

INSTRUCTIONS

OJ DV



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OJ Drives®

A DRIVES PROGRAMME DEDICATED TO VENTILATION SOLUTIONS


OJ ELECTRONICS

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1. Product presentation

The OJ DVs are a range of controllers suitable for regulating the speed of an electric motor in a wide variety of applications.

The OJ DV is highly versatile as it can control various motor types, including:

- ACIM - asynchronous induction motors
- PMSM - permanent magnet synchronous motors

2. Introduction

- Read this manual thoroughly and follow the instructions it contains before taking the OJ DV into use.
- This manual contains important information and should be used when installing, connecting and commissioning the OJ DV as well as during maintenance, service and troubleshooting.
- If the instructions contained in this manual are not observed, the liability of the supplier and the warranty shall be voided (*see also Section 6. Prohibition on use*).
- Technical descriptions, drawings and figures must not be wholly or partly copied or disclosed to third parties without the permission of the manufacturer.
- All rights are reserved if the product is included in patent rights or other form of registration.

3. Key to symbols

Particular attention should be paid to the sections in these instructions which are marked with symbols and warnings.



Warning

- 3.1. This symbol is used where there is a risk of severe or fatal personal injury.



Caution

- 3.2. This symbol is used where potentially dangerous situations may result in minor or moderate personal injury. The symbol is also used to warn against unsafe and hazardous conditions.



Note

- 3.3. This symbol is used to indicate important information and in situations which may result in serious damage to equipment and property.



Warning

4. Ensuring safety before installation

- 4.1. The OJ DV must only be installed by qualified personnel or people who have received appropriate training and have thus become qualified to install the product.
- 4.2. Qualified personnel have knowledge of the installation practices used and can perform installation in accordance with relevant local and international requirements, laws and regulations.
- 4.3. Qualified personnel are familiar with the instructions and safety precautions described in this manual.
- 4.4. The OJ DV contains dangerous high voltage when connected to the mains.
- 4.5. Mains voltage must always be disconnected before any installation, service or maintenance tasks are performed on the product.
- 4.6. When the OJ DV is connected to the mains, there is a risk that the motor could start unintentionally, causing a risk of dangerous situations and personal injuries.
- 4.7. Unintentional start during programming, service or maintenance may result in serious injury or damage to equipment and property.
- 4.8. The motor/fan can be started via an external input signal, RS-485 interface or a connected control panel.
- 4.9. Before connecting mains voltage to an OJ DV, all the OJ DV, motor and fan components must be properly fitted.
- 4.10. Before connecting mains voltage to the OJ DV, all openings, covers and cable glands must be properly fitted and closed. Unused cable glands must be replaced with blank glands.

- 4.11. The OJ DV contains capacitors which become charged during operation. These capacitors can remain charged even after the power supply has been cut off. There is a risk of severe personal injury if the connection terminals or wire ends are touched before these capacitors have been completely discharged. The discharge time is about 3 minutes under normal conditions.

5. Product use

- 5.1. The OJ DV is especially used in ventilation applications (fans).
- 5.2. The OJ DV can also be used in other applications. If the OJ DV is used in applications where it cannot be positioned directly in a flow of air, impaired OJ DV cooling must be taken into account. This can be countered by creating additional ventilation around the product or by reducing performance requirements. See Section 25. Technical specifications.
- 5.3. The OJ DV is an electronic motor controller used to regulate fan speed. The OJ DV can be used to control AC asynchronous motors and PM motors.
- 5.4. Depending on what is needed, the OJ DV is suitable for stand-alone applications or as part of larger systems/machines.
- 5.5. The product can be used under various environmental conditions. See Section 25. Technical specifications.
- 5.6. The OJ DV can be fitted directly to the frame of the fan motor, thus saving space.
- 5.7. Motor operation can be regulated by commands from an external controller.
- 5.8. The OJ DV has built-in motor protection.
- 5.9. The OJ DV can be used in domestic and industrial environments and has a built-in EMC filter.
- 5.10. The OJ DV is developed for use in industry and defined as professional equipment and it is not intended for sales to the general public.



Warning

6. Prohibition on use

- The OJ DV must not be taken into use until the machine or product into which it is incorporated has in its entirety been declared to be in conformity with all relevant national and international regulations.
- The product must not be energised until the entire installation complies with ALL relevant EU directives.
- The product carries a manufacturer's warranty if installed in accordance with these instructions and applicable installation regulations.
- If the product has been damaged in any way, e.g. during transport, it must be inspected and repaired by authorised personnel before being connected to the power supply.
- If the OJ DV is built into machinery with rotating parts, e.g. a ventilation system, transport system, etc., the entire system must comply with the Machinery Directive.

7. Approvals and certifications

7.1. 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/E
 - EMC – Electromagnetic compatibility : 2014/30/EU
 - RoHS – Hazardous substances: 2011/65/EU and amendment annex II: EU/2015/863

7.2. UL 61800-5-1

The OJ DV product series is cULus Recognised.


Additional evaluation is required before the combined drive and motor can be operated. The system in which the product is installed must also be UL listed by the appropriate party. The drive complies with UL 61800-5-1 thermal memory retention requirements.

The OJ DV complies to the US National Electric Code NFPA 70 and the Canadian Electric Code CSA C22.1.

7.3. UK 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
- Ecodesign – The Ecodesign for Energy-Related products and Energy Information Regulations 2010 as retained in UK law and amended.
- RoHS – The Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Table 7.3					
Certification		-4	-5	-6	-7
EC Declaration of Conformity		-	✓	✓	✓
UL Recognised		✓	-	-	✓
UK Conformity Assessment		-	✓	✓	-

7.4. Product standard

- In accordance with EN/BS 61800-2 – Adjustable speed electrical power drive systems. Part 2. General requirements.

7.5. Safety

- In accordance with EN/BS 61800-5-1 – Adjustable speed electrical power drive systems. Part 5. Safety requirements – Electrical, thermal and energy.

7.6. EMC - Electromagnetic compatibility

- The OJ DV has built-in EMC filter.

Table 7.6					
OJ DV size	Motor cable length	Intended use	PDS of category EN/BS-61800-3	Immunity	Emission
0.55.....1.3 kW	<5.0 m	First environment	C1 & C2	EN/BS-61000-6-2	EN/BS-61000-6-3
1.5.....3.0 kW	<5.0 m	First environment	C1 & C2	EN/BS-61000-6-2	EN/BS-61000-6-3
4.0.....7.5 kW	<5.0 m	First environment	C1 & C2	EN/BS-61000-6-2	EN/BS-61000-6-3
11.0 kW	<5.0 m	First environment	C1 & C2	EN/BS-61000-6-2	EN/BS-61000-6-3
15.0 kW	<4.0 m	First environment	C1 & C2	EN/BS-61000-6-2	EN/BS-61000-6-3
11.0.....15.0kW	>4.0	Second environment	C3	EN/BS-61000-6-2	EN/BS-61000-6-4

- In accordance with EN/BS 61800-3 – Adjustable speed electrical power drive systems. Part 3. EMC requirements and specific test methods. The OJ DV 600V has a built in EMC filter but does not comply with EN/BS 61800-3.
- The OJ DV product line fulfils the “residential level” for emissions as per EN/BS-61000-6-3 and the “industrial level” for immunity as per EN/BS-61000-6-2 with up to 5 metre shielded motor cables. (15kW is limited to up to 4 metre motor cables).
- Longer motor cables can be used. Industrial level for both immunity and emissions can be fulfilled, depending on the cable capacity as well as the motor capacity.
- By reducing the motor cable length, it is possible to install up to 6 OJ DVs in the same unit with EN/BS-61800-3 C1 & C2 still being fulfilled.

7.7. Harmonic distortion

The OJ DV 1-phase variants complies with IEC 61000-3-2 class A. The OJ DV 3-phase variants comply with IEC 61000-3-12 provided that the short-circuit power S_{SC} is greater than or equal to that specified at the interface point between the user's supply and the public system. It is the

responsibility of the installer or user of the equipment to ensure, by consulting with distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power S_{SC} greater or equal to as specified. The OJ DV 3-phase variants complies with IEC 61000-3-12 Table 5 for asynchronous motors and PM motors with sinusoidal back-EMF."

Supply short circuit power:

Ensure that the short circuit power of the supply S_{SC} is greater than or equal to:

$$S_{SC} = \sqrt{3} \times R_{SCE} \times U_{mains} \times I_{equipment}$$

at the interface point between the user's supply and the public system (R_{sce}).

7.8. RoHS compatible

- Contains no hazardous substances according to the RoHS Directive.

8. Product programme

- The OJ DV is available in four different enclosures, whose size depends on the rated power of the OJ DV.
- The product programme contains 13 power sizes ranging from 0.55 kW to 15.0 kW, see table 8.
- Enclosures are designated "H1"... "H5", where "H1" is the smallest and "H5" is the largest.
- All enclosures are made of die-cast aluminium.

8.1. OJ DV 600 V Product Presentation

- The OJ DV has a group of products designed for areas where a 600 V supply is provided.
- The OJ DV 600V is UL certified.
- Shown in table 8 is the full product range which includes the OJ DV 600V

Product name	Enclosure	Power	Supply voltage	Dimensions (w, h, d)
OJ-DV-1005	H1	0.55 kW / 0.7 hp	1 x 230 V	185 x 230.5 x 90 mm
OJ-DV-1007	H1	0.75 kW / 1.0 hp	1 x 230 V	185 x 230.5 x 90 mm
OJ-DV-1011	H1	1.1 kW / 1.5 hp	1 x 230 V	185 x 230.5 x 90 mm
OJ-DV-1013	H1x	1.3 kW / 1.7 hp	1 x 230 V	185 x 265 x 125 mm
OJ-DV-3015	H3	1.6 kW / 2.0 hp	3 x 380-480 V	185 x 265 x 100 mm
OJ-DV-3024	H3	2.4 kW / 3.2 hp	3 x 380-480 V	185 x 265 x 100 mm
OJ-DV-3030	H3	3.0 kW / 4.0 hp	3 x 380-480 V	185 x 265 x 100 mm
OJ-DV-3040	H4	4.0 kW / 5.4 hp	3 x 380-480 V	220 x 294 x 107 mm
OJ-DV-3055	H4	5.5 kW / 7.4 hp	3 x 380-480 V	220 x 294 x 107 mm
OJ-DV-3065	H4	6.5 kW / 8.7 hp	3 x 380-480 V	220 x 294 x 107 mm
OJ-DV-3075	H4	7.5 kW / 10.0 hp	3 x 380-480 V	220 x 294 x 107 mm
OJ-DV-3110	H5	11.0 kW / 14.8 hp	3 x 380-480 V	244 x 399 x 144 mm
OJ-DV-3150	H5	15.0 kW / 20.0 hp	3 x 380-480 V	244 x 399 x 144 mm
OJ-DV-6024	H4	2.4 kW / 3.2 hp	3 x 460 - 600 V	220 x 294 x 107 mm
OJ-DV-6030	H4	3.0 kW / 4.0 hp	3 x 460 - 600 V	220 x 294 x 107 mm
OJ-DV-6040	H4	4.0 kW / 5.4 hp	3 x 460 - 600 V	220 x 294 x 107 mm
OJ-DV-6055	H4	5.5 kW / 7.4 hp	3 x 460 - 600 V	220 x 294 x 107 mm
OJ-DV-6065	H4	6.5 kW / 8.7 hp	3 x 460 - 600 V	220 x 294 x 107 mm
OJ-DV-6075	H4	7.5 kW / 10.0 hp	3 x 460 - 600 V	220 x 294 x 107 mm

All 3x380-480V versions can also be connected to 3x230V. The power output (kW) will, however, be limited to max. 58% ($1/\sqrt{3}$) of the rated power output at 3x380-480V. OJ DV 600V is not certified in accordance to EN/BS 61800-3



Caution

With enclosure sizes H3 ... H5, the OJ DV operating and motor parameters are set for connection to a supply voltage of 3x380-480V.

