

8.3 SM 326; DI 24 x DC 24V

8.3.1 Properties, front View, wiring diagram and block diagram

Order number

6ES7326-1BK01-0AB0

Properties

SM 326; DI 24 x DC 24V has the following properties:

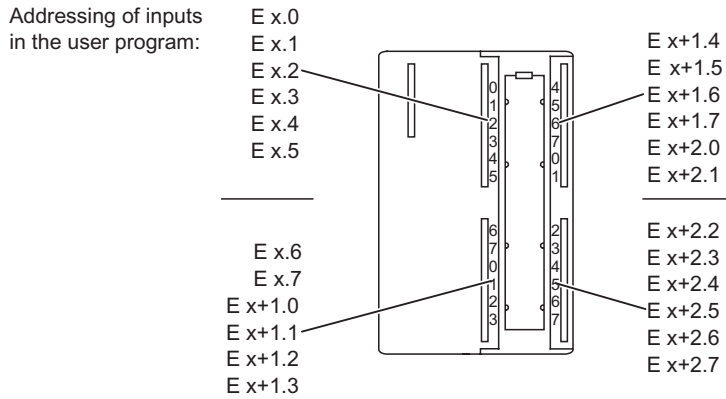
- 24 inputs, electrically isolated groups of 12 inputs
- Rated input voltage 24 V DC
- Suitable for switches and 2-/3-/4-wire proximity switches (BEROs)
- Four short circuit-proof sensor supplies for each of the 6 channels, electrically isolated in groups of 2
- External sensor supply possible
- Group error display (SF)
- Safety mode display (SAFE)
- Status display for each channel (green LED)
- Configuration in Run (CiR) supported in standard mode (non-safety mode)
- Programmable diagnostics functions
- Assignable diagnostic interrupt
- Supports operation in standard and safety mode
- 1oo1 and 1oo2 evaluation can be configured separately for each channel
- Simplified PROFIsafe address assignment
- Supports isochronous mode

WARNING

The fail-safe performance characteristics in the technical data apply to a proof test interval of 10 years and a mean time to repair of 100 hours.

Address assignment

The following figure shows the assignment of channels to addresses.



x = Module start address

Figure 8-1 Address assignment for SM 326; DI 24 x DC 24V

Configuration in RUN (CiR)

SM 326; DI 24 x DC 24V (order no. 6ES7326-1BK01-0AB0 and higher) supports configuration in run (CiR) when operated in standard mode (non-safety mode).

Additional information on CiR

For additional information on CiR, refer to:

- *STEP 7* online help: "System changes in run using CiR"
- in the *Safety Engineering in SIMATIC S7* system description.

