

RCU Series Regenerative Converter Unit Instruction Manual

NOTE: REFER ALSO TO APPLICABLE
INVERTER INSTRUCTION MANUAL



Manual Number: HAL1057C

May 2012

After reading this manual,
keep it handy for future
reference.

Hitachi America, Ltd.

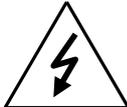
Revision History

Rev A, May 2010 – Miscellaneous corrections throughout. Added cooling clearance drawing.

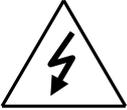
Rev B, June 2010 – Significant updated information.

Rev C May 2012– Redesigned manual format

1. SAFETY

| | |
|---|--|
|  | <p>ONLY A COMPETENT ELECTRICIAN SHOULD CARRY OUT THE ELECTRICAL INSTALLATION.</p> |
|---|--|

1.1 WARNINGS

| | | |
|---|----------|--|
|  | 1 | Internal Components and circuit boards (excepting the isolated I/O terminals) apply an electric current when the RCU is connected to the main voltage. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it. |
| | 2 | When the RCU is connected to the main power, current is flowing in the DC-Link (P, N) and output terminals (R, S, T) even if the RCU is not operating. |
| | 3 | RCU has a large capacitive leakage current. |
| | 4 | The control I/O terminals are isolated from the I/O voltage but the relay outputs and other I/Os may have dangerous voltage even if the power is disconnected from the RCU |
| | 5 | User should install Fuse which can be blown fast between output terminals (R, S, T) and main power source of the RCU |
| | 6 | Spare parts can be delivered only by Hitachi America, Ltd. |

1.2 SAFETY INSTRUCTIONS

| | | |
|---|----------|--|
|  | 1 | Do NOT make any connections when the RCU is connected to main voltage. |
| | 2 | Do NOT make any measurements when the RCU is connected to main voltage. |
| | 3 | After disconnecting main power, wait until the cooling fan stops and the indicator on display goes out. Wait a further 5 minutes before doing any work on the RCU connections. Do NOT open even the cover within this time. |
| | 4 | Do NOT make any voltage withstand tests on any parts of the RCU . |
| | 5 | Make sure that the cover of the RCU is closed before connecting main voltage. |

| Ground | Warning Symbols |
|---|---|
| <p>The ground terminal of the RCU</p>  <p>has to be connected to ground wire .</p> <p>Grounding of the RCU prevents high voltage accidents that are caused by switching.</p> | <p>Please be more cautious for the following warning symbols for user's safety</p>  = Dangerous Voltage  = General Warning |

1.3 Wiring

| | | |
|---|----------|---|
|  | 1 | Do not supply overvoltage which over permissible voltage level for the RCU output side terminals (R, S, T) |
| | 2 | Link the RCU output-side terminals (R, S, T) to the exact order |
| | 3 | Link the RCU output-side terminals (R, S, T) between main input power and input AC reactor of inverter |
| | 4 | Only a competent electrician should perform wiring and inspection |

This manual explains specifications, installation, operation, features and maintenance of **RCU**. This is a manual for users who have prior experience with RCU. Please read this manual carefully before operating the **RCU**. Retain it for future reference.

2. Upon Receipt of Products

2.1 Initial Inspection

Each **RCU** has been subjected to demanding factory tests before release. After unpacking, check that the unit does not show any signs of damage or missing parts. (Refer to the RCU Label in Figure 2.1 and RCU Type in Figure 2.2).

In the event of damage, or if the product does not correspond with your order, please contact your supplier immediately.

| | | |
|------------------------------|--|-----------------------------------|
| TYPE | RCU4022 | RCU Model |
| Serial No. | 0901001P | Serial Number |
| Power Rating | 22[kW], 25[%ED] | RCU Nominal Power(Motor Capacity) |
| INPUT | DC513~650V, DC43A (AVG) | RCU Rated Input |
| OUTPUT | 3Φ, AC 380~460V rms, 50/60Hz, AC 40A rms 100s | RCU Rated Output |
| Hitachi America, Ltd. | | |

Figure 2.1 RCU Label (This is attached to the side of the RCU)