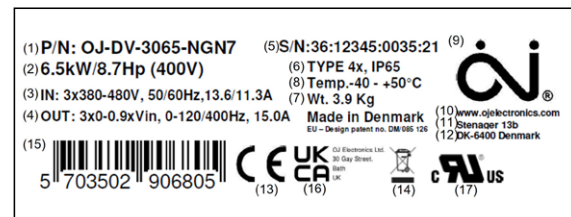
If these types are connected to a 3x230V power supply, operating and motor parameters must therefore be changed for optimum operation.

Motor parameters can be changed by the installer via the hand terminal (OJ-DV-HMI-35T), OJ-Drives-Tool or OJ-DV-PC-Tool. Configuration parameters can only be changed by the manufacturer.

9. Rating plate

- 9.1. The OJ DV is equipped with a silver-coloured rating plate.
See the example in fig. 9.1 and explanation in table 9.2.
Check that the information specified on the rating plate is as expected.

Figure 9.1



- 9.2. Rating plate, information and explanation

9.3. Explanation of product code

Each and every OJ DV is given its own product code during manufacture.
The product code (see table 9.3) gives precise information on the specific OJ DV.
The product code contains the following information:

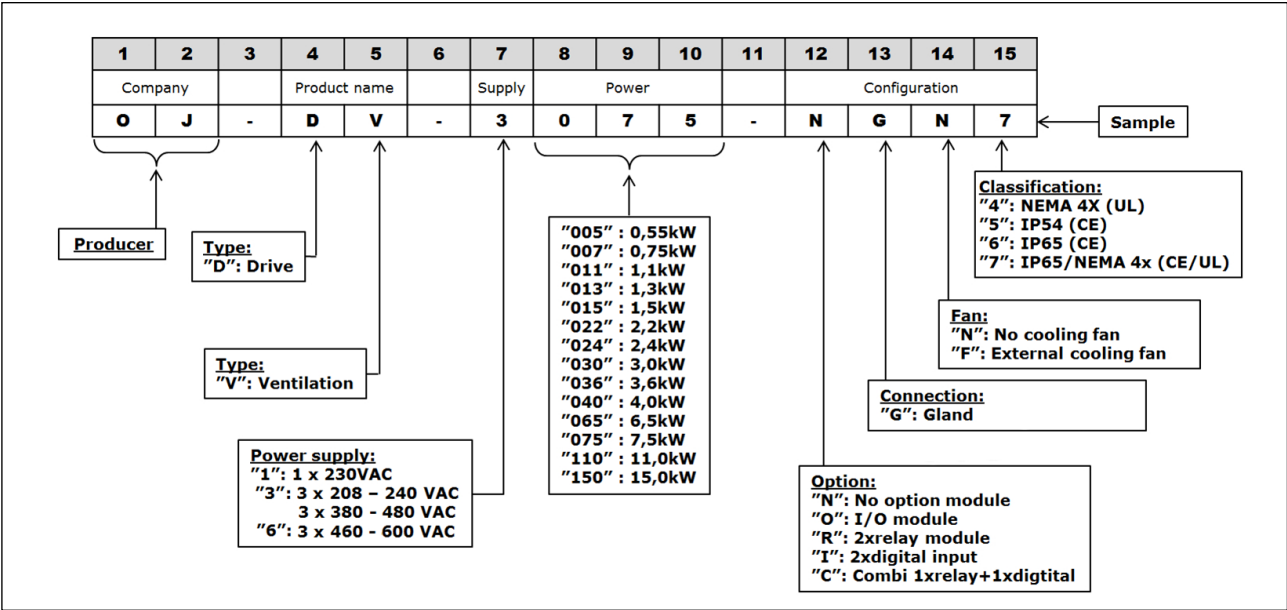
Table 9.3			
Week number	Batch	Serial no.	Year
W W	B B B B B	S S S S S	Y Y
Week of production	Manufacturer's order number	Unit number	Year of manufacture

- 9.4. The product ID consists of a combination of 14 numbers and letters, each of which provides information about the specific product, see fig. 9.4 and table 9.4.

Table 9.2	
1	Product ID = see figure 9.4.
2	Shaft power at nominal voltage
3	Max. input voltage, Hz/A
4	Max. output voltage/Hz/A
5	Product code = see table 9.3.
6	Enclosure rating
7	Weight
8	Temperature range, operating
9	Manufacturer's logo
10	Manufacturer's web address
11	Manufacturer's postal address
12	Country of manufacture
13	CE approved, logo
14	Disposal, logo
15	Bar code
16	UKCA approved, logo
17	UL recognised, logo

Table 9.4	
1	Manufacturer's initials
2	
3	
4	Product type
5	
6	
7	Electrical connection
8	
9	Controller power/size
10	
11	
12	Optional module type
13	Cable entry
14	Integrated cooling fan
15	Classification

Figure 9.4



10. Exploded and dimensioned drawings

Figure 10.1

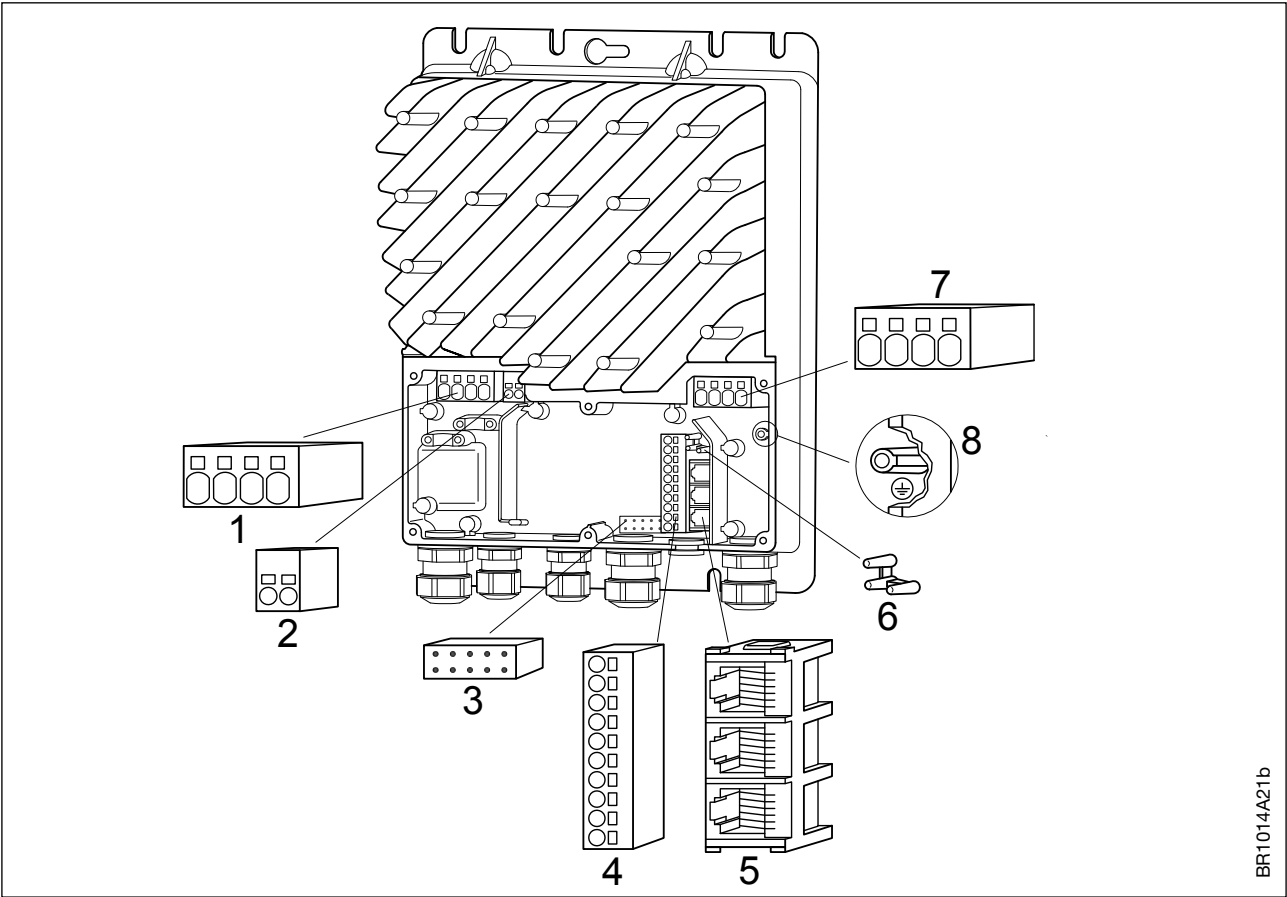


Table 10.1			
No.	Description	No.	Description
1	Motor connection terminals	5	RJ12 RS-485 interface connector (2 x Slave & 1 x Master)
2	Connections for future use	6	3-point strain relief for RS-485 ribbon cable
3	Connector for optional modules	7	Power terminals (H1=L, N, PE); (H3, H4, H5=L1, L2, L3, PE)
4	Terminal strip for RS-485 interface and A/D control signals	8	Connector for the earth (PE) protective conductor

