User Manual

PR series
Modbus Communication Manual

BrainChild

UMPRCM0A
Rev B2, 11/2013

GRAPHIC SYMBOLS

 INFORMATION, It helps users with more details about the topic and failure to follow may lead to unpredictable results.

 WARNING, Failure to follow may lead to minor injury or damage / malfunctioning of equipment

 DANGER, Failure to follow may lead to injury or fatal accident to operating personal or damage/malfunctioning of equipment

 CAUTION, Failure to follow may lead to malfunctioning of equipment, damage or repair

 Protective Earth

 DC Supply

PREFACE

Original equipment manufacturer reserves the right to change information available in this document without notice. Original Equipment manufacturer is not liable for any damages incurred to equipment/personal during installation or use of equipment as explained in this document. User must acquire sufficient knowledge & skills prior to use the equipment in the application and follow all the local standards & regulations to meet safety requirements

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1. OVERVIEW

PR series new generation Paperless Recorder support Modbus communications including Serial (Modbus RTU) and Ethernet (Modbus TCP)

It is possible to configure PR series Recorder as Master/Slave on Serial network and Server/Client in Ethernet network

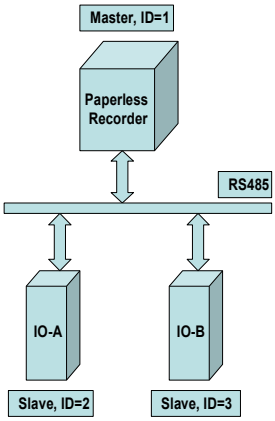

Fig: Recorder- Master (Serial)

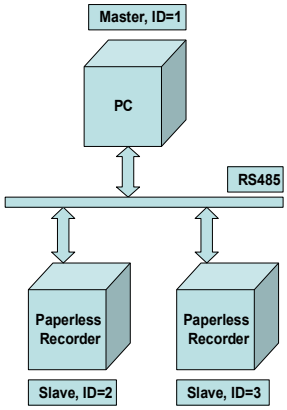

Fig: Recorders- Slave (Serial)

Supported Function codes

SNo	Function Code	Description
1	03	Read Input Registers
2	04	Read/Write Holding Registers
3	10	Present Multiple Registers

Note: Please refer PR series user manual for configuration of Recorder as Master/Slave or Client/Server

1.1 Modbus conversion formula

The word data are regarded as unsigned (positive) data in the Modbus message. However,the actual value of the parameter may be negative value with decimal point. The high/low scale values for each parameter are used for the purpose of such a conversion

In reality, Modbus value is different than process value.

Modbus value should be converted using scaling information to get actual value

Let M=Value of Modbus message
A=Actual value of the parameter
SL=Scale low value of the parameter
SH=Scale high value of the parameter
RH=Range low value of the parameter
RL=Range high value of the parameter
The conversion formulas are as follows:

A=M*(SH-SL)/65535+SL

For AI and Math, the conversion formulas are as follows:

A = ((M*(SH-SL))/(RH-RL))+SL

For AI, the RH = 32767, RL = -32768

For Math, the RH=4294967395, RL = 0

For AO, the conversion formulas are as follows:
A = ((M*SH)/RH)+SL
SH = 65.535, SL = -32.768
RH = 65535, RL = 0

Note1: Please refer section 1.2 & 1.3 for Scale Low (SL) and Scale high (SH) values for the Modbus registers

Note2: Please refer channel configuration directly in the Paperless Recorder for Range low (RL) and Range high (RH)values for the IO channels including Analog Input, Math, Analog Output ec..

1.2 Input Registers

1.2.1 AI/DI/DO/AO Channels

Modbus Address	Notation	Register Name	Access
1	Reserve	Reserve	R
2	AI1	AI 1 process value	R
3	AI2	AI 2 process value	R
4	AI3	AI 3 process value	R
5	AI4	AI 4 process value	R
6	AI5	AI 5 process value	R
7	AI6	AI 6 process value	R
8	AI7	AI 7 process value	R
9	AI8	AI 8 process value	R
10	AI9	AI 9 process value	R
11	AI10	AI 10 process value	R
12	AI11	AI 11 process value	R
13	AI12	AI 12 process value	R
14	AI13	AI 13 process value	R
15	AI14	AI 14 process value	R
16	AI15	AI 15 process value	R
17	AI16	AI 16 process value	R
18	AI17	AI 17 process value	R
19	AI18	AI 18 process value	R
20	AI19	AI 19 process value	R
21	AI20	AI 20 process value	R
22	AI21	AI 21 process value	R
23	AI22	AI 22 process value	R
24	AI23	AI 23 process value	R
25	AI24	AI 24 process value	R
26	AI25	AI 25 process value	R
27	AI26	AI 26 process value	R
28	AI27	AI 27 process value	R
29	AI28	AI 28 process value	R
30	AI29	AI 29 process value	R
31	AI30	AI 30 process value	R
32	AI31	AI 31 process value	R
33	AI32	AI 32 process value	R
34	AI33	AI 33 process value	R
35	AI34	AI 34 process value	R
36	AI35	AI 35 process value	R
37	AI36	AI 36 process value	R
38	AI37	AI 37 process value	R
39	AI38	AI 38 process value	R
40	AI39	AI 39 process value	R
41	AI40	AI 40 process value	R
42	AI41	AI 41 process value	R
43	AI42	AI 42 process value	R

44	AI43	AI 43 process value	R
45	AI44	AI 44 process value	R
46	AI45	AI 45 process value	R
47	AI46	AI 46 process value	R
48	AI47	AI 47 process value	R
49	AI48	AI 48 process value	R
50	DI1	DI 1 process value	R
51	DI2	DI 2 process value	R
52	DI3	DI 3 process value	R
53	DI4	DI 4 process value	R
54	DI5	DI 5 process value	R
55	DI6	DI 6 process value	R
56	DI7	DI 7 process value	R
57	DI8	DI 8 process value	R
58	DI9	DI 9 process value	R
59	DI10	DI 10 process value	R
60	DI11	DI 11 process value	R
61	DI12	DI 12 process value	R
62	DI13	DI 13 process value	R
63	DI14	DI 14 process value	R
64	DI15	DI 15 process value	R
65	DI16	DI 16 process value	R
66	DI17	DI 17 process value	R
67	DI18	DI 18 process value	R
68	DI19	DI 19 process value	R
69	DI20	DI 20 process value	R
70	DI21	DI 21 process value	R
71	DI22	DI 22 process value	R
72	DI23	DI 23 process value	R
73	DI24	DI 24 process value	R
74	DO1	DO 1 process value	R
75	DO2	DO 2 process value	R
76	DO3	DO 3 process value	R
77	DO4	DO 4 process value	R
78	DO5	DO 5 process value	R
79	DO6	DO 6 process value	R
80	DO7	DO 7 process value	R
81	DO8	DO 8 process value	R
82	DO9	DO 9 process value	R
83	DO10	DO 10 process value	R
84	DO11	DO 11 process value	R
85	DO12	DO 12 process value	R
86	DO13	DO 13 process value	R
87	DO14	DO 14 process value	R
88	DO15	DO 15 process value	R
89	DO16	DO 16 process value	R
90	DO17	DO 17 process value	R
91	DO18	DO 18 process value	R
92	DO19	DO 19 process value	R
93	DO20	DO 20 process value	R
94	DO21	DO 21 process value	R
95	DO22	DO 22 process value	R
96	DO23	DO 23 process value	R

