Modbus User's Manual

V1.0_11082022

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1 INTRODUCTION

The following documentation provides information on how to setup, configure, and operate the Modbus communications interface with Phase VFDs.

The Modbus protocol states each device must have these data categories: Coils, Discrete Inputs, Holding Registers, and Input Registers. These categories hold all accessible Read/Write and Read Only parameters and measurements available through the Modbus interface.

2 DEFINITIONS

Master: Device that transmits and requests information to and from Slave devices
Slave: Device that receives requests from and responds to a Modbus Master device
Coil: Single bit (on/off) Read/Write value
Discrete Input: Single bit (on/off) Read Only value
Holding Register: Read/Write 16 bit register
Input Register: Read Only 16 bit register

3 WIRING SETUP

3.1 Two-Wire

To wire the control board using two-wire communication, first short the two positive lines, R+ and T+ together. This becomes the D1(+) line. Next, short together the R- and T- lines together, this becomes the D0(-) line.

If communicating directly to a drive using an RS-485 four-wire adapter, the positive lines should be shorted, and the negative lines should be shorted together.

If the PhaseTech UI is used, the adapter is configurable, and has an Echo Mode feature, **the Echo Mode must be turned ON** to mimic the echo of a four-wire adapter wired in the two-wire configuration.

3.2 Four-Wire

To wire the control board to a four-wire network, connect the following:

- Master's T+ to Slave's R+
- Master's T- to Slave's R-
- Master's R+ to Slave's T+
- Master's R- to Slave's T-
- Common grounds must be connected as well

- Adapters with the Echo Mode feature **must be turned OFF**.

3.3 Line Termination

A Modbus network must have one 120Ohm 1/4W resistor at each end of a Modbus balanced line pair. In two-wire communication, 2 termination resistors are used, and in four-wire communication, a total of four line termination resistors must be used.

If a Phase Technologies VFD is at either end of a Modbus network, a termination resistor may be installed in the Terminal Block on the control board.

When communicating directly to a Phase VFD Slave using an adapter, it may be useful to provide termination resistors at either end of the line. Depending on how long the cable is, the baud rate, and the type of shielding used, adding termination resistors may improve the quality of communication between Master and Slave.

3.4 Line Polarization (Biasing)

Providing a bias for Phase VFDs is not necessary for operation, but can still function if connected to a biased network. Phase VFDs do not supply line biasing by default. +5V and ground terminals are available, but it is recommended that the biasing resistors be close to the Master device. 450-650 Ohm resistors must be used, and it is required that only one bias resistor be on each data line.

Note: To avoid excess loading on a network with bias resistors, the maximum number of devices on a single network without a repeater is reduced from 32 to 28.

When communicating directly to a Phase VFD Slave using an adapter, it may also be useful to provide biasing resistors. The 5VO and COM ports on the control board terminals may be used to provide the +5V and ground for biasing.

3.5 Line Shielding and Wiring

The Modbus standard requires shielded twisted-pair cabling, as this aids the most in mitigating noise interference. In a Modbus network, it is not recommended to tie the shielding of the cable to the Phase VFD's COM port, and instead should be grounded near the Master device.

When communicating directly to a Phase VFD Slave using an adapter, it is recommended to tie the shielding to ground via the control board's COM screw terminal, and not to the adapter itself.

4 MODBUS CONFIGURATIONS

Modbus ID – Modbus network device address from 1 to 247. The Modbus ID of the Phase VFD must be the only device on that network with that value, otherwise multiple devices will read and respond to the same message.
Modbus Data Rate – Baud Rate of the network. 2400*, 4800, 9600, 19200, 38400, 57600, and 115200* rates are supported. *Only the LH-V series supports these baud rates.
Modbus Parity – Parity Bit enable/configuration. Even, Odd, and None parities are supported.
Modbus Stop Bits – The number of stop bits following a byte, 1 or 2 are supported.
Modbus Wiring – Select between two and four-wire communication.

