

# **USER'S MANUAL**

## **3G3AX-RBU**

**Regenerative Braking Unit**



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# Introduction

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Thank you for choosing the Regenerative Braking Unit 3G3AX-RBU. This User's Manual (hereinafter called "this manual") describes the installation/wiring of the 3G3AX-RBU model, as well as troubleshooting and inspection methods.

- This manual should be delivered to the actual end user of the product.
- After reading this manual, keep it handy for future reference.
- This manual describes the specifications and functions of the product as well as the relations between them. You should assume that anything not described in this manual is not possible with the product.
- Intended readers

This manual is intended for:

Those with knowledge of electrical systems (qualified electrical engineers or the equivalent), and also in charge of:

- Introducing the control equipment
- Designing the control system
- Installing and/or connecting the control equipment
- Field management

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# Read and Understand This Manual

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Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

## Warranty and Limitations of Liability

<b>WARRANTY</b>
<p>OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.</p> <p>OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.</p>

<b>LIMITATIONS OF LIABILITY</b>
<p>OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.</p> <p>In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.</p> <p>IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.</p>

## Application Considerations

### SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

### PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

## Disclaimers

### **CHANGE IN SPECIFICATIONS**

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

### **DIMENSIONS AND WEIGHTS**

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

### **PERFORMANCE DATA**

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

### **ERRORS AND OMISSIONS**

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

# Safety Precautions

## ■ Indications and Meanings of Safety Information

In this user's manual, the following precautions and signal words are used to provide information to ensure the safe use of the Regenerative Braking Unit 3G3AX-RBU.

The information provided here is vital to safety. Strictly observe the precautions provided.

## ■ Meanings of Signal Words

 <b style="font-size: 24px; margin-left: 10px;">WARNING</b>	<p>Indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or may result in death. Additionally there may be severe property damage.</p>
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 <b style="font-size: 24px; margin-left: 10px;">CAUTION</b>	<p>Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or in property damage.</p>
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## ■ Alert Symbols in This Document

 <b style="font-size: 24px; margin-left: 10px;">WARNING</b>	
	<p>Turn off the power supply and implement wiring correctly. Not doing so may result in a serious injury due to an electric shock.</p>
	<p>Wiring work must be carried out only by qualified personnel. Not doing so may result in a serious injury due to an electric shock.</p>
	<p>Be sure to ground the unit. Not doing so may result in a serious injury due to an electric shock or fire.</p>
	<p>Do not remove the front cover during the power supply and 10 minutes after the power shutoff. Doing so may result in a serious injury due to an electric shock.</p>
	<p>Do not operate the switches with wet hands. Doing so may result in a serious injury due to an electric shock.</p>
	<p>Do not touch the inside of the Regenerative Braking Unit or terminals, and do not check a signal, wire, put on or take off the connectors while the power is being supplied. Doing so may result in a serious injury due to an electric shock or fire.</p>
	<p>Do not remove the front cover during the power supply. Doing so may result in a serious injury due to an electric shock. Be sure to put on the front cover before turning on the input power.</p>
	<p>Turn off the input power of the Inverter and wait for more than 10 minutes before changing wiring or operating the DIP switch. Not doing so may result in a serious injury due to an electric shock.</p>

 <b>CAUTION</b>	
	Place covers on the openings or take other precautions to make sure that no metal objects such as cutting bits or lead wire scraps go inside when installing and wiring.
	Install a stop motion device to ensure safety. Not doing so might result in a minor injury.
	Be sure to use a specified type of Braking Resistor/Regenerative Braking Unit. In case of a Braking Resistor, install a thermal relay that monitors the temperature of the Resistor. Not doing so might result in a moderate burn due to the heat generated in the Braking Resistor/Regenerative Braking Unit. Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected in the Braking Resistor/Regenerative Braking Unit.
	Do not connect Resistors to the DC terminals (P, N) directly. Doing so might result in a small-scale fire, heat generation or damage to the unit.
	Do not touch the fins, Braking Resistors, which become too hot during the power supply and for some time after the power shutoff. Doing so may result in a burn.
	The models of 3G3AX-RBU23/-RBU24/-RBU42/-RBU43 do not have terminals for the alarm input (R1, R2). Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected.
	The 3G3AX-RBC Braking Resistor does not have a built-in thermal fuse. Be sure to use the alarm contact terminals (AL1, AL2) of the Resistor and configure a sequence that enables the Inverter power to turn off when unusual overheating is detected. Not doing so might result in a small-scale fire, heat generation or damage to the unit.
	Do not dismantle, repair or modify the product. Doing so may result in an injury.

**Installation and Wiring**

 <b>WARNING</b>	
	Turn off the power supply and implement wiring correctly. Not doing so may result in a serious injury due to an electric shock.
	Wiring work must be carried out only by qualified personnel. Not doing so may result in a serious injury due to an electric shock.
	Be sure to ground the unit. Not doing so may result in a serious injury due to an electric shock or fire.
 <b>CAUTION</b>	
	Place covers on the openings or take other precautions to make sure that no metal objects such as cutting bits or lead wire scraps go inside when installing and wiring.
	Install a stop motion device to ensure safety. Not doing so might result in a minor injury.
	Be sure to use a specified type of Braking Resistor/Regenerative Braking Unit. In case of a Braking Resistor, install a thermal relay that monitors the temperature of the Resistor. Not doing so might result in a moderate burn due to the heat generated in the Braking Resistor/Regenerative Braking Unit. Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected in the Braking Resistor/Regenerative Braking Unit.
	Do not connect Resistors to the DC terminals (P, N) directly. Doing so might result in a small-scale fire, heat generation or damage to the unit.

Operation

 <b>WARNING</b>	
	Do not remove the front cover during the power supply and 10 minutes after the power shutoff. Doing so may result in a serious injury due to an electric shock.
	Do not operate the switches with wet hands. Doing so may result in a serious injury due to an electric shock.
	Do not touch the inside of the Regenerative Braking Unit or terminals, and do not check a signal, wire, put on or take off the connectors while the power is being supplied. Doing so may result in a serious injury due to an electric shock or fire.

 <b>CAUTION</b>	
	Do not touch the fins, Braking Resistors, which become too hot during the power supply and for some time after the power shutoff. Doing so may result in a burn.
	The models of 3G3AX-RBU23/-RBU24/-RBU42/-RBU43 do not have terminals for the alarm input (R1, R2). Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected.
	The 3G3AX-RBC Braking Resistor does not have a built-in thermal fuse. Be sure to use the alarm contact terminals (AL1, AL2) of the Resistor and configure a sequence that enables the Inverter power to turn off when unusual overheating is detected. Not doing so might result in a small-scale fire, heat generation or damage to the unit.

**Maintenance and Inspection**

 <b>WARNING</b>	
	<p>Do not remove the front cover during the power supply. Doing so may result in a serious injury due to an electric shock. Be sure to put on the front cover before turning on the input power.</p>
	<p>Turn off the input power of the Inverter and wait for more than 10 minutes before changing wiring or operating the DIP switch. Not doing so may result in a serious injury due to an electric shock.</p>
 <b>CAUTION</b>	
	<p>Do not touch the fins, Braking Resistors, which become too hot during the power supply and for some time after the power shutoff. Doing so may result in a burn.</p>
	<p>Do not dismantle, repair or modify the product. Doing so may result in an injury.</p>

# Precautions for Safe Use

## ■ Installation and Storage

Do not store or use the product in the following places.

- Locations subject to direct sunlight.
- Locations subject to ambient temperature exceeding the specifications.
- Locations subject to relative humidity exceeding the specifications.
- Locations subject to condensation due to severe temperature fluctuations.
- Locations subject to corrosive or flammable gases.
- Locations subject to exposure to combustibles.
- Locations subject to dust (especially iron dust) or salt.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

## ■ Transportation, Installation, and Wiring

Observe the following instructions during transportation, installation, and wiring.

- Do not drop or apply a strong impact on the product. Doing so may result in damaged parts or malfunction.
- Do not hold by the front cover, but hold by the fins during transportation.
- The specified wire size or larger one must be used for the power lines.

Model (3G3AX-)	Connectable resistance	P, RB, N connection wires	SL1, SL2, MA1, MA2 connection wires	Ground wire
RBU21	17 Ω min.	3.5 mm <sup>2</sup> min.	0.75 mm <sup>2</sup> min.	5.5 mm <sup>2</sup> min.
RBU22	17 Ω min.	3.5mm <sup>2</sup> min.		
RBU23	8 Ω min.	5.5 mm <sup>2</sup> min.		
	5 to 7.9 Ω	8 mm <sup>2</sup> min.		
	4 to 4.9 Ω	14 mm <sup>2</sup> min.		
RBU24	4 Ω min.	14 mm <sup>2</sup> min.		
	3 to 3.9 Ω	22 mm <sup>2</sup> min.		
	2 to 2.9 Ω	38 mm <sup>2</sup> min.		
RBU41	34 Ω min.	3.5 mm <sup>2</sup> min.		
RBU42	17 Ω min.	3.5 mm <sup>2</sup> min.		
	13 to 16.9 Ω	5.5 mm <sup>2</sup> min.		
	10 to 12.9 Ω	8 mm <sup>2</sup> min.		
RBU43	10 Ω min.	8 mm <sup>2</sup> min.		
	7.5 to 9.9 Ω	14 mm <sup>2</sup> min.		
	6 to 7.4 Ω	22 mm <sup>2</sup> min.		

Note 1. For wires connecting to the P, RB and N terminals use an MLFC wire (flame retardant Polyflex wire, dielectric strength of 600 V).

Note 2. If the wiring length between the Regenerative Braking Unit and Braking Resistor exceeds 10 m, use the wire size larger than the specified one.

A wire of more than 10 m to 25 m : One rank higher wire size

A wire of more than 25 m to 50 m : Two ranks higher wire size

For the 3G3AX-RBU42 model, keep the wiring length between the Regenerative Braking Unit and Braking Resistor within 5 m.

### ■ Maintenance and Inspection

Be sure to confirm safety before conducting maintenance, inspection or parts replacement.

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# Precautions for Correct Use

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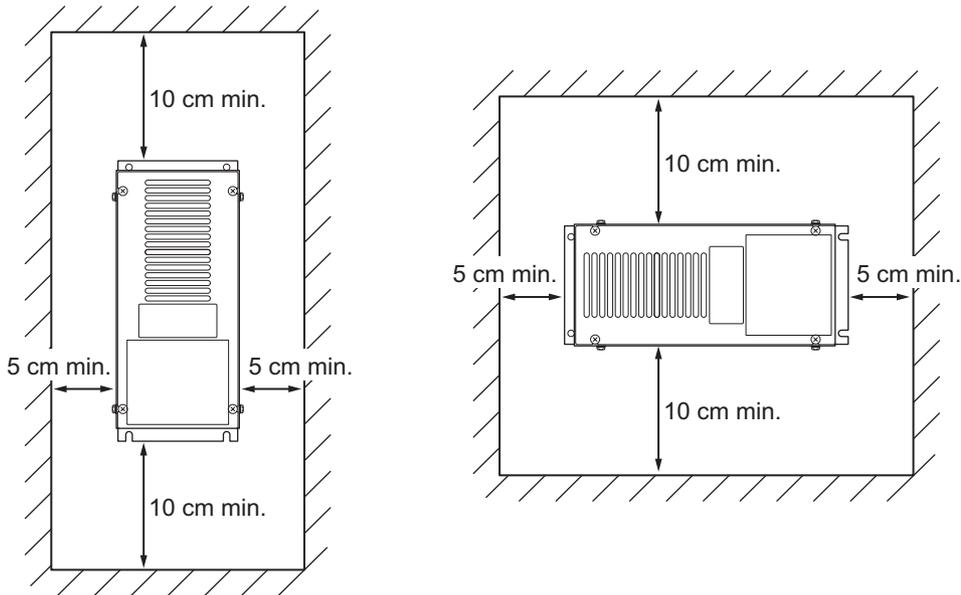
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## Installation

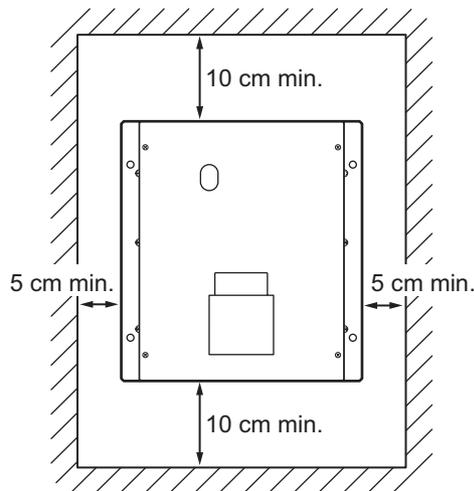
Mount the product on the vertical wall.