Dimensioned drawings

Figure 10.2

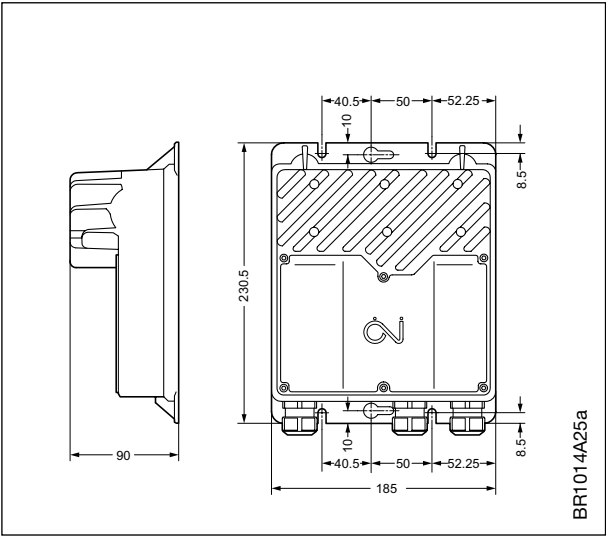


Figure 10.3

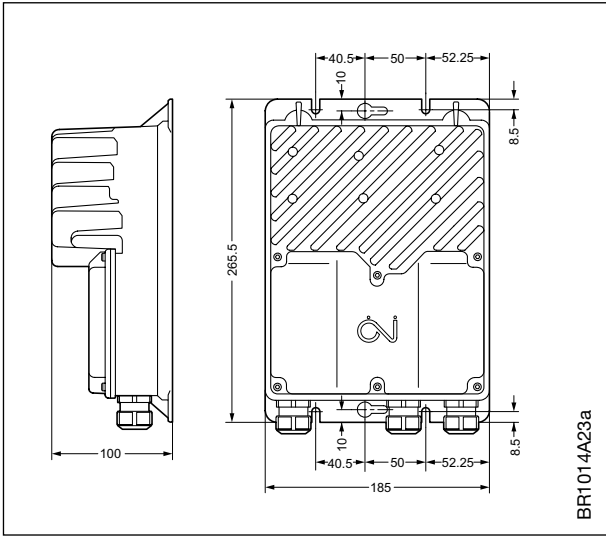


Figure 10.4

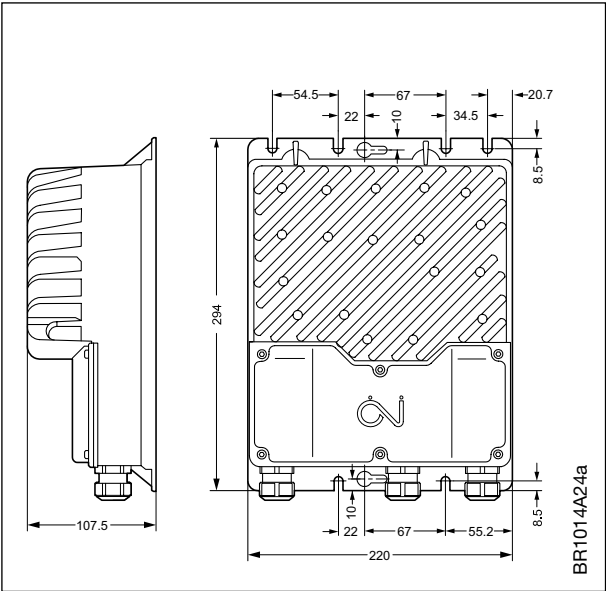


Figure 10.5

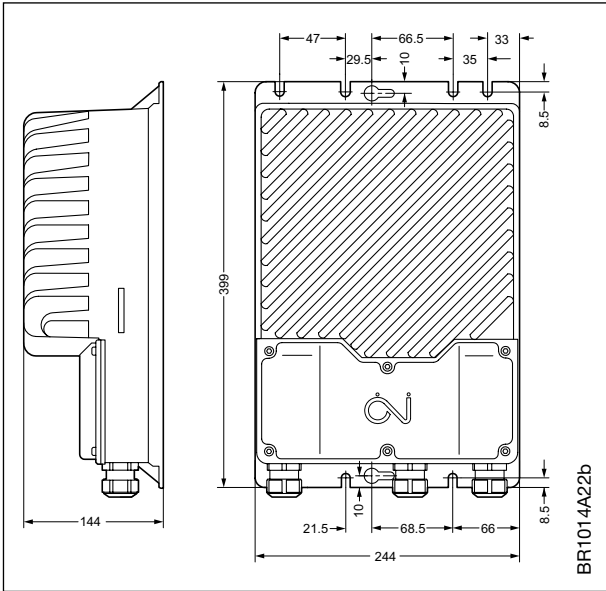
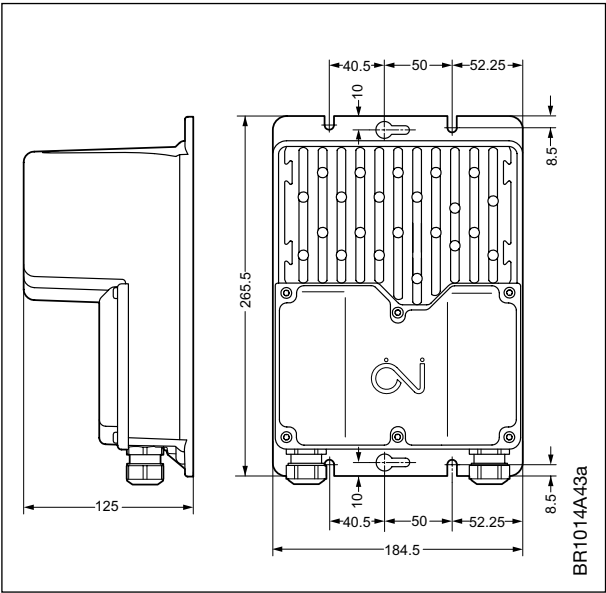


Figure 10.6



11. Mechanical installation



Warning

Incorrect mechanical installation may cause overheating and impaired performance.

- The OJ DV must only be installed by trained/experienced personnel.
- To ensure proper cooling of the OJ DV, it must be positioned in such a way that the passing air flow (> 3 m/s turbulent air speed) can cool the OJ DV cooling fins. (3 m/s turbulent air speed is equivalent to 6.5 m/s laminar air speed). If the OJ DV is installed in a reduced air flow (< 3 m/s turbulent air speed) or mounted outside a direct airstream, the output power (kW) will be reduced. External on-board cooling fan can be added.
- Only OJ-DV-1013 can be installed without considering the above requirements for sufficient air flow over the cooling fins. OJ-DV-1013 is supplied with extra large cooling fins and can therefore be mounted in still air with an air temperature of max. 40°C.
See Section 25: Technical Specifications.
- To facilitate future service and maintenance tasks, ensure that there is sufficient space around the unit after it has been installed.
- To achieve the specified enclosure rating, the cable glands must not point upwards (see fig. 11.1).
- To prevent water from entering the OJ DV via cables and cable glands, ensure that connection is performed in such a way that water is prevented from accumulating around the cable in the gland. See fig. 11.2.
- Check that the surface to which the OJ DV is attached is capable of supporting the entire weight of the unit.
- The OJ DV can be mounted vertically, horizontally or at an incline. See fig. 11.1).
- The OJ DV must be installed on a flat solid surface.
- To avoid unnecessarily long motor cables (max. 5 m), the OJ DV should be installed as close to the motor as possible.
- Use only the pre-cut installation holes/screw holes to secure the OJ DV in place.
- Dimensioned drawings, see figs 10.2 to 10.6.

Figure 11.1

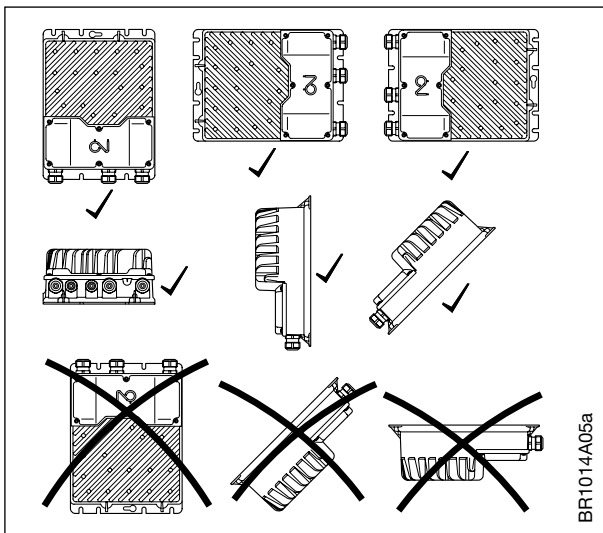
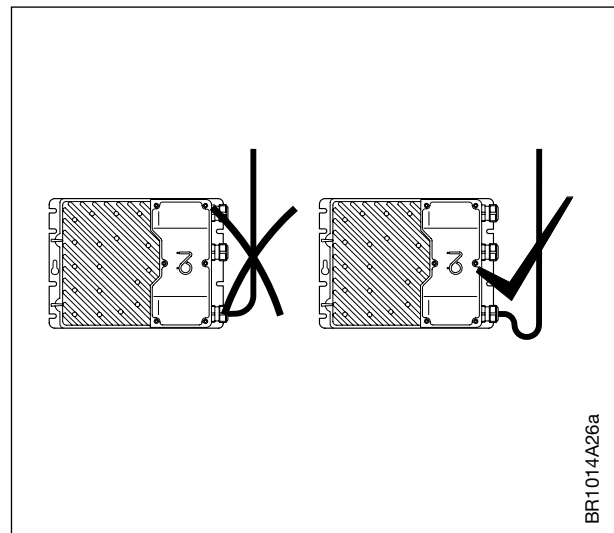


Figure 11.2



12. Electrical installation



Warning

- The OJ DV must only be installed and commissioned by trained/qualified personnel.
- Check that the data specified on the rating plate of the motor matches the data specified on the OJ DV rating plate.
- Incorrect electrical installation may cause a risk of severe or fatal personal injury.



Advarsel

12.1 Dangerous induced voltage (Windmilling)

- If natural drafts through the duct system cause the fan to rotate even when it has not received an operating signal (called windmilling), there is a risk that the motor will induce voltage on the OJ DV motor terminals, making them dangerous to touch.



Caution

12.2 EMC-compliant installation

- Always use shielded cables as motor cables.
- Shielded cable is not necessary for I/O signal cables and RS-485 interface cables.
- Cable shields must always be electrically connected to the earthed product enclosure.
- Use the internal, factory-fitted cable clamps to ensure proper shield connection.
- Never convey mains voltage, motor connections and control signals in the same cable.
- The +24 VDC from the OJ DV is not intended to be used as power supply for third party products. If the +24 is used for power supply to third party products, the product might not fulfill the EMC regulations.



Note

12.3 Short-circuit protection – Power supply

- Short-circuit protection for the supply side of the OJ DV is not provided together with the product.
- Correct short-circuit protection at the power supply input side on the OJ DV must always be used in accordance with local and international regulations.
- Short-circuit protection equipment must as a minimum have a tripping curve “C” conforming to IEC 60898-1.
- Short-circuit protection is supplied by the installer.



Warning

12.4 Personal protection - use of RCDs (TT-system), direct current (AC/DC) risk

This product can cause a DC current in the ground protective conductor in the event of a ground fault.

If the 3 phases to the OJ DV are not switched in at exactly the same time, then there will be a generated current in the earthing/ground conductor during the switching time until all 3 phases are connected.

Take notice of the following precautions:

- If a residual current device (RCD) is used for extra personal protection, use only an RCD of Type B on the supply side of this product (B type, for alternating and/or pulsating current with DC components and continuous fault current).
- RCDs of type B must comply with all provisions of IEC 61008/9
- Protective earthing of the OJ DV in combination with the use of RCDs must always be performed in accordance with the relevant local and international requirements, laws and regulations
- Failure to follow these precautions can lead to severe or fatal injuries to persons and animals.

**Warning****12.5 Potential equalisation**

- There is a risk of electrical interference if the ground potential between the OJ DV and the air handling unit or duct differ from each other.
- An equalisation conductor must always be fitted to prevent potential differences between system components.
- Recommended cable cross section: 10 mm².
- Lugs should be used, and the equalisation conductor should be attached to the OJ DV enclosure via one of the screws used to mechanically install the unit.

**Warning****12.6 Grounding hazard (PE) leakage current hazard**

Follow national and local regulations regarding protective earthing of equipment with a leakage current exceeding 3.5 mA.

The OJ DV technology causes switching at high frequency. This will generate a leakage current in the earth/grounding connection, PE. (PE=Protective Earth).

This ground leakage current is dependant on the different configurations, including RFI filtering, shielded motor cables and the motor type.

EN/IEC61800-5-1 (Power Drive System Product Standard) requires special emphasis because the leakage current in the OJ DV possibly exceeds 3.5 mA. See EN60364-5-54 paragraph 543.7 (Reinforced protective conductors for protective conductor currents exceeding 10 mA) for further information.

Earth/grounding connection must be made in one of the following 3 ways:

- When connecting only one (1) PE conductor, the minimum cross-section should be at least 10 mm², or
- When connecting 2 separate ground conductors, both should comply with the dimensioning rules.
- If 2 conductors are used, they must be connected to individual earth/grounding connectors in the OJ DV controller.
- External grounding connection. If the machine housing is approved as a grounding connector, then the OJ DV can be grounded to the machine.
- Grounding connectors must always be made in accordance with applicable local and international standards and directives.
- Follow all local and national electrical regulations for earth/grounding the OJ DV properly.
- Establish well-executed protective grounding for this OJ DV that has a leakage current exceeding 3.5 mA.
- A dedicated ground conductor is required for input power, motor power and control wiring.
- Use the clamps and connectors on the OJ DV for proper ground connections.
- Do not “daisy chain” the ground connection between 2 or more OJ DV controllers.
- Keep the ground conductor connections as short as possible.
- Always use shielded cables between the OJ DV and motor, to reduce electrical noise.
- Follow motor manufacturer wiring requirements.

**Note****12.7 Cable requirements**

- All cables and conductors used in connection with the OJ DV must comply with local and national rules and regulations.
- The OJ DV product line fulfils the “residential level” for emissions as per EN/BS-61000-6-3 and “industrial level” for immunity as per EN/BS-61000-6-2 with up to 5 metre shielded motor cables. (15 kW is limited to up to 4 metre motor cables). Longer motor cables can be used but it is the installer’s responsibility to ensure the standards in EN/BS-61000-6-2 are complied with. Industrial level for both immunity and emissions can be fulfilled, depending on the cable capacity as well as the motor capacity.
- A 6-core, unshielded, 30 AWG/0.066 mm² telecommunications cable can be used as a RS-485 interface cable.
- Generally, cable types with copper conductors are recommended.

