

INSTRUCTIONS



KLINGENBURG

member of CAREL group

CAREL



Controller
Klingenburg DRHX AC

1.	Introduction	3
2.	Product	3
3.	Approvals and certifications:	3
4.	Warnings and recommendations	4
5.	Dimensions	6
6.	Installation	6
7.	External rotor guard	10
8.	Settings and functions	11
9.	Modbus	13
10.	AC Parameters	13
11.	Checklist – mechanical and electrical installation	15
12.	Troubleshooting	16
13.	Alarms and fault codes	18
14.	Disposal	19
15.	Technical specifications	19
16.	Full Modbus registry	20

1. Introduction

This instruction is an extension of the KL DRHX instruction featuring function, size and setup possibilities.

2. Product

This describes the following drive using an AC motor: KL-DRHX-1750-MAN5-AC

Table 10.1	
RS-485 Interface	Yes
Modbus	Yes
BACnet	Yes
0-10V	Yes
External Rotor Guard	Standard
Auxillary Purge Function	Yes
Deformation safeguard	Yes
Power (max.)	750 W
Supply Voltage	1 x 230V
Max Hz	120 Hz
Motor voltage	3 x 0- 230 V AC
Dimensions (w,h,d) (mm)	185.0 x 230.5 x 90.0
Enclosure ratings	IP54 when cables connected and glands tightened

3. Approvals and certifications:

CE marking

- OJ Electronics A/S hereby declares under sole responsibility that the product complies with the following European Parliament directives:
- LVD - Low voltage: 2014/35/EU
- EMC - Electromagnetic compatibility: 2014/30/EU
- RoHS - Restriction of the use of certain hazardous substances in electrical and electronic equipment: 2011/65/EU

Product standard

- In accordance with EN 61800-2 – Adjustable speed electrical motor drive, general requirements.

Safety

- In accordance with EN 61800-5-1 – Adjustable speed electrical motor drive: Safety requirements – Electrical, thermal and energy.

EMC – Electromagnetic compatibility

- In accordance with EN 61800-3 (C1 and C2) – Adjustable speed electrical motor drive. Part 3. EMC requirements and specific test methods.

RoHS compatible

- Contains no hazardous substances according to the RoHS Directive.

3.2 UKCA Marking OJ electronics Ltd hereby declares under sole responsibility that the product complies with the following UK legislations:

- LVD – The Electrical Equipment (Safety) Regulations 2016
- EMC - The Electromagnetic Compatibility Regulations 2016
- RoHS – The Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
- Machinery -The Supply of Machinery (Safety) Regulations 2008

4. Warnings and recommendations



Warning

- The KL DRHX must only be installed and commissioned by trained/qualified personnel.
- Check that the data specified on the rating plate of the AC motor and the data specified on the KL DRHX product label matches the required configuration and application.
- Incorrect electrical installation may cause a risk of severe or fatal personal injury.



Warning

4.1 Dangerous induced voltage

- If natural drafts through the air handling unit cause the rotor to rotate even when it has not received an operating signal, there is a risk that the AC motor will induce voltage on the AC motor terminals, making them dangerous to touch.



Caution

4.2 EMC-compliant installation

- There is no requirement for shielded cables to the I/O and RS-485 interface communication, just as there is no requirement for shielded motor cables, as per Electromagnetic compatibility: 2014/30/EU and standard EN 61800-3 (C1 and C2).
- Never convey mains voltage, AC motor connections and control signals in the same cable.
- The drive and AC motor must be installed within the enclosure/chassis of the air handling unit.
- The cable between the AC motor and the KL DRHX drive must be fixed to the enclosure/chassis of the air handling unit for its entire length. The cable consists of the AC motor cable, connector and extension cable.



Note

4.3 Short-circuit protection

- Correct short-circuit protection must always be used ahead of KL DRHX in accordance with local and international regulations.
- The short-circuit protection of the KL DRHX is not included with the product, but is delivered and installed by the fitter, the unit or rotor manufacturer.



Warning

4.4 Residual Current Device (TT-system)

This product can draw a direct current in the earth wire in the event of an earth fault.

Please note the following precautions:

- If using a residual current device (RCD), a type B RCD must be used on the product's supply side (B type for AC power and/or pulsating power with DC components and fixed fault current).
- Type B residual current devices must comply with all IEC 61008/9 provisions.
- Protective grounding of the KL DRHX in combination with the use of residual current devices must always be executed in accordance with relevant local and international requirements, laws and regulations.
- Non-compliance with these measures may result in serious injury to people and animals.



Warning

4.5 Potential equalisation

There is a risk of electrical interference if the ground potential between the KL DRHX and the rotor chassis or the air handling unit differ from each other. In the event of potential differences between system components, an equalisation conductor must always be fitted.

Recommended cable cross section: 10 mm².

Lugs should be used, and the equalisation conductor should be attached to the KL DRHX enclosure via one of the screws used to mechanically install the KL DRHX drive.



Warning

4.6 Leakage current risk (PE)

Follow national and local regulations for the protective earthing of devices with leakage current rated over 3.5 mA.

The KL DRHX technology produces engagement/disengagement at high frequencies. This can generate a leakage current in the earth connection, PE (PE=Protective Earth).

EN/IEC61800-5-1 (the product standard for Adjustable Speed Electrical Power Drive Systems) requires special attention, because the leakage current in the KL DRHX may exceed 3.5 mA.

See further information in EN60364-5-54 § 543.7 Reinforced protective conductors for current in protective conductor exceeding 10 mA.

The earth connection must be implemented in one of the following 3 ways:

- If only one (1) PE-conductor is connected, the min. cable cross-section must be at least 10 mm², or
- If two separate earth conductors are connected, they must both comply with the regulations for dimensioning.
- If two conductors are used, each must be connected to its own earth connection in the KL DRHX.
- External earth connection: If the rotor is approved as earth connection, KL DRHX can be earthed to the rotor.
- Use the terminals and connectors of the KL DRHX to achieve proper earthing.
- Avoid serial (daisy chain) connection of the earth connection between two or more KL DRHX units.
- Keep earth connection wires as short as possible.
- Earth connections must always be carried out in accordance with applicable local and international standards and directives.



Note

4.7 Cable requirements

- All cables and leads used in connection with the KL DRHX must comply with local and national rules and regulations.
- Generally, cable types with copper wires are recommended.
- Recommended cable dimensions for M20 connectors are 6-3 mm.
- Control wires installed in the terminal strip for control signals must comply with min./max. dimensions in accordance with table 3.7.1.
- Power leads installed in the terminal strip marked “L”, ”N” & “PE” must comply with min./ max. dimensions in accordance with table 3.7.2.
- The RS-485 interface cable that is routed through the special rubber seal can be a telecom cable, 6-wire, unshielded, 30 AWG/0.066 mm² or equivalent.
- There are no requirements concerning the use of shielded cables.

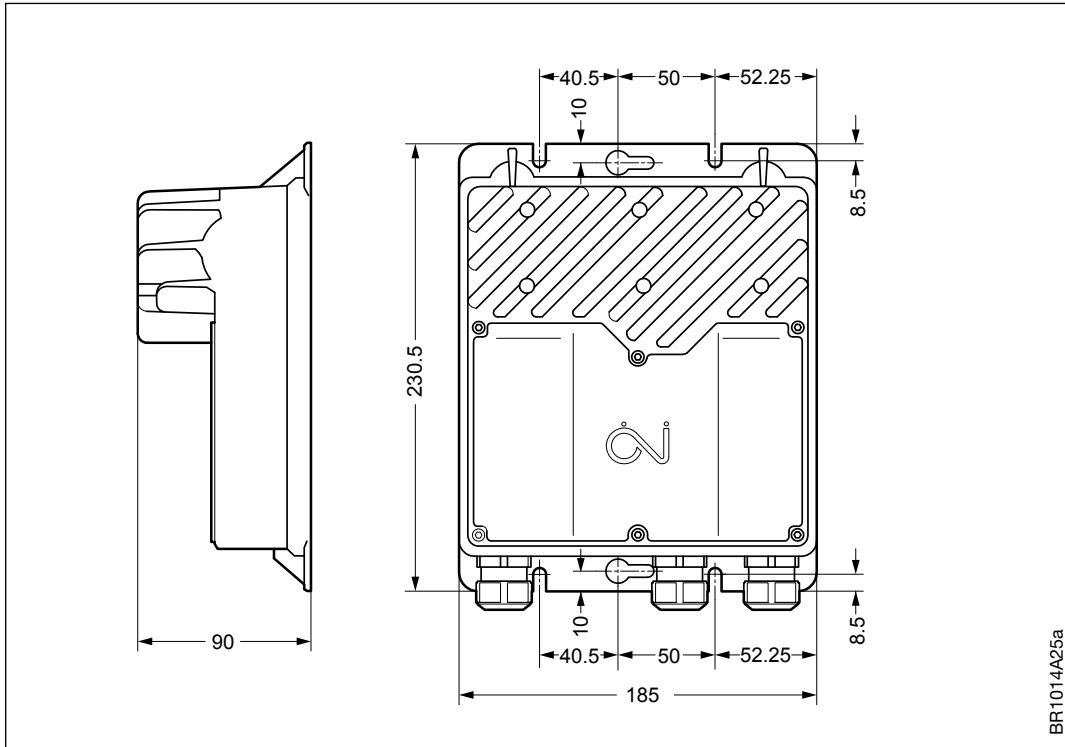
Control wires and cables			
Table 4.7.1	Conductor dimension. Min.	Conductor dimension. Max.	Cable dimension
Solid wires	0.08 mm ²	1.5 mm ²	3-8 mm
Multi-core wires*	0.14 mm ²	1.0 mm ²	3-8 mm

