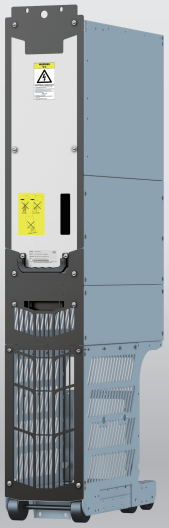
INOVANCE

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MD880-60 Series
Three-phase Braking Unit
User Guide

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code 19012477A01

Preface

Introduction

The MD880-60M series three-phase braking module provides comprehensive protection functions, including protections against overcurrent, overvoltage, overtemperature, braking resistor open circuit, and short circuit. It supports parameter setting and parallel operation of masters and slaves to meet the braking requirements of high power starters.

The braking unit is used to consume the regenerative energy generated during braking to prevent the drive from stopping due to overvoltage protection. The MD880 series three-phase braking units mainly apply to applications requiring rapid speed reduction, positioning, and braking.

This guide presents product information, mechanical installation, electrical installation, and routine maintenance. For complete information on parameters and fault codes, see *MD880-60 Series Three-Phase Braking Unit Parameter Guide*.

Note

- The drawings in this guide are shown for illustration only and may be different from the product. Actual products may vary.
- The user guide is subject to change due to product upgrade, specification modification as well as efforts to the accuracy and convenience of the guide.

More information

Name	Data code	Description
MD880-60 Series Three-phase Braking Unit User Guide	PS00003725	Presents the product information, mechanical installation, electrical installation, and routine maintenance.

Revision history

Revision date	Version	Revision
November 2024	A01	Updated the content.
April 2024	A00	Initial release

Access to the guide

This guide is not delivered with the product. You can obtain the PDF version in the following ways:

- Do keyword search under Service and Support at www.inovance.com.
- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install My Inovance app, where you can search for and download user guides.



Warranty disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for faults or damage that occur during normal operation. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance will be charged for the following damage:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or unusual voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see Product Warranty Card.

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Fundamental Safety Instructions

Safety Precautions

- This chapter provides essential safety instructions for proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to observe the safety precautions may result in serious injury or death of personnel or device damage.
- "Danger", "Warning", and "Caution" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper usage.

Safety Levels and Definitions



Indicates that failure to comply with the notice will result in severe personal injury or even death.



Indicates that failure to comply with the notice may result in death or severe personal injury.



Indicates that failure to comply with the notice may result in minor or moderate personal injury or equipment damage.

Safety Precautions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as anti-smashing shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

Unpacking
 • Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package in sequence. Do not hit the package violently. • Check whether there is damage, rust, or signs of bumping on the surface of the equipment and equipment accessories before unpacking. • Check whether the package contents are consistent with the packing list before unpacking.

Storage and transportation



- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injury or equipment damage.
- Do not stand or stay below the equipment when it is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injury or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal injury or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injury.
- Store and transport the equipment strictly based on the requirements. Failure to comply may result in equipment damage.
- Do not store or transport the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the product for more than 3 months. When the product needs to be stored for an extended period, take more strict protection and necessary inspection.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Do not transport the equipment with other devices or materials that may harm or have negative impacts on the equipment.

Installation



- Installation must be carried out by skilled personnel who have undergone specialized electrical training and possess comprehensive electrical expertise. Non-professionals are not allowed to install the equipment.



- Read through the guide and safety precautions before installation.
- Do not install the equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing equipments with strong electromagnetic interference, such as a transformer, install a shielding equipment for the equipment to prevent malfunction.
- Install the equipment on an incombustible object such as metal and do not touch or attach the equipment to combustibles. Failure to comply can result in fire.



- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed switches to variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Before wiring, disconnect all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. Measure the DC voltage of the main circuit and make sure that it is below the safety voltage. Failure to comply can result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power on. Failure to comply can result in electric shock.
- Ensure the equipment is grounded properly. Failure to comply can result in electric shock.



- Do not connect the input power supply to the output end of the equipment. Failure to comply will result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Tighten the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may result in overheat, damage to the connecting parts, or a fire.
- After wiring, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in electric shock or equipment damage.



- During wiring, follow proper electrostatic discharge (ESD) proceduresand wear an anti-static wrist strap. Failure to comply can result in damage to the equipment or internal product circuits.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding. Failure to comply can result in equipment malfunction.

Power-on



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before powering on to prevent equipment damage or a fire.
- When the equipment is powered on, do not open the cabinet door or protective cover, touch any wiring terminal, or disassemble any component of the equipment. Failure to comply can result in electric shock.



- After wiring and parameter setting, perform a trial run to ensure the equipment operates safely. Failure to comply may result in personal injury or equipment damage.
- Before powering on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire.
- Before powering on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injury.

Operation



- The equipment must be operated only by professionals. Failure to comply can result in death or personal injury.
- During operation, do not touch any connecting terminals or disassemble any component of the equipment. Failure to comply can result in electric shock.



- Do not touch the equipment enclosure, fan, or resistor with bare hands. Failure to comply may result in burns.
- During operation, prevent metal or other objects from falling into the equipment. Failure to comply may result in fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply can result in electric shock.
- Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- When a permanent magnet motor is used, do not touch the motor terminals immediately after power-off because the motor terminals can generate induced voltage during rotation even after the equipment is powered off. Failure to comply can result in electric shock.



- Perform routine and periodic inspection and maintenance on the equipment in accordance with maintenance requirements and keep a record.

Repair



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- Submit a request for repair services in accordance with the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injury, or equipment damage.
- Troubleshooting and maintenance must be performed by professionals according to the maintenance instructions, with maintenance records kept properly.
- Replace quick-wear parts of the equipment in accordance with the replacement instructions.
- Do not operate on damaged equipment. Failure to comply may result in death, personal injury, or equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal
WARNING • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in death, personal injury, or property damage. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Safety label

To ensure safe operation, comply with safety signs on the equipment and do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

To ensure safe operation, comply with equipment-related safety labels. See the following table for descriptions of the safety labels.

Safety Label	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result equipment damage, personal injury, or even death. • Do not touch the terminals or remove the cover with power ON or within 10 min after power-off. Failure to comply will result in an electric shock.

1 Product Information

1.1 Model and Nameplate

MD880-60M-1300-7
① ② ③ ④

① **Product series** MD880: MD880 series AC drive	③ **Rated power** 1300: 1300 kW
② **Product type** 60M: Three-phase braking module	④ **Voltage class** 4: 400 VAC system 7: 690 VAC system

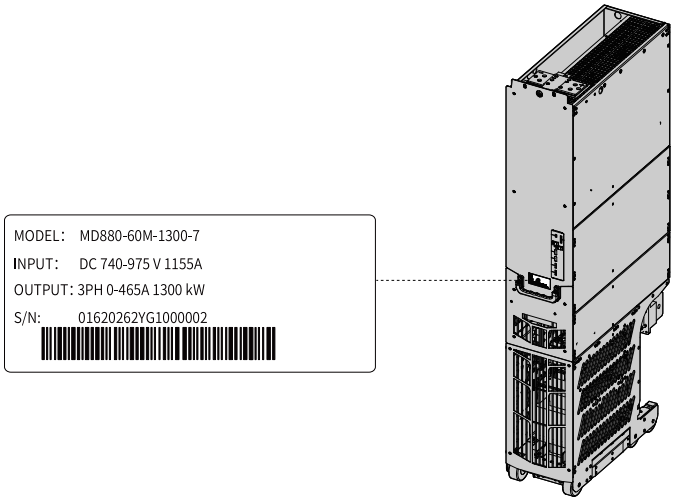


Figure 1-1 Nameplate of three-phase braking module

Note

- INPUT indicates the allowable input voltage range under rated operating conditions, instead of the braking voltage.
- OUTPUT indicates the output current range and rated power.

