

SIEMENS

Product Information

SIMATIC S7-300

Analog Output Module SM 332; AO 4 × 16 Bit as of Version $\frac{X|2}{3|4}$

New Analog Output Module Available

The S7-300 Analog Output Module SM 332; AO 4 × 16 Bit has been added to the S7-300 family. The order number for this module is 6ES7 332-7ND02-0AB0.

This product information includes details about the characteristics and technical specifications of the Analog Output module SM 332; AO 4 × 16 Bit. Refer to the *S7-300 Installation and Hardware Manual* for more information about the S7-300 product family.

You will also learn:

- How to start up the analog output module
- The output ranges available for the analog output module
- How to configure the analog output module

Additional Assistance

For assistance in answering technical questions, for training on this product, or for ordering, contact your Siemens distributor or sales office.

Analog Output Module SM 332; AO 4 × 16 Bit; (6ES7 332-7ND02-0AB0)

Order No.

6ES7 332-7ND02-0AB0

Characteristic Features

The Analog Output Module SM 332; AO 4 × 16 Bit has the following characteristic features:

- 4 outputs in 4 channel groups
- Individual output channels can be programmed as
 - voltage outputs
 - current outputs
- Resolution of 16 bits
- Supports clocked operation
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable substitute value output
- Galvanic Isolation between:
 - backplane bus interface and analog output channels
 - the different analog output channels
 - analog output and L+, M
 - backplane bus interface and L+, M

Terminal Connection Diagram

Figure 1 shows the analog terminal connection diagram and the wiring diagram for the Output Analog Module SM 332 AO 4 × 16 Bit.

The detailed technical specifications for this analog output module are on the following page.

