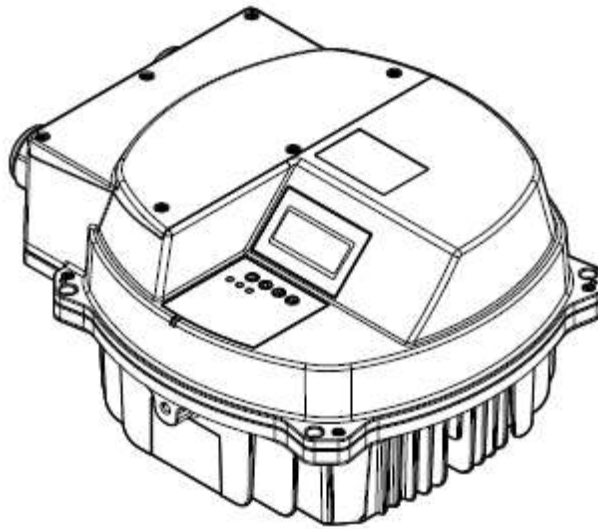


HYDROVAR®



HVL 2.015 – 4.220

Modbus Protocol & Parameters

HVL Software Version: 2.10

HVL Software Version: 2.20

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Read and follow the operating instructions and safety instructions carefully before starting operations! All modifications must be done by qualified technicians!



2 A Few Facts about the Modbus Protocol on HYDROVAR HVL



NOTE: *The Modbus Protocol is an international standardized Bus Protocol! The general information within this Manual is just a brief overview, for detailed information please use the Modbus Protocol reference guide, or any other source of information (e.g. Modbus org. “MODBUS application protocol specification” available on the Internet).*

This protocol defines a message structure that controllers will recognize and use, regardless of the type of networks over which they communicate. It describes the process a controller uses to request access to another device, how it will respond to requests from the other devices, and how errors will be detected and reported. It establishes a common format for the layout and contents of message fields.

During communications on a Modbus network, the protocol determines how each controller will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message.

2.1 Communication

HYDROVAR HVL uses the RS485 serial interface that defines connect pinouts, cabling, signal levels, transmission baud rates and parity checking.

Controllers communicate using a master-slave technique, in which only the master can start a transfer or polling. The other devices (Slaves) respond by supplying the requested data to the master, or by taking the action requested in the query.

2.2 Broadcasting

On HYDROVAR HVL broadcast function is not supported.

2.3 Data Protection

Standard Modbus serial networks use two kinds of error checking:

- Parity checking (even or odd) can be optionally applied to each character.
- Frame checking (LRC or CRC) is applied to the entire message.

Both the character check and message frame check are generated in the master device and applied to the message contents before transmission. The slave device checks each character and the entire message frame during receipt.

Detailed information can be found in the Modbus Protocol Reference Guide!

2.4 *Transmission Mode*

When using the Modbus Protocol the selection to choose is between two transmission Modes: ASCII or RTU.

The different modes determine how information will be packed into the message fields and decoded.

In addition to the desired transmission mode, the serial port communication parameters (baud rate, parity mode...) shall be selected.

! The mode and serial parameters must be the same for all devices on the Modbus network!

The following modes can be selected and are supported by HYDROVAR HVL:

| | |
|-----------------|---|
| RTU / 8, E, 1 | 1 start bit, 8 data bits, 1 stop bit, Even parity |
| RTU / 8, O, 1 | 1 start bit, 8 data bits, 1 stop bit, Odd parity |
| RTU / 8, N, 2 | 1 start bit, 8 data bits, 2 stop bits, No parity |
| RTU / 8, N, 1 | 1 start bit, 8 data bits, 1 stop bit, No parity |
| ASCII / 7, N, 2 | 1 start bit, 7 data bits, 2 stop bits, No parity |
| ASCII / 7, E, 1 | 1 start bit, 7 data bits, 1 stop bit, Even parity |
| ASCII / 7, O, 1 | 1 start bit, 7 data bits, 1 stop bit, Odd parity |

2.5 Supported Function Codes

- **0x03 Read Holding Registers – READ COMMAND**

Read the binary contents of holding registers in the slave!

Note: The Modbus Registers are addressed starting at zero!
E.g. Holding Register indexed 0x33 has to be addressed as 0x32

Example: Read the Actual Value

QUERY

| | | |
|-----------------------|------|--|
| Slave Address | 0x01 | Could be set on HVL via Parameter ADDRESS [P1205] |
| Function | 0x03 | Read Holding Register |
| Starting Address High | 0x00 | |
| Starting Address Low | 0x32 | Modbus Index 0x33 – Actual value has to be addressed |
| No. of Points High | 0x00 | |
| No. of Points Low | 0x01 | Read one holding register is supported |
| Error Check CRC-High | 0x25 | |
| Error Check CRC-Low | 0xC5 | Generated CRC-Checksum |

RESPONSE

| | | |
|----------------------|------|---|
| Slave Address: | 0x01 | |
| Function | 0x03 | |
| Byte Count | 0x02 | |
| Data High | 0x02 | |
| Data Low | 0x08 | => 208 HEX = 520 DEC => Actual Value = 5.20 bar |
| Error Check CRC-High | 0xB8 | |
| Error Check CRC-Low | 0xE2 | Generated CRC-Checksum |

- **0x06 Write Single Register – WRITE COMMAND**

Writes a value into a single holding register! Broadcast is not supported!

Note: The Modbus Registers are addressed starting at zero!
E.g. Holding Register indexed 0xE9 has to be addressed as 0xE8

Example: Set the Required Value 1 to 3.50 bar

QUERY

| | | |
|-----------------------|------|---|
| Slave Address | 0x01 | Could be set on HVL via Parameter ADDRESS [P1205] |
| Function | 0x06 | Write Single Register |
| Register Address High | 0x00 | |
| Register Address Low | 0xE8 | Modbus Index 0xE9 – Req. Value 1 has to be addressed |
| Preset Data High | 0x01 | |
| Preset Data Low | 0x5E | => 15E HEX = 350 DEC => sets the Required Value 1 to 3.50 bar |
| Error Check CRC-High | 0x89 | |
| Error Check CRC-Low | 0x96 | Generated CRC-Checksum |

RESPONSE

| | | |
|-----------------------|------|--|
| Slave Address: | 0x01 | |
| Function | 0x06 | |
| Register Address High | 0x00 | |
| Register Address Low | 0xE8 | |
| Preset Data High | 0x01 | |
| Preset Data Low | 0x5E | => Required Value 1 is set to 3.50 bar |
| Error Check CRC-High | 0x89 | |
| Error Check CRC-Low | 0x96 | Generated CRC-Checksum |

- **0x10 Write Multiple Registers – WRITE COMMAND**

Writes values into a block of contiguous registers! Broadcast is not supported!

