

The AROS implementation of MODBUS protocol for the String Box device follows the document *MODBUS over serial line specification and implementation guide V1.02*, downloadable from www.modbus.org.

In detail the MODBUS frame implemented:

- Is transmitted in RTU mode with the exception that parity used is “none”
- The frame has the form Slave Address/Function Code/Data/CRC as in the following picture:

Slave Address	Function Code	Data	CRC
1 byte	1 byte	0 up to 252 byte(s)	2 bytes <small>CRC Low, CRC Hi</small>

- The function codes are those of the Modicon implementation, and in detail:
 Read Input Status = function code 0x02
 Read Holding Register = function code 0x03
 Preset Single Register = function code 0x06
 Set multiple register = function code 0x10

In AROS implementation of the Data section:

- The addresses of the registers follow the old Modicon MODBUS implementation, where we have MSByte first, followed by LSByte.
- The registers are transmitted as words of 16 bits, LSByte first, followed by MSByte, if not differently indicated in the description tables.

The Modbus mapping of the String Box is divided into the following sections:

- Status registers
- Alarm registers
- Measures
- Configuration
- Identification

Status registers:

MODBUS Read = Read Input Status, addr. In range [10001;10001]

Register	Bit	Name	Description	Units
1	1	Hw_conf_1	Bit 1 of Hw_conf	
	2	Hw_conf_2	Bit 2 of Hw_conf	
	3	Hw_conf_3	Bit 3 of Hw_conf	
	4	Hw_conf_4	Bit 4 of Hw_conf	
	5			
	6			
	7			
	8			
	9	Addr_1	Bit 1 of address	
	10	Addr_2	Bit 2 of address	
	11	Addr_3	Bit 3 of address	
	12	Addr_4	Bit 4 of address	
	13	Addr_5	Bit 5 of address	
	14	Addr_6	Bit 6 of address	
	15	Addr_7	Bit 7 of address	
	16	Addr_8	Bit 8 of address	

Alarm registers:

MODBUS Read = Read Input Status, addr. In range [10160; 10207]

Register	Bit	Name	Description	Units
10	1	String1_alarm	Measure of current of string 1 in alarm	
	2	String2_alarm	Measure of current of string 2 in alarm	
	3	String3_alarm	Measure of current of string 3 in alarm	
	4	String4_alarm	Measure of current of string 4 in alarm	
	5	String5_alarm	Measure of current of string 5 in alarm	
	6	String6_alarm	Measure of current of string 6 in alarm	
	7	String7_alarm	Measure of current of string 7 in alarm	
	8	String8_alarm	Measure of current of string 8 in alarm	
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	11	1	V_IN_alarm	V_IN measure in alarm
2		Input_1	Insulated input 1 status	
3		Input_2	Insulated input 2 status	
4		RTC_Fault	RTC communication fault	
5		Eeprom_fault	Eeprom communication fault	
6		REF_V_fault	Reference voltage measure fault	
7		Calibration Err	Calibration procedure error	
8		IO_in1	Discharger alarm (alarm = input at ZERO, contact J3[1;2] open)	
9		IO_in2	Auxiliary contact	
10		I_Null	Null current persistence alarm (it's active after N days of null current, see parameter)	
11		LINK	Power board link status	
12		Strings	Strings in alarm	
13				
14				
15				
16				
12	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			

Register	Bit	Name	Description	Units
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			

Sample:

Request:

02 02 00 A0 00 20 79 C3

Answer:

02 02 04 01 00 02 08 C9 B8

In this example Strings = 1, Input 1 closed, String1 in alarm.

Measures:

MODBUS Read = Read Holding Register, addr. in range [40020; 40049] and in range [40050;40052]

