Modbus for Vindum Pumps (v1.2)

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Section 1: Modbus Overview

Vindum pumps, both the VP-Series and the VIPR-Series, support direct connection to external equipment using the Modbus RTU communication protocol. The user can query pump status, read, and write pump parameters (e.g., pumping rate and pressure), and operate the pump via the Modbus interface.

Users can read and write discrete values (called "coils" and "contacts") and numeric values ("registers") to get pump status and control pump operation. The addresses for coils, contacts, and registers are found in
Exiting Modbus Mode
The pump can be restored to its "normal" communication mode (for connection to VPware) by writing a "1" value to the discrete coil "Exit Modbus mode" found in the table below.
`Section 3: Modbus Registers`.

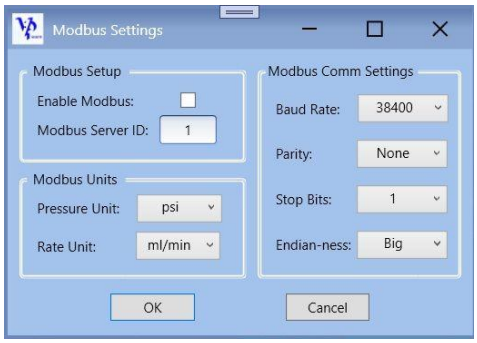
Vindum pumps support the following Modbus functions:

- 1 (0x01) – Read Coils
- 2 (0x02) – Read Discrete Inputs
- 3 (0x03) – Read Holding Registers
- 4 (0x04) – Read Input Registers
- 5 (0x05) – Write Single Coil
- 6 (0x06) – Write Single Register
- 16 (0x10) – Write Multiple Registers (writes are limited to a single parameter value)
- 17 (0x11) – Read Server ID

Writing multiple coils or writing more than one parameter value are disabled, as errors can occur when writing values, and multiple writes would prevent the user from discovering which write had failed.

Section 2: Modbus Settings (Serial Port Settings, Cable Type, Firmware) in VPware

Modbus requires VPware Version 1.3.34 (and later) AND Firmware Version 329 (and later). Contact Vindum Engineering if you need these updates. Modbus configuration is accessed by clicking on the "Modbus Setup" button at the bottom of the VPware Configure/Pump Configuration window. The "Modbus Setup" button will appear for connected pumps that support the Modbus protocol, as shown below.



Modbus Configuration

Modbus Server ID

To support multiple devices on the same bus, each Modbus device has a Server ID, ranging from 1 to 247. The default value for Vindum Pumps is 1.

Modbus Units

The user can select the units for pressure and rate used on the Modbus interface. Supported units are:

- Pressure: psi, bar, kPa, MPa
- Rate: ml/min, ml/hour

Modbus Serial Port Settings

The following serial communication modes are supported:

- Baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
- Parity, data bits, and stop bits:
    - No parity, 8 data bits, 1 stop bit
    - Even parity, 8 data bits, 1 stop bit
    - Odd parity, 8 data bits, 1 stop bit
    - No parity, 8 data bits, 2 stop bits

The serial connection between a Modbus client and the pump uses a standard RS232 “Straight Through Cable” (also called “Non-Null Cable”).

- Pin 2: TX (Transmit data)
- Pin 3: RX (Receive data)
- Pin 5: GND (Ground)

Connection to a Modbus client using a serial-to-USB cable is also supported, but using a USB-USB cable will not work for Modbus communication.

"Endian-ness"

The byte order of data sent over Modbus is configurable using the "Endian-ness" setting. By default, Modbus uses "big endian" encoding, meaning a numerical quantity larger than a single byte transmitted, the most significant byte is sent first. For example, a 16-bit value of hexadecimal 0x1234 will be sent as two bytes, 0x12 then 0x34. "Little endian" transmission would reverse the order of the bytes. The Vindum pump supports both methods.

Exiting Modbus Mode

The pump can be restored to its "normal" communication mode (for connection to VPware) by writing a "1" value to the discrete coil "Exit Modbus mode" found in the table below.

Section 3: Modbus Registers

Modbus separates its address space according to the type of data (single bits or numeric values) and whether the value can be written or is read-only. The following tables describe the Vindum pump interface.

Important Note: When using a single-cylinder (VIPR) pump in an unpaired mode, cylinder 2 reads will always return a value of zero, and cylinder 2 writes will be ignored.