When using the PhaseTech UI program, it is important to match the configurations between the Phase VFD and the UI's configurations under the Options menu.

5 PHASETECH UI OPERATION

Phase Technologies provides a Windows application to communicate with Phase VFDs.

5.1 Start Up

To begin, run the application PhaseTechUI.exe. When ran for the first time, the user will be prompted to select a Phase VFD control. Select "LH Aqua Phase Control" for LH Aqua Phase systems or "LH-V Control" for LH-V systems.

Once the main page is loaded, use the Modbus Slave Address Select box to type in the Modbus ID of the Phase VFD. Click Set to configure the PhaseTech UI to communicate with the selected device.

Next, use the drop down menu in the top right labeled "Port Select" to select the COM Port that is being used by the RS-485 adapter. If the COM Port is not found, make sure the adapter is plugged in and connected to the Phase VFD, and ensure that drivers are installed correctly. Either click the Reset button or restart the PhaseTech UI program to reload the COM Port list.

After selecting the correct COM Port, click the Connect button, and automatic communication with the VFD will begin. Parameters will load their current values into the "Current" column.

5.2 Configuration

To configure the Default, Min, and Max columns, double click the table's Cell that you wish to change. A text box will appear prompting for a new value. New Min values cannot be lower than the default Min values, and new Max values cannot be higher than the default Max values.

Changing either the Min or Max value of a parameter will automatically adjust the Default value, and it will ensure that the Default value cannot be set below or above the Min or Max values.

Any changes made will be highlighted in red text. Once done configuring the Defaults, the configuration can be saved under File->Save, or by pressing Control+S. A prompt will appear to give the save file a

name and a file location. If the user exits the program with unsaved changes, the PhaseTech UI will ask if the changes should be saved.

Note: Parameters cannot be set higher or lower than the Phase VFD's model parameter min/max values. For example, Overcurrent Limit cannot be set higher than 48A on 30HP systems.

A configuration file can be loaded under File->Open to load a previous configuration. The default configuration can be loaded under File->Reset Default Params. This will load the default parameter configurations.

5.3 Changing Parameters

To write to a Read/Write parameter address, either type in the Register Address in the text box, use the Register Name dropdown menu, or click the row of the parameter to select that parameter. Type in a Value that is in the Min/Max range of that parameter, and click the Send button. Allow for a few seconds for the parameter to be updated in the table.

The user can use the Apply Defaults button to sequentially send **all** Default values to every Read/Write parameter.

5.4 Relays

To control the relays through Modbus, the Interface Parameter "Program Relay No x" **must** be set to "Modbus Control", otherwise, the command to toggle the relay will be ignored.

6 MESSAGE STRUCTURE + FUNCTION CODES

Message Structure
Every Modbus message must contain a Slave ID, a Function Code, and a two-byte CRC. Two-byte register number and data fields must always be "Big-Endian" where the high byte is transmitted first, followed by the low byte. Every two-byte CRC must be transmitted with the low byte transmitted first, followed by the high byte.

Example request to read 4 Coils starting from Address 0:

Slave ID	1 Byte	1
Function Code	1 Byte	0x01
Starting Register	2 Bytes[Hi:Lo]	[0x00, 0x00]
Number of Coils	2 Bytes[Hi:Lo]	[0x00, 0x04]
CRC	2 Bytes[Lo:Hi]	[CRCL, CRCH]

Note 1: In the following sections, the Slave ID and CRC fields will be excluded, as every request and response will need these fields.

Note 2: The category offsets **must not** be added to the address field before sending a request. To access Coil number 1 the address must be 0, to access Discrete Input Register 10002 the address must be 1, etc.

6.1 Read Coil – Function Code 1(0x01)

Coil Register Start: 00001
Request:

Function Code	1 Byte	0x01
Starting Address	2 Bytes[H:L]	0 to 3
Number of Coils	2 Bytes[H:L]	1 to 4

Response:

Function Code	1 Byte	0x01
Data Byte Count	1 Byte	1
Coil Statuses	1 Byte	Bit Field

Note: Bit Field contains the status of each requested coil.
The 1st requested coil is in Bit 0, the 2nd requested coil is in Bit 1, etc.

