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OMNUC U–Series
AC Servo Motors/Drivers
(30-750-W Analog Inputs)

User Manual

Cat. No. 1501-E3-1

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Thank you for choosing this OMNUC UA-series product.
This manual provides details on the installation, wiring, troubleshooting, and maintenance of OMNUC UA-series products along with parameter settings for the operation of the products.

- Make sure that actual users of this product will read this manual thoroughly and handle and operate the product with care.
- Retain this manual for future reference.
- This manual describes the specifications and functions of the product and relations with other products. Assume that nothing described in this manual is possible.
- Specifications and functions may change without notice to improve product performance.
- Forward and reverse rotation of AC Servomotors described in this manual are defined as looking at the end of the output shaft of the motor as follows: counterclockwise rotation (CCW) is forward and clockwise rotation (CW) is reverse.

General Instructions

1. Refer to Precautions first and carefully read and be sure to understand the information provided.
2. Familiarize yourself with this manual and understand the functions and performance of the Servomotor and Servo Driver for proper use.
3. The Servomotor and Servo Driver must be wired and the Parameter Unit must be operated by experts in electrical engineering.
4. We recommend that you add the following precautions to any instruction manuals you prepare for the system into which the product is being installed.
   - Precautions on the dangers of high-voltage equipment.
   - Precautions on touching the terminals of the product even after power has been turned off. (These terminals are live even with the power turned off.)
5. Do not perform withstand voltage or other megameter tests on the product. Doing so may damage internal components.
6. Servomotors and Servo Drivers have a finite service life. Be sure to keep replacement products on hand and to consider the operating environment and other conditions affecting the service life.
7. Do not set any parameter not described in this manual, otherwise the Servomotor or Servo Driver may malfunction. Contact your OMRON representatives if you have any inquiry.
8. The functions and specifications differ for the various models, as shown below. Be sure to check which models are being used before proceeding.
   - HA/LA/V/W AC Servo Drivers: R88D-UA□□HA, R88D-UA□□LA, R88D-UA□□V, and R88D-UA□□W
   - H/L AC Servo Drivers: R88D-UA□□H and R88D-UA□□L
   - Incremental AC Servomotors: R88M-U□□□30H(A), R88M-U□□□30L(A), R88M-U□□□30VA, and R88M-U□□□30WA
   - Absolute AC Servomotors: R88M-U□□□30T(A), R88M-U□□□30S(A), R88M-U□□□30XA, and R88M-U□□□30YA

NOTICE

Before using the product under the following conditions, consult your OMRON representatives, make sure that the ratings and performance characteristics of the product are good enough for the systems, machines, or equipment, and be sure to provide the systems, machines, or equipment with double safety mechanisms.

1. Conditions not described in the manual.
2. The application of the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, or safety equipment.
3. The application of the product to systems, machines, or equipment that may have a serious influence on human life and property if they are used improperly.

Items to Check After Unpacking

Check the following items after removing the product from the package:

- Has the correct product been delivered (i.e., the correct model number and specifications)?
- Has the product been damaged in shipping?

The product is provided with this manual. No connectors or mounting screws are provided.

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Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

⚠ DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

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General Warnings

Observe the following warnings when using the OMNUC Servomotor and Servo Driver.

This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

⚠ **WARNING** Always connect the frame ground terminals of the Servo Driver and the Servomotor to a class-3 ground (to 100 Ω or less). Not connecting to a class-3 ground may result in electric shock.

⚠ **WARNING** Do not touch the inside of the Servo Driver. Doing so may result in electric shock.

⚠ **WARNING** Do not remove the front cover, terminal covers, cables, Parameter Units, or optional items while the power is being supplied. Doing so may result in electric shock.

⚠ **WARNING** Operation, maintenance, or inspection must be performed by authorized personnel. Not doing so may result in electric shock or injury.

⚠ **WARNING** Wiring or inspection must be performed at least 5 minutes after turning off the power supply. Doing so may result in electric shock.

⚠ **WARNING** Do not damage, press, or put excessive stress or heavy objects on the cables. Doing so may result in electric shock.

⚠ **WARNING** Do not touch the rotating parts of the Servomotor under operation. Doing so may result in injury.

⚠ **WARNING** Do not modify the product. Doing so may result in injury or damage to the product.

⚠ **Caution** Use the Servomotors and Servo Drivers in a specified combination. Doing so may result in fire or damage to the products.

⚠ **Caution** Do not store or install in the following places. Doing so may result in fire or damage to the Product.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to shock or vibration.
- Locations subject to exposure to water, oil, or chemicals.

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⚠ **Caution** Do not touch the Servo Driver radiator or Servomotor while the power is being supplied or soon after the power is turned off. Doing so may result in a skin burn due to the hot surface.

Storage and Transportation Precautions

⚠ **Caution** Do not hold by the cables or motor shaft while transporting the product. Doing so may result in injury or malfunction.

⚠ **Caution** Do not place any load exceeding the figure indicated on the product. Doing so may result in injury or malfunction.

⚠ **Caution** Use the motor eye-bolts only for transporting the Motor. Using them for transporting the machinery may result in injury or malfunction.

Installation and Wiring Precautions

⚠ **Caution** Do not step on or place a heavy object on the product. Doing so may result in injury.

⚠ **Caution** Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product. Doing so may result in fire.

⚠ **Caution** Be sure to install the product in the correct direction. Not doing so may result in malfunction.

⚠ **Caution** Provide the specified clearances between the Servo Driver and the control panel or with other devices. Not doing so may result in fire or malfunction.

⚠ **Caution** Do not apply any strong impact. Doing so may result in malfunction.

⚠ **Caution** Be sure to wire correctly and securely. Not doing so may result in motor runaway, injury, or malfunction.

⚠ **Caution** Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.

⚠ **Caution** Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.

⚠ **Caution** Always use the power supply voltage specified in the User's Manual. An incorrect voltage may result in malfunction or burning.

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⚠ **Caution** Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.

⚠ **Caution** Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.

⚠ **Caution** Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety.) Not doing so may result in injury.

⚠ **Caution** Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.

⚠ **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations:

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

Operation and Adjustment Precautions

⚠ **Caution** Check the newly set parameters for proper execution before actually running them. Not doing so may result in equipment damage.

⚠ **Caution** Do not make any extreme adjustments or setting changes. Doing so may result in unstable operation and injury.

⚠ **Caution** Separate the Servomotor from the machine, check for proper operation, and then connect to the machine. Not doing so may cause injury.

⚠ **Caution** When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation. Not doing so may result in injury.

⚠ **Caution** Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart. (Take appropriate measures to secure safety against an unexpected restart.) Doing so may result in injury.

⚠ **Caution** Do not use the built-in brake of the Servomotor for ordinary braking. Doing so may result in malfunction.

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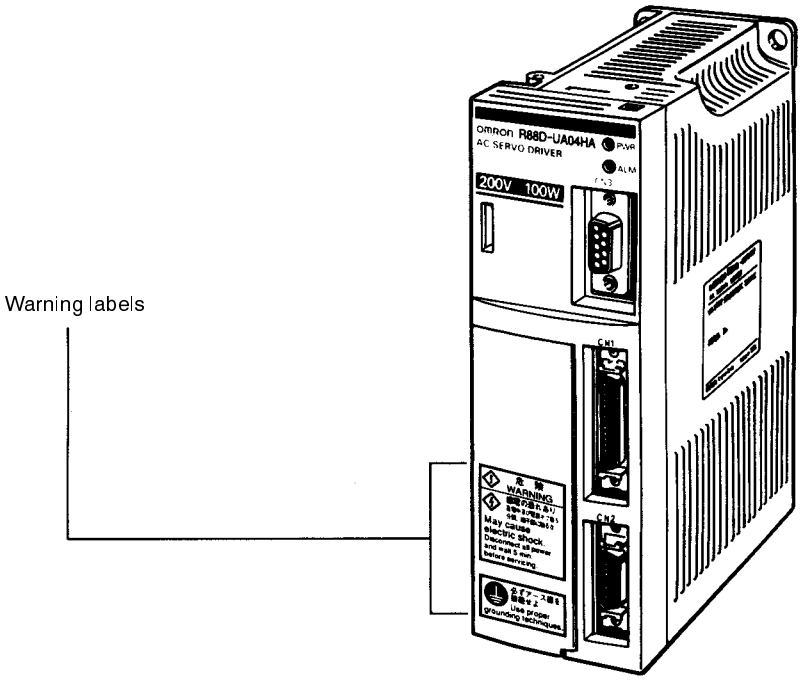
Maintenance and Inspection Precautions

⚠ WARNING Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

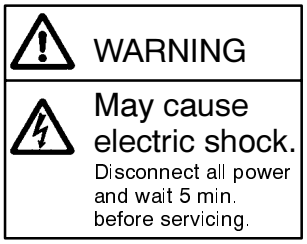
⚠ Caution Resume operation only after transferring to the new Unit the contents of the data required for operation. Not doing so may result in an unexpected operation.

Warning Labels

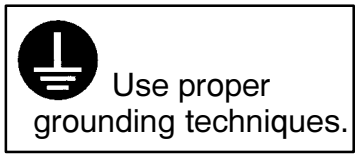
Warning labels are pasted on the product as shown in the following illustration. Be sure to follow the instructions given there.



Warning Labels for Non-conforming Models



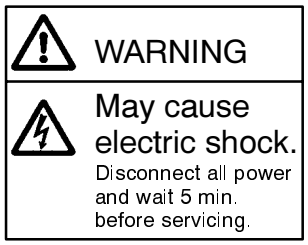
Warning label 1



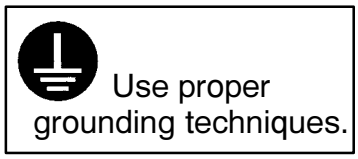
Warning label 2

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Warning Labels for Models Conforming to EC Directives



Warning label 1

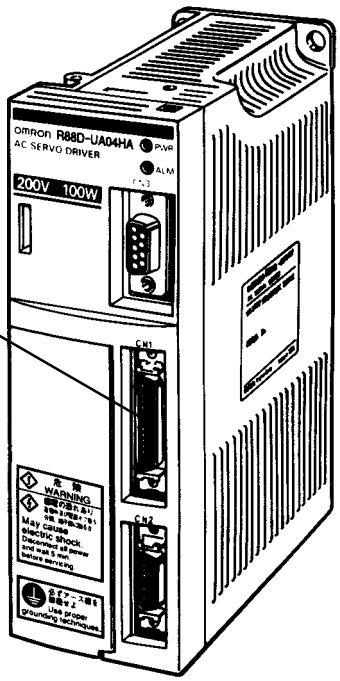


Warning label 2

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OMNUC U Series

OMNUC U-series AC Servo Driver

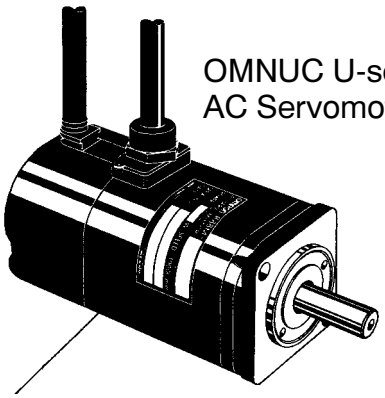


I/O Operations
Chapter 5: 5-1-3

Cable Specifications
Chapter 5: 5-3-2, 5-3-3

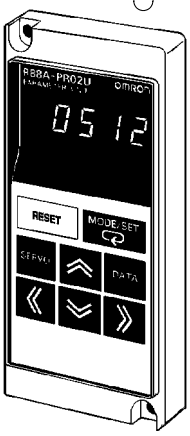
Encoder signals

Power signals



OMNUC U-series AC Servomotor

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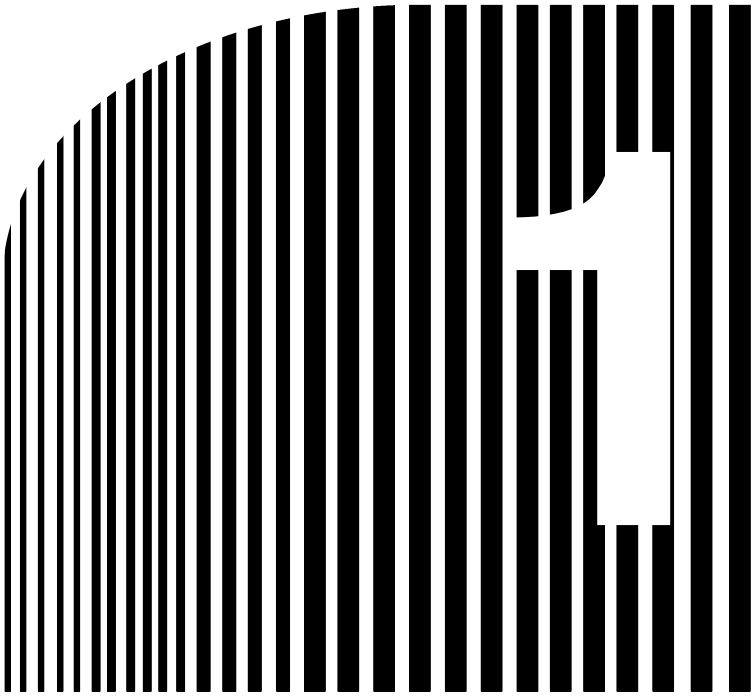
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Revision History

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Chapter 1

• Introduction •

1-1 Features
1-2 System Configuration
1-3 Servo Driver Nomenclature
1-4 Applicable Standards and Models

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1-1 Features

OMNUC AC Servo Drivers control the power supplied to AC Servomotors with analog input signals to perform precise speed control. There are 7 types of AC Servomotors: 30-W, 50-W, 100-W, 200-W, 300-W, 400-W, and 750-W.

■ Motor Output Capacity

AC Servomotors with the following output capacities are available.

- For 200/230-VAC (170 to 253 V) single-phase, 50/60-Hz Input
  30 W, 50 W, 100 W, 200 W, 400 W, and 750 W
- For 100/115-VAC (85 to 127 V) single-phase, 50/60-Hz Input
  30 W, 50 W, 100 W, 200 W, and 300 W

The Servomotors also come with and without brakes, and with and without keys on the straight shaft. Servomotors that conform to EC Directives, however, are available only with keys on the shaft.

■ Models Conforming to UL/cUL Standards Available (UL/cUL Markings)

AC Servomotors and Servo Drivers that conform to UL/cUL Standards are now available. Their performance, functionality, and appearance are the same as the conventional U-series (HA/LA) models. They are useful for obtaining approvals required for specific applications.

Models conforming to UL/cUL Standards have the same product names as conventional U-series (HA/LA) models. As shown in the following table, they are distinguished by the manufacturing date.

Model	Manufacturing date	Type	Remarks
Models not conforming to any standards	Before April 1998	H/L, HA/LA	Production of H/L models discontinued.
Models conforming to UL/cUL Standards	After May 1998	HA/LA	UL/cUL markings are attached to products.

■ EC Directives (CE Markings)

AC Servomotors and Servo Drivers that conform to EC low-voltage and EMC directives are now available. These provide the same performance and functions as the rest of the U Series (HA/LA), and will aid in obtaining specifications.

■ Motors with Incremental or Absolute Encoders

The following encoders are available on the AC Servomotors.

- Incremental encoders with 2,048 pulses/rotation
- Absolute encoders with 1,024 pulses/rotation and a maximum number of rotations of ±99,999.

Select the best encoder for your application.

If a Servomotor with an absolute encoder is used, it can be combined with a CV500-MC221/421 or C200H-MC221 Motion Control Unit to build an absolute encoder system, eliminating the need for origin searches to reduce startup time.

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■ Control Functions

Any one of the following 8 control modes can be selected in the parameter settings.

- Speed Control

  Controls the speed of the Servomotor very precisely with an analog input signal (the speed command voltage).
  The ratio between the command voltage and number of revolutions can be set in the parameters.
  The setting range is ±2 to 10 V/rated number of revolutions. (With the factory setting the rated number of revolutions is reached at ±10 V.)

- Speed Control with Position-lock Function

  This control mode adds the position-lock function to the speed control mode.
  When the position-lock command (PLOCK) is input, the control mode switches from speed control to position control and the motor is servo-locked so temperature drift won't cause slight rotation.
  The number of revolutions caused by position-lock can be set in the parameters.

- Internal Speed Control Settings (Servo-lock when Stopped)

  The speed of the motor is controlled with the three speeds (No. 1, No. 2, and No. 3 internal speed settings) set in the parameters.
  This mode is effective for simple position control or speed-switching operation.

- Internal Speed Control Settings (Position-lock when Stopped) HA/LA/V/W Models

  This control mode has the same operation as the internal speed control settings described above, except that a position loop is established when the Servomotor is stopped, so the stopped position can be maintained even when an external force is applied.

- Internal Speed Control Settings (Servo-lock when Stopped) + Speed Control HA/LA/V/W Models

  Speed control can be performed with the internal speed settings as well as analog inputs (the speed command voltage).
  With the internal speed settings, the Servomotor will be servo-locked when it is stopped.

- Internal Speed Control Settings (Position-lock when Stopped) + Speed Control HA/LA/V/W Models

  Speed control can be performed with the internal speed settings as well as analog inputs (the speed command voltage).
  With the internal speed settings, the Servomotor will be position-locked when it is stopped.

- Torque Control 1

  Controls the output torque of the Servomotor with an analog input signal (the torque command voltage).
  The ratio between the command voltage and the torque can be set in the parameters.
  The setting range is ±1 to 10 V/rated torque. (With the factory setting the rated torque is reached at ±3 V.)

- Torque Control 2

  This control mode allows the user to switch between torque control and speed control.
  Speed control is enabled when the torque/speed control switch (TVSEL) is ON, and torque control is enabled when TVSEL is OFF.
  The ratio between the command voltage and torque and the ratio between the command voltage and the number of revolutions can both be set in the parameters.

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■ Auto-tuning

The gain can be adjusted automatically when the responsiveness has been selected to match the rigidity of the mechanical system. The auto-tuning feature automatically finds the optimum adjustment to match the load, with no need for difficult operations.

■ Monitor

Displays the driver's operating status on the Parameter Unit.
The following items can be monitored: speed feedback, speed commands, torque commands, number of pulses from the U-phase edge, electrical angle, and the internal status (bit display).

■ Jog Operation

Forward/Reverse motor operation can be controlled from the Parameter Unit. Rotational speed can be set in the parameters.

■ Automatic Adjustment of Control Offset (Speed Control and Torque Control)

The offsets of the speed command input and torque command input can be adjusted automatically.

■ Encoder Resolution Setting

The encoder signal output from the driver can be set anywhere within the following ranges.

- Incremental encoders: 16 to 2,048 pulses/revolution
- Absolute encoders: 16 to 1,024 pulses/revolution

■ Software Start Function (Speed Control)

This function causes the motor to be started/stopped in the preset acceleration/deceleration times, allowing a simple position control system to be constructed without a Positioner or Host Controller.

The acceleration and deceleration times are set separately, and the setting range is 0 to 10 s for each.

■ Reverse Mode

Forward/Reverse commands can be switched in the parameters, without changing the wiring to the motor or encoder.

■ Brake Interlock Output

Outputs a timing signal interlocked with the motor's ON/OFF status and rotational speed. The holding brake of a motor with a brake can be operated reliably.

■ Overtravel Sequence

An overtravel sequence compatible with the system can be selected. There are three deceleration methods available: dynamic brake deceleration, free-run deceleration, and emergency-stop torque deceleration (parameter setting).

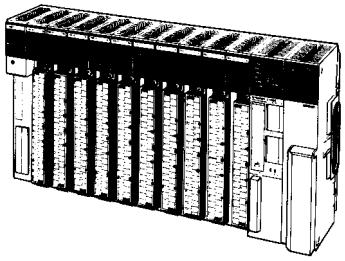
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■ Computer Monitor Software (HA/LA/V/W Models)

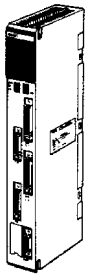
The special Servo Driver Communications Software allows parameter setting, speed and current monitoring, I/O monitoring, auto-tuning, and jog operations to be performed from a personal computer. It is also possible to perform multiple-axis communications that set the parameters and monitor the operation of several drivers. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details.

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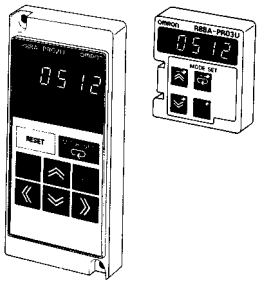
1-2 System Configuration



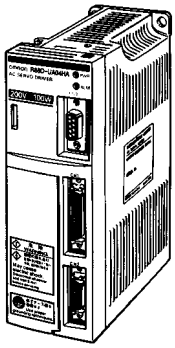
SYSMAC C/CV-series
Programmable Controller



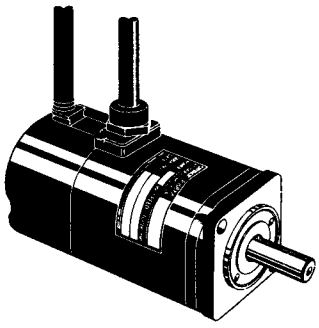
CV500-MC221/CV500-MC421
C200H-MC221
Motion Control Unit
C500-NC222-E
Position Control Unit



Parameter Units



OMNUC U-series
AC Servo Driver

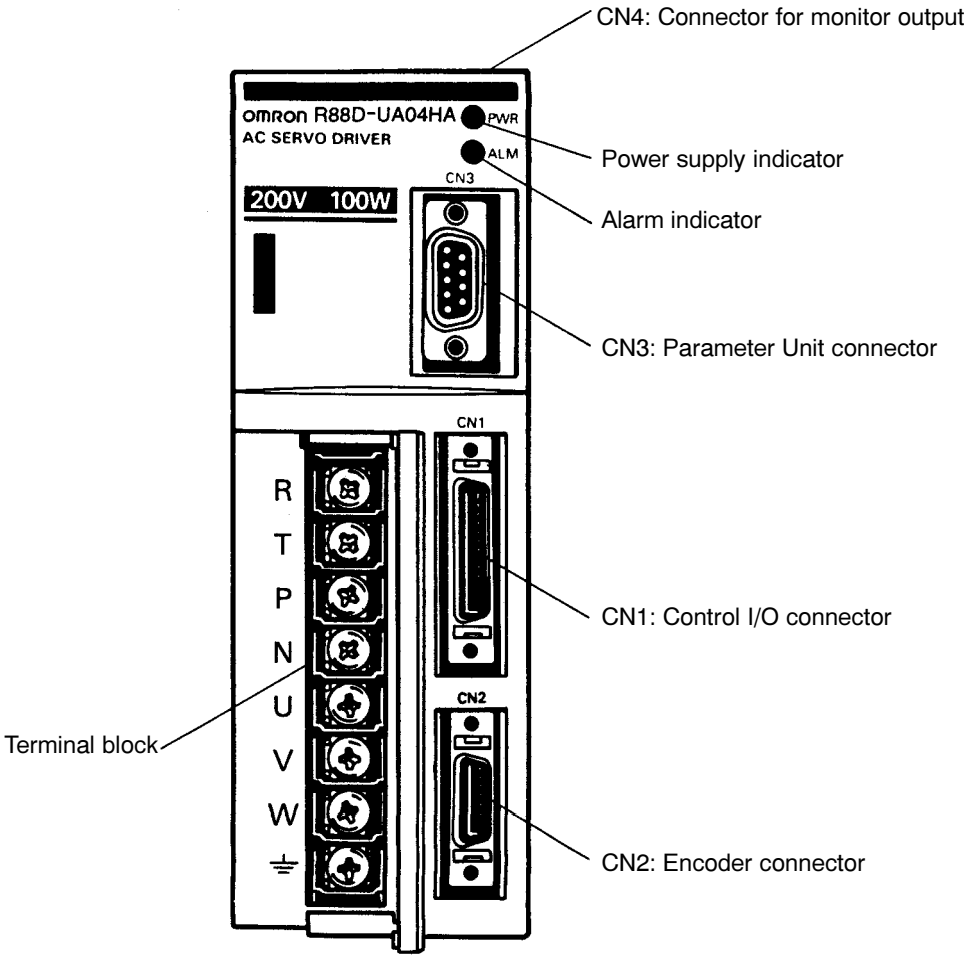


OMNUC U-series
AC Servomotor

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1-3 Servo Driver Nomenclature

■ Front View



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1-4 Applicable Standards and Models

1-4-1 UL/cUL Standards

■ Applicable Standards

Standard	Product	Applicable Standard	File No.	Remarks
UL	AC Servo Driver	UL508C	E179149	Power conversion equipment
	AC Servomotor	UL1004	E179189	Electric motors
cUL	AC Servo Driver	cUL C22.2 No. 14	E179149	Industrial equipment
	AC Servomotor	cUL C22.2 No.100	E179189	Motor and generators

■ Applicable Models

Power supply	AC Servo Drivers	AC Servomotors	
		With incremental encoder	With absolute encoder
200 VAC	R88D-UA□□HA (See note 1.)	R88M-U□□□30HA-□ (See note 2.) (See note 3.)	R88M-U□□□30TA-□ (See note 2.) (See note 3.)
100 VAC	R88D-UA□□LA (See note 1.)	R88M-U□□□30LA-□ (See note 2.) (See note 3.)	R88M-U□□□30SA-□ (See note 2.) (See note 3.)

Note 1. Maximum output current: for example, “04” means approx. 4 A.

Note 2. Motor capacity: for example, “100” means 100 W.

Note 3. Optional specifications

None: Straight shaft without keys and without brake
B: Straight shaft without keys and with brake
S1: Straight shaft with keys and without brake
BS1: Straight shaft with keys and with brake

Note 4. UL/cUL Standards apply to models manufactured after May 1998.

1-4-2 EC Directives

■ Applicable Standards

EC Directive	Product	Directive	Remarks
Low voltage	AC Servo Driver	EN61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	AC Servomotor	IEC34-1, -5, -8, -9	Rotating electrical machines.
EMC	AC Servo Driver AC Servomotor	EN55011 class A group 1	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment.
		EN50082-2	Electromagnetic compatibility generic immunity standard, Part 2 Industrial environment.

Note Installation under the conditions specified in *2-3-3 Wiring Products Conforming to EMC Directives* is required to conform to EMC Directives.

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■ Applicable Models

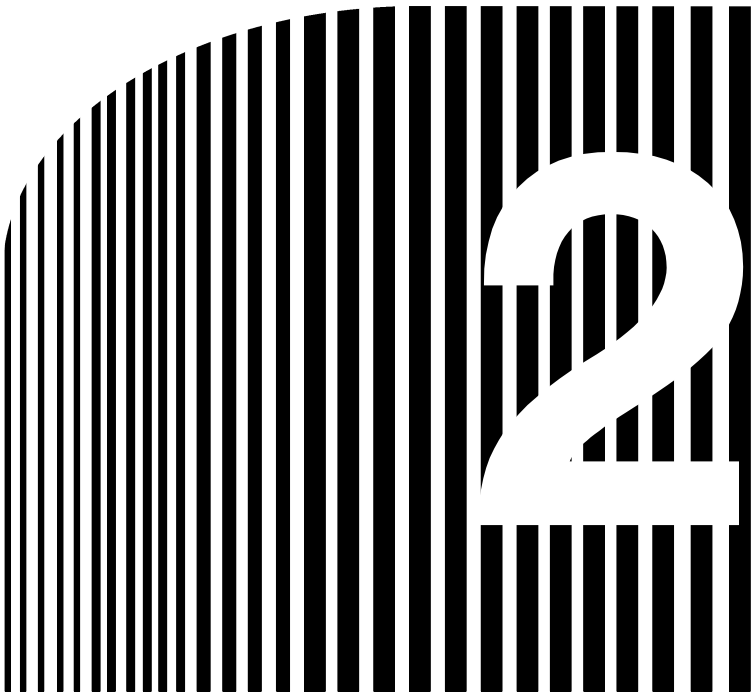
Power supply	AC Servo Drivers	AC Servomotors	
		With incremental encoder	With absolute encoder
200 VAC	R88D-UA□□V	R88M-U□□□30VA-□ (See note.)	R88M-U□□□30XA-□ (See note.)
100 VAC	R88D-UA□□W	R88M-U□□□30WA-□ (See note.)	R88M-U□□□30YA-□ (See note.)

Note Optional specifications (shaft profile: straight shaft with keys)

S1: Straight shaft with keys and without brake

BS1: Straight shaft with keys and with brake

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Chapter 2

• System Design and Installation •

2-1 Installation

2-2 Wiring Products Conforming to UL/cUL and Wiring Products Not Confrorming to Any Standards

2-3 Wiring Products Conforming to EC Directives

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Installation and Wiring Precautions

⚠Caution Do not step on or place a heavy object on the product. Doing so may result in injury.

⚠Caution Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product. Doing so may result in fire.

⚠Caution Be sure to install the product in the correct direction. Not doing so may result in malfunction.

⚠Caution Provide the specified clearances between the Servo Driver and the control panel or with other devices. Not doing so may result in fire or malfunction.

⚠Caution Do not apply any strong impact. Doing so may result in malfunction.

⚠Caution Be sure to wire correctly and securely. Not doing so may result in motor runaway, injury, or malfunction.

⚠Caution Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.

⚠Caution Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.

⚠Caution Always use the power supply voltage specified in the User's Manual. An incorrect voltage may result in malfunction or burning.

⚠Caution Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.

⚠Caution Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.

⚠Caution Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety.) Not doing so may result in injury.

⚠Caution Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.

⚠Caution Take appropriate and sufficient countermeasures when installing systems in the following locations:

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

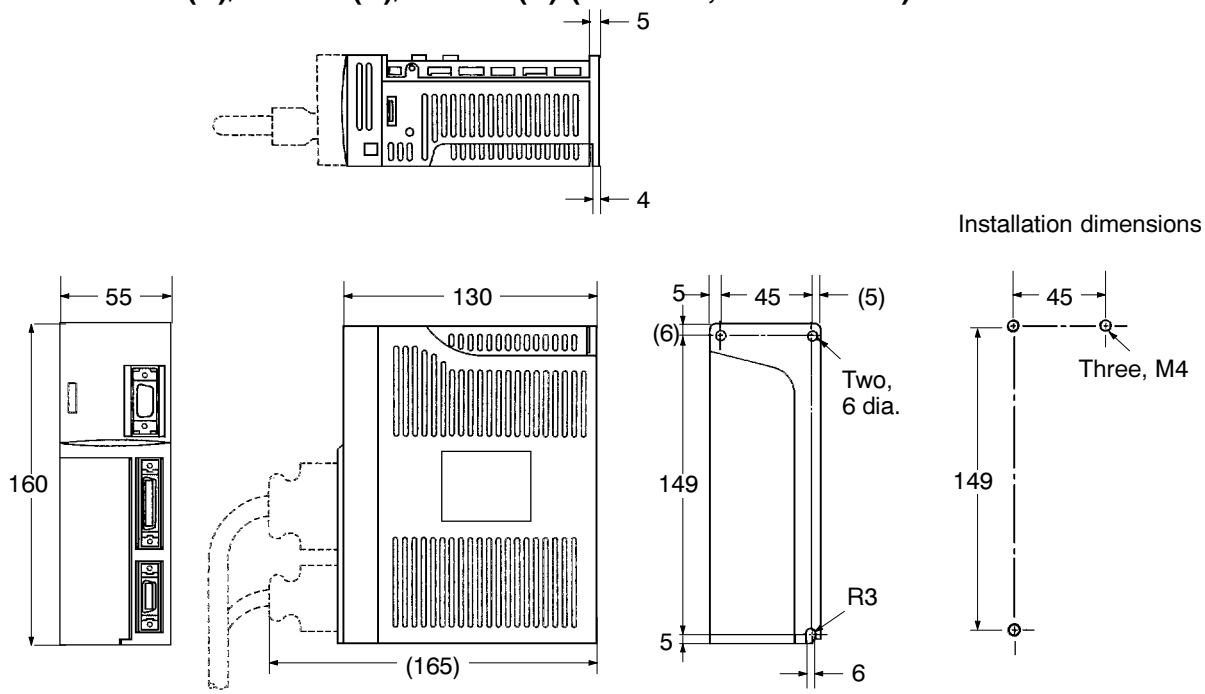
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2-1 Installation

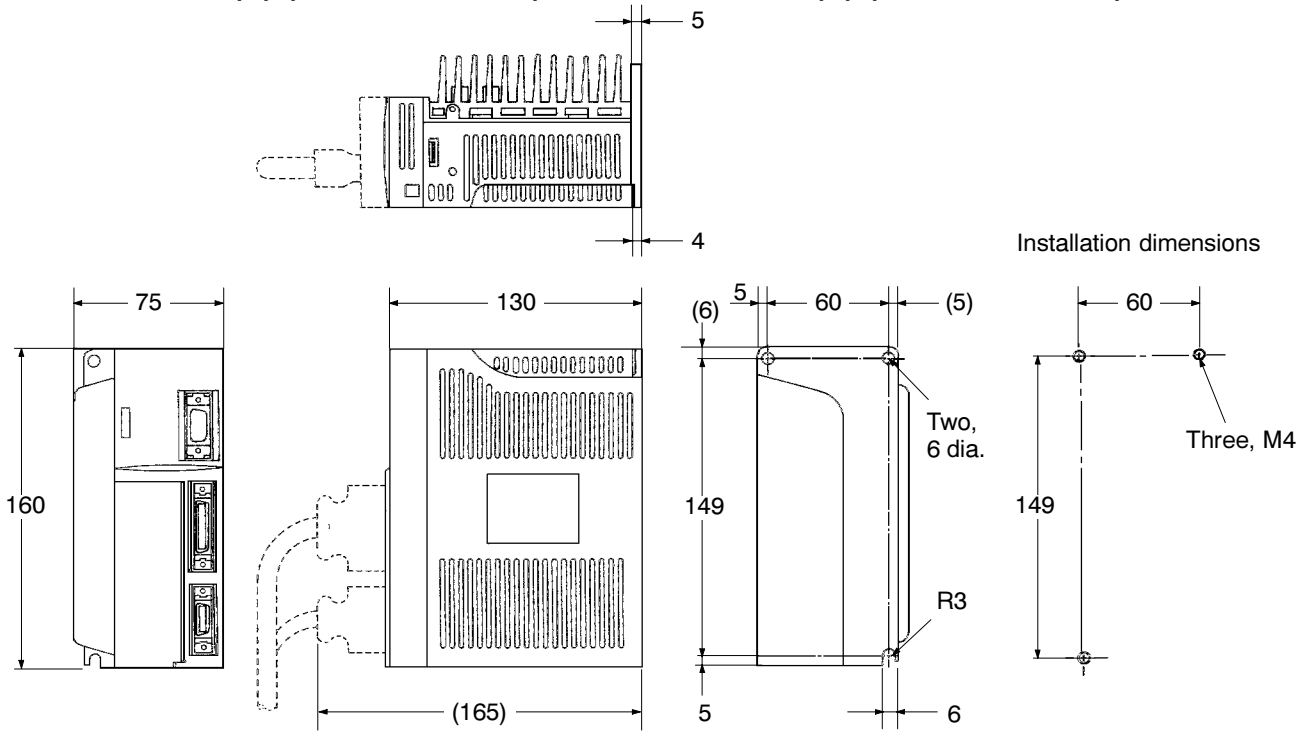
2-1-1 External Dimensions (Unit: mm)

■ AC Servo Drivers Conforming to UL/cUL Standards and AC Servomotors Not Conforming to Any Standards

- **R88D-UA02H(A)/-UA03H(A)/-UA04H(A)/-UA08H(A) (200 VAC, 30 to 200 W)**
  R88D-UA03L(A)/-UA04L(A)/-UA10L(A) (100 VAC, 30 to 100 W)

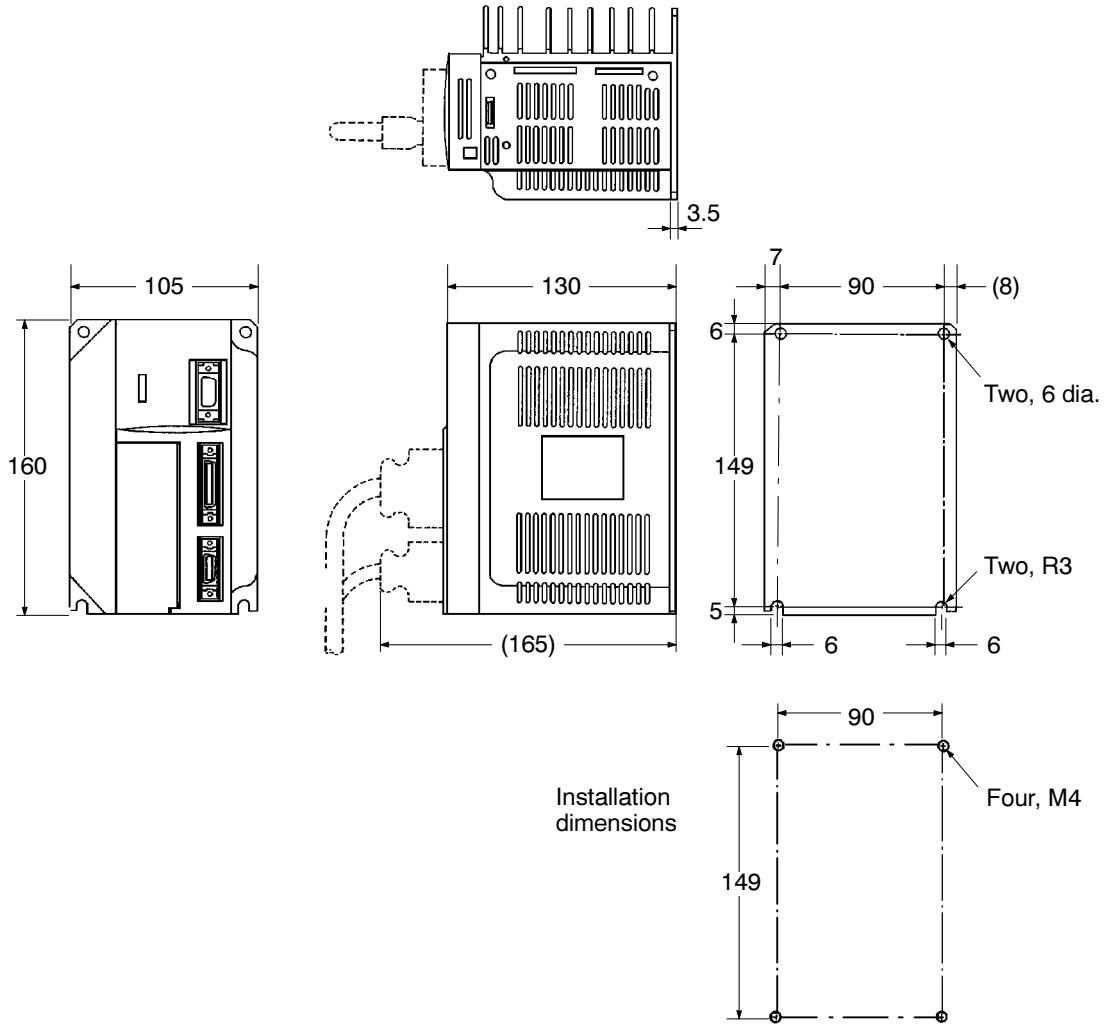


- **R88D-UA12H(A) (200 VAC, 400 W) and R88D-UA12L(A) (100 VAC, 200 W)**



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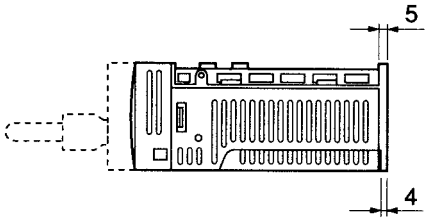
● **R88D-UA20H(A) (200 VAC, 750 W) and R88D-UA15LA (100 VAC, 300 W)**



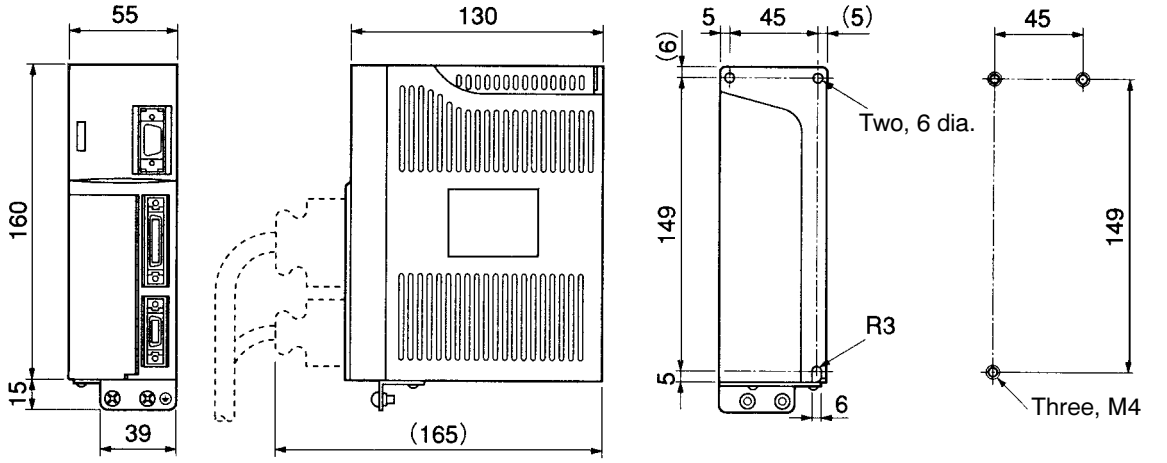
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■ AC Servo Drivers Conforming to EC Directives

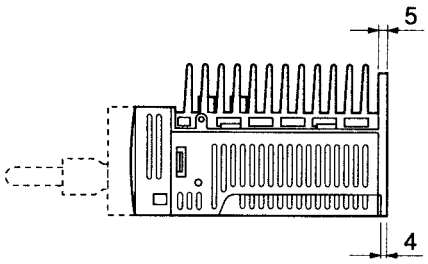
● R88D-UA02V/-UA03V/-UA04V/-UA08V (200 VAC, 30 to 200 W) R88D-UA03W/-UA04W/-UA10W (100 VAC, 30 to 100W)



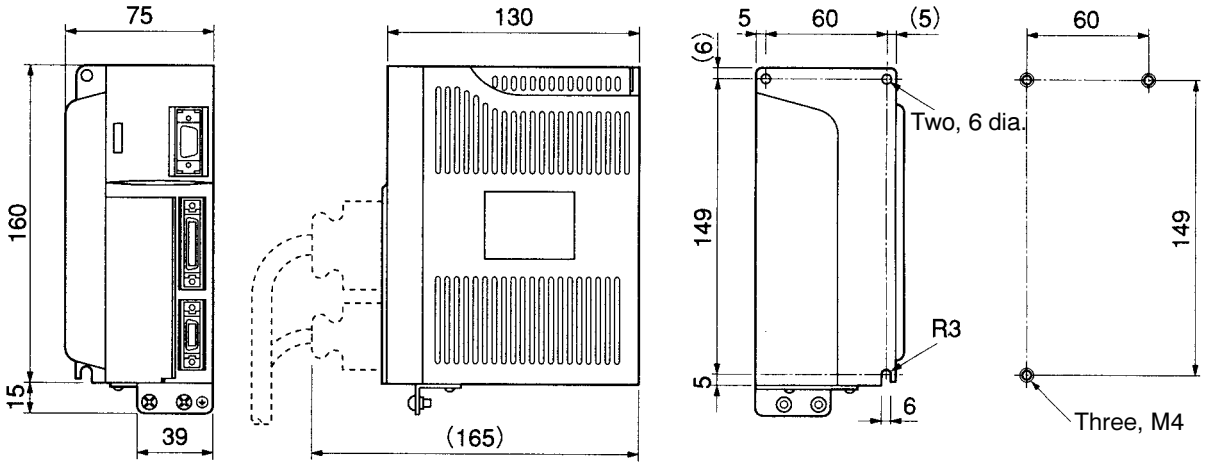
Installation dimensions



● R88D-UA12V (200 VAC, 400 W) and R88D-UA12W (100 VAC, 200W)

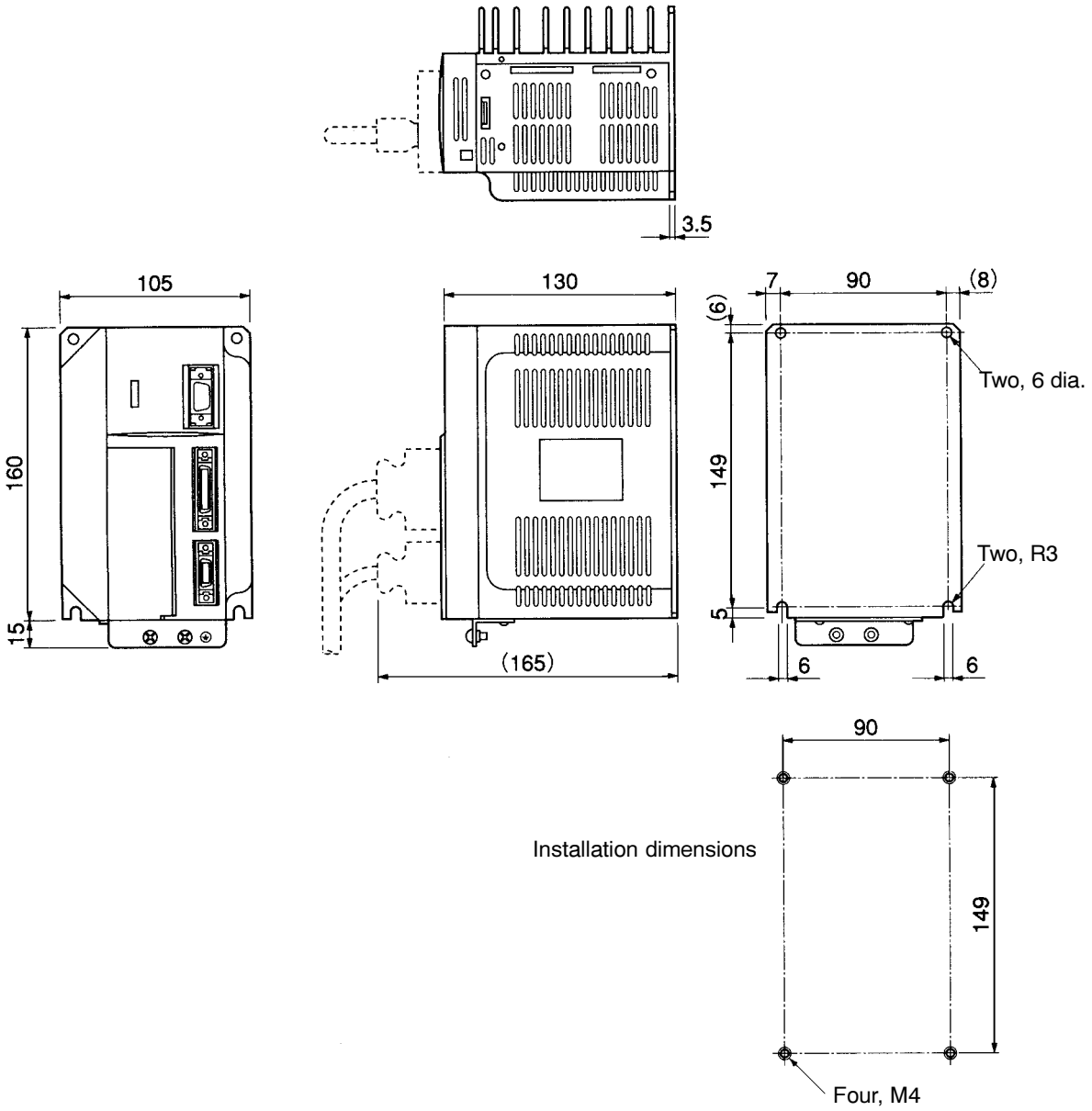


Installation dimensions



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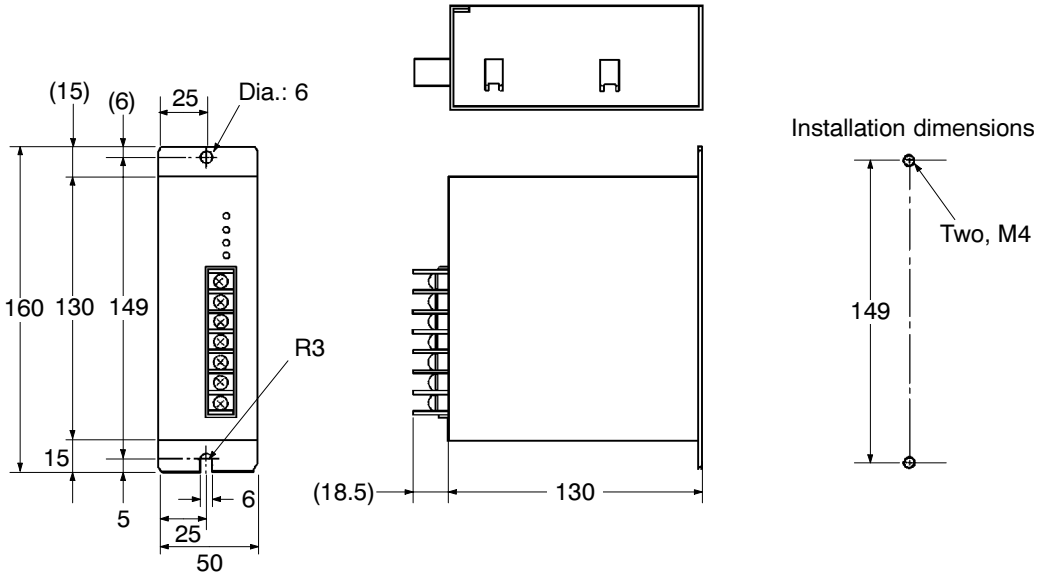
● **R88D-UA20V (200 VAC, 750 W) and R88D-UA15W (100 VAC, 300W)**



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■ Regeneration Unit

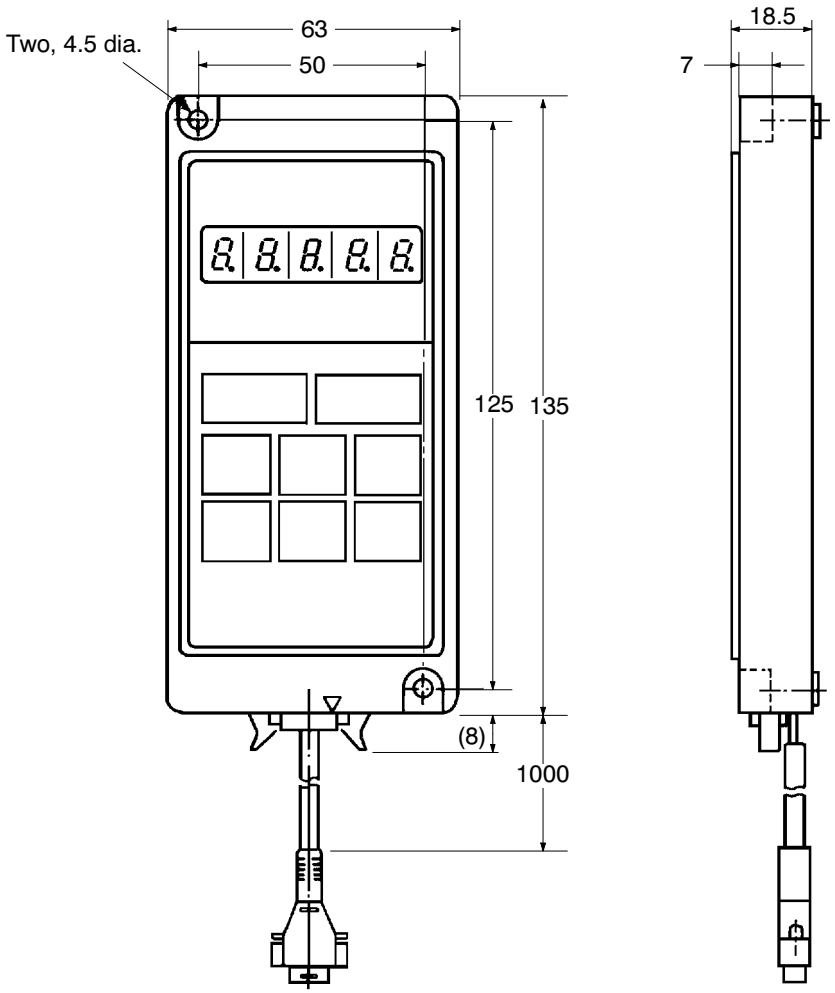
● R88A-RG08UA



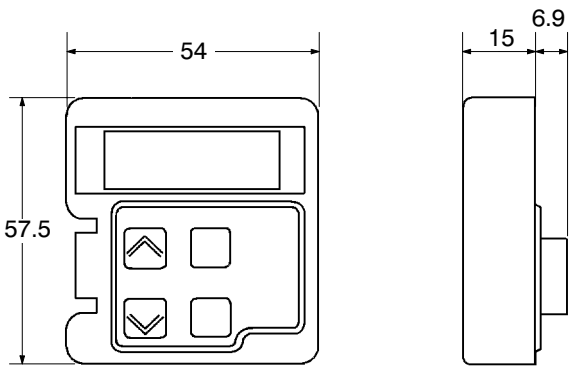
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■ Parameter Units

● R88A-PR02U



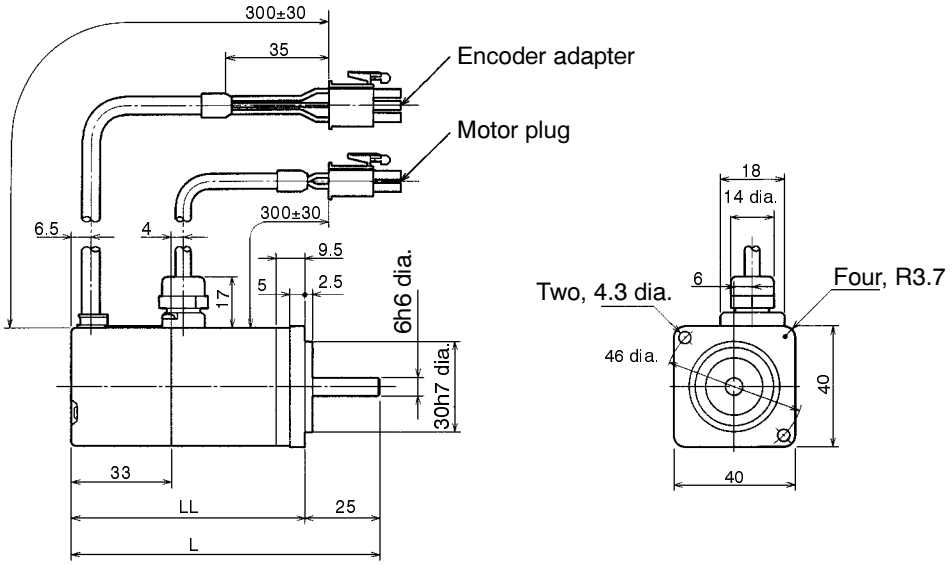
● R88A-PR03U



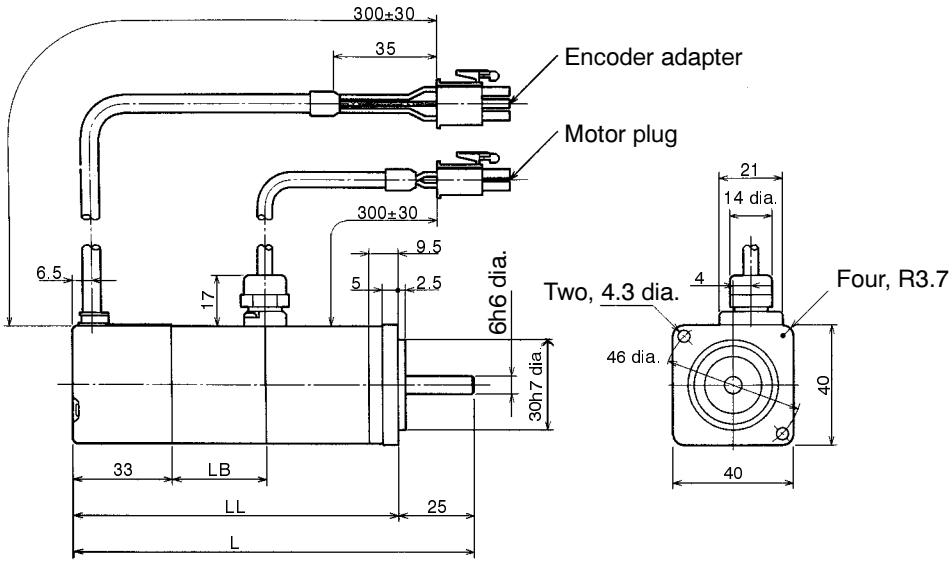
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■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and AC Servomotors Not Conforming to Any Standards

- **30-W/50-W/100-W Standard Models:**
  R88M-U03030HA, R88M-U05030HA, R88M-U10030HA
  R88M-U03030LA, R88M-U05030LA, R88M-U10030LA



- **30-W/50-W/100-W Models with Brake:**
  R88M-U03030HA-B, R88M-U05030HA-B, R88M-U10030HA-B
  R88M-U03030LA-B, R88M-U05030LA-B, R88M-U10030LA-B



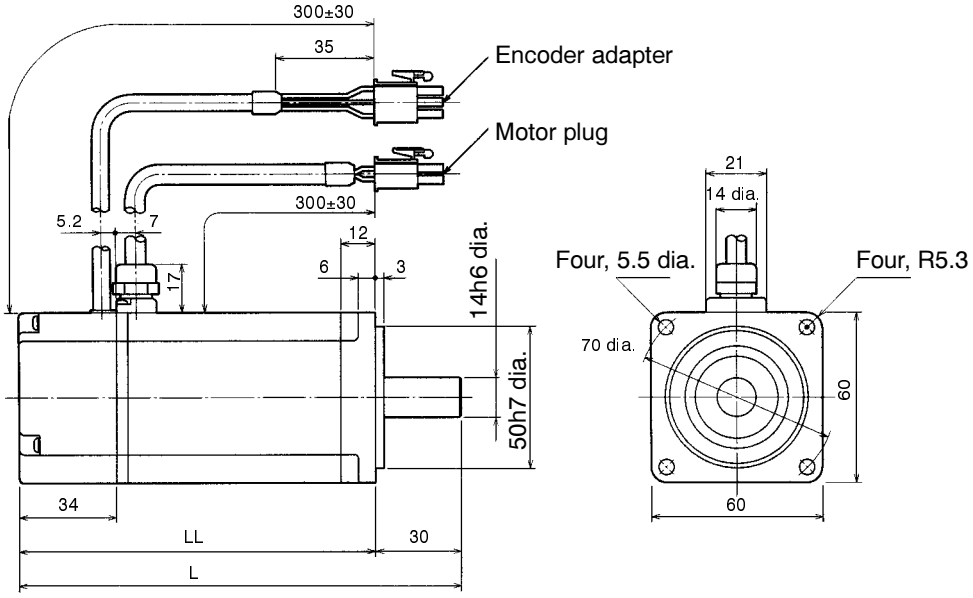
Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030HA R88M-U03030LA	94.5	69.5	6
R88M-U05030HA R88M-U05030LA	102.0	77.0	6
R88M-U10030HA R88M-U10030LA	119.5	94.5	8

Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030HA-B R88M-U03030LA-B	126	101	31.5	6
R88M-U05030HA-B R88M-U05030LA-B	133.5	108.5	31.5	6
R88M-U10030HA-B R88M-U10030LA-B	160	135	40.5	8

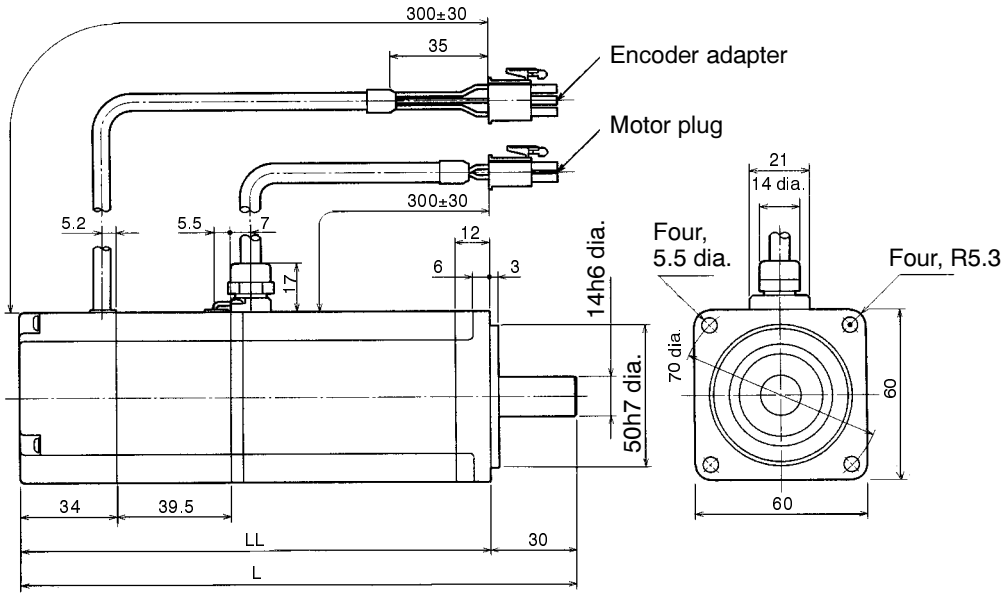
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■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

● 200-W/300-W/400-W Standard Models: R88M-U20030HA, R88M-U40030HA R88M-U20030LA, R88M-U30030LA



● 200-W/300-W/400-W Models with Brake: R88M-U20030HA-B, R88M-U40030HA-B R88M-U20030LA-B, R88M-U30030LA-B



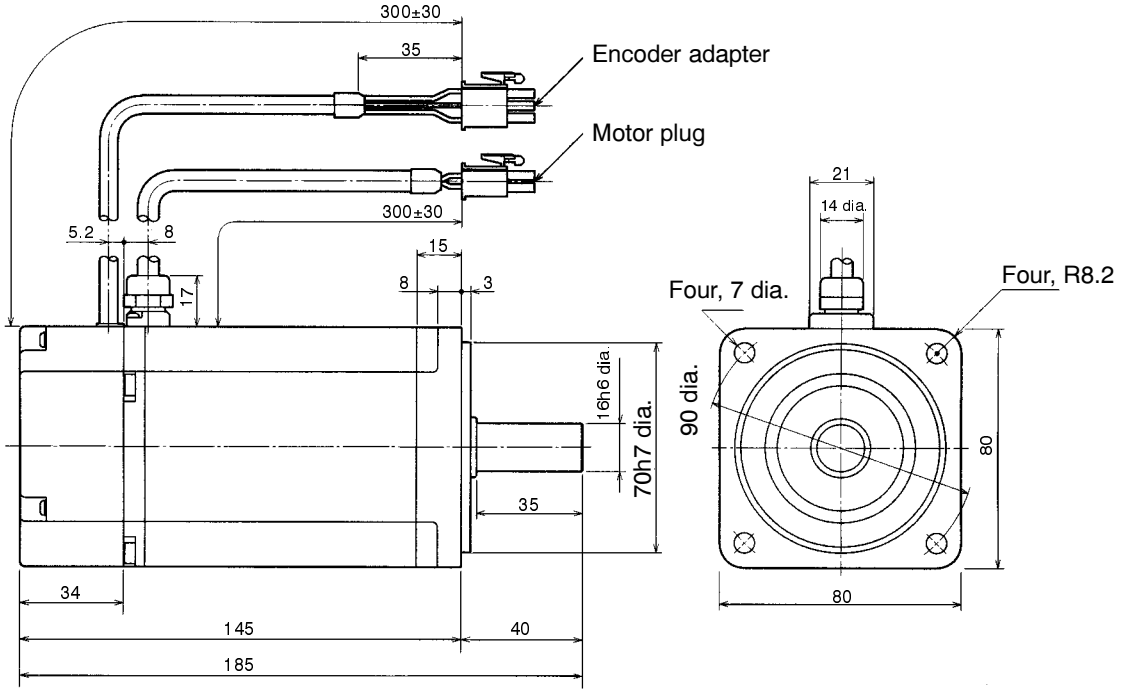
Standard Models		
Model	**L**	**LL**
R88M-U20030HA R88M-U20030LA	126.5	96.5
R88M-U40030HA R88M-U30030LA	154.5	124.5

Models with Brake		
Model	**L**	**LL**
R88M-U20030HA-B R88M-U20030LA-B	166	136
R88M-U40030HA-B R88M-U30030LA-B	194	164

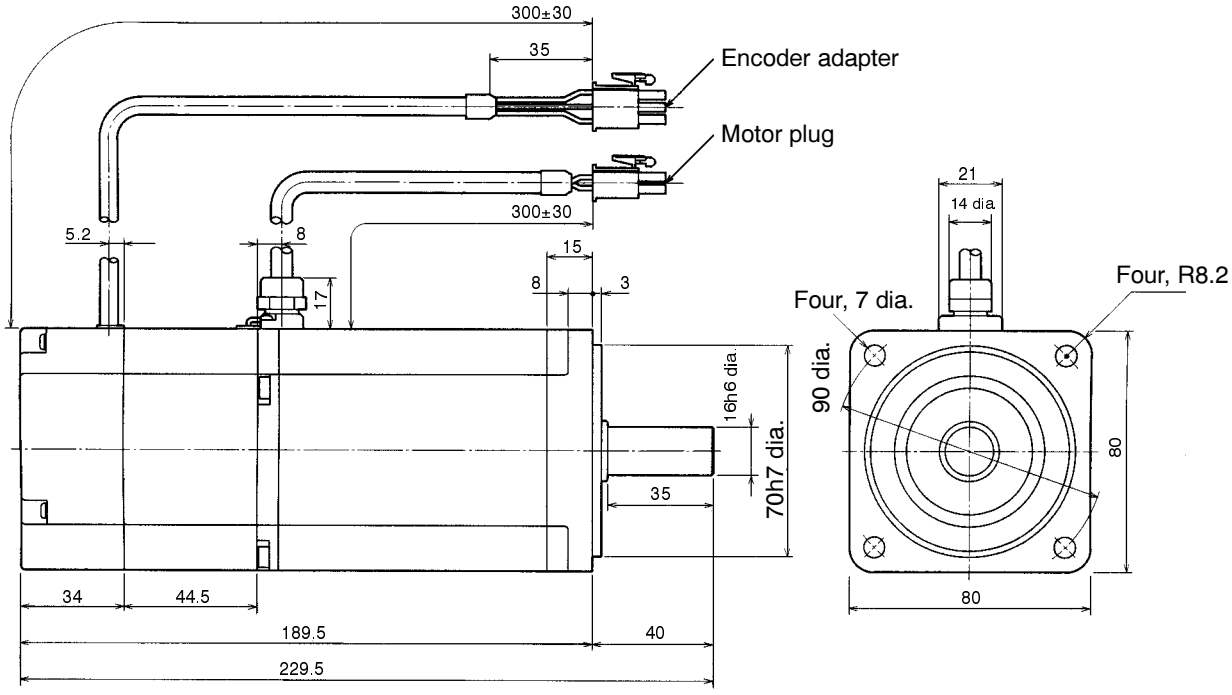
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■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

● 750-W Standard Models: R88M-U75030HA



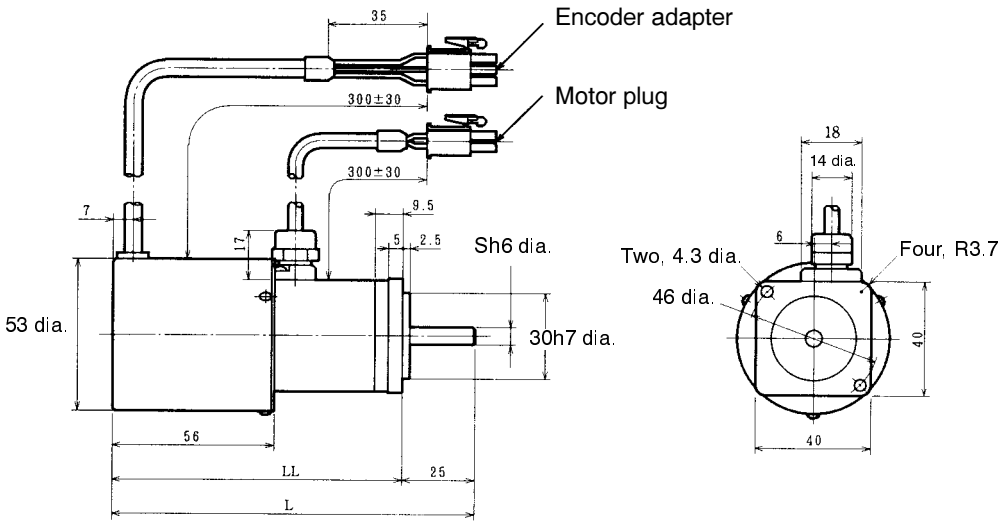
● 750-W Models with Brake: R88M-U75030HA-B



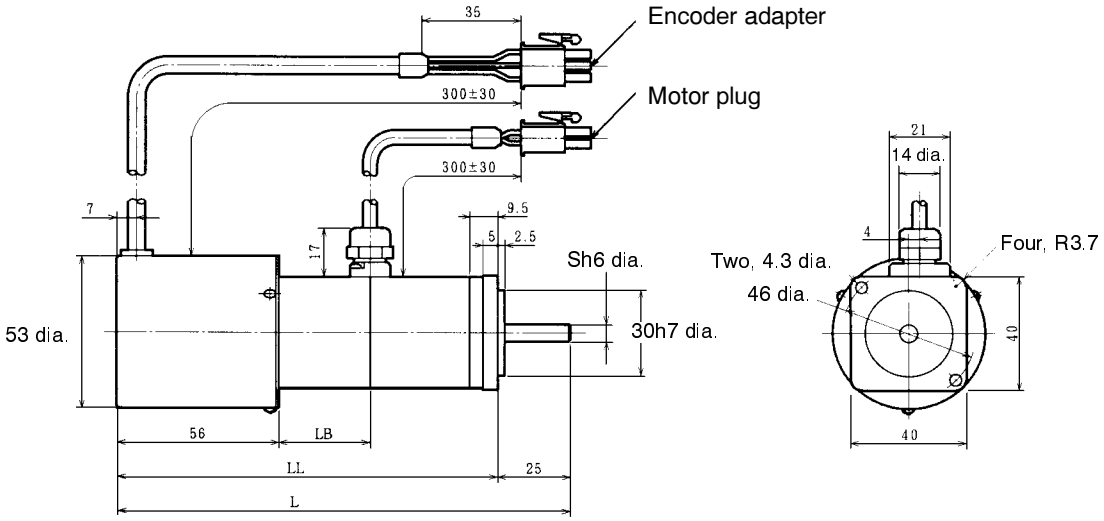
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■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards

- **30-W/50-W/100-W Standard Models:**
  R88M-U03030TA, R88M-U05030TA, R88M-U10030TA
  R88M-U03030SA, R88M-U05030SA, R88M-U10030SA



- **30-W/50-W/100-W Models with Brake:**
  R88M-U03030TA-B, R88M-U05030TA-B, R88M-U10030TA-B
  R88M-U03030SA-B, R88M-U05030SA-B, R88M-U10030SA-B



