APPLICATION NOTE

OJ DRHX Modbus protocol

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OJ DRHX
A DRIVES PROGRAMME DEDICATED TO ROTARY HEAT EXCHANGERS

OJ ELECTRONICS

Introduction

This protocol contains the Modbus addresses and registers which are available in the OJ DRHX. Modbus can access single addresses or several addresses simultaneously, either reading or writing 1-bit or 16-bit values. A Modbus address contains either a 1-bit value or a 16-bit integer

This protocol applies to the following product variants:

- **OJ-DRHX-1055-MNN5**
- **OJ-DRHX-1055-MAD5**
- **OJ-DRHX-1220-MNN5**
- **OJ-DRHX-1220-MAD5**
- **OJ-DRHX-1690-MAN5**
- **OJ-DRHX-1790-MAN5**

Modbus connection

OJ DRHX is provided with connections for Modbus communication.

The product variants:

- **OJ-DRHX-1055-MNN5**
- **OJ-DRHX-1055-MAD5**
- **OJ-DRHX-1220-MNN5**
- **OJ-DRHX-1220-MAD5**

- Do have 2 pcs. EIA-485 RJ12-plug connectors marked ”A” & ”B” (see fig. 1)

AND

- 1 set of spring terminals marked ”A” & ”B” + “GND” (see fig. 2)
- All “MNN5”-variants only support terminal 3, 4 & 5

The Modbus terminals (terminal no. 3/**Bus A** & terminal no. 4/**Bus B**) on the strip of spring terminals are internally connected in parallel to the Modbus pins in the RJ12 connectors marked ”A” and ”B” (pin no. 3/**Bus A** & pin no. 4/**Bus B**).

Product variants:

- **OJ-DRHX-1690-MAN5**
- **OJ-DRHX-1790-MAN5**

- Do have 1 pcs. of RJ12-plug marked with ”B” (see fig. 4)

Note

RJ 12 Plug connector marked with “A” supplies 24V to some pins, only use compatible products.
RJ 12 Plug connector marked with ”C” cannot not be used.

AND

- 1 set of spring terminals (see fig. 4)

The Modbus terminals (terminal **A** & terminal **B**) on the strip of spring terminals are internally connected in parallel to the Modbus pins in the RJ12 connectors marked ”A” and ”B” (pin no. 3/**Bus A** & pin no. 4/**Bus B**).