1.2 Components

The three-phase braking unit adopts the H8 structure. The power range of the three-phase braking unit with 400 V voltage class is 500 kW to 750 kW. The power range of the three-

phase braking unit with 690 V voltage class is 870 kW to 1300 kW. The unit is installed with pulleys at the bottom for easy installation and maintenance.

The following shows the components layout of the braking unit.

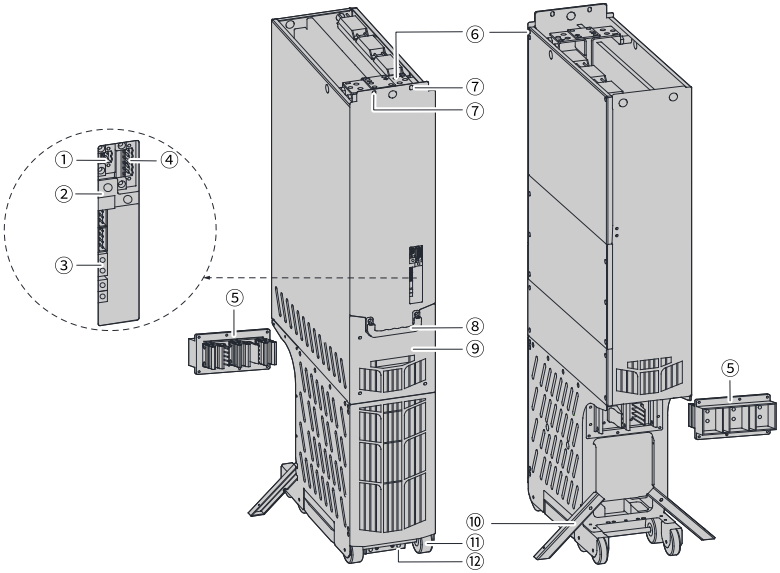


Figure 1-2 Components

No.	Name
①	External 24 VDC auxiliary power supply terminal
②	Shield clamp
③	Optical fiber interface 1
④	External I/O terminal
⑤	Quick connector socket (secured to the cabinet behind the module)
⑥	DC bus input terminal
⑦	Fastening hole with spray coating on the top, grounding point (PE) between the three-phase braking unit frame and cabinet frame
⑧	Handle
⑨	Cooling fan
⑩	Anti-tilting bracket
⑪	Caster
⑫	Fastening hole with spray coating at bottom, grounding point (PE) between the three-phase braking unit frame and cabinet frame

1.3 Product Dimensions

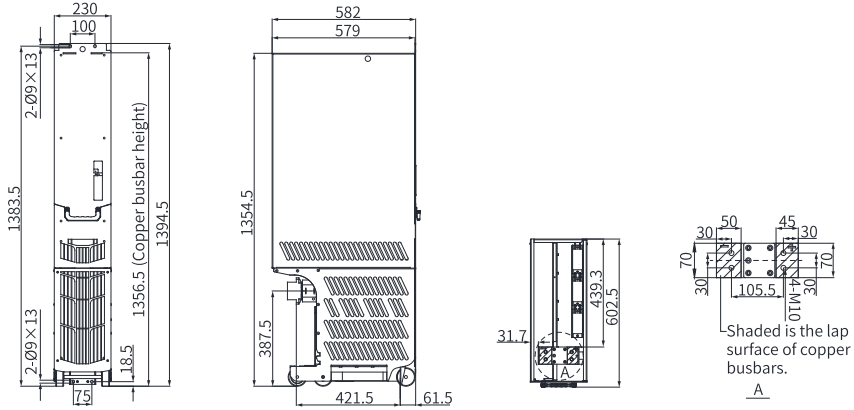


Figure 1-3 Outline dimensions of the braking unit (unit: mm)

1.4 Product Specifications

1.4.1 Electrical Specifications

Table 1–1 Electrical specifications of three-phase braking unit

Drive model	Input voltage class	Max. power of a single unit (without overload)	Starting voltage of the brake	Max. continuous braking current	Min. braking resistance	Max. continuous braking power (kW)	Loss
			(V)	(A)	(Ω)	(kW)	(kW)
MD880-60M-0500-4	• For use with a 400 V system: 640 VDC to 750 VDC • For use with a 690 V system: 1075 VDC to 1150 VDC	• 400 V single unit: 750 kW • 690 V single unit: 1300 kW	653	310	1.7	500	5
MD880-60M-0750-4			653	465	1.2	750	7.5
MD880-60M-0870-7			1126	310	3	870	8.7
MD880-60M-1300-7			1126	465	2	1300	13

Note

Note: Multiple braking units in the same voltage class can be connected in parallel.

1.4.2 Technical Data

Table 1–2 Technical data of the three-phase braking unit

No.		Specification
Basic performance	Operating efficiency	> 99%
Environmental requirements	Operating temperature	-10°C to +40°C (For temperatures above 40°C, derate the output current by 1% for every additional 1°C. The maximum ambient temperature is 50°C.)
	Altitude	⩽ 1000 m (For altitudes above 1000 m, derate the output current by 1% for every additional 100 m. The maximum altitude is 4000 m.)
	Pollution degree	PD2
	Storage temperature	-40°C to +70°C
	Humidity	5% RH to 95% RH, without condensation
	Overvoltage category	OVCIII
	Power grid system	-
Mechanical data	Vibration level	Compliant with vibration level 3M4 in GB/T4798.3 Steady-state sinusoidal vibration: • 2 Hz to 9 Hz, 3 mm • 9 Hz to 200 Hz, 10 m/s^2 Shock: 100 m/s^2; time: 11 ms
	Cooling method	Forced air cooling (AF) that compliant with EN 60146
	Safety category	Compliant with EN61800-5-1
	IP rating	IP00

1.4.3 Overload Characteristics

For some drive systems where overload may occur, a proper base load current is necessary for the MD880-60M series three-phase braking unit. The criterion for overload is that the drive is operated with its base load current before and after the overload occurs (repeated every 300s).

In the low overload duty (IL) mode, the base load current (I_{LD}) is based on 60s cyclic operation at 110% of rate load.