97	DO24	DO 24 process value	R
98	AO1	AO 1 process value	R
99	AO2	AO 2 process value	R
100	AO3	AO 3 process value	R
101	AO4	AO 4 process value	R
102	AO5	AO 5 process value	R
103	AO6	AO 6 process value	R
104	AO7	AO 7 process value	R
105	AO8	AO 8 process value	R
106	AO9	AO 9 process value	R
107	AO10	AO 10 process value	R
108	AO11	AO 11 process value	R
109	AO12	AO 12 process value	R

∗ *Note: If the register value is 65534, which value represents communication error.*

Math Area

Modbus Address	Notation	Register Name	Access
201	Math1	Math 1 process value high word	R
202	Math1	Math 1 process value low word	R
203	Math2	Math 2 process value high word	R
204	Math2	Math 2 process value low word	R
205	Math3	Math 3 process value high word	R
206	Math3	Math 3 process value low word	R
207	Math4	Math 4 process value high word	R
208	Math4	Math 4 process value low word	R
209	Math5	Math 5 process value high word	R
210	Math5	Math 5 process value low word	R
211	Math6	Math 6 process value high word	R
212	Math6	Math 6 process value low word	R
213	Math7	Math 7 process value high word	R
214	Math7	Math 7 process value low word	R
215	Math8	Math 8 process value high word	R
216	Math8	Math 8 process value low word	R
217	Math9	Math 9 process value high word	R
218	Math9	Math 9 process value low word	R
219	Math10	Math 10 process value high word	R
220	Math10	Math 10 process value low word	R
221	Math11	Math 11 process value high word	R
222	Math11	Math 11 process value low word	R
223	Math12	Math 12 process value high word	R
224	Math12	Math 12 process value low word	R
225	Math13	Math 13 process value high word	R
226	Math13	Math 13 process value low word	R
227	Math14	Math 14 process value high word	R
228	Math14	Math 14 process value low word	R
229	Math15	Math 15 process value high word	R
230	Math15	Math 15 process value low word	R
231	Math16	Math 16 process value high word	R
232	Math16	Math 16 process value low word	R
233	Math17	Math 17 process value high word	R
234	Math17	Math 17 process value low word	R

235	Math18	Math 18 process value high word	R
236	Math18	Math 18 process value low word	R
237	Math19	Math 19 process value high word	R
238	Math19	Math 19 process value low word	R
239	Math20	Math 20 process value high word	R
240	Math20	Math 20 process value low word	R
241	Math21	Math 21 process value high word	R
242	Math21	Math 21 process value low word	R
243	Math22	Math 22 process value high word	R
244	Math22	Math 22 process value low word	R
245	Math23	Math 23 process value high word	R
246	Math23	Math 23 process value low word	R
247	Math24	Math 24 process value high word	R
248	Math24	Math 24 process value low word	R
249	Math25	Math 25 process value high word	R
250	Math25	Math 25 process value low word	R
251	Math26	Math 26 process value high word	R
252	Math26	Math 26 process value low word	R
253	Math27	Math 27 process value high word	R
254	Math27	Math 27 process value low word	R
255	Math28	Math 28 process value high word	R
256	Math28	Math 28 process value low word	R
257	Math29	Math 29 process value high word	R
258	Math29	Math 29 process value low word	R
259	Math30	Math 30 process value high word	R
260	Math30	Math 30 process value low word	R
261	Math31	Math 31 process value high word	R
262	Math31	Math 31 process value low word	R
263	Math32	Math 32 process value high word	R
264	Math32	Math 32 process value low word	R
265	Math33	Math 33 process value high word	R
266	Math33	Math 33 process value low word	R
267	Math34	Math 34 process value high word	R
268	Math34	Math 34 process value low word	R
269	Math35	Math 35 process value high word	R
270	Math35	Math 35 process value low word	R
271	Math36	Math 36 process value high word	R
272	Math36	Math 36 process value low word	R
273	Math37	Math 37 process value high word	R
274	Math37	Math 37 process value low word	R
275	Math38	Math 38 process value high word	R
276	Math38	Math 38 process value low word	R
277	Math39	Math 39 process value high word	R
278	Math39	Math 39 process value low word	R
279	Math40	Math 40 process value high word	R
280	Math40	Math 40 process value low word	R
281	Math41	Math 41 process value high word	R
282	Math41	Math 41 process value low word	R
283	Math42	Math 42 process value high word	R
284	Math42	Math 42 process value low word	R
285	Math43	Math 43 process value high word	R
286	Math43	Math 43 process value low word	R
287	Math44	Math 44 process value high word	R

288	Math44	Math 44 process value low word	R
289	Math45	Math 45 process value high word	R
290	Math45	Math 45 process value low word	R
291	Math46	Math 46 process value high word	R
292	Math46	Math 46 process value low word	R
293	Math47	Math 47 process value high word	R
294	Math47	Math 47 process value low word	R
295	Math48	Math 48 process value high word	R
296	Math48	Math 48 process value low word	R
297	Math49	Math 49 process value high word	R
298	Math49	Math 49 process value low word	R
299	Math50	Math 50 process value high word	R
300	Math50	Math 50 process value low word	R
301	Math51	Math 51 process value high word	R
302	Math51	Math 51 process value low word	R
303	Math52	Math 52 process value high word	R
304	Math52	Math 52 process value low word	R
305	Math53	Math 53 process value high word	R
306	Math53	Math 53 process value low word	R
307	Math54	Math 54 process value high word	R
308	Math54	Math 54 process value low word	R
309	Math55	Math 55 process value high word	R
310	Math55	Math 55 process value low word	R
311	Math56	Math 56 process value high word	R
312	Math56	Math 56 process value low word	R
313	Math57	Math 57 process value high word	R
314	Math57	Math 57 process value low word	R
315	Math58	Math 58 process value high word	R
316	Math58	Math 58 process value low word	R
317	Math59	Math 59 process value high word	R
318	Math59	Math 59 process value low word	R
319	Math60	Math 60 process value high word	R
320	Math60	Math 60 process value low word	R

