
Instruction Manual

DBU-4

Dynamic Braking Unit



CAUTION

Thank you for purchasing the IMO DBU-4 dynamic braking unit.

- Improper handling might result in incorrect operation, a short life, or even a failure of this product.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.

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1 Safety Precautions

1.1 Safety definition

Danger:	Serious physical injury or even death may occur if safety warnings are not adhered to.
Warning:	Physical injury or damage to the devices may occur safety warnings are not adhered to.
Note:	Physical injury may occur if relevant requirements are not followed.
Qualified electricians:	People working on the device should have completed professional electrical and safety training, complete the certification and be familiar with all steps and requirements of installing, commissioning, operating and maintaining the device in a safe manner.

1.2 Warning symbols

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advice on how to avoid the danger. Following warning symbols are used in this manual:

Symbols	Name	Instruction	Abbreviation
 Danger	Danger	Serious physical injury or even death may occur if not follow the relative requirements	
 Warning	Warning	Physical injury or damage to the devices may occur if not follow the relative requirements	
Note	Note	Physical hurt may occur if not follow the relative requirements	Note

1.3 Safety guidelines

	✧ Only qualified electricians are authorized to operate. ✧ Do not carry out any wiring and inspection or changing components when the power supply is applied.
	✧ Do not refit incorrectly; otherwise fire, electric shock or other injury may occur.

1.3.1 Delivery and installation

	✧ Please install the braking units and braking resistors on fire-retardant material and keep them away from combustible materials. ✧ Do not use any braking unit and braking resistor with loose and damaged components. ✧ High voltage DC current is present after connecting braking unit. Do not touch the braking unit, internal component and PCB with hands; otherwise the electric shock may occur.
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Note:

- ✧ Select appropriate moving and installing tools to ensure a safe and normal running of the dynamic braking unit and avoid physical injury or death. For physical safety, the erector should take some mechanical protective measurements, such as wearing exposure shoes and working uniforms.
- ✧ Ensure to avoid physical shock or vibration during delivery and installation.
- ✧ Do not hold its front cover only. The cover may fall off.
- ✧ Install away from children and other public places.
- ✧ The dynamic braking unit does not meet the requirements of low voltage protection in IEC61800-5-1 if the sea level of installation site is above 2000m.
- ✧ Please use the DBU on appropriate condition (See chapter **Installation Environment**).
- ✧ Do not allow screws, cables and other conductive items to fall inside the DBU.
- ✧ Fasten the screws while wiring, otherwise loose wiring may cause fire or current leakage.

1.3.2 Commission and running

	✧ Disconnect all power supplies applied before the terminal wiring and wait. ✧ Only qualified electricians are authorized to operate on the dynamic braking unit. ✧ Check the wiring before the running. ✧ Do not touch the terminal of the control board during powering on. ✧ Check the master details and voltage degree before running. ✧ Do adjust and check the dynamic braking unit only after the POWER LED is totally off and the voltage between (+) and (-) is 0. ✧ Do not touch any internal components when the dynamic braking unit is working. ✧ The braking unit is the accessory device of the inverter. Please use it with caution because the damage to the inverter and the dynamic braking unit may occur. ✧ Our company reserves the right to take the responsibility for the DBU (no matter it is relative to the braking unit or not). Please install the safety fuses special for the semiconductors.
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Note:

- ✧ Do not switch on or off the input power supply of the dynamic braking unit frequently.
- ✧ Ensure correct setting of the braking units and resistors.
- ✧ Do not perform voltage test on DBU; otherwise damage to the main circuit of the semiconductor components may occur.
- ✧ If multiple DBU are installed in a cabinet for parallel application, please install a fan or other cooling devices.
- ✧ DBU needs temperature and other protection. It is necessary to isolate the device if fault occurs to the device and cause heating. If not isolated.

1.3.3 Maintenance and replacement of components

	✧ Only qualified electricians are authorized to perform the maintenance, inspection, and components replacement of the DBU. ✧ Disconnect all power supplies to the DBU before the terminal wiring. Wait for at least the time designated on the DBU after disconnection. ✧ Take measures to avoid screws, cables and other conductive matters to fall into the DBU during maintenance and component replacement.
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Note:

- ✧ Please select proper torque to tighten screws.
- ✧ Keep the dynamic braking unit, parts and components away from combustible materials during maintenance and component replacement.
- ✧ Do not carry out any isolation and voltage test on the dynamic braking unit and do not measure the control circuit of the dynamic braking unit by megameter.
- ✧ Perform a sound anti-electrostatic protection to the dynamic braking unit and its internal components during maintenance and component replacement.