Error Response:

Function Code	1 Byte	0x81
Exception Code	1 Byte	02 or 03

6.2 Read Discrete Inputs – Function Code 2(0x02)

Discrete Input Start: 10001

Request:

Function Code	1 Byte	0x02
Starting Address	2 Bytes[H:L]	0 to 7
Number of Inputs	2 Bytes[H:L]	1 to 8

Response:

Function Code	1 Byte	0x02
Data Byte Count	1 Byte	1
Coil Statuses	1 Byte	Bit Field

Note: Bit Field contains the status of each discrete input.
The 1st requested input is in Bit 0, the 2nd requested input is in Bit 1, etc.

Error Response:

Function Code	1 Byte	0x82
Exception Code	1 Byte	02 or 03

6.3 Read Holding Registers – Function Code 3(0x03)

Holding Register Start: 40001
Note 1: In LH AquaPhase systems, **N** is limited to 6 registers. In LH-V systems, **N** is limited to 30 registers in a single response.

Request:

Function Code	1 Byte	0x03
Starting Address	2 Bytes[H:L]	0 to 136
Number of Registers	2 Bytes[H:L]	1 to **N***

Response:

Function Code	1 Byte	0x03
Data Byte Count	1 Byte	2 x **N***
Register Value 0	2 Bytes[H:L]	Value
	…….	
Register Value [**N*** - 1]	2 Bytes[H:L]	Value

Error Response:

Function Code	1 Byte	0x83
Exception Code	1 Byte	02 or 03

6.4 Read Input Registers – Function Code 4(0x04)

Input Register Start: 30001
Note *: In LH AquaPhase systems, **N** is limited to 6 registers. In LH-V systems, **N** is limited to 30 registers in a single response.

Request:

Function Code	1 Byte	0x04
Starting Address	2 Bytes[H:L]	0 to 28
Number of Registers	2 Bytes[H:L]	1 to **N***

Response:

Function Code	1 Byte	0x04
Data Byte Count	1 Byte	2 x **N***
Register Value 0	2 Bytes[H:L]	Value
	…….	
Register Value [**N*** - 1]	2 Bytes[H:L]	Value

Error Response:

Function Code	1 Byte	0x84
Exception Code	1 Byte	02 or 03

6.5 Write Single Coil – Function Code 5(0x05)

Request:

Function Code	1 Byte	0x05
Coil Address	2 Bytes[H:L]	0 to 3
Coil Value	2 Bytes[H:L]	0x0000(off) or 0xFF00(on)

Response:

Function Code	1 Byte	0x05
Coil Address	2 Bytes[H:L]	0 to 3
Coil Value	2 Bytes[H:L]	0x0000(off) or 0xFF00(on)

Error Response:

Function Code	1 Byte	0x85
Exception Code	1 Byte	02 or 03

6.6 Write Single Holding Register – Function Code 6(0x06)

Request Message:

Function Code	1 Byte	0x06
Register Address	2 Bytes[H:L]	0 to 136
Register Value	2 Bytes[H:L]	0x0000 to 0xFFFF

Response:

Function Code	1 Byte	0x06
Register Address	2 Bytes[H:L]	0 to 136
Register Value	2 Bytes[H:L]	0x0000 to 0xFFFF

Error Response:

Function Code	1 Byte	0x86
Exception Code	1 Byte	02 or 03

6.7 Diagnostics – Function Code 8(0x08)

All Diagnostic messages and responses will have the same format.
Request:

Function Code	1 Byte	0x08
Sub Function Code	2 Bytes[H:L]	[Sub Function Code]
Data	2 Bytes[H:L]	[Data]

Response:

Function Code	1 Byte	0x08
Sub Function Code	2 Bytes[H:L]	[Sub Function Code]
Data	2 Bytes[H:L]	[Data]

Error Response:

Function Code	1 Byte	0x88
Exception Code	1 Byte	01, 03, 04

6.7.1 Return Query Data – Sub Function Code 0

Sub Function Code: 0x0000
Data: Any
Response: Echo Data

6.7.2 Restart Communications – Sub Function Code 1

Sub Function Code: 0x0001
Data: Any
Response: Echo Request Data

Note 1: Event Log is not implemented. Setting Data to 0xFF00 will not affect the Restart Communications command.