Figure 1

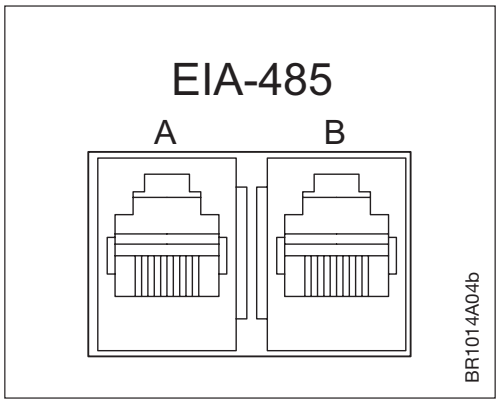


Figure 2

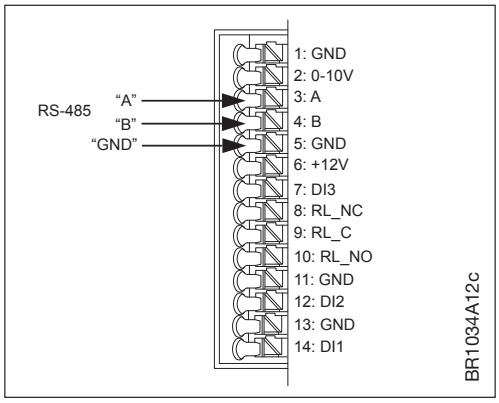


Figure 3

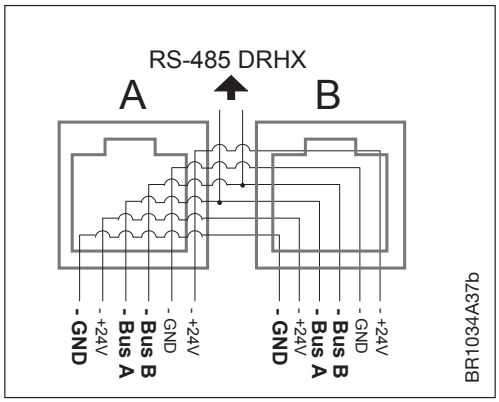
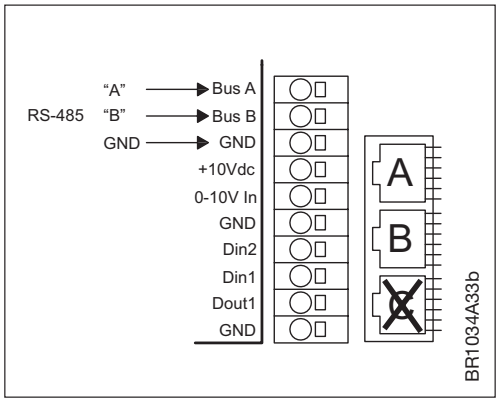


Figure 4



Modbus cable

Types of Modbus cables which can be used:

- Round communications cable (like twisted pair cables) can be used and connected in the spring terminals marked ”A” & ”B” + “GND”.
- Flat cable/tele cable, 6-wire, not shielded, 30 AWG, 0,066 mm^2 or equal types of flat cable.

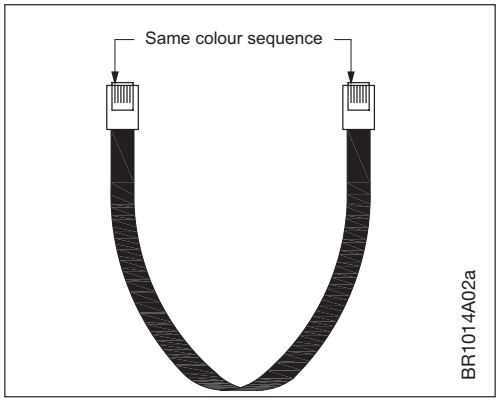
Note

If flat cable/tele cable is used, RJ12 connectors must be attached to both ends of the cable, using a special crimp tool.

Note

IMPORTANT! If flat cable/tele cable is used, the RJ12 connectors in both ends must be attached in such a way that the two connectors follow the same sequence of wire colours. (See fig. 5)

Figure 5



Modbus register types:

Modbus Type	Description	Reference
Coil Status (R/W)	Discrete Output	0x
Input Status (R)	Discrete Input	1x
Input Register (R)	16-bit Input Register	3x
Holding Register (R/W)	16-bit Output Register	4x

R=Read only
R/W = Read / Write

Supported Modbus commands

Function code	Description
1	Read Coil Status
2	Read Input Status
3	Read Holding Registers
4	Read Input Registers
5	Force Single Coil
6	Preset Single Registers
8	Diagnostics. Sub-function 00 Only - Return Query Data (loop back).
15	Force Multiple Coils
16	Preset Multiple Registers

Modbus address

From factory the Modbus ID is pre-set to: 79
Modbus ID can be changed using a Modbus tool (e.g. Modbus Poll) or the OJ-DRHX-PC-Tool (Service level 1). OJ-DRHX-PC-Tool (User level 0) can be downloaded from www.ojelectronics.com
Contact OJ, if a higher level is required. If you are not a direct customer of OJ Electronics, please contact your supplier.

Communication parameters

Communication parameters (see table 1) can be change using a Modbus tool or the OJ-DRHX-PC-Tool.

Table 1				
	Range	**Unit**	**Default setting**	**Alternative setting**
Address	1-247	n/a	79	3
Baud rate	9.600, 19.200, 38.400, 57.600, 115.200	bps	38.400	115.200
Parity	None, even, odd	n/a	None	Even
Stop bit(s)	0, 1, 2	n/a	1	2

n/a=not applicable

Modbus register list

Coil Stat Bits – Available Coil Stat Bits: According to the table below (see table 2)

Standard-MODBUS (RTU)

Coil Stat Bits: 11 (R/W)
0x01: Read
0x05: Write Single Coil (NOTE: ON => output value = 0xFF00)
0x0F: Write Multiple Coils

