MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

Siemens

PRODUCT MODEL

6ES7135-4MB02-0AB0

Two-channel High Feature Current Output. Relevant section pages: 7, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19, 20, 21. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

2AO I HF analog electronic module (6ES7135-4MB02-0AB0); 04/2007, A5E01076972-01

Siemens original documentation and product reference

Selected original Siemens equipment manual for 6ES7135-4MB02-0AB0, 04/2007. It supplements the ET 200S system operating instructions and retains the timing-dependent cable restriction and IM151-7 startup note.

AMIKON PRODUCT SUPPORT

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Amikon Limited prepared this independent reference package. Selected manufacturer pages follow with their original content and pagination visible.

SIEMENS

SIMATIC

ET 200S distributed I/O
2AO I HF analog electronic module
(6ES7135-4MB02-0AB0)

Manual

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04/2007
A5E01076972-01

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Ⓟ 09/2007

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Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions for the ET 200S are described in the *ET 200S Distributed I/O System* Operating Instructions.

The information in this document along with the operating instructions enables you to commission the ET 200S.

Basic knowledge requirements

To understand these operating instructions you should have general knowledge of automation engineering.

Scope of the manual

This manual applies to this ET 200S module. It describes the components that are valid at the time of publication.

Recycling and disposal

Thanks to the fact that it is low in contaminants, this ET 200S module is recyclable. For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Additional support

If you have any questions relating to the products described in these operating instructions, and do not find the answers in this document, please contact your local Siemens representative.

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Properties

1

1.1 2AO I HF analog electronic module (6ES7135-4MB02-0AB0)

Properties

- 2 outputs for current output
- Output range:
  - ± 20 mA, resolution 15 bits + sign
  - 4 mA to 20 mA, resolution 15 bits
- Isolated from the load voltage L+
- Supports isochronous operation
  - Minimum time for the synchronous DP cycle (T_{DPmin}): 0.7 ms
  - Minimum conversion time of the output modules: (T_{WAmin}): 0.5 ms
- Supports I&M functions

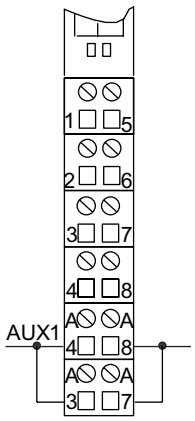
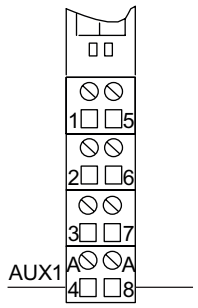
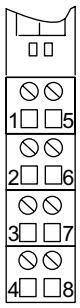
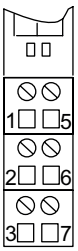
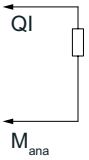
General terminal assignment

Note

Terminals 4, 8, A4, A8, A3 and A7 are only available at specified terminal modules.

Terminal assignment for 2AO I HF (6ES7135-4MB02-0AB0)				
Terminal	**Assignment**	**Terminal**	**Assignment**	**Notes**
1	QI_0	5	QI_1	• QI_n: Current analog output, Channel n • M_{ana}: Ground of the module • n.c.: Not connected (max. 30 V DC can be connected) • AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)
2	n.c.	6	n.c.	
3	M_{ana}	7	M_{ana}	
4	n.c.	8	n.c.	
A4	AUX1	A8	AUX1	
A3	AUX1	A7	AUX1	

Usable terminal modules

Usable terminal modules for 2AO I HF (6ES7135-4MB02-0AB0)				
TM-E15C26-A1 (6ES7193-4CA50-0AA0)	TM-E15C24-A1 (6ES7193-4CA30-0AA0)	TM-E15C24-01 (6ES7193-4CB30-0AA0)	TM-E15C23-01 (6ES7193-4CB10-0AA0)	← Spring terminal
TM-E15S26-A1 (6ES7193-4CA40-0AA0)	TM-E15S24-A1 (6ES7193-4CA20-0AA0)	TM-E15S24-01 (6ES 193-4CB20-0AA0)	TM-E15S23-01 (6ES7193-4CB00-0AA0)	← Screw-type terminal
TM-E15N26-A1 (6ES7193-4CA80-0AA0)	TM-E15N24-A1 (6ES7193-4CA70-0AA0)	TM-E15N24-01 (6ES7193-4CB70-0AA0)	TM-E15N23-01 (6ES7193-4CB60-0AA0)	← Fast Connect
				Sample connection 