Note 2: This is the only command that the drive will act on when in Listen Only Mode. Sending this command will reset communications, and Listen Only Mode will be disabled. If the drive is coming out of Listen Only Mode, no response message will be sent.

6.7.3 Force Listen Only Mode – Sub Function Code 4

Sub Function Code: 0x0004
Data: 0x0000
Response: No Response

This command will force the drive into Listen Only Mode. The drive can receive Modbus messages, but it will perform no actions, and give no responses. The only way to set the drive to normal Modbus operation is to send the Diagnostics - Restart Communications command, and no response will be given. Future requests will be acted on and responded to.

6.7.4 Clear Counters – Sub Function Code 10

Sub Function Code: 0x000A
Data: 0x0000
Response: Echo Data

This command clears all Modbus and SCI counters. The Diagnostics register is not implemented. All counters are reset when the drive powers up.

6.7.5 Return Bus Message Count – Sub Function Code 11

Sub Function Code: 0x000B
Data: 0x0000
Response: Total Message Count

The drive will respond with the total number of Modbus Messages that it has seen.

6.7.6 Return Bus Comm Error Count – Sub Function Code 12

Sub Function Code: 0x000C
Data: 0x0000
Response: CRC Error Count

The drive will respond with the total number of CRC errors.

6.7.7 Return Bus Exception Error Count – Sub Function Code 13

Sub Function Code: 0x000D
Data: 0x0000
Response: Exception Error Count

The drive will respond with the total number of Illegal Function, Address, and Value errors.

6.7.8 Return Server Message Count – Sub Function Code 14

Sub Function Code: 0x000E
Data: 0x0000
Response: Server Message Count

The drive will respond with the total number of Modbus Messages that have been addressed to that device.

6.7.9 Return Server No Response Count – Sub Function Code 15

Sub Function Code: 0x000F
Data: 0x0000
Response: No Response Count

The drive will respond with the total number of Modbus Messages that it has not responded to.

6.7.10 Return Server NAK Count – Sub Function Code 16

Sub Function Code: 0x0010
Data: 0x0000
Response: Server NAK Count

The drive will respond with the total number of Negative Acknowledge exception responses.

6.8 Report Slave ID – Function Code 17(0x11)

Request Message:

Function Code	1 Byte	0x11

Response:

Function Code	1 Byte	0x11
Byte Count	1 Byte	3
Slave ID	1 Byte	Slave ID
Run Status	1 Byte	0x00(off) or 0xFF(on)
System Status	1 Byte	0(ok), positive number = Fault

6.9 Extended Diagnostics – Function Code 65 (0x41)

Extended Diagnostics Start: 60001

This is a Phase Technologies specific function code, which functions similar to the Input Registers (function code 4). The extended diagnostics register array contains all of the Modbus and SCI counters and parameter offsets and counts.

Note *: In LH AquaPhase systems, **N** is limited to 6 registers. In LH-V systems, **N** is limited to 30 registers in a single response.

Request Message:

Function Code	1 Byte	0x41
Starting Address	2 Bytes[H:L]	0 to 21
Number of Registers	2 Bytes[H:L]	1 to **N***

Response:

Function Code	1 Byte	0x41
Data Byte Count	1 Byte	2 x **N***
Register Value 0	2 Bytes[H:L]	Value
	…….	
Register Value [**N*** - 1]	2 Bytes[H:L]	Value

Error Response:

Function Code	1 Byte	0xC1
Exception Code	1 Byte	02 or 03

6.10 Phase Command – Function Code 66 (0x42)

This is a Phase Technologies specific function code with multiple sub-function codes.

