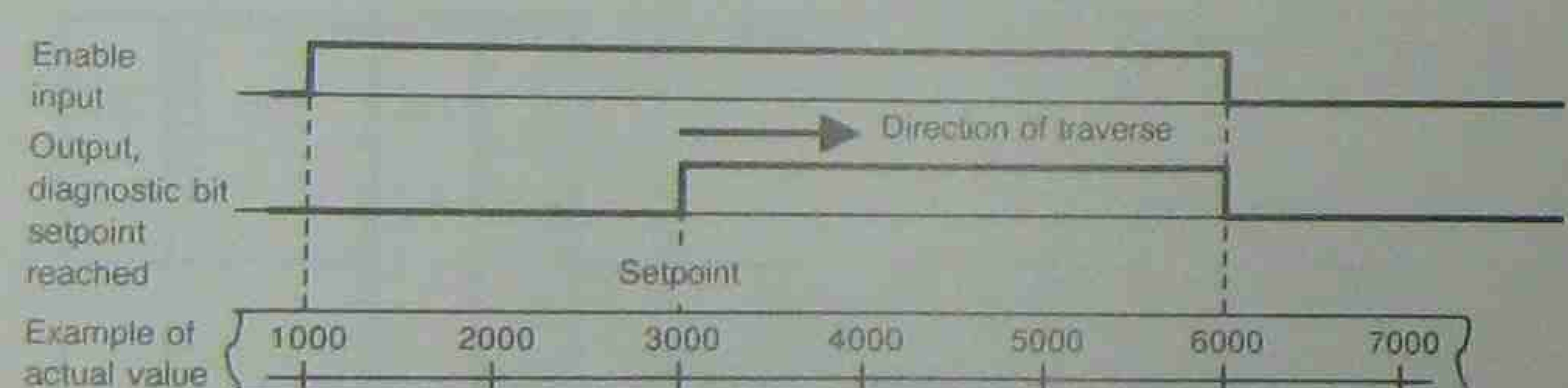

Figure 16-23. Approaching a Setpoint in Up-Count Direction

- With actual value = 1000, the enable input is set to "1".
- With actual value = 3000, the setpoint is reached, output and diagnostic bit "setpoint reached" are set.
- With actual value = 6000, the enable input is set to "0", output and diagnostic bit are reset.

Example 2: Approaching a Setpoint in Down-Count Direction

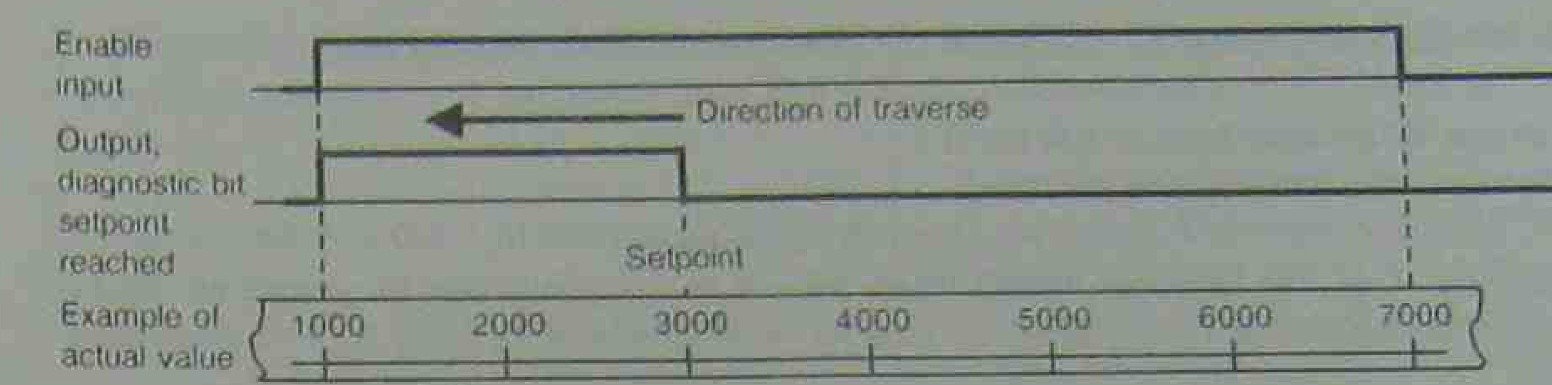

Figure 16-24. Approaching a Setpoint in Down-Count Direction

- With actual value = 7000, the enable input is set to "1".
- With actual value = 3000, the setpoint is reached, the output and the diagnostic bit "setpoint reached" are set.
- With actual value = 1000, the enable input is set to "0", the output and the diagnostic bit are reset.

Example 3: Reversal of Direction after Approaching a Setpoint

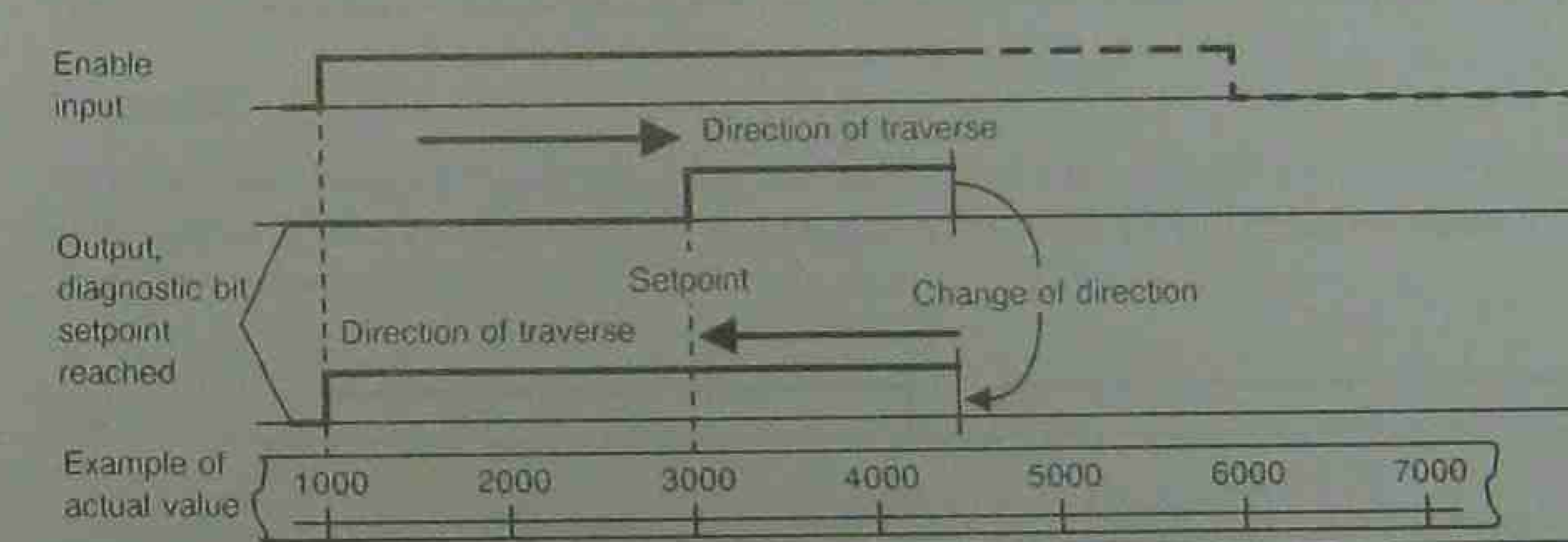

Figure 16-25. Approaching a Setpoint in Up-Count Direction and Consecutive Reversal of Direction

- With actual value = 1000, the enable input is set to "1".
- With actual value = 3000, the setpoint is reached, the output and the diagnostic bit "setpoint reached" are set.
- With actual value = 4500, the traversing path is reversed.
- With actual value = 1000, the enable input is set to "0", the output and the diagnostic bit are reset.

Note

Set outputs can be reset only via a "0" signal to the enable input.

Performance during Overflow

If the counter leaves the counting range of -32768 to + 32767, then the following occur.

- Bit 3 (overflow) in the diagnostic byte is set to "1".
- The outputs of the counter module are disabled.

The enable input (terminal 4 of the terminal block) must be set to "0", in order to switch off active outputs.

After an overflow, a new reference point approach operation has to be executed for synchronization of the actual value detection. After reaching the synchronization, bit 3 in the diagnostic byte is again set to "0", and the outputs along with the active enable input can be turned on.

> **Note**
>
> During an overflow, active outputs are not switched off, and the SYNC bit (bit 0 in the diagnostic byte) is not reset.

16.6.5 Entering New Setpoints for the Counter and Position Decoder

Entering new setpoints is always possible via the PIQ. However, a setpoint is only valid if the respective output is not switched on. The status of the outputs is displayed with diagnostic bits S 1 and S 2.

Diagnostic bit S 1 (bit 1 in the diagnostic byte) = 1: setpoint 1 is reached and output 1 is switched on.

Diagnostic bit S 2 (bit 2 in the diagnostic byte) = 1: setpoint 2 is reached and output 2 is switched on.

Table 16-5. Reaction of the Counter Module during Transfer of the Setpoints

Diag. Bit	Response
S 1 = 0 S 2 = 0	New setpoint 1 is transferred and is valid immediately. New setpoint 2 is transferred and is valid immediately.
S 1 = 1 S 2 = 1	New setpoint 1 only becomes active if a positive edge has appeared at the enable input. New setpoint 2 only becomes active if a positive edge has appeared at the enable input.

Example:

You want to control a drive by using the outputs of the counter module. After a run of positioning, both setpoints are reached and both outputs are turned on. You can enter the new setpoints by using the following sequence.

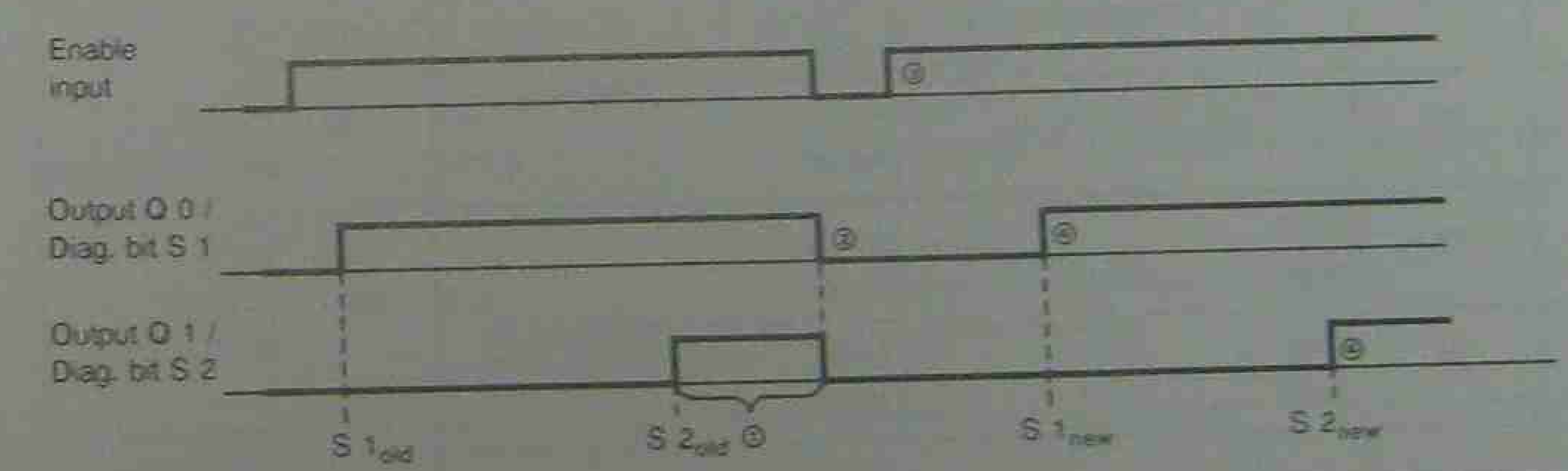

Figure 16-26. Requirement for New Setpoints

① Transfer the new setpoints to the module. Since both diagnostic bits S 1 and S2 are set to "1", the actual values are **not yet accepted**.

② Switch the signal now at the enable input to "0". With the falling edge, the outputs are switched off and the diagnostic bits are reset.

③ Switch the signal at the enable input again to "1". The new **setpoints are accepted and are now active.**

④ After reaching the new setpoints, the respective output is turned on again.

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16.6.6 Addressing

The counter module is addressed like an analog module (see section 6.3).

- The module may only be plugged into slots 0 to 7.
- The address space extends from byte 64 to byte 127.
- In both process images, eight bytes are reserved per slot and of these eight bytes only the first four are used.

Slot Addressing

Table 16-6. Slot Addressing

Slot	0	1	2	3	4	5	6	7
Address PII/PIQ	64-71	72-79	80-87	88-95	96-103	104-111	112-119	120-127

Meaning of the Bytes of a Slot Address (Example: Slot 1)

Table 16-7. Meaning of the Address Bytes of a Slot Address (Example: Slot 1)

<table>
<tr><th>Byte Number</th><th>Byte Address</th><th colspan="2">Meaning in PII</th><th colspan="2">Meaning in PIQ</th></tr>
<tr><td>0</td><td>72</td><td colspan="2">Irrelevant</td><td>High byte</td><td rowspan="2">Setpoint 1</td></tr>
<tr><td>1</td><td>73</td><td colspan="2">Diagnostic byte</td><td>Low byte</td></tr>
<tr><td>2</td><td>74</td><td>High byte</td><td rowspan="2">Actual value</td><td>High byte</td><td rowspan="2">Setpoint 2</td></tr>
<tr><td>3</td><td>75</td><td>Low byte</td><td>Low byte</td></tr>
<tr><td>4-7</td><td>76-79</td><td colspan="4">Irrelevant</td></tr>
</table>

Examples for Data Exchange between the Programmable Controller and the Counter Module

1) The counter module is plugged into slot 4. If you now wish to check whether your system for position decoding has been synchronized by a reference point approach, you must scan the sync bit in the diagnostic byte (bit 0). If this bit is set, a branch is to be made to FB20. The position decoding operation is started in FB20.

<table>
<tr><th>STL</th><th>Description</th></tr>
<tr><td><pre>...
A   I   97.0
JC   FB20

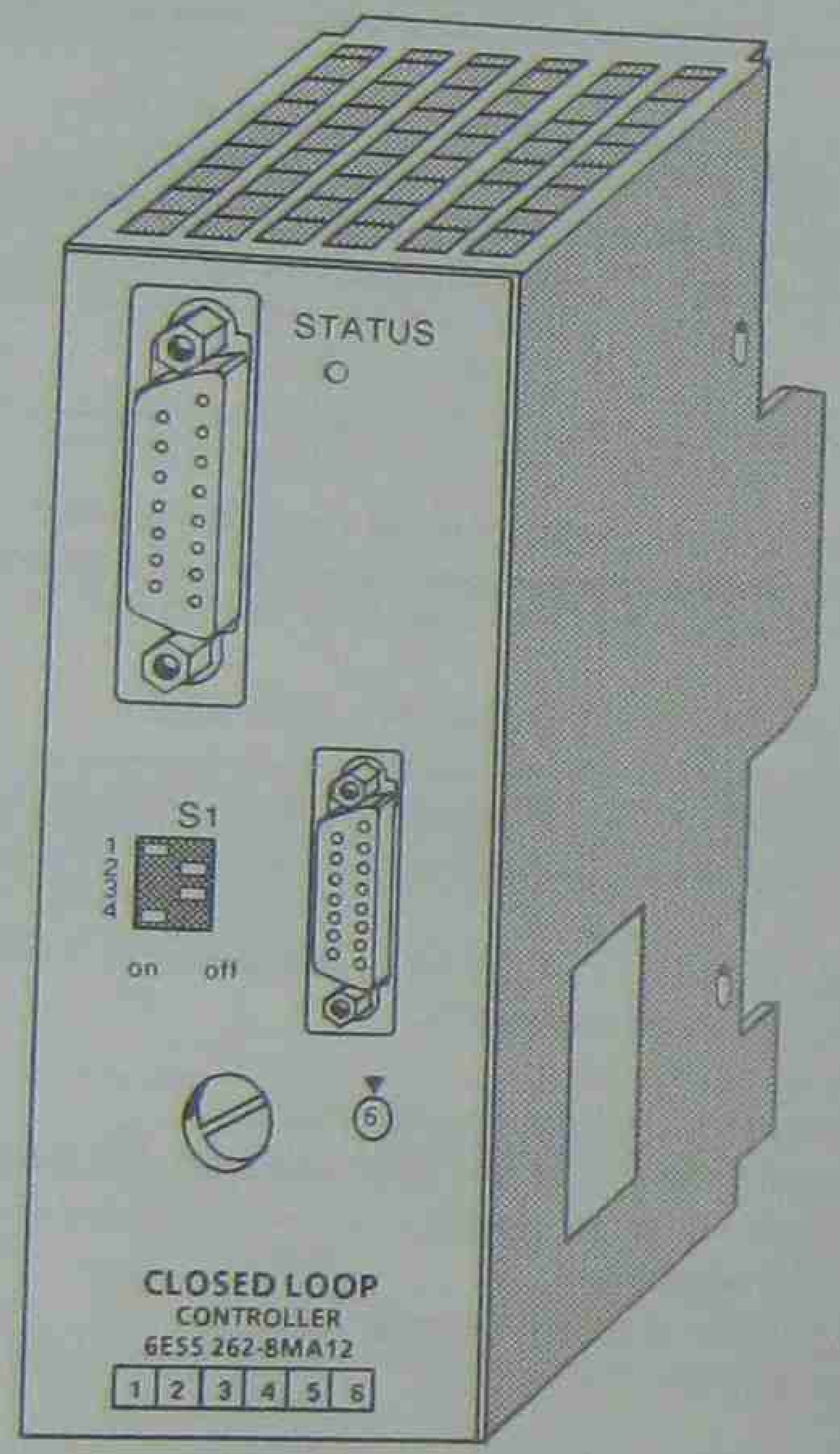
...</pre></td><td>Read in bit 0 of the diagnostic byte (sync bit).
If this bit is set, a branch is made to FB20.
If the bit is not set, program scanning is continued
with the statement following the block call.</td></tr>
</table>

2) Transferring the setpoints stored in flag words 0 and 2 to the counter module inserted into slot 7 (0 to 5 for S5-90U). The module has only to accept the setpoints when the old setpoints have been reached or exceeded.

<table>
<tr><th>STL</th><th>Description</th></tr>
<tr><td><pre>   ...
           AN   I   121.1
          JC=   L001
            L   FW   0
            T   QW   120
L001   AN   I   121.2
          JC=   L002
            L   FW   2
            T   QW 122
L002   BE
         ...</pre></td><td>If setpoint 1 has not yet been reached (bit 1 = 0), a
branch is made to label 1.
Read in setpoint 1
and transfer it to the counter module.
If setpoint 2 has not yet been reached (bit 2 = 0), a
branch is made to label 2.
Read in setpoint 2
and transfer it to the counter module.
Block end</td></tr>
</table>

16.7 Closed-Loop Control Module IP 262

(6ES5 262-8MA12)
(6ES5 262-8MB12)



Technical Specifications

Controller	
Total cycle time (equals scan time)	100 to 200 ms
Resolution of the open-loop controller	5 ms at 50 Hz 4.2 ms at 60 Hz
Analog Inputs	
Number of inputs	4 (suited for current, thermocouple, or resistance thermometer) Voltage with external switching
Additional input for reference temperature	1 (resistance thermometer)
Galvanic isolation	no
Permissible voltage difference	
Between inputs	- 1 V to + 1 V
Between inputs and central ground point	- 1 V to + 1 V
Digital representation of the input signal	11 bits + sign
Current input	
Input signal range	0 to 20 mA or 4 to 20 mA
Input resistance	24.3 Ω ± 0.1%
mV Input (for thermocouple)	
Input signal range	0 to 50 mV or - 8.9 to 41.1 mV (type J, K, L, S)
Cable impedance	30 Ω per wire
Resistance thermometer	
Start	18.49 Ω
End	219.12 Ω
Permissible cable impedance	30 Ω per wire
Binary Inputs	
Number of inputs	4
Galvanic isolation	no
Signals state "0"	- 30 to + 4.5 V or open
Signal state "1"	+ 13 to + 30 V (signal state invertible)
Input resistance	approx. 4 kΩ
Number of analog outputs of the constant controller (6ES5 262-8MA11)	
Number of outputs	3
Galvanic isolation	no
Output signal range	0 to 20 mA or 4 to 20 mA
Maximum permissible load	600 Ω
No load voltage	(L +) - 2 V
Binary outputs for the open-loop controller (6ES5 262-8MB11)	
Number of outputs	8
Galvanic isolation	no
Signal state "0"	< 1.5 V
Signal state "1"	(L +) - 3.8 V
Maximum load current	100 mA short-circuit proof
Wiring method	
Programmer (PG) Operator panel (OP) SINEC-L1 network connection	front side via 15-pin subminiature D connector
Connectable are	PG 605, PG 615, PG 635,PG 675, PG 685, PG 695, PG 730, PG 750, OP 393, OP 396, OP 395
Analog and binary inputs	front side via 25-pin subminiature D connector
Analog and binary outputs	via terminal block of the bus unit
General data	
Input voltage	
Rated value	24 V DC
Permissible range	18 to 34 V DC
Permissible range with the PG 605/OP 393	18 to 27 V DC
Current consumption	
Internal (from the CPU; 9 V)	approx. 20 mA
External (for 24 V; without load)	approx. 180 mA
External (for 24 V; without load; with PG 605 / OP 393)	approx. 340 mA
Ambient temperature	0° to 55°C (32 to 131°F)

Function

SIMATIC S5-90U and SIMATIC S5-95U offer different solutions for individual closed-loop control (PID) tasks. First there is a software solution via function blocks (only for the S5-95U) and second, a control module (for example, a module that can solve PID control tasks simply and in a time saving manner). The basis, in both cases, is a PID-control algorithm.