Front view

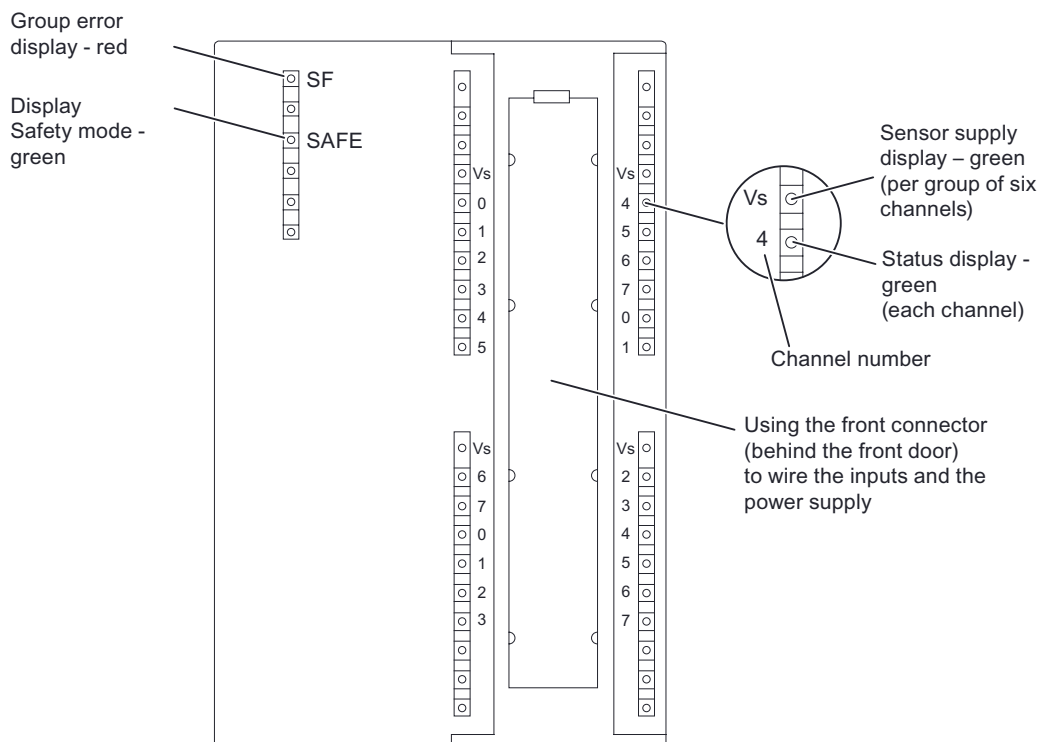


Figure 8-2 Front view of SM 326; DI 24 x DC 24V

Channel numbers

The channel numbers are used to uniquely identify the inputs and to assign channel-specific diagnostic messages. You can configure 1oo1 and 1oo2 evaluation of the sensors separately for each module channel or channel pair (see table below for example).

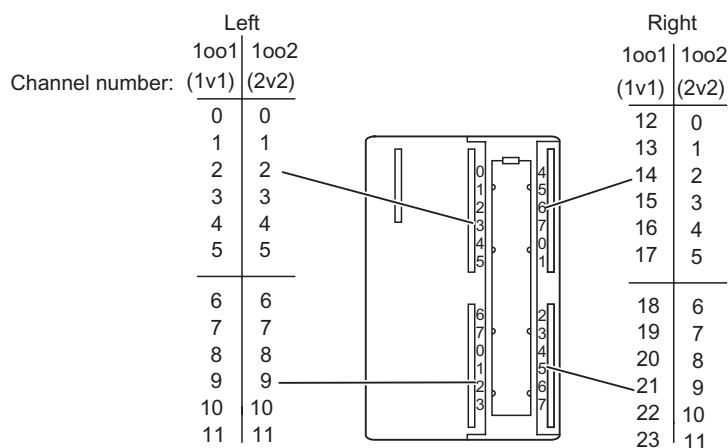
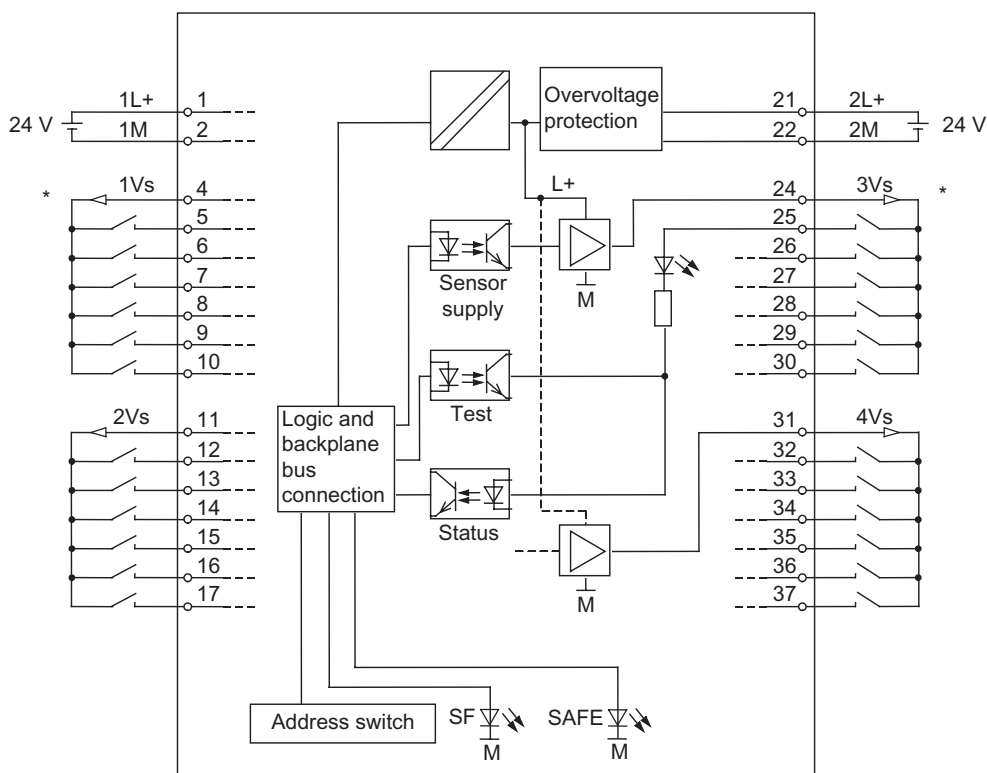