∗ *Note: If the register value is 4294967294, which value represents communication error.*

Holding Register Parameter Table for Modbus RTU Slave / TCP Server

2 Bytes Type Area

Modbus Address	Notation	Register Name	Access
1	Ext1	Measured data on External 1	R/W
2	Ext2	Measured data on External 2	R/W
3	Ext3	Measured data on External 3	R/W
4	Ext4	Measured data on External 4	R/W
5	Ext5	Measured data on External 5	R/W
6	Ext6	Measured data on External 6	R/W
7	Ext7	Measured data on External 7	R/W
8	Ext8	Measured data on External 8	R/W
9	Ext9	Measured data on External 9	R/W
10	Ext10	Measured data on External 10	R/W
11	Ext11	Measured data on External 11	R/W

12	Ext12	Measured data on External 12	R/W
13	Ext13	Measured data on External 13	R/W
14	Ext14	Measured data on External 14	R/W
15	Ext15	Measured data on External 15	R/W
16	Ext16	Measured data on External 16	R/W
17	Ext17	Measured data on External 17	R/W
18	Ext18	Measured data on External 18	R/W
19	Ext19	Measured data on External 19	R/W
20	Ext20	Measured data on External 20	R/W
21	Ext21	Measured data on External 21	R/W
22	Ext22	Measured data on External 22	R/W
23	Ext23	Measured data on External 23	R/W
24	Ext24	Measured data on External 24	R/W
25	Ext25	Measured data on External 25	R/W
26	Ext26	Measured data on External 26	R/W
27	Ext27	Measured data on External 27	R/W
28	Ext28	Measured data on External 28	R/W
29	Ext29	Measured data on External 29	R/W
30	Ext30	Measured data on External 30	R/W
31	Ext31	Measured data on External 31	R/W
32	Ext32	Measured data on External 32	R/W
33	Ext33	Measured data on External 33	R/W
34	Ext34	Measured data on External 34	R/W
35	Ext35	Measured data on External 35	R/W
36	Ext36	Measured data on External 36	R/W
37	Ext37	Measured data on External 37	R/W
38	Ext38	Measured data on External 38	R/W
39	Ext39	Measured data on External 39	R/W
40	Ext40	Measured data on External 40	R/W
41	Ext41	Measured data on External 41	R/W
42	Ext42	Measured data on External 42	R/W
43	Ext43	Measured data on External 43	R/W
44	Ext44	Measured data on External 44	R/W
45	Ext45	Measured data on External 45	R/W
46	Ext46	Measured data on External 46	R/W
47	Ext47	Measured data on External 47	R/W
48	Ext48	Measured data on External 48	R/W
49	Ext49	Measured data on External 49	R/W
50	Ext50	Measured data on External 50	R/W
51	Ext51	Measured data on External 51	R/W
52	Ext52	Measured data on External 52	R/W
53	Ext53	Measured data on External 53	R/W
54	Ext54	Measured data on External 54	R/W
55	Ext55	Measured data on External 55	R/W
56	Ext56	Measured data on External 56	R/W
57	Ext57	Measured data on External 57	R/W
58	Ext58	Measured data on External 58	R/W
59	Ext59	Measured data on External 59	R/W
60	Ext60	Measured data on External 60	R/W
61	Ext61	Measured data on External 61	R/W
62	Ext62	Measured data on External 62	R/W
63	Ext63	Measured data on External 63	R/W
64	Ext64	Measured data on External 64	R/W

65	Ext65	Measured data on External 65	R/W
66	Ext66	Measured data on External 66	R/W
67	Ext67	Measured data on External 67	R/W
68	Ext68	Measured data on External 68	R/W
69	Ext69	Measured data on External 69	R/W
70	Ext70	Measured data on External 70	R/W
71	Ext71	Measured data on External 71	R/W
72	Ext72	Measured data on External 72	R/W
73	Ext73	Measured data on External 73	R/W
74	Ext74	Measured data on External 74	R/W
75	Ext75	Measured data on External 75	R/W
76	Ext76	Measured data on External 76	R/W
77	Ext77	Measured data on External 77	R/W
78	Ext78	Measured data on External 78	R/W
79	Ext79	Measured data on External 79	R/W
80	Ext80	Measured data on External 80	R/W
81	Ext81	Measured data on External 81	R/W
82	Ext82	Measured data on External 82	R/W
83	Ext83	Measured data on External 83	R/W
84	Ext84	Measured data on External 84	R/W
85	Ext85	Measured data on External 85	R/W
86	Ext86	Measured data on External 86	R/W
87	Ext87	Measured data on External 87	R/W
88	Ext88	Measured data on External 88	R/W
89	Ext89	Measured data on External 89	R/W
90	Ext90	Measured data on External 90	R/W
91	Ext91	Measured data on External 91	R/W
92	Ext92	Measured data on External 92	R/W
93	Ext93	Measured data on External 93	R/W
94	Ext94	Measured data on External 94	R/W
95	Ext95	Measured data on External 95	R/W
96	Ext96	Measured data on External 96	R/W

∗ *Note: If the register value is 65534, which value represents communication error.*

4 Bytes Type Area

Modbus Address	Notation	Register Name	Access
201	Ext1	The low word of measured data is on External 1	R/W
202	Ext1	The high word of measured data is on External 1	R/W
203	Ext2	The low word of measured data is on External 2	R/W
204	Ext2	The high word of measured data is on External 2	R/W
205	Ext3	The low word of measured data is on External 3	R/W
206	Ext3	The high word of measured data is on External 3	R/W
207	Ext4	The low word of measured data is on External 4	R/W
208	Ext4	The high word of measured data is on	R/W

		External 4	
209	Ext5	The low word of measured data is on External 5	R/W
210	Ext5	The high word of measured data is on External 5	R/W
211	Ext6	The low word of measured data is on External 6	R/W
212	Ext6	The high word of measured data is on External 6	R/W
213	Ext7	The low word of measured data is on External 7	R/W
214	Ext7	The high word of measured data is on External 7	R/W
215	Ext8	The low word of measured data is on External 8	R/W
216	Ext8	The high word of measured data is on External 8	R/W
217	Ext9	The low word of measured data is on External 9	R/W
218	Ext9	The high word of measured data is on External 9	R/W
219	Ext10	The low word of measured data is on External 10	R/W
220	Ext10	The high word of measured data is on External 10	R/W
221	Ext11	The low word of measured data is on External 11	R/W
222	Ext11	The high word of measured data is on External 11	R/W
223	Ext12	The low word of measured data is on External 12	R/W
224	Ext12	The high word of measured data is on External 12	R/W
225	Ext13	The low word of measured data is on External 13	R/W
226	Ext13	The high word of measured data is on External 13	R/W
227	Ext14	The low word of measured data is on External 14	R/W
228	Ext14	The high word of measured data is on External 14	R/W
229	Ext15	The low word of measured data is on External 15	R/W
230	Ext15	The high word of measured data is on External 15	R/W
231	Ext16	The low word of measured data is on External 16	R/W
232	Ext16	The high word of measured data is on External 16	R/W
233	Ext17	The low word of measured data is on External 17	R/W
234	Ext17	The high word of measured data is on External 17	R/W
235	Ext18	The low word of measured data is on External 18	R/W