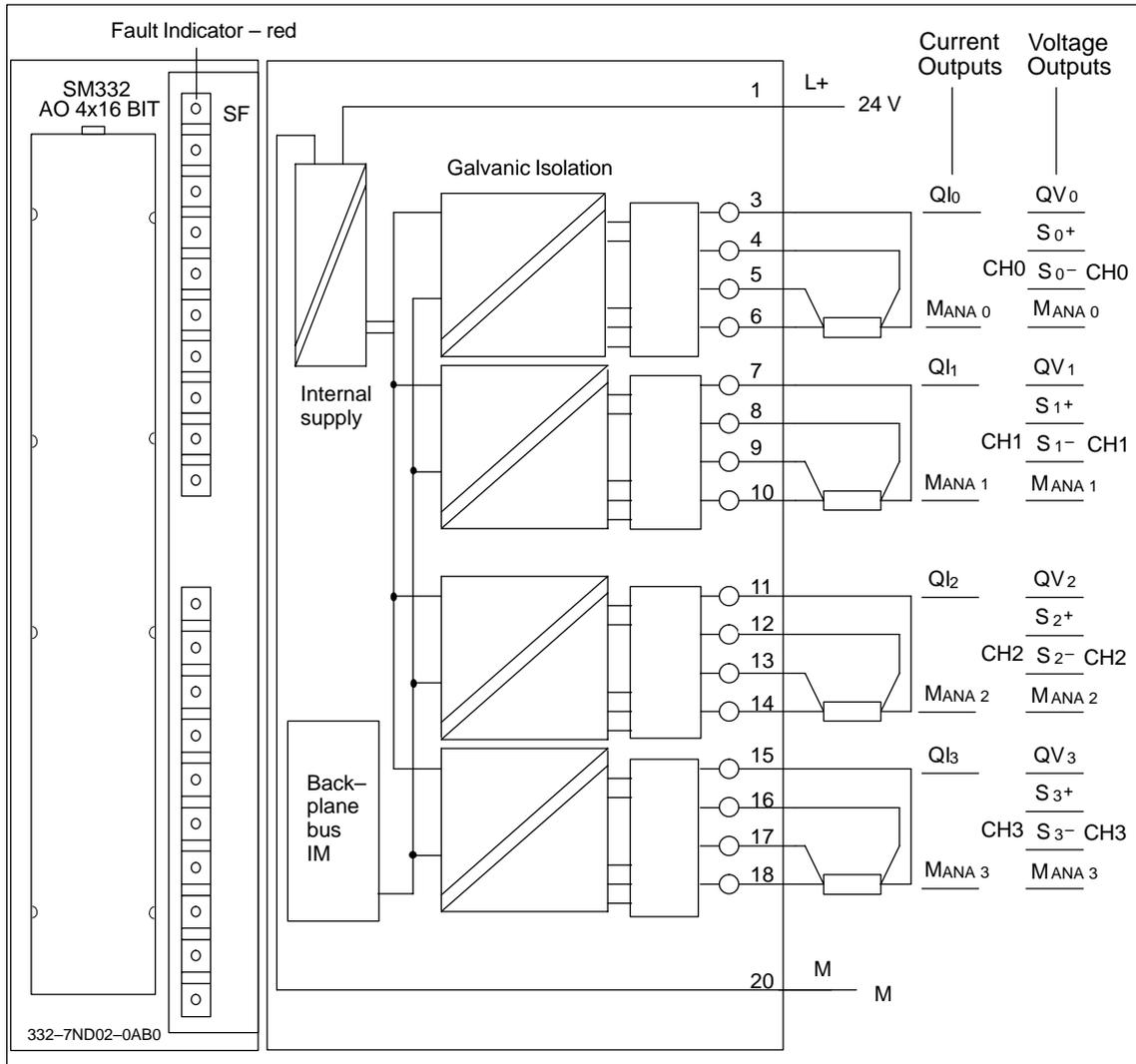


Figure 1 Connection Diagram of Analog Output Module SM 332; AO 4 x 16 Bit

Note

Switching the rated load voltage (L+) on and off, can cause wrong intermediate values at the output for approximately 10 ms.

Hazardous Location Information

“Power, input and output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods [Article 501-4 (b) of the National Electric Code, NFPA 70] and in accordance with the authority having jurisdiction.”

Peripheral equipment must be suitable for the location it is used in.

The equipment must be suitable for use in Class I, Div. 2, Groups A, B, C, and D Hazardous Locations and nonhazardous locations only.



Warning **Explosion Hazard**

Substitution of components may impair suitability for Class I, Div. 2 Hazardous Locations. Different or lesser quality components may cause an explosion or other hazardous situation, which could result in death or serious injury, and/or damage to equipment.

To avoid potentially hazardous situations, always use the appropriate components.



Warning **Explosion Hazard**

Never disconnect equipment before powering off or before ascertaining that the area is nonhazardous. Disconnecting equipment before powering off or in a hazardous area may cause an explosion, which could result in death or serious injury, and/or damage to equipment.

To avoid potentially hazardous situations, always power off equipment and assure that the area is nonhazardous before disconnecting.

Dimensions and Weight		Analog Value Generation	
Dimensions W × H × D (in millimeters)	40 × 125 × 117	Resolution including sign	
Weight	Approx. 220 g	• ± 10 V	16 bits
Data for Specific Module		• 0 to 10 V	15 bits
Supports clocked operation	Yes	• 1 to 5 V	14 bits
Number of outputs	4	• ± 20 mA	16 bits
Length of cable		• 0 to 20 mA	15 bits
• Shielded	max. 200 m	• 4 to 20 mA	15 bits
Voltages, Currents, Potentials		Conversion time (per channel)	
Power rated voltage of the electronics L+	24 VDC	• In standard mode	< 200 μs
• Reverse polarity protection	Yes	• In clocked mode	640 μs
Isolation		Basic response time of module (all channels enabled)	
• Between channels and backplane bus	Yes	• In standard mode	< 800 μs
• Between channels and power supply of the electronics	Yes	• In clocked mode	750 μs
• Between the channels	Yes	Settling time	
Permitted potential difference		• For resistive load	0.2 ms
• Between the outputs (E _{CM})	DC 200 V/AC 120 V	• For capacitive load	3.3 ms
• Between M _{ANA} and M _{internal} (E _{ISO})	DC 200 V/AC 120 V	• For inductive load (1 mH)	0.5 ms
Insulation tested with	DC 1500 V	• For inductive load (10 mH)	3.3 ms
Current consumption			
• From the backplane bus	max. 120 mA		
• From the power supply L+	max. 290 mA		
Power dissipation of the module	typ. 3 W		