- For recommended cable dimensions, see table 12.7.

Table 12.7					
Power cable *1					
	Cable gland	Cable diameter	Cable size, min.	Cable size, max.	Core sleeve/stripped min.
H1/H1x	M20	6-12 mm	3x1.5 mm ²	3x2.5 mm ²	10 mm
H3	M20	6-12 mm	4x1.5 mm ²	4x2.5 mm ²	10 mm
H4	M20	6-12 mm	4x1.5 mm ²	4x4 mm ²	10-15 mm
H5	M25	11-18 mm	4x2.5 mm ²	4x10 mm ²	10-18 mm
Motor cable *1					
	Cable gland	Cable diameter	Cable size, min.	Cable size, max.	Core sleeve/stripped min.
H1/H1x	M20	6-12 mm	3x1.5 mm ²	3x2.5 mm ²	10 mm
H3	M20	6-12 mm	4x1.5 mm ²	4x2.5 mm ²	10 mm
H4	M20	6-12 mm	4x1.5 mm ²	4x4 mm ²	10-15 mm
H5	M25	11-18 mm	4x2.5 mm ²	4x10 mm ²	10-18 mm
A/D control cable					
	Cable gland	Cable diameter	Cable size, min.	Cable size, max.	Core sleeve/stripped min.
H1/H1x	M20	6-12 mm	2x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H3	M20	6-12 mm	2x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H4	M20	6-12 mm	2x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H5	M20	6-12 mm	2x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
RS-485 interface round cable					
	Cable gland	Cable diameter	Cable size, min.	Cable size, max.	Core sleeve/stripped min.
H1/H1x	M16	4-8 mm	3x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H3	M16	4-8 mm	3x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H4	M16	4-8 mm	3x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
H5	M16	4-8 mm	3x2x0.7 mm ²	10x2x0.7 mm ²	10 mm
RS-485 interface ribbon cable					
H1 ... H5: Telecommunication cable/ribbon cable, 6-core, unshielded, 30 AWG/0.066 mm ²					

Note 1: Power and motor cables for OGF variants must be 90°C rated

Note 2: All cable dimensions are based on copper wires

12.8 Opening the OJ DV

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

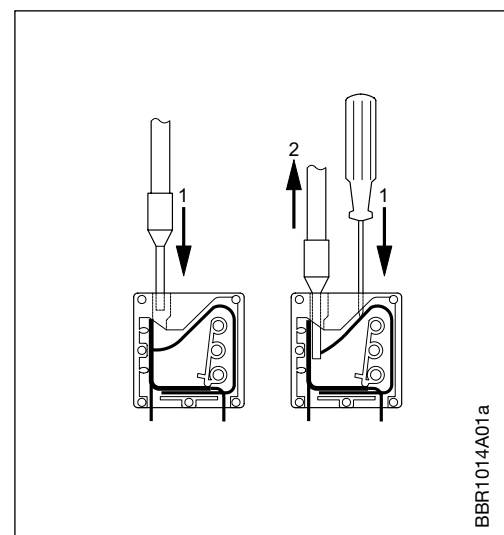
12.9 Cable entries – cable glands – strain relief

- The factory-fitted cable glands should be used when inserting power, motor and control cables into the OJ DV.
- Remember to re-tighten the cable glands to ensure ingress protection and strain relief.
- The RS-485 interface cable entry features 3-point strain relief, which must be used.

12.10 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 by carefully pushing the wire 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. 12.10.

Figure 12.10



- 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. 12.10.

12.11 Terminal and connector overview

Figure 12.11

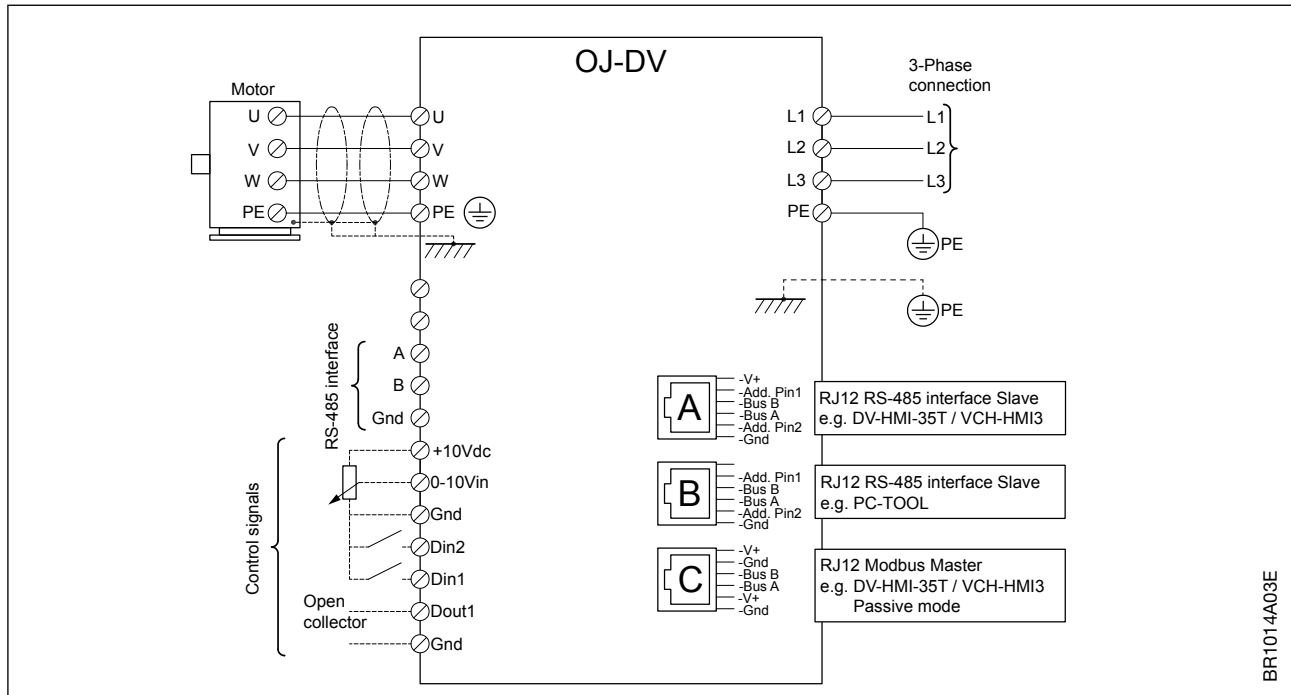
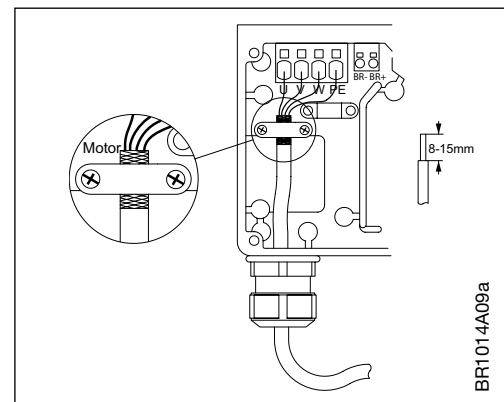


Figure 12.12

12.12 Motor connection

- The motor cable must be connected to the terminals marked "U", "V", "W" and "PE".
- When the stripped wire is properly inserted into the terminal (see section 12.10), the terminal tensions automatically with the correct torque.
- IMPORTANT! The motor cable must always be a shielded cable and the shield must be ended in the clamp intended for that purpose. See fig. 12.12.
- Remember to re-tighten the cable glands to ensure ingress protection and strain relief.



12.13 Mains voltage connection

- With 3-phase OJ DV units, connect the power cable to the terminals marked "L1", "L2", "L3" and "PE". See fig. 12.13.1. On 1-phase OJ DV units, the terminals are marked "L", "N" and "PE". See fig. 12.13.2.
- Pay special attention to section 13.6 in these instructions, in particular:
 - Earth/grounding connection must be made in one of the following 3 ways:
 - When connecting only one (1) PE conductor, the minimum cross-section should be at least 10 mm², or
 - When connecting 2 separate ground conductors, both should comply with the dimensioning rules.
 - If 2 conductors are used, they must be connected to individual earth/grounding connectors in the OJ DV controller.
 - External grounding connection. If the machine housing is approved as a grounding connector, then the OJ DV can be grounded to the machine.
 - Grounding connectors must always be made in accordance with applicable local and international standards and directives.
- It is recommended that the PE wire is 20 mm longer than the other wires in the cable. If the cable is accidentally pulled out of the OJ DV while there is voltage on the cable and terminals, the PE wire will then be the last to be disconnected. OJ DV is thus prevented from causing electric shock.
- When the stripped wire is properly inserted into the terminal (see section 12.10), the terminal tensions automatically with the correct torque.
- Remember to re-tighten the cable glands to ensure ingress protection and strain relief.

Figure 12.13.1

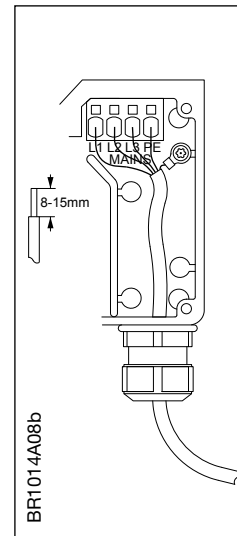
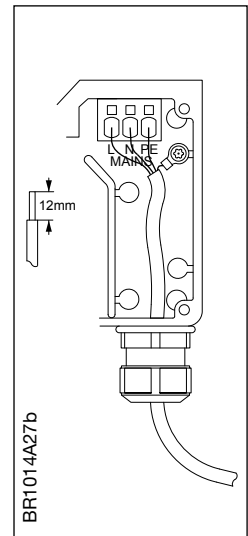


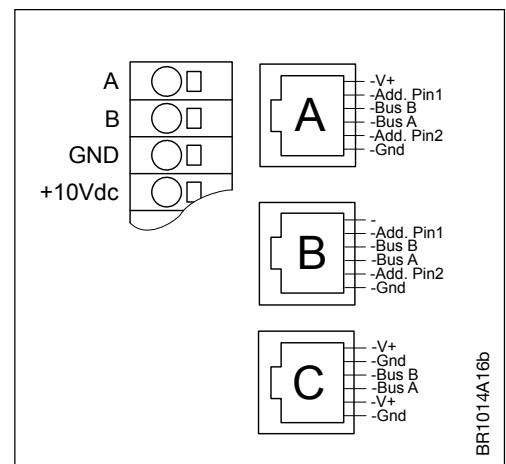
Figure 12.13.2



12.14 RS-485 interface connection

- The OJ DV uses two types of RS-485 interface controls: Modbus and a limited BACnet MS/TP. See Modbus and BACnet MS/TP Protocols for more information.
- The OJ DV is equipped with four connectors, three RS-485 connections, two RJ12 connectors and designated spring terminals and one Modbus connection.
- On the spring terminals for control signals (A/D I/O), the terminals for connecting RS-485 interface are marked "A", "B" and "GND". See fig. 12.14.1.
- Note:** "GND" must be used to ensure a proper signal.
- The RS-485 interface spring terminals are internally connected in parallel to the RS-485 interface pins in the RJ12 connectors marked "A" and "B".
- The three 3 RJ12 connectors are marked "A", "B" and "C".
 - "A": RS-485 interface connection, slave, +24 V voltage in connector.
 - "B": RS-485 interface connection, slave, no +24 V voltage in connector.
 - "C": RS-485 interface connection, master, external equipment, e.g. OJ-DV-HMI-35T / OJ-VCH-HMI3 in passive mode. See fig. 12.11.
- A 6-core, unshielded, 30 AWG/0.066 mm² telecommunications cable or similar type of ribbon cable can also be used for RS-485 interface communication.
- Attach RJ12 connectors to both ends using a special-purpose tool.