Block diagram

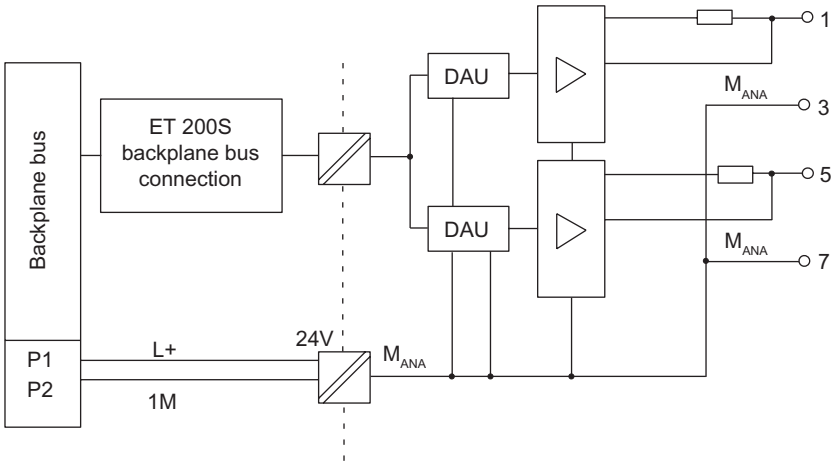


Figure 1-1 Block diagram of the 2AO I HF

2AO I HF technical data (6ES7135-4MB02-0AB0)

Dimensions and weight	
Width (mm)	15
Weight	Approx. 40 g
Module-specific data	
Supports isochronous operation	Yes
Supports I&M functions	Yes
Number of outputs	2
Cable length	
• Shielded	Max. 200 m Max. 100 m at T_{WA} < 2 ms
Parameter length	7 bytes
Address space	4 bytes
Analog value representation	S5 and S7 format
Voltages, currents, potentials	
Rated supply voltage of the electronics L+	24 VDC
• Reverse polarity protection	Yes
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between modules and power supply of the electronics	Yes
• Between the channels	No
Permissible potential difference	
• Between M_{ANA} and the central grounding point (U_{iso})	75 V DC/60 V AC
Insulation tested	500 VDC
Current consumption	
• From the power supply L+	Max. 80 mA
Power dissipation of the module	Max. 1.2 W
Status, interrupts, diagnostics	
Diagnostics function	
• Group error display	Red "SF" LED
• Diagnostic information readable	Yes
Substitute values can be applied	Yes, parameterizable
Analog value generation	
Resolution (including sign)	±20 mA/15 bits + sign 4 to 20 mA/15 bits
Conversion time (per channel)	Max. 0.5 ms
Settling time	
• For resistive load	0.3 ms
• For capacitive load	1.0 ms
• For inductive load	0.5 ms

Suppression of interference, limits of error	
Crosstalk between the outputs	< -60 dB
Operational limit (in the entire temperature range, with reference to the output range)	± 0,1 %
Basic error limit (operational limit at 25°C with reference to output range)	± 0,05 %
Temperature error (with reference to the output range)	±0.003%/K
Linearity error (with reference to the output range)	±0.01% (for resistive load)
Repeatability (in steady state at 25°C with reference to output range)	± 0,01 %
Transmitter selection data	
Output range (rated value)	± 20 mA 4 mA to 20 mA
Load impedance (in the rated range of the output)	
• For current outputs • For inductive load	Max. 500 Ω 1 mH
Current output	
• Open circuit voltage	18 V
Destruction limit against voltages/currents applied from outside	
• Voltage at the outputs to M_{ANA}	Max. 15 V continuous; 75 V for max. 1 ms (sampling ratio 1:20)
• Current	Max. 50 mA DC
Connection of actuators	
• Current output two-wire connection	Supported