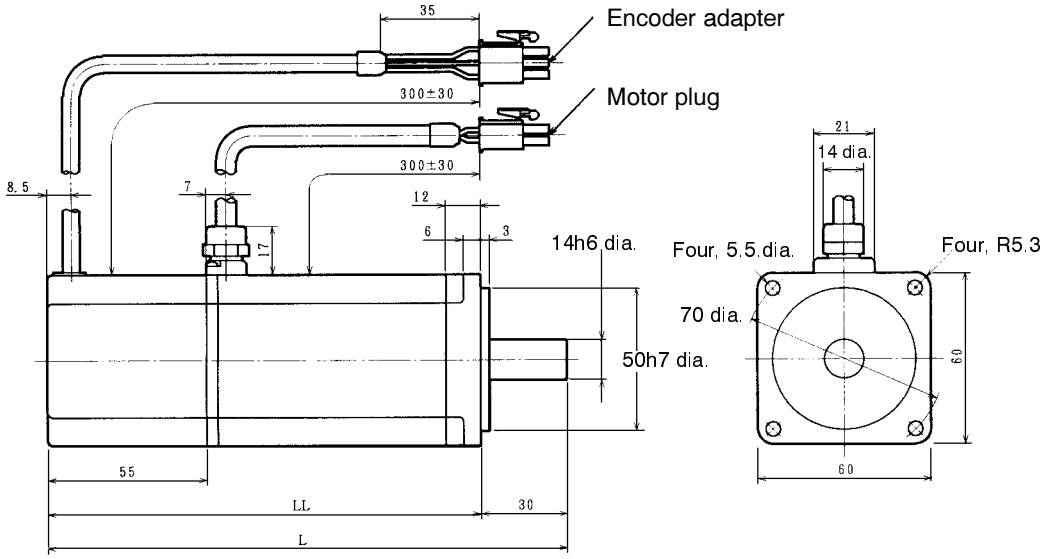
Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030TA R88M-U03030SA	117.5	92.5	6
R88M-U05030TA R88M-U05030SA	125	100	6
R88M-U10030TA R88M-U10030SA	142.5	117.5	8

Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030TA-B R88M-U03030SA-B	149	124	31.5	6
R88M-U05030TA-B R88M-U05030SA-B	156.5	131.5	31.5	6
R88M-U10030TA-B R88M-U10030SA-B	183	158	40.5	8

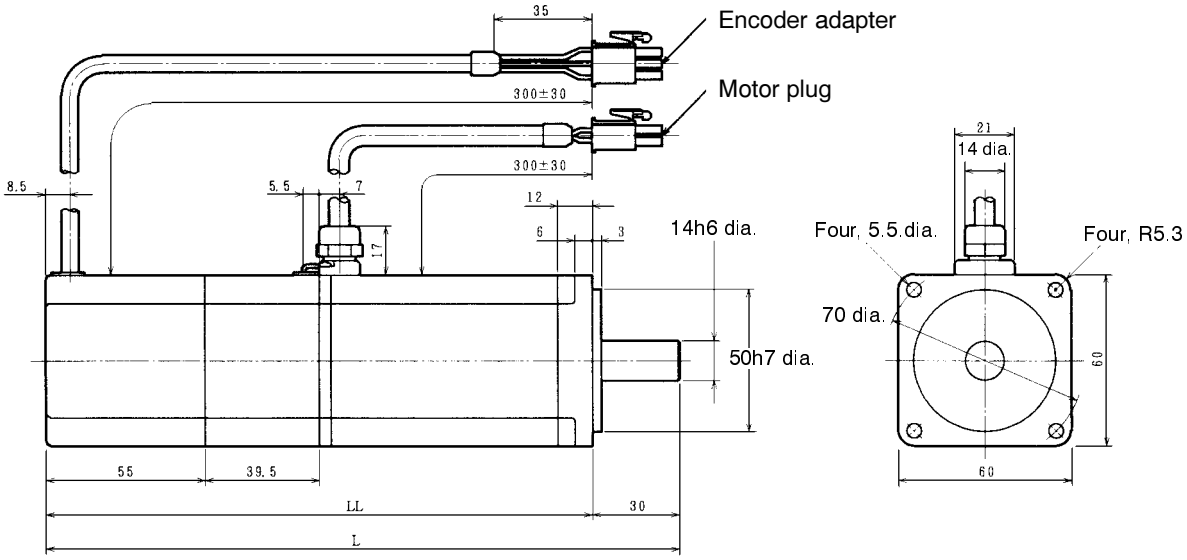
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■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

● 200-W/300-W/400-W Standard Models: R88M-U20030TA, R88M-U40030TA, R88M-U20030SA, R88M-U30030SA



● 200-W/300-W/400-W Models with Brake: R88M-U20030TA-B, R88M-U40030TA-B, R88M-U20030SA-B, U30030SA-B



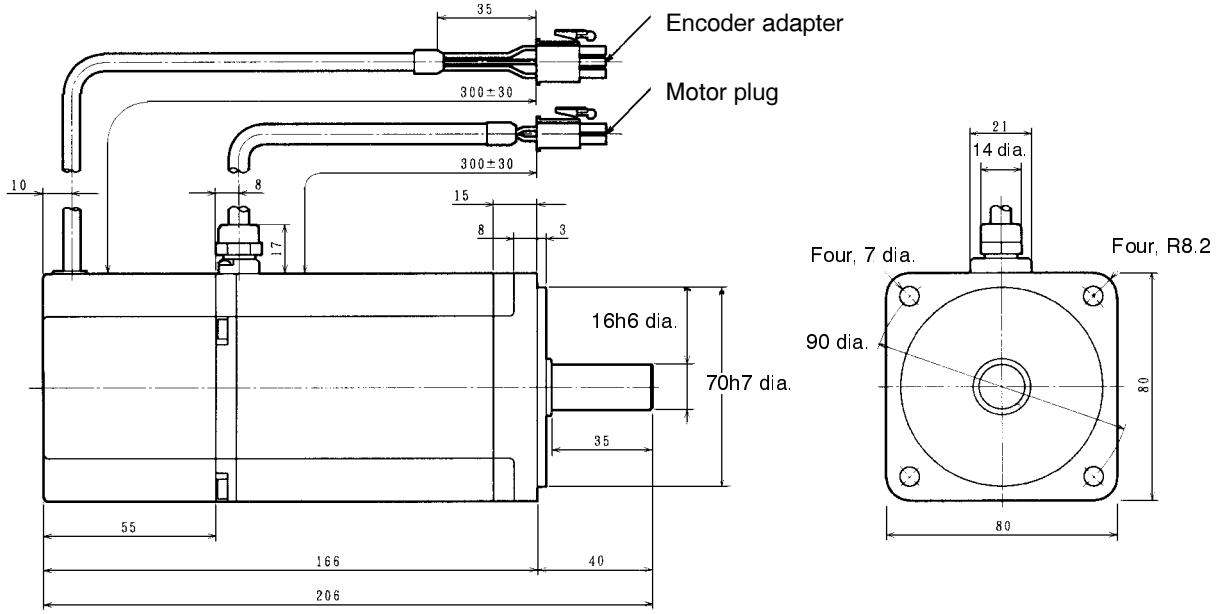
Standard Models		
Model	**L**	**LL**
R88M-U20030TA R88M-U20030SA	147.5	117.5
R88M-U40030TA R88M-U30030SA	175.5	145.5

Models with Brake		
Model	**L**	**LL**
R88M-U20030TA-B R88M-U20030SA-B	187	157
R88M-U40030TA-B R88M-U30030-SA-B	215	185

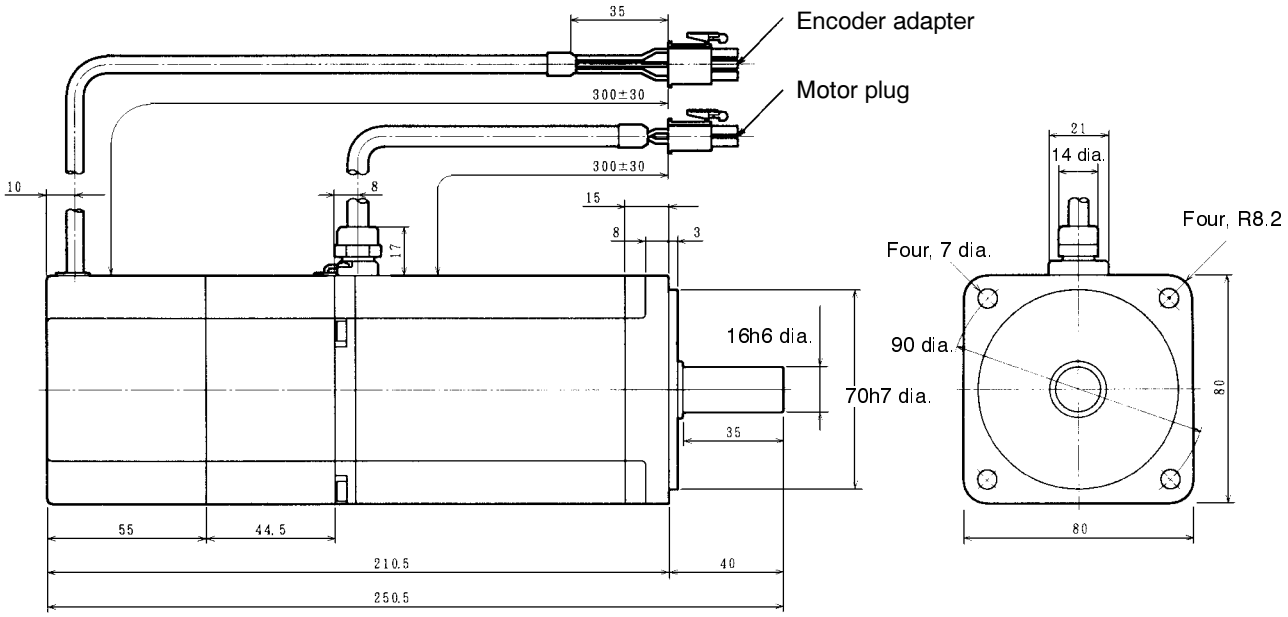
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■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

● 750-W Standard Models: R88M-U75030TA



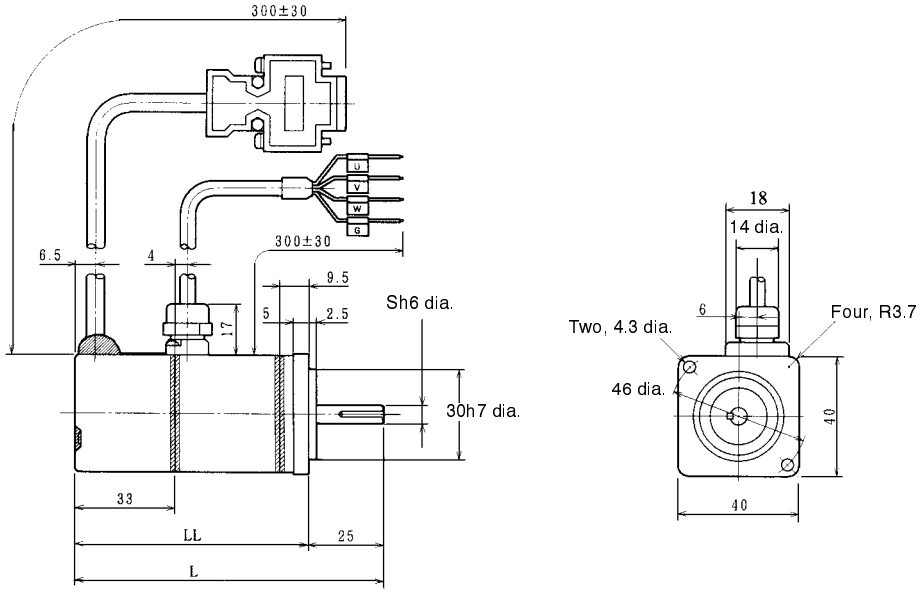
● 750-W Models with Brake: R88M-U75030TA-B



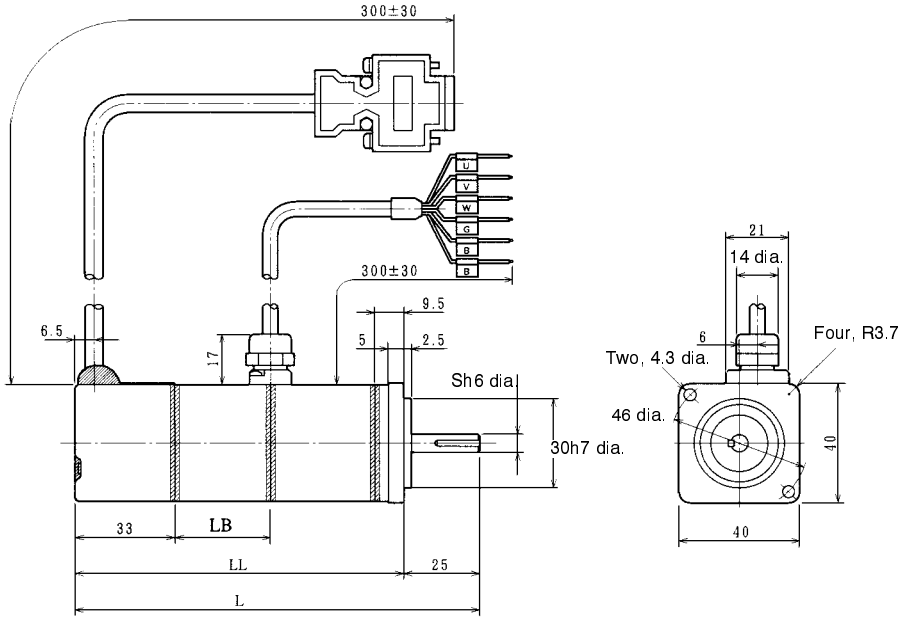
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■ AC Servomotors, EC Directives with Incremental Encoders

- **30-W/50-W/100-W Standard Models:**
  R88M-U03030VA-S1, R88M-U05030VA-S1, R88M-U10030VA-S1
  R88M-U03030WA-S1, R88M-U05030WA-S1, R88M-U10030WA-S1



- **30-W/50-W/100-W Models with Brake:**
  R88M-U03030VA-BS1, R88M-U05030VA-BS1, R88M-U10030VA-BS1
  R88M-U03030WA-BS1, R88M-U05030WA-BS1, R88M-U10030WA-BS1



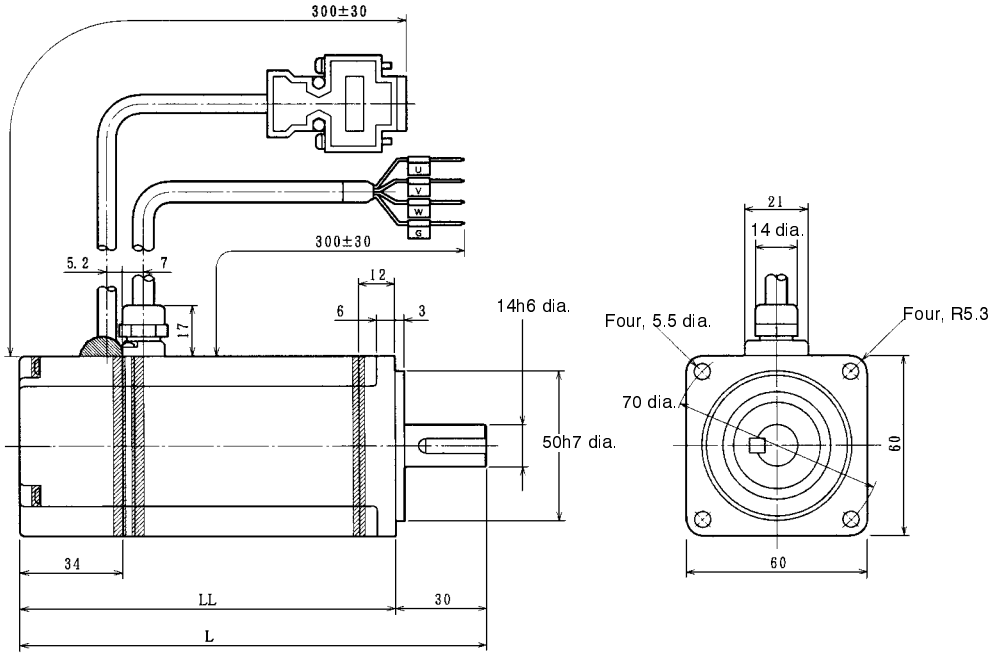
Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030VA-S1 R88M-U03030WAS1	94.5	69.5	6
R88M-U05030VA-S1 R88M-U05030WA-S1	102.0	77.0	6
R88M-U10030VA-S1 R88M-U10030WA-S1	119.5	94.5	8

Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030VA-BS1 R88M-U03030WA-BS1	126	101	31.5	6
R88M-U05030VA-BS1 R88M-U05030WA-BS1	133.5	108.5	31.5	6
R88M-U10030VA-BS1 R88M-U10030WA-BS1	160	135	40.5	8

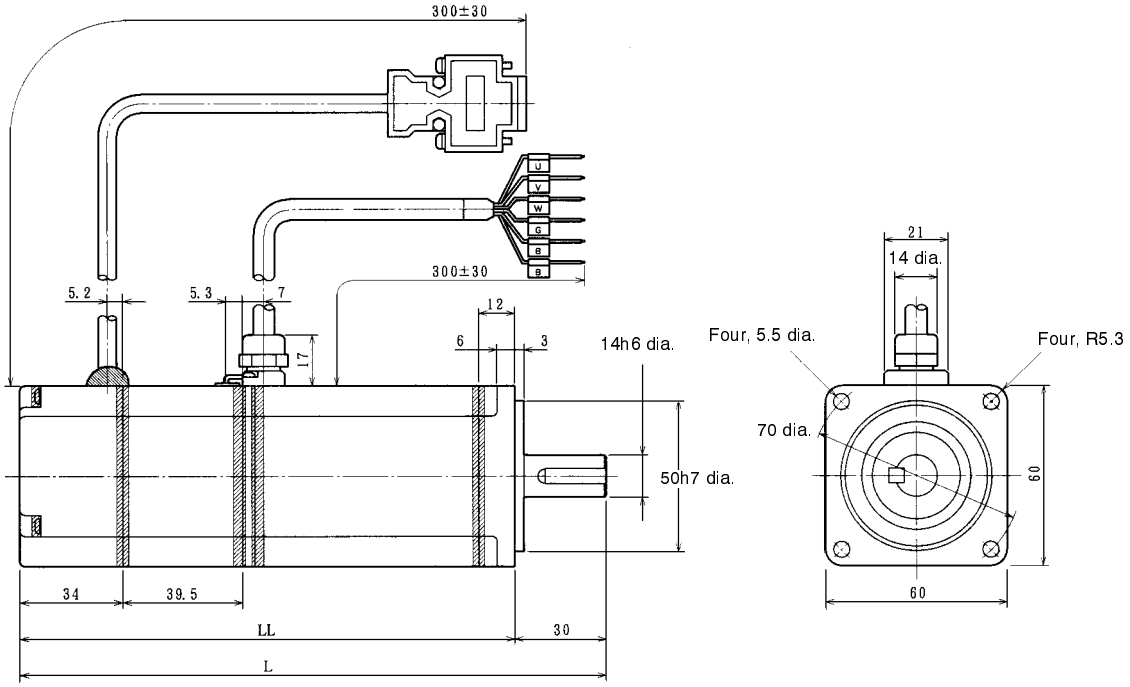
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■ AC Servomotors, EC Directives with Incremental Encoders (Contd.)

- **200-W/300-W/400-W Standard Models:**
  R88M-U20030VA-S1, R88M-U40030VA-S1, R88M-U20030WA-S1, R88M-U30030WA-S1



- **200-W/300-W/400-W Models with Brake:**
  R88M-U20030VA-BS1, R88M-U40030VA-BS1, R88M-U20030WA-BS1, U30030WA-BS1



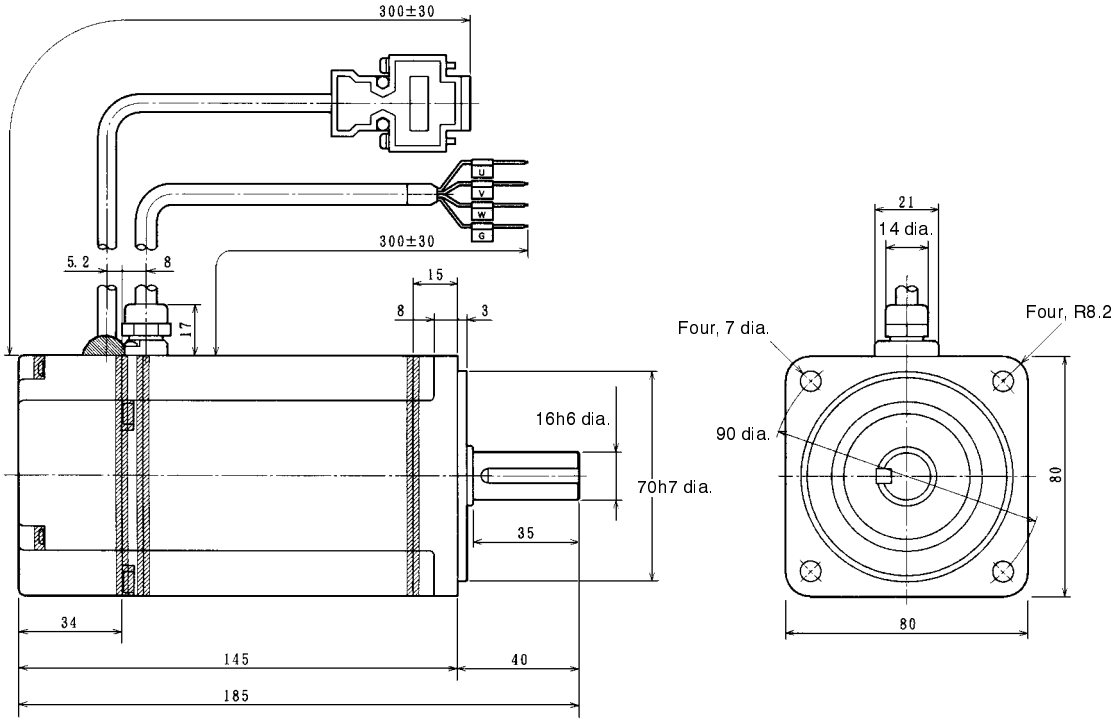
Standard Models		
Model	**L**	**LL**
R88M-U20030VA-S1 R88M-U20030WA-S1	126.5	96.5
R88M-U40030VA-S1 R88M-U30030WA-S1	154.5	124.5

Models with Brake		
Model	**L**	**LL**
R88M-U20030VA-BS1 R88M-U20030WA-BS1	166	136
R88M-U40030VA-BS1 R88M-U30030WA-BS1	194	164

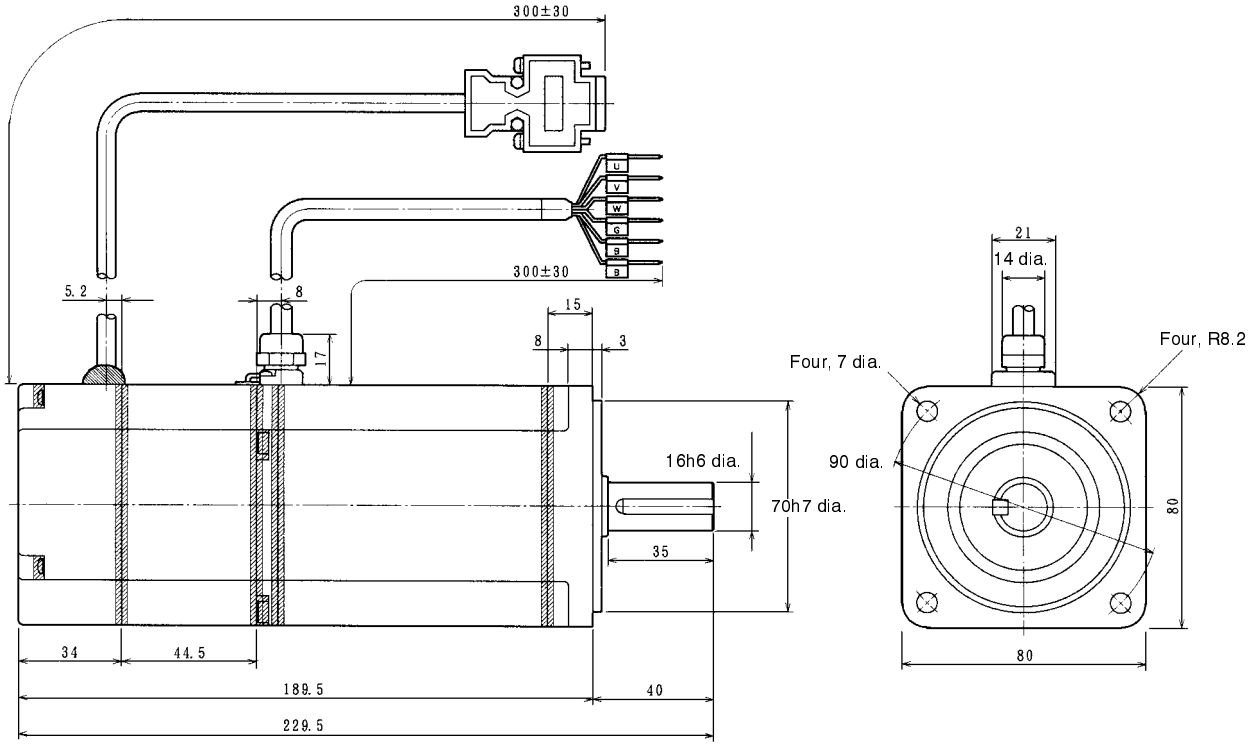
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■ AC Servomotors, EC Directives with Incremental Encoders (Contd.)

● 750-W Standard Models: R88M-U75030VA-S1



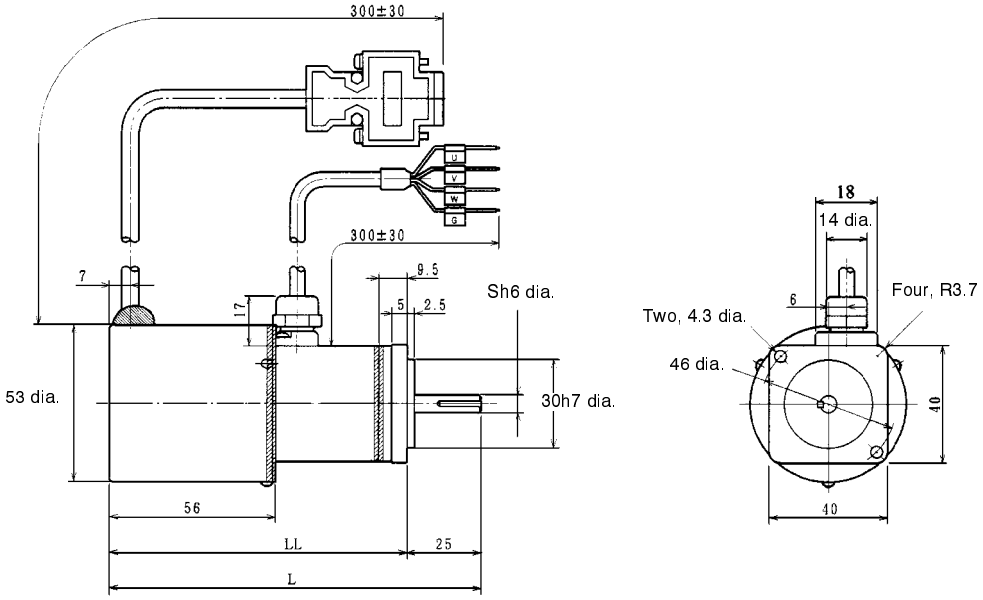
● 750-W Models with Brake: R88M-U75030VA-BS1



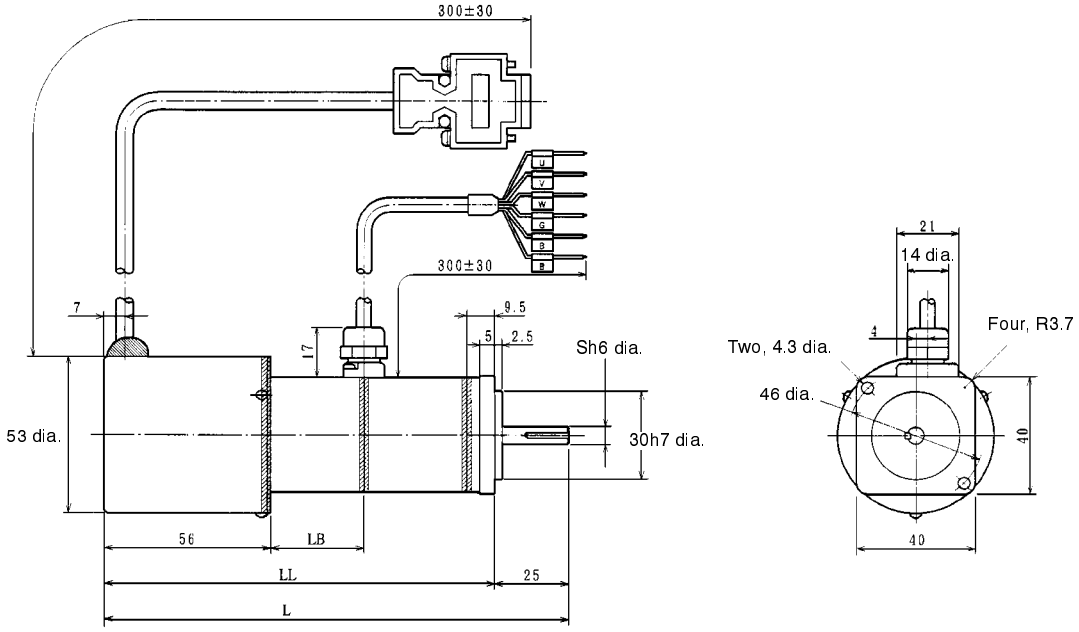
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■ AC Servomotors, EC Directives with Absolute Encoders

- **30-W/50-W/100-W Standard Models:**
  R88M-U03030XA-S1, R88M-U05030XA-S1, R88M-U10030XA-S1
  R88M-U03030YA-S1, R88M-U05030YA-S1, R88M-U10030YA-S1



- **30-W/50-W/100-W Models with Brake:**
  R88M-U03030XA-BS1, R88M-U05030XA-BS1, R88M-U10030XA-BS1
  R88M-U03030YA-BS1, R88M-U05030YA-BS1, R88M-U10030YA-BS1



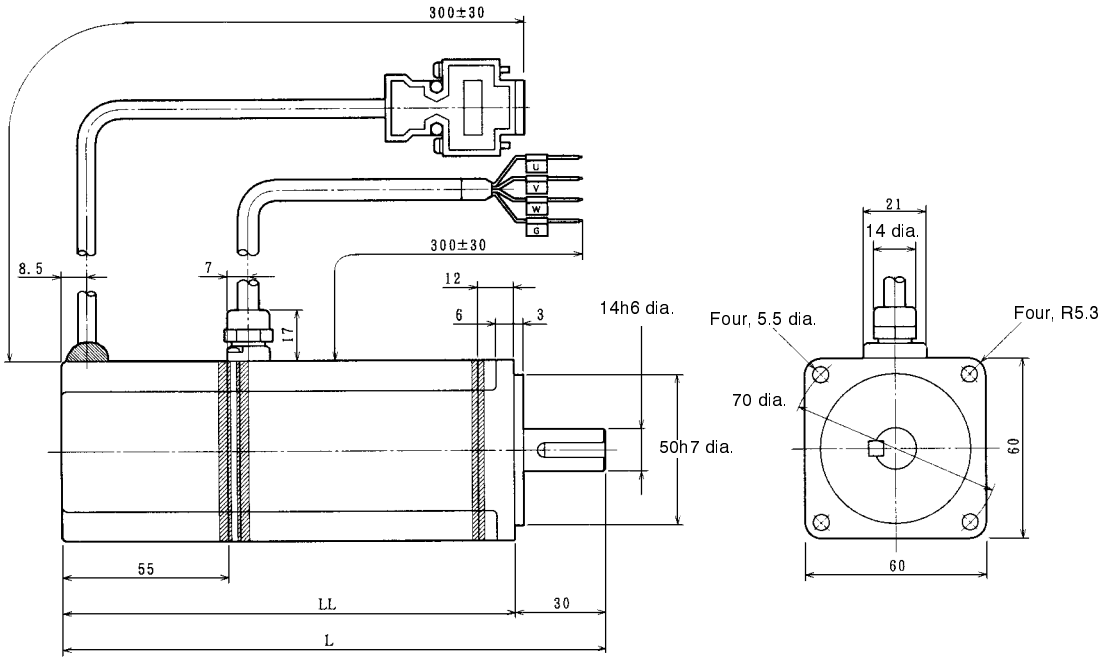
Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030XA-S1 R88M-U03030YAS1	117.5	92.5	6
R88M-U05030XA-S1 R88M-U05030YA-S1	125	100	6
R88M-U10030XA-S1 R88M-U10030YA-S1	142.5	117.5	8

Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030XA-BS1 R88M-U03030YA-BS1	149	124	31.5	6
R88M-U05030XA-BS1 R88M-U05030YA-BS1	156.5	131.5	31.5	6
R88M-U10030XA-BS1 R88M-U10030YA-BS1	183	158	40.5	8

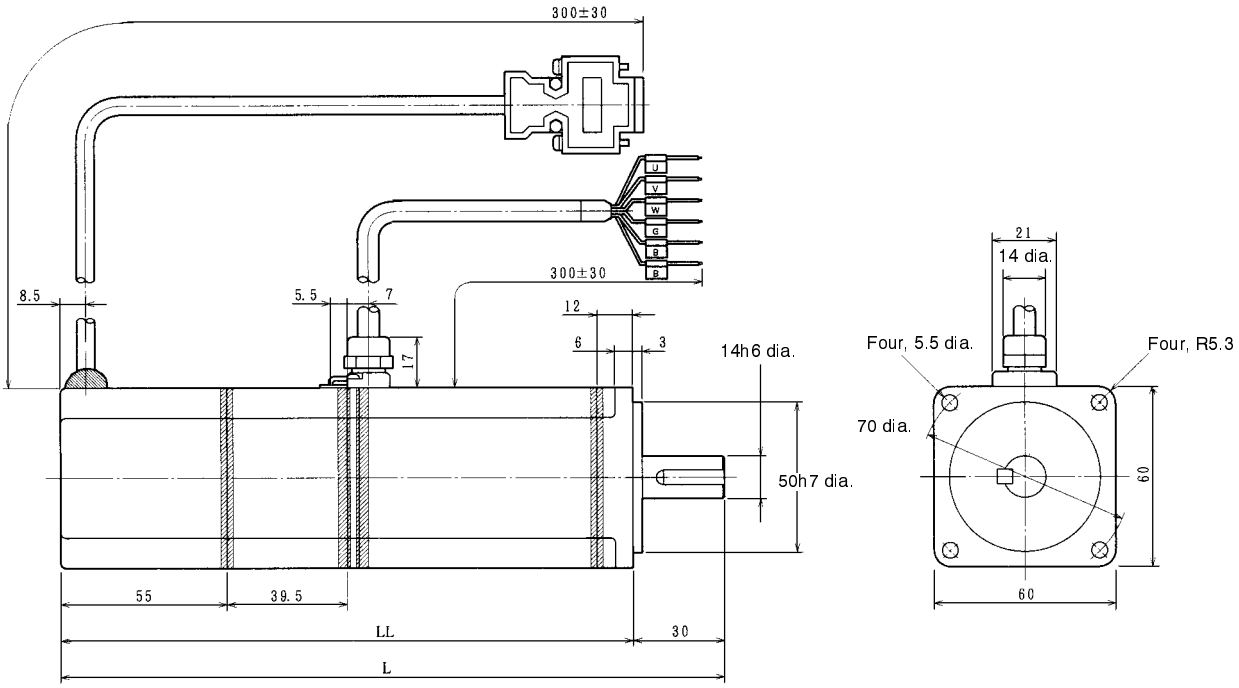
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■ AC Servomotors, EC Directives with Absolute Encoders (Contd.)

- **200-W/300-W/400-W Standard Models:**
  R88M-U20030XA-S1, R88M-U40030XA-S1, R88M-U20030YA-S1, R88M-U30030YA-S1



- **200-W/300-W/400-W Models with Brake:**
  R88M-U20030XA-BS1, R88M-U40030XA-BS1, R88M-U20030YA-BS1, U30030YA-BS1



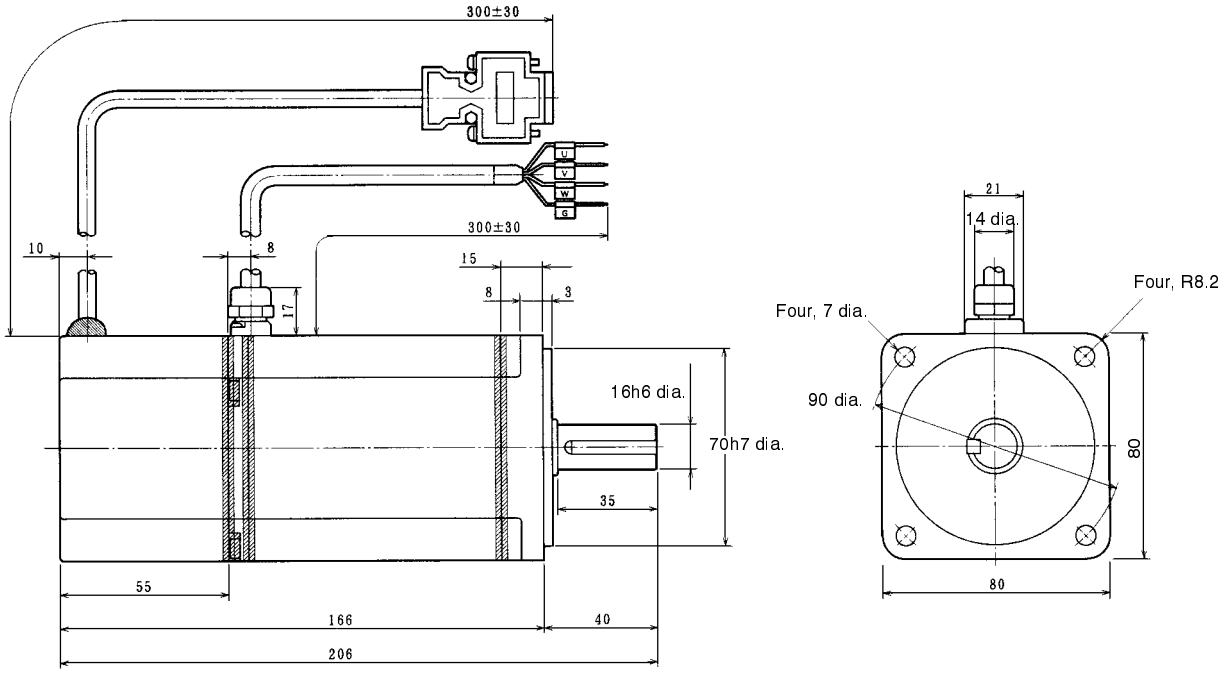
Standard Models		
Model	**L**	**LL**
R88M-U20030XA-S1 R88M-U20030YA-S1	147.5	117.5
R88M-U40030XA-S1 R88M-U30030YA-S1	175.5	145.5

Models with Brake		
Model	**L**	**LL**
R88M-U20030XA-BS1 R88M-U20030YA-BS1	187	157
R88M-U40030XA-BS1 R88M-U30030YA-BS1	215	185

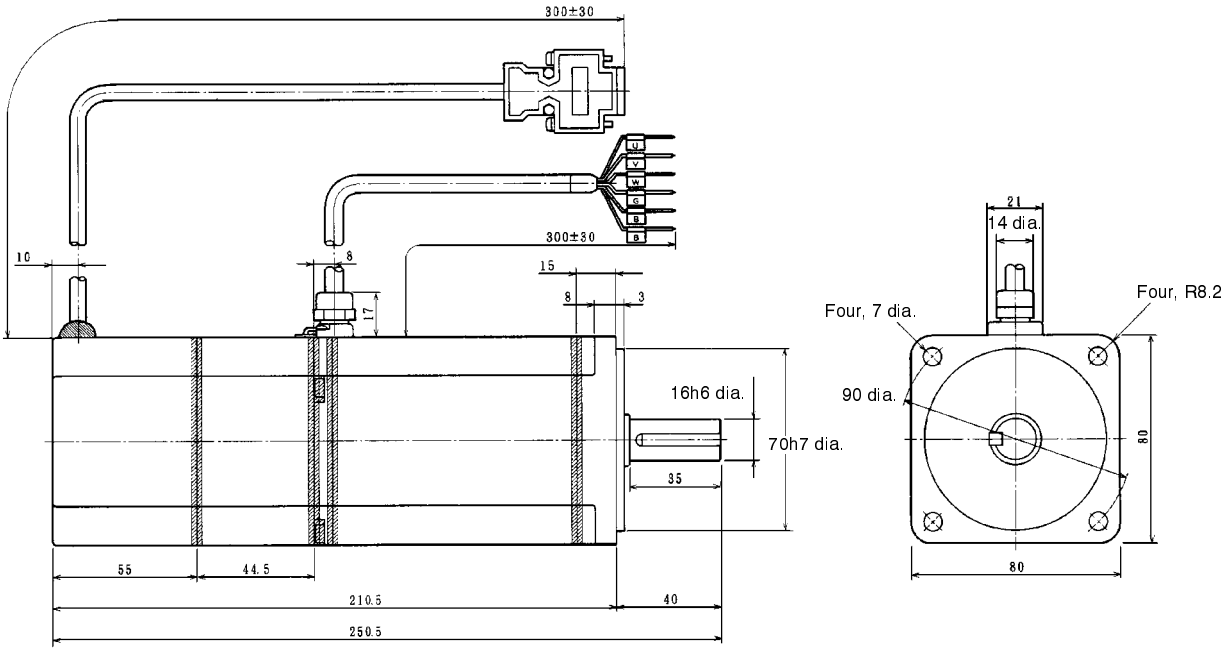
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■ AC Servomotors, EC Directives with Absolute Encoders (Contd.)

● 750-W Standard Models: R88M-U75030XA-S1



● 750-W Models with Brake: R88M-U75030XA-BS1

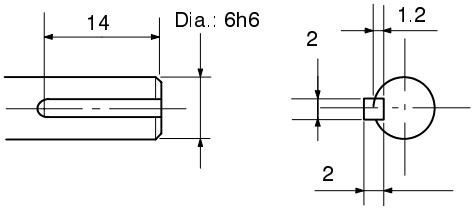


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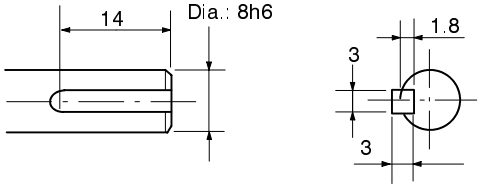
■ Shaft Dimensions of Motors With Keys (Incremental and Absolute)

Standard U-series AC Servomotors do not have keys on the shafts. The dimensions of motors with keys (produced on order) are shown below. Motors with keys are indicated by adding "-S1" to the end of the model number. Key slots are based on JIS B1301-1976.

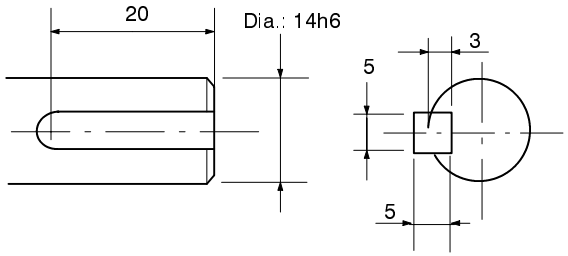
- **30-W/50-W Models**
  Standard: R88M-U03030□□-S1, R88M-U05030□□-S1
  With Brake: R88M-U03030□□-BS1, R88M-U05030□□-BS1



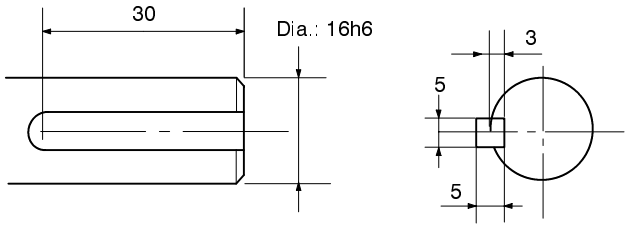
- **100-W Models**
  Standard: R88M-U10030□□-S1
  With Brake: R88M-U10030□□-BS1



- **200-W/300-W/400-W Models**
  Standard: R88M-U20030□□-S1, R88M-U40030□□-S1, R88M-U30030□□-S1
  With Brake: R88M-U20030□□-BS1, R88M-U40030□□-BS1, R88M-U30030□□-BS1



- **750-W Models**
  Standard: R88M-U75030□□-S1
  With Brake: R88M-U75030□□-BS1



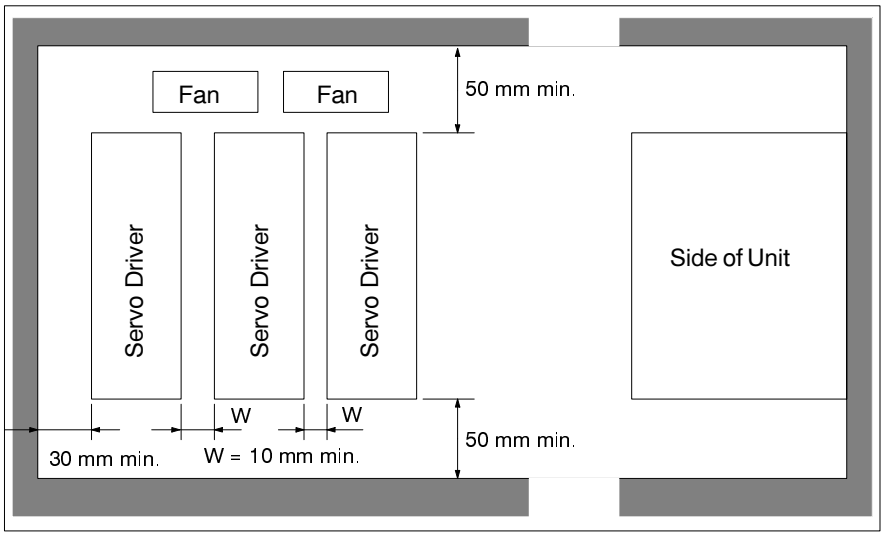
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2-1-2 Installation Conditions

■ AC Servo Drivers

● Space Around Drivers

- Install Servo Drivers according to the dimensions shown in the following illustration to ensure proper heat dispersion and convection inside the panel. Also install a fan for circulation if Servo Drivers are installed side by side to prevent uneven temperatures from developing inside the panel.
- Mount the Servo Drivers vertically (so that the model number and writing can be read).



● Operating Environment

Be sure that the environment in which Servo Drivers are operated meets the following conditions.

- Ambient operating temperature: 0°C to +55°C
- Ambient operating humidity: 35% to 85% (RH, with no condensation)
- Atmosphere: No corrosive gases.

● Ambient Temperature

- Servo Drivers should be operated in environments in which there is minimal temperature rise to maintain a high level of reliability.
- Temperature rise in any Unit installed in a closed space, such as a control box, will cause the ambient temperature to rise inside the entire closed space. Use a fan or a air conditioner to prevent the ambient temperature of the Servo Driver from exceeding 55°C.
- Unit surface temperatures may rise to as much as 30°C above the ambient temperature. Use heat-resistant materials for wiring, and keep separate any devices or wiring that are sensitive to heat.
- The service life of a Servo Driver is largely determined by the temperature around the internal electrolytic capacitors. The service life of an electrolytic capacitor is affected by a drop in electrolytic volume and an increase in internal resistance, which can result in overvoltage alarms, malfunctioning due to noise, and damage to individual elements. If a Servo Driver is always operated at the maximum ambient temperature of 55°C, then a service life of approximately 50,000 hours can be expected. A drop of 10°C in the ambient temperature will double the expected service life.

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● Keeping Foreign Objects Out of Units

- Place a cover over the Units or take other preventative measures to prevent foreign objects, such as drill filings, from getting into the Units during installation. Be sure to remove the cover after installation is complete. If the cover is left on during operation, heat buildup may damage the Units.
- Take measures during installation and operation to prevent foreign objects such as metal particles, oil, machining oil, dust, or water from getting inside of Servo Drivers.

■ AC Servomotors

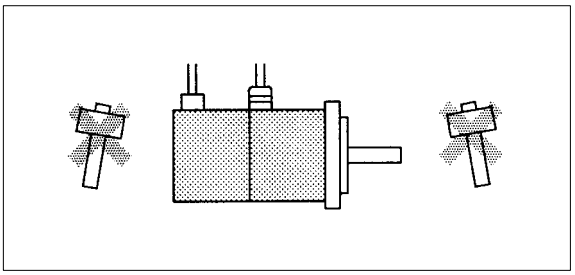
● Operating Environment

Be sure that the environment in which the Servomotor is operated meets the following conditions.

- Ambient operating temperature: 0°C to +40°C
- Ambient operating humidity: 20% to 80% (RH, with no condensation)
- Atmosphere: No corrosive gases.

● Impact and Load

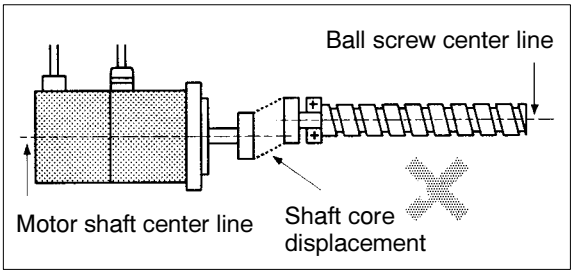
- The Servomotor is resistant to impacts of up to 10 G {98 m/s^2}. Do not subject it to heavy impacts or loads during transport, installation, or positioning. In addition, do not hold onto the encoder, cable, or connector areas when transporting it.
- Always use a pulley remover to remove pulleys, couplings, or other objects from the shaft.



- Secure cables so that there is no impact or load placed on the cable connector areas.

● Connecting to Mechanical Systems

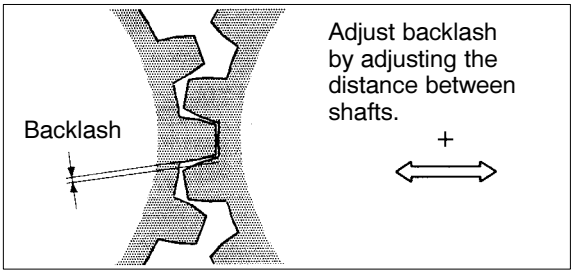
- The axial loads for Servomotors are specified in section 5-2-4. If an axial load greater than that specified is applied to a Servomotor, it will reduce the service life of the motor bearings and may damage the motor shaft. When connecting to a load, use couplings that can sufficiently absorb mechanical eccentricity and variation.



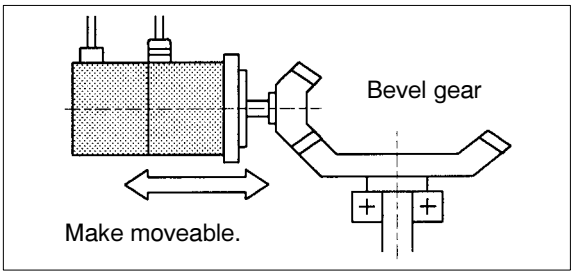
Recommended Coupling

Name	Maker
Oldham coupling	Myghty Co., Ltd

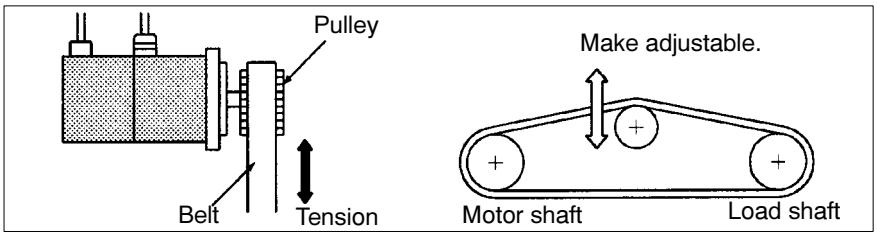
- For spur gears, an extremely large radial load may be applied depending on the gear precision. Use spur gears with a high degree of accuracy (for example, JIS class 2: normal line pitch error of 6 μm max. for a pitch circle diameter of 50 mm). If the gear precision is not adequate, allow backlash to ensure that no radial load is placed on the motor shaft.



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- Bevel gears will cause a load to be applied in the thrust direction depending on the structural precision, the gear precision, and temperature changes. Provide appropriate backlash or take other measures to ensure that no thrust load is applied which exceeds specifications.
- Do not put rubber packing on the flange surface. If the flange is mounted with rubber packing, the motor flange may separate due to the tightening strength.
- When connecting to a V-belt or timing belt, consult the maker for belt selection and tension. A radial load twice the belt tension will be placed on the motor shaft. Do not allow a radial load exceeding specifications to be placed on the motor shaft due to belt tension. If an excessive radial load is applied, the motor shaft may be damaged. Set up the structure so that the radial load can be adjusted. A large radial load may also be applied as a result of belt vibration. Attach a brace and adjust Servo Driver gain so that belt vibration is minimized.



● Water and Drip Resistance

- The Servomotor does not have a water-proof structure. Except for the connector areas, the protective structure is covered by the following JEM (The Japan Electrical Manufacturers' Association) standards.

  Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards: IP-42
  EC Directive Models: IP-44 (except shaft penetration point)

- If the Servomotor is used in an environment in which condensation occurs, water may enter inside of the encoder from the end surfaces of cables due to motor temperature changes. Either take measures to ensure that water cannot penetrate in this way, or use water-proof connectors. Even when machinery is not in use, water penetration can be avoided by taking measures, such as keeping the motor in servo-lock status, to minimize temperature changes.
- If machining oil with surfactants (e.g., coolant fluids) or their spray penetrate inside of the motor, insulation defects or short-circuiting may occur. Take measures to prevent machining oil penetration.

● Oil Seals

If the motor shaft is exposed to oil or grease, use a Servomotor with oil seals. (Contact your OMRON representative for details.)

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- **Other Precautions**
  - Do not apply commercial power directly to the Servomotor. The Servomotors run on synchronous AC and use permanent magnets. Applying 3-phase power will burn out the motor coils.
  - Do not carry the Servomotor by its cable, otherwise the cable may become disconnected or the cable clamp may become damaged.
  - Take measures to prevent the shaft from rusting. The shafts are coated with anti-rust oil when shipped, but anti-rust oil or grease should also be applied when connecting the shaft to a load.
  - Absolutely do not remove the encoder cover or take the motor apart. The magnet and the encoder are aligned in the Servomotor. If they become misaligned, the motor will not operate.

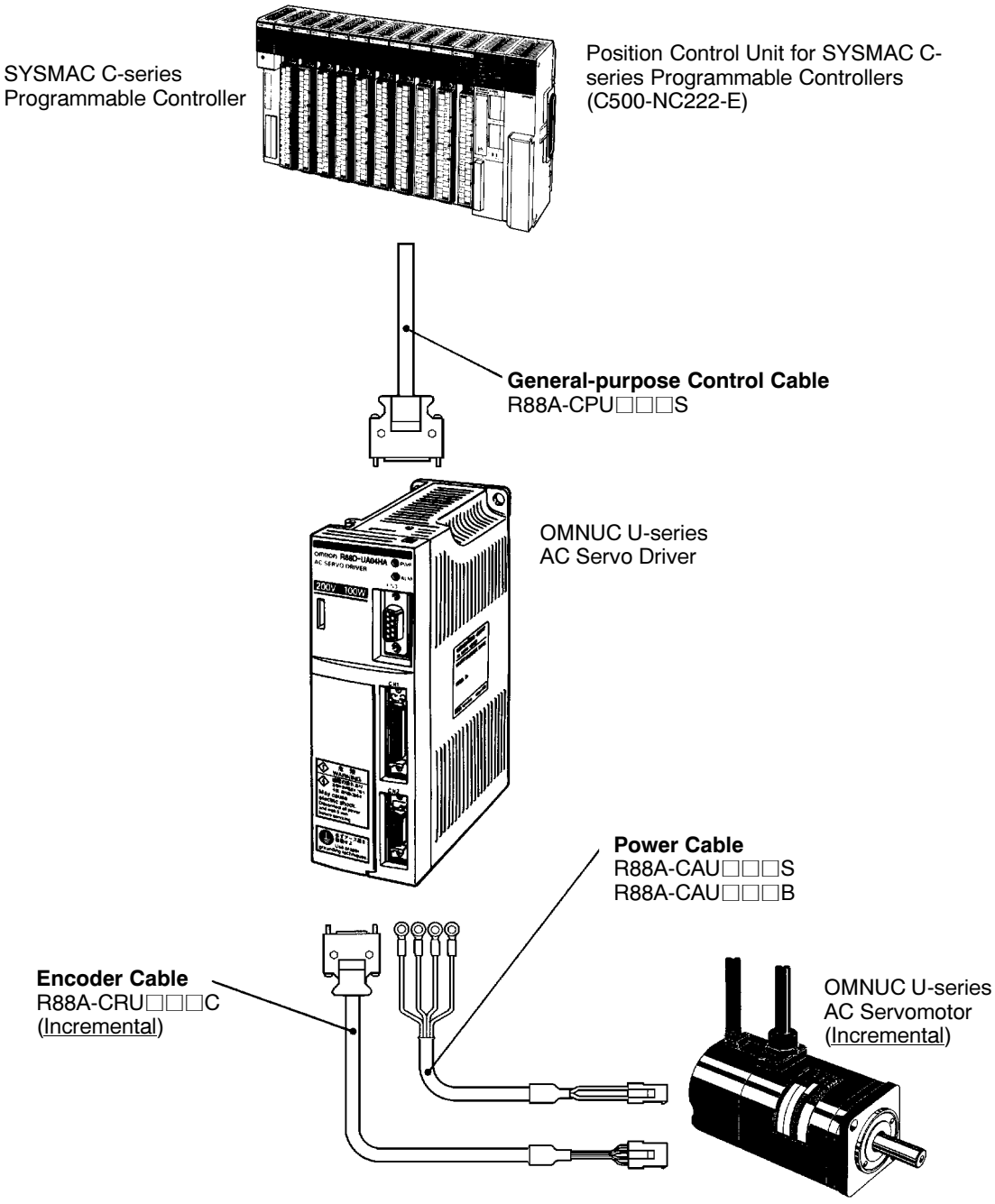
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2-2 Wiring Products Conforming to UL/cUL and Wiring Products Not Confrorming to Any Standards

2-2-1 Wiring to an OMRON Controller

Use the dedicated control cables and a general-purpose control cable (purchased separately) to connect U-series AC Servomotors and Servo Drivers to Position Control Units.

■ SYSMAC C/CV-series Position Control Units

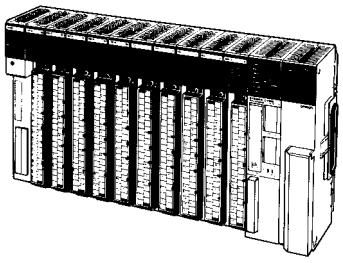


Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

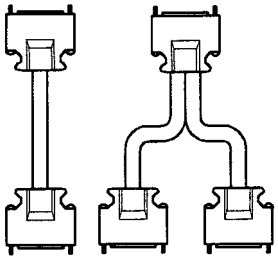
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■ SYSMAC CV-series Motion Control Units

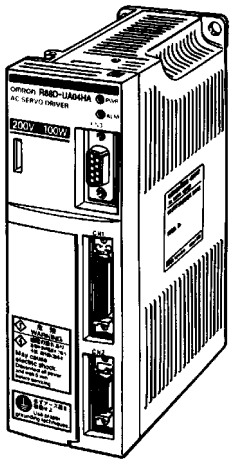
SYSMAC C/CV-series
Programmable Controller



CV500-MC221/CV500-MC421
C200H-MC221
Motion Control Unit

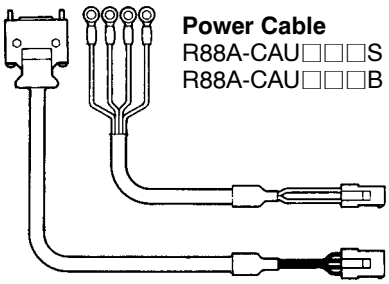


Special Cables
R88A-CPU□□□M1 (for one-axis control)
R88A-CPU□□□M1 (for two-axis control)

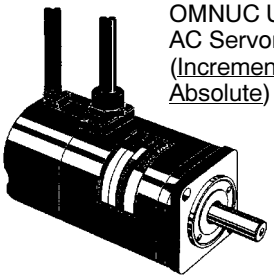


OMNUC U-series
AC Servo Driver

Encoder Cable
R88A-CRU□□□C
(Incremental)
R88A-CSU□□□C
(Absolute)



Power Cable
R88A-CAU□□□S
R88A-CAU□□□B



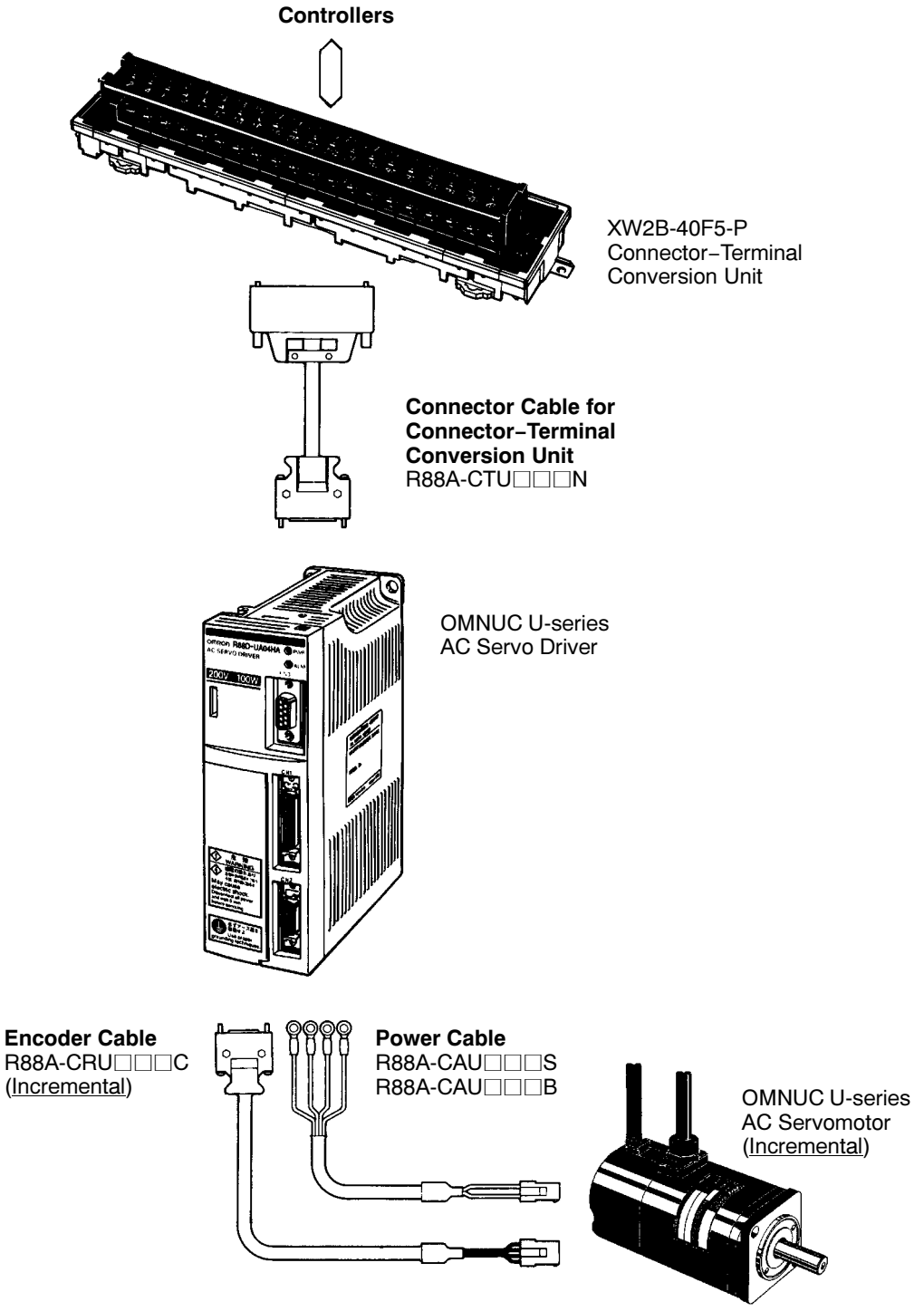
OMNUC U-series
AC Servomotor
(Incremental, or
Absolute)

Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

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2-2-2 Connector–Terminal Conversion Unit

The AC Servo Driver can be easily connected to the Connector–Terminal Conversion Unit through a special cable without soldering.



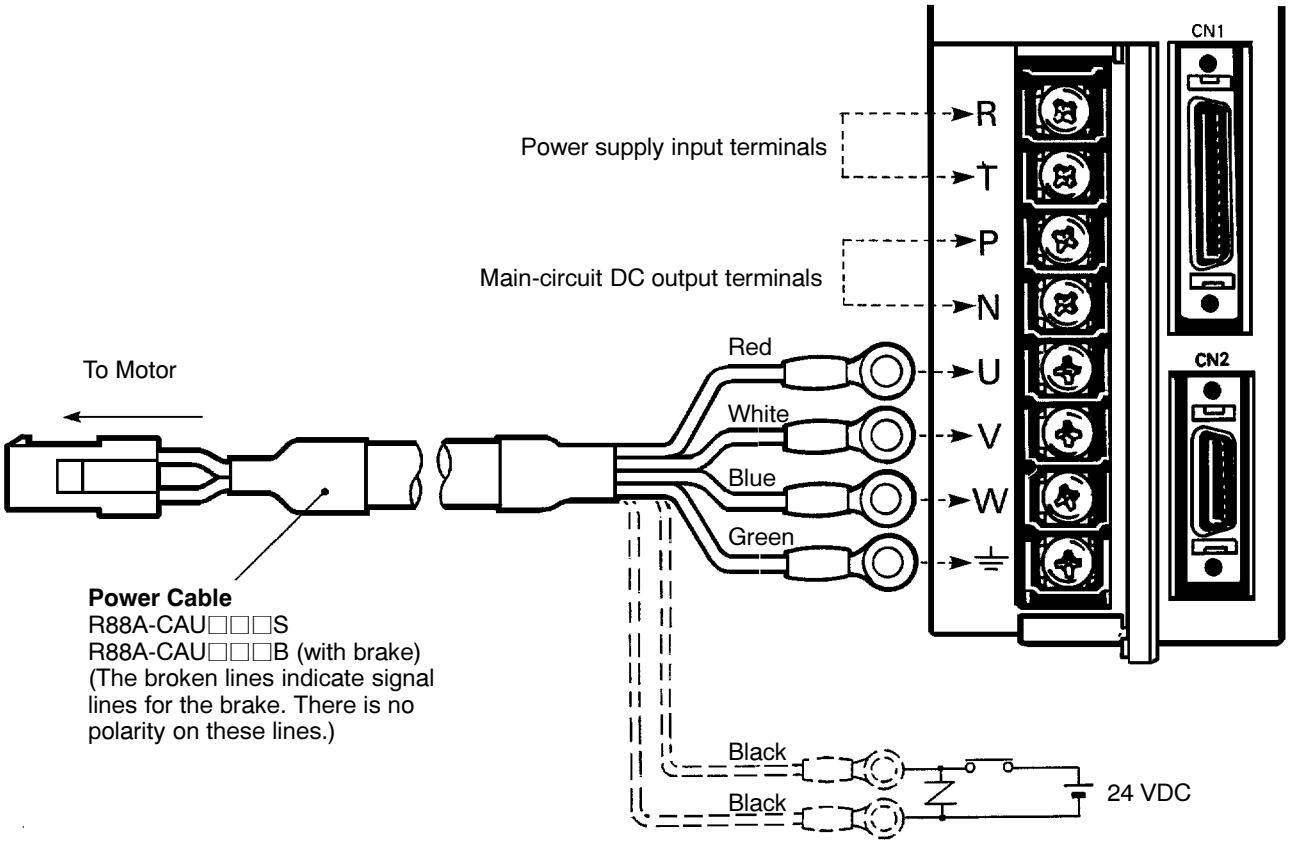
Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

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2-2-3 Wiring Terminal Blocks

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
R	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry.	
T		R88D-UA□□H(A): Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UA□□L(A): Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
P	Main circuit DC output	The terminals for connecting Regeneration Units (R88A-RG08UA). Connect these terminals when there is a high level of regenerative energy.	
N			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	The ground terminal for both the motor output and power supply input. Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to *3-8 Regenerative Energy Absorption* for the methods to calculate regenerative energy.

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■ Terminal Block Current and Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

● Servo Drivers with 200-VAC Input (R88D-UA□□H(A))

Driver (Watts)	R88D-UA02H(A) (30 W)	R88D-UA03H(A) (50 W)	R88D-UA04H(A) (100 W)	R88D-UA08H(A) (200 W)	R88D-UA12H(A) (400 W)	R88D-UA20H(A) (750 W)
Power supply input current (R, T)	1.3 A	1.5 A	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.42 A	0.6 A	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.				1.25 mm^2	2.0 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20			AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.					
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.					

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

● Servo Drivers with 100-VAC Input (R88D-UA□□L(A))

Driver model (Watts)	R88D-UA03L(A) (30 W)	R88D-UA04L(A) (50 W)	R88D-UA10L(A) (100 W)	R88D-UA12L(A) (200 W)	R88D-UA15LA (300 W)
Power supply input current (R, T)	2.0 A	2.6 A	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	0.63 A	0.7 A	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.			1.25 mm^2	2 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20		AWG 20 to AWG 18		
	Use OMRON standard cable (AWG20). The applicable wire size for motor connectors is AWG22 to AWG18.				
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.				

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

● Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

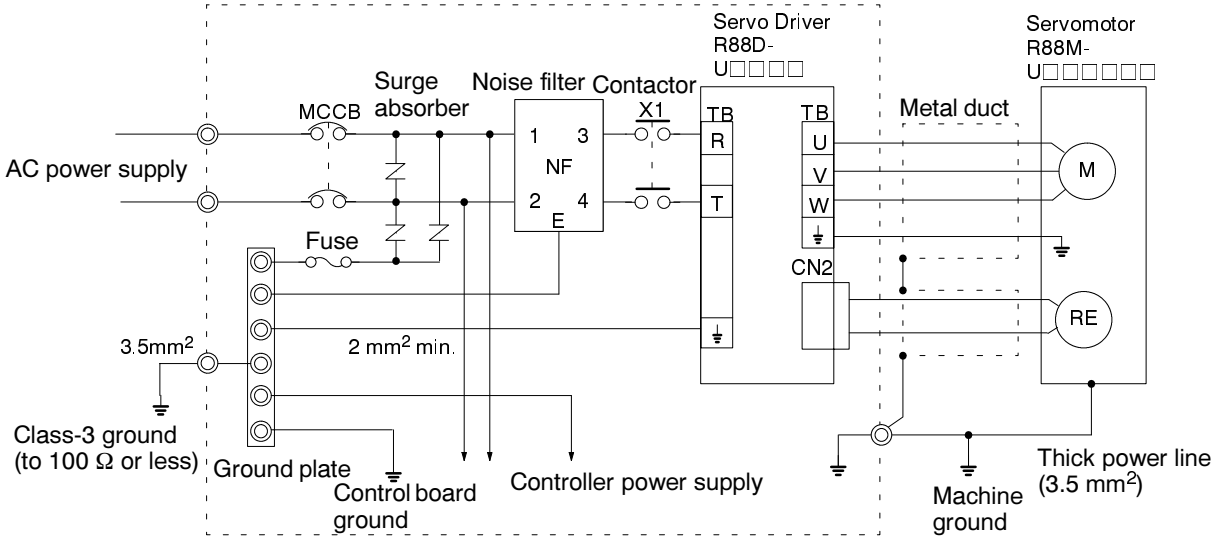
AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

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2-2-4 Wiring for Noise Resistance

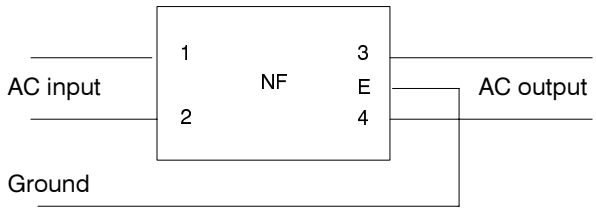
■ Wiring Method

Noise resistance will vary greatly depending on the wiring method used. Resistance to noise can be increased by paying attention to the items described below.