Table 2					
Register	**Address**	**Function**	**Range**	**Active state**	**Factory**
0x0001	0	Motor ON/OFF	0 - 1	1 = ON	0
0x0002	1	Reset Alarms	0 - 1	1 = Reset	0
0x0004	3	Rotation direction	0 - 1	1 = CounterClockWise	0
0x0008	7	Control mode[1]	0 - 1	0 = Modbus, 1 = 0-10V	1
0x0009	8	Use alternative comm. settings	0 - 1	1 = Alternative	0
0x0010	9	Autodetect communication [3]	0 - 1	1 = Enable	1
0x0011	10	Analog start signal [1]	0 - 1	1 = Enable	1
0x0012	11	Autodetect control mode [1]	0 - 1	1 = Enable	1
0x0013	12	Disable internal rotor guard	0 - 1	1 = Disabled	0
0x0014	13	Enable external rotor guard [1]	0 - 1	1 = Enabled	0
0x0015	14	High speed resolution	0 - 1	0 = Resolution = 0.1 RPM 1 = Resolution = 0.01 RPM	1
0x0016	15	Use K-factor in AOC	0 - 1	1 = K-Factor used by AOC	1
0x0017	16	Enable autostoring UDF	0 - 1	1 = UDF stored automatically	1
0x0018	17	Show flashing alarm on LED [2]	0 - 1	1 = Show alarms by flashing	
0x0019	18	BACnet Enable	0 - 1	1 = Enabled	
0x0020	19	Autodetect BACnet	0 - 1	1 = Enabled	

[1]: Not supported on “Modbus only” variant (DRHX-1xxx-xNNx)
[2]: Only supported on DRHX-1690-MAN5 & DRHX-1790-MAN5

Note

[3]: Factory setting (0x0010: Autodetect communication) is “1”=Enabled.

This means that even if the communication parameters of the DRHX have changed to the alternative settings (4x0014 – 4x0017), it will always be possible to communicate on the default communication settings (Modbus ID 79, baudrate 38.400, no parity, 1 stop bit).

If Autodetect communication is “0”=Disabled and the communication parameters of the DRHX have changed to the alternative settings, it will only be possible to communicate on these alternative settings.
Input Stat Bits – Available Input Stat Bits: According to the table below (see table 3)
Input Stat Bits: 23 (R)
0x02: Read

Table 3

Register	Address	Function	Range	Active state
1x0001	0	Rotorguard Alarm	0 - 1	1 = Alarm
1x0002	1	V LO Alarm	0 - 1	1 = Alarm
1x0003	2	V HI Alarm	0 - 1	1 = Alarm
1x0004	3	I HI Alarm (Motor out short)	0 - 1	1 = Alarm
1x0005	4	Temperature High	0 - 1	1 = Warning
1x0009	8	Rotorguard Signal	0 - 1	1 = Pulse
1x0010	9	Overload / I_Limit	0 - 1	1 = Warning
1x0011	10	Internal Stop	0 - 1	1 = Alarm (Stop)
1x0012	11	Rotor Blocked	0 - 1	1 = Alarm
1x0013	12	EEPROM error	0 - 1	1 = Warning
1x0014	13	Communication error MOC [1]	0 - 1	1 = Alarm
1x0015	14	Motor Phase Error	0 - 1	1 = Alarm
1x0016	15	Ripple	0 - 1	1 = Warning
1x0017	16	Digital Input 1 [1]	0 - 1	1 = HI
1x0018	17	Digital Input 2 [1]	0 - 1	1 = HI
1x0019	18	Ext. 24V supply overload [2]	0 - 1	1 = Overload
1x0020	19	MOC in bootloader [1]	0 - 1	1 = Alarm
1x0021	20	Digital Input 3 [1]	0 - 1	1 = HI
1x0022	21	Digital Input 4 [2]	0 - 1	1 = HI
1x0023	22	Communication error IOM [2]	0 - 1	1 = Warning
1x0024	23	Rotation OK	0 - 1	1 = OK
1x0025	24	Test function active	0 - 1	1 = Active
1x0026	25	Purging active	0 - 1	1 = Active
1x0027	26	IO Config mismatch [1]	0 - 1	1 = Warning

[1]: Not supported on “Modbus only” variant (DRHX-1xxx-xNNx)
[2]: Only supported on DRHX-1690-MAN5 and DRHX-1790-MAN5

Input Registers – Available Input Registers: According to the table below (see table 4)
Input Registers: 31 (R)
0x04: Read