Figure 12.14.1



- The OJ DV is ready to be installed in to, either a daisy chain or star Modbus network. Every OJ DV has a preinstalled Modbus termination resistor of size 1 k Ω , which in most applications would be sufficient.
- Extra Modbus termination resistors are not to be used, except in installations where the Modbus exceeds >100 m in a daisy chain Modbus connection.
- If the Modbus exceeds >100 m, it might be necessary to install an extra Modbus termination resistor of size 180 Ω . This resistor is only to be installed in the last OJ DV in the chain.
- In Modbus star connection installations, a Modbus termination resistor is generally not to be used.
- IBACnet MS/TP can only be installed in a daisy chain connection.



Note

IMPORTANT! RJ12 connectors must be fitted to the ends in such a way that both connectors have the same colour sequence as the cable. See fig. 12.14.2.

12.15 A/D control signal connections

- Connect A/D control signals to the terminal strip, see fig. 12.15.1
- For further information on using the spring terminals, see section 12.10.
- The function/programming of A/D inputs and outputs can be changed via Modbus.
For further information on the Modbus protocol, see the OJ DV website at ojelectronics.com
- **+10Vdc** = Constant + 10 VDC for control signal and can be used as a supply source with a max. load of 10mA - higher loads can cause damage to drive.
- Short-circuit proof also short-circuit between +24 VDC and +10 VDC
- Tolerance $\pm 3\%$
- **0-10V In** = Analogue 0-10V control input for speed
 - Potentiometer, electrical connection, see fig. 12.15.2.
 - Potentiometer: min. 500 Ω , recommended 4.7 k Ω
 - Internal input impedance: 60 k Ω
- External controller, electrical connection, see fig. 12.15.3

Figure 12.14.2

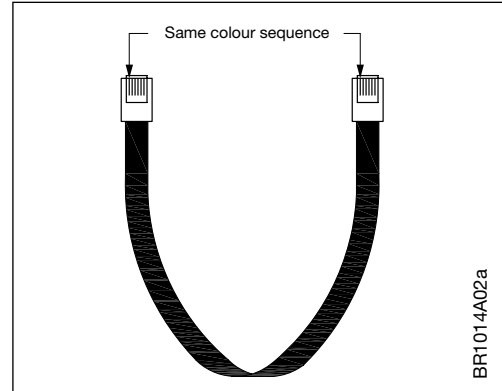


Figure 12.15.1

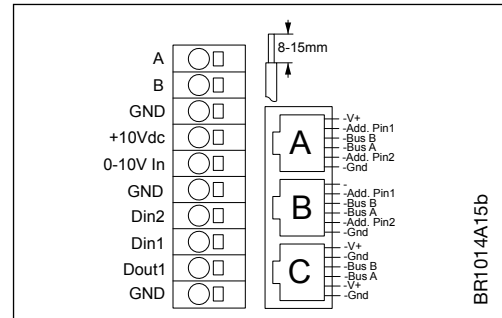


Figure 12.15.2

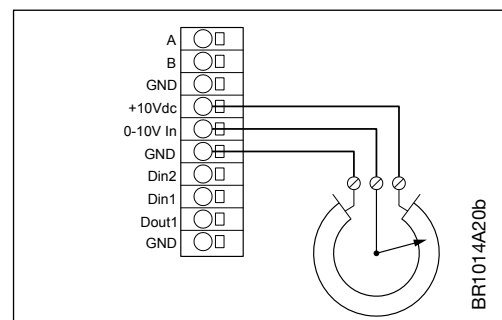
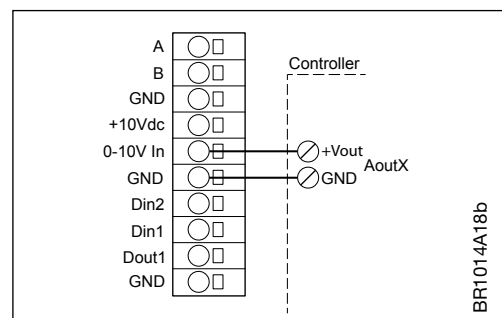


Figure 12.15.3



- **GND** = Ground (-)
- **Din2** = Alarm reset (*factory setting*)
 - Digital input
 - Internal input impedance: 60 k Ω
 - Electrical connection, see fig. 12.15.4
- **Din1** = Start/Stop (*factory setting*)
 - Digital input
 - Internal input impedance: 60 k Ω
 - Electrical connection, see fig. 12.15.4
- **Dout1** = Tacho Out; Open Collector (*factory setting*)
 - Digital output
 - Pull-up resistance range 1.5-22 k Ω
 - Pull-up voltage range 0-24 V DC
 - Pull-up current range 1-20 mA
 - Logical low for high stability after 1 ms
 - If EMC sensitive equipment is to be connected, then an external RC filter must be mounted with a time constant of 1 μ s.
 - Electrical connection, see fig. 12.15.5
- **GND** = Ground (-).

Figure 12.15.4

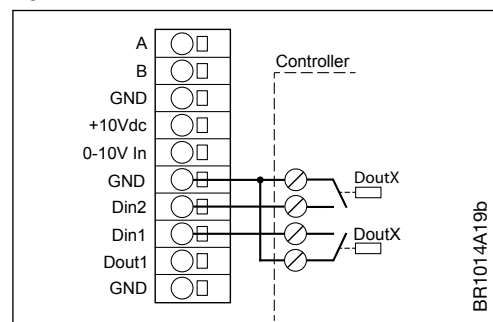
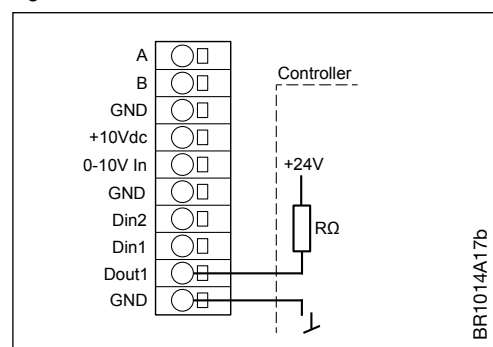


Figure 12.15.5



12.16 Closing of the OJ DV

- When all electrical connections have been correctly mounted, OJ DV can be closed again
- Be careful not to trap the wires when replacing the plastic cover.
- 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.

13. Checklist – mechanical and electrical installation

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

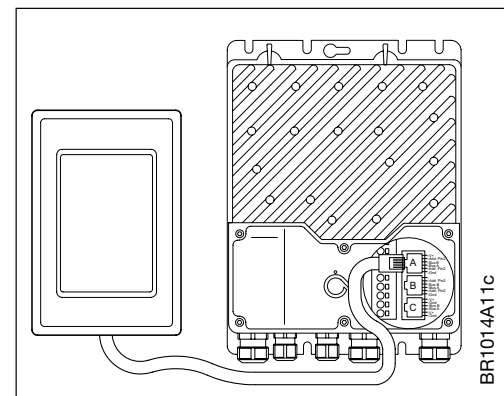
Item to be checked	Description of check	✓
Completion	Check that the entire installation is ready to be commissioned, both electrically and mechanically, before energizing the installation.	
	Check that no people or animals are present in the vicinity of moving parts.	
Product conformity	Check that the mains voltage on the supply terminals corresponds to the rated input voltage of the OJ DV.	
	Check the rating plates of the motor and OJ DV to ensure that the units have been sized correctly.	
Mechanical installation	Check that the OJ DV is correctly and securely attached to a flat surface. See Section 12 in this manual.	
	Check that there is a free, unobstructed passage of air to the cooling fins. See Section 12 in this manual.	
	Check that the blue plastic cover on the OJ DV 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.	

Item to be checked	Description of check	✓
Ambient conditions	Check that requirements on the surrounding environment have been met. Check that temperature and other environment specifications are observed. <i>See technical specifications, Section 25 in this manual.</i>	
Cabling	Check that all cabling has been fitted correctly and that motor and control cables are kept apart in separate cable conduits.	
	Check that the motor cable is a shielded cable and that its length is no longer than 5 metres.	
	Check that all cables are securely attached and relieved of tension and torsion.	
Electrical installation	Check that cables have been correctly inserted into the OJ DV and that the cable glands have been correctly tightened.	
	Check that the OJ DV voltage supply terminals have been connected to the correct mains voltage level.	
	Check that all cables are correctly ended and securely attached.	
	Check that all cables are free of visible damage throughout their length.	
	Check whether there are any loose connections, which may cause overheating and serious damage to the product and property.	
Mains voltage	Check that the mains voltage wires have been correctly fitted to the supply terminals: one-phase on terminals "L", "N" and "PE" and three-phase on terminals "L1", "L2", "L3" and "PE".	
	Check by means of voltage measurement that there is the correct voltage on the terminals.	
	Check short-circuit protection and supplementary protection.	
Motor connection	Check that motor cables are correctly connected to "U", "V", "W" and "PE" – and check that tightening torque is correct on the spring terminals of the motor.	
Control and signal wires	Check that control cables are ended correctly and securely attached.	
	Check that both ends of the RS-485 interface cable have been attached to the correct connectors.	
Shield	Check that the motor cable shield is ended correctly and use continuity measurement to check that the shield is connected to an active earth connection at both ends.	
Fuses and circuit breakers	Check that active short-circuit protection has been correctly fitted and sized.	
	Check that all safety equipment is operative and set correctly.	
Earthing	Check that all earth connections in the motor and the OJ DV are correctly connected and free of oxidation.	
	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.	

14. OJ-DV-HMI-35T: connection and functions

- The OJ DV range can be connected to an HMI-35T hand terminal via RS-485 interface RJ12 connector "A" and "C".
- If an HMI-35T is connected to terminal "A", it will act as a master to the OJ DV.
- Only one master at a time can be connected to the RJ12 connectors marked "A" and "B". It is thus not possible to connect both a hand terminal to connector "A" and an active Modbus communication cable to connector "B" at the same time.
- When connected to terminal "C" the OJ-DV-HMI-35T will be passive to the OJ DV acting as a screen for the DV. If the Modbus communication is lost between the BMS controller and OJ DV or the OJ-DV-HMI-35T is set to "Manual override", the OJ-DV-HMI-35T will be able to take over control of the OJ DV, until communication is re-established between the controller and the DV or "manual override" has been deselected.

Figure 14.1



Note

For further information, please refer to separate OJ-DV-HMI-35T instructions or contact OJ Electronics A/S.

15. OJ-DV-PC-Tool – connection and functions

- The OJ DV range can be configured using OJ-DV-PC-Tool, which must be connected to RS-485 interface RJ12 "B" or the spring terminals A, B and GND.
- OJ-DV-PC-Tool allows motor and controller parameters to be viewed and set, including:
 - Status: Control and operating parameters for connected OJ DV
 - Setup: Setting application parameters
 - Alarm: Read-out of alarm log for connected OJ DV
 - Modbus: Changing Modbus settings for and initiating BACnet SM/TP control for the OJ-DV
 - About: Read-out of software version no. and type for connected OJ DV
 - Config: Configuration of motor, input and output settings
 - Log data: Read-out of log files
 - Firmware: Updating firmware and motor/fan/user configuration
 - Motor: Configuring motor parameters
 - Fan: Configuring fan parameters
 - Hardware: Configuring OJ DV hardware

OJ-DV-PC-Tool is used solely by fan and system manufacturers.

For further information on OJ-DV-PC-Tool operation and menus, please refer to separate OJ-DV-PC-Tool instructions or contact OJ Electronics A/S.

16. Optional modules – connection and function

- Various optional modules can be connected to OJ DV, providing extra versatility where the unit is to be built into systems and applications that require additional inputs and outputs.

For further information on the possibilities offered by optional modules, contact OJ Electronics A/S.