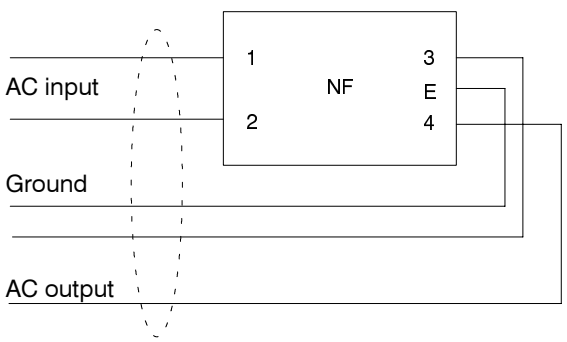


- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use a grounding plate for the frame ground for each Unit, as shown in the illustration, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.
- No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.
- Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.

Good: Separate input and output

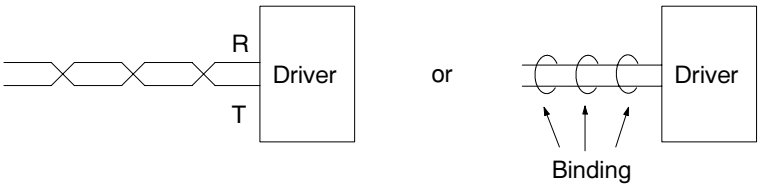


NO: Noise not filtered effectively



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• Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



• Separate power supply cables and signal cables when wiring.

■ Selecting Components

● No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum output current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

● Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Varistor voltage	Max. limit voltage	Surge immunity	Energy resistance	Fuse capacity	Type
Matsushita Electric Parts	ERZC10DK471(W)	470 V	775 V	1,250 A	45 J	3 to 5 A	Disk
	ERZC14DK471(W)	470 V	775 V	2,500 A	80 J	3 to 10 A	
	ERZC20DK471(W)	470 V	775 V	4,000 A	150 J	5 to 15 A	
	ERZC20EK471(W)	470 V	775 V	5,000A	150 J	---	Block
Ishizuka Electronics Co.	Z10L471	470 V	773 V	1,000A	15 W•s	3 to 5 A	Disk
	Z15L471	470 V	738 V	1,250 A	20 W•s	3 to 5 A	
	Z21L471	470 V	733 V	3,000 A	30 W•s	5 to 10 A	
	Z25M471S	470 V	810 V	10,000 A	235 J	---	Block
Okaya Electric Ind.	R.A.V -781BWZ-2A	---	783 V	1,000 A	---	---	Block
	R.A.V -781BXZ-2A	---	783 V	1,000 A	---	---	
	R.A.V -401.621BYR-2	---	620 V	1,000 A	---	---	

Note **1.** The (W) Matsushita models are UL and CSA certified.

Note **2.** Refer to manufacturers documentation for operating details.

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Note 3. The surge immunity is for a standard impulse current of 8/20 μs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

Note 4. The energy resistance is the value for 2 ms. It may not be possible to retard high-energy pulses at less than 700 V. In that case, absorb surges with an insulated transformer or reactor.

• Noise Filters for Power Supply Input

Use a noise filter to attenuate extraneous noise and to diminish noise radiation from the Servo Driver. Select a noise filter with a load current of at least twice the rated current. The following table shows noise filters that reduce by 40 dB noise between 200 kHz and 30 MHz.

Maker	Model	Rated current	Remarks
Tokin	LF-210N	10 A	For single-phase
	LF-215N	15 A	
	LF-220N	20 A	

To attenuate noise at frequencies of 200 kH or less, use an insulated transformer and a noise filter. For high frequencies of 30 MHz or more, use a ferrite core and a high-frequency noise filter with a through-type capacitor.

• Noise Filters for Motor Output

Use noise filters without built-in capacitors on the Servomotor output lines. The following table shows the noise filters that are recommended for motor output.

Maker	Model	Rated current	Remarks
Tokin	LF-310KA	10 A	Three-phase block noise filter
	LF-320KA	20 A	
	ESD-R-47B	---	EMI core for radiation noise
Fuji Electrochemical Co.	RN80UD	---	10-turn for radiation noise

Note 1. The Servomotor output lines cannot use the same noise filters used for power supplies.

Note 2. Typical noise filters are used with power supply frequencies of 50/60 Hz. If these noise filters are connected to outputs of 7.8 to 11 KHz (the Servo Driver's PWM frequency), a very large (about 100 times larger) leakage current will flow through the noise filter's condenser and the Servo Driver could be damaged.

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• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 μF-50 Ω CRE-50500 0.5 μF-50 Ω S2-A-0 0.2 μF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	G6C-2BND	10 A	---	24 VDC
	LY2-D	10 A	---	24 VDC
	G7L-2A-BUBJ	25 A	---	24 VDC, 200 to 240 VAC
	J7AN-E3	15 A	120 A	24 VDC
	LC1-D093A60	11 A	200 A	24 VDC, 200/220 VAC, 200 to 240 VAC

• Leakage Breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.

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• The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UA02H to -UA08H	80 mA	3 mA
R88D-UA12H	60 mA	4 mA
R88D-UA20H	110 mA	5 mA

Note **1.** Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

Note **2.** Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note **3.** Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

The following encoder signals are used.

Incremental Encoders:

A, B, and S phase. The frequency for A- or B-phase signals is 154 kHz max.; the transmission speed for S-phase signals is 616 kbps.

Absolute Encoders:

A, B, and Z phase, plus the absolute encoder signal. The frequency for A- or B-phase signals is 76.8 kHz max.; the transmission speed for absolute encoder signals is 9.6 kbps.

Follow the wiring methods outlined below to improve encoder noise resistance.

• Be sure to use dedicated encoder cables.

• If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.

• Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.

• When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

• Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

■ Improving Control I/O Signal Noise Resistance

Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

• Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.

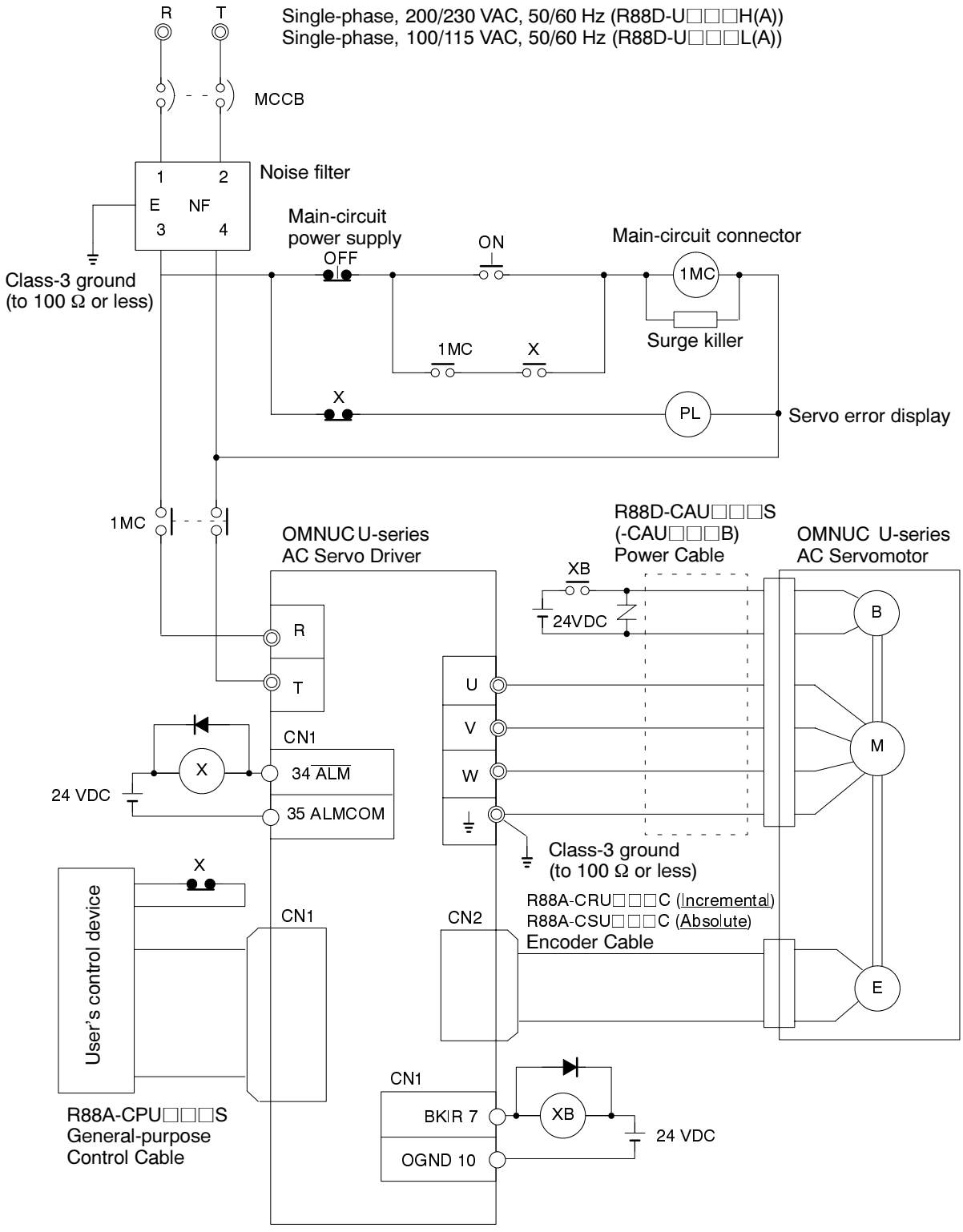
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- For speed and torque command input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-μF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output lines (A, B, and Z phases, plus the absolute encoder signal), be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.

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2-2-5 Peripheral Device Connection Examples

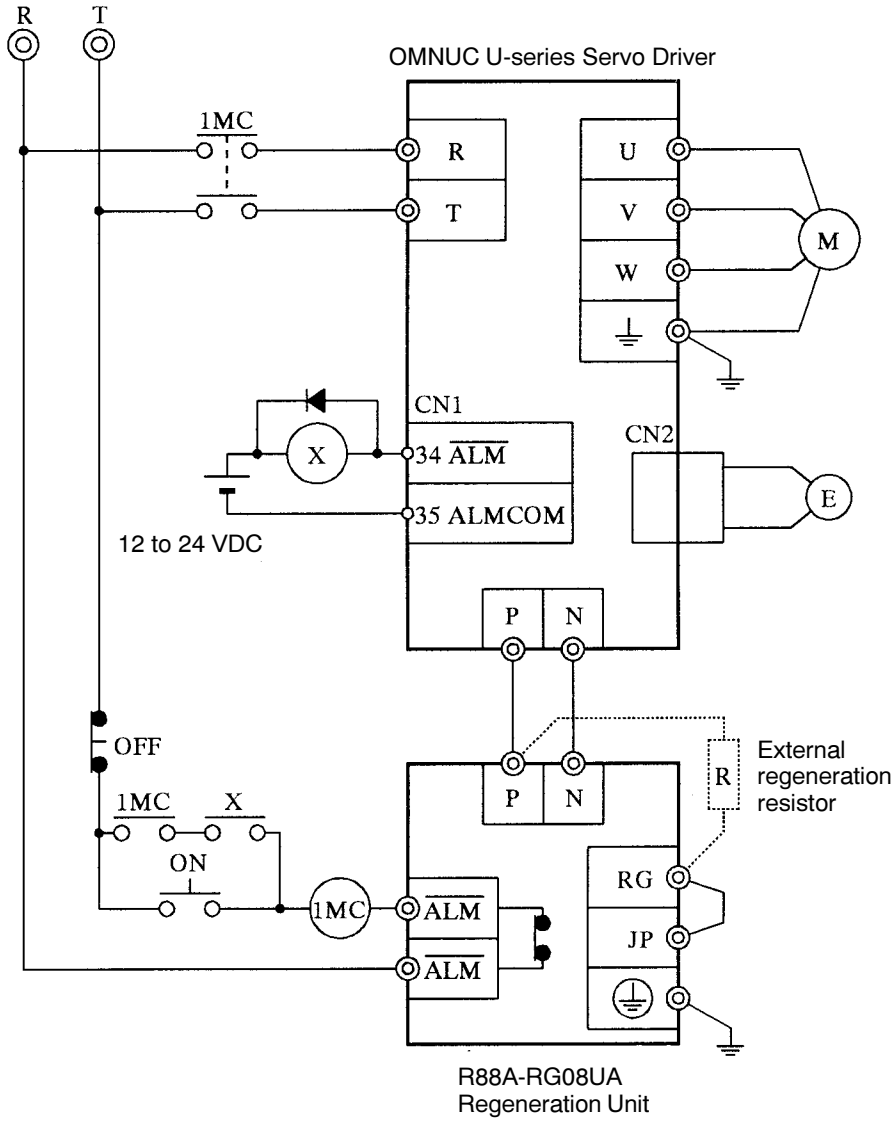
■ Connecting to Peripheral Devices



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■ Connecting a Regeneration Unit

Single-phase 200/230 VAC 50/60 Hz: R88D-UA□□H(A)
or 100/115 VAC 50/60 Hz: R88D-UA□□L(A)



Note **1.** Remove the short bar from between the RG and JP terminals when connecting external regeneration resistor.

Note **2.** Connect the external regeneration resistor to between the P and RG terminals.

Note **3.** The Regeneration Unit does not conform to EC Directives.

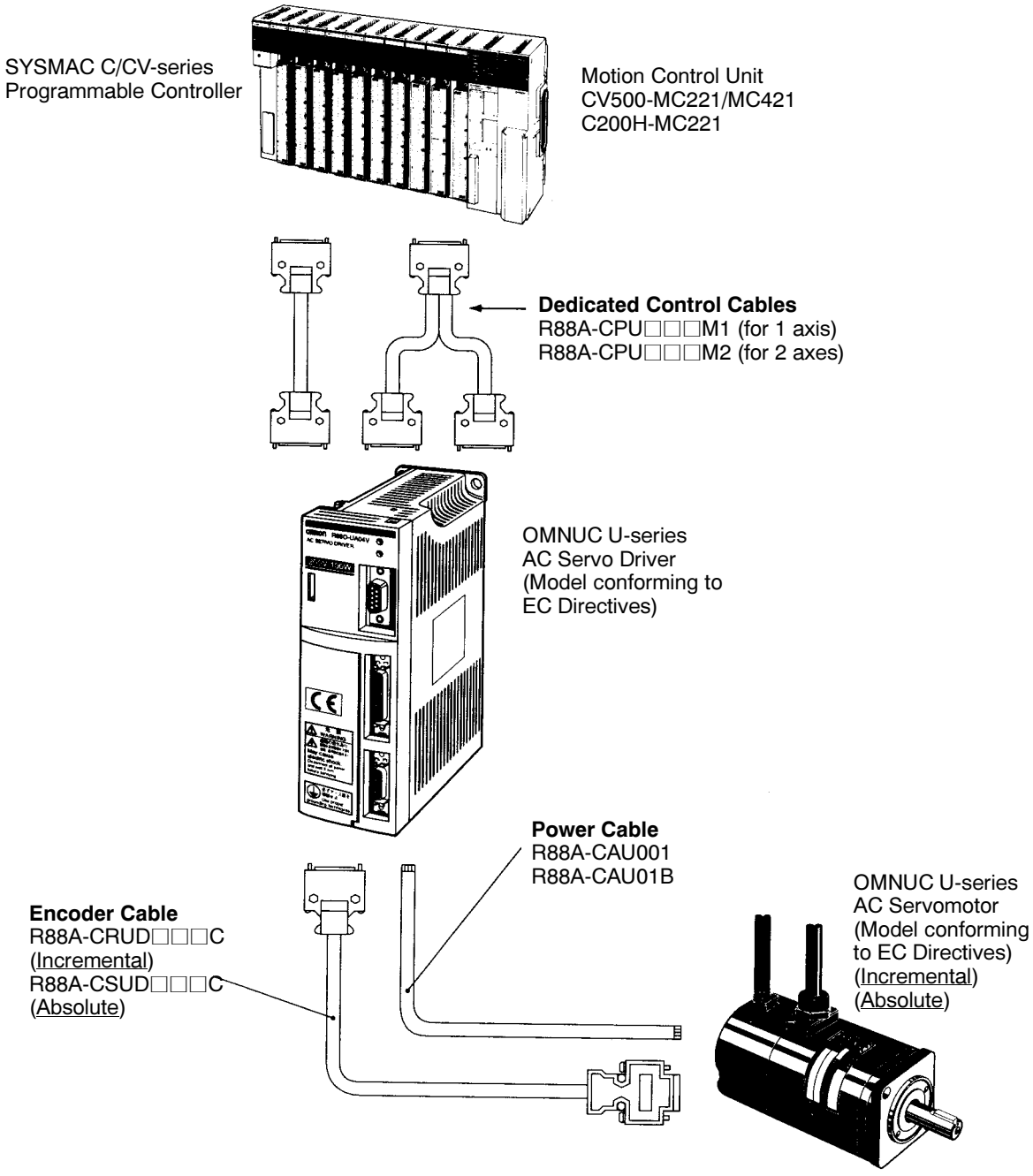
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2-3 Wiring Products Conforming to EC Directives

2-3-1 Wiring to an OMRON Controller

Use general-purpose control cable (purchased separately) to connect U-series AC Servomotors and Servo Drivers (models conforming to EC Directives) to Motion Control Units.

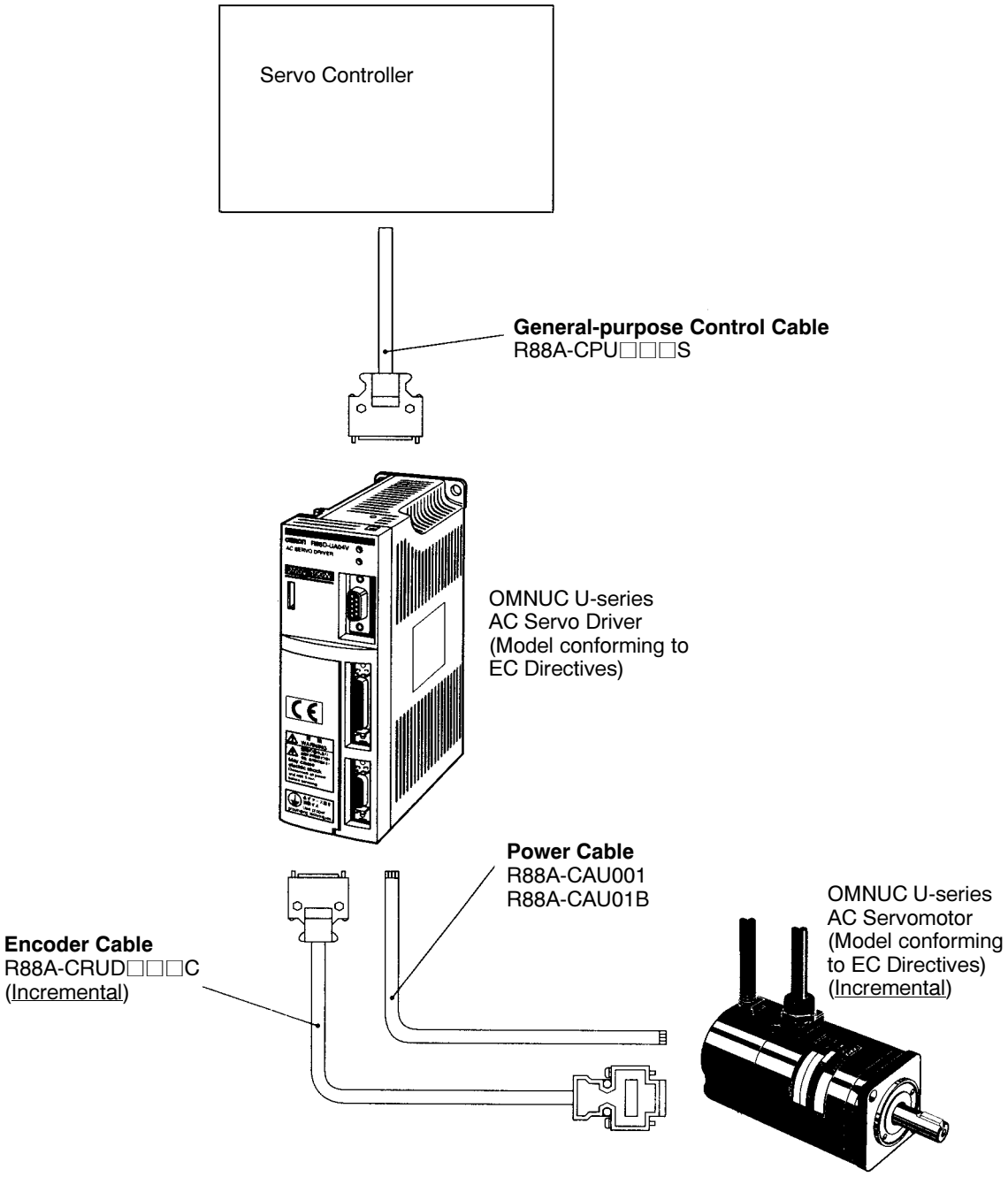
■ SYSMAC C/CV-series Motion Control Units



Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

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■ Connecting to a Servo Controller



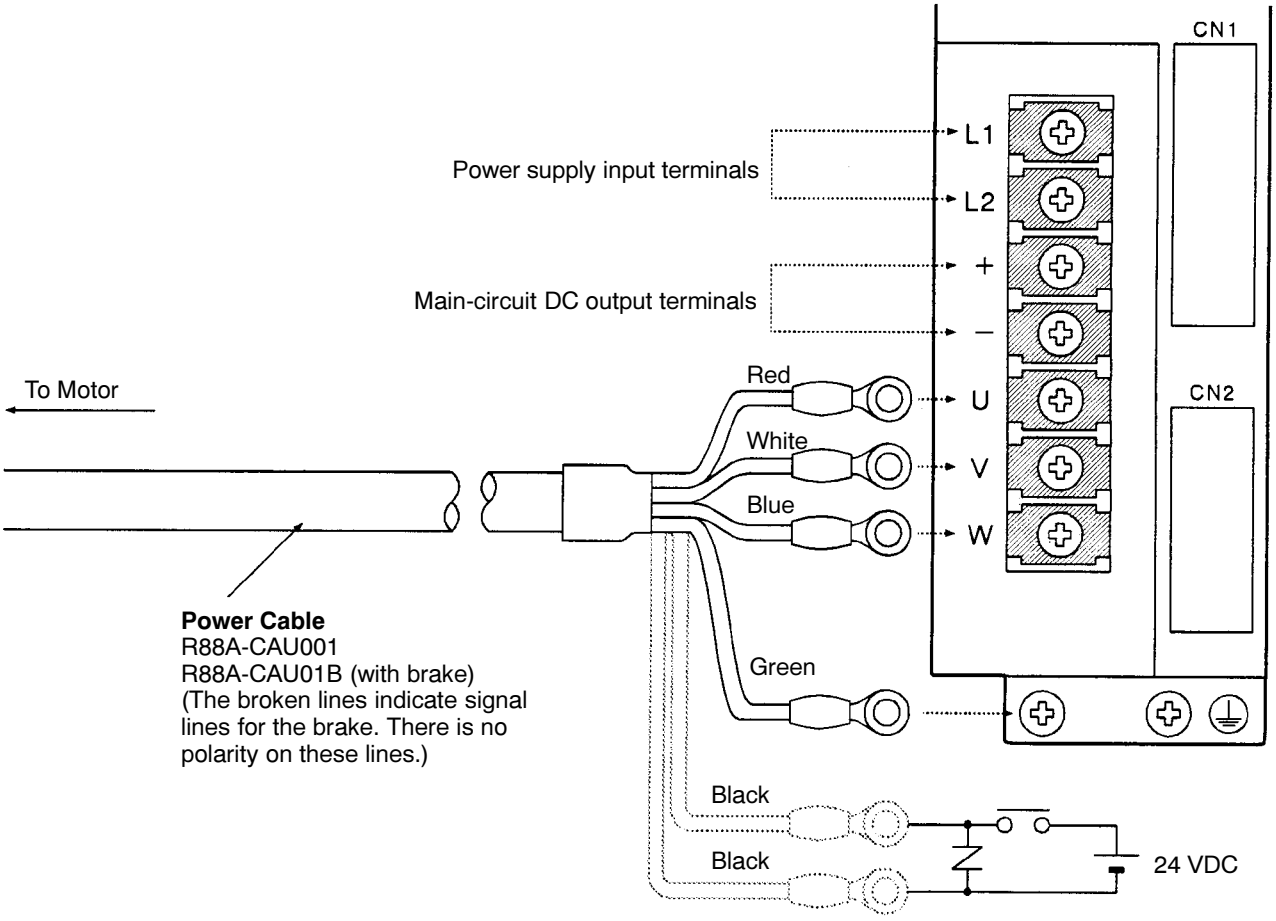
Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

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2-3-2 Wiring Terminal Blocks

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
L1	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry.	
L2		R88D-UA□□V: Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UA□□V: Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
+	Main circuit DC output	When there is a high level of regenerative energy in a multi-axis system, the + terminals can be connected together and the – terminals can be connected together to increase the ability to absorb regenerative energy.	
–			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to *3-8 Regenerative Energy Absorption* for the methods to calculate regenerative energy.

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■ Terminal Block Current and Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

● Servo Drivers with 200-VAC Input (R88D-UA□□V)

Driver (Watts)	R88D-UA02V (30 W)	R88D-UA03V (50 W)	R88D-UA04V (100 W)	R88D-UA08V (200 W)	R88D-UA12V (400 W)	R88D-UA20V (750 W)
Power supply input current (L1, L2)	1.3 A	1.5 A	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.42 A	0.6 A	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.				1.25 mm^2	2.0 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20			AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.					
Protective earth terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.					

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

● Servo Drivers with 100-VAC Input (R88D-UA□□W)

Driver model (Watts)	R88D-UA03W (30 W)	R88D-UA04W (50 W)	R88D-UA10W (100 W)	R88D-UA12W (200 W)	R88D-UA15W (300 W)
Power supply input current (L1, L2)	2.0 A	2.6 A	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	0.63 A	0.7 A	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.			1.25 mm^2	2 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20		AWG 20 to AWG 18		
	Use OMRON standard cable (AWG20). The applicable wire size for motor connectors is AWG22 to AWG18.				
Protective earth terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.				

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

● Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

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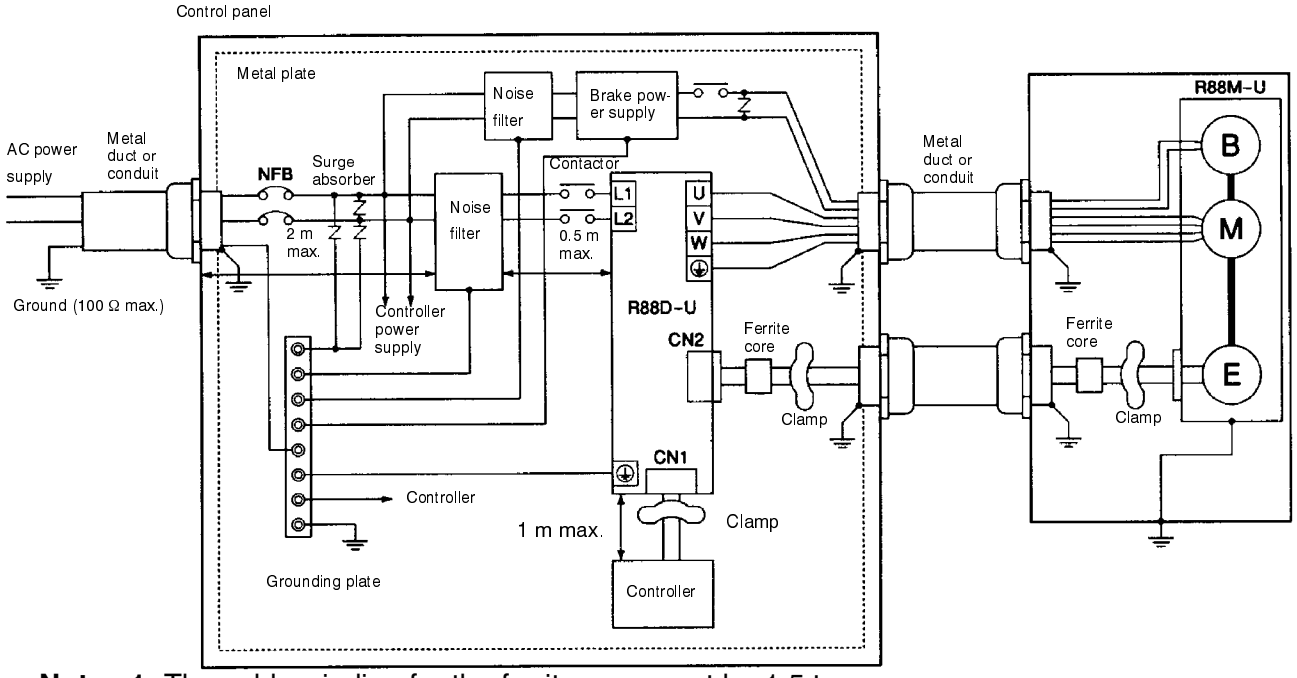
2-3-3 Wiring Products Conforming to EMC Directives

Model conforming to EC Directive will meet the requirements of the EMC Directives EN55011 Class A Group 1 (EMI) and EN50082-2 (EMS) if they are wired under the conditions described in this section. If the connected devices, wiring, and other conditions cannot be made to fulfill the installation and wiring conditions when the product is incorporated into a machine, the compliance of the overall machine must be confirmed.

The following conditions must be met to conform to EMC Directives.

- The Servo Driver must be installed in a metal case (control panel).
- Noise filters and surge absorbers must be installed on all power supply lines.
- Shielded cables must be used for all I/O signal lines and encoder lines. (Use tin-plated, soft copper wires for the shield weaving.)
- All cables leaving the control panel must be wired in metal ducts or conduits with blades.
- Ferrite cores must be attached to the shielded cable and the shield must be clamped directly to the ground plate to ground it.

■ Wiring Methods



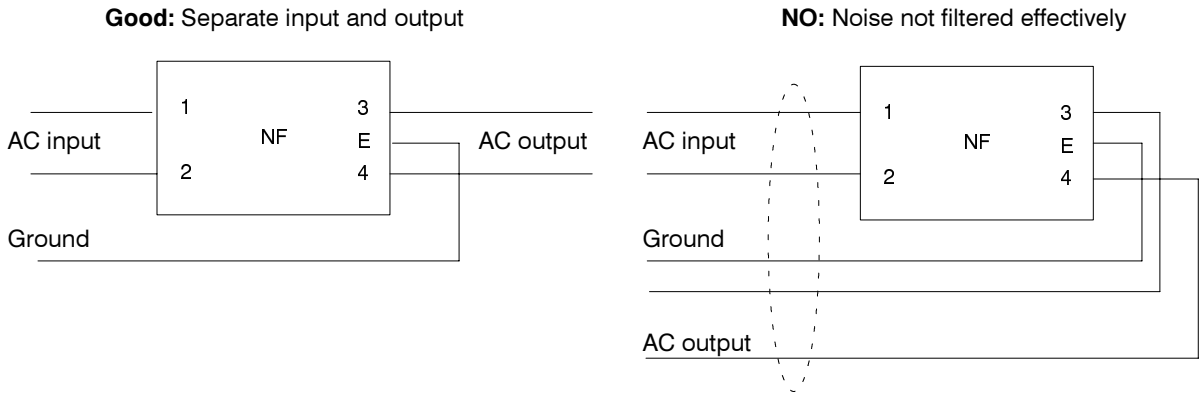
Note 1. The cable winding for the ferrite core must be 1.5 turns.

Note 2. Remove the sheath from the cable and ground it directly to the metal plate at the clamps.

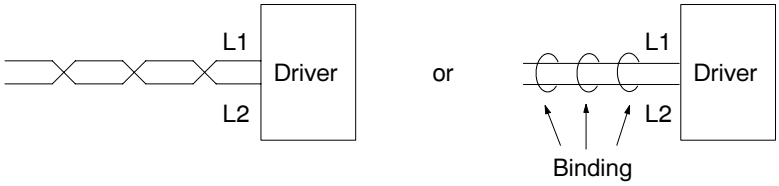
- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use the grounding plate for the protective earth for each Unit, as shown in the illustration, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.

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- No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.
- Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.



- Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



- Separate power supply cables and signal cables when wiring.

■ Control Panel Structure

Any gaps in the cable entrances, mounting screws, cover, or other parts of a control panel can allow electric waves to leak from or enter the control panel. The items described in this section must be abided by in panel design and selection to ensure that electric waves cannot leak or enter the control panel.

● Case Structure

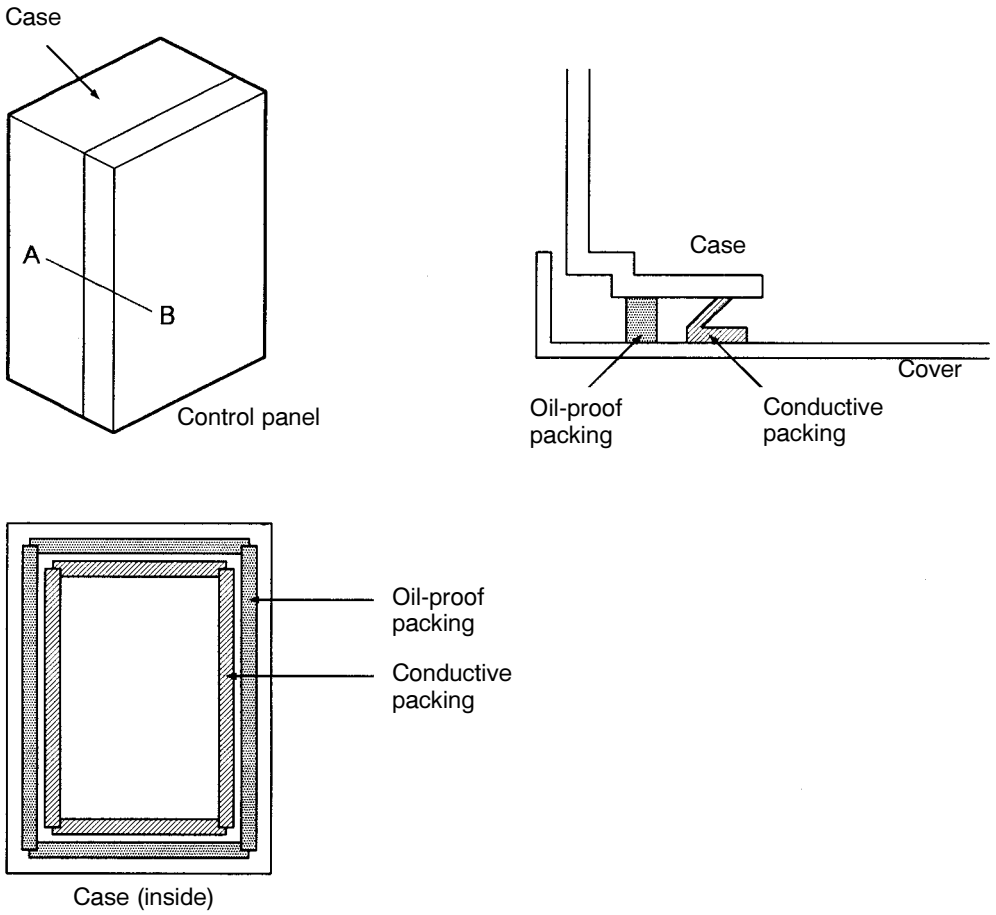
- Use a metal control panel with welded joints on the top, bottom, and all sides. The case must be electrically conductive.
- When assembling the control panel, remove the coating from all joints (or mask the joints when coating) to ensure electrical conductivity.
- Be sure that no gaps are created when installing the control panel, as gaps can be caused by distortion when tightening screws.
- Be sure there are not any electrically conductive parts that are not in electrical contact.
- Ground all Units mounted in the control panel to the panel case.

● Cover Structure

- Use a metal cover.
- Use a water-proof structure, as shown in the following diagram, and be sure there are no gaps.

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- Use electrically conductive packing between the cover and the case, as shown in the following diagram. (Remove the coating the contact points of the packing (or mask the contact points when coating) to ensure electrical conductivity.)
- Be sure that no gaps are created when installing the cover, as gaps can be caused by distortion when tightening screws.



■ Selecting Components

● No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum output current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

● Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge

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immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Max. limit voltage	Surge immunity	Type	Remarks
Okaya Electric Ind.	R.A.V-781BYZ-2	783 V	1,000 A	Block	For power supply line
	R.A.V-781BXZ-4	783 V	1,000 A		For power supply line ground

Note **1.** Refer to manufacturers documentation for operating details.

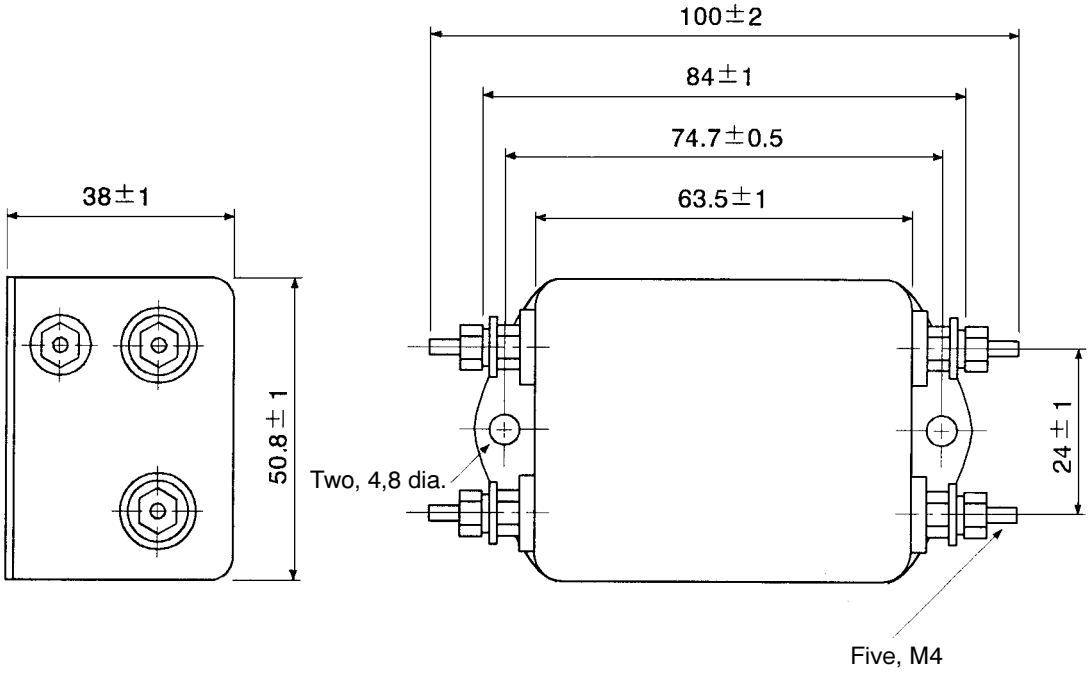
Note **2.** The surge immunity is for a standard impulse current of 8/20 μs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

● Noise Filters

Use the following noise filters on the power supplies for the Servo Driver and brake. These filters are manufactured by Okaya Electric Ind.

Application	Model	Rated current	Test voltage	Insulation resistance	Leakage current (max.)	Attenuation characteristic	
						Normal (MHz)	Common (MHz)
200 V, 30 to 100 W 100 V, 30 or 50 W Brake power supply	SUP-P5H-EPR-4	5 A	Between terminals: 1,250 V rms, 50/60 Hz, 60 s Between terminals and case: 2,000 V rms, 50/60 Hz, 60 s	Between terminals and case: 6,000 MΩ min. (at 500 VDC)	0.6 mA (at 250 V rms 60 Hz)	0.5 to 30	0.2 to 30
200 V, 200 or 400 W 100 V, 100 W	SUP-P8H-EPR-4	8 A				0.6 to 30	0.3 to 30
200 V, 750 W 100 V, 200 or 300W	SUP-P10H-EPR-4	10 A				0.7 to 30	0.4 to 30

The appearance of the noise filters is shown below. Screw terminals are used.



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• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 μF-50 Ω CRE-50500 0.5 μF-50 Ω S2-A-0 0.2 μF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	J7AN-E3	15 A	120 A	24 VDC

• Leakage Breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.
- The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UA02V to -UA08V	80 mA	3 mA
R88D-UA12V	60 mA	4 mA
R88D-UA20V	110 mA	5 mA

Note 1. Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

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Note **2.** Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note **3.** Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

Incremental Encoders:

A, B, and S phase. The frequency for A- or B-phase signals is 154 kHz max.; the transmission speed for S-phase signals is 616 kbps.

Absolute Encoders:

A, B, and Z phase, plus the absolute encoder signal. The frequency for A- or B-phase signals is 76.8 kHz max.; the transmission speed for absolute encoder signals is 9.6 kbps.

Follow the wiring methods outlined below to improve encoder noise resistance.

- Be sure to use dedicated encoder cables.
- If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.
- Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.
- When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

- Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

■ Improving Control I/O Signal Noise Resistance

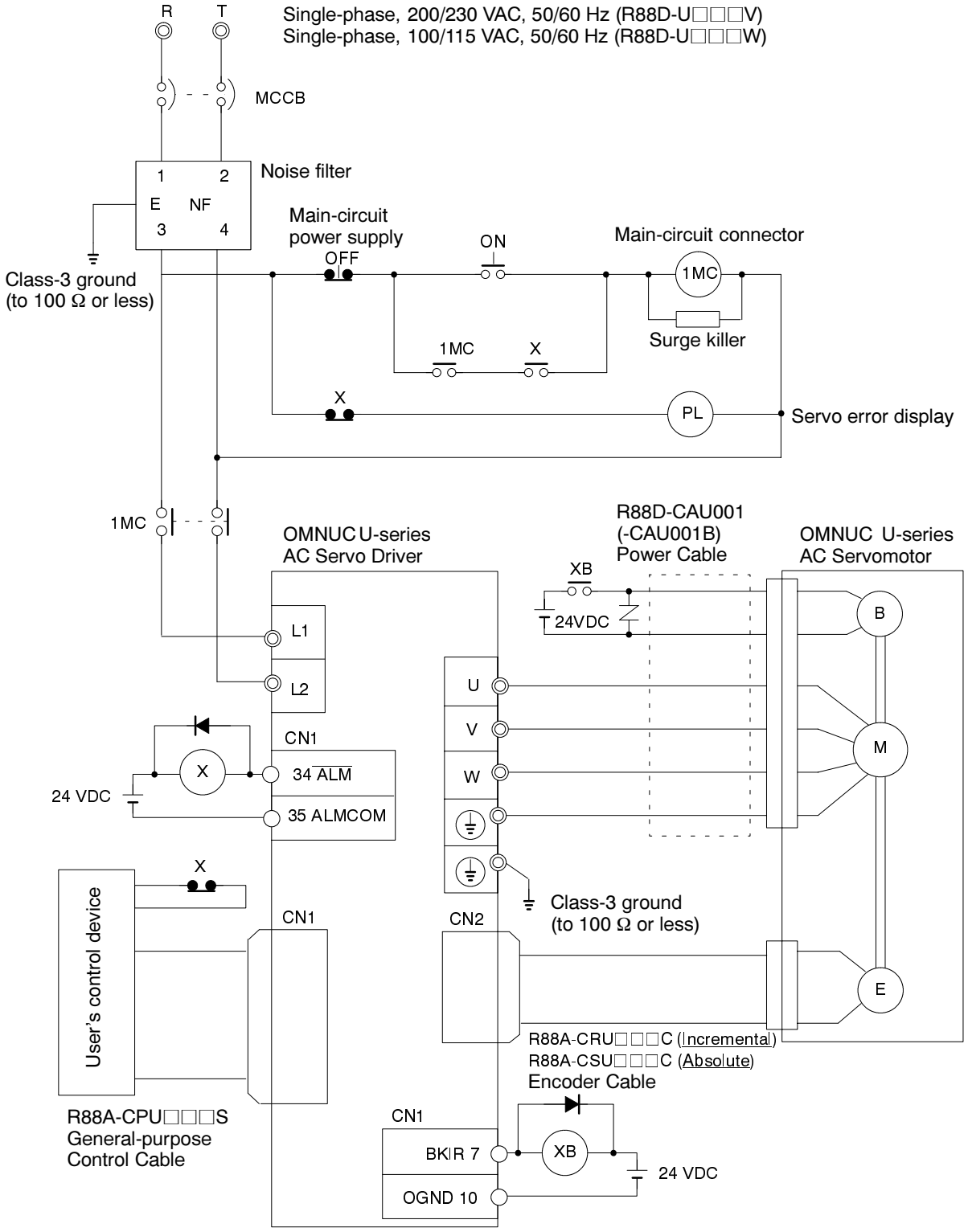
Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

- Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.
- For speed and torque command input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-μF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output (A, B, and Z phase, plus the absolute encoder signal) lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.

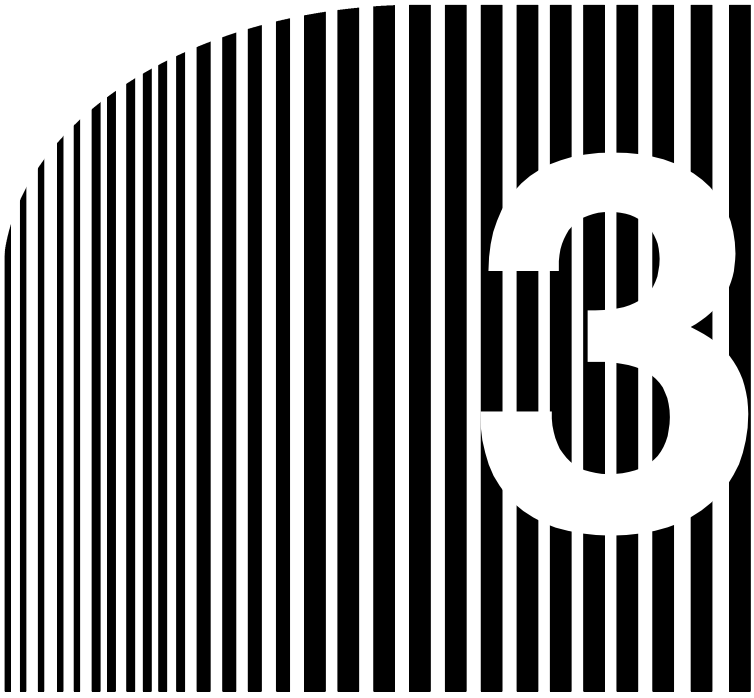
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2-3-4 Peripheral Device Connection Examples

■ Connecting to Peripheral Devices



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Chapter 3

• Operation •

3-1 Operational Procedure
3-2 Turning On Power and Checking Displays
3-3 Using Parameter Units
3-4 Initial Settings: Setup Parameters
3-5 Setting Functions: User Parameters
3-6 Trial Operation
3-7 Making Adjustments
3-8 Regenerative Energy Absorption

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Operation and Adjustment Precautions

⚠ **Caution** Check the newly set parameters for proper execution before actually running them. Not doing so may result in equipment damage.

⚠ **Caution** Do not make any extreme adjustments or setting changes. Doing so may result in unstable operation and injury.

⚠ **Caution** Separate the Servomotor from the machine, check for proper operation, and then connect to the machine. Not doing so may cause injury.

⚠ **Caution** When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation. Not doing so may result in injury.

⚠ **Caution** Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart. (Take appropriate measures to secure safety against an unexpected restart.) Doing so may result in injury.

⚠ **Caution** Do not use the built-in brake of the Servomotor for ordinary braking. Doing so may result in malfunction.

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3-1 Operational Procedure

After confirming that the system has been correctly installed and wired, make the initial settings for the Servo Driver. Then, set the functions as required for the application of the Servomotor.
Any incorrect settings in the parameters could cause unexpected motor operation, creating an extremely dangerous situation. Use the procedures provided in this section to carefully set all parameters.

■ Startup Procedure

1. Mounting and installation

   Install the Servomotor and Servo Driver according to the installation conditions: **Chapter 2, section 2-1.**

2. Wiring and connections

   Connect to power supply and peripheral devices: **Chapter 2, section 2-2.**

   The specified installation and wiring conditions are particularly important to ensure that models conforming to EC Directives actually conform to the EC Directive in the final system.

3. Turning on power supply

   Before turning on the power supply, check the necessary items. In order to make the initial settings, turn on an application power supply: **Chapter 3, section 3-2.**

4. Checking display status

   Check by means of the displays to see whether there are any internal errors in the Servo Driver: **Chapter 3, section 3-2**

5. Initial settings

   Make the settings for the operation setup parameters (initial settings): **Chapter 3, section 3-4.**

6. Function settings

   By means of the user parameters, set the functions according to the operating conditions: **Chapter 3, section 3-5.**

7. Trial operation

   Before performing trial operation, turn the power supply off and then back on so that any parameters that have been set will be valid.
   Check to see whether protective functions such as emergency stop and operational limits are working reliably. Check operation at both low speed and high speed: **Chapter 3, section 3-6.**

8. Adjustments

   Execute auto-tuning. Manually adjust the gain as required: **Chapter 3, section 3-7.**

9. Operation

   Operation can now begin. If any trouble should occur, refer to Chapter 4 Application: **Chapter 4.**

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3-2 Turning On Power and Checking Displays

3-2-1 Items to Check Before Turning On Power

■ Checking Power Supply Voltage

- Check to be sure that the power supply voltage is within the ranges shown below.

R88D-UA□□H(A) (200 VAC specifications):Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz
R88D-UA□□L(A) (100 VAC specifications): Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz
R88D-UA□□V (200 VAC specifications): Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz
R88D-UA□□W (100 VAC specifications): Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz

■ Checking Terminal Block Wiring

- The power supply inputs R and T, or L1 and L2, must be properly connected to the terminal block.
- The Servomotor's red (U), white (V), and blue (W) power lines and the green ground wire (⏚) must be properly connected to the terminal block.

■ Checking the Servomotor

- There should be no load on the Servomotor. (Do not connect to the mechanical system.)
- The power line connectors at the Servomotor must be securely connected.

■ Checking the Encoder Connectors

- The encoder connectors (CN2) at the Servo Driver must be securely connected.
- The encoder connectors at the Servomotor must be securely connected.

■ Checking the Control Connectors

- The control connectors must be securely connected.
- The Run command must be OFF.

■ Checking the Parameter Unit Connection

- The Parameter Unit (R88A-PR02U or R88A-PR03U) must be securely connected to connector CN3.

3-2-2 Turning On Power and Confirming the Display

■ Turning On Power

- Confirm that it is safe to turn on the power supply and then turn on the power supply.

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- When turning on the power for the first time with an absolute encoder, a backup error (A.81) will occur. Use the procedure provided in *4-1 Absolute Encoder Setup and Battery Replacement* to set up the absolute encoder.

■ Checking Displays

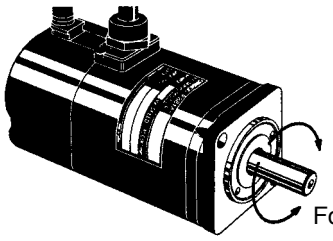
- When the power is turned on, one of the codes shown below will be displayed.

Normal (Base Block)	Error (Alarm Display)
-. bb	-. A.02

Note 1. "Baseblock" means that the Servomotor is not receiving power.

Note 2. The alarm code (the number shown in the alarm display) changes depending on the contents of the error.

- If the display is normal (i.e., no errors), use it as a monitor mode speed display. Manually turn the Servomotor shaft clockwise and counterclockwise, and check to be sure that it agrees with the positive and negative on the speed display. If it does not agree, then the encoder signal line may be wired incorrectly.



Display example
0038 - - - Forward rotation
–0025 - - - Reverse rotation

Note To monitor the speed feedback value, press the MODE/SET Key and go into monitor mode un–00. Then press the DATA Key.

- If there is an error, refer to *Chapter 4 Application* and take the necessary countermeasures.

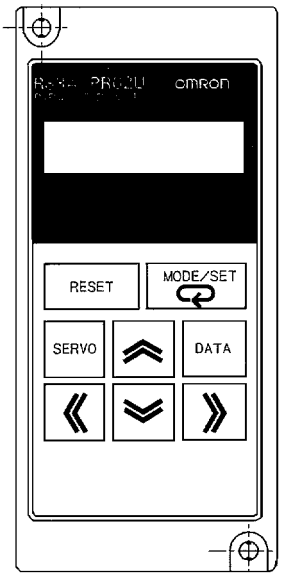
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3-3 Using Parameter Units

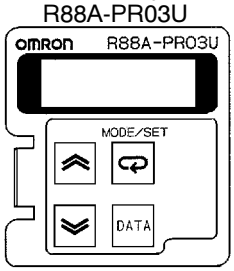
The key operations for the Handy-type R88A-PR02U and the Mounted-type R88A-PR03U vary depending on the functions used.

3-3-1 Parameter Unit Keys and Functions

Handy-type
R88A-PR02U



Mounted-type
R88A-PR03U



PR02U	PR03U	Function
RESET	∧ + ∨	Alarm reset
↩	↩	Mode switching Data memory
SERVO	DATA	Servo ON/OFF during jog operations
DATA	DATA	Switching between parameter display and data display; data memory
∧	∧	Increments parameter numbers and data values.
∨	∨	Decrements parameter numbers and data values.
≪		Left shift for operation digits
≫		Right shift for operation digits

3-3-2 Modes and Changing Modes

■ Modes

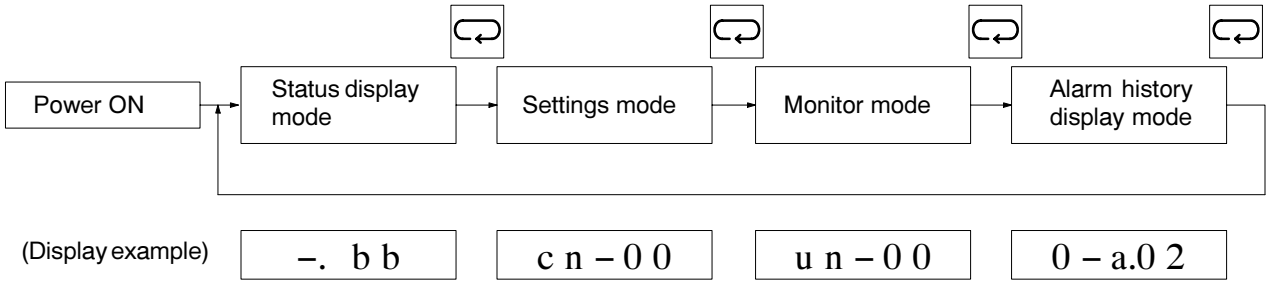
OMNUC U-series AC Servo Drivers have four operating modes, as described in the following table. For example, the Settings Mode is used to set parameters.

Mode	Function
Status display mode	Bit display (indicating internal status via indicators): Power supply ON display, baseblock, speed conformity, rotation detection and current limit detection, speed command being input, torque command being input Symbol display (indicating internal status via 3-digit 7-segment display): Baseblock, operating, forward rotation prohibited, reverse rotation prohibited, alarm display
Settings mode	System check: Jog operations, command offset automatic adjustment, alarm history data clear, command offset manual adjustment, motor parameters check, auto-tuning Setting and checking setup parameters Setting and checking user parameters
Monitor mode	Speed feedback, speed commands, torque commands, number of pulses from U-phase, electrical angle, internal status bit display
Alarm history display mode	Displays contents of alarms that have been previously generated (up to a maximum of 10).

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■ Changing Modes

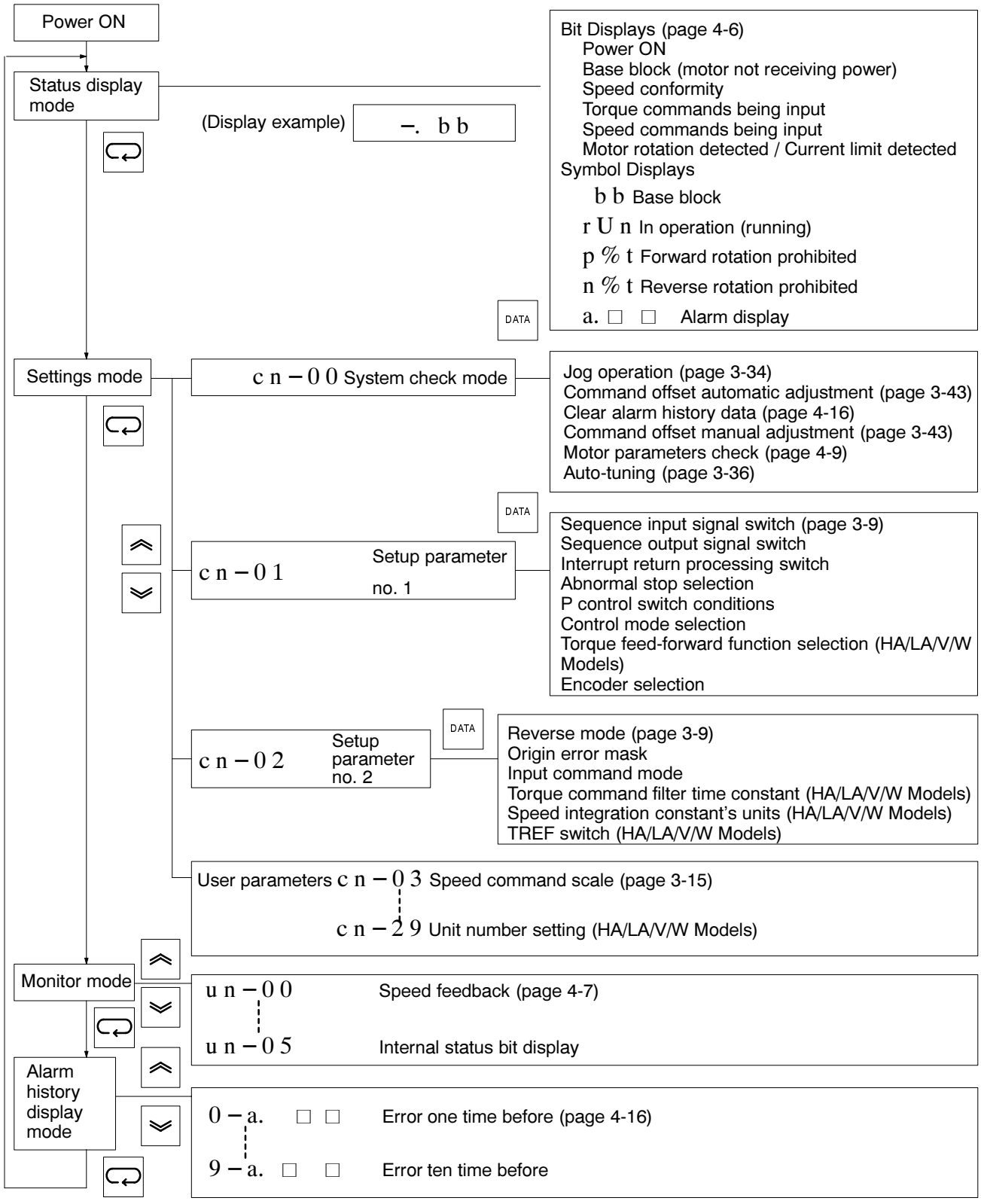
To change modes, press the MODE/SET Key.



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3-3-3 Mode Changes and Display Contents

The following diagram shows the functions and references for each mode.



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3-4 Initial Settings: Setup Parameters

Setup parameters are parameters that are essential for starting up the system. They include I/O signal function changes, selection of processing for momentary stops and errors, control mode changes, and so on. Set them to match the user system.
Once the parameters have been set, they become effective when the power supply is turned on again after having been turned off. (Check to see that the LED display has gone off.)

3-4-1 Setting and Checking Setup Parameters (Cn-01, 02)

■ Displaying Setup Parameters

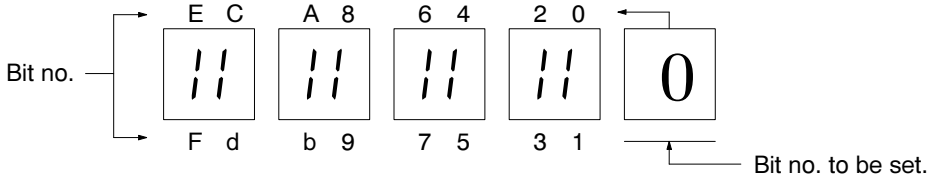
There are two setup parameters: No. 1 (Cn-01) and No. 2 (Cn-02).

To display the contents of setup parameters, execute the following key operations.

1. Press the MODE/SET Key to go into settings mode (cn–00).
2. Press the Up Key to display the setup parameter No. 1 (cn–01).
3. Press the DATA key to display the setting of the setup parameter.

To display the setting of setup parameter No. 2, press the Up Key twice at step 2. before pressing the DATA Key.

The setting of the setup parameters are displayed as follows:



In the leftmost four digits, 16 bits of information are displayed. In the rightmost digit, the bit number that can be set is displayed. It can be checked whether the bit information is “0” (not lit) or “1” (lit), according to the 7-segment LED vertical bar. To change the set value, first set the bit number in the rightmost digit, and then set the appropriate bit to “0” or “1.”

■ Setting Setup Parameters

First, display the setting of the setup parameter (No. 1 or No. 2) using the procedure given above. To change a setting, specify the bit to be changed and then set it to “1” or “0.”

● Making Settings with Handy-type (R88A-PR02U)

1. Use the Right and Left Keys to display in the rightmost digit the bit number that is to be set.
2. Using the Up (or Down) Key, reverse the lit/not lit status of the appropriate bit number. For “lit,” set the bit number to “1.” For “not lit,” set it to “0.”
3. Repeat steps 1 and 2 above as required.
4. Save the data in memory by pressing the MODE/SET Key (or the DATA Key).
5. With this, the parameter setting operation is complete. Pressing the DATA Key at this point will bring back the parameter number display.

● Making Settings with Mounted-type (R88A-PR03U)

1. Use the Up and Down Keys to display in the rightmost digit the bit number that is to be set.
2. Using the MODE/SET Key, reverse the lit/not lit status of the appropriate bit number. For “lit,” set the bit number to “1.” For “not lit,” set it to “0.”

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3. Repeat steps 1 and 2 above as required.
4. Save the data in memory by pressing the DATA Key.
5. With this, the parameter setting operation is complete. Pressing the DATA Key at this point will bring back the parameter number display.

3-4-2 Setup Parameter Contents (Cn-01, 02)

■ Setup Parameters No. 1 (Cn-01)

Item	Bit no.	Factory setting	Setting	Explanation
Sequence input signal switching	0	0	0	Servo turned ON or OFF by Run command (externally input).
			1	Servo always ON.
	ABS 1	0	0	Valid on the sensor ON input (externally input).
			1	Always regarded as high level internally regardless of the sensor ON input signal.
	2	1	0	Enables forward drive prohibit input (POT).
			1	Permits always-forward drive.
	3	1	0	Enables reverse drive prohibit input (NOT).
			1	Permits always -reverse drive.
Sequence output signal switching	4	0	0	Takes TGON/CLIMT signal as motor rotation detection output.
			1	Takes TGON/CLIMT signal as current limit detection output.
Processing at time of recovery from momentary stop	5 (see note 1)	1	0	Servo alarm set at time of recovery from momentary stop.
			1	Servo alarm automatically cleared at time of recovery from momentary stop.
Abnormal stop	6	1	0	Motor stopped by dynamic brake.
			1	Motor stopped with free run.
	7 (see note 2)	1	0	Dynamic brake OFF after motor stopped.
			1	Dynamic brake ON after motor stopped.
	8	0	0	Method for stopping when over-travel occurs depends on bit no. 6 setting.
			1	When over-travel occurs, motor is stopped at the torque set by user parameter Cn-06 (emergency stop torque).
	9	0	0	When over-travel occurs, motor comes to deceleration stop and servo turns OFF.
			1	When over-travel occurs, motor comes to deceleration stop and position is locked.

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Item	Bit no.	Factory setting	Setting	Explanation
Control mode selection	b, A (see note 5)	0, 0	0, 0	Speed Control • Speed controlled by speed command input (REF). • CN1-15 is for gain reduction (MING); when ON, P control is set, and when OFF, PI control is set.
			0, 1	Speed Control with Position Lock Function • Speed controlled by speed command input (REF). • CN1-15 is for the position lock command (PLOCK). When the position lock command (PLOCK) is ON, if the motor speed is below the setting of user parameter Cn-0F (number of position lock rotations), the control mode changes from speed control to position control and the motor is servo-locked.
			1, 0	Torque Control I • Torque control depends on torque command input (TREF). • CN1-15 and speed command input (REF) are disabled.
			1, 1	Torque Control II • Control mode for using an external signal to switch between torque control via the torque command (TREF) and speed control via the speed command (REF). • CN1-15 is for torque control switching (TVSEL); when OFF, torque control is set, and when ON, speed control is set. • When set for torque control, if the speed command input (REF) is for +voltage, it becomes the speed limit value for forward or reverse rotation. (See note 4.)
P control switch conditions	d, C (see note 6)	1, 1	0, 0	The torque command value (Cn-0C) is taken as the condition.
			0, 1	The speed command value (Cn-0d) is taken as the condition
			1, 0	The acceleration command value (Cn-0E) is taken as the condition.
			1, 1	No P control switching function.
Encoder selection	ABS E	0	0	Incremental encoder
			1	Absolute encoder
Torque feed-forward function selection (HA/LA/V/W Models)	F	0	0	Torque feed-forward function disabled.
			1	Torque feed-forward function enabled.

Note 1. If power is immediately turned back on after having been cut off, a momentary stop alarm may be generated. If bit no. 5 is set to "1," the alarm will be cleared automatically even if it is generated, and operation will resume.

Note 2. If set bit 6 to "1" and bit 8 to "0," the dynamic brake relay will turn OFF after the Servomotor stops, regardless of the setting of bit no. 7.

Note 3. In the torque control mode, the method of stopping for errors depends on the setting of bit no. 6. The setting of bit no. 8 has no effect.

Note 4. Outside of the speed limit range, a torque is generated in proportion to the difference with the speed limit value, in order to bring down the Servomotor rotation speed. At this time, the Servomotor rotation speed will not necessarily match the speed limit. (The Servomotor rotation speed varies depending on the load.)

Note 5. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

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Note 6. With P control switch conditions, a change from PI control to P control is selected. This function is only valid for speed control.

Note 7. Do not change the setting of bits 1 and E of setup parameter no. 1 (Cn-01) when a Servomotor with an incremental encoder is being used. Change the setting of bit E of setup parameter no. 1 (Cn-01) when a Servomotor with an absolute encoder is being used.

Note 8. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

■ Setup Parameters No. 2 (Cn-02)

Item	Bit no.	Factory setting	Setting	Explanation
Reverse rotation mode	0	0	0	Rotates in the CCW direction with a + analog command. (See note 5.)
			1	Rotates in the CW direction with a + analog command.
Origin error mask (ABS)	1	0	0	Origin errors are detected.
			1	Origin errors are not detected.
Input command mode (see note 2)	2	0	0	CN1-11 and 12 are used as forward and reverse current command inputs (PCL, NCL).
			1	[Internal speed control settings] CN1-11 and 12 are used as speed selection command 1 and 2 inputs (SPD1, SPD2). CN1-15 is used as rotation direction command (RDIR).
	3	0	---	Not used
	4	0	---	Not used
	5	0	---	Not used
	6	0	---	Not used
	7	0	---	Not used
	8	0	---	Not used
	9	0	---	Not used
	A	0	---	Not used
Speed integration constant's units (HA/LA/V/W Models)	b	0	0	1 ms
			1	0.01 ms
Torque command filter time constant (HA/LA/V/W Models)	C	0	0	Primary filter
			1	Secondary filter
	d	0	---	Not used
	E	0	---	Not used
TREF switch (see note 3) (HA/LA/V/W Models)	F	0	0	Terminal TREF (CN1-1) isn't the analog current control.
			1	Terminal TREF (CN1-1) is the analog current control.

Note 1. Do not set bit nos. 1, 3 to A, d, and E of setup parameter no. 2 (Cn-02).

Note 2. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

Note 3. The TREF switch setting (bit F) is valid only for speed control. When this bit is set to "1," the voltage applied to TREF determines the current limit. (HA/LA/V/W Models)

Note 4. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

Note 5. Counterclockwise direction when viewed from the motor output shaft is CCW and clockwise direction is CW.

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3-4-3 Important Setup Parameters (Cn-01 and Cn-02)

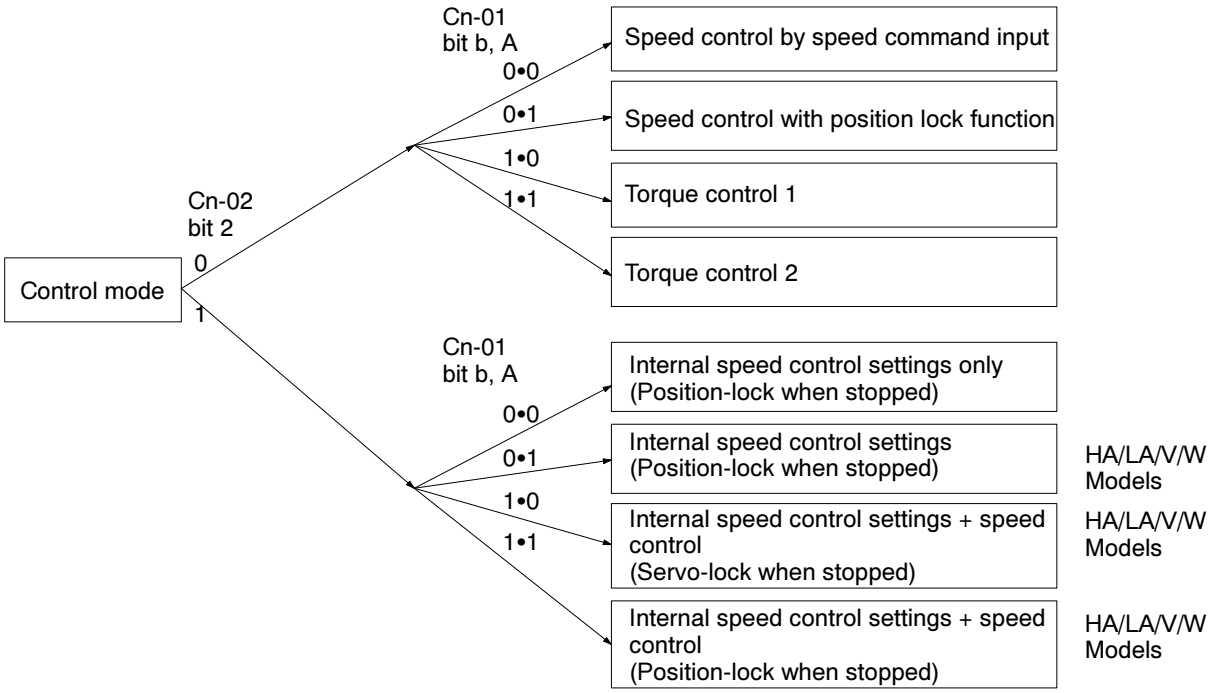
This section explains the particularly important setup parameters. If these parameters aren't set properly, the motor might not operate or might operate unpredictably. Set these parameters appropriately for the system being used.

■ Control Mode Settings

The control mode is determined by the following setup parameters:

- Input command mode: Cn-02 bit 2 Switches between external analog input control and internal speed control settings.
- Control mode selector: Cn-01 bit b, A (The function of this bit depends on the setting of Cn-02 bit 2.)

The following diagram shows the function of these two bits:



Cn-02 bit 2	Cn-01 bits b, A	Control mode
0	0, 0	Speed control by speed command inputs (factory setting)
	0, 1	Speed control with position lock
	1, 0	Torque control 1: torque control by torque commands
	1, 1	Torque control 2: switchable between torque control and speed control
1	0, 0	Internal speed control settings only (servo-lock when stopped)
	0, 1	Internal speed control settings only (position-lock when stopped)
	1, 0	Internal speed control settings + speed control (servo-lock when stopped)
	1, 1	Internal speed control settings + speed control (position-lock when stopped)

Note It is possible to select from the 8 control modes only when using an HA/LA/V/W model. When Cn-02 bit 2 is set to "1" in an H/L model, the control mode will be "Internal speed control settings only (servo-lock when stopped)" regardless of the settings of Cn-01 bits A and b.