2.2 RCU Type

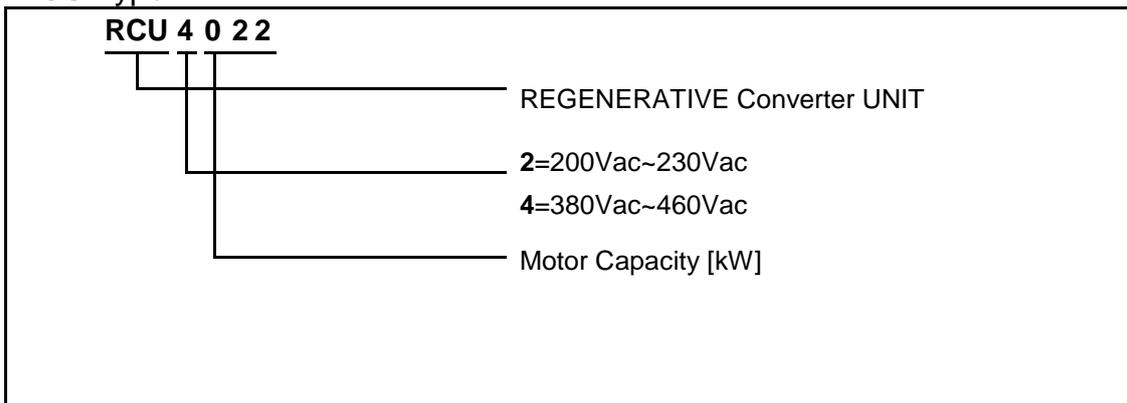


Figure 2.2 RCU Type

2.3 Storage and Warranty

Check the ambient conditions in the storage room before making the first trial run (temperature: -25°C~+60°C, relative humidity: 5~95%, condensation is not allowed).

Hitachi America, Ltd. will not be responsible for the damage caused by ambient conditions.

The period of the product warranty under normal installation and handling conditions is 12 months from the date of installation or 18 months from date of shipment, whichever occurs first. Warranty remedy is limited to either repair at Hitachi's designated service center, or replacement, of the only the RCU in question, at Hitachi America's sole discretion. The warranty does not cover damage to associated equipment, or damage caused by improper installation, unauthorized modification, fire, flood, etc.

Contact Hitachi America for a copy of the complete warranty terms and conditions which govern this sale. If any questions concerning warranty arise, please contact your distributor.

2.4 Power rating

2.4.1 200V RCU output rating

Id = rated DC input current, In = rated AC output current (100sec per 400sec, or 25%ED)

Ic = continuous AC output current, * = ask factory for detail

| Main Voltage 200V - 230V, 50/60Hz RCU Series | | | | | | | |
|--|-------------------------------|-----------|-----------|-----------|------|----------------------|-------------|
| RCU Model | Rated power and Rated current | | | | Size | Dimension WxHxD (mm) | Weight (kg) |
| | P [kW] | Id [Aavg] | In [Arms] | Ic [Arms] | | | |
| RCU2011 | 11 | 36 | 30 | 15 | KE3 | 195x425x210 | 12 |
| RCU2015 | 15 | 48 | 40 | 20 | | | |
| RCU2022 | 22 | 72 | 60 | 30 | | | |

Table 2.4-1 200V series RCU Power ratings and dimensions

2.4.2 400V RCU output rating

Id = rated DC input current, In = rated AC output current (100sec per 400sec,)

Ic = continuous AC output current , * =ask factory for detail

| Main Voltage 380V - 460V, 50/60Hz RCU Series | | | | | | | |
|--|-------------------------------|-----------|-----------|-----------|------|----------------------|-------------|
| RCU Model | Rated power and Rated current | | | | Size | Dimension WxHxD (mm) | Weight (kg) |
| | P [kW] | Id [Aavg] | In [Arms] | Ic [Arms] | | | |
| RCU4011 | 11 | 22 | 20 | 16 | KE2 | 195x425x195 | 12 |
| RCU4015 | 15 | 29 | 27 | 21.6 | | | |
| RCU4022 | 22 | 43 | 40 | 32 | KE3 | 195x425x210 | |
| RCU4030 | 30 | 58 | 54 | 43.2 | KE4 | 195x455x210 | 13.5 |

Table 2.4-2 400V series RCU Power ratings and dimensions

2.5 Mounting

The **RCU** should be mounted in a vertical position on the wall or on the back plane of a cubicle. Follow the requirement for cooling. See chapter 3.2 for dimensions.