The material of the wall has to be nonflammable such as a metal plate, and do not place flammable materials nearby.

### ■3G3AX-RBU21/RBU22/RBU41/RBU42



### ■3G3AX-RBU23/RBU24/RBU43



Note. The product cannot be mounted horizontally, but vertically only.

## Rated Voltage

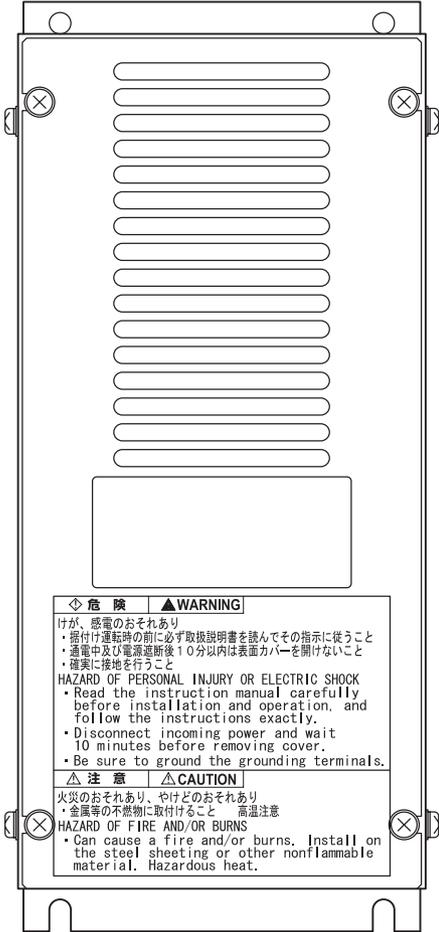
Confirm that the rated voltage of the product is the same as that of the Inverter to be used.

### Product Disposal

Comply with the local ordinance and regulations when disposing of the product.

### Warning Labels

Warning labels are located on the product as shown in the following illustration. Be sure to follow the instructions.



### Warning Description

◇ 危険	▲ WARNING
けが、感電のおそれあり ・据付け運転の前に必ず取扱説明書を読んでその指示に従うこと ・通電中及び電源遮断後10分以内は表面カバーを開けないこと ・確実に接地を行うこと HAZARD OF PERSONAL INJURY OR ELECTRIC SHOCK ・ Read the instruction manual carefully before installation and operation, and follow the instructions exactly. ・ Disconnect incoming power and wait 10 minutes before removing cover. ・ Be sure to ground the grounding terminals.	
△ 注意	△ CAUTION
火災のおそれあり、やけどのおそれあり ・ 金属等の不燃物に取付けること 高温注意 HAZARD OF FIRE AND/OR BURNS ・ Can cause a fire and/or burns. Install on the steel sheeting or other nonflammable material. Hazardous heat.	

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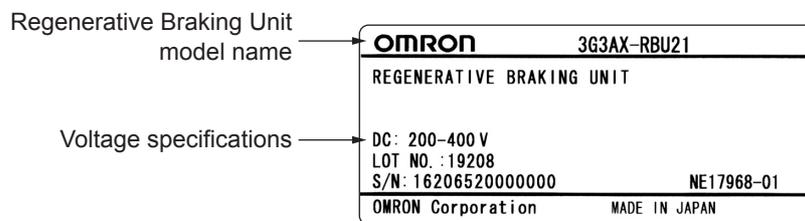
# Checking Before Unpacking

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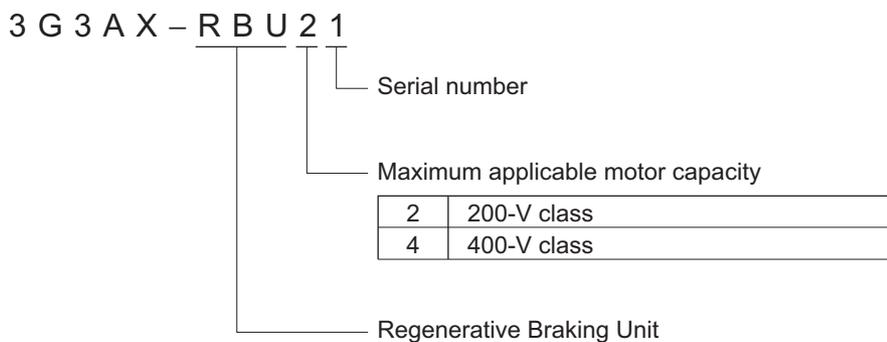
## Checking the Product

On delivery, be sure to check that the delivered product is the Regenerative Braking Unit 3G3AX-RBU model that you ordered.  
Should you find any problems with the product, immediately contact your nearest local sales representative or OMRON sales office.

### ■Checking the Nameplate



### ■Checking the Model



## Checking the Accessories

Note that this manual is the only accessory included with the Regenerative Braking Unit 3G3AX-RBU model.  
Mounting screws and other necessary parts must be provided by the user.

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# Revision History

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A manual revision code appears as a suffix to the catalog number located at the lower left of the front and back covers.

<b>Cat.No.</b>	<b>I563-E1-01</b>
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↑  
Revision code

Revision code	Revision date	Changes and revision pages
01	April 2008	First printing

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# About This Manual

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This User's Manual is compiled chapter by chapter for user's convenience as follows:  
Understanding the following configuration ensures more effective use of the product.

Chapter	Overview
Chapter 1 Design	Describes installation and wiring procedures, terminal names and other information required for design.
Chapter 2 Functions	Describes the DIP switch settings.
Chapter 3 Maintenance Operations	Describes the analysis of possible trouble causes as well as troubleshooting methods.
Chapter 4 Inspection and Maintenance	Describes items for periodic inspection and/or maintenance for the product.
Chapter 5 Specifications	Describes the product specifications and dimensions.

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# Chapter 1

## Design

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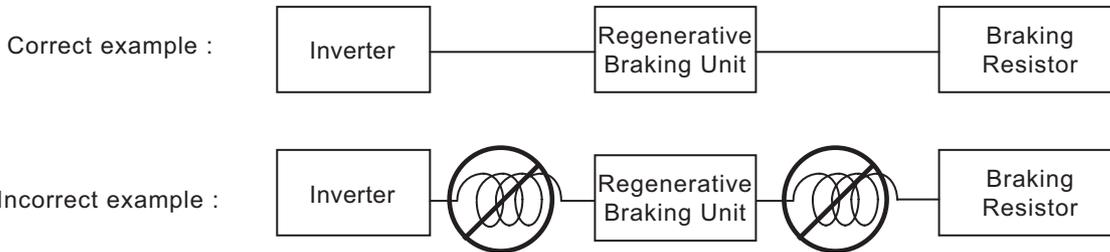
# 1-1 Wiring

For connections of the Regenerative Braking Unit, Inverter and Braking Resistor (P, RB, and N terminals), use cables with the following length:

Model (3G3AX-)	Between Regenerative Braking Unit and Inverter	Between Regenerative Braking Unit and Braking Resistor
RBU21	5 m max.	5 m max.
RBU22	5 m max.	5 m max.
RBU23	4 m max.	50 m max.
RBU24	Braking resistance: 4 Ω min. 4 m max. Less than 4 Ω 3 m max.	50 m max.
RBU41	5 m max.	5 m max.
RBU42	4 m max.	5 m max.
RBU43	4 m max.	50 m max.

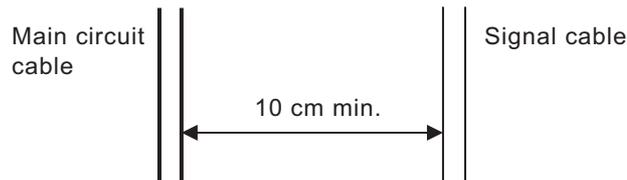
The wiring must be routed at the shortest distance. Be sure not to coil up any surplus cables. Doing so may cause a fault in the equipment.

The cable connected to the P and N terminals for wiring between the Regenerative Braking Unit and the Inverter, as well as the cable connected to the P and RB terminals for wiring between the Regenerative Braking Unit and the Braking Resistor must be bundled with a tie band, so that these cables are not placed at a distance.



In order to prevent the Braking Register in the Regenerative Braking Unit from burning due to overheating, be sure to connect the alarm contacts (AL1 and AL2) and provide a circuit to turn off the primary power supply for the Inverter.

When several Regenerative Braking Units are connected in parallel, the length of the signal cables (MA1, MA2, SL1, SL2) between individual Regenerative Braking Units must be 5 m or less, and the cable size must be 0.75 mm<sup>2</sup> or more. Be sure to separate the signal cables from the main circuit cable.



When multiple resistors are used in combination, a voltage rise during switching is increased due to the internal inductive components of the resistor. In this case, increase the cable size, or twist the cable.

For the Braking Resistor, use a non-inductive resistor. Do not use six or more resistors in combination.

For connections on the PCB terminal block, be sure to use crimp terminals with insulation coating.

To use the optional Braking Resistor, select the model with combined resistance higher than the specified connectable resistance. If a resistor whose resistance is less than the connectable resistance is used, it may result in a fault of the Regenerative Braking Unit. Use thorough caution in regards to the resistance.

When using these Braking Resistors, be sure to remove the built-in resistor. (3G3AX-RBU21/-RBU22/-RBU41 only)

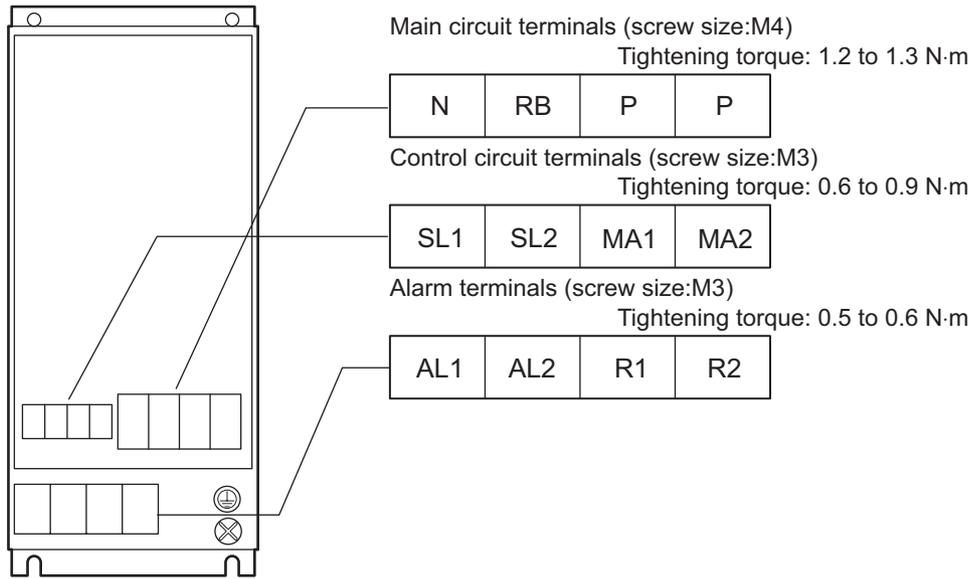
Model (3G3AX-)	Connectable resistance
RBU21	17 $\Omega$ min.
RBU22	17 $\Omega$ min.
RBU23	4 $\Omega$ min.
RBU24	2 $\Omega$ min.
RBU41	34 $\Omega$ min.
RBU42	10 $\Omega$ min.
RBU43	6 $\Omega$ min.