*With or without core sleeves/end sleeves

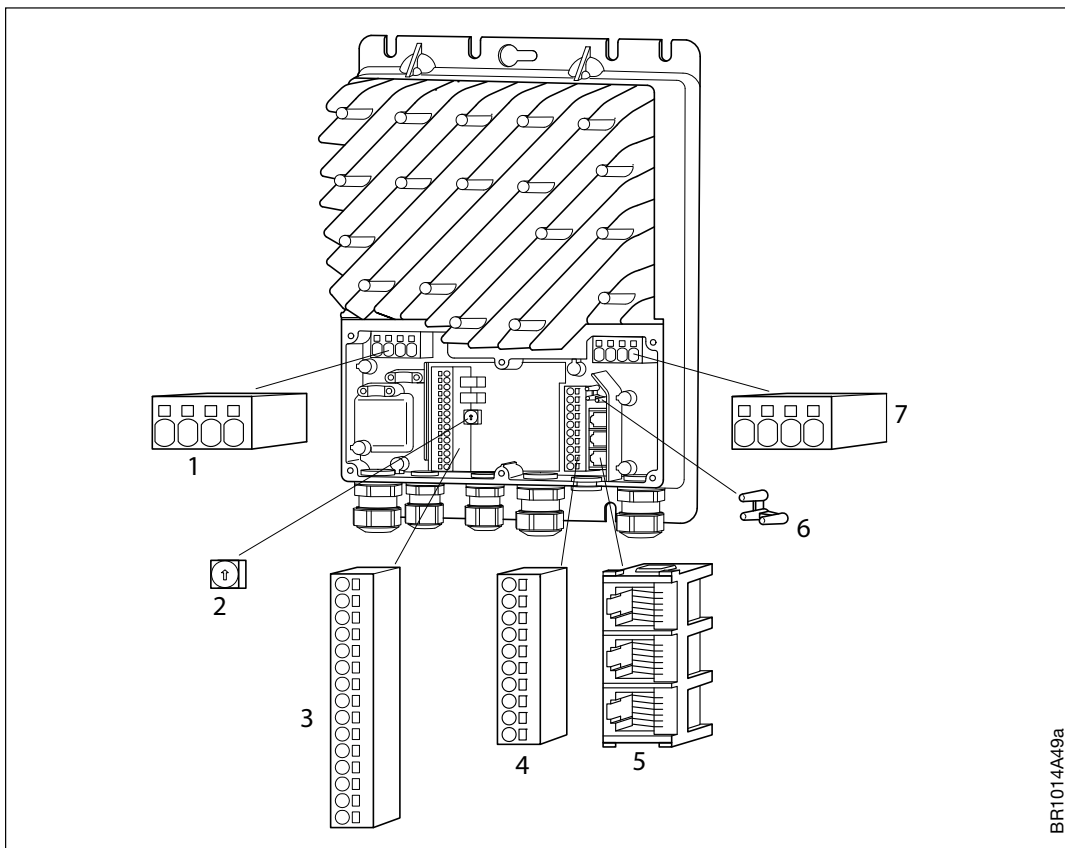
Power leads and cables			
Table 4.7.2	Conductor dimension. Min.	Conductor dimension. Max.	Cable dimension
Solid wires	0.2 mm ²	4.0 mm ²	3-8 mm
Multi-core wires*	0.2 mm ²	2.5 mm ²	3-8 mm

*With or without core sleeves/end sleeves

5. Dimensions



6. Installation



No.	Description	No.	Description
1	Motor connections (U, V, W, PE)	5	RJ12 RS-485 interface connectors
2	Rotary switch settings	6	3-point strain relief for ribbon cable
3	Terminal Strip for A/D control signals	7	Supply terminals (L, N, PE)
4	Terminal strip for Modbus and A/D control signals		

6.1 **Opening the drive**

- Check that the voltage supply to the KL DRHX has been disconnected before opening the cover.
- Wait approx. 3 minutes after disconnecting mains voltage before removing the cover.
- The KL DRHX is opened by loosening the six Torx 20 screws holding the plastic cover in place.
- Carefully remove the loosened cover.

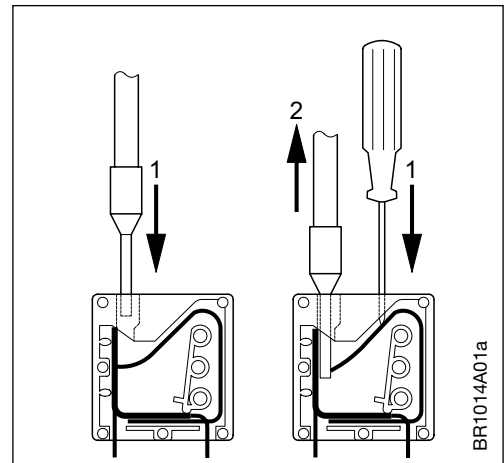
6.2 **Cable entries – cable glands – strain relief**

- The factory-fitted M20 cable glands should be used when inserting power, motor and control cables into the KL DRHX.
- Remember to re-tighten the cable glands to ensure the ingress protection level and to provide cable strain relief.

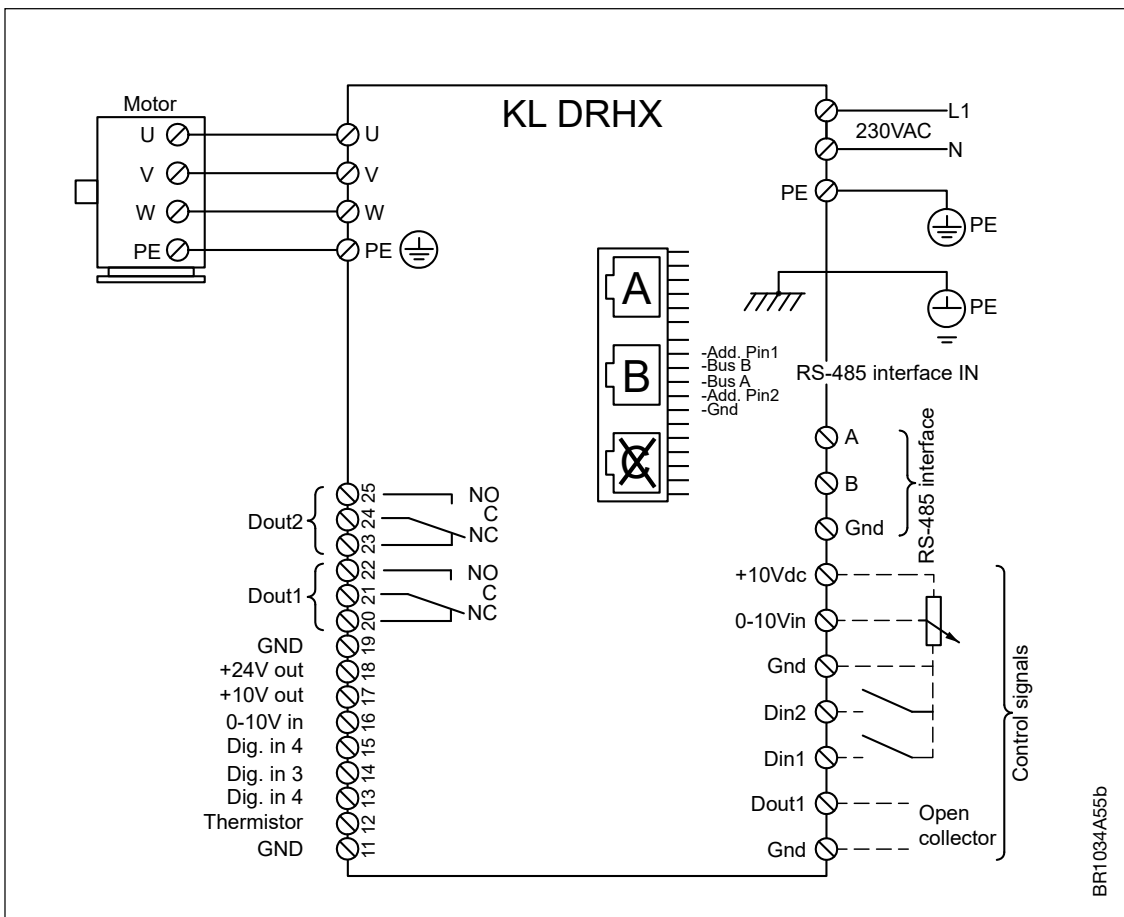
6.3 **Spring terminals**

- If multi-core cables/leads are used, core sleeves/end sleeves must always be used.
- The connection terminals are spring loaded and the stripped wire can be easily inserted into the terminal without using tools. Alternatively, the terminal spring can be loosened by pressing it lightly with a screwdriver or similar implement. See fig. 6.3.
- Solid and multi-core cables/leads can be used.
- Stripped wire ends or end sleeves must be between 8 and 15 mm.
- Wires can be removed by carefully loosening the terminal spring by pressing lightly with a screwdriver or similar implement. See fig. 6.3.

