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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 Section 3: Modbus Registers.

Modbus Addressing

Data types

The Vindum Modbus implementation divides available data into four standard Modbus categories. These categories are confusingly named, so a description of the data types is shown in the table below:

Data Type	Number of Bits	Read-Only or Read-Write	Logical Start Address	Function Code to Read Data	Function Code to Write Data
Coils	1	Read-Write	1	0x01	0x05
Discrete Inputs	1	Read-Only	10,001	0x02	NA
Holding Registers	16	Read-Write	30,001	0x03	0x06
Input Registers	16	Read-Only	40,001	0x04	NA

Note that two consecutive 16-bit registers can be treated as a single 32-bit value by most Modbus clients. Vindum pumps encode floating-point and 23-bit integer values in this way.

Logical vs. Physical Addressing

The logical addresses in the table above are NOT the physical addresses that are sent over the serial line by the Modbus protocol. For physical addressing, Modbus starts each data region at an address of zero. For example, if you want to read the first value of the holding registers, you’d use the 0x03 function code and, while the logical address of the requested data is 30,001, the address going over the serial line (the physical address) is 30,000.

In the data tables below, the logical address, the address used by Modbus clients, and the physical address are all listed.

Vindum pumps support the following Modbus functions (values below show decimal value, followed by the hex equivalent):

- 1 (0x01) – Read Coils
- 2 (0x02) – Read Discrete Inputs

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- 3 (0x03) – Read Holding Registers
- 4 (0x04) – Read Input Registers
- 5 (0x05) – Write Single Coil
- 6 (0x06) – Write Single Register
- 17 (0x11) – Read Server ID

Writing Registers

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. Additionally, attempting to write one register of a two-register value will result in an error. For two-register values, a multiple-register write is required.

Section 2: Modbus Connection and Configuration

Vindum has offered Modbus control of Vindum pumps since 2024. The features and images used in this documentation are based on VPware version 1.3.61, and firmware versions 368.hex (for VP dual-cylinder pumps) and firmware version 1157.hex (for VIPR pumps). Ensure that your versions of VPware and pump firmware are these versions, or later versions. The latest versions of VPware and pump firmware can be downloaded from the Customer Area of Vindum Engineering's website. A customer account is required to access the Customer Area. You can request a customer account from the home page (<https://vindum.com>), or by contacting Vindum support (support@vindum.com).

Pump Ports for Modbus

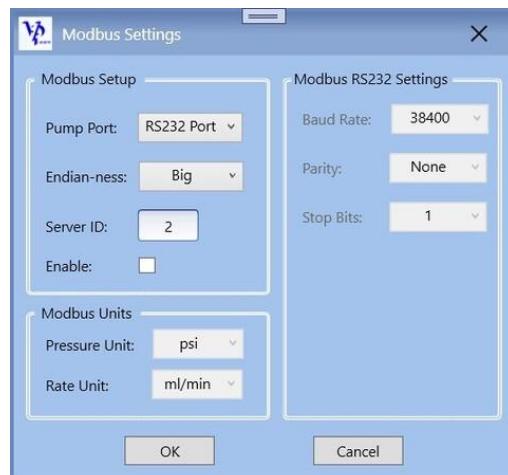
As of VPware Version 1.3.61 (with firmware versions 368.hex and 1157.hex installed), you may use either the pump's USB port or RS232 port for Modbus control. We recommend keeping VPware and Modbus on separate ports, since a port can only communicate with one control system at a time. If you engage Modbus on the port that is already connected to VPware, VPware notifies the user that VPware control will be disconnected when Modbus control is engaged. VPware also issues a "lost communication" warning when Modbus is enabled on the port that was already connected to VPware.

We don't recommend having VPware and Modbus enabled/active simultaneously on a pump's RS232 and USB ports, since it's very likely that command conflicts will occur. Conflicts occur when both control systems send commands to the pump at the same time. When this happens, both commands are disregarded by the pump, resulting in "lost commands." VPware constantly sends commands to the pump, to update current pressure, pumping rates, and many other settings. As a result, command conflicts can occur even if the user isn't actively sending commands to VPware. Whenever a command conflict happens, VPware issues a pop-up "Command Conflict" message, and the pump's LEDs blink red momentarily. If you choose to leave VPware running and connected to a pump that is being controlled by Modbus, beware of possible command conflicts. Avoid command conflicts by disabling VPware (i.e., uncheck the COM Port / Enabled box on the VPware main screen) so that only Modbus is communicating with the pump.

