



Product Information on the Manual

Edition 08.2003

S7-300 Module Specifications, Edition 11/2002, (A5E00105505-02)

Introduction

The S7-300 product family has been enhanced and improved. This document contains details of the features and technical specifications of the modules.

Contents

Section	Contents	Page
1	Analog input module SM 331; AI 8 x 13 Bit; (6ES7 331-1KF01-0AB0)	2
2	Parameters of the SM 331; AI 8 x 13 Bit	6
3	Measuring Methods of the SM 331; AI 8 x 13 Bit	7
4	Parameters of the SM 331; AI 8 x 13 Bit	8

1 SM 331 Analog Input Module; AI 8 × 13 Bit; (6ES7 331-1KF01-0AB0)

Order Number

6ES7 331-1KF01-0AB0

Characteristics

The SM 331; AI 8 × 13 Bit has the following features:

- 8 inputs
- Measured-value resolution 12 bits + sign
- Measuring method selectable:
 - Voltage
 - Current
 - Resistance
 - Thermal resistance
- Isolated against the backplane bus interface

Terminal Assignment and Block Diagram of the SM 331; AI 8 × 13 Bit

On channels 4 to 7 in the figure below you will find a number of connection examples for the different measuring methods. These connection examples can be applied in the same way to all channels (channels 0 to 7).

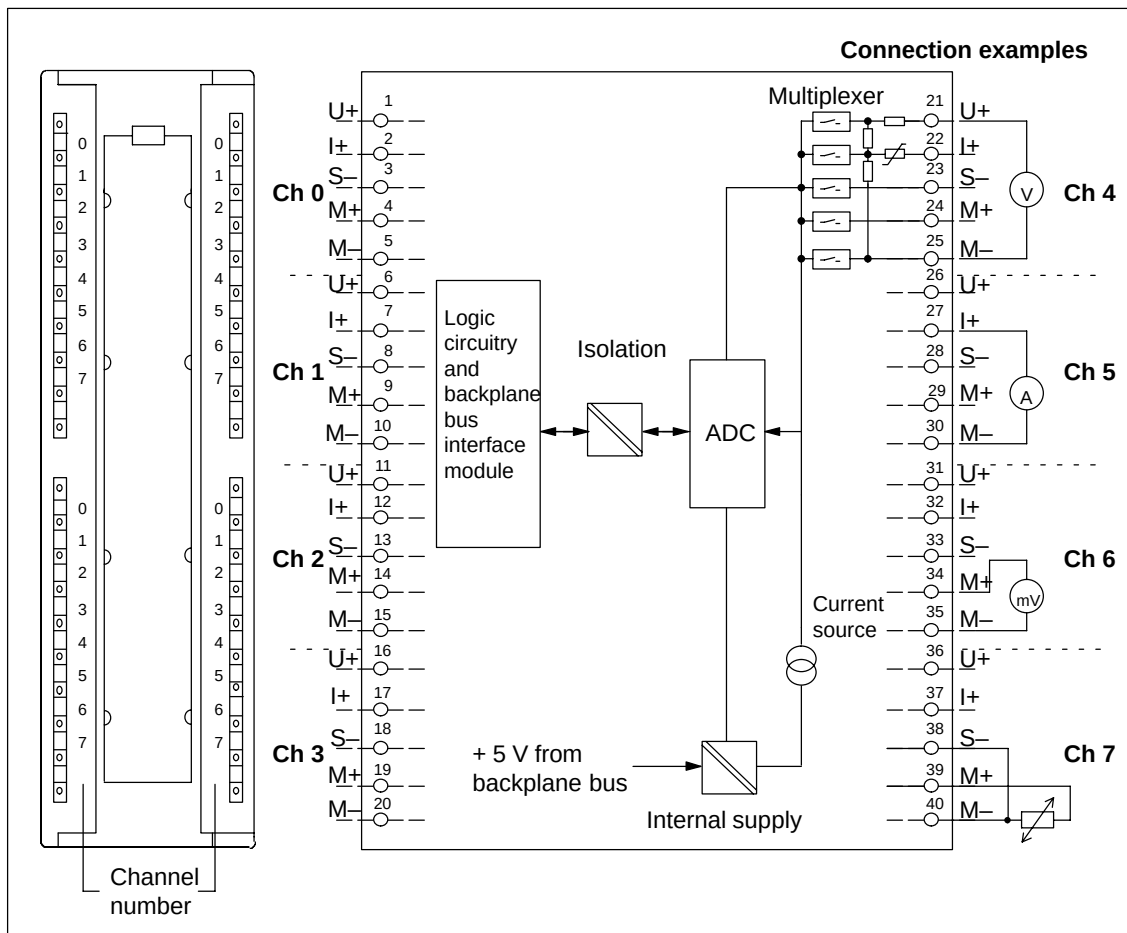


Figure 1 Module View and Block Diagram of the SM 331; AI 8 × 13 Bit

Note

When connecting voltage and current sensors, ensure that the maximum permissible common mode voltage U_{CM} of 2 V is not exceeded between the inputs. To prevent incorrect measurements being made, you should therefore connect the different M- connections to each other.