I&M functions

The I&M data can be read from the module using interface modules with the following order numbers or firmware/product versions (or higher):

Interface module	Order number	Firmware version	Product version
IM151-1 HIGH FEATURE	6ES7151-1BA01-0AB0	V2.0	02
IM151-3 PN	6ES7151-3AA20-0AB0	V4.0	01
IM151-3 PN HIGH FEATURE	6ES7151-3AA20-0AB0	V4.0	01
IM151-3 PN FO	6ES7151-3BB21-0AB0	V4.0	01

Note

Using the module after an IM151-7 CPU

If the module is positioned after an IM151-7 CPU, it outputs the last values before a RUN-STOP transition, provided no values were output by the user program after the STOP-RUN transition.

Take this into account when programming the control function startup (OB100 or OB1).

Reference

For further information on the I&M data, refer to the manuals for the interface modules.

Parameters

2

2.1 Parameters

Table 2-1 Parameters for analog output module

2AO I HF	Range of values	Default setting	Applicability
Group diagnostics (parameter assignment error, internal error)	• Disable • Enable	Disable	Module
Diagnostics: Wire break [1]	• Disable • Enable	Disable	Channel
Response to CPU/master STOP	• No output current or voltage • Substitute a value • Keep last value	No output current or voltage	Module
Type/range of output	• Deactivated • 4 to 20 mA • ± 20 mA	4 to 20 mA	Channel
Substitute value [2]	To 65,535 (value range must lie within the nominal range)	± 20 mA: 0 mA 4 mA to 20 mA 4 mA	Channel

[1] No diagnostics detection between -1.1852 mA and +1.1852 mA.

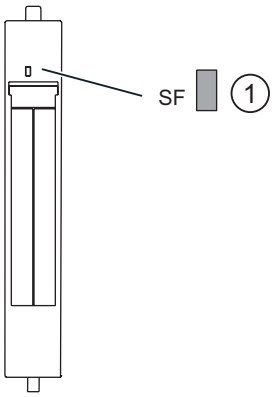
[2] If there is no voltage being supplied to the interface module or COMPACT module but the supply to the analog output modules continues, the substitute values that have been assigned parameters are output. Substitute values must be within the nominal range. You can assign values from -27,648 to +27,648 as parameters (when assigning parameters using the GSD file).

Diagnostics

3

3.1 Diagnostics using LED display

LED display



① Batch error (red)

Status and error displays

Event (LED)	Cause	Remedy
SF		
On	No configuration or incorrect module plugged in. No load voltage.present There is a diagnostic message.	Check the parameter assignment. Check the load voltage. Evaluate the diagnostics.

3.2 Error types

Analog output module error types

Table 3-1 Error types

Error type		Meaning	Remedy
16_D	10000: Parameter assignment error	Module cannot use the parameter for the channel: Inserted module does not match the one configured. Incorrect parameter assignment.	Correct the configuration (align actual and set configuration). Correct the parameter assignment (wire break diagnostics only parameterized for the permitted measuring ranges).
9_D	01001: Error	Internal module error has occurred (diagnostic message on channel 0 applies to the entire module).	Replace the module.
6_D	00110: Open circuit	Line to the final controlling element interrupted.	Correct the process wiring.

Analog value representation

4

4.1 Introduction

Electronic modules with analog outputs

With the electronic modules with analog outputs, digital values set by a controller can be converted to a corresponding analog signal (current) in an analog output module and used to control suitable actuators (setpoint input for speed controllers, temperature controllers and similar).

4.2 Analog value representation for measuring ranges with SIMATIC S7 with 2AO U HF

Analog value representation

With the same nominal range, the digitized analog value is the same for input and output values. Analog values are represented in two's complement.

The following table shows the analog value representation for the analog electronic modules.

Table 4-1 Analog value representation (SIMATIC S7 format)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	S	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Sign

The sign (S) of the analog value is always in bit number 15:

- "0" → +
- "1" → –

Output value

The following table shows the representation of the binary analog values and the corresponding decimal and hexadecimal representation of the units of the analog values.

