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mod. IO-MB/AO-08HL

M.U. IO-MB/AO-08HL-1/05.06
 Cod. J30-478-1A01-08HL E

User manual

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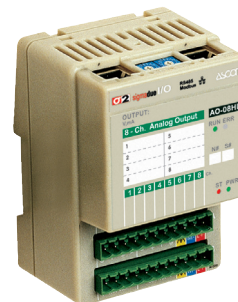
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MODBUS I/O Module 8 High Level Analogue Outputs mod. IO-MB/AO-08HL



8 Analogue Outputs for:

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



COMMON CHARACTERISTICS

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.
 MODBUS is a registered trademark of Schneider Automation Inc.



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

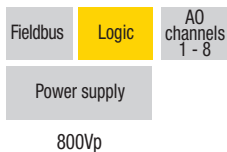
Technical data

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)	Inhanced mode: 20 ms
Overvoltage protection	30 V

General

3 way isolation	800 Vp
Power supply	24 Vdc; -15...+25%
Power consumption	6 W
Dimensions	L: 76; H: 110; W: 65
Weight	220 g
Safety regulations	Isolation class II (50 Vrms)
EN61010-1	Installation category II Pollution degree 2
CE marking	EN61131-2

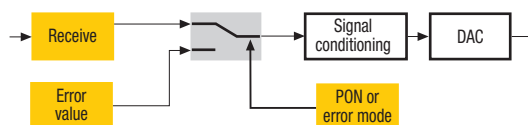
2 way isolation diagram



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	Vertical, free air	
Protection	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:

- 0000h → min. value (0V, 4mA, 0mA, other user defined engineering units);
- FFFFh → max. value (10V, 20mA, other user defined engineering units).

Function Codes used by the module

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

			Function codes	(hex)	
Data access	Bit access	Physical Discrete Inputs	Read Inputs status	02	02
		Internal Bits Or Physical coils	Read Coils status	01	01
			Write Single Coil	05	05
	Word access	Physical Input Register Or Physical Output Registers	Write Multiple Coils	15	0F
			Read Input Register	04	04
			Read Holding Registers	03	03
Diagnostics		Write Single Register	06	06	
		Write Multiple Registers	16	10	
		Read Exception status	07	07	
		Diagnostics	08	08	

MODBUS Address Map organisation

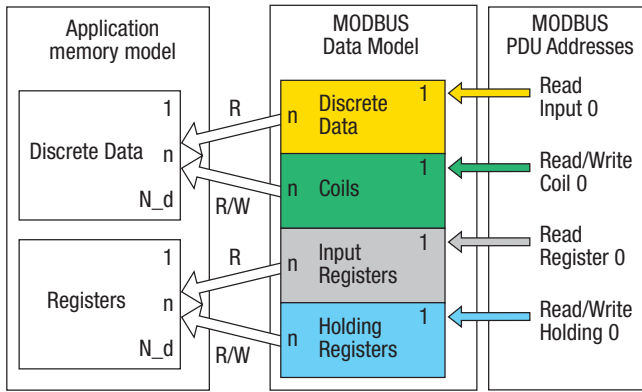
Data Type	Address Range	Sub range	Data sub type
Discrete Data	1 - 400	1 - 100	Physical Digital I/O
		101 - 200	Digital I/O Extension
		20 - 300	Alarms
		301 - 400	Status variables
Registers	1 - 1200	1 - 120	Field/Process I/O Data
		121 - 200	Device Id/Info Area
		201 - 300	Field/Process I/O Extension
		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 Coils to be written in a single message	Max. 128
Number of Coils to be read in a single message	Max. 160
Number of Registers to be written in a single message	Max. 16
Number of Registers to be read in a single message	Max. 125

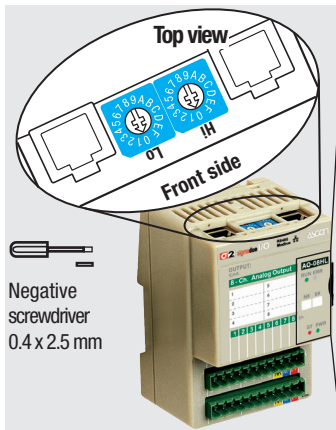
APPLICATION MEMORY MODEL VS. MODBUS DATA MODEL

Discrete inputs and Coils tables will be overlapped, as well as Input and Holding Registers.