Figure 8-3 Channel numbers for SM 326; DI 24 x DC 24V

Table 8-1 SM 326; DI 24 x DC 24V: Example of a channel configuration

Left channels	Right channels	Evaluation of the sensors	Description
0	12	1oo2	Channel pair configured for 1oo2 evaluation; channel 0 is available as I x.0 in the I/O input area in the F-CPU
1	13	1oo2	Channel pair configured for 1oo2 evaluation; channel 1 is available as I x.1 in the I/O input area in the F-CPU
2	14	1oo1	Single channels configured for 1oo1 evaluation, channels 2 and 14 are available as I x.2 and I x+1.6 in the I/O input area in the F-CPU
3	15	1oo1	Single channels configured for 1oo1 evaluation, channels 3 and 15 are available as I x.3 and I x+1.7 in the I/O input area in the F-CPU
4	16	1oo2	Channel pair configured for 1oo2 evaluation; channel 4 is available as I x.4 in the I/O input area in the F-CPU

Wiring / block diagram of SM 326; DI 24 x DC 24V and of its internal sensor supply



* The representation of NO contacts matches the module labeling. Usually, the sensors must be equipped with NC contacts in order to ensure the safe state of process variables.

Figure 8-4 Wiring / block diagram of SM 326; DI 24 x DC 24V and of its internal sensor supply

External sensor supply

The figure below shows how you can connect the sensors to an external sensor supply (for example, from another module: L+). All 6 channels of a channel group (0 to 5; 6 to 11; 12 to 17 or 18 to 23) must be connected to the same external sensor supply.

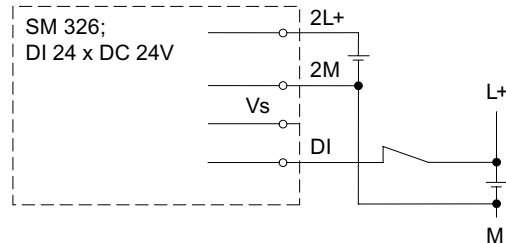


Figure 8-5 External sensor supply for SM 326; DI 24 x DC 24V

Note

Note that the errors outlined cannot be detected when operating with external sensor supply:

- Short-circuit to L+ on the unconnected sensor line (open contact)
- Short-circuit between channels of a channel group
- Short-circuit between channels of different channel groups

8.3.2 SM 326; DI 24 x DC 24V applications

Selecting the application

The figure below helps you to select an application in accordance with requirements of availability and fail-safe operation. The next pages provide information on the module wiring for a specific application, and on the parameters to set in *STEP 7* using the *S7 Distributed Safety* or *S7 F Systems* optional package.