Suppression of interference, Limits of Error		Status, Interrupts, Diagnostics	
Crosstalk between the outputs	> 100 dB	Interrupts	
Operational limit (in the entire temperature range, with reference to the output range)		• Diagnostics interrupt	Parameters can be assigned
• Voltage output	±0.12%	Diagnostics functions	Parameters can be assigned
• Current output	±0.18%	• Group error display	Red LED (SF)
Basic error (operational limit at 25° C, with reference to the output range)		• Diagnostics information can be displayed	Possible
• Voltage output		Substitute value can be applied	Yes. Parameters can be assigned
± 10 V	± 0.02%	Data for Selecting an Actuator	
0 to 10 V	± 0.02%	Output ranges (rated values)	
1 to 5 V	± 0.04%	• Voltage	± 10 V 0 to 10 V 1 to 5 V
• Current output		• Current	± 20 mA 0 to 20 mA 4 to 20 mA
± 20 mA	± 0.02%	Load resistance (in the nominal range of the output)	
0 to 20 mA	± 0.02%	• For voltage outputs	min. 1 kΩ
4 to 20 mA	± 0.04%	Capacitive load	max. 1 µF
Temperature error (with reference to the output range)		• For current outputs	max. 500 Ω
• Voltage output	± 0.0025% / K	Inductive load	max. 1 mH
• Current output	± 0.004% / K	Voltage output	
Linearity error (with reference to the output range)	± 0.004%	• Short-circuit protection	Yes
Repeatability (in steady state at 25° C, with reference to the output range)	±0.002%	• Short-circuit current	max. 40 mA
Output ripple; bandwidth 0 to 50Khz (with reference to the output range)	±0.05%	Current output	
		• No-load voltage	max. 18 V

Destruction limit against voltages/currents applied from outside	
• Voltage to the outputs against M_{ANA}	max. 15 V continuous; 75 V for max. 1 s (pulse duty factor 1:20)
• Current	max. DC 50 mA
Connection of actuators	
• For voltage output	Possible
Four-conductor connection (measuring circuit)	
• For current output	Possible
Two-conductor connection	

Synchronous Operation

Characteristics

Reproducible response times (i.e., of equal length) are achieved in SIMATIC with an equidistant DP bus cycle and synchronization of the following individual asynchronous cycles:

- Asynchronous cycle of the user program. Cycle length can vary, due to acyclical program branches.
- Asynchronous, variable DP cycle on the PROFIBUS subnet
- Asynchronous cycle on the DP slave backplane bus
- Asynchronous cycle during signal conditioning and conversion in the electronic modules of the DP slaves

With equidistance, the DP cycle operates in the same clock cycle, with the same length. The execution levels of a CPU (OB61 to OB64) and the synchronous I/O are synchronized with this clock cycle. Thus, I/O data are transferred in defined, constant time intervals (synchronous operation). The maximum "jitter" is $\pm 50 \mu\text{s}$.

Requirements

- The DP master and DP slave must support synchronous operation. You must have Step 7 Version 5.2 or higher.

Operating Mode: Synchronous Operation

The following conditions are applicable for synchronous operation:

Table 1 Conditions for Synchronous Operation

Processing and activation time T_{WA} between read in of output value in the transfer buffer and loading in the output DAC	750 μ s
T_{DPmin}	1100 μ s
Diagnostic interrupt	4 x $T_{DP, max}$

Processing and Output Update Time

The same time conditions are always applicable, irrespective of the number of channels programmed.