The closed-loop control module IP 262 can be used with any of the S5-90U, S5-95U, and S5-100U programmable controllers. It can be used without COM software.

The module relieves the programmable controller from closed-loop control tasks. The IP 262 also works with its own power supply in a stand-alone operation. The module can function independently without a programmable controller and can handle up to four closed-loop control circuits.

Two interfaces are located on the front panel of the module.

- An interface for the connection of a programmer (PG) or an operator panel (OP) or the SINEC L1 Network (under development)
- An interface for the connection of analog and binary inputs

In addition, the following items are available.

- A selector switch for each channel for current and voltage (thermocouples or PT 100)
- A status LED for RUN (a continuously lit green light), transducer malfunction (blinking light), and module malfunction (off)

The module is well-suited to take over control-loop tasks in the area of industrial processing technology, for example, temperature control, pressure and flow control, continuous injection functions, and non-time-critical closed-loop speed controls.

Modules

There are two IP 262 modules.

- ... - 8MA 12 with 3 analog outputs for continuous controllers with analog output signals
- ... - 8MB12 with 8 binary outputs for continuous controllers with pulse time interval signals for step-action controllers

Additionally, the module offers the following inputs.

- 4 analog inputs for direct feed of setpoint and actual values
- 4 binary inputs for control variables

Installation

- The closed-loop control module is plugged into a bus unit like any other input or output module (see section 3.2.1).
- The module can only be plugged into slots 0 through 7.
- The connections for power supply and the analog and binary output signals are located on the terminal block of the bus unit.
- The analog and binary inputs are connected to the module with a 25-pin sub-D female connector.

Addressing

The module is addressed like a four-channel analog module.

Operating Modes

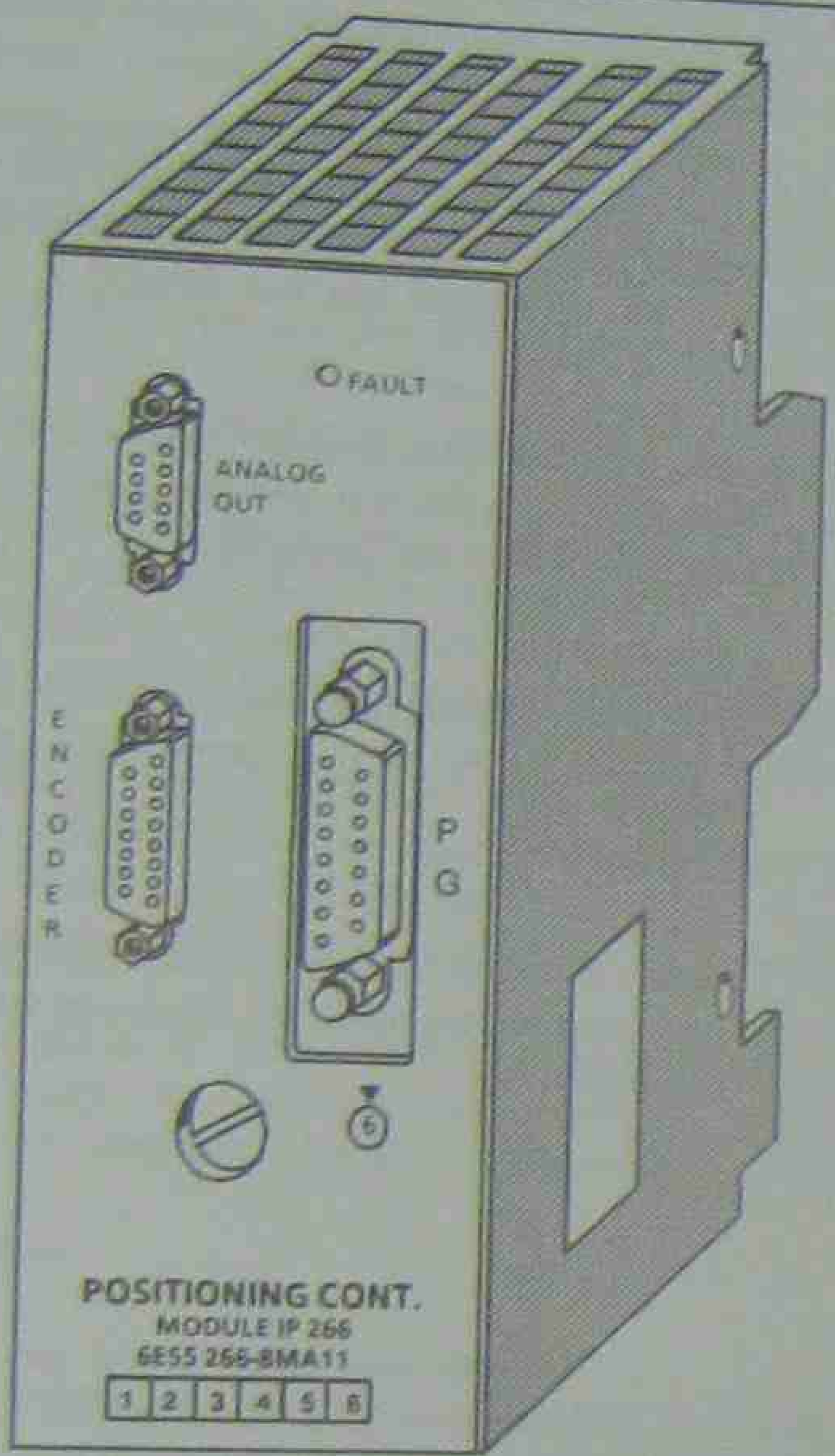
Since transducers and sensors are directly wired to the module, the module can work independently from a programmable controller in stand-alone operation, provided that the setpoints and the 24-V power supply voltage are fed directly to the IP 262. This means that the module executes the control and the output of the control value and can work alone or be controlled via the SINEC L1 by a master unit.

Besides this, the IP 262 has its own back-up, which means that the module can continue to work alone in the event the master CPU (e.g., S5-135U with R64) fails. It uses the last setpoint received from the CPU or the predefined back-up setpoint. Two operating modes are possible.

- DDC-Operation (Direct Digital Control):
  The control is executed entirely from the CPU and the IP only outputs the manipulated variable. If the CPU fails, the module can continue to control independently with a predefined back-up setpoint.

- SPC-Operation (Setpoint Control):
  The module receives only the setpoint from the CPU; the control is carried out independently of the CPU. If the CPU fails, the IP continues to control using the last setpoint received from the CPU. It is also possible to use a predefined back-up setpoint here.

16.8 Positioning Module IP 266 (6ES5 266-8MA11)



Technical Specifications

Analog Output		
Output signal range		±10 V
Digital signal representation		13 bits plus sign
Short-circuit proof		yes
Reference potential of the analog output signal		analog ground of the power section
Cable length shielded	max.	32 m (105 ft.)
Pulse Input		
Position decoder		incremental
Traverse range		±32767.999 mm/ 0.1 inch/degree
Input voltages for the tracks - differential inputs - asymmetrical inputs		5 V/RS 422 24 V/typ. 7.3 mA
Supply voltage for the sensor (short-circuit proof)		5 V/350 mA 24 V/350 mA
Input Frequency and Cable Length		
Symmetrical sensors (5 V)	max. max.	500 kHz, 30 m (98 ft.) shielded cable length
Asymmetrical sensors (24 V)	max.	100 kHz for 25 m (82 ft.) cable length shielded
	max.	25 kHz for 100 m (330 ft.) cable length shielded
Input Signals		2 pulse series 90 degrees out of phase 1 zero pulse
Digital Inputs		
Input voltage range		±30 V
Galvanic isolation		no
"0" signal		-30 V to +5 V
"1" signal		13 V to 30 V
Permissible zero signal current at "0" signal		1.5 mA
Typ. input current at 24 V		7.3 mA
Digital Outputs		
Output voltage range		20 V to 30 V
Galvanic isolation		no
Max. output current at "1" signal		100 mA
Short-circuit protector		short-circuit proof output
Cable length shielded	max.	100 m (330 ft.)
Supply Voltage		
Logic voltage from 24-V ext. supply produced with switched-mode power supply		4.7 V to 5.5 V
Current consumption from 24-V supply without outputs and 24-V sensor	typ.	180 mA

Because of its performance capability and the complexity of its description, the IP 266 has its own manual. The order number is: 6ES5 998-5SC21. The positioning control module IP 266 expands the field of application for "positioning operations" of the S5-90/95U.

As an "intelligent I/O module", it allows you to use open-loop as well as closed-loop control positioning.

The positioning operations are processed independently of the execution times of the user programs in the programmable controller. Thus the CPU is not burdened with positioning jobs constantly being processed. You can plug the IP 266 into slots 0 through 7 on the S5-90U/S5-95U. The IP 266 is assigned addresses in the analog address area of the programmable controller.

Operation Principle of the IP 266

The IP 266 enables you to control the positioning operation of your drive exactly. The module delivers a voltage setpoint in the range of ±10 V via an analog output for the control of a power section for servo motors.

The IP 266 needs exact data about your drive system in order to calculate speed, acceleration, or traverse residual distances. This data can be stored in an EEPROM that is permanently installed in the programmable controller. By using its own start-up routine, this data can be accessed immediately after you switch on the programmable controller and can be processed directly.

The IP 266 allows you to select between a linear axis and a circular axis. You can also select the unit of measurement for processing the data: either [mm], [in.] or [deg].

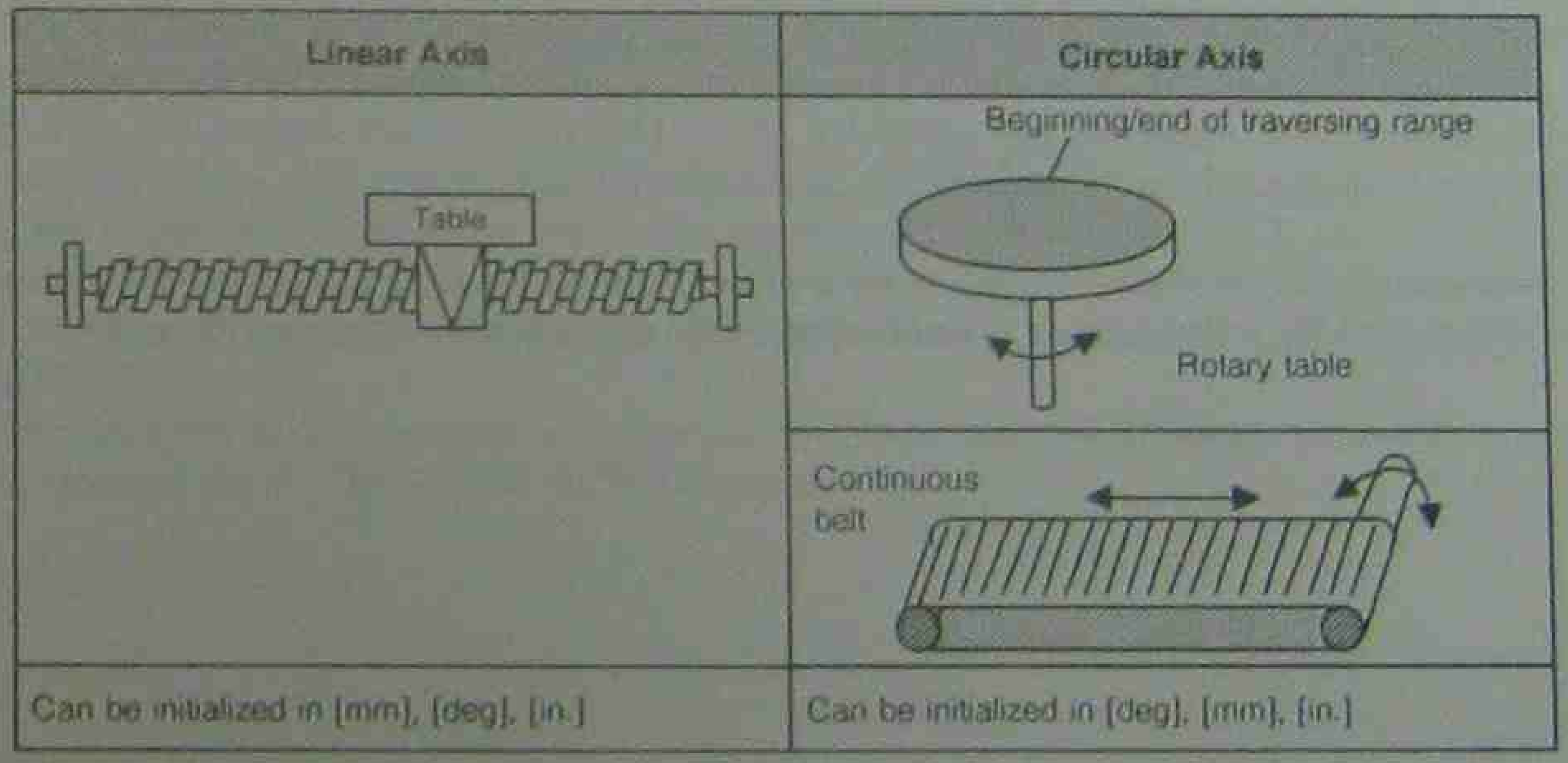


Figure 16-27. Processed Units of Measurement for Circular Axis and Linear Axis

Besides purely traversing movements, other operating modes allow offset generation of axis coordinates or drift compensation in the system. In addition, the IP 266 offers operating modes to read data such as positioning actual value or residual traversing distances.

In order to use the IP 266 in an automatic manufacturing process, it is possible to combine individual traversing applications, positioning corrections, offsets or dwell times in a "traversing program". These traversing programs can be called up via two special operating modes and processed automatically or semi-automatically.

Such a traversing program can be created by using the "learning capable" "Teach-in-mode" for positioning applications. The information from single positioning applications can be stored at the end of an operation in a traversing program.

Positioning

For the positioning operation, the IP 266 calculates the setpoint from the selected end data and velocity data in conjunction with the programmed machine data. The actual value follows the selection. The deviation (following error) which occurs reaches a constant value after the short start-up phase and must reach zero at the end of the positioning operation.

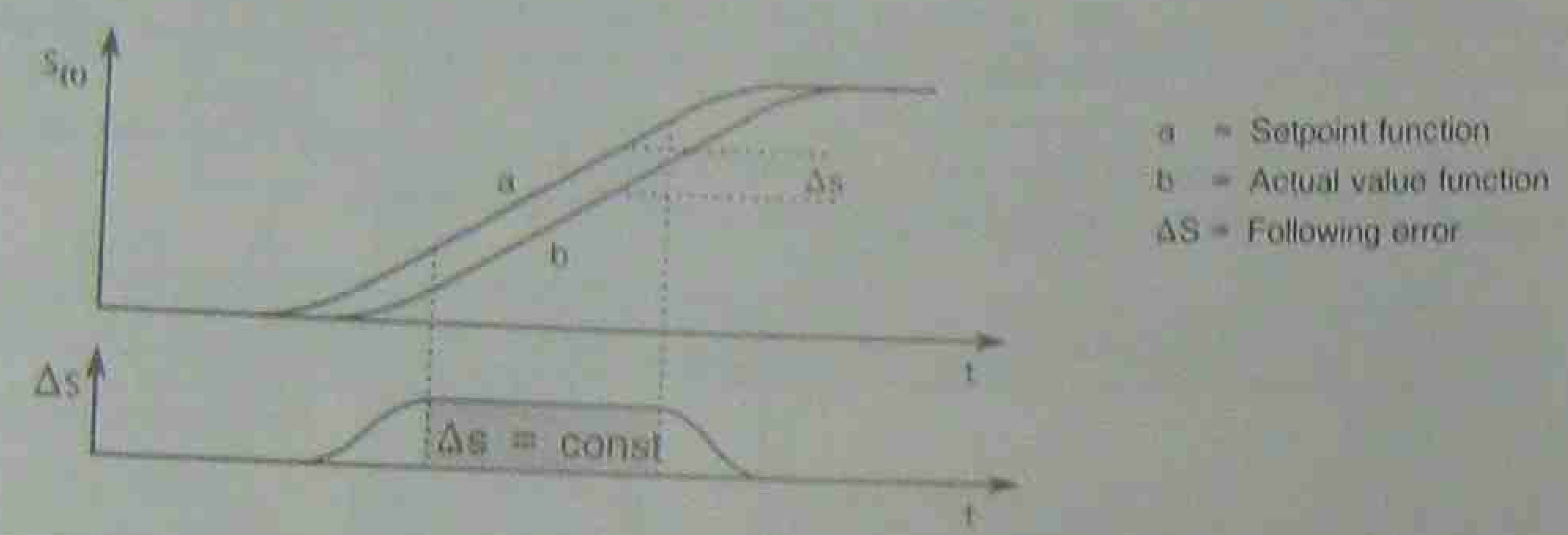


Figure 16-28. Course of a Following Error during a Positioning Operation

Overview of the Operation Modes

Table 16-8. Designation of the Operating Modes

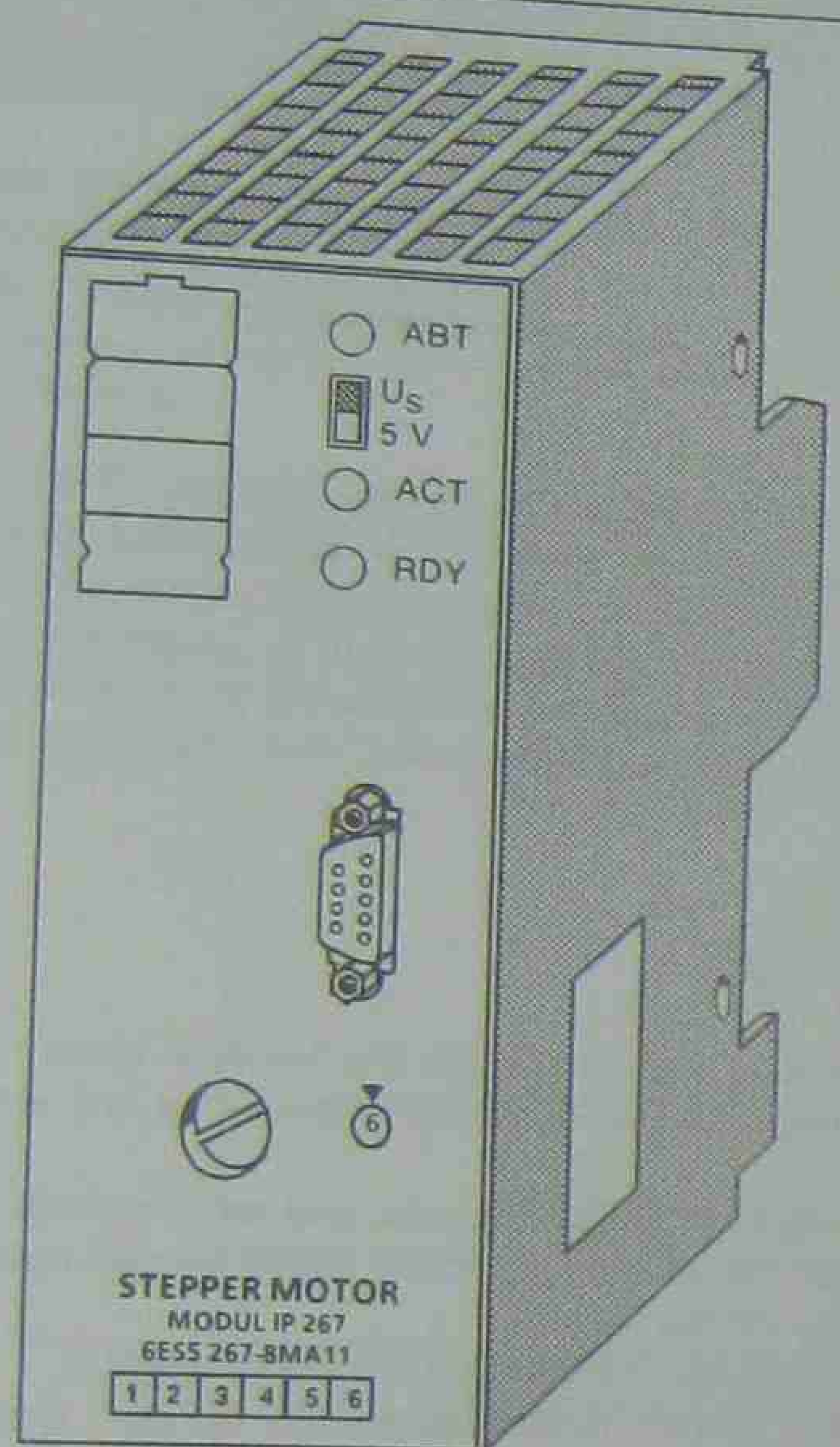
Description		
JOG 1 JOG 2 CONTROLLED JOG FOLLOW-UP MODE REFERENCE POINT INCREMENTAL ABSOLUTE INCREMENTAL RELATIVE AUTOMATIC	AUTOMATIC SINGLE BLOCK TEACH-IN ON TEACH-IN OFF ZERO OFFSET ABSOLUTE ZERO OFFSET RELATIVE CLEAR ZERO OFFSET TOOL OFFSET ON TOOL OFFSET OFF	ACKNOWLEDGE ERROR DRIFT COMPENSATION ON DRIFT COMPENSATION OFF RAM ↔ EEPROM READ ACTUAL POSITION READ FOLLOWING ERROR READ DISTANCE TO GO SYNCHRONIZE IP

The COM 266 software package offers user friendly operation and parameter settings. The IP 266 exchanges all data with the programmable controller via a serial interface. All tasks written in 8-byte messages are sent to the IP 266 during the program cycle via the process output image (PIQ). The IP 266 transmits feedback messages cyclically via the process image input (PII). These messages can be about the actual value position, remaining traversing distance, or following error as well as a status byte, error byte, the current operation mode, and special data from the traversing program.