Register	Bit	Name	Description	Units
20		I_String_1	String current, input 1	0.1 A
21		I_String_2	String current, input 2	0.1 A
22		I_String_3	String current, input 3	0.1 A
23		I_String_4	String current, input 4	0.1 A
24		I_String_5	String current, input 5	0.1 A
25		I_String_6	String current, input 6	0.1 A
26		I_String_7	String current, input 7	0.1 A
27		I_String_8	String current, input 8	0.1 A
28				
29				
30				
31				
32				
33				
34				
35				
36		V_REF	Reference voltage	0.001 V
37		V_IN	Input voltage	0.1 V
38		Analog1	Generic analog	
39		Analog2	Generic analog	
40		HwConfig	(Internal use)	
41		Temp1	Probe 1 temperature	0.1 K
42		Temp2	Probe 1 temperature	0.1 K
43		4_20MA low ¹		0.1 mA
44		4_20MA high		
45		0_10V low		0.1 V
46		0_10V high		
47				
48				
49				
50		Dip-switch	dip-switch reading	8 bit più bassi
51		Generic I/O	I/O generic reading	8 bit più bassi
52		NumAlarms	Number of alarms	N in [0:65535]
53				
54				
55				
56				

¹ The values of the two probes are transmitted on two words.

Register	Bit	Name	Description	Units
57				
58				
59				

Configuration registers:

MODBUS Read = Read Holding Register, addr. In range [40100; 40203]

MODBUS Write = Set multiple register, block mode only: 100-106; 108-115, 124-131, 140-171, 200-206. Other write modes are not supported.

In order to save in Eeprom the actual configuration, use the write command on address 600.

Register	Bit	Name	Description	Units
100		DateSet_Hour	Hour [0:23]	N
101		DateSet_Min	Minutes [0:59]	N
102		DateSet_Sec	Seconds [0:59]	N
103		DateSet_Day	Day[1:31]	N
104		DateSet_Month	Month [1:12]	N
105		DateSet_Year	Year [2009:...]	N
106		I_Days_Alarm	Days for I_Null	Days
107				
108		Num_strings_1	Number of strings on input 1	% ²
109		Num_strings_2	Number of strings on input 2	%
110		Num_strings_3	Number of strings on input 3	%
111		Num_strings_4	Number of strings on input 4	%
112		Num_strings_5	Number of strings on input 5	%
113		Num_strings_6	Number of strings on input 6	%
114		Num_strings_7	Number of strings on input 7	%
115		Num_strings_8	Number of strings on input 8	%
116				
117				
118				
119				
120				
121				
122				
123				
124				
125				
126				
127				
128				
129				
130				
131				
132				
133				
134				
135				
136				

² In units of 0.1% The range is from 0 to 1000.

Register	Bit	Name	Description	Units
137				
138				
139				
140		Input_1_win1	Window 1 for measure 1	³
141		Input_1_win2	Window 2 for measure 1	
142		Input_1_win1_start	Initial date for window 1	⁴
143		Input_1_win2_start	Initial date for window 2	
144		Input_2_win1	Window 1 for measure 2	
145		Input_2_win2	Window 2 for measure 2	
146		Input_2_win1_start	Initial date for window 1	
147		Input_2_win2_start	Initial date for window 2	
148		Input_3_win1	Window 1 for measure 3	
149		Input_3_win2	Window 2 for measure 3	
150		Input_2_win1_start	Initial date for window 1	
151		Input_3_win2_start	Initial date for window 2	
152		Input_4_win1	Window 1 for measure 4	
153		Input_4_win2	Window 2 for measure 4	
154		Input_4_win1_start	Initial date for window 1	
155		Input_4_win2_start	Initial date for window 2	
156		Input_5_win1	Window 1 for measure 5	
157		Input_5_win2	Window 2 for measure 5	
158		Input_5_win1_start	Initial date for window 1	
159		Input_5_win2_start	Initial date for window 2	
160		Input_6_win1	Window 1 for measure 6	
161		Input_6_win2	Window 2 for measure 6	
162		Input_6_win1_start	Initial date for window 1	
163		Input_6_win2_start	Initial date for window 2	
164		Input_7_win1	Window 1 for measure 7	
165		Input_7_win2	Window 2 for measure 7	
166		Input_7_win1_start	Initial date for window 1	
167		Input_7_win2_start	Initial date for window 2	
168		Input_8_win1	Window 1 for measure 8	
169		Input_8_win2	Window 2 for measure 8	
170		Input_8_win1_start	Initial date for window 1	
171		Input_8_win2_start	Initial date for window 2	

³ This is a 16 bits mask; each bit represents an hour starting from 6 AM up to 9 PM; if bit is 1, the measure is valid.

⁴ Two bytes: one for the month, the other for the day of the month.

