SIMATIC S7
SM 338
Ultrasonic Position Encoding Module

Equipment Manual Release 06/96

SIEMENS

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SM 338
Ultrasonic Position Encoding Module

Equipment Manual

762 21 087

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Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

Danger

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

The device/system may only be set up and operated in conjunction with this manual.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Siemens AG
Automation Group
Systems Engineering
P. O. Box 2355
D-90713 Fuerth
Germany

Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Technical data subject to change.

Siemens Aktiengesellschaft **Order No. 762 21 087**

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Notes on the CE Seal

EU EMC directive 89/336/EEC

The following applies to the product described in this manual.

CE Products bearing the CE seal meet the requirements of EU Directive 89/336/EEC 'Electromagnetic Compatibility' and the harmonized European standards (EN) listed therein.

In accordance with article 10 of the above-mentioned EU Directive, the EU declarations of conformity are held available for inspection by responsible authorities at the addresses listed below:

Siemens Aktiengesellschaft
Bereich Automatisierungstechnik
AUT7 WKF KB2
Postfach 2355
D-90713 Fürth

Area of application

The products have been designed for use in the industrial area and meet the following requirements:

Area of Application	Requirements	
	Emitted interference	Immunity
Industry	EN 50081-2 : 1993	EN 50082-2 : 1995

Observing the installation guidelines

The products meet the requirements if you:

1. Observe the installation guidelines and safety notes contained in the applicable manuals and supplementary documentation, both for the programmable system and the individual module.
2. Observe the rules below.

Installing the devices

The programmable systems and the listed modules must be installed in grounded, closed metal enclosures (e.g., switching cabinets).

All signal lines outside this enclosure must be shielded as described in the equipment manuals. The shields of the signal lines must be applied to the shield bar at the entrance to the cabinet.

Working on switching cabinets

In order to protect the modules from static electrical discharge, operating personnel must discharge themselves of static electricity before opening switching cabinets or switchboxes.

Updated technical specifications

In contrast to the specifications contained in the ”General Technical Specifications” of the manual, the specifications listed below on electromagnetic compatibility apply to modules which carry the CE seal.

The specifications apply to devices installed in accordance with the stated installation guidelines.

Electromagnetic Compatibility Specifications	Test Values
Immunity to static electrical discharge[1] Tested in accordance with EN 61000-4-2	Discharge to air 8 kV Discharge on contact 4 kV
Immunity to electromagnetic fields[1]	
• Tested in accordance with EN V 50140 (amplitude-modulated HF)	80 to 1000 MHz 10 V/m 80% AM (1 kHz)
• Tested in accordance wit EN V 50204 ((pulse-modulated HF)	900 MHz 10 V/m 50% ED, 200 Hz repetition frequency
Immunity to fast transient bursts Tested in accordance with EN 61000-4-4	
• Supply lines for AC 120/230 V	2 kV
• Signal lines (I/O and bus lines)	2 kV [2]
Immunity to high frequency Tested in accordance with EN V 50141	0.15 to 80 MHz 10 V 80% AM (1 kHz) Source impedance 150 Ω
Emitted interference[1] Tested in accordance wit EN 55011	
• Emission of electromagnetic fields	Limit value class A, group 1
• Emitted interference over supply cable	Limit value class A, group 1

1 For closed metal housing

2 Signal lines that are not used for process control: 1 kV (e.g., connections to external printers)

Product Overview

1

The SM 338 is a position encoding module for the S7-300 programmable controller. The module is connected to the P bus of the programmable controller, and its parameters are assigned by the CPU. The SM 338 belongs to the family of signal modules.

Position encoding with ultrasonic sensors

Position encoding is performed by ultrasonic sensors. These sensors offer the following primary advantages.

- No wear and tear
- High protection class
- Steady accuracy regardless of the sensor length
- Low costs for longer sensors (> 500 mm)
- Up to four measuring points (magnets) per sensor possible
- The digital sensor interface (RS 422) is not sensitive to interference and permits lines up to 50 m in length.

The SM 338 does not condition the data. Its only function is to supply the CPU with counting values. Eight counters are available for the acquisition of measured values.

Up to four sensors can be connected on the SM 338 module, and each sensor can contain up to four measuring points. The sum of the measuring points on all connected sensors may not exceed 8.

Operating modes

The sensors connected to the module can operate in synchronous or asynchronous mode. This requires that the parameters of the selected sensors be assigned appropriately.

Synchronous mode

The selected sensors operate synchronously (i.e., at the end of the **cycle time**, the counting values of all synchronous sensors are transferred to the input area of the dual port RAM). If enabled, an end-of-cycle alarm to the CPU is then triggered. Synchronous mode does not use a parameterized, sensor-related, measuring cycle time.

Asynchronous mode

The selected sensors operate asynchronously (i.e., each sensor operates with its own **specific sensor measuring cycle time**). The measuring cycle time is the time available to the sensor for one measurement. This time can be set separately for each sensor. Cycle time and measuring cycle time are not dependent on each other. At the end of the measuring cycle time, the counting values allocated to this sensor are transferred to the input area of the dual port RAM.

Functionality

The SM 338 module is equipped with the following functions.

- Each sensor can be parameterized separately.
- Cycle time and measuring cycle time can be parameterized separately (and with different lengths).
- Global enabling of an end-of-cycle alarm (i.e., process alarm) can be parameterized.
- Global enabling of diagnosis alarms can be parameterized.
- Sensor-related enabling of the diagnoses can be parameterized.
- Sensor-related enabling of wire break monitoring can be parameterized.
- Firmware monitoring via watchdog
- Indication of error states via two LEDs
- Module parameters can be reassigned during normal running operation.

Use

The main application area of the SM 338 is with plastics processing machines. Particularly with injection molding and blow molding machines, ultrasonic sensors are being used increasingly for position encoding. The SM 338 is the direct link from the sensor to the S7-300 programmable controller.

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The SM 338 Module

2

2.1 Layout

The SM 338 is installed in a compact, plastic housing. This housing is mounted on the rail of your programmable controller.

The back

The two plug connectors on the back connect the module to the P bus.

The front

All other connection and indicator elements are located on the front of the module. Figure 2-1 shows the location of these elements.

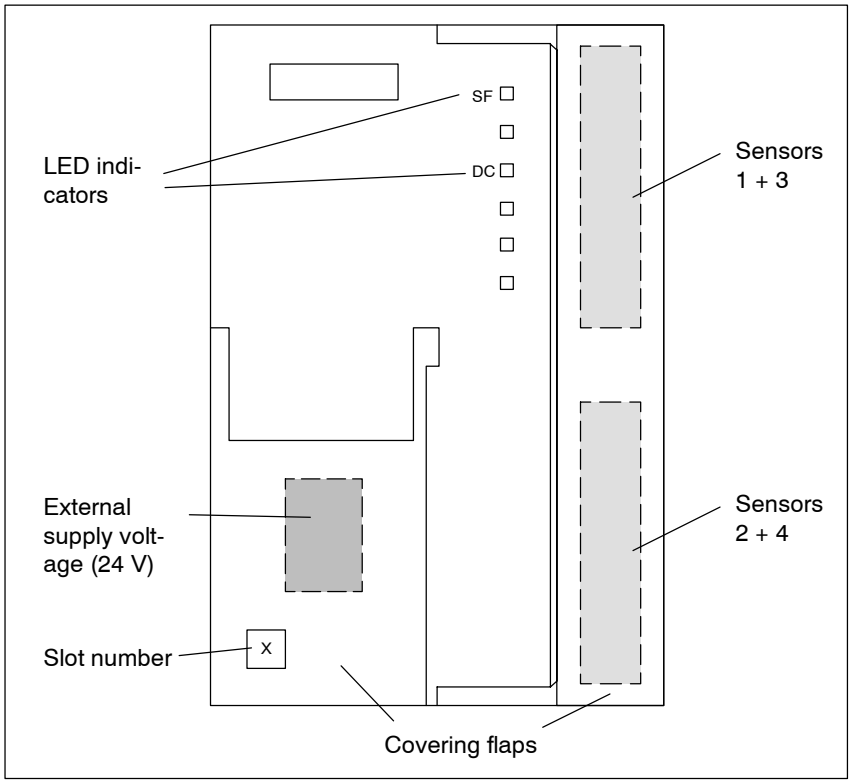

Figure 2-1 Front view of the module

LED indicators

The LED indicators on the front of the module have the functions listed in table 2-1.