17. Functions**17.1 Analogue/digital control**

- The OJ DV can be controlled via analogue/digital (A/D) inputs or via RS-485 interface.
- The factory setting is analogue/digital (A/D) control.
- Connect A/D control signals to the terminal strip, see section 12.15.1.

0-10V In

- Is used to control motor speed in relation to a 0-10V signal.

4-20mA

- Is used to control motor speed in relation to a 4-20mA signal. Note: an OJ-DV-IO-Module is required for this function

**Note**

- With A/D control, functions such as alarm read-out and acknowledgement are still possible via RS-485 interface even though "Protocol control" is not activated.
- The relationship between the 0-10V control signal and motor speed depends on the settings for min./max. speed and ramp up/ramp down times. See figs 17.1 and 17.2.
- The "+10Vdc", "0-10V In" and "GND" terminals can be connected to a potentiometer, see electrical connection in fig.12.15.2.

The function of the digital inputs and outputs has been defined by OJ Electronics A/S as follows:

- Din1 = Start/Stop (1 = Start)
- Din2 = Alarm reset (1 = Alarm reset)
- Dout1 = Tacho Out (1 pulse per motor revolution)

**Note**

The digital inputs and outputs can be given alternative functions via Modbus.

Relationship between control signal (0-10V In) and speed – see fig. 17.1.

The control signal regulates motor speed between the set minimum and maximum speeds (AC motor=Hz; PM motor=rpm) and the set ramp times – see fig.17.2.

Figure 17.1

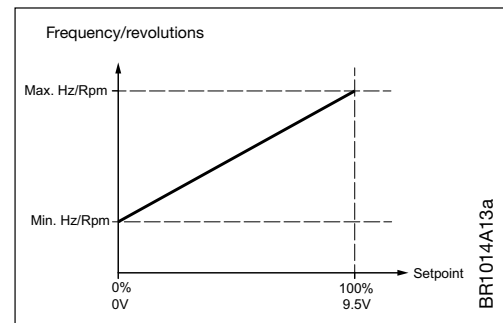
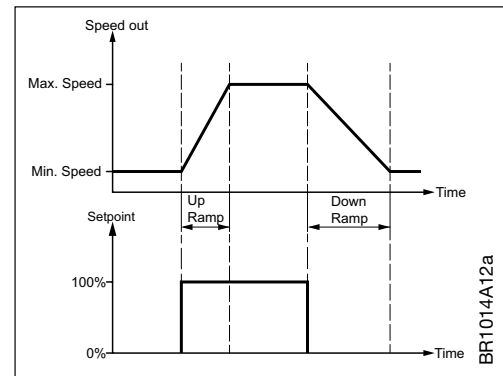


Figure 17.2

**17.2 RS-485 interface control**

- The OJ DV can be controlled via Modbus or BACnet MS/TP commands according to the Modbus and BACnet MS/TP protocols. (Note: BACnet MS/TP does not have the full range of commands as Modbus).
- BACnet MS/TP needs to be selected via Modbus or OJ-DV-PC-Tool.
- Control of motor speed via RS-485 interface communication is factory disabled.
- If the OJ DV is to be controlled via RS-485 interface, Coil Stat Bit register 8 must be set to "0" = "Protocol control".
- Other functions, such as alarm read-out and acknowledgement, are still possible via RS-485 interface even though "Protocol control" is not activated.
- *NOTE! See OJ Electronics OJ DV web page for Modbus and BACnet MS/TP Protocols.*

17.3 Switching frequency

Switching frequency is crucial in determining the amount of audible acoustic noise emitted by the OJ DV.

The higher the switching frequency, the less audible noise will be emitted by the OJ DV. At the same time, however, internal losses will be increased, reducing efficiency.

The OJ DV can be set to operate constantly with a switching frequency of either 4 kHz or 8 kHz, or it can be set to change switching frequency automatically depending on motor speed (AUTO setting).

Switching frequency (switching mode) is set via Modbus:

- Setting "4kHz" = Constant 4kHz switching frequency
- Setting "8kHz" = Constant 8kHz switching frequency
- Setting "AUTO" = Switching frequency is changed automatically:
 - At motor speeds higher than 60% of rated speed, switching frequency is changed to 4 kHz
 - At motor speeds lower than 50% of rated speed, switching frequency is changed to 8 kHz
 - The higher set point can be changed using OJ-DV-PC-Tool. The lower set point is automatically set to 10% less.

17.4 Braking power

The electronics within the OJ DV can as a starting point supply braking power corresponding to its own consumption. It is expected that an air flow capable of maintaining typically up to 30% of nominal fan speed can be braked by this function.

17.5 Fire mode

Fire mode designates a function in which the OJ DV is kept in operation by an emergency program which disables the alarm monitor.

Among other things, the function can be used in connection with smoke extraction from a burning property. When fire mode is activated, an extraction fan will continue to remove smoke from the property for as long as possible. The fire mode function can be activated via RS-485 interface or

digital input.

In fire mode, the OJ DV is able to maintain operation for at least an hour, even when the OJ DV and the fan motor are overheated (max. 70°C).

There are three different fire mode to choose from; normal-, max-, and analog fire mode.

Normal fire mode

All warnings and alarms in the OJ DV will be ignored and the OJ DV output to the motor remains the same value as it was just before the fire mode condition was activated. If the OJ DV is controlled via RS-485 interface and there is a communication failure when in normal fire mode, the output signal to the motor will have the same value as just before the RS-485 interface communication was disconnected. The DV continues to deliver voltage & current to the motor as long as possible until the OJ DV is powered off and the digital input go back to the normal position.

If the motor is not operating when normal fire mode is activated, the motor will remain stopped.

Max fire mode

All warnings and alarms in the OJ DV will be ignored and the OJ DV will go to the max. output frequency (for AC motor) or max. RPM (for PM motor).

The motor will continue to work this way for as long as possible and until the OJ DV is powered off and the digital input returns to the normal position. Even if the motor is not operating when fire mode is activated, the output to the motor goes to the maximum rotation speed defined.

Analog fire mode

If the 0-10V analog input detects 9V or higher, fire mode is activated even if the analog input is reduced below 9V again. All warnings and alarms in the OJ DV will be ignored and the motor will run at max. speed as long as possible or until the OJ DV is powered off and the analog input is below 9V again.

17.6 Frequency converter mode – for asynchronous motors

The OJ DV factory-set to frequency converter mode for standard asynchronous induction motors (AC-IM) and the control mode is 0-10VDC input. This can be changed using the OJ-DV-PC-Tool or OJ-DV-HMI-35T.

If you use the OJ DV in frequency converter mode, you must connect a standard 3 phase~ AC-IM motor. Pay special attention to the information that you will find on the nameplate of the motor.

The voltage output from the OJ DV is for the OJ-DV-1005.....OJ-DV-1011 maximum 250 VAC.

For the OJ-DV-3015.....OJ-DV-3150 the maximum voltage output is 364 VAC.

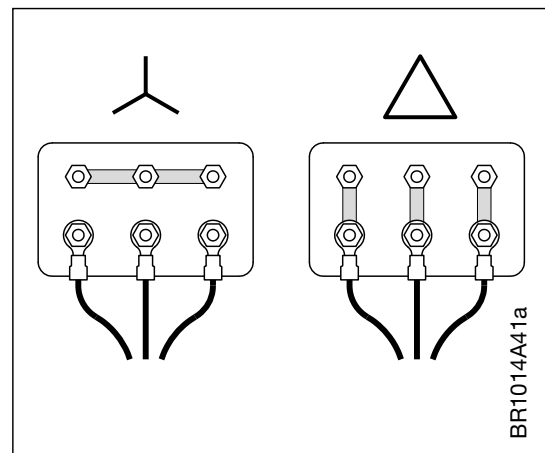
If the supply voltage is higher than the rated voltage of the single windings in the connected motor, then the motor will be damaged.

Pay special attention if the motor is connected in “star” or “delta” connections.

On a standard AC-IM motor, the “star”/“delta” connection often can be changed by rearranging the jumpers on the motor terminal, see figure 17.6.1

With the OJ DV in frequency converter mode, it is the installer’s responsibility to enter the correct control and motor parameters.

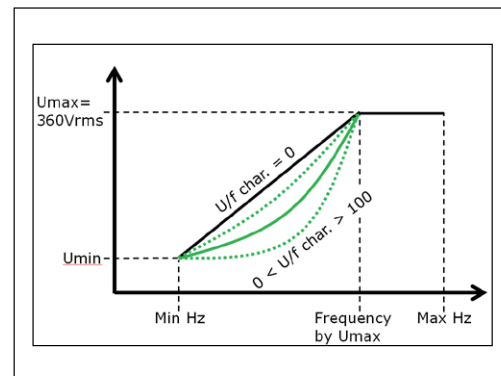
Figure 17.6.1



Pay special attention to the following parameters:

Minimum frequency	Even if the control signal is e.g. 0% or 0.0V and the OJ DV has an activated start signal, the motor will not run slower than the value in this parameter.
Maximum frequency	Even if the control signal is e.g. 100% or 10.0V and the OJ DV has an activated start signal, the motor will not run faster than the value in this parameter.
Ramp-up time	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, the OJ DV could possibly trigger a current limit alarm
Ramp-down time.	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. If this ramp-down is too short, the OJ DV will use power to stop or slow down the motor. This could possibly trigger a current limit alarm from the OJ DV.
Switch frequency	Switch frequency is a parameter that has an influence on the efficiency and the audible noise from the connected motor and/or the OJ DV controller. In the OJ DV it is possible to select "Auto", "4 kHz" or "8 kHz". Activating the "Extra high" Modbus parameter makes it possible to select "Auto", "4 kHz" or "10 kHz". The higher the switch frequency, the lower the audible noise from the OJ DV controller system, but the consequence of lower audible noise is decreasing efficiency of the OJ DV controller system. In "Auto" the OJ DV will automatically switch between "4 kHz" and "8/10 kHz". During start-up from 0 – 60% speed, the switch frequency will be "8/10 kHz" and this will make for less audible noise from the connected motor and/or the OJ DV controller. When the speed has increased and passes 60%, the switch frequency will then switch to "4 kHz". The noise from the fan and airflow will now drown out the audible noise from the OJ DV controller system. In the speed-down sequence, the OJ DV will switch to "8/10 kHz" when the speed of the motor passes 50% downwards. It is also possible to select a fixed switch frequency of "4 kHz" or "8/10 kHz".
U-min Hz	This parameter selects the voltage to the motor at minimum frequency.
Freq U-max	This parameter selects the frequency to the motor at maximum voltage.
U/f characteristic	<p>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 100 the ratio is parabolic (See Figure 17.6.2). Factory set is 75.</p> <p>A motor with a poor efficiency may require a higher U/f characteristic (a lower number than 75)</p>

Figure 17.6.2



For further information about parameters in the OJ DV, see Modbus and BACnet MS/TP protocols.

17.7 Electronically commutated mode (EC mode) – for PM

The OJ DV factory-set to frequency converter mode for standard asynchronous induction motors (AC-IM) and the control mode is 0-10 VDC input.

This can be changed using the OJ-DV-PC-Tool or OJ-DV-HMI-35T (Hand terminal).

The difference between an AC-IM motor and a PM-SM is basically the rotor.

In the PM-SM motor, the windings in the rotor are replaced with permanent magnets, but the control system has to be and is very different. Due to the permanent magnets in the rotor, they will induce voltage in the stator windings as they rotate and as a result also voltage back to the controller. This is what is called back EMF (EMF = electromotive force) and describes an important and special characteristic of the motor.

The controller has to be able to handle this back EMF and that is why you cannot control a PM-SM

motor with an OJ DV controller in frequency converter mode.

Before operation, select and load the correct fan and motor parameter files using the OJ-DV-HMI-35T or OJ-DV-PC-Tool. It is the installer's responsibility to enter the correct control and motor parameters.