Installation

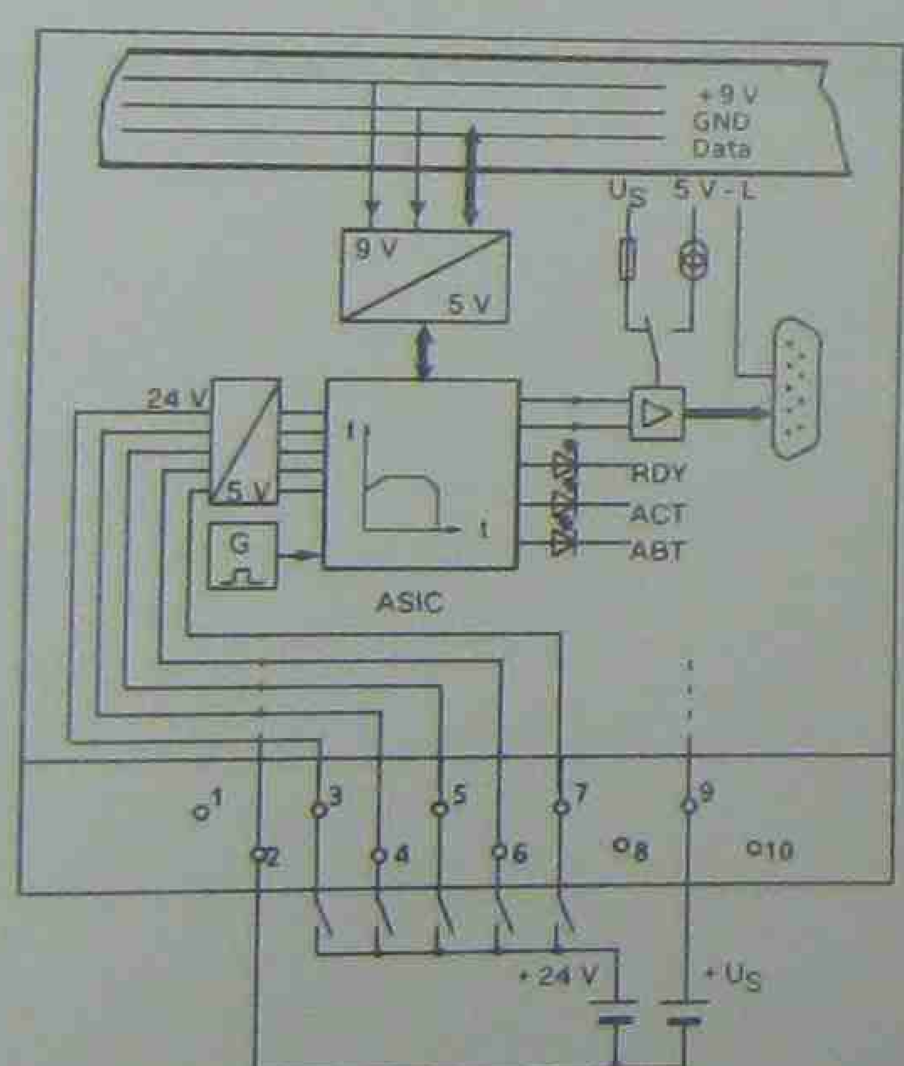
- Plug the IP 266 into a bus unit like any other I/O module.
- Insert the IP 266 only into slots 0 through 7.
- Connect the external switches to the digital inputs of the IP 266 via the terminal block. These switches are used to limit the traversing range. They also allow you to intervene at any time into the processing of the module.
- The IP 266 can bypass the STEP 5 OB1 cycle, via three digital outputs, and send signals directly to external I/Os. The controller must, however, be enabled (function signal enable controller, FUM) and must be connected to the power section of the drive.
- Connect the servo motor's power section to the 9-pin subminiature D female connector.
- Connect the incremental sensor to the left 15-pin subminiature D female connector "ENCODER".
- You can connect a programmer with screen to the 15-pin subminiature connector on the right side to operate the IP 266 via the COM software.

16.9 Stepper Motor Control Module IP 267 (6ES5 267-8MA11)



Technical Specifications

Supply voltage (BUS)		9 V
Current consumption	approx.	150 mA
Special voltage V_S		5 V to 30 V
Digital Inputs		
Rated input voltage		24 V
Galvanic isolation		no
Input voltage: "0" signal / "1" signal		- 33 V to 5 V / 13 V to 33 V
Input current	typ.	8.5 mA
Supply voltage for two-wire BEROs		22 V to 30 V
9-pin Subminiature D Interface		
Output voltage with 5-V supply "0" signal / "1" signal	max. / min.	0.4 V / 4.5 V
With special supply voltage V_S (5 V to 30 V) "0" signal / "1" signal	max. / min.	0.4 V / V_S - 0.4 V
Output current		20 mA (short-circuit proof)
Output frequency	max.	204 kHz
Increment number of steps	max.	2^{20} - 1 pulses/order
Permissible cable length	max.	50 m (165 ft.) at 50 kHz (twisted pair cable)



Because of its performance capability and the complexity of its description, the IP 267 has its own manual. The order number is: 6ES5 998-5SD21. The IP 267 Stepper Motor Control Module expands the field of application as an intelligent I/O module (IP) of the S5-100U and S5-95U programmable controllers for "closed-loop control positioning". The IP 267 controls positioning processes independently of the run time of user programs in the programmable controller. The CPU is not loaded with processing positioning job operations. You can plug the IP 267 into slots 0 through 7 in the programmable controller. It then occupies addresses in the analog address area of the programmable controller.

Principle of Operation

The IP 267 generates pulses for the stepper motor power section. The number of output pulses determines the length of the traversing path and the pulse frequency is a measure of the velocity. Each pulse causes the stepper motor shaft to turn through a certain angle. In the case of high-speed pulse trains, this step movement becomes a constant rotational movement. Stepper motors can reproduce all movement sequences only as long as no steps are lost. Step losses can be caused when load variations occur or when the programmed pulse trains exceed motor-specific values.

To enable the IP 267 to generate these pulse trains, the user must enter the following data.

- Configuration data: This data describes the individual stepper motors and the technical characteristics of the drive system.
- Positioning data: This data describes the individual traverse jobs and indicates the velocities, directions, and lengths of the configured paths.

The IP exchanges data with the programmable controller via the serial interface. During the program scans, all necessary information is sent from the process image output table (PIQ) to the IP 267 in 4-byte messages. The IP 267 cyclically transmits feedback signals on the remaining distance to go and various status bits to the process image input table (PII).

Using the configuration and positioning data settings, the IP 267 generates a symmetrical traverse profile consisting of an acceleration ramp, a constant velocity range and a deceleration ramp.

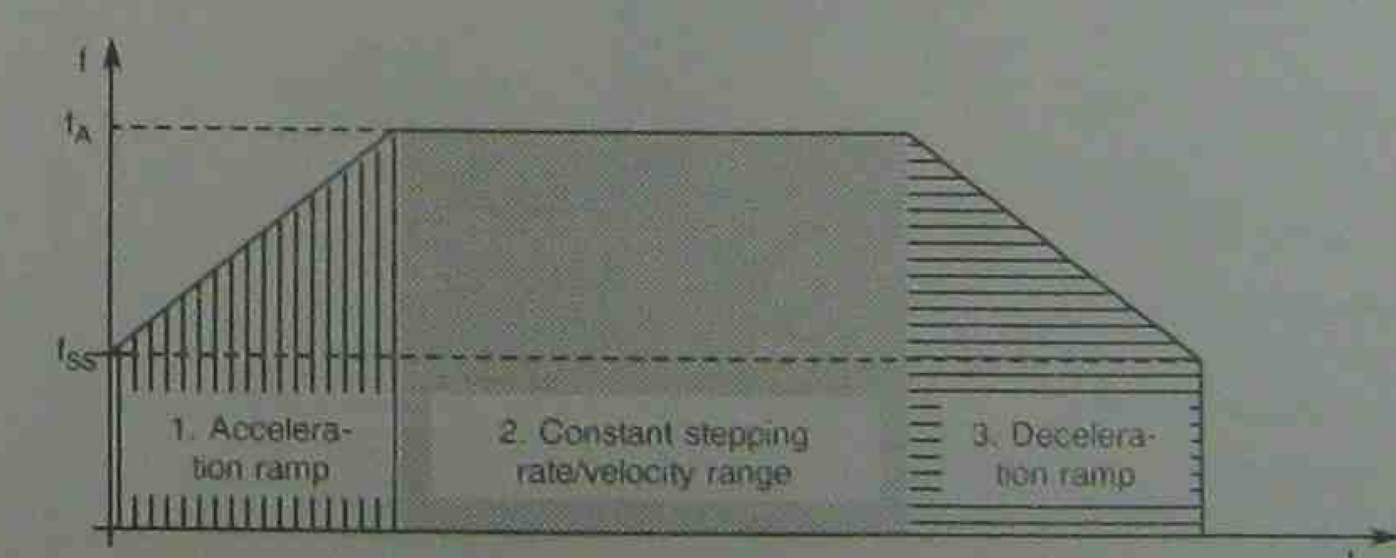


Figure 16-29. Velocity Profile of the IP 267

Using a limit switch on the digital inputs, IP 267 can monitor the limits of a traversing range and stop the traversing movement when the permissible range limit is exceeded. The activated input "external stop" causes a calculated decelerating of the traversing movement. An emergency limit switch can be installed at input "IS" (pulse inhibit). When this switch responds, the pulse output is interrupted immediately.

For a reference point approach operation, an additional switch can be connected at input REF that lies within the traversing zone. The reference point approach operation is also possible without this switch.

Status LEDs provide you with the following information.

The IP 267 is configured	RDY
Pulse outputs during a positioning operation	ACT
Interruption of the positioning operation	ABT

There are four operating modes.

- STOP
- START FORWARDS
- START BACKWARDS
- NEUTRAL

Installation

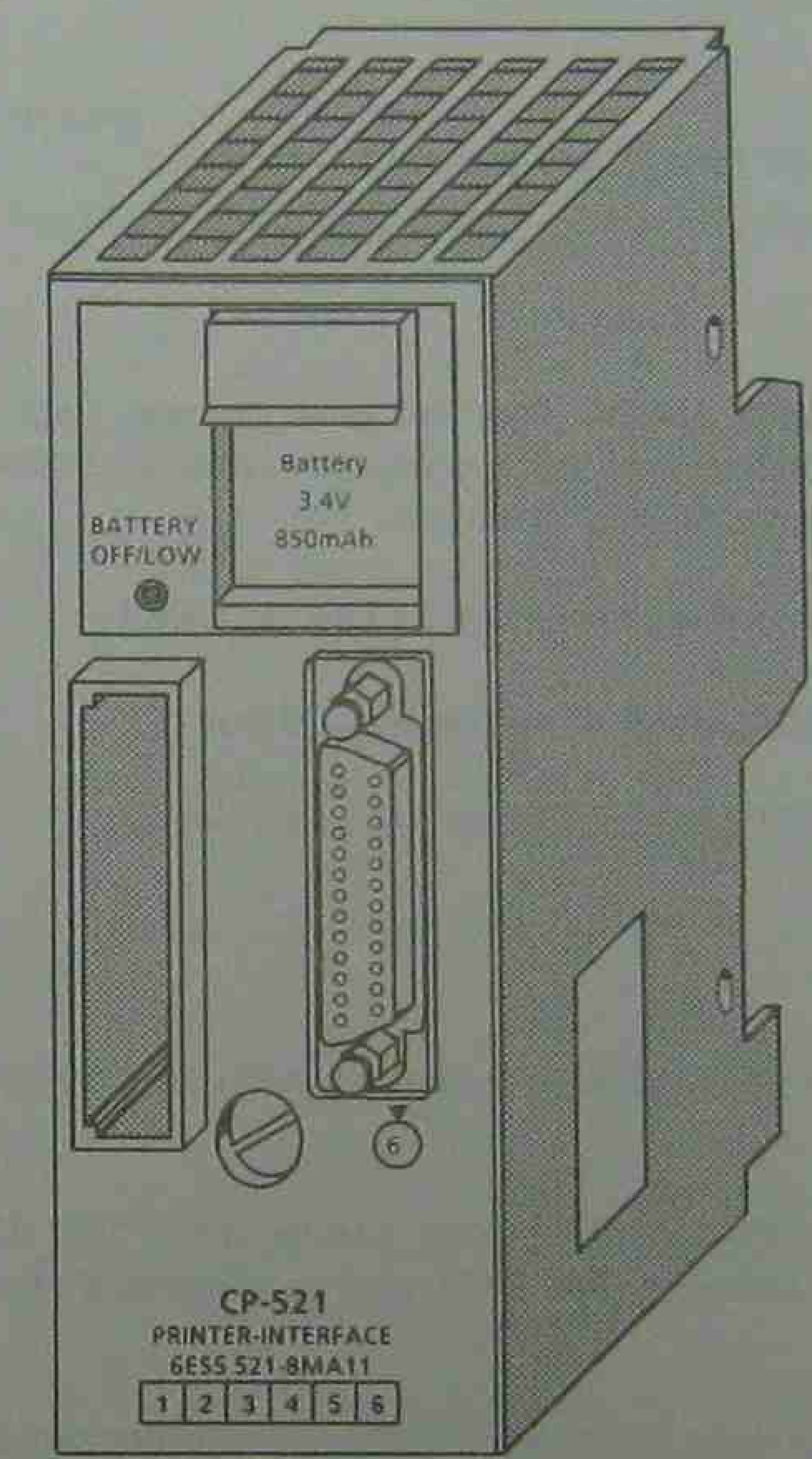
- Plug the IP 267 into a bus unit like any other I/O module.
- Insert the IP 267 module only into slots 0 through 7.
- Connect the external switches to the DIs of the IP 267 via the terminal block.
- Connect the stepper motor's power section to the 9-pin subminiature D female connector.

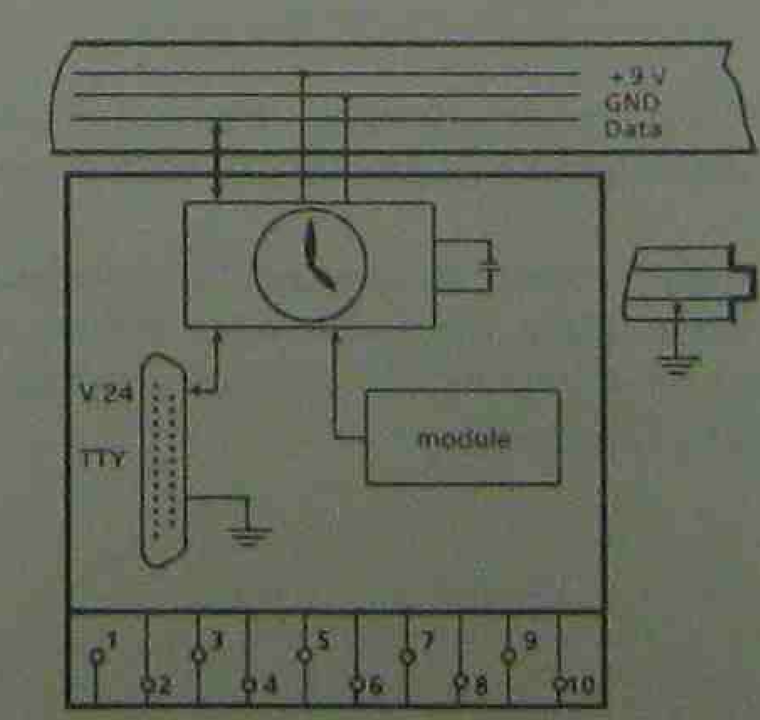
Addressing

The IP 267 is addressed like an analog module.

16.10 Communications Modules

16.10.1 Printer Communications Module CP 521 (6ES5 521-8MA11)





Technical Specifications

Galvanic isolation		TTY signals are isolated
Memory submodule		EPROM/EEPROM
Serial interface		V.24 (RS-232-C)/TTY, passive
Real-time clock - accuracy - variation due to temperature change (t_V ambient temperature T_A in °C) - e.g. tolerance at 40° C (104° C)		 ± 2 s/day - 3.5 × (T_A -15)² ms/day ± 2 s - 3.5 × (40-15)² ms/day approx. 0 to - 4 s/day
Transmission mode		asynchronous 7-bit mode = 10-bit character frame 11-bit character frame
Baud rate		110 to 9600 Bd
Permiss. length of cable - TTY (PT 88) - V.24 (RS-232-C)		 30 m (98.4 ft.) 15 m (49.2 ft.)
Battery low LED (yellow)		yes
Back-up battery Lithium ½AA Life expectancy		 3.4 V/850 mAh 1 year minimum
Degree of protection		IP20
Permiss. ambient temperature - horizontal arrangement - vertical arrangement		 0 to 60° C (32 to 140° F) 0 to 40° C (32 to 104° F)
Relative humidity		15% to 95%
Current consumption from + 9 V (CPU)	typ.	140 mA
Power loss of the module	typ.	1.2 W
Weight	approx.	500 g (1 lb. 1.5 oz.)

Note:
It is only possible to run the CP 521 with the interrupt processing of the CPU 103 if the interrupts are disabled at the end of the OB 1 cycle and enabled again at the beginnging of the OB 1 cycle.

The CP 521 is a powerful peripheral module that can be used with the SIMATIC systems S5-90U, S5-95U and the S5-100U. It has its own central processor (cannot be used with the CPU 100, 6ES5 100-8MA01).

A separate manual for this module is available. The order number is 6ES5 100-0UD21.

A brief overview of the functions of this module follows.

Function

You can operate the CP 521 module in both the "Printer Mode" and the "ASCII Mode".

Printer Mode

In the printer mode, you can transfer message text to a printer. You can print process data and process malfunctions. The printing of messages to a printer does not increase the response time of the programmable controller. You can print the following types of information.

- Messages configured by the user in a memory submodule in data blocks DB2 to DB63
- Time of day and date from the modules's real-time clock
- Values for variables, transferred to the communications module via the S5-100 bus

The messages can be stored in an EPROM or in an EEPROM submodule (up to 8 Kbytes).

ASCII Mode

In the ASCII mode, the module can exchange data with other peripheral devices such as a computer terminal, CP 523 or other CP 521s.

You can network programmable controllers to each other (point-to-point connection). The ASCII mode makes it possible to transfer data messages between the CPU and a peripheral device connected to the CP 521.

In the ASCII mode, the module's real-time clock can be used for tasks in the user program requiring the date and time of day.

The following statements are valid for both modes.

- The peripheral device and the module are connected via a serial interface. You can choose (by setting parameters) between a passive TTY current-loop interface or an RS-232 V.24 interface.

- The DB editor of the programmers makes parameter setting to the printer interface and configuration of message texts easier . You can either store the parameters for the printer interface in DB1 on the memory submodule or transfer them directly into the user program.
  The CP 521 can be programmed and operated without COM software.

