

mod. IO-MB/AO-08HL

M.U. IO-MB/AO-08HL-3/09.02
Cod. J30-478-1A01-08HL E

User manual

Contents

- Characteristics
- Functional Block Diagram
- Function Codes used by the module
- Diagnostics
- MODBUS Address Map organisation
- Hardware Setup
- Common parameters
- Module parameters
- MODBUS Map summary
- Parameters Store/Restore
- Three way isolation diagram

MODBUS I/O Module 8 High Level Analogue Outputs mod. IO-MB/AO-08HL



8 Analogue Outputs for:

- 0... 10 V (default)
- 4... 20 mA
- 0... 20 mA

Applicable standards

The AO-08HL module is suited for the Modbus-IDA Organization protocol [1] and implements a subset of it, as explained in the text.
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⚠ WARNING

The product described in this manual should only be installed, operated and maintained by qualified application programmers and software engineers who are familiar with automation safety concepts and applicable national standards.

Characteristics

Technical data

Accuracy at 25°C	±0.1% FS
Temperature coefficient	0.005% FS/K
Load impedance	mA < 600Ω V > 600Ω
Digital resolution	16 bit
Output ranges	0...10 V 0...20 mA 4...20 mA
Conversion time (4 channels)	Enhanced mode: 20 ms
Overvoltage protection	30 V

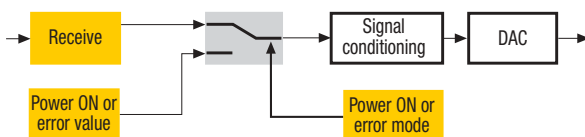
General

3 way isolation (see last page)	Channel to channel to logic: no isolation (channels-logic) to serial bus to power supply: 800 Vp	
Power supply	24 Vdc; -15...+25%	Consumption: 6 W
Dimensions	L: 76; H: 110; W: 65;	
Weight:	220g	
Safety regulations EN61010-1	Isolation class II (50 Vrms), Installation category II	
CE marking	EN61131-2	

Environment

	Operating	Storage
Temperature	-10...+65°C	-40...+85°C
Relative Humidity	5...95% non condensing Appropriate measures must be taken against humidity >85%	5...95% non condensing For a short period, slight condensation may appear on the housing
Mounting Protection	Vertical, free air IP20	
Vibrations (3 axes)	10...57Hz 0.0375mm, 57...150Hz 0.5g	
Shock (3 axes)	15g, 11ms half sine	

Functional Block Diagram



The analogue output function block describes, for each output channel, how received values are actuated. An “error mode value” is provided as well. The signal conditioning block only traduces a 16 bit integer into linear physical or engineering values, i.e:

- 0x0000 → min. value (0V, 4mA, 0mA, other user defined engineering units);
- 0xFFFF → max. value (10V, 20mA, other user defined engineering units).

Function Codes used by the module

			Functions	(hex)	
Data access	Bit access	Physical Digital Inputs	Read Inputs status	02	02
		Internal Bits Or	Read Coil status	01	01
		Physical Digital output	Write Single Coil	05	05
	Word access	Physical Input Registers	Read Input Register	04	04
			Read Holding Registers	03	03
		Or Physical Output Registers	Write Single Register	06	06
			Write Multiple Registers	16	10
Diagnostics			Read Exception status	07	07
			Diagnostics	08	08

The function codes provided for all the modules are a subset of the “Public Function Codes”, validated by the Modbus-IDA Organization.

Function 01 and Function 02 can be used to read both digital output and digital input. Function 03 and Function 04 can be used to read both output and input registers.

Diagnostics

MODBUS Exception Responses:

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server (or slave)
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server (or slave).
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server (or slave)
07	NEGATIVE ACKNOWLEDGE - NAK	The server (or slave) is in the wrong state to process a request of this type or an attempt to write to a read only address has been made

Code 07 has not been provided by Modbus.org Protocol. Use it for ASCON products compatibility only.