When measuring resistances and resistance thermometers, the M- connections do not have to be interconnected.

Technical Specifications of the SM 331; AI 8 × 13 Bit

Dimensions and Weight		Analog Value Generation		
Dimensions W × H × D (in millimeters)	40 × 125 × 117	Measuring principle	Integrative	
Weight	Approx. 250 g	Integration time/conversion time/resolution (per channel)		
Data for Specific Modules		Parameters can be assigned	Yes	
Supports clocked operation	No	Suppression of interference voltage for interference frequency f1 in Hz	50	60
Number of inputs	8	Integration time in milliseconds	60	50
For resistance-type sensor	8	Basic conversion time incl. integration time in ms	66	55
Length of cable		Additional conversion time for resistance measurement in ms	66	55
Shielded	max. 200 m max. 50 m at 50 mV	Resolution in bits (incl. overrange)	13 bits	13 bits
Voltages, Currents, Potentials		Suppression of Interference, Limits of Error		
Constant current for resistance-type sensor		Interference voltage suppression for $f = n \times (f1 \pm 1 \%)$, ($f1 =$ interference frequency) $n = 1.2$		
Resistance thermometer and resistance measurement 0 ... 600 Ω	0.83 mA	Common-mode interference ($U_{CM} < 2 \text{ V}$)	> 86 dB	
Resistance measurement 0 ... 6 kΩ	0.25 mA	Series-mode interference (peak value of interference < rated value of input range)	> 40 dB	
Isolation		Crosstalk between the inputs	> 50 dB	
Between channels and backplane bus	Yes			
Between the channels	No			
Permitted potential difference				
Between the inputs (ECM)	2.0 VDC			
Between the inputs and $M_{\text{internal}} (U_{\text{ISO}})$	75 VDC / 60 VAC			
Insulation tested with	500 VDC			
Current consumption				
From the backplane bus	max. 90 mA			
Power dissipation of the module	typ. 0.4 W			

Operational limit (in the entire temperature range, with reference to the input range)			Temperature error (with reference to the input range)		± 0.006 %/K / 0.006 K/K		
• Voltage input	± 5 V	± 0.6 %	Linearity error (with reference to the input range)	± 0.1 %/ 0.1 K			
	± 10 V						
	1 to 5 V						
	0 to 10 V						
• Current input	± 50 mV	± 0.5 %	Repeat accuracy (steady state at 25 °C, with reference to the input range)	± 0.1 % / ± 0.1 K			
	± 500 mV						
	± 1 V						
Status, Interrupts, Diagnostics							
Interrupts		None					
Diagnostic functions		None					
Data for Selecting a Sensor							
Input range (rated values)/input resistance							
• Voltage	± 50 mV	100 kΩ	• Current	± 20 mA	50 Ω		
	± 500 mV			0 to 20 mA			
	± 1 V			4 to 20 mA			
	± 5 V						
• Resistance	± 10 V		• Resistance thermometer	0 to 6 kΩ	100 MΩ		
	1 to 5 V			0 to 600 Ω			
	0 to 10 V						
• Resistance thermometer	Pt 100	± 1.2 K	Permissible input voltage for voltage input U+ (destruction limit)	max. 30 V continuous			
	Ni 100			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)	max. 12 V continuous; 30 V for max. 1 s		
	Standard				Permissible input current for current input I+ (destruction limit)	40 mA	
	Pt 100	± 1 K					
Ni 100							
• Resistance thermometer	Climatic						
	Ni 1000, LG-Ni 1000	± 1 K					
	Standard						
	Ni 1000	± 1 K					
• Resistance thermometer	LG-Ni 1000						
	Climatic						
Basic error limit (operational limit at 25 °C, with reference to the input range)							
• Voltage input	± 5 V	± 0.4 %	Permissible input voltage for voltage input U+ (destruction limit)	max. 30 V continuous			
	± 10 V			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)	max. 12 V continuous; 30 V for max. 1 s		
	1 to 5 V				Permissible input current for current input I+ (destruction limit)	40 mA	
	0 to 10 V						
• Current input	± 50 mV	± 0.3 %	Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	± 500 mV			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	± 1 V				Permissible input current for current input I+ (destruction limit)	40 mA	
• Resistance	± 20 mA	± 0.3 %	Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	0 to 20 mA			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	4 to 20 mA				Permissible input current for current input I+ (destruction limit)	40 mA	
• Resistance	0 to 6 kΩ	± 0.3 %	Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	0 to 600 Ω	± 0.3 %		Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
					Permissible input current for current input I+ (destruction limit)	40 mA	
• Resistance thermometer	Pt 100	± 1 K	Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	Ni 100			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	Standard				Permissible input current for current input I+ (destruction limit)	40 mA	
	Pt 100	± 0.8 K					
• Resistance thermometer	Ni 100		Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	Climatic			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	Ni 1000	± 0.8 K			Permissible input current for current input I+ (destruction limit)	40 mA	
	LG-Ni 1000						
• Resistance thermometer	Standard		Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	Ni 1000	± 0.8 K		Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	LG-Ni 1000				Permissible input current for current input I+ (destruction limit)	40 mA	
	Standard						
• Resistance thermometer	Ni 1000	± 0.8 K	Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	LG-Ni 1000			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
	Standard				Permissible input current for current input I+ (destruction limit)	40 mA	
	Ni 1000	± 0.8 K					
• Resistance thermometer	LG-Ni 1000		Permissible input voltage for voltage input U+ (destruction limit)			max. 30 V continuous	
	Climatic			Permissible input voltage for voltage inputs M+, M–, S– (destruction limit)		max. 12 V continuous; 30 V for max. 1 s	
					Permissible input current for current input I+ (destruction limit)	40 mA	

