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DELTA_IA-MDS_REG2000_UM_EN_20210519

Delta Power Regenrative Unit REG2000 Series User Manual

Delta Power Regenerative Unit REG2000 Series User Manual

www.deltaww.com

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Delta reserves the right to make changes to the user manual and the products described in the user manual without prior notice and afterwards.

Preface

Please read the following installation safety instructions.

- ☑ Ensure the power is OFF before wiring or installing the Power Regenerative Unit.
- ☑ After the AC power is turned off, do not touch the internal circuits and components until the POWER indicator on the unit (below the digital keypad) turns off, because the Power Regenerative Unit is still charged with a high-voltage current and is very dangerous.
- ☑ The components on the internal circuit board of the Power Regenerative Unit are susceptible to damage from electrostatic discharge. Do not touch the circuit board with bare hands before taking proper antistatic measures. Do not modify components or circuits within the Power Regenerative Unit.
- ☑ The Power Regenerative Unit ⏚ must be properly grounded. The 230V series uses Type 3 grounding; the 460V series uses special grounding.
- ☑ Install the Power Regenerative Unit and its components away from heat sources and flammable objects.

- ☑ The power system voltage rating onto which the Power Regenerative Unit is installed must not be higher than 240 V for the 230V series (480 V for the 460V series), and the current must not be greater than 5000 A RMS [10000 A RMS for models of 40 HP (30 kW) or more].
- ☑ Only a qualified professional electrician shall install, wire, repair and maintain the Power Regenerative Unit.
- ☑ Even when the Power Regenerative Unit is in standby mode, its main circuit terminals may still carry dangerously high voltage.
- ☑ If unopened and unused for more than three months, the ambient storage temperature must not be higher than 30°C. The electrolytic capacitors are likely to deteriorate if stored without power at high ambient temperatures. Do not leave the unit without power for more than one year.
- ☑ Notes for the disinfection and disinfestation of packaging materials for transportation and installation (including wooden crates, planks, cardboard boxes, etc.):
  1. When sterilizing or deworming packaging materials, such as crates or cartons, do not fumigate to avoid damaging internal components.
  2. Use alternative environmental sterilization or deworming methods.
  3. Permitted high temperature method: leave the packaging materials at a temperature of over 56°C for 30 minutes or more.
  4. Do not fumigate. Any damage caused by fumigation is not covered by warranty.

NOTE

- The pictures and corresponding descriptions in this manual feature the product with the outer casing or safety shields removed or disassembled to better explain the product in detail. Correctly install the outer casing and wirings in accordance with the rules and regulations, and operate the product following the instructions in the manual to ensure your safety.
- The illustrations in the manual may differ slightly from the actual product for demonstration purposes, but do not affect the rights and interests of the customer.
- You can download the latest updated product documentation from the industrial automation product page on the Delta Electronics website (http://www.delta.com.tw/industrialautomation/).

Table of Contents

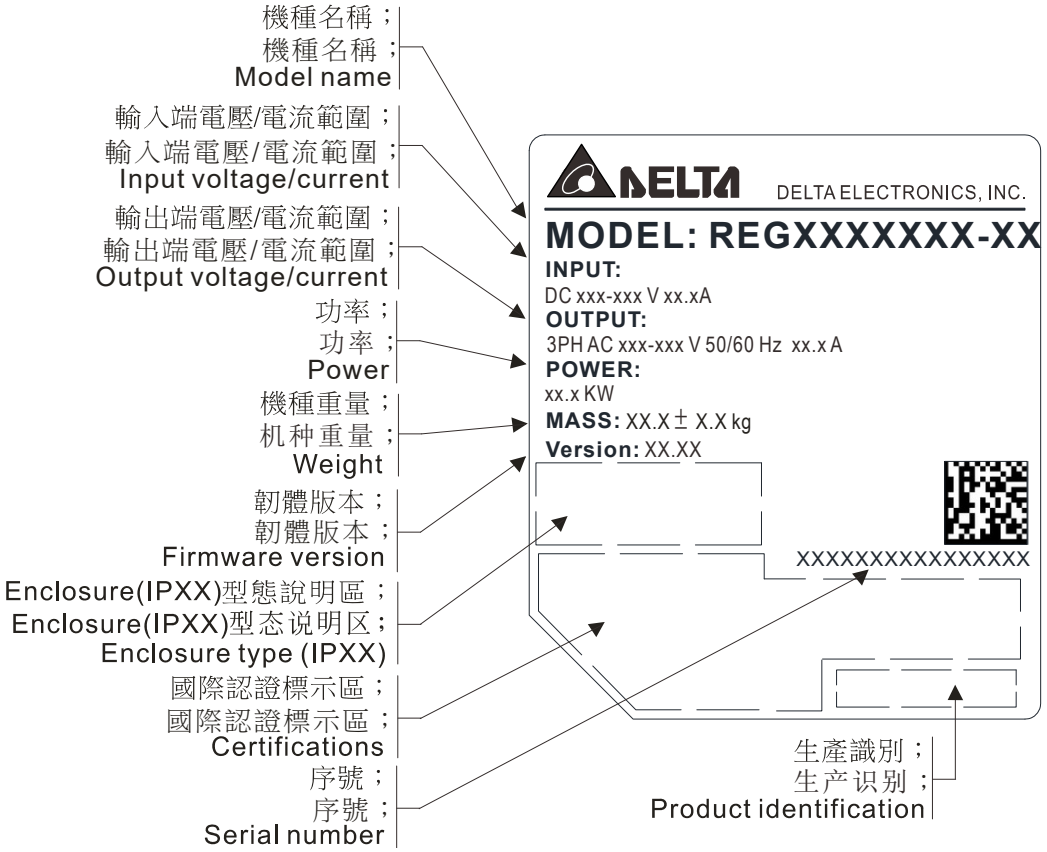
Supported Version **Firmware V1.03 and later**

01 Product Overview

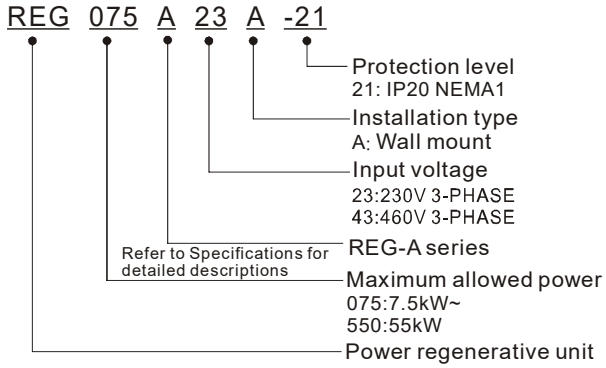
Follow these steps before using the product to ensure safety during use.

1) After opening the packaging, first check that the product has not been damaged during shipment. Inspect and ensure that the nameplate labels on the product match the labels on the box.
2) Make sure the wiring is suitable for the Power Regenerative Unit voltage range. Follow the instructions in the installation manual when installing the Power Regenerative Unit.
3) When wiring the Power Regenerative Unit, be aware of the wiring positions of the main circuit terminals "R/L1, S/L2, T/L3, DC+, DC-", and make sure the terminals are wired correctly to prevent any damage.

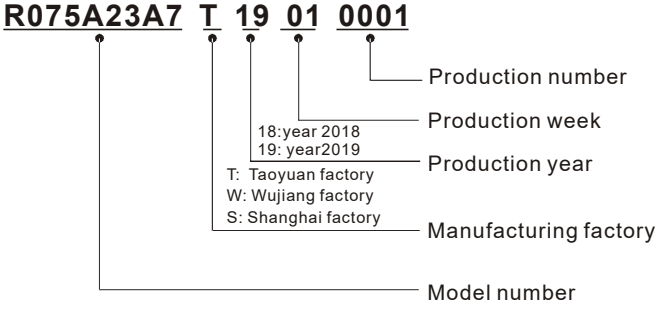
1-1 Nameplate



1-2 Model Number



1-3 Serial Number

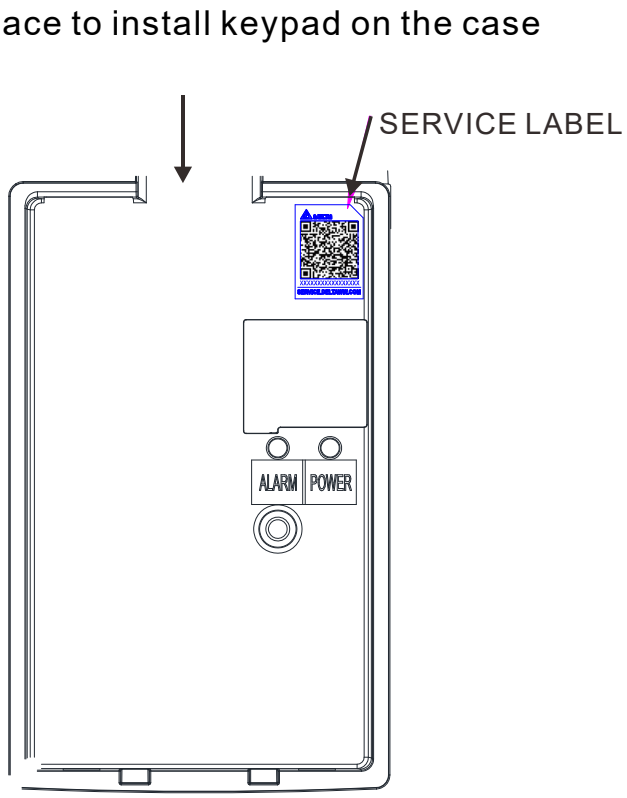


1-4 Apply for After-sales Service by Mobile Device

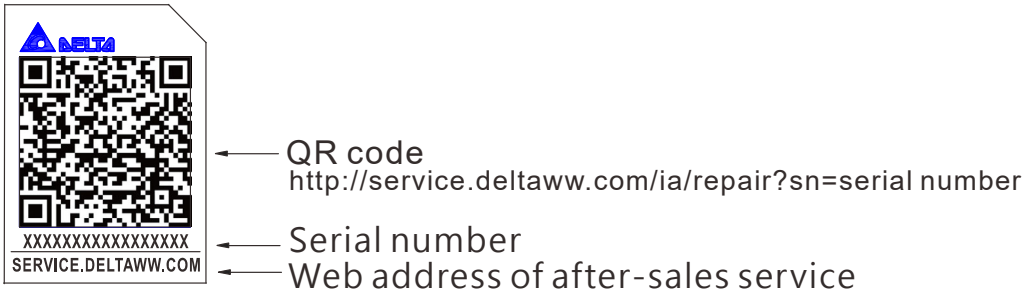
1-4-1 Location of Service Link Label

Frame A–C

Remove the display panel to find the service link label (service label), located in the upper-right corner of the case (see the following drawing).



1-4-2 Service Link Label



Scan QR Code to apply

1. Find the QR code sticker (as shown above).
2. Start the QR code reader app on your smartphone.
3. Point your camera to the QR Code. Hold your camera steady so that the QR code comes into focus.
4. Access the Delta After-Sales Service website.
5. Fill in the information into the fields marked with an orange star.
6. Enter the CAPTCHA and click **Submit** to complete the application.

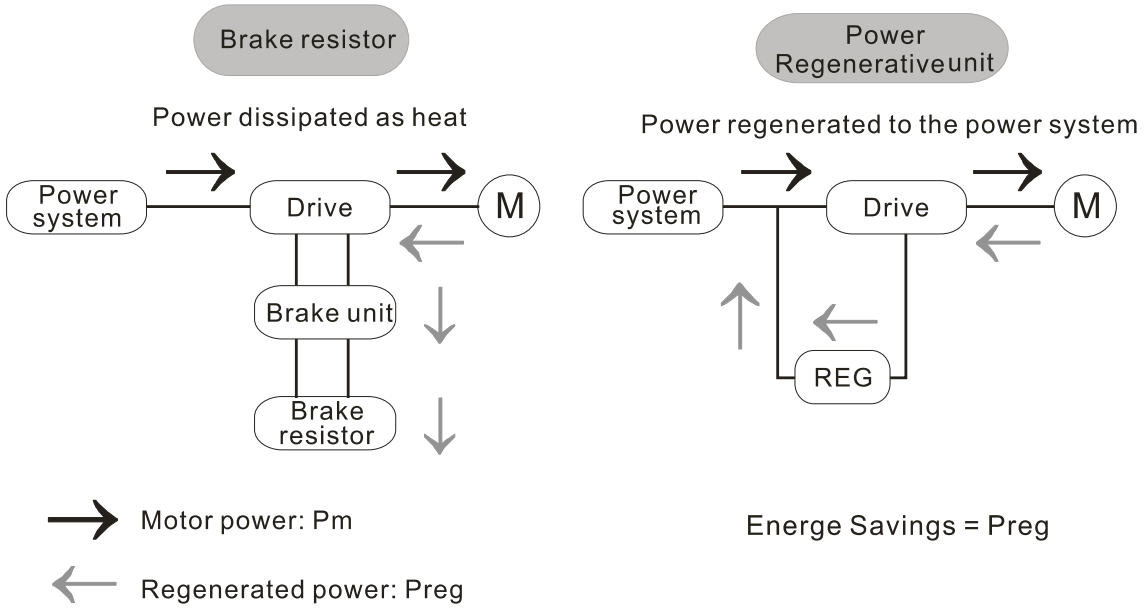
Cannot find our QR Code?

1. Open a web browser on your computer or smartphone.
2. Type https://service.deltaww.com/ia/repair into the address bar and press Enter.
3. Fill in the information into the fields marked with an orange star.
4. Enter the CAPTCHA and click **Submit** to complete the application.

1-5 Operating Principle

In a variable-frequency drive system, the motor is in a power generating state due to the high inertia in a drive system such as centrifuges and washing machines, or applications requiring fast braking such as machine tool spindles. In other words, because the rotor is rotated by external forces, the actual motor speed exceeds the drive-controlled synchronous speed, quickly feeding the energy generated by the motor back to the DC BUS. This results in a rapid rise in the DC BUS voltage and endangers the drive. This excess energy must be quickly consumed to keep the DC BUS voltage within a safe range; otherwise, the drive will either malfunction or enter over-voltage protection mode.

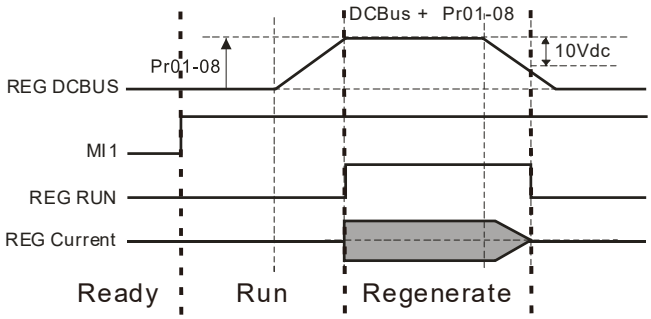
The traditional method is to convert the excess energy into heat with a brake resistor. This method has the advantages of simpler wiring and lower total cost, but has the disadvantages of a large brake resistor, requiring additional cooling devices, a limited braking capability, and inefficient energy use. On the other hand, the Power Regenerative Unit (REG2000) converts the power generated by the motor into electric energy, and then returns it to the electrical grid for other electrical applications, thereby conserving energy. Installing the Power Regenerative Unit can increase the motor's braking capability.



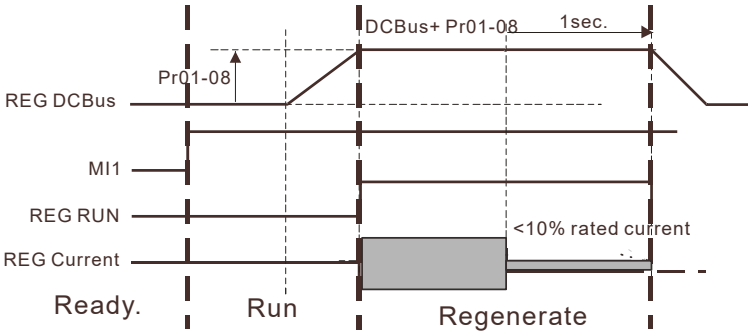
When you set the DC BUS voltage activation level (Pr.01-08), the Power Regenerative Unit (REG2000) determines the motor drive’s DC BUS voltage regenerative trigger point to satisfy the regenerative demands in various industrial applications. When the DC BUS voltage is higher than the voltage activation level, the Power Regenerative Unit (REG2000) starts regenerating power. The capacitance clamping voltage is set as the activation level and the excess energy generated by the motor is converted to three-phase AC current to regenerate the mains power (AC).

The Power Regenerative Unit (REG2000) stops the power regeneration immediately and continues to operate (RUN) when either of the following conditions occurs. The DC BUS voltage triggers the DC-side voltage activation level until the motor brakes for the next time.

(1) When the DC BUS voltage is lower than the activation voltage level (default value = 10 V)
or
(2) When the output current (A_{AC}) of the Power Regenerative Unit (REG2000) is 10% lower than the rated output current for 1 second.



(1) The DC BUS voltage is lower than the activation voltage level.



(2) The output current (A_{AC}) of the Power Regenerative Unit (REG2000) is 10% lower than the rated output current for 1 second.

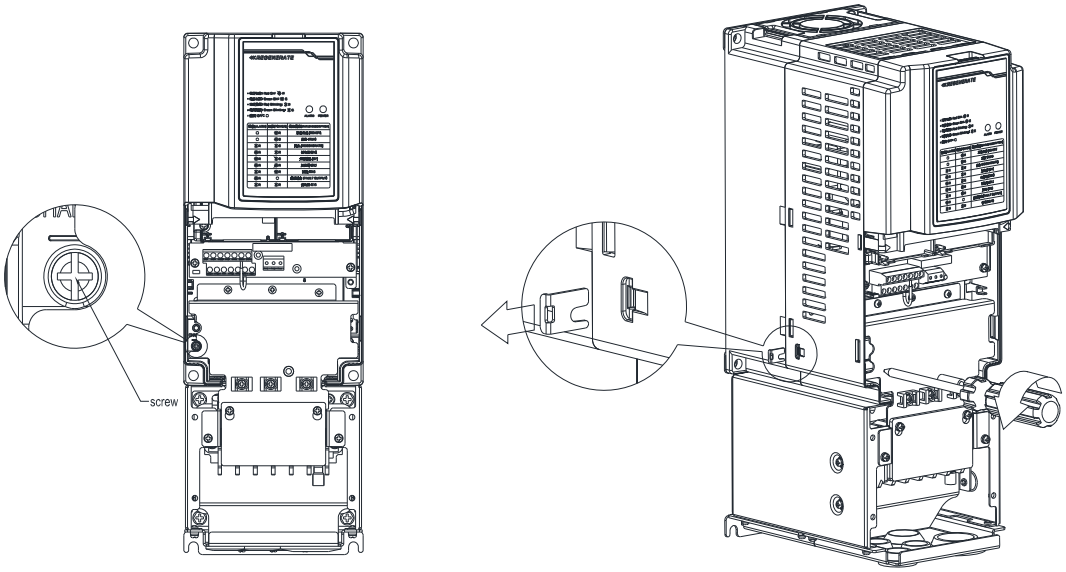
The Working Principle of Power Regenerative Unit

1-6 RFI Jumper

RFI (Radio Frequency Interference): The Power Regenerative Unit generates electrical noise, resulting in frequency interference on the AC power cable.

Frame A–C Screw torque: 6–8 kg-cm (5.2–6.9 lb-in.)

After loosening the screws, remove the RFI jumper (MOV-PLATE/ RFI jumper) as shown in the diagram below. Make sure to tighten the screw again after removing the RFI jumper.

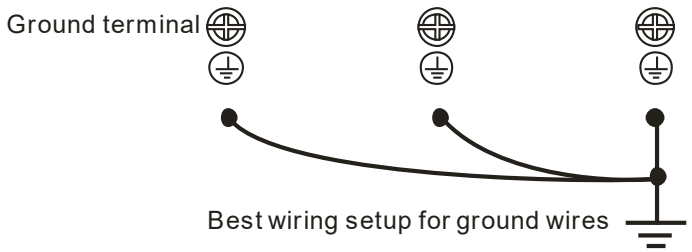


1-6-1 Isolating main power from ground

When the Power Regenerative Unit power distribution system is a floating ground system (IT) or an asymmetric ground system (TN), you must remove the RFI jumper when using Delta's EMI filter. Removing the RFI jumper cuts off the internal RFI capacitor (filter capacitor) between the system's ground and the central circuits to avoid damaging the central circuits and reduces the ground leakage current (according to IEC 61800-3).

Important points regarding ground connection:

- ☑ To ensure the safety of personnel, proper operation, and to reduce electromagnetic radiation, the Power Regenerative Unit must be properly grounded during installation.
- ☑ The diameter of the cables must meet the size specified by safety regulations.
- ☑ The shielded cable must be connected to the Power Regenerative Unit ground to meet safety regulations.
- ☑ The shielded cable can only be used as the ground for equipment when the above points are met.
- ☑ When installing multiple sets of Power Regenerative Units, do not connect the Power Regenerative Units grounds in series, as shown below.



Pay particular attention to the following points:

- ☑ After turning on the main power, do not remove the RFI jumper while the power is on.
- ☑ Make sure the main power is turned off before removing the RFI jumper.
- ☑ Removing the RFI jumper also cuts off the capacitor electrical conductivity, the transient voltage surge suppressor, and the common-mode capacitor. The Power Regenerative Unit no longer guarantees that the electromagnetic compatibility conforms to regulations.
- ☑ Do not remove the RFI jumper if the main power is a grounded power system.
- ☑ Do not remove the RFI jumper while conducting high voltage tests. When conducting a high voltage test to the entire facility, disconnect the main power and the motor if the leakage current is too high.

Floating Ground System (IT Systems)

A floating ground system is also called IT system, ungrounded system, or high impedance/resistance (greater than 30 Ω) grounding system.

- ☑ Remove the RFI jumper to cut off the transient voltage suppressor and the common-mode capacitance connecting to the ground.
- ☑ When installing an external capacitor or an external EMI filter, you form a circuit through the capacitor/EMI filter common capacitors' grounding. That circuit might damage the capacitor and the EMI filter.
- ☑ In situations where EMC is required, install an EMI filter specially designed for IT Systems. Removing the EMI filter might avoid damage but might also not conform to EMC regulations.
- ☑ In situations where EMC is required, check for excess electromagnetic radiation affecting nearby low-voltage circuits. In some situations, the adapter and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main circuit and the control terminals to increase security.

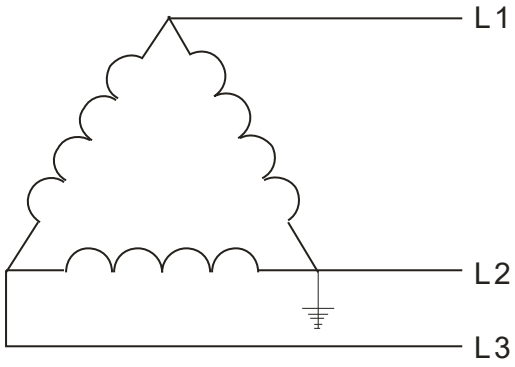
Asymmetric Ground System (Corner Grounded TN Systems)

Caution: Do not remove the RFI jumper while the input terminal of the Power Regenerative Unit carries power.

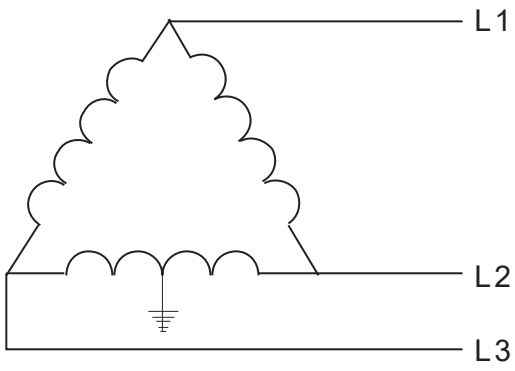
In the following four situations, you must remove the RFI jumper, because the phase to ground voltage is not symmetrical in the power system. This prevents the Power Regenerative Unit from grounding through the RFI jumper and damaging the Power Regenerative Unit.

Corner Grounded TN Systems: remove the RFI jumper

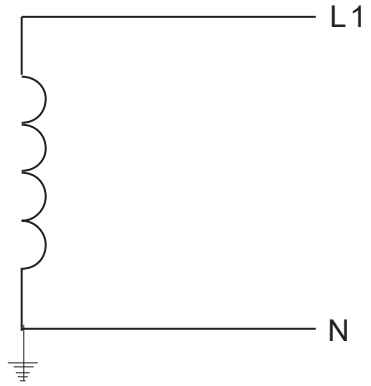
1 Grounding at a corner in a triangle configuration



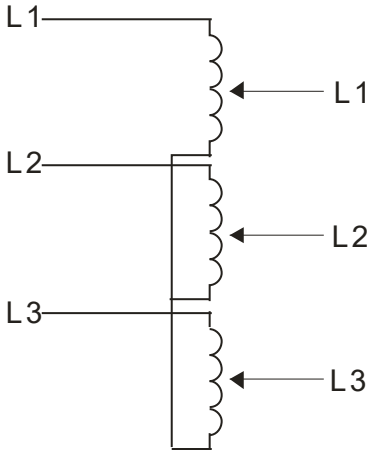
2 Grounding at a midpoint in a polygonal configuration



3 Grounding at one end in a single-phase configuration

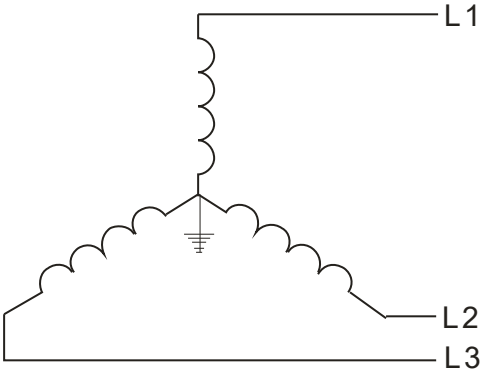


4 No stable neutral grounding in a three-phase autotransformer configuration



Symmetrical Power System: Can use the RFI jumper

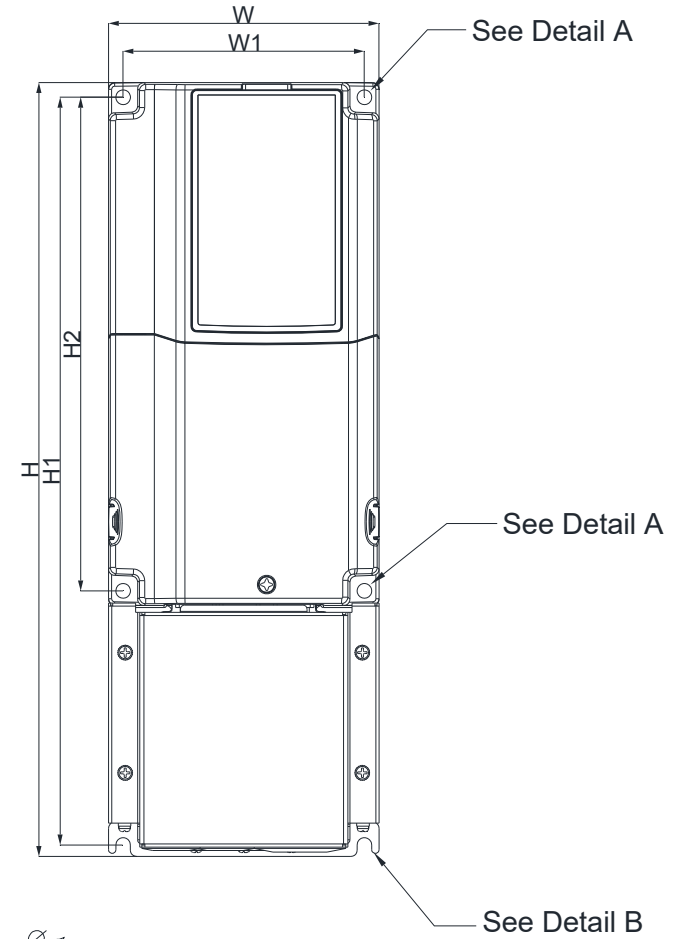
Connect a symmetrical grounding power system to a RFI jumper to maintain the efficiency of the transient voltage surge suppressor. For reference, the diagram on the right is a symmetrical grounding power system.

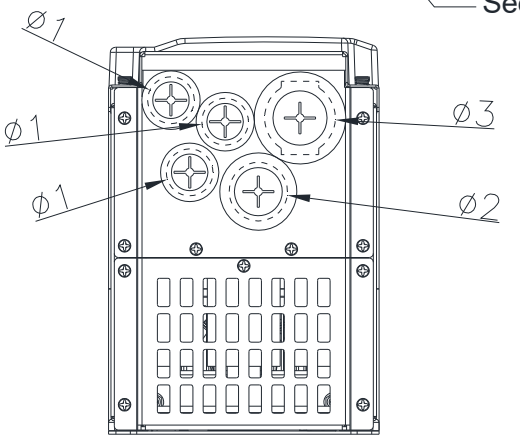


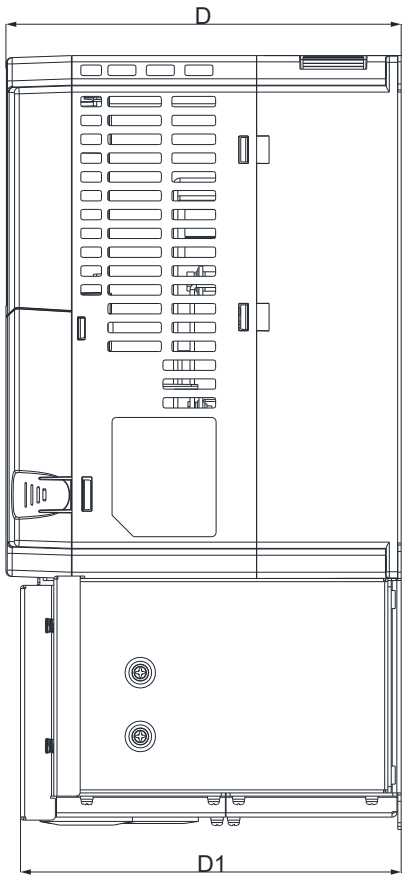
1-7 Dimensions

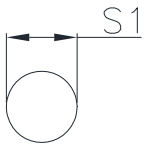
Frame A

REG075A23A-21; REG110A23A-21; REG075A43A-21; REG110A43A-21; REG150A43A-21

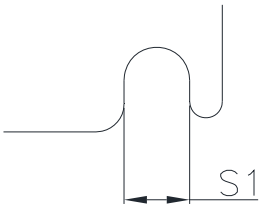








Detail A (Mounting Hole)



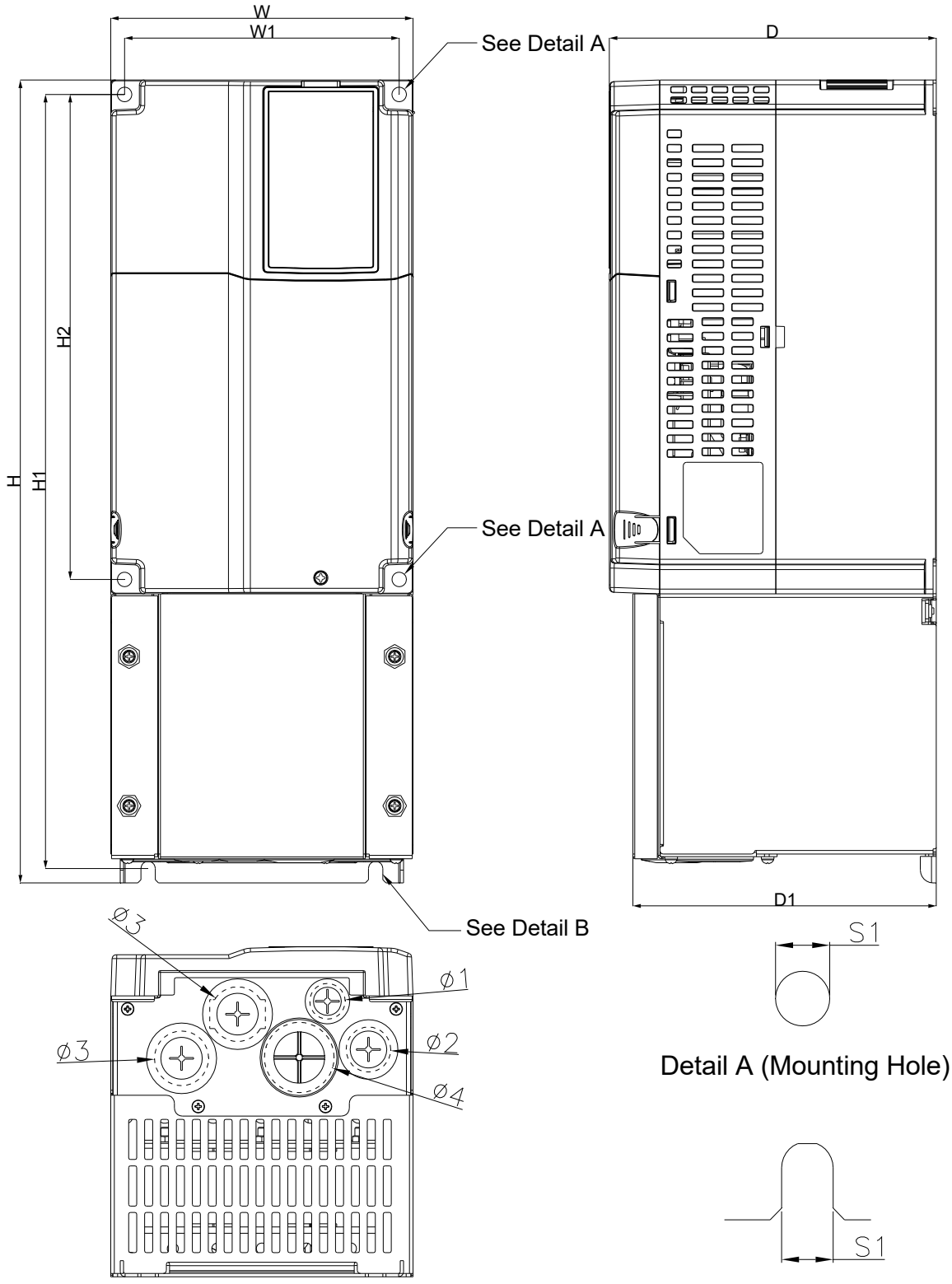
Detail B (Mounting Hole)

Unit: mm [inch]

Frame	W	H	D	W1	H1	H2	D1	S1	Φ1	Φ2	Φ3
A	130.0 [5.12]	370.0 [14.56]	190.0 [7.48]	116.0 [4.57]	357.5 [14.07]	236.0 [9.29]	183.0 [7.20]	7.0 [0.28]	22.2 [0.87]	28.0 [1.10]	34.0 [1.34]

Frame B

REG150A23A-21; REG185A23A-21; REG220A23A-21; REG185A43A-21; REG220A43A-21; REG300A43A-21



Detail A (Mounting Hole)

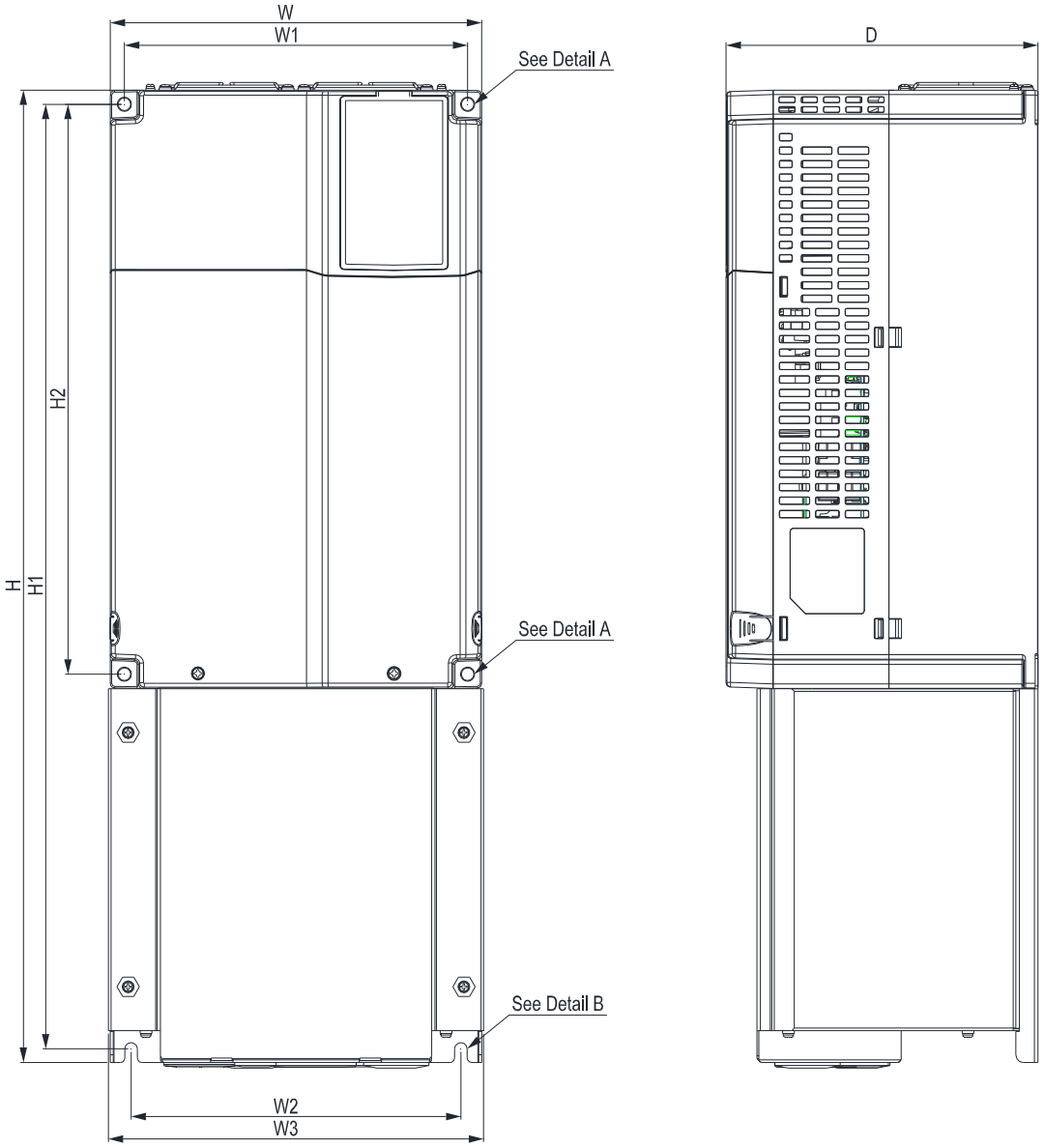
Detail B (Mounting Hole)

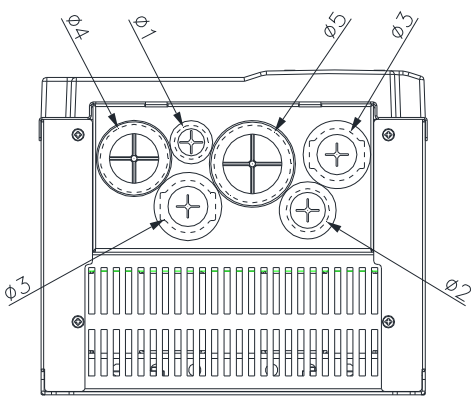
Unit: mm [inch]

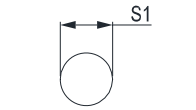
Frame	W	H	D	W1	H1	H2	D1	S1	Φ1	Φ2	Φ3	Φ4
B	190.0 [7.48]	500.0 [19.68]	205.0 [8.09]	172.5 [6.79]	482.0 [18.98]	302.0 [11.89]	190.5 [7.50]	9.0 [0.35]	22.2 [0.87]	28.0 [1.10]	34.0 [1.34]	43.8 [1.72]

Frame C

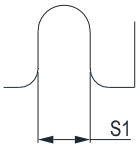
REG300A23A-21; REG370A23A-21; REG370A43A-21; REG450A43A-21; REG550A43A-21







Detail A (Mounting Hole)



Detail B (Mounting Hole)

Unit: mm [inch]

Frame	W	H	D	W1	W2	W3	H1	H2	S1	Φ1	Φ2	Φ3	Φ4	Φ5
C	250.0 [9.84]	650.0 [25.59]	210.0 [8.27]	231.0 [9.09]	220.0 [8.74]	252.5 [9.94]	631.5 [24.86]	381.0 [15.00]	8.5 [0.33]	22.2 [0.87]	28.0 [1.10]	34.0 [1.34]	44.0 [1.73]	50.1 [1.97]

02 Checking & Recommendations

Installation Distances & Wiring Description

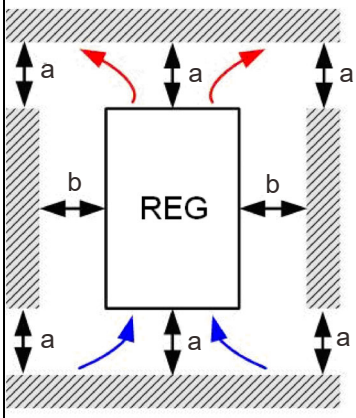
NOTE

- ☑ Install this product upright.
- ☑ Do not allow foreign materials such as fibers, paper, wood chips/dust, or scrap metal to enter the Power Regenerative Unit or stick to the cooling fan.
- ☑ Connect the unit to a metallic or other nonflammable control panel to prevent causing a fire.
- ☑ Install the Power Regenerative Unit in an environment that complies with pollution degree 2 with clean circulating air. Clean circulating air is defined as air without polluting substances or electronically contaminated dust.