Pay special attention to the following parameters:

	Even if the control signal is e.g. 0% or 0.0V and the OJ DV has an activated start signal, the motor will not run slower than the value in this parameter.
Maximum rpm	Even if the control signal is e.g. 100% or 10.0V and the OJ DV has an activated start signal, the motor will not run faster than the value in this parameter.
Ramp-up time	Ramp-up time is the time (in seconds) between 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 upwards jumps between speed setpoints. If this ramp up is too short, the OJ DV possibly could trigger an current limit alarm.
Ramp-down time	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. If this ramp-down is too short, the OJ DV will use power to stop or slow down the motor. This could possibly trigger a high voltage alarm (Vhi), from the OJ DV.
Switch frequency	Switch frequency is a parameter that has an influence on the efficiency and the audible noise from the connected motor and/or the OJ DV controller. In the OJ DV it is possible to select "Auto", "4 kHz" and "8 kHz". The higher the switch frequency, the lower the audible noise from the OJ DV controller system, but the consequence of lower audible noise is decreasing efficiency of the OJ DV controller system. In "Auto" the OJ DV will automatically switch between "4 kHz" and "8 kHz". During start-up from 0 - 60% speed, the switch frequency will be "8kHz" and this will make for less audible noise from the connected motor and/or the OJ DV controller. When the speed has increased and passes 60%, the switch frequency will then switch to "4 kHz". The noise from the fan and airflow will now drown out the audible noise from the OJ DV controller system. In the speed-down sequence, the OJ DV will switch to "8 kHz" when the speed of the motor passes 50% downwards. It is also possible to select a fixed switch frequency of "4 kHz" or "8 kHz". In the speed-down sequence, the OJ DV will switch to "8/10 kHz" when the speed of the motor passes 50% downwards. It is also possible to select a fixed switch frequency of "4 kHz" or "8/10 kHz".

For further information about parameters in the OJ DV, see Modbus and BACnet MS/TP protocols.

17.8 Jumping frequency

In an application with resonance problems, it is possible to avoid the frequencies that trigger the resonance.

By programming the OJ DV, it is possible to avoid three different frequency bands.

1. Low1 rpm/Hz – High1 rpm/Hz: the rpm/Hz between Low1 and High1 will be avoided.
2. Low2 rpm/Hz – High2 rpm/Hz: the rpm/Hz between Low2 and High2 will be avoided.
3. Low3 rpm/Hz – High3 rpm/Hz: the rpm/Hz between Low3 and High3 will be avoided.

These three low and high rpm/Hz frequency bands must be configured via PC Tool, UDF or Modbus.

Example: There is resonance in the application at 250 rpm. Program Low1 = 245 rpm & High1 = 255 rpm, and the OJ DV will not let the motor run at a rpm between 245 and 255 rpm in other words; the OJ DV jumps over the troublemaking 250 rpm.

Tip: If there are problems with resonance at a specific rpm, there may also be problems at double the rpm. If so, use the second frequency band to avoid that too.

17.9 Dual speed digital input

If only two speeds are needed, dual speed can be controlled by using digital input. When the chosen digital input is open the low speed is selected and the high speed when closed. High and low speeds

must be configured through the UDF or PC tool.

18. Built-in protection

- If the temperature inside the OJ DV exceeds 95°C, the OJ DV will attempt to reduce its internal heat generation by reducing motor speed (rpm).
- The OJ DV has built-in current limitation for the protection of motor and cables and cannot therefore supply more current than it is set to.
- In the event of lacking phase on the supply input, the OJ DV will reduce speed and activate a non-critical alarm.
- The OJ DV motor output terminals are short-circuit protected against phase-to-phase short circuiting.

19. Alarms

The OJ DV has a built-in warning and alarm monitor, which monitors optimal fault-free operation and triggers a warning or alarm if operating or performance problems are observed.

Warnings are “non-critical” alarms that reduce motor performance, whereas alarms are “critical” and will stop the OJ DV. Once the alarm situation passes, the alarm will automatically reset and the OJ DV will restart.

If the maximum number of restarts (factory setting: 5 times/60 min.) is exceeded, the alarm must be reset manually. The alarm can be reset by means of a RS-485 interface command, via an OJ-DV-HMI-35T or it will automatically reset if the power is disconnected for longer than 60 seconds.

Warnings and alarms can be read via the OJ-DV-HMI-35T or RS-485 interface.

Alarm overview, see table 19.1.

Alarm overview	Trigger	Alarm priority	Motor operation/ response
Supply voltage too low	<ul style="list-style-type: none"> ✓ Supply voltage to the OJ DV is too low. ✓ The OJ DV is mistakenly connected to mains voltage 3 x 230VAC. 	Alarm	"RP"
Supply voltage too high	<ul style="list-style-type: none"> ✓ Supply voltage to OJ DV is too high. 	Alarm	"SA5"
The motor's power use is too high	<ul style="list-style-type: none"> ✓ Short circuit in motor cable. ✓ Short circuit in one or more motor windings. 	Alarm	"SA5"
Internal temperature in the OJ DV too high (>95 °C)	<ul style="list-style-type: none"> ✓ Cooling of the OJ DV enclosure too low. ✓ Insufficient air circulation around the OJ DV. ✓ Air temperature around the OJ DV is too high. 	Warning	"RP"
Phase error; one phase disconnected (L1, L2, L3)	<ul style="list-style-type: none"> ✓ Missing phase in supply voltage to the OJ DV ✓ Large imbalance in supply voltage. 	Warning	"RP"
Blocked rotor	<ul style="list-style-type: none"> ✓ The rotor is unable to rotate due to a mechanical blockage of the rotor or fan. 	Alarm	"SA5"
Motor power has reached it's limit	<ul style="list-style-type: none"> ✓ The OJ DV has reached the limit for maximum output power. ✓ The connected motor is larger than allowed for the chosen OJ DV. ✓ The load is too big for the connected motor. 	Warning	"RP"
Earth fault (Only OJ-DV-3110 & OJ-DV-3150)	<ul style="list-style-type: none"> ✓ Earth fault on motor cables or motor windings. 	Alarm	"SA5"
Running in the wrong direction	<ul style="list-style-type: none"> ✓ Windmilling in the opposite direction during the start up process. 	Alarm	"SA5"
Fault in internal EEPROM circuit	<ul style="list-style-type: none"> ✓ Incorrectly chosen configuration file - tried to download a configuration file which is not contained in the OJ DV. ✓ The OJ DV is defective. 	Warning	"RP"
Phase error in motor supply (U, V, W)	<ul style="list-style-type: none"> ✓ One or more motor phases / motor cables is disconnected. ✓ One or more motor windings is disconnected. 	Alarm	"SA5"

Table 19.1			
Alarm overview	Trigger	Alarm priority	Motor operation/ response
Internal communication fault	<ul style="list-style-type: none"> ✓ During the process of updating the MOC configuration file, communication was inadvertently disconnected. ✓ If the alarm goes off during normal operation, it usually indicates a defective OJ DV. 	Alarm	"SA5"
Ripple voltage too high	✓ Imbalance on voltage supply.	Warning	"RP"
External 24VDC supply overloaded.	✓ Overloading or short circuit on +24V voltage supply.	Warning	"RP"

Abbreviations:

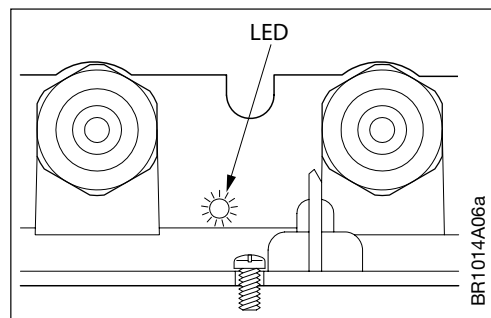
"RP"=Reduced performance

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

20. LED indications

- The OJ DV is equipped with a two-colour LED which indicates operating status.
- The LED is located on the underside of the OJ DV beside the entry for the mains cable.
See fig. 20.1.
 - Lights constantly green when mains voltage is connected
 - Flashes green when RS-485 interface communication is active
 - Lights constantly red when at least one critical alarm is active
 - The LED can be set (Show alarm on LED) by Modbus or OJ-DV-PC-Tool to flash in a sequence to indicate where the error has arisen.
 - 1 Flash = Supply issue
 - 3 Flashes = Internal DV issue
 - 5 Flashes = Motor issue
 - Flashes red when at least one non-critical alarm is active

Figure 20.1



21. Modbus addressing of the OJ DV

Modbus addressing of the OJ DV can be accomplished in two different ways.

- Via the addressing pins of the "A" or "B" connectors – see fig. 12.14.1 and table 21.1.

Table 21.1				
Add. Pin. no.	0X36 (54 dec)	0X37 (55 dec)	0X38 (56 dec)	0X39 (57 dec)
Add.Pin1				
Add.Pin2				



= No connection between "GND" and Add.Pin1/ Add.Pin2



= Connection between "GND" and Add.Pin1/ Add.Pin2

- Via OJ-DV-PC-Tool, where the OJ DV can be set to other Modbus addresses – see *instructions for OJ-DV-PC-Tool*.

Modbus communication

- OJ DV is supplied with the factory setting (see table 21.2):

Table 21.2			
	Setting range	Unit	Factory settings
Address	1-247	n/a	54 dec
Baud rate	9.6, 19.2, 38.4, 57.6, 115.2	kbs	38.4 kbs
Parity	None, Odd, Even	n/a	None
Stop bit(s)	One, Two	n/a	One
Communication timeout	0-240	Sec.	10

- OJ DV supports the following commands (see table 21.3):

Table 21.3	
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 OJ DV via Modbus are rounded off to the nearest valid value.

Detection of active Modbus

- The OJ DV automatically detects valid Modbus communication on the Modbus inputs (RJ12 connector or “A” & “B” terminals on the terminal strip).
- The OJ DV will first detect on the communication parameters: ID 54, 38.4 –None-One
- Alternative communications parameters can be set using the Modbus register.
- After 10 seconds without receiving a valid Modbus request with the default parameters, the DV will try to detect a Modbus request with the alternative parameters.
- The Modbus protocol for the OJ DV can be found on the OJ DVs web page

22. BACnet MS/TP

BACnet MS/TP can only be used for the operation of the OJ DV. When the application specific configurations (Digital Inputs etc.) needs to be set in the OJ DV, only the Modbus interface or OJ-DV-PC-Tool can be used.

BACnet communication parameters

BACnet communications parameters can be set using OJ-DV-PC-Tool or Modbus

Table 22			
	Setting range	Unit	Factory settings
Baud rate	9.6, 19.2, 38.4, 57.6, 115.2	kbs	115.2 kbs
BACnet MAC	0-127	1	0
BACnet MaxMaster	1 - 127	1	1
Device Object ID	0 - 4194302	1	0

The OJ DV can be configured to automatically detect valid BACnet MS/TP communication on the RS-485 interface RJ12 connectors “A” & “B” or sprint terminals 1(A), 2(B) and 3(GND).

- After 10 seconds without detecting an active BACnet MS/TP network, the DV will try to detect a different communication protocol.

- The BACnet MS/TP protocol for the OJ DV can be found on the OJ DVs web page

23. Maintenance

- 23.1. The OJ DV is maintenance free under normal operating conditions and load profiles.
- 23.2. The cooling fins must be kept free of dust, dirt and other foreign matter so that air can pass freely over them. Deposits of dust, dirt or other foreign matter on and between the cooling fins will prevent cooling of the OJ DV and thus impair performance.



Caution

- 23.3. The cooling fins may become very hot. (Max. 95°C under normal operating conditions.)



Warning

- 23.4. The OJ DV cannot be repaired on site. Never attempt to repair a defective unit. Contact your supplier

to obtain a replacement.