Table 2-1 LED indicators

Indicator	Function	
DC (green)	☼	External voltage present
	○	External voltage not present
SF (red)	☼	System error/module requires diagnosis
	○	Normal operation

2.2 Measuring Principle

A START pulse is sent by the SM 338 via the RS 422 interface. The sensor electronics send an echo of this pulse back to the SM 338. The START pulse generates a current pulse in the sensor electronics. This current pulse moves from the sensor electronics toward the end of the measuring bar.

Figure 2-2 shows a diagram of the interaction between module and sensor.

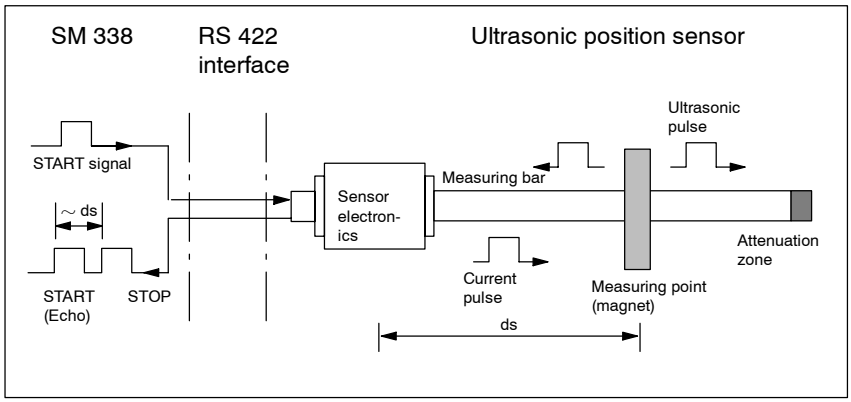

Figure 2-2 Principle of ultrasonic position encoding

The moving magnet field with the current pulse and the permanent magnet field of the measuring point begin to affect each other. An ultrasonic pulse is generated at the position of the measuring point (i.e., magnetostrictive principle).

This ultrasonic pulse spreads out in the direction of the end of the bar and the sensor electronics. The pulse is attenuated at the end of the bar. The sensor electronics convert this pulse into an electrical signal (i.e., the STOP pulse).

The time between the echo of the START pulse and the STOP pulse is proportionate to the distance. This time is acquired by the SM 338 and forwarded.

Note

Conversion of the position into mm using an offset factor is performed by the CPU.

2.3 Ultrasonic Measuring System

System scope

A system for ultrasonic position encoding includes the following:

- S7-300 PLC with CPU and power supply
- Ultrasonic positioning module SM 338
- External supply voltage of 24 V
- Ultrasonic position encoding sensor(s)

Sensor capabilities

Ultrasonic position encoding sensors with the following capabilities can be used.

- START/STOP interface with RS 422 signals
- Power supply: for all sensors connected simultaneously to the SM 338
  - $\pm$15 V/max. of 200 mA, floating or
  - +24 V/max. of 300 mA, floating

Recommended sensors

The following sensors are recommended for connection to the SM 338.

Table 2-2

Company	Model	Supply	Remarks
MTS (Temposonic)	TTM LP	$\pm$15 V/100 mA 15 to 24 V/30 mA	Bar form Substitute for linear potentiometer
T&R	LP 38-SS	15 to 27 V/40 mA	Substitute for linear potentiometer
Balluff	BTL2-P1-xxxx-B-xx BTL2-P1-xxxx-P/F-xx	22 to 26 V/80 mA 22 to 26 V/80 mA	Bar form Substitute for linear potentiometer

Sensor length and measuring accuracy

The resolution is 0.05 mm for a sensor length of less than 3 m. The resolution is 0.1 mm for the maximum sensor length of 6 m.

Number of sensors

Up to 4 encoding sensors can be connected to one SM 338. Up to 4 measuring points per encoding sensor are permitted. One SM 338 can evaluate a total of up to 8 measuring points.

Minimum distance of the measuring points

When several measuring points are located on a sensor, the sensor-related, minimum distance must be maintained. This distance ensures that the measuring points do not interfere with each other.

Allocation of the measuring points

Except for the restrictions mentioned above, the measuring points can be allocated to the sensors as desired (e.g., 4-2-1-1, 2-2-2-2, 1-0-4-3, and so on).

Figure 2-3 shows a complete system and a possible assignment of the measuring points.

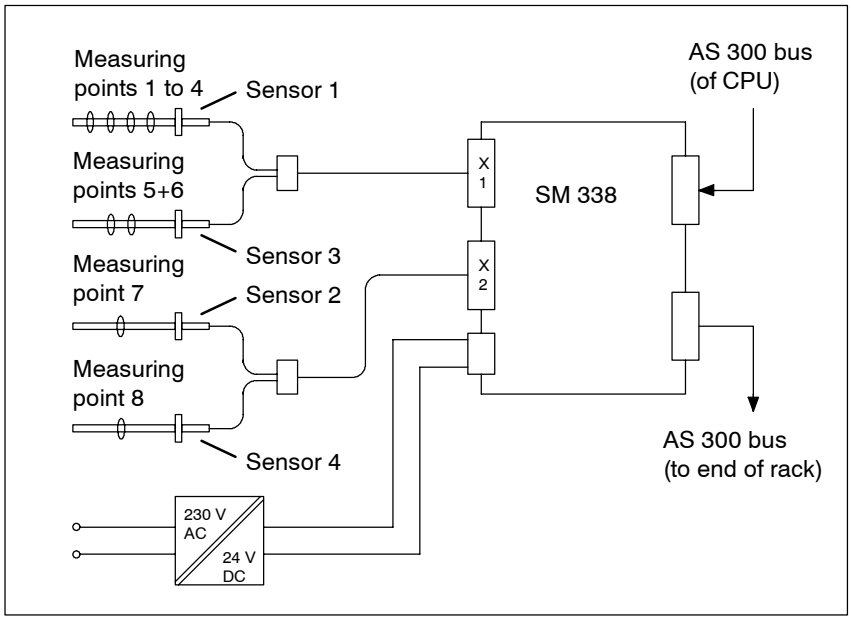

Figure 2-3 Possible assignment of the measuring points

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Installation

3

3.1 Mounting

Introduction

The S7-300 is a programmable controller which can be equipped with various modules to meet the requirements of the particular automation task.

Certain rules apply when positioning the SM 338 on the rail of the S7-300.

- A maximum of 8 signal modules may be placed to the right next to the CPU.
- The number of modules which can be installed is restricted by their current consumption from the S7-300 bus.

Make sure that the total current consumption of all modules on the rail does not exceed 1.2 A.

Position and environmental temperature

When a vertical setup of the S7-300 is used, the maximum environmental temperature permitted is reduced from 60° to 40° C.

Slots

Table 3-1 shows you which slots can be used for the SM 338.

Table 3-1 Slots for the SM 338

Slot number	1	2	3	4	5	6	7	8	9	10	11
Rack 1											
Rack 2		-									
Rack 3		-									
Rack 4		-									

Module can be installed. Module cannot be installed. - Slot does not exist.