Function Code 07: Read Exception Status:

bit	7	6	5	4	3	2	1	0
status	0	0	0	X	X	X	X	X

Digital Input writing attempted (1) → bit 4
 Dummy Data Field (0 fill) (1) → bit 5
 Output Data Valid (1) → bit 6
 Local Value state (1) → bit 7
 Invalid Input Data (1) → bit 0

Function Code 08: Diagnostics

The only supported sub code is 0 – Return Query Data

MODBUS Address Map organisation

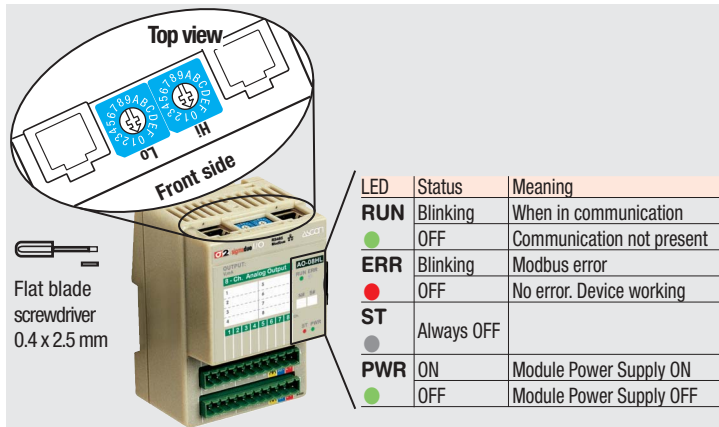
Data Type	Address Range	Sub range	Data sub type
Digital I/O	1 - 400	1 - 100	Physical Digital I/O
		101 - 200	Digital I/O Extension
		201 - 300	Alarms
		301 - 400	Status variables
Registers	1 - 1200	1 - 120	Field/Process I/O Data
		121 - 200	Device Id/Info Area
		201 - 300	Field/Process I/O Extension
		301 - 400	Non retentive Device Management
		401 - 800	Retentive Device Management
		801 - 1000	Configuration Data
		1001 - 1050	Diagnostics
		1101 - 1200	Reserved registers

Writing and reading data length limits:

Number of Digital Outputs to be written in a single message	Max. 128
Number of Digital I/O to be read in a single message	Max. 160
Number of Output Registers to be written in a single message	Max. 16
Number of I/O Registers to be read in a single message	Max. 125

Hardware Set-up

Hexadecimal rotary switches, service and I/O LEDs



Baud Rate and Node ID configuration

Baud Rate

Lo switch	Baud rate bps
0	300
1	1200
2	2400
3	4800
4	9600
5	19200

Node ID

Hi switch	Lo switch	Valid ID Node
0	1	1 (address 1)
0	2	2 (address 2)
↓	↓	↓
F	7	0xF7 (address 247)

Common parameters

Common Digitals

Digital outputs	Name	Access	Notes
397	Parity	R/W	0: Disabled; 1: Enabled
398	EvenOdd	R/W	0: Even; 1: Odd

Common Registers

Output Registers	Name	Access	Notes
400	StackCom	R/W	Modbus Stack Command Register

Commands:

0x0	Normal State
0x5354 (ASCII code "ST")	Store Configuration in non volatile memory
0x5253 (ASCII code "RS")	Restore default configuration values
0x5254 (ASCII code "RT")	RESET (Cold Start)

Output Registers	Name	Access	Notes
801	NodeA	R/W	Node Address Register
802	BaudR	R/W	Baud Rate Register

Baud Rate	Register Value	Node Address	Register Value
300	0	0 reserved	0
1200	1	1	1
2400	2	...	...
4800	3	...	...
9600	4	247	0xF7
19200	5	248..256 reserved	0xF8...0xFF

Procedure for Node Address and Baud Rate configuration

The HI and LO hexadecimal rotary switches set the module's Baud Rate and MODBUS Node Address. To configure the module, follow the procedure:

- 1 Turn the Power OFF
- 2 Set the **HI** and **LO** switches to "F"
- 3 Turn the Power ON
- 4 Select the desired Baud Rate value by setting the **LO** switch following the table (e.g. "4" for 9600 bps)
- 5 Shift the **HI** switch to "E" (all the module service LEDs should flash)
- 6 Turn the Power OFF. Now configure Node ID
- 7 Set the **HI** and **LO** switches to the desired valid Node ID following the table
- 8 Turn the Power ON.