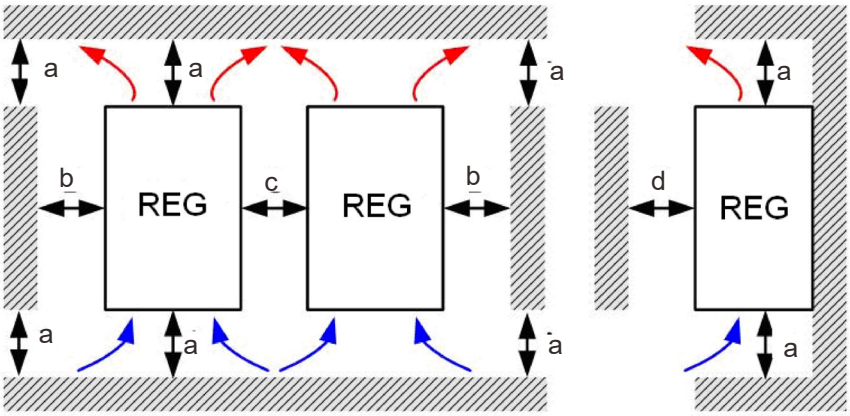
The following diagrams are for demonstration purposes only, and may differ from the actual product.

← (Blue arrow) Air intake ← (Red arrow) Air outflow

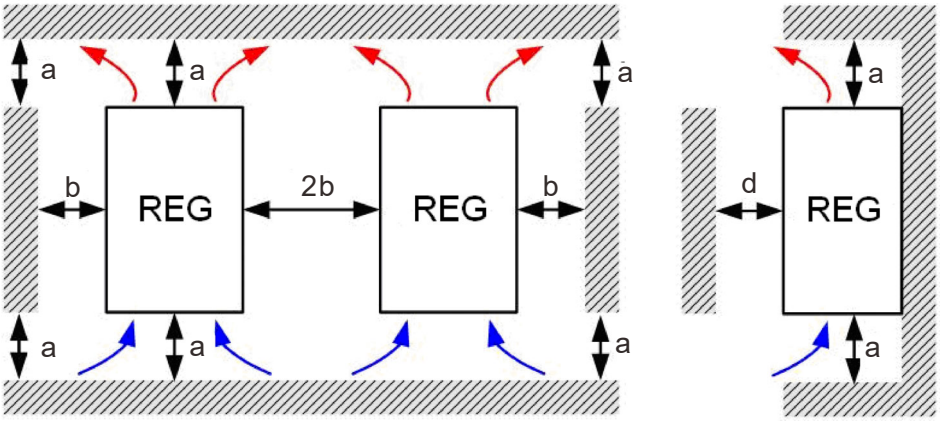
Single unit - Standalone setup
(Frame A, B, C)



Horizontal linked setup
(Frame A, B, C)



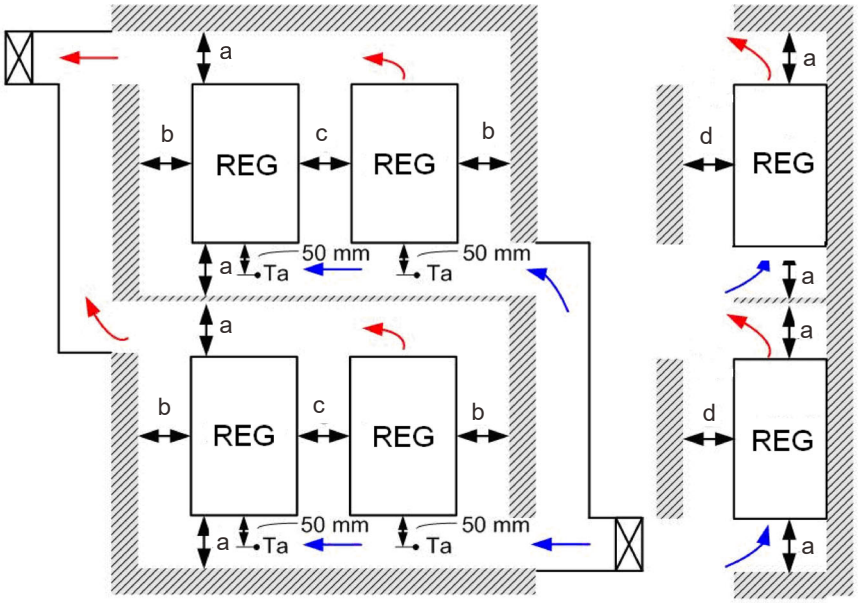
Multiple units - Horizontal standalone setup
(Frame A, B, C)



Multiple units - Vertical linked setup (Frame A, B, C)

Frame A, B, C

When setting up multiple units in a vertical standalone setup, install dividers between the levels. Determine the divider dimensions on the principle that the temperature at the intake fans should be lower than the operating temperature as shown in the diagrams below. Operating temperature is defined as the temperature measured 50 mm in front of the fan inlet.

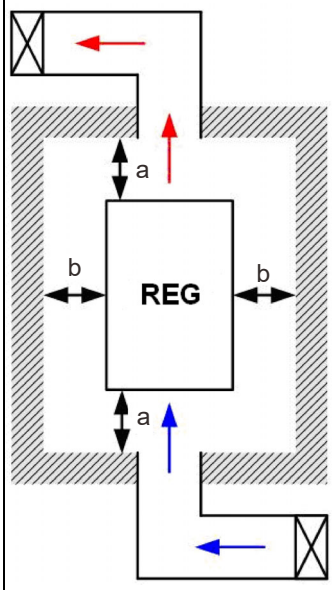


Minimum Distance Required (mm) / Frame	A	B	C	D
A, B, C	60	30	10	0

Frame A	REG075A23A-21; REG110A23A-21; REG075A43A-21; REG110A43A-21; REG150A43A-21
Frame B	REG150A23A-21; REG185A23A-21; REG220A23A-21; REG185A43A-21; REG220A43A-21; REG300A43A-21
Frame C	REG300A23A-21; REG370A23A-21; REG370A43A-21; REG450A43A-21; REG550A43A-21

NOTE

Frames A–C above are all required minimum distances; any distance less than these values will affect the cooling fan's function.



NOTE

※ The specified distances are only applicable in open spaces. As shown in the diagram on the left, if the units are being installed in an enclosed space, such as distribution channel or chassis, install ventilation or air conditioning systems to keep the ambient temperature under the operating temperature.

※ The table shows the required airflow rate for each model when installing single units in an enclosed space. For multiple units, multiply the required airflow rate by the number of units installed.

※ Refer to the “Airflow Rate for Cooling” table below when selecting and designing ventilation systems.

※ Refer to the “Power Dissipation of REG” table below for the design of air conditioning systems.

Airflow Rate for Cooling						
Model No.	Flow Rate (cfm)			Flow Rate (m^3/hr)		
	External	Internal	Total	External	Internal	Total
REG075A23A-21	44	-	44	75	-	75
REG110A23A-21	44	-	44	75	-	75
REG150A23A-21	92	-	92	155	-	155
REG185A23A-21	92	-	92	155	-	155
REG220A23A-21	92	-	92	155	-	155
REG300A23A-21	121	-	121	206	-	206
REG370A23A-21	118	15	133	201	25	226
REG075A43A-21	44	-	44	75	-	75
REG110A43A-21	44	-	44	75	-	75
REG150A43A-21	44	-	44	75	-	75
REG185A43A-21	92	-	92	155	-	155
REG220A43A-21	92	-	92	155	-	155
REG300A43A-21	92	-	92	155	-	155
REG370A43A-21	121	-	121	206	-	206
REG450A43A-21	118	15	133	201	25	226
REG550A43A-21	118	15	133	201	25	226

※ The table shows the required airflow rate for each model when installing single units in an enclosed space.

※ For multiple units, multiply the required airflow rate for single-unit installation by the number of units installed.

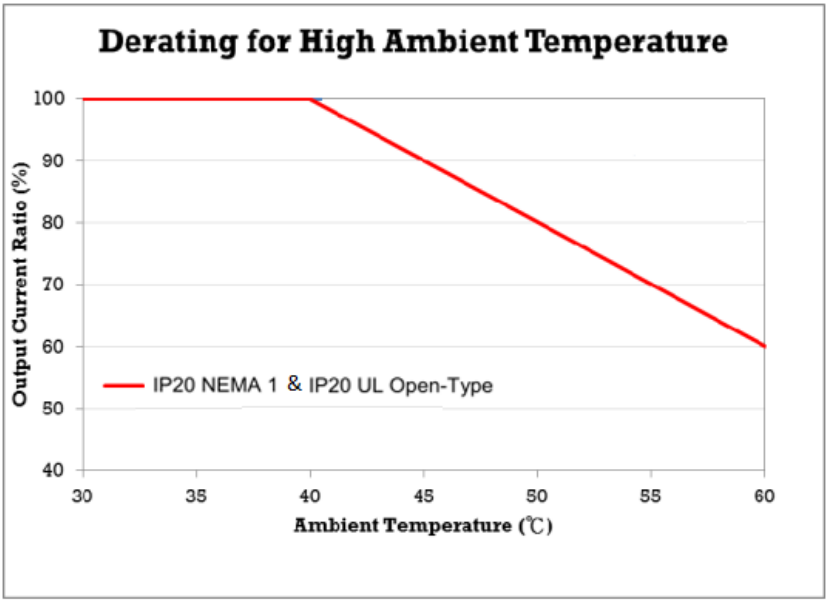
Power Dissipation of REG			
Model No.	Power Dissipation		
	Loss External (Heat sink)	Internal	Total
REG075A23A-21	127	86	213
REG110A23A-21	203	121	324
REG150A23A-21	219	161	380
REG185A23A-21	255	184	439
REG220A23A-21	336	216	552
REG300A23A-21	434	186	620
REG370A23A-21	678	220	898
REG075A43A-21	128	76	204
REG110A43A-21	198	93	291
REG150A43A-21	240	122	362
REG185A43A-21	291	138	429
REG220A43A-21	368	158	526
REG300A43A-21	446	211	657
REG370A43A-21	508	184	692
REG450A43A-21	664	218	882
REG550A43A-21	919	257	1176

※ The table shows the required heat dissipation rate due to heat loss for each model when installing single units in an enclosed space.

※ For multiple units, multiply the heat dissipation rate for single units by the number of units installed. The heat dissipation data are calculated based on each model operating under rated voltage, current, and default carrier wave.

NOTE

■ Normal Control Ambient Temperature Derating Factor Curve



03 Specifications

230V Series

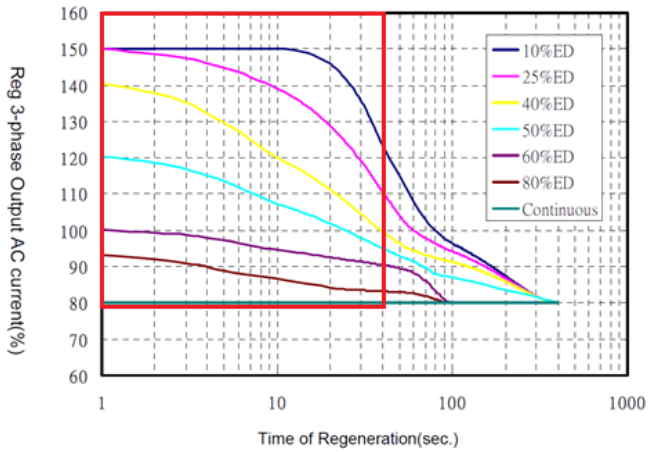
Frame		A		B			C	
Model REG_ _ _A23A-21		075	110	150	185	220	300	370
Rated power (kW)		7.5	11	15	18.5	22	30	37
DC BUS	Rated input current (A_{DC})	24.0	39.0	46.0	59.8	73.2	97.6	122
	Range of voltage activation level	270–390 V_{DC} (Specify in Pr.01-08)						
Mains	Output current (A_{AC})	20	32	38	49	60	80	100
	Rated voltage / frequency	Three-phase 200–240 V_{AC} (-15%–10%), 50/60 Hz						
	Operation voltage range	170–265 V_{AC}						
	Frequency range	47–63 Hz						
Net weight		7.9 ± 0.5 kg		16.5 ± 0.5 kg			25.5 ± 0.5 kg	28.0 ± 0.5 kg

460V Series

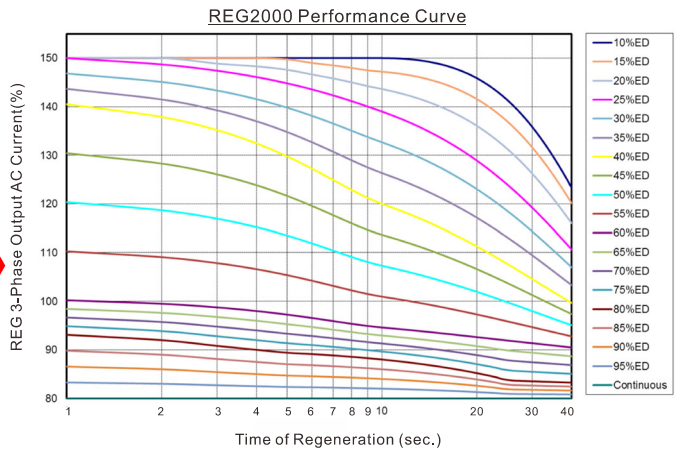
Frame		A			B			C		
Model REG_ _ _A43A-21		075	110	150	185	220	300	370	450	550
Rated power (kW)		7.5	11	15	18.5	22	30	37	45	55
DC BUS	Rated input current (A_{DC})	12.8	20.7	24.4	30.5	39.0	52.5	59.8	73.0	91.5
	Range of voltage activation level	516–780 V_{DC} (Specify in Pr.01-08)								
Mains	Output current (A_{AC})	10.5	17	20	25	32	43	49	60	75
	Rated voltage / frequency	Three-phase 380–480 V_{AC} (-15%–10%), 50/60 Hz								
	Operation voltage range	323–528 V_{AC}								
	Frequency range	47–63 Hz								
Net weight		7.5 ± 0.5 kg			17.0 ± 0.5 kg			26.5 ± 0.5 kg	29.0 ± 0.5 kg	29.5 ± 0.5 kg

General Specifications

Control method	SVPWM
Brake torque	80% rated output current when regenerating continuously; 100% rated output current when regenerating for 60 seconds at 25% ED. See REG2000 Performance Curve below for more information.
Overload capacity	150% rated output current when regenerating for 10 seconds at 10% ED
Generic input signal	Five channels of signal terminals, 24 V_{DC} 6 mA
Generic output signal	Two channels of signal terminals, 48 V_{DC} 50 mA; one channel of signal terminal, relay output
Cooling method	Forced air cooling (Fan cooling)
Certifications	CE, UL CERTIFIED IND. CONT. EQ. SAFETY US·CA E176972, SEMI F47

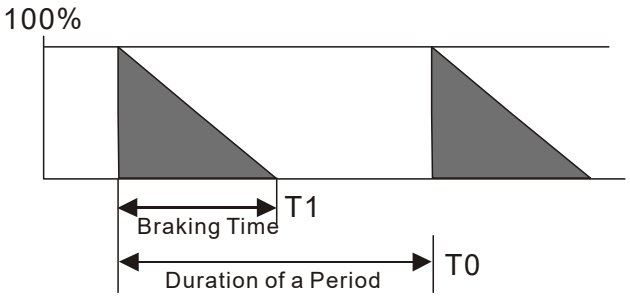


REG2000 Performance Curve



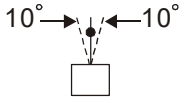
REG2000 Performance Curve | Magnified Performance Curve in Red Rectangle

- The plots above show the measurement by combining a Power Regenerative Unit with a DC choke.
- Regardless of the ED%, if the Power Regenerative Unit has a regeneration output for more than 400 seconds, the Power Regenerative Unit is performing a continuous regeneration.
- The LED indicators on the standard keypad display the operating status of the Power Regenerative Unit. If you need to set up the unit from a keypad, you can buy an optional keypad. See Chapter 05 Optional Accessories for more information.
- Definition of the brake utilization rate ED%:

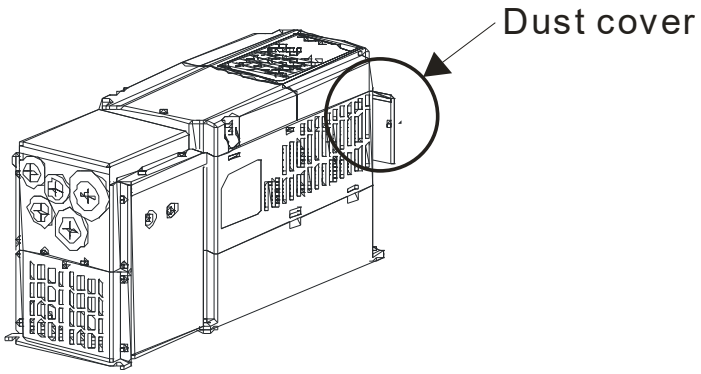


Utilization Rate
ED% = T1 / T0x100 (%)

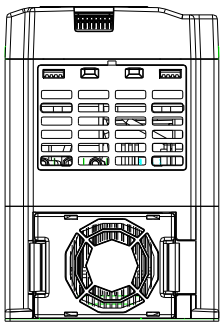
Operation, Storage and Transportation Environment

<table>
<tr><td colspan="5">DO NOT expose the Power Regeneration Unit to environmental conditions such as dust, direct sunlight, corrosive/inflammable gasses, oil, humidity, liquid, or vibration. The salt in the air must be less than 0.01 mg/cm^2 every year.</td></tr>
<tr><td rowspan="15">Environmental</td><td colspan="2">Installation Location</td><td colspan="2">IEC60364-1/IEC60664-1 Pollution degree 2. Indoor use only.</td></tr>
<tr><td rowspan="3">Surrounding Temperature</td><td>Operation</td><td colspan="2">-10–40°C</td></tr>
<tr><td>Storage/ Transportation</td><td colspan="2">-25–70°C</td></tr>
<tr><td colspan="3">Non-condensing, non-freezing</td></tr>
<tr><td rowspan="3">Rated Humidity</td><td>Operation</td><td colspan="2">Maximum 90%</td></tr>
<tr><td>Storage / Transportation</td><td colspan="2">Maximum 95%</td></tr>
<tr><td colspan="3">Non-condensing, non-freezing</td></tr>
<tr><td rowspan="2">Air Pressure</td><td>Operation / Storage</td><td colspan="2">86–106 kPa</td></tr>
<tr><td>Transportation</td><td colspan="2">70–106 kPa</td></tr>
<tr><td rowspan="5">Pollution Level</td><td colspan="3">IEC721-3-3</td></tr>
<tr><td>Operation</td><td colspan="2">Class 3C2; Class 3S2</td></tr>
<tr><td>Storage</td><td colspan="2">Class 2C2; Class 2S2</td></tr>
<tr><td>Transportation</td><td colspan="2">Class 1C2; Class 1S2</td></tr>
<tr><td colspan="3">No concentrate</td></tr>
<tr><td>Altitude</td><td>Operation</td><td colspan="2">If the Power Regeneration Unit is installed at altitude of 0–1000 m, follow normal operation restrictions. If it is installed at altitude of 1000–3000 m, decrease the rated current by 2% or lower 0.5°C of temperature for every 100 m increase in altitude. Maximum altitude for Corner Grounded installation is 2000 m.</td></tr>
<tr><td rowspan="2">Package Drop</td><td>Storage</td><td colspan="3" rowspan="2">ISTA procedure 1A (based on weight) IEC60068-2-31</td></tr>
<tr><td>Transportation</td></tr>
<tr><td>Vibration</td><td colspan="4">[Frame A & B] 2–13.2 Hz, 1.0 mm; 13.2–55 Hz, 0.7–1.5 G; 55–512 Hz, 1.5 G (Complies with IEC 60068-2-6)
[Frame C] 2–13.2 Hz, 1.0 mm; 13.2–55 Hz, 0.7–1.0 G; 55–512 Hz, 1.0 G (Complies with IEC 60068-2-6)</td></tr>
<tr><td>Impact</td><td colspan="4">IEC/EN 60068-2-27</td></tr>
<tr><td>Operating position</td><td colspan="2">Maximum allowed offset angle ±10° (under normal installation position)</td><td colspan="2"> 
</td></tr>
</table>

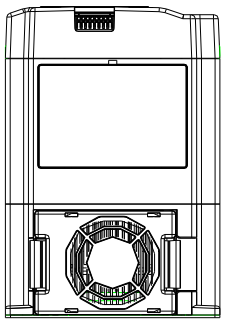
Operating Temperature and Protection Level Specifications



IP20 UL Open-Type

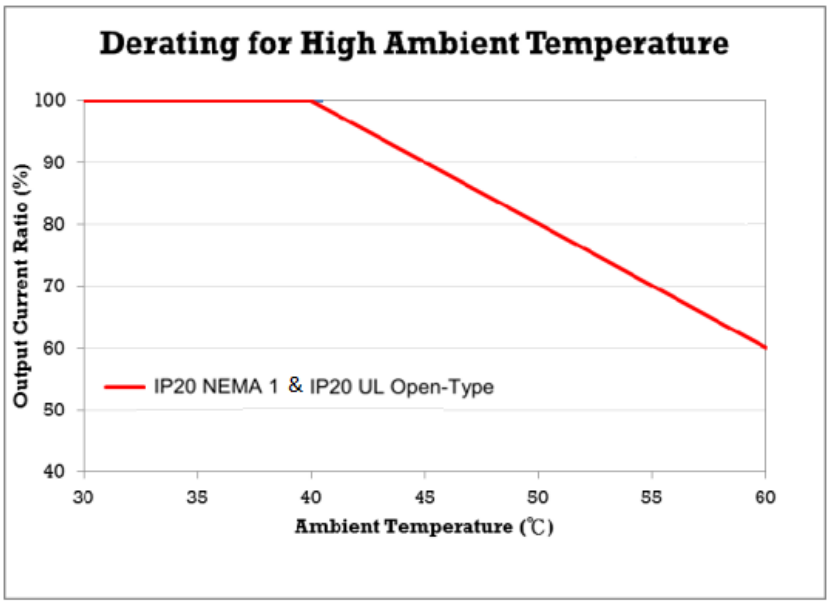


IP20 NEMA 1



Dust cover	Protection Level	Operating Temperature
with	IP20 NEMA 1	When operating at rated current, the surrounding temperature must be between -10–40°C. When the surrounding temperature is over +40°C, decrease the rated current by 2% for every 1°C increase in temperature. The maximum allowable surrounding temperature is 60°C.
without	IP20 UL Open-Type	

■ Normal Control Ambient Temperature Derating Factor Curve



1. Derating of the Power Regenerative Unit decreases by multiplication.
2. Derating is required not only when there is a continuous regeneration, but in addition the conditions covered by the Performance Curve are required to have the same derating ratio.

Calculation 1:

When the ambient temperature = 40°C, ED = 10%, the braking capacity of the Power Regenerative Unit = 150%, 10 seconds (See REG2000 Performance Curve).

When the ambient temperature = 45°C, see Normal Control Ambient Temperature Derating Factor Curve, and the Power Regenerative Unit needs a derating of 10% = (45°C - 40°C) x 2%. Therefore, when ED is at 10%, the braking capacity of the Power Regenerative Unit = 150% x (100%-10%) = 135%, 10 seconds.

Calculation 2:

When the ambient temperature = 40°C and the regeneration is continuous, the braking capacity of the Power Regenerative Unit = 80% of the rated output current.

When the ambient temperature = 55°C and the regeneration is continuous, the braking capacity of the Power Regenerative Unit is 56% = [80% x (100% - 30%)] of the rated output current.

04 Wiring

After removing the front cover, verify that the power and control terminals are clearly noted. Read the following precautions before wiring.

☑ Make sure that power is only applied to the R/L1, S/L2, T/L3, DC+, and DC- terminals. Failure to comply may result in damage to the equipment. The voltage and current should be within the specified range on the nameplate (Section 1-1).

☑ All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock and reduce interference.

☑ Securely tighten the main circuit terminal screws to prevent sparks caused by screws loosened by vibration.

☑ If a braking resistor is already installed in the existing system, keep the braking resistor for future use. Set Pr.01-08 to the reasonable power regenerative level when equipping with a braking resistor: (V_{AC} Voltage Level x 1.414) < REG DC BUS voltage activation level (Pr.01-08) < braking resistor trigger level. Use a reasonable margin to ensure that DC ripple does not trigger Pr.01-08 setting by mistake.

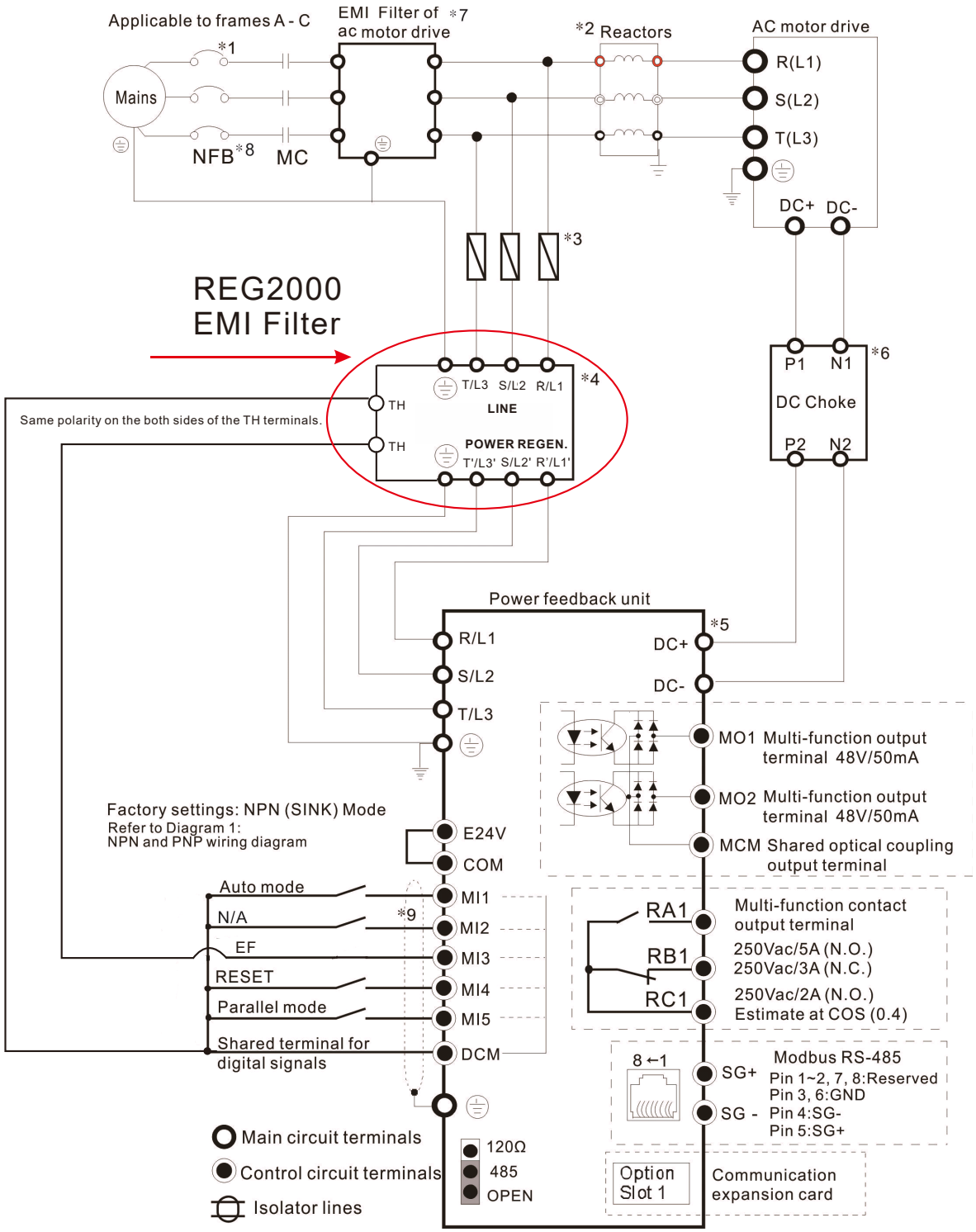
☑ If the Power Regenerative Unit is NOT equipped with a braking resistor, pay attention to the **DFMEA** (Design Failure Mode and Effect Analysis). The Power Regenerative Unit provides full status indication. Signals can be provided by external terminals to ensure system integration reliability.

☑ If a Power Regenerative Unit is malfunctioning, it can send signals through communication and MOx terminals.

 **DANGER**	☑ It is crucial to turn off the Power Regeneration Unit power before wiring. A charge with hazardous voltages may still remain in the DC BUS capacitors even if the power has been turned off. Always measure the remaining voltage before wiring. For your safety, do not perform any wiring before the voltage drops to a safe level < 25 V_{DC}. Wiring while voltage remains can cause sparks and short circuits. ☑ Only qualified personnel familiar with the Power Regeneration Unit are allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shock.
 **CAUTION**	☑ When wiring, use wires that comply with local regulations for your safety. ☑ Check following items after finishing the wiring: 1. Are all connections correct? 2. Are there any loosen wires? 3. Are there any short circuits between the terminals or to ground?

4-1 Wiring Diagram

1. Normal Wiring Diagram



*1 Select the NFB based on the drive type.

*2 If a reactor is connected to the drive, install the reactor here (optional).

*3 Refer to 05 Optional Accessories for the selection of fuses.

*4 The cable length between REG2000 EMI filter and the Power Regenerative Unit must be less than 10 m, and cannot provide power to other equipment from here. While using the REG2000 EMI filter, remove the RFI jumper on the Power Regenerative Unit.

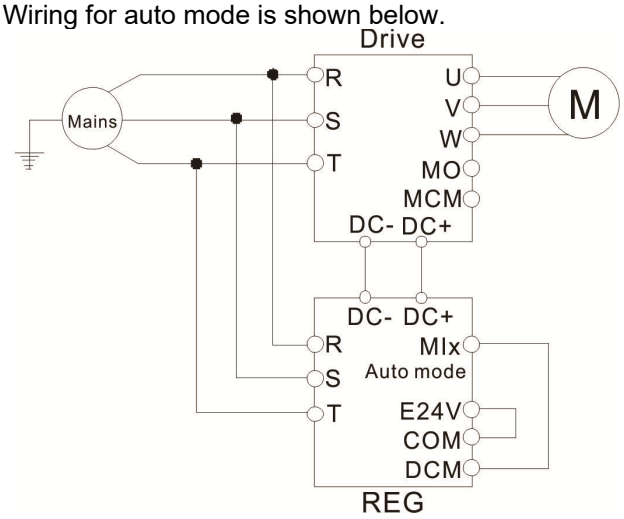
*5 The length of the DC+/DC- wires must be less than 5 m, and twisted wires are highly recommended.

*6 There is an attached DC choke shipped with the unit; install it as shown in the above wiring diagram. The P1, P2, N1, N2 in Normal Wiring Diagram is equal to the terminal 1, 2, 3, 4 in the Dimensions of DC Choke (Diagram 2). Installing the included DC choke can increase the regenerative efficiency and prevent electromagnetic interference. The DC choke part numbers in the REG2000 series are in Table 1.

*7 If there is no REG2000 EMI filter, we recommend using inductors (without capacitors) as the EMI filter for AC motor drives in order to prevent capacitors from being damaged by current ripples. If you have any concern about phase sequence protection, install Delta's EMI filter.

*8 If you need to provide power to other instruments, we recommend using the magnetic contactor (MC) terminals or NFB to connect to other instruments.

*9 If there is no keypad for the unit, refer to Pr.02-00–Pr.02-04 for detailed wiring of the multi-function input terminal (MIx, default setting is MI1). Wiring for auto mode is shown below.



*10 There are two wiring methods of multi-function input terminal (MIx). Refer to the Diagram 1.