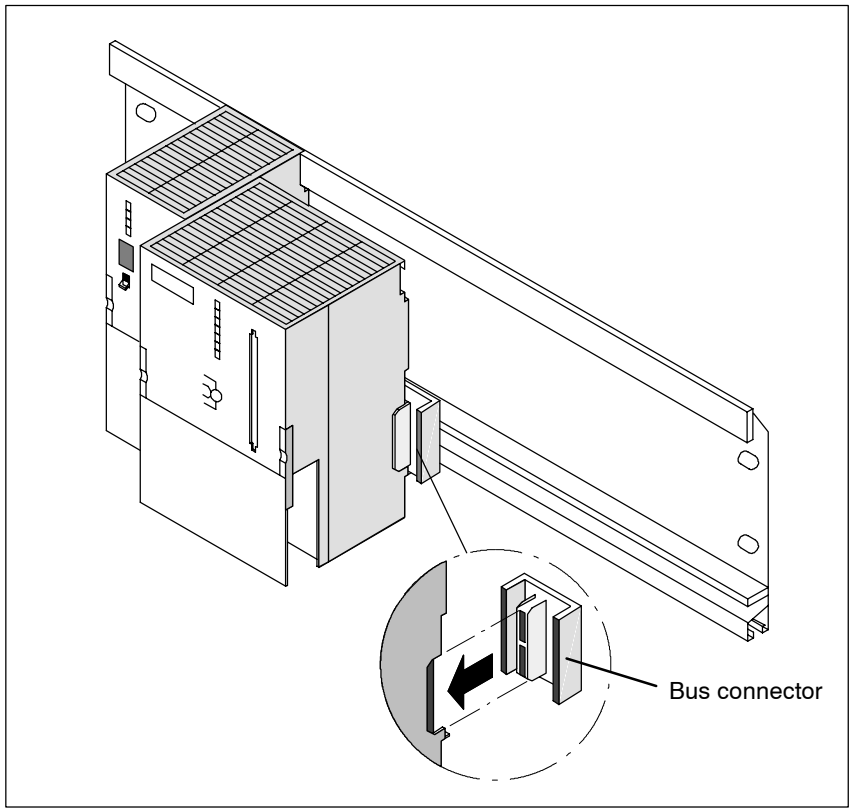
Handling

The standard precautionary measures as set forth in the ESD guidelines must be adhered to when handling the module.

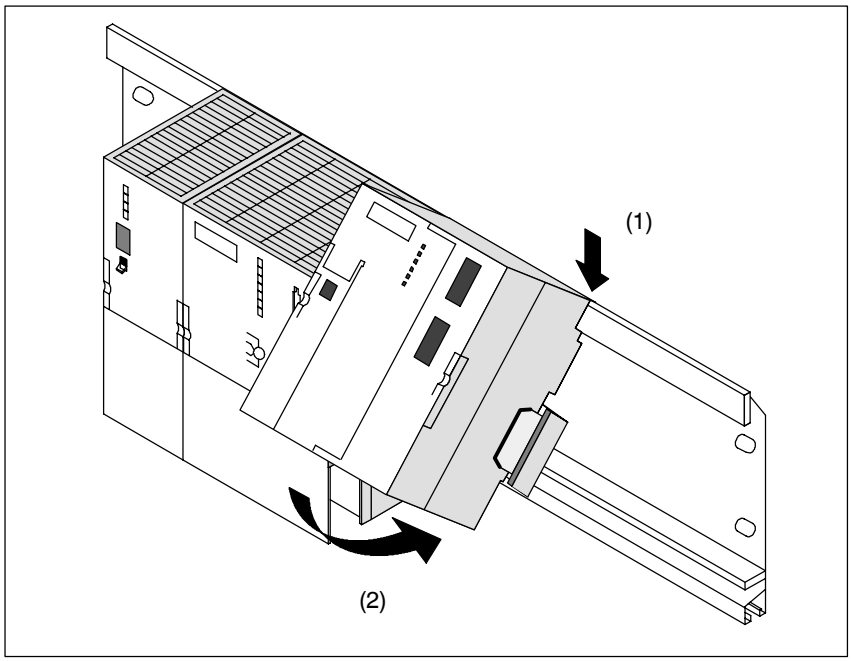
Mounting the module

To mount the module on the rail, proceed as shown below.

3. Switch CPU to STOP status.
4. Unscrew the screw on the bottom of the module to the left of the SM 338.
5. Swing this module up, and insert the included bus connector.



6. Hook in (1) the SM 338 on the top of the rail, and swing down (2).

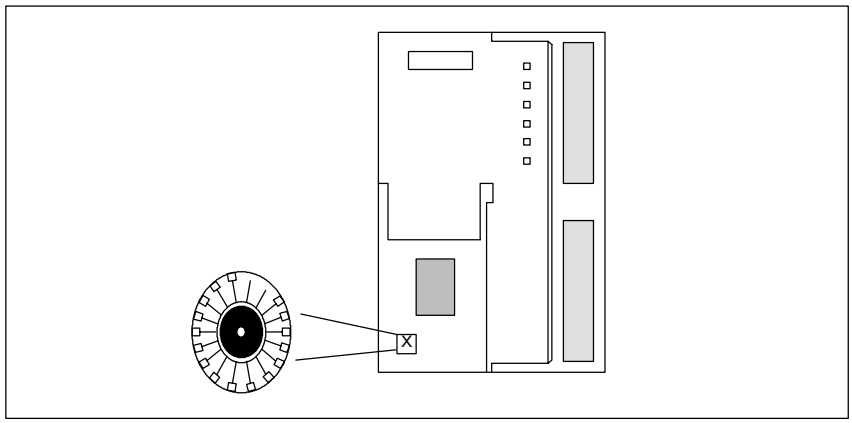


7. Tighten both modules with screws (turning moment for screwdriver: 80 to 110 Ncm).
8. Assign the SM 338 a slot number as shown in table 3-2.

Table 3-2 Slot numbers for S7 modules

Slot Number	Module	Remarks
1	Power supply (PS)	-
2	Central processing unit (CPU)	-
3	Interface module (IM)	-
4	1st signal module	To the right, next to the CPU or IM
5	2nd signal module	-
6	3rd signal module	-
7	4th signal module	-
8	5th signal module	-
9	6th signal module	-
10	7th signal module	-
11	8th signal module	-

9. Punch out the appropriate number on the front.



Connecting external supply voltage

To connect the external supply voltage, open the covering flap on the left side of the module.

Table 3-3 Terminal assignment

Terminal	Assignment
1	P24 (input voltage jumpered with 3)
2	M24 (ground externally jumpered with 4)
3	P24 (jumpered with 1)
4	M24 (jumpered with 2)

Connect the supply voltage as shown on the printed terminal assignment.

Warning

It is absolutely essential to use a powerpack with potential isolation.

3.2 Wiring

- For notes on installing an automation system, see the section on wiring an S7-300 in the S7-300 manual.

  For detailed information, see also the guidelines on interference-proof setup of programmable controllers.
  Order no: EWA 4NEB 811 617001

- Use the following to connect the sensors.

  - Connectors with shield spring (V42254-A1115-C325)

    and

  - Connector covers with shielding (V42254-A6000-Gx25)

- The sensor lines are shielded (6AP5 400-2AA01). The shield must be applied in the connectors as required for RF, (i.e., shield braiding via cable clamp on connector housing).
- All line shields must be applied to a grounded shield rail (6ES7 390-5AA00-0AA0) with small shield clamps.
- All sub D connectors must be secured with screws.
- Only one central connection between reference potential and shield is permitted. When an S7 power supply module is used, this connection has already been implemented inside.

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Data Communication with the PLC

4

Introduction

The SM 338 is not equipped with operator control components. Software handles the complete configuration of the module. The housing does not need to be opened, and jumpers do not have to be inserted.

Data communication with the PLC

Data communication with the CPU of the PLC takes place in the dual port RAM of the module.

Organization of the dual port RAM

Figure 4-1 shows the organization of the dual port RAM.