23.5. Additional technical data are available on request from OJ Electronics A/S.

24. Troubleshooting



Warning

- 24.1. Before opening the OJ DV, the mains voltage must be disconnected for at least 3 minutes to ensure there is no risk of dangerous residual currents in electronic circuits or capacitors.
- 24.2. If natural drafts through the duct system cause the fan to rotate even though it has received no operating signal, there is a risk that the motor will induce voltage on the OJ DV motor terminals, making them dangerous to touch.
- 24.3. Troubleshooting when the OJ DV is controlled via A/D signals:

Symptom	Cause	Action
Motor inoperative	Lacking supply voltage	Check the voltage supply to the OJ DV terminals "L" and "N" on 230V models (H1) or terminals "L1", "L2" and "L3" on 3x400V and 3x230V models (H3...H5). (Nominal supply voltage is stated on the rating plate.)
		Check whether short-circuit protection has been activated.
		Check that the voltage supply to the OJ DV has not been cut off by other components.
	Poor electrical connections	Check electrical connections.
	Wrong motor for the OJ DV setup	Check that the correct motor settings have been read into and stored in the OJ DV setup.
	Lacking operating signal	A/D control: Check that the OJ DV can receive an operating signal. With A/D control, the OJ DV must have a signal connected to the "Start/Stop" input – digital input Din1 or Din2 depending on the setup.
	Lacking 0-10VDC control signal	Check that an operating signal is connected to "0-10V In".
		Potentiometer control: Check that the potentiometer is correctly connected to terminals "+10Vdc", "0-10V In" and "GND" on the terminal strip.
	Active alarm	Read out active alarms and remedy their cause.
Motor running in wrong direction	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 power supply to the OJ DV and reconnecting it after approx. 60 seconds.
	Defective OJ DV controller	Replace the OJ DV. Never attempt to repair a defective OJ DV controller. Contact your supplier for replacement/repair.
	Defective motor	Replace motor.
Motor running in wrong direction	Wrong phase sequence in motor cable	Interchange two phase wires on the motor or the OJ DV terminal strip.
The OJ DV noisier than acceptable	Switching frequency too low	Increase switching frequency. 0 = Auto 1 = Low = 4 kHz 2 = High = 8 kHz Increasing switching frequency increases losses within the OJ DV, thus reducing efficiency. The OJ DV switching frequency can be changed via OJ-DV-HMI-35T, Modbus or OJ-DV-PC-Tool.

Symptom	Cause	Action
The OJ DV cuts out due to an alarm	At least one alarm active	Use OJ-DV-HMI-35T 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 power supply to the OJ DV and reconnecting it after approx. 60 seconds.
	The alarm is re-activated after reset	Use OJ-DV-PC-Tool to view the alarm and determine which alarm has stopped the controller/motor.
		Remedy the cause of repeated alarm activation.

24.4. Troubleshooting when the OJ DV is controlled via RS-485 interface :

Symptom	Cause	Action
Motor inoperative	Lacking supply voltage	Check the voltage supply to the OJ DV terminals "L" and "N" on 230V models (H1) or terminals "L1", "L2" and "L3" on 3x400V and 3x230V models (H3...H5). (Nominal supply voltage is stated on the rating plate.)
		Check whether short-circuit protection has been activated.
		Check that the voltage supply to the OJ DV has not been cut off by other components.
	Poor electrical connections	Check electrical connections.
	Wrong motor for the OJ DV setup	Check that the correct motor settings have been read into and stored in the OJ DV setup.
	Lacking operating signal	Check that OJ DV can receive an operating signal. Coil Stat Bits Register 0X0001: Motor start/stop (1=On).
	Speed set point has not been set	Check the RS-485 interface control signal at Modbus address: Holding registers; Register 3X0001 or BACnet Integer Value, IV:0 PrcSet 0-10000 (0-100%).
	The motor has been stopped 5 times by the built-in motor protector because of overloading	Reset alarm: Coil Stat Bits Register 0X0002: Reset (1 pulse = Reset). The alarm can also be reset by disconnecting the power supply to the OJ DV and reconnecting it after approx. 60 seconds.
	Defective OJ DV controller	Replace the OJ DV. Never attempt to repair a defective OJ DV controller. Contact your supplier for replacement/repair.
	Defective motor	Replace motor.
Motor running in wrong direction	Wrong phase sequence in motor cable	Interchange two phase wires on the motor or the OJ DV terminal strip.
The OJ DV noisier than acceptable	Switching frequency too low	Increase switching frequency. 0 = Auto 1 = Low = 4 kHz 2 = High = 8 kHz Increasing switching frequency increases losses within the OJ DV, thus reducing efficiency. The OJ DV switching frequency can be changed via OJ-DV-HMI-35T, Modbus or OJ-DV-PC-Tool.
The OJ DV cuts out due to an alarm	At least one alarm active	Use OJ-DV-HMI-35T 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 power supply to the OJ DV and reconnecting it after approx. 60 seconds.
	The alarm is re-activated after reset	Read out the alarm via RS-485 interface registers and determine which alarm has stopped the controller/motor.
		Remedy the cause of repeated alarm activation.

25. Storage

The OJ DV should be stored indoors, if possible in the original packing. Recommended: a dry

room with temperatures between -40°C and +50°C and a relative humidity below 70%. When the OJ DV is stored as recommended, the drive can be stored for years from the date of manufacture.

26. Disposal

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



27. Fuse and Circuit Breaker Specifications

27.1 Overcurrent protection

Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to local and national regulations. Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 480V maximum. Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10,000 Arms (symmetrical), 480 V maximum; or the value rated on the individual circuit breaker.





27.2 UL / Not UL Compliance

Use the breakers or fuses listed below in table 25.1 to ensure compliance with UL or IEC 61800-5-1. Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10,000 Arms (symmetrical), 480 V maximum. In the event of malfunction, failure to follow the protection recommendation may result in damage to the drive / frequency converter. Circuit breaker must comply with UL 489.

27.3 Circuit breaker and fuse rating

Enclosure	Nominal power rating	Circuit breaker		Fuses	
		Rec. UL	Max. UL	Rec. UL	Max. non-UL
				Type	
				RK5, RK1,J, T,CC	gG
H1	0.55	4	15	6	16
	0.75	6	20	6	16
	1.1	8	30	15	16
H1x	1.3	10	35	15	16
H3	1.5	4	15	6	16
	2.4	6	20	6	16
	3.0	8	25	15	16
H4	4.0	10	35	15	16
	5.5	15	50	20	16
	6.5	15	60	25	16
	7.5	20	70	25	16
H5	11.0	30	100	35	32
	15.0	35	125	40	40

28. Technical specifications

	Type	DV-1005	DV-1007	DV-1011	DV-1013	DV-3015	DV-3024	DV-3030	DV-3040	DV-3055	DV-3065	DV-3075	DV-3110	DV-3150
Enclosure		H1			H1x	H3			H4				H5	
Power size	kW	0.5	0.75	1.1	1.3	1.5	2.4	3.0	4.0	5.5	6.5	7.5	11	15
Horsepower	Hp	0.7	1.0	1.5	1.7	2.0	3.2	4.0	5.4	7.4	8.7	10.0	14.7	20.1
Efficiency	%	> 94%				> 96.5%			> 96.5%				> 97.5%	
Power supply														
Voltage	VAC	1 x 230 VAC 50/60 Hz +/-10%				3 x 208 - 240 VAC 50/60 Hz +/-10% *1 3 x 380 - 480 VAC 50/60 Hz +/-10%								
Supply current at max. load at nominal supply voltage (400V/480V)	A	3.0	4.4	6.5	8.5	3.1/2.6	5.0/4.2	6.3/5.2	8.4/7.0	11.5/9.6	13.6/11.3	15.7/13.1	23/19.1	31.1/26.1
Power factor (cos-phi) at max. load		> 0.99 (Active PFC)				> 0.9								
Motor output														
Nominal motor power (on shaft) *2	kW	0.5	0.8	1.15	1.3	1.5	2.4	3.0	4.0	5.5	6.5	7.5	11	15
Frequency	Hz	AC motor: 0-120 PM motor: 0-400												
Max. output voltage	Vrms	3 x 0 - 250 VAC				3 x 0 - 0.9 x Vin								
Max. output current	Arms	2	3.2	4.5	5.2	4.5	6.4	7.8	10.0	12.0	15.0	19.0	27	35.0 *3
Protection														
Max. fuse	A	16											32	
Short circuit capacity	A	1000	1000	2000	2000	2000	3500	3500	3500	3500	5000	5000	5000	5000
FLA	A	3.6	5.3	7.8	9.2	3.3	5.2	6.6	8.7	12.0	14.2	16.4	23.8	32.5
Motor output		Short-circuit protected between phases												
Motor		Protected by current limit												
Over-voltage protection		Yes, 400 V (PTC)				Yes, 565 V								
Overload protection		Current and temperature overload protection												
Environment														
Operating temperature	°C	-40°C to +50°C												
Starting temperature	°C	-40°C to +50°C												
Storage temperature	°C	-40°C to +70°C												
Dimensions	mm	185 x 230,5 x 90 mm			185 x 265 x 125 mm	185 x 265 x 100 mm			220 x 294 x 107 mm				244 x 399 x 144 mm	
Protection rating		IP 54 & 65 / Type 4x												
Enclosure material		Aluminium												
Front cover		Plastic												
Weight	kg	2.0			3.6	3.0			3.9				9.5	
Humidity	% rh	10-95% rh, non-condensing												
Surface		Corrosion resistant to 12944-2:1998 Category C4												
Air flow / cooling		Turbulent air speed of min. 3 m/s to achieve max. output power at max. ambient temperature. Turbulent air speed below 3m/s and higher ambient temperature might lead to reduced output power. (3m/s turbulent air speed is equivalent to 6,5m/s laminar air speed)												
Interfaces														
Modbus RTU		RS485 (baud rate: 9.6, 19.2, 38.4, 57,6 115.2 Kbaud)												
BACnet MS/TP		Baud rate: 9600, 19200, 38400, 57600, 115200 kbs MAC: 0 - 127, MAX Master: 1 -127, Device object ID: 0 - 4194302												
Digital Communication	Slave	2 x RJ12 & 3 x spring terminal												
Digital Communication	Master	1 x RJ12 connection												
Analogue In 1		0-10 VDC, 100% @ 9.5 VDC +/-2%												
Analogue Out 1		+10 VDC												
Digital In 1		Start/stop with internal pull-up												
Digital In 2		Alarm reset												
Digital Out 1		Tacho: 1 pulse/revolution Alarm/running signal												
Green LED		Lit: Power connected Flashing: Active communication												
Red LED		Flashing: Alarm but still running Constantly lit: Critical alarm - stop motor												
Features														
Technology		Sinusoidal back-EMF signal controlled via FOC (Field Oriented Control)												
Flying start		Yes, < 30% of max. speed												
Ramp-up time	sec.	15-300												
Ramp-down time	sec.	15-300												
Alarm		Yes												
Alarm reset		Via digital input, RS-485 interface or powering down for more than 60 seconds												
Fan stop	sec.	The braking system stops the fan as quickly as possible. Braking time will depend on the inertia of the fan.												
Service data log		Operating hours, alarms, loads, software version, max. temp., max. motor voltage, max. motor current, max. ripple voltage, max. ripple current												
Software updating		Yes, via serial interface												
Motor parameters		Preprogrammed by OJ or on-site configuration												
Fire mode		Nominal power for 1 hour at 70°C ambient temperature												
Field weakening		Yes												
Short-circuit protection		Yes												
Integrated EMC filters		Yes												
Approvals														
EMC		EN 61800-3 (C1 & C2)												
LVD		EN/BS 61800-5-1 / UL 508C												
Product standard		61800 Part 2												
RoHS Directive		Yes												
Product approvals		 /   / 												

Note: Data are valid at: nominal supply voltage, +25°C and sufficient air flow
* 1: At 3 x 230V supply the output power is derated to 58%
* 2: Motor Power Factor = 0.8 and efficiency = 90%
* 3: H5 OGF variant is limited to 32A

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