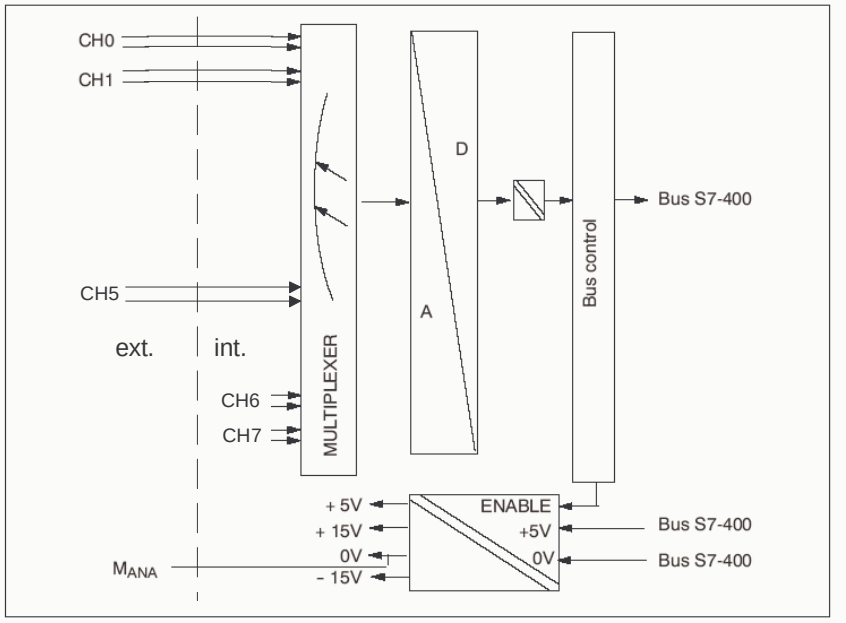
Analog Input Module SM 431 - BEG; AI 6 x 14 Bit; (6AG1431-1KF20-4AY0, based on 6ES7 431-1KF20-0AB0)

Characteristics

The analog input module SM 431; AI 6 x 14 Bit has the following features:

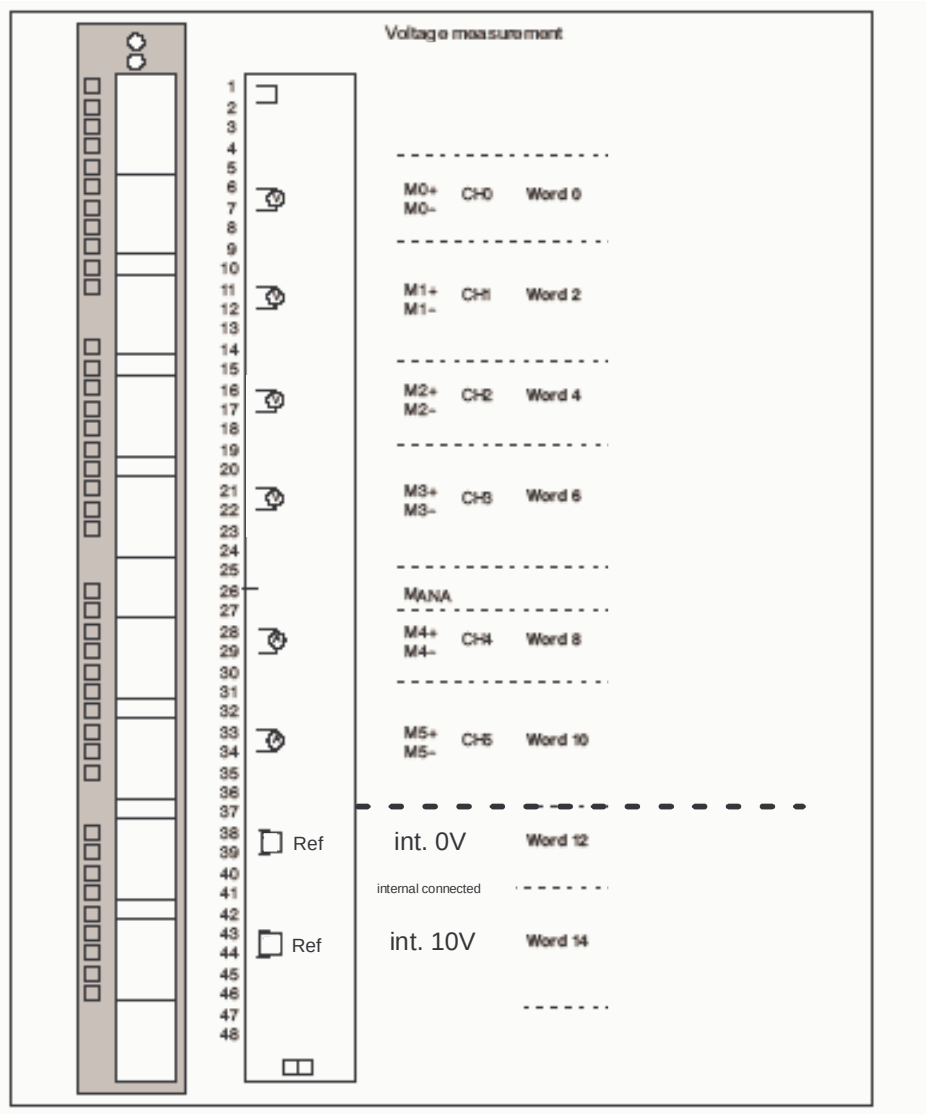
- Rapid A/D changeover, therefore particularly suitable for highly dynamic processes
- 6 inputs for voltage measurement
- Fixed measuring range ±10V
- 14-bit resolution
- Supply voltage: 24 VDC required only for the connection of 2-wire transmitters
- Analog section isolated from CPU
- The maximum permissible common mode voltage between the channels and between the reference potential of the connected sensors and MANA is 8 VAC