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■ Encoder Selection (Bit E of Cn-01)

Set this parameter according to the type of encoder used by the Servomotor. This parameter is set for an incremental encoder at the factory, so be sure to change it when an absolute encoder is being used.

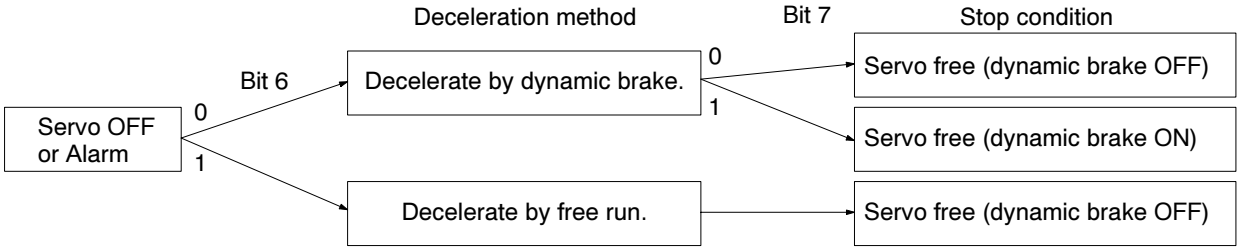
Encoder selection Cn-01, bit E	Encoder
0	Incremental encoder (factory setting)
1	Absolute encoder

Note When using a Servomotor with an absolute encoder, set the number of encoder pulses in user parameter Cn-11 to "1024."

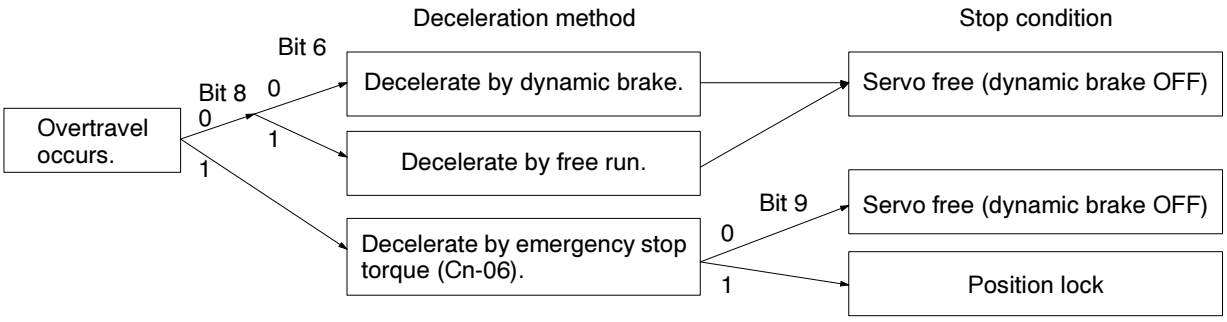
■ Error Stop Processes

Bits 6, 7, 8, and 9 of Cn-01 specify how the motor will be stopped when the servo goes OFF (the run command is OFF), an alarm is generated, or overtravel occurs. The following diagrams show the function of these four bits:

Stop Process for Servo OFF/Alarm



Stop Process for Overtravel



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3-5 Setting Functions: User Parameters

Set the user parameters in order as follows:	
Go into settings mode.	MODE/SET Key
Display the pertinent parameter number.	Direction Keys (Handy-type) Up and Down Keys (Mounted-type)
Display the contents (data) of the parameter.	DATA Key
Change the data.	Direction Keys (Handy-type) Up and Down Keys (Mounted-type)
Save the data in memory.	MODE/SET and DATA Keys

3-5-1 Setting and Checking User Parameters (Cn-03 to 29)

■ Displaying User Parameters

Perform the following procedures on the Parameter Unit to display the user parameters.

● Displaying with Handy-type (R88A-PR02U)

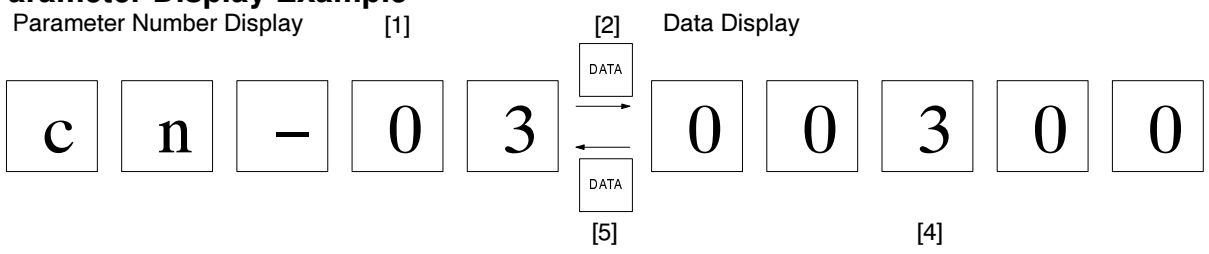
1. Press the MODE/SET Key to go into settings mode (cn–□□).
2. Press the Direction Keys to display the desired user parameter number.
   Press the Right and Left Keys to select the digit to be set. The digit whose value can be set will blink.
   Press the Up and Down Keys to increment or decrement the digit.
3. Press the DATA Key to display the setting of the specified parameter.
4. Press the DATA Key again to return to the parameter number display.

Note If only the Up or Down Key is pressed at step 2., the parameter number can be set directly. In this case, the rightmost digit will blink. The number cannot be set if the second digit (the 10s digit) is blinking (i.e., blinking indicates the digit that can be changed).

● Displaying with Mounted-type (R88A-PR03U)

1. Press the MODE/SET Key to go into settings mode (cn–□□).
2. Press the Up and Down Keys to display the desired user parameter number.
   The number will be incremented or decremented each time the Up or Down Key is pressed.
3. Press the DATA Key to display the setting of the specified parameter.
4. Press the DATA Key again to return to the parameter number display.

● Parameter Display Example



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■ Setting User Parameters

First, use the previous procedure to display the settings of the user parameter. Then use the following procedures to set user parameters.

● Making Settings with Handy-type (R88A-PR02U)

1. Use the Right and Left Keys to select the digit that is to be set. The digit for which the value can be changed will blink.
2. Press the Up and Down Keys to change the value of the digit.
3. Repeat the previous two steps as required to set the parameter.
4. Press the MODE/SET or DATA Key. The parameter will be set and the display will blink.
5. Press the DATA Key again to return to the parameter number display.
6. Repeat steps 1 through 5 above as required to set other parameters.

Note 1. Settings can also be made by pressing only the Up and Down Keys in stead of using steps 1. and 2. This will enable setting digits higher than the one that is blinking. Use whichever method is faster for the number of digits that need to be set.

Note 2. The Down Key can be pressed when all digits higher than the blinking one are zeros to set the minimum value in the setting range.

Note 3. The fifth digit (i.e., the leftmost digit) cannot be made to blink by pressing the Left Key. The fifth digit can be set from the fourth digit. For example, to set "10000," press the Left Key to make the fourth digit blink and then press the Up Key again once the fourth digit reaches "9." The fifth digit will change to "1" and the fourth digit will change to "0."

● Making Settings with Mounted-type (R88A-PR03U)

1. Using the Up and Down Keys, set the data. If the keys are held down, the numbers will change 10 at a time. If the keys are held down even longer, the numbers will change 100 and then 1,000 at a time.
2. Press the MODE/SET Key (or the DATA Key). The parameter will be set and the display will blink.
3. Pressing the DATA Key again will bring back the parameter number display.
4. Repeat steps 1 through 4 above as required to set other parameters.

3-5-2 User Parameter Chart

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-00	System check mode	---	---	---	Refer to system check mode explanation.
Cn-01	Setup parameter no. 1	---	---	---	Refer to setup parameter no. 1 explanation.
Cn-02	Setup parameter no. 2	---	---	---	Refer to setup parameter no. 2 explanation.
Cn-03	Speed command scale	300	(r/min)/V	0 to 2,162	Rotation speed setting per 1 V of speed command voltage.
Cn-04	Speed loop gain (See note 1.)	80	Hz	1 to 2,000	Adjusts speed loop response.

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PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-05	Speed loop integration constant	20	ms	2 to 10,000	Speed loop integration constant With the HA/LA/V/W Models, the units can be set with bit b of Cn-02. Bit b=0: 1-ms units Bit b=1: 0.01-ms units
Cn-06	Emergency stop torque	Maximum torque	%	0 to maximum torque	Deceleration torque when abnormality occurs (compared to rated torque).
Cn-07	Soft start acceleration time	0	ms	0 to 10,000	Acceleration time setting for software start.
Cn-08	Forward torque limit	Maximum torque	%	0 to maximum torque	Output torque for rotation in forward direction (compared to rated torque).
Cn-09	Reverse torque limit	Maximum torque	%	0 to maximum torque	Output torque for rotation in reverse direction (compared to rated torque).
Cn-0A	Encoder divider rate (See note 2.)	1,000	Pulses/ revolution	INC 16 to 2,048 ABS 16 to 1,024	Setting for number of output pulses from Servo Driver.
Cn-0b	Rotation speed for motor rotation detection	20	r/min	1 to 4,500	Setting for rotation speed for motor rotor detection output.
Cn-0C	P control switching (torque commands)	200	%	0 to maximum torque	If a torque command exceeds this value, the mode switches from PI to P control.
Cn-0d	P control switching (speed commands)	0	r/min	0 to 4,500	If a speed command exceeds this value, the mode switches from PI to P control.
Cn-0E	P control switching (acceleration commands)	0	10 (r/min)/s	0 to 3,000	If an acceleration command exceeds this value, the mode switches from PI to P control.
Cn-0F	Position lock rotation speed	10	r/min	0 to 4,500	Setting for the rotation speed to cause position lock.
Cn-10	Jog speed	500	r/min	0 to 4,500	Setting for manual rotation speed
Cn-11	Number of encoder pulses (See notes 2 and 3.)	2,048	Pulses/ revolution	INC 2,048 ABS 1,024	Setting for number of pulses for encoder used.
Cn-12	Brake timing 1	0	10 ms	0 to 50	Delay time setting from brake command until servo turns off.
Cn-13	Torque command scale	30	0.1 V/ rated torque	10 to 100	Sets gain for torque command input.
Cn-14	Speed limit (torque control mode I)	3,000	r/min	0 to 4,500	Sets speed limit value for torque control mode I.
Cn-15	Brake command speed	100	r/min	0 to 4,500	Sets rotation speed for outputting brake commands.
Cn-16	Brake timing 2	50	10 ms	10 to 100	Waiting time from servo-off to brake command output.

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PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-17	Torque command filter time constant	4	100 μs	0 to 250	Setting for torque command filter time constant (6.4 to 398 Hz).
Cn-18	Forward rotation external current limit	100	%	0 to maximum torque	Output torque for when forward rotation current limit is input (compared to rated torque).
Cn-19	Reverse rotation external current limit	100	%	0 to maximum torque	Output torque for when reverse rotation current limit is input (compared to rated torque).
Cn-1A	Position loop gain	40	1/s	1 to 500	For servo-lock strength adjustment when position lock function is used.
Cn-1F	No. 1 internal speed setting	100	r/min	0 to 4,500	Rotation speed, no. 1 internal setting
Cn-20	No. 2 internal speed setting	200	r/min	0 to 4,500	Rotation speed, no. 2 internal setting
Cn-21	No. 3 internal speed setting	300	r/min	0 to 4,500	Rotation speed, no. 3 internal setting
Cn-22	Speed conformity signal output width	10	r/min	0 to 100	Sets the allowable fluctuation width for the speed conformity signal.
Cn-23	Soft start deceleration time	0	ms	0 to 10,000	Sets the deceleration time for software starts.
Cn-28	Compensating gain (HA/LA/V/W Models)	0	---	0 to 100	Adjustment gain during position control
Cn-29	Unit number setting (HA/LA/V/W Models) (See note 4)	0	---	0 to 14	Unit number setting used during multi-axis communications

Note 1. Cn-04 (speed loop gain) is factory-set for three times the load inertia. Therefore, if the load inertia is extremely small, some oscillation may occur. If it does, then lower Cn-04 to 20 or less.

Note 2. After the settings for Cn-0A (encoder divider rate) and Cn-11 (number of encoder pulses) have been made, they become effective when the power is turned on again after having been cut off. (Check to see that the LED display has gone off.)

Note 3. Set Cn-11 (number of encoder pulses) according to the number of pulses (resolution) of the encoder. The motor might not operate correctly if the setting is incorrect.
Incremental: 2,048
Absolute: 1,024

Note 4. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details on Cn-29 (unit number setting).

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3-5-3 Internal Speed Control Setting

■ Function

- This function controls Servomotor speed using the speeds set in the parameters (No. 1, No. 2, and No. 3 internal speed settings).
- This function can be used in the speed control modes. (It can't be used with torque control.) Select the internal speed using the control inputs CN1-11 and 12 (speed selection commands 1 and 2) and specify the rotational direction using the CN1-15 (rotation direction command).
- When both speed selection commands 1 and 2 are OFF, the motor will decelerate to a stop in the software start deceleration time (specified in Cn-23) and then go into servo lock status. Depending on the parameter settings, It might be possible use speed command inputs (when performing speed control) in this status. (HA/LA/V/W Models)

■ Setup Parameter Settings

- Set bit 2 of setup parameter number 2 (Cn-02) to "1." When this bit is set to "1," the internal speed control settings function can be used and CN1-11, 12, and 15 have the following functions:

  Control inputs CN1-11 and 12: . . . . Speed selection commands 1 and 2 (SPD1 and SPD2)
  Control input CN1-15: . . . . . Rotation direction command (RDIR)

- The following table shows the combinations of speeds and directions that can be selected with these three control inputs.

CN1-11 SPD1	CN1-12 SPD2	CN1-15 RDIR	Internal speed setting, rotational direction
OFF	ON	OFF	No. 1 internal speed setting, forward
		ON	No. 1 internal speed setting, reverse
ON	ON	OFF	No. 2 internal speed setting, forward
		ON	No. 2 internal speed setting, reverse
ON	OFF	OFF	No. 3 internal speed setting, forward
		ON	No. 3 internal speed setting, reverse

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• The following control modes can be set with bits b and A of setup parameter number 1 (Cn-01).

Cn-01		Control mode
Bit b	Bit A	
0	0	Internal speed control settings only (servo-lock when stopped) When SPD1 and SPD2 are both OFF, the Unit decelerates to a stop and goes into servo-lock with an internal speed command of 0 r/min. (The position loop won't operate.) The speed command input (REF) can't be received.
0	1	Internal speed control settings only (position-lock when stopped) HA/LA/V/W Models When SPD1 and SPD2 are both OFF, the Unit decelerates to a stop and goes into position-lock when the number of revolutions falls below the setting in Cn-0F (position lock revolutions). (The position loop will operate.) The speed command input (REF) can't be received.
1	0	Internal speed control settings + speed control (servo-lock when stopped) HA/LA/V/W Models When SPD1 and SPD2 are both OFF, the Unit decelerates to a stop and goes into servo-lock with an internal speed command of 0 r/min. (The position loop won't operate.) The speed command input (REF) can be received after SPD1 and SPD2 are both OFF.
1	1	Internal speed control settings + speed control (position-lock when stopped) HA/LA/V/W Models When SPD1 and SPD2 are both OFF, the Unit decelerates to a stop and goes into position-lock when the number of revolutions falls below the setting in Cn-0F (position lock revolutions). (The position loop will operate.) The speed command input (REF) can be received after SPD1 and SPD2 are both OFF.

■ User Parameter Settings

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-07	Soft start acceleration time	0	ms	0 to 10,000	Sets the time for the motor to accelerate from 0 r/min to 4,500 r/min.
Cn-23	Soft start deceleration time	0	ms	0 to 10,000	Sets the time for the motor to decelerate from 4,500 r/min to 0 r/min.
Cn-0F	Position lock revolutions	10	r/min	0 to 4,500	Sets the number of revolutions that cause position lock.
Cn-1F	No. 1 internal speed setting	100	r/min	0 to 4,500	Sets the speed for when SPD1 is OFF and SPD2 is ON.
Cn-20	No. 2 internal speed setting	200	r/min	0 to 4,500	Sets the speed for when SPD1 is ON and SPD2 is ON.
Cn-21	No. 3 internal speed setting	300	r/min	0 to 4,500	Sets the speed for when SPD1 is ON and SPD2 is OFF.

Note 1. The software start acceleration and deceleration times are effective on the internal speed settings and the speed command input (REF).

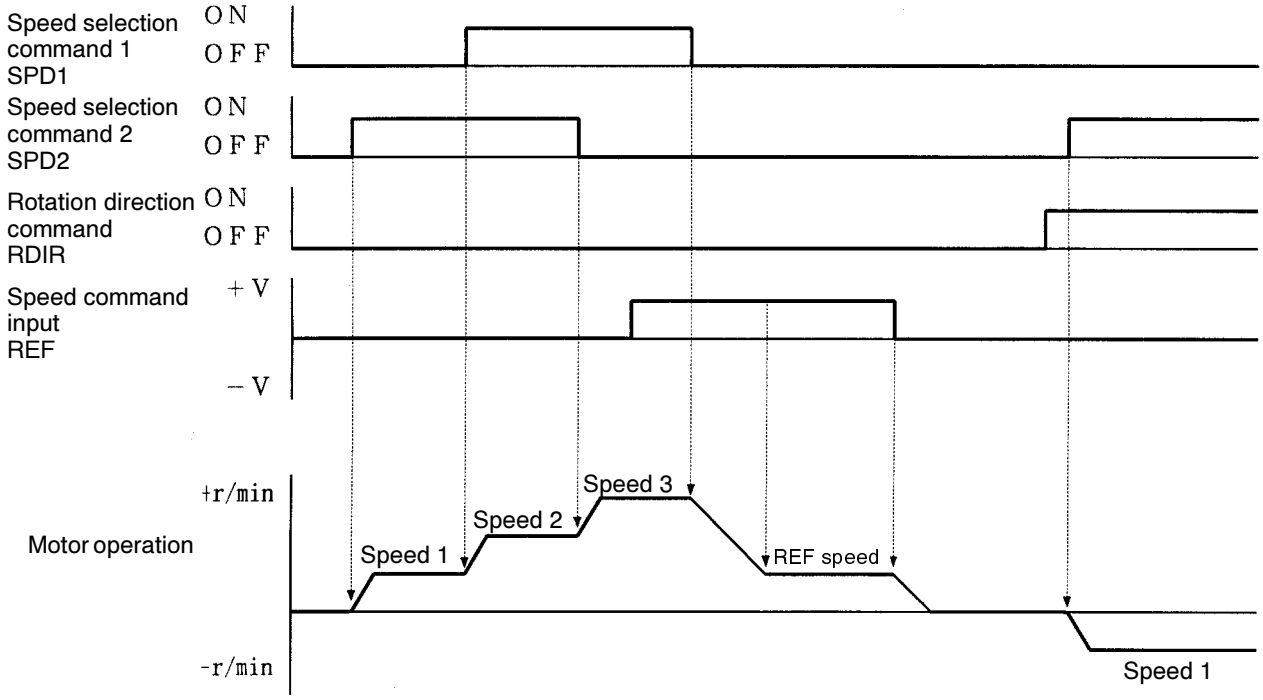
Note 2. Acceleration and deceleration times are set at up to 4,500 r/min. The actual acceleration and deceleration times are found by means of the following formula:

$$\text{Actual acceleration (deceleration) time} = \frac{\text{Internally set speed (r/min)}}{\text{4,500 (r/min)}} \times \text{Soft start acceleration (deceleration) time}$$

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■ Operation Example

● Internal Speed Control Settings + Speed Control (HA/LA/V/W Models)



Note When the control mode is "internal speed control settings + speed control," operation follows the speed command input (REF) immediately after SPD1 and SPD2 are both OFF (although there is a delay of up to 6 ms in reading the input signal.)
It isn't necessary to wait until the Unit goes into servo-lock.

3-5-4 Soft Start Function (Speed Control, Internally Set Speed Control)

■ Function

- This function starts and stops the Servomotor according to acceleration and deceleration times that have been set.
- The acceleration curve is trapezoidal. Acceleration and deceleration can be set independently.
- Use software start processing for speed command inputs (analog inputs) to minimize impact at the time of acceleration and deceleration.
- This function is effective for simple positioning and when changing speeds.

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■ User Parameter Settings

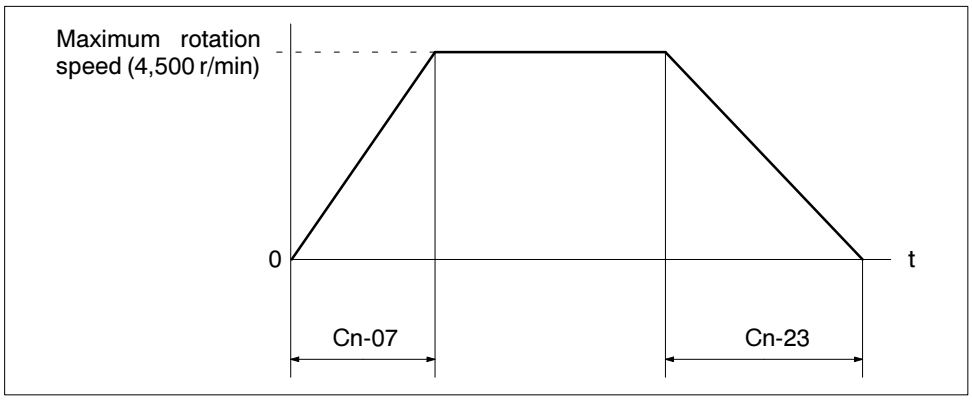
PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-07	Soft start acceleration time	0	ms	0 to 10,000	Sets the time for the motor to accelerate from 0 r/min to 4,500 r/min.
Cn-23	Soft start deceleration time	0	ms	0 to 10,000	Sets the time for the motor to decelerate from 4,500 r/min to 0 r/min.
Cn-0F	Position lock rotation speed	10	r/min	0 to 4,500	Setting for the rotation speed to cause position lock.
Cn-1A	Position loop gain	40	1/s	1 to 500	For servo-lock strength adjustment when position lock function is used.

Note 1. The software start acceleration and deceleration times are effective on the internal speed settings and the speed command input (REF).

Note 2. The position loop gain adjusts the servo-lock force during position-lock.

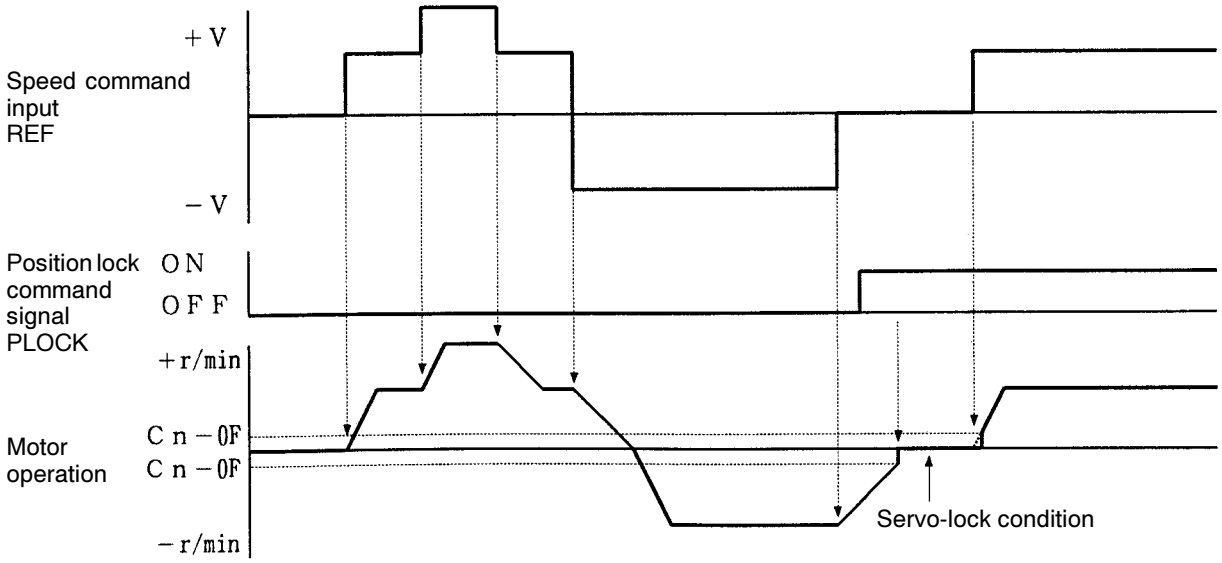
Note 3. Acceleration and deceleration times are set at up to 4,500 r/min. The actual acceleration and deceleration times are found by means of the following formula:

$$\text{Actual acceleration (deceleration) time} = \frac{\text{Internally set speed (r/min)}}{\text{4,500 (r/min)}} \times \text{Soft start acceleration (deceleration) time}$$



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■ Timing Chart



Note 1. Select "speed control with position lock" as the control mode when controlling the position lock with an external signal. (Refer to *page 3-13, Important Setup Parameters* for details.)

Note 2. The Unit will go into position lock if the position lock signal (PLOCK) is ON and the number of motor revolutions falls below the position lock revolutions set in Cn-0F. The motor will revolve when the internal speed command exceeds the position lock revolutions.

3-5-5 Encoder Dividing Function (INC)

■ Function

- With this function, any number of pulses can be set for encoder signals output from the Servo Driver.
- The number of pulses per Servomotor revolution can be set within a range of 16 to 2,048.
- Use this function for the following applications:
  When connecting to a positioner with a low response frequency.
  When it is desirable to set a pulse rate that is easily understandable.
  (For example, in a mechanical system in which a single Servomotor revolution corresponds to a movement of 10 mm, if the resolution is 5 μm/pulse, set the encoder dividing rate to 2,000 (pulses/revolution).

■ User Parameter Settings

PRM No.	Parameter name	Factory setting	Setting range	Explanation
Cn-0A	Encoder divider rate	1,000 pulses/revolution	16 to 2,048 pulses/revolution	Setting for number of output pulses from Servo Driver.
Cn-11	Number of encoder pulses	2,048 pulses/revolution	1,024, 2,048	Set the number of encoder pulses as follows: Absolute encoders: 1,024 Incremental encoders: 2,048

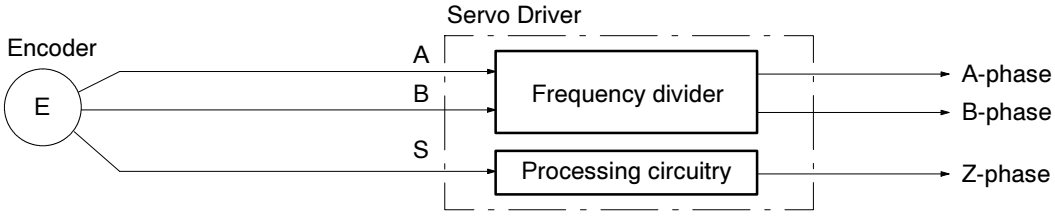
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Note **1.** Set the number of encoder pulses to 2,048 pulses/revolution when using an incremental encoder.

Note **2.** The power must be toggled to enable this parameter (be sure that the indicators go out completely).

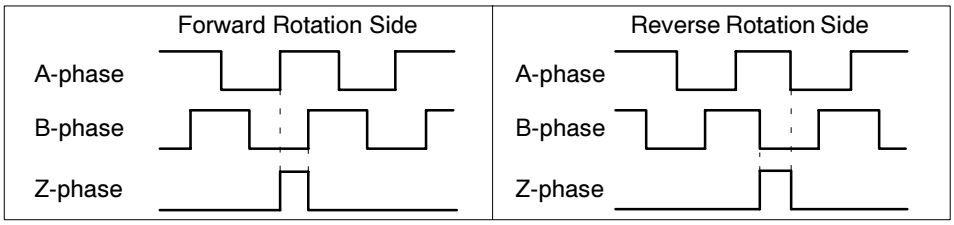
■ Operation

• Incremental pulses are output from the Servo Driver through a frequency divider.

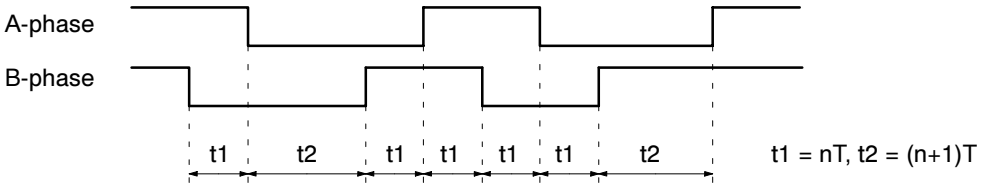


• The output phases of the encoder signal output from the Servo Driver are as shown below (when divider rate Cn-0A = 2,048).

Note The width of the Z-phase output pulse is not affected by the divider rate and will remain constant.

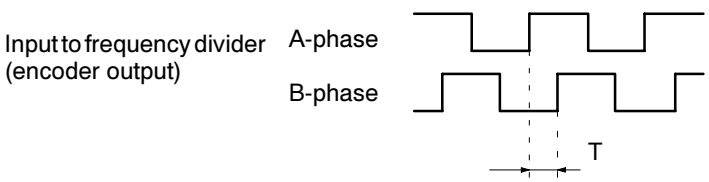


Note When the encoder divider rate is set to other than 2,048, 1024, 512,..., the phase difference for phases A and B is not 90°, but scatters for time T. (See the diagram below.)



In this diagram, T represents the time between phase A and phase B, and n is an integer that satisfies the following formula (with digits below the decimal point discarded).

n = 2,048/encoder divider rate



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3-5-6 Encoder Dividing Function (ABS)

■ Function

- With this function, any number of pulses can be set for encoder signals output from the Servo Driver.
- The number of pulses per Servomotor revolution can be set within a range of 16 to 1,024.
- Use this function for the following applications:
  When connecting to a positioner with a low response frequency.
  When it is desirable to set a pulse rate that is easily understandable.
  (For example, in a mechanical system in which a single Servomotor revolution corresponds to a movement of 5 mm, if the resolution is 5 μm/pulse, set the encoder dividing rate to 1,000 (pulses/revolution).

■ User Parameter Settings

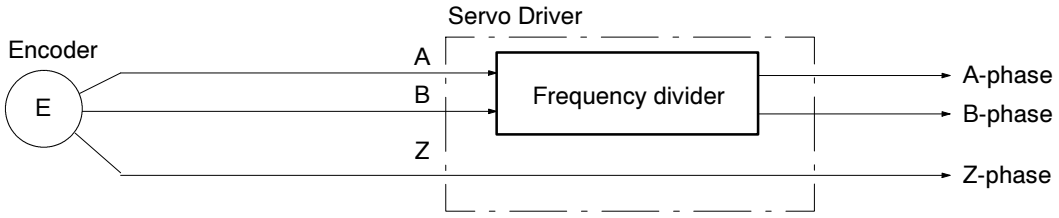
PRM No.	Parameter name	Factory setting	Setting range	Explanation
Cn-0A	Encoder divider rate	1,000 pulses/ revolution	16 to 2,048 pulses/revolution	Setting for number of output pulses from Servo Driver.
Cn-11	Number of encoder pulses	2,048 pulses/ revolution	1,024, 2,048	Set the number of encoder pulses as follows: Absolute encoders: 1,024 Incremental encoders: 2,048

Note 1. Set the number of encoder pulses to 1,024 pulses/revolution when using an absolute encoder.

Note 2. The power must be toggled to enable this parameter (be sure that the indicators go out completely).

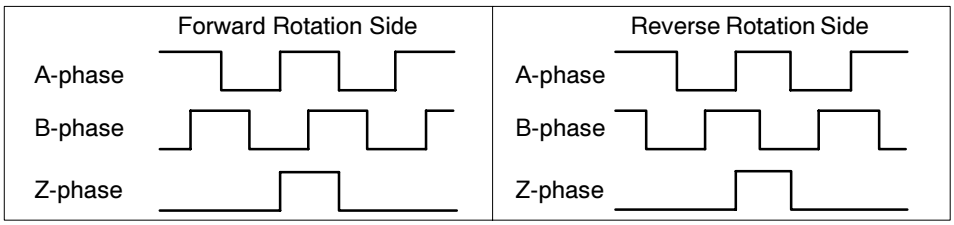
■ Operation

- Incremental pulses are output from the Servo Driver through a frequency divider.



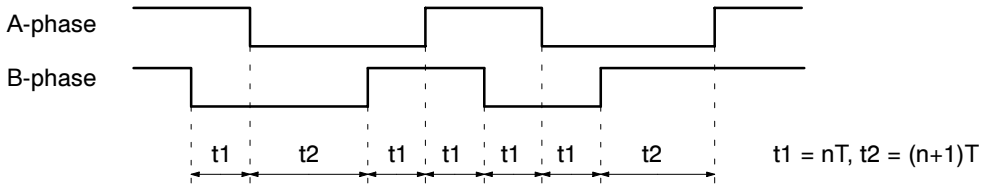
- The output phases of the encoder signal output from the Servo Driver are as shown below (when divider rate Cn-0A = 1,024).

Note The width of the Z-phase output pulse is not affected by the divider rate and will remain constant.



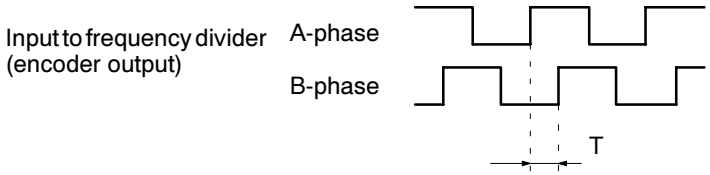
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Note When the encoder divider rate is set to other than 1,024, 512, 256,..., the phase difference for phases A and B is not 90°, but scatters for time T. (See the diagram below.)



In this diagram, T represents the time between phase A and phase B, and n is an integer that satisfies the following formula (with digits below the decimal point discarded).

n = 1,024/encoder divider rate



3-5-7 Torque Limit Function (Speed Control, Torque Control)

■ Function

- The torque limit function limits the Servomotor's output torque; it can be used with speed control and torque control.
- This function can be used to protect the Servomotor and machine system by preventing excessive force or torque on the machine system when the machine (moving part) pushes against the workpiece with a steady force, such as in a bending machine.
- There are three methods that can be used to limit the torque:

1. Limit the steady force applied during normal operation with user parameters Cn-08 (forward torque limit) and Cn-09 (reverse torque limit).
2. Limit operation with external signals connected to pins CN1-11 (PCL: forward current limit input) and CN1-12 (NCL: reverse current limit input). Set user parameters Cn-18 (forward rotation external current limit) and Cn-19 (reverse rotation external current limit).
3. Limit operation with analog voltage by using TREF (torque command input) as the analog current limit input. (HA/LA/V/W Models)

■ Parameter Settings

● Method 1: Limiting the Force Applied During Operation

- User Parameter Settings

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-08	Forward torque limit	Maximum torque	%	0 to maximum torque	This parameter sets the output torque limit for the forward direction (as a percentage of the rated torque).
Cn-09	Reverse torque limit	Maximum torque	%	0 to maximum torque	This parameter sets the output torque limit for the reverse direction (as a percentage of the rated torque).

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Note 1. This method is effective with speed control, internal speed control settings, and torque control.

Note 2. Set these parameters to the maximum torque (the factory setting) when the torque limit function isn't being used.

• Method 2: Limiting Operation with External Signals

• Setup Parameter Settings (Bit 2 of Cn-02 = 0)

Set bit 2 of Cn-02 (the input command mode) to "0." When bit 2 is "0," control input terminal CN1-11 will be PCL (forward current limit input), CN1-12 will be NCL (reverse current limit input), and it will be possible to use the external current limit function.

• User Parameter Settings

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-18	Forward rotation external current limit	100	%	0 to maximum torque	This parameter sets the output torque limit (as a percentage of the rated torque) when the forward rotation current limit is input.
Cn-19	Reverse rotation external current limit	100	%	0 to maximum torque	This parameter sets the output torque limit (as a percentage of the rated torque) when the reverse rotation current limit is input.

Note This method is effective with speed control and torque control. (This function can't be used with internal speed control settings.)

• Method 3: Limiting Operation with Analog Voltage (HA/LA/V/W Models)

• Setup Parameter Settings (Bit F of Cn-02 = 1)

Set bit F of Cn-02 (the TREF switch) to "1." When bit F is "1," terminals CN-1 and CN-2 (TREF and AGND) become the analog current limit input terminals. The current limit value can be calculated from the following equation:

Current limit value = |(voltage applied to TREF)| × (torque command scale)

The polarity of the analog voltage is irrelevant and the same current limit value is used for forward and reverse.

• User Parameter Settings

PRM No.	Parameter name	Factory setting	Units	Setting range	Explanation
Cn-13	Torque command scale	30	0.1 V/rated torque	10 to 100	This parameter sets the gain for the torque command input.

Note 1. This method is useful when controlling torque in multiple stages.

Note 2. This method is effective with speed control and torque control.

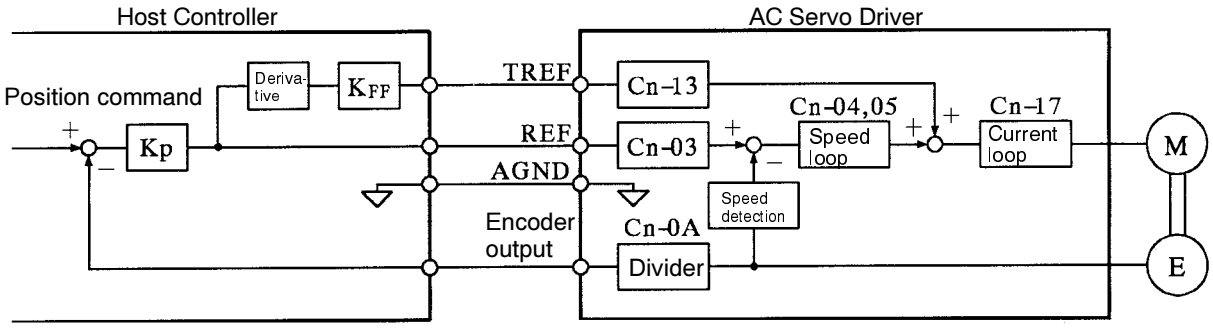
Note 3. This method can't be used when the torque feed-forward function is being used (i.e., when bit F of Cn-01 is set to "1.")

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3-5-8 Torque Feed-forward Function (Speed Control with HA/LA/V/W Models)

■ Function

- The torque feed-forward function reduces the acceleration time by adding the value of the torque command input (TREF) to the current loop; it can be used with speed control.
- Normally a derivative value is generated in the Controller and this value is input to TREF.
- Overshooting will occur if the feed-forward amount (the voltage input to TREF) is too high, so adjust user parameter Cn-13 (the torque command scale) as required.
- The following figure shows a block diagram when the torque feed-forward function is used.



■ Parameter Settings

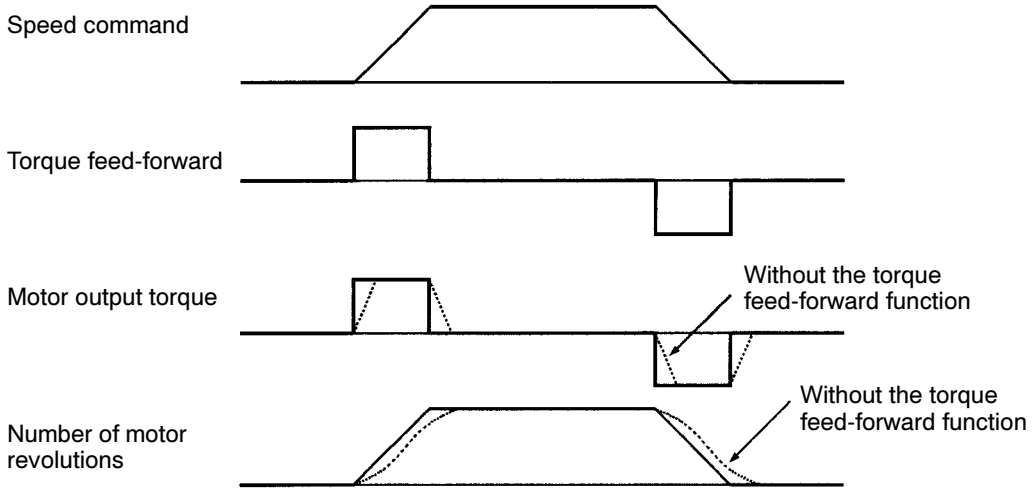
- Setup Parameter Settings (Bit F of Cn-01 = 1)

  Set bit F of Cn-01 (the torque feed-forward switch) to "1." When bit F is "1," terminals CN-1 and CN-2 (TREF and AGND) become the torque feed-forward input terminals.

- User Parameter Settings

PRM No.	Parameter name	Factory setting	Units	Setting range	Explanation
Cn-13	Torque command scale	30	0.1 V/rated torque	10 to 100	This parameter sets the gain for the torque command input.

■ Operation



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Note 1. If torque feed-forward is input when the motor's rotational speed is fixed, the rotational speed won't match the speed command. Design the Controller's circuit so that torque feed-forward is applied only when the motor is accelerating or decelerating.

Note 2. A torque will be generated that accelerates the motor in the forward direction if torque feed forward is applied with a positive (+) voltage. Be sure that the polarity is correct because errors such as reverse motor rotation or oscillation will occur if the feed-forward is applied with a polarity opposing the acceleration direction.

3-5-9 Brake Interlock (For Motors with Brakes)

■ Magnetic Brake Precautions

The magnetic brakes for Servomotors with brakes are specialized holding brakes with non-magnetized operation. Therefore set the parameters so that the brake power supply is turned off after the Servomotor stops. If the brake is applied while the Servomotor is operating, the brake will suffer abnormal wear or even damage, and will quickly become defective.

■ Function

The output timing of the brake interlock signal (BKIR) that control turning the magnetic brake ON and OFF can be set.

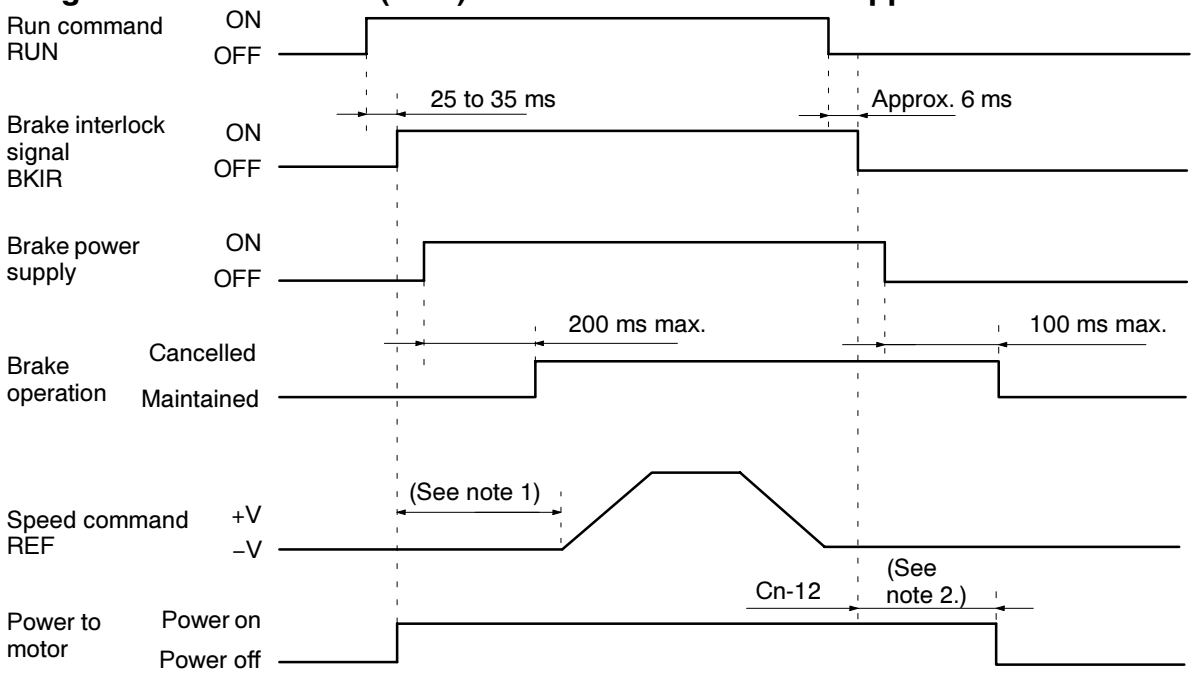
■ Parameters to be Set

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-12	Brake timing 1	0	10 ms	0 to 50	Delay time setting from brake command until servo turns off.
Cn-15	Brake command speed	100	r/min	0 to 4,500	Sets rotation speed for outputting brake commands.
Cn-16	Brake timing 2	50	10 ms	10 to 100	Waiting time from servo-off to brake command output.

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■ Operation

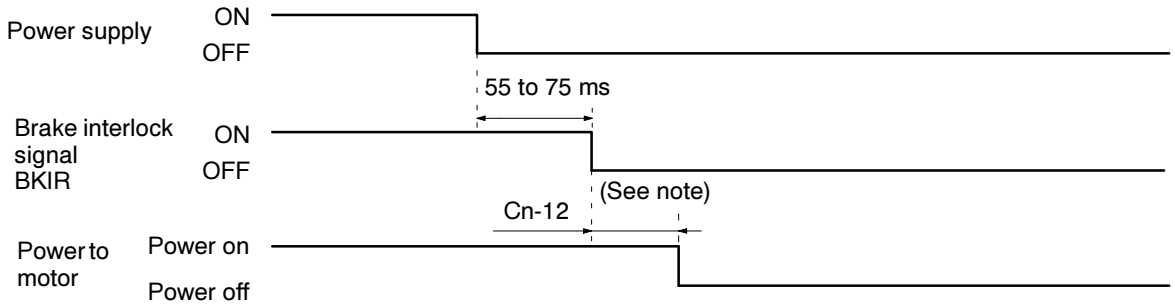
● Timing for Run Command (RUN) <When Servomotor is Stopped>



Note 1. It takes up to 200 ms for the brake to be cleared after the brake power supply has been turned on. Taking this delay into account, have the speed command be given after the brake has been cleared.

Note 2. It takes up to 100 ms for the brake to be held after the brake power supply has been turned off. When using it for the vertical shaft, take this delay into account and set brake timing 1 (Cn-12) so that the Servomotor will not receive power until after the brake is held.

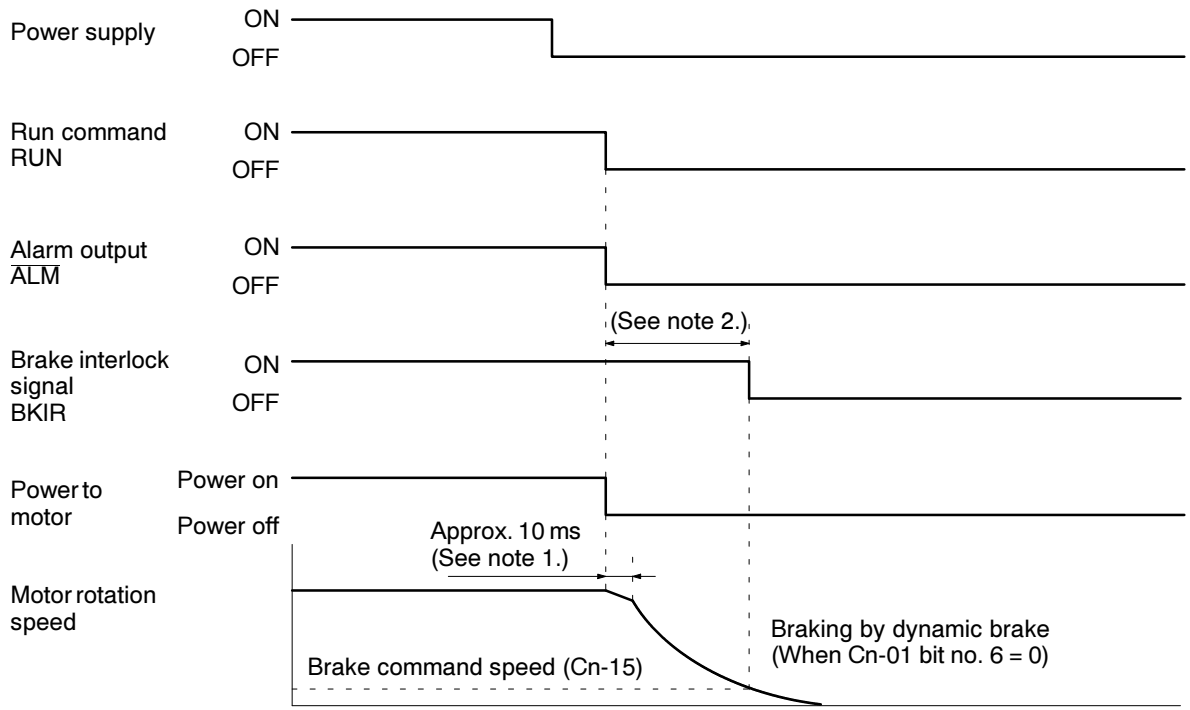
● Timing for Power Supply <When Servomotor is Stopped>



Note It takes up to 100 ms for the brake to be held after the brake power supply has been turned off. When using it for the vertical shaft, take this delay into account and set brake timing 1 (Cn-12) so that the Servomotor will not receive power until after the brake is held.

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- **Timing for Run Command (RUN), Errors, Power Supply <When Servomotor is Stopped>**



Note 1. For the approximately 10 ms it takes from when the power to the Servomotor turns off until the dynamic brake operates, the Servomotor rotates by momentum.

Note 2. If the Servomotor rotation speed falls below the speed set for the brake command speed (Cn-15), or if the time set for brake timing 2 (Cn-16) elapses after the Servomotor stops receiving power, the brake interlock signal (BKIR) will turn OFF.

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3-6 Trial Operation

After the wiring is complete and the parameter settings have been made, conduct a trial operation. First, check with rotation of the motor without connecting a load (i.e., without connecting the mechanical system). Then, connect the mechanical system, auto-tune the system, and confirm that the correct operation pattern is performed.

3-6-1 Preparations for Trial Operation

■ Preparations

● Absolute Encoder Setup (ABS)

When using a Servomotor with an absolute encoder, the absolute encoder must be set up to set the machine rotation amount data to zero or when absolute encoder has been left longer than two days without a battery connected. Refer to *4-1 Absolute Encoder Setup and Battery Replacement* for the absolute encoder setup procedure.

● Power Off

The power supply must be toggled to apply some of the parameter settings. Always turn off the power supply before starting.

● No Motor Load

Do not connect a load to the motor shaft during trial operation, just in case the motor runs out of control.

● Stopping the Motor

Make sure that the power switch can be turned off or the Run command used to stop the motor immediately in case of trouble.

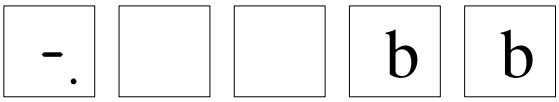
● Connecting a Parameter Unit

Connect a Parameter Unit to the CN3 connector on the front of the Servo Driver if one is not already connected.

■ Actual Trial Operation

(1) Powering Up

- With the run command (RUN) OFF, apply an AC voltage.
- After internal initialization, the mode will be the status display mode.

Display example: 

- Set the speed loop gain (Cn-04) to 20 or less. (Match the gain with no load.)

1. Confirm the initial display shown above.
2. Press the MODE/SET Key to enter the settings mode.

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3. Press the Up Key to specify user parameter Cn-04.
4. Press the DATA Key to display the setting of Cn-04.
5. Press the Down Key to change the setting to 20.
6. Press the DATA Key to record the new setting in memory.
7. Press the DATA Key again to return to the parameter number display.

(2) Jog Operations (See *3-6-2 Jog Operations*.)

- Perform jog operations using the Parameter Unit and confirm the following:
  Does the motor turn in the correct direction?
  Is there any unusual sound or vibration?
  Do any error occur?
- If an error occurs, refer to *Chapter 4 Application* for troubleshooting.

(3) Connect a load and auto-tune (See *3-7 Making Adjustments*.)

- Connect the motor shaft to the load (mechanical system) securely, being sure to tighten screws so that they will not become loose.
- Perform auto-tuning with the Parameter Unit.
- Automatically adjust the offset.

(4) Turning ON the Run command Input

- Turn ON the run command input. The Servomotor will go into servo-ON status.
- Give a speed command, or carry out the following check with a jogging operation.

(5) Low Speed Operation

- Operate at low speed.
  For speed control, apply a low-voltage speed command.
  For torque control, apply a low-voltage torque command.
  The meaning of "low speed" can vary with the mechanical system. Here, "low speed" means approximately 10% to 20% of the actual operating speed.
- Check the following items.

  Is the emergency stop operating correctly?
  Are the limit switches operating correctly?
  Is the operating direction of the machinery correct?
  Are the operating sequences correct?
  Are there any abnormal sounds or vibration?
  Is anything abnormal occurring?

- If anything abnormal occurs, refer to *Chapter 4 Application* and apply the appropriate countermeasures.

(6) Operation Under Actual Load Conditions

- Operate the Servomotor in a regular pattern and check the following items.

  Is the speed correct? (Use the speed display.)
  Is the load torque roughly equivalent to the measured value? (Use the torque command display.)
  Are the positioning points correct?
  When an operation is repeated, is there any discrepancy in positioning?
  Are there any abnormal sounds or vibration?
  Is either the Servomotor or the Servo Driver abnormally overheating?
  Is anything abnormal occurring?

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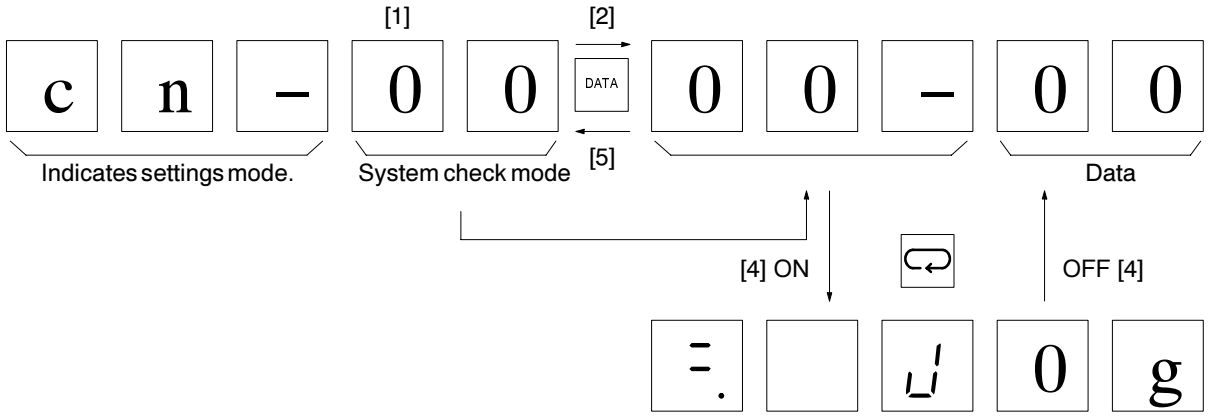
- If anything abnormal occurs, refer to *Chapter 4 Application* and apply the appropriate countermeasures.

(7) Readjust the gain.

- If the gain could not be adjusted completely using auto-tuning, perform the procedure in *3-7 Making Adjustments* to adjust the gain.

3-6-2 Jog Operations

Jog operations rotate the Servomotor in a forward or reverse direction using the Parameter Unit. Jog operations are made possible when system check mode Cn-00 is set to "00." The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



■ Operating Procedure (Key in Parentheses are for Mounted-type Parameter Units)

1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number "00." (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to "00." (Jog operation)
6. Press the MODE/SET Key to shift to the jog display.
7. Press the SERVO (DATA) Key to turn on the servo.
8. Press the Up Key to jog forward. Forward operation will continue as long as the key is held down.
9. Press the Down Key to jog in reverse. Reverse operation will continue as long as the key is held down.
10. Press the SERVO (DATA) Key to turn off the servo.
11. Press the MODE/SET Key to return to the data display.
12. Press the DATA Key to return to the settings mode.

■ User Parameter Settings

The rotational speed during jog operation can be set with user parameter Cn-10, as shown in the following table.

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PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-10	Jog speed	500	r/min	0 to 4,500	Speed setting for jog operation

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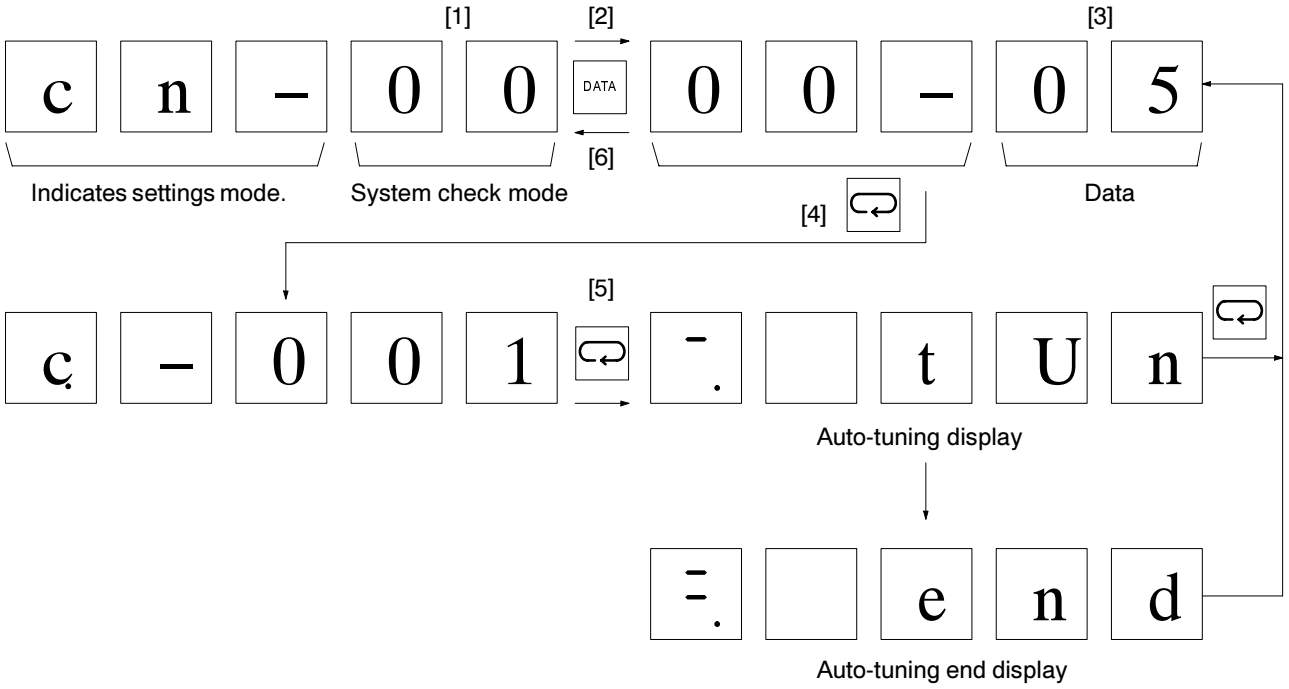
3-7 Making Adjustments

3-7-1 Auto-tuning

Auto-tuning rotates the Servomotor with a load connected (mechanical system), and automatically adjusts the position loop gain, the speed loop gain, and the speed loop integration time constant. When adjustments cannot be made by auto-tuning, refer to *3-7-2 Manually Adjusting Gain*.

■ Executing Auto-tuning

Make sure that Cn-28 for compensation gain adjustment is set to 0 before performing auto-tuning. Proper gain adjustment may not be possible with auto-tuning if the parameter is not set to 0. This parameter is factory-set to 0.



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number “00.” (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to “05.” (Auto-tuning)
6. Press the MODE/SET Key to switch to the mechanical rigidity selection display.
7. Using the Up and Down Keys, adjust the rigidity to the mechanical system. (Refer to *Selecting Mechanical Rigidity* below.)
8. Press the MODE/SET Key to switch to the auto-tuning display.
9. Press the SERVO (DATA) Key to turn on the servo. (This step is not required if the Run Command Input is ON.)

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10. Perform auto-tuning, using the Up Key for forward operation and the Down Key for reverse operation. Continue pressing the key until “End” is displayed, indicating that auto-tuning has been completed.
11. Release the key. The data display will return.
12. Press the DATA Key to return to the settings mode.

• Selecting Mechanical Rigidity

Select the set value to match the rigidity of the mechanical system.

HA/LA/V/W Models

Response	Set value	Position loop gain (1/s)	Representative applications
Low	001	16	Articulated robots, harmonic drives, chain drives, belt drives, rack and pinion drives, etc.
	002	28	
Medium	003	40	XY tables, Cartesian-coordinate robots, general-purpose machinery, etc.
High	004	56	Ball screws (direct coupling), feeders, etc.
	005	78	
	006	108	
	007	130	

H/L Models

Response	Set value	Position loop gain (1/s)	Representative applications
Low	001	20	Articulated robots, harmonic drives, chain drives, belt drives, rack and pinion drives, etc.
Medium	002	40	XY tables, Cartesian-coordinate robots, general-purpose machinery, etc.
High	003	60	Ball screws (direct coupling), feeders, etc.

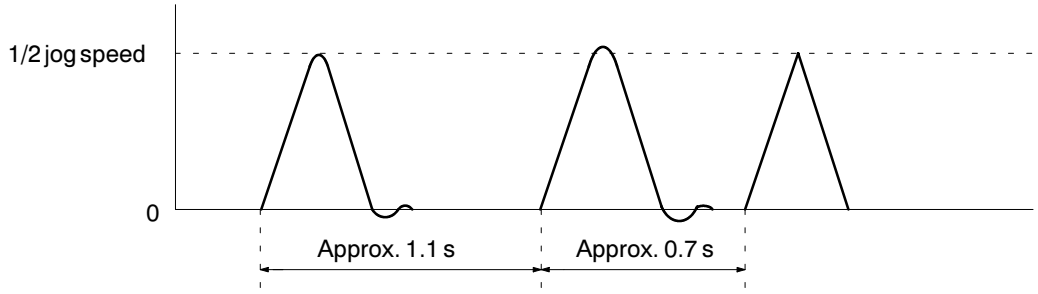
Note The higher the rigidity of the mechanical system is, the higher the response becomes.

• Auto-tuning

- Auto-tuning will not be complete until at least three operations have been completed. Be sure there is plenty of room for the machine to operate.
- If the auto-tuning is not complete after three operation, operations will be repeat as long as the key is held down.
- The Servomotor rotation speed will be approximately 1/2 that of the jog speed (Cn-10).
- Auto-tuning will automatically change the setting of the user parameter position loop gain (Cn-1A), speed loop gain (Cn-04), and speed loop integration time constant (Cn-05). These values will not be changed, however, until the auto-tuning operation has been completed.

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- If auto-tuning does not complete or if the gain set via auto-tuning is not sufficient, adjust the gain manually using the procedure in *3-7-2 Manually Adjusting Gain*.

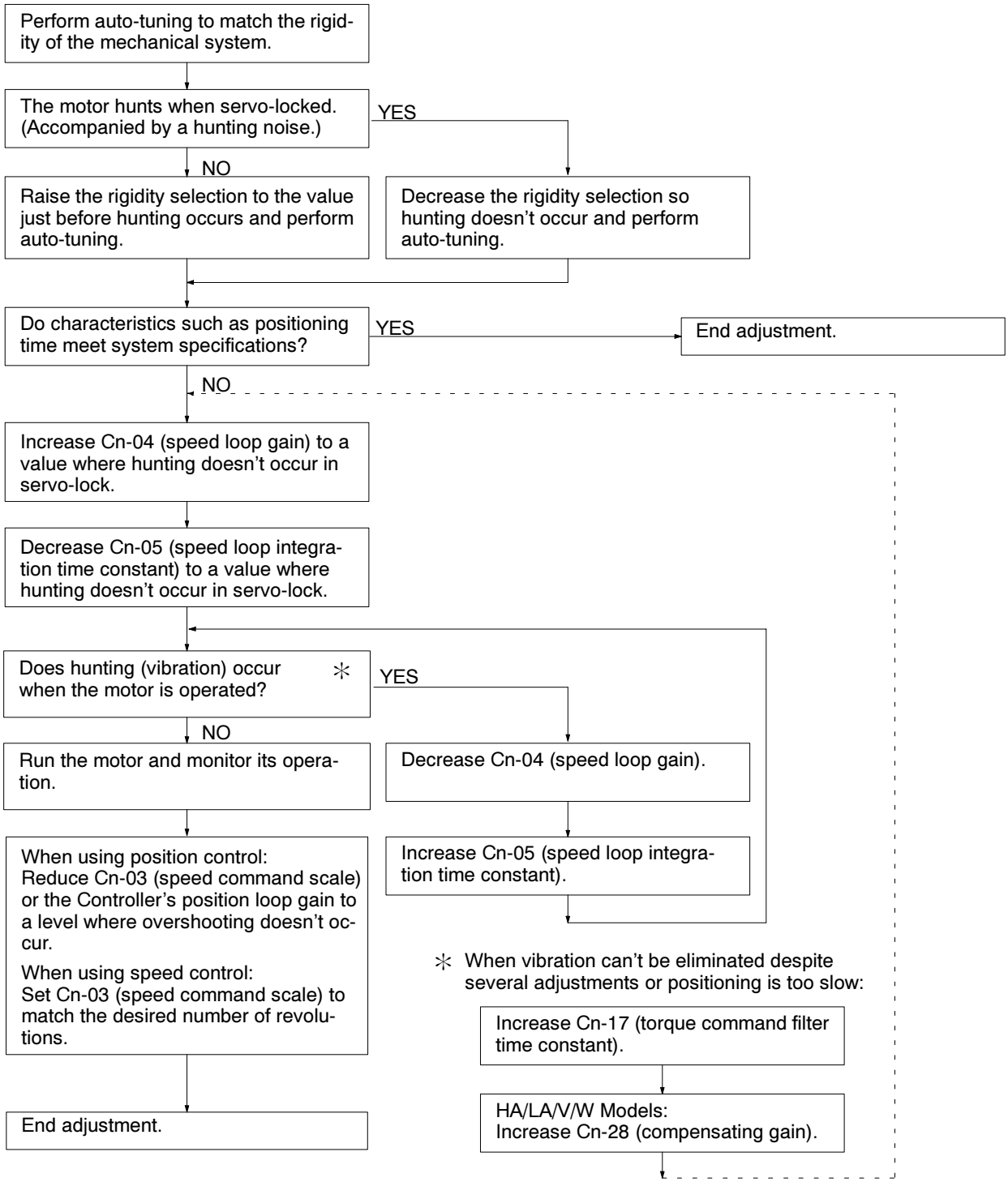


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3-7-2 Manually Adjusting Gain

Make sure that Cn-28 for compensation gain adjustment is set to 0 before performing auto-tuning. This parameter is factory-set to 0.

● Gain Adjustment Flowchart



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● Gain Adjustment Standards

The following table shows reference values for gain adjustment. Adjustments can be made quickly if these values are used as standards. Make the initial gain setting based on the load inertia.

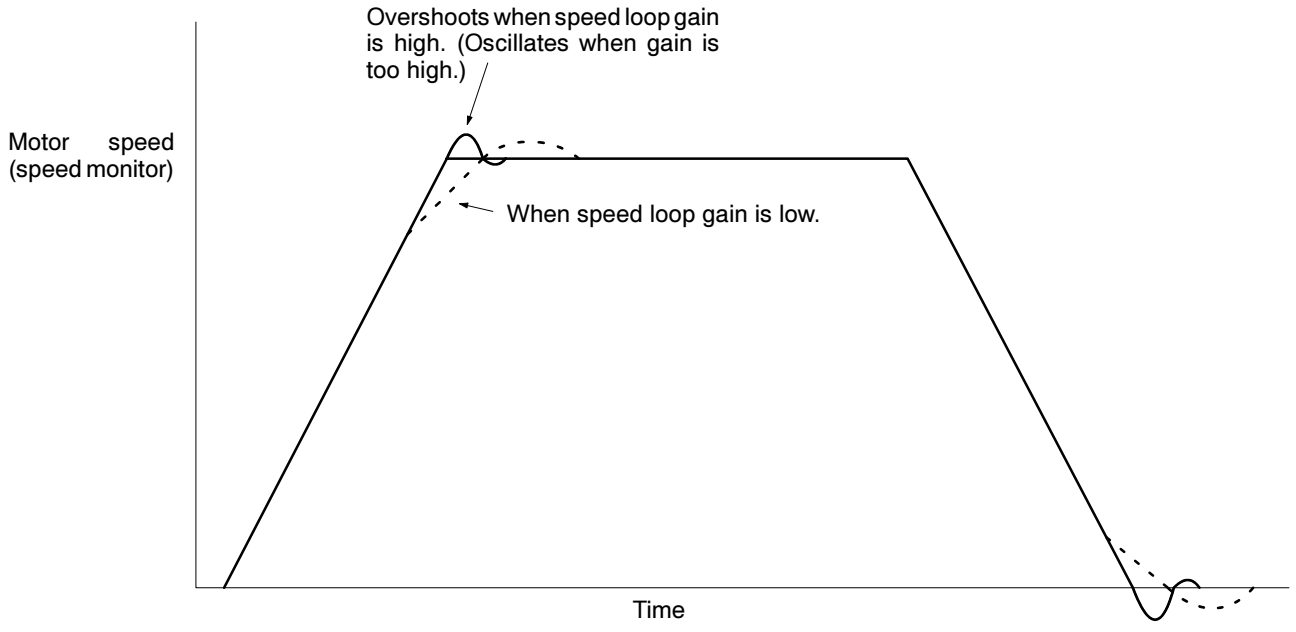
Load inertia factor	Speed loop gain Cn-04 (Hz)	Speed loop integration constant Cn-05 (ms)	Position loop gain Cn-1A (1/s)	Comments
1	80	40	60	High rigidity
3	80	20	40	Factory setting
3	120	30	40	---
10	350	40	40	---
20	420	80	20	Moderate rigidity
20	200	120	10	Low rigidity

■ Adjustment Parameters

● Adjusting Speed Loop Gain

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-04	Speed loop gain	80	Hz	1 to 2,000	Adjusts the speed loop response. As the gain is increased, the servo rigidity is strengthened. The greater the inertia rate, the higher this is set. If the gain is set too high, oscillation will occur.

When the speed loop gain is manipulated, the response is as shown in the diagram below.

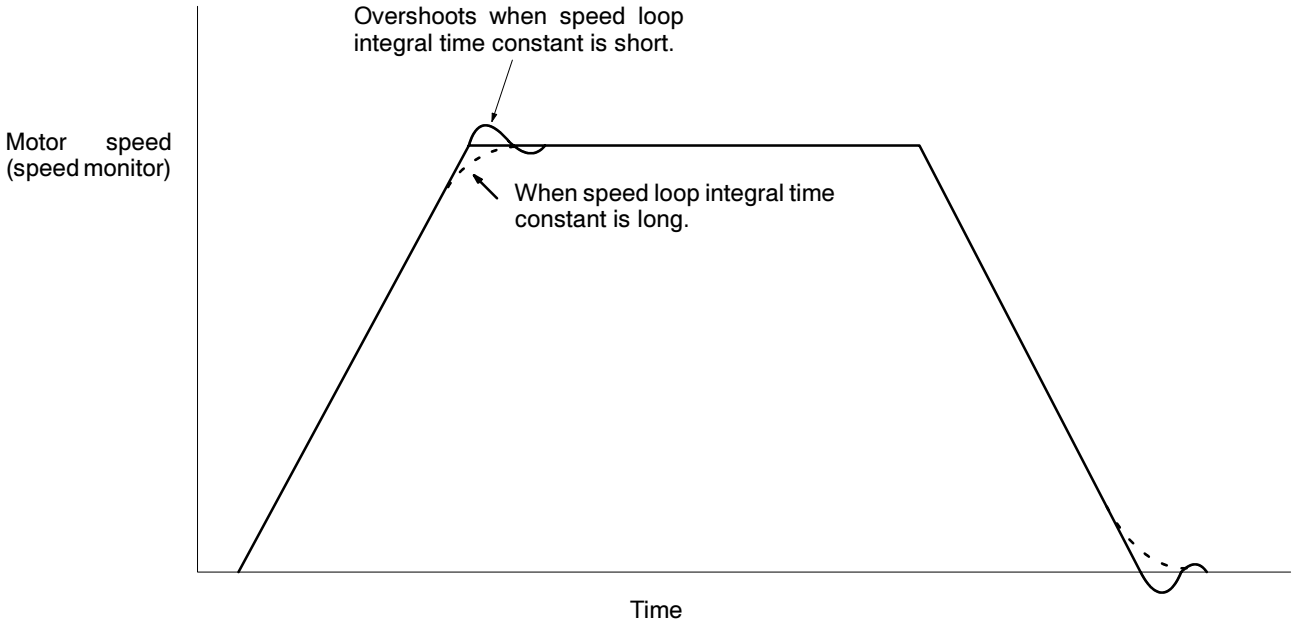


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● Adjusting the Speed Loop Integration Time Constant

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-05	Speed loop integration constant	20	1 ms/ 0.01 ms	2 to 10,000	Speed loop integration constant. As the constant is increased, the response is shortened and the resiliency toward external force is weakened. If it is set too short, oscillation will occur. The unit set in bit b of Cn-02 (integration constant's unit) is used to set the constant. (HA/LA/V/W Models)

When the speed loop integration time constant is manipulated, the response is as shown in the diagram below.



