

Modbus Interface for AM Series Models:

Water Heaters

- AM 399W
- AM 500W
- AM 750W
- AM 1000W

Boilers

- AM 399B
- AM 500B
- AM 750B
- AM 1000B

Rapid Recovery Water Heaters

- AM 199R
- AM 250R
- AM 399R
- AM 500R
- AM 750R
- AM 1000R

USER MANUAL

Modbus Interface

For



AM Series

Boilers and Water Heaters

8	Header sensor (HS)	24Vdc VOLTAGE TERMINALS
9	Header sensor (HS)	
10	Room thermostat (dry contact)	
11	Room thermostat (dry contact)	
12	Tank sensor	
13	Tank sensor	
14	Outdoor sensor (OS)	
15	Outdoor sensor (OS)	
16	Bus (HC command)	
17	Bus (HC command)	
18	RS 485 Modbus T+	
19	RS 485 Modbus T-	
20	RS 485 Modbus GND	
22	0-10 Vdc input (GND)	
23	0-10 Vdc input (+)	
24	Cascade header sensor	
25	Cascade header sensor	
28	Bus (cascade)	
29	Bus (cascade)	

AM Series Junction Box
485 Modbus Interface Connections



Latest Update: 1/11/2016

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TABLE OF CONTENTS

CHAPTER 1: MODBUS CONNECTION.....	3
1.1 Modbus Configuration SETTINGS.....	3
1.2 Modbus Functionality.....	3
1.3 Modbus Holding Registers	4
1.3.1 Control Register.....	4
1.3.2 Controller Type.....	5
1.3.3 Modbus Version	5
1.3.4 Modbus Units	5
1.3.5 Device Type	6
1.4 Pre-Defined Devices.....	7
1.4.1 General Notes.....	7
1.4.2 Boiler Parameter List.....	7
CHAPTER 2: ERROR, STATE, AND, STATUS TABLES.....	10
2.1 Lockout Error Codes Table	10
2.2 Blocking Error Codes Table	11
2.3 State Parameters Table	12
2.4 Status Parameters Table.....	12

CHAPTER 1: MODBUS CONNECTION

1.1 MODBUS CONFIGURATION SETTINGS

The table below summarizes the Modbus configuration details.

Modbus Configuration Settings	
Protocol	Modbus RTU
Default address	0x01 (settable via parameter 3085)
Supported Modbus commands	Read Holding registers (0x03) Write single holding register (0x06)
Baud rate	9600bps
Data Length	8
Parity	None
Stop Bits	2 (settable via parameter 3086)
Physical layer	RS485 (two wire + optional GND)

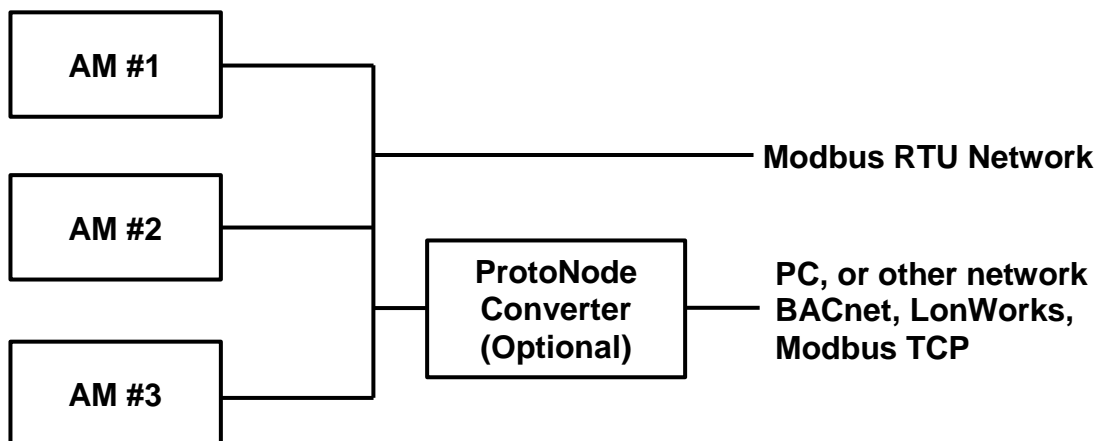
The default setting for the Modbus (dependent) address is 1. The address setting resides in the e2prom of the interface and can be changed if required. This can be done via parameter 3085 in the AM unit Factory Menu. The number of stop bits can be changed via parameter 3086. For further information on Factory Menu parameters, consult Appendix B in user Manual GF-146.