Important Note: Command to the pump via Modbus will result in a status code being written to the register "Command Response" (see the Read-Only Analog Input Registers table below). Vindum recommends reading the "Command Response" register after every Modbus write to verify command success. Details on error codes can be found in the "Vindum Pump Error Codes" document

Read/Write Single-Bit Discrete Values ("Coils")

Register Address	Number of Registers	Date Type	Description	Values
1	1	Boolean	Cylinder A Fill Valve State	Closed=0, Open = 1
2	1	Boolean	Cylinder A Deliver Valve State	Closed=0, Open = 1
3	1	Boolean	Cylinder B Fill Valve State	Closed=0, Open = 1
4	1	Boolean	Cylinder B Deliver Valve State	Closed=0, Open = 1
5	1	Boolean	Save Safety Pressure on Pump Mode	0=Don't save safety pressure on pump, 1=save safety pressure on pump
10	1	Boolean	Start Cylinder A in Volume Mode	1 = Start function. Always reads 0, Uses CYL1_START_VOLUME parameter below to set volume for command

11	1	Boolean	Start Cylinder A in Auto Volume Mode	1 = Start function. Always reads 0, Uses CYL1_START_VOLUME parameter below to set volume for command
12	1	Boolean	Start Cylinder B in Volume Mode	1 = Start function. Always reads 0, Uses CYL2_START_VOLUME parameter below to set volume for command
13	1	Boolean	Start Cylinder B in Auto Volume Mode	1 = Start function. Always reads 0, Uses CYL2_START_VOLUME parameter below to set volume for command
14	1	Boolean	Zero Cylinder A Pressure Sensor	1 = Start function. Always reads 0
15	1	Boolean	Zero Cylinder B Pressure Sensor	1 = Start function. Always reads 0
16	1	Boolean	Start Cylinder A	1 = Start function. Always reads 0
17	1	Boolean	Start Cylinder A in Auto Mode	1 = Start function. Always reads 0
18	1	Boolean	Start Cylinder B	1 = Start function. Always reads 0
19	1	Boolean	Start Cylinder B in Auto Mode	1 = Start function. Always reads 0
20	1	Boolean	Stop Cylinder A	1 = Start function. Always reads 0
21	1	Boolean	Stop Cylinder B	1 = Start function. Always reads 0
22	1	Boolean	Stop Both Cylinders	1 = Start function. Always reads 0
23	1	Boolean	Reset Cylinder A Volume	1 = Start function. Always reads 0
24	1	Boolean	Reset Cylinder B Volume	1 = Start function. Always reads 0
25	1	Boolean	Reset Cumulative Volume	1 = Start function. Always reads 0
26	1	Boolean	Reset All Volumes	1 = Start function. Always reads 0
27	1	Boolean	Reset Cylinder A Cumulative Volume	1 = Start function. Always reads 0
28	1	Boolean	Reset Cylinder B Cumulative Volume	1 = Start function. Always reads 0
29	1	Boolean	Modbus interface “endian” mode	1 = big endian, 0 = little endian

30	1	Boolean	Exit Modbus mode	1 = Exit Modbus mode and enable standard serial communication. Always reads 0
31	1	Boolean	Reset Errors	1 = Reset all latched errors

Read-only Discrete Inputs ("Contacts")

Register Address	Number of Registers	Date Type	Description	Values
10001	1	Boolean	Cylinder A Running	0=Stopped, 1=Running
10002	1	Boolean	Cylinder B Running	0=Stopped, 1=Running
10003	1	Boolean	Cylinder A Active	0=Not Active, 1=Active
10004	1	Boolean	Cylinder B Active	0=Not Active, 1= Active
10005	1	Boolean	Cylinder A Safety Pressure Error Flag	0=No Error, 1=Safety Pressure Error
10006	1	Boolean	Cylinder B Safety Pressure Error Flag	0=No Error, 1=Safety Pressure Error