In order to ensure a safe installation, make sure that the mounting surface is relatively flat.

Fixing is done with four or more screws or bolts depending on the size of the unit. See Figure 2.5-1 ~ 2.5-3.

2.5.1 KE2

| class | Model |
|-------|---------|
| 400V | RCU4011 |
| | RCU4015 |

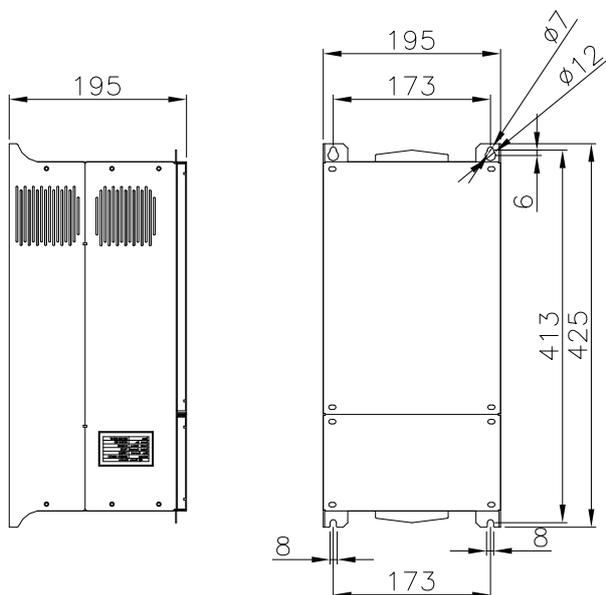


Figure 2.5-1 KE2 Mounting dimension

2.5.2 KE3

| Class | Model |
|-------|---------|
| 400V | RCU4022 |

| Class | Model |
|-------|---------|
| 200V | RCU2011 |
| 200V | RCU2015 |
| 200V | RCU2022 |

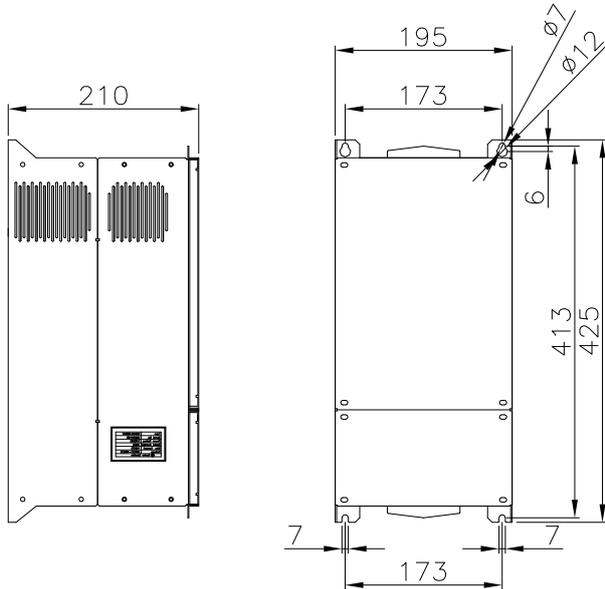


Figure 2.5-2 KE3 Mounting dimension.

