

# SIEMENS

## Product Information on the Manual

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www.DataSheet4U.com S7-300 Module Specifications, Edition 11/2002, (A5E00105505-02)

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### Introduction

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

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

## **Order Number**

6ES7 331-1KF01-0AB0

## **Characteristics**

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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).

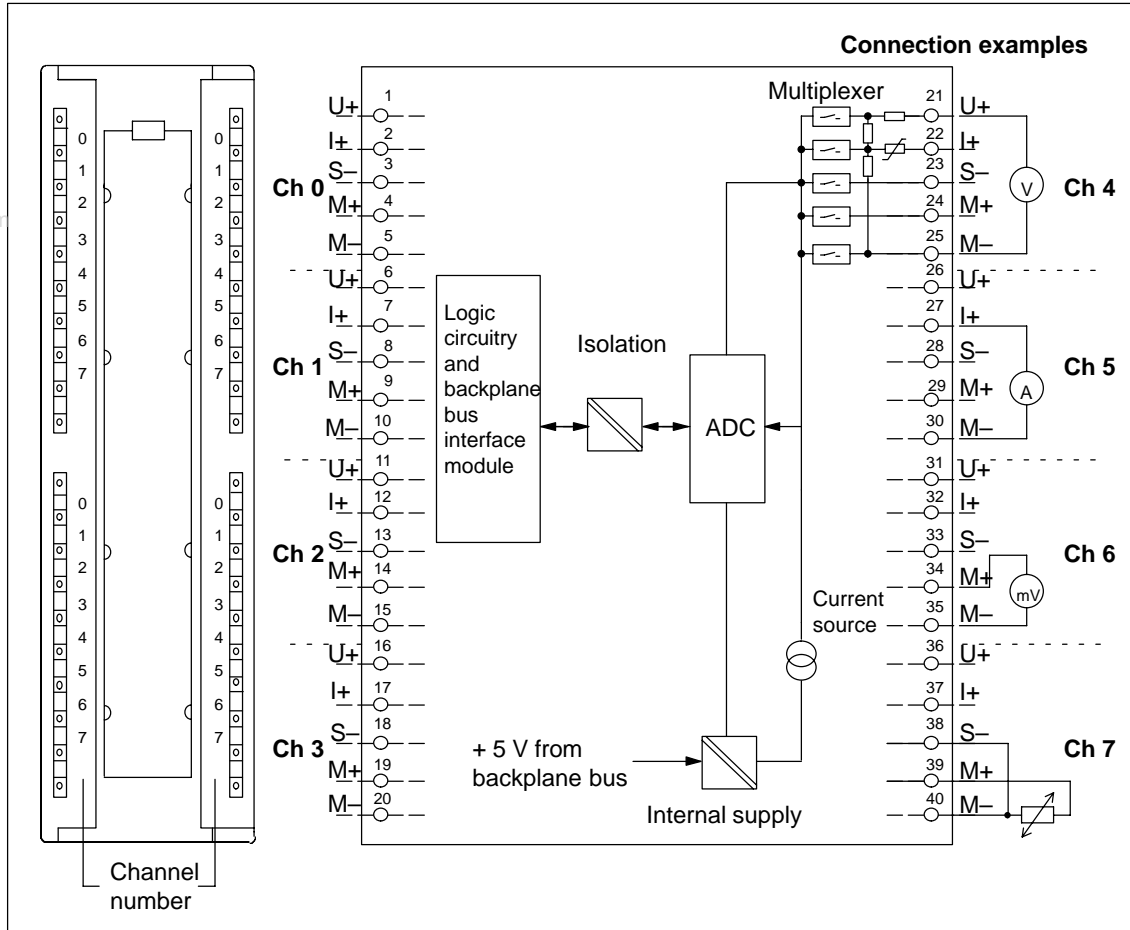


Figure 1 Module View and Block Diagram of the SM 331; AI 8 × 13 Bit

### 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		<ul style="list-style-type: none"> <li>Parameters can be assigned</li> </ul>	Yes
Supports clocked operation	No	<ul style="list-style-type: none"> <li>Suppression of interference voltage for interference frequency f1 in Hz</li> </ul>	50 60
Number of inputs	8	<ul style="list-style-type: none"> <li>Integration time in milliseconds</li> </ul>	60 50
<ul style="list-style-type: none"> <li>For resistance-type sensor</li> </ul>	8	<ul style="list-style-type: none"> <li>Basic conversion time incl. integration time in ms</li> </ul>	66 55
Length of cable		Additional conversion time for resistance measurement in ms	66 55
<ul style="list-style-type: none"> <li>Shielded</li> </ul>	max. 200 m max. 50 m at 50 mV	<ul style="list-style-type: none"> <li>Resolution in bits (incl. overrange)</li> </ul>	13 13 bits 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) $n = 1.2$	
<ul style="list-style-type: none"> <li>Resistance thermometer and resistance measurement 0 ... 600 Ω</li> </ul>	0.83 mA	<ul style="list-style-type: none"> <li>Common-mode interference (<math>U_{CM} &lt; 2 V</math>)</li> </ul>	> 86 dB
<ul style="list-style-type: none"> <li>Resistance measurement 0 ... 6 kΩ</li> </ul>	0.25 mA	<ul style="list-style-type: none"> <li>Series-mode interference (peak value of interference &lt; rated value of input range)</li> </ul>	> 40 dB
Isolation		Crosstalk between the inputs	> 50 dB