Register	Bit	Name	Description	Units
200		TD	This is the time, expressed in seconds, going from the first occurrence of the fault and its declaration.	1 sec (default <u>300</u>)
201		TO	Tolerance	% (default 20%)
202		SINIZ	Initial check string threshold	%
203		NOT USED	-	
204		AlarmRele1Mask	Enabling alarm mask for relais 1	
205		AlarmRele2Mask	Enabling alarm mask for relais 2	
206		IsolatedInputPolarity	See Note 2	
207-218		4/20mA Label	Label of probe 4/20 mA	12 byte
219		4_20mA_min	Minimum value	4 byte
221		4_20mA_max	Maximum value	4 byte
222-233		0/10V Label	Label of probe 0/10 V	12 byte
234		0_10V_min	Minimum value	4 byte
236		0_10V_max	Maximum value	4 byte

Note 1: For the parameters TO, SINIZ, 4_20mA_xxx and 0_10V_xxx: the decimal part is transmitted first, the integer part comes next, so 20.5% is obviously:

05	14
----	----	-----	-----

Identification registers:

MODBUS Read = Read Holding Register, addr. In range [40500; 40503]

Register	Bit	Name	Description	Unità di m.
500		Fw version	High byte: Major, lower byte: minor	
501-510		Serial number	Serial number.	
511-520		Vendor	Vendor string	
521		N_CHANN	Number of channels available	
522		FS_A	Maximum current supported on a single string channel.	A

Command registers:

MODBUS Write = Preset Single Register, addr. In range [40600; 40601]

Register	Bit	Name	Description	Units
600		Save Configuration	Save configuration on non-volatile memory (eeprom)	-
601		Relais 1 ON		
602		Relais 1 OFF		
603		Relais 2 ON		
604		Relais 2 OFF		
605		ZeroAlarmCount	Zero the counter of alarms	
606		Default Config	Restore to default configuration	
607		Log Download	Start of download of log	
608		Log Erase	Erase the log	
609		Cal command 1	Command for calibration of first parameter of PT100 probes	
610		Cal command 2	Command for calibration of second parameter of PT100 probes	
611		Cal command break	Command to stop the calibration procedure and restore of the old calibration parameters.	

Detailed description of the download of the log:

- 1) The MODBUS master writes to 607 address
- 2) The String Box answers with log data or with a special acknowledge, this last one telling the records are over.
- 3) Optionally the master can wipe the log out writing to address 608.

Example:

The master writes to 607 address:

0x01	0x06	0x02	0x5F	0x00	0x01	0x01	0x01	CHK1	CHK2
------	------	------	------	------	------	------	------	------	------

The String Box answers with log data:

0x01	0x06	0x02	0x5F	0x00	0x20	CHK1	CHK2
------	------	------	------	------	------	----	----	------	------

..

..

Or with:

0x01	0x06	0x02	0x5F	0x00	0x01	0x01	0x01	CHK1	CHK2
------	------	------	------	------	------	------	------	------	------

When download is finished. If the log is empty, this last message is received as answer to the very first write to 607 address.

Sample MODBUS messages:

Request:30/11/2009 16.12.45.71364 (+12.1241 seconds)

01 03 01 F4 00 17 45 CA ...ô...EÊ

Answer:30/11/2009 16.12.45.88564 (+0.1719 seconds)

01 03 2E 02 01 30 00 31 00 32 00 33 00 34 00 350.1.2.3.4.5
 00 36 00 37 00 38 00 39 00 20 00 00 00 00 00 00 .6.7.8.9.
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 08 00 C8È
 00 9B 17 .>

Request:30/11/2009 16.12.45.05664 (+0.1719 seconds)

01 03 01 F4 00 17 45 CA ...ô...EÊ

Answer:30/11/2009 16.12.45.22864 (+0.1719 seconds)

01 03 2E 02 01 30 00 31 00 32 00 33 00 34 00 350.1.2.3.4.5
 00 36 00 37 00 38 00 39 00 20 00 00 00 00 00 00 .6.7.8.9.
 00 00 00 00 00 00 00 00 00 00 00 00 00 00 08 00 C8È
 00 9B 17 .>

Request:30/11/2009 16.12.46.46364 (+0.2344 seconds)

01 03 00 C8 00 27 84 2E ...È.'''