Note: The Modbus Registers are addressed starting at zero!
E.g. Holding Register indexed 0x98 has to be addressed as 0x97

Example: Set Ramp 1 and Ramp 2 to 25sec, Ramp 3 and Ramp 4 to 100sec

QUERY

| | | |
|--------------------------|------|---|
| Slave Address | 0x01 | Could be set on HVL via Parameter ADDRESS [P1205] |
| Function | 0x10 | Write Multiple Registers |
| Starting Address High | 0x00 | |
| Starting Address Low | 0x97 | Modbus Index 0x98 – Ramp 1 has to be addressed |
| Quantity of Registers Hi | 0x00 | |
| Quantity of Registers Lo | 0x04 | In total 4 registers (Ramp 1 to Ramp 4) to be written |
| Byte Count | 0x08 | 2 * Quantity of Registers |
| Reg Value High | 0x00 | |
| Reg Value Low | 0x19 | => 19 HEX = 25 DEC => sets Ramp 1 to 25sec |
| Reg Value High | 0x00 | |
| Reg Value Low | 0x19 | => 19 HEX = 25 DEC => sets Ramp 2 to 25sec |
| Reg Value High | 0x00 | |
| Reg Value Low | 0x64 | => 64 HEX = 100 DEC => sets Ramp 3 to 100sec |
| Reg Value High | 0x00 | |
| Reg Value Low | 0x64 | => 64 HEX = 100 DEC => sets Ramp 4 to 100sec |
| Error Check CRC-High | 0x55 | |
| Error Check CRC-Low | 0x07 | Generated CRC-Checksum |

RESPONSE

| | | |
|--------------------------|------|---|
| Slave Address: | 0x01 | |
| Function | 0x10 | |
| Starting Address High | 0x00 | |
| Starting Address Low | 0x97 | |
| Quantity of Registers Hi | 0x00 | |
| Quantity of Registers Lo | 0x04 | In total 4 registers (Ramp 1 to Ramp 4) written |
| Error Check CRC-High | 0x70 | |
| Error Check CRC-Low | 0x26 | Generated CRC-Checksum |

2.6 Not supported Modbus Function Codes

HYDROVAR HVL only supports Function Codes described in par. 2.5; for the sake of clarity, other Modbus Function Codes not used/supported by HVL are:

- 0x01 - Read Coils
- 0x02 - Read Discrete Inputs
- 0x04 - Read Input Registers
- 0x05 - Write Single Coil
- 0x07 - Read Exception Status
- 0x08 - Diagnostics
- 0x0B - Get Comm Event Counter
- 0x0C - Get Comm Event Log
- 0x0F - Write Multiple Coils
- 0x11 - Report Slave ID
- 0x14 - Read File Record
- 0x15 - Write File Record
- 0x16 - Mask Write Register
- 0x17 - Read/Write Multiple registers
- 0x18 - Read FIFO Queue
- 0x2B - Encapsulated Interface Transport

3 Connections and data handling

3.1 Single HVL connected to an External Device



NOTE: For detailed information regarding installation, wiring and configuration of the HYDROVAR HVL, please read and follow the relative Installation, Operation and Maintenance Manual



WARNING: This product is intended to be operated by qualified personnel only.

Unscrew the dedicated 6 screws and remove the plastic cover of HYDROVAR HVL, in order to proceed wiring the control terminals; for reference, the wiring harness scheme is reported on the backside of the plastic cover too.

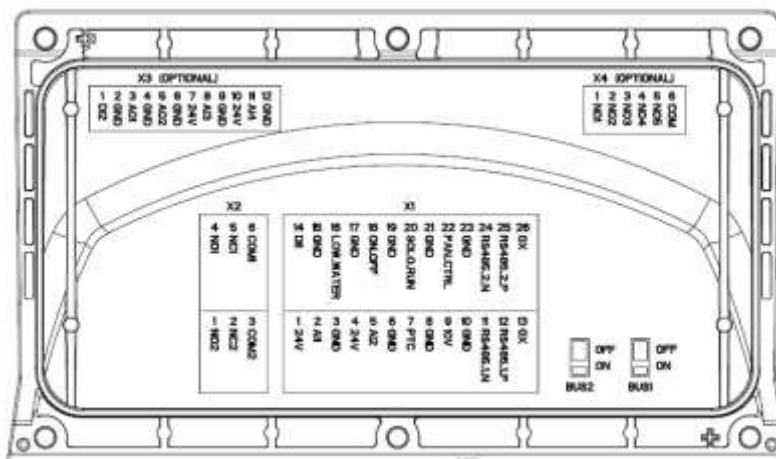


Figure 1

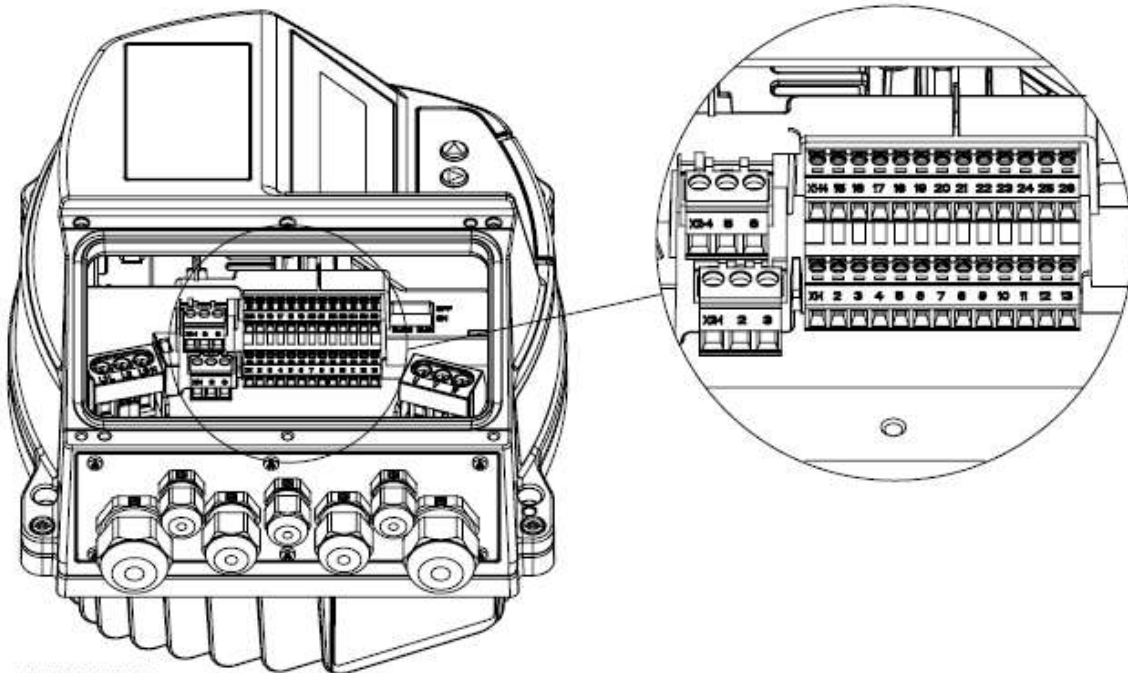


Figure 2

Terminals X1/24, X1/25 and X1/26 are used for the communication with an external-control-device (e.g. PLC, BMS or a PC too); a dedicated termination resistor switch (BUS2, see image below) is made available to add a parallel terminator resistor to this RS485 port: if the resistor is needed put BUS2 switch on ON position.