Alternatively, at step 7 set the value 00h (default value). Then, at the next Power ON, the last valid stored value will be resumed as Node ID. The default values are: Baud Rate = 9600 bps, Node ID = 247.

Module Identity Registers

Output Registers	Name	Access	Notes
121	ManuCode	R	Manufacturer Code
122	ProdCode-1	R	Product Code # 1
123	ProdCode-2	R	Product Code # 2
124	RelCode-1	R	Hardware Release Code
125	RelCode-2	R	Software Release Code
126	SpecialCode	R	Special Product Code
127	ProdCode-3	R	Product Code # 3

User defined Registers

Output Registers	Name	Access	Notes
189	Usr#1	R/W	User Defined Register # 1 (retentive)
190	Usr#2	R/W	User Defined Register # 2 (retentive)
...
198	Usr#10	R/W	User Defined Register # 10 (retentive)

Module parameters

Output type selection

Output Registers	Name	Access	Notes
811	InTypeCh-1	R/W	See selection codes
...	...	R/W	
818	InTypeCh-8	R/W	

Selection codes

Type	Register Value
V 0... 10	0
mA 0... 20	1
mA 4... 20	2

Analogue Output

Output Registers	Name	Access	Notes
1	OutAO-1	R/W	The n-th index (from 1 to 8) contains the scaled output value if Power ON or error mode values not programmed
...	...	R/W	
8	OutAO-8	R/W	

Decimal points

Output Registers	Name	Access	Notes
417	DecPointCh-1	R/W	Decimal point position, only for supervision purposes. Does not change the actual output value
...	...	R/W	
424	DecPointCh-8	R/W.	

Analogue Output Power-ON or Error Value

Output Registers	Name	Access	Notes
474	PO OutAO-1	R/W	Device failures shall set the outputs to the value configured by these registers. Default = 0
...	...	R/W	
481	PO OutAO-8	R/W	

Scaling outputs

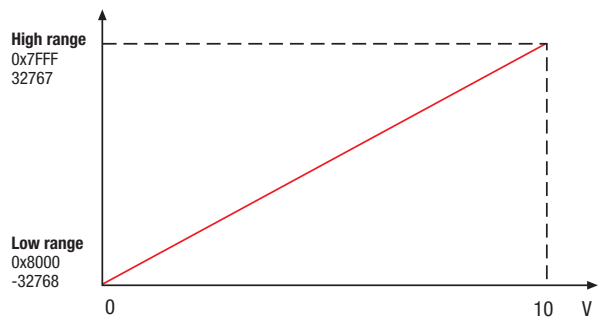
HI range

Output Registers	Name	Access	Notes
401	HI_Ch-1	R/W	Signed integer value (from 0x8000... 0x7FFF from -32768.... 32767)
...	...	R/W	
408	HI_Ch-8	R/W	

LO range

Output Registers	Name	Access	Notes
409	LO_Ch-1	R/W	Signed integer value (from 0x8000... 0x7FFF from -32768.... 32767)
...	...	R/W	
416	LO_Ch-8	R/W	

Scaling example



MODBUS Map summary (with default values)

Modbus address	Module digital I/O	Name	Access	Description	default (hex)
396	397	Parity	R/W	0: Parity Disabled; 1: Parity Enabled	0
397	398	EvenOdd	R/W	0: Parity Even; 1: Parity Odd	0