Table 4					
Register	**Address**	**Function**	**Range**	**Resolution**	**Unit**
3x0001	0	DRHX Type	1 – 14 [6]	1	-
3x0002	1	MOC SW version	0 - ?	0.01	-
3x0003	2	PrcOut	0 – 10000	0.01	%
3x0004	3	Intern Temp	0 - 12000	0.01	ºC
3x0005	4	Motor Speed Out	0 - 40000	0.1 OR 0.01 [5]	RPM
3x0006	5	V In	0 - 300	1	V
3x0007	6	I Out (RMS)	0 - 10000	1	mA
3x0008	7	Power In	0 - 1000	1	W
3x0009	8	ExternSet [2]	0 - 10000	1	mV
3x0010	9	Operation Day	0 - 9999	1	Day
3x0011	10	Operation Minutes	0 - 1439	1	Min.
3x0012	11	I Ripple	0 - 10000	1	mA
3x0013	12	V Ripple	0 - 100	1	V
3x0014	13	Config file variant	AA - ZZ	2 ASCII characters	
3x0015	14	Config file version	100 - 32000	0.01	-
3x0016	15	AOC SW version [1]	0 - ?	0.01	-
3x0017	16	Rotor Speed Out	0 - 40000	0.1 OR 0.01 [5]	RPM
3x0018	17	Torque	0 - 1500	0.01	Nm
3x0019	18	SW variant [3]	-	-	-
3x0020	19	AOC Boot SW [1]	0 - ?	0.01	-
3x0021	20	MOC Boot SW	0 - ?	0.01	-
3x0022	21	Motor Cfg. Var.	0 - 65535	1	-
3x0023	22	Motor Cfg. Ver.	0 - 65535	0.01	-
3x0024	23	Rotor Cfg. Var.	0 - 65535	1	-
3x0025	24	Rotor Cfg. Ver.	0 - 65535	0.01	-
3x0026	25	User Data Var.	0 - 65535	1	-
3x0027	26	User Data Ver.	0 - 65535	0.01	-
3x0028	27	IOM SW version [4]	0 - ?	0.01	-
3x0029	28	V DC Bus (Peak)	0 – 400	1	V
3x0030	29	V Motor (Peak)	0 – 400	1	V
3x0031	30	ExternSet2 (IOM) [4]	0 - 10000	1	mV
3x0032	31	SpeedStepFails	1 – 65535	1	-
3x0033	32	BACnet SW Version	0-?	Format is. x.xx.xx	-

[1]: Version 0.00 shown in “Modbus only” variant (DRHX-1xxx-xNNx)
[2]: Not supported on “Modbus only” variant without AOC (DRHX-1xxx-xNNx)
[3]: “100” on “analog” variant (DRHX-1xxx-xADx), “200” on “Modbus only” variant (DRHX-1xxx-xNNx), “300” on DRHX-1690-MAN5 and DRHX-1790-MAN5
[4]: Only supported on DRHX-1690-MAN5 and DRHX-1790-MAN5
[5]: Depending on Coil Stat 15
[6]: 1 = 1 Nm, 2 = 2 Nm, 4 = 4 Nm, 8 = 8 Nm, 14 = 14 Nm DRHX

Holding Registers – Available Holding Registers: According to the table below (see table 5)
Holding Registers: 32 (R/W)
0x03: Read
0x06: Write Single
0x10: Write Multiple

