Multi Products
Petro-Tech Modbus Protocol Manual

Ver 3.6 Aug 9, 2010

Ver 3.6 Corrects Door Sensor documentation, '0' is door open, not closed. Also, PetroTech software rev 1.609 and above allows function code 3 as well as 4, for the Discreet Input Register equivalents 3510-3513 for more Enron compatibility.

****NOTE**: PetroTech software version 1.516 and above changes floating point registers from middle endian, byte order "3 4 1 2", to big endian, byte order "1 2 3 4", where byte "1" contains the most significant bits. This is to help support the addition of Enron Modbus 7001-7007 floating point registers for the Turner equation values.

The Multi Products Petro-Tech controller, board Rev 1.3 and above, supports Standard Modbus. It also has some Enron Modbus compatibility as listed below. In the controller Options menu, you may select baud rates, parity and standard or extended receiver (slave) addressing. Most actions that can be done at the controller can also be done via Modbus. While in Auto Mode, multiple pressure settings should be changed in one Modbus command because pressure setting changes take place immediately. You don't want half of the changes to take place while the controller is actively using the pressure settings. Note that you can check to see if the controller door is open or not. This can help avoid changing settings remotely while someone is using the controller locally. Remote actions via Modbus do not lock out local actions at the controller. The local controller screen displays "MODBUS" to warn the operator that remote access is occurring.

Local actions can lock out some remote actions. If the local operator opens the door and sees that the controller is already in Manual mode, or he presses the Stop button, putting the controller in Manual mode, the remote operator cannot put the controller in Auto mode or open/close the valves. To re-enable those remote actions, the local operator must put the controller in Auto mode and close the door. This provides some safety for the local operator. However, we strongly recommend disabling remote control by either shutting off the controller or disconnecting the Modbus cable during well maintenance.

Modbus modes supported: RTU
Modbus function codes supported: 01(Read Coils), 02(Read Discrete Inputs), 03(Read Holding Reg)
04(Read Input Reg), 05(Write Single Coil), 06(Write Single Reg), 15(Write Multiple Coils),
16(Write Multiple Reg)
Supported Hardware: RS485, half duplex (two-wire)
Supported Baud rates: 2400, 9600, 19.2K, 38.4K, 57.6K, 115.2K
Parity: Even, Odd, None
Register transfer limit: Up to 160 registers can be transferred in one Modbus message.
Register format: All registers are 16 bit unsigned integers, except signed holding register "Degrees F".
Turner equation registers 28-41 are 16 bit unsigned integer pairs that convert to real numbers.

Enron Modbus compatibility: Only Enron registers in the 1001-1999 range (Boolean) and the 3001-3999 range (16 bit short integer) and 7000s (32bit floating point) are supported, using function codes 01, 03, 05, 06, 16. Standard Modbus address "zero" refers to register "one", while Enron Modbus address "zero" refers to register "zero". Both Standard and Enron addresses are listed in the map below. For more compatibility with certain devices, function codes 03 and 06 may be substituted for 01 and 05, but the data format remains standard Modbus for 01 and 05 (coils and discrete input registers). The recently added Enron 7000 series registers add 32 bit float compatibility to the Turner equation registers.

For devices that cannot read bit formats (coils and discrete input registers) we have alternate 3000 range addressing. Example: Instead of Coil address 1001 for one bit, you can use 16 bit unsigned register 3501 with values of '1' or '0'.

Timing

Holding Registers: for 41 total, response time of less than 200ms.
Input Registers: for 160 total, response time of less than 20ms (all ten plunger logs.)
For all other function codes, response time is less than 200ms.

Physical Connection

RS485 on small green terminal strip in center of board, left to right, D+ D- GND.

Modbus Register Map

Holding Reg Address Standard/Enron	Name	Description
	Pressure Settings	**Be sure to change multiple pressure limits in one MODBUS command, or in Manual Mode. Changes take effect immediately.**
0 / 3001	High Casing Limit	Valve A opens when casing pressure exceeds this limit
1 / 3002	Low Casing Limit	Valve A closes when casing pressure less than this limit
2 / 3003	Open Diff Limit	Valve A opens when casing minus tubing pressure is less than this limit
3 / 3004	Close Diff Limit	Valve A closes when casing minus tubing pressure exceeds this limit
4 / 3005	Load Factor Limit	Valve A opens when (casing-tubing)/(casing-line) exceeds this limit
5 / 3006	Shutin Pressure limit	If plunger missed arrival, stays shut in until casing pressure exceeds this limit
6 / 3007	High Line Limit	Shuts A valve while line pressure exceeds this limit
7 / 3008	Low Line Limit	Shuts A valve while line pressure is less than this limit
8 / 3009	High Line Window Limit	After High Line limit is exceeded, line pressure must go below that limit minus this window to exit High Line mode.
9 / 3010	Low Line Window Limit	After Low Line limit is met, line pressure must go above that limit plus this window to exit Low Line mode.