Modbus address	Module registers	Name	Access	Description	default (hex)
0	1	OutAO-1	R/W	AO Value # 1	
...	...	...	R/W	...	
7	8	OutAO-8	R/W	AO Value # 8	
120	121	ManuCode	R	Manufacturer Code	0258
121	122	ProdCode-1	R	Product Code # 1	3038
122	123	ProdCode-2	R	Product Code # 2	484C
123	124	RelCode-1	R	Hardware Release Code	
124	125	RelCode-2	R	Software Release Code	
125	126	SpecialCode	R	Special Product Code	
126	127	ProdCode-3	R	Product Code # 3	414F
188	189	Usr#1	R/W	User Defined Register # 1	FFFF
189	190	Usr#2	R/W	User Defined Register # 2	FFFF
...	...	Usr#n	R/W	User Defined Register # n	FFFF
197	198	Usr#10	R/W	User Defined Register # 10	FFFF
400	401	HI_Ch-1	R/W	High range # 1	7FFF
...	...	...	R/W	...	7FFF
407	408	HI_Ch-8	R/W	High range # 8	7FFF
408	409	LO_Ch-1	R/W	Low range # 1	8000
...	...	...	R/W	...	8000
415	416	LO_Ch-8	R/W	Low range # 8	8000
416	417	DecPointCh-1	R/W	Number of decimal digits Ch 1	FFFF

...	...	...	R/W	...	FFFF
423	424	DecPointCh-8	R/W	Number of decimal digits Ch 8	FFFF
473	474	PO OutAO-1	R/W	Power ON or error mode value Ch 1	0000
...	...	...	R/W	...	0000
480	481	PO OutAO-8	R/W	Power ON or error mode value Ch 8	0000
800	801	NodeA	R/W	Node Address Register	00F7
801	802	BaudR	R/W	Baud Rate Register	0004
810	811	OutTypeCh-1	R/W	Channel 1 Output type	0000
...	...	...	R/W	...	0000
817	818	OutTypeCh-8	R/W	Channel 8 Output type	0000

WARNING

The data written at retentive and configuration registers are stored in EEPROM (see "Address Map organisation" paragraph for details). This type of memory has a limited number of writing cycles. Also if this number is very high (about 100000 cycles), this limit can be easily reached if the storing process is forced through a serial communications line. Please check that the storing procedure of these registers is not performed automatically.

Parameter Store/Restore

This module allows parameters to be saved in a non volatile memory. In order to avoid storing configuration data parameters (registers 801...1000) by mistake, storage is only executed when a specific signature is written to the appropriate register. The signature is "ST".

Similarly, the default values of parameters are restored. On receipt of the correct signature in the appropriate register, the device restores the default parameters. The signature is "RS".

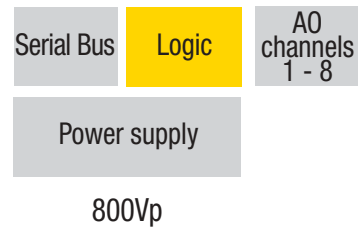
The new configuration becomes active after a reset, i.e. after a "Power Down" or a reset command (signature "RT"). See Register 400.

es.Node address change by serial communications:

1. Write the new address in register 801 (NodeA). - Write value.
2. Write 0x5354 (ASCII code "ST") to register 400. - Store value.
3. Write 0x5254 (ASCII code "RT") to register 400. - Cold reset.

The retentive device management data (registers 401... 800) are immediately valid after writing. To maintain the values after a power OFF/ON cycle, the command Store ("ST") must be executed.

Three way isolation diagram



Reference documents

The user should refer to the following list of documents:
 [1] MODBUS.ORG: MODBUS Application Protocol Specification V1.1a, June 2004

Accessories, Spare Parts and Warranty

Power Supply 45W 24Vdc 2A	AP-S2/AL-DR45-24
Power Supply 120W 24Vdc 5A	AP-S2/AL-DR120-24
Additional Terminal Block 2x11	AP-S2/TB-211-1
Female Plug 11 Screw clamp	AP-S2/SPINA-V11
Female Plug 11 Spring clamp	AP-S2/SPINA-M11
RJ45 terminated cable 14cm	AP-S2/LOCAL-BUS76
RJ45 terminated cable 22cm	AP-S2/LOCAL-BUS152
Termination Adapter	AP-S2/TERM-CAN

Warranty: 3 years excluding defects due to improper use