Diagram 1: SINK (NPN) /SOURCE (PNP) Mode switching terminal descriptions

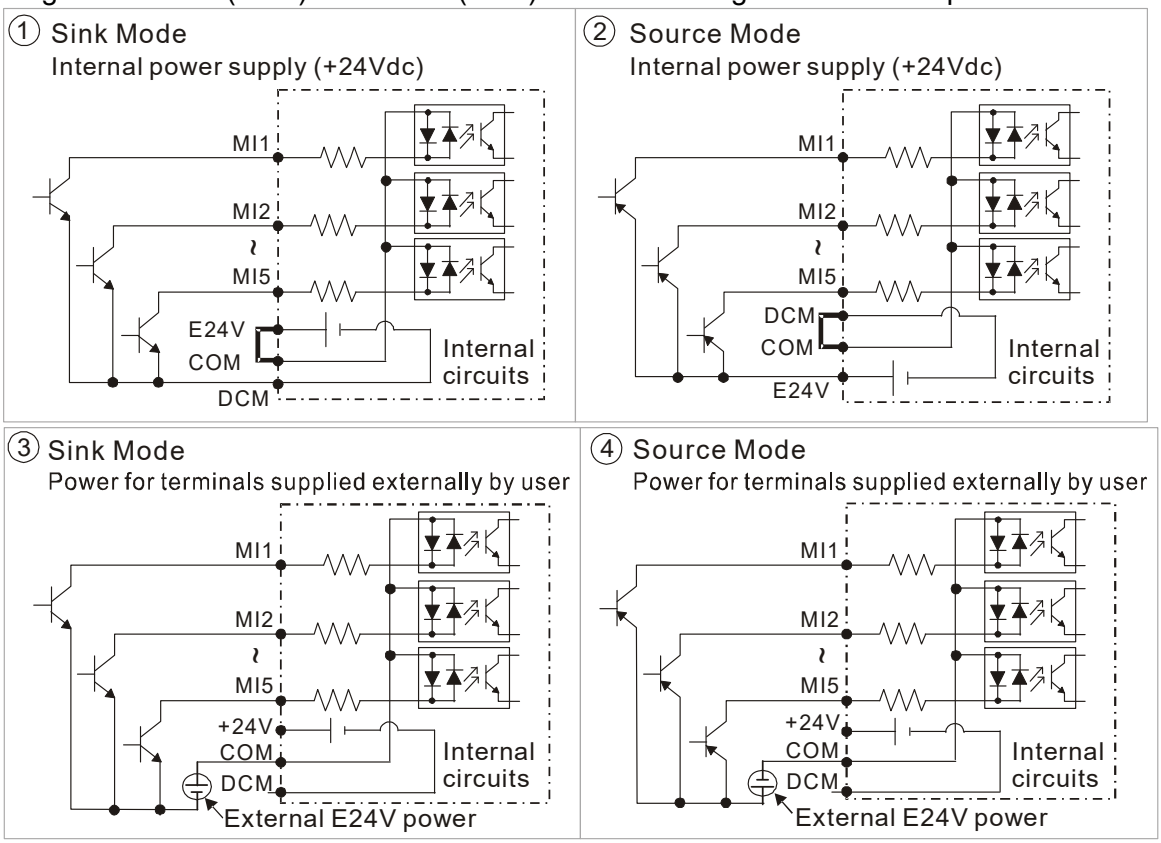
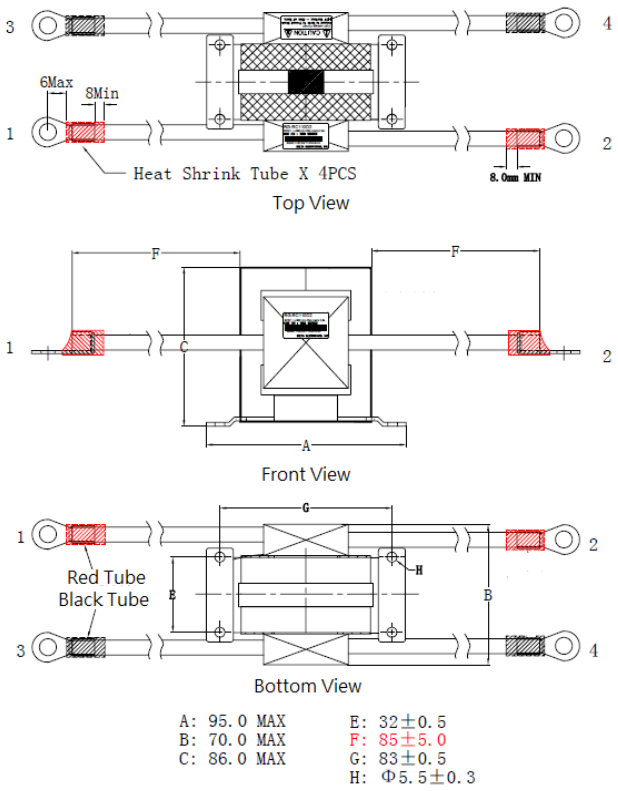


Diagram 2: Dimensions of DC choke

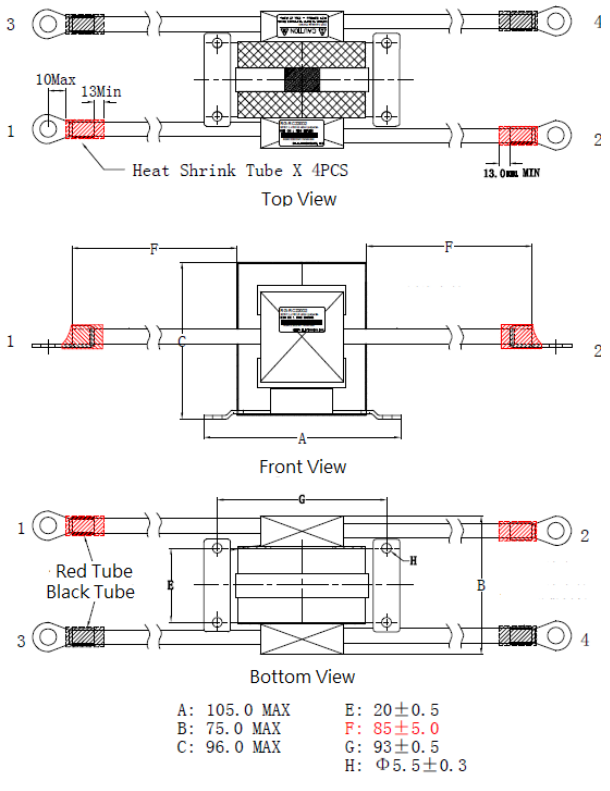
Terminals: #1 = P1, #2 = P2, #3 = N1, #4 = N2

RG-RC110D2, RG-RC150D4



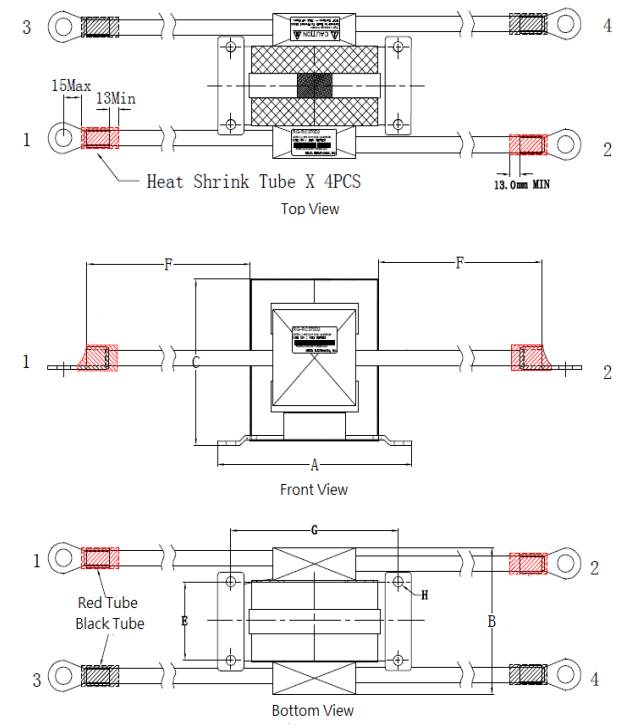
A: 95.0 MAX
B: 70.0 MAX
C: 86.0 MAX
E: 32±0.5
F: 85±5.0
G: 83±0.5
H: Φ5.5±0.3

RG-RC220D2, RG-RC300D4



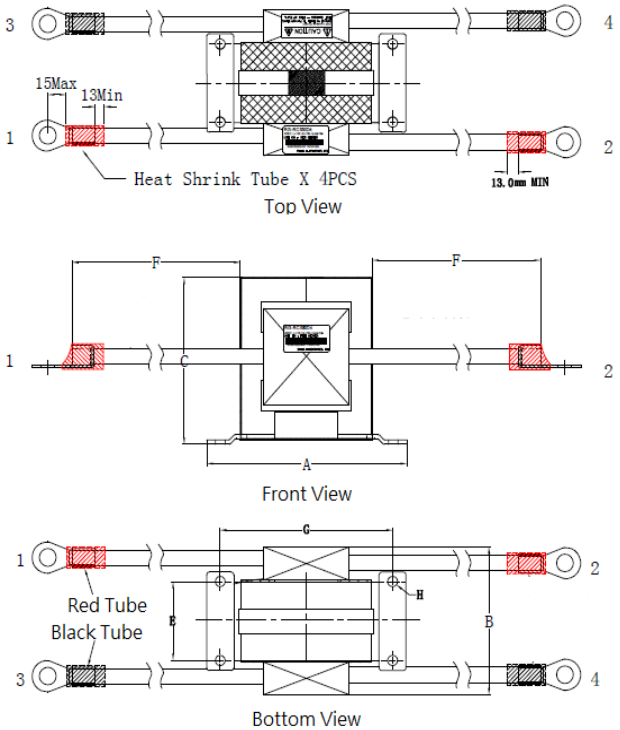
A: 105.0 MAX
B: 75.0 MAX
C: 96.0 MAX
E: 20±0.5
F: 85±5.0
G: 93±0.5
H: Φ5.5±0.3

RG-RC370D2



A: 105.0 MAX
B: 85.0 MAX
C: 96.0 MAX
E: 20±0.5
F: 85±5.0
G: 93±0.5
H: Φ5.5±0.3

RG-RC550D4



A: 105.0 MAX
B: 75.0 MAX
C: 96.0 MAX
E: 20±0.5
F: 85±5.0
G: 93±0.5
H: Φ5.5±0.3

- Make sure that P, N terminals (DC BUS) do not short through while installing DC chokes.
- The DC choke wiring sizes are defined in the user manual. See Section 4-10, 4-11, and 4-12 for recommended wire sizes for different frames.

Table 1: Part numbers of DC choke in REG2000 series

REG Model Name	Model of DC Choke (standard accessory)	Weight (g/unit)
REG075A23A-21	RG-RC110D2	836
REG110A23A-21		
REG150A23A-21	RG-RC220D2	900
REG185A23A-21		
REG220A23A-21		
REG300A23A-21	RG-RC370D2	1086
REG370A23A-21		
REG075A43A-21	RG-RC150D4	838
REG110A43A-21		
REG150A43A-21		
REG185A43A-21	RG-RC300D4	1058
REG220A43A-21		
REG300A43A-21		
REG370A43A-21	RG-RC550D4	1220
REG450A43A-21		
REG550A43A-21		

2. Multiple AC Motor Drives Wiring

The following are important points for your attention.

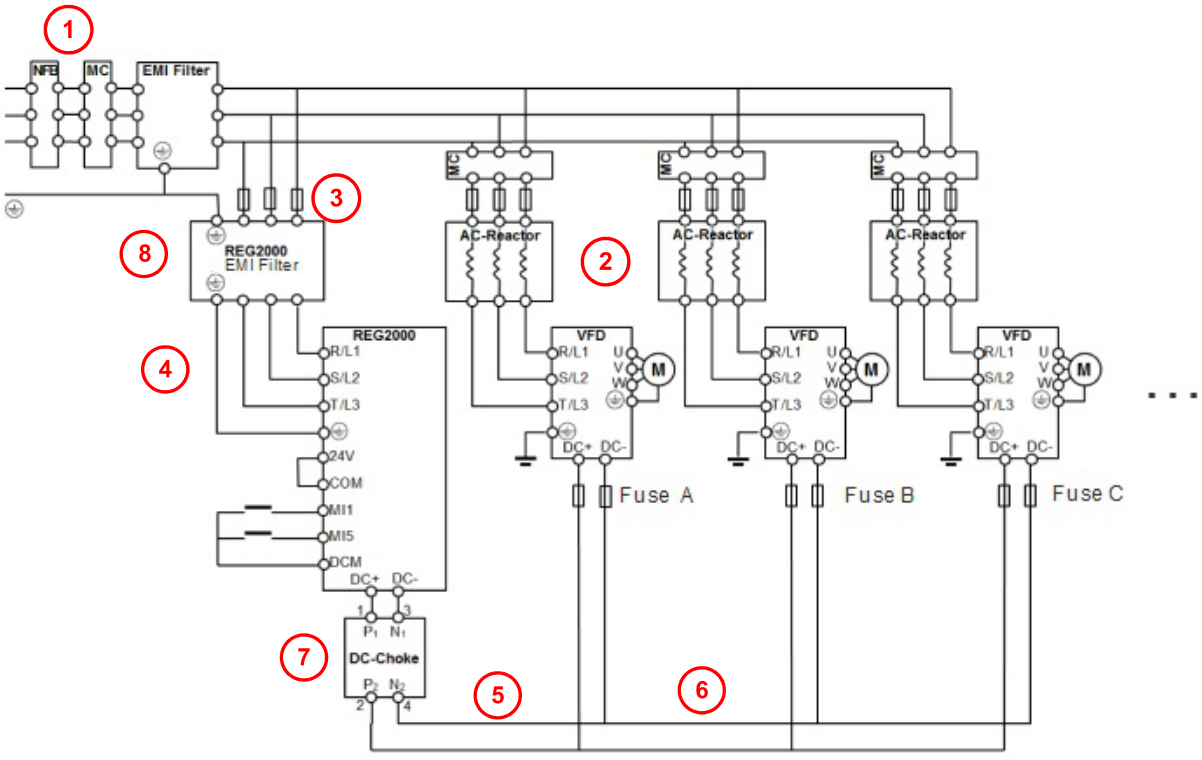
A. Refer to the diagram below to wire the unit.

1) Follow the motor drive specifications to choose the appropriate non-fuse breaker (NFB) and the magnetic contactor (MC).
2) Connect an input reactor to a motor drive following the instructions in the user manual. A 3% AC input reactor is recommended. Connect an input reactor to the motor drive with the shortest distance possible.
3) See Section 5-3 to choose an appropriate fuse.
4) The maximum cable length between a REG2000 and an EMI filter cannot be more than 10 m. Remove the RFI jumper before you install an EMI filter.
5) DO NOT install any other Power Regenerative Unit on the common DC BUS.
6) The maximum cable length between DC+ and DC- cannot be more than 5 m. Twisted pair is recommended.
7) Follow the wiring diagram to install the DC reactor (standard accessory) to reduce the electromagnetic interference (EMI) and to increase the work efficiency.
8) Follow the specifications in Section 5-4 to choose an appropriate EMI filter to avoid strong electromagnetic interference (EMI).

B. Make sure that your AC motor drives can operate on a common DC BUS at first. Verify that the AC motor drives have the correct specifications.

C. In order to choose the proper Power Regenerative Unit, first confirm the maximum regenerative energy while all AC motor drives work at the same time.

D. For one-to-many installation, install a fuse (Fuse A/B/C…, as shown in the diagram below) at the DC input side of every drive. Calculate and select a suitable fuse for every drive: Fuse type = (Rated input current of the drive) x 2.5.



Multiple AC Motor Drives Wiring Diagram

3. Multiple REG2000 Wiring in Parallel

The following are important points for your attention.

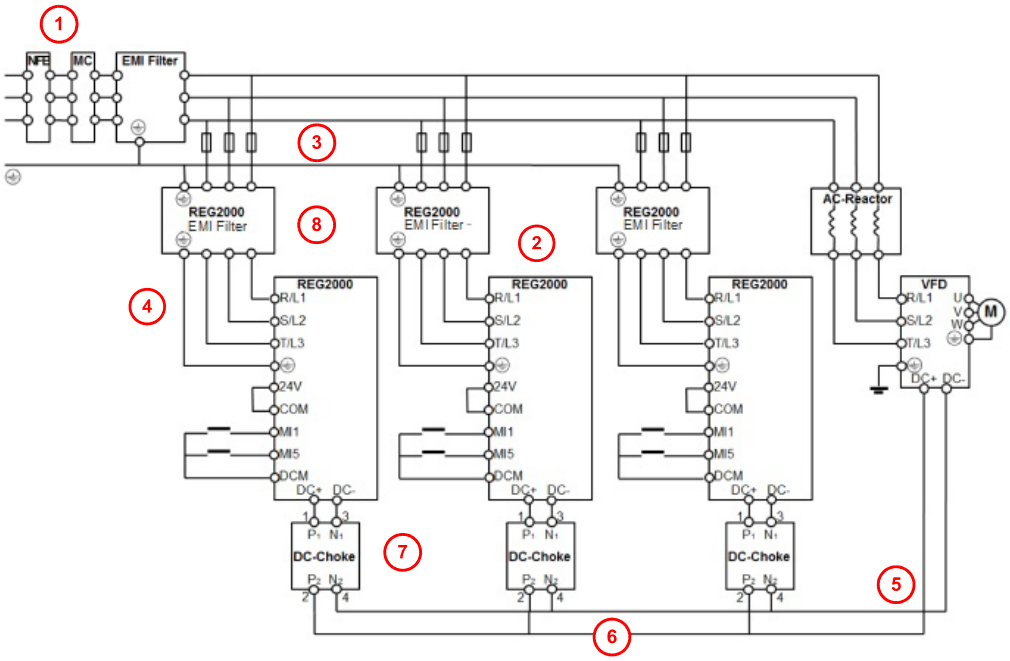
A. Install a maximum of four Power Regenerative Units working in parallel at the same time.

1) Follow the motor drive specifications to choose the appropriate non-fuse breaker (NFB) and the magnetic contactor (MC).
2) Connect an input reactor to a motor drive following the instructions in the user manual. A 3% AC input reactor is recommended. Connect an input reactor to the motor drive with the shortest distance possible.
3) See Section 5-3 to choose an appropriate fuse.
4) The maximum cable length between a REG2000 and an EMI filter cannot be more than 10 m. Remove the RFI jumper before you install an EMI filter.
5) DO NOT install any other Power Regenerative Unit on the common DC BUS.
6) The maximum cable length between DC+ and DC- cannot be more than 5 m. Twisted pair is recommended.
7) Follow the wiring diagram to install the DC reactor (standard accessory) to reduce the electromagnetic interference (EMI) and to increase the work efficiency.
8) Follow the specifications in Section 5-4 to choose an appropriate EMI filter to avoid strong electromagnetic interference (EMI).

B. A DC choke is required. Install the DC choke as close to each Power Regenerative Unit as possible.

C. Refer to the following diagram for wiring in parallel mode. Note that the wiring that connects to Power Regenerative Unit 2 comes from the AC motor drive DC BUS, and not directly from Power Regenerative Unit 1. Using copper bars for wiring is highly recommended.

D. The following diagram shows wiring in parallel mode. Refer to Pr.02-00–Pr.02-04 for detailed wiring of multi-function input terminal (MIx, default setting is MI5) to connect to the terminal DCM. Working in parallel, each Power Regenerative Unit reduces its current limit to 80% automatically. If the Power Regenerative Unit is in parallel mode, and continuous regenerative power is required, you can still select the capacity for single units based on 80% of the rated output.



Multiple REG2000 Wiring Diagram in Parallel

4-2 Main Circuit Terminals

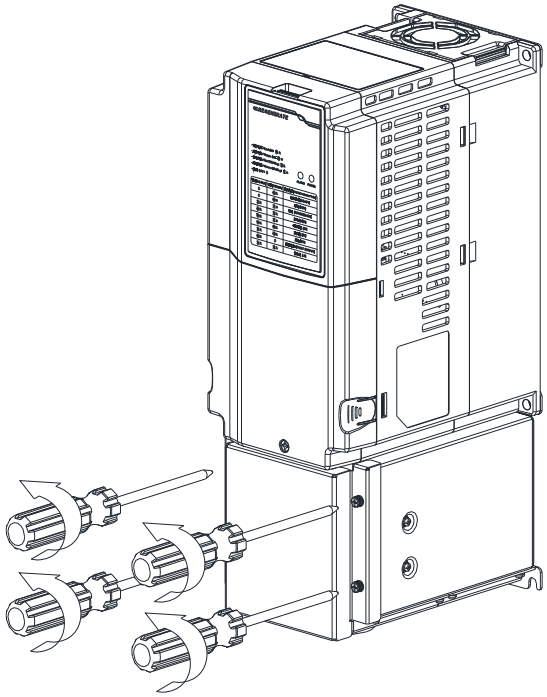
Remove the top cover before wiring the main circuit terminals.

The unit shown in the figures are for reference only and your drive may look different.

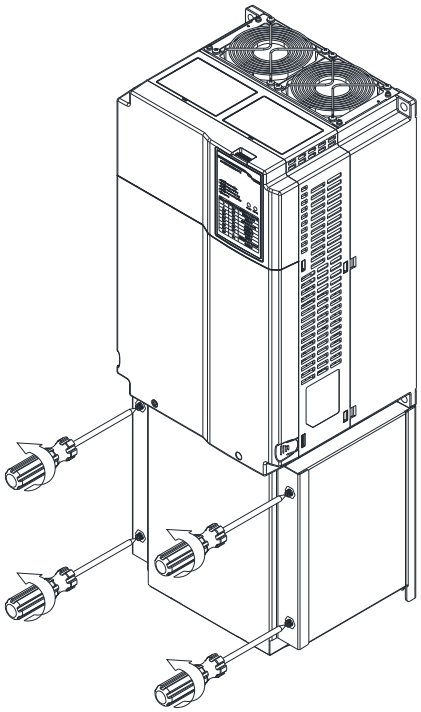
Removing the outer cover for wiring

1) Screw torque: 14–16 kg-cm [12.15–13.88 lb-in.] (1.37–1.57 Nm)

Loosen the screws for the wiring top cover as shown in the diagrams below.

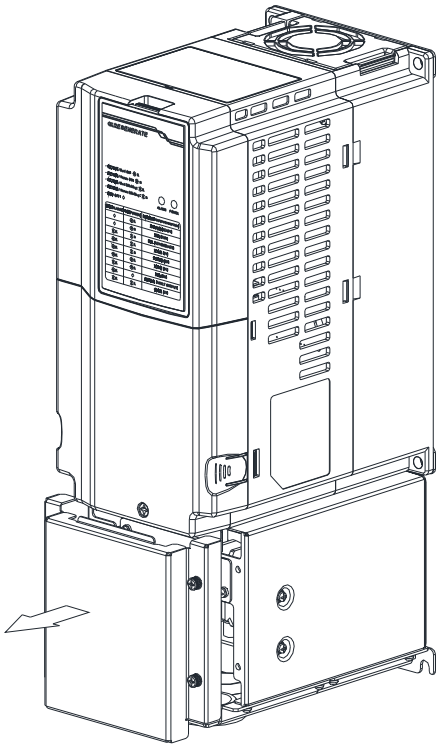


Frame A, B

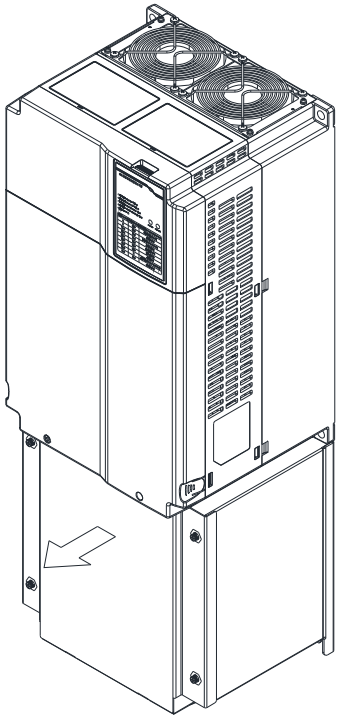


Frame C

2) After loosening the screws, remove the wiring top cover as shown in the diagrams below.



Frame A, B



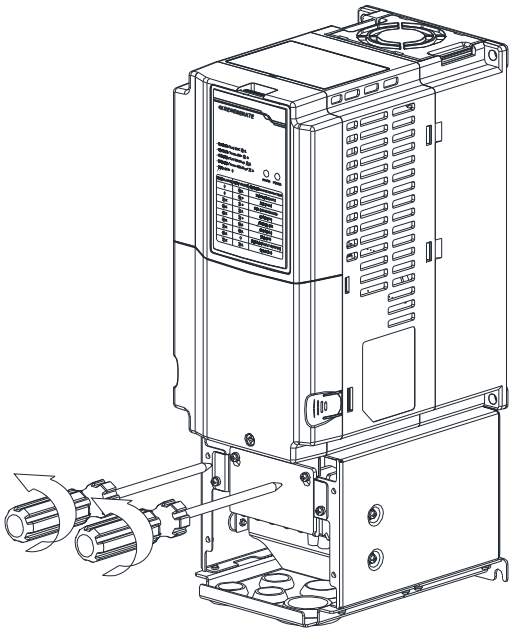
Frame C

3) Loosen the screws to wire the main circuit terminals.

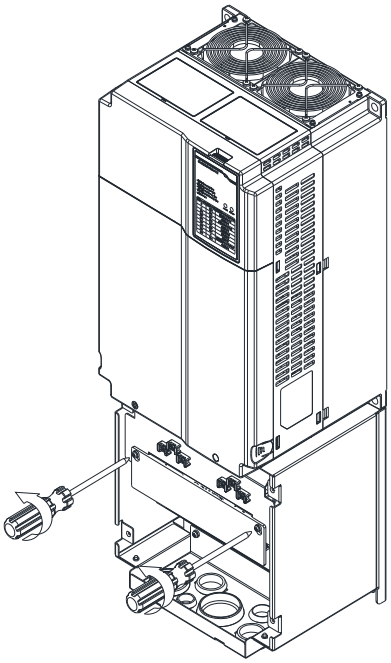
Frame A, screw torque: 6–8 kg-cm [5.2–6.9 lb-in.] (0.59–0.78 Nm)

Frame B, screw torque: 14–16 kg-cm [12.15–13.88 lb-in.] (1.37–1.57 Nm)

Frame C, screw torque: 10–12 kg-cm [8.68–10.42lb-in.] (0.98–1.18 Nm)



Frame A, B

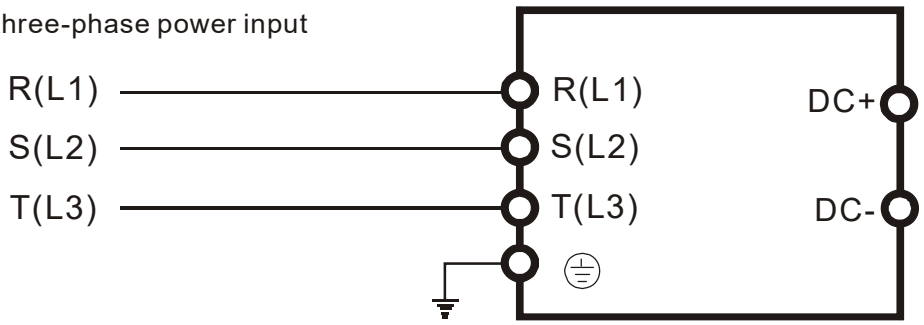


Frame C

Main Circuit Terminal Diagram

Applicable to frames A - C

Provides three-phase power input

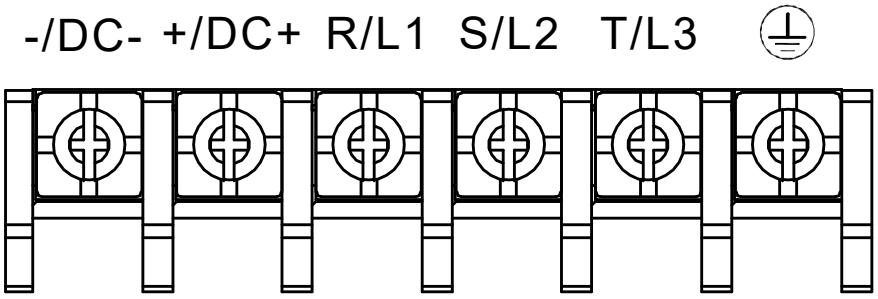


Terminal labels	Descriptions
R/L1, S/L2, T/L3	AC power input terminals (three-phase)
DC+, DC-	Connect to the AC motor drive's terminals DC+ and DC- respectively. There is a built-in fuse in the internal hardware circuit, which can prevent damage to the AC motor drive if the REG malfunctions.
⏚	Ground connection. Comply with local regulations.

Main Circuit Terminal Specifications

Frame A

Main Circuit Terminals



REG2000 Frame A						
Model Name	Terminals: R/L1, S/L2, T/L3, -/DC+, +/DC+			Terminals: ⏚		
	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)
REG075A23A-21	10 mm² [8 AWG]	6 mm² [10 AWG]	M4 12 kg-cm (10.4 lb-in.) (1.2 N-m)	6 mm² [10 AWG]	6 mm² [10 AWG]	M4 12 kg-cm (10.4 lb-in.) (1.2 N-m)
REG110A23A-21		10 mm² [8 AWG]		10 mm² [8 AWG]	10 mm² [8 AWG]	
REG075A43A-21		2.5 mm² [14 AWG]		2.5 mm² [14 AWG]	2.5 mm² [14 AWG]	
REG110A43A-21		6 mm² [10 AWG]		6 mm² [10 AWG]	6 mm² [10 AWG]	
REG150A43A-21		6 mm² [10 AWG]		6 mm² [10 AWG]	6 mm² [10 AWG]	

- 🕮 If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- 🕮 If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- 🕮 For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Unit: mm

AWG	VENDOR	VENDOR P/N	A (MAX.)	B (MAX.)	C (MIN.)	D (MAX.)	d2 (MIN.)	E (MIN.)	F (MIN.)	W (MAX.)	t (MAX.)
14	KST	RNBL2-4	20	5	5.5	9	4.3	8	5.5	10	1.5
10		RNBL5-4									
8		RNBS8-4									

NOTE

- Use Figure 1 to choose terminal wire size.
- As shown in Figure 2, use insulated heat shrink tubing that is resistant to at least 600 V_{AC} to comply with UL and CSA regulations (600 V_{AC}, YDPU2).

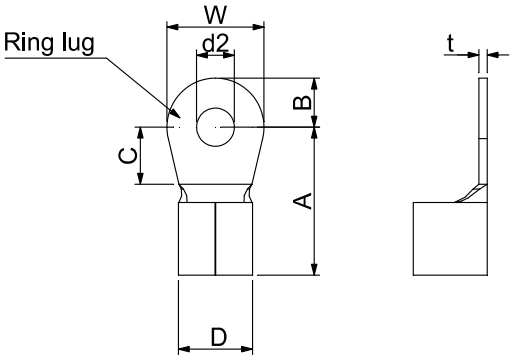


Figure 1.

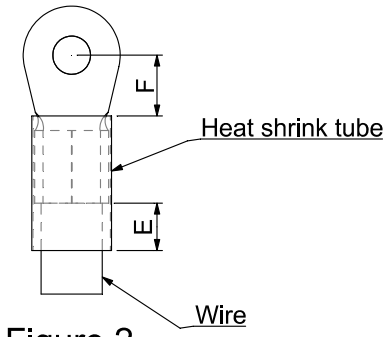
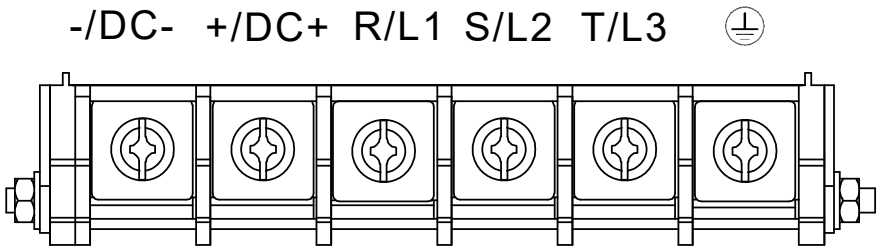


Figure 2.

Frame B

Main Circuit Terminals



REG2000 Frame B						
Model Name	Terminals: R/L1, S/L2, T/L3, -/DC+, +/DC+			Terminals: ⏚		
	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)
REG150A23A-21	25 mm² [4 AWG]	16 mm² [6 AWG]	M6 31 kg-cm (26.9 lb-in.) (3.0 N-m)	16 mm² [6 AWG]	16 mm² [6 AWG]	M6 31 kg-cm (26.9 lb-in.) (3.0 N-m)
REG185A23A-21		25 mm² [4 AWG]		25 mm² [4 AWG]	16 mm² [6 AWG]	
REG220A43A-21		25 mm² [4 AWG]		25 mm² [4 AWG]	16 mm² [6 AWG]	
REG185A43A-21		10 mm² [8 AWG]		10 mm² [8 AWG]	10 mm² [8 AWG]	
REG220A43A-21		10 mm² [8 AWG]		10 mm² [8 AWG]	10 mm² [8 AWG]	
REG300A43A-21		16 mm² [6 AWG]		16 mm² [6 AWG]	16 mm² [6 AWG]	

- 🕮 If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- 🕮 If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- 🕮 For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Unit: mm

AWG	VENDOR	VENDOR P/N	A (MAX.)	B (MAX.)	C (MIN.)	D (MAX.)	d2 (MIN.)	E (MIN.)	F (MIN.)	W (MAX.)	t (MAX.)
8	KST	RNBL8-6	25.5	7.5	8.5	13	6.2	13	10	15	1.5
6		RNBS14-6									
4		RNBS22-6									

NOTE

- Use Figure 1 to choose terminal wire size.
- As shown in Figure 2, use insulated heat shrink tubing that is resistant to at least 600 V_{AC} to comply with UL and CSA regulations (600 V_{AC}, YDPU2).

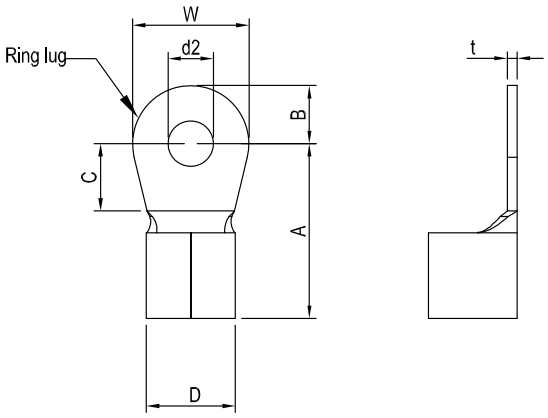


Figure 1.

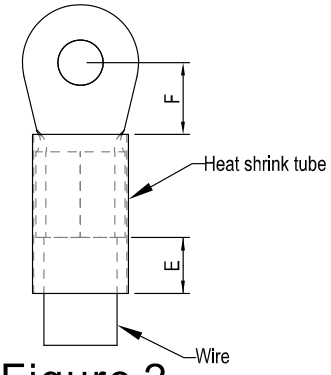
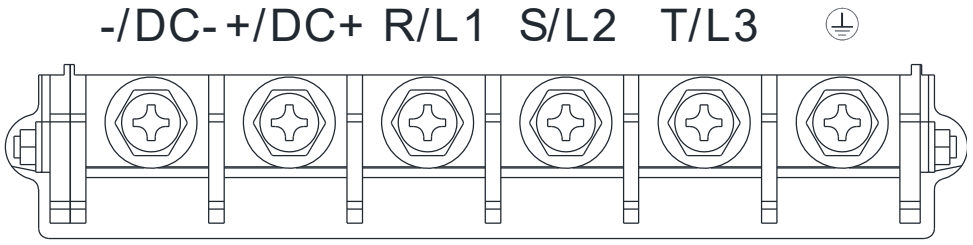


Figure 2.

Frame C

Main Circuit Terminals



REG2000 Frame C						
Model Name	Terminals: R/L1, S/L2, T/L3, -/DC+, +/DC+			Terminals: ⏚		
	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)	Maximum Wire Gauge	Minimum Wire Gauge	Screw Size Tightening Torque (±10%)
REG300A23A-21	50 mm² [1/0 AWG]	35 mm² [2 AWG]	M8 81.5 kg-cm (70.8 lb-in.) (8 N-m)	35 mm² [2 AWG	16 mm² [6 AWG]	M8 81.5 kg-cm (70.8 lb-in.) (8 N-m)
REG370A23A-21		50 mm² [1/0 AWG]		50 mm² [1/0 AWG]	25 mm² [4 AWG]	
REG370A43A-21		25 mm² [4 AWG]		25 mm² [4 AWG]	16 mm² [6 AWG]	
REG450A43A-21		25 mm² [4 AWG]		25 mm² [4 AWG]	16 mm² [6 AWG]	
REG550A43A-21		35 mm² [2 AWG]		35 mm² [2 AWG]	16 mm² [6 AWG]	

- 🕮 If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- 🕮 If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- 🕮 For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Unit: mm

AWG	VENDOR	VENDOR P/N	A (MAX.)	B (MAX.)	C (MIN.)	D (MAX.)	d2 (MIN.)	E (MIN.)	F (MIN.)	W (MAX.)	t (MAX.)
6	KST	RNB14-8	40.0	11.0	9.5	22.0	8.3	13.0	11.0	24.0	2.5
4		RNB22-8									
2		RNBS38-8									
1/0		RNB60-8									

NOTE

- Use Figure 1 to choose terminal wire size.
- As shown in Figure 2, use insulated heat shrink tubing that is resistant to at least 600 V_{AC} to comply with UL and CSA regulations (600 V_{AC}, YDPU2).

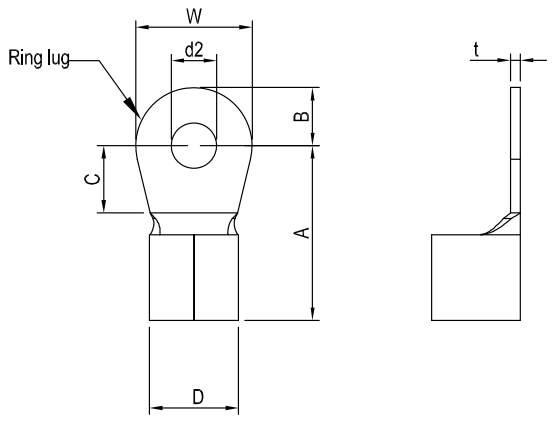


Figure 1.

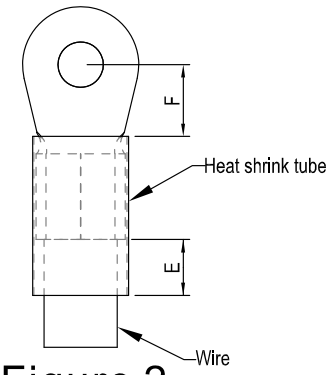


Figure 2.