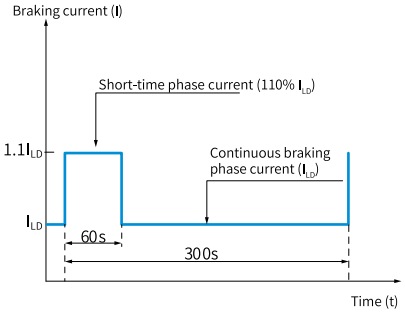


Figure 1-4 Load curve of the braking unit

1.5 Selecting the Braking Unit and Braking Resistor

1.5.1 Selecting the Braking Unit

Selecting a braking unit based on the following principles

- Select a braking unit with voltage class matching the input voltage class of the drive.
- Select a braking unit with power matching the braking power needed by the drive.

Estimating the power of the braking unit

Ensure that the power of the braking unit is larger than the braking power.

If the braking power is unknown, estimate the braking power based on formula "Pb = P x Td x k", as detailed in the following table.

Param.	Description
Pb	Braking power
P	Motor power
K	Mechanical energy conversion efficiency
Td	Ratio of braking torque to rated torque of the motor The value of Td varies with the system: • Elevator, Hoist, Crane: 100% • Decoiler and recoiler: 120% • High-inertia device that requires quick stop: 120% • Normal inertia load: 80% If the value is 100%, about 90% loads can be satisfied.

Rated power of the drive

The following table lists the rated power of the drive for different braking units.

Rated power of the drive	Braking unit
500 kW	MD880-60M-0500-4
750 kW	MD880-60M-0750-4
870 kW	MD880-60M-0870-7
1300 kW	MD880-60M-1300-7

1.5.2 Selecting the Braking Resistor

Resistance Calculation

During braking, the regenerative energy generated by the motor is consumed by the braking resistor. Based on this principle, the resistance of the braking resistor can be calculated according to the following formula: U x U/R = Pb/3.

Note

- U: Braking voltage for stabilizing the brake (653 V for 380 VAC systems and 1126 V for 690 VAC systems)
- When the calculated resistance (R) is lower than the minimum resistance of each voltage class, multiple braking units are needed.

Power of the braking resistor

In theory, the power of the braking resistor (Pr) is consistent with the braking power (Pb). As the derating rate is 70%, you can calculate the power of the braking resistor based on the following formula: 0.7 x Pr=Pb/3 x D.

D: Braking frequency, which is the percentage of the regenerative process to the whole working process (The braking frequency is 10% generally, which may vary with applications, as shown below.)

- Elevator: 20% to 30%
- Decoiler and recoiler: 20% to 30%
- Centrifuge: 50% to 60%
- Occasional braking load: 5%

1.6 Fuse Selection

Table 1–3 Recommended fuse

Model	Fuse on the DC side		Fuse on the braking resistor side	
	Bussmann	Sinofuse	Bussmann	Sinofuse
MD880-60M-0500-4	170M4416 (DC- x 2, DC+ x 2)	RS306-1-S1P-630A690V310 (DC- x 2, DC+ x 2)	170M4416	RS306-1-S1P-630A690V310
MD880-60M-0750-4	170M6413 (DC- x 2, DC+ x 2)	RS306-3-S1P-900A690V (DC- x 2, DC+ x 2)	170M6413	RS306-3-S1P-900A690V
MD880-60M-0870-7	170M6545 (DC- x 2, DC+ x 2)	RS306-3-S5P-700A1250V-D (DC- x 2, DC+ x 2)	170M6545	RS306-3-S5P-700A1250V-D
MD880-60M-1300-7	170M6547 (DC- x 2, DC+ x 2)	RS306-3-S5P-900A1250V-D (DC- x 2, DC+ x 2)	170M6547	RS306-3-S5P-900A1250V-D

2 Mechanical Installation

2.1 Installation Flowchart

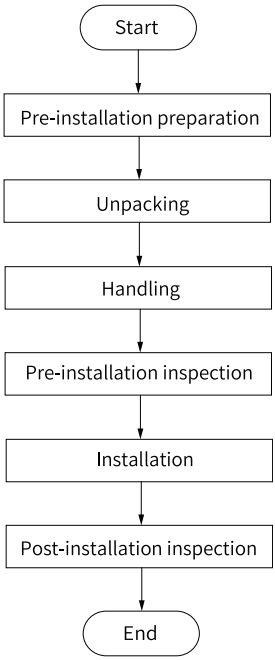


Figure 2-1 Mechanical installation flowchart

2.2 Installation Precautions

- Install the braking resistor in a place with good ventilation. The braking resistor will be heated when consuming the regenerative energy generated during braking.
- Install the braking unit vertically to facilitate heat dissipation. Do not lay it upside-down or horizontally.
- Ensure that the clearance between the braking unit, drive, and other electric device meets the requirements shown in *"Figure 2–2 Installation clearance of the braking unit" on page 22*.

2.3 Pre-installation Preparation

2.3.1 Installation Environment Requirements

- The environmental requirements for the braking unit and the drive are the same. The ambient temperature and humidity the braking unit cannot exceed the permitted range of the design, as shown in the following table.
- Install the braking unit and external braking resistor on the surface of incombustible objects with sufficient space reserved for heat dissipation.
- Free from corrosive, flammable, and explosive gas
- Ensure that the installation environment is free from excessive dust and metal powder.

Table 2–1 Environment requirements for MD880 series three-phase braking unit

Condition	Requirement
Altitude	< 1000 m (Derate 1% for every additional 100 m above 1000 m. The maximum altitude is 4000 m.)
Ambient temperature	-10°C to +40°C (Derate 1% for every additional 1°C above 40°C. The maximum ambient temperature is 50°C.)
Relative humidity	Less than 95% RH (without condensation)
Vibration	< 10 m/s^2 (1 g)
Storage temperature	-20°C to +60°C
Pollution degree	2
Cooling method	Fan-cooled
IP rating	IP20

2.3.2 Installation Clearance

Braking units with different power rating require different installation clearance. See the following for details.

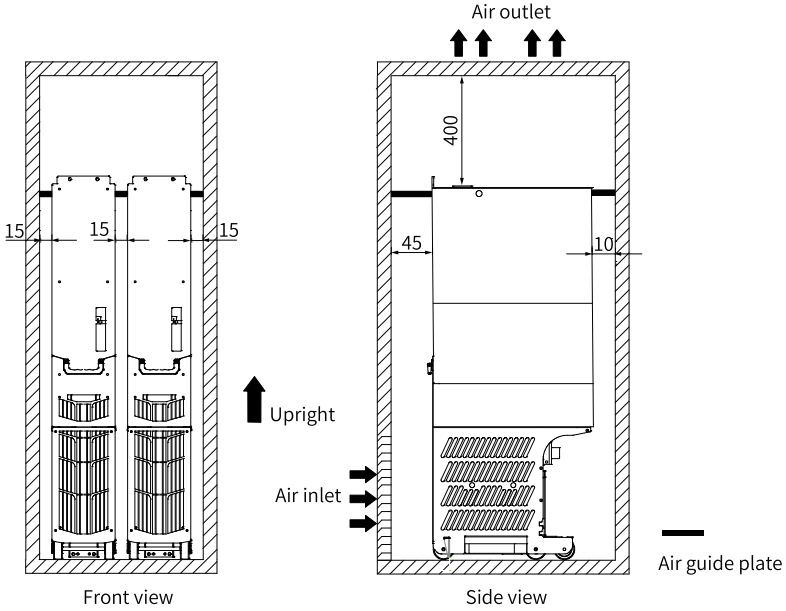


Figure 2-2 Installation clearance of the braking unit

Note

The dimensions above represent the minimum space requirements (unit: mm).