Figure 6.3



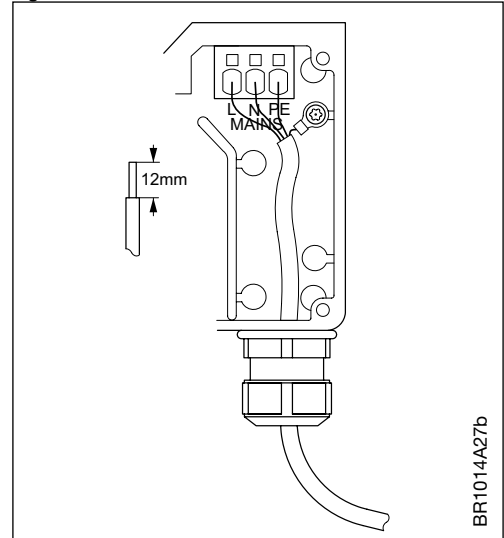
6.5 **Terminal and connector overview**



6.6 Mains voltage connection

- The supply voltage must be 230 V AC; +/-10%.
- The power cable is connected to the KL DRHX drive on the terminals marked "L", "N" and "PE". See fig. 6.6.
- It is recommended that the PE wire is 20 mm longer than the other wires in the cable (see fig. 6.6). If the cable is accidentally pulled out of the KL DRHX while there is voltage on the cable and terminals, the PE wire will then be the last to be disconnected. The KL DRHX is thus prevented from causing electric shock.
- When the stripped wire is properly inserted into the terminal, the terminal tensions automatically with the correct torque.
- Remember to re-tighten the cable glands to ensure the ingress protection level and to provide cable strain relief.

Figure 6.6



BR1014A27b

6.7 RS-485 interface

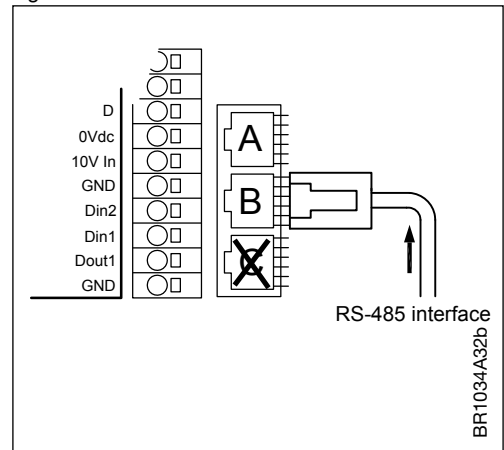
- RS-485 interface can be connected to the KL DRHX via RJ12 connectors marked "B" or via spring terminals in the terminal strip.



Warning

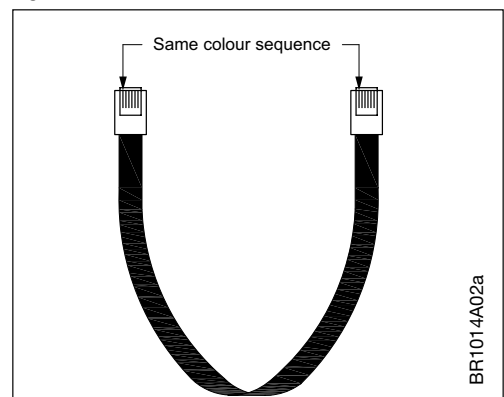
- RJ 12 Plug connector marked with "A" supplies 24V to some pins, only use compatible products.
- RJ 12 Plug connector marked with "C" cannot not be used. (see fig. 6.7.1).
- If RJ12 connectors are used, we recommend the use of telecom cable, 6-wire, unshielded, 30 AWG/0.066 mm² (flat/telecom cable).
- When installing the RJ12 connectors, note that the connectors must be aligned so that the colour sequence in the connectors is the same at both ends (see fig. 6.7.2).

Figure 6.7.1



BR1034A32b

Figure 6.7.2



BR1014A02a

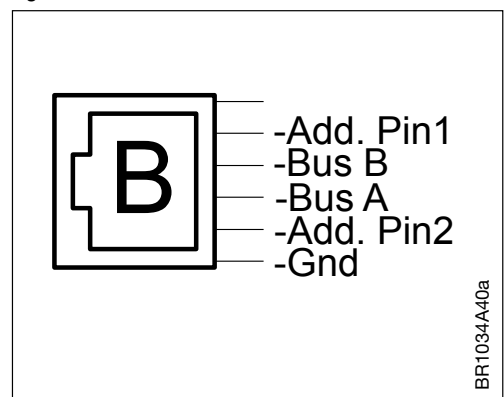
- Connection overview of RJ12 connector – (see fig. 6.7.3)



Warning

- "Add. Pin1" and "Add. Pin2" are not used and must not be connected to any active electrical signal.

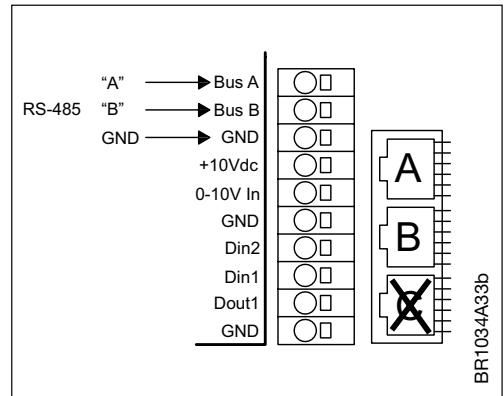
Figure 6.7.3



BR1034A40a

- RS-485 interface can also be connected via spring terminals in the terminal strip (see fig. 6.7.4)

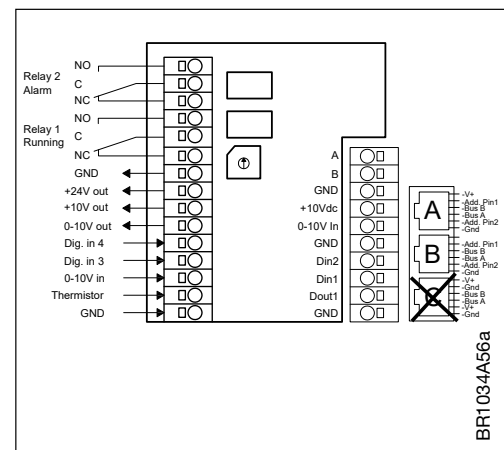
Figure 6.7.4



6.8 Analogue/digital signal connections

- Connect A/D control signals to the terminal strip, (see fig. 6.8).
- Max. wire dimension is 0.75 mm² for control terminals.
- For further information on using the spring terminals, see section 6.3.

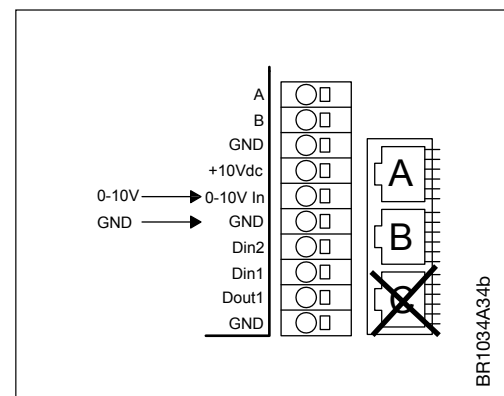
Figure 6.8



6.9 0-10 V in

- Analogue 0-10 V control input for speed control via external 0-10 V control signal – (see fig. 6.9).