# 1-2 Terminals

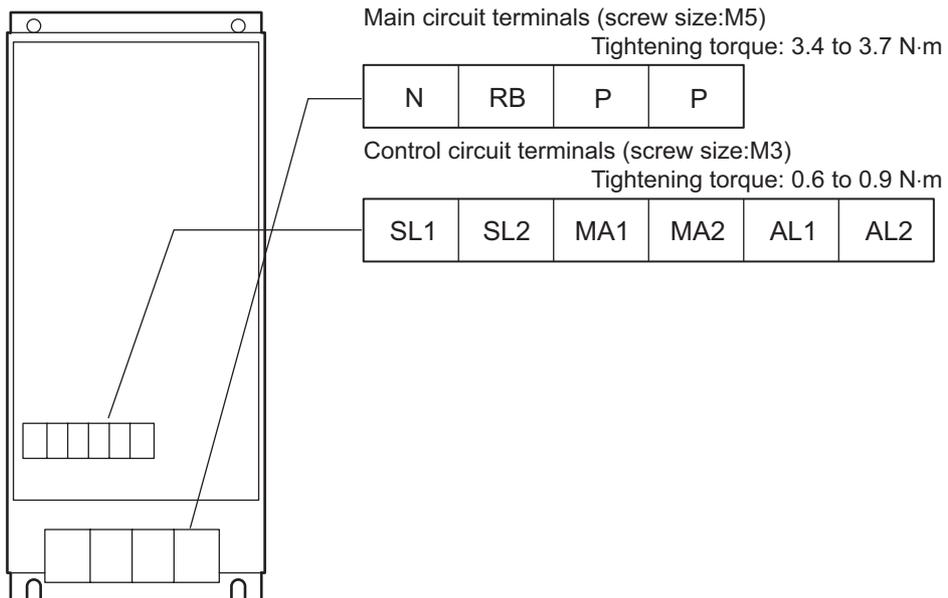
## Terminal Position and Arrangement

The terminal arrangement on the Regenerative Braking Unit is shown below.

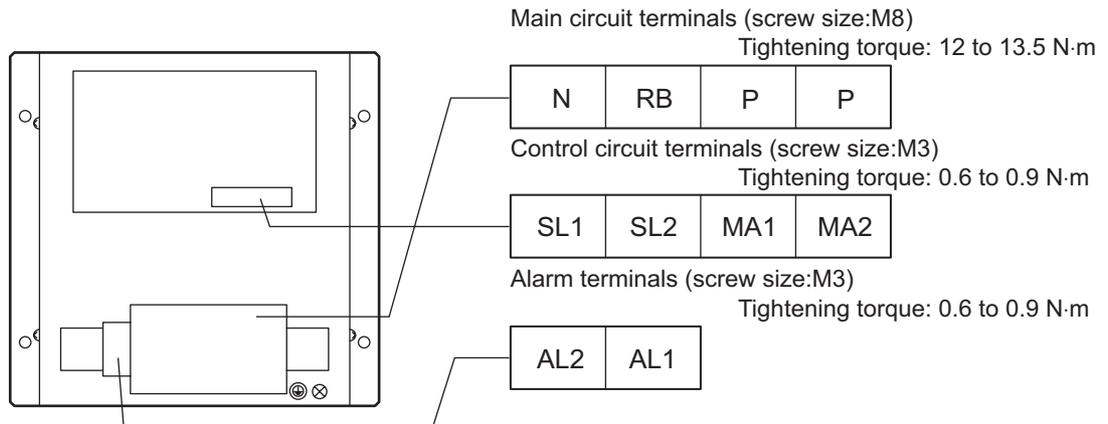
### ■3G3AX-RBU21/-RBU22/-RBU41



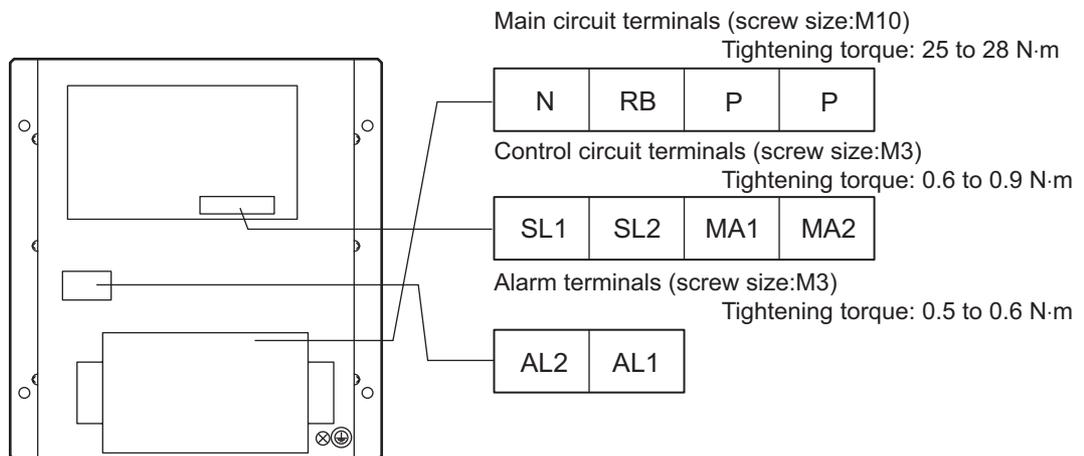
### ■3G3AX-RBU42



### ■ 3G3AX-RBU23/-RBU43



### ■ 3G3AX-RBU24



## Terminal Description

Terminal name	Terminal symbol	Description
Main circuit terminal	N	Connect to the N/- terminal of the Inverter.
	RB	Connect to the Braking Resistor. With the default connection, this terminal is connected to the built-in resistor. (Only for the models 3G3AX-RBU21/-RBU22/-RBU41)
	P	Connect to the P/+2 terminal of the Inverter.
	P	Connect to the Braking Resistor. With the default connection, this terminal is connected to the built-in resistor. (Only for the models 3G3AX-RBU21/-RBU22/-RBU41)
Control circuit terminal	SL1 SL2	Connect to the MA1 and MA2 terminals of a master unit when used as slave unit terminals in parallel operation.
	MA1 MA2	Connect to the SL1 and SL2 terminals of a slave unit when used as master unit terminals in parallel operation.
Alarm terminal	AL1 AL2	The alarm output terminals for the Regenerative Braking Unit. Provide a circuit to turn off the primary power supply for the Inverter when the temperature relay of the built-in resistor or optional Braking Resistor is activated.
	R1 R2	Connect to the AL1, AL2 (1, 2) terminals of the Braking Resistor when the optional Braking Resistor is used. Short-circuit between the AL1 and AL2 terminals when the optional Braking Resistor is not used. (Only for the models 3G3AX-RBU21/-RBU22/-RBU41)

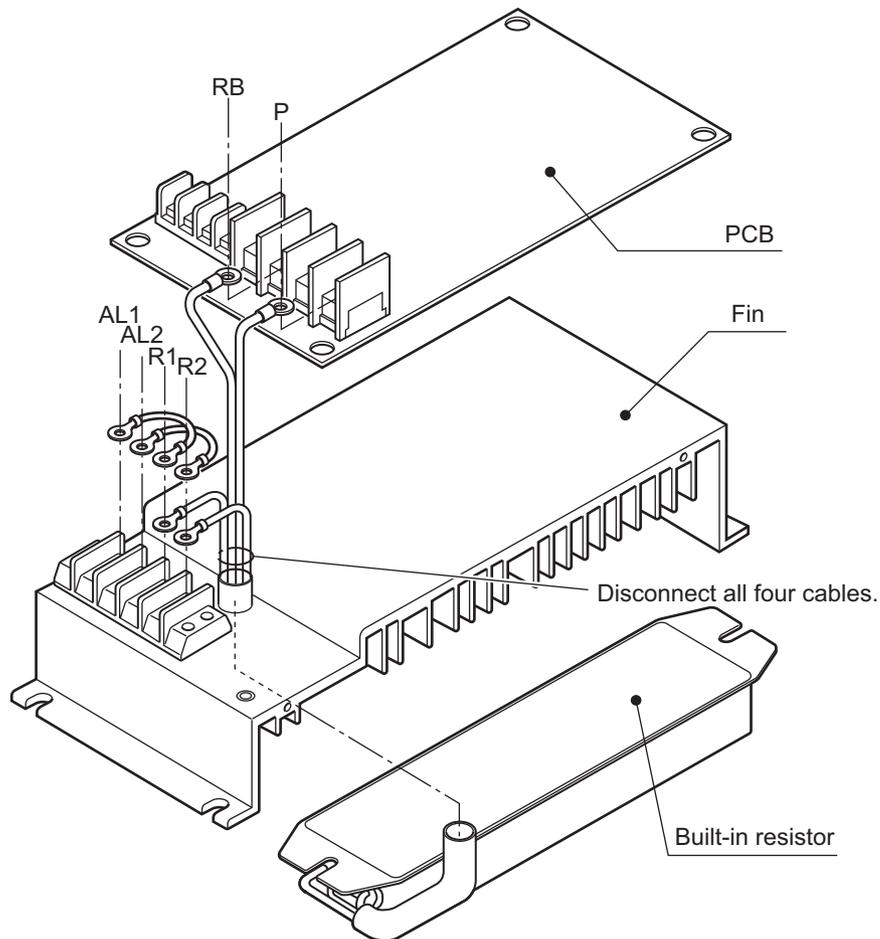
# 1-3 Removing the Built-in Resistor

1

Design

To remove the built-in resistor, follow the procedure described below (3G3AX-RB21/-RBU22/-RBU41 only).

1. Disconnect the lead wires connected from the built-in resistor to the P and RB terminals on the PCB, and to the R1 and R2 terminals on the fin.



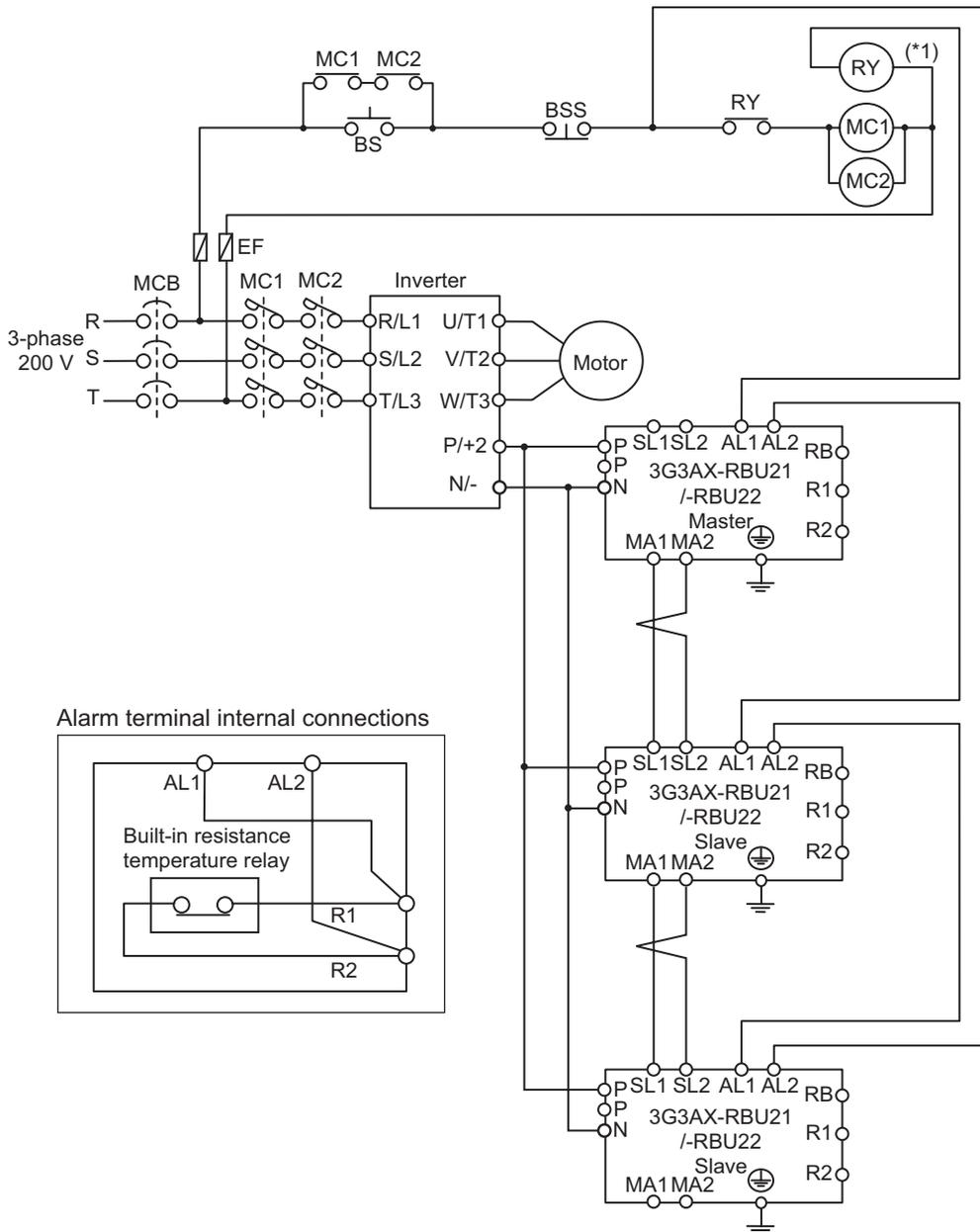
2. Remove the built-in resistor from the bottom of the unit.
3. Reconnect the wiring between the AL1 and R1 terminals and between the AL2 and R2 terminals on the fin.