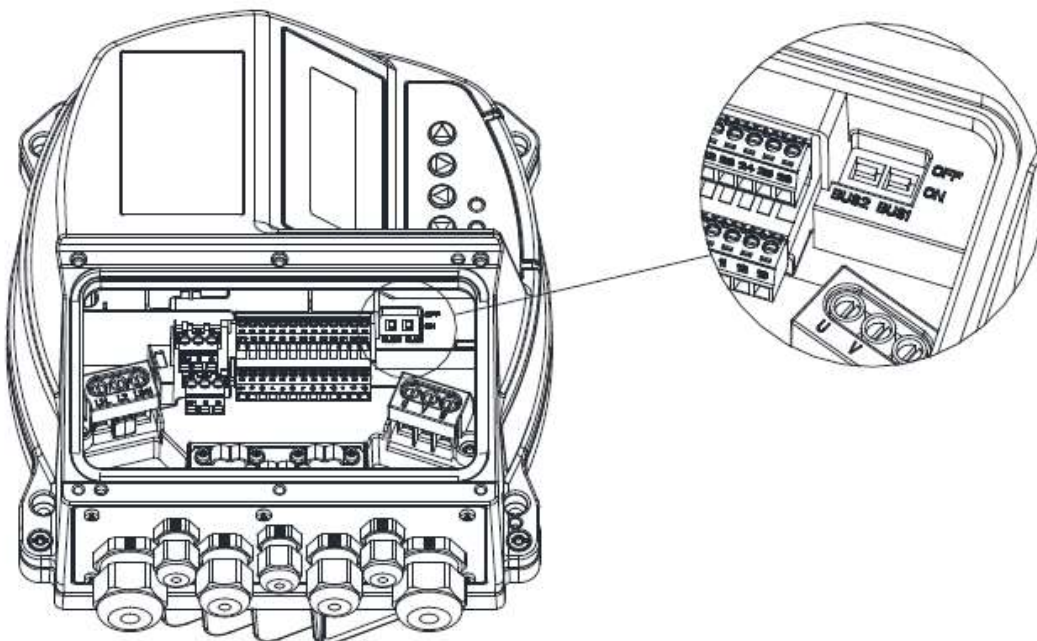


Figure 3

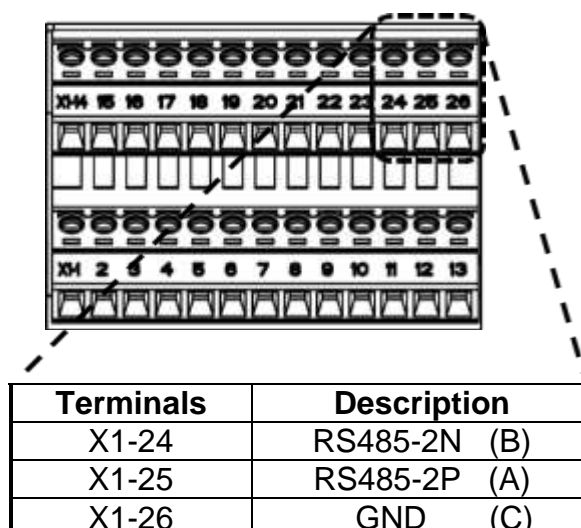


Figure 4



NOTE: Do not connect the ground of the control card to other voltage potentials. All ground terminals and ground of the RS485 connection are connected internally.

For connecting HYDROVAR HVL to a PC, is it possible to simply refer to the provided “USB/RS485 Cable Kit M&C” (cod.109395920), which integrates a USB/RS485 converter, and then to the relative wiring table below

| USB/RS485 Cable Kit M&C (cod. 109395920) | Terminals | Description |
|---|-----------|------------------------|
| B = YL (Yellow) | X1-24 | RS485 port 2: RS485-2N |
| A = OR (Orange) | X1-25 | RS485 port 2: RS485-2P |
| GND = BK (Black) | X1-26 | GND, electronic ground |

3.1.1 HVL data handling when connected to an External Device

When the Modbus communication is active between the HVL and an External Device, HVL “locks” the possibility to change most of the system parameters from the local push buttons on the inverter. This is to prevent conflicts between the values (read and written) by the (remote) External Device, and the parameters values that could be over-written/changed by the local operator. The HVL display is showing a “REMOTE” indication to signal the active locking on parameter edit during an External Device Modbus access.

The parameters free from REMOTE change lock are the same related to the function of parameter P115 “LOCK FUNCT.”, e.g. Stop/Start manual command on HOME display, and P61 “PASSWORD”.

To un-lock the parameter editing by the local push buttons on the HYDROVAR HVL, the Modbus communication with the device must be stopped or interrupted.

3.2 HVLs in Multi-Pump application connected to an External Device

Terminals X1/11, X1/12 and X1/13 are used for the communication among up to 8 HYDROVAR HVL in a Multi-Pump application; a dedicated termination resistor switch (BUS1, see image below) is made available to add a parallel terminator resistor to this RS485 port: if the resistor is needed put BUS1 switch to ON position, using as a reference the Modbus org. “MODBUS over serial line specification and implementation guide” that can be found on the Internet.