CAUTION

Main circuit power input terminals

- ☑ Do not connect a three-phase model to single-phase power. R/L1, S/L2 and T/L3 have no phase-sequence requirement.
- ☑ Normally, based on local regulations, installing a non-fuse breaker as system protection on the connection between three-phase input power and main circuit terminal (R/L1, S/L2 and T/L3) is required. However, it is recommended to add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when activating the Power Regeneration Unit protection function. (Both ends of the MC should have an R-C surge absorber to prevent abnormal voltage surge caused by sudden current breakdown, further causing flashover to damage the equipment.)
- ☑ Tighten the screws in the main circuit terminal to prevent sparks caused by screws loosened by vibration.
- ☑ Use specified voltage and current and pay attention to the maximum allowance.
- ☑ When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200 mA or above and not less than 0.1-second operation time to avoid nuisance tripping.
- ☑ Use shielded wire or conduit for the power wiring and ground the two ends of the shielded wire or conduit.

4-3 Control Circuit Terminals

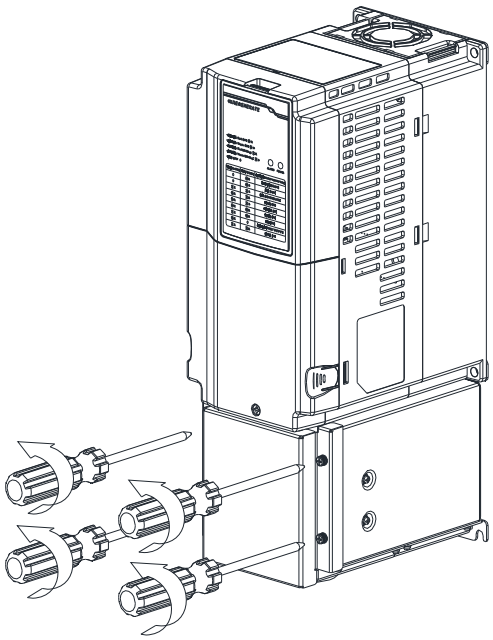
Remove the top cover before wiring the multi-function input and output terminals.

The units shown in the figures are for reference only and your drive may look different.

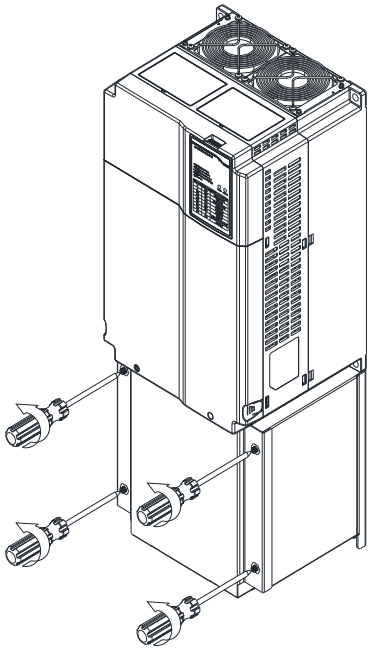
Removing the outer cover for wiring

1) Screw torque: 14–16 kg-cm [12.15–13.88 lb-in.] (1.37–1.57 Nm).

Loosen the screws for the wiring top cover as shown in the diagrams below.

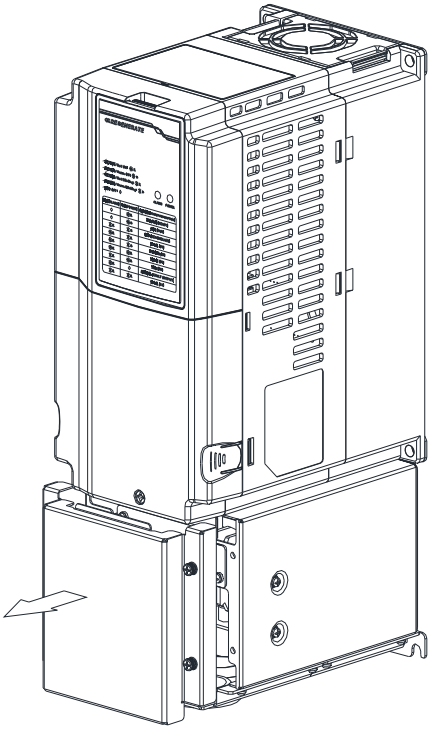


Frame A, B

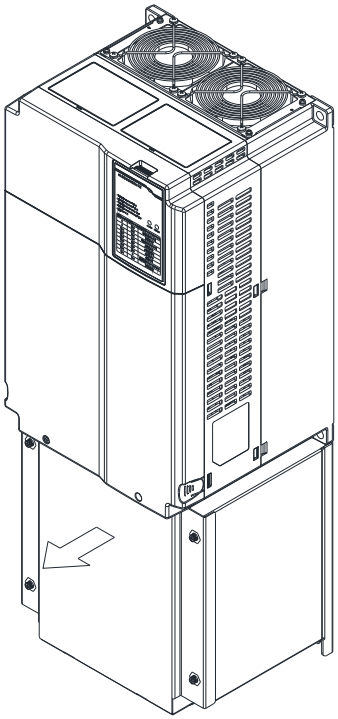


Frame C

2) After loosening the screws, remove the wiring top cover as shown in the diagrams below.



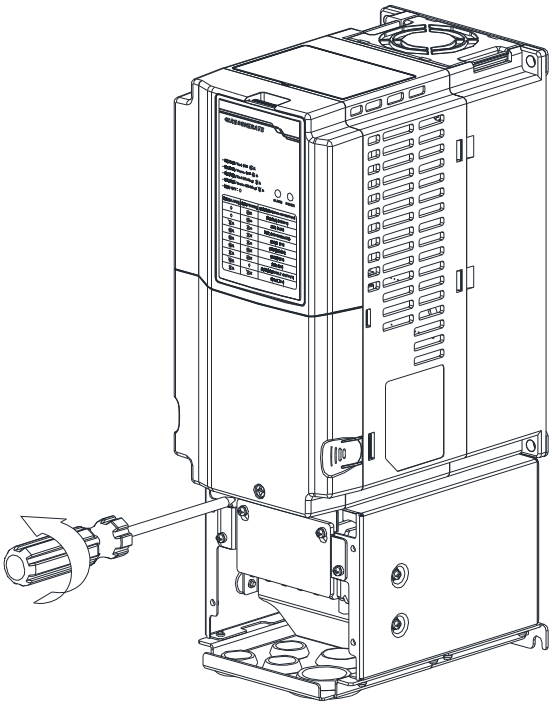
Frame A, B



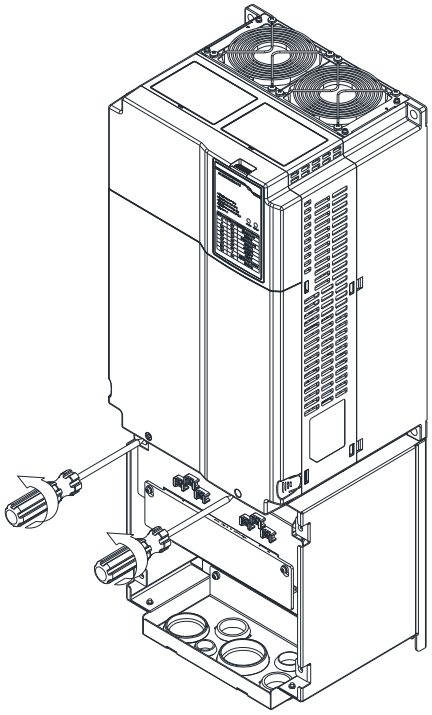
Frame C

3) Loosen the screws.

Frames A, B, C Screw torque: 10–12 kg-cm [8.68–10.42 lb-in.] (0.98–1.18 Nm)

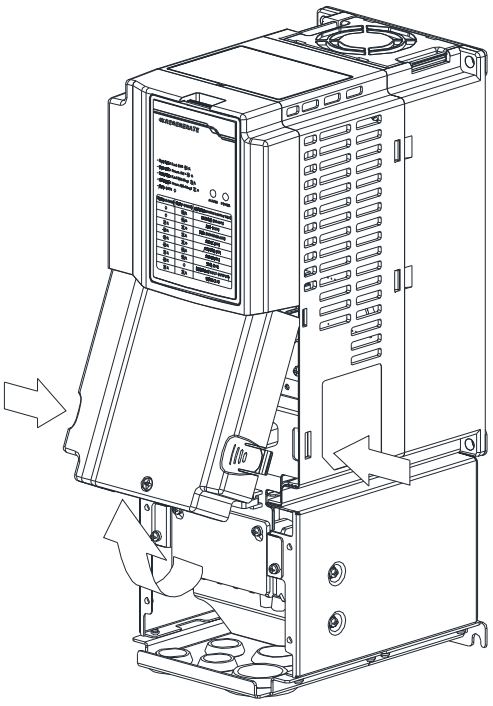


Frame A, B

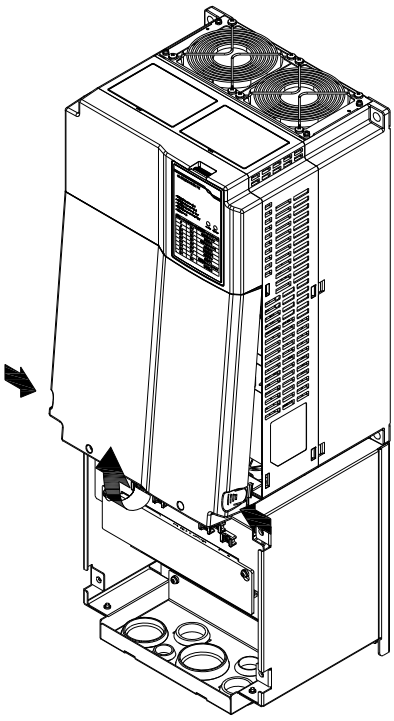


Frame C

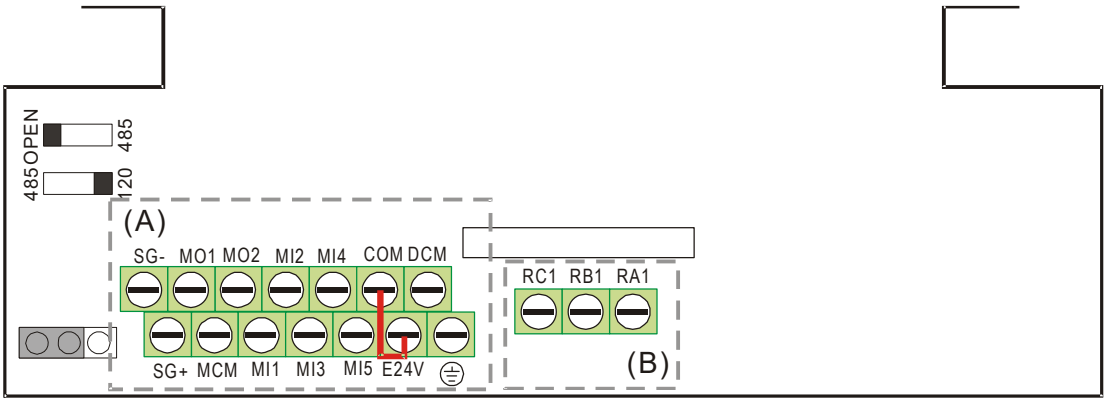
4) You can now wire the control terminals.



Frame A, B



Frame C



Control Terminal Specifications

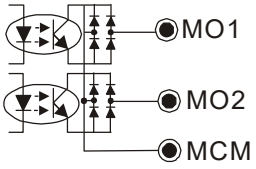
Function	Wire Size					Tightening Torque (±10%)
	Group	Conductor	Stripping Length	Minimum Wire Gauge	Maximum Wire Gauge	
Control Terminal	A	Solid/Strand	6 mm	0.2 mm² [26 AWG]	1.5 mm² [16 AWG]	5.1 kg-cm [4.42 lb-in.] [0.5 Nm]
	B					5.6 kg-cm [4.86 lb-in.] [0.55 Nm]

📖 To set to auto-mode without a keypad, wire the Power Regenerative Unit to go through a multi-function input terminal (MIx, default setting is MI1) to connect to the terminal DCM.

Wiring notes:

- The default for E24V-COM is short circuit and SINK mode (NPN). Refer to Diagram 1 in Section 4-1 Wiring Diagram.

Terminal	Function Description	Default (NPN mode)
E24V	The default for +24 V-COM is short circuit and SINK mode (NPN) (Source).	+24 V ± 5% 200 mA
COM	Common terminal for digital control signals (Sink)	Common terminal for multi-function inputs
MI1 – MI5	Multi-function input 1–5	Refer to Pr.02-00–Pr.02-04 to program the multi-function inputs MI1–MI5. ON: the activation current is 6.5 mA ≥ 11 V_{DC}; OFF: leakage current tolerance is 10 μA ≤ 5 V_{DC}
DCM	Common terminal for digital control signals (Sink)	Common terminal for multi-function inputs
MO1	Multi-function output 1 (photo coupler)	The Power Regeneration Unit releases various monitor signals, using a transistor (open collector).

Terminal	Function Description	Default (NPN mode)
MO2	Multi-function output 2 (photo coupler)	
MCM	Common terminal for multi-function outputs	Max 48 V_{DC} 50 mA
RA1	Multi-function relay output 1 (N.O.) a	Resistive load 5 A (N.O.)/3 A (N.C.) 250 V_{AC} 5 A (N.O.)/3 A (N.C.) 30 V_{DC} N.O. minimum load: 5 V/0.1 A; 24 V/ 3 mA N.C. minimum load: 5 V/ 0.1 A; 24 V/ 3 mA Inductive load (COS 0.4) 2.0 A (N.O.)/1.2 A (N.C.) 250 V_{AC} 2.0 A (N.O.)/1.2 A (N.C.) 30 V_{DC} Outputs various monitoring signals. N.O. minimum load: 5 V/ 0.1 A; 24 V/3 mA N.C. minimum load: 5 V/ 0.1 A; 24 V/3 mA
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Common terminal for multi-function relays	
SG+	Modbus RS-485	
SG-	PIN 1, 2, 7, 8: Reserved PIN 3, 6: GND PIN 4: SG- PIN 5: SG+	

NOTE: Analog control signals wire size: 18 AWG (0.75 mm^2) with shielded wire

Contact Input Terminals (MI1–MI5, COM)

☑ When using contacts or switches to control the input terminals, use high quality components to prevent contact bounce.

Transistor Output Terminals (MO1, MO2, MCM)

☑ Make sure to connect the digital outputs to the correct polarity.

☑ When connecting a relay to the digital outputs, connect a surge absorber across the coil and check the polarity.

4-4 Display Panel Indicators

Display Panel

警报〈ALARM〉	电源〈POWER〉	状态描述〈STATUS DESCRIPTION〉
○	☼R	准备完成〈READY〉
○	☼G	运转〈RUN〉
○	☼G	回生〈REGENERATE〉
☼R	☼R	过电压〈OV〉
☼R	☼G	外部错误〈EF〉
☼R	☼R	过负载〈OL〉
☼R	☼R	温度异常〈OH〉
☼R	○	过电流〈OC〉
☼R	☼R	通讯异常〈Comm.Err.〉
☼R	○	电源异常〈MAINS Err.〉
☼G	☼G	硬件 / 内存异常〈HW Err.〉

Power & Alarm Indicator Status Descriptions

ALARM	POWER	Description	Note
Blinking red + green lights	Blinking red + green lights	Prepare*	Once the Power Regenerative Unit is powered on, it performs auto-system checking.
OFF	Constant red light ON	Ready**	Once the Power Regenerative Unit is powered on, if there are no faults or warnings and phase lock is completed, you can now send the RUN command.
OFF	Constant green light ON	RUN**	Once you send the RUN command, the Power Regenerative Unit runs smoothly and waits for the conditions to regenerate energy.
OFF	Blinking green light	REGENERATE**	Power Regenerative Unit regenerates AC current to the mains power.
ALARM	POWER	Description	Fault/Warning Name Corresponds to the Keypad
Constant red light ON	Blinking red light	OV (Over-voltage)	ovn, ovs
Constant red light ON	Blinking green light	EF (External fault)	EF
Constant red light ON	Constant red light ON	OL (Overload)	oL
Blinking red light	Constant red light ON	OH (Overheat)	oH1, oH2, tH1o, tH2o
Constant red light ON	OFF	OC (Over-current)	ocn, ocs
Blinking red light	Blinking red light	Comm. Err. (Communication fault)	Pco, CE1, CE2, CE3, CE4, CE10, SE1, SE2, SE3
Blinking red light	OFF	Mains Err. (Mains power error)	Phase loss (OrP), phase lock (PLE) and low direct voltage (LvS) warning at input.
Blinking green light	Blinking green light	HW Err. (Hardware fault/ memory fault)	cd1, cd2, cd3, Hd1, Hd2, 5VF, RYF, cF1, cF2

*The start-up time is too short, so there is no message on the keypad.
**Different regeneration statuses are defined in Diagram 3 below.

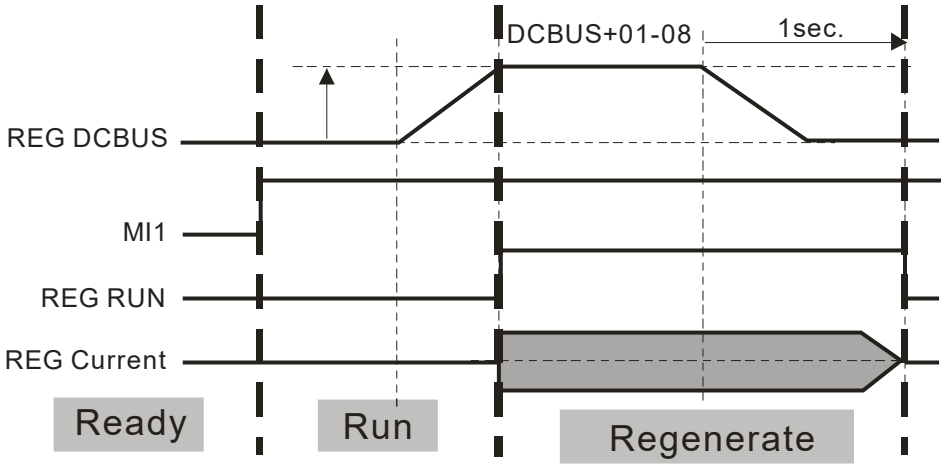


Diagram 3: The Definition of Different Working Status of Power Regeneration

05 Optional Accessories

The optional accessories listed in this chapter are available upon request. These accessories can improve your Power Regeneration Unit's performance. Select the accessories you need or contact your local distributor for suggestions.

Optional Accessories:

5-1 Digital Keypad

5-2 USB/RS-485 Communication Interface IFD6500, IFD6530

5-3 Fuse Specification Chart

5-4 EMI Filter

5-5 External Power Supply Card (24 V) EMC-BPS01

5-6 Fan Kit

5-1 Digital Keypad

KPC-CC01

KPC-CE01

Communication interface

RJ45 (socket), RS-485 interface

Installation Method

- ☑ The embedded type can be installed flat on the surface of the control box. The front cover is waterproof.
- ☑ Buy a MKC-KPPK model for wall mounting or embedded mounting. Its protection level is IP56.

Keys	Description
ESC	**ESC Key** Return to the previous page. This also returns you to the last category in the sub-menu.
MENU	**Menu Key** Return to the main MENU. Menu content: 1. Parameter Detail 3. Keypad Locked 5. PLC copy 2. Copy Parameter 4. PLC function 6. Fault Record REG does not support menu item 4 and 5 (PLC functions).
ENTER	**ENTER Key** Go to the next level. If it is the last level, then press ENTER to execute the command.
HAND	No assigned function
AUTO	No assigned function
FWD/REV	No assigned function
RUN	**Start Operation Key** ☑ It is only valid when you issue the operation command from the keypad. ☑ The drive runs according to the function setting and the RUN LED is ON. ☑ You can press the RUN key many times during the Power Regeneration Unit's stop process.
STOP/RESET	**Stop Key** ☑ **<u>The STOP key has the highest priority in command.</u>** ☑ When you press the STOP key, the Power Regenerative Unit stops under any condition. ☑ Use the RESET key to reset the Power Regenerative Unit when faults occur. If the RESET key is not responding, check MENU → Fault Record for the most recent fault.

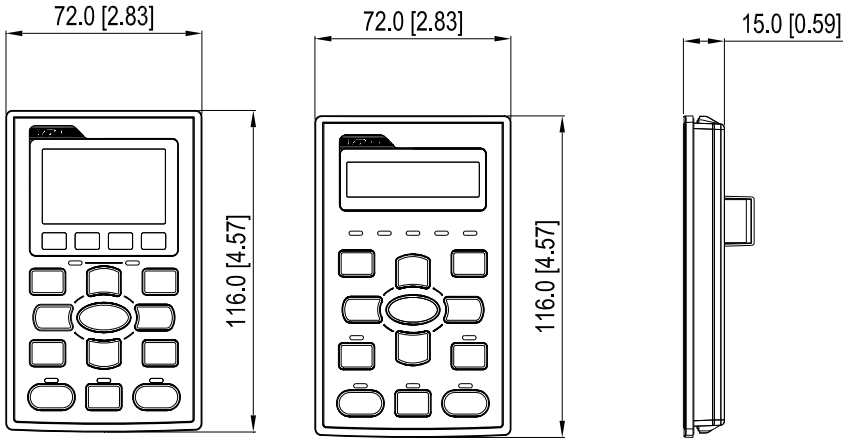
Digital keypad LED status description

RUN	STOP	Description	Note
Constant ON	Blinking	Prepare	Once the Power Regenerative Unit is powered on, it performs auto-system checking.
OFF	Constant ON	Ready*	Once the Power Regenerative Unit is powered on, if there are no faults or warnings and phase lock is completed, you can now send the RUN command.
Blinking	Constant ON	RUN*	Once you send the RUN command, the Power Regenerative Unit runs smoothly and waits for the conditions to regenerate energy.
Constant ON	OFF	REGENERATE*	Power Regenerative Unit regenerates AC current to the mains power.

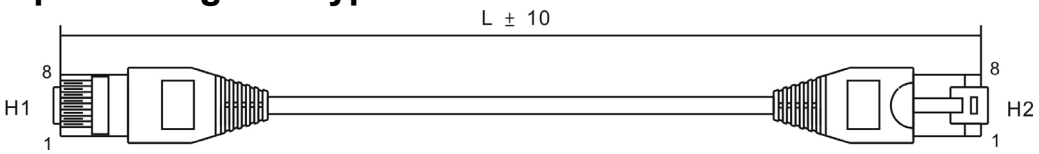
*See Diagram 3 in Section 4-4 for the definition of different working status of power regeneration.

KPC-CC01 & KPC-CE01 Dimensions

Unit: mm [inch]



Optional digital keypad RJ45 extension cable



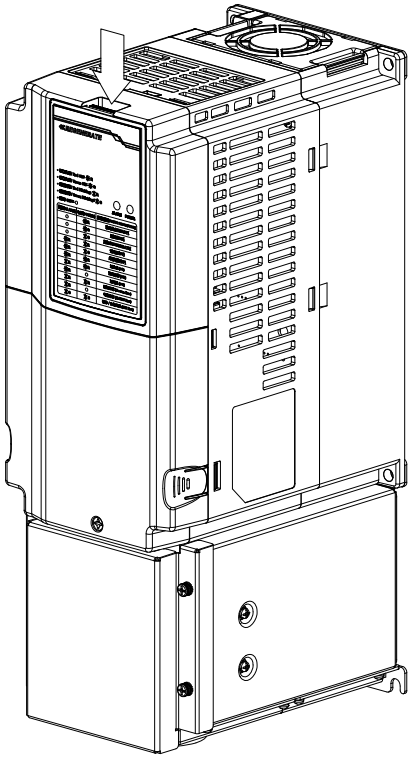
No.	Part No.	L	
		mm	inch
1	UC-CMC003-01A	300	11.8
2	UC-CMC005-01A	500	19.6
3	UC-CMC010-01A	1000	39
4	UC-CMC015-01A	1500	59
5	UC-CMC020-01A	2000	78.7
6	UC-CMC030-01A	3000	118.1
7	UC-CMC050-01A	5000	196.8
8	UC-CMC100-01A	10000	393.7
9	UC-CMC200-01A	20000	787.4

The Power Regenerative Unit is controlled by an external terminal MIx by default. You can also control the Power Regenerative Unit from the keypad.

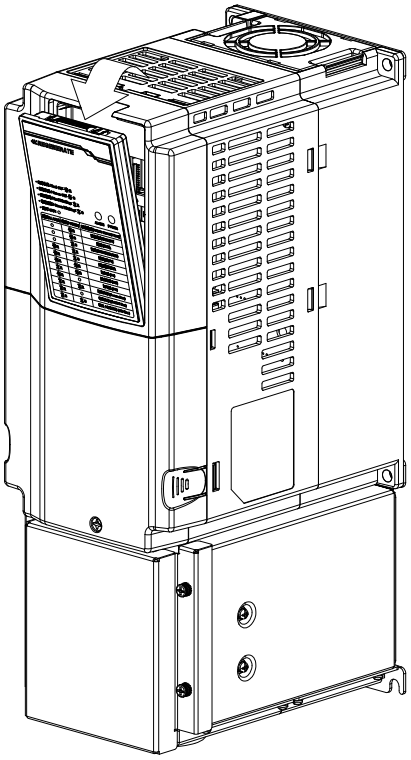
1. Control from the digital keypad:
   Set Pr.01-04 = 2 to change to the digital keypad as the operation command source.

2. Control by an external terminal (default: MI1):
   Set Pr.01-04 = 1 to change to the external terminals as the operation command source.
   The Power Regenerative Unit activation level is determined by the voltage level. It is not necessary to unplug and reconnect the external terminals.

🕮 How to remove the plastic cap?



1. Press the pin on top of the keypad.



2. Pull forward to remove the keypad.

5-2 USB/RS-485 Communication Interface IFD6500, IFD6530

⚠ Caution

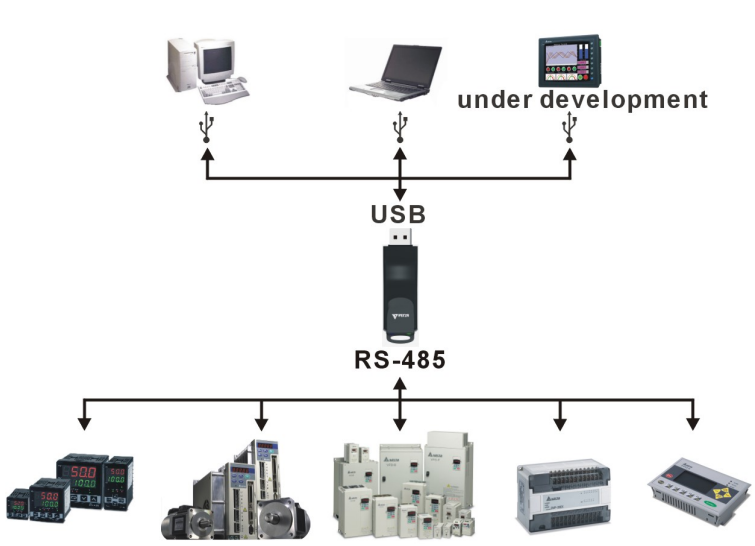
✓ Read this instruction sheet thoroughly before installation and operation.
✓ The contents of this instruction sheet and the driver file may be revised without prior notice. Consult our distributors or download the most updated instruction/driver version at http://www.delta.com.tw/product/em/control/cm/control_cm_main.asp

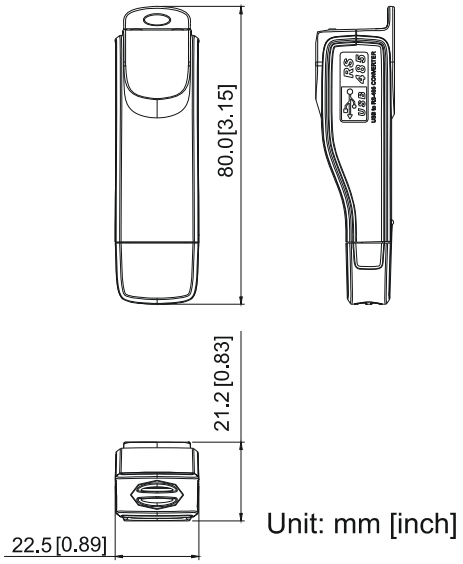
Introduction

The IFD6530 is a convenient RS-485-to-USB converter, and does not require external power-supply or complex set up. It supports baud rates from 75–115.2 kbps and auto-switching of the direction of data transmission. It uses RJ45 in an RS-485 connectors for convenient wiring. Its tiny dimensions, use of plug-and-play and hot swapping make it easy to connect all DELTA IABU products to your PC.

Applicable Models: All DELTA IABU products.

■ Applications and Dimensions

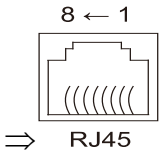




Specifications

Power supply	No external power is needed
Power consumption	1.5 W
Isolation voltage	2,500 V_{DC}
Baud rate	75; 150; 300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400; 57,600; 115,200 kbps
RS-485 connector	RJ45
USB connector	A type (plug)
Compatibility	Full compliance with USB V2.0 specification
Maximum cable length	RS-485 Communication Port: 100 m
Supports RS-485 half-duplex transmission	

RJ45



PIN	Description
1	Reserved
2	Reserved
3	GND
4	SG-

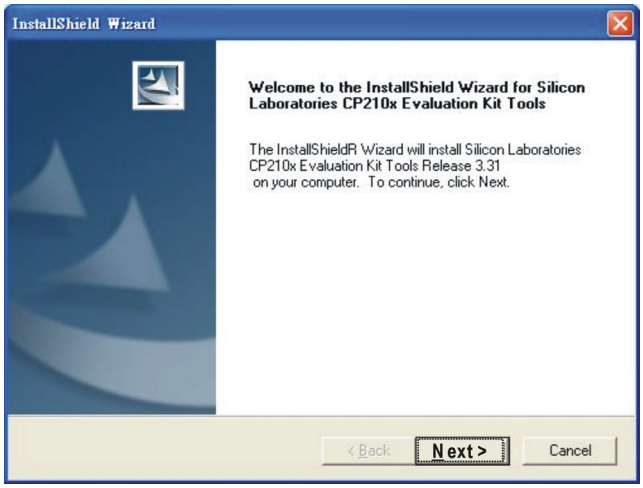
PIN	Description
5	SG+
6	GND
7	Reserved
8	+9V

Preparing for Driver Installation

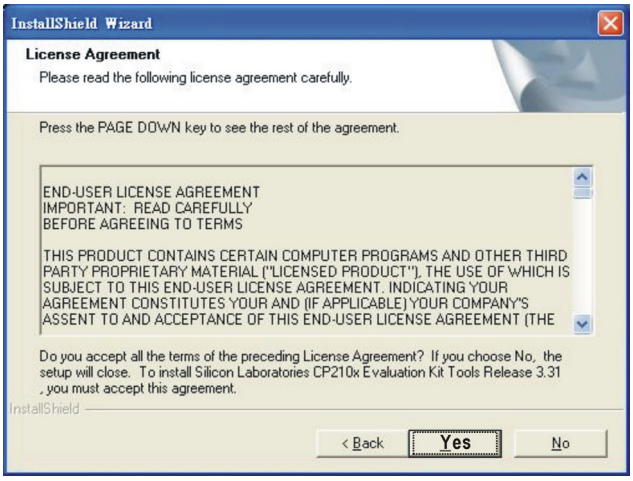
Extract the driver file (IFD6530_Drivers.exe) with following steps. You can find the driver file (IFD6530_Drivers.exe) on the CD supplied with the IFD6530.

Note: DO NOT connect the IFD6530 to your PC before extracting the driver file.

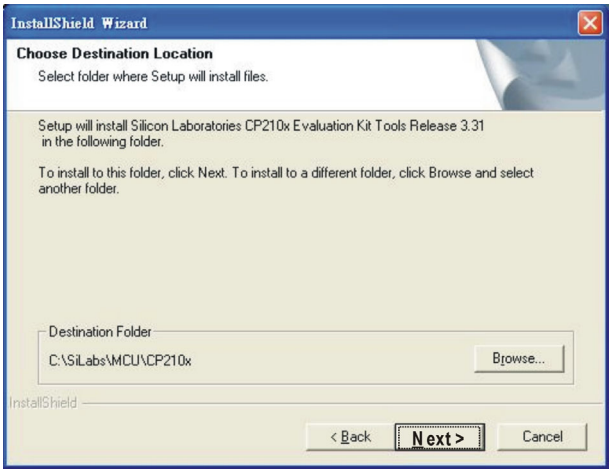
STEP 1



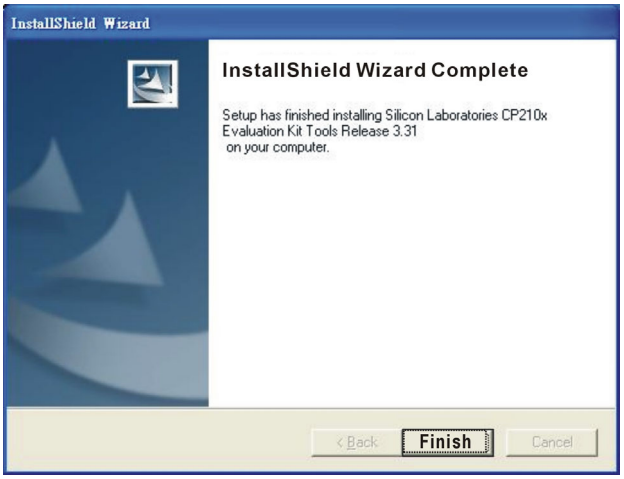
STEP 2



STEP 3



STEP 4



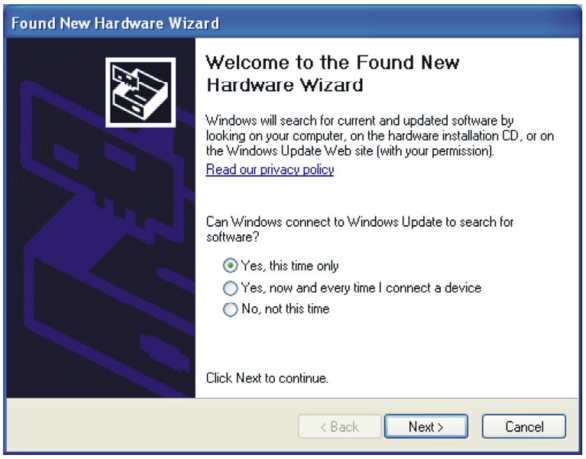
STEP 5

You should now have a folder marked SiLabs under drive C (C:\ SiLabs).

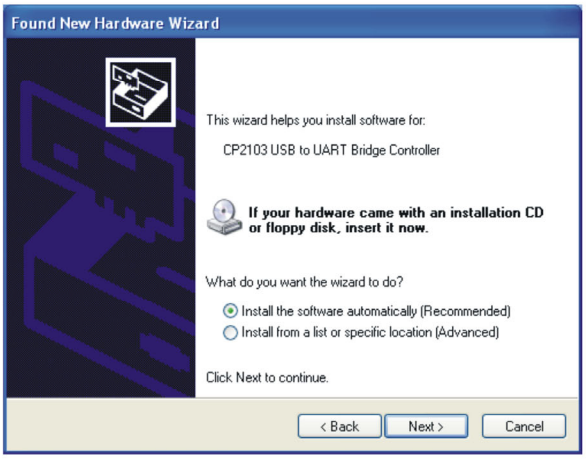
Driver Installation

After connecting the IFD6530 to your PC, install the driver by following these steps.

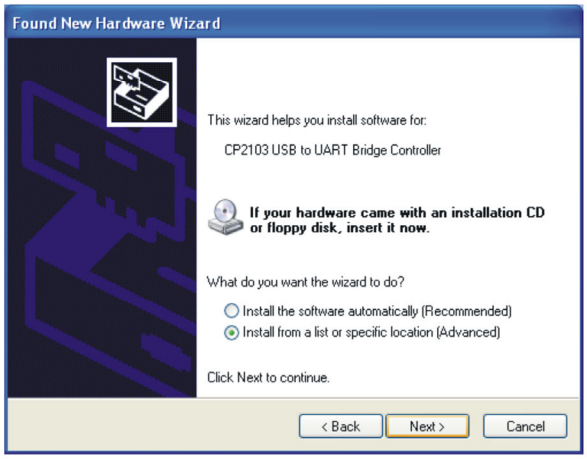
STEP 1

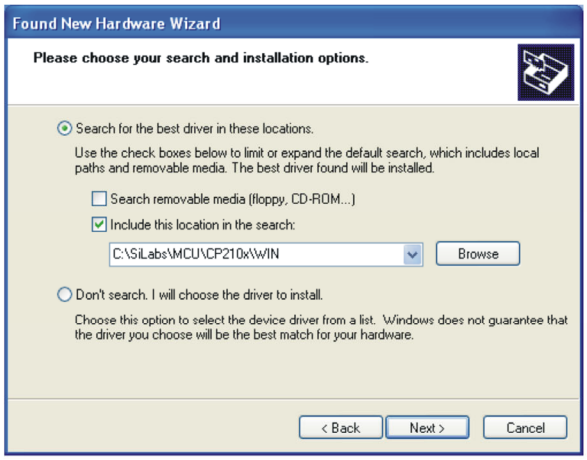


STEP 2



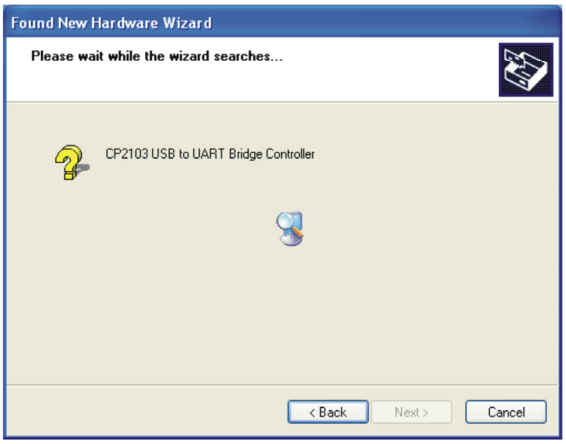
OR



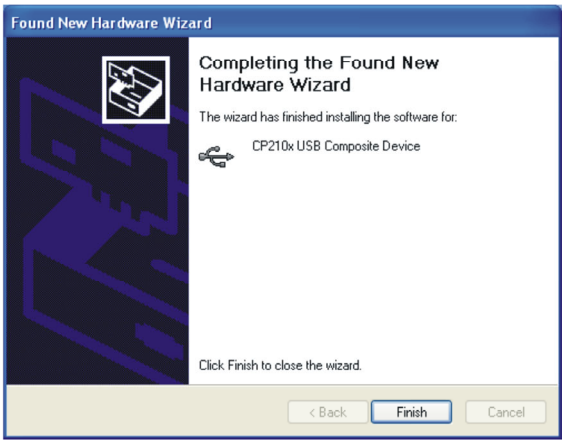


Browse and select directory, or enter C:\SiLabs\MCU\CP210x\WIN

STEP 3



STEP 4



STEP 5
Repeat Step 1 to Step 4 to complete COM PORT setting.