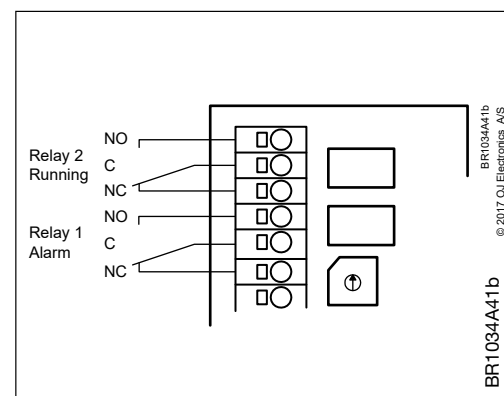
Figure 6.9



6.10 Digital relay outputs

- The KL DRHX is equipped with 2 digital relay outputs, which can e.g. be used for alarm signal (see fig. 6.10).
- The relay outputs are potential-free relays with changeover switch.
- Max. load is 2 A/30 V DC/24 V AC
- The function of the relays can be defined using Modbus commands – see Modbus, section 18.
- The factory settings are:
 - Relay1: Alarm relay
Use spring contacts 20 (C) and 21 (NO)
 - Relay2: Operation relay
Use spring contacts 24 (C) and 23 (NC)

Figure 6.10



6.11 Digital inputs

- The KL DRHX is equipped with 4 digital inputs, which can e.g. be configured and used for alarm reset, external rotor guard and operating test (see figs. 5.11.1 & 5.11.2).
- The function of the digital inputs can be defined using OJ-DRHX-PC-Tool or Modbus commands – see Modbus protocol.
 - The factory settings are:
 - DI1: Motor overheat - used with bimetallic switch in motor
 - DI2: Alarm Reset
 - DI3: Signal from external rotor guard - see fig. 6.2
 - DI4: Start/stop for fixed max. speed found in table 7.1 - digital start stop of rotary switch setting 1, 5, 8 and C



Note

See section 7 "External rotor guard" for more information regarding DI3.

6.12 Closing of the KL DRHX

- When all electrical connections are made, the test has been completed and the checklist (see checklist, section 9) has been filled in, the KL DRHX must be closed again.
- Fasten the blue plastic cover with the associated 6 TX20 screws.
- Tightening torque on the screws in the blue cover is 2 Nm. To ensure that the product constantly maintains the IP enclosure rating specified for the product, it must be ensured that the 6 TX20 screws are sufficiently tightened to the tightening torque. At the same time, it must be ensured that the tightening torque is not so high that the blue plastic cover is deformed.

7. External rotor guard

Mechanical installation - Rotor guard

- The "external rotor guard" is an inductive sensor.
- A sensor plate must be fitted to the rotary heat exchanger. The sensor plate must be of metallic material, e.g. the head of a bolt, a screw or similar. See fig. 7.1.
- Max. sensor range is 20 mm.
- One or more sensor plates should be installed on the rotor, depending on pulley and rotor size. The DRHX needs to receive a signal at least 1 time pr. 50 revolutions of the motor shaft, to register the sensor. If more than one sensor plate is needed, the drive will receive a corresponding number of signals per revolution.
 - If more sensor plates are needed, the amount of sensor plates mounted should be entered in the setup of the drive using OJ-DRHX-PC-Tool or correspondingly in the Modbus register - see Modbus protocol.
- The value in this register will be used in the calculation of the rotor's actual speed, as shown in the OJ-DRHX-PC-Tool or in the Modbus register – see Modbus protocol.
- If the ratio between the pulley and rotor is above 25, its recommended to use extra sensor plates, to avoid false errors should a sensor plate not be read.
- If the rotor is running at high speeds, it can cause issues reading the sensor plate due to the short time it will be within trigger range, in this case we recommend adding an extra sensor plate next to the original to prolong the time the sensor plate is within range. - less than 4ms will not be read.
- This function allows for the drive to monitor for untensioned or broken belts.

Figure 6.11.1

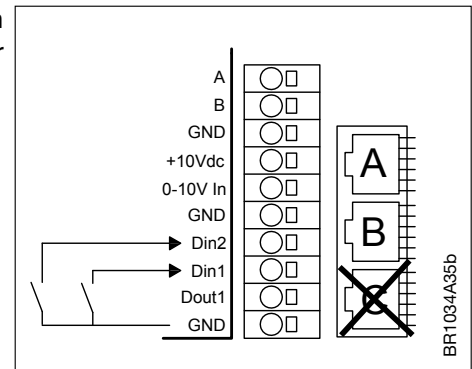


Figure 6.11.2

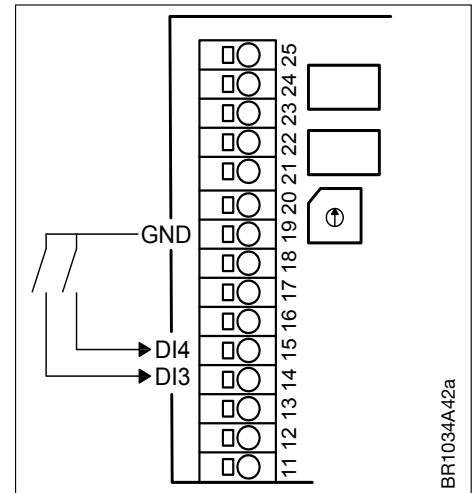
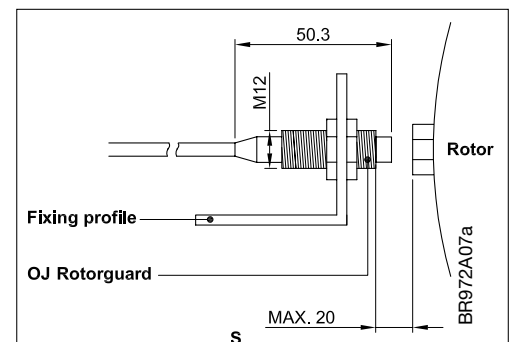


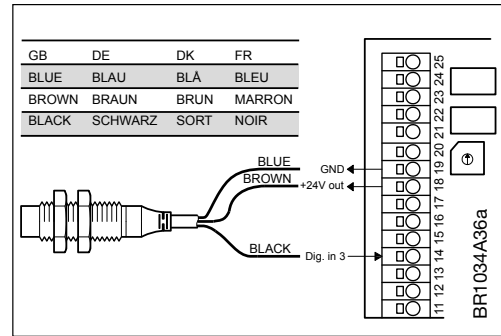
Figure 7.1



Connecting Rotor guard

- If the rotor is to be monitored via an external rotor guard, this should be connected to terminal: "Ø19/GND", "Ø18/+24V" and "Ø14/DI3" (see fig. 7.2).
- The rotor guard is a triple-conductor inductive sensor and is supplied by OJ Electronics A/S as an accessory.

Figure 7.2

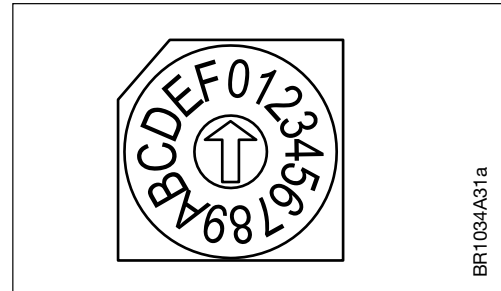


8. Settings and functions

8.1 Rotary switch

The KL DRHX AC is fitted with a rotary switch for setting min./max. motor speed, and reset alarms – see fig. 8.1. see table 8.1.

Figure 8.1



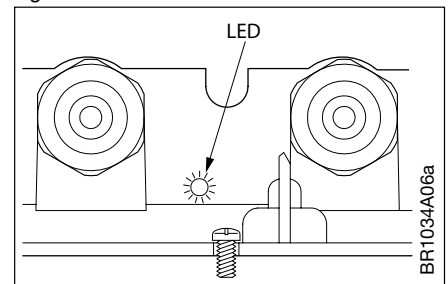
Rotary Switch	Max Speed [HZ]	External Rotorguard	Speed Control Mode
-1	Modbus or UDF controlled		
2	80	Enabled	0 -10V with digital start via DI4
3	80	Enabled	0 -10V with analog start
4	80	Enabled	4 -20mA via IO option module (OJ_DA_MODU_2R250_IO)
5	80	Disabled	0-10V with digital start via DI4
6	80	Disabled	0 -10V with analog start
7	80	Disabled	4 -20mA via IO option module (OJ_DA_MODU_2R250_IO)
8	120	Enabled	0 -10V with digital start via DI4
9	120	Enabled	0 -10V with analog start
A	120	Enabled	4 -20mA via IO option module (OJ_DA_MODU_2R250_IO)
B	120	Disabled	0 -10V with digital start via DI4
C	120	Disabled	0 -10V with analog start
D	120	Disabled	4 -20mA via IO option module (OJ_DA_MODU_2R250_IO)
E	Test function	Test function	Test function
F	Alarm Reset		

NOTE 1: Use values set via Modbus registers – see section Modbus protocol

8.2 LED indicator

- The KL DRHX AC is fitted with an LED indicator.
- The LED is located on the underside of the KL DRHX beside the entry for the mains cable – see fig. 8.3

Figure 8.3



The LED is set according to table 8.2, seen below.