Block Diagram of the 431; AI 6 x 14 bits



Block Diagram of the SM 431; AI 6 x 14 Bit

Terminal Assignment Diagram of the SM 431; AI 6 x 14 Bit



Terminal Assignment Diagram of the SM 431; AI 6 x 14 Bit

Caution: Only connect terminals for Voltage input (CH0..CH5) and for M_{ANA}. All other terminals are not connected or are internal used.

Technical Specifications of the SM 431; AI 6 x 14 Bit

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	25 x 290 x 210
Weight	Approx. 500 g

Data for Specific Module	
Number of inputs	6
• Only voltage measurement	
Length of cable	
• Shielded	Max. 200 m

Voltage,Potentials	
• External voltage supply for the inputs	Not necessary
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	No
Permitted potential difference	
• Between inputs and M_{ANA} (U_{CM})	8 VAC
• Between the inputs (E_{CM})	8 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC/60 VAC
Insulation tested	
• Between bus and analog section	2120 VDC
• Between bus and chassis	500 VDC
• Between analog section and L+/M	707 VDC
• Between analog section and chassis ground	2120 VDC
• Between M and chassis ground	2120 VDC

Current consumption	
• From the backplane bus	Max. 1000 mA
Power dissipation of the module	Typ. 4.9 W

Analog Value Generation	
Measuring principle	Actual-value conversion
Integration time/ conversion time/resolution (per channel)	(Does not go into the response time)
• Parameters can be assigned	Yes
• Interference voltage suppression f1 in Hz	None/400/60/50
• Basic conversion time	52 µs
• Resolution (incl. overrange)	14/14/14
Smoothing if the measured values	Can be configured “none - a lot”
Time constant of the input filter	15 µs
Basic execution time of the module, in ms (all channels enabled)	0.420

Suppression of interference, Limits of Error

Interference voltage suppression configured for
f = nx (f1 ±1%), (f1 = interference frequency) n = 1, 2 ,
...
filter 400/60/50 Hz

• Common-mode Interference (U_{CM} < 11 V_{ss})	>80 db
• Series-mode interference (peak value of interference < rated value of input range)	>40 db
Crosstalk between the inputs	> 70 db

Each channel low pass filtering -6dB @ 159 Hz

Operational limit (in the entire temperature range, with reference to the input range)

• Voltage input	
- ± 10 V	± 0.15 %

Basic error (operational limit at 25℃, referred to input range

• Voltage input	
- ± 10 V	± 0.1 %
Temperature error (with reference to the input range)	± 0.002 % K
Linearity error (with reference to the input range)	± 0,001 % K
Repeat accuracy (in the steady state at 25 ℃, referred to the input range)	± 0.05 %

Status, Interrupts, Diagnostics

Interrupts	None
Diagnostic functions	None
Substitute value can be applied	No

Data for Selecting a Sensor

Input range (rated values) / Input impedance	
• Voltage ± 10 V	>200kΩ (OFF-state) >80MΩ (ON-state)
Maximum input voltage for voltage input (destruction limit)	Max. 18 V continous; 75 V for 1 ms (cycle factor 1 : 20)
Connection of the signal Sensor	
• For measuring voltage	Possible
• For measuring current	Not Possible
• For measuring resistance	Not Possible

Commissioning the SM 431; AI 6 x 14 Bit

Measuring Range Modules

Fixed ± 10V

Parameters

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

Parameter	Value Range	Default[1)]
Measurement • Measuring type • Measuring range • Interference suppression • Smoothing	U Voltage fixed 400 Hz; 60 Hz; 50 Hz; none None High	U ± 10 V 50 Hz None

1) Only in the CC (central controller) is it possible to start up the analog modules with the default settings.