LED Display

1. Steady green LED ON: power is ON.
2. Blinking orange LED: data is transmitting.

5-3 Fuse Specification Chart

☑ Use UL certified fuses for short circuit protection. For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. Use UL classified fuses to fulfill this requirement.

☑ For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. Use UL classified fuses to fulfill this requirement.

☑ See Section 4-1 Wiring Diagram for fuse installation.

Frame A	
Model No.	Ampere
REG075A23A-21	50
REG110A23A-21	80
REG075A43A-21	25
REG110A43A-21	45
REG150A43A-21	50

Frame B	
Model No.	Ampere
REG150A23A-21	100
REG185A23A-21	125
REG220A23A-21	150
REG185A43A-21	60
REG220A43A-21	80
REG300A43A-21	100

Frame C	
Model No.	Ampere
REG300A23A-21	200
REG370A23A-21	250
REG370A43A-21	125
REG450A43A-21	150
REG550A43A-21	200

5-4 EMI Filter

Cautions

In order to make sure that the EMI filter can bring out the maximum effect on suppressing the interference of the motor drive, apart from following the installation and wiring instructions in the user manual (Chapter 4 Wiring), pay attention to the following points should be noted:

⚠ Warnings

✓ Before you use this product, please follow the **regular inspection and recommended steps** to make sure the normal operation of the product.

✓ After you have used this product, you have to do regular inspections according to the **regular inspections and recommendations** every six months. .

Precautions on Function

After you install the Power Regenerative Unit, install an EMI filter on the power system to suppress high frequency interference.

Installing the EMI filter [suppressing electromagnetic interference and radio frequency interference (CLASS A/3m)] makes the Power Regenerative Unit compliant with EN55011 regulations.

Specifications

Input Voltage

230V series: 170–265 $V_{AC,}$ input from main circuit terminals L1, L2, and L3.
460V series: 323–528 V_{AC}, input from main circuit terminals L1, L2, and L3.

Input Frequency

50 Hz (47–53) / 60 Hz (57–63)

Input Current

Model	Rated Current when Running Continuously (Arms)
RG-EF110A2	25.6
RG-EF220A2	48
RG-EF370A2	80
RG-EF150A4	16
RG-EF300A4	34.4
RG-EF550A4	60

📖 With variation in ED%, a Power Regenerative Unit can still function normally when overloaded. The rated output current of the EMI filter corresponds to that of the Power Regenerative Unit. Follow the table below to select an EMI filter. Delta ensures that all EMI filters are within output current specifications.

🕮 Since there are many conditions and changes at the installation site of a Power Regenerative Unit and temperature rise during continuous operation is the harshest environment for the electronic components, only the rated current during continuous regeneration is listed in the table below.

EMI Filter Specifications

Frame	REG2000 Model	REG EMI Filter	Weight(kg)
A	REG075A23A-21 REG110A23A-21	RG-EF110A2	3.0±0.5
B	REG150A23A-21 REG185A23A-21 REG220A23A-21	RG-EF220A2	4.7±0.5
C	REG300A23A-21 REG370A23A-21	RG-EF370A2	6.2±0.5
A	REG075A43A-21 REG110A43A-21 REG150A43A-21	RG-EF150A4	3.1±0.5
B	REG185A43A-21 REG220A43A-21 REG300A43A-21	RG-EF300A4	5.0±0.5
C	REG370A43A-21 REG450A43A-21 REG550A43A-21	RG-EF550A4	6.5±0.5

Terminal Specifications

🕮 Refer to Section 4-1 Wiring Diagram for details on EMI filter wiring.

🕮 To avoid any interference, install the EMI filter on the Power Regenerative Unit for different applications as well as at the installation site.

- Frame A

Model Name	Main Circuit Terminals R/L1、S/L2、T/L3				Grounding Terminal ⏚			
	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
RG-EF110A2	10	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	18 kg-cm [15.62 lb-in.] [1.77 Nm]	10	10 mm^2 [8 AWG]	10 mm^2 [8 AWG]	18 kg-cm [15.62 lb-in.] [1.77 Nm]
RG-EF150A4			6 mm^2 [10 AWG]			6 mm^2 [10 AWG]	6 mm^2 [10 AWG]	

1. Tighten the wiring with a Philips screwdriver. Specification of this Philips screwdriver: PH1
2. When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
3. If you install at Ta 40°C environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
4. If you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
5. To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire

- Frame B

Model Name	Main Circuit Terminals R/L1、S/L2、T/L3				Grounding Terminal ⏚			
	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
RG-EF200A2	13~15	25 mm^2 [4 AWG]	25 mm^2 [4 AWG]	30.59 kg-cm [26.55 lb-in.] [3.0 Nm]	13~15	25 mm^2 [4 AWG]	16 mm^2 [6 AWG]	30.59 kg-cm [26.55 lb-in.] [3.0 Nm]
RG-EF300A4								

1. Tighten the wiring with a slotted screwdriver: Specification of the slotted screwdriver: the width of the blade should be 5.5mm and the thickness of the blade should be 1.0mm.
2. When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
3. If you install at Ta 40°C environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
4. If you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
5. To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire

- Frame C

Model Name	Main Circuit Terminals R/L1、S/L2、T/L3				Grounding Terminal ⏚			
	Stripping Length (mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))	Stripping Length(mm)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%))
RG-EF370A2	16~18	50 mm^2 [1/0 AWG]	50 mm^2 [1/0 AWG]	61.18 kg-cm [53.10 lb-in.] [6.0 Nm]	16~18	50 mm^2 [1/0 AWG]	25 mm^2 [4 AWG]	61.18 kg-cm [53.10 lb-in.] [6.0 Nm]
RG-EF550A4			35 mm^2 [2 AWG]			35 mm^2 [2 AWG]	16 mm^2 [6 AWG]	

1. Tighten the wiring with a slotted screwdriver: Specification of the slotted screwdriver: the width of the blade should be 5.5mm and the thickness of the blade should be 1.0mm.
2. When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
3. If you install at Ta 40°C environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 75°C or 90°C.
4. If you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600V and are temperature resistance to 90°C or above.
5. To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire

- Temperature Signal Terminal

Terminal Name and Function	Cable Specifications				Screw Spec. and Torque (±10%))
	Type of Conductor	Stripping Length	Max. Wire Gauge	Min. Wire Gauge	
Temperature Signal Terminal (TH)	Hard Cable Soft Cable Soft cable with tube pre-insulating terminal	7~8 mm	2.5 mm^2 [14 AWG]	0.2 mm^2 [24 AWG]	5.10 kg-cm [4.43 lb-in.] [0.5 Nm]

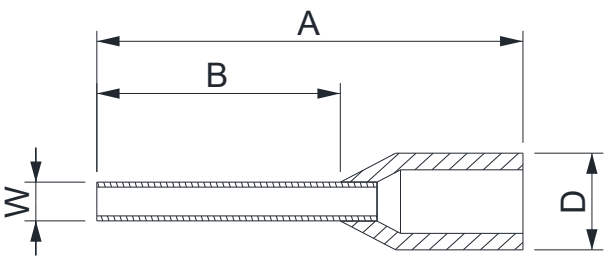
1. Tighten the wiring with a slotted screwdriver: Specification of the slotted screwdriver: the width of the blade should be 3.5mm and the thickness of the blade should be 0.6mm.
2. When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.

Ring Terminals of Temperature Signal Terminal specification:

Recommended Ring Terminals Part# and Size						
AWG	VENDOR	VENDOR P/N	A (MAX)	B (MAX)	D (MAX)	W (MAX)
0.2 mm^2 [24 AWG]	K.S.T	E0308	15mm	8mm	4.5mm	2.5mm
0.34 mm^2 [22 AWG]		E0508				
0.5 mm^2 [20 AWG]		E7508				
0.75 mm^2 [18 AWG]		E1008				
1.5 mm^2 [16 AWG]		E1508				
2.5 mm^2 [14 AWG]		E2508				

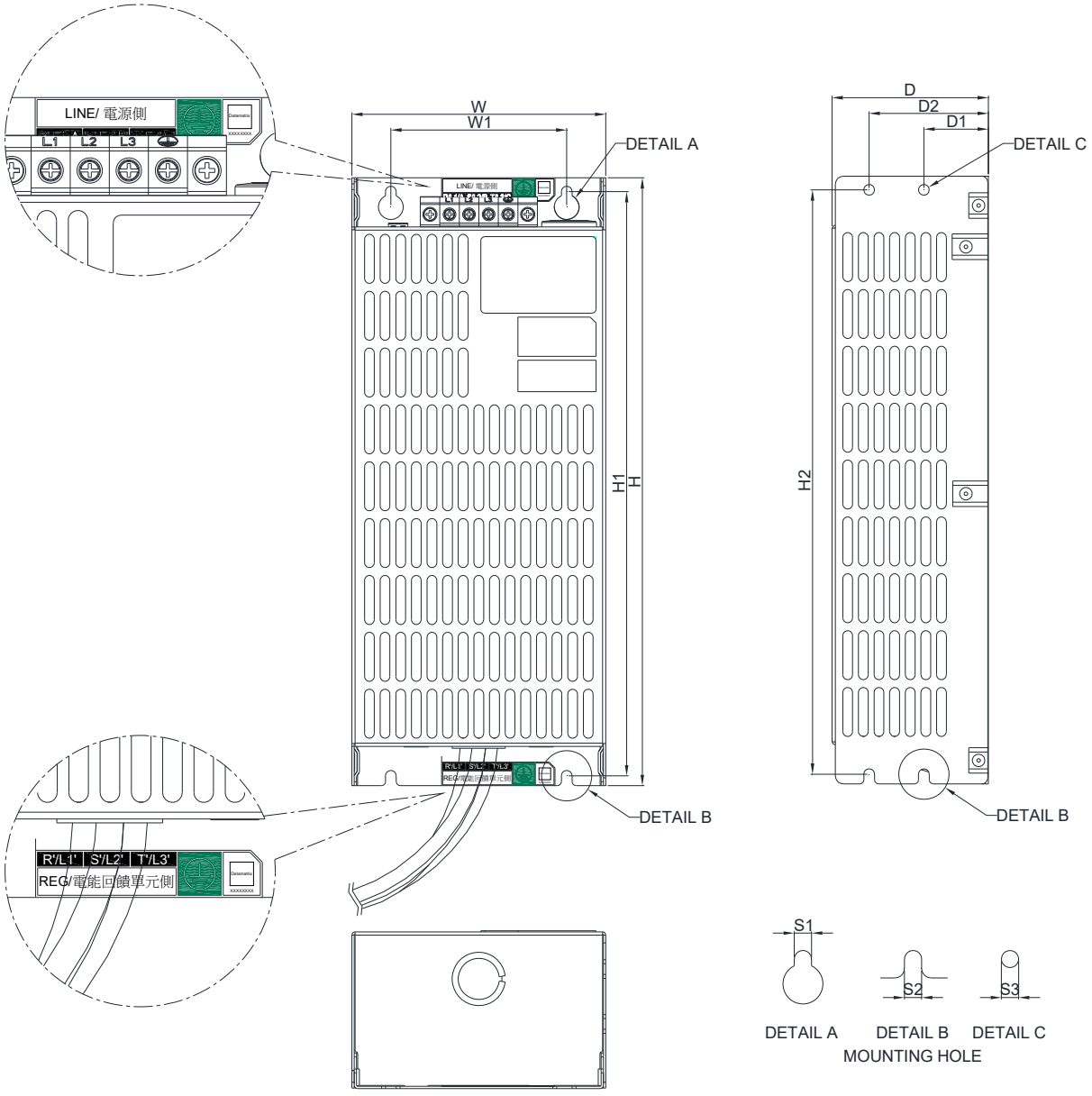
NOTE:

Definition of Size:
Size A : It depends on the actual wiring space.
Size B : It depends on the allowable depth of the terminal block
Size D : It depends on the distance between terminal blocks.
Size W : It depends on the allowable width.



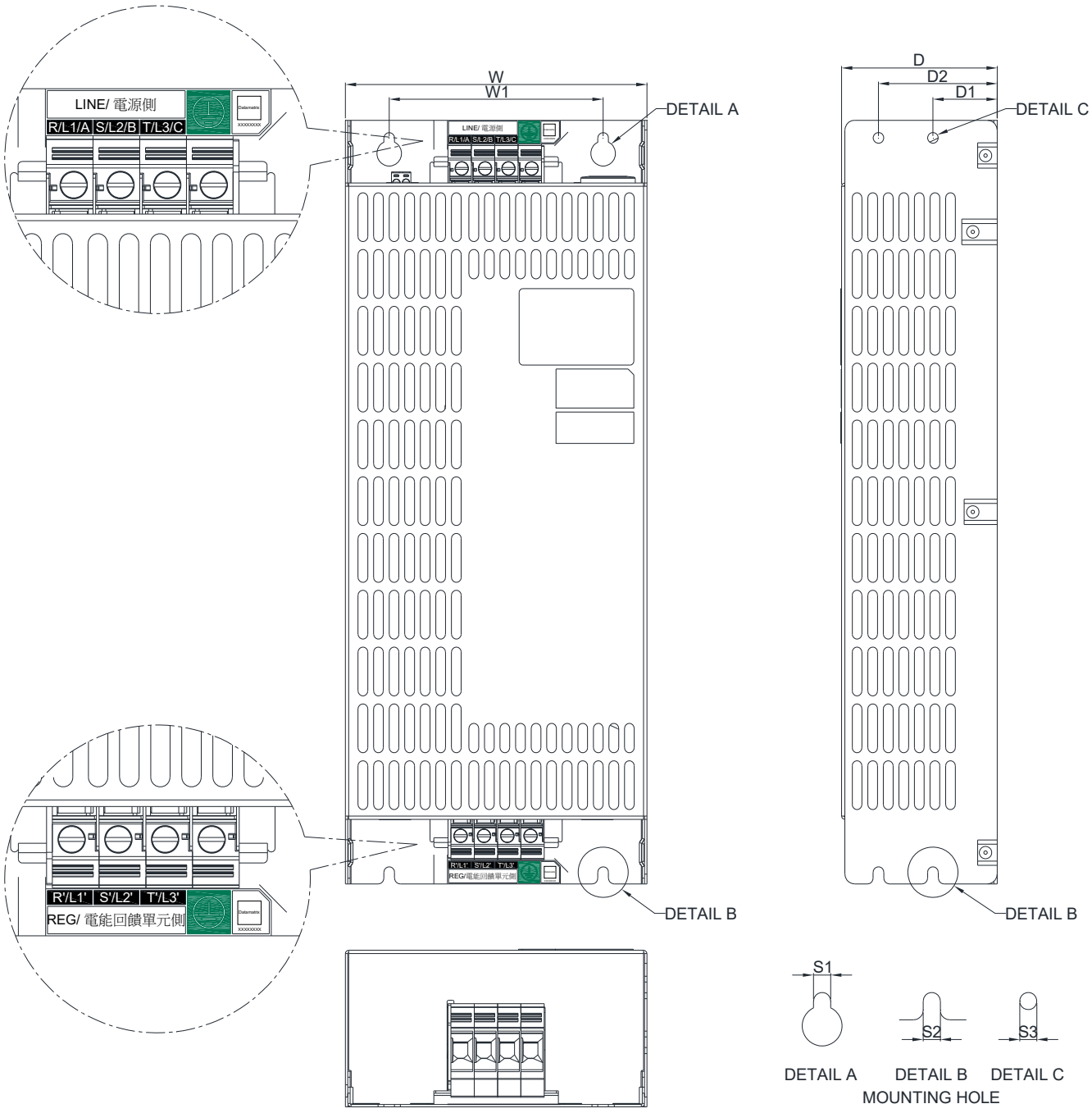
EMI Filter Dimensions

[Frame A] RG-EF110A2; RG-EF150A4



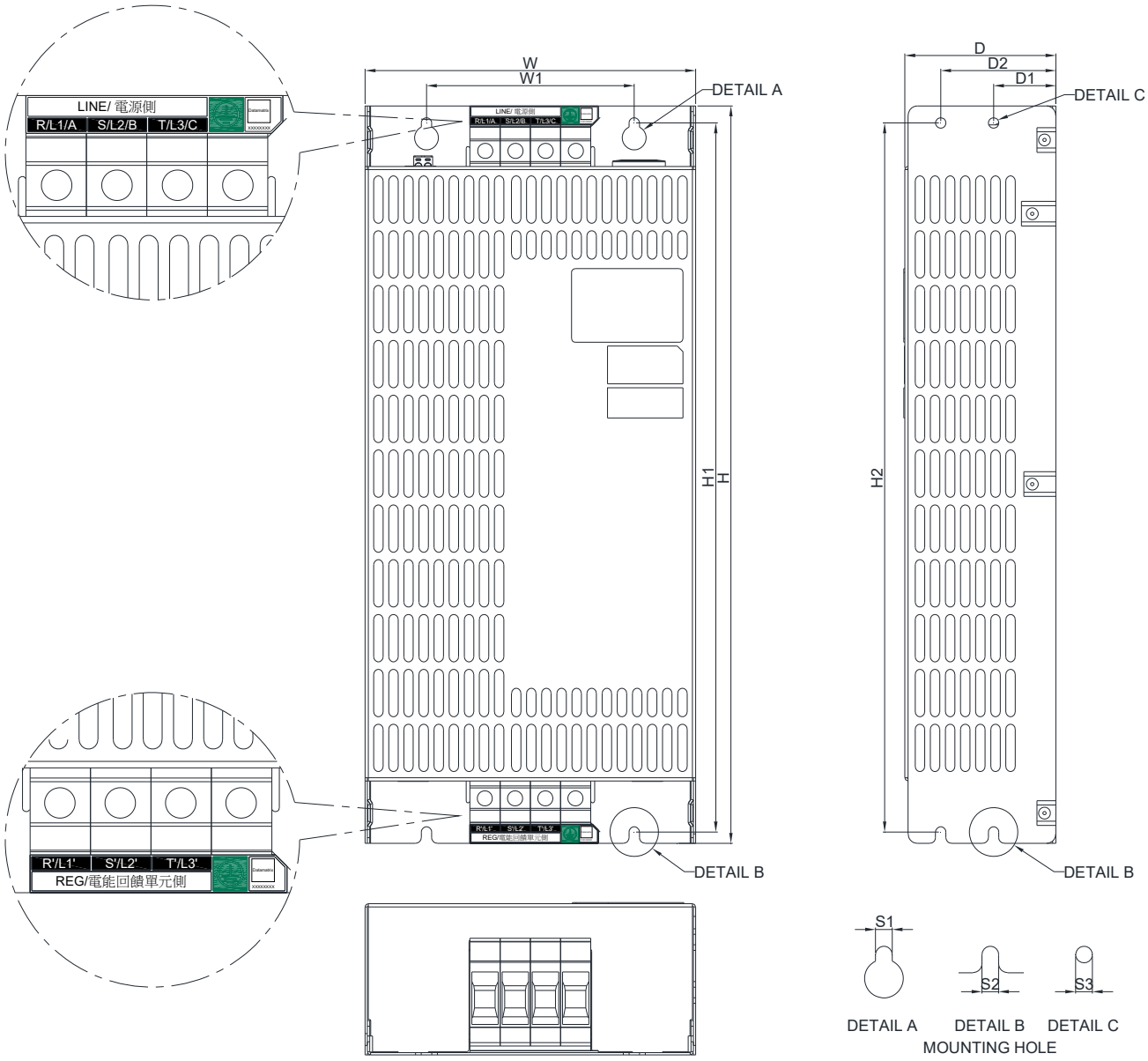
Frame	W	W1	H	H1	H2	S1	S2	S3	D	D1	D2
A	130.0 [5.12]	90.0 [3.54]	310.0 [12.20]	298.0 [11.73]	298.0 [11.73]	5.5 [0.22]	5.5 [0.22]	5.5 [0.22]	80.0 [3.15]	33.0 [1.30]	61.0 [2.40]

[Frame B] RG-EF220A2; RG-EF300A4



Frame	W	W1	H	H1	H2	S1	S2	S3	D	D1	D2
B	155.0 [6.10]	110.0 [4.33]	390.0 [15.35]	375.0 [14.76]	375.0 [14.76]	5.5 [0.22]	5.5 [0.22]	5.5 [0.22]	80.0 [3.15]	33.0 [1.30]	61.0 [2.40]

[Frame C] RG-EF370A2; RG-EF550A4



Frame	W	W1	H	H1	H2	S1	S2	S3	D	D1	D2
C	175.0 [6.89]	110.0 [4.33]	390.0 [15.35]	375.0 [14.76]	375.0 [14.76]	5.5 [0.22]	5.5 [0.22]	5.5 [0.22]	80.0 [3.15]	33.0 [1.30]	61.0 [2.40]

Regular inspections and recommendations

Long-term storage or long-term usage of capacitors lead to capacitor decay and cause product defects. So for your safety, we recommend that you follow the steps below to verify if the capacitors' condition is within the standard value before you use this product or every six months after the product has been used to make sure that this product can operate normally.

Tools required for inspection: a slotted screwdriver, a Phillips screwdriver, a multimeter (models which support measuring capacitance).

Inspection steps:

1. Disconnect the supply mains first
2. After confirming that all the related machinery/equipment have stopped running, disconnect REG and EMI filter. Then disconnect the supply mains terminal and the EMI filter, as shown in images 1 and 2.

NOTE:

After the disconnection, do NOT short-circuit the wires.

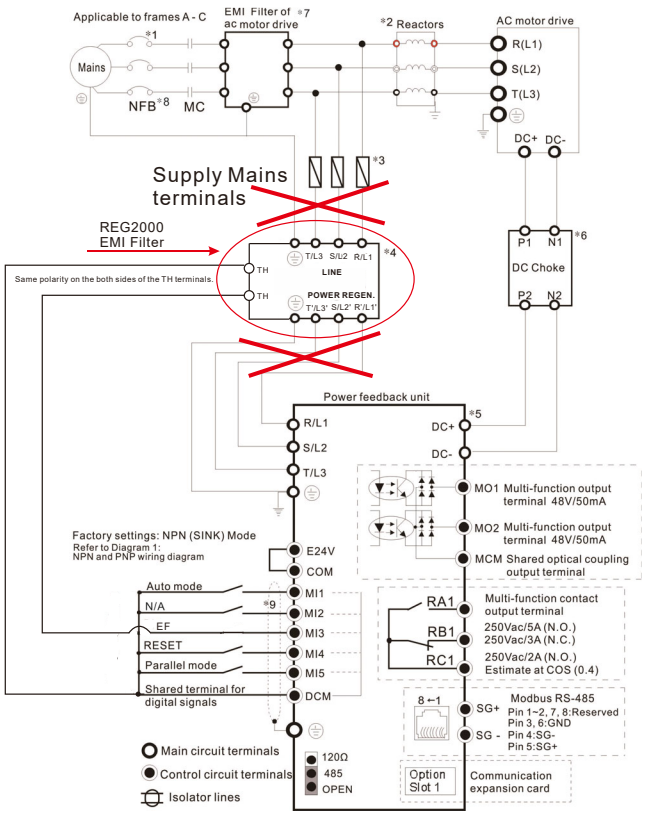


Image 1

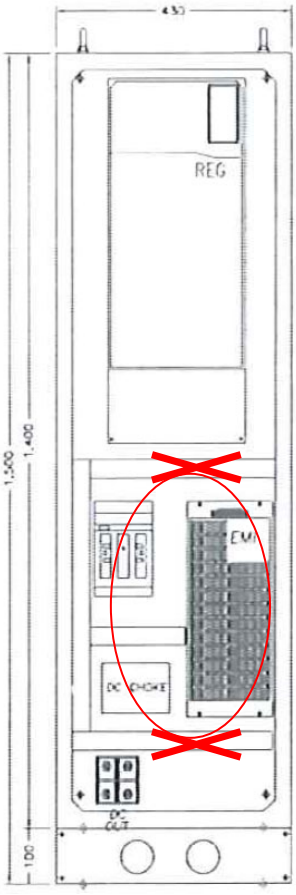


Image 2

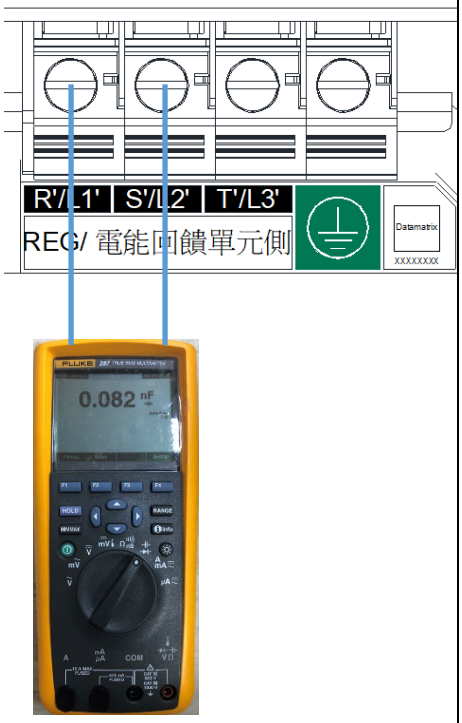
Measuring the capacitance between the phases of EMI filers on REG2000.

Use a multimeter to measure the capacitance between the phases (R'-S' phase, S'-T' phase, T'-R' phase):

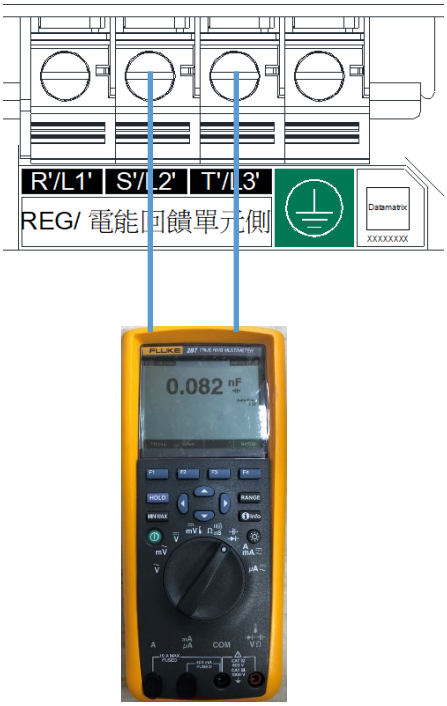
Capacitance Measurement

1. Connect the BLACK test lead to the COM terminal and the RED test lead to the V/Ω terminal.
2. Set the rotary switch to  position. Select measurement using the function key.
3. Observe polarity when measuring polarized capacitors.
4. Connect the test leads across the capacitor under measurement.

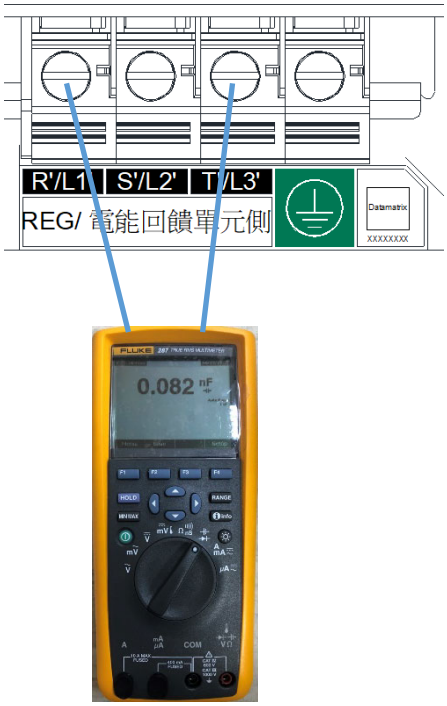
Measuring R'- S' phase



Measuring S'-T' phase



Measuring T'- R' phase



📖 RG-EF110A2 and RG-EF150A4 don't have terminal blocks, but they have outgoing cords, so you only need to measure R'S'T' cords.

Standard Rate of Capacitor (failure rate)

If two of three capacitances (R'-S' phase, S'-T' phase and T'-R' phase) are under their failure rate, you need to replace a new EMI filter right away. The table below lists the standard rates (in blue color) and the failure rates (in red color) with unit uF.

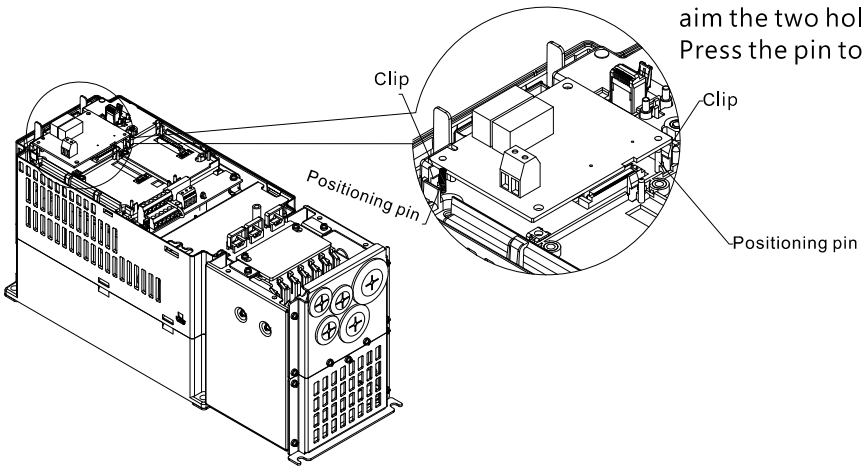
Product Serial #	Before xxxxxxxxx2109xxxx 21: year of production 2021 09 : week of productionw9	After xxxxxxxxx2110xxxx 21: year of production 2021 10 : week of productionw10
RG-EF110A2	11.65 (10.3)	
RG-EF150A4	4.6 (4.0)	
RG-EF220A2	22.35 (19.8)	
RG-EF300A4	9.15 (8.0)	
RG-EF370A2	31.65 (28.3)	
RG-EF550A4	14.85 (13.1)	12.35 (10.8)

📖 Estimation by the failure rate: There are three capacitors in the EMI filter, when one of the capacitor's failure rate is over 15%, that means this capacitor is decaying. A decaying capacitor might cause malfunction of the REG2000 and even cause safety hazards.

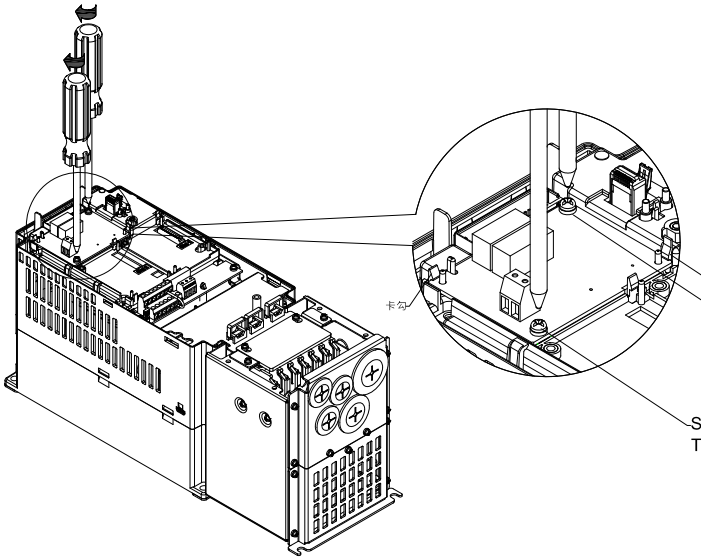
5-5 External Power Supply Card (24 V) EMC-BPS01

Installing the EMC-BPS01

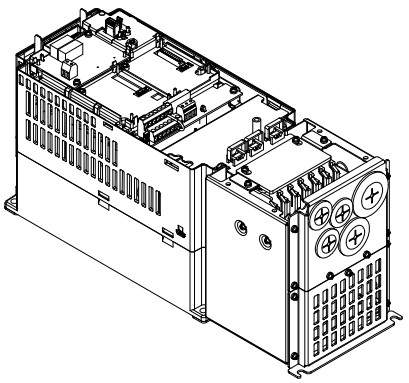
Installation

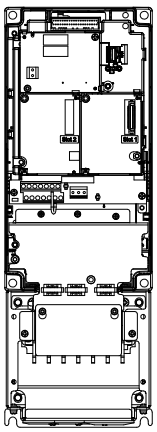


As shown in the figure on the left,
aim the two holes at the positioning pin.
Press the pin to clip the holes with the PCB



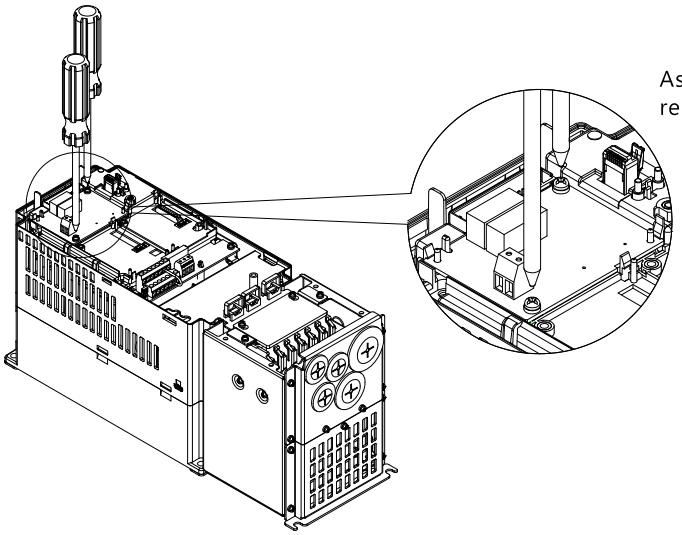
As shown in the figure on the left,
fasten the screw after the PCB is clipped
with the holes.



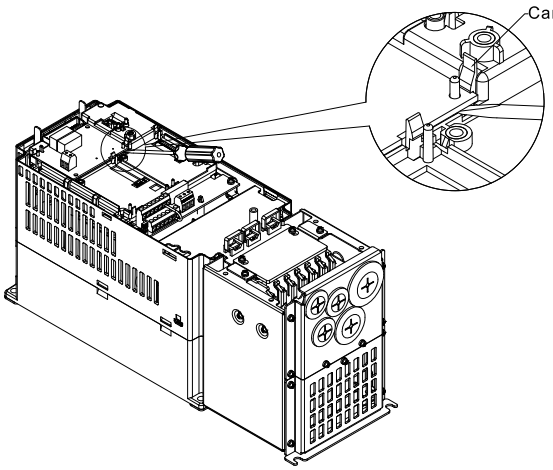


Removing the EMC-BPS01

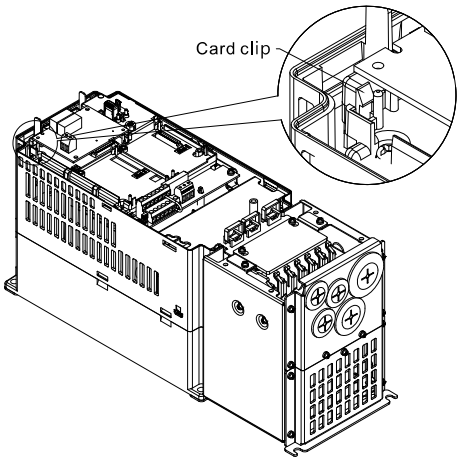
Removing



As shown in the figure on the left,
remove the two screws.



Twist to open the card clip,
insert a slot type screwdriver into
the hollow to prize the PCB off the card clip.



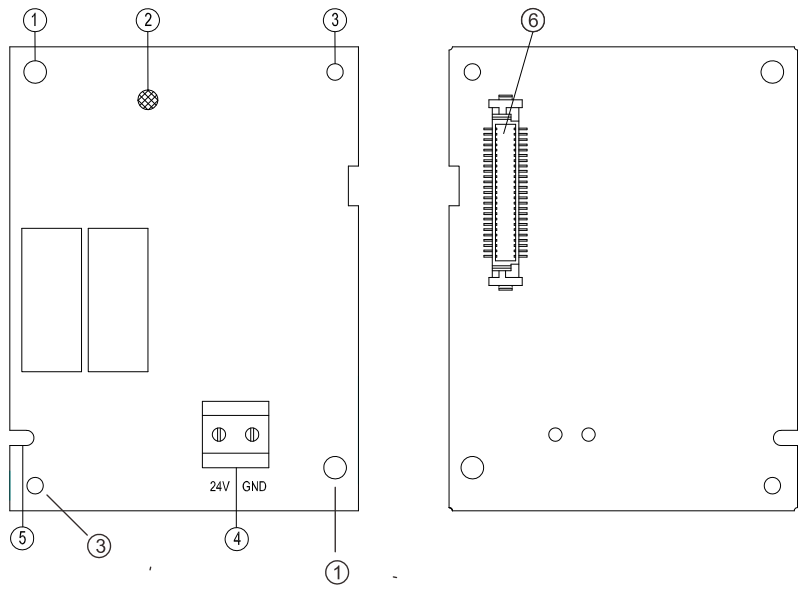
Twist to open the card clip
to remove the PCB.