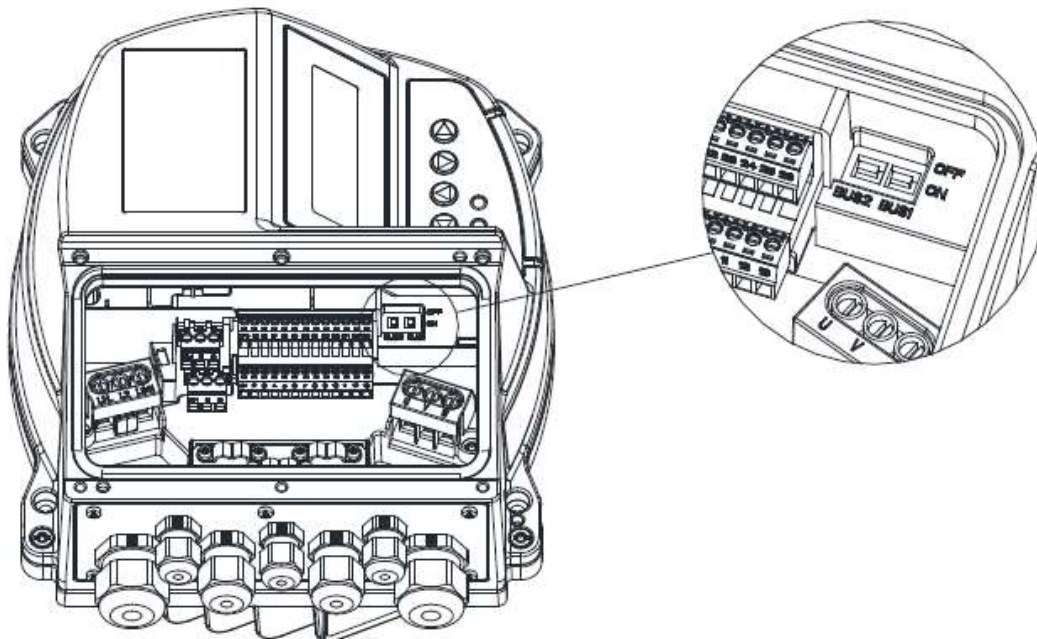


Figure 5

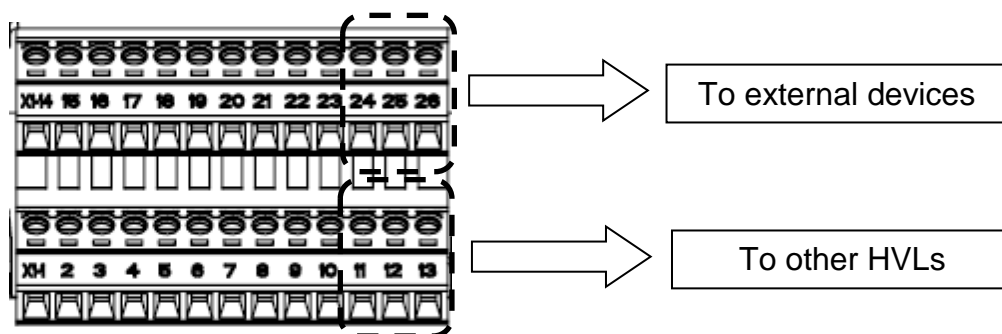


Figure 6

In a Multi-Pump application communicating with an external device (e.g. PLC or BMS), each HYDROVAR HVL shall be connected to the external device by wiring the terminals X1/24, X1/25 and X1/26, as described in par. 3.1

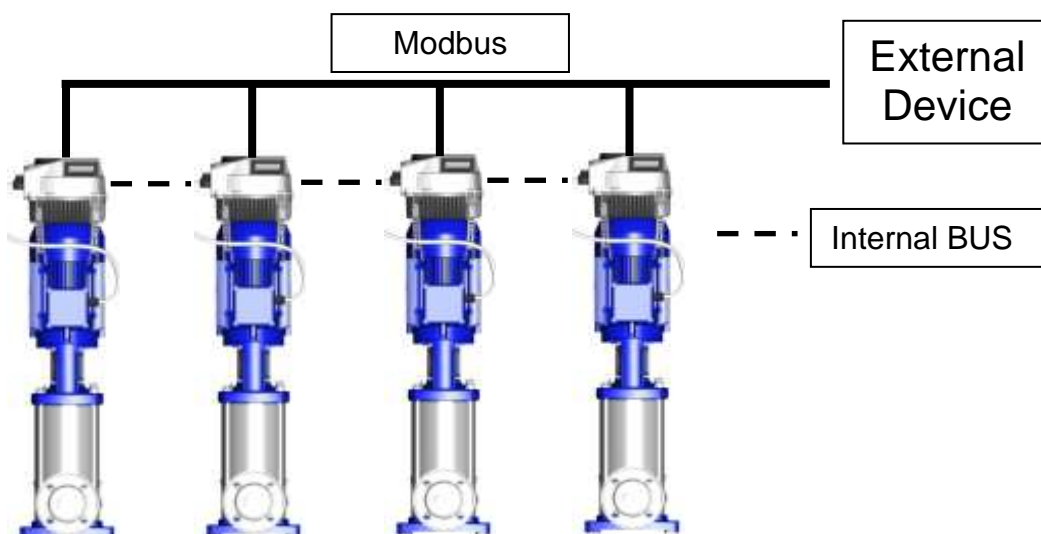


Figure 7

3.2.1 HVL data handling when connected in Multi-Pump and to an External Device

Special care should be taken when an External Device (by mean of Modbus protocol), requires to read and write HVL parameters, being the drive connected into a Multi-Pump system too.

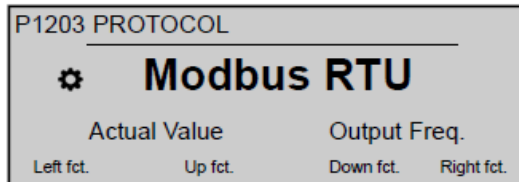
In particular

- In a Multi-Pump application, to “Read Holding Registers” requests on the Modbus, each HVL returns to the External Device exclusively its own parameters, not parameters of other drives (HVL) connected in the booster set
- In a Multi-Pump application, requests of “Write Single Registers” or “Write Multiple Registers” on the Modbus must be sent, by the external device, to all HVLs connected, even if the parameters to be written are “Global” (for the booster set)

As previously detailed at par. 3.1.1, if the Modbus communication is active between the HYDROVAR HVL linked within a booster set and connected to an External Device, then it will be “locked” the possibility to change most system parameters from the local push buttons on the Hydrovar, to prevent conflicts between the values read/written by the remote External Device. The REMOTE lock for parameters edit can be disabled stopping the Modbus communication.

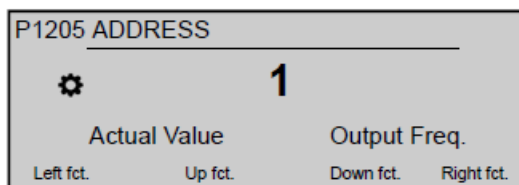
4 HYDROVAR HVL Settings

The following 4 parameters, on HYDROVAR HVL, have to be set to guarantee correct Modbus communication.

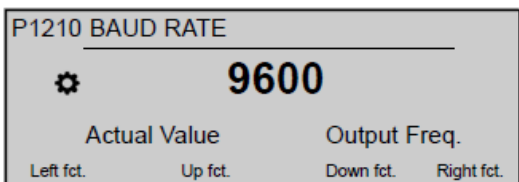


Sets the desired communication protocol; possible settings are:

- Disabled
- Modbus RTU
- Modbus ASCII
- BACNet MS/TP




Sets the desired Modbus address (possible setting 1 - 247): each drive must be allocated its own address!