Table 5						
Register	**Address**	**Function**	**Range**	**Resolution**	**Unit**	**Factory**
4x0001		Setpoint / PrcSet	0 - 10000	0.01	%	-
4x0002		Min. Motor Speed	100 - Max.	0.1 OR 0.01 [4]	RPM	100
4x0003		Max. Motor Speed	Min. - 40000	0.1 OR 0.01 [4]	RPM	25000
4x0004		Start I Out (Boost)	0 - Imax + 50%	1	mA (RMS)	I_{max} + 50%
4x0005		Start Time (Boost)	0 - 100	1	Sec.	10
4x0009		Prc Holding Torque	0 - 200	0.1	% of max	0
4x0010		UpRampTime	30 - 300	1	Sec.	60
4x0011	10	DownRampTime	30 - 300	1	Sec.	60
4x0012	11	SwitchMode	0	(Auto)		
			1	8	kHz	
			2	10	kHz	X
4x0013	12	DRHX Type	0 - ?	1	-	0 [3]
4x0014	13	Alternative Modbus ID	1 - 247	1	-	3
4x0015	14	Alternative BaudRate	0	9600	bps	
			1	19200	bps	
			2	38400	bps	
			3	57600	bps	
			4	115200	bps	X
4x0016	15	Alternative Parity	0	None	-	
			1	Odd	-	
			2	Even	-	X
4x0017	16	Alternative Stop Bits	0	INVALID	-	
			1	1	-	
			2	2	-	X
4x0018	17	Number of retries	-1 - 100	1	-	5
4x0019	18	Modbus Timeout	0 - 240	1	Sec.	0
4x0020	19	Pulley size (diameter)	0 - 1000	1	mm.	0
4x0021	20	Rotor size (diameter)	0 - 10000	1	mm.	0
4x0022	21	Pulses per rotation	0 - 10	1	-	1
4x0023	22	K factor	0-10000	-	-	100
4x0024	23	DigIn1 config [2]	0	Disabled	-	
			1	Start/stop	-	
			2	AlarmReset	-	X
			3	Rotation direction	-	
			4	Test function	-	
			5	Ext. rotor guard signal	-	
			6	Enable ext. rotor guard	-	
4x0025	24	DigIn2 config [2]	0	Disabled	-	
			1	Start/stop	-	
			2	AlarmReset	-	
			3	Rotation direction	-	
			4	Test function	-	
			5	Ext. rotor guard signal	-	
			6	Enable ext. rotor guard	-	X
4x0026	25	DigOut config [1]	0	Disabled	-	

Table 5						
Register	**Address**	**Function**	**Range**	**Resolution**	**Unit**	**Factory**
			1	TachoOut	-	X
			2	RunningStart	-	
			3	AlarmOut	-	
			4	RunningSpin	-	
4x0027	26	MotorConfigVar	0 - 65535	1	-	0 [3]
4x0028	27	RotorConfigVar	0 - 65535	1	-	0 [3]
4x0029	28	DigIn3 config [2]	0	Disabled	-	
			1	Start/stop	-	
			2	AlarmReset	-	
			3	Rotation direc-tion	-	
			4	Test function	-	
			5	Ext. rotor guard signal	-	X
			6	Enable ext. rotor guard	-	
4x0030	29	DigIn4 config [1]	0	Disabled	-	X
			1	Start/stop	-	
			2	AlarmReset	-	
			3	Rotation direc-tion	-	
			4	Test function	-	
			5	Ext. rotor guard signal	-	
			6	Enable ext. rotor guard	-	
4x0031	30	Relay1 config [2]	0	Disabled	-	
			1	N/A	-	
			2	RunningStart	-	
			3	AlarmOut	-	X
			4	RunningSpin	-	
4x0032	31	Relay2 config [1]	0	Disabled	-	X
			1	N/A	-	
			2	RunningStart	-	
			3	AlarmOut	-	
			4	RunningSpin	-	
4x0033	32	AnalogOut1 config [1]	0	Disabled	-	X
			1	ActSpeed	-	
4x0035	34	AnalogIn2 config [1]	0	Disabled	-	X
			1	Enable ext. rotor guard	-	
4x0036	35	Modbus Response Wait Time	0 - 200	1	ms	1
4x0038	37	Max speed step	0 - 10.000	0.01	RPM	0
4x0039	38	Purging inteval	0 - 30.000	1	Sec.	600
4x0040	39	Purging rotation	0 - 5.000	1	Rotation	10
4x0042	41	BACnet MAC	0 - 127	1	-	
4x0043	42	BACnet MaxMaster	0 - 127	1	-	
4x0044	43	BACnet DeviceObjectInstance Low	0 - 4194302	1	-	
4x0045	44	BACnet DeviceObjectInstance High				

[1]: Only supported on DRHX-1690-MAN5 and DRHX-1790-MAN5
[2]: Not supported on “Modbus only” variant (DRHX-1xxx-xNNx)
[3]: Set by DIP1 & 2 on DRHX-1xxx-xNNx and DRHX-1xxx-xADx
[4]: Depending on Coil Stat 15

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