1.3.4 What to do after scrapping

	✧ There are hazardous metals in the dynamic braking unit. Deal with it as industrial waste.
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2 Inspection

2.1 Unpacking inspection

Check as followings after receiving products:

1. Check there is no damage or humidification to the package. If so, please contact your supplier.
2. Check the information on the type designation label on the outside of the package to verify that the DBU is of the correct type. If not, please contact your supplier.
3. Check there are no signs of water in the package and no signs of damage or breach to the DBU. If so, please contact your supplier.
4. Check the information on the type designation label on the outside of the package to verify that the name plate is of the correct type. If not, please contact your supplier.

2.2 Environment

Check as followings before the actual installation and usage:

1. Check the ambient temperature of the DBU is below 40°C. If exceeds, derate 3% for every additional 1°C. Additionally, the DBU can not be used if the ambient temperature is above 50°C. Note: for the cabinet DBU, the ambient temperature refers to the air temperature inside the cabinet.
2. Check the ambient temperature of the DBU in actual usage is above -10°C. If not, add heating facilities. Note: for the cabinet DBU, the ambient temperature refers the air temperature inside the cabinet.
3. Check the altitude of the installation site is below 1000m. If exceeds, derate 1% for every additional 100m.
4. Check the humidity of the installation site is below 90% and condensation is not allowed. If not, add additional protection the DBU.
5. Check the installation site is away from direct sunlight and foreign objects can not enter the DBU. If not, add additional protective measures.
6. Check there is no conductive dust or flammable gas in the actual usage site. If not, add additional protection to the DBU.

2.3 Installation confirmation

Check as followings after the installation:

1. Check the load range of the input and output cables meet the need of actual load.
2. Check the accessories of the DBU are correctly and properly installed. The installation cables should meet the needs of every component (including reactors, input filters, output reactors, output filters, DC reactors, braking units and braking resistors).
3. Check the DBU is installed on non-flammable materials and the calorific accessories (reactors and brake resistors) are away from flammable materials.
4. Check all control cables and power cables are run separately and the routation complies with EMC requirement.
5. Check all grounding systems are properly grounded according to the requirements of the DBU.
6. Check the free space during installation is sufficient according to the instructions in user's manual.
7. Check the external connection terminals are tightly fastened to correct torque.
8. Check there are no screws, cables and other conductive items left in the DBU.

3 Installation Guidelines

	✧ Only qualified electricians are authorized to carry out what described in this chapter. Please operate as the instructions in Safety Precautions. Ignoring these may cause physical injury or death or damage to the devices. ✧ Ensure the power supply of the dynamic braking unit is disconnected during the operation. Wait for at least the time designated until the POWER indicator is off after the disconnection if the power supply is applied. It is recommended to use the multimeter to monitor that the DC bus voltage of the drive is under 36V. ✧ The installation and design of the dynamic braking unit should comply with the requirement of the local laws and regulations in the installation site. If the installation infringes the requirement, IMO will be exempt from any responsibility. Additionally, if users do not comply with the recommendations, some damage beyond the assured maintenance range may occur.
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3.1 Installation environment

The installation environment is the safeguard for a full performance and long-term stable functions of the DBU. Check the installation environment as followings:

Environment	Conditions
Installation site	Internal
Environment temperature	-10~+50℃ If the ambient temperature of the dynamic braking unit is above 40℃, derate 3% for every additional 1℃. It is not recommended to use the dynamic braking unit if the ambient temperature is above 50℃. To improve the reliability of the device, do not use the dynamic braking unit if the ambient temperature changes frequently. Please provide cooling fan or air conditioner to control the internal ambient temperature below the required one if the dynamic braking unit is used in an enclosed space such as in the control cabinet. When the temperature is too low, if the dynamic braking unit needs to restart to run after a long stop, it is necessary to provide an external heating device to increase the internal temperature, otherwise damage to the devices may occur.
Humidity	RH≤90% No condensation is allowed. The maximum relative humidity should be equal to or less than 60% in corrosive air.
Storage temperature	-30~+60℃
Running environment condition	The installation site of the DBU should: keep away from the electromagnetic radiation source; keep away from contaminative air, such as corrosive gas, oil mist and flammable gas; ensure foreign objects, such as metal power, dust, oil, water cannot enter the DBU (do not install the DBU on the flammable materials such as wood); keep away from direct sunlight, oil mist, steam and vibration environment.
Altitude	Below 1000m If the sea level is above 1000m, please derate 1% for every additional 100m.
Vibration	≤ 5.8m/s ² (0.6g)
Installation direction	The DBU should be installed on an upright position to ensure sufficient cooling effect.