Supply	Internal	Motor output
Flashing red 1 blink and 2 sec pause	Flashing red 3 blink and 2 sec pause	Flashing red 5 blink and 2 sec pause
Undervoltage	Temperature high	Ext. Rotor Guard
Overvoltage	Software error	Rotor Blocked
Overcurrent		Motor phase error
Comm missing		Short circuit between U,V,W / I HI Alarm

8.3 RS-485 interface - Modbus control

- The KL DRHX can be controlled via RS-485 interface, by use of Modbus protocol, see section Full Modbus registry.
- If a signal is received via RS-485 interface at the start register and/or speed register, the drive will temporarily change from 0-10 V control to protocol control until the next restart.
- If the KL DRHX is to be controlled permanently via protocol, Coil Stat Bit register 8 must be set to "0" = "protocol"
- Alarms and operating status can still be monitored via RS-485 interface, even if "protocol control" is not activated.

8.4 Rotation monitoring

The rotation of the rotor is monitored by the external rotor guard.
 If false broken belt errors are experience, this could be due to the lack of an extra magnet/bolt on the rotor. If the DRHX receives no signal, from the external rotor guard, within 50 rotations of the motor shaft the drive will stop and restart the motor. After five attempts the DRHX will stop and give an alarm.

8.5 Start function

- The KL DRHX series has a built-in "Start function" which automatically allows higher current for the motor during start-up.
- The KL DRHX can deliver up to 60% of rated current (stated in mA) to the AC motor during startup (max. 100 sec.)
- The KL DRHX stops the start function when the "Start time" that has been set in the timer runs out or when the AC motor has reached 50% of the maximum set speed.

8.6 Purging function

- When the KL DRHX is controlled via 0-10 V signal, the purging function starts automatically when the motor has been stopped for 10 minutes.
- When the KL DRHX drive is set to "Protocol" control, the automatic purging function can be deactivated and the purging function must be controlled from the air handling unit's control system.
- The purging function will start the motor for 10 seconds at 10% of max. speed, after which the motor will stop again.
- The function is repeated every 10 minutes when the motor is stopped.
- The function thus prevents mechanical breakdown and deformation of the rotor.

8.7 Holding Torque

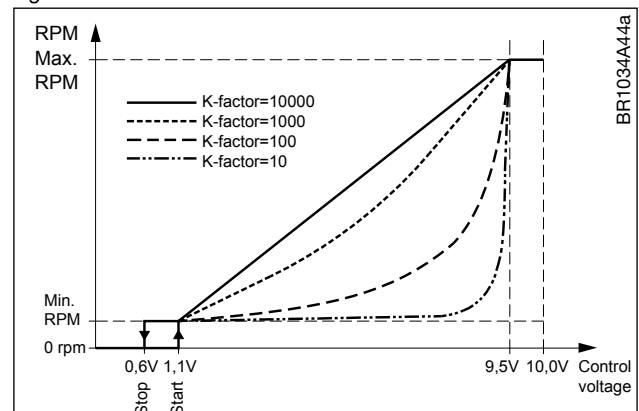
- To prevent the rotor from rotating due to air flow, the KL DRHX has a brake function which retains the rotor in a fixed position.
- This brake function is automatically activated when the motor has no operating signal.
- The retention torque is factory configured to 10% of configured max. torque.
- Setting of retention torque level can be altered via the KL DRHX-PC-Tool or via Modbus command.
- The function can be deactivated by setting the value to 0%.

8.8 K-factor

Compensation for non-linear heat exchange on the rotor can be set or adjusted using a K-factor.

- K-factor is configured via Modbus register
- Default K-factor is configured by the manufacturer to 10000

Fig 8.8



9. Modbus

9.1 Modbus introduction

- The KL DRHX can be controlled via Modbus RTU, according to the Modbus protocol.
- The KL DRHX is factory-set for "0-10 V" control.
- When the KL DRHX detects a start signal or speed setpoint via Modbus, the KL DRHX will automatically shift to control via Modbus RTU. The "0-10 V" signal is ignored. The function is automatically reset when the KL DRHX is power cycled .
- The KL DRHX can be locked via the Modbus register to always be controlled via Modbus. The 0-10 V signal will thus be ignored also when no active Modbus communication is detected.
- To change and read out Modbus registers, use OJ-DRHX-PC-Tool.



Warning

Any changes to values are at your own responsibility:
It is your own responsibility to ensure that values and settings are configured so that no overload or damage is caused to the AC motor or rotor.

9.2 Modbus communication

- The KL DRHX is supplied with the factory setting (see table 9.2.1):

	Setting range	Unit	Factory setting
Address	1-247	n/a	79 dec.
Baud rate	9.6, 19.2, 38.4, 57.6, 115.2 kBaud		38.4
Parity	None, even, odd	n/a	None
Stop bit(s)	0, 1, 2	n/a	2
Communication timeout	0-240	Sec.	10

- The KL DRHX supports the following commands (see table 9.2.2):

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

- Values that are written to the KL DRHX via Modbus are rounded off to the nearest valid value.

9.3 Detection of active RS-485 interface

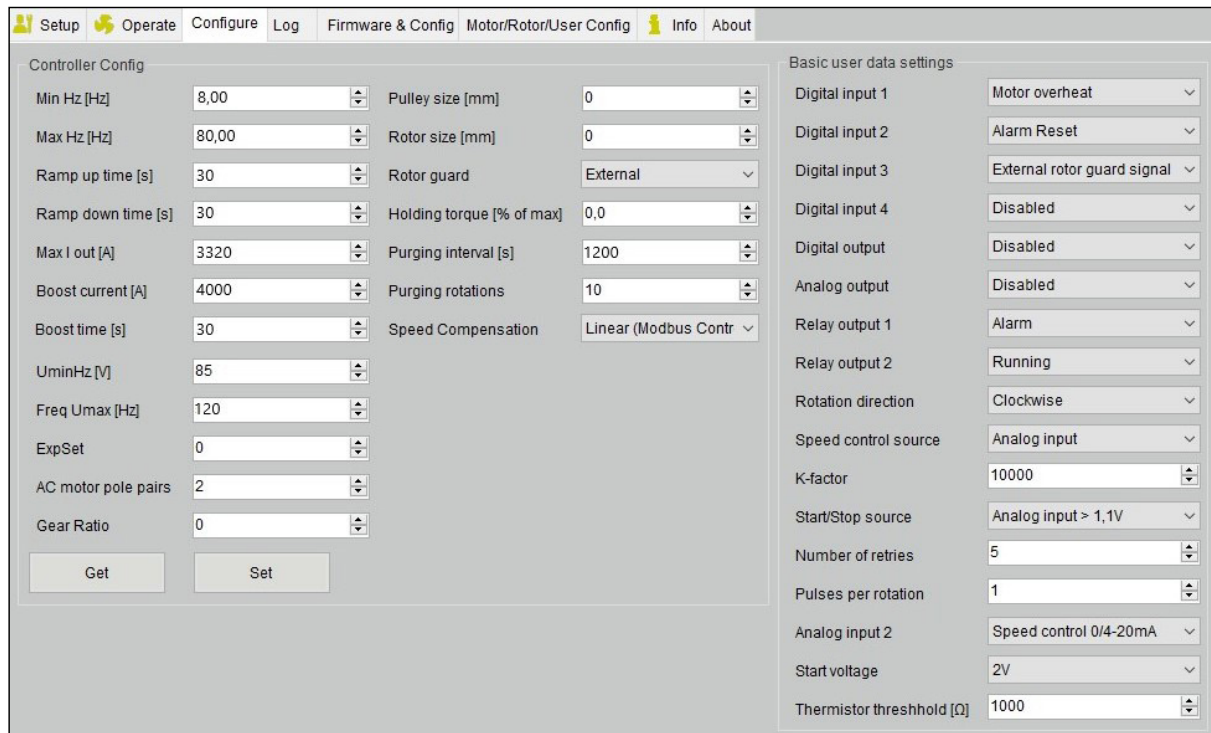
- The KL DRHX automatically detects valid Modbus communication on the Modbus inputs (RJ12 connector or "A" & "B" terminals on the terminal strip).
- First connection with the DRHX will be on the default Modbus parameters: ID 79, 38.4 – 8 – N – 2
- Alternative communications parameters and BACnet MS/TP can be set using the Modbus register.
- If no valid active Modbus communication is found, the KL DRHX will automatically set the drive to "0-10 V" control.

The current Modbus protocol is available for download at www.ojelectronics.com

10. AC Parameters

Parameters can be entered in the Configuration tab and UDF, using the OJ-DRHX-PC-Tool or by a Modbus tool.