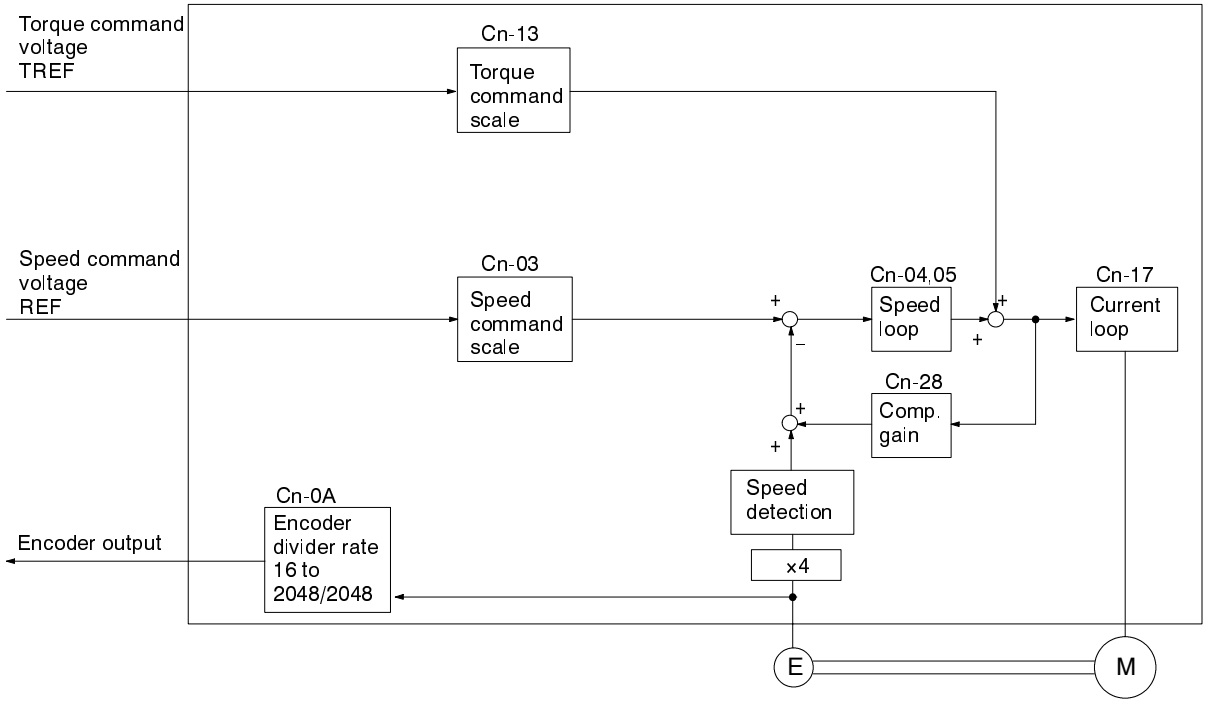
PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-17	Torque command filter time constant	4	0.1 ms	0 to 250	Sets torque command filter time constant. Increase the time constant to reduce oscillation due to machinery resonance frequency. The filter characteristic is switched using the torque command filter time constants. (HA/LA/V/W Models)
Cn-1A	Position loop gain	40	1/s	1 to 500	For servo-lock strength adjustment when position lock function is used. Adjust to match mechanical rigidity.

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● Adjusting the Compensating Gain

PRM No.	Parameter name	Factory setting	Unit	Setting range	Explanation
Cn-28	Compensating gain (HA/LA/V/W Models)	0	---	0 to 100	Decreases the speed loop gain by the set value when a large torque is output due to acceleration, deceleration, etc. Increasing the compensating gain will reduce motor vibration and will also enable setting a larger speed loop gain, allowing faster positioning. Increasing the compensating gain too much will delay following accelerations/decelerations. Adjust the compensating gain only after adjusting the speed loop gain (Cn-04) and the speed loop integration constant (Cn-05). Depending on the values of the speed loop gain (Cn-04) and the speed loop integration constant (Cn-05), the upper limit of the compensating gain may be 100 or less. An error will occur if the compensating gain is set too high. Set the compensating gain to 0 when autotuning. The gain will not be adjusted correctly if the compensating gain is not set to 0.

■ Block Diagram of the Speed/Torque (Current) Loops



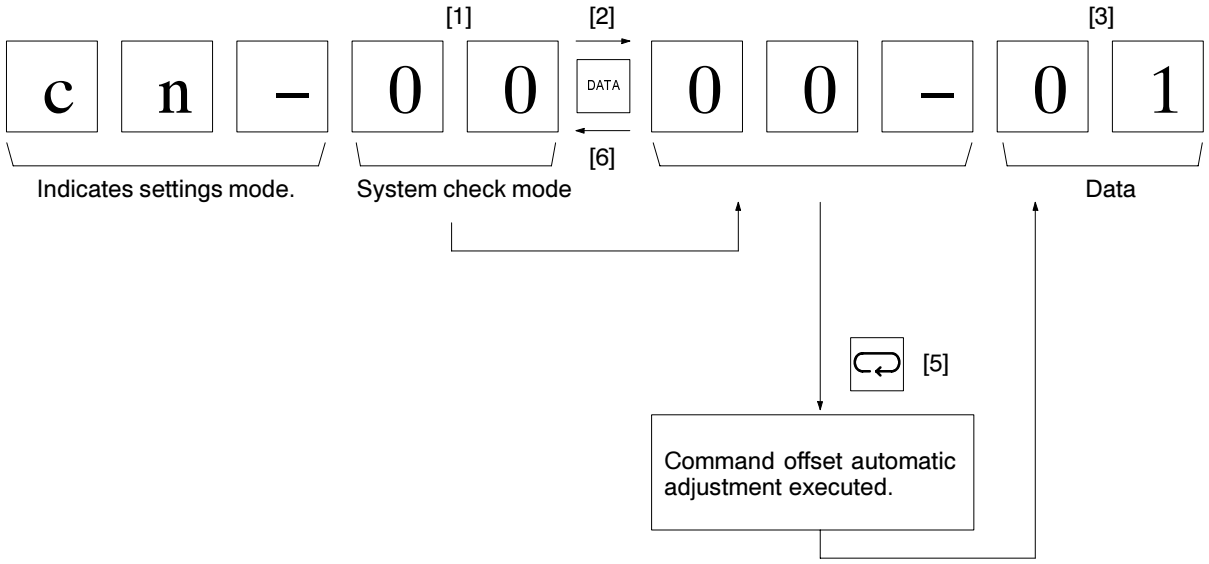
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3-7-3 Adjusting Command Offset

Use the following procedure to adjust the analog voltage offsets for the speed command and torque command.
Command offset can be adjusted either automatically or manually.
The torque command's offset can't be adjusted manually, so adjust it automatically.

■ Adjusting Command Offset Automatically

Automatic adjustment of command offset is made possible when the system check mode Cn-00 is set to "01." The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.

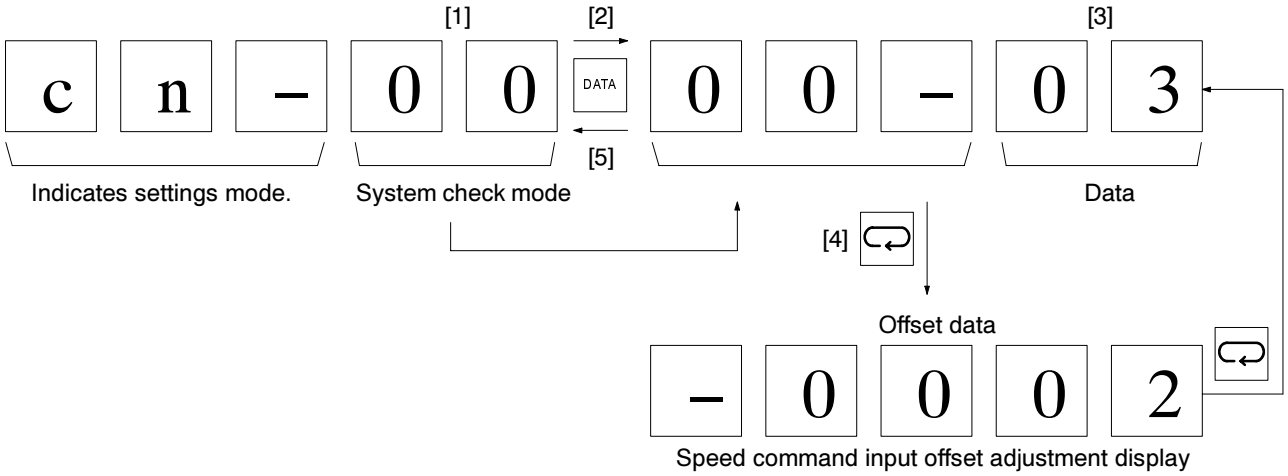


1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number "00." (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to "01." (Command offset automatic adjustment)
6. Input the voltage required to set the speed command input (REF) and the torque command input (TREF) to zero rotation speed and zero output torque respectively. (Normally 0 V.)
7. Press the MODE/SET Key to automatically adjust the command offset.
8. Press the DATA Key to return to the settings mode.

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■ Adjusting Command Offset Manually

Manual adjustment of command offset is made possible when the system check mode Cn-00 is set to "03." The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number "00." (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to "03." (Command offset manual adjustment)
6. Press the MODE/SET Key to change to the manual adjustment display.
7. Input the voltage required to set the speed command input (REF) to zero rotation speed. (Normally 0 V.)
8. Use the Up and Down Keys to adjust the offset.
   While the Up Key is being pressed, the offset increases in the forward direction.
   While the Down Key is being pressed, the offset increases in the reverse direction.
9. Press the MODE/SET Key to save the offset data to memory and return to the data display.
10. Press the DATA Key to return to the setting mode.

Note When the offset data display indicates zero, it is not necessarily the optimal adjustment. For speed control, make the offset adjustment so that the motor does not drift (rotate at 0 V). For position control, make the offset adjustment so that the number of pulses in the error counter in the controller is reduced.

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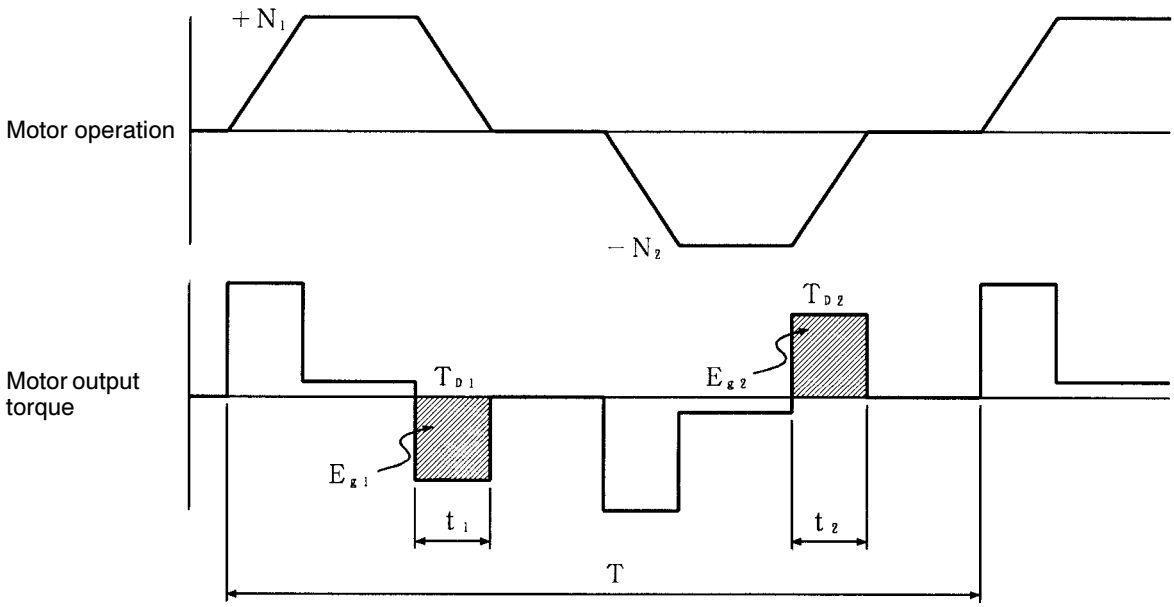
3-8 Regenerative Energy Absorption

Regenerative energy produced at times such as Servomotor deceleration is absorbed by the Servo Driver's internal capacitors, thereby preventing an increase in DC voltage. If the regenerative energy from the Servomotor becomes too large, however, an over-voltage error will occur. In such cases, it is necessary to connect a Regeneration Unit to increase the capacity for absorbing regenerative energy.

3-8-1 Calculating Regenerative Energy

Regenerative energy is produced when the direction of Servomotor rotation or output torque is reversed. The methods for calculating regenerative energy for the horizontal and vertical shafts are explained below.

■ Horizontal Axle



Note In the output torque graph, when the rotation direction and the torque direction match it is shown as positive.
The regenerative energy for each section can be found by means of the following formulas:

$E_{g1} = 1/2 \bullet N_1 \bullet T_{D1} \bullet t_1 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g2} = 1/2 \bullet N_2 \bullet T_{D2} \bullet t_2 \bullet 1.027 \times 10^{-2}$ [J]

N_1, N_2: Rotation speed at beginning of deceleration [r/min]
T_{D1}, T_{D2}: Deceleration torque [kgf • cm]
t_1, t_2: Deceleration time [s]

Note There is some loss due to winding resistance, so the actual regenerative energy will be approximately 90% of the figure derived by the formula.

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The maximum regenerative energy for the Servo Driver's internal capacitors only can be found by means of the following formula:

$E_g = (E_{g1}, E_{g2})$ [J]
E_g is the larger of E_{g1} and E_{g2}.

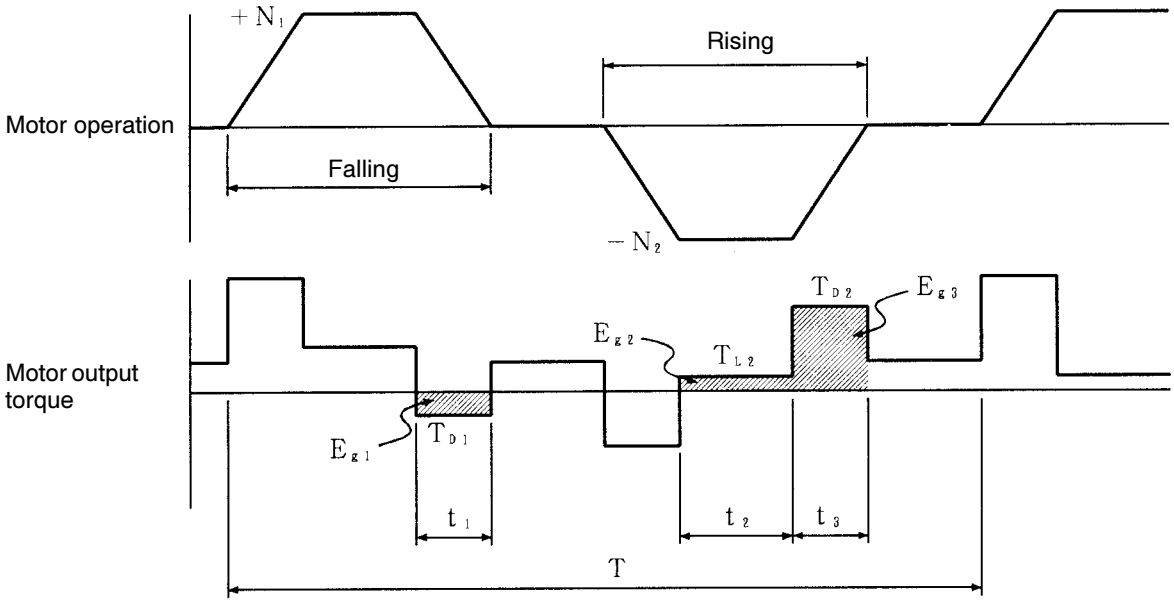
When regenerative energy is absorbed at the Servo Driver only, E_g must not exceed the amount of regenerative energy that can be absorbed at the Servo Driver. In addition, the average regenerative power when a Regeneration Unit is connected can be found by means of the following formula:

$P_r = (E_{g1} + E_{g2})/T$ [W]
T: Operation cycle [s]

E_g must not exceed the maximum regeneration absorption capacity of the Servo Driver when only the Servo Driver is used to absorb regenerative energy. When a Regeneration Unit is connected, the average regenerative power (P_t) must not exceed the regeneration processing power (12 W) of the Regeneration Unit.

Connect an external regeneration resistor when the regeneration processing power of the Regeneration Unit (12 W) is exceeded. Refer to *3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor* for details on external regeneration resistors.

■ Vertical Axle



Note In the output torque graph, when the rotation direction and the torque direction match it is shown as positive.
The regenerative energy for each section can be found by means of the following formulas:

$E_{g1} = 1/2 \bullet N_1 \bullet T_{D1} \bullet t_1 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g2} = N_2 \bullet T_{L2} \bullet t_2 \bullet 1.027 \times 10^{-2}$ [J]
$E_{g3} = 1/2 \bullet N_2 \bullet T_{D2} \bullet t_3 \bullet 1.027 \times 10^{-2}$ [J]

N_1, N_2: Rotation speed at beginning of deceleration [r/min]
T_{D1}, T_{D2}: Torque when declining [kgf • cm]
T_{L2}: Deceleration torque [kgf • cm]

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t_1, t_3: Travel time equivalent to torque when declining [s]
t_2: Deceleration time [s]

Note There is some loss due to winding resistance, so the actual regenerative energy will be approximately 90% of the figure derived by the formula.

The maximum regenerative energy for the Servo Driver's internal capacitors only can be found by means of the following formula:

E_g is the larger of E_{g1}, $E_{g2,}$ + $E_{g3.}$

When regenerative energy is absorbed at the Servo Driver only, E_g must not exceed the amount of regenerative energy that can be absorbed at the Servo Driver. In addition, the average regenerative power when a Regeneration Unit is connected can be found by means of the following formula:

$P_r = (E_{g1}+ E_{g2}+ E_{g3})/T$ [W]
T: Operation cycle [s]

E_g must not exceed the maximum regeneration absorption capacity of the Servo Driver when only the Servo Driver is used to absorb regenerative energy. When a Regeneration Unit is connected, the average regenerative power (P_t) must not exceed the regeneration processing power (12 W) of the Regeneration Unit.

Connect an external regeneration resistor when the regeneration processing power of the Regeneration Unit (12 W) is exceeded. Refer to *3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor* for details on external regeneration resistors.

3-8-2 Servo Driver Absorbable Regenerative Energy

■ Regenerative Energy Absorbed Internally

The Servo Driver absorbs regenerative energy by means of an internal capacitor. If there is more regenerative energy than can be absorbed by the capacitor, an overvoltage error will be generated and operation cannot continue. The amounts of regenerative energy that can be absorbed by the various Servo Drivers alone are shown in the tables below. If regenerative energy exceeding these values is produced, take the following measures.

- Connect a Regeneration Unit (R88A-RG08UA) (Refer to 3-8-3). (Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards)
- Lower the operating rotation speed. (The regenerative energy is proportional to the square of the rotation speed.)
- Lengthen the deceleration time. (Reduce the amount of regenerative energy per unit time.)
- When using multiple axes, the + terminals can be connected together and the – terminals can be connected together to use regenerative energy as the drive energy for the other axes (Refer to 3-8-4). (Models Conforming to EC Directives)

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● 200-VAC Input Type (Incremental Encoder)

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($x10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UA02H(A)/UA02V (30 W)	7.0	0.63	Rotor inertia × 30, 4,500 r/min
R88D-UA03H(A)/UA03V (50 W)	8.7	0.78	Rotor inertia × 30, 4,500 r/min
R88D-UA04H(A)/UA04V (100 W)	13.3	1.2	Rotor inertia × 30, 4,500 r/min
R88D-UA08H(A)/UA08V (200 W)	23.9	3.69	Rotor inertia × 30, 3,000 r/min
R88D-UA12H(A)/UA12V (400 W)	21.1	3.8	Rotor inertia × 20, 3,000 r/min
R88D-UA20H(A)/UA20V (750 W)	52.2	13.4	Rotor inertia × 20, 3,000 r/min

Note 1. The input voltage is the value at 200 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

● 100-VAC Input Type (Incremental Encoder)

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($x10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UA03L(A)/UA03W (30 W)	7.0	0.63	Rotor inertia × 30, 4,500 r/min
R88D-UA04L(A)/UA04W (50 W)	8.7	0.78	Rotor inertia × 30, 4,500 r/min
R88D-UA10L(A)/UA10W (100 W)	13.3	1.2	Rotor inertia × 30, 4,500 r/min
R88D-UA12L(A)/UA12W (200 W)	23.9	3.69	Rotor inertia × 30, 3,000 r/min
R88D-UA15LA/UA15W (300 W)	99.5	3.8	Rotor inertia × 20, 4,500 r/min

Note 1. The input voltage is the value at 100 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

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● 200-VAC Input Type (Absolute Encoder)

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($x10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UA02H(A)/UA02V (30 W)	7.0	0.92	Rotor inertia × 20, 4,500 r/min
R88D-UA03H(A)/UA03V (50 W)	8.7	1.02	Rotor inertia × 20, 4,500 r/min
R88D-UA04H(A)/UA04V (100 W)	13.3	1.30	Rotor inertia × 20, 4,500 r/min
R88D-UA08H(A)/UA08V (200 W)	23.9	3.70	Rotor inertia × 25, 3,000 r/min
R88D-UA12H(A)/UA12V (400 W)	21.1	4.32	Rotor inertia × 20, 3,000 r/min
R88D-UA20H(A)/UA20V (750 W)	52.2	12.5	Rotor inertia × 18, 3,000 r/min

Note 1. The input voltage is the value at 200 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

● 100-VAC Input Type (Absolute Encoder)

Model	Absorptive regeneration energy (J)	Maximum applicable load inertia ($x10^{-4}$ kg•m^2)	Remarks (see note *3)
R88D-UA03L(A)/UA03W (30 W)	7.0	0.92	Rotor inertia × 20, 4,500 r/min
R88D-UA04L(A)/UA04W (50 W)	8.7	1.02	Rotor inertia × 20, 4,500 r/min
R88D-UA10L(A)/UA10W (100 W)	13.3	1.30	Rotor inertia × 20, 4,500 r/min
R88D-UA12L(A)/UA12W (200 W)	23.9	3.70	Rotor inertia × 25, 3,000 r/min
R88D-UA15LA/UA15W (300 W)	99.5	4.32	Rotor inertia × 20, 4,500 r/min

Note 1. The input voltage is the value at 100 VAC. As the input voltage is increased, the amount of regenerative energy that can be absorbed is decreased.

Note 2. For Servomotors with brakes, add the brake inertia to the load inertia.

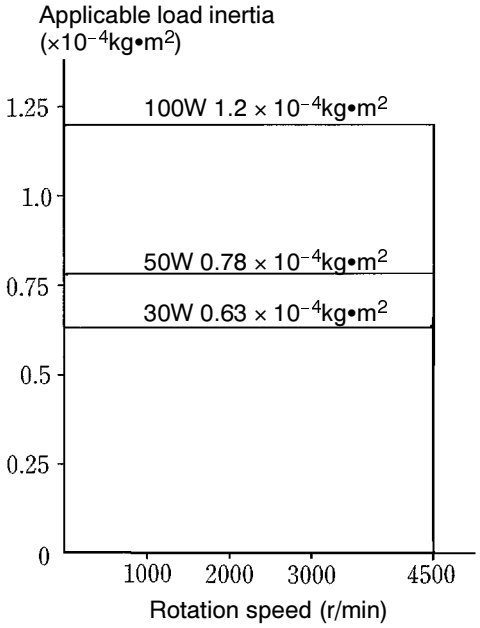
Note 3. This is the applicable range for the horizontal shaft. (No external force should be applied.)

■ Range for Absorbing Regenerative Energy

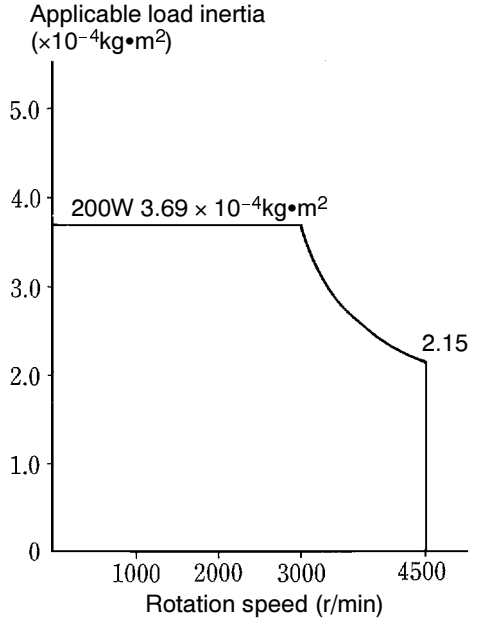
The relationship between rotation speed and the load inertia that can be absorbed by a Servo Driver alone is shown in the diagrams below. If a Servo Driver is operated outside of this range, a Regeneration Unit must be connected. These diagrams show the applicable range for the horizontal shaft. If an external force acts in the same direction as the Servomotor rotation, due to factors such as the fall time on the vertical shaft, be sure to measure the regenerative energy and check to see that the amount that can be absorbed is not exceeded.

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- **Incremental Encoder**
  R88D-UA02H(A)/-UA03H(A)/-UA04H(A)/-UA02V/-UA03V/-UA04V (30 W, 50 W, 100 W)
  R88D-UA03L(A)/-UA04L(A)/-UA10L(A)/-UA03W/-UA04W/-UA10W (30 W, 50 W, 100 W)

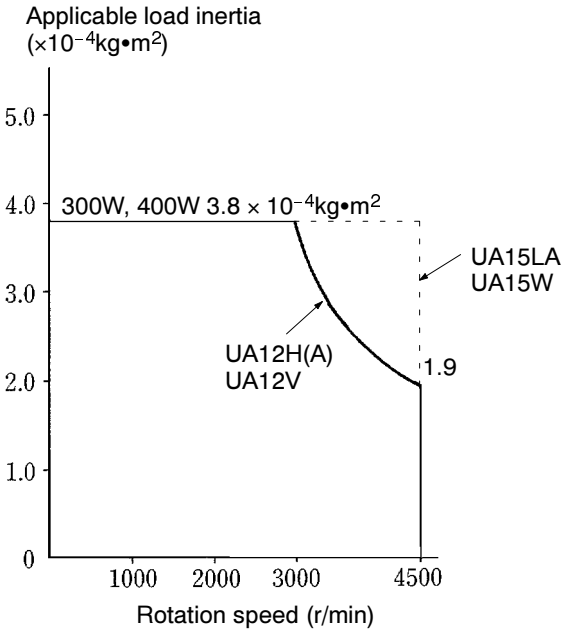


- **Incremental Encoder**
  R88D-UA08H(A)/-UA08V (200 W)
  R88D-UA12L(A)/-UA12W (200 W)

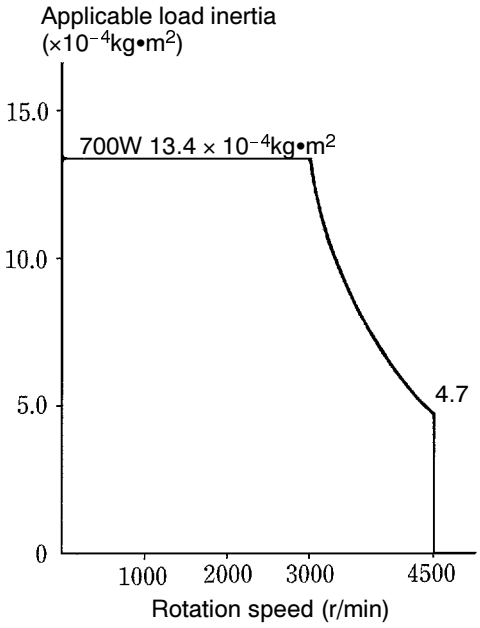


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- **Incremental Encoder**
  R88D-UA12H(A)/-UA12V (400 W)
  R88D-UA15LA/-UA15W (300 W)

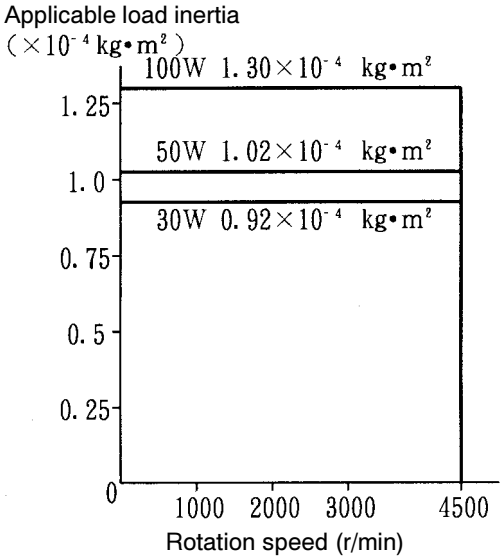


- **Incremental Encoder**
  R88D-UA20H(A)/-UA20V (750 W)

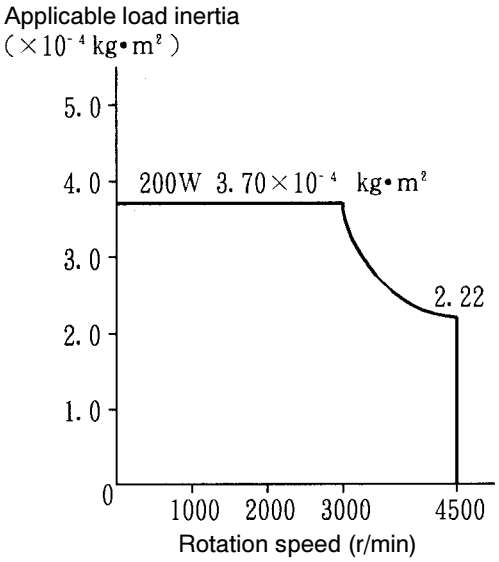


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- **Absolute Encoder**
  R88D-UA02H(A)/-UA03H(A)/-UA04H(A)/-UA02V/-UA03V/-UA04V (30 W, 50 W, 100 W)
  R88D-UA03L(A)/-UA04L(A)/-UA10L(A)/-UA03W/-UA04W/-UA10W (30 W, 50 W, 100 W)

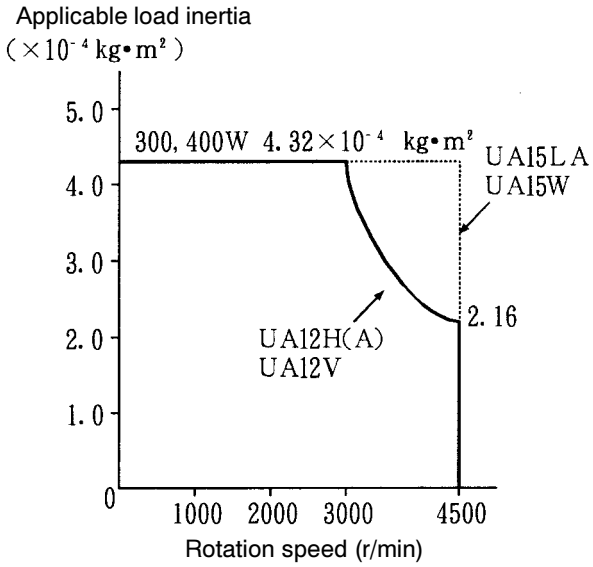


- **Absolute Encoder**
  R88D-UA08H(A)/-UA08V (200 W)
  R88D-UA12L(A)/-UA12W (200 W)

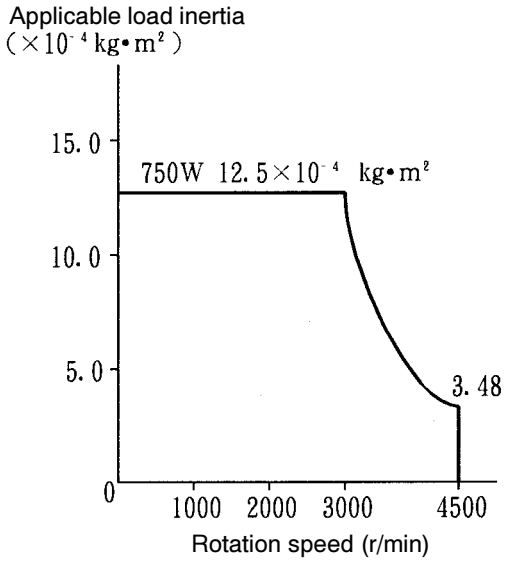


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- **Absolute Encoder**
  R88D-UA12H(A)/-UA12V (400 W)
  R88D-UA15LA/-UA15W (300 W)



- **Absolute Encoder**
  R88D-UA20H(A)/-UA20V (750 W)



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3-8-3 Absorption of Regenerative Energy with the External Regeneration Resistor (Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards)

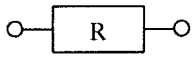
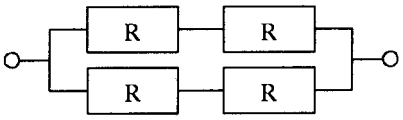
Connect one or more external regeneration resistors when a Regeneration Unit (R88A-RG08UA) cannot absorb all of the regenerative energy. Remove the short bar from between the RG and JP terminals on the Regeneration Unit and connect the resistor between the P and RG terminals. Connecting to the wrong terminals may destroy the Regeneration Unit, so connect the resistor carefully. (The Regeneration Unit does not conform to EC Directives.)
The external regeneration resistor will heat to approximately 120°C. Do not install it near devices or wiring that is sensitive to heat. Install heat radiation plates suitable to the radiation conditions.

■ External Regeneration Resistors

● Models

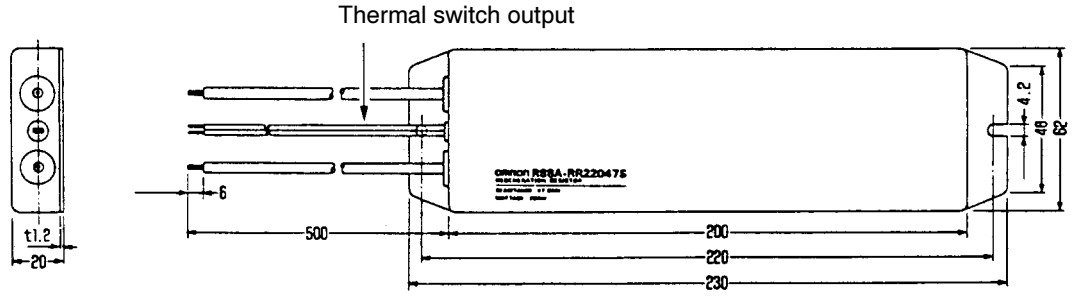
Model	Resistance	Nominal capacity	Regeneration absorption at 120°C	Heat radiation conditions	Thermal switch output specifications
R88A-RR22047S	47Ω ±5%	220 W	70 W	t1.0 × □350 (SPCC)	Operating temperature: 170°C N.C. contact

● Combining External Regeneration Resistors

Item	Regeneration absorption capacity	
	70 W	280 W
Combining external regeneration resistors		

Note Use a combination with an absorption capacity larger than the average regenerative power (P_r).

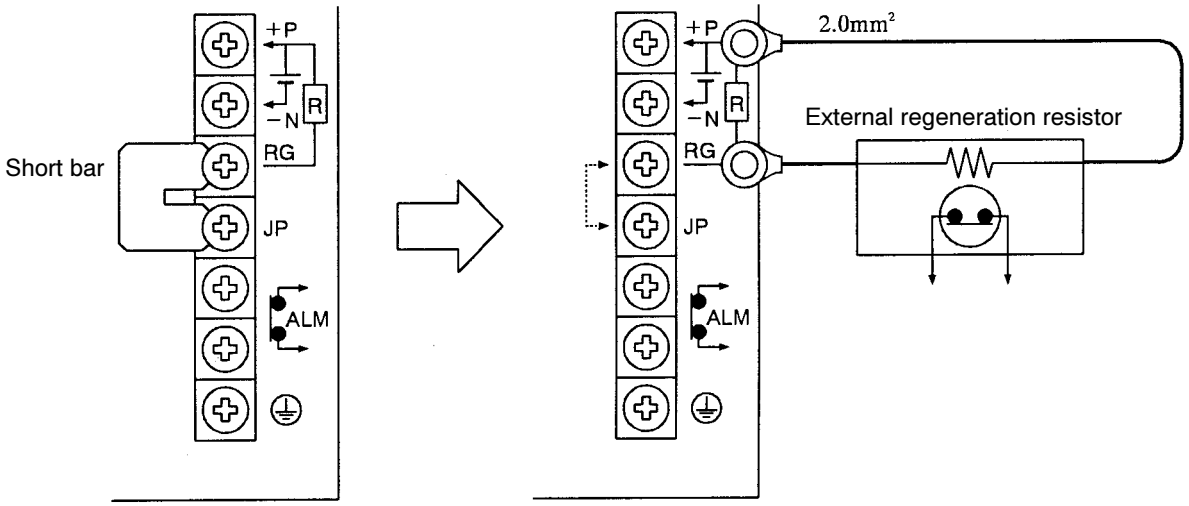
● Dimensions (Unit: mm)



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■ Wiring External Regeneration Resistors

Remove the short bar from between the RG and JP terminals on the Regeneration Unit and connect the resistor(s) between the P and RG terminals.



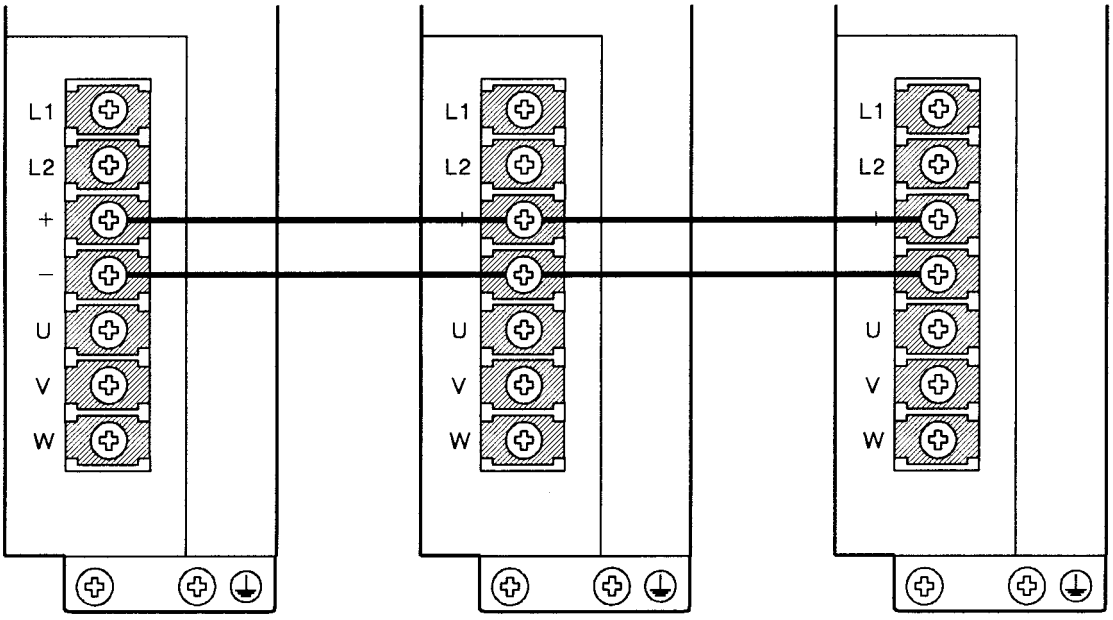
Note The thermal switch output must be connected in the same way as the ALM output from the Regeneration Unit, i.e., so that power supply is broken when the contacts open.

3-8-4 Processing Regenerative Energy with Multiple Axes (Models Conforming to EC Directives)

When using multiple axes, the + terminals on the Servo Drivers can be connected together and the – terminals can be connected together to use regenerative energy as the drive energy for the other axes, thus absorbing the energy. Servo Drivers with different power supply voltages, however, cannot be connected. Also, regeneration absorption capacity will not be increased when all axes simultaneously produce regenerative energy.

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■ Wiring Method (Example for 3 Axes)



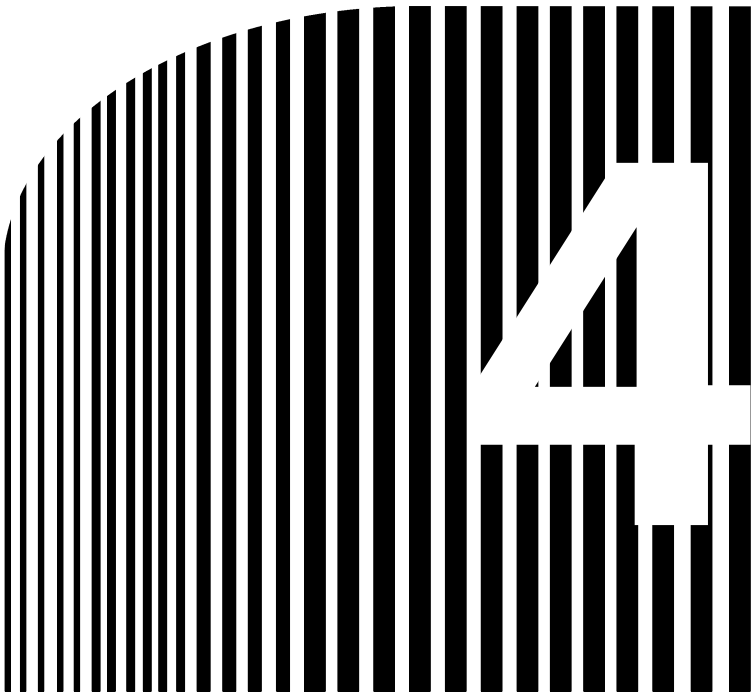
Note 1. Do not open or close the connections between the + or – terminals while power is being supplied. The Units may be destroyed.

Note 2. Do not connect Servo Drivers that are using different power supply voltages. The Units may be destroyed.

Regeneration absorption capacity will not be increased when all axes simultaneously produce regenerative energy. Take one or more of the following methods if this occurs.

- Reduce the number of rotations being used. (Regenerative energy is directly proportional to the square of the number of rotations.)
- Increase the deceleration time. (This will reduce the regenerative energy per unit time.)

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Chapter 4

• Application •

4-1 Absolute Encoder Setup and Battery Replacement

4-2 Using Displays

4-3 Using the Monitor Output

4-4 Protective and Diagnostic Functions

4-5 Troubleshooting

4-6 Periodic Maintenance

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4-1 Absolute Encoder Setup and Battery Replacement

This section describes the absolute encoder setup method and the battery replacement method.

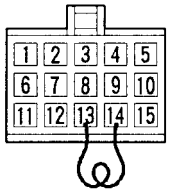
4-1-1 Setup

Setup is required to set the amount of machine rotation to zero for trial operation of the Servomotor or when the absolute encoder has been left disconnected from the battery for more than two days. (This is because the voltage of the capacitor inside the absolute encoder will drop if a battery is not connected for more than two days, possibly interfering with the proper operation of internal elements.)

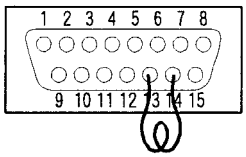
■ Setup Method

Perform the following procedure carefully. Mistakes may lead to errors in the setup.

1. Wire the Servo Driver, Servomotor, and encoder correctly if they are not already wired correctly.
2. Connect the battery.
3. Turn on power to the Servo Driver.
4. Turn ON the SEN signal (Cn1-5). When the SEN signal turns ON, 5 V will be supplied to the encoder. (If there is no SEN signal, then turn on the Cn-01 bit 1 in the Servo Driver.)
5. Wait at least 3 minutes to allow time for the backup capacitor to be charged. An alarm will be generated for the encoder at this time.
6. Turn off power to the Servo Driver.
7. Short terminals 13 and 14 on the encoder connector to the motor for 1 to 2 seconds (see following diagram).



Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards



Models Conforming to EC Directives

8. Remove the short between terminals 13 and 14.
9. Turn power on to the Servo Driver.
10. Turn ON the SEN signal. If no error occurs, the setup has been completed. (If Cn-01 bit was turned on in step 4, then make sure to turn it off.)
11. If an alarm (A.00) occurs, repeat this procedure from the beginning.

Note 1. When the CV500-MS221/421 or C200H-MC221 Motion Control Unit is connected, perform the setup near the mechanical original.

Note 2. An error will occur is the absolute value data exceeds ±32,767 pulses when the CV500-MS221/421 or C200H-MC221 Motion Control Unit is connected

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4-1-2 Battery

■ Lithium Battery

A battery must be used to back up the position data when power is not supplied to an absolute encoder. Use one of the following batteries.

Manufacturer	Model	Voltage	Electrical capacity	Remarks
Toshiba	ER6V	3.6 V	2,000 mA•h	One battery/Servo Driver Predicted life: Approx. 10 years.
Hitachi Maxell	ER6	3.6 V	2,050 mA•h	One battery/Servo Driver Predicted life: Approx. 10 years.
OMRON (made by Hitachi Maxell)	C500-BAT08 (ER17/33)	3.6 V	1,650 mA•h	One battery/Servo Driver Predicted life: Approx. 7 years.

Note The battery voltage is not monitored internally when power is not supplied to the Servo Driver. Do not let the voltage drop below 2.8 V. If required by the system for proper operation, install a voltage drop detection circuit or monitor.

■ Replacing the Battery

The following procedure can be used to replace the battery without loosing the encoder rotation amount data.

1. Turn on power to the Servo Driver.
2. Turn ON the SEN signal and wait for 3 minutes for the capacitor inside the encoder to charge.
3. Turn off power to the Servo Driver.
4. Replace the battery.

The battery is connected between pins 28 and 29 of the Servo Drivers control I/O connector (CN1).

28: BAT + input for the backup battery (connect a 2.8 to 4.5-VDC battery).
29:BATGND – input for the backup battery (backup battery ground)

Note **1.** The encoder can be left without a battery for two days after the above step 2., above, is performed.

Note **2.** Do not short the + and – terminals when replacing the battery.

Note **3.** When cutting the lead wires from the battery, cut them separately, never together. The terminals will be shorted if the lead wires are cut at the same time, possibly causing sparks.

Note **4.** Dispose of the used battery using the specified methods. Never incinerate or throw the battery into fire; it may explode.

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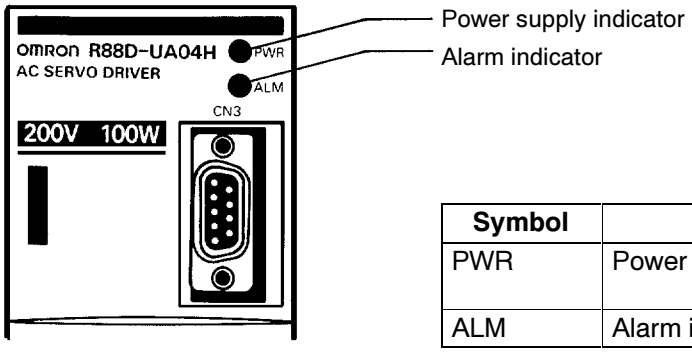
4-2 Using Displays

4-2-1 Display Functions

OMRON U-series AC Servomotors have unique servo software that enables quantitative monitoring in real time, on digital displays, of changes in a variety of characteristics. Use these displays for checking the various characteristics during operation.

■ Servo Driver Displays

There are two LED indicators on the Servo Driver itself. One is for the power supply and another is for alarms.

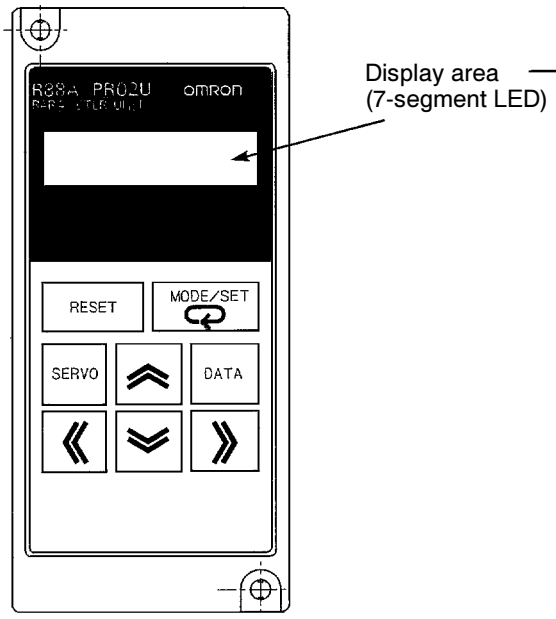


Symbol	Name	Function
PWR	Power supply indicator	Lit when AC power supply is normal.
ALM	Alarm indicator	Lit when error occurs.

■ Parameter Unit Displays

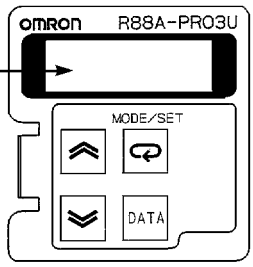
When a Parameter Unit is connected, monitoring can be conducted by means of a 5-digit 7-segment LED.

R88A-PR02U Handy Type



Display area
(7-segment LED)

R88A-PR03U Mounted Type



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■ Parameter Unit Key Functions

The contents displayed by the Parameter Unit can be changed by key operations.

Handy type R88A-PR02U	Mounted type R88A-PR03U	Function
RESET	∧ + ∨	Alarm reset
↩	↩	Mode switching; data memory
SERVO	DATA	Servo ON/OFF during jog operations
DATA	DATA	Switching between parameter display and data display; data memory
∧	∧	Increments parameter numbers and data values.
∨	∨	Decrements parameter numbers and data values.
≪		Left shift for operation digits
≫		Right shift for operation digits

■ Types of Modes

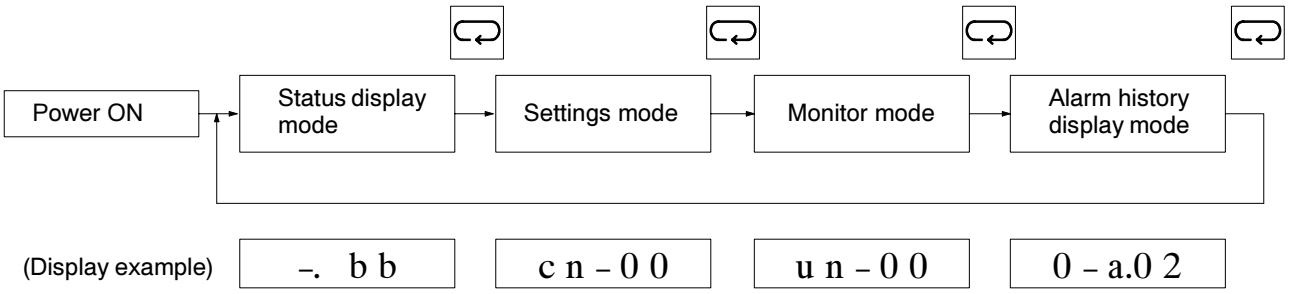
There are four types of modes for Parameter Unit displays. The functions in each mode are shown in the following table.

Mode	Function
Status display mode	Bit display (indicating internal status via indicators): Power supply ON display, base block, speed conformity, rotation detection and current limit detection, inputting speed command, inputting torque command Symbol display (indicating internal status via 3-digit 7-segment display: Base block, operating, forward rotation prohibited, reverse rotation prohibited, alarm display
Settings mode	System check: Jog operations, command offset automatic adjustment, alarm history data clear, command offset manual adjustment, motor parameters check, auto-tuning Setting and checking setup parameters Setting and checking user parameters
Monitor mode	Speed feedback, speed commands, torque commands, number of pulses from U-phase, electrical angle, internal status bit display
Alarm history display mode	Displays contents of alarms that have been previously generated (up to a maximum of 10).

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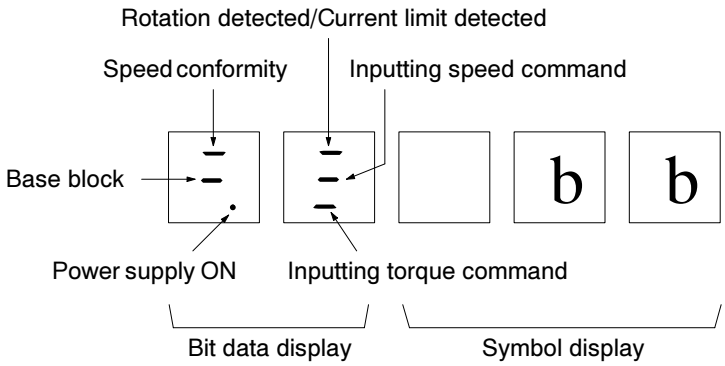
■ Changing the Mode

Use the MODE/SET Key to change from one mode to another.



4-2-2 Status Display Mode

The status display mode is entered when powering up or by means of the MODE/SET Key. In the status display mode, Servo Driver status is displayed in two ways: bit data and symbols. These displays are shown in the following illustration.



■ Bit Data Display Contents

Bit data	Contents
Power supply ON	Lit when Servo Driver power supply is ON.
Base block	Lit during base block (no power to motor); dimmed when servo is ON.
Speed conformity	Lit when the motor rotation speed reaches the speed command value.
Rotation detection /current limit detection (See note.)	Lit when the motor rotation speed is equal to or greater than the rotation speed for motor rotation detection (Cn-0b).
	Lit when a torque command is limited by the torque limit value (Cn-08, 09 or Cn-18, 19 or the limit value from TREF.)
Inputting speed command	Lit when a speed command input meets the rotation speed for motor rotation detection (Cn-0b).
Inputting torque command	Lit when a torque command at least 10% of the rated torque is input.

Note The setting of bit no. 4 in setup parameter no. 1 (Cn-01) determines whether rotation detection or current limit detection will be output.

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■ Symbol Display Contents

Symbol display	Contents
bb	Base block (no power to motor)
rUn	Operating
p%t	Forward rotation prohibited
n%t	Reverse rotation prohibited
a.□□	Alarm display (Refer to alarm table.)

4-2-3 Monitor Mode (Un-)

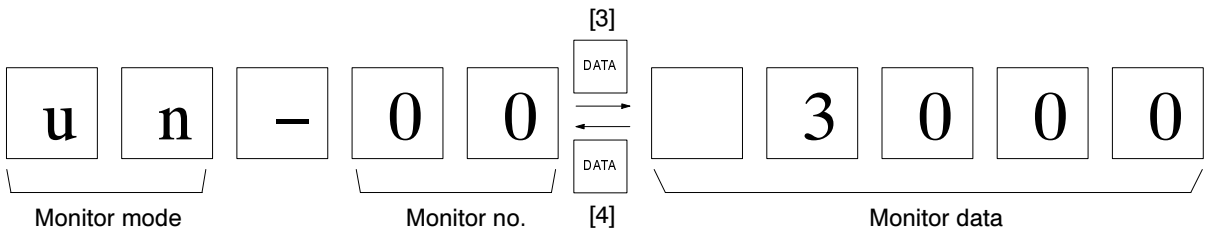
■ Types of Monitoring

In monitor mode, six types of monitoring can be carried out.

Monitor no.	Monitor contents	Unit	Explanation
00	Speed feedback	r/min	Displays actual rotation speed of motor.
01	Speed command	r/min	Displays command to speed loop. For analog speed control, the command voltage is converted to r/min for display.
02	Torque command	%	The command to the current loop is displayed as 100% of the rated torque. For torque control, the command voltage is converted to % for display.
03	Number of pulses from U-phase edge	Pulses	The number of pulses from the U-phase edge is displayed in units of encoder resolution. Incremental encoder: Number of pulses per 1/4 turn displayed as 2,048 pulses. Absolute encoder: Number of pulses per 1/4 turn displayed as 1,024 pulses. Error factor: ±5 pulses.
04	Electrical angle	Degrees	Displays the electrical angle of the motor.
05	Internal status bit display	---	Displays Servo Driver internal information as either lit or not lit.

■ Operation in Monitor Mode

In order to conduct monitoring, first go into monitor mode and then set the monitor number and press the DATA Key. The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



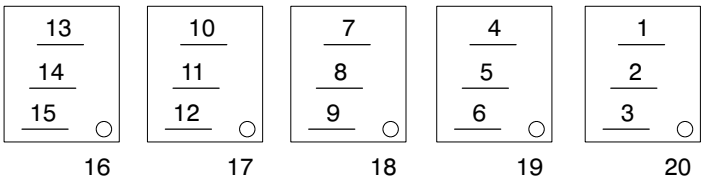
1. Press the MODE/SET Key to go into monitor mode.
2. Using the Up and Down (and Right and Left) Keys, set the monitor number.

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3. Press the DATA Key to display the monitor data.
4. Press the DATA Key to return to the monitor number display.
5. Press the MODE/SET Key to move from monitor mode to alarm history display mode.

■ Internal Status Bit Display (Un-05)

Internal status is displayed by 7-segment bit lighting. The bit number allocation is shown in the following diagram.



Bit no.	Symbol	Contents
1	ALM	Lit when alarm is generated.
2	DBON	Lit during dynamic brake operation.
3	DIR	Lit when in reverse rotation mode (when Cn-02 bit no. 0 = 1).
4	TGON/CLIMT	Lit when the motor rotation speed is equal to or greater than the rotation speed for motor rotation detection (Cn-0b). Lit when a torque command is limited by the torque limit value (Cn-08, 09 or Cn-18, 19 or the limit value from TREF.)
5	VCMP	Lit when the motor rotation speed reaches the speed command value.
6	PCON	Lit when the speed control loop is in P control.
7	PCL/SPD1	Lit when forward rotation current limit / speed selection command 1 (CN1-11) is ON.
8	NCL/SPD2	Lit when reverse rotation current limit / speed selection command 2 (CN1-12) is ON.
9	SVON	Lit when motor is receiving power.
10	A	Encoder A phase (HA/LA/V/W Models: Lit when there is a signal; H/L Models: Not lit when there is a signal.)
11	B	Encoder B phase (HA/LA/V/W Models: Lit when there is a signal; H/L Models: Not lit when there is a signal.)
12	Z	Encoder Z phase (HA/LA/V/W Models: Lit when there is a signal; H/L Models: Not lit when there is a signal.)
13	PU	Poll sensor U phase (Incremental encoder)
14	PV	Poll sensor V phase (Incremental encoder)
15	PW	Poll sensor W phase (Incremental encoder)
16	RUN	Lit when run command is ON.
17	MING/PLOCK TVSEL/RDIR	Lit when CN1-15 is ON. (Input signal functions change according to parameter settings.)
18	POT	Lit when forward drive prohibit input is ON.
19	NOT	Lit when reverse drive prohibit input is ON.
20	SEN	Lit when the sensor ON input is ON (Absolute encoder)

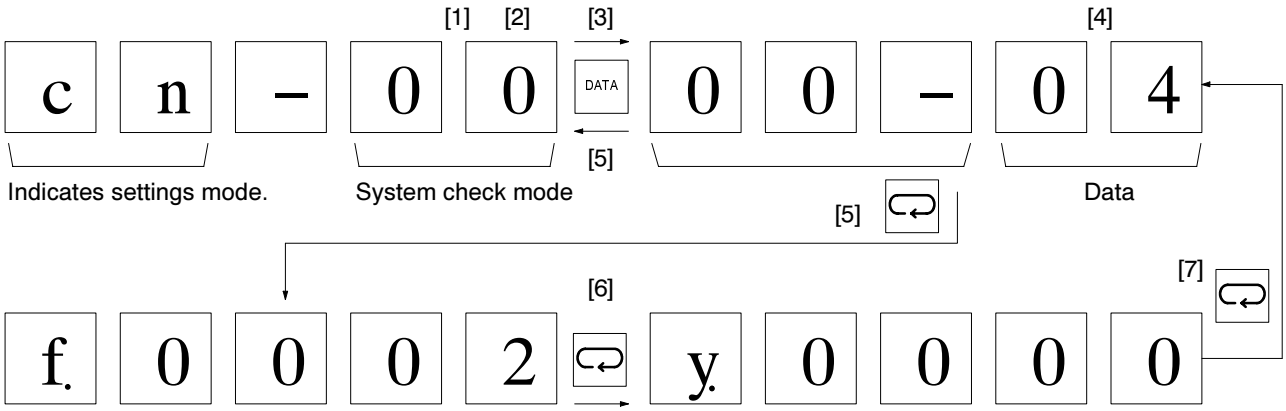
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4-2-4 Checking Servomotor Parameters (Cn-00 Set to 04)

Servomotor parameters can be checked when system check mode Cn-00 is set to “04.” Servomotor parameters are the Servomotor specifications that can be controlled by that Servo Driver. They are not the specifications of the Servomotor that is connected. Use this to check whether the Servo Driver and Servomotor combination is suitable.

■ Servomotor Parameter Checking Operation

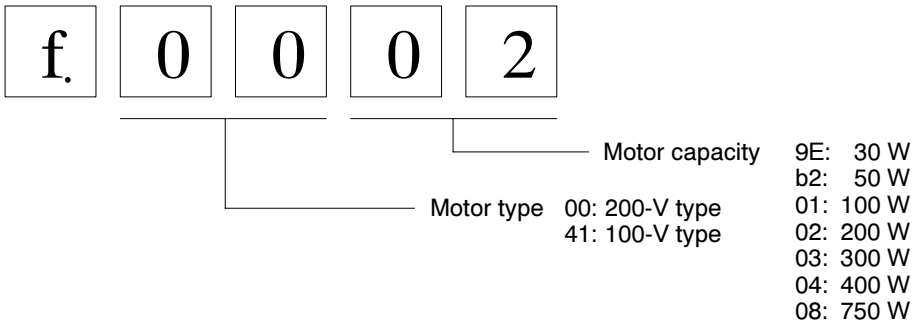
The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



1. Press the MODE/SET Key to switch to the settings mode.
2. Using the Up and Down Keys, set parameter number “00.” (System check mode)
3. Press the DATA Key to display the setting of Cn-00.
4. Using the Up and Down Keys, change the setting to “04.” (Servomotor parameter check)
5. Press the MODE/SET Key, and check the Servomotor parameters in order.
6. Press the MODE/SET Key to display special specifications in hexadecimal.
7. Press the MODE/SET Key to return to the data display for the system check mode.

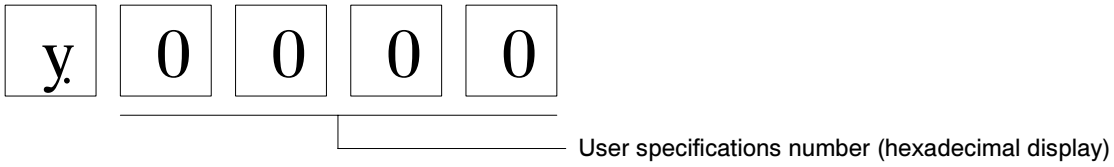
■ Parameter Display Contents

● Servomotor Parameters



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● **Special Specifications**

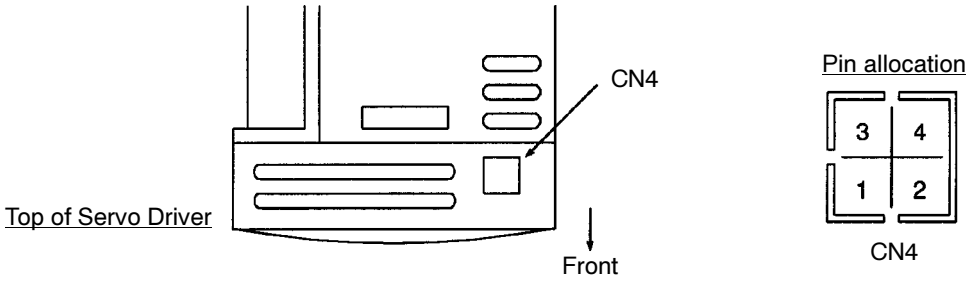


4-3 Using the Monitor Output

The Servo Drive outputs a monitor voltage proportional to the Servomotor rotation speed and current from the monitor output connector (CN4) on the top of the Servo Driver. This output can be used to install a meter in the control panel or to enable more precise gain adjustments.

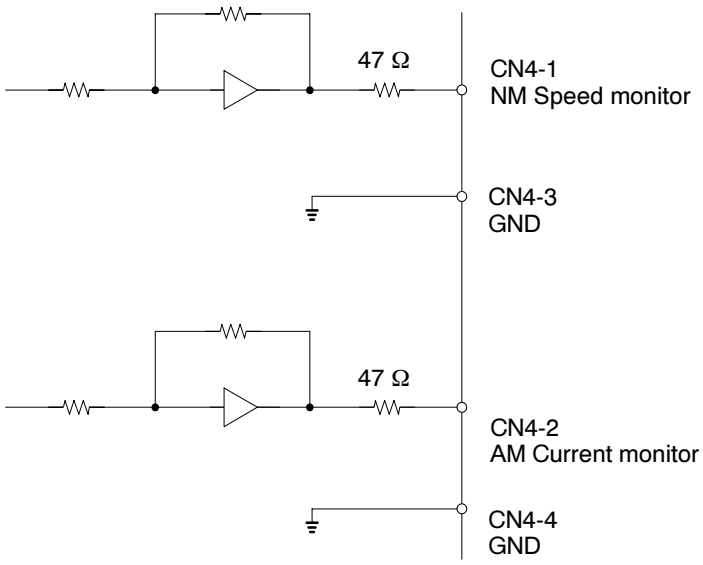
■ Analog Monitor Output Specifications

● **Monitor Output Terminals (Top of the Servo Driver)**



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● Monitor Output Circuit



● Monitor Output Specifications

Speed monitor	With 0 V as center, voltage output at 0.5 V/(1000 r/min) ratio. Forward rotation: (–) voltage; reverse rotation: (+) voltage Output accuracy: approximately ±10%
Current monitor	With 0 V as center, voltage output at 0.5 V/(rated torque) ratio. Forward acceleration: (–) voltage; reverse acceleration: (+) voltage Output accuracy: approximately ±10%

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4-4 Protective and Diagnostic Functions

4-4-1 Alarm Displays and Alarm Code Outputs

The Servo Driver has the error detection functions shown below. When an error is detected, the alarm output ($\overline{ALM}$) and the alarm code output (AL01-03) are output, the Servo Driver's internal power drive circuit is turned off, and the alarm is displayed.

■ Alarm Table

Display	Alarm code			Alarm $\overline{ALM}$	Error detection function	Detection contents
	ALO1	ALO2	ALO3			
a.00	OFF	OFF	OFF	OFF	Absolute value error (Absolute Encoder)	An error has been detected in the absolute value data when the SEN signal is input.
a.02	OFF	OFF	OFF	OFF	Parameter corruption	The checksum for the parameters read from the EEP-ROM does not match.
a.04	OFF	OFF	OFF	OFF	Parameter setting error	Incorrect parameter setting. (HA/LA/V/W Models)
a.10	ON	OFF	OFF	OFF	Overcurrent	Overcurrent or overheating detected.
a.40	OFF	OFF	ON	OFF	Overvoltage	Main circuit DC voltage exceeded the allowable value (410 VDC or more).
a.51	ON	OFF	ON	OFF	Over speed	Detected at 4,950 r/min.
a.52	ON	OFF	ON	OFF	Excessive speed command input	Speed command for 4,700 r/min was input. (H/L Models)
a.70	ON	ON	ON	OFF	Overload	Detected at reverse limit characteristics when the output torque exceeds120% of the rated torque. (HA/LA/V/W Models)
a.71	ON	ON	ON	OFF	Overload	Detected at reverse limit characteristics when 135% of the rated torque was exceeded. (H/L Models)
a.72	ON	ON	ON	OFF	Overload	Detected at reverse limit characteristics for 120% to 135% of the rated torque. (H/L Models)
a.80	OFF	OFF	OFF	OFF	Encoder error (Absolute Encoder)	An error was detected in the number of feedback pulses for 1 revolution.
a.81	OFF	OFF	OFF	OFF	Backup error (Absolute Encoder)	The encoder backup voltage has dropped. (This error is always given the first time the encoder is used.)
a.82	OFF	OFF	OFF	OFF	Checksum error (Absolute Encoder)	An error occurred in an encoder memory data check.
a.83	OFF	OFF	OFF	OFF	Battery error (Absolute Encoder)	The voltage of the encoder battery has dropped (less than 2.6 to 2.8 V).
a.84	OFF	OFF	OFF	OFF	Absolute error (Absolute Encoder)	An encoder sensor check error has occurred. (Internal encoder error.)
a.85	OFF	OFF	OFF	OFF	Over speed error (Absolute Encoder)	The rotational speed was 400 r/min or higher for a 5-V power supply input.
a.b1	OFF	OFF	OFF	OFF	Command input reading error	The A/D end signal was not output from the A/D converter within a fixed time.

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Display	Alarm code			Alarm ALM	Error detection function	Detection contents
	ALO1	ALO2	ALO3			
a.c1	ON	OFF	ON	OFF	Runaway detected.	Faulty power or encoder wiring.
a.c2	ON	OFF	ON	OFF	Phase error detected.	Connector not properly connected. Encoder not properly wired.
a.c3	ON	OFF	ON	OFF	Encoder A or B phase wire disconnection.	Either Phase A or Phase B signal was disconnected or short circuited.
a.c4	ON	OFF	ON	OFF	Encoder S phase wire disconnection.	Encoder S phase was disconnected or short circuited.
a.f3	OFF	ON	OFF	OFF	Momentary power failure alarm	The power supply was re-started within the power retention period.
a.99	OFF	OFF	OFF	ON	Alarm reset power supply turned on.	This is history data only, and is not an alarm.
cpf00	OFF	OFF	OFF	OFF	Parameter Unit transmission error 1	Data could not be transmitted after the power supply was turned on. (It no longer exists in the alarm history.)
cpf01	---	---	---	---	Parameter Unit transmission error 2	Transmission timeout error (It no longer exists in the alarm history.)