Connection of the sensor		Characteristic linearization	Parameters can be assigned
• For measuring voltage	Possible	• For resistance thermometer	Pt 100 Standard / Climatic Ni 100 Standard / Climatic Ni 1000 Standard / Climatic LG-Ni 1000 Standard / Climatic
• For measuring current		• Technical unit for temperature measurement	Degrees Celsius, degrees Fahrenheit, Kelvin
As two-wire transmitter	Possible, with external supply		
As four-wire transmitter	Possible		
• For measuring resistance			
With 2-conductor terminal	Possible		
With 3-conductor terminal	Possible		
With 4-conductor terminal	Possible		

2 Parameters of the SM 331; AI 8 × 13 Bit

Parameter

Section 4.7 of the reference manual describes how the analog modules are generally parameterized.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 1 Parameters of the SM 331; AI 8 × 13 Bit

Parameter	Value Range	Default Settings	Parameter Type	Scope
Measurement				
• Measuring method	Deactivated U Voltage I Current R Resistance RTD Thermal resistance	U	Dynamic	Channel
• Measuring range	Voltage ± 50 mV; ± 500 mV; ± 1 V; 1 to 5 V; ± 5 V; 0 to 10 V; ± 10 V Current 0 to 20 mA; 4 to 20 mA; ± 20 mA Resistance 0 to 600 Ω; 0 to 6 kΩ Thermal resistance (linear) Pt 100 Climatic / Standard Ni 100 Climatic / Standard Ni 1000 Climatic / Standard LG-Ni 1000 Climatic/Standard	± 10 V ± 20 mA 600 Ω Pt 100 Standard		
• Temperature coefficient	Pt 100 0.003850 Ω/Ω/ °C (IST-90) Ni 100 / Ni 1000 0.006180 Ω/Ω/ °C LG-Ni 1000 0.005000 Ω/Ω/ °C	0.003850		
• Interference frequency suppression	50 Hz, 60 Hz	50 Hz		Module
• Temperature unit	Degrees Celsius, degrees Fahrenheit, Kelvin*	Degrees Celsius		

* Only Pt 100 Standard, Ni 100 Standard, Ni 1000 Standard, LG-Ni 1000 Standard

3 Measuring Methods of the SM 331; AI 8 × 13 Bit

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement
- Current measurement
- Resistance measurement

You make the setting by means of the "Measuring type" parameter in *STEP 7*.

Unused Channels

Set the "Measuring type" parameter for unused channels to "disabled". In this way you shorten the module's scan cycle time.

4 Parameters of the SM 331; AI 8 × 13 Bit

Structure of Record 1

The figure below shows the structure of record 1 of the parameters of the analog input module.

You activate a parameter by setting the corresponding bit in the bytes to "1".