236	Ext18	The high word of measured data is on External 18	R/W
237	Ext19	The low word of measured data is on External 19	R/W
238	Ext19	The high word of measured data is on External 19	R/W
239	Ext20	The low word of measured data is on External 20	R/W
240	Ext20	The high word of measured data is on External 20	R/W
241	Ext21	The low word of measured data is on External 21	R/W
242	Ext21	The high word of measured data is on External 21	R/W
243	Ext22	The low word of measured data is on External 22	R/W
244	Ext22	The high word of measured data is on External 22	R/W
245	Ext23	The low word of measured data is on External 23	R/W
246	Ext23	The high word of measured data is on External 23	R/W
247	Ext24	The low word of measured data is on External 24	R/W
248	Ext24	The high word of measured data is on External 24	R/W
249	Ext25	The low word of measured data is on External 25	R/W
250	Ext25	The high word of measured data is on External 25	R/W
251	Ext26	The low word of measured data is on External 26	R/W
252	Ext26	The high word of measured data is on External 26	R/W
253	Ext27	The low word of measured data is on External 27	R/W
254	Ext27	The high word of measured data is on External 27	R/W
255	Ext28	The low word of measured data is on External 28	R/W
256	Ext28	The high word of measured data is on External 28	R/W
257	Ext29	The low word of measured data is on External 29	R/W
258	Ext29	The high word of measured data is on External 29	R/W
259	Ext30	The low word of measured data is on External 30	R/W
260	Ext30	The high word of measured data is on External 30	R/W
261	Ext31	The low word of measured data is on External 31	R/W
262	Ext31	The high word of measured data is on External 31	R/W
263	Ext32	The low word of measured data is on	R/W

		External 32	
264	Ext32	The high word of measured data is on External 32	R/W
265	Ext33	The low word of measured data is on External 33	R/W
266	Ext33	The high word of measured data is on External 33	R/W
267	Ext34	The low word of measured data is on External 34	R/W
268	Ext34	The high word of measured data is on External 34	R/W
269	Ext35	The low word of measured data is on External 35	R/W
270	Ext35	The high word of measured data is on External 35	R/W
271	Ext36	The low word of measured data is on External 36	R/W
272	Ext36	The high word of measured data is on External 36	R/W
273	Ext37	The low word of measured data is on External 37	R/W
274	Ext37	The high word of measured data is on External 37	R/W
275	Ext38	The low word of measured data is on External 38	R/W
276	Ext38	The high word of measured data is on External 38	R/W
277	Ext39	The low word of measured data is on External 39	R/W
278	Ext39	The high word of measured data is on External 39	R/W
279	Ext40	The low word of measured data is on External 40	R/W
280	Ext40	The high word of measured data is on External 40	R/W
281	Ext41	The low word of measured data is on External 41	R/W
282	Ext41	The high word of measured data is on External 41	R/W
283	Ext42	The low word of measured data is on External 42	R/W
284	Ext42	The high word of measured data is on External 42	R/W
285	Ext43	The low word of measured data is on External 43	R/W
286	Ext43	The high word of measured data is on External 43	R/W
287	Ext44	The low word of measured data is on External 44	R/W
288	Ext44	The high word of measured data is on External 44	R/W
289	Ext45	The low word of measured data is on External 45	R/W
290	Ext45	The high word of measured data is on External 45	R/W

291	Ext46	The low word of measured data is on External 46	R/W
292	Ext46	The high word of measured data is on External 46	R/W
293	Ext47	The low word of measured data is on External 47	R/W
294	Ext47	The high word of measured data is on External 47	R/W
295	Ext48	The low word of measured data is on External 48	R/W
296	Ext48	The high word of measured data is on External 48	R/W
297	Ext49	The low word of measured data is on External 49	R/W
298	Ext49	The high word of measured data is on External 49	R/W
299	Ext50	The low word of measured data is on External 50	R/W
300	Ext50	The high word of measured data is on External 50	R/W
301	Ext51	The low word of measured data is on External 51	R/W
302	Ext51	The high word of measured data is on External 51	R/W
303	Ext52	The low word of measured data is on External 52	R/W
304	Ext52	The high word of measured data is on External 52	R/W
305	Ext53	The low word of measured data is on External 53	R/W
306	Ext53	The high word of measured data is on External 53	R/W
307	Ext54	The low word of measured data is on External 54	R/W
308	Ext54	The high word of measured data is on External 54	R/W
309	Ext55	The low word of measured data is on External 55	R/W
310	Ext55	The high word of measured data is on External 55	R/W
311	Ext56	The low word of measured data is on External 56	R/W
312	Ext56	The high word of measured data is on External 56	R/W
313	Ext57	The low word of measured data is on External 57	R/W
314	Ext57	The high word of measured data is on External 57	R/W
315	Ext58	The low word of measured data is on External 58	R/W
316	Ext58	The high word of measured data is on External 58	R/W
317	Ext59	The low word of measured data is on External 59	R/W
318	Ext59	The high word of measured data is on	R/W

		External 59	
319	Ext60	The low word of measured data is on External 60	R/W
320	Ext60	The high word of measured data is on External 60	R/W
321	Ext61	The low word of measured data is on External 61	R/W
322	Ext61	The high word of measured data is on External 61	R/W
323	Ext62	The low word of measured data is on External 62	R/W
324	Ext62	The high word of measured data is on External 62	R/W
325	Ext63	The low word of measured data is on External 63	R/W
326	Ext63	The high word of measured data is on External 63	R/W
327	Ext64	The low word of measured data is on External 64	R/W
328	Ext64	The high word of measured data is on External 64	R/W
329	Ext65	The low word of measured data is on External 65	R/W
330	Ext65	The high word of measured data is on External 65	R/W
331	Ext66	The low word of measured data is on External 66	R/W
332	Ext66	The high word of measured data is on External 66	R/W
333	Ext67	The low word of measured data is on External 67	R/W
334	Ext67	The high word of measured data is on External 67	R/W
335	Ext68	The low word of measured data is on External 68	R/W
336	Ext68	The high word of measured data is on External 68	R/W
337	Ext69	The low word of measured data is on External 69	R/W
338	Ext69	The high word of measured data is on External 69	R/W
339	Ext70	The low word of measured data is on External 70	R/W
340	Ext70	The high word of measured data is on External 70	R/W
341	Ext71	The low word of measured data is on External 71	R/W
342	Ext71	The high word of measured data is on External 71	R/W
343	Ext72	The low word of measured data is on External 72	R/W
344	Ext72	The high word of measured data is on External 72	R/W
345	Ext73	The low word of measured data is on External 73	R/W