Modbus Connection Window

Follow the steps below to engage Modbus control:

1. Ensure that your PC has VPware is Version 1.3.61, or later, installed. Required firmware is VP Firmware Version 368.hex, or later (for VP dual-cylinder pumps), and VIPR Firmware Version 1157.hex, or later (for VIPR syringe pumps);
2. Connect either a USB-USB cable or a RS232-USB (straight-through type) cable from your PC to each pump you want to control;
3. Establish communication between each pump and VPware in the normal manner. Refer to Vindum Pump User Guides for instructions on connecting Vindum pumps to VPware.
4. For Modbus control, connect a second COM cable to the pump's other COM port. If using an RS232-USB cable, ensure that it is the "Straight Through" or "Non-Null" type. The pin configuration of this RS232 cable is:
 - Pin 2: TX (Transmit data)
 - Pin 3: RX (Receive data)
 - Pin 5: GND (Ground)
5. In VPware, go to the Configure/Pump Configuration window and click on the "Modbus Setup" button at the bottom of the Pump Configuration window. This opens the "Modbus Settings" window shown on the right. If you do not see the Modbus Setup button, ensure that the versions of VPware and pump firmware are updated to the versions listed in step #1 of this list. **If using dual-VIPR pumps with Modbus, first connect each VIPR pump to VPware per the instructions above. Next, pair the two VIPR pumps in VPware "Tools" menu, i.e., "Tools/Multi-Pump Modes/Pair VIPR Pumps". Finally, go to VPware Configure/Pump Configuration window and click on the "Modbus Setup" button at the bottom of that window.** Only connect the "main/primary" VIPR pump to Modbus. To avoid command conflicts, disable the VPware connection to the main/primary VIPR pump once Modbus is enabled.
6. Follow the Modbus Configuration instructions in the next section. Repeat for each Vindum pump, except for paired VIPR pumps, which require that only the primary VIPR pump be connected to Modbus.



Modbus Setup Parameters

Refer to the "Modbus Settings" window on the previous page for the configuration steps in this section.

Pump Port

Each Vindum pump has two communication ports on the back of the pump: an RS232 port and a USB Type B port. Either of these ports may be for Modbus control. As explained in the previous section, we recommend removing or disabling VPware communication with the pump once Modbus is engaged. In the case of VIPR pumps that have been paired, it is only necessary to remove the VPware communication cable (or disable VPware communication) of the “main” VPware pump to prevent command conflicts.

“Endian-ness”

The byte order of data sent over Modbus is configurable using the “Endian-ness” setting. Modbus is a 16-bit protocol, so only the order of the two bytes is all that is configurable. When combining two 16-bit registers to make a 32-bit number, Vindum pumps encode the least significant 16-bit value as the lower address. For example, if you read a 32-bit number from addresses 10 and 11 on the pump, the least significant value will be in address 10.

“Big endian” encoding, means that 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. The endian setting is stored in the pump’s firmware, so once it is set by the user, it will remain.

Modbus Server ID

To support multiple devices on the same bus, each Modbus device is given a Server ID, ranging from 1 to 247. The default starting 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 RS232 Port Settings

The following communication settings are supported by the pump's RS232 port. The USB port does not use these settings, so they can be ignored when using the pump's USB port for Modbus:

- 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

Enabling Modbus Control

Once the Modbus configuration parameters have been selected, click the "Enable" box of the Modbus Settings window, then the "OK" button. This transfers control to Modbus on the selected USB or RS232 port.

Exiting Modbus Control

There are two ways to exit Modbus control of the pump:

1. Using the Modbus controller, write a "1" value to the discrete coil "Exit Modbus mode" (see tables below); or,
2. Connect the pump (main pump if using paired VIPR pumps) to VPware by connecting a COM cable to the pump's other port (i.e., whichever of the RS232 or USB port that is not being used for Modbus control) and plug it into a PC running VPware. Connect VPware to that port and go to the Modbus Setup window (by clicking on the "Modbus Setup" box at the bottom of the Pump Configuration window). Unclick the "Enable" box, then "OK," to terminate the Modbus connection.

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 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.