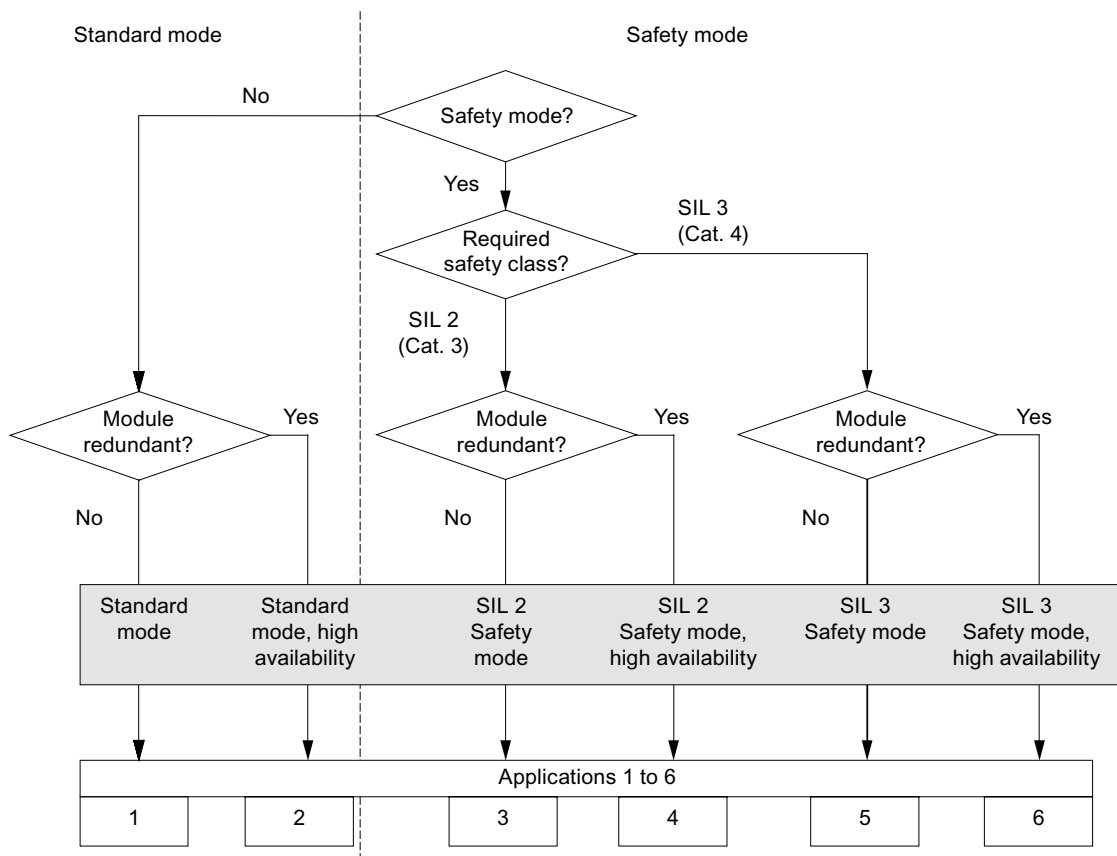


Figure 8-6 SM 326; DI 24 x DC 24V - Selecting an application

WARNING

The maximum Safety Integrity Level is determined by the sensor quality and the length of the proof-test interval to IEC 61508. Always wire sensors whose quality does not meet Safety Integrity Level requirements redundantly to two channels.

Note

You can define 1oo1 and 1oo2 sensor evaluation for a module (for example, see table *SM 326; DI 24 x DC 24V: Example of channel configuration* in the chapter *Properties, front View, wiring diagram and block diagram*).

8.3.9 Diagnostic messages of SM 326; DI 24 x DC 24V

Possible diagnostic messages

The table below shows an overview of the diagnostic messages of SM 326; DI 24 x DC 24V.

Diagnostic messages are assigned either to a channel or to the entire module. Some diagnostic messages occur only in certain applications.

Table 8-8 Diagnostic messages of SM 326; DI 24 x DC 24V

Diagnostic message	Signaled in the application	Effective range of diagnostics	Assignable
Internal short-circuit or defective sensor supply	1, 2, 3, 4, 5, 6	Channel	Yes
Short-circuit to L+ on the unconnected sensor line (open contact)			
Ground-short circuit or defective sensor supply			
Discrepancy error (1oo2 evaluation)	5, 6		
No external auxiliary voltage	1, 2, 3, 4, 5, 6	Module	no
Module parameters not assigned			
Incorrect module parameters			
Communication error			
Internal supply voltage of the module failed			
Time monitoring activated (watchdog)			
EPROM error			
RAM error			
Processor failure			
Parameter assignment error (with specification of a consecutive number)			
Internal error in read circuit/test circuit	1, 2, 3, 4, 5, 6	Channel	
CRC signature error	3, 4, 5, 6	Module	
Timeout of safety message frame monitoring			
Message frame error	1,2	Module	

Short-circuit to M and L+

Sequence of the internal short-circuit tests:

- Short-circuit to chassis ground is always tested, independent of the configuration.
- Short-circuit to L+ is only tested if "Sensor supply via module" and "Short-circuit test" are configured in *HW Config*.