Figure 10.1



AC Control Modbus Registers:

Register	Address	Function	Range	Resolution	Unit	Default value
4x0010	9	Ramp up time	30-300	1	Sec	30 sec.
4x0011	10	Ramp down time	30-300	1	Sec	30 sec.
4x0005	4	Start Time(Boost)	0 - 100	1	Sec	30
4x0046	45	UminHZ	0 - 200	1	V	85
4x0047	46	Freq Umax	0 - 12000	00:01	HZ	12000
4x0048	47	Exponent set factor	0 - 100	1		0
4x0049	48	AC Motor pole pairs	0 - 200			2
4x0050	49	Gear ratio	0 - 200	1		0



Note

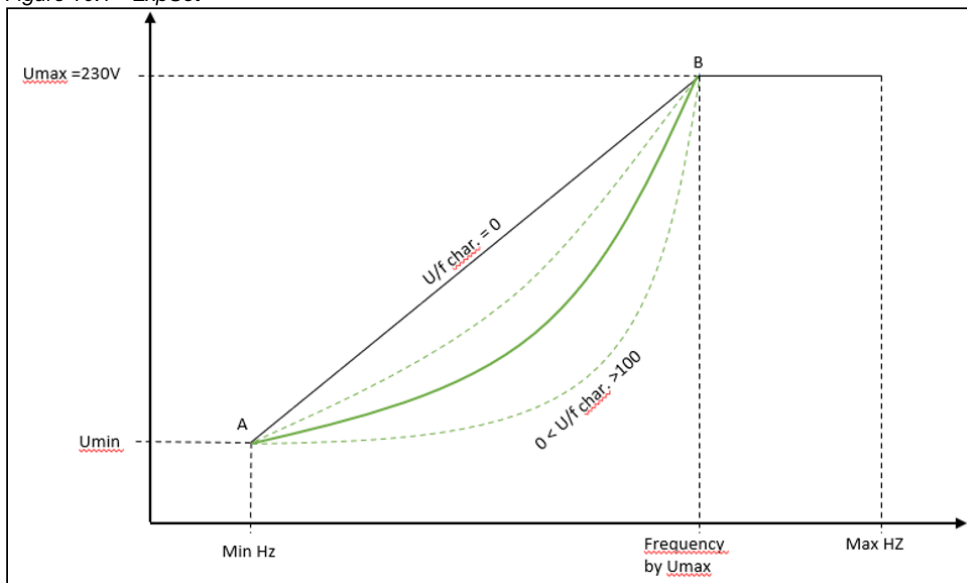
For full Modbus registers see section "full Modbus registry"

Function name and description:

Table 10.2		
Function name	Description	Function description
Min Hz (Hz)	Minimum speed frequency.	Minimum set frequency for DRHX rotation speed. When a digital start signal is activated, this will be the slowest the motor will run.
Max Hz (Hz)	Maximum speed Frequency Max120 Hz	Maximum set frequency for DRHX rotation speed at 100% or 10V
Ramp-up time(s)	Time from motor starts running in closed loop to maximum speed has been reached.	Ramp-up time is the time (in seconds) from when the OJ DV gets the start signal until the speed has been reached according to the setpoint. The ramp-up time is used to avoid overload and damage to the controller and motor. The ramp-up time is also used in upward jumps between speed setpoints. If this ramp-up is too short, it is possible to trigger a current limit warning.
Ramp-Down time (s)	Time from running speed to minimum speed.	Ramp-down time is the time (in seconds) from when the OJ DV receives a stop signal until the motor comes to a halt. The ramp-down time is used to avoid overload and damage to the controller and motor. Ramp down time is also used in connection with downward jumps between speed setpoints.
Max I out	Max current for AC motor	Maximum current allowed, stated on the AC motor's nameplate [Default value 3,32A]
Boost current (A)	Boost current on Start. Max. I _{max} + 50%	The boost function is used to get a higher torque when starting the rotation of the RHX, where the RHX might be slightly blocked or jammed. The DRHX and the motor will be able to run with a higher current than specified under normal operation, but only for a limited time
Boost time (s)	Boost current run time. Max. 100s	Amount of time the Boost current should run.
UminHz(V)	Min. voltage at min. Hertz	This parameter selects the voltage to the motor at minimum frequency.
Freq Umax (Hz)	Frequency at Max. voltage	This parameter selects the frequency to the motor at maximum voltage.
ExpSet	Voltage/Frequency characteristics	The U/f characteristic parameter makes it possible to change the ratio between voltage (U) and frequency (f) for the motor. Set to zero the ratio is linear and set to 100 the ratio is parabolic (See Figure 8.1). Factory default setting is 0. A motor with less efficiency may require change to the U/f characteristic. See Fig 8.1.
AC Motor pole pairs	Number of motor poles divided with by 2.	Number of AC motor Pole Pairs
Gear Ratio		Attached Gear box ratio
Motor overheat		When the motor overheats the circuit will be broken to D1 and the motor will stop.
Thermistor threshold	Set motor thermistor threshold resistance	Thermistor threshold is used to monitor the motor temperature, and report if motor is getting overheated.
Activate Fixed Speed		Configure a Digital Input to activate Fixed speed (Value 7 in udf and Modbus protocol for digital inputs)
Fixed Speed		Fixed speed required (Range of 1 -120Hz)

Example showing the U/f curve:

Figure 10.1 - ExpSet



11. Checklist – mechanical and electrical installation

Before the KL DRHX is energized for the first time, installation and connection must be checked. Use the table below as a checklist.

Item to be checked	Description of item to be checked	√
Completion	Check that the entire installation is ready to be commissioned, both electrically and mechanically, before energizing the installation.	
	Check that no people or animals are present in the vicinity of moving parts.	
Product conformity	Check that the indication of the nominal voltage on the KL DRHX rating plate is in compliance with the nominal mains voltage to which the KL DRHX will be connected.	
	Check that the selected AC motor size meets the required torque in order to be able to run the specific rotor.	
Mechanical installation	Check that the KL DRHX is correctly and securely attached to a flat surface. See section 12.1 in these instructions.	
	Check that there is a free, unobstructed passage of air to the cooling fins of the KL DRHX.	
	Check that the blue plastic cover on the KL DRHX is correctly mounted and that all screws are sufficiently tightened before switching the power on to the product. Tightening torque on the screws is 2 Nm.	
	Check that all unused cable glands and other unused openings are appropriately blanked off in accordance with the applicable enclosure rating.	
	Check that the drive belt is tensioned correctly and that the rotor can rotate easily and unhindered, with a torque that is less than the rated torque for the AC motor.	
	Make sure that the belt is not tensioned beyond the maximum permissible vertical tension on the AC motor shaft.	
Ambient conditions	Check that requirements on the surrounding environment have been met. Check that temperature and other environment specifications are observed. See <i>technical specifications, section 23 in these instructions.</i>	
Cabling	Check that all cabling has been fitted correctly and that AC motor and control cables are kept apart in separate cable conduits. The motor cable must be fixed to the chassis of the rotor for its entire length	
	Check that all cables are securely attached and relieved of tension and torsion.	
	Check that all cables are free of visible damage throughout their length.	
Electrical installation	Check that cables have been correctly inserted into the KL DRHX and that the cable glands have been correctly tightened.	
	Check whether there are any bad electrical connections, as they may cause overheating and serious damage to the product and to property.	
Mains voltage	Check that the mains voltage wires have been correctly fitted to the supply terminals "L", "N" and "PE"	
	Check by means of voltage measurement that there is the correct voltage on the terminals.	
AC motor connection	Check that the cable is properly connected to the KL DRHX terminals: "U", "V", "W" and "PE".	
Connector terminals and AC motor.	Check that the connector terminals between the AC motor cable and the DRHX terminals are properly assembled and correctly engaged.	
Control and signal wires	Check that control cables are correctly terminated in the spring terminals and that the control cables are securely attached. (<i>A/D control</i>)	
	Check that both ends of the RS-485 interface cable have been attached to the correct connectors. (<i>RS-485 interface control</i>)	
Fuses and circuit breakers	Check that the active short-circuit protection is correctly inserted and dimensioned and complies with applicable local and international directives and regulations	
	Check that all safety equipment, including supplementary protection, is operative and set correctly.	
Earthing	Check by means of continuity measurement that the earth connection is active and that the contact resistance complies with applicable local and international directives and regulations.	

12. Troubleshooting



Warning

Before opening the KL DRHX, the mains voltage must be disconnected for at least 3 minutes to ensure that there is no risk of dangerous residual currents in electronic circuits or capacitors. If the KL DRHX has no operating signal, but natural drafts through the air handling unit cause the rotor and thus the motor to rotate, there is a risk that the motor will induce voltage on the KL DRHX motor terminals, making them dangerous to touch. The motor can become very hot >60°C.