10 / 3011	Line Safety Limit	Tubing pressure must be this much above line pressure, or the well will shut in.

Time Settings

Time changes take effect at next cycle start.

11 / 3012	Plunger Max / A Open Time	Max time allowed for plunger to arrive on A valve.
12 / 3013	A Close Time	Time valve stays closed at cycle end. (Pressure settings can override).
13 / 3014	B Open Delay	Delay between A shutting and B opening
14 / 3015	B Open Time	Max time allowed for B valve to remain open.
15 / 3016	After flow	Time to keep A valve open even after plunger arrives.
16 / 3017	B Purge Time	Time to keep B valve open even after plunger arrives.
17 / 3018	Fallback	Time to allow plunger to fall to bottom of well.
18 / 3019	Shut-in Time	Time to keep well shut-in after plunger misses once.
19 / 3020	Mandatory Shut-in Time	Time to keep well shut-in after plunger misses for “Consecutive Plunger Fails”.
20 / 3021	Consecutive Plunger Fails	Max consecutive times plunger is allowed to miss arrival. Triggers Mandatory Shut-in Time.
21 / 3022	Critical Flow Time	“A” valve closes when flow is less than critical flow for these number of seconds
22 / 3023	Clock Month	Clock used to time stamp logs.
23 / 3024	Clock Day	Clock used to time stamp logs.
24 / 3025	Clock Year	Clock used to time stamp logs.
25 / 3026	Clock Hour	Clock used to time stamp logs.
26 / 3027	Clock Minute	Clock used to time stamp logs.
27 / 3028	Clock Second	Clock used to time stamp logs.
	Turner equation values----------->	**Can use Enron 32bit float 7000 registers (big endian)**
28/3029/7001	Gas flow	First part of float (from EFM)
29 / 3030	Gas flow	Second part of float
30/3031/7002	Degrees F	First part of float (from EFM)
31 / 3032	Degrees F	Second part of float
32/3033/7003	Liquid density	First part of float (internal or EFM)
33 / 3034	Liquid density	Second part of float
34/3035/7004	Gas gravity	First part of float (internal or EFM)

35 / 3036	Gas gravity	Second part of float
36/3037/7005	Surface tension	First part of float (internal or EFM)
37 / 3038	Surface tension	Second part of float
38/3039/7006	Pipe id	First part of float (internal or EFM)
39 / 3040	Pipe id	Second part of float
40/3041/7007	Gas compressibility constant	First part of float (internal or EFM)
41 / 3042	Gas compressibility constant	Second part of float

Coil Reg / Holding Reg Address	Name	
0 / 1001/3501	Run Button	Write '1' to start auto mode (Momentary contact, so always reads '0').
1 / 1002/3502	Stop Button	Write '1' to start manual mode (Momentary contact, so always reads '0').
2 / 1003/3503	A Valve	Write '1' to open A valve, '0' to close. (Must be in Manual Mode for write. A and B cannot be open at the same time.)
3 / 1004/3504	B Valve	Write '1' to open B valve, '0' to close. (Must be in Manual Mode for write. A and B cannot be open at the same time.)

Discrete Input Reg /Input Reg Address	Name	
0 / 1010/ 3510	Plunger Sensor	'1' =Plunger up, '0'=Plunger down.
1 / 1011/ 3511	Plunger Arrival	'1'=Plunger did arrive on this cycle, '0'=Plunger has not yet arrived.
2 / 1012/ 3512	AUX	'1'=AUX input is closed, '0'=AUX input is open.
3 / 1013/ 3513	Door sensor	'0'=Controller Door is Open, '1'= Controller Door is Closed.

Input Register Address	Name	
0 / 3100	Mode	Mode that controller is in. Auto, Manual, etc. See Appendix A.
1 / 3101	Casing Pressure	Current Casing Pressure in PSI.
2 / 3102	Tubing Pressure	Current Tubing Pressure in PSI.
3 / 3103	Line Pressure	Current Line Pressure in PSI.
4 / 3104	Current State	State code. See Appendix B
5 / 3105	Summary Plunger Arrival Count	Number of times plunger arrives since Summary was reset.
6 / 3106	Summary Plunger Total Count	Number of times plunger missed or arrived since Summary was reset (resettable only at the

		controller).
7 / 3107	Summary A Open Time	Time that valve A was open since Summary was reset (resettable only at the controller).
8 / 3108	Summary A Close Time	Time that valve A was open since Summary was reset (resettable only at the controller).

Plunger Logs

Ten Plunger logs are in groups of 16 registers starting at address 100.