6.10.1 Set HOA Mode –Function Code 66/1(0x42/0x01)

This will set the drive into Off, Manual, or Auto Mode.

Request:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0001
Mode Select	1 Byte	0x00(Off), 0x0F(Manual), 0xF0(Auto)

Response:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0001
Mode Select	1 Byte	Echo Data

Error Response:

Function Code	1 Byte	0xC2
Sub Function Code	2 Bytes[H:L]	0x0081
Exception Code	1 Byte	03

6.10.2 Set Run State – Function Code 66/2(0x42/0x02)

If the drive is in Manual Mode, this command will Run/Stop the drive. If the Interface Parameter: **Disable Manual Mode** is configured to "Yes", this command will **not** toggle the run state of the drive.

Request:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0002
Mode Select	1 Byte	0x00(Off), 0x0F(Run)

Response:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0002
Mode Select	1 Byte	Echo Data

Error Response:

Function Code	1 Byte	0xC2
Sub Function Code	2 Bytes[H:L]	0x0082
Exception Code	1 Byte	03

6.10.3 Reset System Status – Function Code 66/3(0x42/0x03)

If the drive is in a Fault State, this command will reset the drive. This command will only work if the system has faulted. The System Reset byte **must** be 0xA5 for the command to work.

Request:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0003
System Reset Data	1 Byte	0xA5

Response:

Function Code	1 Byte	0x42
Sub Function Code	2 Bytes[H:L]	0x0003
System Reset Data	1 Byte	Echo Data

Error Response:

Function Code	1 Byte	0xC2
Sub Function Code	2 Bytes[H:L]	0x0083
Exception Code	1 Byte	03

6.11 Unimplemented Function Codes

Read Exception Status – 7(0x07)
Get Comm Event Counter – 11(0x0B)
Get Comm Event Log – 12(0x0C)
Write Multiple Coils – 15(0x0F)

Write Multiple Registers – 16(0x10)
Read File Record – 20(0x14)
Write File Record – 21(0x15)
Mask Write Register – 22(0x16)
Read/Write Multiple Registers – 23(0x17)
Read FIFO Queue – 24(0x18)
Encapsulated Interface Transport – 43(0x2B)
CANopen General Request and Response PDU – 43/13 (0x2B/0x0D)
Read Device Identification – 43/14 (0x2B/0x0E)

Error Response:

Function Code	1 Byte	0x80 | [Function Code]
Exception Code	1 Byte	01

7 MODBUS COMMUNICATION SPECIFICATIONS

7.1 TX Line Holding

On the TX+/- lines in 4-Wire communication, and the D0/D1 lines in 2-Wire communication, both the LHAP and LH-V series will continue to drive the bus for a set amount of time to ensure that the entire message has been transmitted successfully.

Baud Rate	Delay Amount (ms)
2400*	6.0
4800	4.0
9600	2.0
19200	1.0
38400	0.4
57600	0.4
115200*	0.2

*These baud rates are only available on LH-V systems

7.2 LH Aqua Phase Series

Baud Rate Calculations

Clock Source	Expected Baud Rate	Actual Baud Rate	% Error
60M	4800	4804	0.08%
60M	9600	9615	0.16%
60M	19200	19231	0.16%
60M	38400	38461	0.16%
60M	57600	57692	0.16%

3.5 Char Silent Interval

Baud Rate	3.5 Char Time (ms)
4800	8.0
9600	4.0
19200	2.0
38400	1.8
57600	1.8

1.5 Char Frame Timing

Baud Rate	3.5 Char Time (ms)
4800	3.6
9600	1.8
19200	1.0
38400	0.8
57600	0.8

7.3 LH-V Series

Baud Rate Calculations

Clock Source	Expected Baud Rate	Actual Baud Rate	% Error
120M	2400*	2400	0.0%
120M	4800	4800	0.0%
120M	9600	9603	0.03%
120M	19200	19206	0.03%
120M	38400	38363	0.10%
120M	57600	57692	0.16%
120M	115200*	115384	0.16%