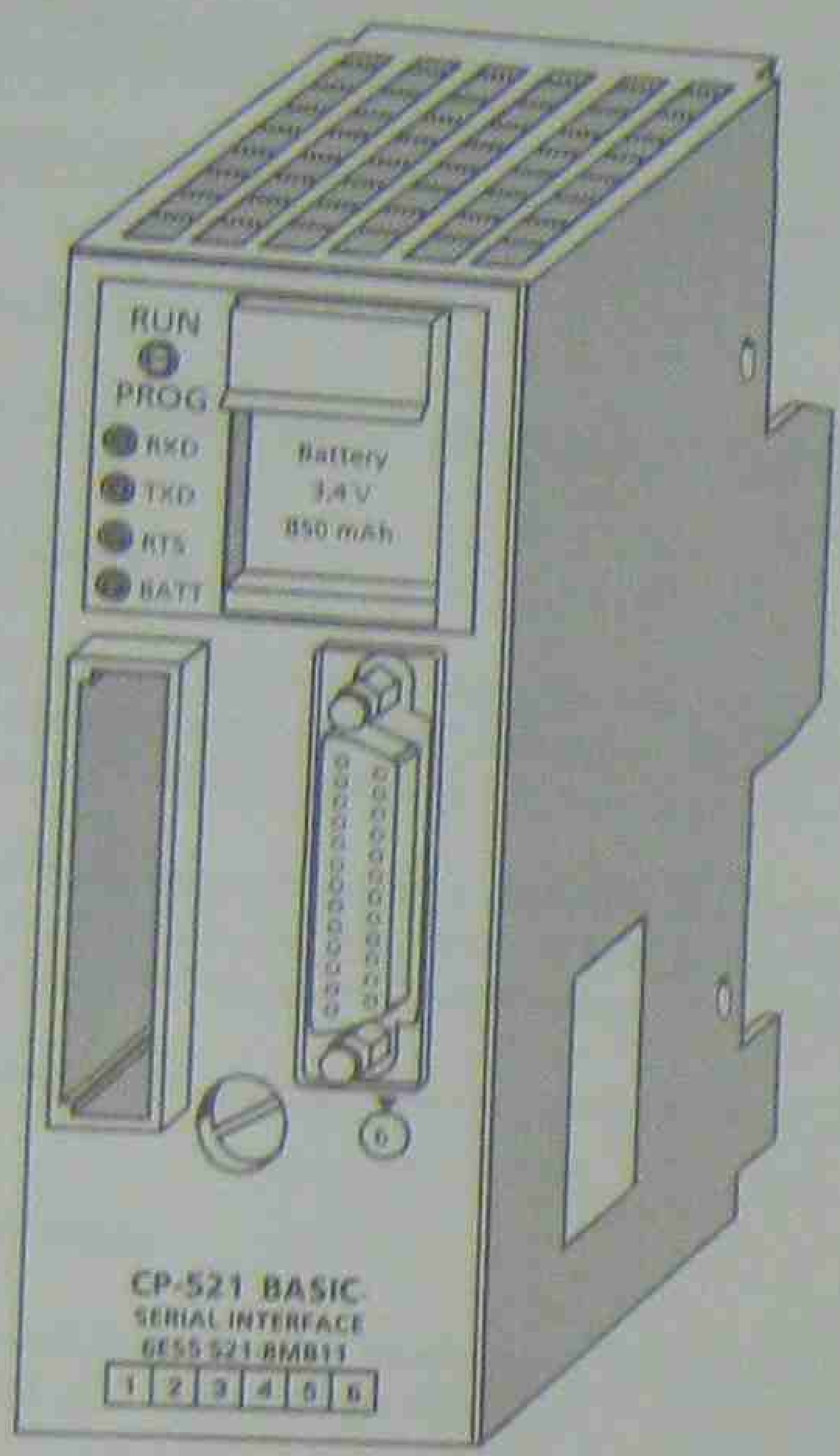
Installation

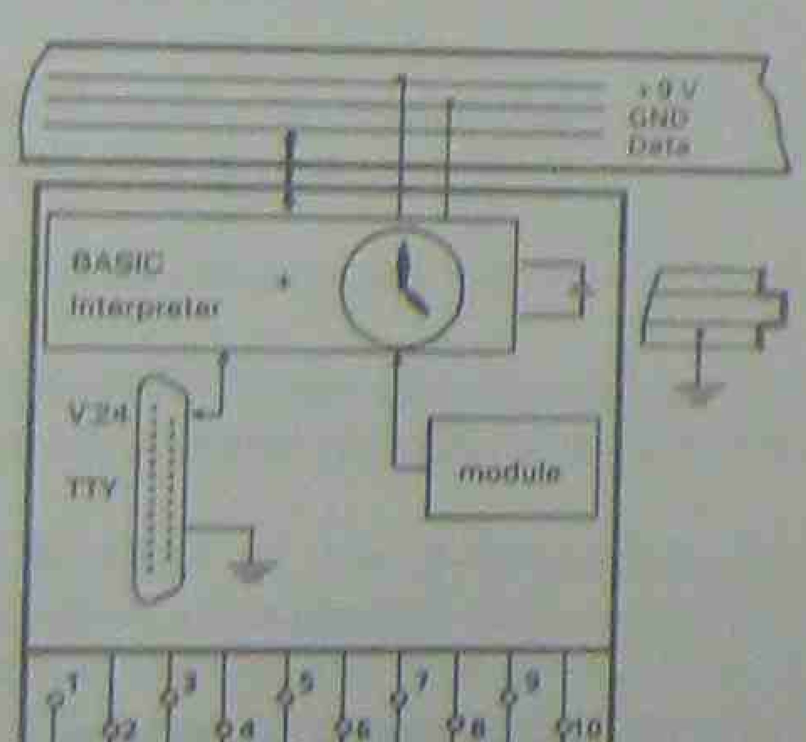
- Install the communications module on the bus module like any other I/O module (see section 3.2.1)
- Plug the module only into slots 0 through 7.
  - The module has no connection to the terminal block.
- Connect the printer to the module via a 25-pin sub-D female connector.

Addressing

The module is addressed like a 4-channel analog module.

16.10.2 Communications Module CP 521 BASIC (6ES5 521-8MB11)





Technical Specifications

Galvanic isolation		TTY signals are isolated
Serial interface		V.24 (RS-232-C)/TTY, passive (active)
Memory submodule		EPROM/EEPROM/RAM
Real-time clock - accuracy tg		+/- 1 s/day at 25 • C (77 • F)
- variation due to temperature change tA0		to 60 • C (32 to 140 • F)
- (ambient temperature TV in •C) →		1 s to -11 s according to data sheet
Transmission mode		asynchronous 10-bit character frame /11-bit character frame
Baud rate		110 to 9600 Bd
LED displays: -TXD - RXD - RTS - BATT		 Send data Receive data Ready to send Battery low signal (yellow LED)
Permissible cable lengths -TTY, dependent on voltage drop on the + line: - typical for receiver - typical for sender - V.24		 1.5 V + 0.9 V 15 m (50 feet)
Back-up battery Lithium 1/2 AA		3.4 V/850 mAh
Life expectancy		1 year minimum
Degree of protection		IP 20
Permissible ambient temperature - horizontal arrangement		0 to 60 • C (32 to 140• F)
- vertical arrangement		0 to 40 • C (32 to 104• F)
Relative humidity		15% to 95%
Current consumption from + 9 V (CPU)	typ.	180 mA
Power loss of the module	typ.	1.6 W
Weight	approx.	500 g (1 lb 5 oz.)

NOTE: It is only possible to run the CP 521 with the interrupt processing if the interrupts are disabled at the end of the OB1 cycle and enabled again at the beginning of the OB1 cycle.

The CP 521 BASIC is a powerful peripheral module that can be used with the SIMATIC systems S5-90U, S5-95U and the S5-100U. It has its own central processor (cannot be used with the CPU 100, 6ES5 100-8MA01).

A separate manual for this module is available. The order number is 6ES5 521-8MB21.

A brief overview of the functions of this module follows.

Function

This module comes with a special COM software package that is required for generating and storing BASIC programs (on a floppy disk or an EPROM submodule).

Since the CP 521 includes a basic interpreter, you can create and run BASIC programs that exchange data with a CPU and a connected peripheral device. Use a programmer or a PC terminal and the COM software to program the BASIC interpreter.

You can store the BASIC programs in the module's own battery backed-up RAM or on a memory submodule that can be plugged in.

Connect programmers or PC terminals to the CP 521 via a serial interface. You can choose (by setting parameters) between a passive TTY current-loop interface or a RS-232 C V.24 interface to connect a programmer or terminal. Connect a printer to the unidirectional V.24 interface of the module to print listings or messages.

Change parameter settings for the peripheral interface by using a BASIC command or by using the BASIC program.

The CP 521 has an integral real-time clock that can be backed up by a battery. You can use the clock data in unidirectional data traffic to log process statuses or process malfunctions.

Installation

- Install the communications module on the bus module like any other I/O module (see section 3.2.1)
- Plug the module only into slots 0 through 7.
  - The module has no connection to the terminal block.
- Connect the printer to the module via a 25-pin sub-D female connector.

Addressing

The module is addressed like a 4-channel analog module.

A	Operations List, Machine Code and List of Abbreviations

A

EWA 4NEB 812 6065-02a

A Operations List, Machine Code and Abbreviations

A.1 Operations List

A.1.1 Basic Operations

☒ for organization blocks (OB)
☒ for program blocks (PB)
☒ for function blocks (FB)
☒ for sequence blocks (SB)

Operation (STL)	Permissible Operands	RLO*			S5-90U Execution Time in µs		S5-95U Execution Time in µs		Function
		1	2	3	Onboard	Ext. I/O	Onboard	Ext. I/O	
Boolean Logic Operations									
A	I, Q	N	Y	N	1 to 2	3 to 5	1 to 2	3 to 5	Scan operand for "1" and combine with RLO through logic AND.
	F	N	Y	N	3 to 5		3 to 5		
	T	N	Y	N	6 to 10		6 to 10		
	C	N	Y	N	3 to 6		3 to 6		
AN	I, Q	N	Y	N	2	3 to 5	2	3 to 5	Scan operand for "0" and combine with RLO through logic AND.
	F	N	Y	N	3 to 5		3 to 5		
	T	N	Y	N	6 to 10		6 to 10		
	C	N	Y	N	3 to 6		3 to 6		
O	I, Q	N	Y	N	1 to 2	3 to 5	1 to 2	3 to 5	Scan operand for "1" and combine with RLO through logic OR.
	F	N	Y	N	3 to 5		3 to 5		
	T	N	Y	N	6 to 10		6 to 10		
	C	N	Y	N	3 to 6		3 to 6		
ON	I, Q	N	Y	N	2	3 to 5	2	3 to 5	Scan operand for "0" and combine with RLO through logic OR.
	F	N	Y	N	3 to 5		3 to 5		
	T	N	Y	N	6 to 10		6 to 10		
	C	N	Y	N	3 to 6		3 to 6		
O		N	Y	Y	2 to 5		2 to 5		Combine AND operations through logic OR.
A(		N	Y	Y	4 to 8		4 to 8		Combine expressions enclosed in parentheses through logic AND (6 nesting levels).
O(		N	Y	Y	4 to 8		4 to 8		Combine expressions enclosed in parentheses through logic OR (6 nesting levels).
)		N	Y	Y	4 to 10		4 to 10		Close parentheses (conclusion of a parenthetical expression).
Set / Reset Operations									
S	I, Q	Y	N	Y	2	5 to 8	2	5 to 8	Set operand to "1".
	F	Y	N	Y	5 to 8		5 to 8		

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

A

Oper-ation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Set / Reset Operations (cont.)									
R	I, Q	Y	N	Y	2	5 to 8	2	5 to 8	Reset operand to "0".
	F	Y	N	Y	5 to 8		5 to 8		
=	I, Q	N	N	Y	2	4 to 7	2	4 to 7	Assign value of RLO to operand.
	F	N	N	Y	4 to 7		4 to 7		
Load Operations									
L	IB	N	N	N	5	11	5	11	Load an input byte from the PII into ACCU 1.
L	QB	N	N	N	5	11	5	11	Load an output byte from the PIQ into ACCU 1.
L	IW	N	N	N	5	15	5	15	Load an input word from the PII into ACCU 1: byte n→ACCU 1 (bits 8-15); byte n+1→ACCU 1 (bits 0-7)
L	QW	N	N	N	5	15	5	15	Load an output word from the PIQ into ACCU 1: byte n→ACCU 1 (bits 8-15); byte n+1→ACCU 1 (bits 0-7)
L	PY0 to 31 PY64 to 127	N N	N N	N N	—		39		Permissible only in OB13. Load an input byte of the digital/analog inputs from the interrupt PII into ACCU 1.
	PY32/33 PY34/35 PY36 to 39 PY40 to 55	N N N N	N N N N	N N N N	8/11 — — —		40 to 48 40 to 48 45 to 60 105		Load an input word of the digital/analog inputs into ACCU 1.
L	PW0 to 30 PW64 to 126	N N	N N	N N	—		42		Permissible only in OB13. Load an input word of the digital/analog inputs from the interrupt PII into ACCU 1.
	PW32 PW33 to 35 PW36 to 39 PW40 to 45	N N N N	N N N N	N N N N	17 — — —		50 to 67 50 to 67 55 to 80 104		Load an input word of the digital/analog inputs into ACCU 1.
L	FY	N	N	N	11		11		Load a flag byte into ACCU 1.
L	FW	N	N	N	15		15		Load a flag word into ACCU 1: byte n→ACCU 1 (bits 8-15); byte n+1→ACCU 1 (bits 0-7).
L	DL	N	N	N	33		33		Load a data word (left-hand byte) of the current data block into ACCU 1.

1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

Oper-ation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Load Operations (cont.)									
L	DR	N	N	N	35		35		Load a data word (right-hand byte) of the current data block into ACCU 1.
L	DW	N	N	N	35		35		Load a data word of the current data block into ACCU 1: byte n→ACCU 1 (bits 8-15); byte n+1→ACCU 1 (bits 0-7).
L	KB	N	N	N	5		5		Load a constant (1-byte number) into ACCU 1.
L	KS	N	N	N	5		5		Load a constant (2 characters in ASCII format) into ACCU 1.
L	KF	N	N	N	5		5		Load a constant (fixed-point number) into ACCU 1.
L	KH	N	N	N	5		5		Load a constant (hexadecimal code) into ACCU 1.
L	KM	N	N	N	5		5		Load a constant (bit pattern) into ACCU 1.
L	KY	N	N	N	5		5		Load a constant (2-byte number) into ACCU 1.
L	KT	N	N	N	5		5		Load a constant (time in BCD) into ACCU 1.
L	KC	N	N	N	5		5		Load a constant (count in BCD) into ACCU 1.
L	T, C	N	N	N	14		14		Load a time or count (in binary code) into ACCU 1.
LD	T	N	N	N	58		58		Load times or counts (in BCD) into ACCU 1.
	C	N	N	N	59		59		
Transfer Operations									
T	IB	N	N	N	2	5	2	5	Transfer the contents of ACCU 1 to an input byte (into the PII).
T	QB	N	N	N	2	5	2	5	Transfer the contents of ACCU 1 to an output byte (into the PIQ).
T	IW	N	N	N	4	12	4	12	Transfer the contents of ACCU 1 to an input word (into the PII): ACCU 1 (bits 8-15)→byte n; ACCU 1 (bits 0-7)→byte n+1.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

A

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Transfer Operations (cont.)									
T	QW	N	N	N	4	12	4	12	Transfer the contents of ACCU 1 to an output word (into the PIQ): ACCU 1 (bits 8-15)→byte n; ACCU 1 (bits 0-7)→byte n+1.
T	PY0 to 31 PY64 to 127	N N	N N	N N	—		41		Permissible only in OB13. Transfer the contents of ACCU 1 to the interrupt PIO with updating of the PIO.
	PY32/33	N	N	N	5/2		38		Transfer the contents of ACCU 1 to the output with updating of the PIQ.
T	PW0 to 30 PW64 to 126	N N	N N	N N	—		45		Permissible only in OB13. Transfer the contents of ACCU 1 to the interrupt PIO with updating of the PIO.
	PW32 PW40	N N	N N	N N	10 —		49 113		Transfer the contents of ACCU 1 to the output with updating of the PIQ.
	PW36/38	N	N	N	—		49 to 75		Reset counter to "0". Transfer comparison value.
T	FY	N	N	N	5		5		Transfer the contents of ACCU 1 to a flag byte.
T	FW	N	N	N	12		12		Transfer the contents of ACCU 1 to a flag word (into the PIQ): ACCU 1 (bits 8-15)→byte n; ACCU 1 (bits 0-7)→byte n+1.
T	DL	N	N	N	25		25		Transfer the contents of ACCU 1 to a data word (left-hand byte).
T	DR	N	N	N	26		26		Transfer the contents of ACCU 1 to a data word (right-hand byte).
T	DW	N	N	N	34		34		Transfer the contents of ACCU 1 to a data word.
Timer Operations									
SP	T	Y+	N	Y	64		64		Start a timer (stored in ACCU 1) as a signal-contracting pulse on the leading edge of the RLO.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Timer Operations (cont.)									
SE	T	Y+	N	Y	64		64		Start a timer (stored in ACCU 1) as extended pulse (signal contracting and stretching) on the leading edge of the RLO.
SD	T	Y+	N	Y	65		65		Start an on-delay timer (stored in ACCU 1) on the leading edge of the RLO.
SS	T	Y+	N	Y	65		65		Start a stored on-delay timer (stored in ACCU 1) on the leading edge of the RLO.
SF	T	Y+	N	Y	64		64		Start an off-delay timer (stored in ACCU 1) on the trailing edge of the RLO.
R	T	Y	N	Y	21		21		Reset a timer.
Counter Operations									
CU	C	Y+	N	Y	35		35		Counter counts up 1 on the leading edge of the RLO.
CD	C	Y+	N	Y	40		40		Counter counts down 1 on leading edge of the RLO.
S	C	Y+	N	Y	62		62		Set counter if RLO = "1".
R	C	Y	N	Y	17		17		Reset counter if RLO = "1".
Arithmetic Operations									
+F		N	N	N	19		19		Add two fixed-point numbers: ACCU 1 + ACCU 2. CC 1 / CC 0 / OV are affected.
-F		N	N	N	22		22		Subtract one fixed-point number from another: ACCU 2 - ACCU 1. CC 1 / CC 0 / OV are affected.
Comparison Operations									
! = F		N	Y	N	20		21		Compare two fixed-point numbers for "equal to": If ACCU 2 = ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.
> < F		N	Y	N	22		22		Compare two fixed-point numbers for "not equal to": If ACCU 2 ≠ ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded?

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Ext. I/O	Function
Comparison Operations (cont.)									
>F		N	Y	N	22		22		Compare two fixed-point numbers for "greater than": If ACCU 2 > ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.
> =F		N	Y	N	22		22		Compare two fixed-point numbers for "greater than or equal to": If ACCU 2 ≥ ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.
<F		N	Y	N	22		22		Compare two fixed-point numbers for "less than": If ACCU 2 < ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.
< =F		N	Y	N	22		22		Compare two fixed-point numbers for "less than or equal to": If ACCU 2 ≤ ACCU 1, the RLO is "1". CC 1 / CC 0 are affected.
Block Call Operations									
JU	PB	N	N	Y	63		61		Jump unconditionally to a program block.
JU	FB	N	N	Y	65		63		Jump unconditionally to a function block.
JU	SB	N	N	Y	—		61		Jump unconditionally to a sequence block.
JC	PB	Y	Y1)	Y	64		63		Jump conditionally to a program block.
JC	FB	Y	Y1)	Y	67		65		Jump conditionally to a function block.
JC	SB	Y	Y1)	Y	—		63		Jump conditionally to a sequence block.
C	DB	N	N	N	30		30		Call a data block.
G	DB	N	N	Y	—		109		Generate or delete a data block.
Return Operations									
BE		N	N	Y	37		39		Block end (termination of a block)
BEC		Y	Y1)	Y	38		40		Block end, conditional

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

1) RLO is set to "1".

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Ext. I/O	Function
Return Operations (cont.)									
BEU		N	N	Y	37		39		Block end, unconditional (BEU cannot be used in organization blocks.)
"No" Operations									
NOP 0		N	N	N	0		0		No operation (all bits reset)
NOP 1		N	N	N	0		0		No operation (all bits set)
Stop Operation									
STP		N	N	N	1		1		Stop: scanning is still completed before a stop. Error ID "STS" is set in the ISTACK.
Display Generation Operations									
BLD 130		N	N	N	0		0		Display generation operation for the programmer: carriage return generates blank line.
BLD 131		N	N	N	0		0		Display generation operation for the programmer: switch to statement list (STL).
BLD 132		N	N	N	0		0		Display generation operation for the programmer: switch to control system flowchart (CSF).
BLD 133		N	N	N	0		0		Display generation operation for the programmer: switch to ladder diagram (LAD).
BLD 255		N	N	N	0		0		Display generation operation for the programmer: terminate a segment.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

A.1.2 Supplementary Operations and System Operations

- [ ] for organization blocks (OB)
- [ ] for program blocks (PB)
- [x] for function blocks (FB)
- [ ] for sequence blocks (SB)

Oper-ation (STL)	Permissible Operands	RLO* 1	2	3	S5-90U Execution Time in µs Onboard	Ext. I/O	S5-95U Execution Time in µs Onboard	Ext. I/O	Function
Boolean Logic Operations									
A =	Formal operand I, Q, F, T, C	N	Y	N	—		43 to 64		AND operation: scan formal operand for "1". (Data type: BI)
AN =	Formal operand I, Q, F, T, C	N	Y	N	—		44 to 65		AND operation: scan formal operand for "0". (Data type: BI)
O =	Formal operand I, Q, F, T, C	N	Y	N	—		43 to 64		OR operation: scan formal operand for "1". (Data type: BI)
ON =	Formal operand I, Q, F, T, C	N	Y	N	—		44 to 65		OR operation: scan formal operand for "0". (Data type: BI)
AW		N	N	N	16		16		Combine contents of ACCU 2 and ACCU 1 through logic AND (word operation). Result is stored in ACCU 1. CC 1 / CC 0 are affected.
OW		N	N	N	16		16		Combine contents of ACCU 2 and ACCU 1 through logic OR (word operation). Result is stored in ACCU 1. CC 1 / CC 0 are affected.
XOW		N	N	N	16		16		Combine contents of ACCU 2 and ACCU 1 through logic EXCLUSIVE OR (word operation). Result is stored in ACCU 1. CC 1 / CC 0 are affected.
Bit Operations									
TB	T, C	N	Y	N	—		5		Test a bit of a timer or counter word for "1".
TB	D	N	Y	N	—		32		Test a bit of a data word for "1".
TB	RS	N	Y	N	—		5		Test a bit of a data word in the system data area for "1".
TBN	T, C	N	Y	N	—		5		Test a bit of a timer or counter word for "0".