2.4 Unpacking

2.4.1 Precautions for Unpacking

- Upon receiving the product, check the three-phase braking unit for damage, rust, and bumping.
- Check that you have received all the items specified on the delivery note. If there is any part missing or damaged, notify the carrier immediately. Contact Inovance technical support or local agent if necessary.
- If the equipment is damaged during transportation, the electrical safety of the equipment can no longer be guaranteed. Do not connect the equipment before performing a professional high-voltage test.

Danger

Failure to comply may result in property damage, personal injury, or even death.

2.4.2 Unpacking Procedure

The three-phase braking unit is packed into the corrugated carton box and fixed to the wooden pallet through PET straps before delivery. Unpack the module in the following steps:

1. Remove all the straps and ties and open the cover of the box.
2. Remove all filler materials.
3. Take out the three-phase braking unit and its accessories.
4. Cut the stretch wrap film on the unit.
5. Check that the braking unit is not damaged.
6. Dispose of or recycle the packing material according to local regulations.

2.4.3 Post-unpacking Inspection

Check the following items after unpacking.

Table 2–2 Post-unpacking checklist

No.	Item	Compliance
1	There is no sign of damage, scratching, or bumping on the surface of the product.	☐
2	All the optional parts ordered are in the packing box.	☐
3	The model of the product ordered is consistent with the nameplate.	☐
4	There is no sign of damage, scratch, or blur on the warning labels.	☐

2.5 Storage

Store the braking unit in a clean and dry room, with temperatures between -40°C and +70°C and temperature variation lower than 1°C/min. If the braking unit needs to be stored for a long period of time, cover it up or take similar measures to prevent the braking unit from being polluted or affected by the surrounding environment.

For storage of the braking unit, pay attention to the following two items:

- Keep the braking unit in the original packing box provided by Inovance.

- Do not expose the braking unit to environments with moisture, high temperatures, or direct sunlight for a long time.

2.6 Precautions for Handling

- Place the device on a flat and firm ground that can bear its weight.
- The device must always be transported vertically, as indicated on the packing box.
-

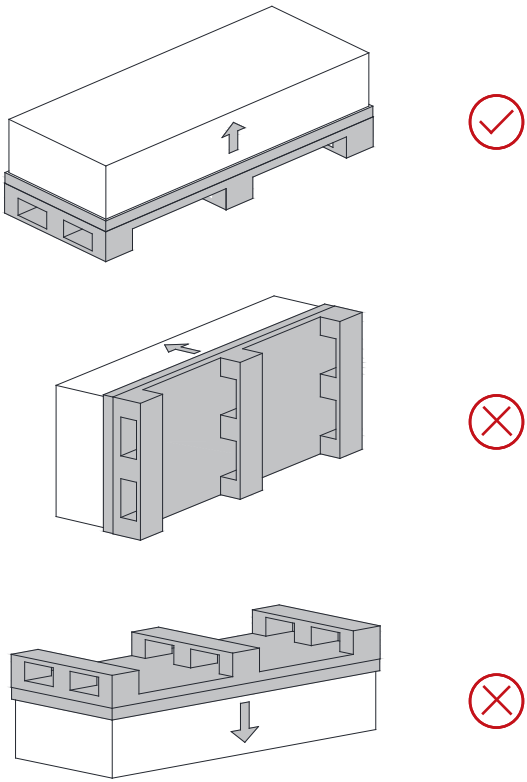


Figure 2-3 Transportation method

2.7 Pre-installation Inspection



- To ensure safe and reliable operation, the equipment must be properly installed and commissioned by professionals, taking into account all the warning notices provided.
- Failure to comply may result in property damage, physical injury, or even death.

Check the following items before installation.

Table 2–3 Pre-inspection checklist

No.	Item	Compliance
1	The packing box is intact and dry.	☐
2	The enclosure of the unpacked braking unit is not deformed, peeled off, or cracked. No sign of water stain is found inside the enclosure.	☐
3	All accessories and options ordered are delivered.	☐
4	The minimum space required for unblocked air passage is reserved around the braking unit. Sufficient space is reserved in the air inlet and outlet to allow unblocked dissipation.	☐
5	The surroundings of the braking unit has been protected properly before commissioning.	☐

3 Electrical Installation

3.1 Safety Precautions

3.2 Pre-wiring Inspection

Caution

Read through the safety instructions in *" Fundamental Safety Instructions" on page 5*. Failure to comply may result in serious consequence.

- Do not use the power from IT system for the drive. Use the power from TN/TT system for the drive. Failure to comply may result in an electric shock.
- Check that the input power supply of the drive is within the specified voltage range. Failure to comply may result in faults.
- The main circuit cable must be away from the motor so that its insulation will not be damaged by high temperature of the motor surface.
- Ground the entire system properly. Failure to comply may result in equipment malfunction.
- After the power supply is cut off, residual voltage is still present in the internal capacitor of the drive, wait for at least 15 min before further operations. Failure to comply may result in an electric shock.

3.3 Typical Electrical Wiring Diagram

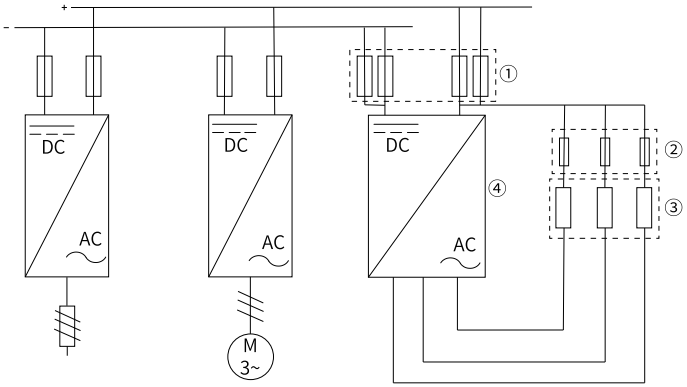


Figure 3-1 Connecting a single braking unit

No.	Note
①	Fuse on the DC side
②	Fuse on the braking resistor side
③	Braking resistor
④	Three-phase braking module

3.4 Connecting Multiple Braking Units in Parallel

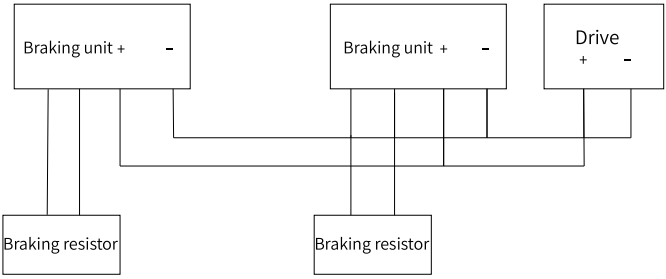


Figure 3-2 Connecting multiple braking units in parallel

Note

The braking resistor must be connected only to the braking unit. Do not connect the braking resistor in parallel at the output end of the braking unit. Failure to comply may damage the braking unit.