3.5 Char Silent Interval

Baud Rate	3.5 Char Time (ms)
2400*	16.0
4800	8.0
9600	4.0
19200	2.0
38400	1.8
57600	1.8
115200*	1.8

1.5 Char Frame Timing

Baud Rate	3.5 Char Time (ms)
2400*	6.9
4800	3.5
9600	1.8
19200	0.9
38400	0.8
57600	0.8
115200*	0.8

*These baud rates are only available on LH-V systems.

8 MODBUS ADDRESSES

Index	Name	Address	Read Only
0	"Relay 1"	1	0
1	"Relay 2"	2	0
2	"Relay 3"	3	0
3	"Relay 4"	4	0
4	"HOA Run-Stop "	10001	1
5	"AUX 1 Setting "	10002	1
6	"AUX 2 Setting "	10003	1
7	"AUX 3 Setting "	10004	1
8	"AUX 4 Setting "	10005	1
9	"Fan_Drive"	10006	1
10	"Contactor_Drive"	10007	1
11	"Relay_Drive"	10008	1
12	"HOA Auto-Manual "	30001	1
13	"I_u"	30002	1
14	"I_v"	30003	1
15	"I_w"	30004	1
16	"Output HP"	30005	1
17	"Output KW"	30006	1
18	"Output KVA"	30007	1
19	"Output PF"	30008	1
20	"Bus Cap Voltage"	30009	1
21	"Input Voltage"	30010	1
22	"Input Current"	30011	1
23	"Model Number"	30012	1
24	"Frequency"	30013	1
25	"Measured Current Unbalance"	30014	1
26	"Input Current 2"	30015	1
27	"Input Current 3"	30016	1
28	"IGBT Case Temp 1"	30017	1
29	"IGBT Case Temp 2"	30018	1
30	"V 5VDC Input"	30019	1
31	"I_1 4-20mA Input"	30020	1
32	"I_2 4-20mA Input"	30021	1
33	"DIP States"	30022	1
34	"Internal Temp"	30023	1
35	"RTC Year"	30024	1
36	"RTC Month"	30025	1
37	"RTC Day"	30026	1
38	"RTC Hour"	30027	1
39	"RTC Minute"	30028	1
40	"RTC Second"	30029	1
41	"System Status"	30030	1

42	"Output Voltage"	40001	0
43	"Min Frequency"	40002	0
44	"Max Frequency"	40003	0
45	"Start Up Ramp Time"	40004	0
46	"Overcurrent Limit"	40005	0
47	"Dry Well Current"	40006	0
48	"Current Unbalance"	40007	0
49	"Dry Well KW"	40008	0
50	"Switching Frequency"	40009	0
51	"Coast to Stop"	40010	0
52	"GND Fault Detect Fault Sensitivity"	40011	0
53	"Submersible Pump"	40012	0
54	"Reverse Rotation"	40013	0
55	"Shutdown Ramp"	40014	0
56	"Overcurrent Derate Enable"	40015	0
57	"Overtemp Derate Enable"	40016	0
58	"Minimum Derate Frequency"	40017	0
59	"PWM Over Modulation"	40018	0
60	"Pivot Overcurrent"	40019	0
61	"Enable Restarts"	40020	0
62	"Dry Well Delay"	40021	0
63	"Restart Delay 1"	40022	0
64	"Restart Delay 2"	40023	0
65	"Restart Delay 3"	40024	0
66	"Restarts Motor Overload"	40025	0
67	"Restarts Dry Well"	40026	0
68	"Restarts Current Imbalance"	40027	0
69	"Restarts Undervoltage"	40028	0
70	"Restarts Overvoltage"	40029	0
71	"Restarts Bus Overvoltage"	40030	0
72	"Startup Delay"	40031	0
73	"Restarts 1ph V"	40032	0
74	"Restarts Sensor Conn Fail"	40033	0
75	"Restarts 4-20mA"	40034	0
76	"Short Cycle Delay"	40035	0
77	"Sensor Connection Fault Delay"	40036	0
78	"Restarts Locked Motor"	40037	0
79	"System Config"	40038	0
80	"Troubleshooting"	40039	0
81	"Analog Select"	40040	0
82	"Program Relay 1"	40041	0
83	"Program Relay 2"	40042	0
84	"Program Relay 3"	40043	0
85	"Program Relay 4"	40044	0
86	"Analog in Reverse"	40045	0