Hardware Set-up

Hexadecimal rotary switches, service and I/O LEDs



LED	Status	Meaning
RUN	ON	Operational
	Blinking	Pre-operational (CANopen)
	Single flash	STOPPED
	OFF	Device in RESET state
	ON	BUS OFF
ERR	Single flash	Warning limit reached
	Double flash	Error Control Event
	Triple flash	Sync Error (CANopen)
	OFF	No error. Device working
	ON	DIAG Error
ST	Blinking	INIT and DIAG running
	Single flash	Baud rate setting
	OFF	Module OK and ready
PWR	ON	Module Power Supply ON
	OFF	Module Power Supply OFF

Common Registers and 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

Discrete 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 (0000h) – Return Query Data

Common Discrete

Discrete #	Name	Access	Notes
396	ByteOrder	RW	0: Big Endian (Motorola) 1: Little Endian (Intel)
397	Parity	RW	0: Parity Disabled 1: Parity Enabled
398	EvenOdd	RW	0: Parity Even 1: Parity Odd

Bit Rate and Node ID configuration

Bit rate			Node ID		
Lo switch	Baud rate bps	Bus length m	Hi switch	Lo switch	Valid ID Node
0	300	-	0	1	01h (address 1)
1	1200	-	0	2	02h (address 2)
2	2400	-	↓	↓	↓
3	4800	-	F	7	F7h (address 247D)
4	9600	1000			
5	19200	500			

Procedure for Node Address and Bit Rate configuration

The HI and LO hexadecimal rotary switches set the module's Bit 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 Bit 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. Then, at the next Power ON, the last valid stored value will be resumed as Node ID. The default values are: Bit Rate = 9600 bps, Node ID = 247D.

The following discrete inputs and registers define the analogue inputs in terms of engineering units, along with the limit alarms.

COMMON REGISTERS

Register	Name	Access	Notes
398	Ch_LO	RW	Channel Number 8-1 selection

Register	Name	Access	Notes
399	ModuleCom	RW	Module Command Register

bit	15	8	7	0
default	0	0	0	0

Commands:

0x0	Normal State (all channels)
0x4C42 (ASCII code "LB")	Local Value State (only for enabled channels see reg. 398)
0x4342 (ASCII code "CB")	Calibration State (uppermost selected channel)

Register	Name	Access	Notes
1049	ModuleDiag	RW	Module Diagnostics Register

bit	15	8	7	0
default	0	0	0	0

Commands:

To be defined	(ST LED Status)
---------------	-----------------

Register	Name	Access	Notes
400	StackCom	RW	Modbus Stack Command Register

bit	15	8	7	0
default	0	0	0	0

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)

Register	Name	Access	Notes
1050	StackDiag	RW	Modbus Stack Diagnostic Register
bit	15		8 7
default	0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0
Commands:			
To be defined		(Run/Err LED Status)	

Register	Name	Access	Notes
801	BaudR	RW	Baud Rate Register
bit	15		8 7
default	0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 1

Register	Name	Access	Notes
802	NodeA	RW	Node Address Register
bit	15		8 7
default	0 0 0 0 0 0 0 0		1 1 1 1 0 1 1 1

Baud Rate	Register Value	Node Address	Register Value
300	0	0 reserved	0 invalid
1200	1	1	1
2400	2
4800	3
9600	4 (default)	247	F7h (default)
19200	5	248..256 reserved	F8h..FFh invalid

MODULE IDENTITY REGISTERS

Register	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

USER DEFINED REGISTERS

Register	Name	Access	Notes
191	Usr#1	R/W	User Defined Register # 1 (retentive)
192	Usr#2	R/W	User Defined Register # 2 (retentive)
...	...	R/W	...
200	Usr#10	R/W	User Defined Register # 10 (retentive)