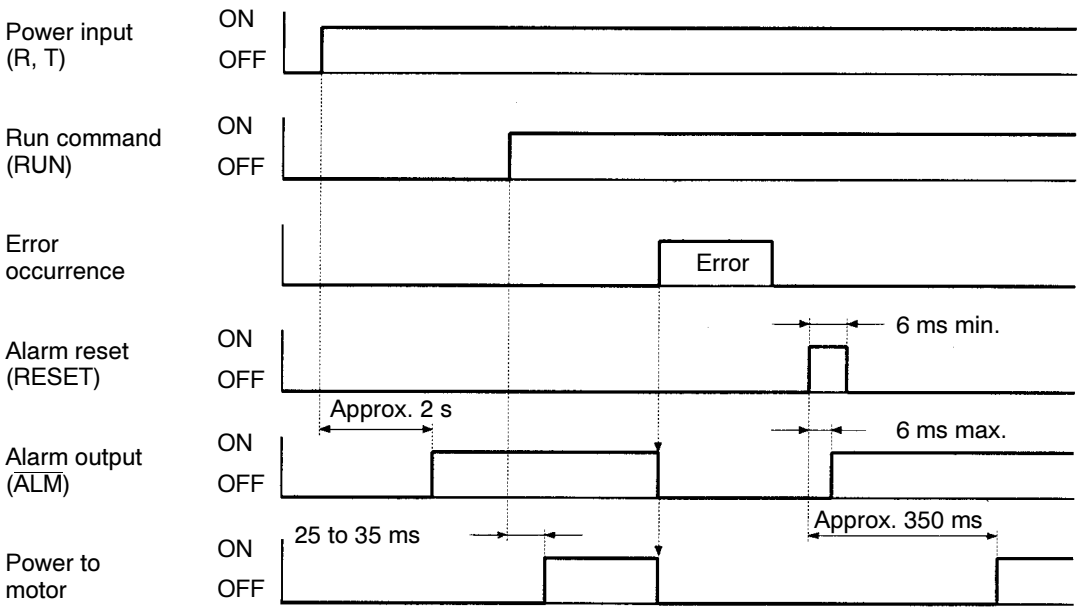
Note 1. A.00 and A.80 to A.85 are detected only for absolute encoders.

Note 2. "---" means indefinite.

4-4-2 Alarm Output

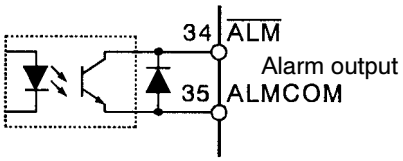
This section describes the timing of alarm outputs when power is turned on and when alarms occur. The method used to clear alarms is also described.

■ Timing Chart



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■ Alarm Output Circuit



Output specifications: 30 VDC, 50 mA max.
Normal: Output transistor ON
Error (alarm): Output transistor OFF

■ Clearing Alarms

• Any of the following methods can be used to clear alarms:
Turn ON the alarm reset signal (RESET).
Toggle the power supply.
Press the Reset Key on the Parameter Unit.
Overcurrent alarms (A.10), however, cannot be cleared by toggling the power supply.

• Operation will start as soon as the alarm is cleared if the alarm is cleared while the Run command (RUN) is ON, possibly creating a dangerous situation. Turn OFF the Run command before clearing alarms. Take adequate safety precautions if an alarm is going to be cleared while the Run command is ON or when the Servo Always ON (Cn-01, bit 0 set to 1) is used.

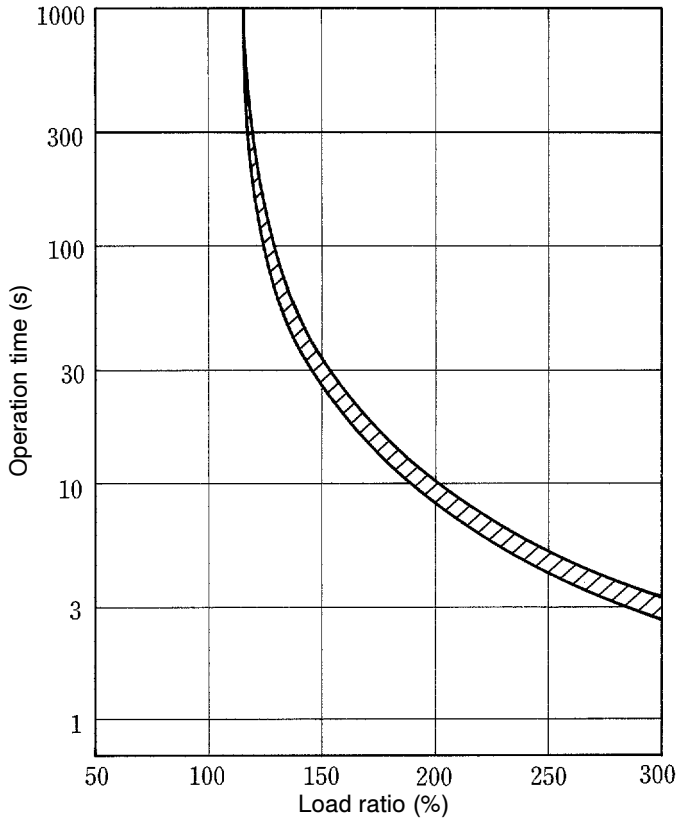
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4-4-3 Overload Characteristics (Electron Thermal Characteristics)

An overload protection function (electron thermal) is built into the Servo Driver to protect against Servo Driver or Servomotor overload. If an overload (A.70 to A.72) does occur, first clear the cause of the error and then wait at least one minute for the Servomotor temperature to drop before turning on the power again. If the power is turned on again too soon, the Servomotor coil may be damaged.

■ Overload Characteristic Graph

The characteristic between the load ratio and the electronic thermal operating time is shown in the following graph.



Note **1.** The load ratio is calculated in relation to the Servomotor's rated current.

$$\text{Load ratio (\%)} = \frac{\text{Servomotor current}}{\text{Servomotor rated current}} \times 100$$

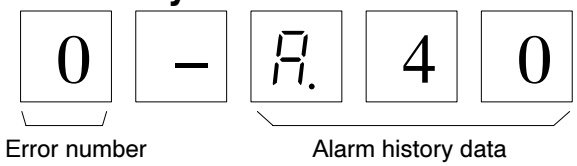
Note **2.** For example, if a current three times the rated motor current is applied continuously, and overload will be detected in approximately 3 s.

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4-4-4 Alarm History Display Mode

The Servo Driver stores the history of the 10 most recent alarms that have been generated. The alarm history can be displayed by going into the alarm history display mode and using the Up and Down Keys.
To clear the alarm history, set the system check mode to “02” and press the MODE/SET Key.

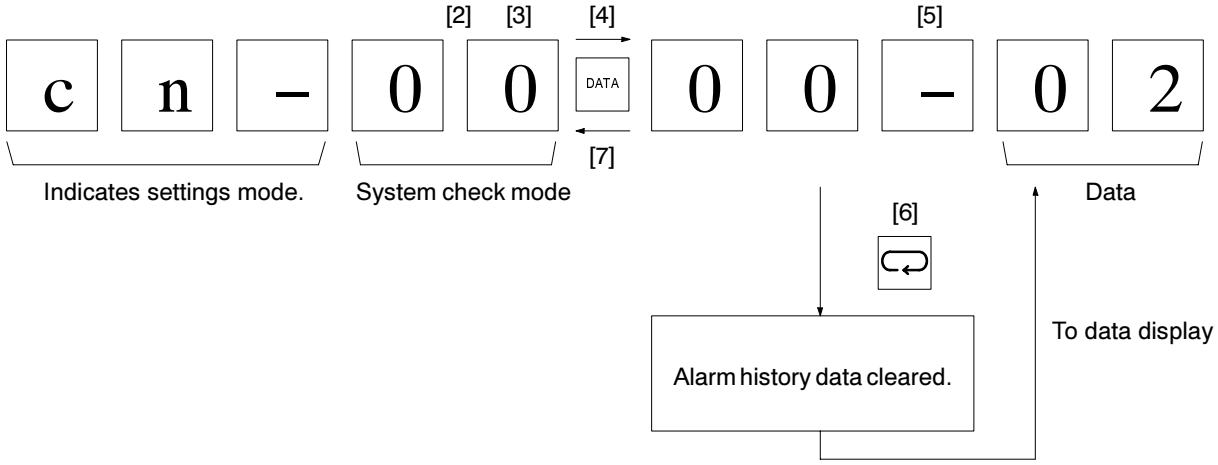
■ Displaying the Alarm History



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to go to the alarm history display mode.
3. Use the Up and Down Keys to go up and down through the error occurrence numbers and display the corresponding alarm history data. (The larger the error occurrence number, the less recent the alarm is.)

■ Clearing Alarm History Data

Alarm history data initialization is executed in the system check mode. The items in parentheses in the following explanation indicate operations using the Handy-type Parameter Unit.



1. Confirm that the initial display is shown (–. bb).
2. Press the MODE/SET Key to enter the settings mode.
3. Using the Up and Down Keys, set parameter number “00.” (System check mode)
4. Press the DATA Key to display the setting of Cn-00.
5. Using the Up and Down Keys, set the parameter to “02.” (Alarm history clear)
6. Press the MODE/SET Key to clear the alarm history data.
7. Press the DATA Key to return to the settings mode.

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4-5 Troubleshooting

When an error occurs, check the error contents by means of the operating status and alarm display, investigate the cause and apply the appropriate countermeasures.

■ Error Diagnosis by Means of Operating Status

Symptom	Probable cause	Items to check	Countermeasures
The power supply indicator (PWR) does not light even when the power supply is turned on.	Power supply lines are incorrectly wired.	• Check the power supply voltage. • Check the power supply lines.	• Correct the power supply. • Correct the wiring.
The motor does not operate even when a speed command (REF) is given. (No alarm is output.)	The RUN signal is OFF (when Cn-01 bit no. 0 is "0").	Check the RUN signal's ON and OFF by means of the monitor mode.	• Input the RUN signal. • Correct the wiring.
	The correspondence between the Servo Driver and the Servomotor is incorrect.	Check the models.	Combine models that correspond correctly.
	The POT and NOT signals are OFF (when Cn-01 bit nos. 2 and 3 are "0").	Check whether POT and NOT are displayed in status display mode.	• Turn ON the POT and NOT signals. • If POT and NOT are not being used, set Cn-01 bit nos. 2 and 3 to "1."
	The mode is the internal speed control setting mode.	Check Cn-02 bit no. 2.	Set Cn-02 bit no. 2 to "0."
	The speed command (REF) voltage is 0 V.	• Check the speed command by means of the monitor mode. • Check the speed command voltage.	Correct the wiring.
	An error occurred with the RESET signal ON.	Check the RESET signal's ON and OFF by means of the monitor mode.	Turn the RESET signal OFF and take measures according to the alarm display.
	The PLOCK signal is ON.	Check the PLOCK signal by means of the monitor mode (internal status bit).	• Turn the PLOCK signal OFF. • Check the Cn-0F value.
	The torque control function is being used.	• Check the settings in Cn-08, 09, 18, and 19. • Check the status of the PCL and NCL signals. • Check the voltage of TREF (analog current limit) (HA/LA/V/W Models).	• Adjust (increase) the settings of Cn-08, 09, 18, and 19. • Input the PCL and NCL signals correctly. • Input TREF correctly.
The motor operates momentarily, but then it does not operate.	The setting for the number of encoder pulses is incorrect.	Check the setting of Cn-11.	• Incremental encoders: Set 2,048. • Absolute encoders: Set 1,024.
	The Servomotor power lines or encoder lines are wired incorrectly.	Check the Servomotor power line U, V, and W phases, and the encoder line wiring.	Correct the wiring.

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Symptom	Probable cause	Items to check	Countermeasures
Servomotor operation is unstable.	The Servomotor power lines or encoder lines are wired incorrectly.	Check the Servomotor power line U, V, and W phases, and the encoder line wiring.	Correct the wiring.
	The polarity of the speed command (REF) input is wrong.	Check the speed command input wiring.	Correct the wiring.
	There are eccentricities or looseness in the coupling connecting the Servomotor shaft and the mechanical system, or there are load torque fluctuations according to how the pulley gears are engaging.	• Check the machinery. • Try operating the Servomotor without a load.	Adjust the machinery.
	Gain is wrong.		• Use auto-tuning. • Adjust the gain manually.
Servomotor is overheating.	The ambient temperature is too high.	Check to be sure that the ambient temperature around the Servomotor is no higher than 40°C.	Lower the ambient temperature to 40°C or lower. (Use a cooler or fan.)
	Ventilation is obstructed.	Check to see whether anything is blocking ventilation.	Ensure adequate ventilation.
	There is an overload.	Check the torque command value by means of monitor mode.	• Lighten the load. • Change to a larger capacity Servomotor.
	The correspondence between the Servo Driver and the Servomotor is incorrect.	Check the models.	Combine models that correspond correctly.
There are unusual noises.	The machinery is vibrating.	Inspect the machinery to see whether there are any foreign objects in the movable parts, or whether there is any damage, deformation, or looseness.	Fix any problems causing vibration.
	The speed loop gain adjustment is insufficient.		• Use auto-tuning. • Adjust the gain manually (speed loop gain).
Vibration is occurring at the same frequency as the applicable power supply.	Inductive noise is occurring.	• Check to see whether the Servo Driver control signal lines are too long. • Check to see whether control signal lines and power supply lines are too close to each other.	• Shorten the control signal lines. • Separate control signal lines from power supply lines. • Use a low-impedance power supply for control signals.
The Servomotor operates even when speed command is for 0 V.	The speed command voltage and the speed command input section are offset.	Check the speed command voltage.	• Adjust the speed command offset. • Position lock should use speed control (Cn-01 b·A =0.1)

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■ Error Diagnosis by Means of Alarm Display (Parameter Unit)

Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.00	Absolute value data error (Absolute encoder)	Occurred when the SEN signal was input.	Error in absolute encoder	• Re-input the SEN signal. • Perform the setup operation for the absolute encoder.
			Incorrect absolute encoder wiring.	Correct the wiring.
a.02	Parameter corruption	Occurred when power was turned on.	Internal memory error	Replace Servo Driver.
a.04	Parameter setting error (HA/LA/V/W Models)	Occurred when power was turned on.	A user parameter was set to a value outside of the setting range previously.	Change the user parameter setting so it is within the setting range.
			Control board defective.	Replace Servo Driver.
		Occurred when auto-tuning.	Auto-tuning was perform when the compensating gain (Cn-28) was not set to 0.	Set Cn-04 and 05 to the factory default values, set Cn-28 to 0 and repeat the auto-tuning. Operate from a Handy-type Parameter Unit.
a.10	Overcurrent	Occurred when power was turned on.	Control board defective.	Replace Servo Driver.
		Occurred when Servo was turned on.	• Current feedback circuit error • Main circuit transistor module error	Replace Servo Driver.
			Servomotor power line is short-circuited or grounded.	• Correct the power line short-circuiting or grounding. • Measure the insulation resistance at the Servomotor itself. If there is short-circuiting, replace the Servomotor.
			There is faulty wiring at the U, V, or W phase, or the GR.	Correct the wiring.
			Servomotor coil are damaged.	Measure the winding resistance. If the coil are damaged, replace the Servomotor.
	Overheating	Occurred during operation. Occurred even though power was on. If reset is executed after waiting for a time, operation resumes.	The ambient temperature for the Servo Driver is higher than 55°C.	Bring the ambient temperature for the Servo Driver down to 55°C or lower.
			The load torque is too high.	• Lighten the load. • Lengthen the acceleration time. • Select another Servomotor.

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Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.40	Overvoltage	Occurred when power was turned on.	The power supply voltage is outside of the allowable range.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.
		Occurred during Servomotor deceleration.	The load inertia is too large.	• Lengthen the deceleration time. • Select another Servomotor.
			The power supply voltage is outside of the allowable range.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.
			Regeneration Unit error	Replace the Regeneration Unit
		Occurred while lowering (vertical shaft)	Gravity torque is too large.	• Add a counterbalance to the machine, and reduce the gravity torque. • Reduce the lowering speed. • Connect a Regeneration Unit.
a.51	Over speed	High-speed rotation occurred when command was input.	The rotation speed exceeded 4,950 r/min due to overshooting.	• Adjust the gain. • Lower the maximum speed of the command.
			Encoder is wired incorrectly.	Correct the wiring.
a.52	Excessive speed command input (H/L Models)	High-speed rotation occurred when command was input.	A speed command exceeding 4,700 r/min was input.	• Lower the speed command. • Adjust the speed command scale (Cn-03).
a.70 a.71 a.72	Overload	Occurred during operation.	Operating at more than 120% of the rated torque. (A.70) HA/LA/V/W Models	• If the Servomotor shaft is locked, unlock it. • If Servomotor power lines are incorrectly wired, correct them. • Lighten the load. • Lengthen the acceleration/deceleration time. • Adjust the gain.
			Operating at more than 135% of the rated torque. (A.71) H/L Models	
			Operating at 120% to 135% of the rated torque. (A.72) H/L Models	
			Power supply voltage dropped.	• The supply voltage must be 170 to 253 VAC when 200 VAC is specified. • The supply voltage must be 85 to 127 VAC when 100 VAC is specified.

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Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.80	Encoder error (Absolute Encoder)	Occurred during operation.	Faulty absolute encoder operation or faulty contact.	Correct the wiring.
			Pulse counter error.	Turn OFF the SEN signal, reset the alarm, and then turn ON the SEN signal.
		Occurred when power was turned on.	Parameter setting error (Cn-01, bit E).	Correct the setting of Cn-01, bit E. Incremental encoder: 0 Absolute encoder: 1
a.81	Backup error (Absolute Encoder)	Occurred when the SEN signal was input.	• Drop in the absolute encoder backup voltage. • The encoder is being used the first time.	Perform the absolute encoder setup.
a.82	Checksum error (Absolute Encoder)	Occurred when the SEN signal was input.	An error occurred in an encoder memory data check.	Perform the absolute encoder setup.
a.83	Battery error (Absolute Encoder)	Occurred when the SEN signal was input.	The voltage of the encoder battery has dropped (less than 2.6 to 2.8 V).	Replace the battery, turn ON the SEN signal twice, and then perform the absolute encoder setup.
a.84	Absolute error (Absolute Encoder)	Occurred when the SEN signal was input.	An encoder sensor check error has occurred. (Internal encoder error.)	• Toggle the power supply. • Replace the Servomotor (because the encoder is faulty).
a.85	Over speed error (Absolute Encoder)	Occurred when the SEN signal was input.	The rotational speed was 400 r/min or higher for a 5-V power supply input.	Turn ON the SEN signal when the motor is stopped.
a.b1	Command input reading error	Occurred during operation.	Malfunctioning of the command input reading area.	Reset and then run again.
			Damage at the command input reading area.	Replace Servo Driver.
a.c1	Runaway detected	Some movement occurred at the beginning of operation.	• Encoder lines wired incorrectly. • Servomotor power lines wired incorrectly.	Correct the wiring.
a.c2	Phase error detected	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct the wiring. • Insert connectors correctly.
		Occurred when the power was turned on.	Parameter setting error (Cn-01, bit E).	Correct the setting of Cn-01, bit E. Incremental encoder: 0 Absolute encoder: 1
a.c3	Encoder A, B phase wire disconnection.	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct any disconnected lines. • Insert connectors correctly.
			Encoder lines wired incorrectly.	Correct the wiring.
			Encoder defective.	Replace the Servomotor.
			Servo Driver defective.	Replace Servo Driver.
		Occurred when the power was turned on.	Parameter setting error (Cn-01, bit E).	Correct the setting of Cn-01, bit E. Incremental encoder: 0 Absolute encoder: 1

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Alarm display	Error content	Condition when error occurred	Probable cause	Countermeasures
a.c4	Encoder S phase wire disconnection.	Some movement occurred at the beginning of operation.	• Encoder lines disconnected. • Connector contact faulty.	• Correct any disconnected lines. • Insert connectors correctly.
			Encoder lines wired incorrectly.	Correct the wiring.
			Encoder defective.	Replace the Servomotor.
			Servo Driver defective.	Replace Servo Driver.
		Occurred when the power was turned on.	Parameter setting error (Cn-01, bit E).	Correct the setting of Cn-01, bit E. Incremental encoder: 0 Absolute encoder: 1
a.f3	Momentary power failure alarm		• A momentary power failure occurred. • The power supply was restarted within the power retention period.	• Reset and then run again. • Set Cn-01 bit no. 5 to “1” to automatically clear the alarm when the power is restored after a momentary power failure.
cpf00	Parameter Unit transmission error 1	Occurred when power was turned on.	Servo Driver defective.	Replace Servo Driver.
cpf01	Parameter Unit transmission error 2	Occurred while the Parameter Unit was being used.	Internal element is malfunctioning.	Reset and then run again.
			Internal element is damaged.	Replace Servo Driver.

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4-6 Periodic Maintenance

⚠ **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

⚠ **Caution** Resume operation only after transferring to the new Unit the contents of the data required for operation. Not doing so may result in an unexpected operation.

Servo Motors and Drives contain many components and will operate properly only when each of the individual components is operating properly. Some of the electrical and mechanical components require maintenance depending on application conditions. In order to ensure proper long-term operation of Servo Motors and Drivers, periodic inspection and part replacement is required according to the life of the components.

The periodic maintenance cycle depends on the installation environment and application conditions of the Servo Motor or Driver. Recommended maintenance times are listed below for Servo Motors and Drivers. Use these are reference in determining actual maintenance schedules.

■ Servo Motors

- Recommended Periodic Maintenance
  Oil Seal: 2,000 hours
  Bearings: 20,000 hours

  Application Conditions: Ambient motor operating temperature of 40°C, within allowable shaft load, rated operation (rated torque and r/m), installed as described in operation manual.

- The radial loads during operation (rotation) on timing pulleys and other components contacting belts is twice the still load. Consult with the belt and pulley manufacturers and adjust designs and system settings so that the allowable shaft load is not exceeded even during operation. If a motor is used under a shaft load exceeding the allowable limit, the motor shaft can break, the bearings can burn out, and other problems can occur.

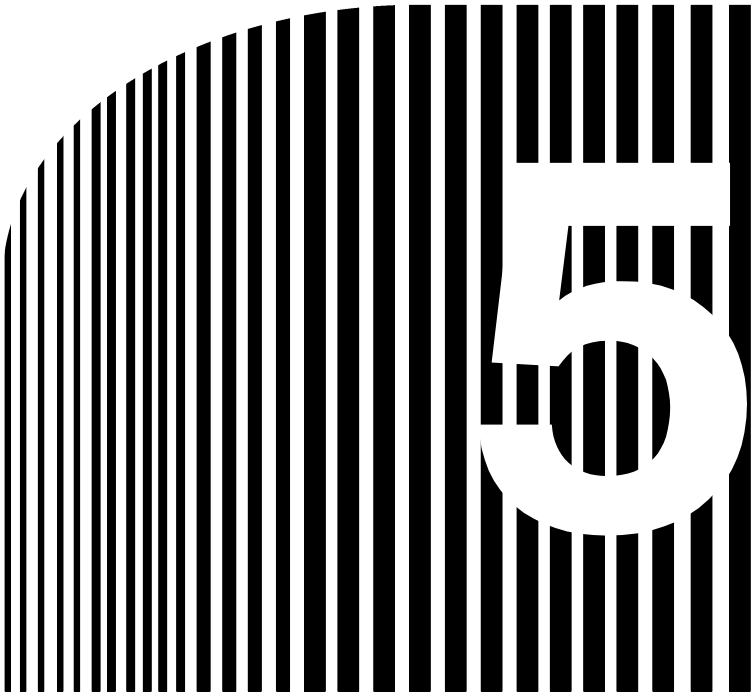
■ Servo Driver and Regeneration Units

- Recommended Periodic Maintenance
  Aluminum analytical capacitors: 50,000 hours

  Application Conditions: Ambient driver (regeneration unit) operating temperature of 55°C, rated operation (rated torque), installed as described in operation manual.

- The life of aluminum analytical capacitors is greatly affected by the ambient operating temperature. Generally speaking, an increase of 10°C in the ambient operating temperature will reduce capacitor life by 50%. We recommend that ambient operating temperature be lowered and the power supply time be reduced as much as possible to lengthen the maintenance times for Servo Drivers and Regeneration Units.
- It is recommended that the Servo Driver and Regeneration Unit be inspected at five-year intervals if they are used under conditions worse than the above or not used over a long time of time. Contact your OMRON representative for inspection and the necessity of any component replacement.

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Chapter 5

• Specifications •

5-1 Servo Driver Specifications
5-2 Servomotor Specifications
5-3 Cable Specifications
5-4 Parameter Unit Specifications
5-5 Regeneration Unit Specifications
5-6 Front-surface Mounting Bracket Specifications

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5-1 Servo Driver Specifications

5-1-1 General Specifications

Item	Specifications
Operating ambient temperature	0°C to 55°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient temperature	–10°C to 75°C
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	10 to 55 Hz in X, Y, and Z directions with 0.10-mm double amplitude; acceleration: 4.9 m/s^2 {0.5 G} max.; time coefficient: 8 min; 4 sweeps
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max., in X, Y, and Z directions, three times
Insulation resistance	Between power line terminals and case: 5 MΩ min. (at 1,000 VDC)
Dielectric strength	Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards Between power line terminals and case: 1,000 VAC for 1 min (20 mA max.) at 50/60 Hz Models Conforming to EC Directives Between power line terminals and case: 1,500 VAC for 1 min at 50/60 Hz
Protective structure	Built into panel.

Note 1. The above items reflect individual evaluation testing. The results may differ under compounded conditions.

Note 2. Absolutely do not conduct a withstand voltage test or a megger test on the Servo Driver. If such tests are conducted, internal elements may be damaged.

Note 3. Depending on the operating conditions, some Servo Driver parts will require maintenance. Refer to *4-6 Periodic Maintenance* for details.

Note 4. The service life of the Servo Driver is 50,000 hours at an average ambient temperature of 55°C (at the rated torque and the rated rotation speed).

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5-1-2 Performance Specifications

■ 200-VAC Input Servo Drivers Conforming to UL/cUL Standards and 200-VAC Input Servo Drivers Not Conforming to Any Standards

Item			R88D-UA02H(A)	R88D-UA03H(A)	R88D-UA04H(A)	R88D-UA08H(A)	R88D-UA12H(A)	R88D-UA20H(A)
Continuous output current (0-P)			0.6 A	0.85 A	1.2 A	2.8 A	3.7 A	6.2 A
Momentary max. output current (0-P)			1.8 A	2.7 A	4.0 A	8.5 A	11.3 A	19.7 A
Input power supply			Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz					
Control method			All-digital servo					
Speed feedback		INC	Optical encoder, 2,048 pulses/revolution					
		ABS	Optical encoder, 1,024 pulses/revolution					
Applicable load inertia		INC	Maximum of 30 times motor's rotor inertia				Maximum of 20 times motor's rotor inertia	
		ABS	Maximum of 20 times motor's rotor inertia			Maximum of 25 times motor's rotor inertia	Maximum of 20 times motor's rotor inertia	Maximum of 18 times motor's rotor inertia
Inverter method			PWM method based on IGBT					
PWM frequency			11 kHz					7.8 kHz
Applicable Servomotor		INC	R88M-U03030H(A)	R88M-U05030H(A)	R88M-U10030H(A)	R88M-U20030H(A)	R88M-U40030H(A)	R88M-U75030H(A)
		ABS	R88M-U03030T(A)	R88M-U05030T(A)	R88M-U10030T(A)	R88M-U20030T(A)	R88M-U40030T(A)	R88M-U75030T(A)
Applicable Servomotor wattage			30 W	50 W	100 W	200 W	400 W	750 W
Weight			Approx. 0.9 kg				Approx. 1.2 kg	Approx. 1.5 kg
Heating value			15 W	18 W	20 W	35 W	45 W	60 W
Capacity	Speed control range		1:5,000					
	Load fluctuation rate		0.1% at 0 to 100% (at rated rotation speed)					
	Voltage fluctuation rate		0% at input voltage of 170 to 253 VAC					
	Temperature fluctuation rate		±0.2% max. at 0 to +50°C					
	Frequency characteristics		250 Hz (HA/LA/V/W Models), 150 Hz (H/L Models) (at the same load as the rotor inertia)					
	Torque control reproducibility		±2.0%					
	Acceleration/deceleration time settings		0 to 10 s (Set separately for acceleration and deceleration.)					
Input signal	Speed command voltage		±2 to 10 VDC (Forward motor rotation by +command) / rated rotation speed Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs					
	Torque command voltage		±1 to 10 VDC / rated torque Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs					
	Sequence input		24-VDC, 5-mA photocoupler input, external power supply: 24±1 VDC, 50 mA min.					
Output signal	Position feedback output		A-, B-, Z-phase line driver output (EIA RS-422A) INC: A-phase and B-phase (dividing rate setting): 16 to 2,048 pulses/revolution ABS: A-phase and B-phase (dividing rate setting): 16 to 1,024 pulses/revolution Z-phase: 1 pulse/revolution					
	Speed monitor output		0.5 V/1,000 r/min					
	Current monitor output		0.5 V/100%					
	Sequence output		Alarm output, alarm code output, motor rotation detection, brake interlock, speed conformity, open collector output, 30 VDC, 50 mA (except for alarm code output, which is 30 VDC, 20 mA)					

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Item		R88D-UA02H(A)	R88D-UA03H(A)	R88D-UA04H(A)	R88D-UA08H(A)	R88D-UA12H(A)	R88D-UA20H(A)
External regeneration processing	INC	Required for regeneration of more than 30 times the motor's rotor inertia.				Required for regeneration of more than 20 times the motor's rotor inertia.	
	ABS	Required for regeneration of more than 20 times the motor's rotor inertia.			Required for regeneration of more than 25 times the motor's rotor inertia.	Required for regeneration of more than 20 times the motor's rotor inertia.	Required for regeneration of more than 18 times the motor's rotor inertia.
Protective functions		Overcurrent, grounding, overload, overvoltage, overspeeding, A/D errors, transmission errors, encoder errors, overrun prevention					

■ 100-VAC Input Servo Drivers Conforming to UL/cUL Standards and 100-VAC Input Servo Drivers Not Conforming to Any Standards

Item		R88D-UA03L(A)	R88D-UA04L(A)	R88D-UA10L(A)	R88D-UA12L(A)	R88D-UA15LA
Continuous output current (0-P)		0.9 A	1.3 A	3.1 A	3.8 A	4.8 A
Momentary maximum output current (0-P)		2.8 A	4.1 A	10 A	12 A	15 A
Input power supply		Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz				
Control method		All-digital servo				
Speed feedback	INC	Optical encoder, 2,048 pulses/revolution				
	ABS	Optical encoder, 1,024 pulses/revolution				
Applicable load inertia	INC	Maximum of 30 times motor's rotor inertia				20 times max.
	ABS	Maximum of 20 times motor's rotor inertia			25 times max.	20 times max.
Inverter method		PWM method based on IGBT				
PWM frequency		11 kHz				7.8 kHz
Applicable Servomotor	INC	R88M-U03030L(A)	R88M-U05030L(A)	R88M-U10030L(A)	R88M-U20030L(A)	R88M-U30030LA
	ABS	R88M-U03030S(A)	R88M-U05030S(A)	R88M-U10030S(A)	R88M-U20030S(A)	R88M-U30030SA
Applicable Servomotor wattage		30 W	50 W	100 W	200 W	300 W
Weight		Approx. 0.9 kg			Approx. 1.2 kg	Approx. 1.5 kg
Heating value		17 W	20 W	30 W	47 W	70 W
Capacity	Speed control range	1:5,000				
	Load fluctuation rate	0.1% at 0 to 100% (at rated rotation speed)				
	Voltage fluctuation rate	0% at input voltage of 85 to 127 VAC				
	Temperature fluctuation rate	±0.2% max. at 0 to +50°C				
	Frequency characteristics	250 Hz (HA/LA/V/W Models), 150 Hz (H/L Models) (at the same load as the rotor inertia)				
	Torque control reproducibility	±2.0%				
	Acceleration/deceleration time settings	0 to 10 s (Set separately for acceleration and deceleration.)				

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Item			R88D-UA03L(A)	R88D-UA04L(A)	R88D-UA10L(A)	R88D-UA12L(A)	R88D-UA15LA
Input signal	Speed command voltage		±2 to 10 VDC (Forward motor rotation by +command) / rated rotation speed Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs				
	Torque command voltage		±1 to 10 VDC / rated torque Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs				
	Sequence input		24-VDC, 5-mA photocoupler input, external power supply: 24±1 VDC, 50 mA min.				
Output signal	Position feedback output		A-, B-, Z-phase line driver output (EIA RS-422A) INC: A-phase and B-phase (dividing rate setting): 16 to 2,048 pulses/revolution ABS: A-phase and B-phase (dividing rate setting): 16 to 1,024 pulses/revolution Z-phase: 1 pulse/revolution				
	Speed monitor output		0.5 V/1,000 r/min				
	Current monitor output		0.5 V/100%				
	Sequence output		Alarm output, alarm code output, motor rotation detection, brake interlock, speed conformity, open collector output, 30 VDC, 50 mA (except for alarm code output, which is 30 VDC, 20 mA)				
External regeneration processing		INC	Required for regeneration of more than 30 times the motor's rotor inertia.				Required for regeneration of more than 20 times the motor's rotor inertia.
		ABS	Required for regeneration of more than 20 times the motor's rotor inertia.			Required for regeneration of more than 25 times the motor's rotor inertia.	Required for regeneration of more than 20 times the motor's rotor inertia.
Protective functions			Overcurrent, grounding, overload, overvoltage, overspeeding, A/D errors, transmission errors, encoder errors, overrun prevention				

■ 200-VAC Input Type, Models Conforming to EC Directives

Item		R88D-UA02V	R88D-UA03V	R88D-UA04V	R88D-UA08V	R88D-UA12V	R88D-UA20V
Continuous output current (0-P)		0.6 A	0.85 A	1.2 A	2.8 A	3.7 A	6.2 A
Momentary maximum output current (0-P)		1.8 A	2.7 A	4.0 A	8.5 A	11.3 A	19.7 A
Input power supply		Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz					
Control method		All-digital servo					
Speed feedback	INC	Optical encoder, 2,048 pulses/revolution					
	ABS	Optical encoder, 1,024 pulses/revolution					
Applicable load inertia	INC	Maximum of 30 times motor's rotor inertia				Maximum of 20 times motor's rotor inertia	
	ABS	Maximum of 20 times motor's rotor inertia			Maximum of 25 times motor's rotor inertia	Maximum of 20 times motor's rotor inertia	Maximum of 18 times motor's rotor inertia
Inverter method		PWM method based on IGBT					
PWM frequency		11 kHz					7.8 kHz
Applicable Servomotor	INC	R88M-U03030VA	R88M-U05030VA	R88M-U10030VA	R88M-U20030VA	R88M-U40030VA	R88M-U75030VA
	ABS	R88M-U03030XA	R88M-U05030XA	R88M-U10030XA	R88M-U20030XA	R88M-U40030XA	R88M-U75030XA
Applicable Servomotor wattage		30 W	50 W	100 W	200 W	400 W	750 W
Weight		Approx. 0.9 kg				Approx. 1.2 kg	Approx. 1.5 kg
Heating value		15 W	18 W	20 W	35 W	45 W	60 W

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Item			R88D-UA02V	R88D-UA03V	R88D-UA04V	R88D-UA08V	R88D-UA12V	R88D-UA20V
Capacity	Speed control range		1:5,000					
	Load fluctuation rate		0.1% at 0 to 100% (at rated rotation speed)					
	Voltage fluctuation rate		0% at input voltage of 170 to 253 VAC					
	Temperature fluctuation rate		±0.2% max. at 0 to +50°C					
	Frequency characteristics		250 Hz (at the same load as the rotor inertia)					
	Torque control reproducibility		±2.0%					
	Acceleration/deceleration time settings		0 to 10 s (Set separately for acceleration and deceleration.)					
Input signal	Speed command voltage		±2 to 10 VDC (Forward motor rotation by +command) / rated rotation speed Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs					
	Torque command voltage		±1 to 10 VDC / rated torque Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs					
	Sequence input		24-VDC, 5-mA photocoupler input, external power supply: 24±1 VDC, 50 mA min.					
Output signal	Position feedback output		A-, B-, Z-phase line driver output (EIA RS-422A) INC: A-phase and B-phase (dividing rate setting): 16 to 2,048 pulses/revolution ABS: A-phase and B-phase (dividing rate setting): 16 to 1,024 pulses/revolution Z-phase: 1 pulse/revolution					
	Speed monitor output		0.5 V/1,000 r/min					
	Current monitor output		0.5 V/100%					
	Sequence output		Alarm output, alarm code output, motor rotation detection, brake interlock, speed conformity, open collector output, 30 VDC, 50 mA (except for alarm code output, which is 30 VDC, 20 mA)					
External regeneration processing		INC	Required for regeneration of more than 30 times the motor's rotor inertia.				Required for regeneration of more than 20 times the motor's rotor inertia.	
		ABS	Required for regeneration of more than 20 times the motor's rotor inertia.			Required for regeneration of more than 25 times the motor's rotor inertia.	Required for regeneration of more than 20 times the motor's rotor inertia.	Required for regeneration of more than 18 times the motor's rotor inertia.
Protective functions			Overcurrent, grounding, overload, overvoltage, overspeeding, A/D errors, transmission errors, encoder errors, overrun prevention					

■ 100-VAC Input Type, Models Conforming to EC Directives

Item		R88D-UA03W	R88D-UA04W	R88D-UA10W	R88D-UA12W	R88D-UA15W
Continuous output current (0-P)		0.9 A	1.3 A	3.1 A	3.8 A	4.8 A
Momentary maximum output current (0-P)		2.8 A	4.1 A	10 A	12 A	15 A
Input power supply		Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz				
Control method		All-digital servo				
Speed feedback	INC	Optical encoder, 2,048 pulses/revolution				
	ABS	Optical encoder, 1,024 pulses/revolution				
Applicable load inertia	INC	Maximum of 30 times motor's rotor inertia				20 times max.
	ABS	Maximum of 20 times motor's rotor inertia			25 times max.	20 times max.

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Item			R88D-UA03W	R88D-UA04W	R88D-UA10W	R88D-UA12W	R88D-UA15W
Inverter method			PWM method based on IGBT				
PWM frequency			11 kHz				7.8 kHz
Applicable Servomotor		INC	R88M-U03030WA	R88M-U05030WA	R88M-U10030WA	R88M-U20030WA	R88M-U30030WA
		ABS	R88M-U03030YA	R88M-U05030YA	R88M-U10030YA	R88M-U20030YA	R88M-U30030YA
Applicable Servomotor wattage			30 W	50 W	100 W	200 W	300 W
Weight			Approx. 0.9 kg			Approx. 1.2 kg	Approx. 1.5 kg
Heating value			17 W	20 W	30 W	47 W	70 W
Capacity	Speed control range		1:5,000				
	Load fluctuation rate		0.1% at 0 to 100% (at rated rotation speed)				
	Voltage fluctuation rate		0% at input voltage of 85 to 127 VAC				
	Temperature fluctuation rate		±0.2% max. at 0 to +50°C				
	Frequency characteristics		250 Hz (at the same load as the rotor inertia)				
	Torque control reproducibility		±2.0%				
	Acceleration/deceleration time settings		0 to 10 s (Set separately for acceleration and deceleration.)				
Input signal	Speed command voltage		±2 to 10 VDC (Forward motor rotation by +command) / rated rotation speed Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs				
	Torque command voltage		±1 to 10 VDC / rated torque Input impedance: Approx. 30 kΩ; circuit time constant: Approx. 47 μs				
	Sequence input		24-VDC, 5-mA photocoupler input, external power supply: 24±1 VDC, 50 mA min.				
Output signal	Position feedback output		A-, B-, Z-phase line driver output (EIA RS-422A) INC: A-phase and B-phase (dividing rate setting): 16 to 2,048 pulses/revolution ABS: A-phase and B-phase (dividing rate setting): 16 to 1,024 pulses/revolution Z-phase: 1 pulse/revolution				
	Speed monitor output		0.5 V/1,000 r/min				
	Current monitor output		0.5 V/100%				
	Sequence output		Alarm output, alarm code output, motor rotation detection, brake interlock, speed conformity, open collector output, 30 VDC, 50 mA (except for alarm code output, which is 30 VDC, 20 mA)				
External regeneration processing		INC	Required for regeneration of more than 30 times the motor's rotor inertia.				Required for regeneration of more than 20 times the motor's rotor inertia.
		ABS	Required for regeneration of more than 20 times the motor's rotor inertia.			Required for regeneration of more than 25 times the motor's rotor inertia.	Required for regeneration of more than 20 times the motor's rotor inertia.
Protective functions			Overcurrent, grounding, overload, overvoltage, overspeeding, A/D errors, transmission errors, encoder errors, overrun prevention				

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5-1-3 I/O Specifications

■ Terminal Block Specifications, Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards

Signal	Function	Condition	
R T	Power supply input	R88D-UA□□H(A) (200-VAC Units): Single-phase 200/230 VAC (170 to 253 VAC) 50/60 Hz R88D-UA□□L(A) (100-VAC Units): Single-phase 100/115 VAC (85 to 127 VAC) 50/60 Hz	
P N	Main circuit DC output	These are the connection terminals for the Regeneration Unit (R88A-RG08UA). Connect these when the regeneration energy is high.	
U	Servomotor U-phase output	Red	These are the terminals for outputs to the Servomotor.
V	Servomotor V-phase output	White	
W	Servomotor W-phase output	Blue	
⏚	Frame ground	Green	This is the connection terminal. Use a 100 Ω or less (class-3) or better ground. It is used in common for Servomotor output and power supply input.

■ Terminal Block Specifications, Models Conforming to EC Directives

Signal	Function	Condition	
L1 L2	Power supply input	R88D-UA□□V (200-VAC Units): Single-phase 200/230 VAC (170 to 253 VAC) 50/60 Hz R88D-UA□□W (100-VAC Units): Single-phase 100/115 VAC (85 to 127 VAC) 50/60 Hz	
+ –	Main circuit DC output	When using multiple axes and there is excessive regenerative energy, the + terminals can be connected together and the – terminals can be connected together to increase the regeneration absorption capacity.	
U	Servomotor U-phase output	Red	These are the terminals for outputs to the Servomotor.
V	Servomotor V-phase output	White	
W	Servomotor W-phase output	Blue	
⏚	Protective earth terminal	Green	This is the connection terminal. Use a 100 Ω or less (class-3) or better ground.

■ CN1: Control I/O Specifications (Same for All Models)

● CN1: Control Input

Pin No.	Signal name	Function	Contents
1	TREF	Torque command input	±1 to ±10 V / rated torque Changeable by means of user parameter Cn-13 torque command scale.
2	AGND	Torque command input ground	

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Pin No.	Signal name	Function	Contents
3	REF	Speed command input	±2 to ±10 V / rated torque Changeable by means of user parameter Cn-03 speed command scale.
4	AGND	Speed command input ground	
5	SEN (ABS) (see note)	Sensor ON input	ON: Supplies 5 V to the absolute encoder. This signal is not used when setup parameter Cn-01 bit no. 1 = 1.
6	SENGND (ABS) (see note)	Sensor ON input ground	
11	PCL/SPD1	Forward rotation current limit input / Speed selection command 1 input	Forward/reverse rotation current limit (PCL/NCL) when setup parameter Cn-02 bit no. 2 = 0. (ON: Current limit) Internal setting speed (Cn-1F, 20, 21) selector switch when setup parameter Cn-02 bit no. 2 = 1.
12	NCL/SPD2	Reverse rotation current limit input / Speed selection command 2 input	
13	+24VIN	+24-V power supply input for control DC	Power supply for pin nos. 11, 12, 14, 15, 16, 17, 18; +24-V input
14	RUN	Run command input	ON: Servo ON, when setup parameter Cn-01 bit no. 0 = 0. When setup parameter Cn-01 bit no. 0 = 1, this signal is not used. (Automatically set to Servo ON.)
15	MING	Gain deceleration input	ON: Decrease speed loop gain, when setup parameter Cn-01 bit nos. b, A = 0, 0.
	PLOCK	Position lock command input	When setup parameter Cn-01 bit nos. b, A = 0, 1, then, when this bit is ON, position lock goes in effect if the motor rotation speed is no more than the position lock rotation speed (Cn-0F).
	TVSEL	Torque / Speed control switch input	When setup parameter Cn-01 bit nos. b, A = 1, 1, then, when this bit is ON, the mode changes from the torque command (TREF) mode to the speed command (REF) mode. When in torque command mode, speed command (REF) inputs become forward/reverse rotation speed limits.
	RDIR	Rotation direction command inputs	When setup parameter Cn-02 bit no. 2 = 1, this is the rotation direction command for internal speed settings 1 to 3. (OFF: Forward rotation, ON: Reverse rotation)
16	POT	Forward drive prohibit input	Forward rotation overtravel input (OFF when prohibited). When setup parameter Cn-01 bit no. 2 = 1, this signal is not used.
17	NOT	Reverse drive prohibit input	Reverse rotation overtravel input (OFF when prohibited). When setup parameter Cn-01 bit no. 3 = 1, this signal is not used.
18	RESET	Alarm reset input	ON: Servo alarm status is reset.
28	BAT (ABS) (see note)	Backup battery + input	The backup battery connection terminals used when power is not supplied to an absolute encoder.
29	BATGND (ABS) (see note)	Backup battery – input	

Note Do not connect pins 5, 6, 26, 27, 28, and 29 unless a motor with an absolute encoder is used.

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• CN1: Control Output (Common to Models Conforming to UL/cUL Standards, Models Not Conforming to Any Standards, and Models Conforming to EC Directives)

Pin No.	Signal name	Function	Contents
7	BKIR	Brake interlock output	Outputs external brake interlock signal.
8	VCMP	Speed conformity output	Output when the Servomotor rotation speed conforms to the speed command.
9	TGON	Servomotor rotation detection output	When setup parameter Cn-01 bit no. 4 = 0, this turns ON if the Servomotor rotation speed exceeds the value set for the Servomotor rotation detection speed (Cn-0b).
	CLIMT	Current limit detection output	When bit 4 of setup parameter Cn-01 is set to "1," the CLIMT signal will turned ON in any of the following 3 cases: • The output torque reaches the value set for the torque limit (Cn-08, -09) • The forward/reverse rotation current limit (PCL/NCL) is ON and the output torque reaches the external current limit set in Cn-18 or Cn-19. • The output torque reaches the analog current limit input (TREF). HA/LA/V/W Models (When bit F of Cn-02 is 1)
10	OGND	Output ground common	Output ground common for pins 7, 8, and 9.
19	EGND	Encoder signal output GND	This is the ground for encoder signal outputs.
20	+A	Encoder A-phase + output	Outputs encoder pulses divided according to user parameter Cn-0A. Line driver output (conforming to RS-422A).
21	–A	Encoder A-phase – output	
22	–B	Encoder B-phase – output	Outputs encoder pulses divided according to user parameter Cn-0A. Line driver output (conforming to RS-422A).
23	+B	Encoder B-phase + output	
24	+Z	Encoder Z-phase + output	Encoder Z-phase output (1 pulse/revolution). Line driver output (conforming to RS-422A).
25	–Z	Encoder Z-phase – output	
26	+ABS (ABS) (see note 1)	Absolute encoder signal + output	A serial data output for the rotation amount (conforming to RS-422A).
27	–ABS (ABS) (see note 1)	Absolute encoder signal – output	
30	ALO1	Alarm code output 1	When an alarm is generated for the Servo Driver, the contents of the alarm are output in a 3-bit code. Open collector output: 30 VDC, 20 mA max.
31	ALO2	Alarm code output 2	
32	ALO3	Alarm code output 3	
33	ALOCOM	Alarm code output GND	
34	$\overline{\text{ALM}}$	Alarm output	When an alarm is generated for the Servo Driver, the output is OFF. Open collector output.
35	ALMCOM	Alarm output GND	
36	FG (see note 2)	Frame ground	Ground terminal for shield wire of cable and FG line.

Note 1. Do not connect pins 5, 6, 26, 27, 28, and 29 unless a motor with an absolute encoder is used.

Note 2. Pin 36 is not used on models conforming to EC Directives. Instead, connect the cable shield to the connector plug and ground it directly using a clamp.

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● Connectors Used (36P)

Sumitomo 3M	Receptacle at Servo Driver	10236-52A2JL
	Soldered plug at cable side	10136-3000VE
	Case at cable side	10336-52A0-008

● Pin Arrangement

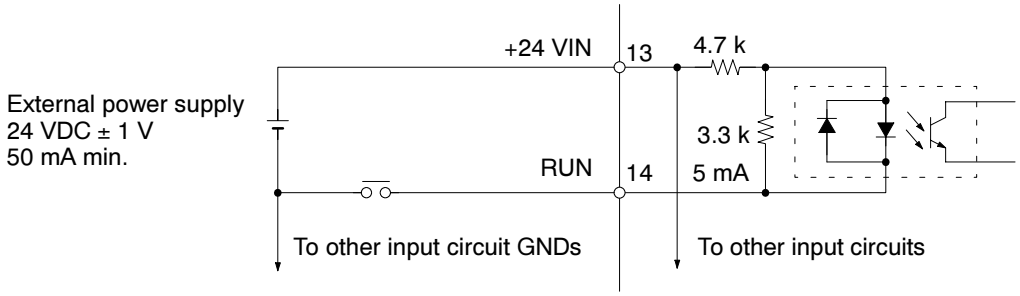
2	AGND	Torque command input GND	1	TREF	Torque command input	20	+A	Encoder A-phase + output	19	EGND	Encoder signal output GND
4	AGND	Speed command input GND	3	REF	Speed command input	22	–B	Encoder B-phase – output	21	–A	Encoder A-phase – output
6	SENGND	Sensor ON input ground	5	SEN	Sensor ON input	24	+Z	Encoder Z-phase + output	23	+B	Encoder B-phase + output
8	VCMP	Speed conformity output	7	BKIR	Brake interlock output	26	+ABS	Absolute encoder signal + output	25	–Z	Encoder Z-phase – output
10	OGND	Output ground common	9	TGON/ CLIMT	Motor rotation detection, current control detection	28	BAT	Backup battery + input	27	–ABS	Absolute encoder signal – output
12	NCL/ SPD2	Reverse rotation current limit input	11	PCL/ SPD1	Forward rotation current limit input	30	ALO1	Alarm code output 1	29	BATGND	Backup battery – input
14	RUN	Run command input	13	+24VIN	Control DC +24-V input	32	ALO3	Alarm code output 3	31	ALO2	Alarm code output 2
16	POT	Forward rotation drive prohibit input	15	MING/ PLOCK/ TVSEL/ RDIR	Gain deceleration, position lock, torque/speed control, rotation direction	34	$\overline{\text{ALM}}$	Alarm output	33	ALOCOM	Alarm code output GND
18	RESET	Alarm reset input	17	NOT	Reverse rotation drive prohibit input	36	FG	Frame ground (see note)	35	ALMCOM	Alarm output GND

Note Pin 36 is not used on models conforming to the EC Directives.

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■ Control Input Interface

The input circuit for the control I/O connector (CN1) is as shown in the following diagram.



● Run Command (14: RUN)

This is the input that turns on the power drive circuit for the main circuit of the Servo Driver. If this signal is not input (i.e., servo-off status), the Servomotor cannot operate. Depending on the setting of setup parameter Cn-01, bit no. 0, this signal can be bypassed. In that case, the servo will be turned on after the power is turned on.

● Gain Reduction, Position Lock Command, Torque and Speed Control Changes, Rotation Direction Command (15: MING/PLOCK/TVSEL/RDIR)

This input signal switches among the following four kinds of signals according to the settings of bit numbers b and A of the setup parameter Cn-01 and Cn-02 bit 2.

- **Gain Reduction (15: MING; Setup Parameter Cn-01, Bit Nos. b, A = 0, 0)**
  Input this signal to lower the loop gain for the control loop, and to weaken servo rigidity (repellant force with respect to external force). If position control is executed without including a position loop, there may be some position deviation due to temperature drift from a device such as the A/D converter. In such a case, if a gain reduction is input, the loop gain of the speed loop will be lowered and the amount of drift will be decreased. If there is static friction torque on the load (5% or more of the rated torque), the Servomotor will completely stop.

  In addition, if a position loop is included, when parts are inserted after positioning, the insertion operation is made easier because the repellant force with respect to external force is weakened by the inputting of this signal. This cannot be used for the vertical shaft where a gravity load is applied, because position deviation will occur.

- **Position Lock Command (15: PLOCK; Setup Parameter Cn-01, Bit Nos. b, A = 0, 1)**
  If position control is executed without including a position loop, there may be some position deviation due to temperature drift from a device such as the A/D converter. In such a case, if this signal is input, when the Servomotor rotation speed is less than the rotation speed set for the position lock rotation speed (user parameter Cn-0F), the mode changes from speed control mode to position control mode. The Servomotor goes into position lock status and completely stops. This function can be used even for the vertical shaft where a gravity load is applied.

- **Torque and Speed Control Changes (15: TVSEL; Setup Parameter Cn-01, Bit Nos. b, A = 1, 1)**
  In torque control mode II, this signal becomes the torque and speed control change input. When this signal is input, the mode changes from the torque control mode to the speed control mode. When in torque control mode, the speed command signal (REF) becomes the forward/reverse speed limit input. The Servomotor rotation speed, however, does not necessarily conform to the speed limit value.

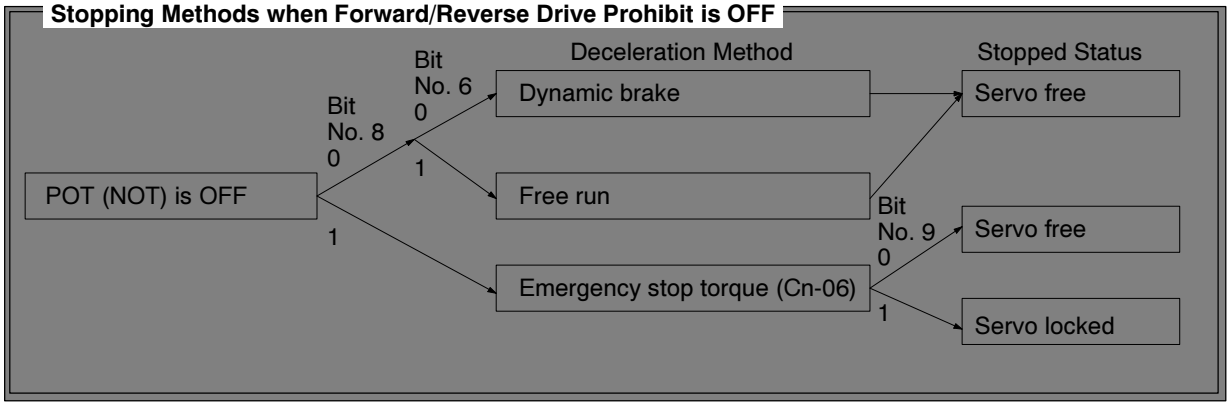
- **Rotation Direction Command (15: RDIR; Setup Parameter Cn-02, Bit No. 2 = 1)**
  This signal becomes the rotation direction change command for when operation is carried out at the internally set speed (no. 1 through no. 3 internally set speeds). When this signal is not input, the rotation direction is forward; when it is input, the direction is reverse.

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● Forward/Reverse Drive Prohibit (16/17: POT/NOT)

The forward/reverse drive prohibits are valid for sequence input signal switching when the following settings have been made.
Forward Drive Prohibit (16: POT): Cn-01 bit No. 2 = 0
Reverse Drive Prohibit (17: NOT): Cn-01 bit No. 3 = 0

These two signals are the inputs for forward and reverse drive prohibit (overtravel). When they are input, driving is possible in the respective directions. When driving is prohibited, movement will stop according to the settings of bits nos. 6, 8, and 9 of setup parameter no. 1 (Cn-01). Alarm status will not be generated at the Driver. When drive prohibit is not used, clear the function by connecting the respective signal to the external power supply +24-V GND or setting setup parameter Cn-01, bit nos. 2, 3 = 1,1.



Note When torque control is being used, the stop method is determined by the status of bit 6. (The status of bit 8 is irrelevant.)

● Forward/Reverse Rotation Current Limit [11, 12: (PCL/SPD1), (NCL/SPD2)]

These input signals switch between the forward/reverse current limit and the speed selection command signal for the internally set speed, depending on the setting of setup parameter Cn-02 bit no. 2. Set the required functions for using it.

- **Forward/Reverse Rotation Current Limit (11, 12: PCL, NCL)**
  When setup parameter Cn-02 bit no. 2 = 0, these input signals become respectively the forward rotation current limit and the reverse rotation current limit, and they limit the current to the Servomotor. The current limit values can be set for the respective directions by means of user parameters Cn-18 and 19. The set values can be set for up to the maximum output current as 100% of the rated output current.
- **Speed Selection Command (11, 12: SPD1, SPD2)**
  When setup parameter Cn-02 bit no. 2 = 1, these input signals become the speed selection command 1 and the speed selection command 2. Depending on the combination, the Servomotor speed can be controlled according to the internally set speeds, nos. 1 through 3, which are set in user parameter Cn-1F, 20, 21. At that time, the CN1-15 pin becomes the rotation direction command (RDIR).

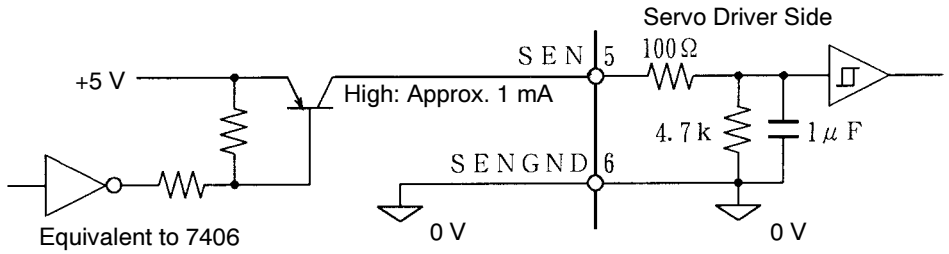
● Alarm Reset (18: RESET)

This is the external reset signal input for the servo alarm. Remove the cause of the alarm and then restart operation. In order to prevent danger, either set the speed command to 0 V or turn OFF the run command before inputting the reset signal.

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● Sensor ON Input/Input Ground (5/6: SEN/SENGND) (Absolute Encoders)

The SEN signal input circuit is shown below.



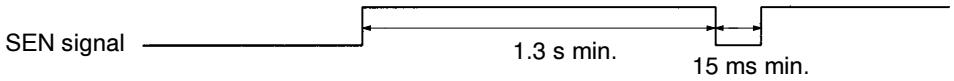
• A PNP transistor is recommended.

• Signal Levels High: 4 V min.
Low: 0.7 V max.

When the SEN signal turns ON (low to high), 5 V is supplied to the absolute encoder. When power is not supplied to the motor (Run command input OFF) and the SEN signal is turned OFF (high to low), the 5 V to the absolute encoder is cut off.

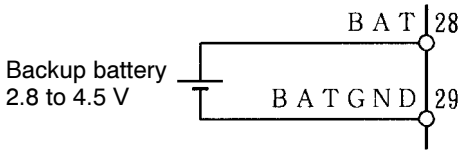
The SEN signal is ignored while power is supplied to the motor even if it is turned OFF.

Power cannot be supplied to the motor even if the Run command is received unless the SEN signal is ON. Power will also not be supplied to the motor between the time that the SEN signal turns ON and the encoder achieves normal operation even if the Run command is received. Do not turn ON the SEN signal for at least 3 s after turning on the power supply. Refer to the chart below to turn the SEN signal ON, OFF, and ON again.



● Backup Battery +/– Input (28/29: BAT/BATGND) (Absolute Encoders)

The backup battery connection diagram is shown below.



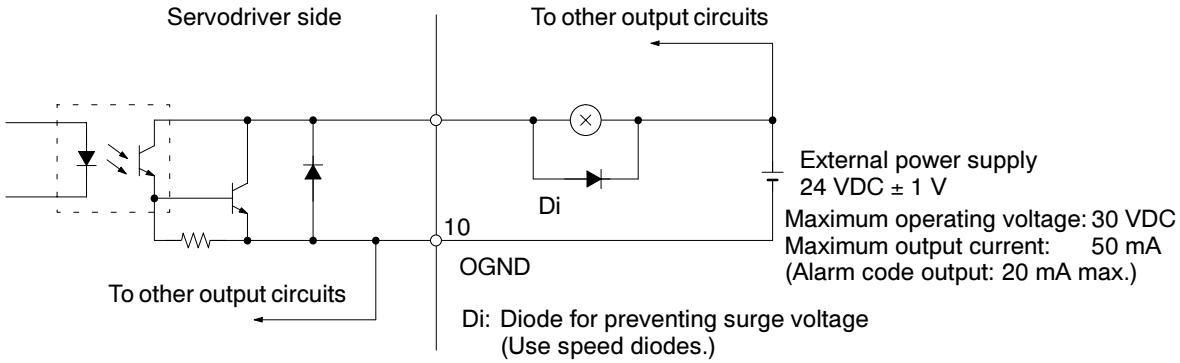
These are the connection terminals for the battery that backs up the absolute encoder when power is not supplied. The voltage is 2.8 to 4.5 V.

A battery is not provided with the motor or drives. The user must provide one.

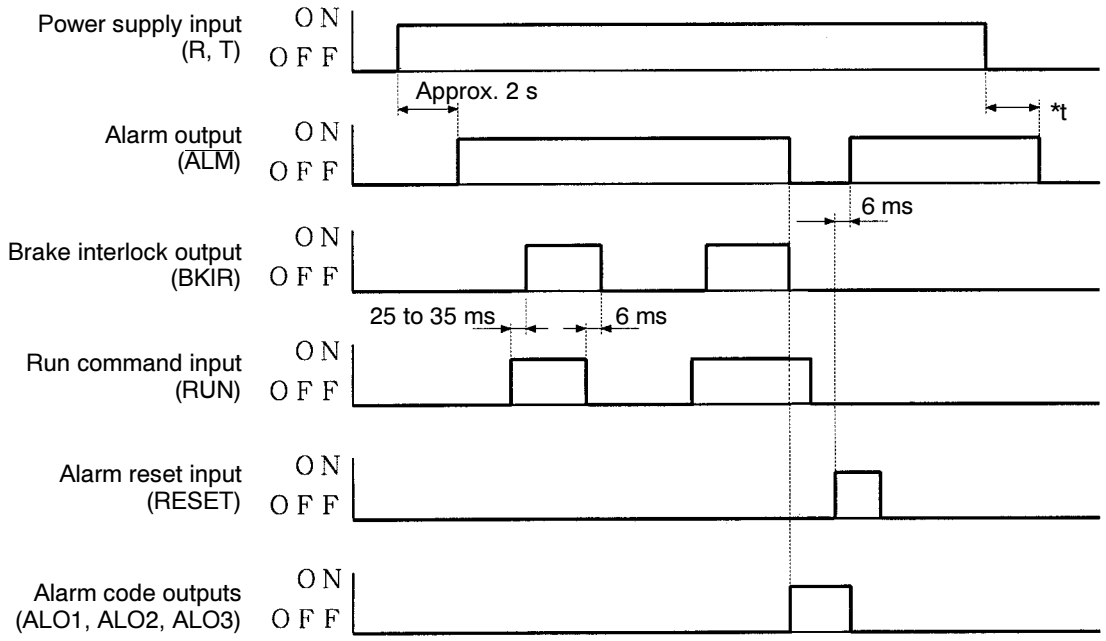
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■ Control Output Interface

The output circuit for the control I/O connector (CN1) is as shown in the following diagram.



● Control Output Sequence



*t = Approx. 6 s: R88D-UA02H(A)/-UA03H(A)/-UA03L(A)
R88D-UA02V/-UA03V/-UA03W
Approx. 10 s: R88D-UA04H(A)/-UA08H(A)/-UA12H(A)
R88D-UA04L(A)/-UA10L(A)/-UA12L(A)
R88D-UA04V/-UA08V/-UA12V
R88D-UA04W/-UA10W/-UA12W
Approx. 15 s: R88D-UA20H(A)/-UA15L(A)
R88D-UA20V/-UA15W

● Brake Interlock (7: BKIR)

This outputs the external brake timing signal set in Cn-12, 15, and 16. Refer to *3-5-9 Brake Interlock (For Motors with Brakes)* for details.

● Speed Conformity (8: VCMP)

This is output when the speed difference between the speed command and the rotation speed is equal to or less than the value set for the speed conformity signal output range (user parameter Cn-22). If the

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speed command is for 3,000 r/min and the set value is for 50 r/min, it is output in the range from 2,950 to 3,050.

● Motor Rotation Detection (9: TGON/CLIMIT)

This output switches between the Servomotor rotation detection output signal and the current limit detection signal depending on the setting of setup parameter Cn-01 bit no. 4.

- **Motor Rotation Detection (9: TGON; Setup Parameter Cn-01 Bit No. 4 = 0)**
  Outputs when the motor rotation speed equals or exceeds the value set for user parameter Cn-0b (rotation speed for motor rotation detection).
- **Current Limit Detection (9: CLIMIT; Setup Parameter Cn-01 Bit No. 4 = 1)**
  The CLIMT signal will turned ON in any of the following 3 cases:
  - The output torque reaches the limit value set in user parameter Cn-08 or Cn-09 (the forward and reverse rotation torque limits).
  - The forward/reverse rotation current limit (PCL/NCL) is ON and the output torque reaches the limit value set in user parameter Cn-18 or Cn-19.
  - The output torque is limited by the analog voltage input through TREF. (HA/LA/V/W Models)

● Alarm Output/Alarm Output Ground (34/35: $\overline{\text{ALM}}$/ALMCOM)

When the Servo Driver detects an error, outputs are turned OFF. At that time, an alarm code (see below) is output according to the contents of the error. This output is OFF at the time of powering up, and turns ON when the power-up processing is completed.

● Alarm Code Outputs 1 to 3 and Alarm Code Output Ground (30, 31, 32: AL01 to AL03 and 33: ALOCOM)

When a Servo Driver error is generated, the contents of the error are output in 3-bit code. For details, refer to *4-4-1 Alarm Displays and Alarm Code Outputs*.

● Encoder A-, B-, and Z-phase Outputs (20, 21: +A, -A; 23, 22: +B, -B, 24, 25: +Z, -Z) and Absolute Encoder Signal +/– Outputs (26/27: +ABS/–ABS) (Absolute Encoders)

Servomotor encoder signals are output as divided phase-difference pulses according to the user parameter encoder divider rate setting (Cn-0A). The output form is line driver output, and conforms to EIA-RS-422A. Receive with a line receiver or high-speed photocoupler.

The absolute data is output when the SEN signal is input (low to high). It is first output as serial data starting with the A phase and then it is output as the initial incremental pulses for the A and B phases (or 90° differential phase pulses). The output then switches to that of a normal incremental encoder (90° differential phase pulses).

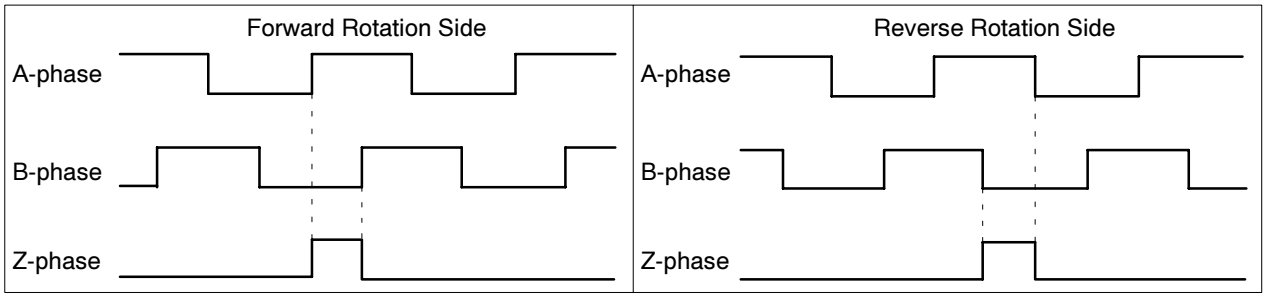
The absolute encoder outputs as serial data the rotation amount and the absolute position within the rotation.

The normal incremental encoder signal (A and B phases) is output approximately 400 ms after the SEN signal is input.