Smoothing of the Measured Values

You can only set strong smoothing for the SM 431; AI 6 x 14 Bit.

The module cycle time is a constant, irrespective of how many channels are enabled. It therefore has no effect on the filter settling time, which is defined by the parameter assignment of interference frequency suppression and smoothing.

Note

It is only advisable to parameterize smoothing if you also parameterize interference frequency suppression; otherwise, the measured value resolution will be reduced to 9 bits (analog value representation is right aligned in this case).

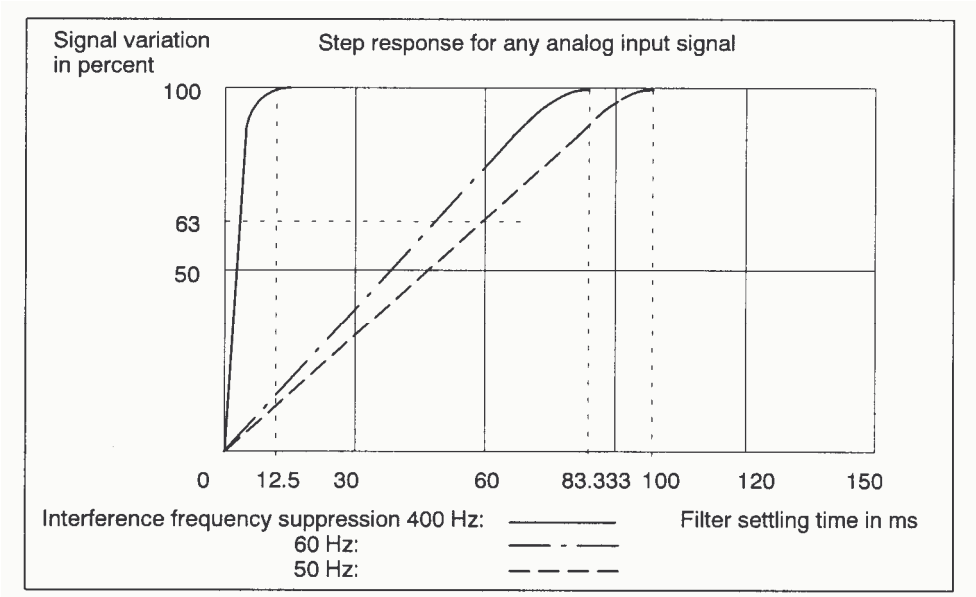
Filter Settling Time with Strong Smoothing

Interference Frequency Suppression and Filter Settling Time with Smoothing of the SM 431; AI 6 x 14 Bit (6AG1431-1KF20-4AY0)

Interference Suppression	Smoothing	Filter settling time in ms
None	High	-
50 Hz	High	100
60 Hz	High	83.333
400 Hz	High	12.5

Step Response with Strong Smoothing

The following figure shows the filter settling time after which, in the case of a step response, the smoothed analog value is applied to almost 100%, depending on the interference frequency suppression that has been set. The figure applies to every change of signal at an analog input.



Step Response of the SM 431; AI 6 x 14 Bit (6AG1431-1KF20-4AY0)

General Information

The SM 431-BEG based on the standard SM 431 AI 8 x 14. The modifications are done only in hardware (input resistance, references, and filter) to get the actual specification.
Note that a successful operation in terms of accuracy only works with an additional function block. Hereby the values of CH0…CH5 first have to be corrected with an offset compensation (CH6 / word 12) and then with a gain scale (CH7 / word 14) each time. The offset value (word 12) has to be subtracted from the values CH0…CH5, and a nominal value (Ref 10,00V = 6C00**h**) divided by the gain reference (word 14) has to be multiplied with the result of the offset compensation.

For example:

Actual value CH0	**Offset value CH6**	**REF CH7**	**Corrected value CH0**
35FFh	0008h	6BF0h	**35FEh**

This calculation is done as follows:

35FFh – 8h = 35F7; (= result of the offset compensation)

35F7h * (6C00h / 6BF0h) = **35FEh (= correct measured value)**

In addition to this specification all not mentioned data can get from the standard description of the SM431 – 6ES7 431-1KF20-0AB0.