# 1-4 Connection

## 3G3AX-RBU21/-RBU22 Connection Example

### ■When the built-in resistor is used

The following is an example of connections using the built-in resistor.  
 Up to five units can be connected in parallel.  
 For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



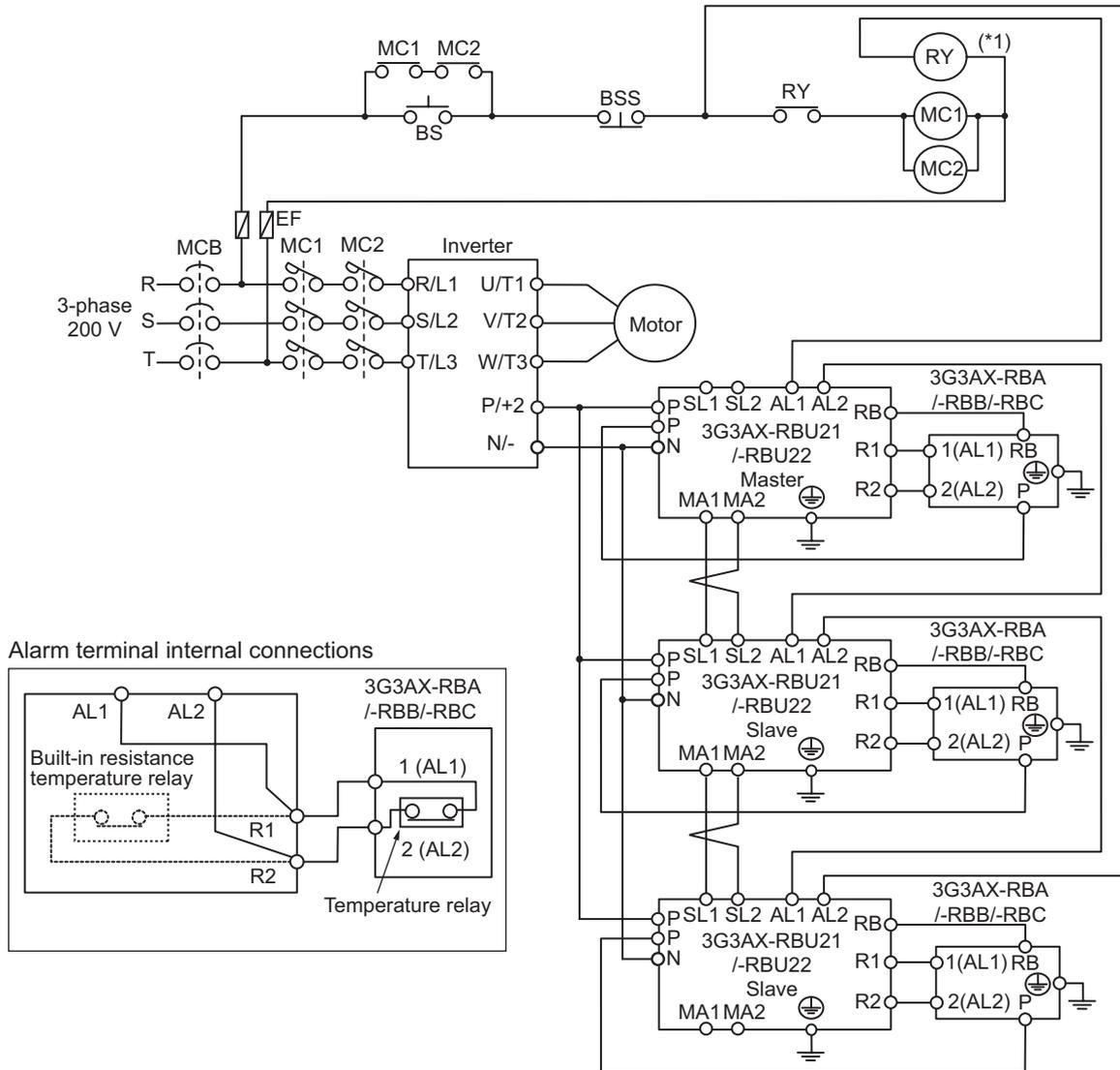
\*1. To select RY, check the MC coil and RY contact specifications.

■ When the optional Braking Resistor 3G3AX-RBA/-RBB/-RBC is used

The following is an example of connections using the Braking Resistor 3G3AX-RBA/-RBB/-RBC. Up to five units can be connected in parallel.

For parallel connection, use Braking Resistors with the same resistance. Be sure to remove the built-in resistor from the bottom of the Regenerative Braking Unit.

For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



\*1. To select RY, check the MC coil and RY contact specifications.

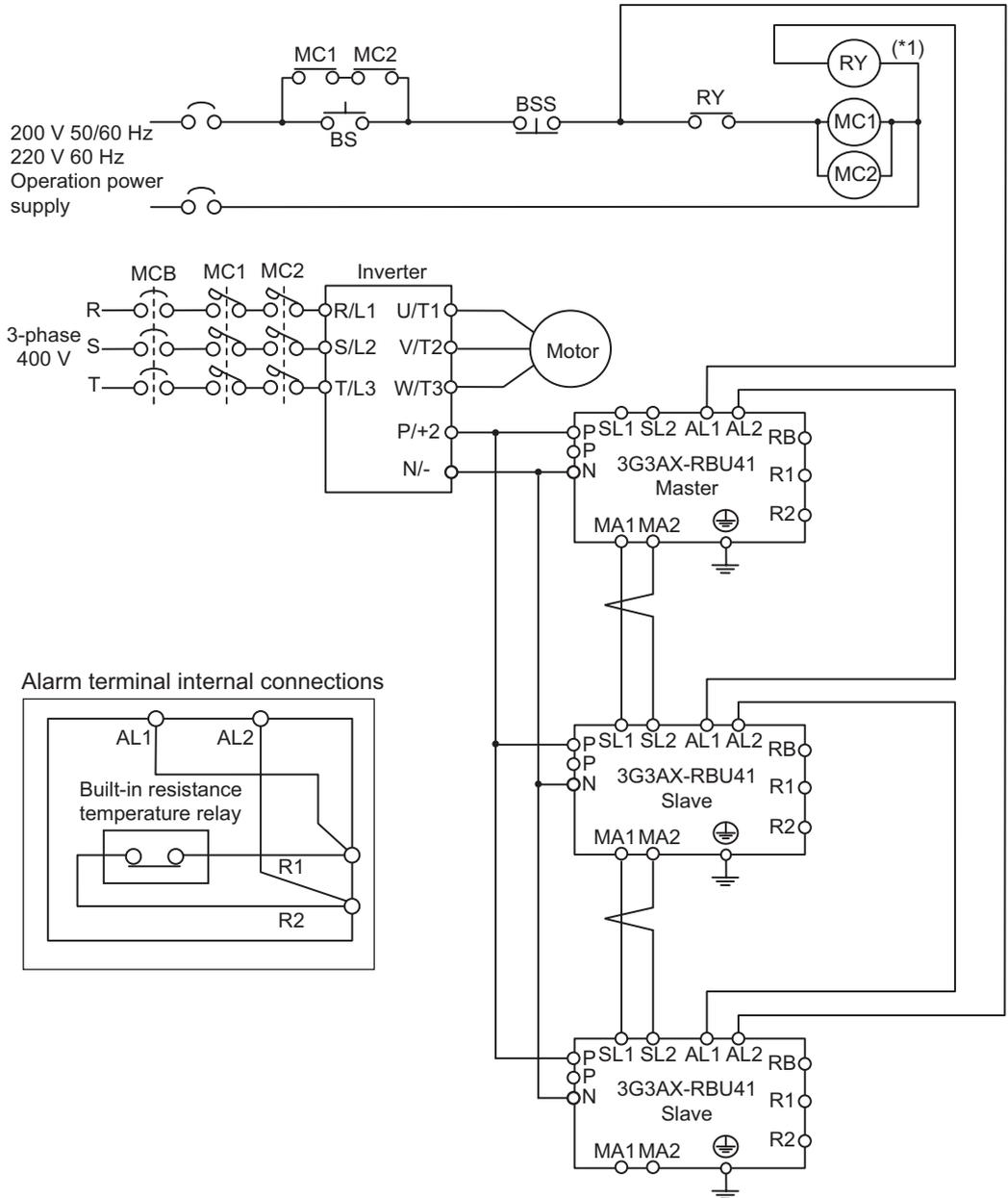


- To use the Braking Resistor (3G3AX-RBA/-RBB/-RBC), be sure to remove the built-in resistor. If the Braking Resistor (3G3AX-RBA/-RBB/-RBC) is used with the built-in resistor connected, it may cause the built-in resistor to burn due to overheating, or result in an overheating detection failure when the Braking Resistor temperature relay is activated.
- To prevent overheating, be sure to connect the alarm contacts 1 (AL1) and 2 (AL2) of the Braking Resistor.

## 3G3AX-RBU41 Connection example

### ■ When the built-in resistor is used

The following is an example of connections using the built-in resistor.  
 Up to five units can be connected in parallel.  
 For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



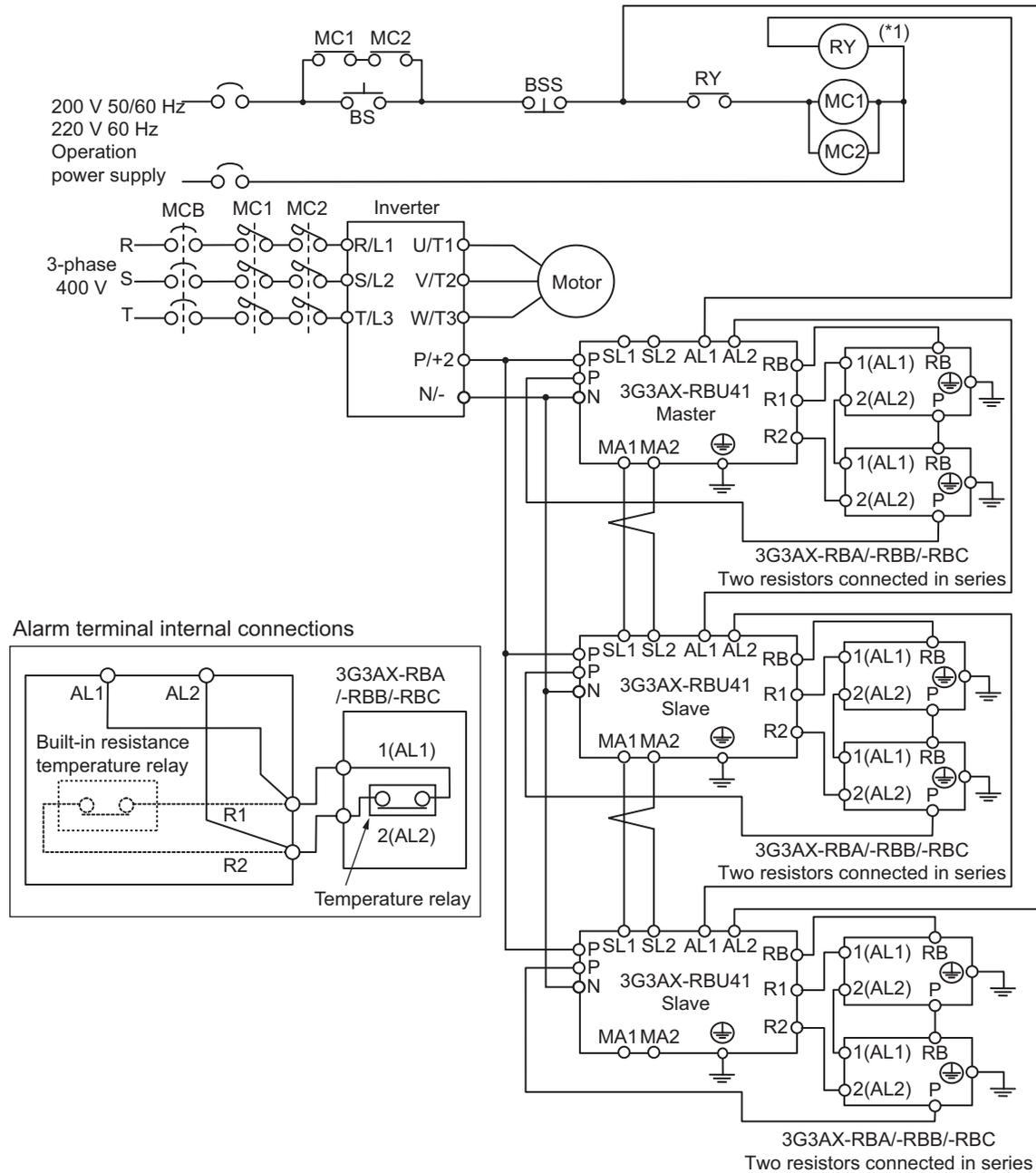
\*1. To select RY, check the MC coil and RY contact specifications.