2.5.3 KE4

| Class | Model |
|-------|---------|
| 400V | RCU4030 |

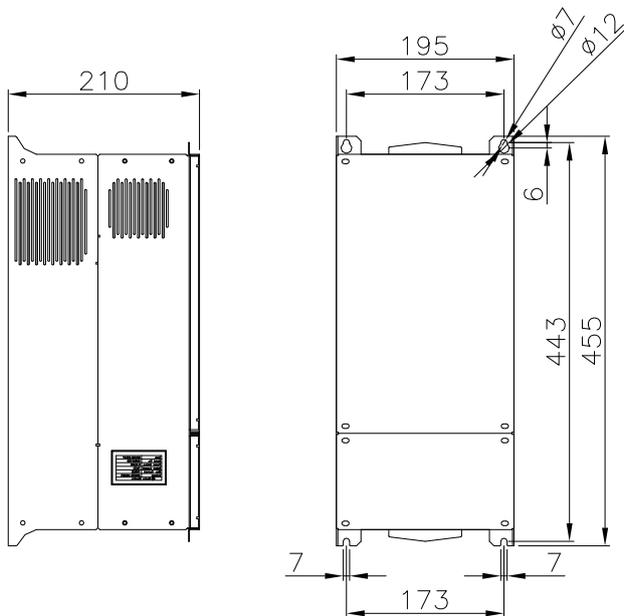


Figure 2.5-3 KE4 Mounting dimension.

2.6 Specification

| | | |
|---------------------------------|---|--|
| Main Connection | Output (AC Source) | (R, S, T) 3-phase 200V _{ac} ~230V _{ac} , 380V _{ac} ~460V _{ac} /45~65Hz |
| | | allowable voltage fluctuation $\pm 10\%$ |
| | allowable imbalance rate between phase $\leq 2\%$ | |
| | Input (DC Source) | AC line voltage X 1.414 |
| Rated Output | Regenerative Torque | 150% for 30sec, 100% for 100sec, 80% continuous |
| | %ED Rating | 25% ED |
| Terminal Characteristics | Control Method | PWM current control method |
| | Input Signal | Run / Enable / Ex. Fault / Fault Reset |
| | Fault Relay Output 1(DO1) | AC 250V, 1A or DC 30V, 1A / N.O/N.C output |
| | Healthy Relay Output 2(DO2) | AC 250V, 1A or DC 30V, 1A / N.O/N.C output |
| Protection Function | Instantaneous over current | Stops at ~ 200% of the current on power side (Protected by Software) |
| | Blown fuse | Motor stops by blown fuse (when over current occurred) |
| | Overvoltage (DC) | Stops at ~ 800 VDC |
| | Overload | Stops after 100% for 100sec, 150% for 30sec |
| | Current limitation | Stops at 150% of rated current operating condition |
| | Overheat | Protected by thermistor at overheat condition (95°C) |
| | Imbalance between phases | In case that imbalance rate between three phases (R, S, T) exceeds 2%. |
| | External Emergency Stop Signal | Protected by external input signal |
| Environmental Conditions | Location | Indoor (Protected from corrosive gases and dust) |
| | Ambient temperature | -10°C ~ +40°C (operating temperature), -20°C ~ +65°C (storage temperature) |
| | Humidity | < 90%, (non-condensing) |
| | Vibration | Up to 9.8 m/s ² (1G), less than 15Hz, up to 1.96 m/s ² (0.2G) at 15 to 60Hz |

***Caution:**

1. RCU cannot be used with single-phase power supply. Use three-phase power supply.
2. RCU capacity is used to select the motor with the same capacity.

3. Installation

3.1 Installation Conditions

Please install the **RCU** in a location satisfying the following conditions.

| | | |
|---|----------|---|
|  | 1 | Avoid rain, high temperature and high humidity. |
| | 2 | Avoid direct sunlight. |
| | 3 | The RCU should be protected from dirt, metal dust, and welding flame. |
| | 4 | Avoid mounting where excessive vibration exists. |
| | 5 | Defective main power may cause the RCU damages. - Using the same power source with welding machine. - Using a generator as the power source. - Sudden changes in the main voltage. |
| | 6 | Keep away from flammable materials. |
| | 7 | Install on nonflammable surfaces only. |