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

Logical Address	Modbus Client Logical Address	Physical Address	Number of Registers	Date Type	Description	Values
1	1	0	1	Boolean	Cylinder A Fill Valve State	Closed=0, Open = 1
2	2	1	1	Boolean	Cylinder A Deliver Valve State	Closed=0, Open = 1
3	3	2	1	Boolean	Cylinder B Fill Valve State	Closed=0, Open = 1
4	4	3	1	Boolean	Cylinder B Deliver Valve State	Closed=0, Open = 1
5	5	4	1	Boolean	Save Safety Pressure to Pump's memory	0=Don't save safety pressure on pump, 1=save safety pressure on pump
10	10	5	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	11	10	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	12	11	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	13	12	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	14	13	1	Boolean	Zero Cylinder A Pressure Sensor	1 = Start function. Always reads 0
15	15	14	1	Boolean	Zero Cylinder B Pressure Sensor	1 = Start function. Always reads 0
16	16	15	1	Boolean	Start Cylinder A	1 = Start function. Always reads 0

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Logical Address	Modbus Client Logical Address	Physical Address	Number of Registers	Date Type	Description	Values
17	17	16	1	Boolean	Start Cylinder A in Auto Mode	1 = Start function. Always reads 0
18	18	17	1	Boolean	Start Cylinder B	1 = Start function. Always reads 0
19	19	18	1	Boolean	Start Cylinder B in Auto Mode	1 = Start function. Always reads 0
20	20	19	1	Boolean	Stop Cylinder A	1 = Start function. Always reads 0
21	21	20	1	Boolean	Stop Cylinder B	1 = Start function. Always reads 0
22	22	21	1	Boolean	Stop Both Cylinders	1 = Start function. Always reads 0
23	23	22	1	Boolean	Reset Cylinder A Volume	1 = Start function. Always reads 0
24	24	23	1	Boolean	Reset Cylinder B Volume	1 = Start function. Always reads 0
25	25	24	1	Boolean	Reset Cumulative Volume	1 = Start function. Always reads 0
26	26	25	1	Boolean	Reset All Volumes	1 = Start function. Always reads 0
27	27	26	1	Boolean	Reset Cylinder A Cumulative Volume	1 = Start function. Always reads 0
28	28	27	1	Boolean	Reset Cylinder B Cumulative Volume	1 = Start function. Always reads 0
29	29	28	1	Boolean	Modbus interface "endian" mode	1 = big endian, 0 = little endian
30	30	29	1	Boolean	Exit Modbus mode	1 = Exit Modbus mode and enable standard serial communication. Always reads 0
31	31	30	1	Boolean	Reset Errors	1 = Reset all latched errors

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Read-Only Discrete Inputs ("Contacts")

Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Data Type	Description	Values
10001	1	0	1	Boolean	Cylinder A Running	0=Stopped, 1=Running
10002	2	1	1	Boolean	Cylinder B Running	0=Stopped, 1=Running
10003	3	2	1	Boolean	Cylinder A Active	0=Not Active, 1=Active
10004	4	3	1	Boolean	Cylinder B Active	0=Not Active, 1= Active
10005	5	4	1	Boolean	Cylinder A Safety Pressure Error Flag	0>No Error, 1=Safety Pressure Error
10006	6	5	1	Boolean	Cylinder B Safety Pressure Error Flag	0>No Error, 1=Safety Pressure Error

Read "Holding" Registers

Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Data Type	Description	Values
30001	1	0	1	Unsigned Integer	Cylinder A Direction	Extending=1, Retracting=2
30002	2	1	1	Unsigned Integer	Cylinder B Direction	Extending=1, Retracting=2
30003	3	2	1	Unsigned Integer	Cylinder A Pump Mode	See Pump Mode document for mode details
30004	4	3	1	Unsigned Integer	Cylinder B Pump Mode	See Pump Mode document for mode details
30006	6	5	2	Float	Cylinder A Set Rate	In selected units
30008	8	7	2	Float	Cylinder B Set Rate	In selected units
30010	10	9	2	Float	Set Pump Maximum Rate	In selected units
30012	12	11	2	Float	Cylinder A Set Pressure	In selected units
30014	14	13	2	Float	Cylinder B Set Pressure	In selected units
30016	16	15	2	Float	Set Pump Max Pressure	In selected units