Note:

- ◆ DBU-4 series should be installed in a clean and ventilated environment according to enclosure classification.
- ◆ Cooling air must be clean, free from corrosive materials and electrically conductive dust.

3.2 Installation direction

DBU-4 must be installed in an upright position.

3.3 Installation mode

DBU-4 can be installed in wall (for all frame sizes)

3.4 External dimensions

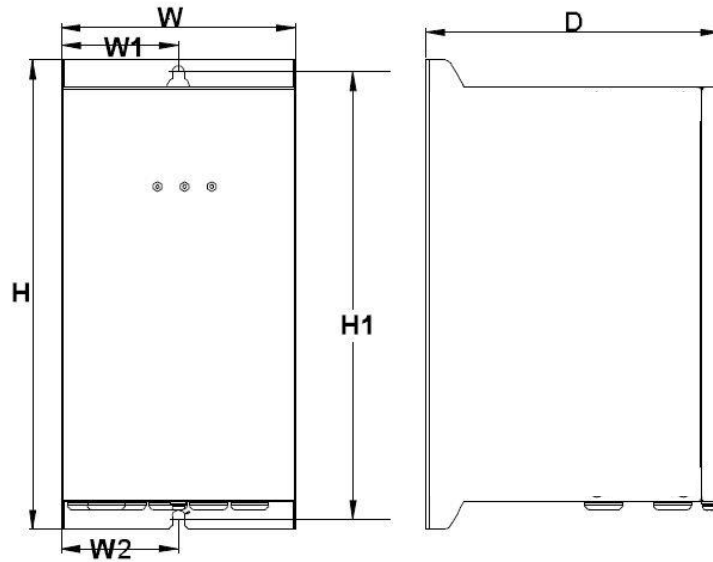


Figure 1: Dimensions of DBU22/37-4

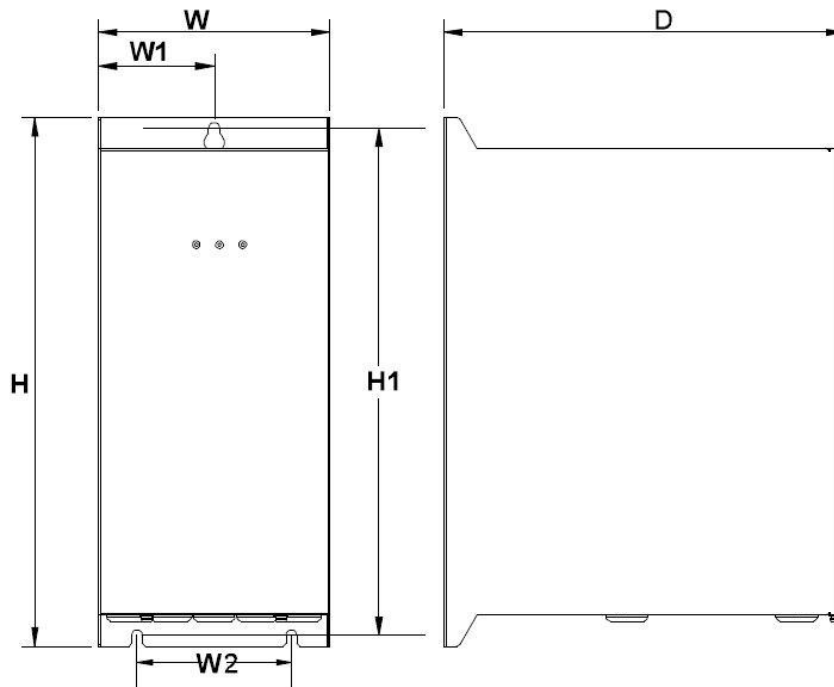


Figure 2: Dimensions of DBU45/75-4, DBU90/110-4 & DBU132-4

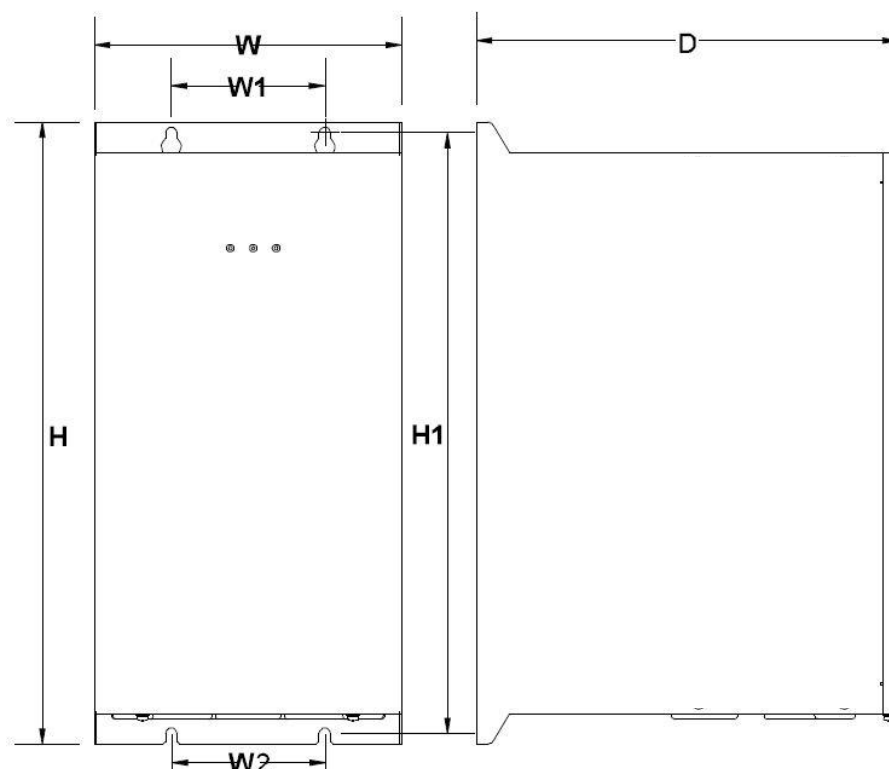


Figure 3: Dimensions of DBU160/200-4 & DBU220/250-4

Model	W (mm)	W1 (mm)	W2 (mm)	D (mm)	H (mm)	H1 (mm)
DBU22/37-4	130	65	65	163	260	246
DBU45/75-4	150	75	100	260	340	326
DBU90/110-4						
DBU132-4						
DBU160/200-4	200	100	100	275	405	391
DBU220/250-4						

4 Product name and usage

DBU-4 series dynamic braking units are high-performance and heavy-load dynamic braking devices, which brake at the rated braking current to meet the application needs in the situation of high inertia, rapid deceleration and stop. When the DBU brakes, momentum will be converted into electric energy due to high inertia, and then the DC bus voltage will increase. The braking unit can consume the regenerative electric energy to ensure normal operation of the DBU; otherwise the DBU will carry out overvoltage protection and work abnormally.