Troubleshooting when the KL DRHX is controlled via A/D signals:

Symptom	Cause	Action
Motor is not running	Lacking supply voltage	Check the voltage supply (230 V AC) to the KL DRHX terminals "L" and "N" (Nominal supply voltage is stated on the rating plate). LED displays constant green light – see section 7.2 for additional LED indications.
		Check whether short-circuit protection has been activated.
		Check that the voltage supply to the KL DRHX has not been cut off by other components.
	Poor electrical connections	Check electrical connections.
	Lacking operating signal	A/D control: DRHX can be configured via the OJ-DRHX-PC-Tool or Modbus register, to receive a start signal via an optional digital input. If this function is selected, check that the KL DRHX has a signal connected to the "Start/Stop" input - digital input Din 1, -2 or -3, depending on the configuration.
	Lacking 0-10 V DC control signal	Check that the KL DRHX receives an operating signal >1.1 V on "0-10 V In".
	Active alarm	Read active alarms via RS-485 registers or with OJ-DRHX-PC-Tool and remove what is causing the alarm.
	The motor has been stopped 5 times by the built-in motor protector because of overloading or other alarm	Reset the alarm by short-circuiting the "Alarm reset" input – digital input Din1 or Din2 depending on the setup. The alarm can also be reset by disconnecting the supply voltage to the KL DRHX and reconnecting it after approx. 60 seconds.
Motor is defective	Defective KL DRHX controller	Replace the KL DRHX. Never attempt to repair a defective KL DRHX controller. Contact your supplier for replacement/repair.
	Motor is defective	Replace motor.
Motor is running in wrong direction	Wrong phase sequence in motor cable	Swap 2 phase wires on motor or on the KL DRHX motor terminals.
	Motor rotation is incorrectly configured	Motor rotation can be checked and changed using the Modbus registers or OJ-DRHX-PC-Tool. (CW=Right/CCW=Left)
The KL DRHX cuts out due to an alarm	At least one alarm active	View the alarm via RS-485 interface or OJ-DRHX-PC-Tool to determine which alarm has stopped the control motor.
		Reset the alarm by short-circuiting the "Alarm reset" input – digital input Din1 or Din2 depending on the setup. The alarm can also be reset by disconnecting the supply voltage to the KL DRHX and reconnecting it after approx. 60 seconds.
	The alarm is re-activated after reset	Use OJ-DRHX-PC-Tool to view the alarm and determine which alarm has stopped the motor.
		Remedy the cause of repeated alarm activation.

Troubleshooting when the KL DRHX is controlled via RS-485 interface:

Table 12.2		
Symptom	Cause	Action
Motor is not running	Lacking supply voltage	Check the voltage supply to the KL DRHX terminals "L" and "N" (230 V AC)
		Check whether short-circuit protection has been activated.
		Check that the voltage supply to the KL DRHX has not been cut off by other components.
	Poor electrical connections	Check electrical connections.
	Wrong motor for the KL DRHX setup	Check that the correct motor settings have been read into and stored in the KL DRHX setup.
	Lacking operating signal	Check that the KL DRHX can receive an operating signal. Coil Stat Bits Register 0X0001: motor start/stop (1=On)
	The motor has been stopped 5 times by the built-in motor protector because of overloading	Reset alarm: Modbus Coil Stat Bits Register 0X0002 or BAC-net Binary Values, BV:1: Reset (1 pulse = Reset) The alarm can also be reset by disconnecting the supply voltage to the KL DRHX and reconnecting it after approx. 60 seconds.
Defective KL DRHX controller	Replace the KL DRHX. Never attempt to repair a defective KL DRHX controller. Contact your supplier for replacement/repair.	
Motor is defective	Replace motor.	
Motor is running in wrong direction	Wrong phase sequence in motor cable	Swap 2 phase wires on motor or on the KL DRHX motor terminals.
	Motor rotation is incorrectly configured	Motor rotation can be checked and changed using the Modbus register or OJ-DRHX-PC-Tool. (CW=Right/CCW=Left)
The KL DRHX cuts out due to an alarm	At least one alarm active	Use Protocols or OJ-DRHX-PC-Tool to view the alarm and determine which alarm has stopped the controller motor.
		Reset the alarm by short-circuiting the "Alarm reset" input – digital input Din1 or Din2 depending on the setup. The alarm can also be reset by disconnecting the supply voltage to the KL DRHX and reconnecting it after approx. 60 seconds.
	The alarm is re-activated after reset	Read out the alarm via Protocol registers and determine which alarm has stopped the controller motor. Remove what is causing the alarm. Remedy the cause of repeated alarm activation.

13. Alarms and fault codes

The KL-DRHX-AC has a built-in alarm monitor, which monitors optimal fault-free operation and triggers an alarm if operating or performance problems are observed.

Alarms are either "Critical" alarms or "Non-critical" alarms.

"Critical" alarms stop the motor.

"Non-critical" alarms reduce motor performance.

The built-in alarm monitor stops the KL DRHX.

If the alarm situation passes, the alarm is automatically reset and the KL DRHX restarted.

If the maximum number of restarts (5 times/60 min) is exceeded, the alarm must be reset.

The alarm can be reset by means of a RS-485 interface command or via a digital input set to "alarm reset".

The alarm is automatically reset if the power is disconnected for longer than 60 seconds.

Alarms can be read using Modbus registers or the OJ-DRHX-PC-Tool.

Motor issue.

Alarm/fault code overview, see table 13.1

Table 13.1			
	Alarm overview	Alarm priority	Activity
	Alarm from rotor guard	"C"	"SA5"
	Excessive supply voltage	"C"	"SA5"
	Insufficient supply voltage	"C"	"S"
	Power to the motor increased at a critical level, e.g. short-circuiting cable, connector or motor	"C"	"SA5"
	Excessive temperature inside KL DRHX (> 95°C)	"NC"	"RP"
	Blocked motor	"C"	"SA5"
	No valid RS-485 interface communication >10 sec.	"C"	"S"
	Phase fault on motor power supply (U, V, W)	"C"	"SA5"
	Internal hardware error	"C"	"S"

Remarks: "C"=critical alarm "NC"=Non-critical

"RP" = Reducing performance

"SA5"= Motor stops after 5 restarts caused by same fault within 60 min

"S" = Motor stops immediately

14. Disposal

- The KL DRHX contains electronic components and must not be disposed of together with household waste.
- The KL DRHX must be disposed of in accordance with applicable local rules and regulations.
- The KL DRHX meets the requirements on marking of electronic waste contained in the European WEEE Directive 2012/19/EU.



15. Technical specifications

Table 15.1 - Technical specifications		
Type		KL-DRHX-1750-MAN5-AC
Power size	W	750 W
Supply and Motor		
Voltage	V AC	1 x 230 V AC
Motor output	V AC	3 x 0- 230 V AC
Boost motor current	A	4 A
Frequency	HZ	120 HZ
Max. continuous output current	A	3.320 A
Protection		
Max. fuse	A	10 A
Motor output		Short-circuit protected between phases
Motor		Protected by current limit
Overload protection		Current and temperature overload protection
Environment		
Operating temperature	°C	-40°C to +40°C
Starting temperature	°C	-40°C to +40°C
Storage temperature	°C	-40°C to +70°C
Dimensions	mm	185.0 x 230.5 x 90.0
Protection rating	IP	54
Enclosure material		Aluminium
Front cover		Plastic
Weight	Kg	3.6 Kg
Humidity	% rh	10-95% rh, non-condensing
Cooling		Self-cooling
Interfaces		
RS-485 interface protocol		RS-485 interface (Baud rate: 9.6, 19.2, 38.4, 57.6, 115.2 Kbaud) Default: 38.4k baud, 1 stop bit, none parity
RS-485 interface connection		2 x RJ12 & 3 x spring terminals
RS-485 interface cable		Max. 100 m
Analogue In1		0 - 10 VDC, 100% @ 9.5 V DC +/-2%
Analogue Out1		+10VDC
Digital In1 (internal Pull up)		Configurable
Digital In2 (internal Pull up)		Configurable
Digital In3 (internal Pull up)		Configurable
Digital Out1		Alarm signal
Alarm relay		SPDT relay 1A 30VDC/24VAC
Green LED		On: Power connected Flashing: Active RS-485 interface communication
Red LED		Flashing: Alarm but keep running Constant on: Serious alarm - stop motor
Rotary switch		Yes
Approvals		
EMC		EN 61800-3 (C1 & C2)
LVD		EN 61800-5-1
Product standard		EN 61800 Part 2
RoHS Directive		Yes
Product approvals		CE

16. Full Modbus registry

Standard-MODBUS (RTU)

Coil Stat Bits: 20

0x01: Read

0x05: Write Single Coil (NOTE: ON => output value = 0xFF00)