100 / 3200	Plunger Log Month	Plunger arrival Month (or timeout).
101 / 3201	Plunger Log Day	Plunger arrival Day (or timeout).
102 / 3202	Plunger Log Year	Plunger arrival 4 digit year (or timeout).
103 / 3203	Plunger Log Hour	Plunger arrival hours (24hr)(or timeout).
104 / 3204	Plunger Log Minutes	Plunger arrival minutes (or timeout).
105 / 3205	Plunger Log Seconds	Plunger arrival seconds (or timeout).
106 / 3206	Plunger Travel Hours	Time from opening of A or B valve and arrival of plunger. (Zero if plunger fails to arrive.)
107 / 3207	Plunger Travel Minutes	Time from opening of A or B valve and arrival of plunger. (Zero if plunger fails to arrive.)
108 / 3208	Plunger Travel Seconds	Time from opening of A or B valve and arrival of plunger. (Zero if plunger fails to arrive.)
109 / 3209	Plunger Log Casing Pressure	Casing pressure at time of plunger arrival or timeout.
110 / 3210	Plunger Log Tubing Pressure	Tubing pressure at time of plunger arrival or timeout.
111 / 3211	Plunger Log Line Pressure	Line pressure at time of plunger arrival or timeout.
112 / 3212	Plunger Log Code	Code to indicate on what valve was open when plunger arrived, was AUX on, etc. See appendix C.
113 / 3213	Plunger Log Sales Time Hours	Total time A valve was open, selling gas.
114 / 3214	Plunger Log Sales Time Minutes	Total time A valve was open, selling gas.
115 / 3215	Plunger Log Sales Time Seconds	Total time A valve was open, selling gas.
116-131 / 3216-3231	Plunger Log 2	
132-147 / 3232-3247	Plunger Log 3	
148-163 / 3248-3263	Plunger Log 4	
164-179 / 3264-3279	Plunger Log 5	
180-195 / 3280-3295	Plunger Log 6	
196-211 / 3296-3311	Plunger Log 7	

212-227 / 3312-3327	Plunger Log 8
228-243 / 3328-3343	Plunger Log 9
244-259 / 3344-3359	Plunger Log 10

Appendix A Modes

Number	Name	Description
1	Manual	Stop button was pressed or controller was powered on. Valves off, automatic control is stopped.
2	Auto Cycle Start	Invoked by Run button. Automatic control is started from beginning of cycle start.
3	Auto Closed	Not currently used.
4	Error Manual	Invoked by controller error, valves off, automatic control is stopped.
5	Manual Low Battery	Invoked by low battery voltage, valves off, automatic control is stopped.
6	AUX On	AUX switch is on, valves are open or closed as selected in the Options/AUX menu.

Appendix B States

Number	Name	"Controller Screen display", Description
0	None Plunger Down	"Waiting for Limit!" Beginning of auto-cycle, both valves closed.
1	None Plunger Middle	"Limit Exceeded!" Plunger is rising, both valves closed.
2	None Plunger Up	"Plunger Arrival B" Plunger has arrived, both valves closed.
3	A Plunger Up	"Plunger Arrival A" Valve A is open, plunger has arrived.
4	A Plunger Down	"B Open Time" Valve B is open, valve A is closed, plunger is at bottom.
5	B Plunger Down	"B Open Time" Valve B is open, valve A is closed, plunger is at bottom.
6	Fallback	"Fallback Time" Both valves are closed, plunger is falling to bottom.

7	Shut-in	"Shut-in Time!" Both valves are closed, well is shut-in for an extended time, recovering from plunger miss.
8	ACT state1	"A Close Time" One valve system, valve closed.
9	ACT state2	"A Close Time" One valve system, valve closed.
10	B Open Delay	"B Open Delay" A and B closed, waiting to open B.
11	Mandatory Shut-in	"Mandatory Shut-in!" A and B closed due to consecutive plunger misses.
12	Line Error Up	"Line Limit!" Line pressure too high, A and B valves closed.
13	Line Error Down	"Line Limit!" Line pressure too low, A and B valves closed.
14	Plunger Error	"Plunger Error!" Valve is opened, yet Plunger sensor claims plunger is still at top.
15	Setting Err Msg	"Check Settings." Need a setting to open and a setting to close.
16	After flow	"After flow" Plunger arrived, A valve open, still selling gas.

Appendix C Plunger Log Code

Ascii Number	Equivalent Letter	Description
65	A	Plunger arrived on “A” valve.
66	B	Plunger arrived on “B” valve.
88	X	Plunger arrived on “A” valve, plus AUX was active during cycle.
76	L	Plunger arrived on “A” valve, plus Line limit was active during cycle.(overrides code X)
77	M	Plunger arrived on “B” valve, plus Low Casing was reached at least once during B open.
89	Y	Plunger arrived on “B” valve, plus AUX was active during cycle. (overrides code M)
75	K	Plunger arrived on “B” valve, plus Line limit was active during cycle. (overrides code Y)