The braking unit is designed for use in high inertia applications where rapid stopping is required. Such as elevators, textile machines, paper machinery, centrifuges, washing machines, wire drawing machines, winder, the proportion of linkage systems, crane and mining, and lifting system.

5 Installation of the dynamic braking unit and parameters setting

5.1 Wiring diagram

Figure 4 Wiring diagram of the main circuit between the dynamic braking unit and the DBU

Note:

The wiring between the DBU and the dynamic braking unit is less than 5m.

The wiring between the braking resistor and the braking unit is less than 10m.

◆ DC+ and DC- are the “+”“-” of the internal DC bus in the DBU. DC+ is the positive pole and DC- is the negative pole.

	✧ Incorrect wiring of the main circuit may cause damage to the DBU and the braking unit. ✧ Do not touch the terminals of the control board when the machine is powered on.
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5.2 Terminals of the main circuit

PE	(+)	(-)	(+)	PB
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Figure 5 Terminals of main circuit DBU22/37-4 to DBU132-4

(+)	(+)	(+)	
PE	(-)	(-)	PB

Figure 6 Terminals of main circuit DBU160/200-4 & DBU220/250-4

Functions description:

Sign	Function
(+), (-)	Input terminals of the DC bus
(+), PB	External braking resistor terminals
PE	Grounding terminal. Each machine should be grounded.