The table below shows the 11, 12, 13, and 15-bit resolutions + sign. Each analog value is entered left-aligned in the ACCU. The bits marked with "x" are set to "0".

Table 4-2 Output values (SIMATIC S7 format)

Resolution in bits	Units		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
11+S	16	10_H	S 0 0 0 0 0 0 0	0 0 1 x x x x
12+S	8	8_H	S 0 0 0 0 0 0 0	0 0 0 1 x x x
13+S	4	4_H	S 0 0 0 0 0 0 0	0 0 0 0 1 x x
15 + sign	1	1_H	S 0 0 0 0 0 0 0	0 0 0 0 0 0 1

4.3 Output ranges

Output ranges for current: ± 20 mA

Table 4-3 SIMATIC S7 format: Output range ± 20 mA

Output range ± 20 mA	Units		Range
	Decimal	Hexadecimal	
> 23,5150	> 32511	> $7EFF_H$	Overflow
23,5150	32511	$7EFF_H$	Overshoot range
:	:	:	
20,0007	27649	$6C01_H$	
20,0000	27648	$6C00_H$	
14,9980	20736	5100_H	
:	:	:	Nominal range
- 14,9980	-20736	$AF00_H$	
- 20,0000	-27648	9400_H	
- 20,0007	-27649	$93FF_H$	Underrange
:	:	:	
- 23,5160	-32512	8100_H	
< - 23,5160	< -32512	< 8100_H	Underflow

Output ranges for current: 4 to 20 mA

Table 4-4 SIMATIC S7 format: Output range 4 mA to 20 mA

Output range 4 mA to 20 mA	Units		Range
	Decimal	Hexadecimal	
0	> 32511	> $7EFF_H$	Overflow
22,8100 : 20,0005	32511 : 27649	$7EFF_H$: $6C01_H$	Overshoot range
20,0000 : 4,0000	27648 : 0	$6C00_H$: 0_H	Nominal range
3,9995 : 0	-1 : -6912	$FFFF_H$: $E500_H$	Underrange
0	< -6913	< $E4FF_H$	Underflow

4.4 Effect on analog value representation

4.4.1 Effect of the supply voltage and the operating state on analog output values

The output values of the analog modules are dependent on the supply voltage for electronics and on the operating state of the PLC (CPU of the DP master). This is illustrated by the table below.

Table 4-5 Relationship between the analog output values for the operating state of the PLC (CPU of the DP master) and the supply voltage L+.

Operating state of the PLC (CPU of the DP master)		Supply voltage L+ on ET 200S (power module)	Output value of the electronic module with analog outputs
POWER ON	RUN	L+ present	PLC values
			Until first value output: • After startup, a signal of 0 mA or 0 V is output. • Dependent on the parameter "CPU/master STOP"
POWER ON	STOP	L+ present	Dependent on the parameter "CPU/master STOP"
		L+ missing	-
POWER OFF	-	L+ present	Dependent on the parameter "CPU/master STOP"
		L+ missing	-

4.4.2 Effect of the value range on the 2AO I HF analog output

The way electronic modules respond to analog outputs depends on where the output values fall within the value range. This is illustrated by the table below.

Table 4-6 Response of the analog modules, depending on where the analog output value falls within the range of values

Output value falls in ...	Output value in SIMATIC S5/S7 format
Nominal range	Value from DP master
Over-/underrange	Value from DP master
Overflow	0-signal
Underflow	0-signal
Prior to parameter assignment, or incorrect parameter assignment	0-signal

Connecting

5

5.1 Connecting analog outputs

Introduction

This chapter describes the factors to consider when connecting the analog outputs.

Cables for analog signals

You should use shielded and twisted-pair cables for the analog signals. This reduces the effect of interference. You should ground the shield of the analog cables at both ends. If there are differences in potential between the cable ends, an equipotential bonding current that may interfere with the analog signals will flow across the shield. In this case, you should only ground the shield at one end of the cable.

Analog output modules

In the case of the analog output modules there is generally galvanic isolation

- Between logic and backplane bus.
- Between the load voltage and $M_{ANA.}$