3.2 Cooling

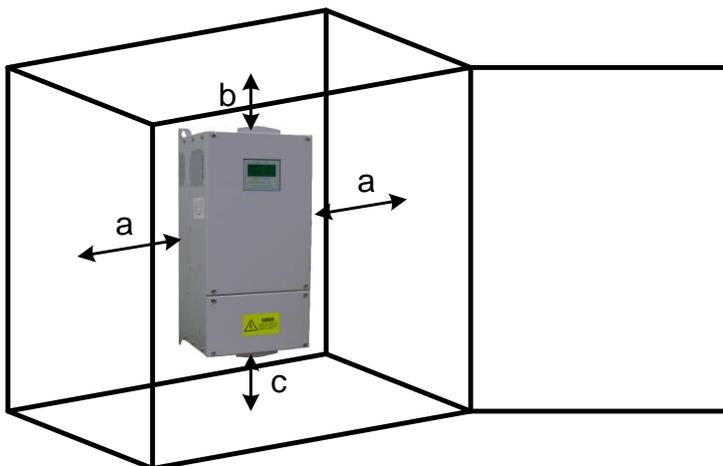


Figure 3.2 Installation space

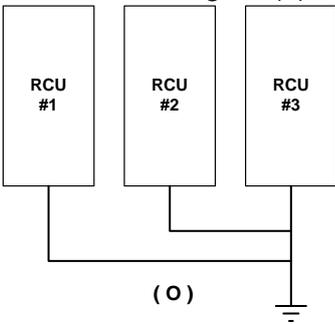
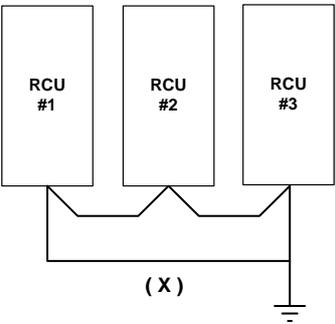
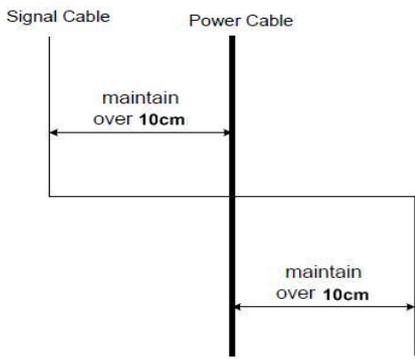
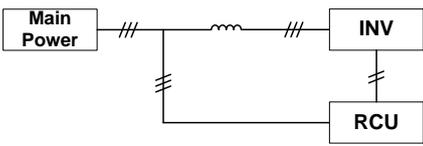
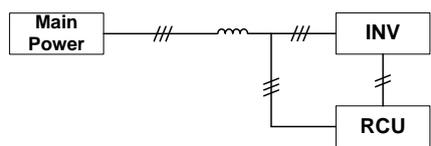
The specified space around the **RCU** ensures proper cooling air circulation. See table 3.2 for dimensions. If multiple units are to be installed above each other, the distance between the units must be $b+c$ and air from the outlet of the lower unit must be directed away from the inlet of the upper unit.

| Size | Dimension(mm) | | | |
|----------------|---------------|----|-----|----|
| | a | a2 | b | c |
| KE2 / KE3/ KE4 | 30 | 10 | 160 | 80 |