Multiple holding registers can be read (up to all of the available registers for the device), writing of holding registers is limited to one register at a time.

1.2 MODBUS FUNCTIONALITY

The basic modbus functionality gives control over the devices connected by their Modbus interface. The control includes building management systems, remote displays, and PLC control.

On installation, all AM Series devices must be set at a unique Modbus address. To connect to networks other than modbus, bus converters can be connected to the system. The optional bus converter can then scans these addresses for active devices, and map them on the network it needs to convert to. The AERCO ProtoNode Gateway can be used for conversion to BACnet, LonWorks, Metasys N2, and Modbus TCP protocols. For further information, see the ProtoNode Gateway user manual, GF-129.



1.3 MODBUS HOLDING REGISTERS

Modbus communicates using words (the contents of 16bit holding registers). The data that is offered is organized as a list of bytes.

Depending on the type of Modbus software used, the holding register addressing range starts either at 0x0000 or at 0x0001. If your Modbus software starts addressing from 0x0000 you can use the holding register addresses shown in the table above. If your Modbus software addressing range starts at 0x0001 then add 1 to the holding register addresses listed in the table above. This is also true for the various test tools available for Modbus.

1.3.1 Control Register

A special control register is implemented to secure certain modbus actions / commands. To activate these actions / commands, first, the control register must be written.

CAUTION!

This must be done only when initiating a write command to a holding register. Do not send this command when no write enable is needed to prevent holding registers from being corrupted.

Control Register Parameter						
Holding Register		Access		Parameter Name	Automatic Conversion	Range
		R	W			
99	0063	X	X	Control register	-	Bit0: Write enable Bit14: Controller Reset

When no Modbus communication (reading or writing) is sensed for more than 4.0 Seconds the *control register* bits will be reset. The bits will also be reset when undefined bits (i.e. other than bits 0 and 14) are set.

1.3.1.1 Write Enable

The 'Write enable' register controls the reading and writing of the holding registers.

'Write enable' = 0: the data in the holding register is read only.

'Write enable' = 1: the data in the holding register can be written.

CAUTION!

Writing of parameters with a different value is limited to 10,000 times. All (CH,DHW) set points and parameters are for preset only, they can be changed with an average of two changes per day, but are NOT to be used for dynamic temperature control!

1.3.1.2 Controller Reset

A controller may be reset (only) when it is in error. Only Lock out errors can be reset. When the controller is in error, it can be reset by setting bit 14 to the control holding register (0x0063) of the Modbus interface. The Interface board then sends a reset command to the controller over the Argus Link bus. Once it has done this, it resets the reset bit of the Control holding register.

1.3.2 Controller Type

For easier handling of holding registers, the data format can be changed on the modbus interface. This means that all unit conversion is done in the modbus interface (for both reading and writing data).

Controller Type Parameter						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
97	0061	X	-	Main Control Group Number	V	0000 – 10000

The group number will identify the Main Control Group number which identifies specific system settings.

1.3.3 Modbus Version

For easier handling of holding registers, the data format can be changed on the modbus interface. This means that all unit conversion is done in the modbus interface (for both reading and writing data).

Modbus Version Parameter						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
98	0062	X	-	Modbus Version	-	12

On readout the value can be displayed with the unit set in this holding register without conversion other than decimal point correction. So 12 is 1.2.

1.3.4 Modbus Units

For easier handling of holding registers, the data format can be changed on the modbus interface. This means that all unit conversion is done in the modbus interface (for both reading and writing data).

Modbus Units Parameter						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
100	0064	X	X	Modbus Units	-	Bit0: °C / °F Bit1: bar / psi

To change the units, first enable writing in the control register, and then set the appropriate configuration bits in the *Modbus Units* register.

To enable decimals on readout, values are multiplied before they are stored in the holding register. They must be divided on readout to obtain the original value.

- Temperatures: resolution xxx.xx factor 100 Unit as set in Unit register
- Voltages: resolution xx.x factor 10 Unit as set in Unit register

On readout the value can be displayed with the unit set in this holding register without conversion other than decimal point correction.