EMC-BPS01

	Terminals	Descriptions
External Power Supply Card	24 V GND	Input power: 24 V ± 5% Maximum input current: 0.5 A Note: 1) Do not connect any control circuit terminal on the Power Regenerative Unit to this +24 V power terminal. 2) Do not connect DCM terminal on the Power Regenerative Unit to the EMC-BPS01 input terminal GND to keep insulation effective.
		Functions: When the EMC-BPS01 is the only Power Regenerative Unit power supply, the communication works normally and the following functions are supported: Read/ Write parameters Keypad display All keys except the RUN key can be operated Effective analog input The following functions are not supported: (1) Relay output (RA1, RB1, RC1); (2) hot swapping

🕮 Once you install the EMC-BPS01, set Pr.03-05 =1 to enable this external power supply card.

🕮 Multi-Input terminals (MI1– MI5) need an external power supply to function.

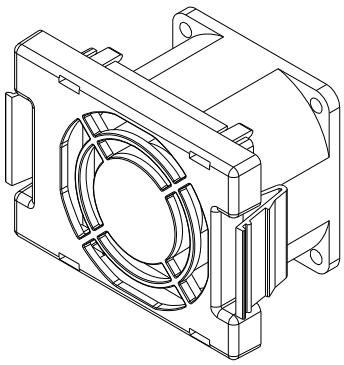
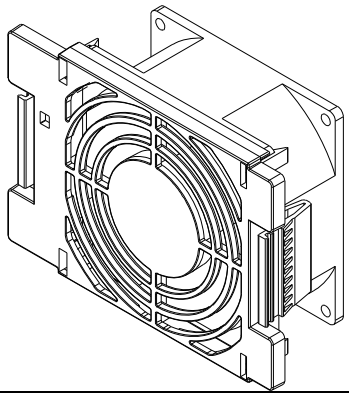
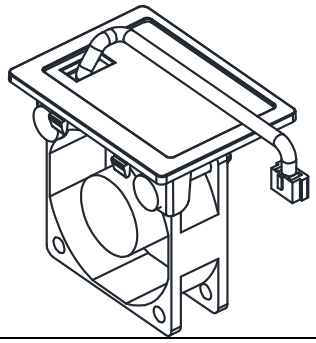
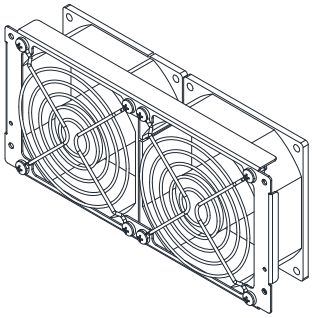


1. Screw fixing hole
2. Power indicator
3. Positioning hole
4. 24V-GND terminal block
5. Fool-proofing groove
6. Motor drive connecting port

Function	Wire Size			Screw Size Tightening Torque (±10%)
	Conductor	Maximum Wire Gauge	Minimum Wire Gauge	
EMC-BPS01	Solid/Strand	0.5 mm² [20 AWG]	0.2 mm² [24 AWG]	5 kg-cm [4.4 lb-in.] [0.5 Nm]

5-6 Fan Kit

- Appearance of Cooling Fans

Frame A Applicable models REG075A23A-21, REG075A43A-21, REG110A23A-21, REG110A43A-21, REG150A43A-21	Cooling fan model 『RG-FK00AAN』 
Frame B Applicable models REG150A23A-21, REG185A23A-21, REG185A43A-21, REG220A23A-21, REG220A43A-21, REG300A43A-21	Cooling fan model 『RG-FK00BAN』 
Frame C Applicable models REG370A23A-21, REG450A43A-21, REG550A43A-21	Capacitance cooling fan model 『MKC-CFKB1』 
Frame C Applicable models REG300A23A-21, REG370A23A-21, REG370A43A-21, REG450A43A-21, REG550A43A-21	Cooling fan model 『RG-FK00CAN』 

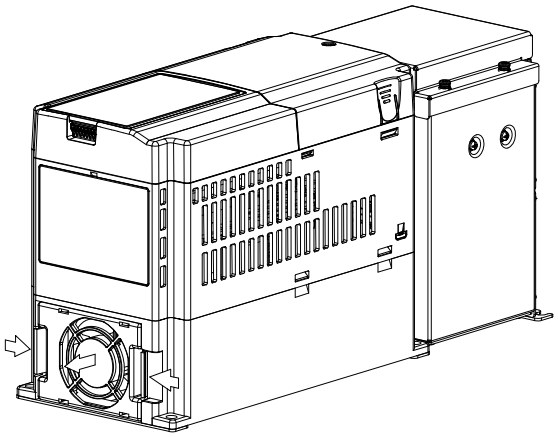
- Removing the Cooling Fan

Frame A

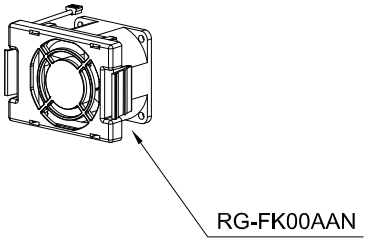
Cooling fan model:『RG-FK00AAN』

Applicable models

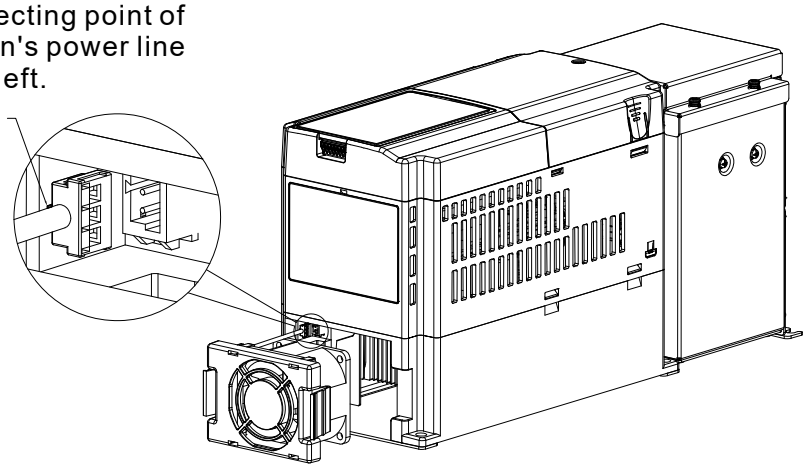
REG075A23A-21, REG075A43A-21, REG110A23A-21, REG110A43A-21, REG150A43A-21



Press the tab on the right and the left to remove the cover



The connecting point of cooling fan's power line is on the left.



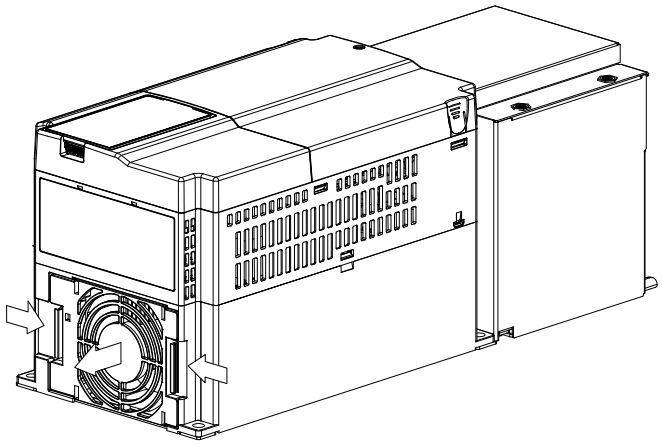
Frame B

Cooling fan model:『RG-FK00BAN』

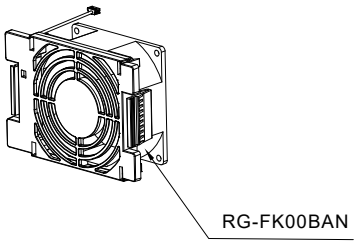
Applicable models

REG150A23A-21, REG185A23A-21, REG185A43A-21,

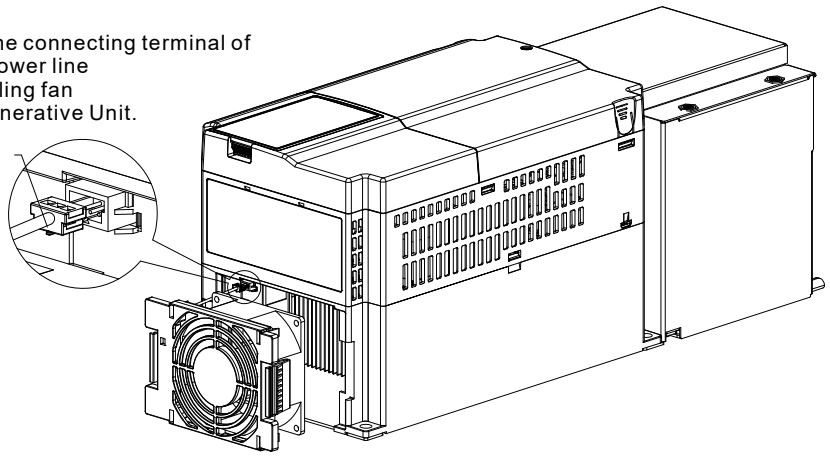
REG220A23A-21, REG220A43A-21, REG300A43A-21



Press the tab on the right and
the left to remove the cover



Place downward the connecting terminal of
the cooling fan's power line
to connect the cooling fan
to the Power Regenerative Unit.



Frame C

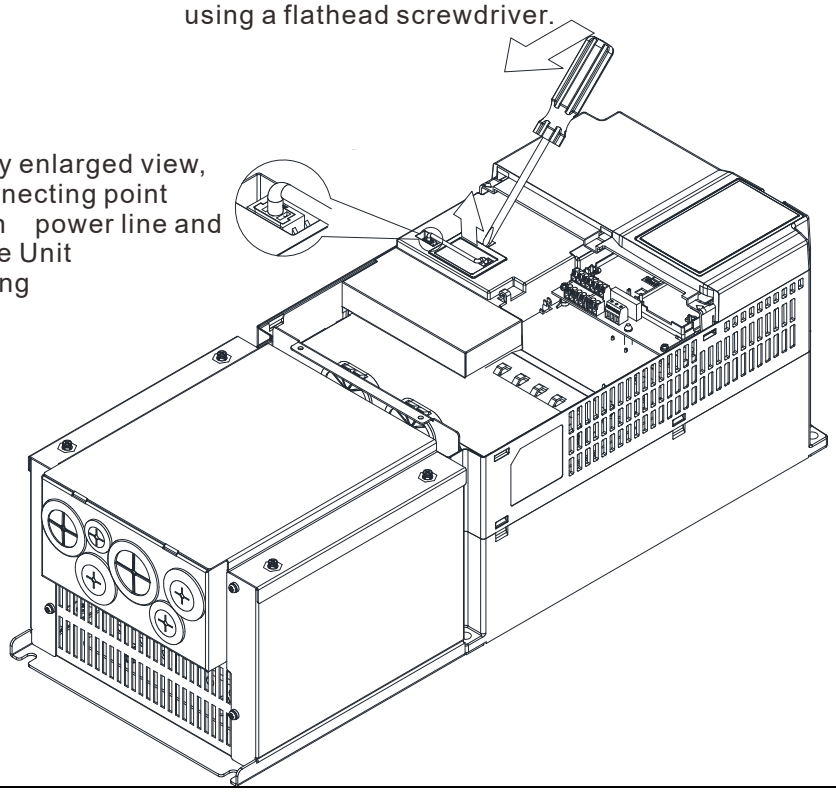
Capacitance cooling fan model:『MKC-CFKB1』

Applicable models

REG370A23A-21, REG450A43A-21, REG550A43A-21

Disconnect the cooling fan power and pull out the cooling fan by using a flathead screwdriver.

As shown in the partially enlarged view, pay attention to the connecting point between the cooling fan power line and the Power Regenerative Unit when installing/ removing the cooling fan.



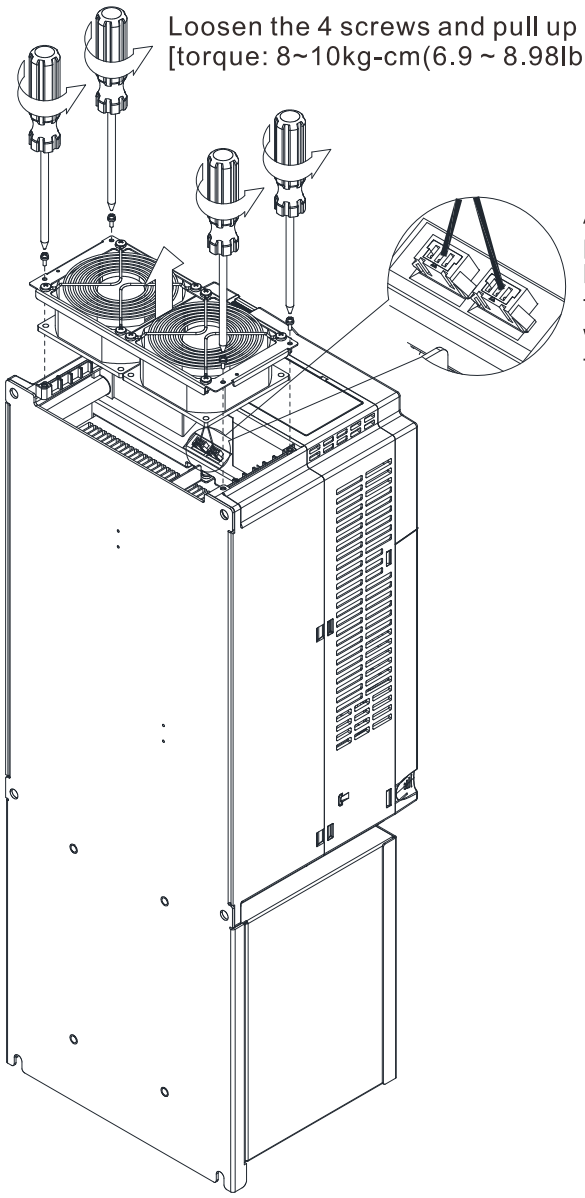
Frame C

Cooling fan model:『RG-FK00CAN』

Applicable models

REG300A23A-21, REG370A23A-21, REG370A43A-21, REG450A43A-21, REG550A43A-21

Disconnect the fan's power and take out the fan by using a slotted screwdriver, as shown in the partially enlarged view below.



06 Summary of Parameter Settings

You can quickly look up the range and default for each parameter when you are setting parameter values. You can set, change, or reset parameter values using the digital keypad (optional) or through the communications.

NOTE

1）↗Means you can set the parameter during operation.
2）For complete parameter descriptions, refer to Chapter 07 Descriptions of Parameter Settings.
3）When a Power Regenerative Unit is at <STOP>, which means it is not performing energy regeneration.

00 Display Parameters

Parameter codes	Parameter names	Setting range	Default
00-00	Power Regenerative Unit Identity code	0: 230 V, 7.5 kW 1: 460 V, 7.5 kW 2: 230 V, 11 kW 3: 460 V, 11 kW 4: 230 V, 15 kW 5: 460 V, 15 kW 6: 230 V, 18.5 kW 7: 460 V, 18.5 kW 8: 230 V, 22 kW 9: 460 V, 22 kW 10: 230 V, 30 kW 11: 460 V, 30 kW 12: 230 V, 37 kW 13: 460 V, 37 kW 15: 460 V, 45 kW 17: 460 V, 55 kW	Read Only
00-01	Power Regenerative Unit rated current display	0: 20 A 1: 10.5 A 2: 32 A 3: 17 A 4: 38 A 5: 20 A 6: 49 A 7: 25 A 8: 60 A 9: 32 A 10: 80 A 11: 43 A 12: 100 A	Read Only

Parameter codes	Parameter names	Setting range	Default
		13: 49 A 15: 60 A 17: 75 A	
00-02	Software version	Read Only (Display according to shipped version)	Read Only
00-03	Display Power Regenerative Unit input current (A_{AC})	Read Only	Read Only
00-04	Display mains frequency (Hz)	Read Only	Read Only
00-05	Display DC BUS voltage (V_{DC})	Read Only	Read Only
00-06	Display power (kW)	-300.0–300.0	Read Only
00-07	Reserved		
00-08	Reserved		
00-09	Display the low word of the kilowatt hours (kWh) regenerated by REG2000	0.0–999.9	Read Only
00-10	Display the high word of the kilowatt hours (kWh) regenerated by REG2000	0–9999	Read Only
00-11	Display the highest internal ambient temperature (°C) (air outlet)	Read Only	Read Only
00-12	Display the highest power module’s temperature (°C)	Read Only	Read Only
00-13	Display internal ambient temperature (°C) (air outlet)	Read Only	Read Only
00-14	Display power module's temperature (°C)	Read Only	Read Only
00-15	Display digital input ON/OFF status	Read Only	Read Only
00-16	Display digital output ON/OFF status	Read Only	Read Only
00-17	DC BUS voltage during a malfunction (V_{DC})	Read Only	Read Only
00-18	Mains frequency during a malfunction (Hz)	Read Only	Read Only
00-19	Current during a malfunction (A)	Read Only	Read Only
00-20	Fault record 1	0: no error record	0

Parameter codes	Parameter names	Setting range	Default
00-21	Fault record 2	3: ocn over-current during regeneration	0
00-22	Fault record 3	6: ocs over-current at stop	0
00-23	Fault record 4	9: ovn over-voltage during regeneration	0
00-24	Fault record 5	10: ovs over-voltage at stop	0
00-25	Fault record 6	15: OrP phase loss in output	0
		16: oH1 power module overheated	
		17: oH2 internal ambient temperature overheated (air outlet)	
		18: tHo1 power module overheated protection circuit error	
		19: tHo2 internal ambient temperature overheated protection circuit error	
		21: oL overload	
		30: cF1 memory writing error	
		31: cF2 memory read error	
		37: Hd1 current detection error when powering on	
		38: Hd2 voltage detection error when powering on	
		42: 5VF 5 V control board error (firmware v.1.02 (included) and later)	
		43: RYF relay error (firmware v.1.02 (included) and later)	
		49: EF external signal input fault	
		52: Pcod wrong password	
		54: cE1 communication error	
		55: cE2 communication error	
		56: cE3 communication error	
		57: cE4 communication error	
		58: cE10 communication time-out	
		66: PLE phase lock error	
00-26	Low word in electricity bill		Read Only
00-27	High word in electricity bill		Read Only
00-28	Display input AC voltage (V_{AC})		Read Only

01 Basic Parameters

Parameter codes	Parameter names	Setting range	Default
01-00	Reset parameters	0: no function 1: parameter cannot be written 10: parameter reset	0
✗01-01	Select start-up display	0: mains frequency 1: DC BUS voltage (V_{DC}) 2: Output current (A_{AC})	0
✗01-02	Enter parameter protection password	1–9998,10000–65535 0–2: number of incorrect passwords entered	0
✗01-03	Set parameter protection password	1–9998,10000–65535 0: password not set or password entered successfully in Pr.01-02 1: parameters locked	0
✗01-04	Operation command source	1: controlled by external terminals 2: controlled through the communication interface or the digital keypad (KPC-CE01/ KPC-CC01)	1
01-05	Reserved		
01-06	Reserved		
01-07	Reserved		
01-08	DC BUS voltage activation level (offset value)	230V series: 30–100 V 460V series: 60–200 V	40 80
01-09	Reserved		
✗01-10	DC BUS voltage control P gain	0–1000%	100
✗01-11	DC BUS voltage control I gain	0–1000%	100
✗01-12	DC BUS voltage control bandwidth	1–100 Hz	40
01-13	Reserved		
✗01-14	Select multi-function display	0: display DC BUS voltage (v)	0
		1: display mains frequency (H)	
		2: display output current (A)	
		3: display output AC voltage (E)	
		7: display power (P)	
		8: display current limit (p)	

02 Digital Input/Output Parameters

Parameter codes	Parameter names	Setting range	Default
02-00	Multi-function input command 1 (MI1)	0: No function	1
02-01	Multi-function input command 2 (MI2)	1: Automatic mode	0
02-02	Multi-function input command 3 (MI3)	2: Reserved	3
02-03	Multi-function input command 4 (MI4)	3: External Fault (EF)	4
02-04	Multi-function input command 5 (MI5)	4: RESET	5
		5: Parallel mode	
		6: No function	
✎02-05	Digital input response time	0.001–30.000 sec.	0.005
✎02-06	Digital input direction	0–65535	0
✎02-07	Multi-function output 1 (Relay1)	0: No function	4
✎02-08	Multi-function output 2 (MO1)	1: Regenerate indicator	3
✎02-09	Multi-function output 3 (MO2)	2: RUN indicator	0
		3: Ready indicator	
		4: Error indicator	
		5: No function	
		6: Warn indicator	
		7: No function	
✎02-10	Multi-function output direction	0–65535	0

03 Special Protection Parameters

Parameter codes	Parameter names	Setting range	Default
✗03-00	Low voltage level	230V series:160.0–220.0 V 460V series:320.0–440.0 V	180.0 360.0
✗03-01	Current limit	0–150%	150
✗03-02	Reserved		
✗03-03	Reserved		
✗03-04	Phase lock frequency deviation time	0–1000 ms	150
✗03-05	External power supply card 24 V (EMC-BPS01) enabled	0: EMC-BPS01 disabled 1: EMC-BPS01 enabled	0
✗03-06	Reserved		
✗03-07	Number of times of auto-restart after fault	0–10	0
✗03-08	Auto-restart interval of fault	0.1–6000.0 sec.	60.0
✗03-09	Cooling fan control mode	0: fan runs always 1: runs for one minute after stop and then stops 2: runs and stops as the Power Regenerative Unit regenerates and stops 3: runs according to the power module’s temperature 4: always off	3
03-10	Reserved		
03-11	Reserved		
✗03-12	Erase the energy regenerated record	0: parameter reset 1: erase	0
✗03-13	Electricity rate	0–6553.5 $ / kWh	3.0

04 Communication Parameters

Parameter codes	Parameter names	Setting range	Default
✎04-00	Communication address	1–254	1
✎04-01	COM1 transmission speed	4.8–115.2 Kbps	9.6
✎04-02	COM1 transmission fault treatment	0: Warn and continue operation 1: Warn and ramp to stop 2: Reserved 3: No action and no display	3
✎04-03	COM1 time-out detection	0.0–100.0 sec.	0
✎04-04	COM1 communication protocol	0: 7, N, 1 (ASCII) 1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	1
✎04-05	Communication response delay time	0.0–200.0 ms	2.0
04-06	Reserved		

05 Application Parameters

Parameter codes	Parameter names	Setting range	Default
↗05-00	DC BUS voltage filter time	0.000–65.535 sec.	0.000
↗05-01	Mains frequency filter time	0.000–65.535 sec.	0.010
05-02 – 05-20	Reserved		

07 Descriptions of Parameter Settings

00 Display Parameters

✓ You can set this parameter during operation.

00-00 Power Regenerative Unit identity code
00-01 Power Regenerative Unit rated current display

Default: read-only

Settings Read-only (Display by model)

📖 Pr.00-00 determines the capacity of the Power Regenerative Unit and is a default setting parameter. Also, the rated current for that model is in the read-only parameter Pr.00-01. Pr.00-00 corresponds to the current displayed in Pr.00-01.

REG2000 Identity Code																
Input voltage	230V							460V								
Model code	**0**	**2**	**4**	**6**	**8**	**10**	**12**	**1**	**3**	**5**	**7**	**9**	**11**	**13**	**15**	**17**
Power Regenerative Unit corresponding capacity (kW)	7.5	11	15	18.5	22	30	37	7.5	11	15	18.5	22	30	37	45	55
Rated input current (A)	20	32	38	49	60	80	100	10.5	17	20	25	32	43	49	60	75

00-02 Software version

Default: #.##

Settings Read-only (Display according to shipped version)

00-03 Display Power Regenerative Unit input current (A_{AC})
00-04 Display mains frequency (Hz) (line frequency)

Default: #.##

Settings Read-only

00-05 Display DC BUS voltage (V_{DC})

Default: #.#

Settings Read-only

00-06 Display power (kW)

Default: #.#

Settings -300.0–300.0

00-07 Reserved
00-08 Reserved

00-09 Display the low word of the kilowatt hours (kWh) regenerated by REG2000

Default: ###.#

Settings 0.0–999.9

00-10 Display the high word of the kilowatt hours (kWh) regenerated by REG2000

Default: ####

Settings 0–9999

- When Pr.03-12 = 1, Pr.00-09 and Pr.00-10 are reset to 0 and Pr.03-12 returns to 0.
- After you set Pr.00-09 and Pr.00-10, the REG starts to run and the counting begins.
- It displays by Pr.00-10 * 1000 + Pr.00-09.

00-11 Display highest internal ambient temperature (°C) (air outlet)
00-12 Display highest power module's temperature (°C)

Default: ##.#

Settings Read-only

00-13 Display internal ambient temperature (°C) (air outlet)
00-14 Display power module's temperature (°C)

Default: ##.#

Settings Read-only

00-15 Display digital input ON/OFF status
00-16 Display digital output ON/OFF status

Default: ###

Settings Read-only

00-17 DC BUS voltage during a malfunction (V_{DC})

Default: ##.#

Settings Read-only

00-18 Mains frequency during a malfunction (Hz)
00-19 Current during a malfunction (A)

Default: #.##

Settings Read-only

00-20 Fault record 1
00-21 Fault record 2
00-22 Fault record 3
00-23 Fault record 4
00-24 Fault record 5
00-25 Fault record 6

Default: 0

Settings

0: no error record

3: ocn over-current during regeneration
6: ocs over-current at stop
9: ovn over-voltage during regeneration
10: ovs over-voltage at stop
15: OrP phase loss in output
16: oH1 power module overheated
17: oH2 internal ambient temperature overheated (air outlet)
18: tHo1 power module overheated protection circuit error
19: tHo2 internal ambient temperature overheated protection circuit error
21: oL overload
30: cF1 memory writing error
31: cF2 memory read error
37: Hd1 current detection error when powering on
38: Hd2 voltage detection error when powering on
42: 5VF 5V control board error (firmware v.1.02 (included) and later)
43: RYF relay error (firmware v.1.02 (included) and later)
49: EF external signal input fault
52: Pcod wrong password
54: cE1 communication error
55: cE2 communication error
56: cE3 communication error
57: cE4 communication error
58: cE10 communication time-out
66: PLE phase lock error

🕮 PLE and OrP errors are recorded as errors only in power regeneration status; otherwise, they are warnings in Ready and Run status.

🕮 OH1 Level

Model	Default
REG075A23A	100
REG110A23A	110
REG150A23A	100
REG185A23A	100
REG220A23A	100
REG300A23A	95
REG370A23A	105

Model	Default
REG075A43A	100
REG110A43A	105
REG150A43A	110
REG185A43A	100
REG220A43A	90
REG300A43A	90
REG370A43A	95
REG450A43A	115
REG550A43A	115

00-26 Low word in electricity bill
00-27 High word in electricity bill

Default: ###

Settings Read only

🕮 When Pr.03-12 =1, Pr.00-26 and Pr.00-27 are reset to 0 and Pr.03-12 returns to 0.
🕮 Display the dollar amount saved on electricity expense. The settings of the related parameters are shown below.
The kW/hr regenerated (Pr.00-09–Pr.00-10) * electricity expense (Pr.03-13).
It displays by Pr.00-27 * 1000 + Pr.00-26.

00-28 Display input AC voltage (V_{AC})

Default: ##.#

Settings Read only

01 Basic Parameters

You can set this parameter during operation.

01-00 Reset parameters

Default: 0

Settings 0: no function
1: parameter cannot be written
10: parameter reset

- 1: You can only adjust Pr.01-00–Pr.01-03, and the other parameters are read-only. In combination with the password parameters, this prevents the parameters from being altered by mistake.
- 10: Restores the parameters to the defaults. If a password is set, you must enter it before restoring the parameter settings, and the password is cleared at the same time.

01-01 Select start-up display

Default: 0

Settings 0: mains frequency
1: DC BUS voltage (V_{DC})
2: Output current (A_{AC})

01-02 Enter parameter protection password

Default: 0

Settings 1–9998,10000–65535
Display value 0–2: number of incorrect passwords entered

- Enter the password set in Pr.01-03 into Pr.01-02 to unlock all the password protected parameters.
- After setting this parameter, write down the setting to avoid being locked out in the future.
- Using parameters Pr.01-02 and Pr.01-03 prevents non-technicians from accidently altering other parameters.
- If you lose or forget the password, you can reset it by entering 9999 and pressing the "ENTER" key, enter 9999 and press "ENTER" again (this sequence must be completed within 10 seconds; otherwise, you have to do it again). This also restores all parameters back to the defaults.

01-03 Set parameter protection password

Default: 0

Settings 1–9998,10000–65535
Display value 0: password not set or password entered successfully in Pr.01-02
1: parameters locked

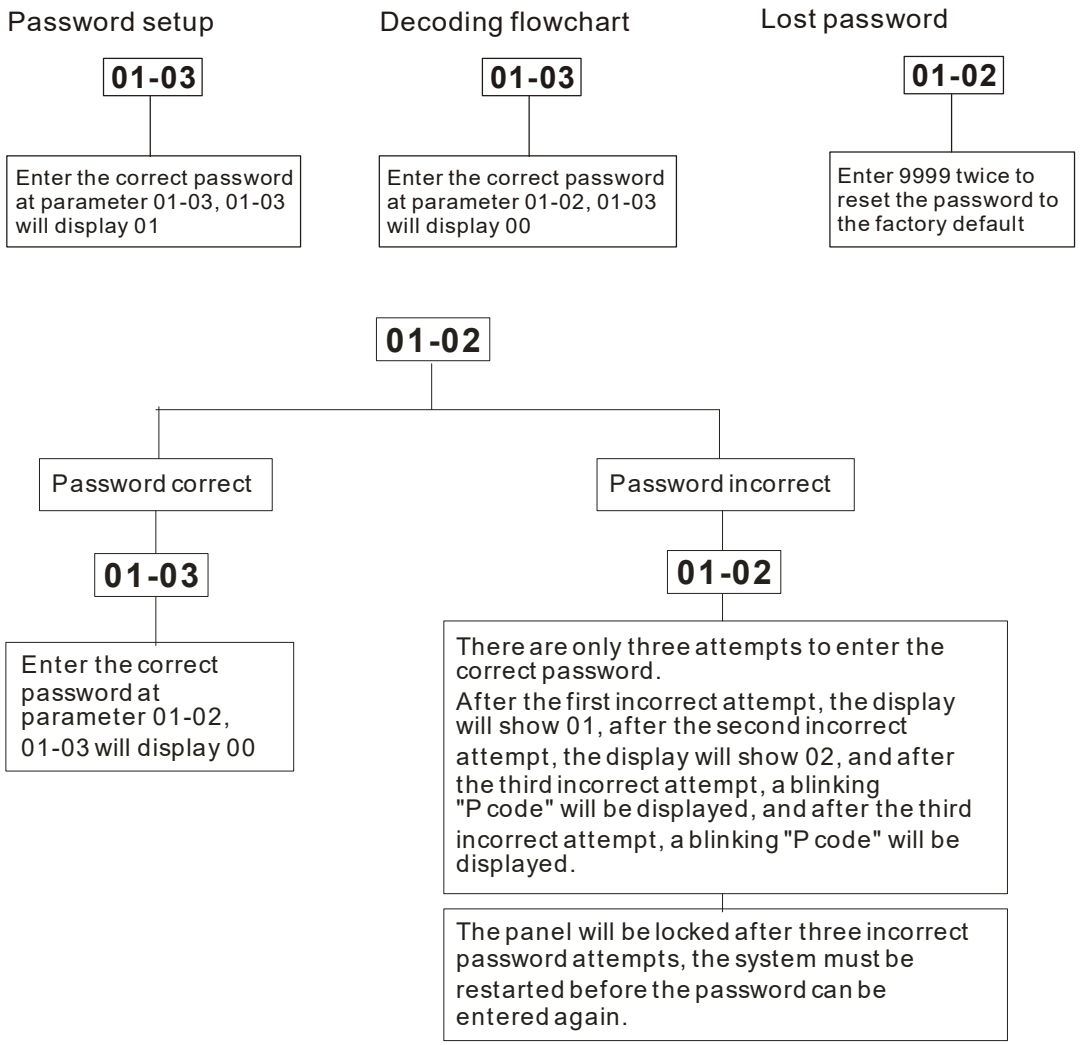
- This parameter sets the password protection, which you can enter directly the first time. After you set the password, this parameter value becomes 1, meaning that password protection is enabled. To make changes to any parameter, first enter the correct password in Pr.01-02. After you unlock the password protection, the Pr.01-02 is reset to 0, and you can set all parameters.

- After password protection is enabled, all parameter values except for Pr.01-03 display 0.
- You can disable password protection by unlocking the password protection in Pr.01-02 and setting this parameter to 0. Password protection remains off after a system reboot.
- Otherwise, the password remains permanently active. After you turn on the system, you must first unlock the password protection in Pr.01-02 before changing any parameters.
- To reactivate password protection:

  Method 1: Reenter the password in Pr.01-03.

  Method 2: Reboot the system to immediately restore the password protection.

  Method 3: Enter any value other than the password in Pr.01-02.



01-04 Operation command source

Default:1

Settings 1: controlled by external terminals

2: controlled through the communication interface or the digital keypad (KPC-CE01/KPC-CC01)

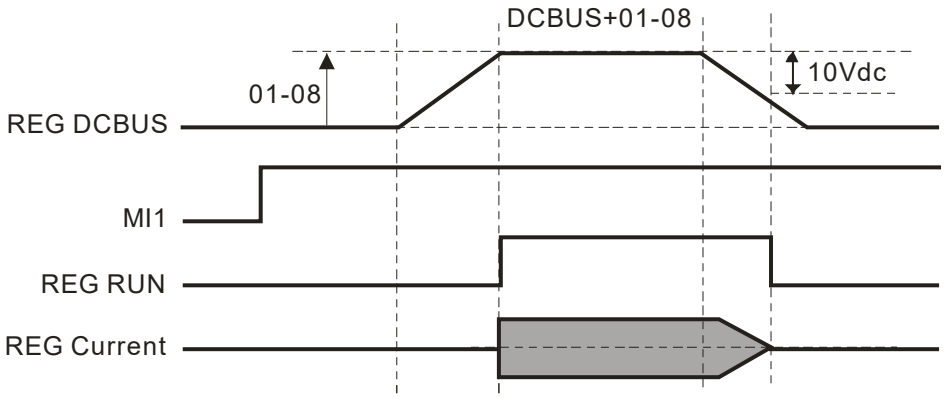
- The standard REG package does not contain the digital keypad and you must control operation with external terminals. Confirm that the wiring between multi-function input terminals is correct before using.
- To operate using the communication interface, you must purchase a digital keypad KPC-CC01 or KPC-CE01 before you can set the operation command source to the communication interface.

01-05 Reserved
01-06 Reserved
01-07 Reserved

01-08 DC BUS voltage activation level (offset value)

Settings 230V series: 30–100 V Default: 40
460V series: 60–200 V Default: 80

- The regenerative activating voltage is set to the mains AC voltage (Pr.00-28) * $\sqrt{2}$ + Pr.01-08.
- The Power Regenerative Unit stops output when (1) DC BUS voltage < (DC BUS voltage + Pr.01-08 - 10 V) and (2) the Power Regenerative Unit output current (A_{AC}) is 10% lower than the rated output for more than one second.
- There is an absolute upper limit and an absolute lower limit in the DC BUS voltage activation level. For example, the absolute upper limit of the DC BUS voltage activation level for 440V models is 780 V. That means even when the input voltage is 528 V_{AC} and the Pr.01-08 = 200 V, the DC BUS voltage activation level should be 528 * 1.414 + 200 = 947 V_{DC}. However, the design of the Power Regenerative Unit forces the trigger upper limit to stay under 780 V_{DC}.



01-09 Reserved

01-10 DC BUS voltage control P gain
01-11 DC BUS voltage control I gain

Default: 100

Settings 0–1000%

- Pr.01-10 is the parameter that decides the P function response speed on the DC BUS voltage bias. With higher gain, the response is faster while the DC BUS voltage bias becomes smaller. If the gain is too high, there will be an oscillation. With lower gain, the response is slower while the DC BUS voltage bias becomes larger. It is scaled to correspond 100% to the Kp value of auto-calculated DC BUS voltage control bandwidth (Pr.01-12).
- Pr.01-11 is an integral controller to eliminate the steady-state error caused by the DC BUS voltage bias. The higher the integral gain, the faster the response to the external disturbance, and the oscillation easily occurs. But the lower the integral gain, the slower the response to the external disturbance. It is scaled to correspond 100% to the Ki value of auto-calculated DC BUS voltage

control bandwidth (Pr.01-12).

01-12 DC BUS voltage control bandwidth

Default: 40

Settings 1–100 Hz

🕮 Controls the DC BUS voltage response speed. The higher the value, the faster the response.

01-13 Reserved

01-14 Select multi-function display

Default: 0

Settings 0: display DC BUS voltage (v)
1: display mains frequency (H)
2: display output current (A_{AC})
3: display output AC voltage (E)
4: reserved
5: reserved
6: reserved
7: display power (P)
8: display current limit (p)

02 Digital Input/Output Parameters

You can set this parameter during operation.