Causes of the problem and corrective measures

The table below shows possible causes of the problem and the appropriate corrective measures for the individual diagnostic messages of SM 326; DI 24 x DC 24V.

Table 8-9 Diagnostic messages of SM 326; DI 24 x DC 24V and their corrective measures

Diagnostic message	Possible causes of the problem	Corrective measures
Internal short-circuit or defective sensor supply	Internal sensor supply error	Replace the module
Short-circuit to L+ on the unconnected sensor line (open contact)	Short circuit to L+ of the unconnected sensor line (open contact)	Eliminate the short-circuit
Ground-short circuit or defective sensor supply	Short-circuit of input to M	Eliminate the short-circuit
	Internal sensor supply error	Replace the module
Short-circuit or wire break at the unconnected sensor line (open contact)	Short-circuit of the unconnected sensor line to M	Eliminate the short-circuit
	Interruption of the line between the module and sensor	Restore the cable connection
Discrepancy error (1oo2 evaluation)	Process signal error	Check the process signal; replace the sensor
	Defective sensor	
	Wire break in connected sensor line (contact closed) or the sensor supply line	Eliminate the wire break
	Assigned discrepancy time too short	Check the discrepancy time parameters
No external auxiliary voltage	Module supply voltage L+ missing	Connect supply voltage L+
Module parameters not assigned	No parameters transferred to module	Assign new module parameters
Incorrect module parameters	Faulty parameters transferred to module	Assign new module parameters
Communication error	Error in communication between the CPU and the module, e.g., due to defective PROFIBUS connection or electromagnetic interference in excess of limits.	Check the PROFIBUS connection Eliminate the interference
	Timeout of safety message frame monitoring	Check the monitoring time parameters
	CRC signature error, e.g., due to electromagnetic interference in excess of limits.	Eliminate the interference
	CPU is in STOP	Read the diagnostics buffer
Internal supply voltage of the module failed	Internal fault at the L+ supply voltage	Replace the module
Time monitoring activated (watchdog)	Overload due to diagnostics request (SFCs)	Reduce the number of diagnostics requests
	Electromagnetic interference has exceeded limits	Eliminate the interference
	Defective module	Replace the module

Diagnostic message	Possible causes of the problem	Corrective measures
EPROM error RAM error	Electromagnetic interference has exceeded limits	Eliminate the interference and cycle the power supply OFF/ON
	Defective module	Replace the module
Processor failure	Electromagnetic interference has exceeded limits	Eliminate the interference
	Defective module	Replace the module
Internal error in read circuit/test circuit	Defective module	Replace the module
CRC signature error	CRC signature error in communication between the CPU and the module, e.g., due to electromagnetic interference in excess of limits or sign-of-life monitoring error.	Eliminate the interference
Timeout of safety message frame monitoring	Assigned monitoring time exceeded	Check the monitoring time parameters
	Startup of the fail-safe signal module	—
Message frame error	Sign-of-life and/or CRC signature entered in the data message frame	Check the sign-of-life and CRC signature entries in the data message frame for "0" value

8.3.10 Technical data - SM 326; DI 24 x DC 24V

Overview

Technical data	
Dimensions and Weight	
Dimensions W x H x D (mm)	80 x 125 x 120
Weight	Approx. 442 g
Module-Specific Specifications	
Configuration in Run (CiR) supported	Yes (only in standard mode)
• Behavior of non-configured inputs during CiR	Return the process value that was valid prior to parameter assignment
Supports isochronous mode	Yes
• Accuracy	30 ms
Number of inputs	
• single channel	24
• dual-channel	12
Assigned address area	
• In I/O input area	10 bytes
• in I/O output area	4 bytes