1.3.5 Device Type

In a complete bus system a lot of different devices may be connected. All these devices supply different data in their holding registers. To make a universal format for equal devices a device type is defined:

Device Type Definition	
DEVICE TYPE	FUNCTION
1	Managing Boiler / Stand-alone Boiler (with build in controller)
2	Dependent Boiler

When reading this *Device Type* register, the fixed format can be found.

NOTE

In some systems the format is defined by the address of the device.

Device Type Parameter						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
101	0065	X	-	Device Type	-	1 = Managing or Stand-alone Boiler 2 = Dependent Boiler 3 = n/a 4 = n/a

1.4 PRE-DEFINED DEVICES

1.4.1 General Notes

For all devices, empty or not, available holding registers return 0. When it is not implemented, requests can be ignored by the Modbus device.

Holding registers below 99 are reserved for legacy devices, and are optional. The functionality of these registers is not changed or influenced by this specification.

1.4.2 Boiler Parameter List

Boiler Parameters						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
100	0064	X	X	Modbus Units	-	Bit0: °C / °F Bit1: bar / psi
101	0065	X	-	Device type	-	1 = Managing / Stand-alone Boiler 2 = Dependent Boiler
102	0066	X	-	State	-	See state table in Section 2.3
103	0067	X	-	Status	-	See status table in Section 2.4
104	0068	X	-	Error Code	-	See error list in Section 2.1
105	0069	X	-	Warning Code	-	See warning list in Section 2.2
106	006A	X	X	Boiler CH setpoint	V	Depending on units °C / °F
107	006B	X	X	Boiler DHW setpoint	V	Depending on units °C / °F
108	006C	X	X	Boiler operation	-	0..x
109	006D	X	X	DHW type	-	0..x
110	006E	X	X	CH mode	-	0..x
111	006F	X	X	DHW mode	-	0..x
112	0070	X	-	Supply temperature	V	Depending on units °C / °F
113	0071	X	-	Return temperature	V	Depending on units °C / °F
114	0072	X	-	DHW temperature	V	Depending on units °C / °F
115	0073	X		Flue gas temperature	V	Depending on units °C / °F
116	0074	X		Heat exchanger temperature	V	Depending on units °C / °F
117	0075	X		Firing Rate	V	0..100%
118	0076	X		Min Firing Rate	V	0..100%
119	0077	X		Flame current	V	0..x uA
120	0078	X		Water pressure	V	Depending on units 0..x bar/psi
121	0079	X		Analog in	V	0..10,0V
122	007A	X		Analog out	V	0..10,0V

Boiler Parameters						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
123	007B	X		Information: (optionally implemented)		Bit0: On/Off - Flame Signal Bit1: Ok/Nok - Water level Bit2: Ok/Nok - Low gas pressure Bit3: Ok/Nok - High gas pressure Bit4: On/Off - Air pressure Bit5: Ok/Nok - Blocked flue Bit6: On/Off - Air damper Bit7:
124	007C	X		CH pump	V	0/100 or 0..100%
125	007D	X		DHW pump	V	0/100 or 0..100%
126	007E	X		Ignition count OK		0..65536, resolution 16
127	007F	X		Ignition count Failed		0..65536, resolution 1
128	0080	X	-	Flame count Failed	-	0..65536, resolution 1
129	0081	X	-	Burner High hours / CH Hours	-	0..65536 hours
130	0082	X	-	Burner Med hours / DHW Hours	-	0..65536 hours
131	0083	X	-	Burner Low hours	-	0..65536 hours
-	..	-	-	Reserved	-	-
150	0096	X		Dependent State	-	See state table
151	0097	X	-	Dependent Status	-	See status table
152	0096	X	-	Dependent Error Number	-	See error list
153	0096	X	-	Dependent Firing Rate	V	0..100%
-	-	-	-	Reserved	-	-
199	00C7	-	-	Reserved	-	-