02-00 Multi-function input command 1 (MI1)

Default: 1

02-01 Multi-function input command 2 (MI2)

Default: 0

02-02 Multi-function input command 3 (MI3)

Default: 3

02-03 Multi-function input command4 (MI4)

Default: 4

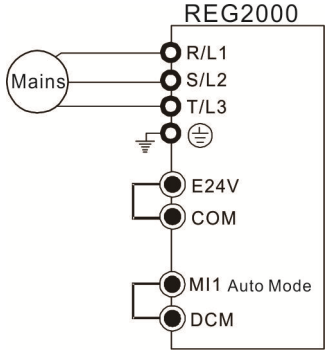
02-04 Multi-function input command 5 (MI5)

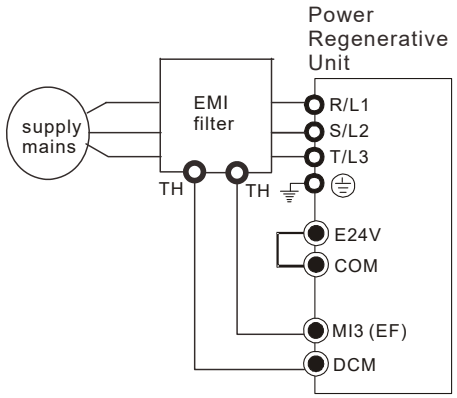
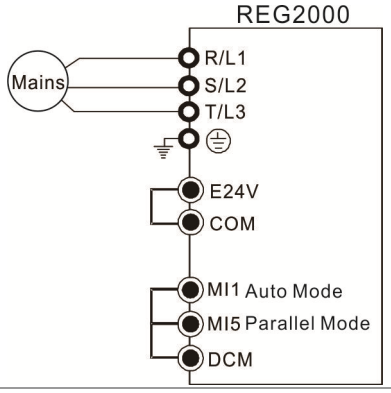
Default: 5

Settings
0: No function
1: Automatic mode
2: Reserved
3: External Fault (EF)
4: RESET
5: Parallel mode
6: No function

Includes the necessary external terminal input functions as required.

The following table lists the multi-function input terminal functions.

Setting	Function	Description
0	No function	The input terminal does not have any function.
1	Automatic mode (the default terminal is MI1)	This terminal setting is effective only when you set Pr.01-04 to 1 "controlled by external terminals". When the automatic mode is ON and the Power Regenerative Unit detects that DC BUS voltage reaches the setting in Pr.01-08, the DC BUS voltage automatically regenerates to the electrical grid. The following diagram shows the default wiring between the multi-function input terminals for each Power Regenerative Unit. Verify that the wiring is correct before using. Refer to Chapter 04 Wiring for more details about automatic mode. 
2	Reserved	The input terminal function is reserved.

Setting	Function	Description
3	External Fault (EF)	While installing an EMI filter, connect one TH terminal to MI3 and another TH terminal (both TH terminals have the same polarity) to DCM to do temperature protection detection. The wiring method is as shown in the image below. See Chapter 4 for more information on wiring. 
4	RESET	You can reset the Power Regenerative Unit after clearing the fault only with this terminal function.
5	Parallel mode (the default terminal is MI5)	This terminal setting is effective only when you set Pr.01-04 to 1 "controlled by external terminals." Before setting to parallel mode, select Automatic as the control mode. When working in parallel mode, each Power Regenerative Unit automatically reduces its current limit to 80%. The following diagram shows the default wiring between the multi-function input terminals for each Power Regenerative Unit. Verify that the wiring is correct before using. Refer to Chapter 04 Wiring for more details about parallel mode. 
6	No function	The input terminal does not have any function.

02-05 Digital input response time

Default: 0.005

Settings 0.001–30.000 sec.

🕮 Adds a delay and confirms process to digital input terminal signals. The delay time is the confirmation time. This prevents unknown interference from causing the digital input terminals

(MI1–5) to malfunction (except counting inputs). This parameter significantly improves these situations, but response time is slightly delayed.

02-06 Digital Input direction

Default: 0

Settings 0–65535

- Sets the activation level for input signals, and has no relation to the terminal's SINK/SOURCE status.
- bits 0–4 correspond to MI1–MI5, respectively.
- Enter corresponding values through communications to alter the ON/OFF status of the terminals.

02-07 Multi-function output 1 (Relay 1)

Default:4

02-08 Multi-function output 2 (MO1)

Default:3

02-09 Multi-function output 3 (MO2)

Default: 0

Settings

0: No function

1: Regenerate indicator

2: Run indicator

3: Ready indicator

4: Error indicator

5: No function

6: Warn indicator

7: No function

- Includes the necessary external terminal output functions as required.

The following table lists the multi-function output terminal functions.

Setting	Function	Description
0	No function	The output terminal does not have any function.
1	Regenerate indicator	When the Power Regenerative Unit is in Regenerate status, the contacts are in ON status.
2	Run indicator	After powering on and sending the RUN command, the Power Regenerative Unit is in normal operation (including standby and regenerate) and the contacts are in ON status.
3	Ready indicator	The contacts are ON when there are no Power Regenerative Unit errors or warnings. (When the phase lock is completed, you can now send the RUN command.)
4	Error indicator	The contacts are ON when the Power Regenerative Unit detects an error.
5	No function	The output terminal does not have any function

6	Warn indicator	The contacts are ON when the Power Regenerative Unit detects a warning.
7	No function	The output terminal does not have any function

📖 See Diagram 3 in Section 4-4 for more information on the definition of different working status of power regeneration.

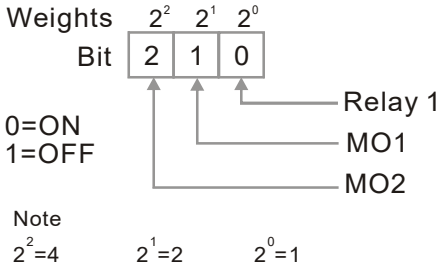
02-10 Multi-function output direction

Default: 0

Settings 0–65535

📖 The setting of this function is binary. If you set a bit to 1, the multi-function output direction is reversed. For example, when you set Pr.02-07 to 1 (Regenerate indicator), if the output direction is forward or you set the bit to 0, Relay 1 activates (ON) only when the Power Regenerative Unit regenerates. When the Power Regenerative Unit is stopped, Relay 1 is OFF. In contrast, if the output direction is reverse and you set the bit to 1, Relay 1 is OFF when the Power Regenerative Unit regenerates, and ON when it stops.

Bit 2	Bit 1	Bit 0
MO2	MO1	RY1



03 Special Protection Parameters

You can set this parameter during operation.

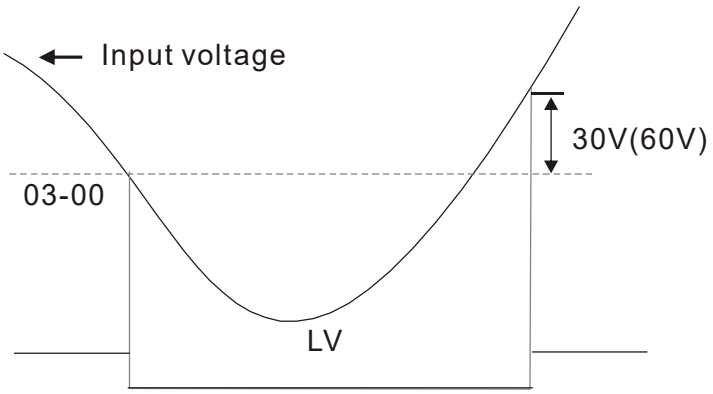
03-00 Low voltage level

Default: 180.0/360.0

Settings 230V series: 160.0–220.0 V
460V series: 320.0–440.0 V

This parameter sets the LV voltage level.

When the Power Regenerative Unit voltage drops below the parameter low voltage level, the system sends a warning.



03-01 Current limit

Default: 150

Settings 0–150%

Limits the Power Regenerative Unit maximum current output.

03-02 Reserved

03-03 Reserved

03-04 Phase lock frequency deviation time

Default: 150

Settings 0–1000 ms

When a frequency is detected to be outside of 47–63 Hz and the duration is longer than the value set in this parameter, the system generates a PLE phase lock signal.

03-05 External power supply card 24 V (EMC-BPS01) enabled

Default: 0

Settings 0: EMC-BPS01 disabled
1: EMC-BPS01 enabled

When using EMC-BPS01 as the external power supply for the Power Regenerative Unit, enable EMC-BPS01 through communications or digital keypad to prevent RyF error. (Only REG2000 manufactured after March 2018 supports this function.)

03-06 Reserved

03-07 Number of times of auto-restart after fault

Default: 0

Settings 0–10

🕮 Sets the number of times the Power Regenerative Unit can automatically reset/restart after a fault (acceptable errors: only over-current during regeneration and at stop, over-voltage during regeneration and at stop, phase lock) at a maximum of ten times. If you set this parameter to 0, then the system does not automatically reset/restart after a fault.

03-08 Auto-restart interval of fault

Default: 60.0

Settings 0.1–6000.0 sec.

🕮 When a restart after fault occurs, the Power Regenerative Unit starts a count-down according to this parameter. Within the Pr.03-08 setting time, the Power Regenerative Unit stops only when the count-down reaches the number of times set in Pr.03-07 (and the faults are recorded). If the count-down does not reach the number of times set in Pr.03-07 within Pr.03-08 setting time, the unit resets Pr.03-07 to the initial value before starting another counting.

03-09 Cooling fan control mode

Default: 3

Settings 0: fan runs always
1: runs for one minute after stop and then stops
2: runs and stops as the Power Regenerative Unit regenerates and stops
3: runs according to the power module's temperature
4: always off

🕮 Determines the cooling fan mode setting.

🕮 0: The cooling fan starts running as soon as the Power Regenerative Unit starts transmitting power.

🕮 1: The cooling fan runs when the Power Regenerative Unit runs and stops one minute after the Power Regenerative Unit stops.

🕮 2: The cooling fan runs when the Power Regenerative Unit runs and stops as soon as the Power Regenerative Unit stops.

🕮 3: The cooling fan adjusts its speed according to the power module's temperature. When the temperature is high, the cooling fan starts running; the higher the temperature the faster the fan runs. When temperature drops into the normal range, as shown in the following table, the cooling fan stops.

🕮 4: The cooling fan is always off.

Model	Operating temperature range of fans (RUN→STOP)
REG075A23A	50→40
REG110A23A	60→50
REG150A23A	50→40
REG185A23A	50→40
REG220A23A	50→40
REG300A23A	45→35
REG370A23A	65→55
REG075A43A	50→40
REG110A43A	55→45

REG150A43A	60→50
REG185A43A	50→40
REG220A43A	40→30
REG300A43A	40→30
REG370A43A	45→35
REG450A43A	65→55
REG550A43A	65→55

03-10 Reserved

03-11 Reserved

03-12 Erase the energy regenerated record

Default: 0

Settings 0: parameter reset
1: erase

📖 Setting this parameter to 1 clears Pr.00-09 and Pr.00-10 to 0, and the system resets this parameter to 0.

03-13 Electricity rate

Default: 3.0

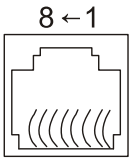
Settings 0–6553.5 $ / kWh

📖 Sets the calculation for the local electricity bill. Unit: $/kWh.

04 Communication Parameters

✍You can set this parameter during operation.

When using the communication interface, the diagram on the right shows the communication port pin definitions. We recommend that you connect the Power Regenerative Unit to your PC by using Delta IFD6530 or IFD6500 as a communication converter.



Modbus RS-485
Pin 1, 2, 7, 8: Reserved
Pin 3, 6: GND
Pin 4: SG-
Pin 5: SG+

✍ 04-00 Communication address

Default: 1

Settings 1–254

🕮 When the system uses the RS-485 serial communication interface for control or monitoring, every Power Regenerative Unit must have its own communication address and every address in the network must be unique.

✍ 04-01 COM1 transmission speed

Default: 9.6

Settings 4.8–115.2 Kbps

🕮 Sets the transmission speed between the Power Regenerative Unit and computers.

✍ 04-02 COM1 transmission fault treatment

Default: 3

Settings 0: Warn and continue operation
1: Warn and ramp to stop
2: Reserved
3: No actions and no display

🕮 Specifies how the Power Regenerative Unit handles a transmission time-out error (such as a broken line) during communications.

✍ 04-03 COM1 time-out detection

Default: 0.0

Settings 0.0–100.0 sec.
0.0: No detection

🕮 Sets the duration for a transmission time-out between communication ports and COM1.

✍ 04-04 COM1 communication protocol

Default: 1

Settings 0: 7, N, 1 for ASCII
1: 7, N, 2 for ASCII
2: 7, E, 1 for ASCII
3: 7, O, 1 for ASCII
4: 7, E, 2 for ASCII
5: 7, O, 2 for ASCII
6: 8, N, 1 for ASCII

7: 8, N, 2 for ASCII
8: 8, E, 1 for ASCII
9: 8, O, 1 for ASCII
10: 8, E, 2 for ASCII
11: 8, O, 2 for ASCII
12: 8, N, 1 for RTU
13: 8, N, 2 for RTU
14: 8, E, 1 for RTU
15: 8, O, 1 for RTU
16: 8, E, 2 for RTU
17: 8, O, 2 for RTU

🕮 Control by PC (Computer Link)

When using the RS-485 serial communication interface, you must first specify a communication address to every Power Regenerative Unit in Pr.04-00. The computer then controls the units based on their individual addresses.

🕮 Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

1. Code Description

The communication protocol is in hexadecimal, ASCII: "0" … "9", "A" … "F", every hexadecimal value represents an ASCII code. The following table shows some examples.

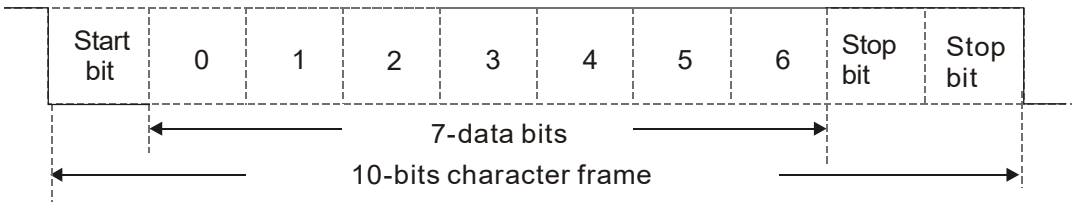
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

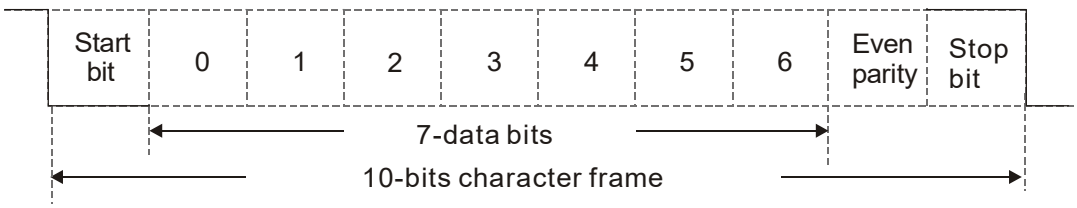
2. Character structure

10-bit character frame (for ASCII)

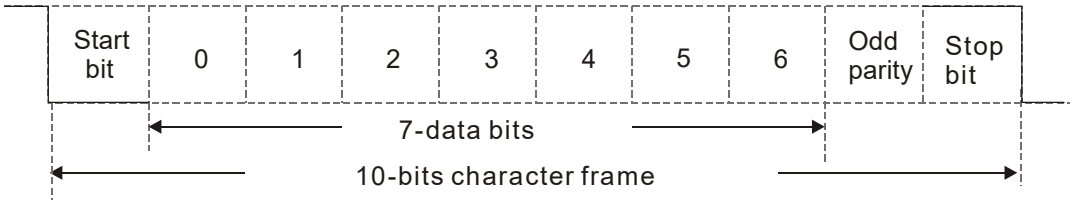
(Data format 7, N, 2)



(Data format 7, E, 1)

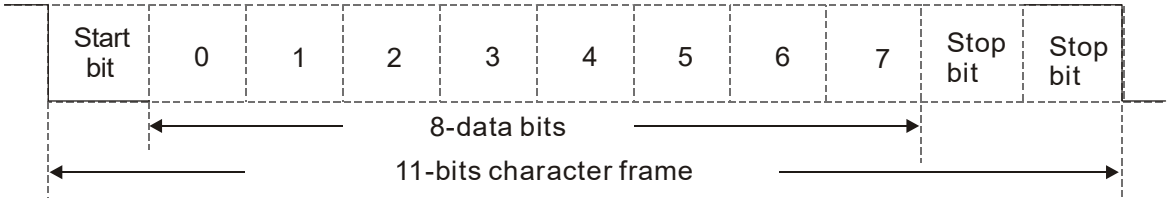


(Data format 7, O, 1)

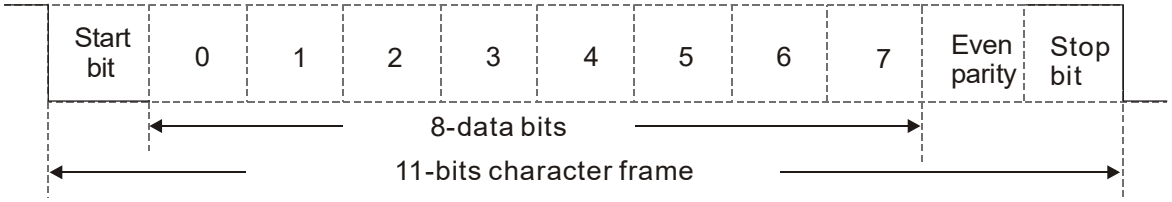


11-bit character frame (For RTU)

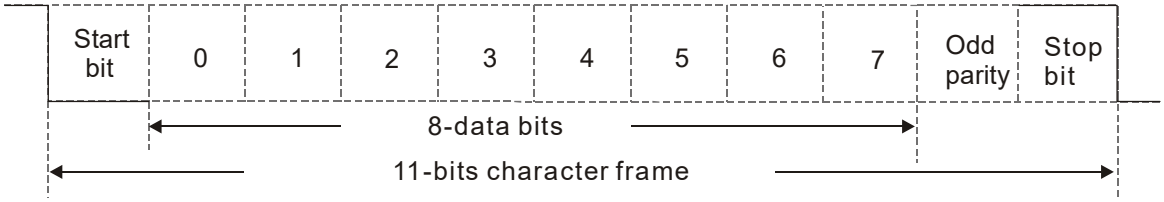
(Data format 8, N, 2)



(Data format 8, E, 1)



(Data format 8, O, 1)



3. Communication data structure

Data format frame

ASCII mode:

STX	Start character = ':' (3AH)
Address Hi	Communication address:
Address Lo	one 8-bit address consists of 2 ASCII codes
Function Hi	Function code:
Function Lo	one 8-bit function code consists of 2 ASCII codes
DATA (n-1)	Contents of data:
…….	N x 8-bit data consists of 2n ASCII codes
DATA 0	N ≤ 16, maximum of 32 ASCII codes (20 sets of data)
LRC CHK Hi	LRC checksum:
LRC CHK Lo	one 8-bit checksum consists of 2 ASCII codes
END Hi	End characters:
END Lo	END Hi = CR (0DH), END Lo = LF(0AH)

RTU mode:

START	Maintains no input signal for at least 10 ms
Address	Communication address: 8-bit binary address
Function	Function code: 8-bit binary address
DATA (n-1)	Contents of data: N × 8-bit data, N ≤ 16
…….	
DATA 0	
CRC CHK Low	CRC checksum: one 16-bit CRC checksum consists of two 8-bit binary codes
CRC CHK High	
END	Maintains no input signal for at least 10 ms

Communication address (Address)

00H: broadcasts to all Power Regenerative Units
01H: targets the Power Regenerative Unit at address 01
0FH: targets the Power Regenerative Unit at address 15
10H: targets the Power Regenerative Unit at address 16
... to the maximum of 254 (FEH)

Function code and data characters

03H: reads data from the register
06H: writes one set of data to the register

For example, reading two continuous data from register address 2102H. The Power Regenerative Unit address is 01H.

ASCII mode:

Inquiry message string format

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Starting address	‘2’
	‘1’
	‘0’
	‘2’
Number of data (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘D’
	‘7’
END	CR
	LF

Response message string format

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Number of data (count by byte)	‘0’
	‘4’
Content of starting address 2102H	‘1’
	‘7’
	‘7’
	‘0’
Content of address 2103H	‘0’
	‘0’
	‘0’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Inquiry message string format

Address	01H
Function	03H
Starting data address	21H
	02H
Number of data (count by world)	00H
	02H
CRC CHK Low	6FH
CRC CHK High	F7H

Response message string format

Address	01H
Function	03H
Number of data (count by byte)	04H
Content of data address 2102H	17H
	70H
Content of data address 2103H	00H
	00H
CRC CHK Low	FEH

CRC CHK High	5CH

06H: single write, write single data to a register. (The system can write up to 20 sets of data simultaneously.)

For example, writing data 6000 (1770H) to register 0100H. The Power Regenerative Unit address is 01H.

ASCII mode:

Inquiry message string format

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

Response message string format

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Data address	'0'
	'1'
	'0'
	'0'
Data content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Inquiry message string format

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

Response message string format

Address	01H
Function	06H
Data address	01H
	00H
Data content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

10H: write multiple registers (write multiple data to registers).Checksum in ASCII mode (LRC Check)

Checksum (LRC Check) is the sum from Address to Data Content. For example, the checksum of the inquiry message above: 01H + 03H + 21H + 02H + 00H + 02H = 29H, and then take the 2's complement = D7H.

Checksum in RTU mode (CRC Check)

Checksum starts from Address and ends at Data content. The calculation is shown below.

Step 1: Set the 16-bit register (CRC register) = FFFFH.

Step 2: Exclusive OR the first 8-bit byte message and the low bit 16-bit CRC register, create Exclusive OR, and store the results in CRC register.

Step 3: Shift one CRC register to the right, and fill in 0 high bit position.

Step 4: Check the shifted value. If it is 0, store the new value from Step 3 in the CRC register; otherwise, Exclusive OR A001H and the CRC register store the results in the CRC

register.

Step 5: Repeat Steps 3–4, until all eight bits are complete.

Step 6: Repeat Step 2–5, and take the message command from the next 8-bit byte until all message commands are computed. Finally, the acquired value in the CRC register is the CRC checksum. Note that the CRC checksum must alternate places within the message command checksum.

The following is an example of computing the CRC checksum using C language.

```
unsigned char* data     ← // message command index
unsigned char length    ← // length of message command
unsigned int crc_chk(unsigned char* data, unsigned char length)
   {
   int j;
   unsigned int reg_crc=0Xffff;
   while(length--){
      reg_crc ^= *data++;
      for(j=0;j<8;j++){
      if(reg_crc & 0x01){    /* LSB(b0)=1 */
         reg_crc=(reg_crc>>1) ^ 0Xa001;
      }else{
         reg_crc=reg_crc >>1;
      }
   }
}

return reg_crc;                          // final value returned to CRC register
```

4. Definition of parameter addresses in the communication protocol

Definition of REG2000 parameters	Parameter address (GGnnH)	Function Description GG stands for the parameter group and nn stands for the parameter number. For example: Pr.04-01 is shown as 0401H.		Read/ Write
Command/ Write only	2000H	bit 1–0	00: No function (operation command remains unchanged)	W
			01: Stop	W
			10: Start	W
		bit 15–3	No function	N/A
	2001H	No function		N/A
	2002H	bit 0	1: Enable the external fault (E.F.)	W
		bit1	2: Reset Command	W
		bit 5–2	No function	N/A
Status monitor/ Read only	2100H	bit7–0	High Byte: Error Code	R
		bit15–8	Low Byte: Warning Code	R
	2110H	bit7–0	Identity code of the Power Regenerative Unit (same as Pr.00-00)	R
		bit15–8	Product model ID (REG2000 code: 14)	R
	2112H	bit15–0	Firmware version (high word, SX.XX) S: 0–9, Defined by Delta X.XX: 0.00–9.99, REG firmware version #	R

Definition of REG2000 parameters	Parameter address (GGnnH)	Function Description GG stands for the parameter group and nn stands for the parameter number. For example: Pr.04-01 is shown as 0401H.		Read/ Write
	2119H	bit 1–0	00: Ready	R
			01: Run	
			10: Prepare	
			11: Regenerate	
		bit 9–2	Reserved	N/A
		bit10	REG operation command source 1: Operation commands come from the external terminals 2: Control commands come from the communication interface or the digital keypad (KPC-CC01).	R
		bit11	Unlock or lock the parameters 0: Unlock the parameters 1: Lock the parameters	R
		bit15–12	Reserved	N/A
Status monitor/ Read only	2102H	bit15–0	Mains electricity frequency (Hz)	R
	2116H	bit15–0	Select multi-function display (Pr.01-14)	R
	2200H	bit15–0	Output current (A_{AC})	R
	2203H	bit15–0	DC BUS voltage (V_{DC})	R
	2204H	bit15–0	Output voltage (V_{AC})	R
	2206H	bit15–0	Output power (kW)	R
	220EH	bit15–0	Internal temperature (air outlet) (℃)	R
	220FH	bit15–0	Power module's temperature (℃)	R
	2210H	bit15–0	Digital input ON/OFF status, see Pr.02-06	R
	2211H	bit15–0	Digital output ON/OFF status, see Pr.02-10	R
	2222H	bit15–0	Cooling fan rotation speed (%)	R
	2229H	bit15–0	Display REG2000 regenerated kWh in low word.	R
	222AH	bit15–0	Display REG2000 regenerated kWh in high word.	R
	2237H	bit15–0	Display current upper limit (p)	R

5. Additional response in communication errors

If an error occurs when the Power Regenerative Unit is making communication connections, the Power Regenerative Unit sends an error code to the main control system and sets the highest bit (bit 7) to 1 (that is, Function code AND 80H) to make the main control system aware of the error. The Power Regenerative Unit keypad displays a warning message CE-XX, where XX is the error code. Refer to the error code definitions in communication errors in the table below.

For example

ASCII mode

STX	':'
Address	'0'
	'1'
Function	'8'
	'6'
Exception code	'0'

RTU mode

Address	01H
Function	86H
Exception code	02H
CRC CHK Low	C3H
CRC CHK High	A1H

	'2'
LRC CHK	'7'
	'7'
END	CR
	LF

Error code definitions

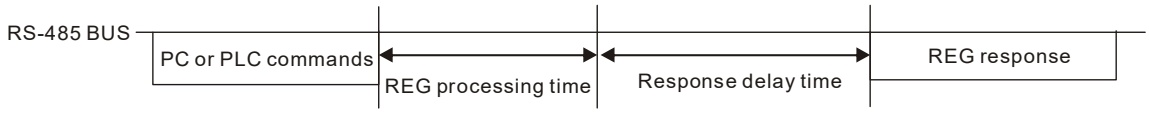
Error code	Description
1	Data character value error: the value is too large and is not recognized by the Power Regenerative Unit.
2	Parameter address error: parameter address is not recognized by the Power Regenerative Unit.
3	Password locked: cannot edit the parameters
4	Parameters cannot be edited in operation
10	Transmission time-out

04-05 Communication response delay time

Default: 2.0

Settings 0.0–200.0 ms

Sets the delay for the Power Regenerative Unit response time in situations where the host machine has not completed the transition (transmission–reception).



04-06 Reserved

05 Application Parameters

✎You can set this parameter during operation.

✎ 05-00 DC BUS voltage filter time

Default: 0.000

Settings 0.000–65.535 sec.

🕮 Sets the filter time to adjust DC BUS voltage. The higher the value, the better the filter result. This may affect control performance, so it normally does not need adjustment.

✎ 05-01 Mains frequency filter time

Default: 0.010

Settings 0.000–65.535 sec.

🕮 Sets the mains frequency filter time which normally does not need adjustment.

05-02 – 05-20 Reserved

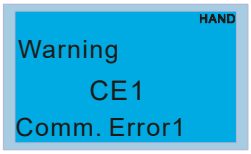
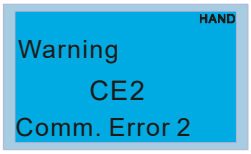
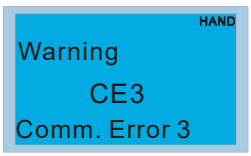
08 Warnings and Error Codes

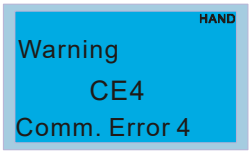
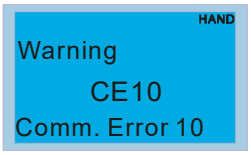
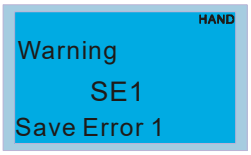
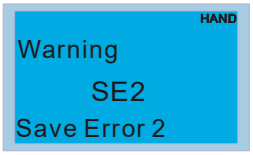
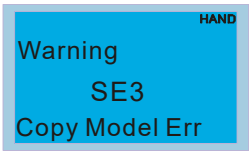
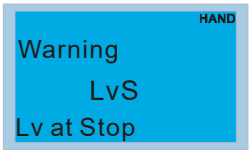
This chapter contains information on the optional digital keypad display (KPC-CC01/KPC-CE01). If you did not purchase the optional digital keypad, you can find out about error signals through the RS-485 communication interface.

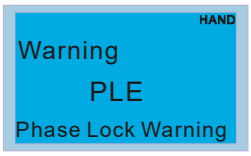
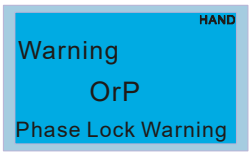
※ When a Power Regenerative Unit is at STOP, it is between the Ready status and the Run status (see Section 4-4 Display Panel Indicators for the definition of different working status of power regeneration).
※ This chapter helps on-site technicians with troubleshooting. If the warning/error remains after following the corrective actions, contact a local dealer near you or Delta to return this product.

Warnings Codes

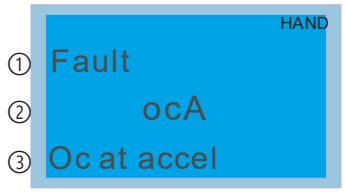
① Display error type
② Display error code (abbreviation)
This error code is the same as displayed on the digital controller (KPC-CE01)
③ Display error description

ID #	LCM panel display	Description
1		Communication Warning 1: Illegal communication command Corrective Action ☑ Verify that the communication wring is correct (see Section 4-3). ☑ Verify that the related parameter settings are in the correct setting ranges (see Chapter 07 Descriptions of Parameter Settings). Press the RESET button after verifying the above items. If the warning message still appears, contact a local dealer near you or Delta to return this product.
2		Communication Warning 2: Illegal communication data address Corrective Action ☑ Verify that the communication wring is correct. ☑ Verify that the communication command is correct. Press the RESET button after verifying the above items. If the warning message still appears, contact a local dealer near you or Delta to return this product.
3		Communication Warning 3: Illegal communication data value Corrective Action ☑ Verify that the communication wiring is correct. ☑ Verify that the communication command is correct. Press the RESET button after verifying the above items. If the warning message still appears, contact a local dealer near you or Delta to return this product..

4		Communication Warning 4: Data written to read-only addresses Corrective Action ☑ Verify that the communication wiring is correct. ☑ Verify that the communication command is correct Press the RESET button after verifying the above items. If the warning message still appears, contact a local dealer near you or Delta to return this product.
5		Communication Warning 10: Modbus transmission time-out Corrective Action ☑ Verify that the communication wiring is correct. ☑ Verify that there is any noise interference. Press the RESET button after verifying the above items. If the warning message still appears, contact a local dealer near you or Delta to return this product.
7		Keypad copy parameter warning 1: Errors during copying which include communication delay, communication error and parameter value error. Corrective Action ☑ Verify that the communication wiring is correct. Press the RESET button after verifying the above item. If the warning message still appears, contact a local dealer near you or Delta to return this product.
8		Keypad copy parameter warning 2: Keypad copy completes but there is still a parameter writing error. Corrective Action ☑ Verify that the communication wiring is correct. Press the RESET button after verifying the above item. If the warning message still appears, contact a local dealer near you or Delta to return this product.
11		Keypad copy parameter warning 3: The copied parameters do not match the Power Regenerative Unit model. Corrective Action ☑ Verify that the model number and model name saved in the keypad match the model number and model name in the copied parameters. Press the RESET button after verifying the above item. If the warning message still appears, contact a local dealer near you or Delta to return this product.
12		Low DC voltage warning: In either the Ready status or the Run status, the Power Regenerative Unit DC BUS voltage (V_{DC}) is lower than the setting value in Pr.03-00. For 440V series when V_{DC} ≤ 360 V and for 220 series when V_{DC} ≤ 180 V, this warning message appears.

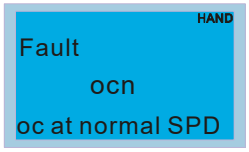
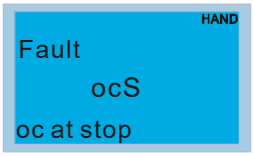
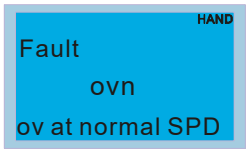
		Corrective Action ☑ Verify that the mains voltage is normal ☑ Verify that the mains three-phase wiring is correct. When the V_{DC} is greater than the setting in Pr.03-00 (+30/60 V), this warning message appears and the system automatically resets. If the warning message still appears after verifying the above items, contact a local dealer near you or Delta to return this product.
13		Phase lock warning: In either the Ready status or the Run status, the mains electricity frequency is not between 47–63 Hz (see Mains Frequency Range in Chapter 03 Specification) and the deviation time is longer than the setting in Pr.03-04. Corrective Action ☑ Verify that the mains frequency is normal. ☑ Verify that the mains three-phase wiring is correct. When the Power Regenerative Unit executes the phase-lock again, the system automatically resets. If the warning message still appears after verifying the above items, contact a local dealer near you or Delta to return this product.
14		Phase loss warning: In the Ready status or the Run status, the three-phase mains power loses one or two phases. Corrective Action ☑ Verify that the mains three-phase voltages are similar. ☑ Verify that the mains three-phase wiring is correct. When the voltage of the mains is back to normal, the system automatically resets. If the warning message still appears after verifying the above items, contact a local dealer near you or Delta to return this product.

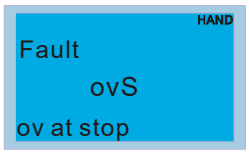
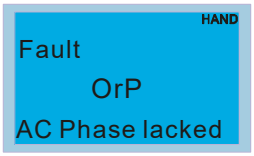
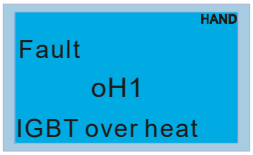
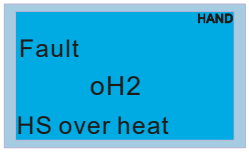
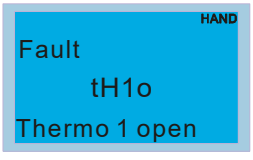
Error Codes

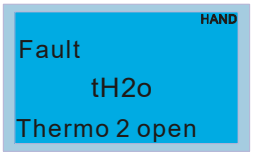
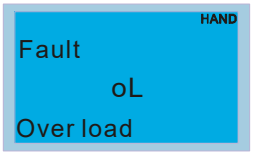
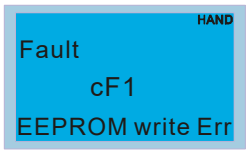
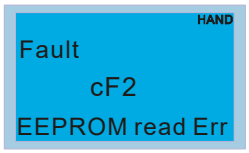
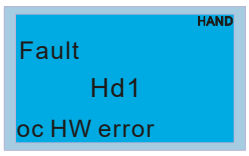
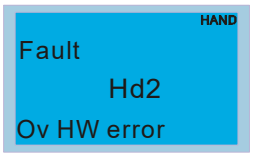


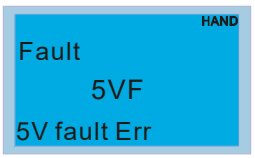
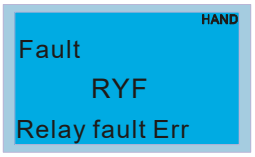
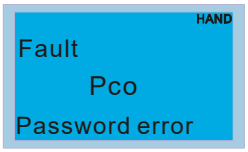
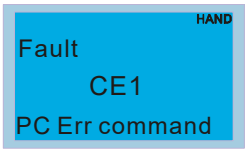
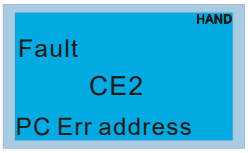
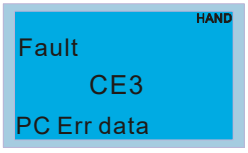
① Display error type
② Display error code (abbreviation)
This error code is the same as displayed on the digital controller (KPC-CE01)
③ Display error description

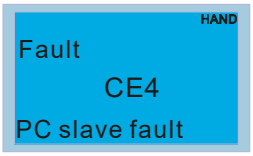
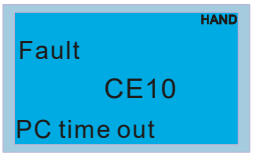
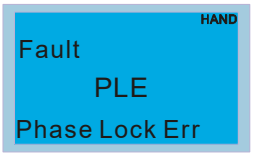
*: In accordance with the setting value in Pr.00-20–Pr.00-25

ID #	LCM panel display	Description
3		Over-current during regeneration; input current exceeds 2.4 times the Power Regenerative Unit rated current. Corrective Action ☑ Check for any poor wiring insulation. ☑ Increase the DC BUS voltage operating level (see Pr.01-08) ☑ Verify that you chose the right Power Regenerative Unit. See Chapter 10 Power Regenerative Unit Selection for more information. ☑ Check for any unusual voltage surge or phase loss at the mains side. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
6		Over-current occurs in the Ready status or the Run status, or hardware circuit error occurs in output current detection. Corrective Action ☑ Check for any poor wiring insulation. ☑ Check for any unusual voltage surge or phase loss at the mains side. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
9		While regenerating, the Power Regenerating Unit detects over-voltage on the high-voltage end of the internal DC voltage. For 440V series when V_{DC} ≥ 820 V and for 220 series when V_{DC} ≥ 410 V, this warning message appears. Corrective Action ☑ Check the power supply wiring between terminals R, S, T for poor insulation or phase loss. ☑ Check that the input voltage is in the Power Regenerative Unit voltage rated range, and monitor for voltage surges. ☑ Lower the DC BUS voltage activation level (Pr.01-08) or increase the current limit (Pr.03-01). ☑ If there is a voltage surge, there may be a phase lead capacitor switch in the same power supply system that causes an abnormal rise in input voltage. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.