3.5 Layout of Wiring Terminals

3.5.1 Main Circuit Terminals

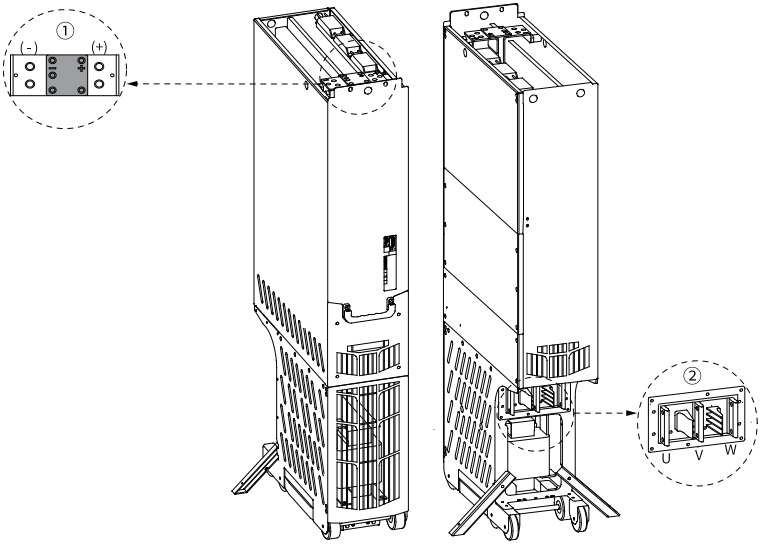


Figure 3-3 Power terminal layout of the braking unit

Table 3–1 Connection parameters

No.	Name	Description
①	(+), (-) DC input	400 V system: 540 VDC to 720 VDC 690 V system: 740 VDC to 975 VDC Connected to the M10/42N·m copper busbar.
②	AC output terminals U, V, and W	Quick insertion

3.5.2 Descriptions of Control Circuit Terminals

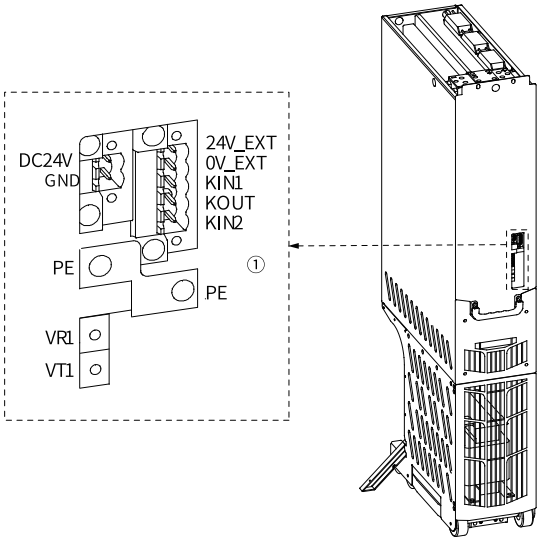


Figure 3-4 Control terminal layout of the braking unit

No.	Name	Description
①	2-pin power supply terminal 5Pin_DIDO terminal Optical fiber terminal	2-Pin_power supply terminal: Two-conductor twisted pair, single-conductor cable, cross-sectional area: 0.5–2.5 mm^2 5-pin_DIDO terminal: single-conductor cable, cross sectional area: 0.5–2.5 mm^2 Optical fiber terminal: Used for optical fiber connection.

3.6 Wiring of Three-phase Braking Unit

1. Make sure that all inputs and outputs of the three-phase braking unit are correctly connected.
2. Secure the power cables to the cable bracket to prevent terminals from being subject to tension.
3. When shielded power cables are used, fix the shield to the shield plate as instructed by EMC requirements.

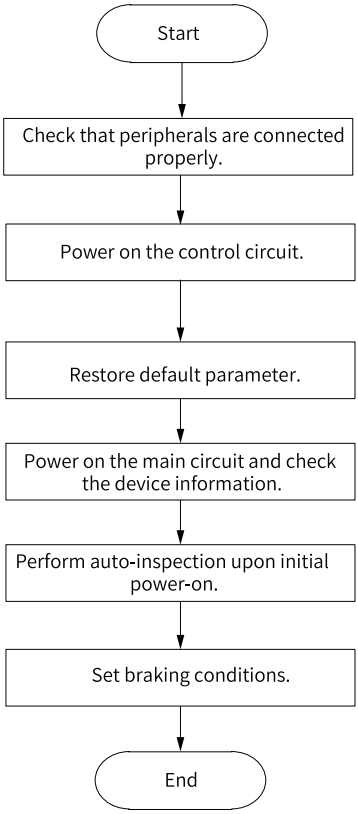
3.7 Post-wiring Inspection

After electrical installation of the three-phase braking module is done, check the following items. Read all the safety instructions before operating the equipment.

No.	Item	Compliance
1	The input power supply is connected to the motor cable properly, with correct voltage supplied.	☐
2	The auxiliary power supply provides the correct voltage.	☐
3	Input/Output power cables are secured to the cable rack for strain relief.	☐
4	Cables are properly connected with the required tightening torque to the terminals provided.	☐
5	For EMC shielded cables, threaded sleeve joints are provided on the motor terminal box and the joints are grounded and in contact with the shield through a large area. The cable shield is fixed to the shielding plate to meet the EMC requirement.	☐
6	Connect braking units with outputs paralleled to the motor correctly.	☐
7	The production date is indicated on the nameplate of the braking unit. If the period from the date of manufacturing to initial commissioning or the downtime of the power components is shorter than one year, the DC bus capacitors do not need to be pre-charged. If the downtime is longer than 1 years, pre-charge the capacitors first.	☐
8	Connect and lay the control cables in accordance with the interface assignment and the shield. To prevent interference, route the control cables and power supply cables through different routes. Comply with the related EMC directives.	☐

4 Commissioning

4.1 Commissioning Flowchart



4.2 Wiring Inspection Before Power-on

No.	Item	Compliance
1	Ensure that the user power line voltage range matches the braking unit voltage class.	☐
2	Check that the incoming line specification and fuse specifications meet the requirements.	☐
3	Check that the bus input wiring (+/-) is correct and secure.	☐
4	Check that braking unit is connected to the resistor (P(+)/R) properly.	☐

No.	Item	Compliance
5	Check the bus input (+/-) to ground and resistance (P(+)/R) to ground to prevent short circuit.	☐
6	Check that the braking resistor temperature switch is wired properly.	☐

4.3 Initial Power-on Parameter Setting

Auto-inspection

It is recommended to perform auto-inspection on the system before use for the first time. This is to check whether the braking unit and peripherals are connected properly. Measure the resistance of the braking resistor.

Set in the preparation state:

1. Check that the braking unit is not faulty and is in S5 state.
2. Set A5-01 to 1 to allow operation and auto-inspection.
3. Set A5-07 to 111 to detect the braking resistance of U/V/W phase.
4. Set A5-08 to 1 to perform auto-inspection. After auto-inspection is done, A5-22, A5-23, and A5-24 display the measured value of the braking resistor.

The following table describes parameters involved in setting auto-inspection.