0x0F: Write Multiple Coils

Stat	Address	Function	Range	Active state
0x0001	0	Motor ON/OFF	0 - 1	1 = ON
0x0002	1	Reset Alarms	0 - 1	1 = Reset
0x0004	3	Rotation direction	0 - 1	1 = CounterClockWise
0x0008	7	Control mode	0 - 1	0 = Modbus, 1 = 0-10V
0x0009	8	Use alternative comm. settings	0 - 1	1 = Alternative
0x0010	9	Autodetect communication	0 - 1	1 = Enable
0x0011	10	Analog start signal	0 - 1	1 = Enable
0x0012	11	Autodetect control mode	0 - 1	1 = Enable
0x0013	12	Disable internal rotor guard	0 - 1	1 = Disabled
0x0014	13	Enable external rotor guard	0 - 1	1 = Enabled
0x0015	14	High speed resolution	0 - 1	0 = Resolution = 0.1 RPM 1 = Resolution = 0.01 RPM
0x0017	16	Enable autostoring UDF	0 - 1	1 = UDF stored automatically
0x0018	17	Show alarm on LED	0 - 1	1 = shows alarm by flasing
0x0021	20	Start voltage	0 - 1	0 = starting voltage of 0.5V(1mA) 1 = starting voltage of 2V(4mA)

Input Stat Bits: 28

0x02: Read

Stat	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 / Rotor Blocked	0 - 1	1 = Alarm
1x0011	10	Internal Stop	0 - 1	1 = Alarm (Stop)
1x0012	11	I_Limit	0 - 1	1 = Warning
1x0013	12	EEPROM error	0 - 1	1 = Warning
1x0014	13	Communication error MOC	0 - 1	1 = Alarm
1x0015	14	Motor Phase Error	0 - 1	1 = Alarm
1x0017	16	Digital Input 1	0 - 1	1 = HI
1x0018	17	Digital Input 2	0 - 1	1 = HI
1x0019	18	Ext. 24V supply overload	0 - 1	1 = Overload
1x0020	19	MOC in bootloader	0 - 1	1 = Alarm
1x0021	20	Digital Input 3 (IOM on H1)	0 - 1	1 = HI
1x0022	21	Digital Input 4 (IOM)	0 - 1	1 = HI
1x0023	22	Communication error IOM	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

Stat	Address	Function	Range	Active state
1x0027	26	IO Config mismatch	0 – 1	1 = Warning
1x0028	27	Fixed speed active	0 – 1	1 = Active
1x0029	28	Low Torque Warning	0 – 1	1 = Warning

Holding Registers: 47

0x03: Read

0x06: Write Single

0x10: Write Multiple

Register	Address	Function	Range	Resolution	Unit
4x0001		Setpoint / PrcSet	0-10000	0.01 %	-
4x0002	1	Min. Motor Speed	100 – Max.	0.1 OR 0.01 ¹	RPM
4x0003	2	Max. Motor Speed	Min. – 40000	0.1 OR 0.01 ¹	RPM
4x0005	4	Start Time (Boost)	0 - 100	1	Sec.
4x0009	8	Prc Holding Torque	0 – 200	00:01	% of max
4x0010	9	UpRampTime	30 – 300	1	Sec.
4x0011	10	DownRampTime	30 – 300	1	Sec.
4x0012	12	SwitchMode	0	(Auto)	
			1	8	kHz
			2	10	kHz
4x0014	14	Alternative Modbus ID	1 – 247	1	-
4x0015	15	Alternative BaudRate	0	9600	bps
			1	19200	bps
			2	38400	bps
			3	57600	bps
			4	115200	bps
4x0016	15	Alternative Parity	0	None	-
			1	Odd	-
			2	Even	-
4x0017	16	Alternative Stop Bits	0	INVALID	-
			1	1	-
			2	2	-
4x0018	17	Number of retries	-1 – 100	1	-
4x0019	18	Modbus Timeout	0 – 240	1	Sec.
4x0020	19	Pulley size (diameter)	0 – 1000	1	mm.
4x0021	20	Rotor size (diameter)	0 – 10000	1	mm.
4x0022	21	Pulses per rotation	0 – 10	1	-
4x0024	23	DigIn1 config	0	Disabled	-
			1	Start/stop	-
			2	AlarmReset	-
			3	Rotation direction	-
			4	Test function	-
			5	Ext. rotor guard signal	-
			6	Enable ext. rotor guard	-
			7	Activate fixed speed	-
4x0025	24	DigIn2 config	0	Disabled	-

Register	Address	Function	Range	Resolution	Unit
			1	Start/stop	-
			2	AlarmReset	-
			3	Rotation direction	-
			4	Test function	-
			5	Ext. rotor guard signal	-
			6	Enable ext. rotor guard	-
			7	Activate fixed speed	-
4x0026	25	DigOut config	0	Disabled	-
			1	TachoOut	-
			2	RunningStart	-
			3	AlarmOut	-
			4	RunningSpin	-
4x0027	26	MotorConfigVar	0 – 65535	1	-
4x0028	27	RotorConfigVar	0 – 65535	1	-
4x0029	28	DigIn3 config (IOM on H1)	0	Disabled	-
			1	Start/stop	-
			2	AlarmReset	-
			3	Rotation direction	-
			4	Test function	-
			5	Ext. rotor guard signal	-
			6	Enable ext. rotor guard	-
			7	Activate fixed speed	-
4x0030	29	DigIn4 config (IOM)	0	Disabled	-
			1	Start/stop	-
			2	AlarmReset	-
			3	Rotation direction	-
			4	Test function	-
			5	Ext. rotor guard signal	-
			6	Enable ext. rotor guard	-
			7	Activate fixed speed	-
4x0031	30	Relay1 config	0	Disabled	-
			1	N/A	-
			2	RunningStart	-
			3	AlarmOut	-
			4	RunningSpin	-
			5	Controlled by Coil 0x0023	-
4x0032	31	Relay2 config (IOM)	0	Disabled	-
			1	N/A	-
			2	RunningStart	-
			3	AlarmOut	-
			4	RunningSpin	-
			5	Controlled by Coil 0x0024	-
4x0033	32	AnalogOut1 config (IOM)	0	Disabled	-
			1	ActSpeed	-
4x0034	33	Thermistor config (IOM)	0	Disabled	-
4x0035	34	AnalogIn2 config (IOM)	0	Disabled	-
			1	Enable ext. rotor guard	-
4x0036	35	ModbusResponseWaitTime	0 - 200	1	ms
4x0037	36	Thermistor threshold	0 – 65000	1	Ohm

Table 16.3

Register	Address	Function	Range	Resolution	Unit
4x0038	37	MaxSpeedStep	0 – 10000	00:01	RPM
4x0039	38	Purging Interval	0 - 30000	1	Sec
4x0040	39	Purging Rotations	0 – 5000	1	Rotation
4x0041	40	Variant for Encoder	0 – 99	-	-
			0	Disabled	
			1	OJ / “Generic”	
4x0047	46	Frequency at max voltage	0 – 12000	00:01	Hz
4x0049	48	AC motor pole pairs	0 - ?		
4x0050	49	Gear ratio	0 - ?	1	-
4x0051	50	AC fixed speed	100 – 12000	00:01	Hz

¹: Depending on Coil Stat 15

Input Registers: 32

0x04: Read

Table 16.4

Register	Address	Function	Range	Resolution	Unit
3x0002	1	MOC SW version	0 - ?	00:01	-
3x0003	2	PrcOut	0 – 10000	00:01	%
3x0004	3	Intern Temp	0 - 12000	00:01	°C
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	0 - 10000	1	mV
3x0010	9	Operation Day	0 - 9999	1	Day
3x0011	10	Operation Minutes	0 - 1439	1	Min.
3x0014	13	Config file variant	AA - ZZ	2 ASCII characters	
3x0015	14	Config file version	100 - 32000	00:01	-
3x0016	15	AOC SW version	0 - ?	00:01	-
3x0017	16	Rotor Speed Out	0 - 40000	0.1 OR 0.01 ²	RPM
3x0018	17	Torque	0 - 1500	00:01	Nm
3x0019	18	SW variant	-	-	-
3x0020	19	AOC Boot SW	0 - ?	00:01	-
3x0021	20	MOC Boot SW	0 - ?	00:01	-
3x0022	21	Motor Cfg. Var.	0 - 65535	1	-
3x0023	22	Motor Cfg. Ver.	0 - 65535	00:01	-
3x0024	23	Rotor Cfg. Var.	0 - 65535	1	-
3x0025	24	Rotor Cfg. Ver.	0 - 65535	00:01	-
3x0026	25	User Data Var.	0 - 65535	1	-
3x0027	26	User Data Ver.	0 - 65535	00:01	-
3x0028	27	IOM SW version	0 - ?	00:01	-
3x0029	28	V DC Bus (Peak)	0 – 400	1	V
3x0030	29	V Motor (Peak)	0 – 400	1	V
3x0031	30	ExternSet2 (IOM)	0 - 10000	1	mV
3x0032	31	SpeedStepFails	1 – 65535	1	-

²: Depending on Coil Stat 15

Technical changes reserved.
Status: 07-2023

Instructions OJ AC 0723 EN