10		Over-voltage occurs in the Ready status or the Run status, or hardware circuit error occurs in voltage detection. Corrective Action ☑ Check that the input voltage is in the Power Regenerative Unit voltage rated range, and monitor for voltage surges. ☑ If there is a voltage surge, there may be a phase lead capacitor switch in the same power supply system that causes an abnormal rise in input voltage. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
15		While regenerating, the three-phase main power loses one or two phases. Corrective Action ☑ Verify that the mains three-phase voltages are similar. ☑ Verify that the mains three-phase wiring is correct. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
16		The Power Regenerative Unit detects a temperature higher than the protection level in the power module (see Pr.00-25 in Chapter 07). Corrective Action ☑ Check if the ambient temperature is too high. ☑ Check for foreign objects in the heat sink, and if the fan is operating. ☑ Check that there is enough ventilation space near the Power Regenerative Unit. After verifying the above items, stop running the unit, wait for ten minutes, and then press the RESET button. If the error message still appears, contact a local dealer near you or Delta to return this product.
17		The Power Regenerative Unit detects an internal (air outlet) overheat higher than the protection level. (This error message appears only when the air outlet temperature for the REG370A23A/REG450A43A/REG550A43A models is higher than 80ºC.) Corrective Action ☑ Check if the ambient temperature is too high. ☑ Check for foreign objects in the heat sink, and if the fan is operating. ☑ Check that there is enough ventilation space near the Power Regenerative Unit. After verifying the above items, stop running the unit, wait for ten minutes, and then press the RESET button. If the error message still appears, contact a local dealer near you or Delta to return this product.
18		The Power Regenerative Unit detects a temperature lower than normal (lower than -30ºC) at the power module or a circuit error in temperature. Corrective Action Increase the temperature and press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near

		you or Delta to return this product.
19		The Power Regenerative Unit detects a temperature lower than normal (lower than -30ºC) at the power module or a circuit error in temperature. Corrective Action Increase the temperature and press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
21		Output current (AC) exceeds the Power Regenerative Unit allowed rated current. (See REG2000 Performance Curve in Chapter 03 for the duration (seconds) of output current in the allowable range.) Corrective Action ☑ Verify that you chose the right Power Regenerative Unit. See Chapter 10 Power Regenerative Unit Selection for more information. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return this product.
30		Memory write error Corrective Action Press the RESET button to restore the system to the default setting. If the error message still appears, contact a local dealer near you or Delta to return this product.
31		Memory read error Corrective Action Press the RESET button to restore the system to the default setting. If the error message still appears, contact a local dealer near you or Delta to return this product.
37		OC protection hardware circuit error Corrective Action Current detection error at first power-on. This error cannot be reset. Shut down the system and then turn the power back on. If the error message still appears, contact a local dealer near you or Delta to return this product.
38		OV protection hardware circuit error Corrective Action Voltage detection error at first power-on. This error cannot be reset. Shut down the system and then turn the power back on. If the error message still appears, contact a local dealer near you or Delta to return this product.

42		Power supply (5V) on control board error Corrective Action Shut down the system and then turn the power back on. Wait for at least five seconds, make sure the supply power is normal, and then reset this error. If the error message still appears, contact a local dealer near you or Delta to return this product.
43		Relay error Corrective Action Press the RESET button to return the system to the default setting. If the error message still appears, contact a local dealer near you or Delta to return the product.
49		External command causes external fault (EF) and closes terminal (MOx). The Power Regenerative Unit stops output. Corrective Action Press the RESET button after clearing the faults. If the error message still appears, contact a local dealer near you or Delta to return the product.
52		Password entered incorrectly for three consecutive times Corrective Action ☑ See Pr.01-02 and Pr.01-03. ☑ Shut down the system and then turn the power back on to enter the correct password.
54		Illegal communication command Corrective Action ☑ Verify that the communication wring is correct. ☑ Check if communication commands are correct (communication commands must be 03, 06, 10, 63). Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return the product.
55		Illegal communication address (00H–254H) Corrective Action ☑ Verify that the communication wring is correct. ☑ Check if the address of communication data is correct. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return the product.
56		Illegal communication data value Corrective Action ☑ Verify that the communication wring is correct. ☑ Check if the communication data value exceeds the maximum / minimum values (see Chapter 07). Press the RESET button after verifying the above items. If the error

		message still appears, contact a local dealer near you or Delta to return the product.
57		Data written to read-only addresses Corrective Action ☑ Verify that the communication wring is correct. ☑ Check that the communication address is correct. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return the product.
58		Modbus transmission time-out Corrective Action ☑ Verify that the communication wring is correct. Press the RESET button after verifying the above item. If the error message still appears, contact a local dealer near you or Delta to return the product.
66		While regenerating, the mains electricity frequency is not between 47–63 Hz (see Mains Frequency Range in Chapter 03 Specification) and the deviation time is longer than the setting in Pr.03-04. Corrective Action ☑ Verify that the mains frequency is normal. ☑ Verify that the mains three-phase wiring is correct. Press the RESET button after verifying the above items. If the error message still appears, contact a local dealer near you or Delta to return the product.

09 Usage Recommendations and Troubleshooting

The Power Regenerative Unit has various warnings and protections against errors such as over-voltage, low voltage, or over-current. Once an error occurs, the protections activate, the Power Regenerative Unit stops output and activates the error contacts. Please refer to the error display from the Power Regenerative Unit and look up the corresponding causes and solutions. The fault record is stored in the Power Regenerative Unit internal memory and can store the six most recent error messages. You can read it from the digital keypad or through the communications by accessing the parameters.

The Power Regenerative Unit includes a large number of electronic components, including ICs, resistors, capacitors, transistors, cooling fans and relays. These components do not last forever. Even under normal circumstances, they will eventually become error-prone if used past their lifespans. Therefore, you must perform periodic preventive maintenance to identify defective and worn out parts, and eliminate the causes of malfunctions in the Power Regenerative Unit at an early stage. At the same time, parts that have exceeded their product life should be replaced whenever possible to ensure safe operation.

Visual checks should be done regularly to monitor the unit's operation, and to make sure nothing unusual happens. Check the situations listed in the following table.

 CAUTION	☑ After an error occurs, the error must be cleared for at least five seconds before the RESET key is enabled. ☑ The Power Regenerative Unit must first be switched off for at least five minutes for ≤ 22 kW models, and 10 minutes for ≥ 30kW models until the charging indicator turns off, and the DC voltage between terminals ⊕–⊖ must be lower than 25 V before it is safe to open the cover to begin maintenance operations. ☑ Only qualified personnel can work on maintenance or replace parts. (Remove metal items such as watch, rings, and other metal items before operation, and use only insulated tools.) ☑ Never modify the Power Regenerative Unit in any way. ☑ The performance and the surrounding environment should meet the standard specifications. There should be no abnormal noise, vibration, or odor.

9-1 Regular Maintenance

For regular maintenance, first stop operation, then turn off the power, and then take off the outer cover. Even after turning off the power supply, charging voltages remaining in the filter capacitor require some time to discharge. To avoid danger, operation must not start until the charging indicator goes off, and you confirm the voltage with a voltmeter to be below the safety value (≤ 25 V_{DC}).

Ambient environment

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration, and check for any dust, gas, oil, water drops, and so on.	Visual inspection and measuring instruments	○		
Are dangerous or abnormal objects such as tools in the surrounding area?	Visual inspection	○		

Voltage

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are the main circuit and control circuit voltages normal?	Measure with a multimeter	○		

Keypad display panel

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are the displays clear for reading?	Visual inspection	○		
Are there any missing characters?	Visual inspection	○		

Mechanical parts

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there abnormal sounds or vibrations?	Visual and auditory inspection	○	○	
Are any bolts (or other fastening pieces) loose?	Securely tighten	○	○	
Are any parts deformed or damaged?	Visual inspection	○	○	
Is there any discoloration due to overheating?	Visual inspection	○	○	
Is there any dust or dirt?	Visual inspection	○	○	

Main circuit

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are any bolts loose or missing?	Securely tighten	○		
Is the machine or insulator deformed, cracked, damaged, or discolored due to overheating and aging?	Visual inspection		○	
Is there any dust or dirt?	Visual inspection		○	

Main circuit terminal and wiring

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are the terminals and copper plates deformed or discolored due to overheating?	Visual inspection		○	
Is any wire insulation damaged or discolored?	Visual inspection		○	

Main circuit terminal block

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Is there any damage?	Visual inspection	○		

Main circuit filter capacitor

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there any liquid leaks, discoloration, cracks, or shell expansions?	Visual inspection	○		
Are the safety valves released? Are the valve bodies significantly expanded?	Visual inspection	○		
Measure electrostatic capacity as required		○		

Main circuit resistor

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there abnormal odors or cracks in the insulator due to overheating?	Visual inspection, smell	○		
Are there broken wires?	Visual inspection	○		
Are the connection joints damaged?	Measure the resistance with a multimeter	○		

Main circuit transformer and reactor

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there abnormal vibrating noises or odors?	Visual inspection, auditory, smell	○		

Main circuit electromagnetic contactor and relay

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Is there a vibrating noise during operation?	Auditory inspection	○		
Are the contacts well connected?	Visual inspection	○		

Control circuit control printed circuit board and connector

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there any loose screws or connectors?	Securely tighten		○	
Are there any abnormal odors or discoloration?	Smell, visual inspection		○	
Are there cracks, damages, deformations, or obvious corrosions?	Visual inspection		○	
Are there signs of leakage or deformation in the capacitors?	Visual inspection		○	

Cooling system cooling fan

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are there abnormal sounds or vibrations?	Auditory, visible inspection, and turn the fan by hand (turn off the power before operation) to see if it rotates smoothly.		○	
Are any bolts loose?	Securely tighten		○	
Is there any discoloration due to overheating?	Visual inspection		○	

Cooling system ventilation channel

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Are heat sinks or vents blocked or obstructed with abnormal objects?	Visual inspection		○	

NOTE

Use a chemically neutral cloth for cleaning and use dust cleaner to remove dust when necessary.

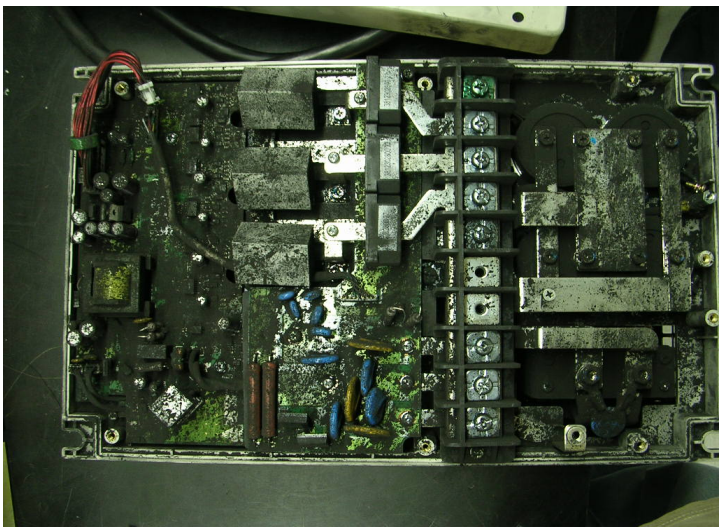
9-2 Greasy Dirt Problems

Serious greasy dirt problems generally occur in processing industries such as machine tools, punching machines and so on. Please be aware of the possible damages that greasy oil may cause to your Power Regenerative Unit.

1. Electronic components that silt up with greasy oil may cause the Power Regenerative Unit to burn out or even explode.
2. Most greasy dirt contains corrosive substances that may damage the Power Regenerative Unit.

Solution

Install the Power Regenerative Unit in a dedicated cabinet to keep it away from greasy dirt. Clean and remove greasy dirt regularly to prevent damage to the unit.



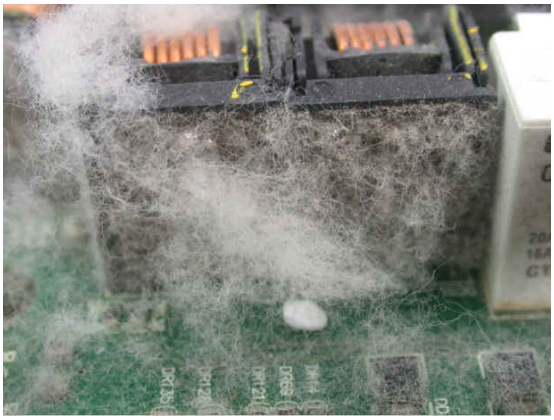
9-3 Fiber Dust Problems

Serious fiber dust problems generally occur in the textile industry. Please be aware of the possible damages that fiber may cause to your Power Regenerative Unit.

1. Fiber that accumulates or adheres to the fans leads to poor ventilation and causes overheating problems.
2. Plant environments in the textile industry have higher degrees of humidity that may cause the Power Regenerative Unit to burn out, become damaged or explode due to wet fiber dust adhering to the devices.

Solution

Install the Power Regenerative Unit in a dedicated cabinet to keep it away from fiber dust. Clean and remove fiber dust regularly to prevent damage to the unit.



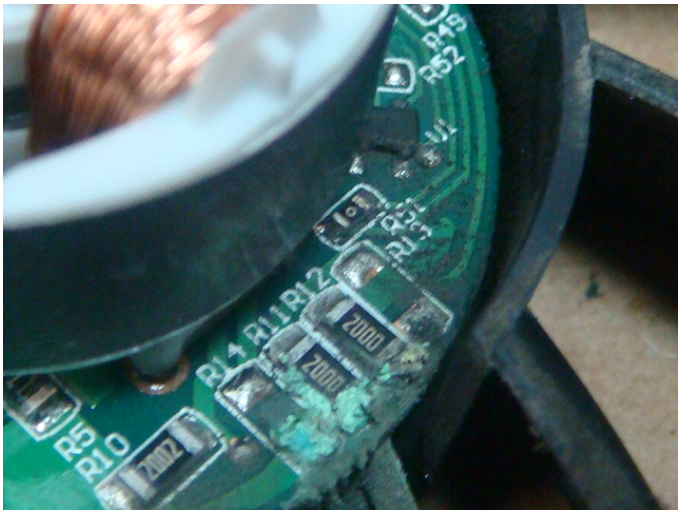
9-4 Corrosion Problems

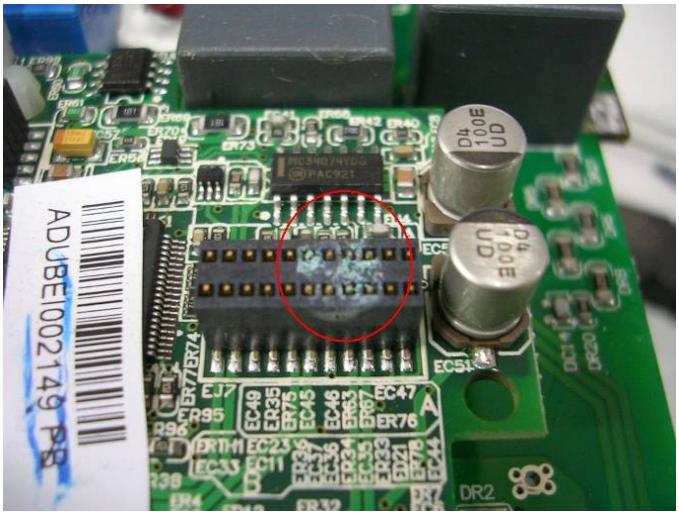
Corrosion problems may occur if any fluids flow into the Power Regenerative Units. Please be aware of the possible damages that corrosion may cause to your Power Regenerative Unit.

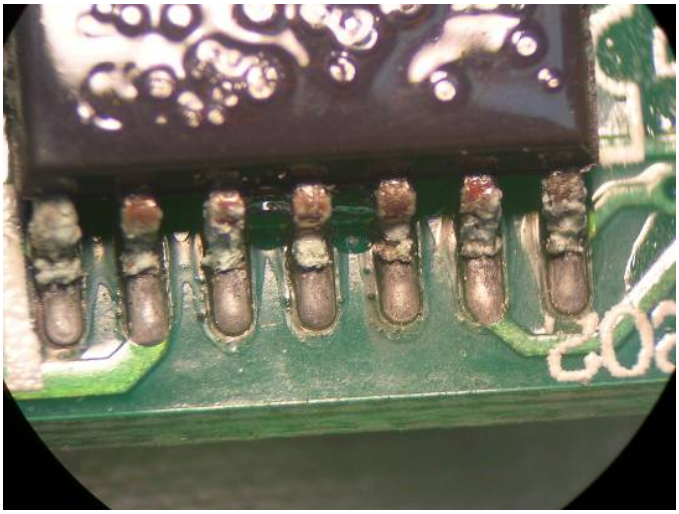
1. Corrosion of internal components may cause the unit to malfunction and possibility to explode.

Solution

Install the Power Regenerative Unit in a dedicated cabinet to keep it away from fluids. Clean the unit regularly to prevent corrosion.







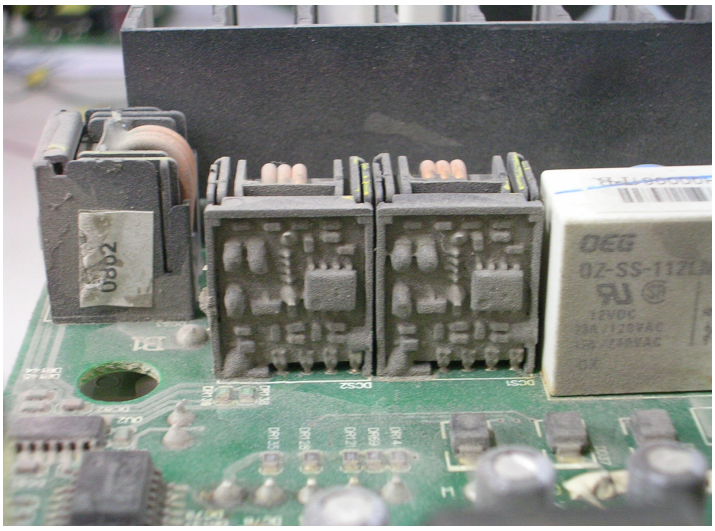
9-5 Industrial Dust Problems

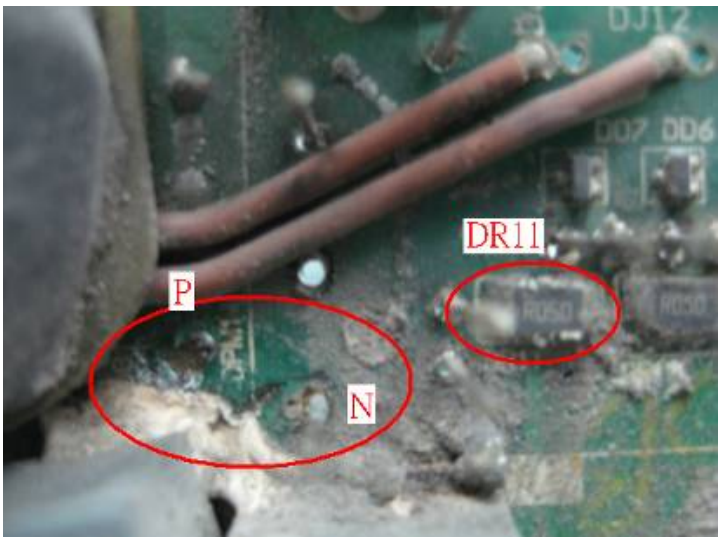
Serious industrial dust pollution frequently occur in environments such as stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damages that industrial dust may cause to your Power Regenerative Unit.

1. Dust accumulating on electronic components may cause overheating problem and shorten the service life of the Power Regenerative Unit.
2. Conductive dust may damage the circuit board and may even cause the unit to explode.

Solution

Install the Power Regenerative Unit in a dedicated cabinet and cover the unit with a dust cover. Clean the cabinet and ventilation holes regularly for good ventilation.





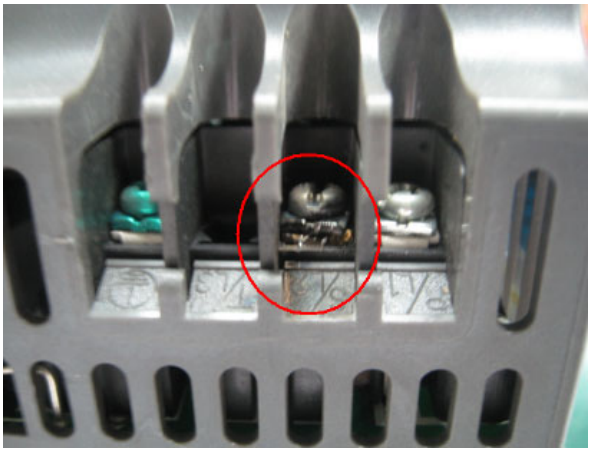
9-6 Installation and Wiring Problems

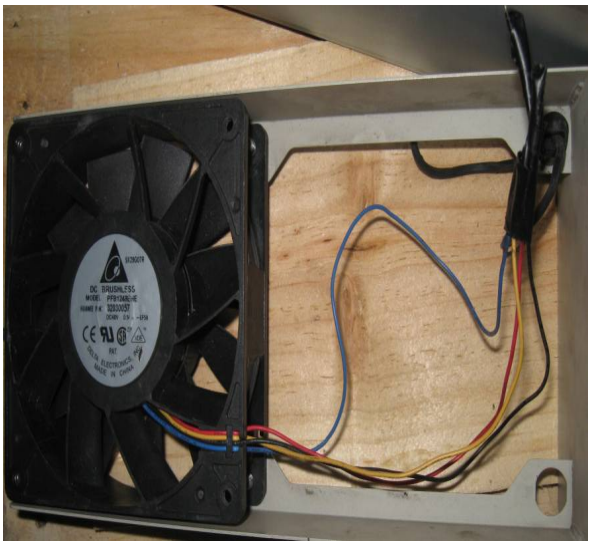
When wiring the Power Regenerative Unit, the most common problem is incorrect wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your units.

1. If screws are not fully tightened, then sparking may occur as impedance increases.
2. If you have opened the unit and modified the internal circuit board, the internal components may have been damaged.

Solution

Ensure that all screws are tightened when installing the Power Regenerative Unit. If the unit functions abnormally, send it back to Delta for repair. DO NOT try to modify or repair the internal components or wiring.





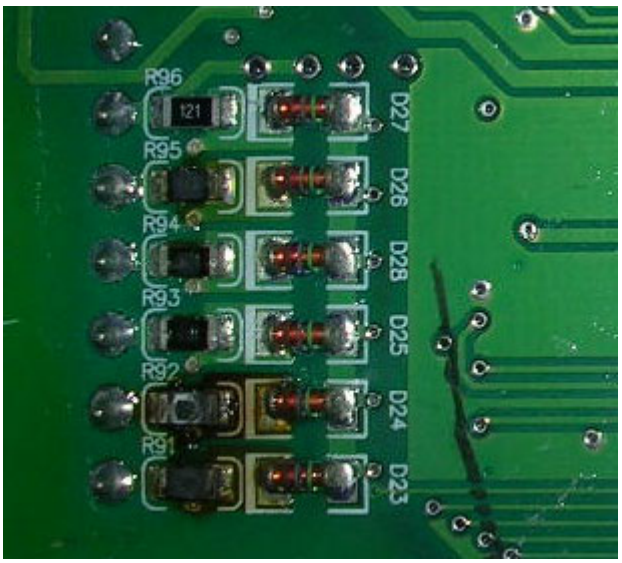
9-7 Multi-function Input/Output Terminal Application Problems

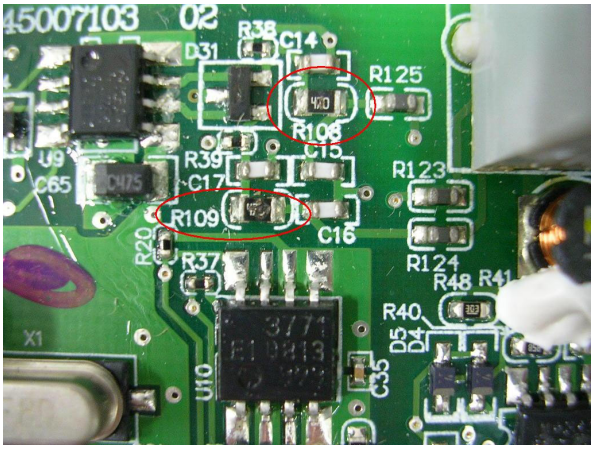
Multi-function input/output terminal errors are generally caused by over-usage of the terminals and not following the specifications. Please be aware of the possible damages that multi-function input/output terminal errors may cause to your Power Regenerative Unit.

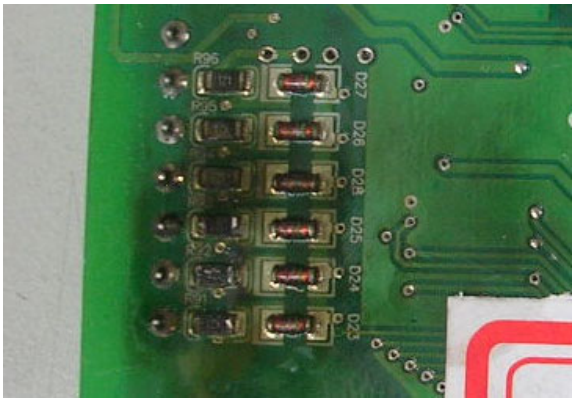
1. Input/output circuit may burn out when the terminal usage exceeds the specified limit.

Solution

Refer to the user manual for multi-function input output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.







10 Power Regenerative Unit Selection

Delta offers four ways to select a REG2000 model.

A. Select the model based on the brake resistor specifications. Select the model according to the applications that require rapid acceleration and deceleration, such as tapping, drilling machines, and lathes.
B. Select the model based on the drive's overload ability. A servo drive has a higher overload ability than an AC motor drive. So select the model that has a larger capacity if you use the servo drive.
C. Select the model based on the application load characteristics. Calculate the regenerated power for the applications using the application's system characteristics and specifications, especially for elevator and hoist application.
D. Use the Delta REG2000 Sizing Wizard:

   中文: http://deltavfdsizingtool.deltaww.com/REG2000/TC/index.html

   ENGLISH: http://deltavfdsizingtool.deltaww.com/REG2000/EN/index.html

This chapter describes the first three model selection methods in more detail.

Model selection method 1 (based on the brake resistor specifications)

Take 220 V as an example; if you select a 1500 W 13 Ω brake resistor with brake level set to 380 V, then the total braking current would be 380 V / 13 Ω = 29 A.

DC power equals to AC power, that is, $V_{DC} * I_{DC} = \sqrt{3} * V_{AC} * I_{AC}$.

V_{AC} is AC voltage

I_{AC} is AC current

V_{DC} is DC voltage

I_{DC} is DC current

For example, $I_{AC} = (V_{DC} * I_{DC}) / (\sqrt{3} * V_{AC}) = (380*29) / (\sqrt{3} * 220) = 28.9$ A.

The brake resistor's braking torque is 125% at 10% ED, and REG2000 is 150% at 10% ED; therefore, you can make your selection using the REG2000's current at 150% in the following tables. In this example, you can select REG075A23A-21, as the current at 150% of 30 A > total braking current of 28.9 A.

230V Series

Frames		A		B			C	
Model REG_ _ _A23A-21		075	110	150	185	220	300	370
Rated Power (kW)		7.5	11	15	18.5	22	30	37
Mains	Input current (A)	20	32	38	49	60	80	100
	Input current at 150%	30	48	57	73.5	90	120	150

460V Series

Frames		A			B			C		
Model REG_ _ _A43A-21		075	110	150	185	220	300	370	450	550
Rated Power (kW)		7.5	11	15	18.5	22	30	37	45	55
Mains	Input current (A)	10.5	17	20	25	32	43	49	60	75
	Input current at 150%	15.8	25.5	30	37.5	48	64.5	73.5	90	112.5

*Please contact Delta if the required current exceeds the units listed above.

Model selection method 2 (based on the drive's overload ability)

Select the model based on the drive's overload ability. The table below is an example for the C2000 using with REG2000 when the condition is 10% ED and the maximum regenerated working time during one cycle is 10 seconds. The overload ability of C2000 is 160% 3 seconds and 120% 60 seconds based on the rated output current.

Voltage	10% ED 10 seconds		
220 V	Drive	REG selection	
	kW	Model	Quantity
	0.7	REG075A23A	1
	1.5	REG075A23A	1
	2.2	REG075A23A	1
	3.7	REG075A23A	1
	5.5	REG075A23A	1
	7.5	REG075A23A	1
	11	REG110A23A	1
	15	REG110A23A	1
	18	REG150A23A	1
	22	REG185A23A	1
	30	REG220A23A	1
	37	REG300A23A	1
	45	REG370A23A	1
	55	Please contact Delta Electronics	-
	75		
	90		

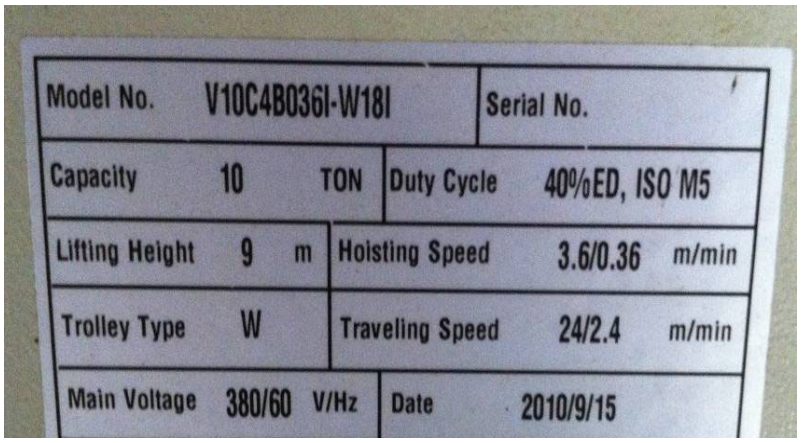
Voltage	10% ED 10 seconds		
440 V	Drive	REG selection	
	kW	Model	Quantity
	0.7	REG075A43A	1
	1.5	REG075A43A	1
	2.2	REG075A43A	1
	3.7	REG075A43A	1
	4	REG075A43A	1
	5.5	REG075A43A	1
	7.5	REG075A43A	1
	11	REG075A43A	1
	15	REG110A43A	1
	18	REG150A43A	1
	22	REG185A43A	1
	30	REG220A43A	1
	37	REG300A43A	1
	45	REG370A43A	1
	55	REG450A43A	1
	75	REG550A43A	1
	90	Please contact Delta Electronics	-
	110		
	132		
	160		
	185		
	220		
	280		
	315		
	355		

Model selection method 3 (based on the application load characteristics)

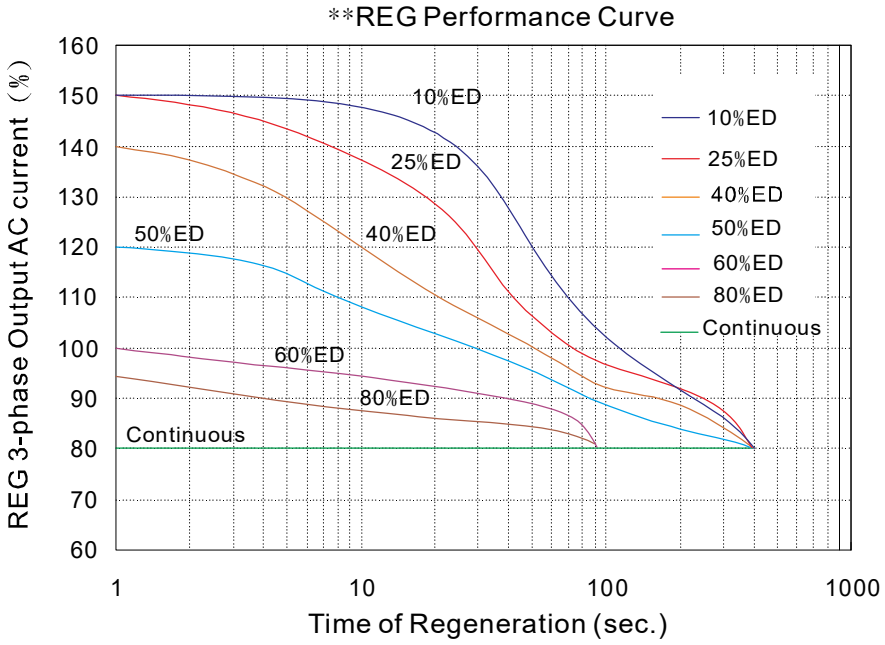
Crane/Hoist Application

The equipment weighs 10 tons, drive model: VFD075CH43A, with a 5.5 kW motor.

From the crane's specification we know



1. In high speed operation, the time it takes from top to bottom is 9 (m)/3.6 (m/min) = 2.5 (min) = 150 (sec).
2. Assuming the motor efficiency is 85%, the mechanical efficiency is 85%, and the drive and the REG2000's efficiencies are both 95%, the useful power output would be 5.5 kW*0.85^2*0.95^2 = 3.57 kW.
3. When using the REG2000, and the mains voltage is 380 V, the current would be 3.57 kW/(sqrt(3)*380 V) = 5.4 A.
4. From the table below, at 40% ED, and a working duration of 150 seconds, the output current must be lower than 90% of the rated current to avoid overload.



※ The diagram above shows the testing result by combining REG and a DC choke.

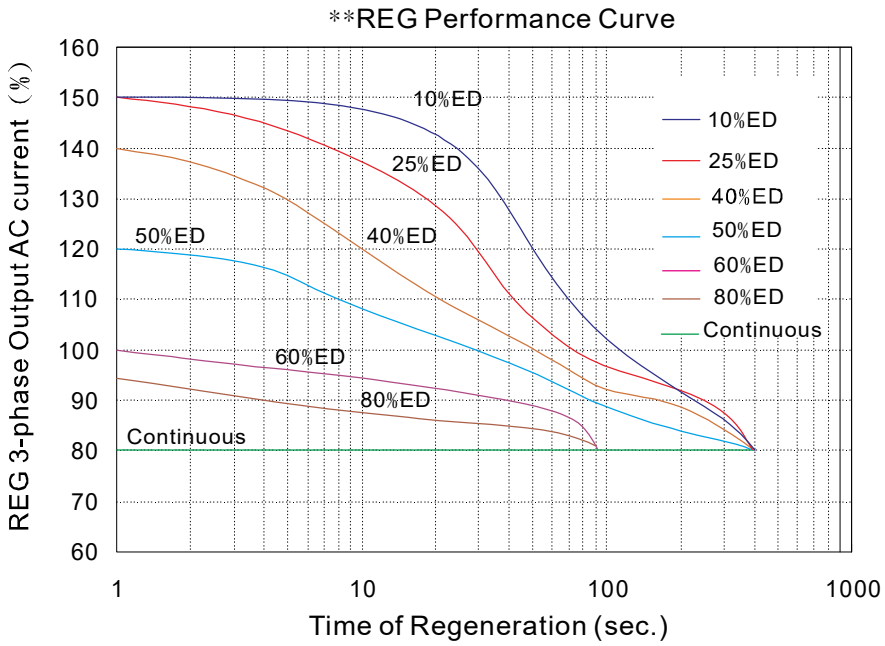
📖 Definition of ED%: See Chapter 03 Specifications.

5. From the specification sheet, the REG075A43A-21 rated current is 10.5 A, and 10.5 A*90% = 9.45 A > 5.4 A; therefore, in this case, you can select the REG075A43A-21.

Elevator Application

For this example, take an elevator with two tons of working load, a speed of 60 m/min, floors from B1–4F, using 22 kW motor, and a counterweight of 48%.

1. The elevator takes 30 seconds to reach floor 4F from B1, and the whole trip takes 100 seconds, then ED = 30/100 = 30%.
2. Assuming the motor efficiency is 85%, mechanical efficiency is 85%, and the drive and the REG2000's efficiencies are both 95%, the useful power output would be 22 kW * 85% * 85% * 95% * 95% = 14.3 kW.
3. When using the REG2000, and the mains voltage is 380 V, the current would be 14.3 kW/(sqrt(3)*380 V) = 21.8 A.
4. From the table below, at 30% ED, and a working duration of 30 seconds, the output current must be lower than 115% of the rated current to avoid overload.



※ The diagram above shows the testing result by combining REG and a DC choke.

📖 Definition of ED%: See Chapter 03 Specifications.

5. From the specification sheet,
   the REG110A43A-21 rated current is 17 A, 17 A*115% = 19.55 A < 21.8 A, and
   the REG150A43A-21 rated current is 20 A, 20 A*115% = 23 A > 21.8 A;
   therefore, in this case, you can select the REG150A43A-21.