Answer:30/11/2009 16.12.46.66664 (+0.2031 seconds)

01 03 4E 1E 00 00 14 00 05 01 00 80 0A FF 0E 00 ..N..... .ÿ..
 00 6D 00 41 00 20 00 20 00 20 00 20 00 20 00 20 .m.A.
 00 20 00 20 00 20 00 20 00 00 00 80 40 00 00 A0 @..
 41 57 00 2F 00 6D 00 32 00 20 00 20 00 20 00 20 AW./m.2. . . .
 00 20 00 20 00 20 00 20 00 00 00 00 00 00 00 96 -
 44 27 34 D'4

Request:30/11/2009 16.12.46.86964 (+0.2031 seconds)

01 03 00 14 00 1B 45 C5EÅ

Answer:30/11/2009 16.12.46.04164 (+0.1719 seconds)

01 03 36 7B 00 6E 00 6A 00 77 00 7B 00 65 00 70 ..6{n.j.w.{e.p
 00 6C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .l.....
 00 00 00 6A 09 73 00 28 00 28 00 00 02 FF FF FF ...j.s.(...ÿÿÿÿ
 FF FF FF FF FF 58 02 00 00 3C AB ÿÿÿÿX...<<

Request:30/11/2009 16.12.46.27564 (+0.2344 seconds)

01 02 00 A0 00 20 79 F0 yð

Answer:30/11/2009 16.12.46.40064 (+0.1250 seconds)

01 02 04 00 00 00 00 FB E2ûâ

Request:30/11/2009 16.12.47.68164 (+0.2812 seconds)

01 03 00 32 00 03 A4 04 ...2...α.

Answer:30/11/2009 16.12.47.82264 (+0.1406 seconds)

01 03 06 01 00 08 00 13 00 2F F4/ô

Request:30/11/2009 16.12.47.08764 (+0.2656 seconds)

01 03 00 64 00 06 84 17 ...d...„.

Answer:30/11/2009 16.12.47.22864 (+0.1406 seconds)

01 03 0C 10 00 0A 00 25 00 1E 00 0B 00 09 00 B7%.
42 B

Request:30/11/2009 16.12.48.49464 (+0.2656 seconds)

01 03 00 14 00 1B 45 C5EÅ

Answer:30/11/2009 16.12.48.69764 (+0.2031 seconds)

01 03 36 7B 00 6E 00 6A 00 77 00 7B 00 66 00 70 ..6{.n.j.w.{.f.p
00 6C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .l.....
00 00 00 6A 09 73 00 28 00 28 00 00 02 FF FF FF ...j.s.(.(...ÿÿÿ
FF FF FF FF FF E0 01 00 00 AB F9 ÿÿÿÿÿà...«ù

Request:30/11/2009 16.12.48.90064 (+0.2031 seconds)

01 02 00 A0 00 20 79 F0 yð

Answer:30/11/2009 16.12.48.02564 (+0.1250 seconds)

01 02 04 00 00 00 00 FB E2ûâ

Request:30/11/2009 16.12.48.30664 (+0.2812 seconds)

01 03 00 32 00 03 A4 04 ...2...ª.

Answer:30/11/2009 16.12.48.44764 (+0.1406 seconds)

01 03 06 01 00 08 00 13 00 2F F4/ô

Request:30/11/2009 16.12.49.71264 (+0.2656 seconds)

01 03 00 64 00 06 84 17 ...d...„.

Answer:30/11/2009 16.12.49.85364 (+0.1406 seconds)

01 03 0C 10 00 0A 00 26 00 1E 00 0B 00 09 00 F7&.....÷
57 W

Request:30/11/2009 16.12.49.11964 (+0.2656 seconds)

01 03 00 14 00 1B 45 C5EÅ

Answer:30/11/2009 16.12.49.29064 (+0.1719 seconds)

01 03 36 7B 00 6E 00 6A 00 77 00 7B 00 66 00 6F ..6{.n.j.w.{.f.o
00 6C 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .l.....
00 00 00 6A 09 73 00 28 00 28 00 00 02 FF FF FF ...j.s.(.(...ÿÿÿ
FF FF FF FF FF E0 01 00 00 61 0D ÿÿÿÿÿà...a.