Controller (Managing) Parameters						
HOLDING REGISTER		ACCESS		PARAMETER NAME	AUTOMATIC CONVERSION	RANGE
		R	W			
200	00C8	X		Controller State	-	See controller state table
201	00C9	X		Controller Status	-	See controller status table
202	00CA	X		Controller Error Code	-	See controller error list
203	00CB	X		Controller Warning Code	-	See controller warning list
204	00CC	X	X	Controller CH setpoint	V	Depending on units °C / °F
205	00CD	X	X	Controller DHW setpoint	V	Depending on units °C / °F
206	00CE	X	X	High Outdoor Air temperature	V	Depending on units °C / °F
207	00CF	X	X	Minimum outdoor air setpoint	V	Depending on units °C / °F
208	00D0	X	X	Low outdoor air temperature	V	Depending on units °C / °F
209	00D1	X	X	Maximum Outdoor air setpoint	V	Depending on units °C / °F
210	00D2	X	X	Outdoor air shutdown temperature	V	Depending on units °C / °F
211	00D3	X	X	Night Setback	-	Depending on units °C / °F
212	00D4	X	-	Header temperature	V	Depending on units °C / °F
213	00D5	X	-	Outside temperature	V	Depending on units °C / °F
214	00D6	X	-	Cascade Firing Rate	V	0..100%
215	00D7	X	-	Min Firing Rate	V	0..100%
216	00D8	X	-	System pump	V	0/100 or 0..100%
	..	-	-	reserved	-	-
299	012B	-	-	reserved	-	-

CHAPTER 2: ERROR, STATE, AND, STATUS TABLES

2.1 LOCKOUT ERROR CODES TABLE

Lockout errors are indicated by an 'A' displayed before the error code number.

"A" Lockout Error Codes			
'A' CODE	ERROR NAME	INT. #	DESCRIPTION
1	IGNIT_ERROR	1	Three unsuccessful ignition attempts in a row
2	GV Relay Error	2	Failure detected in the GV Relay
3	GV Relay not open error	3	Failure detected in the GV Relay
4	GV Relay not closing error	4	Failure detected in the GV Relay
5	Safety relay error	5	Failure detected in the Safety Relay
6	Safety relay open error	6	Failure detected in the Safety Relay
7	Safety relay closed error	7	Failure detected in the Safety Relay
11	Blocking too long error	11	Control had a blocking error for more than 20 hours in a row.
12	Fan error	12	Fan MF deviation for more than 60 sec
13	Ram error	13	Internal software error
14	Wrong eeprom signature	14	Contents of e2prom is not up-to-date
15	X ram error	15	Internal software error
16	E2prom error	16	No communication with E2prom
17	E2prom error safety C	17	Wrong safety parameters in e2prom
18	E2prom error Calibration table	18	Wrong calibration table parameters
19	State error	19	Internal software error
20	Rom error	20	Internal software error
21	Rom error C	21	Internal software error
22	Air sw not open	22	Air pressure switch not working
23	15MS XRL error	23	Internal software error
24	Air sw not closed	24	Air pressure switch not working
25	Max Temp. Error	25	The external overheat protection is activated
26	Stack error	26	Internal error
27	Flame out too late	27	Flame still present 10 sec. after closing the gas valve
28	Flame error 1	28	Flame is detected before ignition
29	20MS XRL error	29	Internal software error
30	41MS XRL error	30	Internal software error
31	Too many flame failures	31	Three times flame lost during one demand
32	Flow switch not closed	32	Flow switch not working / No flow
33	Flow switch not open	33	Flow switch not working / No flow
34	Flag byte integrity	34	Internal software error
35	AD Hi cpl.	35	Internal software error
36	AD Lo cpl.	36	Internal software error
37	Register error	37	Internal software error

2.2 BLOCKING ERROR CODES TABLE

The following errors are related to the general control functions. Blocking errors are indicated by an 'E' before the error code number.