5.3 Main control terminal of the braking unit

EFI	COM	PI	PO	COM	ROA	ROB	ROC
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Functions description:

Sign	Function
EFI	Input terminal of the external fault. EFI-COM is defaulted to be short circuited in factory. When the external fault occurs, it will be switched off and the braking unit outputs a fault signal.
PI	Slave parallel input terminals of the braking unit
PO	Master parallel output terminals of the braking unit
COM	Common terminal of EFI, PI and PO
ROA	1. Fault output terminal. When fault occurs to the braking unit, the fault relay will output fault report signal. 2. ROA NO, ROB NC, ROC is the common terminal 1. Contact Rating: 3A/AC250V, 1A/DC30V 2. Do not use it as the high frequency switch output (with caution)
ROB	
ROC	

When there is only one braking unit, please connect the DBU, braking unit and braking resistor according to figure 4. It will work after setting the voltage level and the braking threshold.

5.4 Adjustment

The braking unit and the braking resistor do not need to be adjusted. Do not adjust the “voltage selection setting” unless specific voltage is required.

5.5 Voltage selection setting

Setting of braking thresholds: set the voltage selection of the braking unit according to the input voltage of the DBU. The voltage selection can only be performed when disconnecting the power supply. Below is the relationship between the voltage selection and the original braking voltage:

Serial No.	S1 selection	Setting range (V)
0	1 0 1 2 3 4	640
1	1 0 1 2 3 4	660
2	1 0 1 2 3 4	680
3	1 0 1 2 3 4 (Factory reserved)	700
4	1 0 1 2 3 4	720
5	1 0 1 2 3 4	740
6	1 0 1 2 3 4	760
7	1 0 1 2 3 4	780
8	1000~1110	Reserved
9	1 0 1 2 3 4	Slave mode

Note:

- ◆ If the supply voltage is more than 20% above the normal supply, set higher braking voltage.
- ◆ Please ensure the allowable original braking voltage of the DBU comply with this setting.



- ✧ Do not operate during powering on. Do not adjust the setting until the POWER LED has completely extinguished (the voltage is present between (+) and (-)).

6 Parallel operation

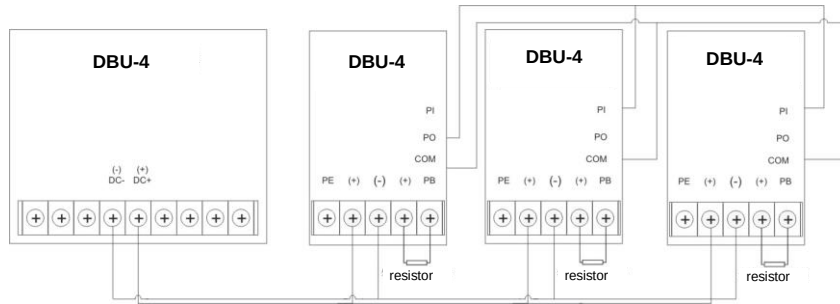


Figure 7 Wiring diagram between the parallel running braking units and the DBU

Connect the DBU, multiple braking units and the braking resistor according to figure 7.

Wiring of the control terminals: when parallel braking units are being used, the first one is the master and others are slaves. The parameters setting of the slave are referred to the section 9 of “braking threshold” and the braking rate of the master and the slave needs to be kept the same. The PO and COM terminal of the first braking unit is connected to the PI and COM terminal of the second braking unit and the PI and COM terminal of the third braking unit and so forth, the running of the whole parallel braking unit system can be monitored.

7 Fault analysis and the solution

Faults can be indicated through LEDs. When the fault LED is on, it means the dynamic braking unit is abnormal. Check the faults one by one according to the information in the below table. Find the possible reasons and the solutions. If not, please contact IMO.

Serial No.	Fault state	Explanation	Solution
1	Serious heat-releasing of the braking resistor during the braking	The power of the braking resistor is too low.	Change a braking resistor with bigger power.
2	Serious heat-releasing of the braking resistor when not braking	IGBT damage	Change the braking unit
		The voltage selection of the braking unit is not correct.	Reset
		Braking unit fault	Change the braking unit
3	OU of the DBU	Insufficient braking capacity of the braking resistor	Recheck the braking condition
		Wrong wiring	Check and correct
		The voltage selection of the braking unit is not correct.	Reset
		Braking unit fault	Change the braking unit
4	Output signal of the fault relay	Valid external fault input	Recheck the running condition
		Short circuit of the braking resistor	Change the braking resistor
		The temperature of IGBT is over 85℃	

Note: when the external supply voltage is too high, please set higher voltage.