346	Ext73	The high word of measured data is on External 73	R/W
347	Ext74	The low word of measured data is on External 74	R/W
348	Ext74	The high word of measured data is on External 74	R/W
349	Ext75	The low word of measured data is on External 75	R/W
350	Ext75	The high word of measured data is on External 75	R/W
351	Ext76	The low word of measured data is on External 76	R/W
352	Ext76	The high word of measured data is on External 76	R/W
353	Ext77	The low word of measured data is on External 77	R/W
354	Ext77	The high word of measured data is on External 77	R/W
355	Ext78	The low word of measured data is on External 78	R/W
356	Ext78	The high word of measured data is on External 78	R/W
357	Ext79	The low word of measured data is on External 79	R/W
358	Ext79	The high word of measured data is on External 79	R/W
359	Ext80	The low word of measured data is on External 80	R/W
360	Ext80	The high word of measured data is on External 80	R/W
361	Ext81	The low word of measured data is on External 81	R/W
362	Ext81	The high word of measured data is on External 81	R/W
363	Ext82	The low word of measured data is on External 82	R/W
364	Ext82	The high word of measured data is on External 82	R/W
365	Ext83	The low word of measured data is on External 83	R/W
366	Ext83	The high word of measured data is on External 83	R/W
367	Ext84	The low word of measured data is on External 84	R/W
368	Ext84	The high word of measured data is on External 84	R/W
369	Ext85	The low word of measured data is on External 85	R/W
370	Ext85	The high word of measured data is on External 85	R/W
371	Ext86	The low word of measured data is on External 86	R/W
372	Ext86	The high word of measured data is on External 86	R/W
373	Ext87	The low word of measured data is on	R/W

		External 87	
374	Ext87	The high word of measured data is on External 87	R/W
375	Ext88	The low word of measured data is on External 88	R/W
376	Ext88	The high word of measured data is on External 88	R/W
377	Ext89	The low word of measured data is on External 89	R/W
378	Ext89	The high word of measured data is on External 89	R/W
379	Ext90	The low word of measured data is on External 90	R/W
380	Ext90	The high word of measured data is on External 90	R/W
381	Ext91	The low word of measured data is on External 91	R/W
382	Ext91	The high word of measured data is on External 91	R/W
383	Ext92	The low word of measured data is on External 92	R/W
384	Ext92	The high word of measured data is on External 92	R/W
385	Ext93	The low word of measured data is on External 93	R/W
386	Ext93	The high word of measured data is on External 93	R/W
387	Ext94	The low word of measured data is on External 94	R/W
388	Ext94	The high word of measured data is on External 94	R/W
389	Ext95	The low word of measured data is on External 95	R/W
390	Ext95	The high word of measured data is on External 95	R/W
391	Ext96	The low word of measured data is on External 96	R/W
392	Ext96	The high word of measured data is on External 96	R/W

∗ *Note: If the register value is 4294967294, which value represents communication error.*

1.3 Modbus Communications

1.3.1 Read Input Registers (Function 0x04)

The function code is used to read from 1 to 120 contiguous input registers in remote device.

Query

The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero: register 1 – 16 are addressed as 0 – 15.

Here is an example of a request to read register 0 (register type is Input Register, address is 1) from slave device 1:

Field Name	RTU example (Hex)
Slave Address	01
Function	04
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	01
Error Check Lo	31
Error Check Hi	CA
Total Bytes	8

Response

The register data in the response message are packed as two bytes per registers, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

The response is return when the data is completely assembled. Here is an example of a response to the query on the opposite page:

Field Name	RTU example (Hex)
Slave Address	01
Function	04
Byte Count	02
Data Hi	00
Data Lo	0A
Error Check Lo	39
Error Check Hi	37
Total Bytes	7

1.3.2 Preset (Write) Multiple Registers (Function 0x10)

The function code is used to write a block of contiguous registers (1 to 120 registers) in remote device.

Query

The query message specified the register references to be preset. Registers are addressed starting at zero: register 1 is addressed as 0. The requested preset values are specified in the query data field. Data is packed as two bytes per register.

Here is an example of a request to preset two registers starting at 40001 to 00 0A and 01 02 hex in slave device 1:

Field Name	RTU example (Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	02
Byte Count	04
Data Hi	00
Data Lo	0A
Data Hi	01
Data Lo	02
Error Check Lo	53
Error Check Hi	FC
Total Bytes	13

Response

The normal response returns the slave address, function code, starting address and quantity of registers preset. Here is an example of a response to the query shown above

Field Name	RTU example (Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	02
Error Check Lo	41
Error Check Hi	C8
Total Bytes	13

1.3.3 Placing CRC into the message

When the 16 bit CRC (two 8 bit bytes) is transmitted in the message, the low order byte will be transmitted first, followed by the high order byte.
For example, if the CRC value is 1241 hex:

Slave Address	Function	Data	CRC Lo	CRC Hi
--	--	--	**41**	**12**

∗ *Note: Broadcast is not supported.*

1.4 Sample code

1.4.1 CRC Generation Function

An example of a C language function performing CRC generation is shown on the following pages. All of the possible CRC values are preloaded into two arrays, which are simply indexed as the function increments through the message buffer. One array contains all of the 256 possible CRC values for the high byte of the 16 bit CRC field, and the other array contains all of the values for the low byte. Indexing the CRC in this way provides faster execution than would be achieved by calculating a new CRC value with each new character from the message buffer.

```
    /
**************************************************************/
    // Parameter:
    //          puchMsg -> unsigned char* puchMsg: message to calculate CRC upon
    // usDataLne -> unsigned short usDataLen: quantity of bytes in message
    /
**************************************************************/
    unsigned short CRC16(puchMsg, usDataLen)
    {
        unsigned char uchCRCHi=0xFF; /* high byte of CRC initialized */
        unsigned char uchCRCLo=0xFF; /* low byte of CRC initialized */
        unsigned uIndex; /* will index into CRC lookup table */
        while (usDataLen—) /* pass through message buffer */
        {
            uIndex = uchCRCHi ^ *puchMsgg++; /* calculate the CRC */
```

```
            uchCRCHi = uchCRCLo ^ auchCRCHi[uIndex];
            uchCRCLo = auchCRCLo[uIndex] ;
        }
        return (uchCRCHi << 8 | uchCRCLo) ;
    }
```