Param.	Name	Description
A5-01	Three-phase braking OFF2 selection	0: Operation and auto-inspection inhibited 1: Operation and auto-inspection allowed 2: DI1 3: DI2 4: DI3 5: DI4 6: DI5 7: DI6 8: DIL 9: HDI1 10: HDI2 Others: B connector
A5-07	Braking resistor selection	Ones: Phase-U baking resistor selection 0: Inhibited 1: Enabled Tens: Phase-V braking resistor selection 0: Inhibited 1: Enabled Hundreds: Phase-W braking resistor selection 0: Inhibited 1: Enabled
A5-08	Auto-inspection request	0: Disabled 1: Enabled

Param.	Name	Description
A5-22	Phase-U braking resistor detection value	-
A5-23	Phase-V braking resistance detection value	-
A5-24	Phase-W braking resistance detection value	-

Brake apply threshold

The following shows the relationship between the braking unit bus voltage and braking duty cycle.

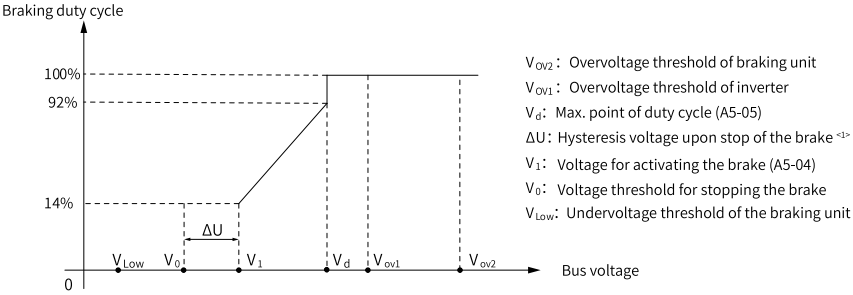


Figure 4-1 Relationship between the braking voltage and the braking duty cycle

Note

<1>: The hysteresis voltage upon stop of a 400 V braking unit is 11 V or 19 V upon stop of a 690 V braking unit.

The above figure shows the overvoltage and undervoltage thresholds of different braking units. The following table describes the related parameters.

Table 4–1 Three-phase braking unit overvoltage/undervoltage threshold

Braking unit (model)	Overvoltage threshold of braking unit	Undervoltage threshold of braking unit
MD880-60M-0500-4	900 V	350 V
MD880-60M-0750-4		
MD880-60M-0870-7	1300 V	600 V

Set in the preparation state:

1. Check that the braking unit is not faulty and is in S5 state.
2. Set A5-01 to 1 to allow operation and auto-inspection.
3. Set A5-00 to 1 to enable three-phase braking.
4. Set A5-16 to 0, and set the voltage for activating the braking unit (A5-06) properly in the standard mode. When the bus voltage is higher than the voltage for activating the braking unit (A5-04), the braking unit applies. When the bus voltage reaches the value of A5-05, the braking unit applies fully.

Note

- In the standard mode (A5-16 = 0), the voltage for activating the 400 V braking unit ranges from 640 V to 750 V, and the voltage for activating the 690 V braking unit ranges from 1075 V to 1150 V.
- In the standard mode (A5-16 = 0), the effective voltage for full braking of 400 V braking units is 780 V or 1180 V for full braking of 690 V braking unit.

The following table describes the parameters involved in the procedure for setting the braking unit.

Param.	Name	Description
A5-00	Three-phase braking selection	0: Inhibited 1: Enabled Others: B connector
A5-01	Three-phase braking OFF2 selection	0: Operation and auto-inspection inhibited 1: Operation and auto-inspection allowed 2: DI1 3: DI2 4: DI3 5: DI4 6: DI5 7: DI6 8: DIL 9: HDI1 10: HDI2 Others: B connector
A5-04	Actual voltage for activating the braking unit	Displays the actual voltage for activating the braking unit.
A5-05	Actual voltage for activating full braking	Displays the actual voltage for activating full braking.
A5-06	Voltage for activating the braking unit	Defines the voltage for activating the braking unit in the stop state.
A5-16	Braking mode selection	0: Standard mode 1: Test mode

5 Maintenance

5.1 Routine Maintenance Checklist

The service life of components inside the braking unit is affected by the ambient temperature, humidity, dust, and vibration, which may result in potential faults and shorter service life. Therefore, it is necessary to carry out routine and regular maintenance.

The following table lists the routine checklist.

Table 5–1 Routine checklist

No.	Item	OK
1	Check whether the installation environment of the braking unit changes.	☐
2	Check whether the cooling fan of the braking unit works properly.	☐
3	Check whether the barking unit vibrates improperly.	☐
4	Check whether the braking unit overheats.	☐

The following table lists the daily cleaning items.

Table 5–2 Routine cleaning list

No.	Item	OK
1	Keep the braking unit clean all the time.	☐
2	Remove the dust, especially metal powder, on the surface of the braking unit, preventing the dust from entering the braking unit.	☐
3	Remove the greasy dirt on the cooling fan of the braking unit.	☐

5.2 Regular Maintenance List

Perform regular maintenance on the items that are difficult to check during routine operation and maintenance. The following table lists the regular checklist.

Table 5–3 Regular checklist

No.	Check Item
1	Check and clean the air filter regularly.
2	Check that all screws are installed properly.
3	Check whether the braking unit is corroded.
4	Check that terminals are free from arcing signs.
5	Perform insulation test on the main circuit.

Before measuring the insulation resistance with a megameter (500 VDC megameter recommended), disconnect the main circuit from the braking unit. Do not use an insulation resistance meter to test the insulation of the control circuit. The high voltage test is not required because it has been done before delivery.

5.3 Replacing Quick-Wear Parts

The quick-wear part of the braking unit is the cooling fan, whose service life is closely related to the operating environment and maintenance status.

Component	Service Life	Possible Cause	Criteria
Fan	2 to 3 years	• Bearing worn out • Blade aging	Check whether there is crack on the blade. Check whether there is unusual vibration noise at start.

5.4 Storing the Braking Unit

For temporary and long-term storage, observe the following requirements:

- Pack the equipment with the original packing box provided by Inovance whenever possible.
- Long-term storage degrades the electrolytic capacitor. Therefore, the unit must be energized once every two years, each time lasting for at least 5 hours. The input voltage must be increased slowly to the rated value with the regulator.

6 Troubleshooting

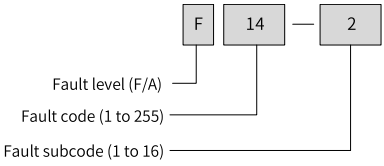
6.1 Fault Levels and Display

6.1.1 Fault Levels

Faults are divided into three types depending on the degree of urgency.

- Fault: Used to indicate that a major fault or error has occurred and the device stops running immediately.
- Limit: The device has encountered a minor fault and can continue to run after derating. However, the running results may deviate from the settings.
- Alarm: Indicates that an alarm has occurred, which does not affect the operation state. You can handle alarms as needed.

A fault code is represented in three segments, as shown in the following figure. F indicates a fault, L indicates a minor fault, and A indicates an alarm.