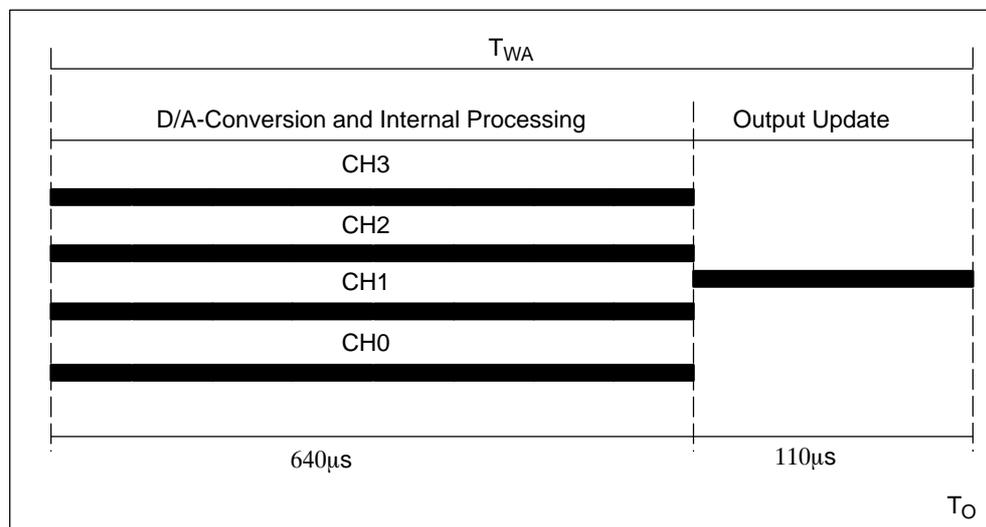


Figure 2 Calculation of the Processing Time and Output Update Time

Description of the Method of Functioning in Synchronous Operation

At time $T_0 - T_{WA}$, the module reads in the output data and saves the data internally. Following internal processing time for each channel, the results are written to each D/A converter.

Additional Information

You will find additional information about synchronous operation in the STEP 7 online Help, the *ET 200M Distributed I/O System manual* and the *Synchronous Operation Manual*.

Starting Up the Analog Output Module SM 332; AO 4 × 16 Bit

Parameter Assignment

The Analog Output Module SM 332; AO 4 × 16 Bit is set using one of the following methods.

- With STEP 7 (see the *STEP 7 User Manual*)
- In the user program by means of SFCs (see the *STEP 7 System and Standard Functions Reference Manual*)

Note

If you modify output ranges when the Analog Output Module SM 332; AO 4 x 16 Bit is in operation, intermediate values can appear at the output.

Default Setting

The Analog Output Module SM 332; AO 4 × 16 Bit has default settings for the type of output, diagnostics, interrupts, etc. (see Table 1).

These default settings apply if you do not re-initialize the module with STEP 7.

Table 1 Parameters and Default Settings for the Analog Output Module SM 332 AO 4 x 16 Bit.

Parameter	SM 332; AO 4 × 16 Bit		Parameter Type	Scope
	Value Range	Default Settings		
Enable • Diagnostics interrupt	Yes/No	No	Dynamic	Module
Diagnostics • Channel Diagnostics	Yes/No	No	Static	Channel
Response with CPU-STOP	LWH Hold last value ASS Output de-energized	ASS	Dynamic	Channel
Output • Output Type	Deactivated Voltage Current	U	Dynamic	Channel
• Output Range	0 to 20 mA 4 to 20 mA ± 20 mA 1 to 5 V 0 to 10 V ± 10 V	± 10 V	Dynamic	Channel

Parameter Assignment in the User Program

You can configure each output channel of the SM 332; AO 4 × 16 Bit individually. This allows you to assign individual parameters for each output channel. When you set the parameters in the user program, the parameters are assigned to channel groups. Each output channel of the Analog Output Module SM 332; AO 4 × 16 Bit is then assigned to one channel group, i.e. output channel 0 = channel group 0.

Unused Output Channels

To ensure the unused output channels of the Analog Output Module SM 332; AO 4 × 16 Bit are not active. You must deactivate them and leave them open. Deactivate the output channel using the "Output" parameter block when you program with STEP 7.