	⚡ Non-isolated circuit is applied in the control circuit of the braking unit. Disconnect the wiring between (+) and (-) and ensure there is no voltage during the operation and checking.
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8 Selection

8.1 Guidelines of braking voltage selection

The setting of the braking voltage is low enough to make the DBU work around the rated voltage and ensure safe running. Select high braking voltage can avoid mis action of the braking unit, but too high voltage has impact on the long-term running safety.

8.2 Calculation of the braking resistor and the braking current

(at 100% of the braking torque)

Braking current is the DC current running through the braking unit and the braking resistor during braking.

Calculating at the standard AC motor of 380V:

P——— Rated power of the motor (kW)

V——— DC operating point of the braking unit, usually it is 700V

I——— Braking current (A)

η —— Conversion efficiency of the mechanical energy during feedback, usually it is 1.0

Calculation basis: the braking resistor needs to absorb all the regenerative electric energy of the motor.

Absorbed power of the braking resistor ($V \cdot I$) = The regenerative electric energy of the motor (W) = $1000 \cdot P \cdot \eta$

8.3 Calculation and selection of the braking resistor

(at 100% of the braking torque)

The braking resistor reflects the braking torque in the system. If the braking torque is too small, the DBU will carry out overvoltage protection.

Calculating at the standard AC motor of 380V:

P——— Rated power of the motor (kW)

P_R ——— Rated consumed power of the braking resistor (kW)

V——— DC operating point of the braking unit, usually it is 700V

R——— Equivalent resistance of the braking resistor (Ω)

η —— Conversion efficiency of the mechanical energy during feedback, usually it is 1.0

ε —— Safety coefficient of the power consumption for the braking resistor $\varepsilon = 1.4$

K_f —— Braking frequency, the time ratio of the regeneration to the whole working time

Usually, K_f is:

Winding up and winding down $K_f = 50 - 60\%$

Oilfield machines $K_f = 10 - 20\%$

Elevators $K_f = 10 - 15\%$

Centrifuge $K_f = 5 - 20\%$

Crane (the height of lifting is more than 100m) $K_f = 20 - 40\%$

Intermittent braking load $K_f = 5\%$

Others $K_f = 10\%$

Basis of resistor calculation: the braking resistor needs to absorb all the regenerative electric energy of the motor.

Absorbed power of the resistor ($V \cdot V/R$) = The regenerative electric energy of the motor (W) = $1000 \cdot P \cdot \eta$

Basis of resistor power calculation:

The regenerative electric energy of the motor needs to be absorbed by the resistor and converted to heat energy.

$P_R = P \cdot K_f \cdot \eta \cdot \varepsilon = P \cdot K_f \cdot 1.0 \cdot 1.4$

Below is the selection reference when the DC operating point of the braking unit is 380V:

8.5 Usage standard and selection reference of the input voltage level for adaptation DBU (380V)

Below is the selection reference when the DC operating point of the braking unit is 700V:

Power	Model	100% of the adaptation braking resistor of the braking torque(Ω)	Dissipated power of the braking resistor(kW) (10% braking)	Dissipated power of braking resistor(kW) (50% of the braking)	Dissipated power of braking resistor(kW) (80% of the braking)	Min braking resistor(Ω)
37kW	DBU22/37-4	13.2	6	28	44	11.7
45kW	DBU45/75-4	10.9	7	34	54	6.4
55kW		8.9	8	41	66	
75kW		6.5	11	56	90	
90kW	DBU90/110-4	5.4	14	68	108	4.4
110kW		4.5	17	83	132	
132kW	DBU132-4	3.7	20	99	158	3.2
160kW	DBU160/200-4	3.1	24	120	192	2.2
200kW		2.5	30	150	240	
220kW	DBU220/250-4	2.2	33	165	264	1.8
250kW		2.0	38	188	300	
280kW	2x DBU160/200-4	3.6*2	21*2	105*2	168*2	2.2*2
315kW		3.2*2	24*2	118*2	189*2	
350kW		2.8*2	27*2	132*2	210*2	
400kW		2.4*2	30*2	150*2	240*2	
500kW	2x DBU220/250-4	2*2	38*2	186*2	300*2	1.8*2

8.7 Selection of the braking resistors:

- It is recommended to apply non-inductive resistance to reduce the inductance.
- The protective devices for auto-disconnection during overheating are necessary.
- The grounding fault is prohibited; otherwise the damage to the device and DBU may occur.
- The capacity of the braking resistor is the reference value and it can be modified according to the inertia loads, braking frequency, braking voltage threshold. Please consult with our IMO for more information.