"E" Blocking Error Codes			
'E' CODE	ERROR NAME	INT. #	DESCRIPTION
45	WD INTERNAL ERROR	45	Internal software error
46	WD INTERNAL ERROR	46	Internal software error
47	WD INTERNAL ERROR	47	Internal software error
48	WD INTERNAL ERROR	48	Internal software error
49	WD INTERNAL ERROR	49	Internal software error
50	REFHI TOO LO	50	Internal hardware error
51	REFHI TOO HI	51	Internal hardware error
52	REFLO TOO LO	52	Internal hardware error
53	REFLO TOO HI	53	Internal hardware error
54	FALSE FLAME	54	Flame is detected, but no flame is observed.
55	WATER LEVEL DETECT	55	Low water level detected
56	WATER LEVEL MEAS	56	Low water level measurement error
57	LOW WATER CUTOFF	57	Low water sensor error
58	LOW WATER PRESSURE	58	Low water pressure error
59	WATER PRESSURE SENSOR	59	Low water pressure
60	FLUE GAS PRESSURE	60	Flue gas pressure error
61	RETURN TEMP	61	Return temperature is higher than stay burning temperature
62	BLOCKED DRAIN	62	Block drain switch is active
64	WD FREQ ERROR	64	No Frequency signal or no communication with the WD
65	PHASE ERROR	65	Hot neutral reversed
66	NET FREQ ERROR	66	Net freq. error detected in the main
67	FAULTY EARTH ERROR	67	Faulty earth connection
68	WD COMM ERROR	68	Watchdog communication error
72	SUPPLY OPEN	72	Supply sensor open
73	RETURN OPEN	73	Return sensor open
76	DHW OPEN	76	DHW sensor open
80	SUPPLY SHORTED	80	Supply sensor shorted
81	RETURN SHORTED	81	Return sensor shorted
84	DHW SHORTED	84	DHW sensor shorted
86	FLUE SHORTED	86	Flue sensor shorted
87	RESET BUTTON	87	Reset button error
93	APPLIANCE SELECTION	93	Appliance selection error
107	GAS PRESSURE ERROR	107	Gas too low
108	FLUW PRESSURE ERROR	108	Flue gas pressure error
109	TRIO_MASTER_ERROR	109	Trio master error
110	FLAP_NOT_OPEN	110	Flap not open
111	FLAP_NOT_CLSD	111	Flap not closed
112	FLOW_SWT_NOT_CLSD_BL	112	Flow switch not closed
113	PASSWORD_INCORRECT	113	Password incorrect
114	TOO_LOW_WATER_FLOW	114	Water flow for CH is too low.
115	MULTI_BRN_PARAM_ERROR	115	Multiple burner settings are incorrect.

2.3 STATE PARAMETERS TABLE

The table below lists a detailed description of the possible values of the *STATE* parameter.

MN States			
STATE		STATE NAME	DESCRIPTION
Dec.	Hex		
0	0x00	RESET_0	initialising
1	0x01	RESET_1	initialising
2	0x02	STANDBY_0	standing by (waiting for demand)
3	0x03	PRE_PURGE	initiating boiler demand handling
4	0x04	PRE_PURGE_1	initiating boiler demand handling
5	0x05	SAFETY_ON	initiating boiler demand handling
6	0x06	SAFETY_OFF	initiating boiler demand handling
7	0x07	IGNIT_0	initiating boiler demand handling
8	0x08	IGNIT_1	initiating boiler demand handling
9	0x09	BURN_0	handle boiler demand
10	0x0A	RELAY_TEST_0	
11	0x0B	RELAY_TEST_1	
12	0x0C	POST_PURGE_0	ending boiler demand handling
13	0x0D	POST_PURGE_1	ending boiler demand handling
14	0x0E	PUMP_CH_0	handling ch demand without boiler demand
15	0x0F	PUMP_CH_1	Post pumping after ch demand end
16	0x10	PUMP_HW_0	handling hw demand without boiler demand
17	0x11	PUMP_HW_1	Post pumping after dhw demand end
18	0x12	ALARM_1	Error handling
19	0x13	ERROR_CHECK	error handling
20	0x14	BURNER_BOOT	controller (re)start
21	0x15	CLEAR_E2PROM_ERROR	error handling
22	0x16	STORE_BLOCK_ERROR	error handling
23	0x17	WAIT_A_SECOND	error handling

2.4 STATUS PARAMETERS TABLE

- The *STATUS* parameter values are described below

MN Status			
STATUS		STATUS NAME	DESCRIPTION
Dec.	Hex		
0	0x00	STANDBY	standing by (waiting for demand)
14	0x0E	BLOCK	error handling
10	0x0A	ALARM	error handling
15	0x0F	FROST_PROTECT	demand for frost protection
16	0x10	CH	demand for central heating
17	0x11	RESET_STATE	initializing
18	0x12	STORAGE	demand for store
19	0x13	TAP	demand for tap (hw)
20	0x14	PRE_HEAT	demand for pre heat (of hw heat exchanger)
21	0x15	STORE_WARM_HOLD	demand for pre heat (of hw store)
22	0x16	GENERAL_PUMPING	

NOTES:

Change Log:

Date	Description	Changed By
11/18/2015	Rev-B: Misc. Changes	Curtis Harvey
1/11/2016	Rev C: DIR 309: Changed "2=Independent Boiler" to "2=Dependent Boiler" on page7	Chris Blair



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