Substitute Values

You can configure the SM 332; AO 4 × 16 Bit for the CPU operating mode STOP as follows: Outputs De-energized, Hold Last Value or Inject Substitute Values. If you inject substitute values, they must be within the output range.

Output Ranges for the Analog Output Module SM 332; AO 4 x 16 Bit

Analog Outputs

You can use the outputs of the Analog Output Module SM 332; AO 4 × 16 Bit as:

- Voltage outputs
- Current outputs

Set the outputs group-wise, using STEP 7 for programming the output type.

Output Ranges

Set the output ranges for the voltage and/or current outputs with STEP 7.

Table 2 lists all the possible output ranges for the Analog Output Module SM 332; AO 4 × 16 Bit.

Table 2 Output Ranges for Analog Output Module

Selected Type of Output	Description	Output Range
Voltage	Table 3 and Table 4 show the digital analog values in the analog output range.	1 to 5V 0 to 10 V ± 10 V
Current	Table 3 and Table 4 show the digital analog values in the analog output measuring range.	0 to 20 mA 4 to 20 mA ± 20 mA

Default Settings

The default settings of the module are “Voltage” for the output type and “± 10 V” for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 4 × 16 Bit in STEP 7.

Analog Value Representation of the Output Ranges for the Analog Output Module SM 332; AO 4 × 16 Bit

Introduction

The tables in this section contain the digitized analog values for the various output ranges of the analog output module.

How to Read the Output-Value Tables

Tables 3 and 4 contain the digital analog values for the various output ranges.

Since the binary representation for the analog values is always the same, these tables only contain the output values and the units.

Voltage and Current Output Ranges

Table 3 shows the representation of the digitized output value:

- For the voltage output ranges ± 10 V and
- For the current output range ± 20 mA.

Table 3 Representation of the Digital Output Value of the Analog Output Module (Voltage and Current Output Ranges)

Range	System Word Units		Output Range ± 10 V	Output Range ± 20 mA
	Decimal	Hexadecimal		
Overflow	32767	7FFF _H	0.0000	0.0000
Overrange	32511	7EFF _H	11.7589	23.515
	∴ 27649	∴ 6C01 _H	∴ 10.0004	∴ 20.0007
Nominal Range	27648	6C00 _H	10.00	20.000
	20736	5100 _H	7.5	14.998
	∴	∴	∴	∴
	-20736 -27648	AF00 _H 9400 _H	-7.5 -10.00	-14.998 -20.000
Underrange	-27649	93FF _H	-10.0004	-20.0007
	∴ -32512	∴ 8100 _H	∴ -11.7589	∴ -23.515
Underflow	-32768	8000 _H	0.0000	0.0000

Table 4 shows the representation of the digitized output value:

- For the voltage output ranges 1 to 5 V, 0 to 10 V and
- For the current output ranges 0 to 20 mA, 4 to 20 mA

Table 4 Representation of the Digital Output Value of the Analog Output Module (Voltage and Current Output Ranges)

Range	System Word Units		Output Range 1 to 5 V	Output Range 0 to 10 V	Output Range 0 to 20 mA	Output Range 4 to 20 mA
	Decimal	Hexadecimal				
Overflow	32767	7FFF _H	0.0000	0.0000	0.0000	0.0000
Ovrange	32511	7EFF _H	5.8794	11.7589	23.515	22.810
	∴ 27649	∴ 6C01 _H	∴ 5.0002	∴ 10.0004	∴ 20.0007	∴ 20.0005
Nominal Range	27648	6C00 _H	5.000	10.00	20.000	20.000
	20736	5100 _H	4.000	7.50	14.998	16.000
	∴ 0	∴ 0 _H	∴ 1.000	∴ 0.000	∴ 0.000	∴ 4.000
Under- range	-1	FFFF _H	0.9999	0.0000	0.0000	3.9995
	∴ -6912	∴ E500 _H	∴ 0.0000	∴ 0.0000	∴ 0.0000	∴ 0.0000
Underflow	-32768	8000 _H	0.0000	0.0000	0.0000	0.0000