Set the BAUD RATE for the communication; possible settings are:

- 1200
- 2400
- 4800
- 9600
- 14400
- 19200
- 38400
- 57600
- 76800
- 115200

| P1215 FORMAT | | | |
|--|---------|--------------|------------|
|  8, N, 1 | | | |
| Actual Value | | Output Freq. | |
| Left fct. | Up fct. | Down fct. | Right fct. |

Set the data FORMAT for the communication port, depending on the value of P1203 PROTOCOL; possible settings are:

- 8, E, 1
- 8, O, 1
- 8, N, 2
- **8, N, 1**
- 7, E, 1
- 7, O, 1
- 7, N, 2

5 HYDROVAR HVL Registers list - SW version 2.10, and SW version 2.20

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|------------------|------------|----------------|------------|----------------------|----------------------|--|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x0031 | 49 | 0x03, 0x06, 0x10 | | "STOP/START" | U08 | 0 | 1 | 0 = Off 1 = On |
| 0x0032 | 50 | 0x03 | | "ACTUAL VALUE" | S16 | 0 | P420 Note 1 | |
| 0x0033 | 51 | 0x03 | P46 | "OUTPUT FREQ." | S16 | 0 | 700 | |
| 0x0037 | 55 | 0x03 | P03 | "EFF.REQ.VAL." | U16 | 0 | P420 Note 1 | |
| 0x0038 | 56 | 0x03, 0x06, 0x10 | P04 | "START VALUE" | U08 | 0 | 100 | |
| 0x0039 | 57 | 0x03, 0x06, 0x10 | P05 | "LANGUAGE" | U08 | 0 | 27 | 0 = English 1 = Italian 2 = French 3 = German 4 = Spanish 5 = Portuguese 6 = Dutch 7 = Danish 8 = Norwegian 9 = Swedish 10 = Finnish 11 = Icelandic 12 = Estonian 13 = Latvian 14 = Lithuanian 15 = Polish 16 = Czech 17 = Slovak 18 = Hungarian 19 = Romanian 20 = Bulgarian 21 = Slovene 22 = Croatian 23 = Serbian 24 = Greek 25 = Turkish 26 = Russian 27 = Ukrainian |
| 0x003A | 58 | 0x03, 0x10 | P06 | "DATE" | U32 | 0x00010100 Note 3 | 0x630C1F07 Note 3 | |
| 0x0040 | 64 | 0x03, 0x10 | P07 | "TIME" | U32 | 0x00000000 Note 4 | 0x00173B3B Note 4 | |
| 0x0046 | 70 | 0x03, 0x06, 0x10 | P08 | "AUTO-START" | U08 | 0 | 1 | 0 = Off 1 = On |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|-----------------------------|------------|---------------------------------|------------|----------------------|----------------------|---|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x0047 | 71 | 0x03 | P09 | "OPERAT.TIME" | U32 | 0x00000000 Note 5 | 0x7FFF3B3B Note 5 | |
| 0x0059 | 89 | 0x03 | P21 | "STATUS UNITS" | _B0 | 0 | 0xFF | |
| 0x005C | 92 | 0x03, 0x06, 0x10 | | "Enable Device – Motor relay 1" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x005D | 93 | 0x03, 0x06, 0x10 | | "Enable Device – Motor relay 2" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x005E | 94 | 0x03, 0x06, 0x10 | | "Enable Device – Motor relay 3" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x005F | 95 | 0x03, 0x06, 0x10 | | "Enable Device – Motor relay 4" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x0060 | 96 | 0x03, 0x06, 0x10 | | "Enable Device – Motor relay 5" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x0061 | 97 | 0x03, 0x06, 0x10 | P24 | "ENABLE DEVICE" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x006B | 107 | 0x03 | P25 | "MOTOR HOURS" | U32 | 0x00000000 Note 5 | 0x7FFF3B3B Note 5 | |
| 0x006D | 109 | 0x03 | P35 | "KWH COUNTER" | U32 | 0 | 0x0000FFFF | |
| 0x0081 | 129 | 0x03 | P41 | "PROD.DATE" | U32 | 0 | 0xFFFFFFFF | |
| 0x0085 | 133 | 0x03 | P43 | "TEMP.INVERTER" | S08 | -128 | 127 | |
| 0x0087 | 135 | 0x03 | P44 | "CURR.INVERTER" | U16 | 0 | 10000 | |
| 0x0088 | 136 | 0x03 | P45 | "VOLT.INVERTER" | U16 | 0 | 1000 | |
| 0x0089 | 137 | 0x03 | P47 | "VER.INVERTER" | U32 | 0 Note 6 | 0xFFFFFFFF Note 6 | |
| 0x008B | 139 | 0x03 0x06, 0x10 (Note 9) | P105 | "MODE" | U08 | 0 | 4 | 0 = Controller 1 = Cascade Relay 2 = Cascade Serial 3 = Actuator 4 = Cascade Synchron |
| 0x008D | 141 | 0x03, 0x06, 0x10 | P115 | "LOCK FUNCT." | U08 | 0 | 1 | 0 = Off 1 = On |
| 0x008E | 142 | 0x03, 0x06, 0x10 | P120 | "DISP.CONTR." | U08 | 0 | 100 | |
| 0x008F | 143 | 0x03, 0x06, 0x10 | P125 | "DISP.BRIGHT." | U08 | 0 | 100 | |
| 0x0090 | 144 | 0x03, 0x06, 0x10 | P130 | "DISP.ROTATION" | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x0092 | 146 | 0x03 0x06, 0x10 (Note 2) | P270 | "MOTOR POLES" | U08 | 2 | 4 | |
| 0x0095 | 149 | 0x03, 0x06, 0x10 | P205 | "MAX.UNITS" | U08 | 1 | 8 | |
| 0x0097 | 151 | 0x03, 0x06, 0x10 | P215 | "RAMP 1" | U16 | 1 | 250 - 1000 (*) | |
| 0x0098 | 152 | 0x03, 0x06, 0x10 | P220 | "RAMP 2" | U16 | 1 | 250 - 1000 (*) | |
| 0x0099 | 153 | 0x03, 0x06, 0x10 | P225 | "RAMP 3" | U16 | 1 | 1000 | |
| 0x009A | 154 | 0x03, 0x06, 0x10 | P230 | "RAMP 4" | U16 | 1 | 1000 | |
| 0x009B | 155 | 0x03, 0x06, 0x10 | P235 | "RAMP FMIN A" | U08 | 10 | 250 | |
| 0x009C | 156 | 0x03, 0x06, 0x10 | P240 | "RAMP FMIN D" | U08 | 10 | 250 | |
| 0x009D | 157 | 0x03, 0x06, 0x10 | P245 | "MAX.FREQ." | U16 | 300 | 700 | |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|-----------------------------|------------|-------------------|------------|---------------------------|----------------|--|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x009E | 158 | 0x03, 0x06, 0x10 | P250 | "MIN.FREQ." | U16 | 0 | P245 Note 1 | |
| 0x009F | 159 | 0x03, 0x06, 0x10 | P255 | "CONF.FMIN" | U08 | 0 | 1 | 0 = f -> 0 1 = f -> fmin |
| 0x00A0 | 160 | 0x03, 0x06, 0x10 | P260 | "FMIN TIME" | U08 | 0 | 100 | |
| 0x00A1 | 161 | 0x03 0x06, 0x10 (Note 2) | P281 | "BOOST" | U08 | 0 | 25 | |
| 0x00A2 | 162 | 0x03 0x06, 0x10 (Note 2) | P282 | "KNEE FREQ." | U16 | 300 | P245 Note 1 | |
| 0x00A4 | 164 | 0x03, 0x06, 0x10 | P283 | "SEL.SW.FREQ." | U08 | Freq.>=P284 (*) Note 1 | 10 (*) | 1 = rand. 5kHz 2 = 2kHz 3 = 3kHz 4 = 4kHz 5 = 5kHz 6 = 6kHz 7 = 8kHz 8 = 10kHz 9 = 12kHz 10 = 16kHz |
| 0x00A5 | 165 | 0x03, 0x06, 0x10 | P261 | "SKIP FRQ.CTR." | U16 | 0 | P245 Note 1 | |
| 0x00A6 | 166 | 0x03, 0x06, 0x10 | P262 | "SKIP FRQ.RNG." | U16 | 0 | 50 | |
| 0x00A7 | 167 | 0x03, 0x06, 0x10 | P295 | "CURR.LIM.FUNCT." | U08 | 0 | 1 | 0 = Disable 1 = Enable |
| 0x00A8 | 168 | 0x03, 0x06, 0x10 | P296 | "CURR.LIMIT SET" | U16 | 10 | 300 | |
| 0x00A9 | 169 | 0x03 0x06, 0x10 (Note 2) | P284 | "MIN.SW.FREQ." | U08 | 2 (*) | 10 (*) | 2 = 2kHz 3 = 3kHz 4 = 4kHz 5 = 5kHz 6 = 6kHz 7 = 8kHz 8 = 10kHz 9 = 12kHz 10 = 16kHz |
| 0x00AA | 170 | 0x03, 0x06, 0x10 | P310 | "WINDOW" | U08 | 0 | 100 | |
| 0x00AB | 171 | 0x03, 0x06, 0x10 | P315 | "HYSTERESIS" | U08 | 0 | 100 | |
| 0x00AC | 172 | 0x03, 0x06, 0x10 | P320 | "REG.MODE" | U08 | 0 | 1 | 0 = Normal 1 = Inverse |
| 0x00AD | 173 | 0x03, 0x06, 0x10 | P325 | "FRQ.LIFT" | U16 | 0 | P245 Note 1 | |
| 0x00AE | 174 | 0x03, 0x06, 0x10 | P330 | "LIFT AMOUNT" | U16 | 0 | 2000 | |