Parameter configuration

Type of Output

ANALOGUE OUTPUT CHANNEL TYPE

Register	Name	Access	Notes
811	OutTypeCh-1	RW	The n-th index (from 1 to 8) contains the configuration parameter of the n-th
...	...	R/W	
818	OutTypeCh-8	R/W	Analogue Output

Value	Output Type	Condition
0x0000	0...10 V	default
0x0001	0...20 mA	
0x0002	4...20 mA	

Unused bits = 0

Standard parameters

Analogue Output

Register	Name	Access	Notes
1	OutAO-1	RW	The n-th index (from 1 to 8) contains the scaled output value (default = 0) if Power
...	...	R/W	
8	OutAO-8	R/W	ON or error mode values not programmed

ANALOGUE OUTPUT POWER-ON OR ERROR VALUE

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

SCALING OUTPUTS

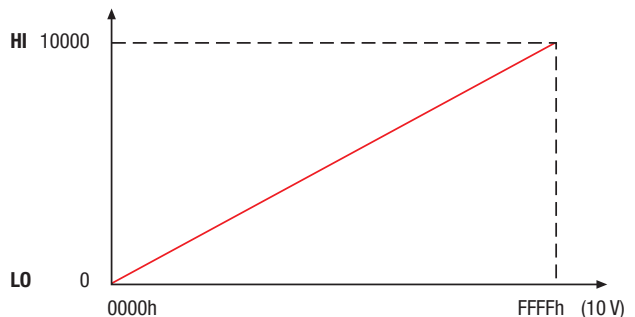
HI range

Register	Name	Access	Notes
401	HI_Ch-1	RW	Max. scaling value
...	...	R/W	
408	HI_Ch-8	R/W	

LO range

Register	Name	Access	Notes
409	LO_Ch-1	RW	Min. scaling value
...	...	R/W	
416	LO_Ch-8	R/W	

Scaling example



CALIBRATION (reserved)

Register	Name	Access	Notes
1102	Calib	RW	Register reserved to the manufacturer
...	
...	

Parameter Store/Restore

This module allows parameters to be saved in a non volatile memory. In order to avoid storing parameters 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.

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
CAN Bus termination Adapter	AP-S2/TERM-CAN

Warranty: 3 years excluding defects due to improper use

MODBUS Map summary (with default values)

Discrete	Name	Access	Description	default (hex)	V
396	ByteOrder	RW	0: Big Endian; 1: Little Endian	0	
397	Parity	RW	0: Parity Disabled 1: Parity Enabled	0	
398	EvenOdd	RW	0: Parity Even 1: Parity Odd	0	

Registers	Name	Access	Description	default (hex)	V
1	OutAO-1	RW	AO Value # 1		
...	...	RW			
8	OutAO-8	RW	AO Value # 8		
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		
191	Usr#1	R/W	User Defined Register # 1	0000	
192	Usr#2	R/W	User Defined Register # 2	0000	
...	Usr#n	R/W	User Defined Register # n	0000	
200	Usr#10	R/W	User Defined Register # 10	0000	
399	ModuleCom	RW	Module Command Register	0000	
400	StackCom	RW	Modbus Stack Command Register	0000	
401	HI_Ch-1	RW	Scaling HI value # 1	FFFF	
...	...	RW	...	FFFF	
408	HI_Ch-8	RW	Scaling HI value # 8	FFFF	
409	LO_Ch-1	RW	Scaling LO value # 1	0000	
...	...	RW	...	0000	
416	LO_Ch-8	RW	Scaling LO value # 8	0000	

474	PO OutAO-1	RW	Power ON or error mode value Ch 1	0000	
...	...	RW	...	0000	
481	PO OutAO-8	RW	Power ON or error mode value Ch 8	0000	
801	NodeA	RW	Node Address Register	00F7	
802	BaudR	RW	Baud Rate Register	0004	
811	OutTypeCh-1	RW	Channel 1 Output type	0000	
...	...	RW	...	0000	
818	OutTypeCh-8	RW	Channel 8 Output type	0000	
1049	ModuleDiag	RW	Module Diagnostics Register	0000	
1050	StackDiag	RW	Modbus Stack Diagnostic Register	0000	
1102	Calib	RW	Calibration		