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

Oper-ation (STL)	Permissible Operands	RLO* 1	2	3	S5-90U Execution Time in µs Onboard	Ext. I/O	S5-95U Execution Time in µs Onboard	Ext. I/O	Function
Bit Operations (cont.)									
TBN	D	N	Y	N	—		33		Test a bit of a data word for "0".
TBN	RS	N	Y	N	—		5		Test a bit of a data word in the system data area for "0".
SU	T, C	N	N	Y	—		6		Set a bit of a timer or counter word unconditionally.
SU	D	N	N	Y	—		34		Set a bit of a data word un-conditionally.
RU	T, C	N	N	Y	—		6		Reset a bit of a timer or counter word unconditionally.
RU	D	N	N	Y	—		34		Reset a bit of a data word unconditionally.
Set / Reset Operations									
S =	Formal operand I, Q, F	Y	N	Y	—		69 to 79		Set a formal operand (when RLO = 1). (Data type: BI)
RB =	Formal operand I, Q, F	Y	N	Y	—		70 to 81		Reset a formal operand (when RLO = 1). (Data type: BI)
RD =	Formal operand T, C	Y	N	Y	—		56 to 60		Reset a formal operand (digital) (when RLO = 1).
= =	Formal operand I, Q, F	Y	N	Y	—		67 to 78		Assign the value of the RLO to the status of the formal operand. (Data type: BI)
Timer and Counter Operations									
FR	T	Y↑	N	Y	—		20		Enable a timer/counter for cold restart. If RLO = "1", - "FR T" restarts the timer - "FR C" sets, decrements, or increments the counter.
	C	Y↑	N	Y	—		16		
FR =	Formal op. T	Y↑	N	Y	—		57		Enable formal operand (timer/counter) for cold restart (for detailed description, see "FR" operation).
	Formal op. C	Y↑	N	Y	—		53		
SP =	Formal op. T	Y↑	N	Y	—		101		Start a timer (formal operand) as pulse with the value stored in ACCU 1.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Timer and Counter Operations (cont.)									
SD =	Formal op. T	Y ↑	N	Y	—		103		Start an on-delay timer (formal operand) with the value stored in ACCU 1.
SEC =	Formal op. T	Y ↑	N	Y	—		101		Start a timer (formal operand) as an extended pulse with the value stored in ACCU 1, or set a counter (formal operand) with the next count value indicated.
	Formal op. C	Y ↑	N	Y	—		99		
SSU =	Formal op. T	Y ↑	N	Y	—		103		Start a stored on-delay timer (formal operand) with the value stored in ACCU 1, or increment a counter (formal operand).
	Formal op. C	Y ↑	N	Y	—		73		
SFD =	Formal op. T	Y ↓	N	Y	—		101		Start an off-delay timer (formal operand) with the value stored in ACCU 1, or decrement a counter (formal operand).
	Formal op. C	Y ↑	N	Y	—		76		
Load and Transfer Operations									
L =	Formal operand I, Q, F, T, C	N	N	N	—		40 to 66		Load the value of the formal operand into ACCU 1. Data type: BY, W Additional actual operands: DL, DR, DW
L	RS	N	N	N	—		15		Load a word from the system data area into ACCU 1.
LD =	Formal operand T, C	N	N	N	—		86		Load the value of the formal operand in BCD code into ACCU 1.
LW =	Formal operand	N	N	N	—		34		Load a formal operand bit pattern into ACCU 1. Data type: D Parameter type: KC, KF, KH, KM, KS, KT, KY
T =	Formal operand I, Q, F	N	N	N	—		34 to 64		Transfer the contents of ACCU 1 to the formal operand. Data type: BY, W Additional actual operands: DR, DL, DW

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Conversion Operations									
CFW		N	N	N	4		4		Form the one's complement of ACCU 1.
CSW		N	N	N	19		19		Form the two's complement of ACCU 1. CC 1 / CC 0 and OV are affected.
Shift Operations									
SLW	Parameter n = 0 to 15	N	N	N	12 + n · 8		12 + n · 8		Shift the contents of ACCU 1 to the left by the value specified in the parameter. Unassigned positions are padded with zeros. CC 1 / CC 0 are affected.
SRW	Parameter n = 0 to 15	N	N	N	12 + n · 8		12 + n · 8		Shift the contents of ACCU 1 to the right by the value specified in the parameter. Unassigned positions are padded with zeros. CC 1 / CC 0 are affected.
Jump Operations									
JU =	Symbolic address max. 4 characters	N	N	N	5		5		Jump unconditionally to the symbolic address.
JC =	Symbolic address max. 4 characters	Y	Y1)	Y	7		7		Jump conditionally to the symbolic address. (If the RLO is "0", it is set to "1".)
JZ =	Symbolic address max. 4 characters	N	N	N	9		9		Jump if the result is zero. The jump is made only if CC 1 = 0 and CC 0 = 0. The RLO is not changed.
JN =	Symbolic address max. 4 characters	N	N	N	12		12		Jump if the result is not zero. The jump is made only if CC 1 ≠ CC 0. The RLO is not changed.
JP =	Symbolic address max. 4 characters	N	N	N	9		9		Jump if the result is greater than 0. The jump is made only if CC 1 = 1 and CC 0 = 0. The RLO is not changed.
JM =	Symbolic address max. 4 characters	N	N	N	9		9		Jump if the result is less than 0. The jump is made only if CC 1 = 0 and CC 0 = 1. The RLO is not changed.
JO =	Symbolic address max. 4 characters	N	N	N	7		7		Jump on overflow. The jump is made only if the OVERFLOW bit is set. The RLO is not changed.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

1) RLO is set to "1".

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Other Operations									
IA		N	N	N	1		1		Disable interrupt. Input / output interrupt or timer OB processing** is disabled.
RA		N	N	N	19		19		Enable interrupt. This operation cancels the effect of IA.
D		N	N	N	—		4		Decrement the low byte (bits 0 to 7) of ACCU 1 by the value n (n = 0 to 255).
I		N	N	N	—		3		Increment the low byte (bits 0 to 7) of ACCU 1 by the value n (n = 0 to 255).
DO =	Formal operand	N	N	Y	—		95		Process a block. (Only C DB, JU OB, J U PB, JU FB, JU SB can be substituted.) Actual operands: C DB, JU OB, JU PB, JU FB, JU SB
DO	DW***	N	N	N	—		181 to 216		Process data word. The next operation is combined with the parameter specified in the data word (OR operation) and then carried out.***
DO	FW***	N	N	N	—		139 to 174		Process flag word. The next operation is combined with the parameter specified in the flag word (OR operation) and then carried out.***

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

** Timer OB processing applies to the S5-95U only

*** Permissible operations:
L FY, T FY, L FW, T FW, L IB, T IB, L QB,T QB, L IW, T IW, L QW, T QW, L DL, T DL, L DR, T DR, L DW, T DW, JU OB/SB/FB/PB, JC OB/SB/FB/PB/ C DB
A F, S F, R F, = F, SS T, SE T, R T, A T, AN T, SLW, SRW

A 1.3 System Operations

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Set Operations									
SU	RS	N	N	Y	—		6		Set bit in system data area unconditionally.
RU	RS	N	N	Y	—		6		Reset bit in system data area unconditionally.
Load and Transfer Operations									
LIR		N	N	N	—		50		Load the contents of a memory word (addressed by ACCU 1) indirectly into the register (0: ACCU 1; 2: ACCU 2).
TIR		N	N	N	—		50		Transfer the register contents (0: ACCU 1; 2: ACCU 2) indirectly into the memory word (addressed by ACCU 1).
TNB	Parameter n = 0 to 255	N	N	N	52 + n · 16		52 + n · 16		Transfer a field byte by byte (number of bytes 0 to 255)
T	RS	N	N	N	—		12		Transfer a word to the system data area.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?

A

Operation (STL)	Permissible Operands	RLO* 1	RLO* 2	RLO* 3	S5-90U Execution Time in µs Onboard	S5-90U Execution Time in µs Ext. I/O	S5-95U Execution Time in µs Onboard	S5-95U Execution Time in µs Ext. I/O	Function
Block Call Operations and Return Operations									
JU	OB	N	N	Y	—		61		Call an organization block unconditionally.
JC	OB	Y	Y1)	Y	—		63		Call an organization block conditionally.
Arithmetic Operations									
ADD	BN	N	N	N	—		10		Add byte constant (fixed point) to ACCU 1.
ADD	KF	N	N	N	—		10		Add fixed-point constant (word) to ACCU 1.
Other Operations									
STS		N	N	N	—		2		Stop operation. Program processing is interrupted immediately after this operation.
TAK		N	N	N	—		10		Swap the contents of ACCU 1 and ACCU 2.

* 1 RLO dependent ? 2 RLO affected ? 3 RLO reloaded ?
1) RLO is set to "1"

A.1.4 Evaluation of CC 1 and CC 0

CC 1	CC 0	Arithmetic Operations	Digital Logic Operations	Comparison Operations	Shift Operations	Conversion Operations
0	0	Result = 0	Result = 0	ACCU 2 = ACCU 1	shifted bit = 0	—
0	1	Result < 0	—	ACCU 2 < ACCU 1	—	Result < 0
1	0	Result > 0	Result ≠ 0	ACCU 2 > ACCU 1	shifted bit = 1	Result > 0

A.2 Machine Code Listing

B0 L	B0 R	B1 L	B1 R	B2 L	B2 R	B3 L	B3 R	Operation	Operand
0	0	0	0					NOP 0	
0	1	0	0					CFW	
0	2	0_d	0_d					L	T
0	3	0_i	0_i					TNB	
0	4	0_d	0_d					FR	T
0	5	0	0					BEC	
0	6	0_c	0_c					FR =	
0	7	0_c	0_c					A =	
0	8	0	0					IA	
0	8	8	0					RA	
0	9	0	0					CSW	
0	A	0_a	0_a					L	FB
0	B	0_a	0_a					T	FB
0	C	0_d	0_d					LC	T
0	D	0_i	0_i					JO =	
0	E	0_c	0_c					LC =	
0	F	0_c	0_c					0	
1	0	8	2					BLD	130
1	0	8	3					BLD	131
1	0	8	4					BLD	132
1	0	8	5					BLD	133
1	0	F	F					BLD	255
1	1	0_n	0_n					I	
1	2	0_a	0_a					L	FW
1	3	0_a	0_a					T	FW
1	4	0_d	0_d					SF	T
1	5	0_i	0_i					JP =	
1	6	0_c	0_c					SFD =	
1	7	0_c	0_c					S =	
1	9	0_n	0_n					D	
1	C	0_d	0_d					SE	T
1	D	0_f	0_f					JC	FB

B0 L	B0 R	B1 L	B1 R	B2 L	B2 R	B3 L	B3 R	Operation	Operand
1	E	0_c	0_c					SEC =	
1	F	0_c	0_c					= =	
2	0	0_f	0_f					C	DB
2	1	2	0					>F	
2	1	4	0					<F	
2	1	6	0					> <F	
2	1	8	0					! =F	
2	1	A	0					> =F	
2	1	C	0					< =F	
2	2	0_g	0_g					L	DL
2	3	0_g	0_g					T	DL
2	4	0_d	0_d					SR	T
2	5	0_i	0_i					JM =	
2	6	0_c	0_c					SR =	
2	7	0_c	0_c					AN =	
2	8	0_e	0_e					L	KB
2	A	0_g	0_g					L	DR
2	B	0_g	0_g					T	DR
2	C	0_d	0_d					SS	T
2	D	0_i	0_i					JU =	
2	E	0_c	0_c					SSU =	
2	F	0_c	0_c					ON =	
3	0	0	1	0_e	0_e	0_e	0_e	L	KC
3	0	0	2	0_e	0_e	0_e	0_e	L	KT
3	0	0	4	0_e	0_e	0_e	0_e	L	KF
3	0	1	0	0_e	0_e	0_e	0_e	L	KS
3	0	2	0	0_e	0_e	0_e	0_e	L	KY
3	0	4	0	0_e	0_e	0_e	0_e	L	KH
3	0	8	0	0_e	0_e	0_e	0_e	L	KM
3	2	0_g	0_g					L	DW
3	3	0_g	0_g					T	DW
3	4	0_d	0_d					SP	T

Machine Code								Operation	Operand
B0		B1		B2		B3			
L	R	L	R	L	R	L	R		
3	5	0_{i}	0_{i}					JN =	
3	6	0_{c}	0_{c}					SI =	
3	7	0_{c}	0_{c}					RB =	
3	C	0_{d}	0_{d}					R	T
3	D	0_{f}	0_{f}					JU	FB
3	E	0_{c}	0_{c}					RD =	
3	F	0_{c}	0_{c}					LW =	
4	0	0	0_{k}					LIR	
4	1	0	0					AW	
4	2	0_{o}	0_{o}					L	C
4	4	0_{o}	0_{o}					FR	C
4	5	0_{i}	0_{i}					JZ =	
4	6	0_{c}	0_{c}					L =	
4	8	0	0_{k}					TIR	
4	9	0	0					OW	
4	A	0_{a}	0_{a}					L	IB
4	A	8_{a}	0_{a}					L	QB
4	B	0_{a}	0_{a}					T	IB
4	B	8_{a}	0_{a}					T	QB
4	C	0_{o}	0_{o}					LC	C
4	D	0_{f}	0_{f}					JC	OB
4	E	0_{g}	0_{g}					B	FW
5	0	0_{e}	0_{e}					ADD	BN
5	1	0	0					XOW	
5	2	0_{a}	0_{a}					L	IW
5	2	8_{a}	0_{a}					L	QW
5	3	0_{a}	0_{a}					T	IW
5	3	8_{a}	0_{a}					T	QW
5	4	0_{o}	0_{o}					LD	C
5	5	0_{f}	0_{f}	0_{e}	0_{e}	0_{e}	0_{e}	JC	PB
5	8	0	0					ADD	KF
5	9	0	0					-F	

Machine Code								Operation	Operand
B0		B1		B2		B3			
L	R	L	R	L	R	L	R		
5	C	0_{o}	0_{o}					S	C
5	D	0_{f}	0_{f}					JC	SB
6	1	0_{h}	0_{h}					SLW	
6	2	0_{g}	0_{g}					L	RS
6	3	0_{g}	0_{g}					T	RS
6	5	0	0					BE	
6	5	0	1					BEU	
6	6	0_{c}	0_{c}					T =	
6	9	0_{h}	0_{h}					SRW	
6	C	0_{o}	0_{o}					CU	C
6	D	0_{f}	0_{f}					JU	OB
6	E	0_{g}	0_{g}					B	DW
7	0	0	0					STS	
7	0	0	2					TAK	
7	0	0	3	C	0	0_{o}	0_{o}	STP	
7	0	1	5	8	0	0_{o}	0_{o}	TB	C
7	0	1	5	4	0	0_{o}	0_{o}	TBN	C
7	0	1	5	0	0	0_{o}	0_{o}	SU	C
7	0	1	5	C	0	0_{d}	0_{d}	RU	C
7	0	2	5	8	0	0_{d}	0_{d}	TB	T
7	0	2	5	4	0	0_{d}	0_{d}	TBN	T
7	0	2	5	0	0	0_{d}	0_{d}	SU	T
7	0	2	5	C	0_{b}	0_{g}	0_{g}	RU	T
7	0	4	6	8	0_{b}	0_{g}	0_{g}	TB	D
7	0	4	6	4	0_{b}	0_{g}	0_{g}	TBN	D
7	0	4	6	0	0_{b}	0_{g}	0_{g}	SU	D
7	0	4	6	C	0_{b}	0_{g}	0_{g}	RU	D
7	0	5	7	8	0_{b}	0_{g}	0_{g}	TB	RS
7	0	5	7	4	0_{b}	0_{g}	0_{g}	TBN	RS
7	0	5	7	0	0_{b}	0_{g}	0_{g}	SU	RS
7	0	5	7					RU	RS

Machine Code								Operation	Operand
B0		B1		B2		B3			
L	R	L	R	L	R	L	R		
7	2	0_{a}	0_{a}					L	PB/PY*
7	3	0_{a}	0_{a}					T	PB/PY*
7	5	0_{f}	0_{f}					JU	PB
7	6	0_{c}	0_{c}					DO =	
7	8	0	5	0	0	0_{f}	0_{f}	G	DB
7	9	0	0					+F	
7	A	0_{a}	0_{a}					L	PW
7	B	0_{a}	0_{a}					T	PW
7	C	0_{o}	0_{o}					R	C
7	D	0_{f}	0_{f}					JU	SB
8	0_{b}	0_{a}	0_{a}					A	F
8	8_{b}	0_{a}	0_{a}					O	F
9	0_{b}	0_{a}	0_{a}					S	F
9	8_{b}	0_{a}	0_{a}					=	F
A	0_{b}	0_{a}	0_{a}					AN	F
A	8_{b}	0_{a}	0_{a}					ON	F
B	0_{b}	0_{a}	0_{a}					R	F
B	8	0_{o}	0_{o}					A	C
B	9	0_{o}	0_{o}					O	C
B	A	0	0					A(	
B	B	0	0					O(	
B	C	0_{o}	0_{o}					AN	C
B	D	0_{o}	0_{o}					ON	C

Machine Code								Operation	Operand
B0		B1		B2		B3			
L	R	L	R	L	R	L	R		
B	F	0	0					)	
C	0_{b}	0_{a}	0_{a}					A	I
C	0_{b}	8_{a}	0_{a}					A	Q
C	8_{b}	0_{a}	0_{a}					O	I
C	8_{b}	8_{a}	0_{a}					O	Q
D	0_{b}	0_{a}	0_{a}					S	I
D	0_{b}	8_{a}	0_{a}					S	Q
D	8_{b}	0_{a}	0_{a}					=	I
D	8_{b}	8_{a}	0_{a}					=	Q
E	0_{b}	0_{a}	0_{a}					AN	I
E	0_{b}	8_{a}	0_{a}					AN	Q
E	8_{b}	0_{a}	0_{a}					ON	I
E	8_{b}	8_{a}	0_{a}					ON	Q
F	0_{b}	0_{a}	0_{a}					R	I
F	0_{b}	8_{a}	0_{a}					R	Q
F	8	0_{d}	0_{d}					A	T
F	9	0_{d}	0_{d}					O	T
F	A	0_{i}	0_{i}					JC =	
F	B	0	0					O	
F	C	0_{d}	0_{d}					AN	T
F	D	0_{d}	0_{d}					ON	T
F	F	F	F					NOP 1	

* depending on the type of programmer used

Explanation of the Indices

- a + byte address
- b + bit address
- c + parameter address
- d + timer number
- e + constant
- f + block number
- g + word address
- h + number of shifts
- i + relative jump address
- k + register address
- l + block length in bytes
- m + jump displacement (16 bits)
- n + value
- o + counter number

A.3 List of Abbreviations

Abbreviation	Explanation	Permissible Operand Value Range for	
		S5-90U	S5-95U
ACCU 1	Accumulator 1 (When accumulator 1 is loaded, any existing contents are shifted into accumulator 2.)		
ACCU 2	Accumulator 2		
AI	DB1 parameter: number of analog inputs that are read in cyclically		
BN	Byte constant (fixed-point number)		(- 127 to + 127)
C	Counter - retentive - non-retentive - for the "Bit Test" and "Set" supplementary operations	(0 to 7) (8 to 31)	(0 to 7) (8 to 127) (0 to 127) (0.0 to 127.15)
CAN	DB1 parameter: counter A counts with negative and positive edge		
CAP	DB1 parameter: counter A counts with positive edge		
CBN	DB1 parameter: counter B counts with negative and positive edge		
CBP	DB1 parameter: counter B counts with positive edge		
CC 0 / CC 1	Condition code 0 / Condition code 1		
CCN	DB1 parameter: cascaded counter counts with negative edge		
CCP	DB1 parameter: cascaded counter counts with positive edge		
F	DB1 parameter: input correction factor (integral real-time clock)		
LK	DB1 parameter: clock data location		
PU	Central processing unit of programmable controller		
SF	STEP 5 control system flowchart method of representation		
	Data (1 bit)		(0.0 to 255.15)
	Data block	(2 to 63)	(2 to 255)
	Data word (left-hand byte)	(0 to 255)	(0 to 255)
	Data word (right-hand byte)	(0 to 255)	(0 to 255)
/	Data word	(0 to 255)	(0 to 255)
	DB1 parameter: SINEC L1, position of receive mailbox		
	Flag - retentive - non-retentive	(0.0 to 63.7) (64.0 to 127.7)	(0.0 to 63.7) (64.0 to 255.7)
	Function block	(0 to 63)	(0 to 255)