■ When the optional Braking Resistor 3G3AX-RBA/-RBB/-RBC is used

The following is an example of connections using the Braking Resistor 3G3AX-RBA/-RBB/-RBC. Up to five units can be connected in parallel.

For parallel connection, use Braking Resistors with the same resistance. Be sure to remove the built-in resistor from the bottom of the Regenerative Braking Unit.

For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



\*1. To select RY, check the MC coil and RY contact specifications.



- To use the Braking Resistor (3G3AX-RBA/-RBB/-RBC), be sure to remove the built-in resistor. If the Braking Resistor (3G3AX-RBA/-RBB/-RBC) is used with the built-in resistor connected, it may cause the built-in resistor to burn due to overheating, or result in an overheating detection failure when the Braking Resistor temperature relay is activated.
- To use the Braking Resistor (3G3AX-RBA/-RBB/-RBC) for 3G3AX-RBU41, be sure to connect two resistors of the same model in series. If the 3G3AX-RBU41 is operated with a single resistor, the Braking Resistor may have a fault.
- To prevent overheating, be sure to connect the alarm contacts 1 (AL1) and 2 (AL2) of the Braking Resistor.

## 3G3AX-RBU23/-RBU24 Connection Example

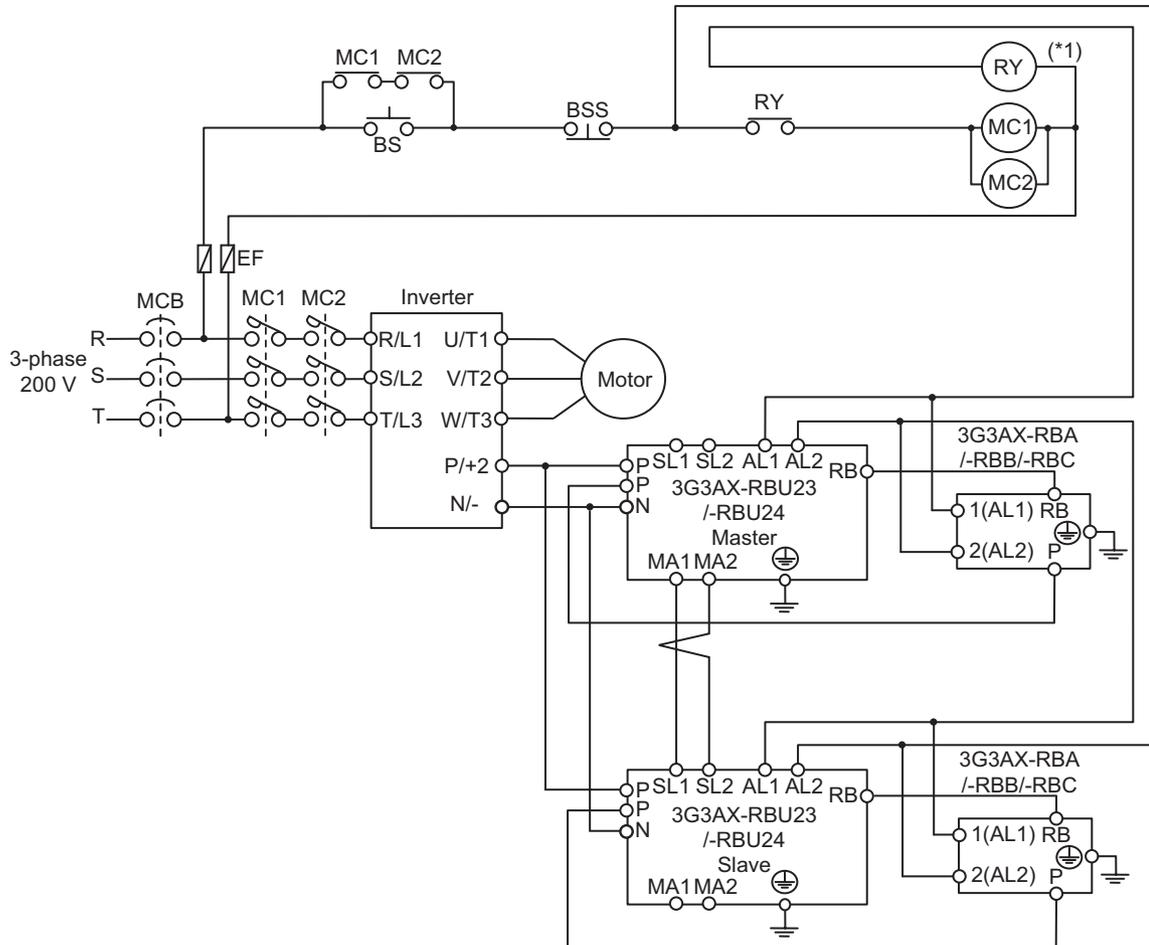
### ■ When the optional Braking Resistor 3G3AX-RBA/-RBB/-RBC is used

The following is an example of connections using the Braking Resistor 3G3AX-RBA/-RBB/-RBC.

Up to two units can be connected in parallel.

For parallel connection, use Braking Resistors with the same resistance.

For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



\*1. To select RY, check the MC coil and RY contact specifications.



- To prevent overheating, be sure to connect the alarm contacts 1 (AL1) and 2 (AL2) of the Braking Resistor.
- The models of 3G3AX-RBU23/-RBU24 do not have terminals for the alarm input (R1, R2). Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected.

## 3G3AX-RBU42/-RBU43 Connection Example

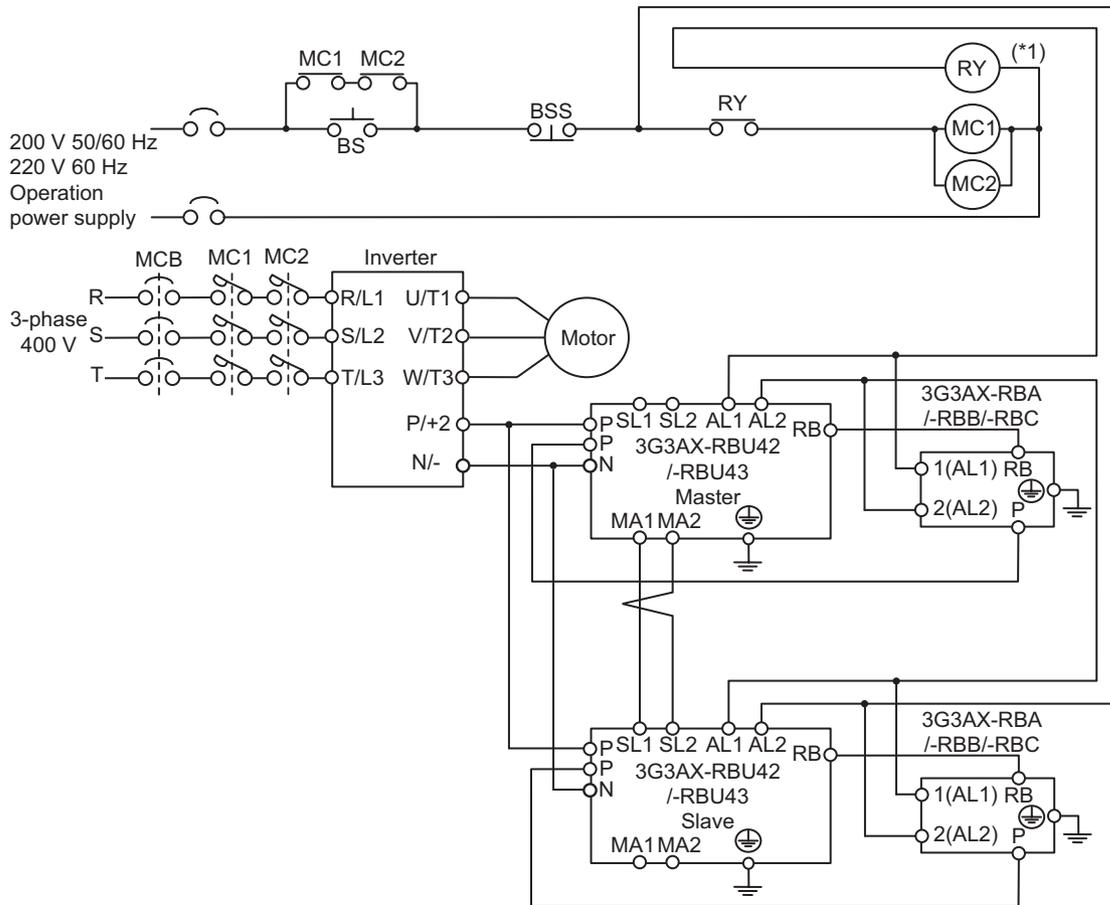
### ■ When the optional Braking Resistor 3G3AX-RBA/-RBB/-RBC is used

The following is an example of connections using the Braking Resistor 3G3AX-RBA/-RBB/-RBC.

Up to two units can be connected in parallel.

For parallel connection, use Braking Resistors with the same resistance.

For DIP switch settings, refer to "2-1 DIP Switch Setting"(page 2-1).



- A voltage of 800 V DC (max.) is applied to the Braking Resistor. Check the rated dielectric strength of the resistor to be connected.
- To use the optional Braking Resistor (3G3AX-RBA/-RBB/-RBC), be sure to connect two resistors of the same model in series. If the 3G3AX-RBU42 or -RBU43 is operated with a single resistor, the Braking Resistor may have a fault.
- To prevent overheating, be sure to connect the alarm contacts 1 (AL1) and 2 (AL2) of the Braking Resistor.
- The models of 3G3AX-RBU42/-RBU43 do not have terminals for the alarm input (R1, R2). Configure a sequence that enables the Inverter power to turn off when unusual overheating is detected.

\*1. To select RY, check the MC coil and RY contact specifications.

# Chapter 2

## Functions

2-1	DIP Switch Setting .....	2-1
-----	--------------------------	-----

## 2-1 DIP Switch Setting

Set up operating voltage level and parallel operation with the DIP switches.

Note: Be sure to turn off the power supply before setting the DIP switches.

### Operating voltage level setting (SW1, SW2)

The operating voltage of the Regenerative Braking Unit can be set at 3 levels: “Standard” (default setting), “-5 %” and “-10 %”, by the DIP switch settings.

This function is useful in preventing an overvoltage trip by lowering the operating voltage of the Regenerative Braking Unit when an overvoltage trip occurs due to the receiving voltage, deceleration time or other factor.

Depending on the receiving voltage, however, the Regenerative Braking Unit will operate continuously even by just turning on the Inverter power supply. When you change the DIP switch settings, use thorough caution in regards to the receiving voltage.

$$\text{Receiving voltage} \times \sqrt{2} + 20 \text{ V} < \text{Operating voltage}$$

### Parallel operation settings (SW3, SW4)

Interlocking operation can be performed by two units (master and slave units) in parallel connection via the signal lines (MA1, MA2, SL1, SL2) connection between the units and the DIP switch setting. When a unit is set as the slave using the DIP switches, the operating voltage of the slave unit depends on the master unit settings.

The DIP switch settings are as follows:

Note: The DIP switches are located at the upper left of the PCB in the Regenerative Braking Unit. The switch numbers are indicated on the switch body.

Setting functions	DIP switch setting (X: Either ON or OFF is acceptable.)	Note
Master unit Operating voltage level: Standard		Default setting
Master unit Operating voltage level: -5 %		
Master unit Operating voltage level: -10 %		
Slave unit		Operating voltage of the slave unit depends on the master unit settings.