<ul style="list-style-type: none"> <li>Between channels and backplane bus</li> </ul>	Yes		
<ul style="list-style-type: none"> <li>Between the channels</li> </ul>	No		
Permitted potential difference			
<ul style="list-style-type: none"> <li>Between the inputs (ECM)</li> </ul>	2.0 VDC		
<ul style="list-style-type: none"> <li>Between the inputs and <math>M_{internal} (U_{ISO})</math></li> </ul>	75 VDC / 60 VAC		
Insulation tested with	500 VDC		
Current consumption			
<ul style="list-style-type: none"> <li>From the backplane bus</li> </ul>	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)		
• Voltage input	± 5 V	± 0.6 %
	± 10 V 1 to 5 V 0 to 10 V	
• Current input	± 50 mV	± 0.5 %
	± 500 mV ± 1 V	
• Resistance	0 to 6 kΩ	± 0.5 %
	0 to 600 Ω	± 0.5 %
• Resistance thermometer	Pt 100	± 1.2 K
	Ni 100	
	Standard	
	Pt 100	± 1 K
	Ni 100 Climatic	
	Ni 1000, LG-Ni 1000 Standard	± 1 K
Ni 1000 LG-Ni 1000 Climatic	± 1 K	
Basic error limit (operational limit at 25 °C, with reference to the input range)		
• Voltage input	± 5 V	± 0.4 %
	± 10 V 1 to 5 V 0 to 10 V	
• Current input	± 50 mV	± 0.3 %
	± 500 mV ± 1 V	
• Resistance	0 to 6 kΩ	± 0.3 %
	0 to 600 Ω	± 0.3 %
• Resistance thermometer	Pt 100	± 1 K
	Ni 100	
	Standard	
	Pt 100	± 0.8 K
	Ni 100 Climatic	
	Ni 1000 LG-Ni 1000 Standard	± 0.8 K
Ni 1000 LG-Ni 1000 Climatic	± 0.8 K	

Temperature error (with reference to the input range)	± 0.006 %/K / 0.006 K/K	
Linearity error (with reference to the input range)	± 0.1 %/ 0.1 K	
Repeat accuracy (steady state at 25 °C, with reference to the input range)	± 0.1 % / ± 0.1 K	
<b>Status, Interrupts, Diagnostics</b>		
Interrupts	None	
Diagnostic functions	None	
<b>Data for Selecting a Sensor</b>		
Input range (rated values)/input resistance		
• Voltage	± 50 mV	100 kΩ
	± 500 mV	
	± 1 V	
	± 5 V	
	± 10 V	
• Current	1 to 5 V	
	0 to 10 V	
	± 20 mA	50 Ω
	0 to 20 mA	
	4 to 20 mA	
• Resistance	0 to 6 kΩ	100 MΩ
	0 to 600 Ω	
• Resistance thermometer	Pt 100	100 MΩ
	Ni 100	
	Ni 1000	
	LG-Ni 1000	
	Standard / Climatic	
Permissible input voltage for voltage input U+ (destruction limit)	max. 30 V continuous	
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	