Abbreviation	Explanation	Permissible Operand Value Range for	
		S5-90U	S5-95U
FB/FY	Flag byte - retentive - non-retentive	(0 to 63) (64 to 127)	(0 to 63) (64 to 255)
Formal operand	Expression with a maximum of 4 characters. The first character must be a letter of the alphabet.		
FW	Flag word - retentive - non-retentive	(0 to 62) (64 to 126)	(0 to 62) (64 to 254)
I	Input	(0.0 to 127.7)	(0.0 to 127.7)
IB	Input byte	(0 to 127)	(0 to 127)
IN	DB1 parameter: activate interrupt on negative edge		
INP	DB1 parameter: activate interrupt on negative and positive edge		
IP	DB1 parameter: activate interrupt on positive edge		
IPN	DB1 parameter: activate interrupt on positive and negative edge		
IW	Input word	(0 to 126)	(0 to 126)
KB	Constant (1 byte)	(0 to 255)	(0 to 255)
KBE	DB1 parameter: SINEC L1, position of the "Receive" coordination byte		
KBS	DB1 parameter: SINEC L1, position of the "Send" coordination byte		
KC	Constant (count)	(0 to 999)	(0 to 999)
KF	Constant (fixed-point number)	(- 32768 to + 32767)	(- 32768 to + 32767)
KH	Constant (hexadecimal code)	(0 to FFFF)	(0 to FFFF)
KM	Constant (2-byte bit pattern)	arbitrary bit pattern: (16 bit)	arbitrary bit pattern: (16 bit)
KS	Constant (2 characters)	(any two alphanumeric characters)	(any two alphanumeric characters)
KT	Constant (time)	(0.0 to 999.3)	(0.0 to 999.3)
KY	Constant (2 bytes)	(0 to 255 per byte)	(0 to 255 per byte)
LAD	STEP 5 ladder diagram method of representation		
NT	DB1 parameter: number of timers being processed		
OB	Organization block for special applications: 1, 3, 13, 21, 22, 31, 34, 251	1, 3, 21, 22	(0 to 255)
OB13	DB1 parameter: interval (ms) within which OB13 is called and processed		
OBA	DB1 block ID for onboard analog inputs		
OBC	DB1 block ID for onboard counters		
OBI	DB1 block ID for onboard interrupt		
OHE	DB1 parameter: enable operating hours counter		

A

Abbreviation	Explanation	Permissible Operand Value Range for	
		S5-90U	S5-95U
OHS	DB1 parameter: set operating hours counter		
OP	Operator panel		
OV	Overflow. This condition code bit is set if, e.g., a numerical range is exceeded during arithmetic operations.		
PB	Program block (with block call and return operations)	(0 to 63)	(0 to 255)
PB or PY (depending on type of programmer used)	Peripheral byte	(32, 33)	(0 to 127)
BUS	DB1 parameter: startup only via connected bus units		
G	Programmer		
GN	DB1 parameter: SINEC L1, programmer bus number		
I	Process image input table		
O	Process image output table		
W	Peripheral word	(32)	(0 to 126)
	Output	(0.0 to 127.7)	(0.0 to 127.7)
	Output Byte	(0 to 127)	(0 to 127)
W	Output word	(0 to 126)	(0 to 126)
O	Result of logic operation		
O affected? Y/N	The RLO is affected/not affected by the operation.		
O dependent? Y Y↑/Y↓ N	The statement is executed only if the RLO is "1". The statement is executed only on positive/negative edge change of the RLO. The statement is always executed.		
reloaded? Y/N	When the next binary operation takes place, the RLO is reloaded/not reloaded (e.g. A I 0.0).		
	System data area - for load operations (supplementary operations) and transfer operations (system operations) - for bit test and set operations (system operations)		(0 to 255) (0.0 to 255.15)
	STEP address counter		
	Sequence block		(0 to 255)
	DB1 block ID for system data parameters		
	DB1 parameter: SINEC L1, position of send mailbox		
	DB1 block ID for SINEC L1		
	DB1 parameter: SINEC L1, slave number		
	STEP 5 statement list method of representation		

Abbreviation	Explanation	Permissible Operand Value Range for	
		S5-90U	S5-95U
STP	DB1 parameter: update the clock while in the STOP state		
STW	DB1 parameter: status word location (integral real-time clock)		
T	Timer - for the "Bit Test" and "Set" supplementary operations	(0 to 31)	(0 to 127) (0.0 to 127.15)
TFB	DB1 block ID for timer function block		
TIS	DB1 parameter: set prompt time		

A

EWA 4NEB 812 6065-02a

B	Dimension Drawings

Figures

B Dimension Drawings

Dimensions are indicated in millimeters. The approximate equivalent in inches is indicated in parentheses. (1 mm = 0.039 in. rounded off to the nearest tenth or hundredth of an inch)