# Chapter 3

## Maintenance Operations

3-1	Precautions before Operation.....	3-1
3-2	When the Alarm Contact is Activated .....	3-2
3-3	When an Inverter Overvoltage Trip Occurs ...	3-3

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## 3-1 Precautions before Operation

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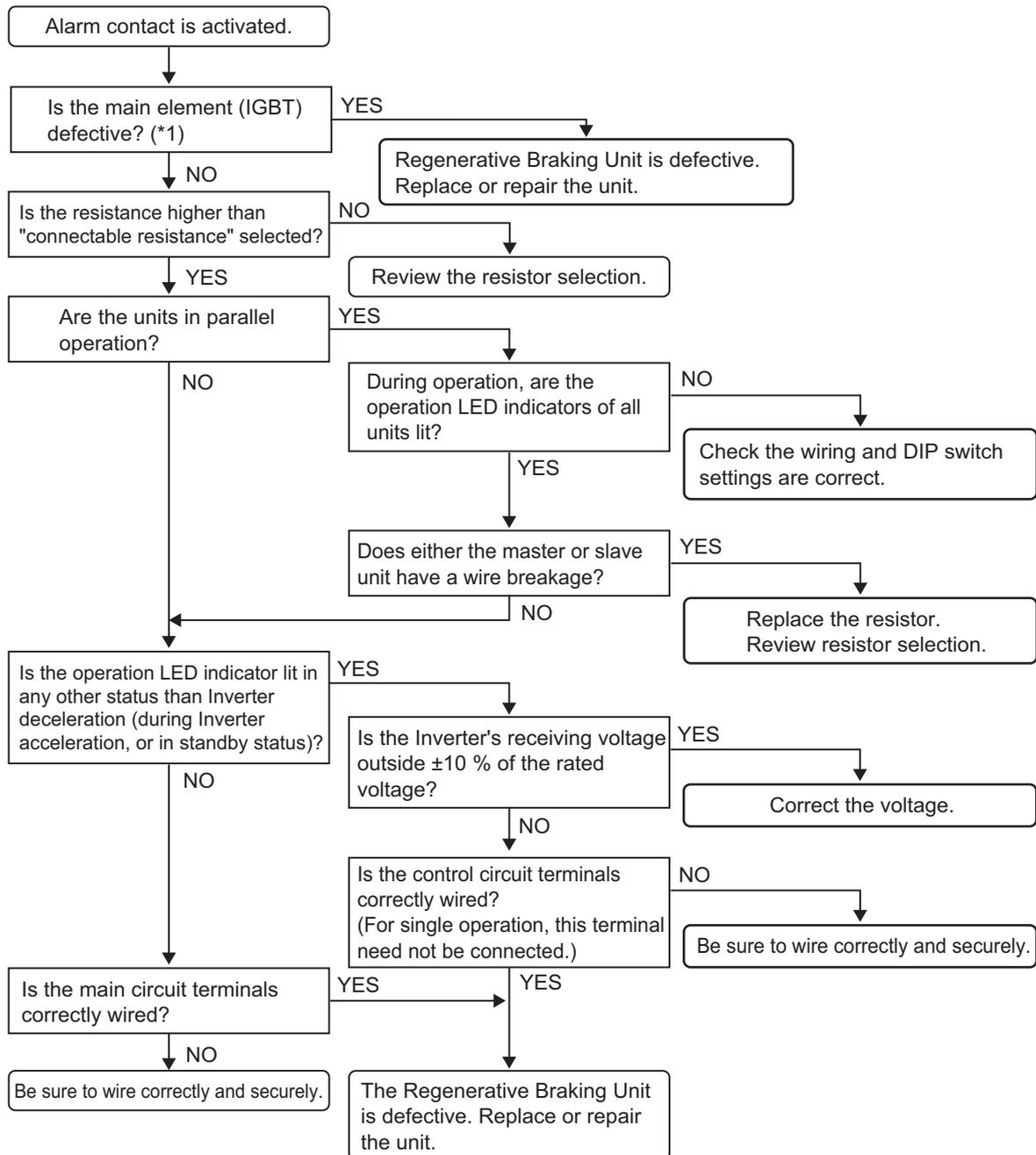
Before operation, check the following items:

- There is no incorrect wiring.  
Incorrect wiring may result in damage or malfunction of the Regenerative Braking Unit.
- Check for grounding of any terminal other than the ground terminal.  
Improper grounding may result in damage or malfunction of the Regenerative Braking Unit.
- Check for any short-circuits caused by a wire scrap or crimp terminal left in the unit after wiring work.  
A short circuit may result in damage or malfunction of the Regenerative Braking Unit.
- There is no short circuit or ground fault.  
A short circuit or ground fault may result in damage or malfunction of the Regenerative Braking Unit.

## 3-2 When the Alarm Contact is Activated

In principle, the alarm contacts of the Regenerative Braking Unit are activated when the Braking Resistor is overheated by excessive regenerative energy or frequent braking.

As a countermeasure, review the capacity of the Braking Resistor, model and number of Regenerative Braking Units, as well as Inverter deceleration time. Incorrect wiring and improper receiving voltage can be also considered as a cause of an alarm. Use the flowchart to diagnose the problem:

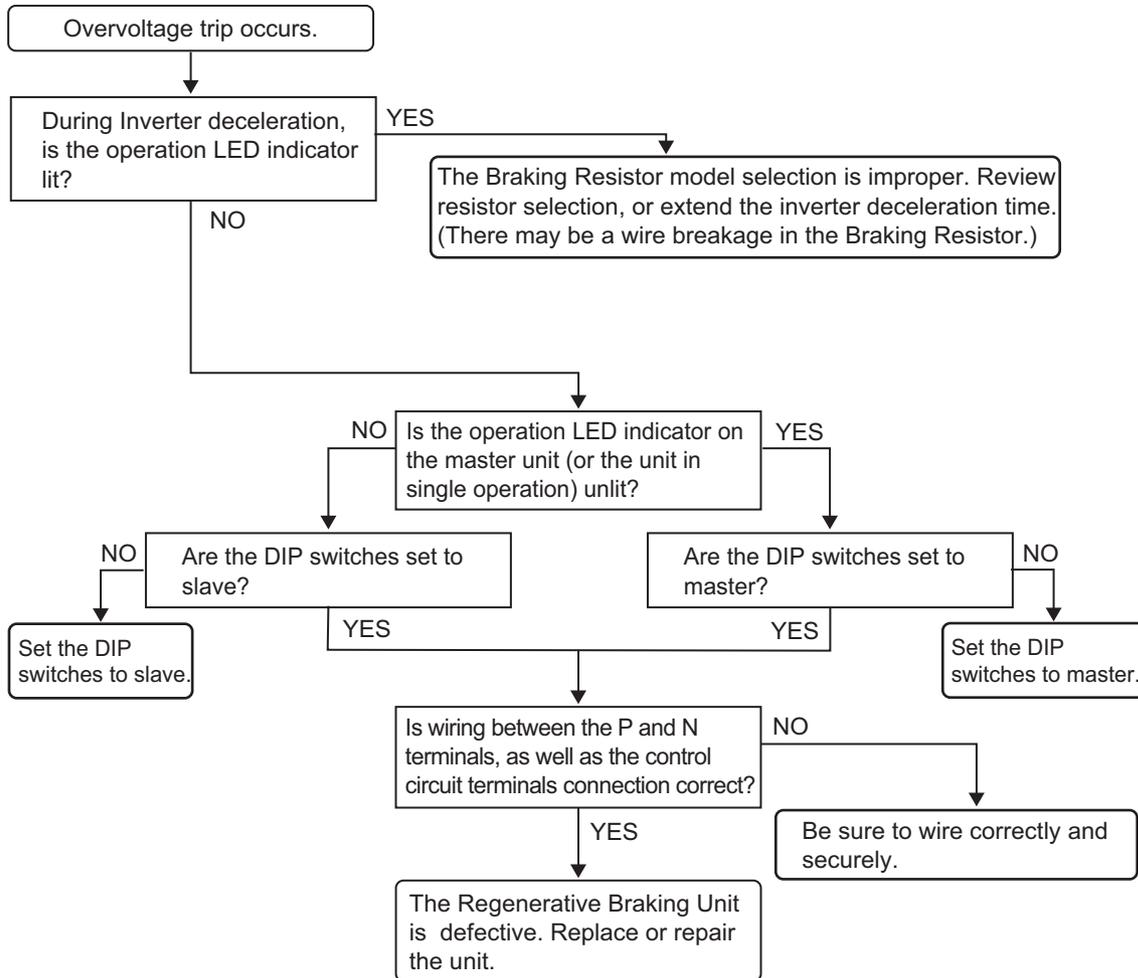


\*1. For the IGBT check procedure, refer to "4-4 Checking the Main Element"(Page 4-5).

# 3-3 When an Inverter Overvoltage Trip Occurs

In principle, an Inverter overvoltage trip occurs when the Inverter cannot completely absorb a voltage rise due to excessive regenerative energy.

As a countermeasure, review the resistance of the Braking Resistor, model and number of Regenerative Braking Units, as well as Inverter deceleration time. Wire breakage in the Braking Resistor, incorrect wiring, and/or improper DIP switch settings can be also considered as a cause of an Inverter overvoltage trip. Use the flowchart to diagnose the problem:



# Chapter 4

## Inspection and Maintenance

4-1	Inspection and Maintenance .....	4-1
4-2	Daily Inspection and Periodic Inspection .....	4-2
4-3	Megger Test .....	4-4
4-4	Checking the Main Element .....	4-5
4-5	Capacitor Life Curve .....	4-6

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# 4-1 Inspection and Maintenance

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## Daily Inspection

Basically, check the following during operation.

- 1) There are no errors in the installation environment.
- 2) There are no errors in the cooling system.
- 3) There are no abnormal vibrations or sounds.
- 4) There are no abnormal overheat or discoloration.
- 5) There are no abnormal odors.

## Cleaning

Always keep the Regenerative Braking Unit clean for operation.

Lightly remove any dirt with a soft cloth moistened with a neutral detergent.

Note: Do not use such solutions as acetone, benzene, toluene, or alcohol for cleaning. Doing so may cause the Regenerative Braking Unit surface to dissolve or its coating to come off.

## Periodic Inspection

Check the parts that cannot be checked without stopping operation, as well as those that require periodic inspection.

- 1) Check that there are no errors in the cooling system (Clean the air filter).
- 2) Check that all parts that need tightening are secure (Screws and bolts may become loose because of vibration or temperature change).
- 3) Check that there is no corrosion or damage to the conductors and/or insulators.
- 4) Measurement of insulation resistance
- 5) Check and replace the capacitor.

## 4-2 Daily Inspection and Periodic Inspection

Inspection part	Inspection item	Inspection point	Inspection period		Inspection method	Criteria	Meter
			Daily	1 year			
General	Ambient environment	Check ambient temperature, as well as humidity and dust levels.	○		Refer to "Installation"(Page 12).	Ambient temperature -10 °C to 50 °C, no freezing Ambient humidity 90 % max., no condensation.	Thermometer, Hygrometer, Recorder
	Entire device	Check that there are no abnormal vibrations or sounds.	○		Visual or acoustic inspection	No faults	
Main circuit	General	Megger test (between main circuit terminal and ground terminal)		○	Disconnect the wirings of the main and the control circuit terminals, use a megger to measure the resistance between the ground terminal and the short-circuited parts of main circuit terminals P, RB, and N.	5 M Ω min. Refer to "4-3 Megger Test".	500 V DC megger
		Check that any parts which may need tightening are secure.	○		Tighten securely.	No faults	
		Check that no part has indications of overheating.	○		Visual inspection		
	Connection conductor and wire	Check that there is no distortion with the conductor.		○	Visual inspection	No faults	
		Check that there is no tearing in the wire coverings.		○			
	Terminal block	Check that there is no damage.		○	Visual inspection	No faults	

## 4-2 Daily Inspection and Periodic Inspection

4

Inspection and Maintenance

Inspection part	Inspection item	Inspection point	Inspection period		Inspection method	Criteria	Meter
			Daily	1 year			
Main circuit	Resistor	There are no crack or discoloration.	○		Visual inspection. Cement resistor, wire-wound resistor, etc.	No faults	Tester, Digital multimeter
		Check for any wire breakage		○	Disconnect one end of the cable, and measure the resistance using a tester.	Error must be within $\pm 10\%$ of the nominal resistance.	
Control circuit Protection circuit	Operation check	Check that there are no errors in protection and display circuits through sequence protection operation.		○	Simulate the protection circuit output	Error is found in the sequence.	
Components	General	Check that there are no abnormal odors, discoloration, or significant rusting.		○	Visual inspection	No faults	
	Smoothing capacitor on the PCB	Check that there is no liquid leakage.	○		Visual inspection	No faults Standard replacement period: 5 years (*1)	
		Check that the safety valve has not come out and that there are no bulges.	○				

\*1. The life of the capacitor depends on ambient temperatures. Refer to "4-5 Capacitor Life Curve"(Page 4-6) for the replacement reference.