<b>Connection of the sensor</b> <ul style="list-style-type: none"> <li>• For measuring voltage                      Possible</li> <li>• For measuring current <ul style="list-style-type: none"> <li>As two-wire transmitter              Possible, with external supply</li> <li>As four-wire transmitter              Possible</li> </ul> </li> <li>• For measuring resistance <ul style="list-style-type: none"> <li>With 2-conductor terminal              Possible</li> <li>With 3-conductor terminal              Possible</li> <li>With 4-conductor terminal              Possible</li> </ul> </li> </ul>		<b>Characteristic linearization</b> <ul style="list-style-type: none"> <li>• For resistance thermometer              Parameters can be assigned Pt 100 Standard / Climatic Ni 100 Standard / Climatic Ni 1000 Standard / Climatic LG-Ni 1000 Standard / Climatic</li> <li>• Technical unit for temperature measurement              Degrees Celsius, degrees Fahrenheit, Kelvin</li> </ul>	
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## 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		
• Temperature unit	Degrees Celsius, degrees Fahrenheit, Kelvin*	Degrees Celsius		Module

\* 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".

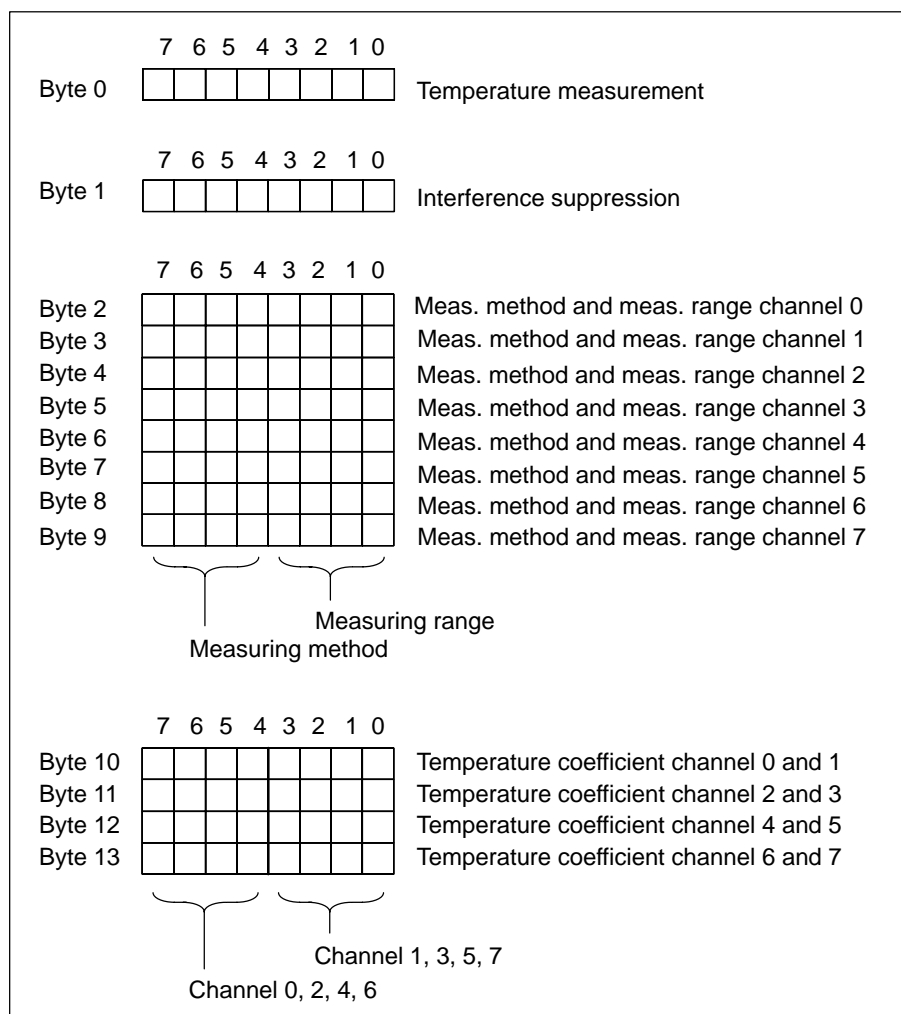


Figure 2 Record 1 of the Parameters of the Analog Input Modules



## 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

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## 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).

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### Note

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

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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 kΩ	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 Ω/Ω/°C (ITS-90)	Pt 100	2#0100
Ni 0.006180 Ω/Ω/°C	Ni 100 / Ni 1000	2#1000
Ni 0.005000 Ω/Ω/°C	LG-Ni 1000	2#1010