6.1.2 Viewing Fault Information

Faults are represented by fault codes and fault sub-codes, which indicate the classification of faults. Fault sub-codes are used to locate specific faults. For example, in F14-2, the fault code 14 indicates the module overtemperature fault; the fault subcode 2 indicates phase-V module overtemperature fault.

Current fault

The HCU can record up to six faults that occur at the same time. When more than six faults occur at the same time, the subsequent faults will not be recorded. Faults activated currently can be viewed through parameters in group A1.

Active fault		Active minor fault		Active alarm	
Fault code	Fault subcode	Fault code	Fault subcode	Fault code	Fault subcode
A1-00	A1-01	A1-12	A1-13	A1-24	A1-25
A1-02	A1-03	A1-14	A1-15	A1-26	A1-27
A1-04	A1-05	A1-16	A1-17	A1-28	A1-29
A1-06	A1-07	A1-18	A1-19	A1-30	A1-31
A1-08	A1-09	A1-20	A1-21	A1-32	A1-33
A1-10	A1-11	A1-22	A1-23	A1-34	A1-35

Fault log

The HCU can record the latest five faults, the latest one minor fault, and the latest one alarm.

Latest fault		Second to latest fault		Third to latest fault		Fourth to latest fault	
Fault code	Fault subcode	Fault code	Fault subcode	Fault code	Fault subcode	Fault code	Fault subcode
H2-00	H2-01	H3-00	H3-01	H4-00	H4-01	H5-00	H5-01
H2-02	H2-03	H3-02	H3-03	H4-02	H4-03	H5-02	H5-03
H2-04	H2-05	H3-04	H3-05	H4-04	H4-05	H5-04	H5-05
H2-06	H2-07	H3-06	H3-07	H4-06	H4-07	H5-06	H5-07
H2-08	H2-09	H3-08	H3-09	H4-08	H4-09	H5-08	H5-09
H2-10	H2-11	H3-10	H3-11	H4-10	H4-11	H5-10	H5-11

Fifth to latest fault		Latest minor fault		Latest alarm	
Fault code	Fault subcode	Fault code	Fault subcode	Fault code	Fault subcode
H6-00	H6-01	H7-00	H7-01	H8-00	H8-01
H6-02	H6-03	H7-02	H7-03	H8-02	H8-03
H6-04	H6-05	H7-04	H7-05	H8-04	H8-05
H6-06	H6-07	H7-06	H7-07	H8-06	H8-07
H6-08	H6-09	H7-08	H7-09	H8-08	H8-09
H6-10	H6-11	H7-10	H7-11	H8-10	H8-11

Fault data record

The HCU records data upon fault occurrence while recording the fault.

Fault data record content	Latest fault data	Second to latest fault data	Third to latest fault data
Current upon fault	H1-01	H1-11	H1-21
Bus voltage upon fault	H1-02	H1-12	H1-22
Fault control word 1	H1-04	H1-14	H1-24
Fault control word 2	H1-05	H1-15	H1-25
Fault status word	H1-06	H1-16	H1-26
State machine upon the latest fault	H1-07	H1-17	H1-27
Time of occurrence of the latest fault	H1-08	H1-18	H1-28
Date of occurrence of the latest fault	H1-09	H1-19	H1-29

Viewing faults through SOP-20-880

SOP-20-880 allows you to view the fault information through previous parameters or the fault menu.

Function	Key	Description
Viewing active fault	Key operations	Go to Menu > Fault state > Current fault.
Viewing active minor faults	Key operations	Go to Menu > Fault state > Current minor fault.
Viewing active alarms	Key operations	Go to Menu > Fault state > Current alarm.
Viewing the help information of the fault		Select a fault and press the help key to display the help information of the fault.
Viewing previous faults	Key operations	Go to Menu > Fault status > History fault.

Note

It is recommended to view the fault information through the fault menu. All recorded faults and related help information can be viewed.

Viewing faults through InoDriveStudio

- When using InoDriveStudio, you can view the fault on the "Fault alarm table" interface.
- On the "Fault alarm table" interface, you can view the fault descriptions, fault causes and solutions, and data recorded when the fault occurs.

6.1.3 Fault Reset Mode

The HCU supports the following fault reset modes:

- Reset through SOP-20-880
- Reset through InoDriveStudio
- Reset through parameter setting

See the fault reset method in the following table.

Method	Description
Reset through SOP-20-880	After connection is done, press the STOP key on any interface to reset the fault.
Reset through InoDriveStudio	After connecting to InoDriveStudio, click the Reset button in the "Control panel" to reset the fault.
Reset through parameter setting	1. Set H0-07 to 1 and set the fault reset time properly to allow fault reset. 2. Set A5-14/A5-15 to reset the fault through the rising edge.

6.1.4 Fault Level Change and Automatic Reset

Fault Level Change

Faults are classified into faults, minor faults, and alarms, which is further divided into seven levels to fit different fault conditions. Up to 10 fault levels can be set, as shown below.

Param.	Setpoint
Fault codes 1 to 10 for changing fault level in H1-00	Fault display code
Fault codes 1 to 10 for changing fault level in H1-02	0: Blocked 1: Reserved 2: Reserved 3: Reserved 4: Reserved 5: Reserved 6: Display alarms only 7: No action

See the following table for details.

Fault level	Meaning	Remark
0: Blocked	Output blocked directly	Fault
1: Reserved	-	-
2: Reserved		
3: Reserved		
4: Reserved		
5: Reserved		
6: Display alarms only	Displaying alarm without interrupting operation	Alarm
7: No action	No alert	No error

Note

- Fault code: A code that is displayed when the system is faulty, such as 15 external fault 1
- Not every fault can be set at any fault level. When a different fault level is selected, the system automatically judges the maximum allowable value.

List of faults with fault levels changeable

Description of fault codes are shown below.

Fault code	Default level	Highest	Lowest
15: External fault	0: Blocked	0: Blocked	6: Display alarms only
31: PID feedback loss	0: Blocked	0: Blocked	6: Display alarms only
44: Expansion module offline	0: Blocked	0: Blocked	6: Display alarms only
45: Expansion module slot address conflict	0: Blocked	0: Blocked	6: Display alarms only
50: SD card error	6: Display alarms only	6: Display alarms only	7: No action
51: RTC error	6: Display alarms only	6: Display alarms only	7: No action
59: Module temperature too low	0: Blocked	0: Blocked	6: Display alarms only
66: Leakage current fault	0: Blocked	0: Blocked	6: Display alarms only
67: Communication card error of bus adapter A	0: Blocked	0: Blocked	6: Display alarms only
68: Communication card error of bus adapter B	0: Blocked	0: Blocked	6: Display alarms only
83: Master-slave communication error	0: Blocked	0: Blocked	6: Display alarms only
94: Braking resistance too large	0: Blocked	0: Blocked	6: Display alarms only
97: Braking resistor overtemperature	0: Blocked	0: Blocked	6: Display alarms only
170: I/O expansion module wiring fault	6: Display alarms only	0: Blocked	6: Display alarms only