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Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Data Type	Description	Values
30018	18	17	2	Float	Cylinder A Pressure Gain	In selected units
30020	20	19	2	Float	Cylinder B Pressure Gain	In selected units
30022	22	21	2	Float	Cylinder A Safety Pressure	In selected units
30024	24	23	2	Float	Cylinder B Safety Pressure	In selected units
30026	26	25	2	Float	Value for Cylinder A Volume Start Command	In milliliters
30028	28	27	2	Float	Value for Cylinder B Volume Start Command	In milliliters
30030	30	29	1	Unsigned Integer	Pressure Units	0=PSI, 1=bar, 2=kPa, 3=MPa
30031	31	30	1	Unsigned Integer	Rate Units	0= ml/min, 1=ml/hour
30032	32	31	1	Unsigned Integer	Server ID	Range 1 to 247
30034	34	33	2	Float	Fill Valve Open Pressure	In selected units
30036	36	35	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 VIPR pumps are paired, otherwise will return a value of -1 when read, and attempts to write will return an error.

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Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Data Type	Description	Values
30038	38	37	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.
30039	39	38	1	Unsigned Integer	Cylinder A Open Valve Differential Gain	Value range is 0 to 65535
30040	40	39	1	Unsigned Integer	Cylinder A Closed Valve Differential Gain	Value range is 0 to 65535
30041	41	40	1	Unsigned Integer	Cylinder A Open Valve Proportional Gain	Value range is 0 to 8000
30042	42	41	1	Unsigned Integer	Cylinder A Closed Valve Proportional Gain	Value range is 0 to 8000
30043	43	42	1	Unsigned Integer	Cylinder B Open Valve Differential Gain	Value range is 0 to 65535
30044	44	43	1	Unsigned Integer	Cylinder B Closed Valve Differential Gain	Value range is 0 to 65535
30045	45	44	1	Unsigned Integer	Cylinder B Open Valve	Value range is 0 to 8000

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Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Data Type	Description	Values
					Proportional Gain	
30046	46	45	1	Unsigned Integer	Cylinder B Closed Valve Proportional Gain	Value range is 0 to 8000

Read-Only Input Registers

Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Date Type	Description	Values
40001	1	0	1	Unsigned Integer	Command Response	0=no error, other values indicate error when processing command
40002	2	1	2	Float	Cylinder A Pressure	In selected units
40004	4	3	2	Float	Cylinder B Pressure	In selected units
40006	6	5	2	Float	Output Pressure	In selected units
40008	8	7	2	Float	Cylinder A Rate	In selected units
40010	10	9	2	Float	Cylinder B Rate	In selected units
40012	12	11	2	Float	Output Rate	In selected units
40014	14	13	2	Float	Cylinder A Volume	In milliliters
40016	16	15	2	Float	Cylinder B Volume	In milliliters
40018	18	17	2	Float	Cumulative Volume	In milliliters
40020	20	19	1	Unsigned Int	Pump Type	
40021	21	20	1	Unsigned Int	Cylinder A Position	Count from 0 to 642 for VP1 dual-cylinder pumps, 0 to 7440 for VIPR single-cylinder pumps
40022	22	21	1	Unsigned Int	Cylinder B Position	Count from 0 to 642 for VP1 dual-cylinder pumps, 0 to 7440 for VIPR single-cylinder pumps
40024	24	23	2	Unsigned Int	Cylinder A Error State	Bit mask of current cylinder A errors (see "Vindum Pump Error")

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Register Address	Modbus Client Logical Address	Physical Address	Number of Registers	Date Type	Description	Values
						Codes" document for details)
40026	26	25	2	Unsigned Int	Cylinder B Error State	Bit mask of current cylinder B errors (see "Vindum Pump Error Codes" document for details)
40028	28	27	2	Unsigned Int	Pump Common Error State	Bit mask of pump errors (see "Vindum Pump Error Codes" document for details)
40030	30	29	2	Unsigned Int	Cylinder A Latched Error State	Bit mask of "latched" errors for cylinder A (see "Vindum Pump Error Codes" document for details)
40032	32	31	2	Unsigned Int	Cylinder B Latched Error State	Bit mask of "latched" errors for cylinder B (see "Vindum Pump Error Codes" document for details)
40034	34	33	2	Unsigned Int	Pump Common Latched Error State	Bit mask of "latched" pump errors (see "Vindum Pump Error Codes" document for details)
40036	36	35	2	Float	Cylinder A Cumulative Volume (ml)	In selected units
40038	38	37	2	Float	Cylinder B Cumulative Volume (ml)	In selected units
40040	40	29	2	Unsigned Int	Pump Common Error State from Secondary pump	Bit mask of pump errors (see "Vindum Pump Error Codes" document for details)
40042	42	441	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)