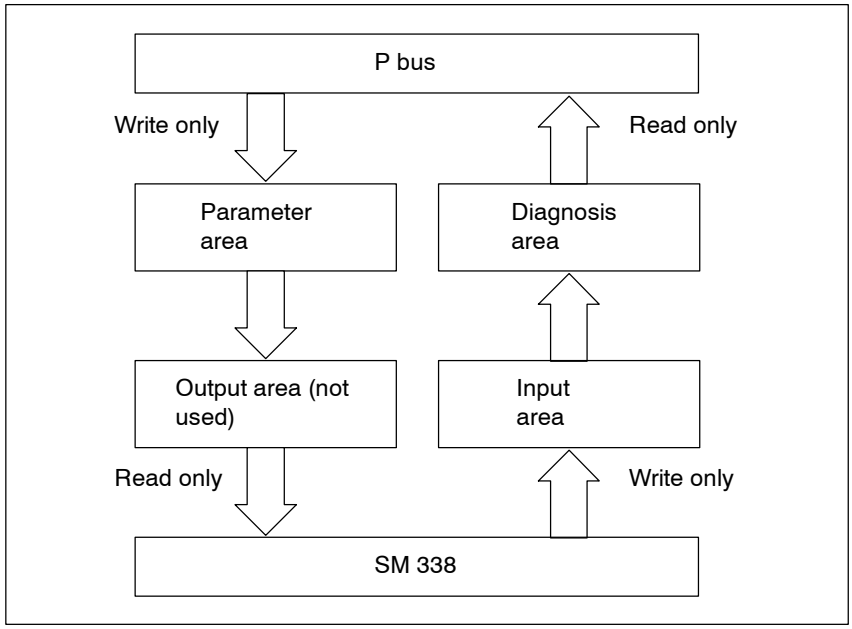


Figure 4-1 Organization of the dual port RAM

4.1 Input Area

Organization

The acquired counting values are stored in the input area. Each of the eight counters is represented with a resolution of 16 bits. Table 4-1 shows the organization of the input area.

Table 4-1 Input area

Value of	HIGH Byte	LOW Byte
Counter 1	0	1
Counter 2	2	3
Counter 3	4	5
Counter 4	6	7
Counter 5	8	9
Counter 6	10	11
Counter 7	12	13
Counter 8	14	15

Default setting

After a RESET, the entire area contains the value 0.

4.2 Parameter Area

General

The parameters required for presetting the SM 338 are stored in two data records in the 16-byte parameter area. This area can only be write-accessed by the P bus. The data can also be modified during running operation (i.e., dynamically).

Note

All bits which are not defined in the following text are reserved and must be "0".

Data record 0

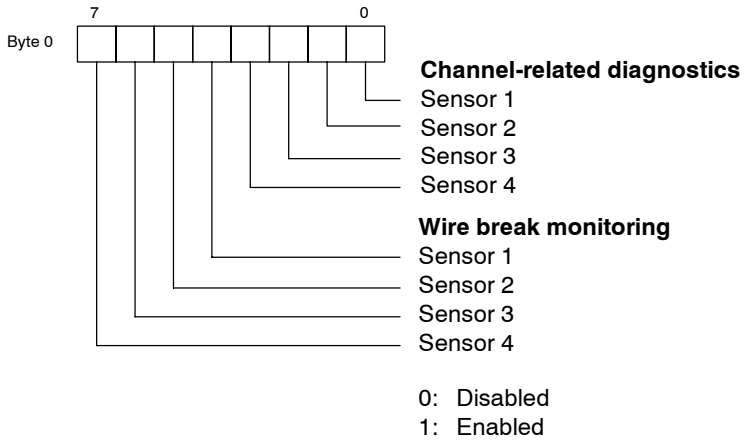
Data record 0 consists of two bytes.

Data record 0 is used to enable the following functions.

- The channel-related diagnostics and wire break monitoring
- Alarms

Channel-related diagnostics, wire break monitoring

The entries in byte 0 specify general enabling of channel-related diagnostics and wire break monitoring for each sensor.



Diagnostics

These bits can be used to enable/disable generation of diagnostics (i.e., reporting of errors) for each position sensor.

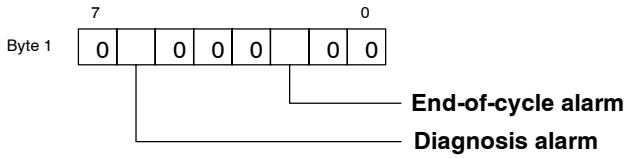
Wire break monitoring

These bits can be used to enable/disable wire break monitoring for each position sensor.

Wire break monitoring is performed indirectly by evaluating the reaction of the position sensor to a START pulse from the SM 338. If the position sensor does not react within a specified period of time, this is considered a wire break.

Enabling alarms

Byte 1 can be used to enable or disable the end-of-cycle or diagnosis alarm.



0: Alarm disabled
(i.e., is not forwarded)
1: Alarm enabled

Data record 1

Data record 1 consists of 14 bytes.

Data record 1 contains the following:

- Assignment of the counters and the counter setting (4 x 3 bytes) for each sensor
- Setting of the cycle time (1 byte)
- Setting of the sensor-related, synchronous mode (1 byte)

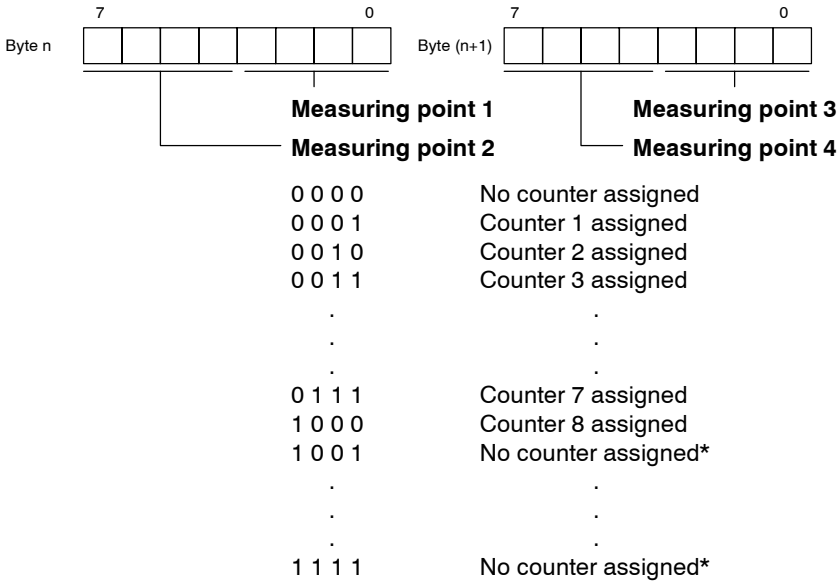
Sensor-related counter assignment

Two bytes each are used to assign the eight counters to the four sensors and to specify their measuring points.

Table 4-2 shows the applicable bytes for each sensor.

Table 4-2 Bytes for counter assignment

Sensor Number	Bytes
1	2 and 3
2	5 and 6
3	8 and 9
4	11 and 12



Note

The counter assignments marked with an * are illegal and will trigger the diagnosis message “wrong parameters on the module”.

Counting of the measuring points of a sensor always begins with the sensor electronics.