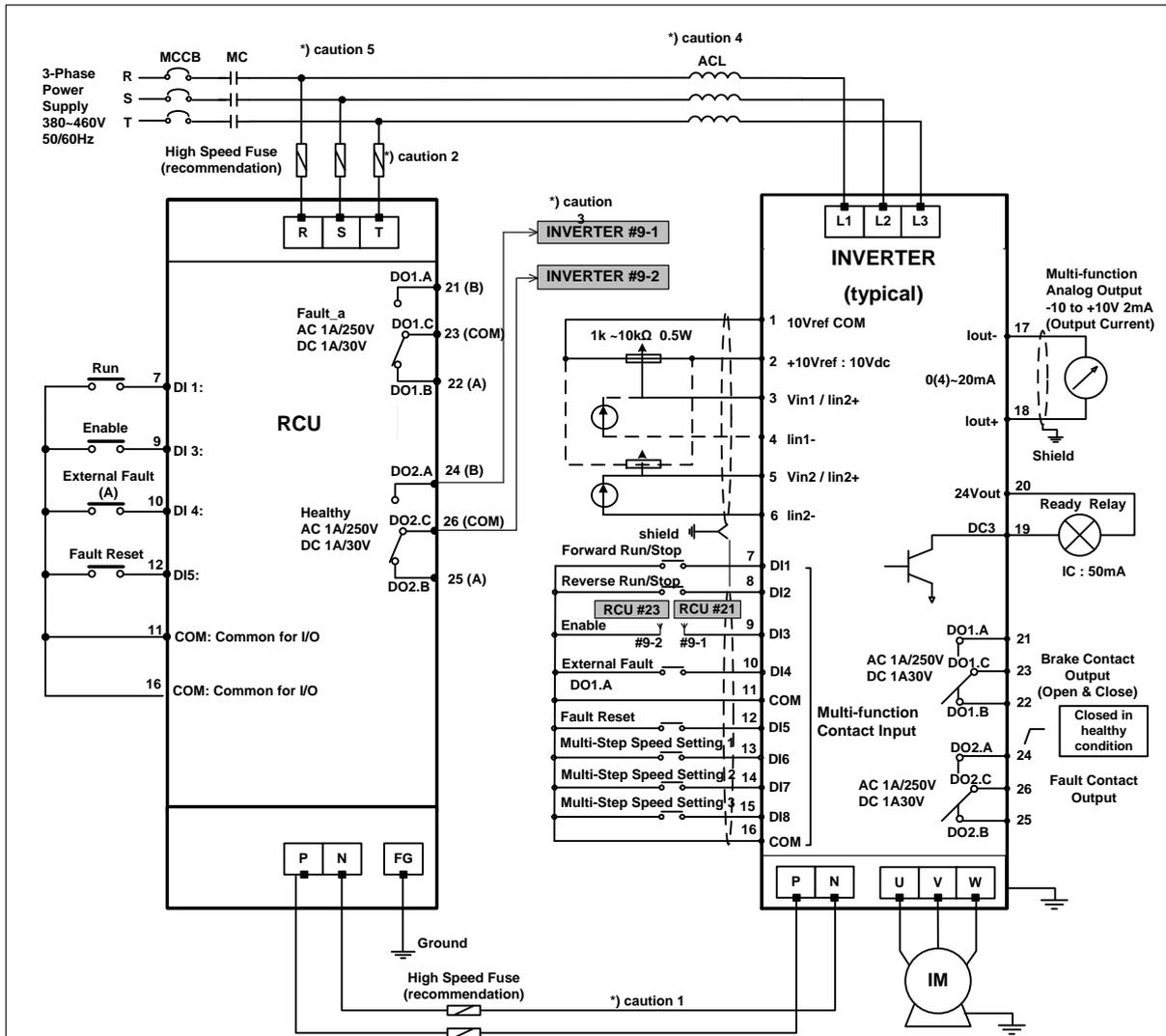
Table 3.2 Installation space dimension
a2 = distance from the RCU to other RCU

4. Wiring

4.1 Cautions in wiring

| | | |
|---|---|--|
|  | 1 | <p>Connect the ground cable surely. If multiple units are to be installed, Do not make the loop with the ground cables like figure (b) below.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(O) (a) GOOD</p> </div> <div style="text-align: center;">  <p>(X) (b) NOT GOOD</p> </div> </div> |
| | 2 | Only a competent electrician should carry out the wiring. |
| | 3 | Make sure that the input main voltage is switched off. |
| | 4 | Fasten the terminal screws to the relevant torque value and make sure that there are not loose terminals. |
| | 5 | <p>The signal cables must be isolated from the power cables. For an unavoidable case, install perpendicular to each other as shown below.</p> <div style="text-align: center;">  </div> |
| | 6 | <p>Link the RCU output-side terminals (R, S, T) between main input power and input AC reactor or filter of the inverter. Otherwise, malfunction of the RCU or inverter could result.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(O) (a) GOOD</p> </div> <div style="text-align: center;">  <p>(X) (b) NOT GOOD</p> </div> </div> |

4.2 Wiring Diagram



*) caution 1 : The cable length between DC Link terminal of inverter and terminal of RCU should be less than 7m. P-N of RCU and DC Link terminal P(+), N(-) of inverter should correspond.

*) caution 2 : Install Fuse between RCU output terminal (R, S, T) and power supply.
(Refer to chapter 4.5 for wire and fuse specification)

*) caution 3 : When you want to connect inverter with RCU, Connect Healthy (A_contact) signal of RCU with Enable signal of inverter.

*) caution 4 : You should install a AC input reactor to prevent the regenerated power from flowing to inverter.