Automatic reset

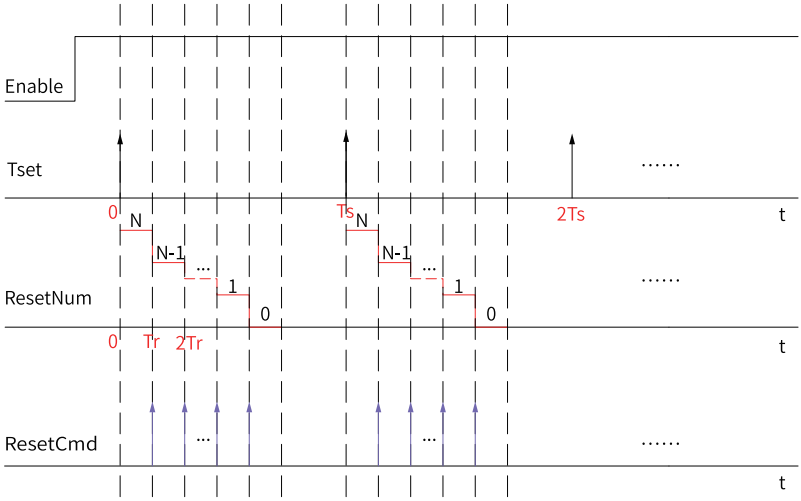
In certain applications, a limited number of automatic fault resets can be set to ensure continuous application when a fault occurs. The fault reset interval (Tr), number of fault resets (ResetNum), reset time of the number of fault resets (Ts), and three non-resettable fault codes can be set.

- Tr: The reset command ResetCmd is generated every Tr time upon fault.
- ResetNum: ResetNum indicates the number of automatic resets. The remaining number of automatic resets is ResetNum-1 for each reset command ResetCmd. When the remaining number of automatic resets is 0, the system loses the automatic fault reset function.
- Ts: Ts indicates the time for resetting the number of fault resets. After the Ts time elapses, the remaining number of fault resets are restored to the number of resets set previously (RestNum).
- Non-resettable fault code: When the non-resettable fault code is included in the current system fault list, the system will not generate an automatic reset command, which means the fault can only be reset manually. See the following table for detailed setting.

Param.	Name	Setpoint	Remark
H0-07	Automatic fault reset	0: Inactive 1: Active	Enable
H0-08	Time for resetting the number of fault resets	0.0s to 3600.0s	Ts
H0-09	Automatic fault reset interval	0.0s to 600.0s	Tr
H0-10	Number of fault resets	0 to 5	ResetNum
H0-11	Non-resettable fault code 1	Fault display code	-
H0-12	Non-resettable fault code 2	Fault display code	-
H0-13	Non-resettable fault code 3	Fault display code	-

Note

- Enable signal: This signal is active when the automatic fault reset function is activated and the number of fault resets (ResetNum) is not 0.
- If the fault reset interval time exceeds the time for resetting the number of fault resets, this function is invalid.



6.2 Custom External Faults and Alarms

6.2.1 External Fault

H0-00 and H0-01 provide two customized sources for triggering customized faults and blocking drive output upon fault.

You can select a bit connector from U0-00 to U4-99 as the source for triggering customized faults.

- When the status bit is 0, the system is operating normally.
- The external fault 15-1 or 15-2 is triggered when the status bit is 1.

6.2.2 External Alarm

H0-02 and H0-03 provide two sources for triggering custom external alarms. Such alarms are used for alarm purpose only, which do not affect operation of the drive.

You can select a bit connector from U0-00 to U4-99 as the source for triggering customized external alarms.

- When the status bit is 0, the system is operating normally.
- The external alarm 63-1 or 63-2 is triggered when the status bit is 1.

6.3 Solutions To Common Faults

6.3.1 Rectifying Parameter Setting Fault

If there is a conflict between user-defined parameters, HCU-60 limits the setpoints internally to ensure normal operation. An alarm 46-1 is also reported, indicating that the parameter inputted is incorrect. The operating state of the system may be different than expected.

See U8-44 to find out the cause of the parameter setting error. When no error occurs, [U8-44] = 0. See details of U8-44 in the following table.

Setpoint	Description
0	No parameter setting error
2	Conflict between min. and max. values of motorized potentiometer
20	Conflict between min. and max. input values of AI1 curve
21	Conflict between min. and max. input values of AI2 curve
22	Conflict between min. and max. output ratios of AO1 curve
23	Conflict between min. and max. output ratios of AO2 curve
24	Conflict between min. and max. input frequencies of HDI1 curve
25	Conflict between min. and max. input frequencies of HDI2 curve
26	Conflict between min. and max. output ratios of HDO1 curve
27	Conflict between min. and max. output ratios of HDO2 curve
28	Slot number of the communication card selected for fieldbus adapter A not set
29	Slot number of the communication card selected for fieldbus adapter B not set
31	Fault reset interval time exceeding the time for resetting the number of fault resets
33	I/O expansion module slot setting conflict
34	Fault handling level setting conflict
36	Incremental setting not applied to X points of multi-point curve module A
37	Incremental setting not applied to X points of multi-point curve module B
38	Brake apply threshold setting error
39	Number of trigger oscilloscope channels (A12-20) exceeding 8 during carrier cycle
42	Customized function block execution sequence conflict (See P9-00 to P9-03 for details.)
43	Incremental setting not applied to X points of customized multi-point curve module
44	Brake fully-apply threshold setting error

Setpoint	Description
45	Start/Stop control word being bus adapter but DP data check bit (n16-10) not being bit10
47	I/O expansion module 1 parameter setting conflict (The minimum input of AI curve is larger than the maximum input value or the minimum output ratio of AO curve is larger than the maximum output ratio.)
48	I/O expansion module 2 parameter setting conflict (The minimum input of AI curve is larger than the maximum input value or the minimum output ratio of AO curve is larger than the maximum output ratio.)
49	I/O expansion module 3 parameter setting conflict (The minimum input of AI curve is larger than the maximum input value or the minimum output ratio of AO curve is larger than the maximum output ratio.)

6.3.2 Rectifying System Initialization Fault

After the control power supply of HCU-60 is switched on, the state machine (A0-00) is always set to "0: system initializing".

Solution

1. Check whether the 24 VDC power supply voltage of HCU-60 is excessively low.
2. Check whether the 24 VDC and 15 VDC power detection circuits of HCU-60 are abnormal.
3. Check whether EEPROM of HCU-60 functions improperly.
4. Contact Inovance technical support.

6.3.3 Rectifying the "Switch-on blocked" Fault

When the system is in the "switch-on blocked" state for a long time, signals such as OFF2 may be in the abnormal state. For example, when the OFF2 signal is activated, the system is in the "switch-on blocked" state.

Locating method

You can quickly find the cause of the problem by viewing the setpoints of A0-16 and A0-17. For details, see the following table.

Note

The system may have multiple types or sources of exceptions at the same time. Resolve them sequentially as prompted.

Param.	Setpoint	Description	Remark
A0-16 Error indication type	0	None	Normal state
	12	OFF2 activated by three-phase brake A5-01, leading to "ON locked"	-
A0-17 Error indication source	0	None	Normal state
	26	When the enable state of the customized function block changes, HCU is not powered on again.	-
	27	Set the three-phase brake (A5-00 = 0).	-
	28	The HINT is not ready, such as model parameter errors.	-

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