High-Order Byte Table

```
    /* Table of CRC values for high–order byte */
    static unsigned char auchCRCHi[] = {
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40,
0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80,
0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1,
0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
0x81,
0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40,
0x01,
0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80,
0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80,
0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
0x81,
0x40
} ;
```

Low-Order Byte Table

```
/* Table of CRC values for low–order byte */
```

```
static char auchCRCLo[] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05, 0xC5,
0xC4,
0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9,
0x09,
0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF,
0x1F, 0xDD,
0x1D, 0x1C, 0xDC, 0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12,
0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6,
0xF7,
0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA,
0x3A,
0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA,
0xEE,
0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6,
0x26,
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3,
0xA2,
0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF,
0x6F,
0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79,
0xBB,
0x7B, 0x7A, 0xBA, 0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75,
0xB5,
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90,
0x91,
0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54, 0x9C,
0x5C,
0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98,
0x88,
0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C,
0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81,
0x80,
0x40
} ;
```

1.4.2 Read Data Function

```
    /
**************************************************************/
    // Parameter:
    //          Addr -> Slave ID
    // StReg -> Starting Register Address
    // RegQuantities -> Register Quantities
    // MbsBuf -> Receive Data Buffer
    /
    **************************************************************/
    bool ReadData(unsigned char Addr, unsigned short StReg,
                        unsigned short RegQuantities, unsigned char* MbsBuf)
    {
        unsigned char msg[8];
        unsigned char Func = 0x04;
        unsigned short Crc;

        msg[0] = Addr;
        msg[1] = Func;
        msg[2] = HIBYTE(StReg);
        msg[3] = LOBYTE(StReg);
        msg[4] = HIBYTE(RegQuantities);
        msg[5] = LOBYTE(RegQuantities);
        Crc = CRC16(msg,6);
        msg[6] = HIBYTE(Crc);
        msg[7] = LOBYTE(Crc);
        int snd = 8; /* byte number of buffer msg */
        int rcv = (5+(RegQuantities*2));
        /* Send snd bytes content of msg to COMM port */
        /* Receive rcv bytes of response from COMM port to MbsBuf */
        if (receiving data length is same as rcv)
            return true;
        else
            return false;
    }
```

1.4.3 Convert Data Function

```
    /
**************************************************************/
    // Parameter:
    //          ValueRangeLo -> Minimum value of the value range
    // ValueRangeHi -> Maximum value of the value range
    // ScaleLo -> Minimum value of the scale value
    // ScaleHi -> Maximum value of the scale value
    // RegData -> Current register data from remote device
    /
    **************************************************************/
    double ConvertData(double ValueRangeLo,
                       double ValueRangeHi,
                       double ScaleLo,
                       double ScaleHi,
                       double RegData)
    {
      double ConvertValue;

      ConvertValue = (((RegData*(ScaleHi - ScaleLo))/
                       (ValueRangeHi - ValueRangeLo))
                       + ScaleLo);
    return ConvertValue;
    }
```

1.4.4 Read AI Function

```
    bool ReadAIData(void)
    {
      unsigned char MsgBuf[40];
      unsigned char Addr = 1; /* Slave Id */
      unsigned short StartRegAdd = 2;
        unsigned short RegQuantities = 5;
        int ScaleLo, ScaleHi,
            ValueRangeLo, ValueRangeHi,
            AiData;
        unsigned short RegData;


        // Read register data from remote device
        ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);
```

```
    // Step 1: Parsing data for AI1
    RegData = MAKEWORD(MsgBuf[4], MsgBuf[3]);

    // Step 2: Set value range
    // Because AI data type was set as 2 bytes, the value range would be
    // showing between -32768 to 32767
    ValueRangeLo = -32768;
    ValueRangeHi = 32767;

    // Step 3: Set value range for scale
    // The default of Sensor type in AI1 is set as 『Thermocouple K Type』.
    // Scale low value is showing "-120", scale high value is showing
    // "1000"
    // Please refer to Appendix B, it will explain that how to inquire AI
    // range in PR, as for another scale range of AI, please refer to AI
    // configuration
    ScaleLo = -120;
    ScaleHi = 1000;

    // Step 4: Execute converted function
    AiData = (int)ConvertData(ValueRangeLo,
                              ValueRangeHi,
                              ScaleLo,
                              ScaleHi,
                              RegData);

// Step 5: Repeat Step 1 to Step 4 for getting another AI data

    * Note: Please refer to Appendix C for more details.
}
```

1.4.5 Read AO Function

```
bool ReadAOData(void)
{
   unsigned char MsgBuf[48];
   unsigned char Addr = 1; /* Slave Id */
   unsigned short StartRegAdd = 601;
      unsigned short RegQuantities = 5;
      unsigned short RegData;
      float AoData;
```

```
    // Read register data from remote device
    ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);

    // Because the AO expression is specific, so we need using specific
    // expression to convert the value as following:
    // Step 1: Parsing data for AO1
    RegData = MAKEWORD(MsgBuf[4], MsgBuf[3]);

    // Step2: To do converted expression for AO1
    AoData = ((RegData * 65.535)/65535)-32.768;

    // Step 3: Repeat Step 1 to Step 2 for getting another AO data
```

＊ *Note: Please refer to Appendix C for more details.*

```
}
```

1.4.6 Read Math Function

```
bool ReadMathData(void)
{
  unsigned char MsgBuf[120];
  unsigned char i, j;
  unsigned char Addr = 1; /* Slave Id */
  unsigned short StartRegAdd = 201;
    unsigned short RegQuantities = (10*2); // Math data is float type, so each
    Math value take two registers
    double ScaleLo, ScaleHi, ValueRangeLo, ValueRangeHi;
    double RegData, MathData;

    // Read register data from remote device
    ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);

    // Step 1: Set value range
    // The default of Math data type was set as 4 bytes, the value range
    // will be showing between 0 to 4294967295
    ValueRangeLo = 0;
    ValueRangeHi = 4294967295;

    // Step 2: Set value range for scale
    // When the property of “Transformation” in scale was set as disable,
    // the range will be showing -2147483648 to 2147483647
    // If the property of “Transformation” in Scale was set as “Value” or
    // “Math Channel”, please refer to Appendix D
    ScaleLo = -2147483648;
```

```
        ScaleHi = 2147483647;

        // Step 3: Please refer to the decimal value for the conversion of each
                    Math
switch(decimal value)
{
  case 1:
      ScaleLo = ScaleLo / 10;
     ScaleHi = ScaleHi / 10;
      break;
  case 2:
      ScaleLo = ScaleLo / 100;
     ScaleHi = ScaleHi / 100;
      break;
  case 3:
      ScaleLo = ScaleLo / 1000;
     ScaleHi = ScaleHi / 1000;
      break;
  case 4:
      ScaleLo = ScaleLo / 10000;
     ScaleHi = ScaleHi / 10000;
      break;
  case 5:
      ScaleLo = ScaleLo / 100000;
     ScaleHi = ScaleHi / 100000;
      break;
  default:
      break;
            }

        // Step 4: Parsing data for Math1
        RegData = (UINT)MAKELONG(MAKEWORD(MsgBuf[j+1],
                                          MsgBuf[j]),
                                 MAKEWORD(MsgBuf[j+3],
                                          MsgBuf[j+2]));

        // Step 5: Execute converted function
        MathData = ConvertData(ValueRangeLo,
                               ValueRangeHi,
                               ScaleLo,
                               ScaleHi,
                               RegData);

        // Step 6: Repeat Step 1 to Step 5 for getting another data of Math

         ＊ Note: Please refer to Appendix D for more details.
}
```