Note:

- Parallel braking unit can increase the braking capacity.
- The braking capacity of 2 parallel braking units is twice the capacity a single braking unit.

9 Maintenance and hardware diagnostics

9.1 Maintenance intervals

If installed in an appropriate environment, the dynamic braking unit requires very little maintenance. The table lists the routine maintenance intervals recommended by IMO.

Checking part		Checking item	Checking method	Criteria
Ambient environment		Check the ambient temperature, humidity and vibration and ensure there is no dust, gas, oil fog and water ingress.	Visual examination and instrument test	Conforming to the manual
		Ensure there are no tools or other foreign or dangerous objects.	Visual examination	There are no tools or dangerous objects.
Voltage		Ensure the main circuit and control circuit are normal.	Measurement by multi-meter	Conforming to the manual
Keypad		Ensure the display is clear.	Visual examination	Characters are displayed normally.
		Ensure the characters are displayed totally	Visual examination	Conforming to the manual
Main circuit	For public use	Ensure the screws are tightened securely	Tighten up	NA
		Ensure there is no distortion, crackles, damage or discoloration caused by overheating and aging to the machine and insulator.	Visual examination	NA
		Ensure there is no dust and dirt	Visual examination	NA Note: Some discoloration of the copper blocks is normal
	The lead of the conductors	Ensure that there is no distortion or discoloration of the conductors caused by overheating.	Visual examination	NA
		Ensure that there are no crackles or discoloration of the protective layers.	Visual examination	NA
	Terminals seat	Ensure that there is no damage	Visual examination	NA
	Resistors	Ensure whether there is replacement and splitting caused by overheating.	Smelling and visual examination	NA
		Ensure that there is no offline.	Visual examination or remove one ending to coagulate or measure with multimeters	The resistors are in $\pm 10\%$ of the standard value.
Control circuit	PCB and plugs	Ensure there are no loose screws and contactors.	Fasten up	NA
		Ensure there is no aroma and discolouration.	Smelling and visual examination	NA
		Ensure there are no crackles, damage distortion and rust.	Visual examination	NA
		Ensure there is no weeping and distortion to the capacitors.	Visual examination or estimate the usage time according to the	NA

Checking part		Checking item	Checking method	Criteria
			maintenance information	
Cooling system	Cooling fan	Estimate whether there is abnormal noise and vibration.	Hearing and Visual examination or rotate with hand	Stable rotation
		Check for loose screws.	Tighten if loose	NA
		Ensure there is no discoloration caused by overheating.	Visual examination or estimate the usage time according to the maintenance information	NA
	Ventilating duct	Ensure there are no foreign objects or dirt blocking the ventilation duct.	Visual examination	NA

Consult the local IMO representative for more details on maintenance.

9.2 Cooling fan

The dynamic braking unit's cooling fan has a minimum life span of 25,000 operating hours. The life span can vary according to usage and ambient temperature.

Fan failure can be determined by the increasing noise from the fan bearings. If the braking unit is operated in a critical part of a process, fan replacement is recommended once these symptoms appear.

9.2.1 Replacing the cooling fan

	✧ Read and follow the instructions in chapter <i>Safety Precautions</i>. Ignoring the instructions could cause physical injury or death, or damage to the equipment.
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1. Stop the DBU and disconnect it from the AC power source and wait for at least the time designated on the DBU.
2. Lever the fan holder off the drive frame with a screwdriver and lift the hinged fan holder slightly upward from its front edge.
3. Free the fan cable from the clip.
4. Disconnect the fan cable.
5. Remove the fan holder from the hinges.
6. Install the new fan holder including the fan in reverse order.
7. Restore power.

9.3 Power cable

	✧ Read and follow the instructions in chapter <i>Safety Precautions</i>. Ignoring the instructions may cause physical injury or death, or damage to the equipment.
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1. Stop the drive and disconnect from the power line. Wait for at least the time designated on the braking unit.
2. Check the tightness of the power cable connections.
3. Restore power.

Dynamic Braking Unit.

DBU-4 Series

Instruction Manual

1st Edition, August 2018

IMO Precision Controls Ltd

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the DBU-4 dynamic braking units. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will IMO Precision Controls Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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