Read-Only Analog Input Registers

Register Address	Number of Registers	Date Type	Description	Values
30001	1	Unsigned Integer	Command Response	0=no error, other values indicate error when processing command
30002	2	Float	Cylinder A Pressure	In selected units
30004	2	Float	Cylinder B Pressure	In selected units
30006	2	Float	Output Pressure	In selected units
30008	2	Float	Cylinder A Rate	In selected units
30010	2	Float	Cylinder B Rate	In selected units
30012	2	Float	Output Rate	In selected units
30014	2	Float	Cylinder A Volume	In milliliters
30016	2	Float	Cylinder B Volume	In milliliters
30018	2	Float	Cumulative Volume	In milliliters
30020	1	Unsigned Int	Pump Type	
30021	1	Unsigned Int	Cylinder A Position	Count from 0 to 642 for VP1 dual-cylinder pumps, 0 to 7440 for VIPR single-cylinder pumps
30022	1	Unsigned Int	Cylinder B Position	Count from 0 to 642 for VP1 dual-cylinder pumps, 0 to 7440 for VIPR single-cylinder pumps
30024	2	Unsigned Int	Cylinder A Error State	Bit mask of current cylinder A errors (see "Vindum Pump

				Error Codes" document for details)
30026	2	Unsigned Int	Cylinder B Error State	Bit mask of current cylinder B errors (see "Vindum Pump Error Codes" document for details)
30028	2	Unsigned Int	Pump Common Error State	Bit mask of pump errors (see "Vindum Pump Error Codes" document for details)
30030	2	Unsigned Int	Cylinder A Latched Error State	Bit mask of "latched" errors for cylinder A (see "Vindum Pump Error Codes" document for details)
30032	2	Unsigned Int	Cylinder B Latched Error State	Bit mask of "latched" errors for cylinder B (see "Vindum Pump Error Codes" document for details)
30034	2	Unsigned Int	Pump Common Latched Error State	Bit mask of "latched" pump errors (see "Vindum Pump Error Codes" document for details)
30036	2	Float	Cylinder A Cumulative Volume (ml)	In selected units
30038	2	Float	Cylinder B Cumulative Volume (ml)	In selected units
30040	2	Unsigned Int	Pump Common Error State from Secondary pump	Bit mask of pump errors (see "Vindum Pump Error Codes" document for details)
30042	2	Unsigned Int	Pump Common Latched Error State from Secondary pump	Bit mask of "latched" errors for cylinder B (see "Vindum Pump Error Codes" document for details)

Read-Write "Holding" Registers

Register Address	Number of Registers	Date Type	Description	Values
40001	1	Unsigned Integer	Cylinder A Direction	Extending=1, Retracting=2
40002	1	Unsigned Integer	Cylinder B Direction	Extending=1, Retracting=2
40003	1	Unsigned Integer	Cylinder A Pump Mode	See Pump Mode document for mode details
40004	1	Unsigned Integer	Cylinder B Pump Mode	See Pump Mode document for mode details
40006	2	Float	Cylinder A Set Rate	In selected units
40008	2	Float	Cylinder B Set Rate	In selected units
40010	2	Float	Set Pump Maximum Rate	In selected units

40012	2	Float	Cylinder A Set Pressure	In selected units
40014	2	Float	Cylinder B Set Pressure	In selected units
40016	2	Float	Set Pump Max Pressure	In selected units
40018	2	Float	Cylinder A Pressure Gain	In selected units
40020	2	Float	Cylinder B Pressure Gain	In selected units
40022	2	Float	Cylinder A Safety Pressure	In selected units
40024	2	Float	Cylinder B Safety Pressure	In selected units
40026	2	Float	Value for Cylinder A Volume Start Command	In milliliters
40028	2	Float	Value for Cylinder B Volume Start Command	In milliliters
40030	1	Unsigned Integer	Pressure Units	0=PSI, 1=bar, 2=kPa, 3=MPa
40031	1	Unsigned Integer	Rate Units	0= ml/min, 1=ml/hour
40032	1	Unsigned Integer	Server ID	Range 1 to 247
40034	2	Float	Fill Valve Open Pressure	In selected units
40036	2	Float	Return Rate Multiplier	Factor used to compute return rate from the current pump rate. **Valid for dual-cylinder pumps and the primary pump when two single-cylinder pumps are paired, otherwise will return a value of -1 when read, and attempts to write will return an error.**
40038	1	Unsigned Integer	Auto Return Rate Time	In seconds. A value of zero turns off auto return rate and turns on the Return Rate Multiplier. Values of 10 to 120 seconds are valid, values of 1 to 9 return an error. **Valid for dual-cylinder pumps and the primary pump when two single-cylinder pumps are paired, otherwise will return a value of -1 when read, and attempts to write will return an error.**