•Do not conduct a withstand voltage test on any part of the Regenerative Braking Unit.  
The Regenerative Braking Unit uses semiconductors in the main circuit. If the unit undergoes a withstand voltage test, it may cause semiconductor deterioration.

## 4-3 Megger Test

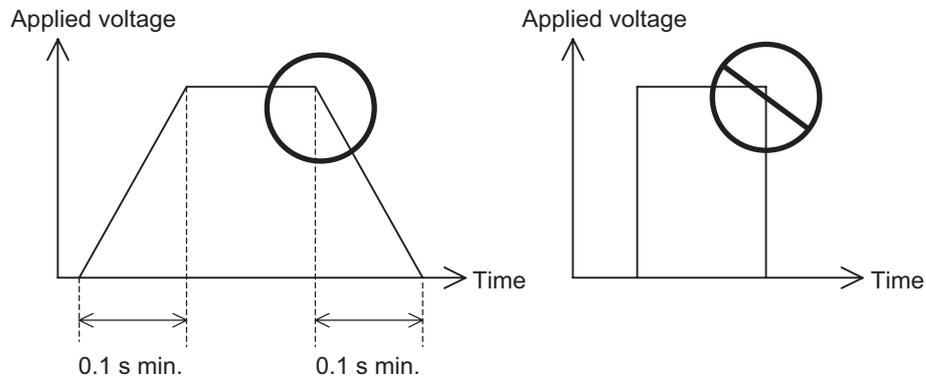
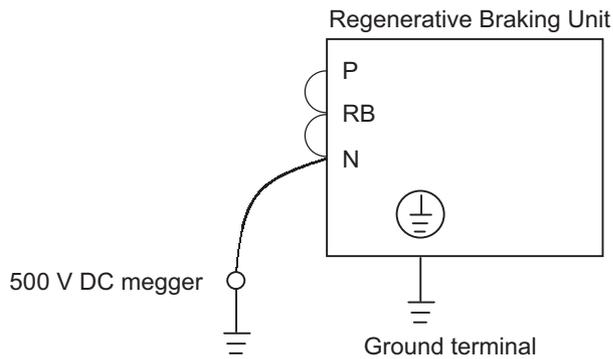
For a megger test of the external circuit, be sure to disconnect all the terminals of the Regenerative Braking Unit, so as not to apply the test voltage to the Regenerative Braking Unit.

Use a high resistance tester for a power distribution test of the control circuit. Do not use a megger or buzzer.

Conduct a Regenerative Braking Unit megger test only to the main circuit, not to the control circuit. Use a 500 V DC megger for a megger test.

Gradually increase the applied voltage, and reduce it to 0 V.

To conduct a megger test for the main circuit, short-circuit the P, RB and N terminals with a wire.



Note: Do not connect the power cable.

## 4-4 Checking the Main Element

The quality of the main element can be checked using a tester.

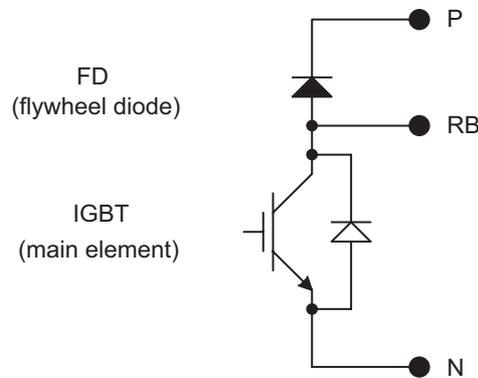
### Preparation

Make preparations for the check by following the procedure below.

1. Disconnect the cables (N, RB, P and P terminals), and the built-in resistor cable (RB and P terminals).
2. Prepare a tester. (Usable range is 1  $\Omega$  measurement resistance.)

### Checking method

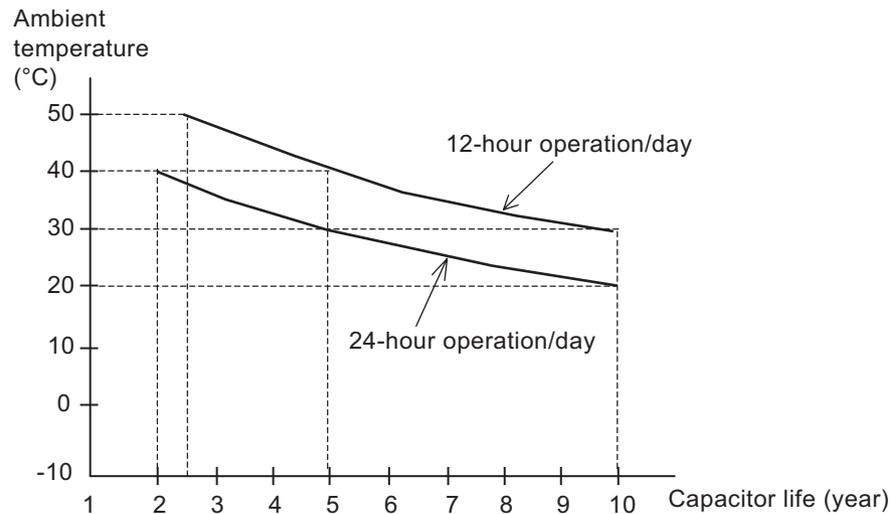
The quality can be judged by measuring the conduction state of the N, RB and P terminals on the Regenerative Braking Unit terminal block (main circuit terminals) while alternating the tester polarity.



- First, measure the voltage between the P and N terminals in the DC voltage range. Then, make sure that there is no residual voltage before performing the check.
- A nearly infinite value is shown in a no-conduction state. The value shown ranges from a few to a few dozen  $\Omega$  in a conduction state. If the measurement result for each item is as listed below, the quality is judged as being acceptable.

	Tester polarity		Measurement results
	+ (red)	- (black)	
IGBT	RB	N	Conduction
	N	RB	No conduction
FD	P	RB	Conduction
	RB	P	No conduction

## 4-5 Capacitor Life Curve



Note 1: Ambient temperature refers to the surrounding (atmospheric) temperature of the Regenerative Braking Unit, or the temperature inside if it's encased or installed in an enclosure.

Note 2: The smoothing capacitor, which will waste because of the internal chemical reaction, should normally be replaced once every 5 years.

If the ambient temperature is high, however, frequent operation of the Regenerative Braking Unit will cause its service life to be significantly shortened due to capacitor deterioration.

**4**

**Inspection and Maintenance**

# Chapter 5

## Specifications

5-1	Standard Specification List.....	5-1
5-2	Dimensional Drawing.....	5-5

# 5-1 Standard Specification List

## Models with a Built-in Resistor (3G3AX-RBU21/-RBU22/-RBU41)

Voltage class		3-phase 200 V class		3-phase 400 V class						
Model (3G3AX-)		RBU21	RBU22	RBU41 <sup>*1</sup>						
Connectable resistance		17 Ω min.	17 Ω min.	34 Ω min.						
Operating voltage ON/OFF		ON: 362.5 ± 5 V, OFF: 355 ± 5 V (-5 % or -10 % setting available)		ON: 725 ± 5 V, OFF: 710 ± 5 V (-5 % or -10 % setting available)						
Operation indication		LED ON (Lit)								
Maximum number of units in parallel operation <sup>*2</sup>		5 units								
Built-in resistor	Built-in resistance	120 W 180 Ω	120 W 20 Ω	120 W 180 Ω x 2 in series						
	Allowable consecutive ON time	10s max.	0.5s max.	10s max.						
	Allowable operation cycle	Cycle 1/10 (10s ON/90s OFF)	Cycle 1/80 (0.5s ON/40s OFF)	Cycle 1/10 (10s ON/90s OFF)						
	Power consumption	Instantaneous: 0.73 kW Short-time rating: 120 W	Instantaneous: 6.6 kW Short-time rating: 120 W	Instantaneous: 1.46 kW Short-time rating: 240 W						
Protective functions	Built-in relay specifications <ul style="list-style-type: none"> <li>The temperature relay operates if the built-in resistor reaches approx. 200 °C or more, and recovers at approx. 170 °C or less.</li> <li>Built-in thermal fuse (recovery impossible)<sup>*3</sup></li> <li>Rating of contact               <table border="0" style="display: inline-table; vertical-align: middle;"> <tr> <td style="padding-right: 10px;">250 V AC</td> <td>200 mA (R load)</td> </tr> <tr> <td>12 V DC</td> <td>500 mA(R load)</td> </tr> <tr> <td>42 V DC</td> <td>200 mA(R load)</td> </tr> </table> </li> <li>Minimum load 1 mA</li> </ul>				250 V AC	200 mA (R load)	12 V DC	500 mA(R load)	42 V DC	200 mA(R load)
250 V AC	200 mA (R load)									
12 V DC	500 mA(R load)									
42 V DC	200 mA(R load)									
Operating environment	Ambient temperature	-10 °C to 50 °C								
	Ambient storage temperature	-20 °C to 65 °C (short-time temperature during transport)								
	Humidity	20 % to 90 % (with no condensation)								
	Vibration	5.9 m/s <sup>2</sup> (0.6G) 10 to 55 Hz								
	Location	At a maximum altitude of 1000m; indoors (without corrosive gases or dust)								
Paint color		Munsell 5Y7/1 (cooling fan: aluminum ground color)								

\*1. To use the Braking Resistor (3G3AX-RAB/-RBB/-RBC) for the 400-V class Regenerative Braking Unit, be sure to remove the built-in resistor, and connect two resistors of the same model in series.

If the 400-V class Regenerative Braking Unit is operated with a single Braking Resistor, the Braking Resistor may be damaged.

\*2. Set the DIP switches.

- \*3. The built-in resistor has a thermal fuse.  
If the alarm terminal is not connected, the fuse may blow out in order to prevent the resistor from burning due to overheating.  
If the fuse blows out, the built-in resistor must be replaced.

## Models without a Built-in Resistor (3G3AX-RBU23/-RBU24/-RBU42/-RBU43)

Voltage class		3-phase 200-V class		3-phase 400-V class							
Model (3G3AX-)		RBU23	RBU24	RBU42 <sup>*1</sup>	RBU43 <sup>*1</sup>						
Connectable resistance	Continuous operation	6 Ω min.	4 Ω min.	24 Ω min.	12 Ω min.						
	Short-time operation/ Allowable operation cycle / Allowable continuous ON time	4 Ω min. Cycle 1/5 (2 min ON/ 8 min OFF) 2 min	2 Ω min. Cycle 1/5 (2 min ON/ 8 min OFF) 2 min	10 Ω min. Cycle 1/10 (10 s ON/ 90 s OFF) 10 s	6 Ω min. Cycle 1/5 (2 min ON/ 8 min OFF) 2 min						
Operating voltage ON/OFF		ON: 362.5 ± 5 V, OFF: 355 ± 5 V (-5 % or -10 % setting available)		ON: 725 ± 5 V, OFF: 710 ± 5 V (-5 % or -10 % setting available)							
Operation indication		LED ON (Lit)									
Maximum number of units in parallel operation <sup>*2</sup>		2 units									
Protective functions	Built-in power module overheat protection	Built-in relay specifications <ul style="list-style-type: none"> <li>• The temperature relay operates if the cooling fin reaches approx. 100°C or more.</li> <li>• Rating of contact               <table style="display: inline-table; vertical-align: middle; margin-left: 10px;"> <tr> <td style="padding-right: 10px;">240 V AC</td> <td>3 A (R load)</td> </tr> <tr> <td>36 V DC</td> <td>2 A(R load)</td> </tr> </table> </li> <li>• Minimum load               <table style="display: inline-table; vertical-align: middle; margin-left: 10px;"> <tr> <td style="padding-right: 10px;">5 V DC</td> <td>50 mA (R load)</td> </tr> </table> </li> </ul>				240 V AC	3 A (R load)	36 V DC	2 A(R load)	5 V DC	50 mA (R load)
240 V AC	3 A (R load)										
36 V DC	2 A(R load)										
5 V DC	50 mA (R load)										
Operating environment	Ambient temperature	-10 °C to 50 °C									
	Ambient storage temperature	-20 °C to 65 °C (short-time temperature during transport)									
	Humidity	20 % to 90 % (with no condensation)									
	Vibration	4.9 m/s <sup>2</sup> (0.5G) 10 to 55 Hz									
	Location	At a maximum altitude of 1000m; indoors (without corrosive gases or dust)									
Paint color		Munsell 5Y7/1 (cooling fan: aluminum ground color)									

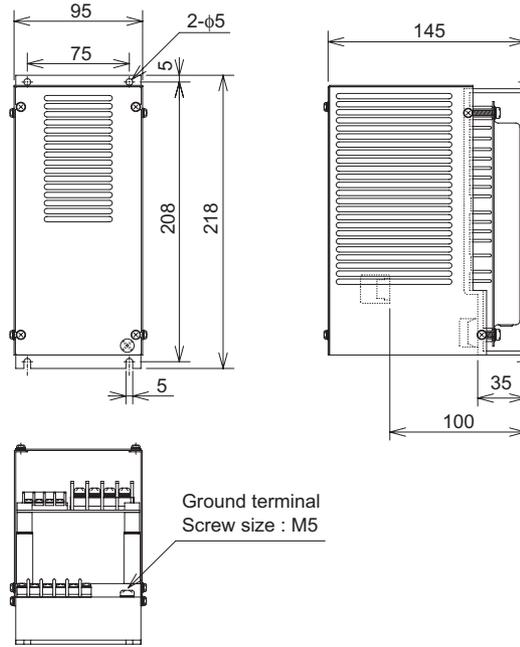
- \*1. To use the Braking Resistor (3G3AX-RAB/-RBB/-RBC) for the 400-V class Regenerative Braking Unit, be sure to connect two resistors of the same model in series. If the 400-V class Regenerative Braking Unit is operated with a single Braking Resistor, the Braking Resistor may be damaged.
- \*2. Set the DIP switches.