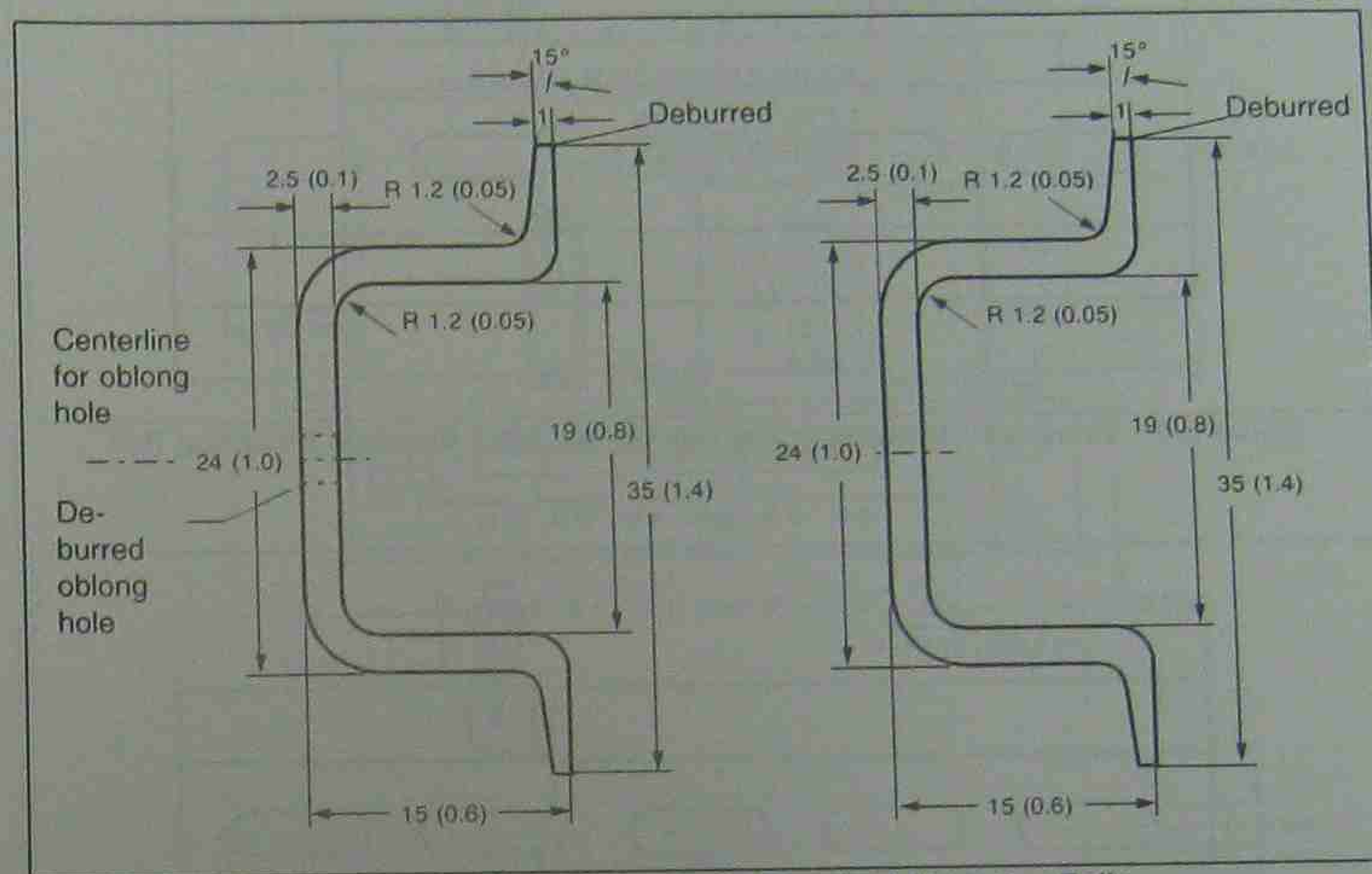


Figure B-1. Cross Sections of Standard Mounting Rails

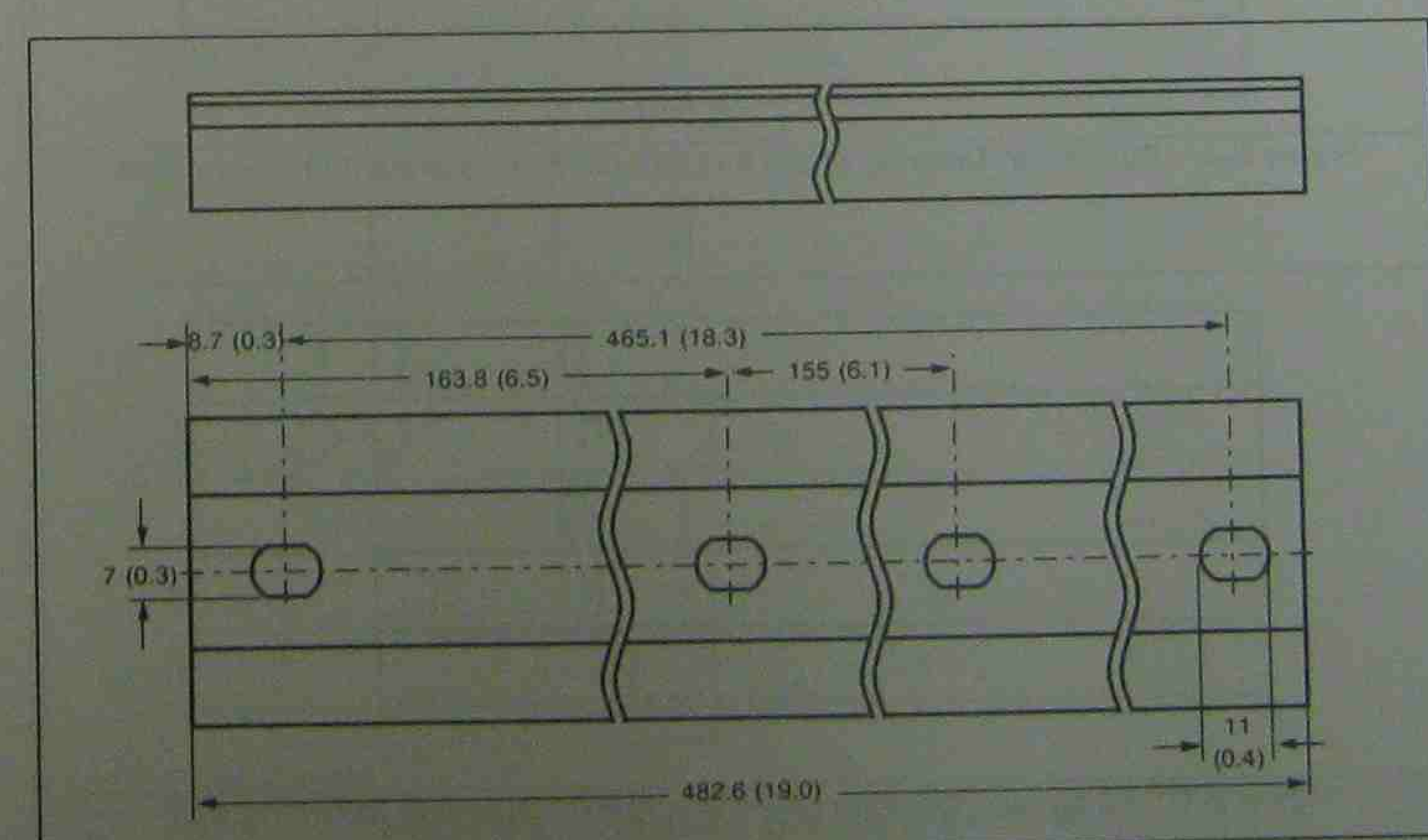


Figure B-2. Dimension Drawing of the 483-mm (19-in.) Standard Mounting Rail

B

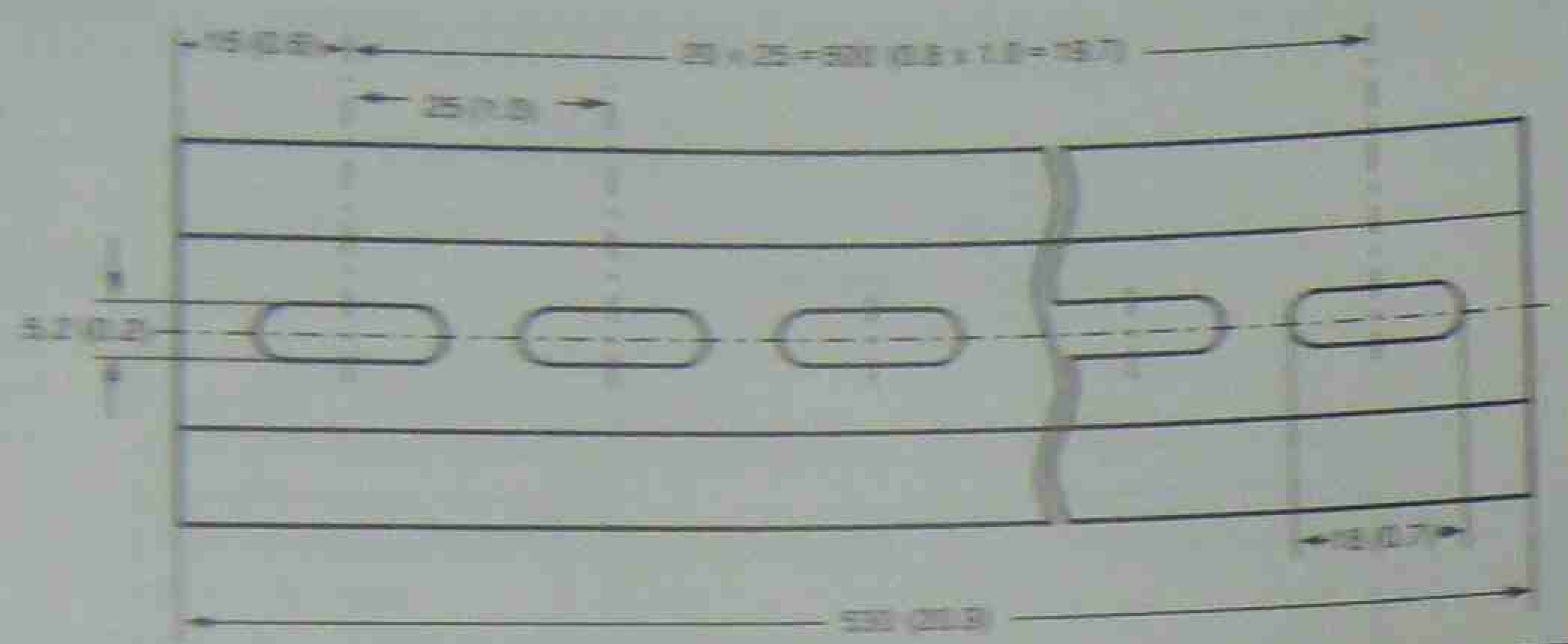


Figure B-3. Dimension Drawing of the 530-mm (20.9-in.) Standard Mounting Rail

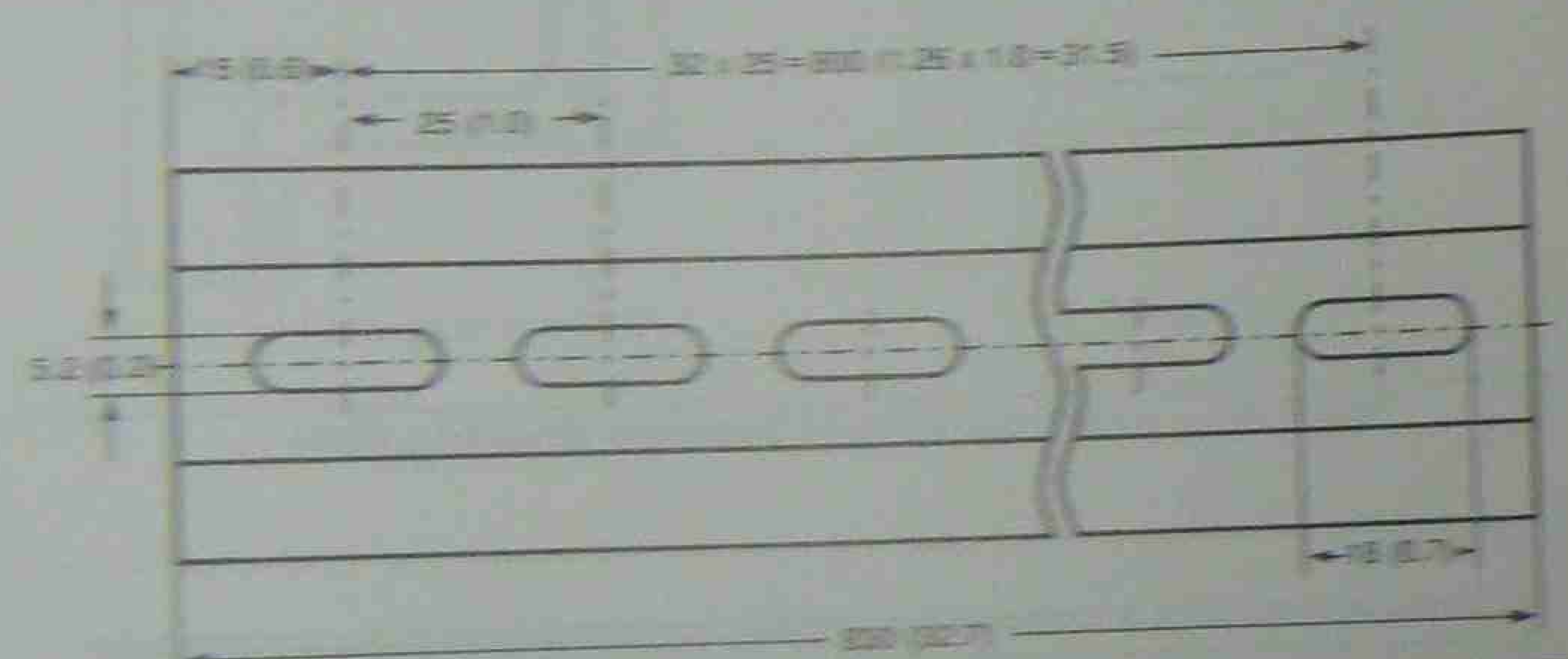


Figure B-4. Dimension Drawing of the 830-mm (32.7-in.) Standard Mounting Rail

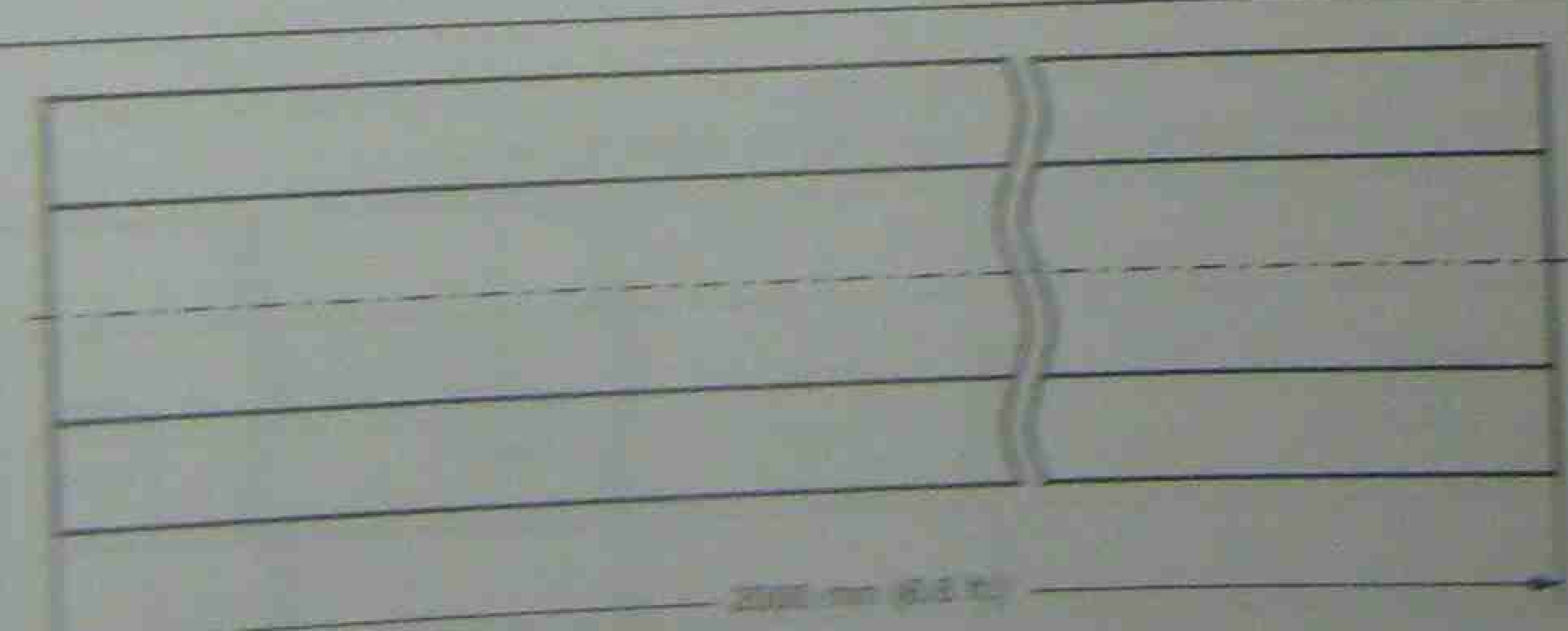


Figure B-5. Dimension Drawing of the 2-m (6.6-ft.) Standard Mounting Rail

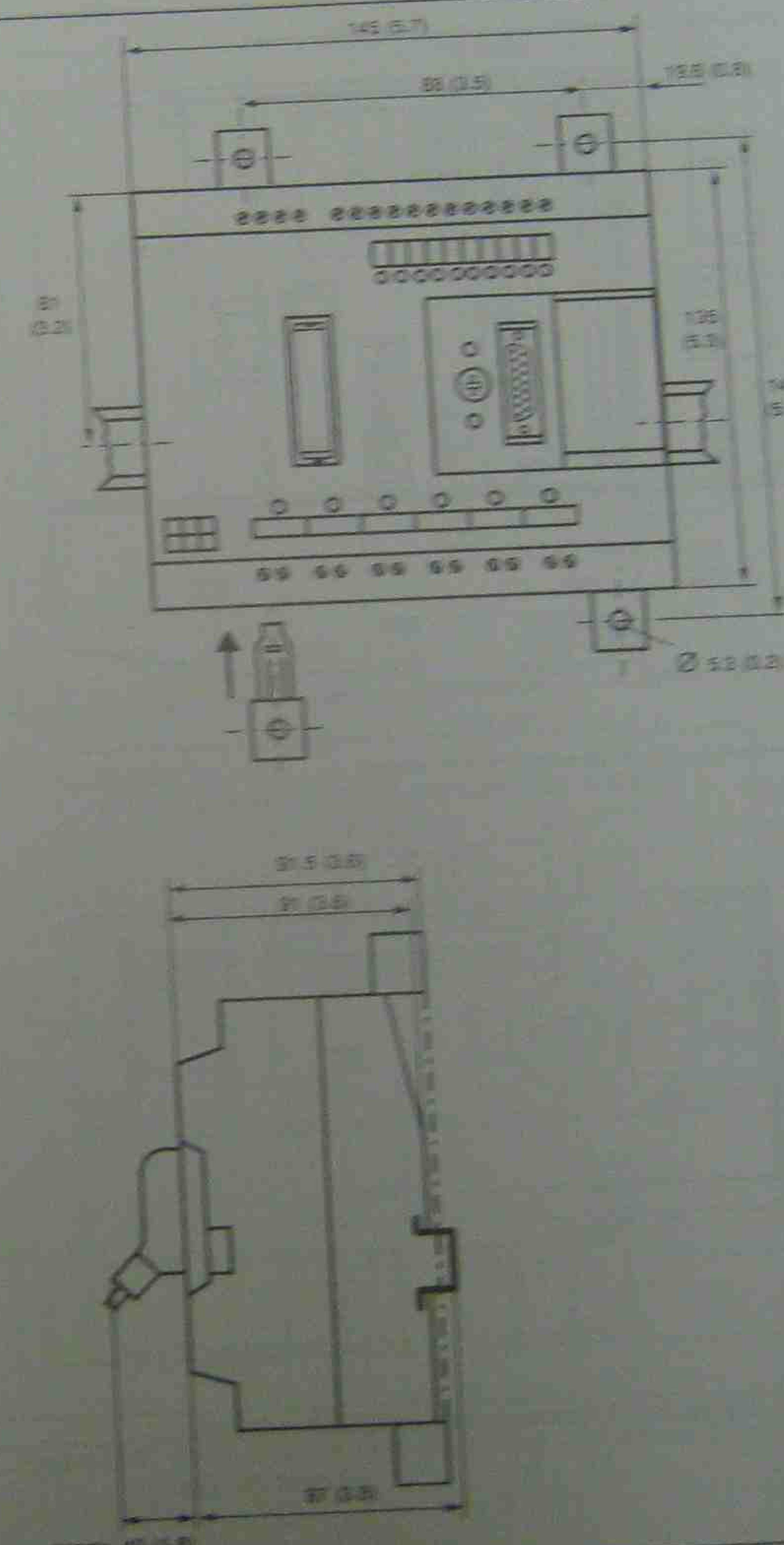


Figure B-6. Dimension Drawing of the S5-90U

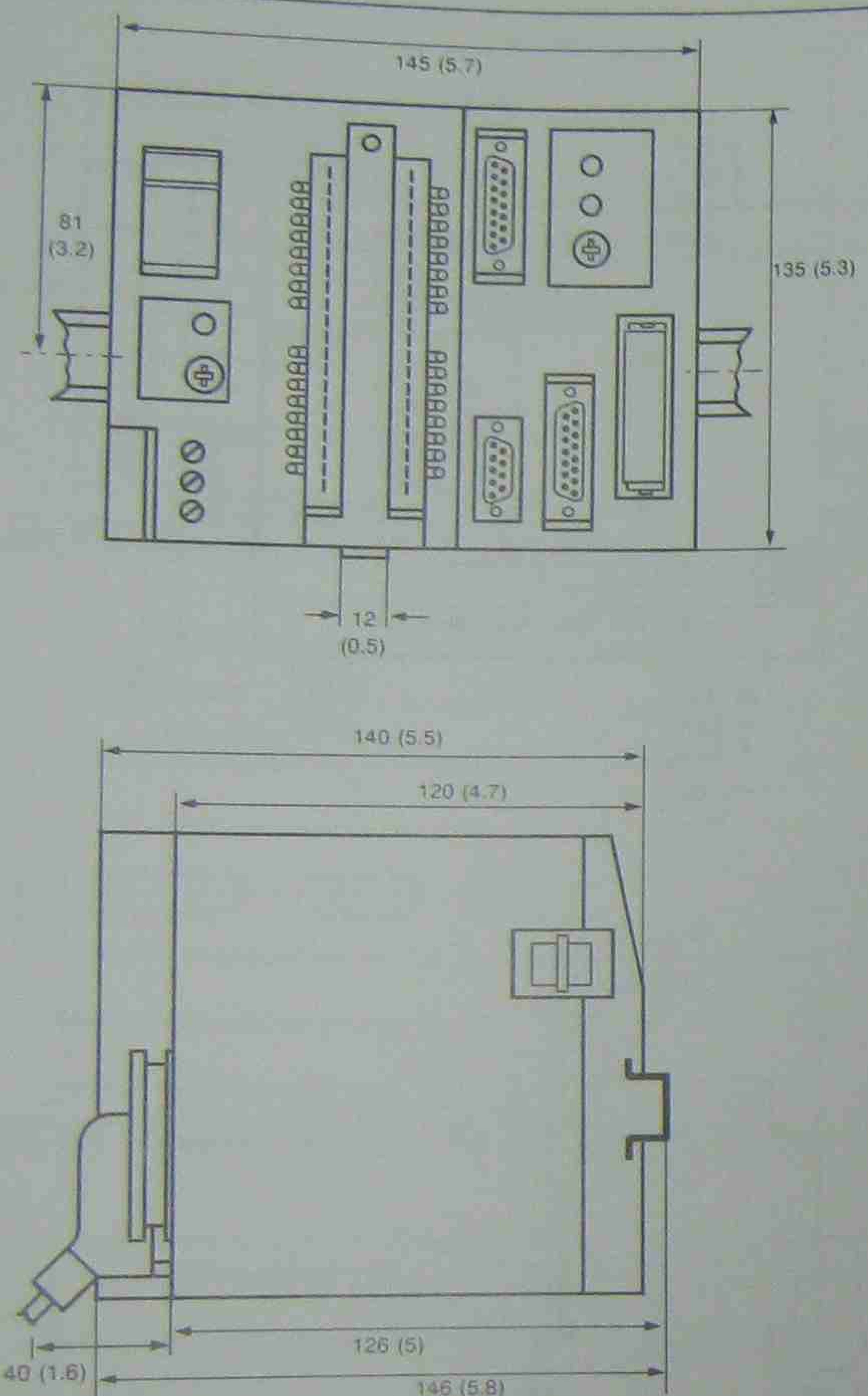


Figure B-7. Dimension Drawing of the S5-95U

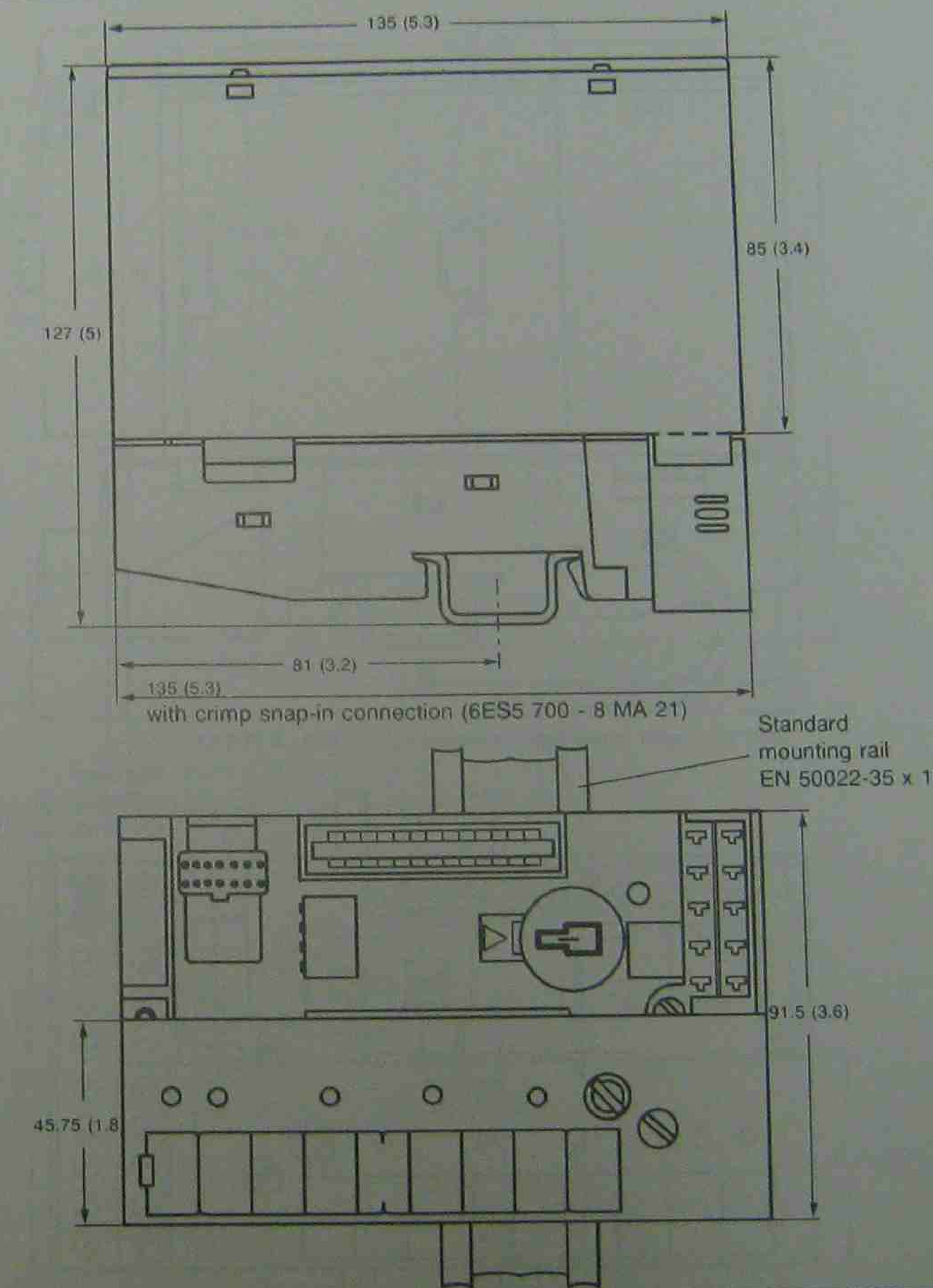


Figure B-8. Dimension Drawing of the Bus Unit (Crimp Snap-in Connections) with I/O Module

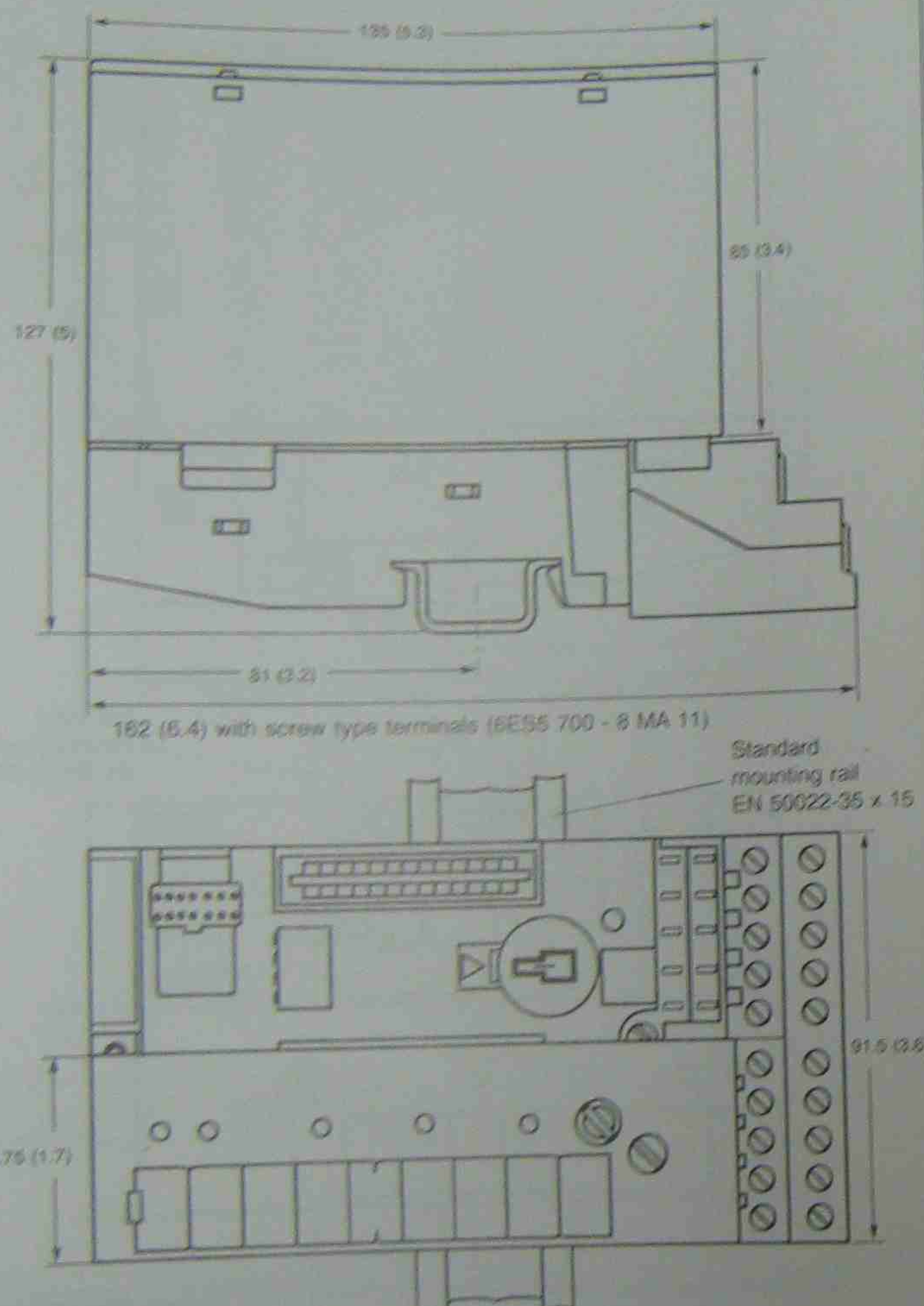


Figure B-9. Dimension Drawing of the Bus Unit (SIGUT Screw-type Terminals) with I/O Module

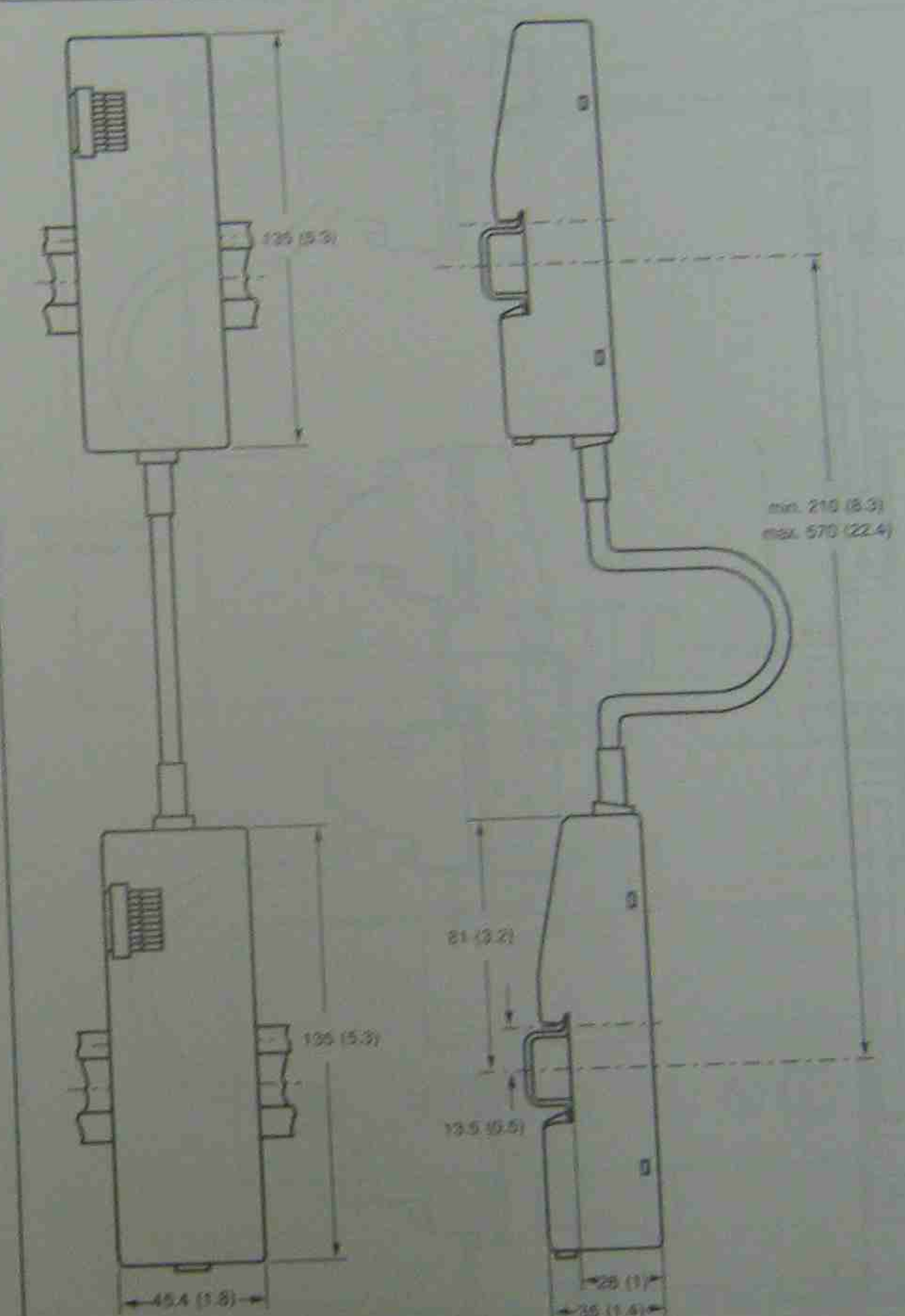


Figure B-10. Dimension Drawing of the IM 315 Interface Module

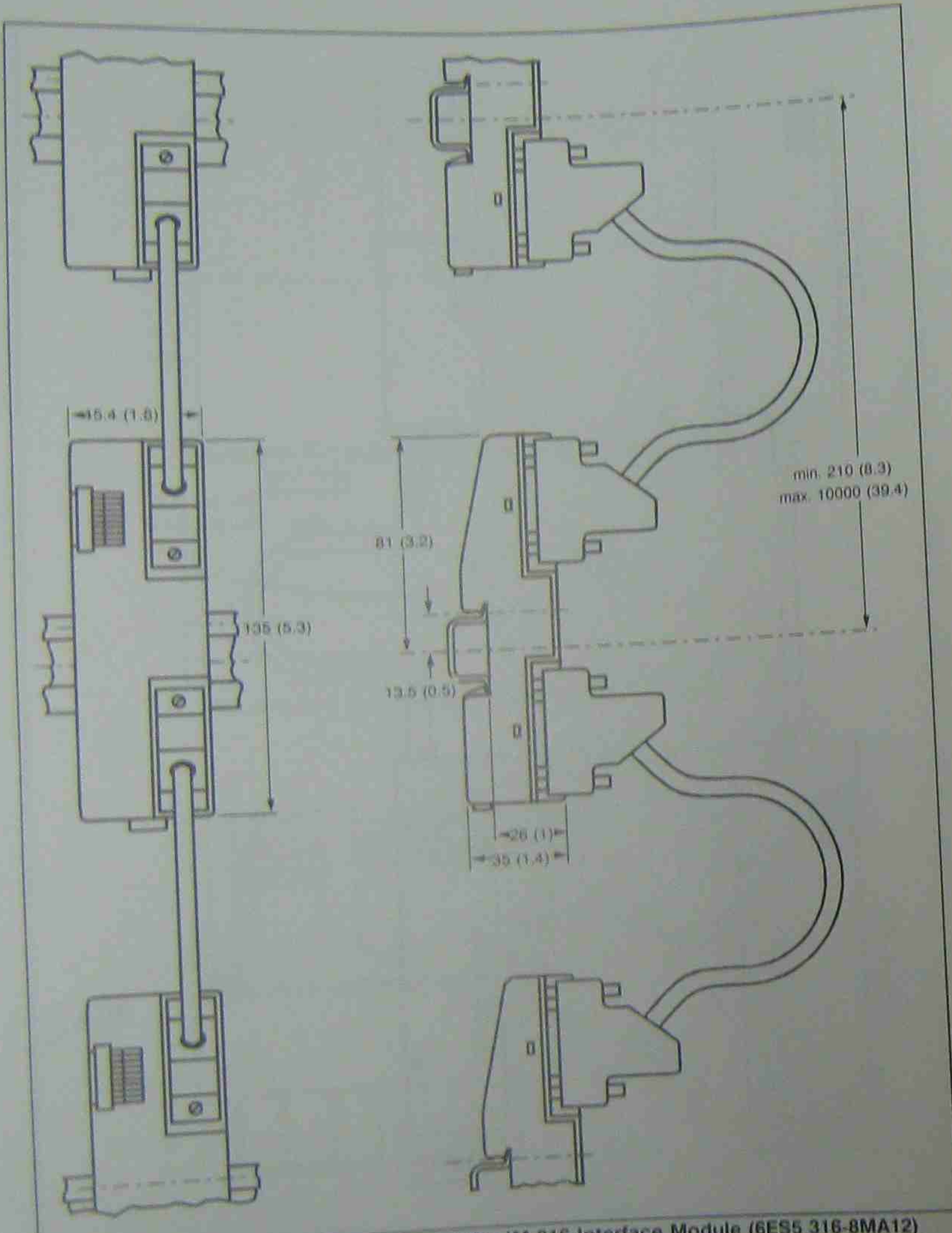


Figure B-11. Dimension Drawing of the IM 316 Interface Module (6ES5 316-8MA12)