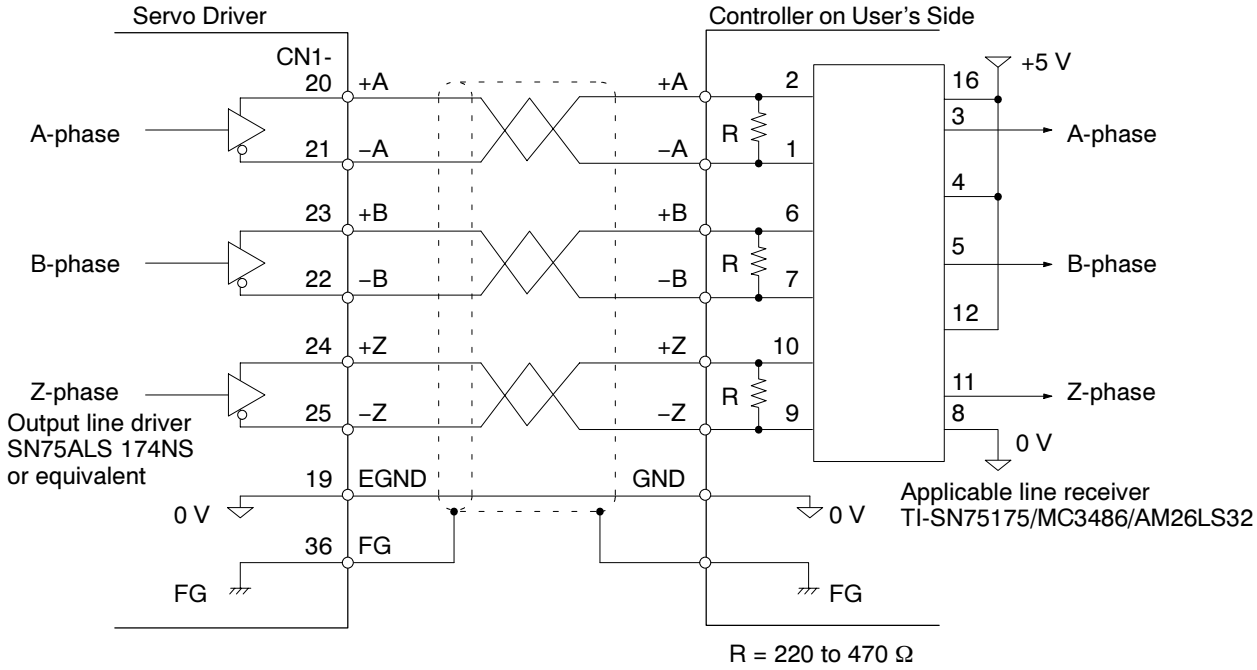
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Incremental Encoders

• Output Phase (When Encoder Divider Rate Setting is 2,048)

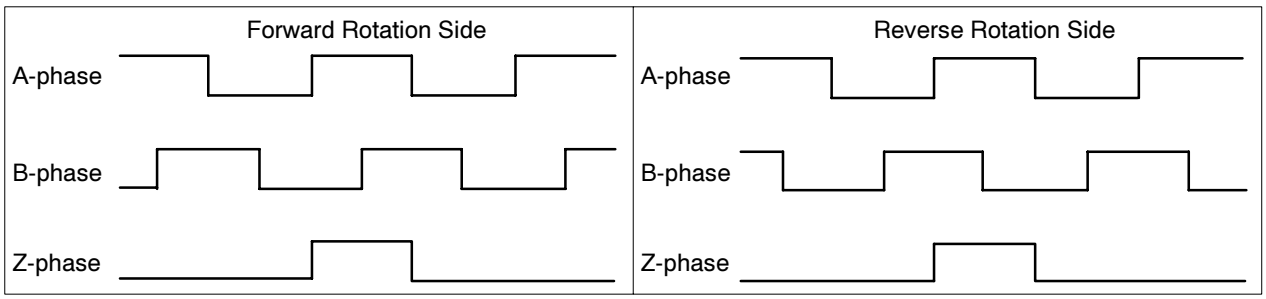


• Output Circuit and Receiving Circuit



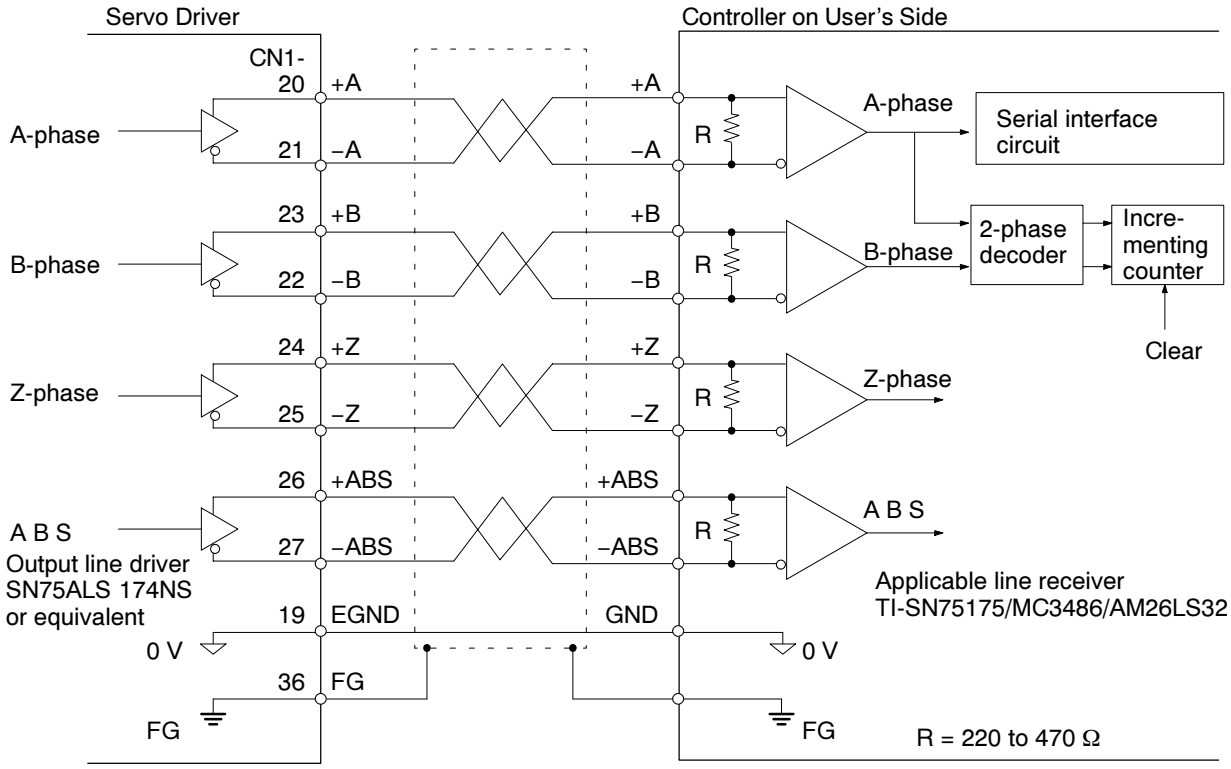
Absolute Encoders

• Output Phase (When Encoder Divider Rate Setting is 1,024)



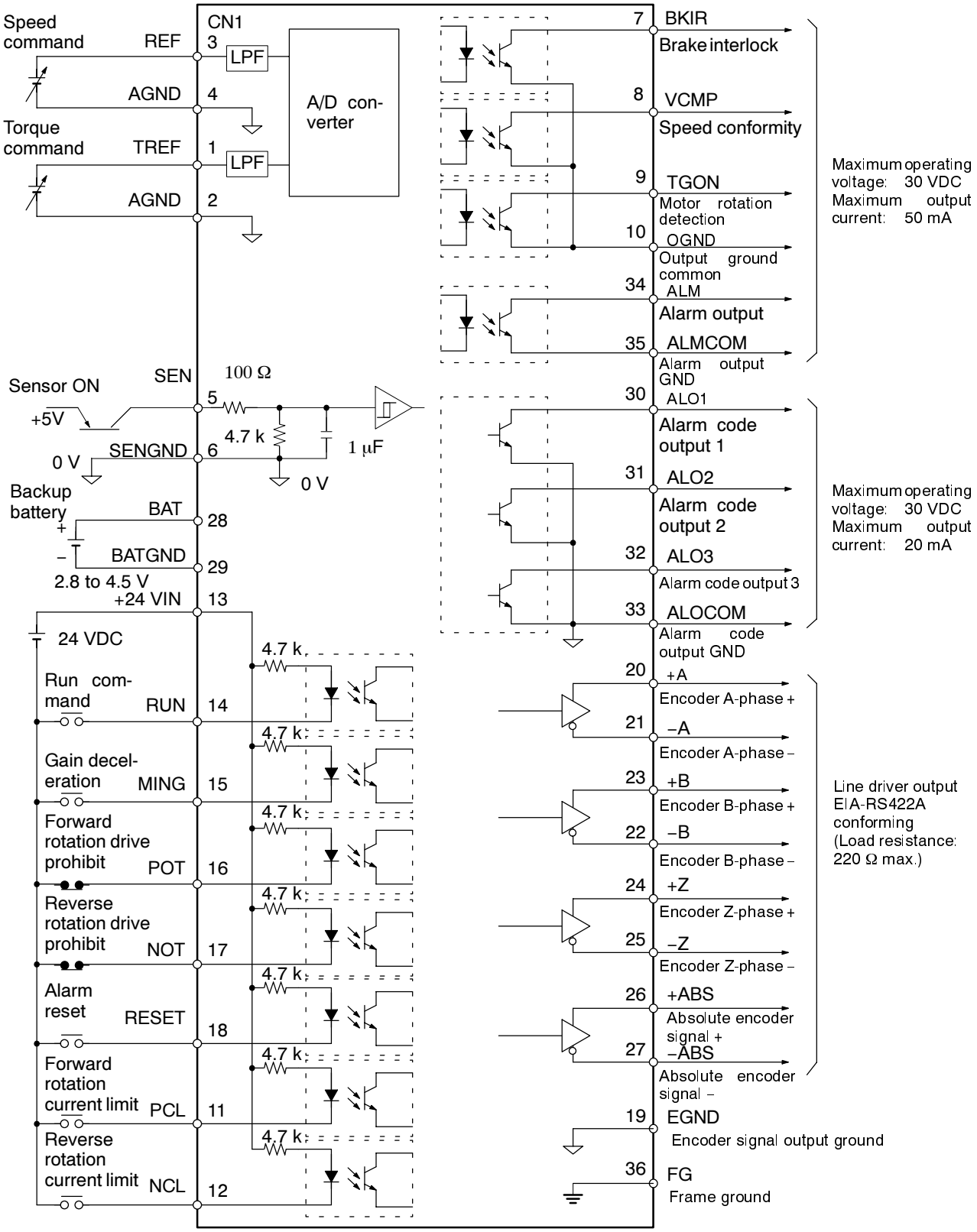
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- **Output Circuit and Receiving Circuit**



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■ Control I/O Signal Connections and External Signal Processing



Note 1. Pins 5, 6, 26, 27, 28, and 29 are used with an absolute encoder.

Note 2. Pin 36 is not used with models conforming to EC Directives.

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■ CN2: Encoder Input Specifications

Pin No.	Signal name	Function	Interface
1, 2, 3	E0V	Encoder power supply GND	Power supply outlet for encoder: 5 V, 120 mA
4, 5, 6	E5V	Encoder power supply +5 V	
7	DIR	Rotation direction switch input	Connects to GND when reverse rotation is executed by + input.
8 (see note 1)	ABS+	Absolute encoder signal + input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
9 (see note 1)	ABS–	Absolute encoder signal – input	
10, 11	NC	Not used	Do not connect.
12 (see note 1)	BAT+	Battery +	Backup power supply input for the encoder. 3.6 V, 16 μA during backup or when operation is stopped, 2 μA when 5 V is supplied
13 (see note 1)	BAT–	Battery –	
14 (see note 2)	S(Z)+	Encoder + S(Z)-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
15 (see note 2)	S(Z)–	Encoder – S(Z)-phase input	
16	A+	Encoder + A-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
17	A–	Encoder – A-phase input	
18	B+	Encoder + B-phase input	Line driver input (conforming to EIA-RS422A) (Input impedance: 220 Ω)
19	B–	Encoder – B-phase input	
20 (see note 3)	FG	Shielded ground	Cable shielded ground

Note 1. These terminals are used for an absolute encoder.

Note 2. This is the S phase for incremental encoders and the Z phase for absolute encoders.

Note 3. Pin 20 is not used on models conforming to EC Directives. Instead, connect the cable shield to the connector plug and ground it directly using a clamp.

● Connectors Used

Sumitomo 3M	Receptacle at Servo Driver	10220-52A2JL
	Soldered plug at cable side	10120-3000VE
	Case at cable side	10320-52A0-008

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● Pin Arrangement

2	E0V	Encoder power supply ground GND
4	E5V	Encoder power supply +5 V
6	E5V	Encoder power supply +5 V
8	ABS+ (see note 1)	Absolute encoder signal + input
10	NC	

1	E0V	Encoder power supply ground GND
3	E0V	Encoder power supply ground GND
5	E5V	Encoder power supply +5 V
7	DIR	Rotation direction switch input
9	ABS– (see note 1)	Absolute encoder signal – input

12	BAT+ (see note 1)	Battery +
14	S+ (Z+)	Encoder + S(Z)-phase input
16	A+	Encoder + A-phase input
18	B+	Encoder + B-phase input
20	FG (see note 2)	Frame ground

11	NC	
13	BAT– (see note 1)	Battery –
15	S– (Z–)	Encoder – S(Z)-phase input
17	A–	Encoder – A-phase input
19	B–	Encoder – B-phase input

Note 1. These pins are used for an absolute encoder.

Note 2. This pin is not used for models conforming to EC Directives.

● Rotation Direction Change (7: DIR)

To set up the mechanical configuration so that a + voltage input causes reverse rotation instead of forward rotation, this terminal can be connected to the GND terminal for any of pins 1 through 3. This function carries out the same operation by means of setting setup parameter Cn-02 bit no. 0 to "1." Use this to prevent runaway when replacing the Servo Driver.

When the rotation direction is changed, the encoder A-phase and B-phase output phases are also changed. When not set, + voltage is for forward rotation and A-phase advance; when set, + voltage if for reverse rotation and A-phase advance (and - voltage is for forward rotation and B-phase advance). Therefore wiring changes are unnecessary for encoder signals to the position controller.

● Absolute Encoder Signals (8/9: ABS+/ABS–) (Absolute Encoders) and Encoder Pulse Input Signals (14 to 19: A-, B-, S-phase (INC), Z-phase (ABS))

Inputs signals output from the Servomotor encoder. In S-phase, servo sensor U-, V-, W-, and Z-phase are transmitted according to A- and B-phase logic.

The absolute encoder signals transmit as serial data the rotation amount and the absolute position with a rotation.

● Encoder Power Supply GND/5 V (1, 2, 3/4, 5, 6: EOV/E5V)

Outputs +5.2 ±0.1 V as the power supply for the Servomotor encoder. The encoder power supply cannot be used for other purposes.

● Battery +/– (12/13: BAT+/BAT–) (Absolute Encoders)

Outputs the backup battery power supply for the encoder.

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■ CN3: Parameter Unit Input Specifications

Pin No.	Signal name	Function	I/O interface
1	TXD+	Transmission data +	This is data transmitted to a Parameter Unit (or a personal computer).
2	TXD–	Transmission data –	
3	RXD+	Reception data +	This is data received from a Parameter Unit (or a personal computer).
4	RXD–	Reception data –	
5	PRMU	Unit switching	This is the switching terminal for a Parameter Unit or personal computer. If the pin is open, it is for a personal computer. If connected to +5V, it is for a Parameter Unit.
6	RT1	Termination resistance enabled/disabled	This is the termination resistance terminal for the line receiver. For 1-to-1 communications or for the final Servo Driver, short-circuit RT1-RT2.
7	RT2		
8	+5V	+5 V output	This is the +5 V output to the Parameter Unit.
9	GND	Ground	

● Pin Arrangement

1	TXD+	Transmission data +	6	RT1	Termination resistance on/off
2	TXD–	Transmission data –	7	RT2	
3	RXD+	Reception data +	8	+5V	+5-V output
4	RXD–	Reception data –	9	GND	Ground
5	PRMU	Unit switching			

● Connectors Used (D-sub Connector, 9P)

Dai-ichi Denshi Kogyo	Socket at Servo Driver	17LE-13090-27 (D2BC)
	Soldered plug at cable side	17JE-23090-02 (D1)
	Cover at cable side	17JE-09H-15
OMRON	Soldered plug at cable side	XM2A-0901
	Cover at cable side	XM2S-0912

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■ CN4: Speed/Current Monitor Specifications

Pin No.	Signal name	Function	I/O interface
1	NM	Speed monitor output	Voltage output with a ratio of ±0.5 V/(1,000 r/min), centered at 0V. (–) voltage is forward, (+) voltage is reverse, and output accuracy is about ±10%.
2	AM	Current monitor output	Voltage output with a ratio of ±0.5 V / (rated torque), centered at 0V. (–) voltage is forward acceleration, (+) voltage is reverse acceleration. Output accuracy is about ±10%.
3, 4	GND	Output ground	This is the output ground mentioned above.

● Connectors Used (4P)

Hirose Electric	Pin header at Servo Driver	DF11-4DP-2DS
	Socket at cable side	DF11-4DS-2C
	Socket crimp terminal at cable side	DF11-2428 SC

5-1-4 Parameter Specifications

Refer to *3-5-2 Setting and Checking User Parameters (Cn-00 to 29)* for a table of user parameters and to *3-4-2 Setup Parameter Contents (Cn-01, 02)* for a table of setup parameters.

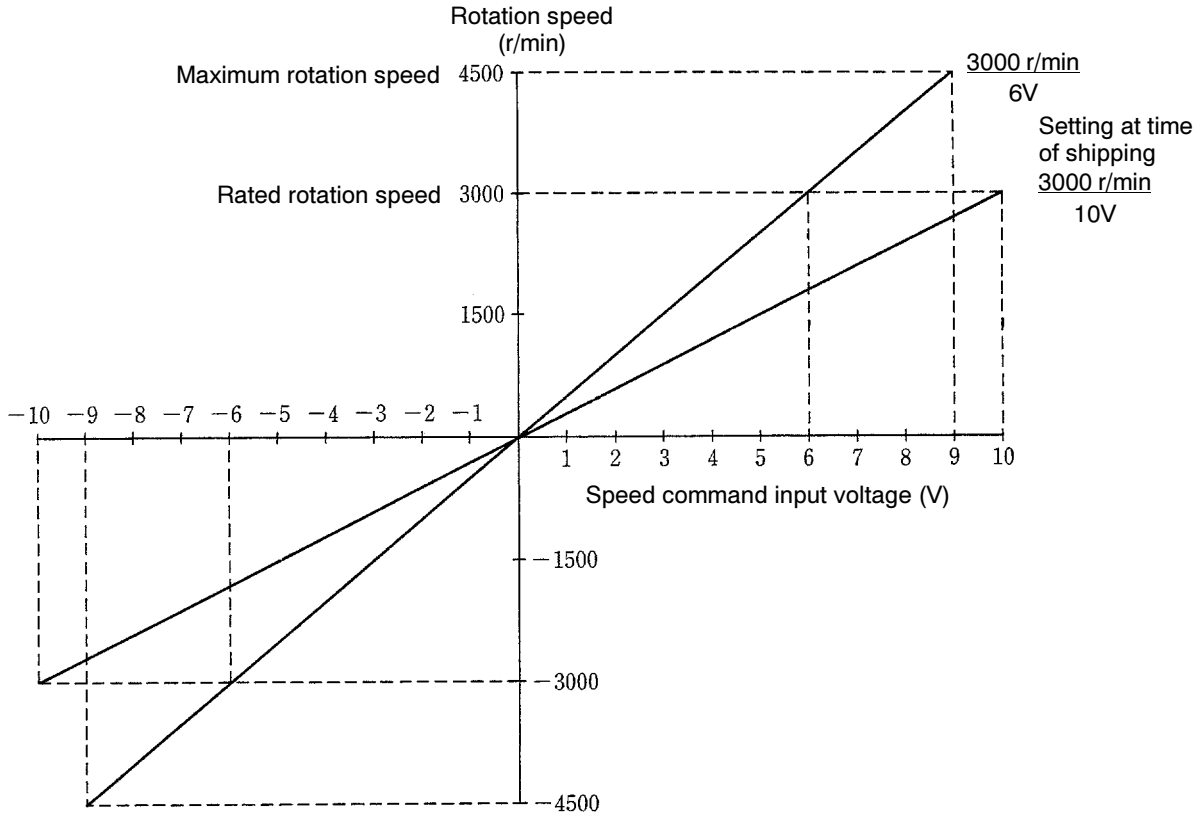
■ User Parameter Details

● Speed Command Scale: Cn-03

This is a constant for adjusting the motor rotation speed for the speed command input. The adjustable range is 0 to 2,162 (r/min/V). The factory setting is for 300 (r/min/V), with an input voltage of 10 V at

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3,000 r/min. This parameter is used as the positioning loop gain if a position controller is connected as the host.



● Speed Loop Gain: Cn-04

This is the proportional gain for the speed controller. The adjustable range is 1 to 2,000 Hz (the response frequency when equivalent inertia is used). As the number is increased, the gain is increased.

The factory setting is for 80 (Hz). Using the factory setting for the Servomotor alone or with a small load inertia will cause vibration to occur, so set the value to a maximum of 20 (Hz) for operation.

● Speed Loop Integration Time Constant: Cn-05

This is the integration time for the speed controller. The adjustable range is 2 to 10,000 (ms), and it is factory set to 20 (ms). As the number is increased, the gain is decreased.

The units for the time constant (1 ms or 0.01 ms) can be changed with bit b of Cn-02 (the speed integration constant's units). (HA/LA/V/W Models)

● Emergency Stop Torque: Cn-06

When setup parameter Cn-01 bit no. 8 = 1, this sets the braking torque for over-travel stopping (forward/reverse drive prohibit input operation). The setting range is 0 to the maximum torque (a percentage of the braking torque as 100% of the Servomotor rated torque). The factory setting is for the maximum torque.

● Software Start Acceleration Time: Cn-07
Software Start Deceleration Time: Cn-23

The Servomotor rotation acceleration time from 0 r/min to 4,500 r/min is set in Cn-07, and the deceleration time from 4,500 r/min to 0 r/min is set in Cn-23. The factory setting is for 0 (ms). When positioning is controlled by connecting a position controller, set it to 0 (ms).

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- **Forward Rotation Torque Control: Cn-08**
  Reverse Rotation Torque Control: Cn-09

The Servomotor output torque control value for forward rotation is set in Cn-08, and the value for reverse rotation is set in Cn-09. The setting range is 0 to the maximum torque, and the factory setting is for the maximum torque.

- **Encoder Dividing Rate Setting: Cn-0A**

The number of pulses detected (A- and B-pulses) per encoder revolution is converted to the number of pulses set for this parameter and output from the Servo Driver. The setting range is 16 to 2,048 pulses/revolution for incremental encoders and 16 to 1,024 pulses/revolution for absolute encoders. The factory setting is for 1,000 (pulses/revolution).

- **Rotation Speed for Servomotor Rotation Detection: Cn-0b**

This sets the rotation speed for detecting whether or not the Servomotor is rotating. The setting range is 1 to 4,500 r/min. When motor rotation detection has been set for the sequence output signal switch (Cn-01 bit 4 = 0), the Servomotor rotation detection output (TGON) is turned ON if the Servomotor rotational speed meets or exceeds this set value. The factory setting is for 20 (r/min).

- **P Control Switching (Torque Command): Cn-0C**
  P Control Switching (Speed Command): Cn-0d
  P Control Switching (Acceleration Command): Cn-0E

These set the various points for switching the speed controller from PI control to P control in order to moderate excessive characteristics when an operation such as acceleration or deceleration is executed accompanied by output saturation of the controller. These selections are made by setting the setup parameter Cn-01 bit nos. d and C.

- **Position Lock Rotation Speed: Cn-0F**

This sets the rotation speed for inducing position lock. The setting range is 0 to 4,500 r/min. This setting is used in the "speed control with position lock" control mode (bit 2 of Cn-02 = 0 and bits b and A of Cn-01 = 0 and 1) for all models. It is also used in the "internal speed control settings (position-lock when stopped)" control mode (bit 2 of Cn-02 = 1 and bit A of Cn-01 = 1) with HA/LA/V/W models. When the position lock command input (PLOCK) is ON and the motor's speed falls below this set value, operation switches from speed control to position control and the motor goes into position lock. (Operation automatically switches to position control and goes into position lock when the control mode is "internal speed control settings" and the motor's speed falls below this set value.) Position lock force is adjusted by means of position loop gain (Cn-1A). The factory setting is for 10 (r/min).

- **Jog Speed: Cn-10**

This sets the speed for manual operation. The setting range is 0 to 4,500 r/min. During manual operation, operating commands are given from the Parameter Unit. The factory setting is for 500 (r/min).

- **Number of Encoder Pulses: Cn-11**

This sets the number of pulses per revolution of a connected encoder. Set 2,048 for incremental encoders and 1,024 for absolute encoders. The Servomotor will not operate correctly if the setting is incorrect. The factory setting is for 2,048 (pulses/revolution).

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- **Brake Timing 1: Cn-12**
  Brake Command Speed: Cn-15
  Brake Timing 2: Cn-16

These parameters determine the output timing of the brake interlock signal (BKIR), which controls the electromagnetic brake.

Brake timing 1 sets the delay time from the time of brake interlock goes OFF until the servo turns off. The setting range is 0 to 50 (× 10 ms), and the factory setting is for 0 (× 10 ms).

The brake command speed is the speed (r/m) used to turn OFF the brake interlock. The setting range is 0 to 4,500 (r/m) and the factory setting is for 100 (r/m).

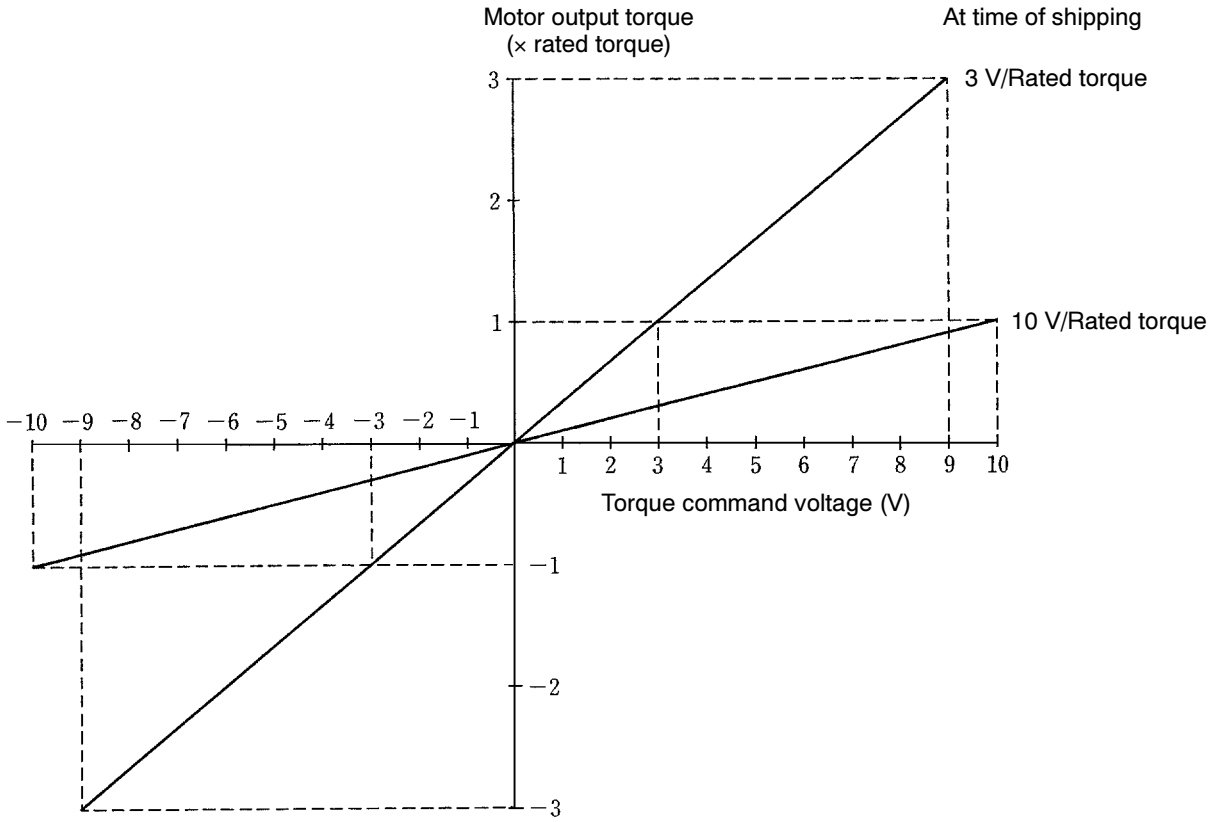
Brake timing 2 sets the wait time from when the servo goes OFF until the brake interlock goes OFF. The setting range is 10 to 100 (× 10 ms), and the factory setting is for 50 (× 10 ms).

If the run command turns off , a servo error occurs, or the main-circuit power supply turns off during operation of a Servomotor with a brake, the dynamic brake comes on (setup parameter Cn-01 bit no. 6 = 0) and Servomotor rotation speed is decreased. When the speed drops to the level of the value set for the brake command speed (Cn-15), the brake interlock output (BKIR: CN1-7) turns OFF.

Even if the speed does not drop to the level of the value set for the brake command speed (Cn-15), the brake interlock output (BKIR: CN1-7) turns OFF after the time set for brake timing 2 has elapsed. (This time setting is made for the purpose of preventing damage to machinery or the Servomotor holding brake.)

- **Torque Command Scale: Cn-13**

This sets the input voltage per rated torque for the torque command scale (TREF: CN1-1). The setting range is 10 to 100 (× 0.1 V/rated torque), and the factory setting is 30 (× 0.1 V/rated torque, for a setting of 3 V/rated torque).



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● Speed Limit: Cn-14

This limits the Servomotor rotation speed for torque control I (bit nos. b, A of Cn-01 = 1, 0 and bit no.2 of Cn-02 = 0) of the setup parameter no. 1 control mode selection. The setting range is 0 to 4,500 (r/min), and the factory setting is for 3,000 (r/min).

● Torque Command Filter Time Constant: Cn-17

This sets the low-pass filter time constant for the torque command. The setting range is 0 to 250 (× 100 μs), and the factory setting is 4 (× 100 μs).

The relationship between the filter time constant and the cut-off frequency can be found by means of the following formula:

fc (Hz) = 1 / (2πT) : T= Filter time constant

If T= 400 (μs), fc will be approximately 400 (Hz).

When the characteristic vibration of the machinery is within the response frequency of the servo loop, Servomotor vibration will occur. In order to prevent this sympathetic vibration based on the characteristic vibration of the machinery, set the torque filter time constant to a value that will eliminate the vibration (i.e., set it to a high value).

● Forward Rotation External Current Limit: Cn-18
Reverse Rotation External Current Limit: Cn-19

These set the Servomotor output torque limits for the forward and reverse directions. They are valid when the forward/reverse current limits (PCL/NCL) are input. This function can't be used when the control mode is "internal speed control settings." The setting range is 0 to the maximum torque, and the factory setting is for the 100 (%).

● Position Loop Gain: Cn-1A

Set this parameter according to the rigidity of the mechanical system.

This adjusts the servo-lock force for position lock. The setting range is 1 to 500 (l/s), and the factory setting is 40 (l/s). If the value is set too high, the servo lock will be too strong. Set a small value if there is vibration during position lock.

● No. 1 Internal Speed Setting: Cn-1F (Factory Setting: 100 r/min)
No. 2 Internal Speed Setting: Cn-20 (Factory Setting: 200 r/min)
No. 3 Internal Speed Setting: Cn-21 (Factory Setting: 300 r/min)

Make these settings to control speeds by means of internal settings. The setting range is 0 to 4,500 (r/min). For details, refer to *3-5-3 Setting Internal Speed Control*.

● Speed Conformity Signal Output Range: Cn-22

When the absolute value of the difference between the speed command and the Servomotor rotation speed (the speed deviation) is equal to or less than the set value, the speed conformity output (VCMP: CN1-8) turns ON. If the speed command is for 2,000 (r/min) and the speed conformity signal output range is 100 (r/min), then the speed conformity output (VCMP) turns ON when the Servomotor rotation speed is between 1,900 (r/min) and 2,100 (r/min). The setting range is 0 to 100 (r/min), and the factory setting is for 10 (r/min).

● Compensating Gain: Cn-28 (HA/LA/V/W Models)

This parameter is used to lower the speed loop gain according to the set value to output a large torque for motor deceleration or acceleration.

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Motor vibration can be reduced by increasing this setting. Also the positioning time can be reduced because the speed loop gain can be set to a higher value.

A time lag may affect motor acceleration and deceleration if the set value is too large.

Adjust the compensation gain after adjusting the speed loop gain with Cn-04 and the speed loop integral time constant with Cn-05.

The compensation gain may not be 100 due to the speed loop gain and speed loop integral time constant set with Cn-04 and Cn-05, in which case increasing the compensation gain will cause an error.

Make sure that the set value is 0 before performing auto-tuning. Proper gain adjustment may not be possible with auto-tuning if the set value is not 0.

• Unit Number Setting: Cn-29 (HA/LA/V/W Models)

This setting specifies the Servo Driver's unit number when communicating with a personal computer. Set the unit number to 0 when communicating with a single axis. Set the unit number from 1 to 14 when communicating with multiple axes; in this case, be sure not to use the same unit number for more than one Unit. The Servo Driver or personal computer might be damaged if the same unit number is used for more than one Unit. The setting range is 0 to 14, and the factory setting is 0. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details on the unit number setting.

5-2 Servomotor Specifications

5-2-1 General Specifications

Item	Specifications
Operating ambient temperature	0°C to 40°C
Operating ambient humidity	20% to 80% RH (with no condensation)
Storage ambient temperature	−10°C to 75°C
Storage ambient humidity	20% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	10 to 150 Hz in X, Y, and Z directions with 0.2-mm double amplitude; acceleration: 24.5 m/s^2 {2.5 G} max.; time coefficient: 8 min; 4 sweeps
Impact resistance	Acceleration 98 m/s^2 {10 G} max., in X, Y, and Z directions, three times
Insulation resistance	Between power line terminals and case: 10 MΩ min. (500 VDC megger)
Dielectric strength	Between power line terminals and case: 1,500 VAC for 1 min (10 mA max.) at 50/60 Hz (JEC 2121)
Run position	All directions
Insulation grade	Type A (JIS C4004): Models conforming to UL Standards Type B (JIS C4004): All models other than those in Type A
Structure	Totally-enclosed self-cooling
Protective structure	Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards: IP-42 (JEM1030) Models Conforming to EC Directives: IP-44 (IEC34-5) (excluding shaft opening) (Cannot be used in environment with water-soluble cutting fluids.)
Vibration grade	V-15 (JEC2121)
Mounting method	Flange-mounting

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Note 1. Vibration may be amplified due to sympathetic resonance of machinery, so use the Servomotor Driver under conditions which will not exceed 19.6 m/s^2 {2 G} over a long period of time.

Note 2. The above items reflect individual evaluation testing. The results may differ under compounded conditions.

Note 3. The Servomotor cannot be used in a misty atmosphere.

Note 4. The drip-proofing specifications for models conforming to UL/cUL Standards and models not conforming to any standards are special specifications covered by IP-44. (Models with drip-proof specifications provide drip-proofing on Servomotors with oil seals.)

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5-2-2 Performance Specifications

■ 200 VAC Specifications

Item		Unit	R88M -U03030H(A) -U03030T(A) -U03030VA -U03030XA	R88M -U05030H(A) -U05030T(A) -U05030VA -U05030XA	R88M -U10030H(A) -U10030T(A) -U10030VA -U10030XA	R88M -U20030H(A) -U20030T(A) -U20030VA -U20030XA	R88M -U40030H(A) -U40030T(A) -U40030VA -U40030XA	R88M -U75030H(A) -U75030T(A) -U75030VA -U75030XA
Rated output (see note)		W	30	50	100	200	400	750
Rated torque (see note)		N•m	0.095	0.159	0.318	0.637	1.27	2.39
		kgf•cm	0.974	1.62	3.25	6.49	13.0	24.3
Rated rotation speed		r/min	3,000	3,000	3,000	3,000	3,000	3,000
Momentary maximum rotation speed		r/min	4,500	4,500	4,500	4,500	4,500	4,500
Momentary maximum torque (see note)		N•m	0.29	0.48	0.96	1.91	3.82	7.10
		kgf•cm	2.92	4.87	9.75	19.5	39.0	72.9
Momentary maximum/ rated current ratio		%	310	317	322	300	308	316
Rated current (see note)		A (rms)	0.42	0.60	0.87	2.0	2.6	4.4
Momentary maximum current (see note)		A (rms)	1.3	1.9	2.8	6.0	8.0	13.9
Rotor inertia	INC	kg•m^2 (GD^2/4)	0.21×10^{-5}	0.26×10^{-5}	0.40×10^{-5}	1.23×10^{-5}	1.91×10^{-5}	6.71×10^{-5}
		kgf•cm•s^2	0.21×10^{-4}	0.27×10^{-4}	0.41×10^{-4}	1.26×10^{-4}	1.95×10^{-4}	6.85×10^{-4}
	ABS	kg•m^2 (GD^2/4)	0.46×10^{-5}	0.51×10^{-5}	0.65×10^{-5}	1.48×10^{-5}	2.16×10^{-5}	6.96×10^{-5}
		kgf•cm•s^2	0.47×10^{-4}	0.53×10^{-4}	0.67×10^{-4}	1.52×10^{-4}	2.21×10^{-4}	7.11×10^{-4}
Torque constant (see note)		N•m/A	0.255	0.286	0.408	0.355	0.533	0.590
		kgf•cm/A	2.60	2.92	4.16	3.62	5.44	6.01
Induced voltage constant (see note)		mV/ (r/min)	8.89	9.98	14.0	12.4	18.6	20.6
Power rate (see note)		kW/s	4.36	9.63	25.4	32.8	84.6	85.1
Mechanical time constant		ms	1.5	0.9	0.5	0.4	0.3	0.3
Winding resistance		Ω	15.8	9.64	6.99	1.34	1.23	0.45
Winding impedance		mH	23.1	16.9	13.2	7.2	7.9	5.7
Electrical time constant		ms	1.5	1.8	1.9	5.4	6.4	13
Weight	INC	kg	Approx. 0.3	Approx. 0.4	Approx. 0.5	Approx. 1.1	Approx. 1.7	Approx. 3.4
	ABS	kg	Approx. 0.45	Approx. 0.55	Approx. 0.65	Approx. 1.2	Approx. 1.8	Approx. 3.5

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Item	Unit	R88M -U03030H(A) -U03030T(A) -U03030VA -U03030XA	R88M -U05030H(A) -U05030T(A) -U05030VA -U05030XA	R88M -U10030H(A) -U10030T(A) -U10030VA -U10030XA	R88M -U20030H(A) -U20030T(A) -U20030VA -U20030XA	R88M -U40030H(A) -U40030T(A) -U40030VA -U40030XA	R88M -U75030H(A) -U75030T(A) -U75030VA -U75030XA
Corresponding Servo Driver		R88D -UA02H(A) -UA02V	R88D -UA03H(A) -UA03V	R88D -UA04H(A) -UA04V	R88D -UA08H(A) -UA08V	R88D -UA12H(A) -UA12V	R88D -UA20H(A) -UA20V

Note The values for torque and rotation speed characteristics, are the values at an armature winding temperature of 100°C, combined with the Servo Driver. Other values are at normal conditions (20°C, 65%). The maximum momentary torque is a reference value.

● AC Servomotor Heat Radiation Conditions

When an AC Servomotor is continuously operated at the rated conditions, a heat radiation plate equivalent to an rectangular aluminum plate of t6 × 250 mm is required at the Servomotor flange mounting area. (This is for horizontal mounting, with nothing around the Servomotor and no interference from heat convection currents.)

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■ 100 VAC Specifications

Item		Unit	R88M -U03030L(A) -U03030S(A) -U03030WA -U03030YA	R88M -U05030L(A) -U05030S(A) -U05030WA -U05030YA	R88M -U10030L(A) -U10030S(A) -U10030WA -U10030YA	R88M -U20030L(A) -U20030S(A) -U20030WA -U20030YA	R88M -U30030LA -U30030SA -U30030WA -U30030YA
Rated output (see note)		W	30	50	100	200	300
Rated torque (see note)		N•m	0.095	0.159	0.318	0.637	0.954
		kgf•cm	0.974	1.62	3.25	6.49	9.74
Rated rotation speed		r/min	3,000	3,000	3,000	3,000	3,000
Momentary maximum rotation speed		r/min	4,500	4,500	4,500	4,500	4,500
Momentary maximum torque (see note)		N•m	0.29	0.48	0.96	1.91	3.72
		kgf•cm	2.92	4.87	9.75	19.5	38.0
Momentary maximum/ rated current ratio		%	317	322	323	311	400
Rated current (see note)		A (rms)	0.63	0.9	2.2	2.7	3.7
Momentary maximum current (see note)		A (rms)	2.0	2.9	7.1	8.4	14.8
Rotor inertia	INC	kg•m^2 (GD^2/4)	0.21×10^{-5}	0.26×10^{-5}	0.40×10^{-5}	1.23×10^{-5}	1.91×10^{-5}
		kgf•cm•s^2	0.21×10^{-4}	0.27×10^{-4}	0.41×10^{-4}	1.26×10^{-4}	1.95×10^{-4}
	ABS	kg•m^2 (GD^2/4)	0.46×10^{-5}	0.51×10^{-5}	0.65×10^{-5}	1.48×10^{-5}	2.16×10^{-5}
		kgf•cm•s^2	0.47×10^{-4}	0.53×10^{-4}	0.67×10^{-4}	1.52×10^{-4}	2.21×10^{-4}
Torque constant (see note)		N•m/A	0.168	0.194	0.156	0.255	0.279
		kgf•cm/A	1.72	1.98	1.59	2.60	2.85
Induced voltage constant (see note)		mV/(r/min)	5.87	6.79	5.43	8.9	9.74
Power rate (see note)		kW/s	4.36	9.63	25.4	32.8	47.3
Mechanical time constant		ms	1.6	0.9	0.6	0.4	0.3
Winding resistance		Ω	7.22	4.34	1.22	0.706	0.435
Winding impedance		mH	9.7	6.9	2.0	4.0	2.3
Electrical time constant		ms	1.3	1.6	1.6	5.7	5.3
Weight	INC	kg	Approx. 0.3	Approx. 0.4	Approx. 0.5	Approx. 1.1	Approx. 1.7
	ABS	kg	Approx. 0.45	Approx. 0.55	Approx. 0.65	Approx. 1.2	Approx. 1.8
Corresponding Servo Driver			R88D -UA03L(A) -UA03W	R88D -UA04L(A) -UA04W	R88D -UA10L(A) -UA10W	R88D -UA12L(A) -UA12W	R88D -UA15LA -UA15W

Note The values for torque and rotation speed characteristics are the values at an armature winding temperature of 100°C, combined with the Servo Driver. Other values are at normal conditions (20°C, 65%). The maximum momentary torque is a reference value.

● AC Servomotor Heat Radiation Conditions

When an AC Servomotor is continuously operated at the rated conditions, a heat radiation plate equivalent to an rectangular aluminum plate of t6 × 250 mm is required at the Servomotor flange mounting area. (This is for horizontal mounting, with nothing around the Servomotor and no interference from heat convection currents.)

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■ Specifications for Servomotors with Magnetic Brakes

The magnetic brakes installed in Servomotors with brakes are status-holding brakes with non-magnetized operation. The magnetic brake is released when a magnetic current (24 VDC) is applied. The magnetic brake is not meant to be used for braking. Using it for braking will damage it. During Servomotor operation, be sure to release the magnetic brake by applying a magnetic voltage. The specifications for Servomotors with brakes are similar to those for Servomotors without brakes, so except for inertia and weight, the various constants are all the same.
Note: The inertia for magnetic brakes is the load inertia.

● Specifications for AC Servomotors With Brakes (Specifications in Common for 100 and 200 VAC)

Item		Unit	R88M -U03030□-B	R88M -U05030□-B	R88M -U10030□-B	R88M -U20030□-B	R88M -U30030□-B	R88M -U40030□-B	R88M -U75030□-B
Rotor inertia	INC	kg•m^2 (GD^2/4)	0.21 × 10^{-5}	0.26 × 10^{-5}	0.40 × 10^{-5}	1.23 × 10^{-5}	1.91 × 10^{-5}	1.91 × 10^{-5}	6.71 × 10^{-5}
		kgf•cm•s^2	0.21 × 10^{-4}	0.27 × 10^{-4}	0.41 × 10^{-4}	1.26 × 10^{-4}	1.95 × 10^{-4}	1.95 × 10^{-4}	6.85 × 10^{-4}
	ABS	kg•m^2 (GD^2/4)	0.46 × 10^{-5}	0.51 × 10^{-5}	0.65 × 10^{-5}	1.48 × 10^{-5}	2.16 × 10^{-5}	2.16 × 10^{-5}	6.96 × 10^{-5}
		kgf•cm•s^2	0.47 × 10^{-4}	0.53 × 10^{-4}	0.67 × 10^{-4}	1.52 × 10^{-4}	2.21 × 10^{-4}	2.21 × 10^{-4}	7.11 × 10^{-4}
Brake inertia		kg•m^2 (GD^2/4)	0.09 × 10^{-5}			0.58 × 10^{-5}			1.40 × 10^{-5}
		kgf•cm•s^2	0.09 × 10^{-4}			0.59 × 10^{-4}			1.43 × 10^{-4}
Total inertia	INC	kg•m^2 (GD^2/4)	0.30 × 10^{-5}	0.35 × 10^{-5}	0.49 × 10^{-5}	1.81 × 10^{-5}	2.49 × 10^{-5}	2.49 × 10^{-5}	8.11 × 10^{-5}
		kgf•cm•s^2	0.30 × 10^{-4}	0.36 × 10^{-4}	0.50 × 10^{-4}	1.85 × 10^{-4}	2.54 × 10^{-4}	2.54 × 10^{-4}	8.28 × 10^{-4}
	ABS	kg•m^2 (GD^2/4)	0.55 × 10^{-5}	0.60 × 10^{-5}	0.74 × 10^{-5}	2.06 × 10^{-5}	2.74 × 10^{-5}	2.74 × 10^{-5}	8.36 × 10^{-5}
		kgf•cm•s^2	0.56 × 10^{-4}	0.62 × 10^{-4}	0.76 × 10^{-4}	2.11 × 10^{-4}	2.80 × 10^{-4}	2.80 × 10^{-4}	8.54 × 10^{-4}
Weight	INC	kg	0.6	0.7	0.8	1.6	2.2	2.2	4.3
	ABS	kg	0.75	0.85	0.95	1.7	2.3	2.3	4.5
Magnetized voltage		V	24 VDC ±10% (No polarity)						
Power consumption		W (at 20°C)	6		6	6.5			6
Current consumption		A (at 20°C)	0.25		0.25	0.27			0.25
Static friction torque		N•m	0.2 min.		0.34 min.	1.5 min.			2.5 min.
		kgf•cm	2.0 min.		3.5 min.	15.0 min.			25.0 min.
Absorption time (see note 1)		ms	(40 max.)		(60 max.)	(100 max.)			(200 max.)
Release time (see note 1)		ms	(20 max.)		(30 max.)	(40 max.)			(50 max.)
Backlash		---	(±1°)						
Rating		---	Continuous						
Insulation grade		---	Type F (brake only)						

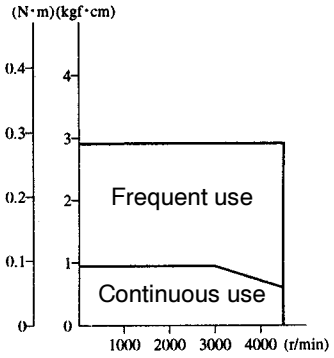
Note 1. The operation time measurement is the measured value with a surge killer (CR50500, by Okaya Electric Industrial Co.) installed.

Note 2. The items in parentheses are reference values.

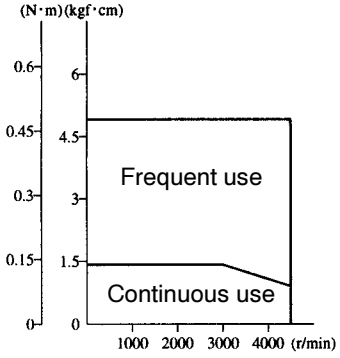
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■ Torque and Rotation Speed Characteristics (With 3-m Standard Cable and 200-VAC Input)

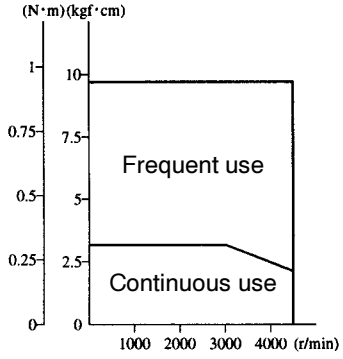
R88M-U03030H(A)/T(A)
R88M-U3030VA/XA



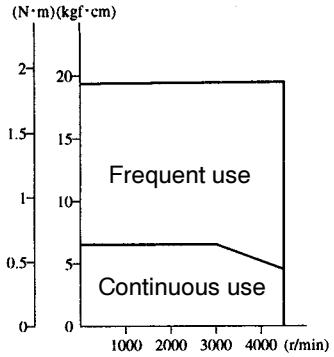
R88M-U05030H(A)/T(A)
R88M-U05030VA/XA



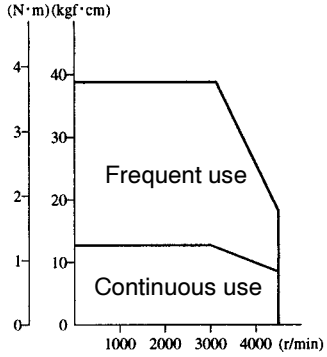
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R88M-U10030VA/XA



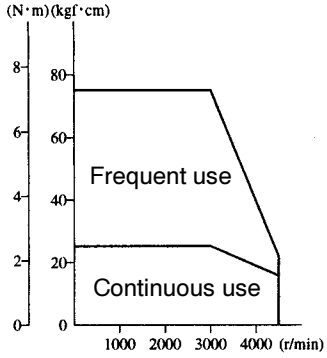
R88M-U20030H(A)/T(A)
R88M-U20030VA/XA



R88M-U40030H(A)/T(A)
R88M-U40030VA/XA



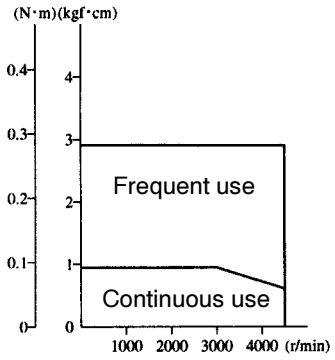
R88M-U75030H(A)/T(A)
R88M-U75030VA/XA



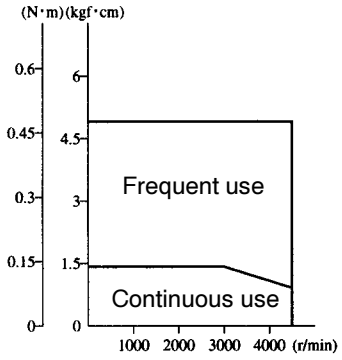
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■ Torque and Rotation Speed Characteristics (With 3-m Standard Cable and 100-VAC Input)

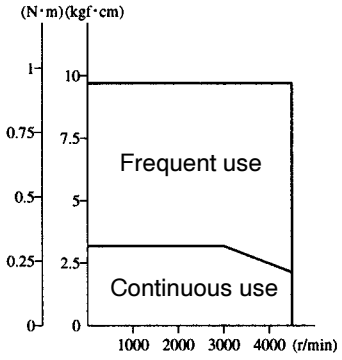
R88M-U03030L(A)/S(A)
R88M-U03030WA/YA



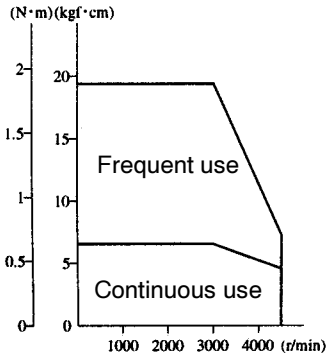
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R88M-U05030WA/YA



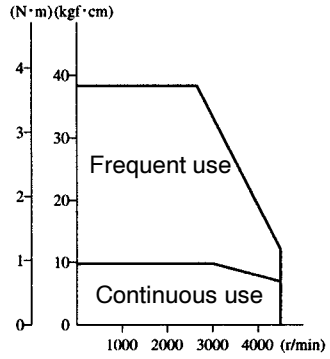
R88M-U10030L(A)/S(A)
R88M-U10030WA/YA



R88M-U20030L(A)/S(A)
R88M-U20030WA/YA



R88M-U30030LA/SA
R88M-U30030WA/YA



■ Servomotor and Mechanical System Temperature Characteristics

- U-series AC Servomotors use rare earth magnets (neodymium–iron magnets). The temperature coefficient for these magnets is approximately -0.13%/°C. As the temperature drops, the Servomotor's momentary maximum torque increases, and as the temperature rises the Servomotor's momentary maximum torque decreases. When the normal temperature of 20°C and -10°C are compared, the momentary maximum torque increases by approximately 4%. Conversely, when the magnet warms up to 80°C from the normal temperature of 20°C, the momentary maximum torque decreases by approximately 8%.
- Generally, in a mechanical system, when the temperature drops the friction torque increases and the load torque becomes larger. For that reason, overloading may occur at low temperatures. In particular, in systems which use deceleration devices, the load torque at low temperatures may be nearly twice the load torque at normal temperatures. Check with a current monitor to see whether overloading is occurring at low temperatures, and how much the load torque is. Likewise, check to see whether there abnormal Servomotor overheating or alarms are occurring at high temperatures.
- An increase in load friction torque visibly increases load inertia. Therefore, even if the Servo Driver parameters are adjusted at a normal temperature, there may not be optimal operation at low temperatures. Check to see whether there is optimal operation at low temperatures too.

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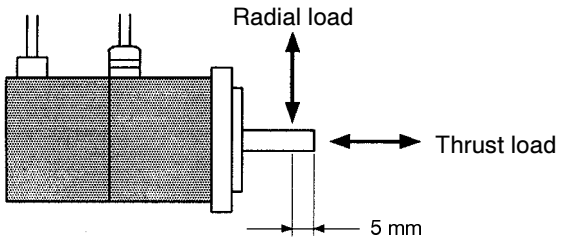
5-2-3 Allowable Loads on Servomotor Shafts

The allowable loads on Servomotor shafts are shown in the following table. Operate the Servomotor at no more than the allowable radial and thrust loads. At the time of assembly, assemble the Servomotor at no more than the momentary maximum radial and thrust loads (static pressure).

Servomotor	Momentary allowable radial load (static pressure)		Momentary allowable thrust load (static pressure)		Allowable radial load		Allowable thrust load	
	N	kgf	N	kgf	N	kgf	N	kgf
R88M-U03030□	186	19	127	13	68	7	54	5.5
R88M-U05030□	186	19	127	13	68	7	54	5.5
R88M-U10030□	186	19	127	13	78	8	54	5.5
R88M-U20030□	490	50	176	18	245	25	74	7.5
R88M-U30030□	490	50	176	18	245	25	74	7.5
R88M-U40030□	490	50	176	18	245	25	74	7.5
R88M-U75030□	735	75	392	40	392	40	147	15

Note 1. The allowable loads are the same for motors with brakes.

Note 2. The allowable radial load is the value at a point 5 mm from the end of the shaft.



Note 3. The allowable radial and thrust loads are values determined with a service life of 20,000 hours taken as a criteria.

Note 4. Absolutely do not impact the Servomotor or the output shaft by striking them with an implement such as a hammer. Doing so will damage the Servomotor and encoder bearings.

Note 5. The service life of bearing grease is 20,000 hours at a Servomotor ambient temperature of 40°C, and under the rated operating conditions.

Note 6. Make sure that the radial load is within the allowable range when there is a radial load applied. If the Servomotor is operated at more than the allowable radial load, the shaft may suffer damage due to fatigue.

Note 7. Applying an excessive load even once can damage the bearings and eventually cause a breakdown.

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5-2-4 Encoder Specifications

Item	Standards	
Encoder method	Optical incremental encoder	Optical absolute encoder
Number of output pulses	A, B phase: 2,048 pulses/revolution Z phase: 1 pulse/revolution	A, B phase: 1,024 pulses/revolution Z phase: 1 pulse/revolution
Maximum rotational amount	---	±99,999 revolution
Power supply voltage	5 VDC±5%	
Power supply current	DC, 350 mA (for load resistance of 220 Ω)	DC, 170 mA (for load resistance of 220 Ω)
Applicable battery voltage	---	3.6 VDC
Battery consumption current	---	16 μA during backup or when operation is stopped, 2 μA when 5 V is supplied
Phase characteristics	90° ±43.2°	90° ±36°
Phase relationship	For rotation in the CW direction, A phase is advanced by 90° compared to B phase.	
Maximum rotation speed	4500 r/min	
Maximum response frequency	153.6 kHz	76.8 kHz
Output signals	+A, −A, +B, −B, +S, −S	+A, −A, +B, −B, +Z, −Z
Output interface	Conforming to EIA RS-422A. Output based on AM26LS31CN or equivalent.	Conforming to EIA RS-422A. Output based on MC3487 or equivalent.
Serial communications data	Z phase, poll sensor, U, V, W phase	---
Serial communications method	Combination communications method based on A, B, and S phases.	---
Absolute value communications data	---	Rotation amount Absolute position within rotation

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5-3 Cable Specifications

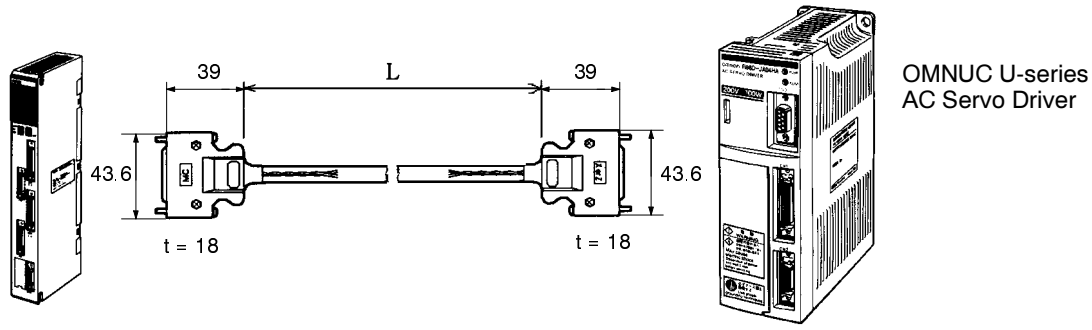
5-3-1 Controller Connecting Cable

■ Connecting Cables for Motion Control Units

● Types of Cable

Number of axes	Model	Length (L)	Outer diameter of sheath
1	R88A-CPU001M1	1 m	8.3 dia.
	R88A-CPU002M1	2 m	
2	R88A-CPU001M2	1 m	8.3 dia.
	R88A-CPU002M2	2 m	

● Connection Configuration (For 1 Axis)



CV500-MC221/421
C200H-MC221

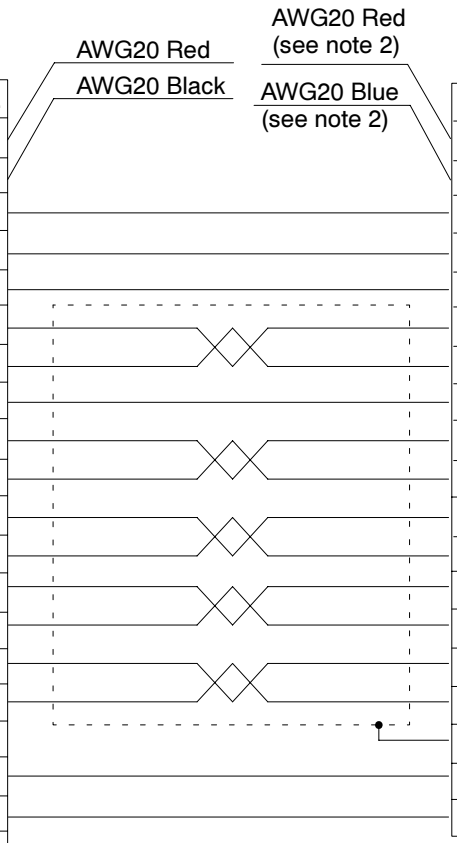
OMNUC U-series
AC Servo Driver

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● Wiring (For 1 Axis)

CV500-MC221/MC421, C200H-MC221

Signal	Insulation color/Marking color/ Marking	No.
+24 V		1
DCGND		2
XALM	White/Black –	3
XRUN	Pink/Black –	4
XAMLRS	Yellow/Black –	5
XSGND	Gray/Black –	8
XSOUT	Gray/Red –	9
X-GND	Orange/Black – –	10
X–A	White/Red –	11
X–$\overline{A}$	White/Black –	12
X–B	Yellow/Red –	13
X–$\overline{B}$	Yellow/Black –	14
X–Z	Pink/Red –	15
X–$\overline{Z}$	Pink/Black –	16
XOUT	Orange/Red –	17
XAGND	Orange/Black –	18
+F24 V	Orange/Black –	19
FDC GND	Gray/Black –	20
YALM		21
YRUN		22
YALMRS		23
YSGND		26
YSOUT		27
Y-GND		28
Y–A		29
Y–$\overline{A}$		30
Y–B		31
Y–$\overline{B}$		32
Y–Z		33
Y–$\overline{Z}$		34
YOUT		35
YAGND		36



No.	Signal	
28	BAT	See note 2
29	BATGND	See note 2
34	$\overline{ALM}$	
14	RUN	
18	RESET	
6	SENGND	See note 2
5	SEN	See note 2
19	EGND	
20	+A	
21	–A	
23	+B	
22	–B	
24	+Z	
25	–Z	
3	REF	
4	AGND	
Shell	FG	
13	+24VIN	
35	ALMCOM	

Connector plug:
10136-3000VE (Sumitomo 3M)
Connector case:
10336-52A0-008 (Sumitomo 3M)

Connector plug:
10136-3000VE (Sumitomo 3M)
Connector case:
10336-52A0-008 (Sumitomo 3M)

⚠ **Caution** The same model of connector is used at both ends of this Connecting Cable. Be sure to check the labels on the connector cases before connecting the Units because the Units could be damaged if the Connecting Cable is reversed.

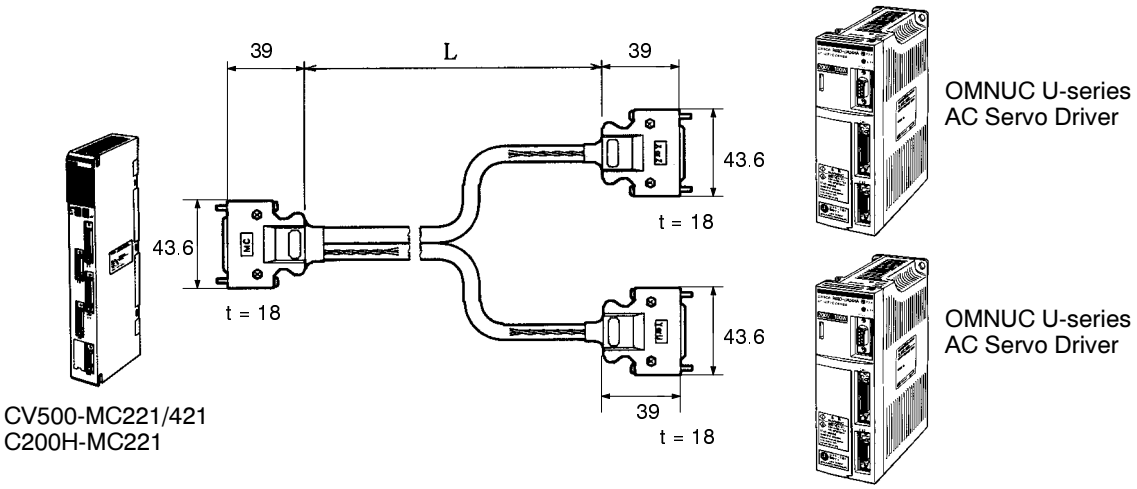
Note 1. The Controller's symbols are the DRVX-Y connector's symbols. In a DRVZ-U connector, X → Z and Y → U.

Note 2. These terminals and wires are used with Absolute Encoders.

Note 3. Supply 24 VDC to the two wires (black and red) that are taken out from the Controller's connector. (Red is + and black is –.)

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● Connection Configuration (For 2 Axes)



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● Wiring (For 2 Axes)

CV500-MC221/MC421, C200H-MC221

Signal	Insulation color/Marking color/Marking	No.
+24 V		1
DCGND		2
XALM	White/Black –	3
XRUN	Pink/Black –	4
XAMLRS	Yellow/Black –	5
XSGND	Gray/Black –	8
XSOUT	Gray/Red –	9
X-GND	Orange/Black – –	10
X–A	White/Red –	11
X–$\overline{A}$	White/Black –	12
X–B	Yellow/Red –	13
X–$\overline{B}$	Yellow/Black –	14
X–Z	Pink/Red –	15
X–$\overline{Z}$	Pink/Black –	16
XOUT	Orange/Red –	17
XAGND	Orange/Black –	18
+F24 V	Orange/Black –	19
FDC GND	Gray/Black –	20
YALM	White/Black –	21
YRUN	Pink/Black –	22
YALMRS	Yellow/Black –	23
YSGND	Gray/Black –	26
YSOUT	Gray/Red –	27
Y-GND	Orange/Black – –	28
Y–A	White/Red –	29
Y–$\overline{A}$	White/Black –	30
Y–B	Yellow/Red –	31
Y–$\overline{B}$	Yellow/Black –	32
Y–Z	Pink/Red –	33
Y–$\overline{Z}$	Pink/Black –	34
YOUT	Orange/Red –	35
YAGND	Orange/Black –	36

Connector plug:
10136-3000VE (Sumitomo 3M)

Connector case:
10336-52A0-008 (Sumitomo 3M)

AWG20 Red
AWG20 Black
AWG20 Red (see note 2)
AWG20 Blue (see note 2)

OMNUC U-series
AC Servo Driver

No.	Signal	
28	BAT	See note 2
29	BATGND	See note 2
34	$\overline{ALM}$	
14	RUN	
18	RESET	
6	SENGND	See note 2
5	SEN	See note 2
19	EGND	
20	+A	
21	–A	
23	+B	
22	–B	
24	+Z	
25	–Z	
3	REF	
4	AGND	
Shell	FG	
13	+24VIN	
35	ALMCOM	

No.	Signal	
13	+24VIN	
35	ALMCOM	
34	$\overline{ALM}$	
14	RUN	
18	RESET	
6	SENGND	See note 2
5	SEN	See note 2
19	EGND	
20	+A	
21	–A	
23	+B	
22	–B	
24	+Z	
25	–Z	
3	REF	
4	AGND	
Shell	FG	
28	BAT	See note 2
29	BATGND	See note 2

AWG20 Red (see note 2)
AWG20 Blue (see note 2)

Connector plug: 10136-3000VE (Sumitomo 3M)
Connector case: 10336-52A0-008 (Sumitomo 3M)

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Note 1. The Controller's symbols are the DRVX-Y connector's symbols. In a DRVZ-U connector, X → Z and Y → U.

Note 2. These terminals and wires are used with Absolute Encoders.

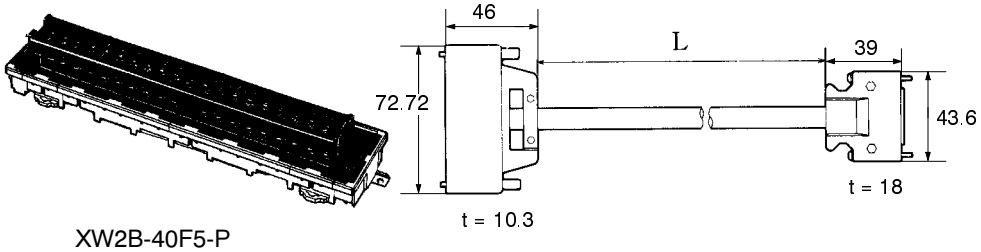
Note 3. Supply 24 VDC to the two wires (black and red) that are taken out from the Controller's connector. (Red is + and black is –.)