*) caution 5 : You should link RCU output-side terminals (R, S, T) between main input power and input AC reactor of inverter.

Figure 4.1 RCU typical wiring diagram

4.3 Control terminal specific

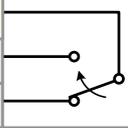
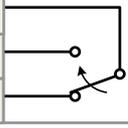
| Catalog | No | Terminal | Signal | Content | |
|----------------|-------|----------|------------------------------------|---|--------------------------|
| Contact Output | 23 | DO1. C | Contact output 1 (common terminal) |  A, B contact common terminal | |
| | 21 | DO1. A | Contact output 1 (a-contact) | | Fault A contact output |
| | 22 | DO1. B | Contact output 1 (b-contact) | | Fault B contact output |
| Contact Output | 26 | DO2. C | Contact output 1 (common terminal) |  A, B contact common terminal | |
| | 24 | DO2. A | Contact output 1 (a-contact) | | Healthy A contact output |
| | 25 | DO2. B | Contact output 1 (b-contact) | | Healthy B contact output |
| Contact Input | 11,16 | DI. COM | Contact input (common terminal) | | |
| | 7 | DI. 01 | Contact Input 1 | RCU operation signal | |
| | 9 | DI. 02 | Contact Input 2 | RCU preparation of operation signal | |
| | 10 | DI. 03 | Contact Input 3 | External fault input signal | |
| | 12 | DI. 04 | Contact Input 4 | RCU fault reset signal | |

Figure 4.2 Control terminal specific

Refer to figure 4.1 for basic connection.

The control cables should be at least 0.5mm² shielded cables. The maximum wire size fitting in the terminals is 2.5mm².

4.4 Terminal block and Screw type (According to Mounting Dimension)

| SIZE | Input/Output Wiring | | | |
|----------------------|---|----------------|------------|---------------------|
| | Terminal Block type | Width (inside) | Screw type | Signed Torque (N·m) |
| KE2P KE3P KE4P |  | 12mm | M5 | 3~4 |

Table 4.1 RCU Terminal Block and Screw type

4.5 I/O Power line and Connection of Fuse

For power lines, use copper wire rated 600V, +75°C. Wire gauge and fuse capacity must be sized based on rated output current of RCU. Please refer to Table 4.2 for the minimum size of power lines (copper) and following fuse capacity. When three or more parallel wires are used, please pay attention to avoid overloading.

| Voltage | Capacity [kW] | I/O cable [mm ²] | Ground cable [mm ²] | FUSE [A] | |
|---------|---------------|------------------------------|---------------------------------|----------------------------|-------------------------------|
| | | | | P, N (800V _{dc}) | R, S, T (500V _{ac}) |
| 200V | 11 | 8 | 4 | 45 | |
| | 15 | 10 | 5 | 60 | |
| | 22 | 16 | 8 | 90 | |
| 400V | 11 | 4 | 2 | 30 | |
| | 15 | 4 | 2 | 40 | |
| | 22 | 8 | 4 | 60 | |
| | 30 | 8 | 4 | 80 | |

Table 4.2 Wire, according to capacity and Fuse recommendation

C A U T I O N S

- 1) Use copper wire rated for 600V, 75°C.
- 2) Use only fast-blow fuses.