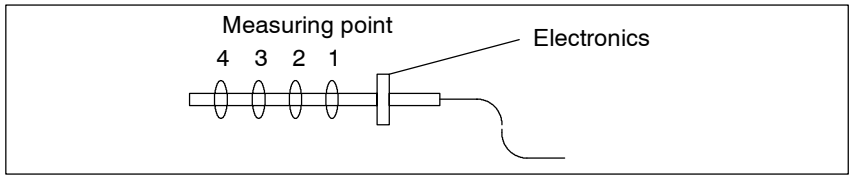


Figure 4-2 Example of the measuring points of a sensor

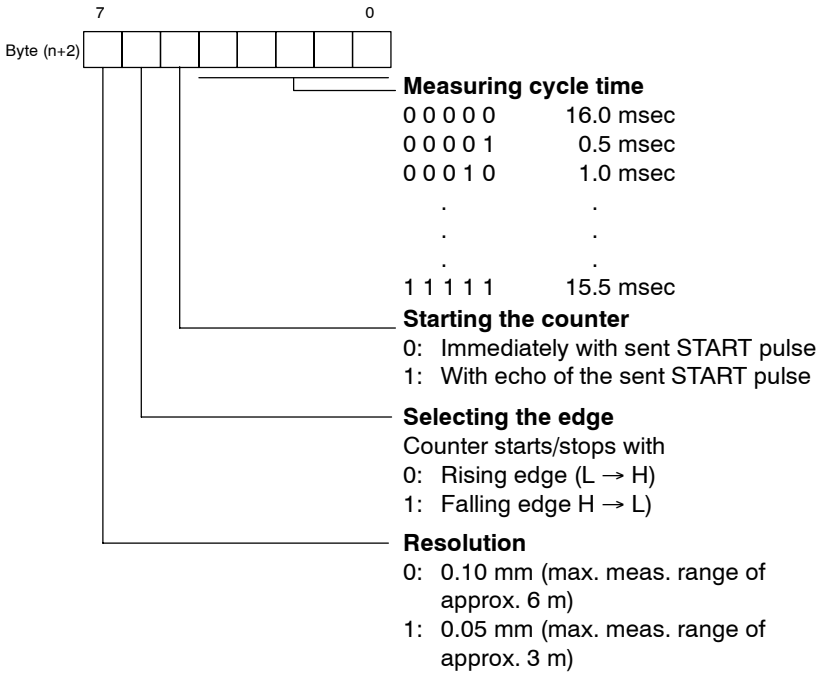
Sensor-related counter setting

The assigned counters for each sensor are set in one byte.

Table 4-3 shows the respective byte assigned.

Table 4-3 Bytes for setting the counters

Sensor Number	Byte
1	4
2	7
3	10
4	13



Measuring cycle time

The measuring cycle time can be set in increments of 0.5 msec depending on the sensor being used (length and required dead times). The maximum measuring cycle time is 16 msec.

Starting the counter

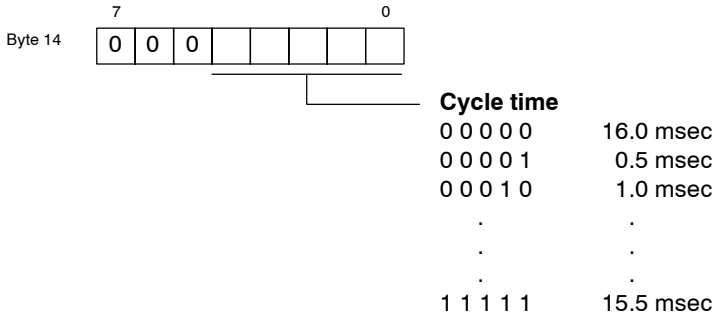
When the counter is started with the sent START pulse, the maximum measuring distance is reduced by the signal run time (approaching and returning line) through all components. If the counter is started with the echo of the START pulse, a synchronization error occurs.

Selecting the edge

Set the edge as described by the manufacturer of the sensor.

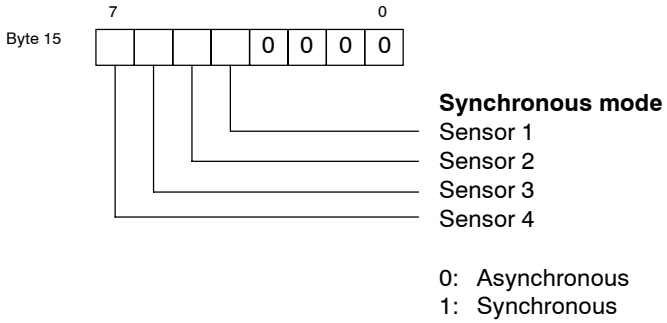
Cycle time

The SM 338 can generate an end-of-cycle alarm (i.e., process alarm 0) at the end of the cycle time set. This requires that generation be enabled in byte 1 of data record 0.



Sensor-related synchronous mode

In synchronous mode, the sensor operates with the cycle time for alarm generation in byte 14 of data record 1, and not with its preset measuring cycle time. In synchronous mode, new measured values are supplied at the same time as the end-of-cycle.



Note

When one or more sensors are operated in synchronous mode, it is absolutely imperative that the cycle time be adjusted to the slowest sensor. The module does not perform a plausibility check of this.

Default settings

Following a new start or a RESET of the module, the parameter area is set with the default values specified in table 4-4.

Table 4-4 Default values for the parameter area

	Value	Meaning
Data record 0		
Byte 0	00_H	No diagnostics and wire break monitoring
Byte 1	00_H	Alarms disabled
Data record 1		
Byte 2	01_H	**Sensor 1:** Counter 1 to measuring point 1
Byte 3	00_H	
Byte 4	00_H	Resolution of 0.1 mm; rising edge starts/stops counter; counter starts immediately with sent START pulse; measuring cycle time is 16 msec.
Byte 5	02_H	**Sensor 2:** Counter 2 to measuring point 1
Byte 6	00_H	
Byte 7	00_H	Same as byte 4
Byte 8	03_H	**Sensor 3:** Counter 3 to measuring point 1
Byte 9	00_H	
Byte 10	00_H	Same as byte 4
Byte 11	04_H	**Sensor 4:** Counter 4 to measuring point 1
Byte 12	00_H	
Byte 13	00_H	Same as byte 4
Byte 14	00_H	Cycle time of 16 msec
Byte 15	00_H	No synchronous mode

4.3 Diagnosis Area

General

The errors detected by the SM 338 are stored in the 12-byte diagnosis area. A set bit signals an error. If the error is a sporadic one, it is stored and reported to the CPU as “arriving”. After acknowledgment of the diagnosis alarm, such an error is then immediately reported as “departing”.

SF LED (system error)

The SF LED only lights up for the actual duration of the error, but at least 1 second. It is switched off again to make on-site error analysis easier.

Access

The P bus can only read-access the diagnosis area.

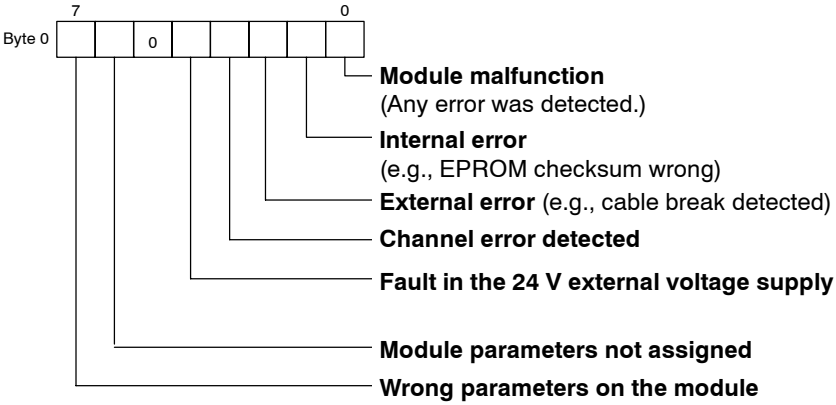
4.3.1 System Diagnosis Bytes

Note

The contents of the system diagnosis bytes are standardized, and fixed designations are used. The standardized term “channel” corresponds to a sensor for the SM 338.

The system diagnosis bytes occupy the first 4 bytes of the diagnosis area. They contain errors occurring at the module level. Their contents are described in detail below.

Module errors



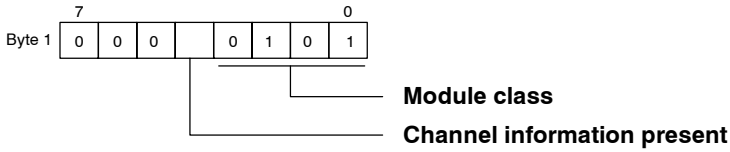
Module parameters not assigned

Valid parameters have not been transferred since booting took place. The bit is reset after the correct parameters have been transferred.

Wrong parameters on the module

When accepting parameters, the SM 338 checks their plausibility within certain limits. A detected error is indicated here and cancelled after valid parameters have been received.