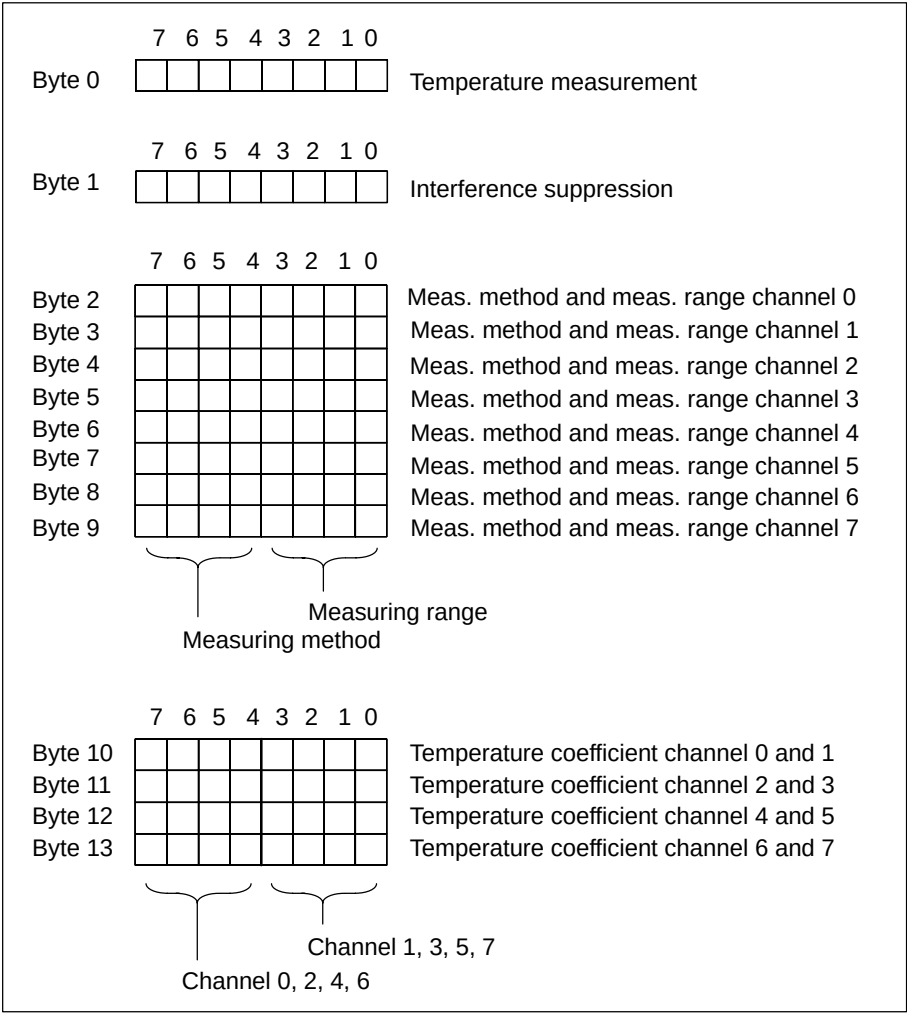


Figure 2 Record 1 of the Parameters of the Analog Input Modules

Temperature Measurement

The table below contains the coding for the different temperature measurements that you enter in byte 0 of record 1 (see Figure 2).

Table 2 Coding for the Temperature Measurement of the Analog Input Module

Temperature Unit for Linearization	Coding
Degrees Celsius	2#0000 0000
Degrees Fahrenheit	2#0000 1000
Kelvin	2#0001 0000

Interference Frequency Suppression

The table below contains the coding for the different frequencies that you enter in byte 1 of record 1 (see Figure 2). You have to calculate the resulting integration time per module.

Table 3 Coding for the Interference Frequency Suppression of the Analog Input Module

Interference Suppression	Integration Time	Coding
60 Hz	50 ms	2#01
50 Hz	60 ms	2#10

Measuring Methods and Measuring Ranges

The table below contains all the measuring methods and measuring ranges of the analog input module with their coding. You have to enter this coding in bytes 2 to 13 of record 1 (see Figure 2).

Note

Note that the front connector on the analog input module must be wired appropriately, depending on the measuring range.

Table 4 Coding for the Measuring Ranges of the Analog Input Module

Measuring Method	Coding	Measuring Range	Coding
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	± 50 mV ± 500 mV ± 1 V ± 5 V 1 to 5 V 0 to 10 V ± 10 V	2#1011 2#0011 2#0100 2#0110 2#0111 2#1000 2#1001
Current	2#0010	0 to 20 mA 4 to 20 mA ± 20 mA	2#0010 2#0011 2#0100
Resistance	2#0101	600 Ω 6 k Ω	2#0110 2#1000
Thermal resistance (linear)	2#1001	Pt 100 Climatic Pt 100 Standard Ni 100 Climatic Ni 100 Standard Ni 1000 / LG-Ni 1000 Climatic Ni 1000 / LG-Ni 1000 Standard	2#0000 2#0010 2#0001 2#0011 2#1010 2#0110

Temperature Coefficient

The table below contains the coding for the temperature coefficient that you enter in bytes 10 to 13 of record 1 (see Figure 2).

Table 5 Coding for the Temperature Measurement of the Analog Input Module

Temperature Coefficient	Measuring Range	Coding
Pt 0.003850 $\Omega/\Omega/^\circ\text{C}$ (ITS-90)	Pt 100	2#0100
Ni 0.006180 $\Omega/\Omega/^\circ\text{C}$	Ni 100 / Ni 1000	2#1000
Ni 0.005000 $\Omega/\Omega/^\circ\text{C}$	LG-Ni 1000	2#1010