| 0x00B3 | 179 | 0x03, 0x06, 0x10 | P405 | "DIMENSION UNIT" | U08 | 0 | 12 | 0 = bar 1 = psi 2 = m3/h 3 = g/min 4 = m/H2O 5 = ft |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|-----------------------------|------------|---------------------|------------|--------------|----------------|--|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| | | | | | | | | 6 = °C 7 = °F 8 = l/sec 9 = l/min 10 = m/sec 11 = ... 12 = % |
| 0x00B4 | 180 | 0x03, 0x06, 0x10 | P410 | "CONF.SENSOR" | U08 | 0 | 7 (*) | 0 = Sensor1 1 = Sensor2 2 = Auto 3 = Switch Dig1 4 = Switch Dig2 5 = Auto Lower 6 = Auto Higher 7 = Sens1 – Sens2 |
| 0x00B5 | 181 | 0x03, 0x06, 0x10 | P415 | "SENSOR TYPE" | U08 | 0 | 2 | 0 = Analog U 0-10V 1 = Analog I 0-20mA 2 = Analog I 4-20mA |
| 0x00B6 | 182 | 0x03, 0x06, 0x10 | P420 | "SENSOR RANGE" | U16 | 1 | 10000 | |
| 0x00B7 | 183 | 0x03, 0x06, 0x10 | P425 | "SENSOR CURVE" | U08 | 0 | 1 | 0 = Linear 1 = Quadratic |
| 0x00B8 | 184 | 0x03, 0x06, 0x10 | P430 | "SENS.1 CAL.0" | S16 | -100 | 100 | |
| 0x00B9 | 185 | 0x03, 0x06, 0x10 | P435 | "SENS.1 CAL.X" | S16 | -100 | 100 | |
| 0x00BA | 186 | 0x03, 0x06, 0x10 | P440 | "SENS.2 CAL.0" | S16 | -100 | 100 | |
| 0x00BB | 187 | 0x03, 0x06, 0x10 | P445 | "SENS.2 CAL.X" | S16 | -100 | 100 | |
| 0x00BC | 188 | 0x03, 0x06, 0x10 | | "RANGE FACTOR" | U08 | 0 | 2 | |
| 0x00BD | 189 | 0x03, 0x06, 0x10 | P505 | "ACT.VAL.INC." | U16 | 0 | P420 Note 1 | |
| 0x00BE | 190 | 0x03, 0x06, 0x10 | P510 | "ACT.VAL.DEC." | U16 | 0 | P420 Note 1 | |
| 0x00BF | 191 | 0x03, 0x06, 0x10 | P515 | "ENABLE FRQ." | U16 | 0 | 700 | |
| 0x00C0 | 192 | 0x03, 0x06, 0x10 | P520 | "ENABLE DLY." | U08 | 0 | 100 | |
| 0x00C1 | 193 | 0x03, 0x06, 0x10 | P525 | "SWITCH DLY." | U08 | 0 | 100 | |
| 0x00C2 | 194 | 0x03, 0x06, 0x10 | P530 | "DISABLE FRQ." | U16 | 0 | 700 | |
| 0x00C3 | 195 | 0x03, 0x06, 0x10 | P535 | "DISABLE DLY." | U08 | 0 | 100 | |
| 0x00C4 | 196 | 0x03, 0x06, 0x10 | P540 | "DROP FRQ." | U16 | 0 | 700 | |
| 0x00C5 | 197 | 0x03, 0x06, 0x10 | P545 | "OVERVALUE" | U16 | 0 | P420 Note 1 | |
| 0x00C6 | 198 | 0x03, 0x06, 0x10 | P550 | "OVERVAL.DLY." | U08 | 0 | 100 | |
| 0x00C7 | 199 | 0x03, 0x06, 0x10 | P555 | "SWITCH INTV." | U08 | 0 | 250 | |
| 0x00C8 | 200 | 0x03, 0x06, 0x10 | P560 | "SYNCHR.LIM." | U16 | 0 | P245 Note 1 | |
| 0x00C9 | 201 | 0x03, 0x06, 0x10 | P565 | "SYNCHR.WND." | U16 | 0 | 100 | |
| 0x00CB | 203 | 0x03 0x06, 0x10 (Note 2) | P280 | "SWITCHING CONTROL" | U08 | 0 | 1 | 0 = V/f 1 = HVC |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|------------------|------------|-----------------|------------|----------------|----------------|---|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x00D1 | 209 | 0x03, 0x06, 0x10 | P605 | "MIN.THRESH." | U16 | 0 | P420 Note 1 | |
| 0x00D2 | 210 | 0x03, 0x06, 0x10 | P610 | "DELAY-TIME" | U08 | 1 | 100 | |
| 0x00D3 | 211 | 0x03, 0x06, 0x10 | P615 | "ERROR RESET" | U08 | 0 | 1 | 0 = Off 1 = On |
| 0x00DB | 219 | 0x03, 0x06, 0x10 | P705 | "ANALOG OUT.1" | U08 | 0 | 1 | 0 = Actual Value 1 = Output Freq. |
| 0x00DC | 220 | 0x03, 0x06, 0x10 | P710 | "ANALOG OUT.2" | U08 | 0 | 1 | 0 = Actual Value 1 = Output Freq. |
| 0x00DD | 221 | 0x03, 0x06, 0x10 | P715 | "CONF.REL.1" | U08 | 0 | 5 | 0 = Power 1 = Running 2 = Errors 3 = Warnings 4= Stand By 5 = Err. Reset |
| 0x00DE | 222 | 0x03, 0x06, 0x10 | P720 | "CONF.REL.2" | U08 | 0 | 5 | 0 = Power 1 = Running 2 = Errors 3 = Warnings 4= Stand By 5 = Err. Reset |
| 0x00E5 | 229 | 0x03, 0x06, 0x10 | P805 | "C.REQ.VAL.1" | U08 | 1 | 4 (*) | 1 = Digital 2 = Analog U 0-10V 3 = Analog I 0-20mA 4= Analog I 4-20mA |
| 0x00E6 | 230 | 0x03, 0x06, 0x10 | P810 | "C.REQ.VAL.2" | U08 | 0 | 4 (*) | 0 = Off 1 = Digital 2 = Analog U 0-10V 3 = Analog I 0-20mA 4= Analog I 4-20mA |
| 0x00E7 | 231 | 0x03, 0x06, 0x10 | P815 | "SW.REQ.VAL." | U08 | 0 | 3 (*) | 0 = Setpoint 1 1 = Setpoint 2 2 = Switch Dig 1 3 = Switch Dig 2 |
| 0x00E8 | 232 | 0x03, 0x06, 0x10 | P820 | "REQ.VAL.1" | U16 | 0 | P420 Note 1 | |
| 0x00E9 | 233 | 0x03, 0x06, 0x10 | P825 | "REQ.VAL.2" | U16 | 0 | P420 Note 1 | |
| 0x00EA | 234 | 0x03, 0x06, 0x10 | P830 | "ACTUAT.FRQ.1" | U16 | P250 Note 1 | P245 Note 1 | |
| 0x00EB | 235 | 0x03, 0x06, 0x10 | P835 | "ACTUAT.FRQ.2" | U16 | P250 Note 1 | P245 Note 1 | |
| 0x00F9 | 249 | 0x03, 0x06, 0x10 | P1005 | "TEST RUN" | U08 | 0 | 100 | |
| 0x00FA | 250 | 0x03, 0x06, 0x10 | P1010 | "TEST RUN FRQ." | U16 | P250 Note 1 | P245 Note 1 | |
| 0x00FB | 251 | 0x03, 0x06, 0x10 | P1015 | "TEST R.BOOST" | U08 | 0 | 25 | |
| 0x00FC | 252 | 0x03, 0x06, 0x10 | P1020 | "TEST R.TIME" | U08 | 0 | 180 | |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|------------------|------------|---------------------|------------|--------------------------|--|---|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x010D | 269 | 0x03, 0x06, 0x10 | P1205 | "ADDRESS" | U08 | 1 (Modbus) 0 (BACNet) | 247 (Modbus) 127 (BACNet) | |
| 0x010E | 270 | 0x03, 0x06, 0x10 | P1210 | "BAUD RATE" | U08 | 0 | 9 | 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 14400 5 = 19200 6 = 38400 7 = 57600 8 = 76800 9 = 115200 |
| 0x010F | 271 | 0x03, 0x06, 0x10 | P1215 | "FORMAT" | U08 | 0 | 6 (Modbus ASCII) 3 (any other protocol) | 0 = 8, N, 1 1 = 8, N, 2 2 = 8, E, 1 3 = 8, O, 1 4 = 7, N, 2 5 = 7, E, 1 6 = 7, O, 1 |
| 0x0110 | 272 | 0x03, 0x06, 0x10 | P1220 | "PUMP ADDR." | U08 | 1 | 8 | |
| 0x0111 | 273 | 0x03, 0x06, 0x10 | P1203 | "PROTOCOL" | U08 | 0 | 3 | 0 = Disabled 1 = Modbus RTU 2 = Modbus ASCII 3 = BACNet MS/TP |
| 0x0112 | 274 | 0x03, 0x10 | P1221 | "BACNET DEV.ID" | U32 | 0 | 0x3FFFFFFF | |
| 0x0117 | 279 | 0x03 | P265 | "MOTOR NOM.POWER" | U08 | 7 (*) | 20 (*) | |
| 0x0118 | 280 | 0x03 | P266 | "MOTOR NOM.VOLT." | U16 | 208 (*) | 460 (*) | |
| 0x0119 | 281 | 0x03 | P267 | "MOTOR NOM.FRQ." | U16 | 30 | 70 | |
| 0x011A | 282 | 0x03 | P268 | "MOTOR NOM.CURR." | U32 | 100 (*) | 13200 (*) | |
| 0x011C | 284 | 0x03 | P269 | "MOTOR NOM.SPEED" | U16 | 1000 | 3600 | |
| 0x011D | 285 | 0x03 | P290 | "STC MOTOR PROT." | U08 | 2 | 4 | |
| 0x011E | 286 | 0x03 | P291 | "STC MOTOR THERMAL" | U08 | 0 | 100 | |
| 0x012B | 299 | 0x03 | P202 | "SOFTWARE" | U32 | 0 Note 6 | 0xFFFFFFFF Note 6 | |
| 0x012D | 301 | 0x03 | | "Errors, H3" | _B2 | 0 Note 7 | 0xFFFFFFFF Note 7 | |
| 0x0137 | 311 | 0x03 | P1225 | "SSID NUMBER" | _B2 | 0 | 0xFFFFFFFF | |
| 0x0139 | 313 | 0x03 | P1226 | "SEC.KEY NUMBER" | _B2 | 0 | 0xFFFFFFFF | |
| 0x013F | 319 | 0x03, 0x06, 0x10 | P905 | "OFFS.INPUT" | U08 | 0 | 6 (*) | 0 = Off 1 = An.U1 0-10V 2 = An.U2 0-10V 3 = An.I1 0-20mA 4 = An.I1 4-20mA 5 = An.I2 0-20mA 6 = An.I2 4-20mA |
| 0x0140 | 320 | 0x03, 0x06, 0x10 | P907 | "OFFSET RANGE" | U16 | 0 | 10000 | |

| Modbus address | | Function codes | Menu Index | Description | Datum type | Values range | | Enum Description |
|----------------|-------|-----------------------------|------------|------------------------------|------------|--------------|------------------|------------------|
| (HEX) | (DEC) | | | | | Minimum | Maximum | |
| 0x0141 | 321 | 0x03, 0x06, 0x10 | P910 | "LEVEL 1" | U16 | 0 | 10000 | |
| 0x0142 | 322 | 0x03, 0x06, 0x10 | P912 | "OFFSET X1" | U16 | 0 | 10000 | |
| 0x0143 | 323 | 0x03, 0x06, 0x10 | P913 | "OFFSET Y1" | U16 | 0 | P420 Note 1 | |
| 0x0144 | 324 | 0x03, 0x06, 0x10 | P915 | "LEVEL 2" | U16 | 0 | 10000 | |
| 0x0145 | 325 | 0x03, 0x06, 0x10 | P917 | "OFFSET X2" | U16 | 0 | 10000 | |
| 0x0146 | 326 | 0x03, 0x06, 0x10 | P918 | "OFFSET Y2" | U16 | 0 | P420 Note 1 | |
| 0x0149 | 329 | 0x03 | P1304 | "PRE-SET MOTOR?" | U08 | 0 | 1 | |
| 0x014A | 330 | 0x03 0x06, 0x10 (Note 9) | P1311 | "CONTROL MODE" | U08 | 0 | 1 | |
| 0x014B | 331 | 0x03, 0x06, 0x10 | P1322 | "START-UP COMPLETE?" | U08 | 0 | 1 | |
| 0x01C1 | 449 | 0x03 | | "Extended Device Status, H4" | _B1 | 0 Note 8 | 0xFFFF Note 8 | |
| 0x0131 | 305 | 0x03 | P135 | "BACK.COMP." | U08 | 0 | 1 | |