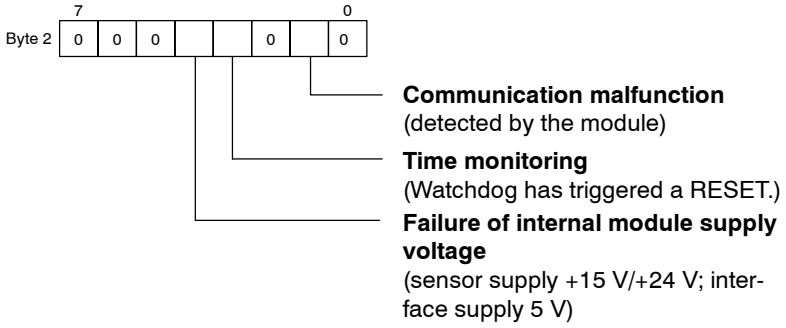
Module class, channel information



Channel information present

The error which occurred on a channel (i.e., sensor) is described in more detail in bytes 4 to 11.

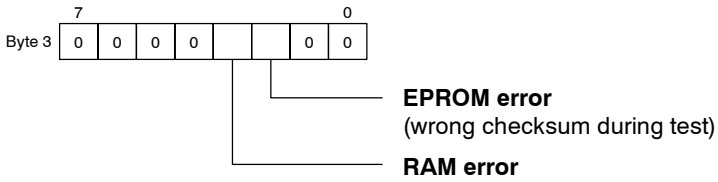
Data communication, program run time and supply voltage



Time monitoring

The module is equipped with a time monitoring function to check that the firmware is functioning correctly. If program run time exceeds a certain time frame, a RESET is triggered on the module. The module then boots with the default parameters and does not go into an undefined state.

Memory error

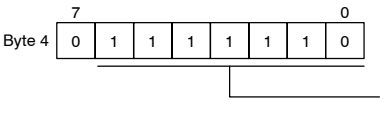


When a memory error occurs, the module can only be started again with a RESET on the bus.

4.3.2 Channel-Related Diagnosis Bytes

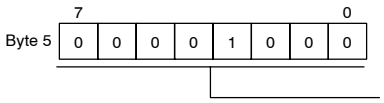
Channel-related data are stored in bytes 4 to 11. The contents of bytes 4 to 6 are fixed while bytes 7 to 11 contain the actual channel errors.

Channel type



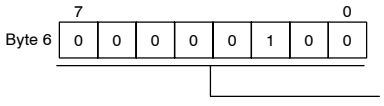
Channel type = $7E_H$

Diagnosis bits per channel



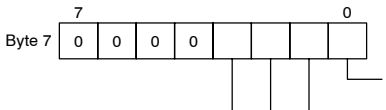
Length of the diagnosis information per channel
= Number of bits per channel
Value: 08_H

Number of channels



Number of channels (i.e., sensors)
Value: 04_H

Group errors of the channels (channel error vector)



Group error for channel 1
See byte 8 for more details.

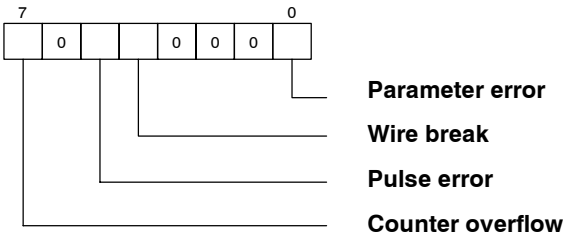
Group error for channel 2
See byte 9 for more details.

Group error for channel 3
See byte 10 for more details.

Group error for channel 4
See byte 11 for more details.

Individual errors of the channels

Byte 8: Channel 1
Byte 9: Channel 2
Byte 10: Channel 3
Byte 11: Channel 4



Parameter error

The channel (i.e., sensor) contains **invalid** parameters.

Wire break

The sensor has **not** supplied a STOP pulse.

Pulse error

The sensor has **not** supplied **enough** STOP pulses.

Counter overflow

A 16-bit counter assigned to the channel (i.e., sensor) has **overflowed**.

Note

All counters assigned to the channel (i.e., sensor) output the value 0 for the duration of the error.

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Operation

5

The parameters of the SM 338 must be assigned before it can begin position encoding. When an error occurs, it provides a diagnosis if this was enabled in the parameter assignment.

5.1 Parameter Assignment

Parameter assignment sets the SM 338 module to the connected sensors.

There are three ways to assign parameters to the SM 338.

- Automatic parameter assignment
- Parameter assignment by the CPU during startup (SDB 100)
- Parameter assignment via SFC during operation

Transferred parameters are always subject to a plausibility check. The following checks are performed.

- Number of counters used $\leq$ 8
- Number of measuring points per sensor $\leq$ 4
- Each counter only used once

Automatic parameter assignment

If the module was not parameterized by the CPU after conclusion of initialization and release, the parameters are assigned automatically.

The following default values are loaded (see table 4-4).

- One measuring point per sensor
- Greatest measuring cycle time
- Sensors operate asynchronously.
- Lowest resolution (i.e., greatest measuring range)
- End-of-cycle and diagnosis alarm disabled
- Channel-related diagnostics and wire break monitoring disabled

Parameter assignment via CPU

Parameter assignment is performed by the CPU during startup (after every transition from STOP to RUN).

The parameter information is taken from the SDB 100 system data block and transferred to the module.

Requirements:

- SDB 100 exists.
- SDB 100 contains appropriate parameter information for all slots which have been used.
- Type identifier in the parameter record matches the type identifier of the module.

Parameter assignment via SFC

Parameter assignment via SFC (abbreviation of System Function Call) is performed during normal operation.

All parameters in data records 0 and 1 can be changed.

Note

All parameters in both data records must always be valid since all 16 bytes are transferred and compared.

Parameter assignment via SFC is primarily used for dynamic, measuring cycle control. The plastics industry uses this method to shorten the duration of a measuring cycle by temporarily disabling measuring channels, or to perform continuous measurements in critical situations.

5.2 Example of an SDB 100

Introduction

Using a programmable controller containing an SDB 100, modules whose parameters can be assigned can be parameterized each time a switch is made from STOP to RUN.

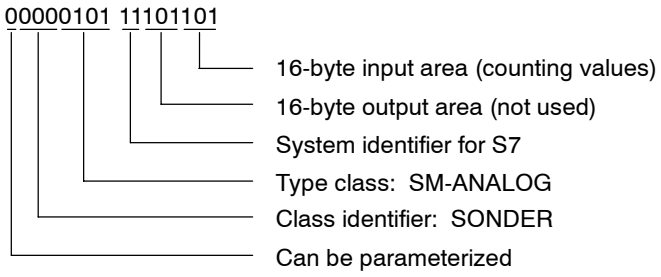
During startup, the CPU performs a bus identification procedure and enters the module identifier(s).
When the SDB 100 is transferred to the module, the CPU first checks to determine whether the module identifier entered for the respective slot matches the module identifier stored in the SDB 100 for this slot. The parameters are not transferred until this check is performed successfully.

Module identifier

The module identifier classifies the installed module with respect to its address in the I/O address area of the CPU.

Example:

The SM 338 has the module identifier $05ED_H$.