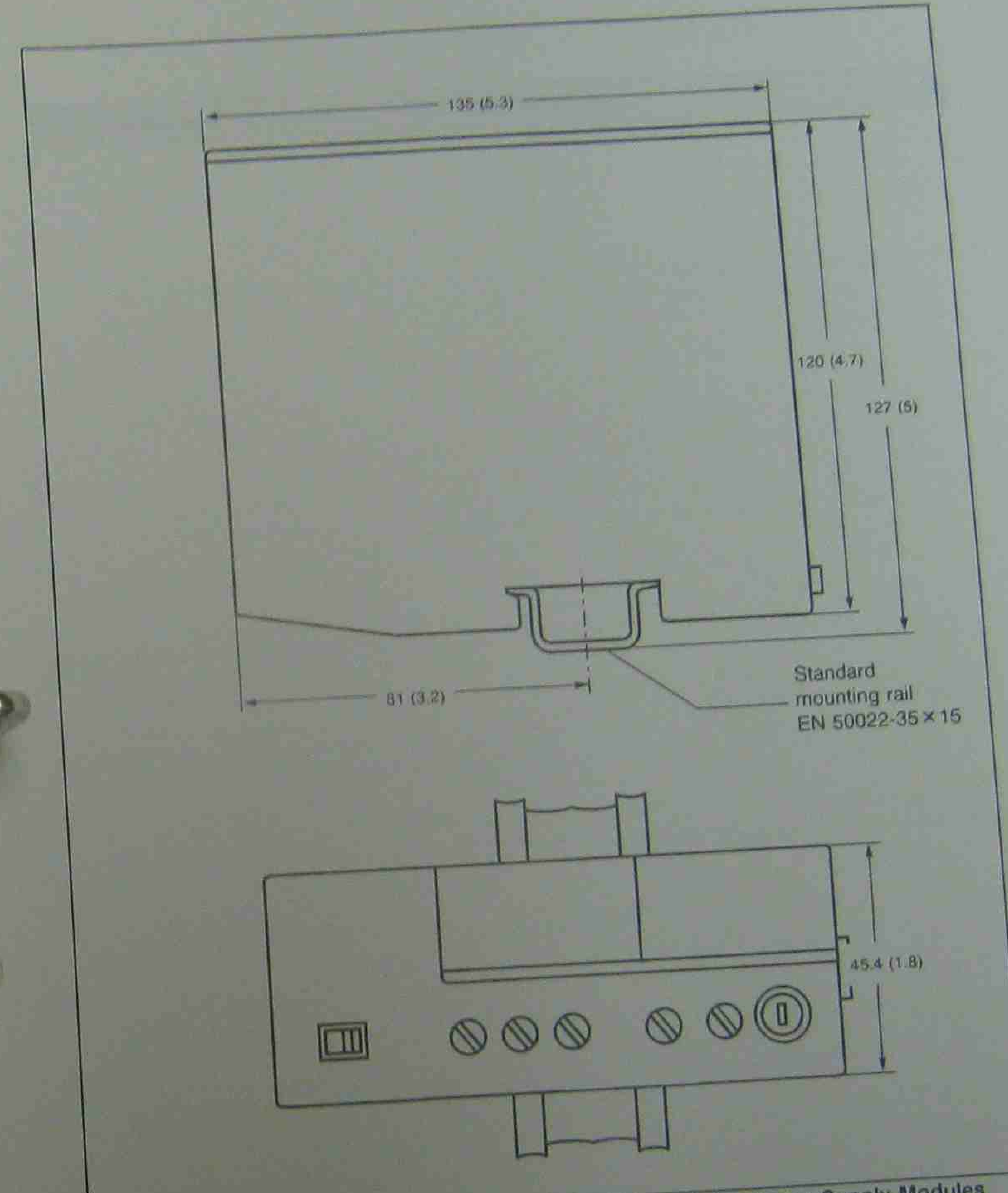


Figure B-12. Dimension Drawing of the PS 930 and PS 931 Power Supply Modules

C	Active and Passive Faults in Automation Equipment

C

C Active and Passive Faults in Automation Equipment

Depending on the particular task for which the electronic automation equipment is used, both **active** as well as **passive** faults can result in a **dangerous** situation. For example, in drive control, an active fault is generally dangerous because it can result in an unauthorized startup of the drive. On the other hand, a passive fault in a signalling function can result in a dangerous operating state not being reported to the operator.

The differentiation of the possible faults and their classification into dangerous and non-dangerous faults, depending on the particular task, is important for all safety considerations in respect to the product supplied.

> **Warning**
>
> In all cases where a fault in automation equipment can result in severe personal injury or substantial property damage, i.e., where a dangerous fault can occur, additional external measures, additional external measures must be taken or equipment provided to ensure or force safe operating conditions even in the event of a fault (e.g., by means of independent limit monitors, mechanical interlocks, etc.).

Procedures for Maintenance and Repair

If you are carrying out measurement or testing work on an active unit, you must adhere to the rules and regulations contained in the "VGB 4.0 Accident Prevention Regulations" of the German employers liability assurance association ("Berufsgenossenschaften"). Pay particular attention to paragraph 8, "Permissible exceptions when working on live parts."

Do not open the S5-90U or S5-95U. Do not attempt to repair an item of automation equipment. Such repairs may only be carried out by **Siemens service personnel or repair shops Siemens has authorized to carry out such repairs.**

D	Information for Ordering Accessories

D

D Information for Ordering Accessories

	Order Numbers
Standard 35 mm Mounting Rail	
for 19-in. cabinets, length 483 mm	6ES5 710-8MA11
for 600 mm cabinets, length 530 mm	6ES5 710-8MA21
for 900 mm cabinets, length 830 mm	6ES5 710-8MA31
Length 2000 mm, without holes	6ES5 710-8MA41
Power Supply Modules	
Power supply module PS 931 115/230 V AC; 24 V DC; 2 A (with electronic protection)	6ES5 931-8MD11
Load power supply 6EW1	(under development)
115/230 V AC ; 24 V DC, 2 A	6EW1 380-0AA
115/230 V AC; 24 V DC; 4 A	6EW1 380-1AA
115/230 V AC; 24 V DC; 8 A	6EW1 380-4AA
Bus Units	
Bus unit with SIGUT screw-type terminals	6ES5 700-8MA11
Bus unit with crimp snap-in connections	6ES5 700-8MA21
Accessories	
Extracting tool for crimp snap-in connections	6ES5 497-8MA11
Crimp snap-in contacts, 250 pieces	6XX3070
Crimping tool for attaching the crimp contacts	6XX3071
Interface Modules	
IM 315 interface module	6ES5 315-8MA11
IM 316 interface module	6ES5 316-8MA12
- Cable connectors (0.5 m/1.6 ft.)	6ES5 712-8AF00
- Cable connectors (2.5 m/8.2 ft.)	6ES5 712-8BC50
- Cable connectors (5.0 m/16.5 ft.)	6ES5 712-8BF00
- Cable connectors (10 m/33 ft.)	6ES5 712-8CB00

			Order Numbers
Programmable Controller (S5-90U)			
S5-90U	(without user's guide)		6ES5 090-8MA01
S5-90U	(with user's guide)	German	6ES5 090-8MA11
"	"	English	6ES5 090-8MA21
"	"	French	6ES5 090-8MA31
"	"	Spanish	6ES5 090-8MA41
"	"	Italian	6ES5 090-8MA51
S5-90U Accessories			
IM 90 interface module			6ES5 090-8ME11 (under development)
Memory submodule (EPROM)		4 Kbytes	6ES5 375-8LA11 (under development)
Memory submodule (EEPROM)		2 Kbytes	6ES5 375-8LC11 (Prog. number 202)
Memory submodule (EEPROM)		8 Kbytes	6ES5 375-8LC21 (Prog. number 211)
Simulator (digital input signals)			6ES5 788-8MK11
Wall brackets, one set (4 pieces)			6ES5 981-8MB11

D

		Order Numbers
Programmable Controller (S5-95U)		
S5-95U (without user's guide)		6ES5 095-8MA01
S5-95U (with user's guide)	German	6ES5 095-8MA11
" "	English	6ES5 095-8MA21
" "	French	6ES5 095-8MA31
" "	Spanish	6ES5 095-8MA41
" "	Italian	6ES5 095-8MA51
S5-95U Accessories		
Memory submodule (EPROM)	8 Kbytes	6ES5 375-0LA15
Memory submodule (EPROM)	16 Kbytes	6ES5 375-0LA21
Memory submodule (EPROM)	32 Kbytes	6ES5 375-0LA41
Memory submodule (EEPROM)	2 Kbytes	6ES5 375-0LC11
Memory submodule (EEPROM)	4 Kbytes	6ES5 375-0LC21
Memory submodule (EEPROM)	8 Kbytes	6ES5 375-0LC31
Memory submodule (EEPROM)	16 Kbytes	6ES5 375-0LC41
Front connector:		
Crimp snap-in connections, 40 pin		6ES5 490-8MA12
Screw-type connections, 40 pin		6ES5 490-8MB11
D-type female connector, 9 pin*, such as is sold by FCT		
housing		FPHGR-2A
connector		F09P
D-type female connector, 15 pin*, such as is sold by FCT		
housing		FPHGR-2A
connector		F15P

* You can use any standard D-type female connector of this type.

System Manual S5-90U/S5-95U, order separately	German	6ES5 998-8MA11
	English	6ES5 998-8MA21
	French	6ES5 998-8MA31
	Spanish	6ES5 998-8MA41
	Italian	6ES5 998-8MA51
Accessories for the S5-90U and the S5-95U		
PC cable with TTY / V.24 conversion		6ES5 734-1BD20
PC software package "STEP 5 LAD 90" for S5-90U	English	6ES5 866-0MA23
Back-up battery, lithium ½ AA; 3.4 V/850 mAh		6ES5 980-0MB11
UV eraser		
for 230 V AC / 50 Hz		6ES5 985-1AA11
for 115 V AC / 60 Hz		6ES5 985-1BA21
Programming pad (STL 50 sheets)		E80850-C254-XA1
CP 521 Printer Output Module Manual	German	6ES5 998-0UB13
	English	6ES5 998-0UB23
	French	6ES5 998-0UB33
	Spanish	6ES5 998-0UB43
	Italian	6ES5 998-0UB53

			Order Numbers
CP 521 BASIC Communications Module Manual		German	6ES5 998-0UW11
		English	6ES5 998-0UW21
		French	6ES6 998-0UW31 (under development)
IP 262 Closed-Loop Control Module Manual		German	6ES5 998-5SG11
		English	6ES5 998-5SG21
		Italian	6ES5 998-5SG51
IP 266 Positioning Module Manual		German	6ES5 998-5SC11
		English	6ES5 998-5SC21
IP 267 Stepper Motor Module Manual		German	6ES5 998-5SD11
		English	6ES5 998-5SD21
		French	6ES5 998-5SD31
		Spanish	6ES5 998-5SD41
Digital Input Modules			
8 x 5...24 V DC	isolated		6ES5 433-8MA11
4 x 24 V DC			6ES5 420-8MA11
8 x 24 V DC			6ES5 421-8MA12
8 x 24 V DC	isolated		6ES5 431-8MA11
4 x 24...60 V DC	isolated		6ES5 430-8MB11
4 x 115 V AC	isolated		6ES5 430-8MC11
8 x 115 V AC	isolated		6ES5 431-8MC11
4 x 230 V AC	isolated		6ES5 430-8MD11
8 x 230 V AC	isolated		6ES5 431-8MD11
Digital Output Modules			
8 x 5...24 V DC/ 0.1A	isolated		6ES5 453-8MA11
4 x 24 V DC / 0.5 A			6ES5 440-8MA11
4 x 24 V DC / 2 A			6ES5 440-8MA21
8 x 24 V DC / 0.5 A			6ES5 441-8MA11
8 x 24 V DC / 0.5 A	isolated		6ES5 451-8MA11
4 x 24...60 V DC / 0.5A	isolated		6ES5 450-8MB11
4 x 115...230 V AC / 1A	isolated*		6ES5 450-8MD11
8 x 115...230 V AC / 0.5A	isolated*		6ES5 451-8MD11
4 relays x 30 V DC / 230 V AC			6ES5 452-8MR11
8 relays x 30 V DC / 230 V AC			6ES5 451-8MR12
* Replacement fuse (10 A extra-fast)			6ES5 980-3BC11
Digital Input/Output Module			
24 V DC 16 inputs/16 outputs			6ES5 482-8MA12
Accessories			
Crimp connector, 40 pin			6ES5 490-8MA12

		Order Numbers
Analog Input Modules		
4 x ± 50 mV	isolated	6ES5 464-8MA11
4 x ± 50 mV	isolated	6ES5 464-8MA21
4 x ± 1 V	isolated	6ES5 464-8MB11
4 x ± 10 V	isolated	6ES5 464-8MC11
4 x ± 20 mA	isolated	6ES5 464-8MD11
4 x + 4...20 mA	isolated	6ES5 464-8ME11
2 x PT 100 / ± 500 mV	isolated	6ES5 464-8MF11
2 x PT 100 / ± 500 mV	isolated	6ES5 466-8MF21
4 x + 0...10 V	isolated	6ES5 466-8MC11
Analog Output Modules		
2 x ± 10 V	isolated	6ES5 470-8MA12
2 x ± 20 mA	isolated	6ES5 470-8MB12
2 x + 4...20 mA	isolated	6ES5 470-8MC12
2 x + 1...5 V	isolated	6ES5 470-8MD12
Function Modules		
IP 262 Closed-loop control module with 3 analog outputs		6ES5 262-8MA11
with 8 binary outputs		6ES5 262-8MB11
IP 266 Positioning module		6ES5 266-8MA11
IP 267 Stepper motor control module		6ES5 267-8MA11
Diagnostic module 330		6ES5 330-8MA11
Timer module 380 2 x 0.3...300 s		6ES5 380-8MA11
Counter module 2 x 0...500 Hz		6ES5 385-8MA11
Counter module 385B 1 x 25 / 500 KHz		6ES5 385-8MB11
Comparator module 461 2 x 1...20 mA / 0.5...10 V		6ES5 461-8MA11
CP 521 Printer output module		6ES5 521-8MA11
CP 521 BASIC communications module		6ES5 521-8MB11
Simulator 788 (digital input/output signals)		6ES5 788-8MA11
Operator Panels and Programmers		
PG 605U Programmer (cannot be used with the S5-90U)		6ES5 605-0UB11
PG 605U Operator Guide		6ES5 998-0UP21
PG 615 Programmer with connecting cable		6ES5 615-0UA11
PG 615 Operator Guide		6ES5 998-0UR11
PG 615 Operating System Submodules STEP 5	German	6ES5 815-0UA12
	English	6ES5 815-0UB12
	French	6ES5 815-0UC12
PG 615 Adapter with Power Supply Unit		
220/240 V AC		6ES5 984-2UA11
110/120 V AC		6ES5 984-2UB11
PG 615 Carrying Case		6ES5 986-0MA11

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PG 635 Programmer with manual and S5 standard system program	6ES5 635-0UB13
PG 685 Programmer with manual and S5 standard system program and MEP adapter	6ES5 685-0UB12
PG 695 Programmer with PC 16-20	6ES5 696-0UB12
OP 393 Operator Panel with connecting cable (cannot be used with the S5-90U)	6ES5 393-0UA13
OP 393-II Operator Guide	6ES5 998-0UQ22
OP 396 Operator Panel with connecting cable 3 m (9.8 ft.)	6ES5 396-0UA11
OP 396 Operator Guide	6ES5 998-0UK11
OP 396 Operating System Submodule	6ES5 816-0AA11
OP 396 Adapter with Power Supply Unit	
for 230 V AC	6ES5 984-2UA11
for 115 V AC	6ES5 984-2UB11
728 Cable Connector for connecting the OP 396 or PG 615 to the CPU	
1 m (3.3 ft.)	6ES5 728-0BB00
2 m (6.6 ft.)	6ES5 728-0BC00
4 m (13.1 ft.)	6ES5 728-0BE00
5 m (16.4 ft.)	6ES5 728-0BF00
10 m (32.8 ft.)	6ES5 728-0CB00
20 m (65.6 ft.)	6ES5 728-0CC00
40 m (130 ft.)	6ES5 728-0CE00
80 m (260 ft.)	6ES5 728-0CJ00
100 m (330 ft.)	6ES5 728-0DB00
200 m (660 ft.)	6ES5 728-0DC00
400 m (1320 ft.)	6ES5 728-0DE00
800 m (2640 ft.)	6ES5 728-0DJ00
1000 m (3300 ft.)	6ES5 728-0EB00

		Order Numbers
Program Packages		
Basic Functions Program Package		
description in German, English, and French		
for the S5-DOS operating system		6ES5 848-8AA01
for the MS-DOS, S5-DOS/MT operating system		6ES5 848-7AA01
Floating Point Arithmetic Program Package		
description in German, English, and French		
for the S5-DOS operating system		6ES5 845-8GP01
for the MS-DOS, S5-DOS/MT operating system		6ES5 845-7GP01
GRAPH 5 Program Package		
description in German, English, and French		
for the S5-DOS operating system		6ES5 845-8DA01
for the MS-DOS, S5-DOS/MT operating system		6ES5 845-7DA01
S5-100U Program Package		
description in	German	6ES5 840-4BC11
	English	6ES5 840-4BC21
	Italian	6ES5 840-4BC51

E	Reference Materials

		Order Numbers
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Basic Functions Program Package		
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for the S5-DOS operating system		6ES5 848-8AA01
for the MS-DOS, S5-DOS/MT operating system		6ES5 848-7AA01
Floating Point Arithmetic Program Package		
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for the MS-DOS, S5-DOS/MT operating system		6ES5 845-7GP01
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for the MS-DOS, S5-DOS/MT operating system		6ES5 845-7DA01
S5-100U Program Package		
description in	German	6ES5 840-4BC11
	English	6ES5 840-4BC21
	Italian	6ES5 840-4BC51

E Reference Materials

E Reference Materials

- **Programming Primer for the SIMATIC® S5-100U**
  Practical Exercises with the PG 615 Programmer
  Siemens AG, Berlin and Munich, 1989 (Order No.: ISBN 3-8009-1528-6)

- **Automating with the SIMATIC® S5-115U**
  Programmable Controllers
  Hans Berger
  Siemens AG, Berlin and Munich, 1989 (2nd Edition)
  (Order No.: ISBN 3-8009-1530-8)

- **Programmable Controllers**
  Basic Concepts
  Siemens AG, 1989 (Order No.: ISBN 3-8009-8032-0)

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