5. Operation

5.1 Display description

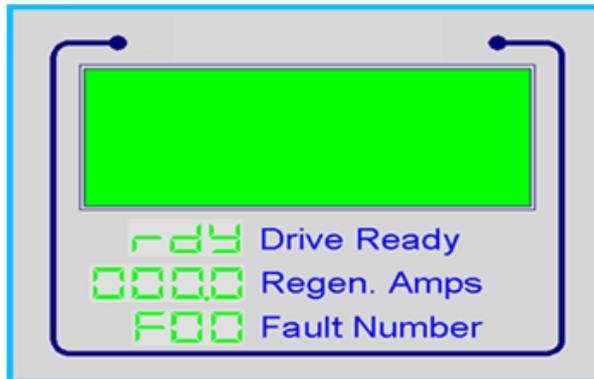


Figure 5.1 keypad display description

5.2 Operation

| | |
|---|--|
| 1 | Refer to wiring diagram in Chapter 4.2 and connect inverter, RCU, and control I/O. Check the RCU P (+) terminal is connected to the inverter DC Link (+) and the RCU N (-) terminal is connected to the inverter DC Link (-). If this condition were not satisfied, RCU could be broken. |
| 2 | After power is supplied to inverter, Check if RCU display on keypad behaves properly. If the display is not good, please check wiring with the inverter. |
| 3 | Enter the DI 1-RUN and DI 2-Enable signal to RCU. |
| 4 | When regenerative energy is generated by inverter driving mode, RCU has a regenerative state. If the magnitude of the regenerative current is not displayed or fault code (Fxx) is displayed, check the operation status and the status of the wiring and control signal input, please. |

5.3 Fault Codes

When RCU fault occurs, the Fault LED on the keypad will be lit. According to the fault states, fault code is displayed such as below. When Fault occurs, Reset should be performed by DI5.

| Fault Code | Function | Fault Description |
|------------|---------------------------------|---|
| F 01 | Overload Protection | Occurs after 100% for 100sec, 150% for 30sec |
| F 02 | Over current Protection | Occurs at approx, 200% of the current on power side (Protected by Software) |
| F 07 | Over voltage Protection | Threshold at approx, 800 VDC |
| F 21 | Overheating Protection | Protected by thermistor at overheat condition(95°C) |
| F 22 | Short Circuit Protection | Detects over current and protects RCU by hardware |
| F 25 | External Emergency Input Signal | Fault generated by external input signal |
| F32 | AC Supply Open | The RCU detects no, or under voltage at the AC line terminals |
| F 35 | Phase Imbalance Protection | Imbalance between phases (R, S, T) exceeds 2%. |

Table 5.1 Fault code / Fault Description

7. Check for Maintenance

| Check Part | Check Item | Check Point | Check Period | | Check Method | Standards of judgment |
|--------------|----------------------------|--|--------------|---------|--|--|
| | | | Daily | Regular | | |
| The Whole | Ambient Environment | Ambient temperature, Humidity, Dust, Hazardous gases, Oil residue Etc. | ○ | | seeing tasting thermometer hygrometer | freezing is not allowed (ambient temperature range : -10~40°C) condensation is not allowed at RH (ambient humidity : 20~90 %) |
| | The whole Equipment | Strange vibration, Strange Sound | ○ | | Seeing, Hearing | No problem |
| | Voltage Source | Voltage fluctuations and Voltage drop | ○ | | Inverter Input voltage measurement | Within ±10% of rated voltage |
| Main Circuit | Overall Point | Insulated resistance | | ○ | Main Circuit Terminal to Ground Terminal (500V-Mega use) | No problem |
| | | Screw extracting | | ○ | Seeing | |
| | | Sign of overheating | | ○ | Seeing | |
| | Terminal Block | Damage | | ○ | Seeing | No damage |
| | Smoothing Condenser | Leaking, Strain | ○ | | Seeing, Hearing | |
| | Relay | Trembling phenomenon | | ○ | Hearing | |
| | Resistor | Crack, Discoloration | | ○ | Seeing | |
| Cooling Fan | Vibration Strange sound | ○ | | Hearing | | |

< Next >

< Continued >

| Check Part | Check Item | Check Point | Check Period | | Check Method | Standards of judgment |
|-----------------|----------------|--------------------------|--------------|---------|---------------------|---|
| | | | Daily | Regular | | |
| Main Circuit | Cooling System | Dust, Stink | | ○ | Seeing | |
| | Wire | Strain peeled | | ○ | Seeing | |
| | RCU Output | 3phase output | | ○ | TESTER Voltmeter | 3 phase output within variation allowed |
| Control Circuit | Operation | Protection Circuit | | ○ | Random behavior | No problem |
| | Connection | Captive state | | ○ | Seeing, Touching | No problem |
| | KEYPAD | Display, Operation state | | ○ | Seeing, Touching | No problem |

Hitachi America, Ltd.

50 Prospect Avenue
Tarrytown, NY 10591

For Technical Support, contact your Hitachi Distributor,

Or visit:

www.hitachi-america.us/inverters

© Hitachi America, Ltd.

Manual Number: **HAL1057C – May 2012**