87	"MODBUS ID"	40046	0
88	"MODBUS Data Rate"	40047	0
89	"MODBUS Parity"	40048	0
90	"MODBUS Stop Bits"	40049	0
91	"Disable Manual Mode"	40050	0
92	"AUX 1 Select"	40051	0
93	"AUX 2 Select"	40052	0
94	"AUX 3 Select"	40053	0
95	"AUX 4 Select"	40054	0
96	"Broken Pipe psi"	40055	0
97	"Broken Pipe Time"	40056	0
98	"T OFF"	40057	0
99	"T1 ON"	40058	0
100	"T2 ON"	40059	0
101	"Shut Off Frequency"	40060	0
102	"Boost Amount"	40061	0
103	"Pre-charge Frequency"	40062	0
104	"Pre-charge Time"	40063	0
105	"Pre-charge psi"	40064	0
106	"Proportional Gain"	40065	0
107	"Integral Gain"	40066	0
108	"Derivative Gain"	40067	0
109	"PID Filter Gain"	40068	0
110	"PID Filter Time"	40069	0
111	"Overpressure psi"	40070	0
112	"4-20mA psi Sensor Range"	40071	0
113	"Duplex Cycle Time"	40072	0
114	"Draw Down psi"	40073	0
115	"psi SETPOINT"	40074	0
116	"psi 1 SETPOINT"	40075	0
117	"psi 2 SETPOINT"	40076	0
118	"psi 3 SETPOINT"	40077	0
119	"psi 4 SETPOINT"	40078	0
120	"PSI Offset"	40079	0
121	"Number Lag Pumps"	40080	0
122	"Stage Pump Dly"	40081	0
123	"Destage Pump Dly"	40082	0
124	"Stage Frq Redct1"	40083	0
125	"Stage Frq Redct2"	40084	0
126	"Stage Frq Redct3"	40085	0
127	"Stage Frq Redct4"	40086	0
128	"Stage Time"	40087	0
129	"Destg psi Boost1"	40088	0
130	"Destg psi Boost2"	40089	0
131	"Destg psi Boost3"	40090	0

132	"Destg psi Boost4"	40091	0
133	"Destage Time"	40092	0
134	"Stage psi Lag"	40093	0
135	"Destage psi Lag"	40094	0
136	"Destage Min Freq"	40095	0
137	"Precharge Pumps"	40096	0
138	"Modbus Msg Count"	60001	1
139	"Modbus Comm Error Count"	60002	1
140	"Modbus Exception Count"	60003	1
141	"Modbus Slave Msg Count"	60004	1
142	"Modbus No Response Count"	60005	1
143	"Modbus Framing Error Count"	60006	1
144	"SCI Error Count"	60007	1
145	"SCI Framing Error Count"	60008	1
146	"SCI Overrun Error Count"	60009	1
147	"SCI Parity Error Count"	60010	1
148	"Operating Start"	60011	1
149	"Auto Restart Start"	60012	1
150	"Interface Start"	60013	1
151	"Constant Pressure Start"	60014	1
152	"Lead Lag Start"	60015	1
153	"Operating Count"	60016	1
154	"Auto Restart Count"	60017	1
155	"Interface Count"	60018	1
156	"Constant Pressure Count"	60019	1
157	"Lead Lag Count"	60020	1

9 REFERENCES

- http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf
- http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf