ITT

Serial Data Transfer - RS485

HYDROVAR®

Modbus – Protocol

for HV 2.015 /2.022
HV 4.022 / 4.030 /4.040
HV 4.055 / 4.075 / 4.110
HV4.150 / 4.185 / 4.220

Software Versions: V01.3 / V01.4

INDEX

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

1 A Few Facts about the Modbus Protocol

**NOTE: The Modbus Protocol is an international standardized Bus Protocol!
The general information within this IOM is just a brief overview, for detailed information please use the Modbus Protocol reference guide, or any other source of information (e.g. available on web)**

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.

1.1 Communication

The HYDROVAR 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.

The Master can address individual slaves, or can initiate a broadcast message to all slaves.

1.2 Broadcasting

Using the BROADCAST function it is possible to write to (WRITE-only) all converters (SLAVE) from the MASTER simultaneously. This means that when changing the setting from Fmax to 60 Hz it is not necessary to address all converters (SLAVE) individually using the appropriate address (set SIO address on the converter). Instead the BROADCAST function (WRITE only) can be used.
Therefore you have to write the appropriate data to SIO address 0.

1.3 Data Protection

Standard Modbus serial networks use two kinds of error checking:
- Parity checking (even of 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 you will find in the Modbus Protocol Reference Guide!

1.4 Transmission Mode

When using the Modbus Protocol you have to choose between two transmission Modes: ASCII or RTU
The different modes determine how information will be packed into the message fields and decoded.

As user you have to select the desired mode, along with the serial port communication parameters (baud rate, parity mode…).

! 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 the HYDROVAR:

RTU N81	1 start bit, 8 data bits, 1 stop bit, No parity
RTU N82	1 start bit, 8 data bits, 2 stop bits, No parity
RTU E81	1 start bit, 8 data bits, 1 stop bit, Even parity
RTU O81	1 start bit, 8 data bits, 1 stop bit, Odd parity
ASCII N72	1 start bit, 7 data bits, 2 stop bits, No parity
ASCII E71	1 start bit, 7 data bits, 1 stop bit, Even parity
ASCI O71	1 start bit, 7 data bits, 1 stop bit, Odd parity

1.5 Function Codes

03 Read Holding Registers – READ COMMAND

Read the binary contents of holding registers in the slave! Broadcast is not supported!

Note:	The Modbus Registers are addressed starting at zero! E.g. Address 33 has to be addressed as 32

Example: Read the Actual Value

QUERY

	HEX	
Slave Address	01	Could be set on the HYDROVAR via Parameter ADDRESS [1205]
Function	03	Read Holding Register
Starting Address High	00	
Starting Address Low	32	Modbus Index 33 (HEX) – Actual value has to be addressed
No. of Points High	00	To read more than one holding register is not supported by the
No. of Points Low	01	HYDROVAR.
Error Check CRC-High	25	
Error Check CRC-Low	C5	Generated CRC-Checksum

RESPONSE

	HEX	
Slave Address:	01	
Function	03	
Byte Count	02	
Data High	02	
Data Low	08	=> 208 HEX = 520 DEZ => Actual Value = 5.20 bar
Error Check CRC-High	76	
Error Check CRC-Low	B8	Generated CRC-Checksum

06 Preset Single Register – WRITE COMMAND

Preset a value into a single holding register.
When broadcast function is used, the function presets the same register reference in all connected slaves.

Note: The Modbus Registers are addressed starting at zero!
E.g. Address E9 has to be addressed as E8

Example: Set the Required Value 1 to 3.50 bar

QUERY

	HEX	
Slave Address	01	Could be set on the HYDROVAR via Parameter ADDRESS [1205]
Function	06	Preset Single Register
Register Address High	00	
Register Address Low	E8	Modbus Index E9 (HEX) – Req. Value 1 has to be addressed
Preset Data High	01	
Preset Data Low	5E	=> 15E HEX = 350 DEZ => sets the Required Value 1 to 3.50 bar
Error Check CRC-High	89	
Error Check CRC-Low	96	Generated CRC-Checksum

RESPONSE

	HEX	
Slave Address:	01	
Function	06	
Register Address High	00	
Register Address Low	E8	
Preset Data High	01	
Preset Data Low	5E	=> Required Value 1 is set to 3.50 bar
Error Check CRC-High	89	
Error Check CRC-Low	96	Generated CRC-Checksum

2 Wiring and Connections

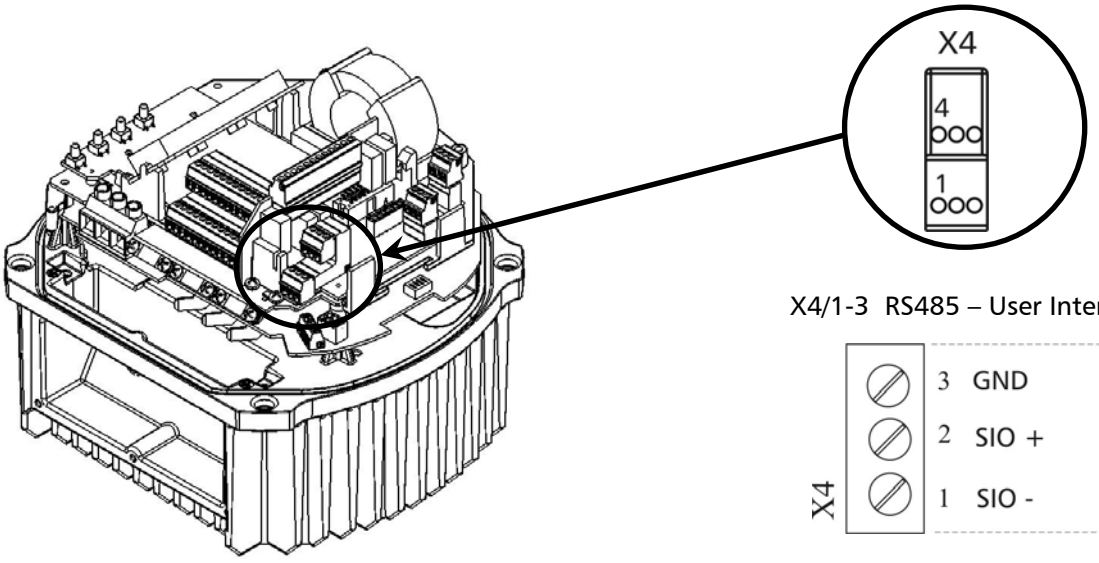
2.1 Between HYDROVAR and external User

NOTE:
For detailed information regarding installation, wiring and configuration of the HYDROVAR, please read and follow the operation instruction of the HYDROVAR itself!

All installations and maintenance have to be performed by properly trained and qualified personal with proper tools!!

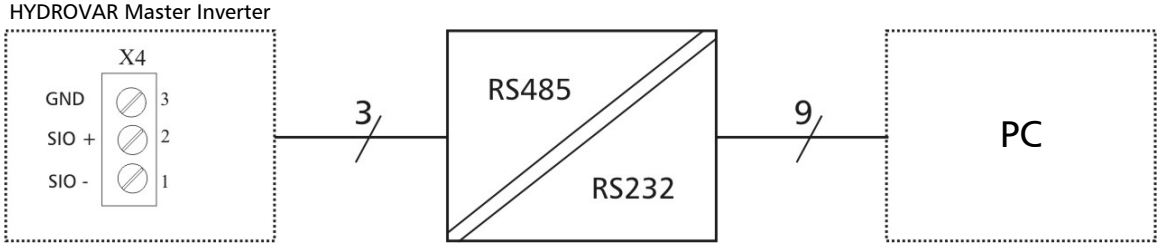
- Remove the screws holding the top cover and lift off the top cover.
- The RS485 terminals which could be used for the communication with an external-control-device via standardized Modbus-protocol are placed on the Control Card at the HYDROVAR Master Inverter. (see picture below)

e.g. shown on a HV 4.040

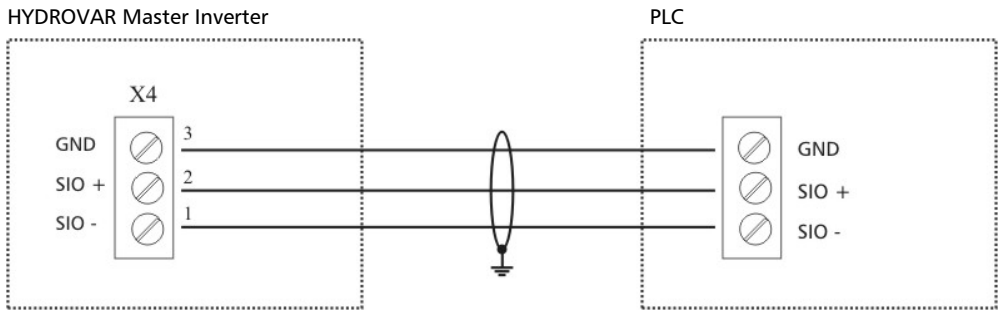


X4/1-3 RS485 – User Interface

Connection examples:
Wiring between HYDROVAR and any external device:
e.g. wiring to a PC



e.g. wiring to a PLC (Programmable Logic Controller)



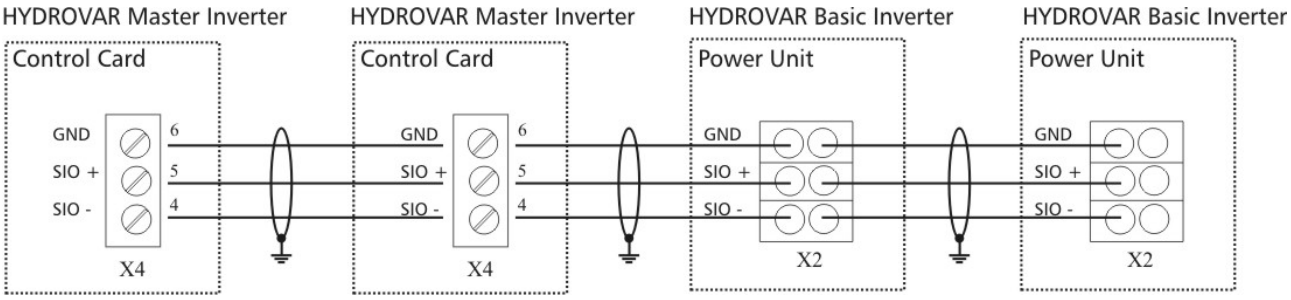
2.2 Multi-pump application with External User

When using a Multi- pump application you have to wire the user-interface **and** the internal interface between all used Master Inverters in the Group!

e.g. 2 Master and 2 Basic Inverters

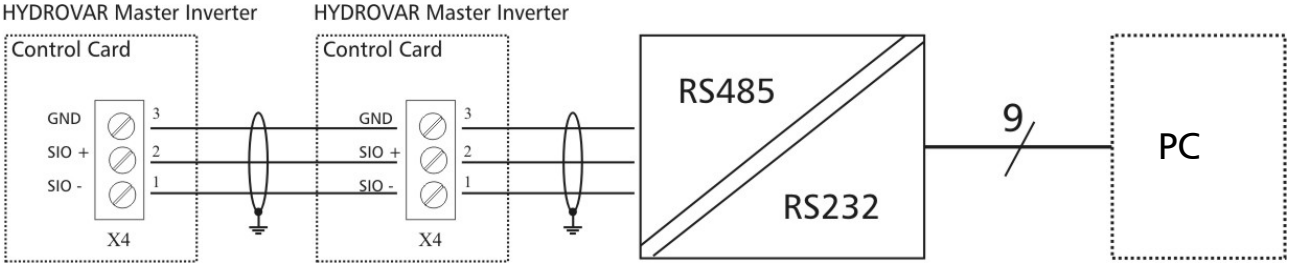
Connection of the internal interface:

You have to connect the internal interface on all used units in the group, even the Master and the Basic Inverters.



Connection of the user interface:

The connection of the User Interface has to be done between each Master Inverter.
The connection from the pump group to any external device can be made on each inverter!



3 HYDROVAR Settings

The following 3 parameters which define the user interface on the HYDROVAR have to be set on each Master Inverter to guarantee correct Modbus communication.

1205	1205 ADDRESS 1	Set desired Address for the User Interface
Possible settings:		1 - 247

Valid Modbus Address for the User Interface could be set between 1 and 247. Each Master Inverter must be allocated its own address!

1210	1210 BAUDRATE 9600	Baudrate for User Interface
Possible settings:		1200, 2400, 4800, 9600, 14400, 19200, 38400

1215	1215 FORMAT RTU N81	Format for User Interface
Possible settings:		RTU N81, RTU N82, RTU E81, RTU O81, ASCII N72, ASCII E71, ASCII 071

The serial port communication parameters Baud rate and Format could be chosen with the above parameters and must be the same for all devices on the Modbus network.

4 Index list HYDROVAR Master Inverter – SW version V01.3 / V01.4

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
32	50	03, 06		Start / Stop of the Inverter		0 = STOP 1= ON
33	51	03		Actual Value		0-10000
35	52	03		Actual frequency	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
38	56	03	03	Eff. Required Value		0-10000
39	57	03,06	04	Start Value	0-99%; OFF	0-100 -> 100=OFF
3A	58	03,06	05	Language (for software version V01.3 only value 0-6 is available)		0 = English 1 = German 3 = French 5 = Portuguese 2 = Italian 4 = Dutch 6 = Spain 7 = Russian 8 = Polish 9 = Czech 10 = Slovenian 11 = Swedish 12 = Norwegian 13 = Danish 14 = Finnish
3B	59	03	06	Read Date - Day	01-31	01-31
3C	60	03		Read Date - Month	01-12	01-12
3D	61	03		Read Date - Year	2000-2099	00-99
3E	62	06	06D	Set Date - Day	01-31	01-31
3F	63	06	06M	Set Date - Month	01-12	01-12
40	64	06	06Y	Set Date - Year	2000-2099	00-99
41	65	03	07	Read Time - Hours	00-23	00-23
42	66	03		Read Time - Minutes	00-59	00-59
43	67	03		Read Time – Seconds	not displayed	00-59
44	68	06	07H	Set Time – Hours	00-23	00-23
45	69	06	07M	Set Time – Minutes	00-59	00-59
46	70	06		Set Time – Seconds	not displayed	00-59
47	71	03,06	08	Auto-Start	OFF / ON	0 = OFF 1 = ON
48	72	03	09	Operation Time – Hours_High	0-99999	0-255
49	73	03		Operation Time – Hours_Low		0-65535
4A	74	03		Operation Time - Minutes	0-59	0-59

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
5A	90	03	21	Status Units		See NOTE H1 (Page 22)
5D	93	03,06	24	Enable Device – Motor relay 1		0 = disabled 1 = enabled
5E	94	03,06	24	Enable Device – Motor relay 2		0 = disabled 1 = enabled
5F	95	03,06	24	Enable Device – Motor relay 3		0 = disabled 1 = enabled
60	96	03,06	24	Enable Device – Motor relay 4		0 = disabled 1 = enabled
61	97	03,06	24	Enable Device – Motor relay 5		0 = disabled 1 = enabled
62	98	03,06	24	Enable Device – Device 1		0 = disabled 1 = enabled
63	99	03,06	24	Enable Device – Device 2		0 = disabled 1 = enabled
64	100	03,06	24	Enable Device – Device 3		0 = disabled 1 = enabled
65	101	03,06	24	Enable Device – Device 4		0 = disabled 1 = enabled
66	102	03,06	24	Enable Device – Device 5		0 = disabled 1 = enabled
67	103	03,06	24	Enable Device – Device 6		0 = disabled 1 = enabled
68	104	03,06	24	Enable Device – Device 7		0 = disabled 1 = enabled
69	105	03,06	24	Enable Device – Device 8		0 = disabled 1 = enabled
6A	106	03,06	22	Select Device	1-8	1-8
6C	108	03	175	Motor Hours – Hours		0-65535
6D	109	03		Motor Hours - Minutes		0-59

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
82	130	03	41	Production Date – Day	1-31	1-31
83	131	03		Production Date – Month	1-12	1-12
84	132	03		Production Date – Year	2000-2099	0-99
85	133	03,06	42	Select Inverter	1-8	1-8
86	134	03	43	Temperature Inverter – Degrees	30-100°C	30-100
87	135	03		Temperature Inverter – Percent	42- 100%	42-100
88	136	03	44	Current Inverter	0-110%	0-110
89	137	03	45	Voltage Inverter	0-750V	0-750
8A	138	03	47	Version Inverter		High Byte: 0… specification value is not valid 1…specification value is valid Low Byte: basic specification value 0…2
8C	140	03,06	0105	Mode	Controller Cascade Relay Cascade Serial Actuator Cascade synchr	0 = Controller 1 = Cascade Relay 2 = Cascade Serial 3 = Actuator 4 = Cascade Synchron
8E	142	03,06	0115	Lock Function	OFF / ON	0= OFF 1= ON
8F	143	03,06	0120	Display Contrast	10-100%	10-100
90	144	03,06	0125	Display Brightness	10-100%	10-100

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
96	150	03,06	0205	Max. Units	1-8	1-8
97	151	03,06	0210	Inverter	1 – 8, ALL	0 = ALL; 1 - 8
98	152	03,06	0215	Ramp 1	1 – 250 sec	1-250
99	153	03,06	0220	Ramp 2	1 – 250 sec	1-250
9A	154	03,06	0225	Ramp 3	1 – 250 sec	1-250
9B	155	03,06	0230	Ramp 4	1 – 250 sec	1-250
9C	156	03,06	0235	Ramp Fmin A	1.0 – 25.0 sec	10 – 250
9D	157	03,06	0240	Ramp Fmin D	1.0 – 25.0 sec	10 – 250
9E	158	03,06	0245	Max. Frequency	30 – 70.0 Hz	300 – 700
9F	159	03,06	0250	Min. Frequency	0 – 30.0 / fmax Hz.	0 – 300 / fmax (depends on the basic software)
A0	160	03,06	0255	Config. Fmin	f->0 f->fmin	0 = f->0 1 = f->fmin
A1	161	03,06	0260	Fmin Time	0-100 sec	0-100
A2	162	03,06	0265	Boost	0 – 25%	0 – 25
A3	163	03,06	0270	Knee Frequency	30.0 – 70.0 Hz	300 – 700
A4	164	03,06	0275	Power Reduction	OFF 85% 75% 50%	0 = OFF 1 = 85% 2 = 75% 3 = 50%
A5	165	03,06	0280	Sel. Switching Frequency	Auto 4kHz 8kHz	0 = Auto 1 = 4kHz 2 = 8kHz
A6	166	03,06	0285	Skipfrequency Center	fmin-fmax	Minimum frequency … Maximum frequency
A7	167	03,06	0286	Skipfrequency Range	0…5.0 Hz	0…50
A8	168	03,06	0290	Current Limit Enable		0=OFF 1=ON
A9	169	03,06	0291	Current limit	10,0-100,0%	100…1000

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
AB	171	03,06	0310	Window	0 – 100%	0 – 100
AC	172	03,06	0315	Hysteresis	0 – 100%	0 – 100
AD	173	03,06	0320	Regulation Mode	Normal inverse	0 = normal 1 = inverse
AE	174	03,06	0325	Frequency Lift	0-70.0 Hz	0-700
AF	175	03,06	0330	Lift Amount	0.0-200.0 %	0-2000
B4	180	03,06	0405	Dimension Unit	bar psi m³/h g/min m/H2O ft °C °F l/sec l/min m/sec … %	0 = bar 1 = psi 2 = m³/h 3 = g/min 4 = m/H2O 5 = ft 6 = °C 7 = °F 8 = l/sec 9 = l/min 10 = m/sec 11 = … 12 = %

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
B5	181	03,06	0410	Config. Sensor	Sensor 1 Sensor 2 Auto Switch Dig1 Switch Dig2 Switch Dig3 Switch Dig4 Auto Lower Auto Higher Sens.1 – Sens.2	0 = Sensor 1 1 = Sensor 2 2 = Auto 3 = Switch Dig1 4 = Switch Dig2 5 = Switch Dig3 6 = Switch Dig4 7 = Auto Lower 8 = Auto Higher 9 = Sens.1 – Sens.2
B6	182	03,06	0415	Sensor Type	analog U 0-10V analog I 0-20mA analog I 4-20mA	0 = analog U 0-10V 1 = analog I 0-20mA 2 = analog I 4-20mA
B7	183	03,06	0420	Sensor Range		0-10000
B8	184	03,06	0425	Sensor Curve	Linear Quadratic	0 = Linear 1 = Quadratic
B9	185	03,06	0430	Sensor 1 Cal. 0	-10% .. +10%	-10..10
BA	186	03,06	0435	Sensor 1 Cal. X	-10% .. +10%	-10..10
BB	187	03,06	0440	Sensor 2 Cal. 0	-10% .. +10%	-10..10
BC	188	03,06	0445	Sensor 2 Cal. X	-10% .. +10%	-10..10
BD	189	03		Decimal Point		0 – 2 See NOTE H5 (Page 26)

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
BE	190	03,06	0505	Actual Value Increase	0-Sensor Range	0 - 10000
BF	191	03,06	0510	Actual Value Decrease	0-Sensor Range	0 - 10000
C0	192	03,06	0515	Enable Frequency	0.0-70.0 Hz	0-700
C1	193	03,06	0520	Enable Delay	0-100 sec	0-100
C2	194	03,06	0525	Switch Delay	0-100 sec	0-100
C3	195	03,06	0530	Disable Frequency	0.0- 70.0Hz	0-700
C4	196	03,06	0535	Disable Delay	0-100 sec	0-100
C5	197	03,06	0540	Drop Frequency	0.0- 70.0Hz	0-700
C6	198	03,06	0545	Overvalue	OFF-Sens. Range	0-1000
C7	199	03,06	0550	Overvalue Delay	0.0- 10.0sec	0-100
C8	200	03,06	0555	Switch Interval	0-250 h	0-250
C9	201	03,06	0560	Synchron Limit	0.0-max. Freq.	0-700
CA	202	03,06	0565	Synchron Window	0.0-10.0%	0-100
CB	203	03,06	0570	Master Priority	OFF ON	0 = OFF 1 = ON
D2	210	03,06	0605	Minimum Threshold Limit	0-Sensor Range	0 - 10000
D3	211	03,06	0610	Delay Time	0-100 sec	0-100
D4	212	03,06	0615	Error Reset	OFF ON	0 = OFF 1 = ON
DC	220	03,06	0705	Analog out 1	Actual Value Output Frequency	0 = Actual Value 1 = Output Frequency
DD	221	03,06	0710	Analog out 2	Actual Value Output Frequency	0 = Actual Value 1 = Output Frequency

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
DE	222	03,06	0715	Config. Relay 1	Power Running Errors Warnings Standby Errorresets Errors of Basic Warnings+Basics	0 = Power 1 = Running 2 = Errors 3 = Warnings 4 = Standby 5 = Errorresets 6 = Errors of basic 7 = Inverter warning and errors of basic
DF	223	03,06	0720	Config. Relay 2	Power Running Errors Warnings Standby Errorresets Errors of Basic Warnings+Basics	0 = Power 1 = Running 2 = Errors 3 = Warnings 4 = Standby 5 = Errorresets 6 = Errors of basic 7 = Inverter warning and errors of basic
E6	230	03,06	0805	Config. Required Value 1	Digital analog U 0-10V analog I 0-20mA analog I 4-20mA	0 = digital 1 = analog U 0-10V 2 = analog I 0-20mA 3 = analog I 4-20mA
E7	231	03,06	0810	Config. Required Value 2	OFF digital analog U 0-10V analog I 0-20mA analog I 4-20mA	0 = OFF 1 = digital 2 = analog U 0-10V 3 = analog I 0-20mA 4 = analog I 4-20mA

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
E8	232	03,06	0815	Switch Required Value	Setpoint 1 Setpoint 2 Switch Dig1 Switch Dig2 Switch Dig3 Switch Dig4	0 = Setpoint 1 1 = Setpoint 2 2 = Switch Dig1 3 = Switch Dig2 4 = Switch Dig3 5 = Switch Dig4
E9	233	03,06	0820	Required Value 1	0-Sensor Range	0 - 10000
EA	234	03,06	0825	Required Value 2	0-Sensor Range	0 - 10000
EB	235	03,06	0830	Actuator Frequency 1		Min Frequency - Max. Frequency
EC	236	03,06	0835	Actuator Frequency 2		Min Frequency - Max. Frequency
FA	250	03,06	1005	Test Run	0-100 h.	0-100; 0 = disabled
FB	251	03,06	1010	Testrun Frequency	30.0-Fmax	300-Maximum frequency
FC	252	03,06	1015	Testrun Boost	0-25 %	0-25
FD	253	03,06	1020	Testrun Time	0-180 sec.	0-180
FE	254	03,06	1025	Select Device		1-8
104	260	06	1125	Clear Errors	ALL 1 2 3 4 5 6 7 8	0 = Clear Errors of all HV 1 = Clear Errors of HV#1 2 = Clear Errors of HV#2 3 = Clear Errors of HV#3 4 = Clear Errors of HV#4 5 = Clear Errors of HV#5 6 = Clear Errors of HV#6 7 = Clear Errors of HV#7 8 = Clear Errors of HV#8

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
105	261	06	1130	Clear Motorhours	ALL 1 2 3 4 5 6 7 8	0 = Reset Motor hours of all HV 1 = Reset Motor of HV#1 2 = Reset Motor of HV#2 3 = Reset Motor of HV#3 4 = Reset Motor of HV#4 5 = Reset Motor of HV#5 6 = Reset Motor of HV#6 7 = Reset Motor of HV#7 8 = Reset Motor of HV#8
10E	270	03,06	1205	Address	1-247	1-247
10F	271	03,06	1210	Baudrate	1200 2400 4800 9600 14400 19200 38400	1 = 1200 2 = 2400 3 = 4800 4 = 9600 5 = 14400 6 = 19200 7 = 38400
110	272	03,06	1215	Format	RTU N81 RTU N82 RTU E81 RTU O81 ASCII N72 ASCII E71 ASCII O71	0 = RTU N81 1 = RTU N82 2 = RTU E81 3 = RTU O81 4 = ASCII N72 5 = ASCII E71 6 = ASCII O71
111	273	03,06	1220	Pump Address	1-8	1-8

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
12B	299	03		Version type		22 = V…Standard Software Type (only for indicating OEM software versions)
12D	301	03		Software		11 = Controlcard Software Version V01.1 12 = Controlcard Software Version V01.2 13 = Controlcard Software Version V01.3 14 = Controlcard Software Version V01.4
12E	302	03		Errors		See NOTE H3 (Page 24)
12F	303	03		Status Device		See NOTE H2 (Page 23)
132	306	03,06	203	Select Specification	sel.xx	0 = Basic SW Version 00 (HV2.015-HV4.110) 1 = Basic SW Version 01 (HV2.015-HV4.040) 2 = Basic SW Version 02 (HV4.055-HV4.220)
133	307	03	203	Specification In Use	act.xx	Indicates the actual used Basic software (see parameter "Select Specification")
140	320	03,06	0905	Offset Input	OFF analog U1 0-10V analog U2 0-10V analog I1 0-20mA analog I1 4-20mA analog I2 0-20mA analog I2 4-20mA	0 = OFF 1 = analog U1 0-10V 2 = analog U2 0-10V 3 = analog I1 0-20mA 4 = analog I1 4-20mA 5 = analog I2 0-20mA 6 = analog I2 4-20mA
141	321	03,06	0907	Offset Range		0 - 10000
142	322	03,06	0910	Offset Level 1		0 - 10000
143	323	03,06	0912	Offset X1		0 – Offset Range
144	324	03,06	0913	Offset Y1		0 – Sensor Range
145	325	03,06	0915	Offset Level 2		Offset Level 1 - Offset Range
146	326	03,06	0917	Offset X2		Offset Level 2 - Offset Range
147	327	03,06	0918	Offset Y2		0 – Sensor Range

Modbus Index (HEX)	Modbus Index (DEC)	Function	Menu - Index	Description	Display Indication	Modbus Value Ranges
1A4	420	03		Frequency Basic address 1	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1A5	421	03		Frequency Basic address 2	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1A6	422	30		Frequency Basic address 3	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1A7	423	03		Frequency Basic address 4	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1A8	424	03		Frequency Basic address 5	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1A9	425	03		Frequency Basic address 6	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1AA	426	03		Frequency Basic address 7	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1AB	427	03		Frequency Basic address 8	0 – 70.0 Hz	0 – 700 (in 1/10 Hz steps)
1C2	450	03		Extended device status		See NOTE H4 (Page 25)
1C3	451	03		Extended device status address 1		
1C4	452	03		Extended device status address 2		
1C5	453	03		Extended device status address 3		
1C6	454	03		Extended device status address 4		
1C7	455	03		Extended device status address 5		
1C8	456	03		Extended device status address 6		
1C9	457	03		Extended device status address 7		
1CA	458	03		Extended device status address 8		

5 Description of Individual Parameters of the HYDROVAR

5.1 Note H1: Status Units (INDEX = 90 DEZ / 5A HEX)

Using this index you will get a quick overview beyond the status of the connected units.
The Indication depends also on the selected Mode.

This information is just available for the function 03 Read Holding Registers!
(It isn't possible to write information to this index!)

- In **Cascade Serial** mode the status of all (max. 8) connected units is shown (whereas 1=activated / 0=deactivated)
- In **Cascade Relay** mode (Master is fitted with additional relay card) the status of the 5 Relay-switching contacts is shown.

Cascade Serial			
BIT0	Unit 8	1: Unit is running	0: Unit is stopped
BIT1	Unit 7	1: Unit is running	0: Unit is stopped
BIT2	Unit 6	1: Unit is running	0: Unit is stopped
BIT3	Unit 5	1: Unit is running	0: Unit is stopped
BIT4	Unit 4	1: Unit is running	0: Unit is stopped
BIT5	Unit 3	1: Unit is running	0: Unit is stopped
BIT6	Unit 2	1: Unit is running	0: Unit is stopped
BIT7	Unit 1	1: Unit is running	0: Unit is stopped

Cascade Relay			
BIT0	Relay Contact 5	1: Relay Contact closed	0: Relay Contact opened
BIT1	Relay Contact 4	1: Relay Contact closed	0: Relay Contact opened
BIT2	Relay Contact 3	1: Relay Contact closed	0: Relay Contact opened
BIT3	Relay Contact 2	1: Relay Contact closed	0: Relay Contact opened
BIT4	Relay Contact 1	1: Relay Contact closed	0: Relay Contact opened
BIT5	-	Not used!	
BIT6	-	Not used!	
BIT7	-	Not used!	

As response you will receive the current Status as Binary Decoded value.
e.g.: Cascade Relay Mode – Unit 1 and 3 are running

RESPONSE:

	HEX		
Preset Data High	00		
Preset Data Low	A0	=> BIN = 00010100	=> Unit 1 and 3 are running

5.2 Note H2: Status Device (INDEX = 303 DEZ / 12F HEX)

Status of "THIS" Control Card
Show the individual Status of the addressed Control card.

This information is just available for the Function 03 Read Holding Registers!
(It isn't possible to write information to this index!)

DAT-L	
BIT1	Reserved (for internal use)
BIT2	1: External ON/OFF (Release Terminal) = ON 0: External ON/OFF (Release Terminal) = OFF
BIT3	1: Key-Enable from Menu = ON 0: Key-Enable from Menu = OFF
BIT4	1: Control Card is in ERROR
BIT5	1: Control Card is in Warning
BIT6	Reserved (for internal use)
BIT7	Reserved (for internal use)
BIT8	Reserved (for internal use)

As response you will receive the current Status as Binary Decoded value.
e.g.: HYDROVAR is stopped because the external release (X3/7-8) is open.

RESPONSE:

	HEX	
Preset Data High	00	
Preset Data Low	04	=> BIN = 00000100 => External Release = OFF

5.3 Note H3: Errors (INDEX = 302 DEZ / 12E HEX)

All errors which could occur on the HYDROVAR could be indicated via the below binary decoded Index!

This information is just available for the Function 03 Read Holding Registers!
(It isn't possible to write information to this index!)

DAT-L		
BIT0	OVERCURRENT	ERROR 11
BIT1	OVERLOAD	ERROR 12
BIT2	OVERVOLTAGE	ERROR 13
BIT3	PHASELOSS	ERROR 16
BIT4	INVERTER OVERHEAT	ERROR 14
BIT5	THERMO MOT/EXT	ERROR 15
BIT6	LACK OF WATER	ERROR 21
BIT7	MINIMUM THRESHOLD	ERROR 22

DAT-H		
BIT8	ACT. VAL. SENSOR 1	ERROR 23
BIT9	ACT. VAL. SENSOR 2	ERROR 24
BIT10	SETPOINT 1 I<4mA	ERROR 25
BIT11	SETPOINT 2 I<4mA	ERROR 26
BIT12	Reserved	
BIT13	Reserved	
BIT14	Reserved	
BIT15	INTERNAL ERRORS	

As response you will receive the current Failure message as Binary Decoded value.
e.g.: HYDROVAR has stopped because of a LACK OF WATER error.

RESPONSE:

	HEX		
Preset Data High	00		
Preset Data Low	40	=>	BIN (DAT-L) = 0100 0000 => LACK OF WATER Error

For detailed Information regarding the Failure messages and how to reset, please look at the HYDROVAR operating instruction!

5.4 Note H4: Extended device status (INDEX = 450..458 DEZ / 1C2..1CA HEX)

Using this index you will get detailed information of the addressed unit. The Indication depends also on the selected Mode.

This information is just available for the Function 03 Read Holding Registers!
(It isn't possible to write information to this index!)

DAT-L		
BIT0	Preset	Device is preset
BIT1	Ready	Device is ready for regulation (but maybe stopped)
BIT2	Error	Device has an error
BIT3	Warning	Device has a warning
BIT4	External ON/OFF	External ON/OFF terminal enabled/disabled
BIT5	Key enabled	Device is enabled with start button
BIT6	Motor runs	Motor is running
BIT7	Reserved	

DAT-H		
BIT8	Pump sequence	Group sequence number of the pump (0 if pump is not in group)
BIT9		
BIT10		
BIT11		
BIT12	Control card	Control card present
BIT13	Master	Device is master
BIT14	Solo Run	Solorun ON/OFF
BIT15	Basic START/STOP	Basic START/STOP

As response you will receive the current extended status information as Binary Decoded value (see above table)

5.5 Note H5: Decimal Point (INDEX = 189 DEC / BD HEX)

This parameter gives information about the position of the decimal point for all values which are depending on the value of the parameter "Sensor Range". These parameters are:

- Actual Value
- Eff. Required Value
- Actual Value Increase
- Actual Value Decrease
- Overvalue
- Minimum threshold Limit
- Required Value 1
- Required Value 2

This information is just available for the function 03 Read Holding Registers!
(It is not possible to write information to this index!)

To get the correct physical values of the above parameters the corresponding parameter and the Decimal Point must be read from the HV. After placing the decimal point in the raw value of the corresponding parameter the correct physical value will be received.
The place of decimal point only changes if the sensor range is changed.

Example: (Actual pressure = 3,5 bar, Sensor range = 10,00bar)
Actual Pressure read from Modbus: 350
Position of decimal point read from Modbus: 2

The parameter "Pressure Decimal Point" represents the position of the decimal point from right.
==> The actual pressure is 3,50bar

6 Examples

A few examples are given to demonstrate the use of the Modbus – Protocol in combination with the HYDROVAR.

6.1 Start of all connected Pumps (using Broadcast Function)

Typical application: e.g. 4 Master Inverters
The following line is also shown in the Index List:

Modbus INDEX HEX	Modbus INDEX DEC.	Function	DESCRIPTION	RANGE
32	50	06	Start / Stop of the Inverter	0 = STOP 1= ON

"32" is the Hexadezimal index value for the parameter "Start/Stop of the Inverter".
The possible settings for this parameter are: 0 … will stop the pump
1 … will start the pump

The accompanying protocol looks like this:

QUERY

	HEX	
Slave Adress	00	00 … Starts Broadcast Function
Function	06	Present Single Register (Write Funcition)
Register Address High	00	
Register Address Low	31	Modbus Index 32 (HEX) – Start / Stop of the Inverter **(1)**
Preset Data High	00	
Preset Data Low	01	=> Will start all pumps connected in the group
Error Check CRC-High	18	
Error Check CRC-Low	14	

Note (1): The Modbus Registers are addressed starting at zero!
E.g. Address 32 has to be addressed as 31

RESPONSE

When using the broadcast function you will not receive a response to the sent query!

Set Minimum Frequency on a Basic Inverter to 25Hz

Typical application: e.g. 1 Master Inverter (ADR. 1) and up to 7 basic Inverters (ADR. 2-8)

The Basic Inverter with Address 3 has to be addressed. (Address Master Inverter = 1)
Therefore you have to chose with Parameter INVERTER (INDEX = 151 DEZ / 97 HEX) the Inverter with Address 3.

The following line is also shown in the Index List:

Modbus INDEX HEX	Modbus INDEX DEC.	Function	DESCRIPTION	RANGE
97	151	03,06	Inverter	0 = ALL; 1 - 8

The relevant protocols look like this:

QUERY

	HEX	
Slave Address	01	Addressing the Master Inverter
Function	06	Present Single Register (Write Funcition)
Register Address High	00	
Register Address Low	96	Modbus Index 97 (HEX) – Selection of the Inverter **(1)**
Preset Data High	00	
Preset Data Low	03	
Error Check CRC-High	29	
Error Check CRC-Low	E7	

Note (1): The Modbus Registers are addressed starting at zero!
E.g. Address 97 has to be addressed as 96

RESPONSE

	HEX	
Slave Adress:	01	
Function	06	
Register Address High	00	
Register Address Low	96	=> Set Parameter INVERTER [0210]
Preset Data High	00	
Preset Data Low	03	=> You have chosen to set the following parameters on Unit 3
Error Check CRC-High	29	
Error Check CRC-Low	E7	

As second step you have to set Parameter Min. Frequency (INDEX = 159 DEZ / 9F HEX) to 25Hz.

The following line is also shown in the Index List:

Modbus INDEX HEX	Modbus INDEX DEC.	Function	DESCRIPTION	RANGE
9F	159	03,06	Min. Frequency	0 - 300

The relevant protocols look like this:

QUERY

	HEX	
Slave Address	01	Addressing the Master Inverter
Function	06	Present Single Register (Write Funcition)
Register Address High	00	
Register Address Low	9E	Modbus Index 9F (HEX) – Min. Frequency **(1)**
Preset Data High	00	
Preset Data Low	FA	=> FA HEX = 250 DEZ => Sets Min. Freq. to 25.0Hz
Error Check CRC-High	68	
Error Check CRC-Low	67	

RESPONSE

	HEX	
Slave Address:	01	
Function	06	
Register Address High	00	
Register Address Low	9E	=> Set Parameter MIN. FREQ. [0250]
Preset Data High	00	
Preset Data Low	FA	=> You set Min. Freq. to 25.0Hz on the Basic Inverter (Addr. 3)
Error Check CRC-High	68	
Error Check CRC-Low	67	

6.2 Request Actual Frequency

Typical application: e.g. Single Pump Application (Master Inverter - ADR. 1)

The following line is also shown in the Index List:

Modbus INDEX HEX	Modbus INDEX DEC.	Function	DESCRIPTION	RANGE
35	52	03	Actual Frequency	0 - 700

QUERY

	HEX	
Slave Address	01	Addressing the Master Inverter
Function	03	Read Holding Register (READ Function)
Starting Address High	00	
Starting Address Low	32	Modbus Index 33 (HEX) – Actual Frequency **(1)**
No. of Points High	00	To read more than one holding register is not supported by the
No. of Points Low	01	HYDROVAR.
Error Check CRC-High	74	
Error Check CRC-Low	05	

Note (1): The Modbus Registers are addressed starting at zero!
E.g. Address 33 has to be addressed as 32

RESPONSE

	HEX	
Slave Address:	01	
Function	03	
Byte Count	02	
Data High	01	
Data Low	F4	=> 1F4 HEX = 500 DEZ => Actual Freq. of the Inverter = 50.0 Hz
Error Check CRC-High	B8	
Error Check CRC-Low	53	

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7 Notes:

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