### ■ Specifications of Braking Resistors (3G3AX-RBA/-RBB/-RBC)

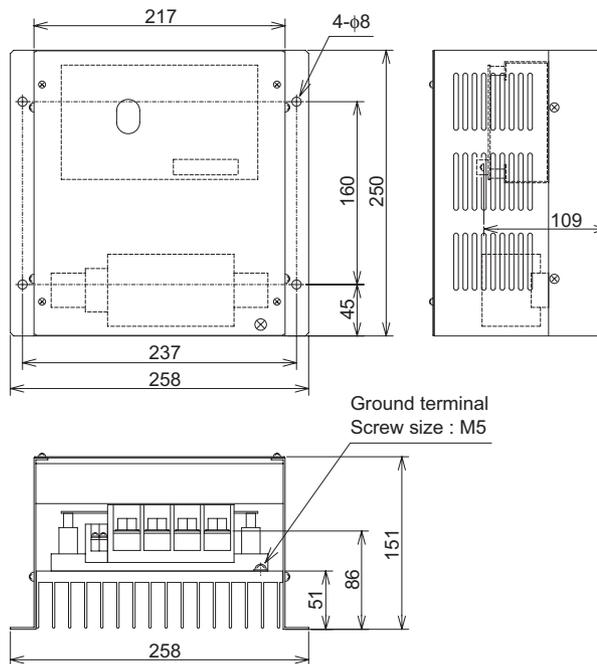
Model	3G3AX-RBA				3G3AX-RBB				3G3AX-RBC		
	1201	1202	1203	1204	2001	2002	3001	4001	4001	6001	12001
Resistance ( $\Omega$ )	180	100	50	35	180	100	50	35	50	35	17
Capacity (W)	120				200		300	400	400	600	1200
Allowable braking frequency (%ED)	5	2.5	1.5	1.0	10	7.5	7.5	7	10		
Allowable continuous braking time(s)	20	12	5	3	30		20	10			

# 5-2 Dimensional Drawing

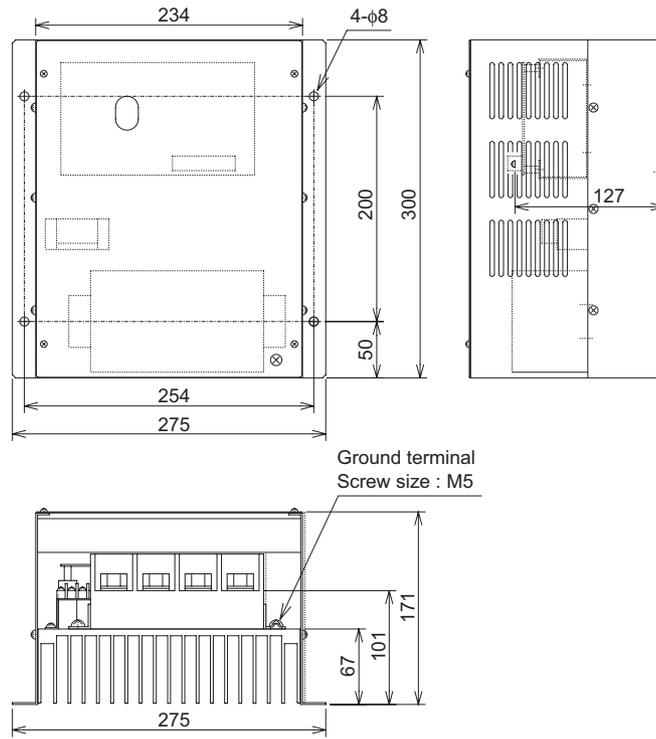
## 3G3AX-RBU21/-RBU22/-RBU41



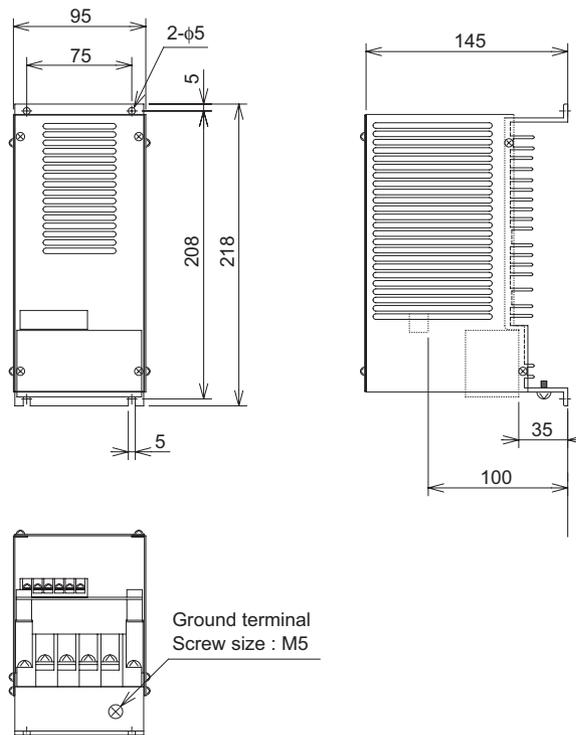
## 3G3AX-RBU23



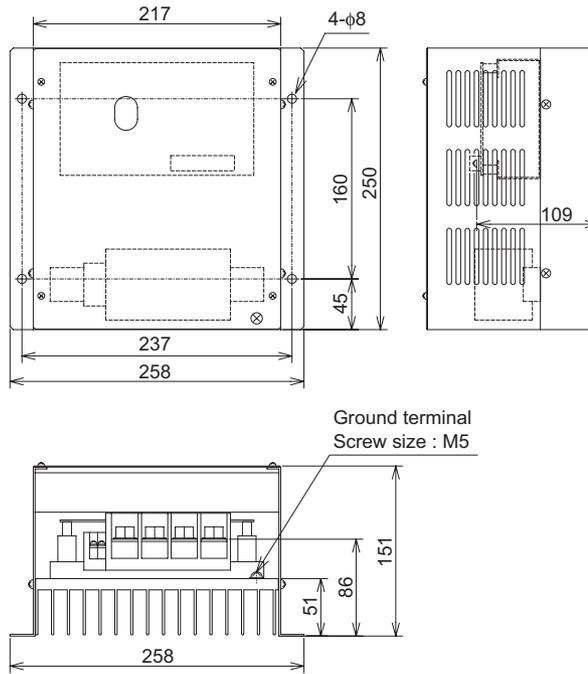
**3G3AX-RBU24**



**3G3AX-RBU42**



**3G3AX-RBU43**





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1. **Offer; Acceptance.** These terms and conditions (these "Terms") are deemed part of all quotes, agreements, purchase orders, acknowledgments, price lists, catalogs, manuals, brochures and other documents, whether electronic or in writing, relating to the sale of products or services (collectively, the "Products") by Omron Electronics LLC and its subsidiary companies ("Omron"). Omron objects to any terms or conditions proposed in Buyer's purchase order or other documents which are inconsistent with, or in addition to, these Terms.
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4. **Interest.** Omron, at its option, may charge Buyer 1-1/2% interest per month or the maximum legal rate, whichever is less, on any balance not paid within the stated terms.
5. **Orders.** Omron will accept no order less than \$200 net billing.
6. **Governmental Approvals.** Buyer shall be responsible for, and shall bear all costs involved in, obtaining any government approvals required for the importation or sale of the Products.
7. **Taxes.** All taxes, duties and other governmental charges (other than general real property and income taxes), including any interest or penalties thereon, imposed directly or indirectly on Omron or required to be collected directly or indirectly by Omron for the manufacture, production, sale, delivery, importation, consumption or use of the Products sold hereunder (including customs duties and sales, excise, use, turnover and license taxes) shall be charged to and remitted by Buyer to Omron.
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10. **Force Majeure.** Omron shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.
11. **Shipping; Delivery.** Unless otherwise expressly agreed in writing by Omron:
  - a. Shipments shall be by a carrier selected by Omron; Omron will not drop ship except in "break down" situations.
  - b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
  - c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
  - d. Delivery and shipping dates are estimates only; and
  - e. Omron will package Products as it deems proper for protection against normal handling and extra charges apply to special conditions.
12. **Claims.** Any claim by Buyer against Omron for shortage or damage to the Products occurring before delivery to the carrier must be presented in writing to Omron within 30 days of receipt of shipment and include the original transportation bill signed by the carrier noting that the carrier received the Products from Omron in the condition claimed.
13. **Warranties.** (a) **Exclusive Warranty.** Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied. (b) **Limitations.** OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right. (c) **Buyer Remedy.** Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty. See <http://www.omron247.com> or contact your Omron representative for published information.
14. **Limitation on Liability; Etc.** OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.
15. **Indemnities.** Buyer shall indemnify and hold harmless Omron Companies and their employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Omron and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party.
16. **Property; Confidentiality.** Any intellectual property in the Products is the exclusive property of Omron Companies and Buyer shall not attempt to duplicate it in any way without the written permission of Omron. Notwithstanding any charges to Buyer for engineering or tooling, all engineering and tooling shall remain the exclusive property of Omron. All information and materials supplied by Omron to Buyer relating to the Products are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and strictly prevent disclosure to any third party.
17. **Export Controls.** Buyer shall comply with all applicable laws, regulations and licenses regarding (i) export of products or information; (ii) sale of products to "forbidden" or other proscribed persons; and (iii) disclosure to non-citizens of regulated technology or information.
18. **Miscellaneous.** (a) **Waiver.** No failure or delay by Omron in exercising any right and no course of dealing between Buyer and Omron shall operate as a waiver of rights by Omron. (b) **Assignment.** Buyer may not assign its rights hereunder without Omron's written consent. (c) **Law.** These Terms are governed by the law of the jurisdiction of the home office of the Omron company from which Buyer is purchasing the Products (without regard to conflict of law principles). (d) **Amendment.** These Terms constitute the entire agreement between Buyer and Omron relating to the Products, and no provision may be changed or waived unless in writing signed by the parties. (e) **Severability.** If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) **Setoff.** Buyer shall have no right to set off any amounts against the amount owing in respect of this invoice. (g) **Definitions.** As used herein, "including" means "including without limitation"; and "Omron Companies" (or similar words) mean Omron Corporation and any direct or indirect subsidiary or affiliate thereof.

## Certain Precautions on Specifications and Use

1. **Suitability of Use.** Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases but the following is a non-exhaustive list of applications for which particular attention must be given:
  - (i) Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
  - (ii) Use in consumer products or any use in significant quantities.
  - (iii) Energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
  - (iv) Systems, machines and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to this Product.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON'S PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
2. **Programmable Products.** Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.
3. **Performance Data.** Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.
4. **Change in Specifications.** Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.
5. **Errors and Omissions.** Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

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