1.4.7 Read DI Function

```
bool ReadDIData(void)
{
   unsigned char MsgBuf[96];
   unsigned char Addr = 1; /* Slave Id */
   unsigned short StartRegAdd = 50;
      unsigned short RegQuantities = 5;
      bool DiData;

      // Read register data from remote device
      ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);

      // Step 1: Parsing data for DI1
      DiData = (bool)MAKEWORD(MsgBuf[4], MsgBuf[3]);

      // Step 2: Repeat Step 1 for getting another DI data
}
```

1.4.8 Read DO Function

```
bool ReadDOData(void)
{
   unsigned char MsgBuf[48];
   unsigned char Addr = 1; /* Slave Id */
   unsigned short StartRegAdd = 74;
      unsigned short RegQuantities = 5;
      bool DoData;

      // Read register data from remote device
      ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);

      // Step 1: Parsing data for DO1
      DiData = (bool)MAKEWORD(MsgBuf[4], MsgBuf[3]);

      // Step 2: Repeat Step 1 for getting another DO data
}
```

1.4.9 Read External Channel Function

```
bool ReadExtData(void)
{
   unsigned char MsgBuf[128];
   unsigned char Addr = 1; /* Slave Id */
   unsigned short StartRegAdd = 401;
      unsigned short RegQuantities = 20;
      unsigned short ExtData;

      // Read register data from remote device
      ReadData(Addr, StartRegAdd, RegQuantities, MsgBuf);

      // Step 1: Parsing data for Ext1
      DiData = MAKEWORD(MsgBuf[4], MsgBuf[3]);

      // Step 2: Repeat Step 1 for getting another Ext data

   *
   Note: Because the Input Register Ext data is same like Holding Register Ext data,
so the data type of the ExtData must according to the setting of real case, if the
data type of ExtData is 4 bytes, please refer to "ReadMathData" function in
Step 1, Step 2, Step 4 and Step 5 to convert data type of customer requirement
   (Such as: Int32 or UInt32 or float data type).
}
```

1: Above sample code is according to the PR20 setting, if user need to change the MsgBuf size and RegQuantities value for other Recorders, please refer to the user manual.

1.4.10 Modbus Register data type table

Modbus RTU Slave / TCP Server Register data type table

Field Name	Data Size	Data Type	Note
AI	2 Bytes	WORD	Little Endian
Math	4 Bytes	UINT32	Little Endian
DI	2 Bytes	WORD	Little Endian
AO	2 Bytes	WORD	Little Endian
DO	2 Bytes	WORD	Little Endian
External	2 Bytes	WORD	Little Endian