Technical data		
Cable length		
• Unshielded	100 m, maximum	
• Shielded	200 m, maximum	
Maximum achievable Safety Integrity Level in safety mode		
• According to IEC 61508	SIL 3	
• According to EN 954-1	Category 4	
Fail-safe performance characteristics	SIL 2	SIL 3
• Low demand mode (average probability of failure on demand)	< 1.00E-04	< 1.00E-05
• High demand/continuous mode (probability of a dangerous failure per hour)	< 1.00E-08	< 1.00E-09
Voltages, Currents, Potentials		
Rated supply voltage of the electronic system and sensors 1L+, 2L+	24 V DC	
• Reverse polarity protection	Yes	
• Power failure ride-through (does not apply to sensor supply outputs)	5 ms	
Number of simultaneously controllable inputs		
• Horizontal installation Up to 40 °C Up to 60 °C	24 24 (with 24 V) 18 (with 28.8 V)	
• Vertical installation Up to 40 °C	24	
Electrical isolation		
• Between channels and backplane bus	Yes	
• Between channels in groups of	12	
Maximum potential difference between different circuits	75 V DC 60 V AC	
Insulation test voltage	500 V DC / 350 V AC for the duration of 1 minute or 600 V for the duration of 1 second	
Current consumption		
• From backplane bus	100 mA, maximum	
• From load voltage 1L+, 2L+ (no sensors)	450 mA, maximum	
Power loss of the module	10 W, typical	
Status, Interrupts, Diagnostics		
Status display	Green LED per channel	
Interrupts		
• Diagnostic interrupt	Assignable	
Diagnostics functions	Assignable	
• Group fault display	Red LED (SF)	
• Fail-safe mode display	Green LED (SAFE)	
• Diagnostic information can be read out	Possible	

Technical data	
Sensor Supply Outputs	
Number of outputs	4
Electrical isolation between channels and backplane bus	Yes
• In groups of	2
Output voltage	
• Loaded	Minimum L+ (-1.5 V)
Output current	
• Rated value	400 mA
• Approved range	0 to 400 mA
Additional (redundant) infeed	Permissible
Short-circuit protection	Yes, electronic
Sensor Selection Data	
Input voltage	
• Rated value	24 V DC
• For "1" signal	11 to 30 V
• For "0" signal	- 30 to 5 V
Input current	
• For "1" signal	Typ. 10 mA
Input characteristic	According to IEC 61131-2 Type 1
Connection of 2-wire BERO	Supported if parameter "with short-circuit test" = "no"
Permissible quiescent current	2 mA, maximum
Time, Frequency	
Internal signal preparation time (without input delay) for	Min./max.
• Standard mode	6 ms / 22 ms
• Safety mode SIL 2 (Category 3)	6 ms / 23 ms
• safety mode SIL 3 (Category 4)	6 ms / 22 ms
Input delay	
• For "0" after "1"	2.1 ms to 3.4 ms
• For "1" after "0"	2.1 ms to 3.4 ms
Acknowledgment time	
• In safety mode with 1oo1 evaluation of the sensors	Max. 29 ms
• In safety mode with 1oo2 evaluation of the sensors	Max. 30 ms
Minimum sensor signal duration	See the table <i>Minimum duration of sensor signals for reliable detection by SM 326; DI 24 x DC 24 V</i> in the chapter <i>Requirements for sensors and actuators for F-SM operation in safety mode</i>

Note

The maximum cable lengths currently specified in this manual ensure against functional impairment, even without more precise examination of the boundary conditions. If the boundary conditions, such as EMC, cable type, cable routing, etc. are examined more precisely, longer cables can be used for all F-SMs.

8.4 SM 326; DI 8 x NAMUR

8.4.1 Properties, front view, wiring diagram and block diagram

Order number

6ES7326-1RF00-0AB0

Properties

Properties of SM 326; DI 8 x NAMUR:

- SIMATIC S7-Ex digital module
suitable for connecting signals from the Ex area
- 8 single-channel inputs or 4 two-channel inputs, electrically isolated
- Rated input voltage 24 V DC
- Suitable for the following sensors
 - In accordance with DIN 19234 and NAMUR (with diagnostic evaluation)
 - connected mechanical contacts (with diagnostic evaluation)
- 8 short-circuit-proof sensor supplies, each to one channel, electrically isolated
- Group error display (SF)
- Safety mode display (SAFE)
- Status display for each channel (green LED)
- Assignable diagnostics functions
- Assignable diagnostic interrupt
- Supports operation in standard and safety mode

WARNING
The fail-safe performance characteristics in the technical data apply to a proof test interval of 10 years and a mean time to repair of 100 hours.