Data types are:

- U08 – Unsigned 8 bits
- U16 – Unsigned 16 bits
- U32 – Unsigned 32 bits (can be written by mean of Write Multiple Register only, function code 0x10)
- S08 – Signed 8 bits
- S16 – Signed 16 bits
- _B0 – 8 bits bitmap
- _B1 – 16 bits bitmap
- _B2 – 32 bits bitmap

(*) : parameter have values boundaries/selections that could be available only based on HVL model variant, and/or optional cards

Note 1: some parameters have values, properties and/or boundaries that are runtime dependent on other parameters values. In particular, if a parameter value range (min. value, max. value) is reported to have dependence on other parameters value(s), the device may report Modbus write exceptions on the dependent parameter.

Note 2: exclusively whilst the motor is running, HVL answers an exception to Modbus writing function requests (0x06, 0x10)

Note 3: parameter data fields: DATE

| U32 0xMNPQRSTV | Value ranges | Description | Formatted on HV display as text “DD-MM-20YY” |
|-------------------|--------------|---------------------------|--|
| Byte 0xMN | 0..99 | Year | the decimal value is shown on display at position YY |
| Byte 0xPQ | 1..12 | Month | the decimal value is shown on display at position MM |
| Byte 0xRS | 1..31 | Day | the decimal value is shown on display at position DD |
| Byte 0xTV | 0..255 | reserved/for internal use | |

Note 4: parameter data fields: TIME

| U32 0xMNPQRSTV | Value ranges | Description | Formatted on HV display as text “hh:mm” |
|-------------------|--------------|---------------------------|--|
| Byte 0xMN | 0 | reserved/for internal use | |
| Byte 0xPQ | 0..23 | Hours | the decimal value is shown on display at position hh |
| Byte 0xRS | 0..59 | Minutes | the decimal value is shown on display at position mm |
| Byte 0xTV | 0..59 | reserved/for internal use | |

Note 5: parameter data fields: TIME COUNTERs

| U32 0xMNPQRSTV | Value ranges | Description | Formatted on HV display as text “hhhhh:mm” |
|-------------------|--------------|---------------------------|---|
| Word 0xMNPQ | 0..65535 | Hours | the decimal value is shown on display at position hhhhh |
| Byte 0xRS | 0..59 | Minutes | the decimal value is shown on display at position mm |
| Byte 0xTV | 0..255 | reserved/for internal use | |

Examples:

0x00082000, 8hours, 32 minutes, other byte: reserved, the time counter is 8:32
0x0220013B, 544hours, 1 minute, other byte: reserved, the time counter is 544:01

Note 6: parameter data fields: VERSIONs

| U32 0xMNPQRSTV | Value ranges | Description | Formatted on HV display as text “V##.##” |
|-------------------|--------------|---------------------------|--|
| Byte 0xMN | 0..99 | Major version value | the two digits decimal value is shown at position ## |
| | 100..255 | -- | “- -” is shown on display at position ## |
| Byte 0xPQ | 0..99 | Minor version value | the two digits decimal value is shown at position ** |
| | 100..255 | -- | “- -” is shown on display at position ** |
| Byte 0xRS | 0..255 | reserved/for internal use | |
| Byte 0xTV | 0..255 | reserved/for internal use | |

Examples:

0x02080000, major version:2, minor version: 8, other bytes: reserved, the version is 2.08, display format is “V02.08”.
 0x0220ABAB, major version:2, minor version: 32, other bytes: reserved, the version is 2.32, display format is “V02.32”.
 0x02FFAA55, major version:2, minor version: --, other bytes: reserved, the version is 2.--, display format is “V02.--”.
 0xFFFFFFFF, major version:--, minor version: --, other bytes: reserved, the version is --.--, display format is “V--.--”.

Note 7: parameter data fields: Error status

| _B2 | Value ranges | Description |
|--|---------------------------------------|---|
| Bit 00 Bit 01 Bit 02 Bit 03 Bit 04 Bit 05 Bit 06 Bit 07 Bit 08 Bit 09 Bit 10 Bit 11 | 0 = error absent 1 = error present | ERROR 11 OVERCURRENT ERROR 12 OVERLOAD ERROR 13 OVERVOLTAGE ERROR 16 PHASE LOSS ERROR 14 INVERTER OVERHEAT ERROR 15 MOTOR OVERHEAT ERROR 21 LACK OF WATER ERROR 22 MINIMUM THRESHOLD ERROR 23 ACT. VAL. SENSOR 1 ERROR 24 ACT. VAL. SENSOR 2 ERROR 25 SETPOINT 1 I<4mA ERROR 26 SETPOINT 2 I<4mA |
| Bits 12.. 31 | 0..1 | Reserved/for internal use |

Example:

0x00000040, Bit 06 is set to 1, “Lack Of Water” error #21 is present.

Note 8: parameter data fields: Extended Device Status

| _B2 | Value ranges | Description |
|--|---|---|
| Bit 00 Bit 01 Bit 02 Bit 03 Bit 04 Bit 05 Bit 06 | 0 = bit not set = False 1 = bit set = True | Device is preset Device is ready for regulation (but maybe stopped) Device has an error Device has a warning External ON/OFF terminal enabled/disabled Device is enabled with start button Motor is running |
| Bit 07 | 0..1 | Reserved/for internal use |
| Bits 08 .. 11 | 0..8 9..15 | Group sequence number of the pump (0 if pump is not in group) Reserved/for internal use |
| Bit 12 Bit 13 Bit 14 Bit 15 | 0 = bit not set = False 1 = bit set = True | Control card is present Device is master Solo-Run ON/OFF Inverter STOP/START |

Note 9: parameters associated to internal device reconfiguration actions: a Modbus writing action to the parameter will restore other HVL dependent parameters to their default values. It is recommended to not write to the parameter unless the present value differs from the desired value.