Table A-1

1.4.11 How to check Channel Range in Recorder

i. Press 『Menu』 -> 『More』 -> 『Config』

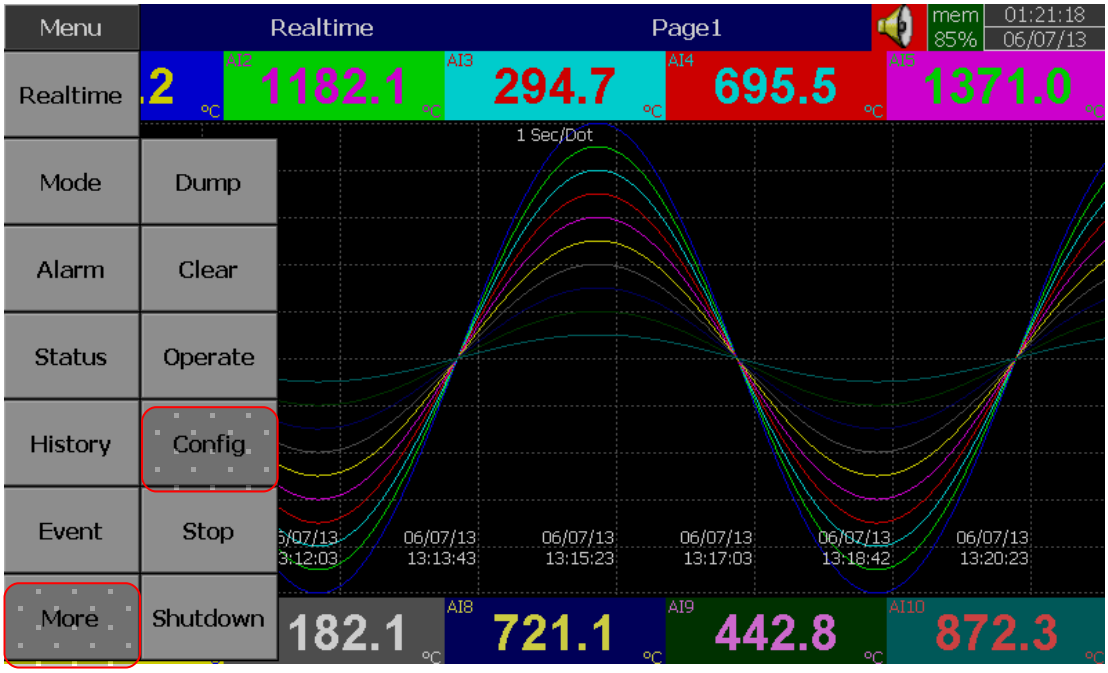

Fig. B-1

ii. Please select 『AI』

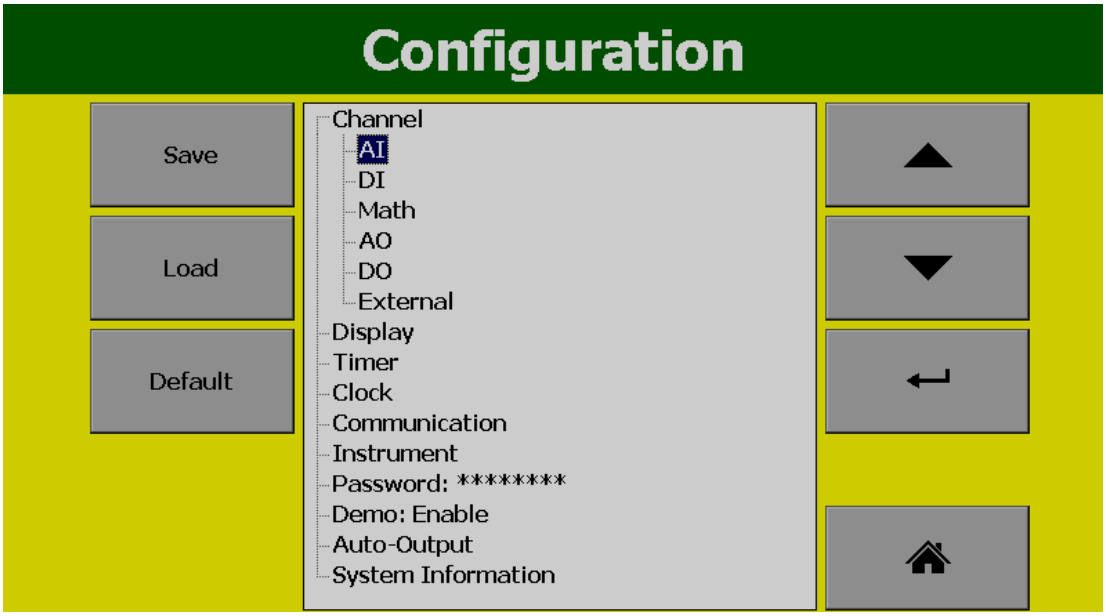

Fig. B-2

iii. Value of AI range is shown in the following screen

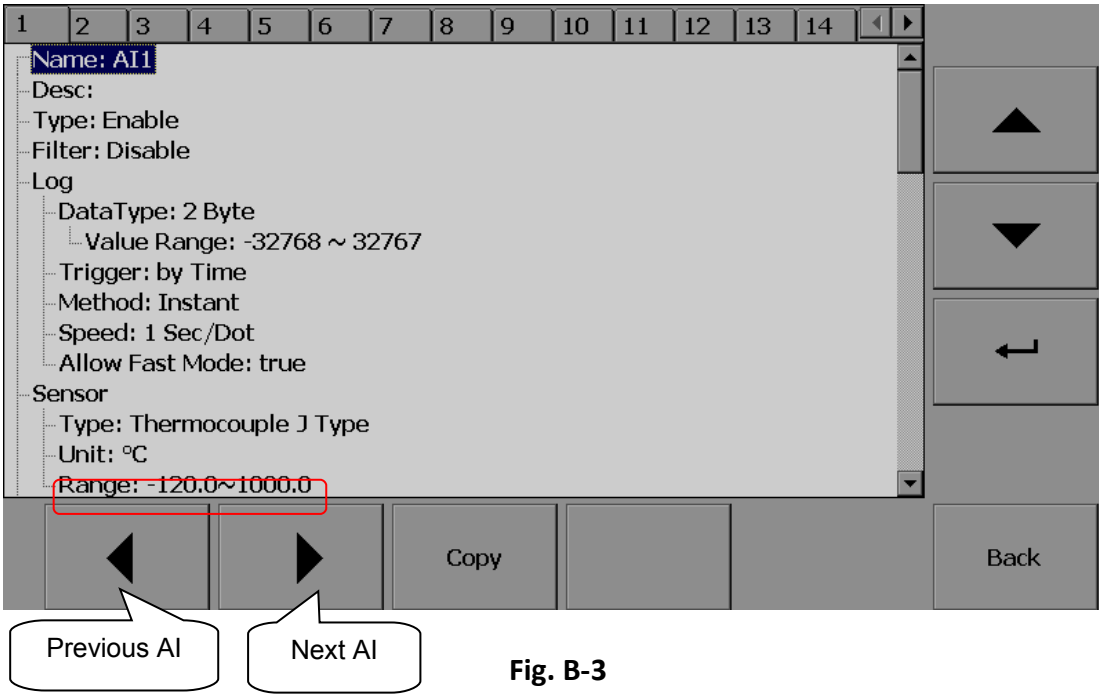

Fig. B-3

1.4.12 Modbus to Proces value conversion AI example

Modbus Master : Modscan 32
Modbus Slave : Recorder

Channel-1, Modbus value is showing 0. What is the actual process value?

// Anlog Input - Example

As per section 1.1.1, for AI, the RH = 32767, RL = -32768

Assume for Analog Input Channel1. SL=-120, SH=1000 (Refer Fig B-3)

Case-1: Modbus valve read by Modscan, M=0

A = ((M*(SH-SL))/(RH-RL))+SL

= ((0 * (1000+120))/(32767+32768) +(– 120)
= (0/65535)-120
= -120

Case-2: Modbus valve read by Modscan, M=65535

A = ((M*(SH-SL))/(RH-RL))+SL

= ((65535 * (1000+120))/(32767+32768) +(– 120)
= (65535 * 1120/65535)-120
= (73399200 / 65535)-120
= 1120 -120
= 1000

Case-3: Modbus valve read by Modscan, M=32768

A = ((M*(SH-SL))/(RH-RL))+SL

= ((32768 * (1000+120))/(32767+32768) +(– 120)
= (32768 * 1120/65535)-120
= (36700160 / 65535)-120
= 560 -120
= 440

1.4.13 Modbus to Proces value conversion Math example

// Math Channel - Example

As per section 1.1.1, for Math, the RH=4294967395, RL = 0

Assume for Math Channel1. SL=100, SH=10000

Case-1: Modbus valve read by Modscan, M=0

A = ((M*(SH-SL))/(RH-RL))+SL

A = ((0 * (10000 - 100)) / 4294967295) + 100
= ((0 / 4294967295) + 100)
= 100

Case-2: Modbus valve read by Modscan, M=390451572

A = ((M*(SH-SL))/(RH-RL))+SL
A = ((390451572* (10000 - 100)) / 4294967295) + 100
= (3865470562800/4294967295) + 100
= 900 + 100
= 1000

Case-3: Modbus valve read by Modscan, M= 4294967295

A = ((M*(SH-SL))/(RH-RL))+SL

A = ((4294967295 * (10000 - 100)) / 4294967295) + 100
= (42520176220500/4294967295) + 9900
= 9900 + 100
= 10000

Case-4: Modbus valve read by Modscan, M= 38625

A = ((M*(SH-SL))/(RH-RL))+SL

A = ((38625 * 65.535)/65535) - 32.768
= (2531289.375/65535) - 32.768
= 38.625-32.768
= 5.857