SDB 100 Program

```
SDB 100

(* Slot directory = contents directory *)
KH = 0008   (* Length of directory: The value corresponds to the number of entries
            (1 entry = 2 bytes)  *)
KH = 0000   (* Data offset in bytes for slot 4 *)
KH = 0000   (* Data offset in bytes for slot 5 *)
KH = 0012   (* Data offset in bytes for slot 6 *)
KH = 0034   (* Data offset in bytes for slot 7 *)
            (* Values are global pointers and specify after how many bytes after the
            start of the file the data for this slot begin *)
KH = 0000   (* Data offset in bytes for slot 8 *)
KH = 0000   (* Data offset in bytes for slot 9 *)
KH = 0000   (* Data offset in bytes for slot 10 *)
KH = 0000   (* Data offset in bytes for slot 11 *)

(* Parameter block of the first SM 338 module *)
            (* Offset 12h = 18 dec:  Data for slot 6 *)
KH = 0002   (* Transmission attribute *)
KH = 0002   (* Number of data records *)                    ── Fixed entries
KH = 05ED   (* Module identifier "SM_AI_SONDER" *)

(* Infos (header) for data record 0 *)
KH = 8012   (* Offset for net data, data record 0 in bytes *)
            (* Offset 12h = 18 dec:  local pointer; specifies after how many bytes
            after the  start of the parameter block the data for data record 0 are
            located *)
KH = 0002   (* Identifier for data record 0; length: 2 bytes *)
KH = 0000   (* Reserved *)

(* Infos (header) for data record 1 *)
KH = 8014   (* Offset for net data, data record 1 in bytes *)
            (* Offset 14h = 20 dec:  local pointer; specifies after how many bytes
            after the start of the parameter block the data for data record 1 are
            located *)
KH = 010E   (* Identifier for data record 1; length: 14 bytes *)
KH = 0000   (* Reserved *)

(* Parameters of the module *)
            (* Starting here, the parameters are to be transferred to the module *)
KH = FF44   (* Channel diagnostics;  diagnosis and end-of-cycle alarm *)
            (* Offset 12h = 18 dec after start of the parameter block *)
KH = 2143   (* S1: meas. pts 2,1 -> counters 2,1; meas. pts 4,3 -> counters 4,3 *)
            (* Offset 14h = 20 dec after start of the parameter block *)
KH = 8200   (* 0.05 mm, r. ed., START-I, 1 msec; S2: meas. pts 2,1 -> free *)
KH = 0000   (* S2: meas. pts 4,3 -> free; 0.1 mm, r. ed., START-I, 16 msec *)
KH = 0000   (* S3: meas. pts. 2,1 free; meas. pts 4,3 -> free *)
KH = 0000   (* 0.1 mm, r. ed., START-I, 16 msec; S4: meas. pts 2,1 -> free *)
KH = 0000   (* S4: meas. pts 4,3 -> free; 0.1 mm, r. ed., START-I, 16 msec *)
KH = 0000   (* Cycle time 16 msec; sensors asynchronous *)
                                                          16 bytes of data
                                                          records 0 and 1

            (* Same as above; parameter record for the second module *)
(* Parameter block of the second SM 338 module *)
            (* Offset 34h = 52 dec:  Data for slot 7 *)
KH = 0002   (* Transmission attribute *)
KH = 0002   (* Number of data records *)
KH = 05ED   (* Module identifier "SM_AI_SONDER" *)

(* Infos (header) for data record 0 *)
KH = 8012   (* Offset for net data, data record 0 in bytes *)
KH = 0002   (* Identifier for data record 0; length: 2 bytes *)
KH = 0000   (* Reserved *)
```

```
(* Infos (header) for data record 1 *)
KH = 8014   (* Offset for net data, data record 1 in bytes *)
KH = 010E   (* Identifier for data record 1; length: 14 bytes *)
KH = 0000   (* Reserved *)

(* Parameters of the module *)
KH = FF44   (* Channel diagnostics;  diagnosis and end-of-cycle alarm *)
KH = 2143   (* S1: meas. pts 2,1 -> counters 2,1; meas. pts 4,3 -> counters 4,3 *)
KH = 8200   (* 0.05 mm, r. ed., START-I, 1 msec; S2: meas. pts 2,1 -> free *)
KH = 0000   (* S2: meas. pts 4,3 -> free; 0.1 mm, r. ed., START-I, 16 msec *)
KH = 0000   (* S3: meas. pts. 2,1 free; meas. pts 4,3 -> free *)
KH = 0000   (* 0.1 mm, r. ed., START-I, 16 msec; S4: meas. pts 2,1 -> free *)
KH = 0000   (* S4: meas. pts 4,3 -> free; 0.1 mm, r. ed., START-I, 16 msec *)
KH = 0000   (* Cycle time 16 msec; sensors asynchronous *)
```

5.3 Normal Operation

After the parameters have been assigned correctly, the SM 338 functions in normal operation. This is signaled by the LEDs as shown below.

- DC (green) on
- SF (red) off

Depending on the parameter assignment, the measured values of a sensor are updated synchronously (i.e., at the end of the cycle time) or asynchronously (i.e., at the end of the measuring cycle time).

The sensor values can then be read in by the user program and evaluated.

Note

Each counting value consists of 2 bytes or 1 word (i.e., data consistency requires that the counting values be fetched via “load I/O input word”).

5.4 Error Diagnostics

Diagnostics acquire errors on the module

Diagnostics

Diagnosis information is updated continuously and stored in the diagnosis area of the dual port RAM. If channel-related diagnostics is enabled, this additional information is entered when channel errors occur. Both arriving and departing errors are considered by the diagnostics.

The CPU can read out the diagnosis area. An error which has occurred is indicated by the red “SF” LED regardless of whether the diagnosis alarm is enabled or not.

Note

This alarm is not forwarded to the CPU unless the diagnosis alarm is enabled.

Diagnosis alarm

If the diagnosis alarm has been enabled during assignment of the SM 338 parameters, an OB 82 must exist in the programmable controller. The first six words of the local data of OB 82 contain information concerning the module address and identifier, and the four bytes of system diagnostics.

When a diagnosis alarm is received, the CPU branches to OB 82 and transfers the diagnosis information to the user program.

Flowchart of channel-related diagnostics

Channel-related diagnostics is performed as shown in the flowchart below.

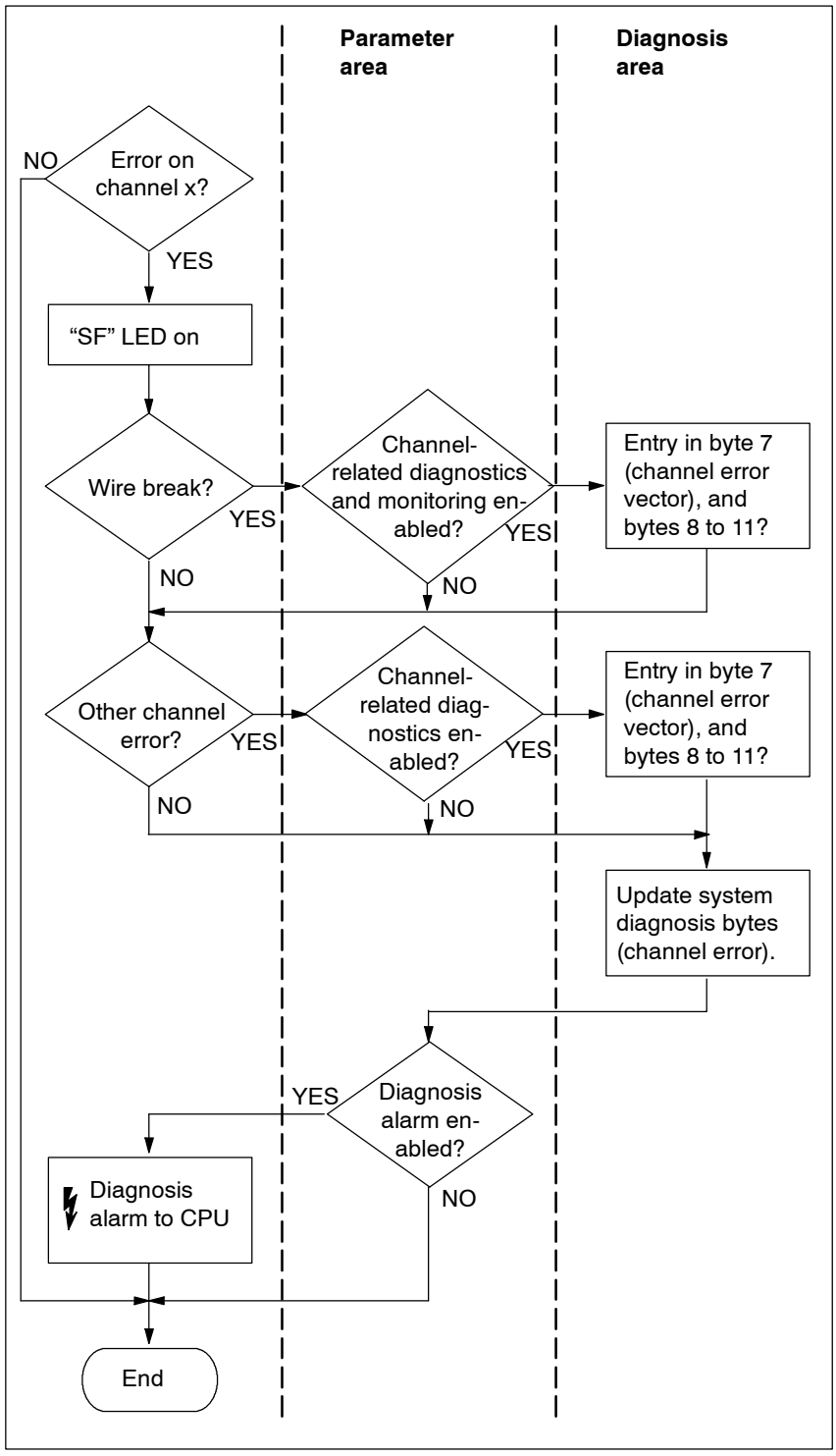


Figure 5-1 Flowchart of channel-related diagnostics

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Appendix A

A.1 Technical Specifications

Housing	
Dimensions (in mm)	80 x 125 x 120
Weight	500 g
Protection class	IP20

Position Sensors	
Number	Max. of 4
Number of measuring points	Max. of 8, max. of 4 per sensor
Measuring range	3/6 m
Resolution	0.05/0.1 mm
Programmable measuring cycles	0.5 to 16 msec
Supply voltage for sensors With potential isolation • Voltage Total current • Voltage Total current Total power to supply sensors	 ±15 V 200 mA 24 V 300 mA Max. of 7.2 W
Interface	RS 422 with START/ STOP interface
Front connector	25-way, sub D socket
Line length	Max. of 50 m

Supply Voltage for the Module	
Internal	From S7-300 bus
Current consumption	80 mA (typical) 100 mA (maximum)
External	24 V
Permissible voltage range	20.4 to 28.8 V
Current consumption Without sensors With sensors	 Max. of 0.1 A Max. of 0.85 A
Fuse	Fine-wire fuse, 1.0 A, delayed
Pole reversal protection	Yes

Environmental Requirements	
Environmental temperature	
Horizontal installation	0° to 60° C
Vertical installation	0° to 40° C
Relative humidity	5 to 95% (without condensation)
Air pressure	860 to 1080 hPa
Pollution concentration	
SO_2	Max. of 10 ppm
H_2S	Max. of 1 ppm
Vibration	
10 to 57 Hz	0.075 mm amplitude
57 to 150 Hz	1 g const. acceleration

Transportation and Storage Requirements*	
Free fall (in acc. with IEC 1131-2)	< 1 m
Temperature (in acc. with IEC 1131-2)	-40° C to +70° C
Air pressure	> 700 hPa (corresponds to a height of 3000 m)
Relative humidity	5 to 95% (without condensation)

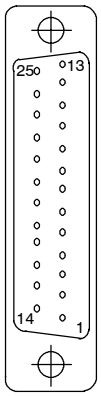
* In original packaging

Electromagnetic Compatibility	
Electrostatic discharge In acc. with DIN VDE 0843, part 2 (IEC 801-2)	8 kV discharge via air 6 kV discharge via contact (Degree 3)
High-energy, single pulse In acc. with DIN VDE 0839, part 10 (IEC 801-5)	Additional measures required Ex: Lighting cond. KT Type AD24V SIMATIC Order no. 919253 Mfg: Dehn und Söhne
Burst pulse In acc. with DIN VDE 0843, part 4 (IEC 801-4)	• 2 kV (supply line) 1 kV (signal line) (Degree 3) • 2 kV (supply line) 2 kV (signal line) for Generic Standard
Interference suppression In acc. With EN 55011; DIN VDE 0871, part 1	Limit value class A, group 1

A.2 Plug Connector Allocation

Connection sensors 1 and 3

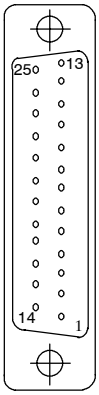
Plug connector X1
Sub D plug connector, 25-way socket



Pin	Function
1	-15 V voltage supply (with fuse/floating)
2	Reference potential, voltage supply
3	+15 V voltage supply (with fuse/floating)
4	-
5	Sensor 1: STOP input (RS 422)
6	Sensor 1: START output (RS 422)
7	-
8	Sensor 3: STOP input (RS 422)
9	Sensor 3: START output (RS 422)
10	-
11	-
12	Reference potential, voltage supply
13	+24 V auxiliary voltage (with fuse/floating)
14	-15 V voltage supply (with fuse/floating)
15	Reference potential, voltage supply
16	+15 V voltage supply (with fuse/floating)
17	-
18	Sensor 1: $\overline{\text{STOP}}$ input (RS 422)
19	Sensor 1: $\overline{\text{START}}$ output (RS 422)
20	-
21	Sensor 3: $\overline{\text{STOP}}$ input (RS 422)
22	Sensor 3: $\overline{\text{START}}$ output (RS 422)
23	-
24	Reference potential, voltage supply
25	+24 V auxiliary voltage (with fuse/floating)

Connection sensors 2 and 4

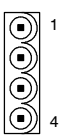
Plug connector X2
Sub D plug connector, 25-way socket



Pin	Function
1	-15 V voltage supply (with fuse/floating)
2	Reference potential, voltage supply
3	+15 V voltage supply (with fuse/floating)
4	-
5	Sensor 2: STOP input (RS 422)
6	Sensor 2: START output (RS 422)
7	-
8	Sensor 4: STOP input (RS 422)
9	Sensor 4: START output (RS 422)
10	-
11	-
12	Reference potential, voltage supply
13	+24 V auxiliary voltage (with fuse/floating)
14	-15 V voltage supply (with fuse/floating)
15	Reference potential, voltage supply
16	+15 V voltage supply (with fuse/floating)
17	-
18	Sensor 2: $\overline{\text{STOP}}$ input (RS 422)
19	Sensor 2: $\overline{\text{START}}$ output (RS 422)
20	-
21	Sensor 4: $\overline{\text{STOP}}$ input (RS 422)
22	Sensor 4: $\overline{\text{START}}$ output (RS 422)
23	-
24	Reference potential, voltage supply
25	+24 V auxiliary voltage (with fuse/floating)

External supply voltage

Quadruple screw terminal



Pin	Function
1	P24 (input voltage = jumpered with pin 3)
2	M24 (external ground = jumpered with pin 4)
3	P24 (input voltage = jumpered with pin 1)
4	M24 (external ground = jumpered with pin 2)

A.3 Recommended Accessories

Plug Connector

Designation	Order Number
Sub D, pin connector, 25-way	V42254-A1115-C325
Plug connector hood	V42254-A6000-G325 black V42254-A6000-G125 pebble gray
Cable sleeve (8 mm)	V42254-A6209-L100 black V42254-A6209-L1 pebble gray
Contact cover	V42254-A6108-L1
Knurled screw	V42254-A112-V109 black (10 each) V42254-A112-V009 kieselgrau (10 each)

See data book on plug connectors from Siemens (order no. A23001-G21-D005) for minimum ordering quantities and packaging units.

Lines

Designation	Order No.
Sensor line	6AP5 400-2AA01

Shielding

Designation	Order No.
Shield rail	6ES7 390-5AA00-0AA0
Shield terminals	
Small (recommended)	6ES7 390-5AB00-0AA0
Medium	6ES7 390-5BA00-0AA0
Large	6ES7 390-5CA00-0AA0

If required for protection against high-energy, single pulses

Lightning conductor — KT type AD24V SIMATIC
Order no: 919 253, mfg: Dehn und Söhne

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