■ Conversion Cables for Connector–Terminal Conversion Unit

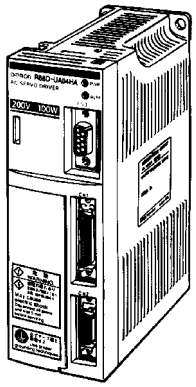
● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CTU001N	1 m	9.9 dia.
R88A-CTU002N	2 m	

● Connection Configuration



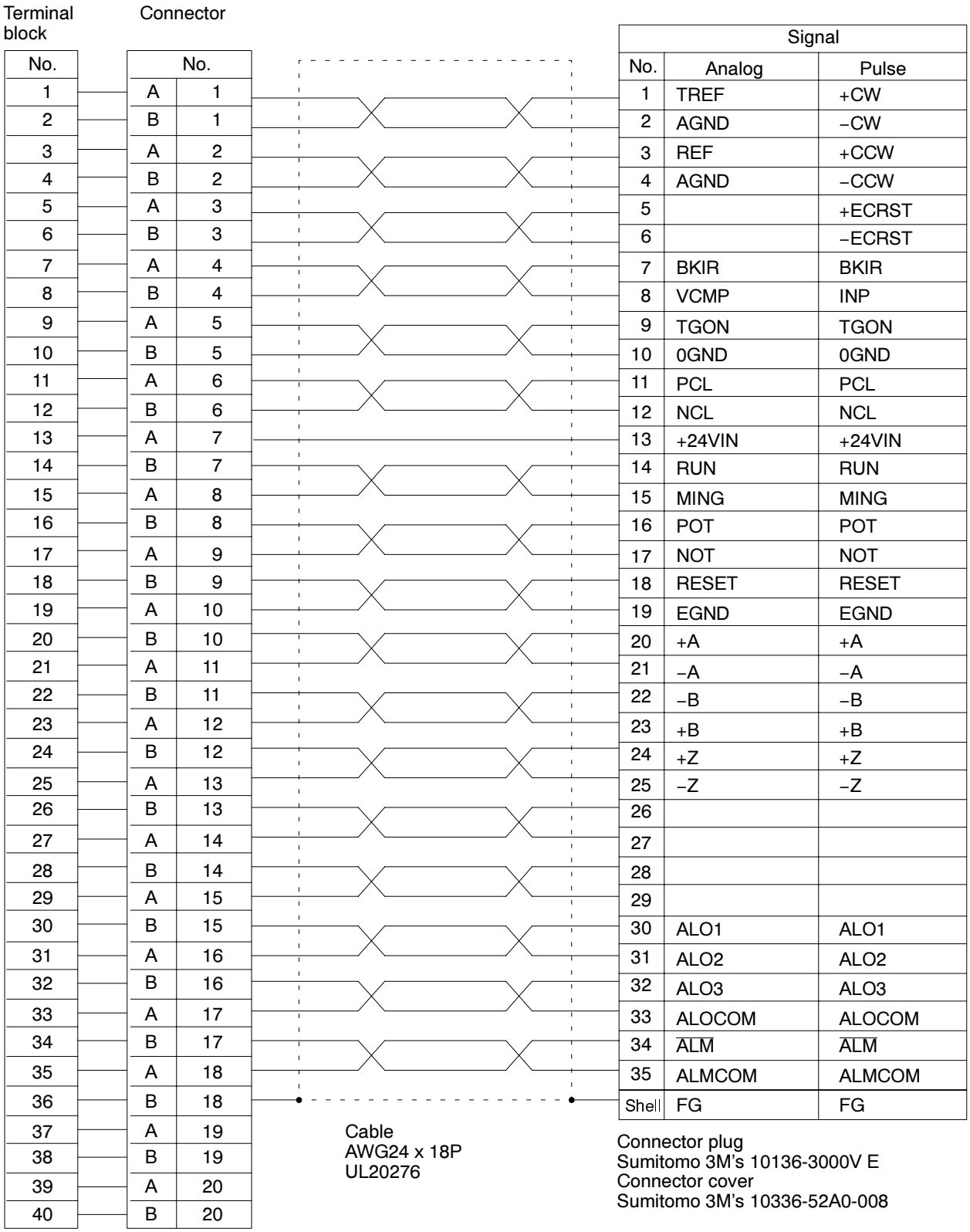
XW2B-40F5-P
Connector–Terminal
Conversion Unit



OMNUC U-Series
AC Servomotor Driver

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● Wiring



Terminal block No.	Connector No.		Signal No.	Signal Analog	Signal Pulse
1	A	1	1	TREF	+CW
2	B	1	2	AGND	−CW
3	A	2	3	REF	+CCW
4	B	2	4	AGND	−CCW
5	A	3	5		+ECRST
6	B	3	6		−ECRST
7	A	4	7	BKIR	BKIR
8	B	4	8	VCMP	INP
9	A	5	9	TGON	TGON
10	B	5	10	0GND	0GND
11	A	6	11	PCL	PCL
12	B	6	12	NCL	NCL
13	A	7	13	+24VIN	+24VIN
14	B	7	14	RUN	RUN
15	A	8	15	MING	MING
16	B	8	16	POT	POT
17	A	9	17	NOT	NOT
18	B	9	18	RESET	RESET
19	A	10	19	EGND	EGND
20	B	10	20	+A	+A
21	A	11	21	−A	−A
22	B	11	22	−B	−B
23	A	12	23	+B	+B
24	B	12	24	+Z	+Z
25	A	13	25	−Z	−Z
26	B	13	26		
27	A	14	27		
28	B	14	28		
29	A	15	29		
30	B	15	30	ALO1	ALO1
31	A	16	31	ALO2	ALO2
32	B	16	32	ALO3	ALO3
33	A	17	33	ALOCOM	ALOCOM
34	B	17	34	$\overline{\text{ALM}}$	$\overline{\text{ALM}}$
35	A	18	35	ALMCOM	ALMCOM
36	B	18	Shell	FG	FG
37	A	19			
38	B	19			
39	A	20			
40	B	20			

Cable
AWG24 x 18P
UL20276

Connector plug
Sumitomo 3M's 10136-3000V E
Connector cover
Sumitomo 3M's 10336-52A0-008

Connector plug: Fujitsu's FCN-361J040-AU
Connector cover: Fujitsu's FCN-360C040-B

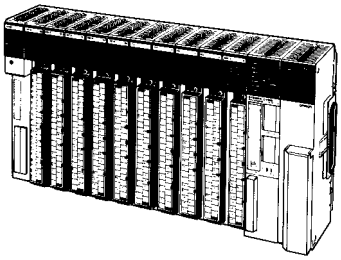
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■ General-purpose Control Cable

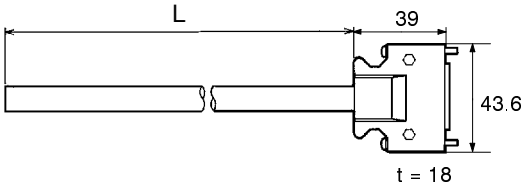
● Types of Cable

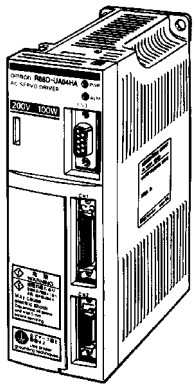
Model	Length (L)	Outer diameter of sheath
R88A-CPU001S	1 m	9.9 dia.
R88A-CPU002S	2 m	

● Connection Configuration



C500-NC222 Position Control Unit on a SYSMAC C-series PC





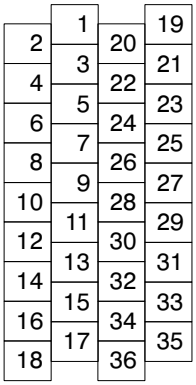
OMNUC U-Series AC Servomotor Driver

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● Wiring

No.	Insulation color	Dot mark	Dot mark color	Signal name	
				Analog	Pulse
1	Orange	–	Black	TREF	+CW
2	Orange	–	Red	AGND	–CW
3	Gray	–	Black	REF	+CCW
4	Gray	–	Red	AGND	–CCW
5	White	–	Black		+ECRST
6	White	–	Red		–ECRST
7	Yellow	–	Black	BKIR	BKIR
8	Yellow	–	Red	VCMP	INP
9	Pink	–	Black	TGON	TGON
10	Pink	–	Red	0GND	0GND
11	Gray	– –	Black	PCL	PCL
12	Gray	– –	Red	NCL	NCL
13	Orange	– –	Black	+24VIN	+24VIN
	Orange	– –	Red		
14	White	– –	Black	RUN	RUN
15	White	– –	Red	MING	MING
16	Yellow	– –	Black	POT	POT
17	Yellow	– –	Red	NOT	NOT
18	Pink	– –	Black	RESET	RESET
19	Pink	– –	Red	EGND	EGND
20	Orange	– – –	Black	+A	+A
21	Orange	– – –	Red	–A	–A
22	Gray	– – –	Black	–B	–B
23	Gray	– – –	Red	+B	+B
24	White	– – –	Black	+Z	+Z
25	White	– – –	Red	–Z	–Z
26	Yellow	– – –	Black		
27	Yellow	– – –	Red		
28	Pink	– – –	Black		
29	Pink	– – –	Red		
30	Orange	– – – –	Black	ALO1	ALO1
31	Orange	– – – –	Red	ALO2	ALO2
32	Gray	– – – –	Black	ALO3	ALO3
33	Gray	– – – –	Red	ALOCOM	ALOCOM
34	White	– – – –	Black	$\overline{\text{ALM}}$	$\overline{\text{ALM}}$
35	White	– – – –	Red	ALMCOM	ALMCOM
Shell	Shield			FG	FG

Connector Pin Arrangement



Connector plug model:
10136-3000VE
(Sumitomo 3M)
Connector case model:
10336-52A0-008
(Sumitomo 3M)

Cable: AWG24X18P
UL20276

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5-3-2 Encoder Cable

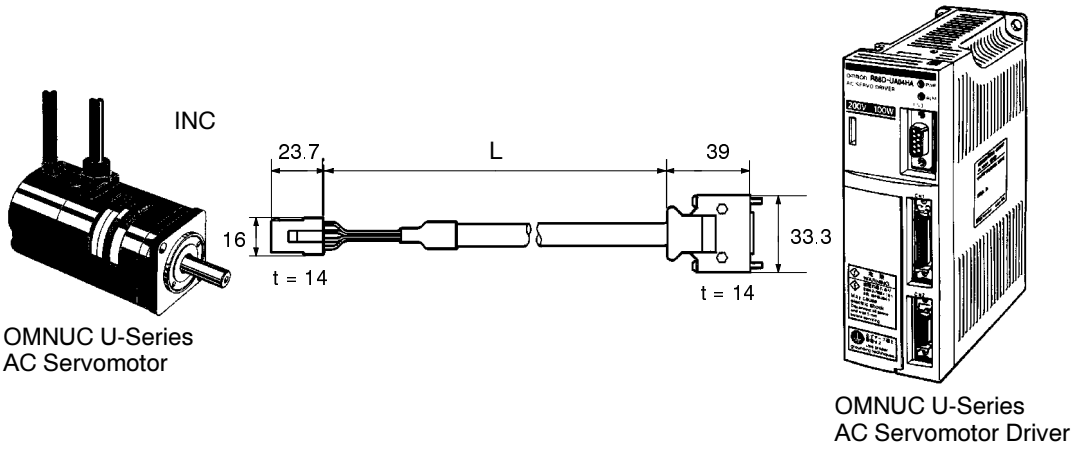
■ Encoder Cables for Motors with Incremental Encoder, Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards

● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CRU003C	3 m	8 dia.
R88A-CRU005C	5 m	
R88A-CRU010C	10 m	
R88A-CRU015C	15 m	
R88A-CRU020C	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

● Connection Configuration



● Wiring

Symbol	No.		No.	Symbol
A+	1	AWG24 (blue)	16	A+
A–	2	AWG24 (white/blue)	17	A–
B+	3	AWG24 (yellow)	18	B+
B–	4	AWG24 (white/yellow)	19	B–
S+	5	AWG24 (green)	14	S+
S–	6	AWG24 (white/green)	15	S–
E0V	7	AWG22 (black)	1	E0V
E5V	8	AWG22 (red)	4	E5V
FG	9	AWG22 (green/yellow)	20	FG

Cable: AWG22 × 3C + AWG24 × 3P
UL2589

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<For Cable>

Connector housing model:	172161-1 (Nippon Amp)	Contact plug model:	10120-3000VE (Sumitomo 3M)
Connector socket contact model:	170365-1 (Nippon Amp)	Contact case model:	10320-52A0-008 (Sumitomo 3M)
Crimping tool:	724649-1		
Pulling tool:	724668-2		

<For Motor>

Connector plug model:	172169-1 (Nippon Amp)
Connector pin contact model:	170359-1 (Nippon Amp)

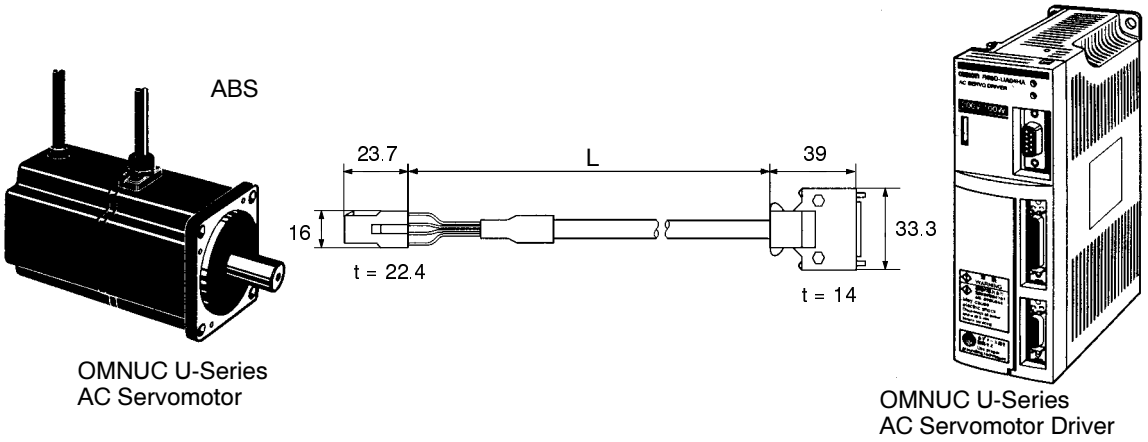
■ Encoder Cables for Motors with Absolute Encoder, Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards

● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CSU003C	3 m	10.3 dia.
R88A-CSU005C	5 m	
R88A-CSU010C	10 m	
R88A-CSU015C	15 m	
R88A-CSU020C	20 m	

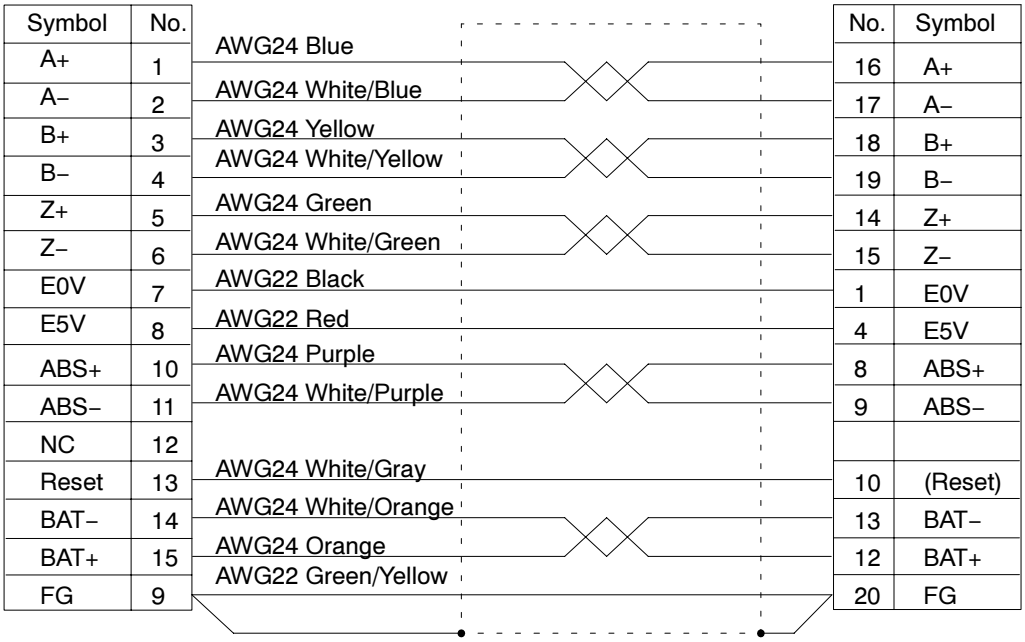
(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

● Connection Configuration



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● Wiring



Cable: AWG22 × 3C + AWG24 × 6P
UL2589

<For Cable>

Connector housing model: 172163-1 (Nippon Amp)
Connector socket contact model: 170365-1 (Nippon Amp)
Crimping tool: 724649-1
Pulling tool: 724668-2
Contact plug model: 10120-3000VE (Sumitomo 3M)
Contact case model: 10320-52A0-008 (Sumitomo 3M)

<For Motor>

Connector plug model: 172171-1 (Nippon Amp)
Connector pin contact model: 170359-1 (Nippon Amp)

■ Motors with Incremental Encoders, Models Conforming to EC Directives

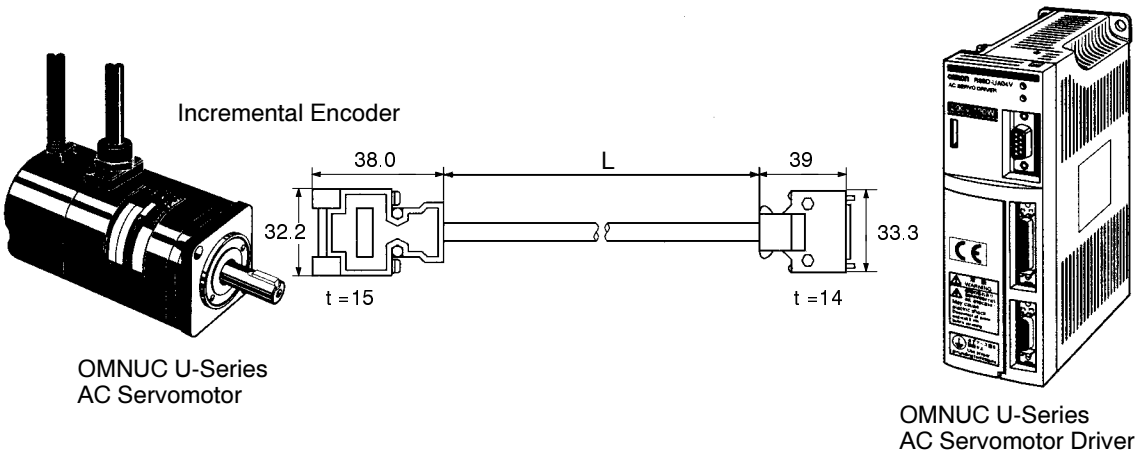
● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CRUD003C	3 m	8 dia.
R88A-CRUD005C	5 m	
R88A-CRUD010C	10 m	
R88A-CRUD015C	15 m	
R88A-CRUD020C	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

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● Connection Configuration



● Wiring

Symbol	No.
A+	1
A–	2
B+	3
B–	4
S+	5
S–	6
E0V	7
E5V	8
FG	9

AWG24 Blue
AWG24 White/Blue
AWG24 Yellow
AWG24 White/Yellow
AWG24 Green
AWG24 White/Green
AWG22 Black
AWG22 Red
AWG22 Green/Yellow

No.	Symbol
16	A+
17	A–
18	B+
19	B–
14	S+
15	S–
1	E0V
4	E5V
20	
Shell	FG

Cable: AWG22 × 3C + AWG24 × 3P
UL2589

<For Cable>

Connector model: 17JE13090-02D8A (DDK)
Stud model: 17L-002A1 (DDK)
Contact plug model: 10120-3000VE (Sumitomo 3M)
Contact case model: 10320-52A0-008 (Sumitomo 3M)

<For Motor>

Connector: 17JE23090-02D8A (DDK)

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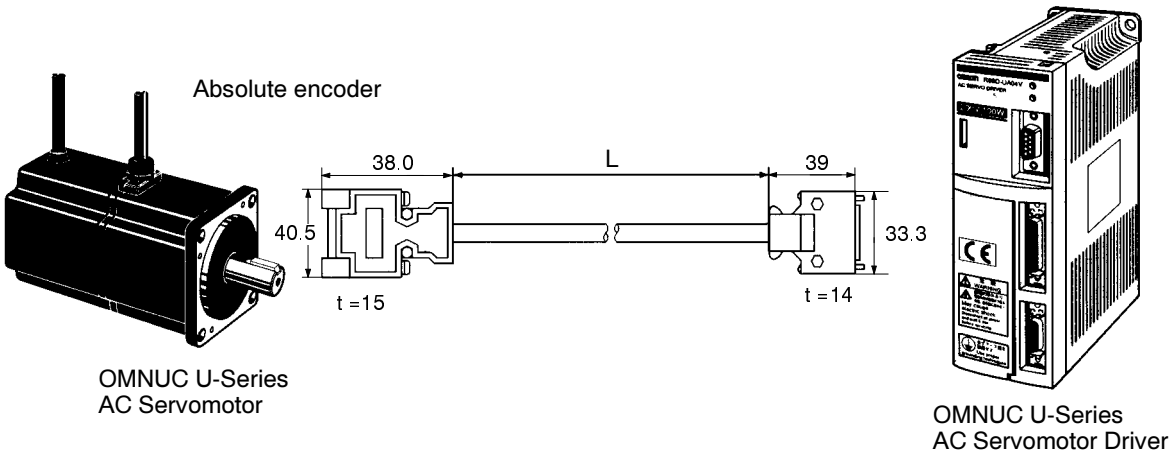
■ Motors with Absolute Encoders, Models Conforming to EC Directives

● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CSUD003C	3 m	10.3 dia.
R88A-CSUD005C	5 m	
R88A-CSUD010C	10 m	
R88A-CSUD015C	15 m	
R88A-CSUD020C	20 m	

(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

● Connection Configuration



● Wiring

Symbol	No.		No.	Symbol
A+	1	AWG24 Blue	16	A+
A–	2	AWG24 White/Blue	17	A–
B+	3	AWG24 Yellow	18	B+
B–	4	AWG24 White/Yellow	19	B–
Z+	5	AWG24 Green	14	Z+
Z–	6	AWG24 White/Green	15	Z–
E0V	7	AWG22 Black	1	E0V
E5V	8	AWG22 Red	4	E5V
ABS+	10	AWG24 Purple	8	ABS+
ABS–	11	AWG24 White/Purple	9	ABS–
NC	12			
Reset	13	AWG24 White/Gray	10	(Reset)
BAT–	14	AWG24 White/Orange	13	BAT–
BAT+	15	AWG24 Orange	12	BAT+
FG	9	AWG22 Green/Yellow	20	
			Shell	FG

Cable: AWG22 × 3C + AWG24 × 6P

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<For Cable>

Connector model: 17JE13150-02D8A (DDK)
Stud model: 17L-002A1 (DDK)
Contact plug model: 10120-3000VE (Sumitomo 3M)
Contact case model: 10320-52A0-008 (Sumitomo 3M)

<For Motor>

Connector: 17JE23150-02D8A (DDK)

5-3-3 Power Cables

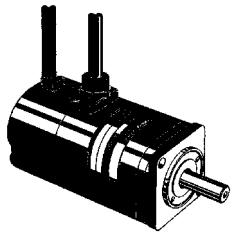
■ Power Cable for Servomotors Without Brakes, Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards

● Types of Cable

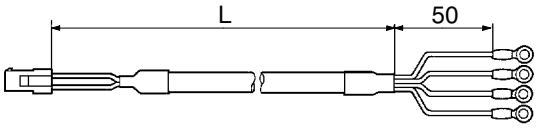
Model	Length (L)	Outer diameter of sheath
R88A-CAU003S	3 m	5.8 dia.
R88A-CAU005S	5 m	
R88A-CAU010S	10 m	
R88A-CAU015S	15 m	
R88A-CAU020S	20 m	

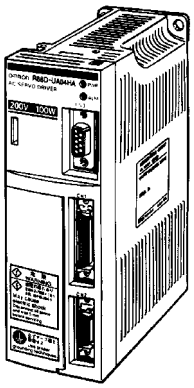
(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

● Connection Configuration



OMNUC U-Series
AC Servomotor

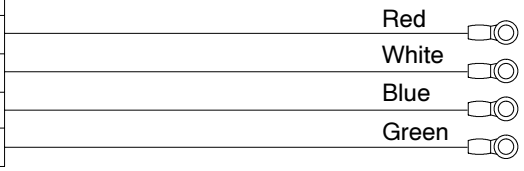




OMNUC U-Series
AC Servomotor Driver

● Wiring

Symbol	No.
U-phase	1
V-phase	2
W-phase	3
GR	4



Cable: AWG20 × 4C
UL2517

Crimp-style terminal

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<For Cable>

Connector housing model: 172159-1 (Nippon Amp)
Connector socket contact model: 170366-1 (Nippon Amp)
Crimping tool: 724651-1
Pulling tool: 724668-2

<For Motor>

Connector plug model: 172167-1 (Nippon Amp)
Connector pin contact model: 170359-1 (Nippon Amp) for 30 to 100-W models
170360-1 (Nippon Amp) for 200 to 750-W models

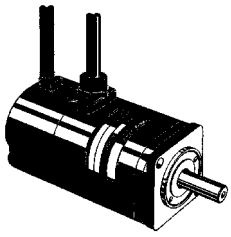
■ Power Cable for Servomotors With Brakes, Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards

● Types of Cable

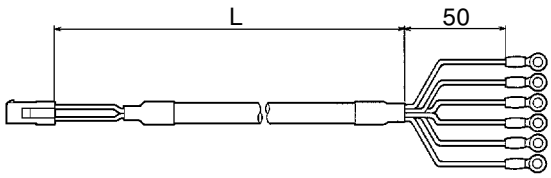
Model	Length (L)	Outer diameter of sheath
R88A-CAU003B	3 m	6.8 dia.
R88A-CAU005B	5 m	
R88A-CAU010B	10 m	
R88A-CAU015B	15 m	
R88A-CAU020B	20 m	

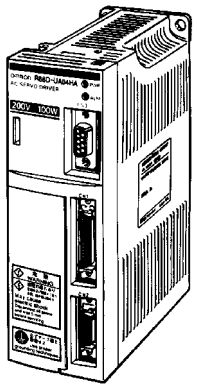
(Up to a maximum of 20 m between the Monitor and the Servo Driver.)

● Connection Configuration



OMNUC U-Series
AC Servomotor





OMNUC U-Series
AC Servomotor Driver

● Wiring

Symbol	No.
U-phase	1
V-phase	2
W-phase	3
GR	4
Brake	5
Brake	6

Red
White
Blue
Green
Black
Black

Cable: AWG20 × 6C
UL2517

Crimp-style terminal

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<For Cable>

Connector housing model: 172160-1 (Nippon Amp)
Connector socket contact model: 170366-1 (Nippon Amp)
Crimping tool: 724651-1
Pulling tool: 724668-2

<For Motor>

Connector plug model: 172167-1 (Nippon Amp)
Connector pin contact model: 170359-1 (Nippon Amp) for 30 to 100-W models
170360-1 (Nippon Amp) for 200 to 750-W models

■ Power Cable for Servomotors Without Brakes, Models Conforming to EC Directives

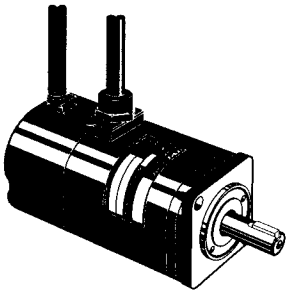
● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CAU001	1 m	5.8 dia.

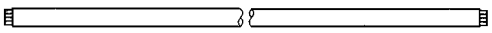
Note 1. Power cables will be cut to the specified length in 1-m increments.

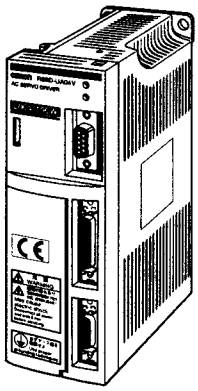
Note 2. The maximum distance between the Servomotor and the Servo Driver is 20 m.

● Connection Configuration



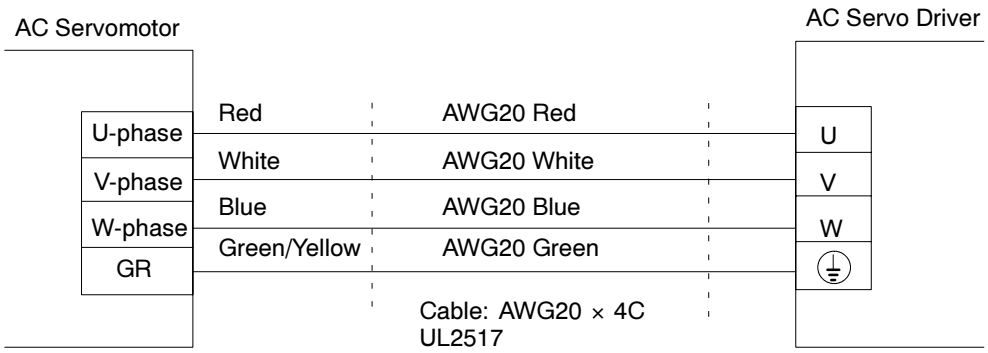
OMNUC U-Series
AC Servomotor





OMNUC U-Series
AC Servomotor Driver

● Wiring



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■ Power Cable for Servomotors With Brakes, Models Conforming to EC Directives

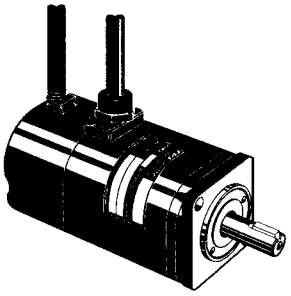
● Types of Cable

Model	Length (L)	Outer diameter of sheath
R88A-CAU01B	1 m	6.8 dia.

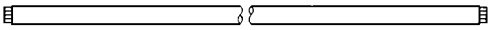
Note 1. Power cables will be cut to the specified length in 1-m increments.

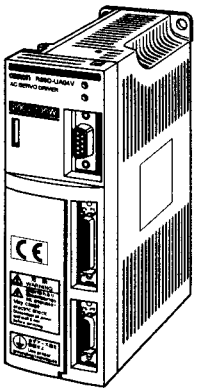
Note 2. The maximum distance between the Servomotor and the Servo Driver is 20 m.

● Connection Configuration



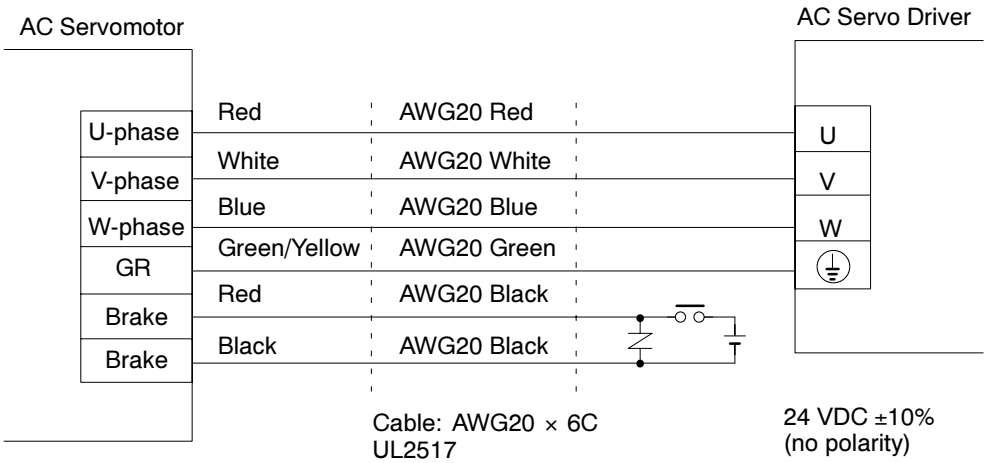
OMNUC U-Series
AC Servomotor





OMNUC U-Series
AC Servomotor Driver

● Wiring



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5-4 Parameter Unit Specifications

■ General Specifications

Item	Standards
Operating ambient temperature	0°C to 55°C
Storage ambient temperature	−10°C to 75°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	4.9 m/s^2 {0.5 G} max.
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max.

■ Performance Specifications

Model		R88A-PR02U		R88A-PR03U
Type		Handy type		Mounted type
Accessory cable		1,000 mm		(Connected by connectors.)
Connectors		7910-7500SC (10 pins)		D sub-connector (9 pins)
Display		7-segment LED, 5 digits		
External dimensions		63 × 135 × 18.5 (W × H × D)		54 × 57.5 × 15 (W × H × D)
Communications specifications	Standard	RS-232C		RS-422A
	Communications method	Asynchronous (ASYNC)		
	Baud rate	2,400 bps		
	Start bits	1 bit		
	Data	8 bits		
	Parity	None		
	Stop bits	1 bit		
Errors detected by Parameter Unit		Display	CPF00	Cannot transmit even after 5 seconds have elapses since power supply was turned on.
			CPF01	A BCC error or faulty reception data has occurred for five consecutive times, or a time overrun (1 s) has occurred for three consecutive times.

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5-5 Regeneration Unit Specifications

■ R88A-RG08UA Regeneration Unit

● General Specifications

Item	
Operating ambient temperature	0°C to 55°C
Storage ambient temperature	−10°C to 75°C
Operating ambient humidity	35% to 85% RH (with no condensation)
Storage ambient humidity	35% to 85% RH (with no condensation)
Storage and operating atmosphere	No corrosive gasses.
Vibration resistance	4.9 m/s^2 {0.5 G} max.
Impact resistance	Acceleration 19.6 m/s^2 {2 G} max.

● Performance Specifications

Model	R88A-RG08U
Regeneration operating voltage	380 V_{DC}
Regeneration processing current	8 A_{DC}
Average regeneration power	12 W (internal resistance: 50 Ω, 60 W)
Externally connected regeneration resistor	47 Ω ±5%
Error detection function	Regeneration resistance disconnection, regeneration transistor damage, overvoltage
Alarm output	1b contact (open contact at time of protective function operation) (200 VAC drive possible.)
External dimensions	55 × 160 × 130 (W × H × D)

● Indicator LED Specifications

Name	Specifications
POWER	Lit while power flows through PN terminal.
REGEN	Lit during regeneration operation.
ALARM-REGEN	Lit for regeneration resistance disconnection or regeneration transistor damage.
ALARM-OV	Lit when overvoltage occurs.

Note 1. When the error detection function operates, an alarm is output from the Unit.

Note 2. Create a sequence so that the power supply (R−T) to the Servo Driver is cut off when an alarm is generated.

Note 3. When the error detection function operates and the Servo Driver's power supply is cut off, the Regeneration Unit won't be restored to its normal status until 2 to 3 seconds have elapsed, even if the power supply is turned on again. (Normal status is restored after the electrolytic capacitor in the Servo Driver has been discharged and the voltage between signals P and N drops.)

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Note **4.** The Regeneration Unit does not conform to EC Directives

5-6 Front-surface Mounting Bracket Specifications

The Front-surface Mounting Brackets (R88A-TK01U/TK02U) are used to mount a Servo Driver from the front surface. The model of the Bracket depends on the model of the Servo Driver.
These Mounting Brackets cannot be used with models conforming to EC Directives.

■ Applicable Models

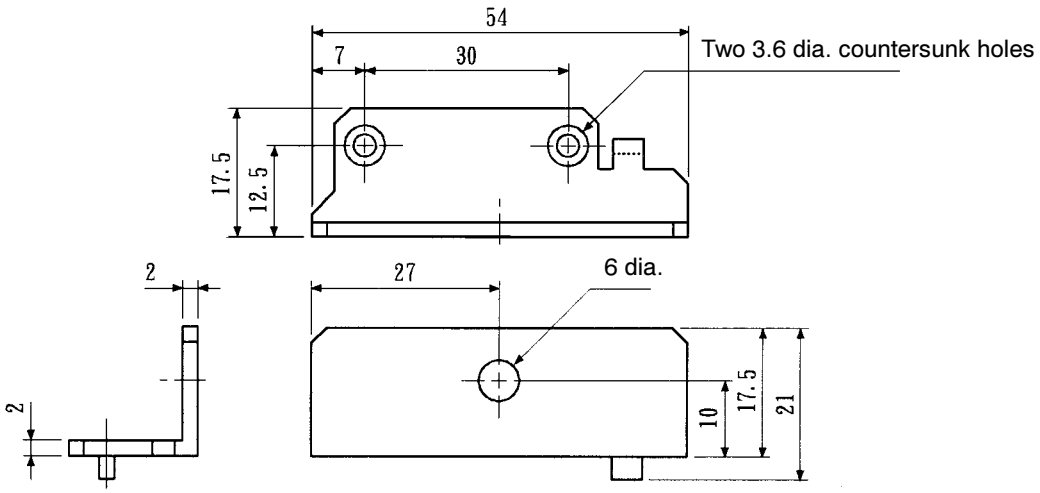
Servo Driver specifications			Front-surface Mounting Bracket model
Model	Power supply	Wattage	
R88D-UA02H(A) to R88D-UA12H(A)	200 V	30 to 400 W	R88A-TK01U
R88D-UA20H(A)		750 W	R88A-TK02U
R88D-UA03L(A) to R88D-UA12L(A)	100 V	30 to 200 W	R88A-TK01U
R88D-UA15L		300 W	R88A-TK02U

Note The Brackets come with a top bracket, a bottom bracket, and five mounting screws.

■ Dimensions (Unit: mm)

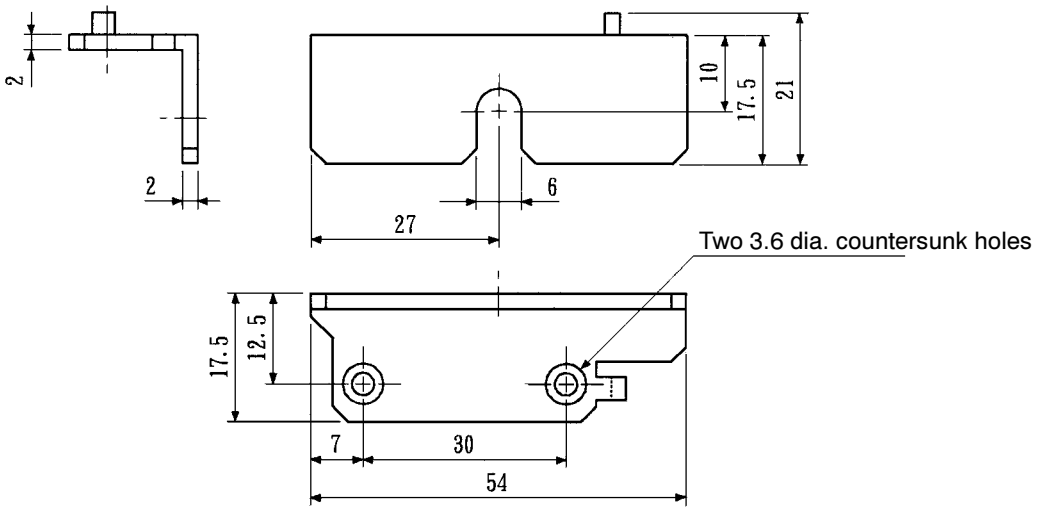
● R88A-TK01U

Top Mounting Bracket



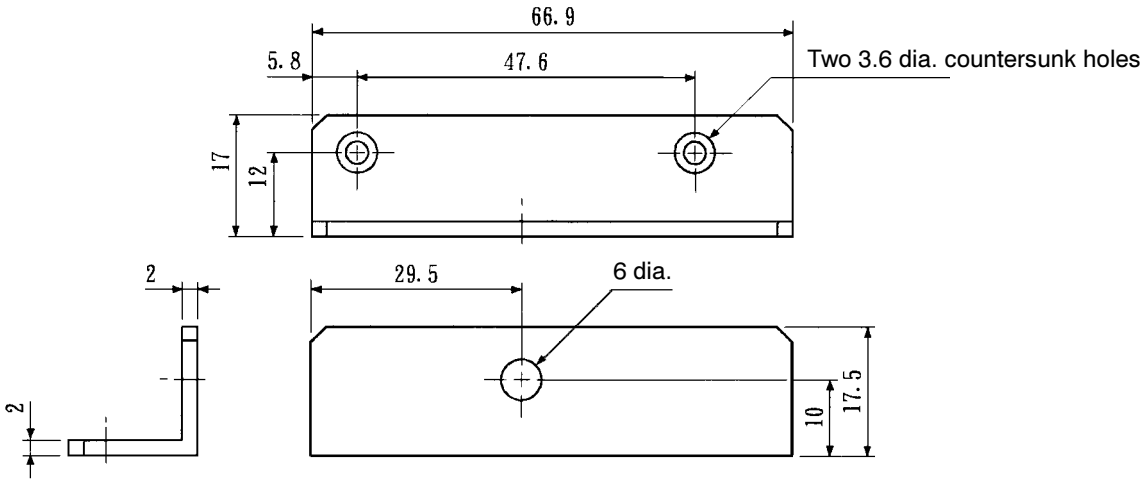
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Bottom Mounting Bracket



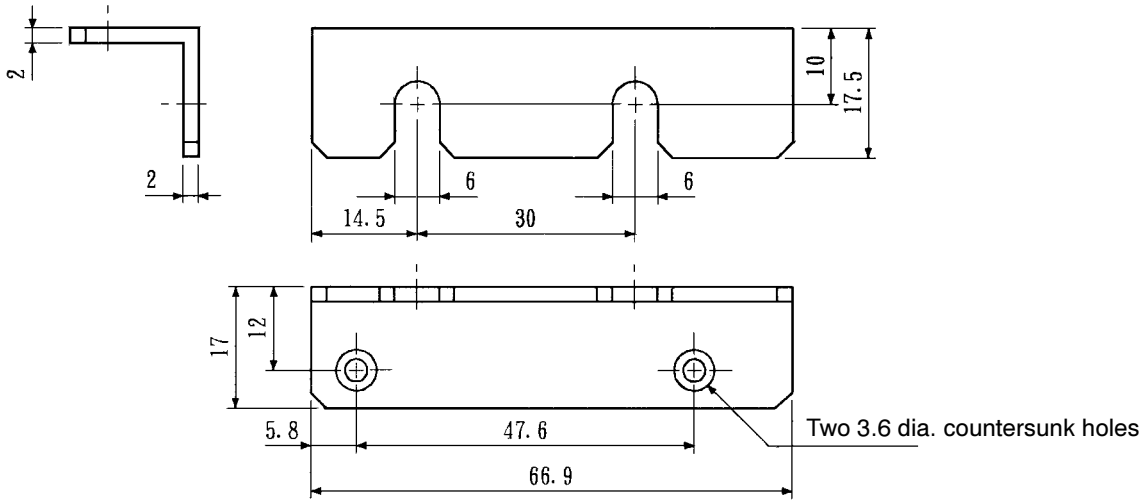
- **R88A-TK02U**

Top Mounting Bracket



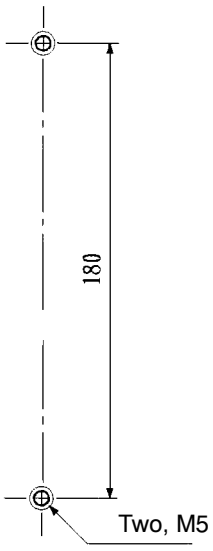
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Bottom Mounting Bracket

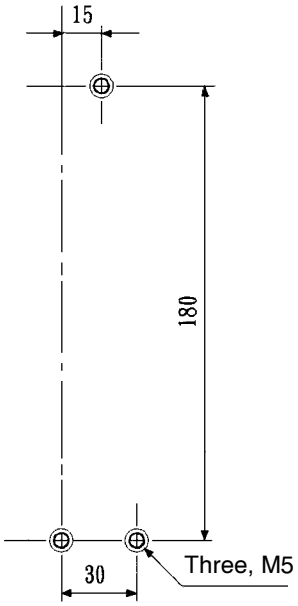


■ Mounting Hole Dimensions (Unit: mm)

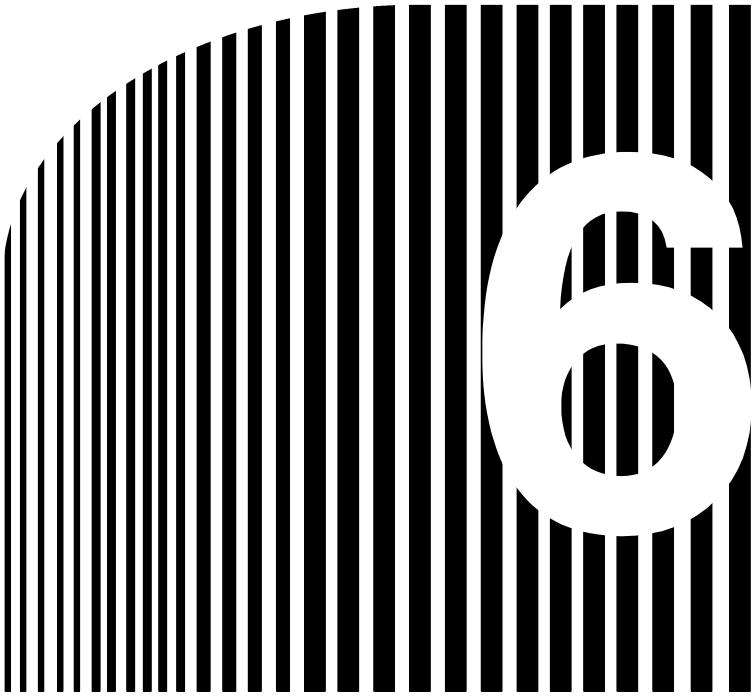
● **R88A-TK01U**



● **R88A-TK02U**



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Chapter 6

• Supplementary Materials •

6-1 Connection Examples

6-2 Encoder Dividing Ratios and Speeds when Connected to OMRON Controllers

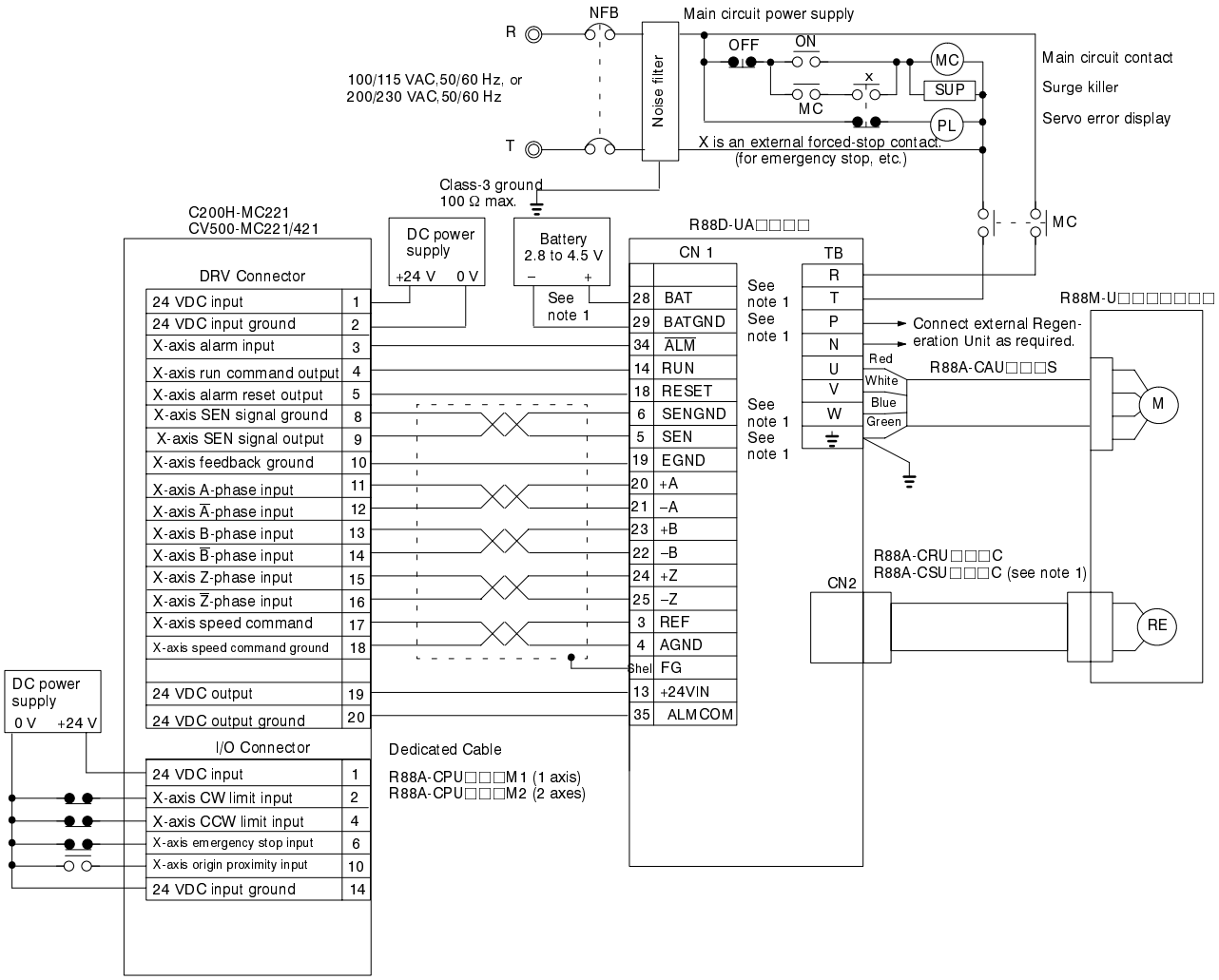
6-3 OMNUC U-series Standard Models

6-4 Parameter Setting Forms

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6-1 Connection Examples

■ Connection Example 1: Connecting to SYSMAC CV500-MC221/421 or C200H-MC221 Motion Control Unit, Models (Incremental and Absolute Encoders) Conforming to UL/cUL Standards and Not Conforming to Any Standards



Note 1. Connect these lines when using an absolute encoder.

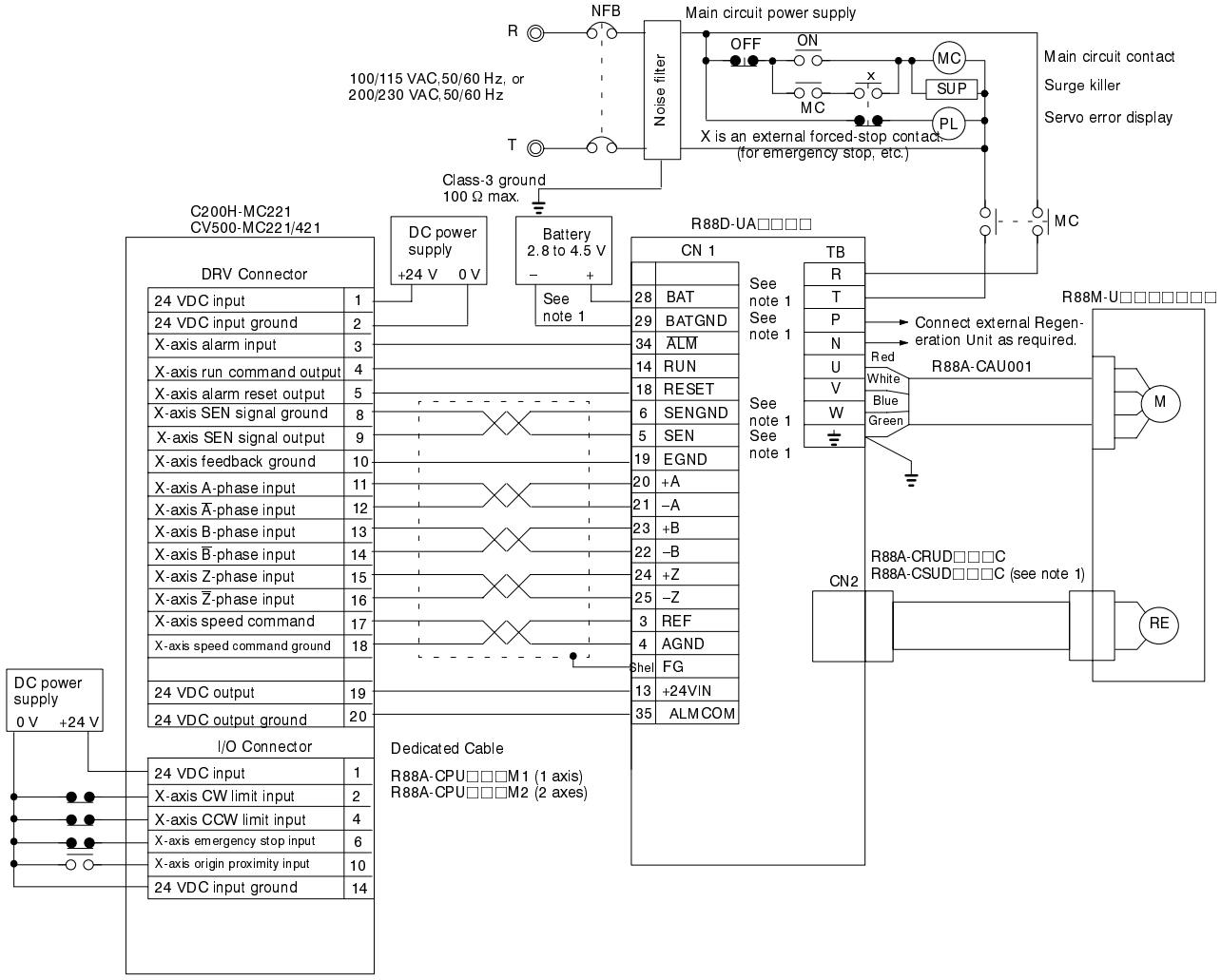
Note 2. This wiring diagram is an example for the X axis only. Connect other Units to the driver in the same way when using other axes.

Note 3. Be sure to short (in the connector) any unused NC input terminals in the CV500-MC221/421's or C200H-MC221's I/O connector.

Note 4. Set system so that the Servo can be turned ON/OFF using the RUN signal.

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■ Connection Example 2: Connecting to SYSMAC CV500-MC221/421 or C200H-MC221 Motion Control Unit, Models Conforming to EC Directives (Incremental and Absolute Encoders)



Note 1. Connect these lines when using an absolute encoder.

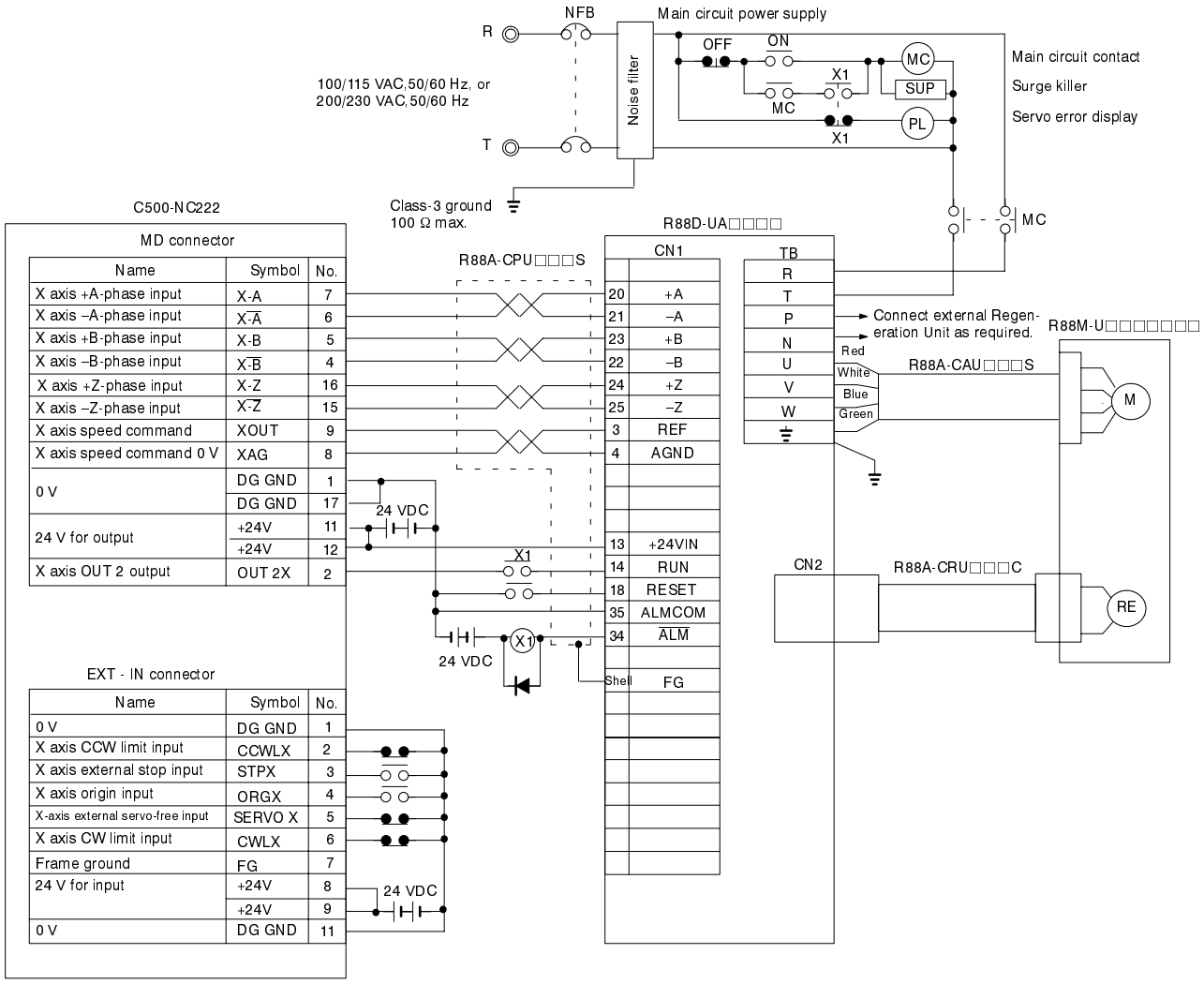
Note 2. This wiring diagram is an example for the X axis only. Connect other Units to the driver in the same way when using other axes.

Note 3. Be sure to short (in the connector) any unused NC input terminals in the CV500-221/421's or C200H-MC221's I/O connector.

Note 4. Set system so that the Servo can be turned ON/OFF using the RUN signal.

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■ Connection Example 3: Connecting to SYSMAC C500-NC222 (Incremental Encoder)



Note **1.** This wiring diagram is an example for the X axis only. Connect driver and external I/O in the same way when using the Y axis.

Note **2.** External output 2 (OUT-2X) is turned ON and OFF using the external servo free input. When doing so, set the external output 2 setting at address 420 (X axis) and address 820 (Y axis) in the C200-NC222-E to “1” (OFF for servo free)

Note **3.** When the C500-NC222-E is used in the C500-221 mode, the external servo free input is used as the emergency stop input. Here, external output 2 cannot be used as the RUN signal. Use a separate I/O signal to input the RUN signal.

Note **4.** Set system so that the Servo can be turned ON/OFF using the RUN signal.

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6-2 Encoder Dividing Ratios and Speeds when Connected to OMRON Controllers

The encoder output pulses can be changed for OMNUC U-Series AC Servo Drivers by setting the encoder dividing ratio. The maximum speed, however, is limited by the maximum response frequency of the encoder input to the controller, as listed in the following table.

■ Encoder Dividing Ratio (Cn-0A) and Maximum Motor Speed

Controller	Dividing ratio					
	2,048 to 1,025		1,024 to 683		2,048/n ≧ Cn-0A > 2,048/n+1	
	4x	2x/1x	4x	2x/1x	4x	2x/1x
CV500-MC221/421 C200H-MC221	4,500		4,500		4,500	
C500-NC222-E	2,197	4,394/4,500	4,394	4,500	2,197 x n	4,394 x n

Note 1. n is a natural integer between 1 and 128, inclusive.

Note 2. The above table provides the maximum speed (r/m) in combination with the specified controllers.

Note 3. The upper limit of the maximum speed is 4,500 r/m.

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6-3 OMNUC U-series Standard Models

■ Models with Incremental Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards

● Servomotors

Specification				Model
Straight shaft with no key	Standard (no brake)	200 VAC	30 W	R88M-U03030HA
			50 W	R88M-U05030HA
			100 W	R88M-U10030HA
			200 W	R88M-U20030HA
			400 W	R88M-U40030HA
			750 W	R88M-U75030HA
		100 VAC	30 W	R88M-U03030LA
			50 W	R88M-U05030LA
			100 W	R88M-U10030LA
			200 W	R88M-U20030LA
			300 W	R88M-U30030LA
	With brake	200 VAC	30 W	R88M-U03030HA-B
			50 W	R88M-U05030HA-B
			100 W	R88M-U10030HA-B
			200 W	R88M-U20030HA-B
			400 W	R88M-U40030HA-B
			750 W	R88M-U75030HA-B
		100 VAC	30 W	R88M-U03030LA-B
			50 W	R88M-U05030LA-B
			100 W	R88M-U10030LA-B
			200 W	R88M-U20030LA-B
			300 W	R88M-U30030LA-B

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Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	30 W	R88M-U03030HA-S1
			50 W	R88M-U05030HA-S1
			100 W	R88M-U10030HA-S1
			200 W	R88M-U20030HA-S1
			400 W	R88M-U40030HA-S1
			750 W	R88M-U75030HA-S1
		100 VAC	30 W	R88M-U03030LA-S1
			50 W	R88M-U05030LA-S1
			100 W	R88M-U10030LA-S1
			200 W	R88M-U20030LA-S1
			300 W	R88M-U30030LA-S1
	With brake	200 VAC	30 W	R88M-U03030HA-BS1
			50 W	R88M-U05030HA-BS1
			100 W	R88M-U10030HA-BS1
			200 W	R88M-U20030HA-BS1
			400 W	R88M-U40030HA-BS1
			750 W	R88M-U75030HA-BS1
		100 VAC	30 W	R88M-U03030LA-BS1
			50 W	R88M-U05030LA-BS1
			100 W	R88M-U10030LA-BS1
			200 W	R88M-U20030LA-BS1
			300 W	R88M-U30030LA-BS1

● Servo Drivers with Analog Inputs

Specification			Model
Analog input	200 VAC	30 W	R88D-UA02HA
		50 W	R88D-UA03HA
		100 W	R88D-UA04HA
		200 W	R88D-UA08HA
		400 W	R88D-UA12HA
		750 W	R88D-UA20HA
	100 VAC	30 W	R88D-UA03LA
		50 W	R88D-UA04LA
		100 W	R88D-UA10LA
		200 W	R88D-UA12LA
		300 W	R88D-UA15LA

● Parameter Unit

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

● Regeneration Unit

Specification	Model
Regeneration processing current: 8 A	R88A-RG08UA

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● External Regeneration Resistor

Specification	Model
Regeneration capacity: 70 W, 47 Ω	R88A-RR22047S

● Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CRU003C
	5 m	R88A-CRU005C
	10 m	R88A-CRU010C
	15 m	R88A-CRU015C
	20 m	R88A-CRU020C
Cable only	1-m units	R88A-CRU001

● Power Cables

Specification			Model
For standard motors (no brake)	Connector at one end	3 m	R88A-CAU003S
		5 m	R88A-CAU005S
		10 m	R88A-CAU010S
		15 m	R88A-CAU015S
		20 m	R88A-CAU020S
	Cable only	1-m units	R88A-CAU001
For motors with brakes	Connector at one end	3 m	R88A-CAU003B
		5 m	R88A-CAU005B
		10 m	R88A-CAU010B
		15 m	R88A-CAU015B
		20 m	R88A-CAU020B
	Cable only	1-m units	R88A-CAU01B

● Dedicated Control Cables

Specification			Model
For Motion Control Units, connectors at both ends	1 axis	1 m	R88A-CPU001M1
		2 m	R88A-CPU002M1
	2 axes	1 m	R88A-CPU001M2
		2 m	R88A-CPU002M2
For N115, N116, U43, or U45, connectors at both ends		1 m	R88A-CPU001N
		2 m	R88A-CPU002N

● General-purpose Control Cables

Specification		Model
For general-purpose controllers, connector at one end	1 m	R88A-CPU001S
	2 m	R88A-CPU002S

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● Connectors and Terminal Blocks

Specification		Model
Control cable connector		R88A-CNU01C
Connector terminal block		XW2B-40F5-P
Connection cable for connector terminal block	1 m	R88A-CTU001N
	2 m	R88A-CTU002N

● Front-surface Mounting Brackets

Specification	Model
For the following Servo Drivers 200 VAC: 30 to 400 W 100 VAC: 30 to 200 W	R88A-TK01U
For the following Servo Drivers 200 VAC: 750 W 100 VAC: 300 W	R88A-TK02U

Note HA/LA models: Models manufactured after May 1998 conform to UL/cUL Standards.

■ Models with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards

● Servomotors

Specification				Model
Straight shafts with no keys	Standard (no brake)	200 VAC	30 W	R88M-U03030TA
			50 W	R88M-U05030TA
			100 W	R88M-U10030TA
			200 W	R88M-U20030TA
			400 W	R88M-U40030TA
			750 W	R88M-U75030TA
		100 VAC	30 W	R88M-U03030SA
			50 W	R88M-U05030SA
			100 W	R88M-U10030SA
			200 W	R88M-U20030SA
			300 W	R88M-U30030SA
	With brake	200 VAC	30 W	R88M-U03030TA-B
			50 W	R88M-U05030TA-B
			100 W	R88M-U10030TA-B
			200 W	R88M-U20030TA-B
			400 W	R88M-U40030TA-B
			750 W	R88M-U75030TA-B
		100 VAC	30 W	R88M-U03030SA-B
			50 W	R88M-U05030SA-B
			100 W	R88M-U10030SA-B
			200 W	R88M-U20030SA-B
			300 W	R88M-U30030SA-B

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Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	30 W	R88M-U03030TA-S1
			50 W	R88M-U05030TA-S1
			100 W	R88M-U10030TA-S1
			200 W	R88M-U20030TA-S1
			400 W	R88M-U40030TA-S1
			750 W	R88M-U75030TA-S1
		100 VAC	30 W	R88M-U03030SA-S1
			50 W	R88M-U05030SA-S1
			100 W	R88M-U10030SA-S1
			200 W	R88M-U20030SA-S1
			300 W	R88M-U30030SA-S1
	With brake	200 VAC	30 W	R88M-U03030TA-BS1
			50 W	R88M-U05030TA-BS1
			100 W	R88M-U10030TA-BS1
			200 W	R88M-U20030TA-BS1
			400 W	R88M-U40030TA-BS1
			750 W	R88M-U75030TA-BS1
		100 VAC	30 W	R88M-U03030SA-BS1
			50 W	R88M-U05030SA-BS1
			100 W	R88M-U10030SA-BS1
			200 W	R88M-U20030SA-BS1
			300 W	R88M-U30030SA-BS1

● Servo Drivers with Analog Inputs

Specification			Model
Analog input	200 VAC	30 W	R88D-UA02HA
		50 W	R88D-UA03HA
		100 W	R88D-UA04HA
		200 W	R88D-UA08HA
		400 W	R88D-UA12HA
		750 W	R88D-UA20HA
	100 VAC	30 W	R88D-UA03LA
		50 W	R88D-UA04LA
		100 W	R88D-UA10LA
		200 W	R88D-UA12LA
		300 W	R88D-UA15LA

● Parameter Unit

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

● Regeneration Unit

Specification	Model
Regeneration processing current: 8 A	R88A-RG08UA

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● External Regeneration Resistor

Specification	Model
Regeneration capacity: 70 W, 47 Ω	R88A-RR22047S

● Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CSU003C
	5 m	R88A-CSU005C
	10 m	R88A-CSU010C
	15 m	R88A-CSU015C
	20 m	R88A-CSU020C

● Power Cables

Specification			Model
For standard motors (no brake)	Connector at one end	3 m	R88A-CAU003S
		5 m	R88A-CAU005S
		10 m	R88A-CAU010S
		15 m	R88A-CAU015S
		20 m	R88A-CAU020S
	Cable only	1-m units	R88A-CAU001
For motors with brakes	Connector at one end	3 m	R88A-CAU003B
		5 m	R88A-CAU005B
		10 m	R88A-CAU010B
		15 m	R88A-CAU015B
		20 m	R88A-CAU020B
	Cable only	1-m units	R88A-CAU01B

● Dedicated Control Cables

Specification			Model
For Motion Control Units, connectors at both ends	1 axis	1 m	R88A-CPU001M1
		2 m	R88A-CPU002M1
	2 axes	1 m	R88A-CPU001M2
		2 m	R88A-CPU002M2

● Front-surface Mounting Brackets

Specification	Model
For the following Servo Drivers 200 VAC: 30 to 400 W 100 VAC: 30 to 200 W	R88A-TK01U
For the following Servo Drivers 200 VAC: 750 W 100 VAC: 300 W	R88A-TK02U

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■ Models Conforming to EC Directives with Incremental Encoders

● Servomotors

Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	30 W	R88M-U03030VA-S1
			50 W	R88M-U05030VA-S1
			100 W	R88M-U10030VA-S1
			200 W	R88M-U20030VA-S1
			400 W	R88M-U40030VA-S1
			750 W	R88M-U75030VA-S1
		100 VAC	30 W	R88M-U03030WA-S1
			50 W	R88M-U05030WA-S1
			100 W	R88M-U10030WA-S1
			200 W	R88M-U20030WA-S1
			300 W	R88M-U30030WA-S1
	With brake	200 VAC	30 W	R88M-U03030VA-BS1
			50 W	R88M-U05030VA-BS1
			100 W	R88M-U10030VA-BS1
			200 W	R88M-U20030VA-BS1
			400 W	R88M-U40030VA-BS1
			750 W	R88M-U75030VA-BS1
		100 VAC	30 W	R88M-U03030WA-BS1
			50 W	R88M-U05030WA-BS1
			100 W	R88M-U10030WA-BS1
			200 W	R88M-U20030WA-BS1
			300 W	R88M-U30030WA-BS1

● Servo Drivers with Analog Inputs

Specification			Model
Analog inputs	200 VAC	30 W	R88D-UA02V
		50 W	R88D-UA03V
		100 W	R88D-UA04V
		200 W	R88D-UA08V
		400 W	R88D-UA12V
		750 W	R88D-UA20V
	100 VAC	30 W	R88D-UA03W
		50 W	R88D-UA04W
		100 W	R88D-UA10W
		200 W	R88D-UA12W
		300 W	R88D-UA15W

● Parameter Units

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

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● Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CRUD003C
	5 m	R88A-CRUD005C
	10 m	R88A-CRUD010C
	15 m	R88A-CRUD015C
	20 m	R88A-CRUD020C
Cable only	1-m units	R88A-CRU001

● Power Cables (Cables Only)

Specification		Model
For standard motor (no brake)	1-m units	R88A-CAU001
For motor with brake	1-m units	R88A-CAU01B

● Dedicated Control Cable

Specification			Model
For Motion Control Unit, connectors at both ends	1 axis	1 m	R88A-CPU001M1
		2 m	R88A-CPU002M1
	2 axes	1 m	R88A-CPU001M2
		2 m	R88A-CPU002M2

● General-purpose Control Cables

Specification		Model
For general-purpose controller, connector at one end	1 m	R88A-CPU001S
	2 m	R88A-CPU002S

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■ Models Conforming to EC Directives with Absolute Encoders

● Servomotors

Specification				Model
Straight shafts with keys	Standard (no brake)	200 VAC	30 W	R88M-U03030XA-S1
			50 W	R88M-U05030XA-S1
			100 W	R88M-U10030XA-S1
			200 W	R88M-U20030XA-S1
			400 W	R88M-U40030XA-S1
			750 W	R88M-U75030XA-S1
		100 VAC	30 W	R88M-U03030YA-S1
			50 W	R88M-U05030YA-S1
			100 W	R88M-U10030YA-S1
			200 W	R88M-U20030YA-S1
			300 W	R88M-U30030YA-S1
	With brake	200 VAC	30 W	R88M-U03030XA-BS1
			50 W	R88M-U05030XA-BS1
			100 W	R88M-U10030XA-BS1
			200 W	R88M-U20030XA-BS1
			400 W	R88M-U40030XA-BS1
			750 W	R88M-U75030XA-BS1
		100 VAC	30 W	R88M-U03030YA-BS1
			50 W	R88M-U05030YA-BS1
			100 W	R88M-U10030YA-BS1
			200 W	R88M-U20030YA-BS1
			300 W	R88M-U30030YA-BS1

● Servo Drivers with Analog Inputs

Specification			Model
Analog inputs	200 VAC	30 W	R88D-UA02V
		50 W	R88D-UA03V
		100 W	R88D-UA04V
		200 W	R88D-UA08V
		400 W	R88D-UA12V
		750 W	R88D-UA20V
	100 VAC	30 W	R88D-UA03W
		50 W	R88D-UA04W
		100 W	R88D-UA10W
		200 W	R88D-UA12W
		300 W	R88D-UA15W

● Parameter Units

Specification	Model
Handy type	R88A-PR02U
Mounted type	R88A-PR03U

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● Encoder Cables

Specification		Model
Connectors at both ends	3 m	R88A-CSUD003C
	5 m	R88A-CSUD005C
	10 m	R88A-CSUD010C
	15 m	R88A-CSUD015C
	20 m	R88A-CSUD020C

● Power Cables (Cables Only)

Specification		Model
For standard motor (no brake)	1-m units	R88A-CAU001
For motor with brake	1-m units	R88A-CAU01B

● Dedicated Controller Cables

Specification			Model
For Motion Control Units, connectors at both ends	1 axis	1 m	R88A-CPU001M1
		2 m	R88A-CPU002M1
	2 axes	1 m	R88A-CPU001M2
		2 m	R88A-CPU002M2

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6-4 Parameter Setting Forms

6-4-1 Parameters when Using an Incremental Encoder

■ User Parameters

PRM No.	Parameter name	Factory setting	Unit	Setting range	Setting
Cn-03	Speed command scale	300	(r/min)/V	0 to 2,162	
Cn-04	Speed loop gain (See note 1.)	80	Hz	1 to 2,000	
Cn-05	Speed loop integration constant	20	H/L: ms HA/LA/ V/W: ms or 0.01 ms	2 to 10,000	
Cn-06	Emergency stop torque	Maximum torque	%	0 to maximum torque	
Cn-07	Soft start acceleration time	0	ms	0 to 10,000	
Cn-08	Forward torque limit	Maximum torque	%	0 to maximum torque	
Cn-09	Reverse torque limit	Maximum torque	%	0 to maximum torque	
Cn-0A	Encoder divider rate (See note 2.)	1,000	Pulses/ revolution	16 to 2,048	
Cn-0b	Rotation speed for motor rotation detection	20	r/min	1 to 4,500	
Cn-0C	P control switching (torque commands)	200	%	0 to maximum torque	
Cn-0d	P control switching (speed commands)	0	r/min	0 to 4,500	
Cn-0E	P control switching (acceleration commands)	0	10 (r/min)/s	0 to 3,000	
Cn-0F	Position lock rotation speed	10	r/min	0 to 4,500	
Cn-10	Jog speed	500	r/min	0 to 4,500	
Cn-11	Number of encoder pulses (See notes 2 and 3.)	2,048	Pulses/ revolution	2,048	2,048
Cn-12	Brake timing 1	0	10 ms	0 to 50	
Cn-13	Torque command scale	30	0.1 V/rated torque	10 to 100	
Cn-14	Speed limit (torque control mode I)	3,000	r/min	0 to 4,500	
Cn-15	Brake command speed	100	r/min	0 to 4,500	
Cn-16	Brake timing 2	50	10 ms	10 to 100	
Cn-17	Torque command filter time constant	4	100 μs	0 to 250	
Cn-18	Forward rotation external current limit	100	%	0 to maximum torque	
Cn-19	Reverse rotation external current limit	100	%	0 to maximum torque	
Cn-1A	Position loop gain	40	1/s	1 to 500	

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PRM No.	Parameter name	Factory setting	Unit	Setting range	Setting
Cn-1F	No. 1 internal speed setting	100	r/min	0 to 4,500	
Cn-20	No. 2 internal speed setting	200	r/min	0 to 4,500	
Cn-21	No. 3 internal speed setting	300	r/min	0 to 4,500	
Cn-22	Speed conformity signal output width	10	r/min	0 to 100	
Cn-23	Soft start deceleration time	0	ms	0 to 10,000	
Cn-28	Compensating gain (HA/LA/V/W Models)	0	---	0 to 100	
Cn-29	Unit number setting (HA/LA/V/W Models) (See note 4)	0	---	0 to 14	

Note 1. Cn-04 (speed loop gain) is factory-set for three times the load inertia. Therefore, if the load inertia is extremely small, some oscillation may occur. If it does, then lower Cn-04 to 20 or less.

Note 2. After the settings for Cn-0A (encoder divider rate) and Cn-11 (number of encoder pulses) have been made, they become effective when the power is turned on again after having been cut off. (Check to see that the LED display has gone off.)

Note 3. Set Cn-11 (number of encoder pulses) according to the number of pulses (resolution) of the encoder. The parameter must be set to 2,048 for an incremental encoder.

Note 4. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details on Cn-29 (unit number setting).

■ Setup Parameters No. 1 (Cn-01)

Item	Bit No.	Factory setting	Setting	Explanation	Setting
Sequence input signal switching	0	0	0	Servo turned ON or OFF by Run command (externally input).	0 =
			1	Servo always ON.	
	1	0	---	No used.	1 = 0
	2	1	0	Enables forward drive prohibit input (POT).	2 =
			1	Permits always-forward drive.	
	3	1	0	Enables reverse drive prohibit input (NOT).	3 =
			1	Permits always -reverse drive.	
Sequence output signal switching	4	0	0	Takes TGON/CLIMT signal as motor rotation detection output.	4 =
			1	Takes TGON/CLIMT signal as current limit detection output.	
Processing at time of recovery from momentary stop	5 (see note 1)	1	0	Servo alarm set at time of recovery from momentary stop.	5 =
			1	Servo alarm automatically cleared at time of recovery from momentary stop.	

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Item	Bit No.	Factory setting	Setting	Explanation	Setting
Abnormal stop	6	1	0	Motor stopped by dynamic brake.	6 =
			1	Motor stopped with free run.	
	7 (see note 2)	1	0	Dynamic brake OFF after motor stopped.	7 =
			1	Dynamic brake ON after motor stopped.	
	8	0	0	Method for stopping when over-travel occurs depends on bit no. 6 setting.	8 =
			1	When over-travel occurs, motor is stopped at the torque set by user parameter Cn-06 (emergency stop torque).	
	9	0	0	When over-travel occurs, motor comes to deceleration stop and servo turns OFF.	9 =
			1	When over-travel occurs, motor comes to deceleration stop and position is locked.	
Control mode selection	b, A	0, 0	0, 0	Speed Control	A = b =
			0, 1	Speed Control with Position Lock Function	
			1, 0	Torque Control I	
			1, 1	Torque Control II	
P control switch conditions	d, C	1, 1	0, 0	The torque command value (Cn-0C) is taken as the condition.	C = d =
			0, 1	The speed command value (Cn-0d) is taken as the condition	
			1, 0	The acceleration command value (Cn-0E) is taken as the condition.	
			1, 1	No P control switching function.	
Encoder selection	E	0	---	Not used.	E = 0
Torque feed-forward function selection (HA/LA/V/W Models)	F	0	0	Torque feed-forward function disabled.	F =
			1	Torque feed-forward function enabled.	

Note 1. If power is immediately turned back on after having been cut off, a momentary stop alarm may be generated. If bit no. 5 is set to "1," the alarm will be cleared automatically even if it is generated, and operation will resume.

Note 2. If set bit 6 to "1" and bit 8 to "0," the dynamic brake relay will turn OFF after the Servomotor stops, regardless of the setting of bit no. 7.

Note 3. In the torque control mode, the method of stopping for errors depends on the setting of bit no. 6. The setting of bit no. 8 has no effect.

Note 4. Outside of the speed limit range, a torque is generated in proportion to the difference with the speed limit value, in order to bring down the Servomotor rotation speed. At this time, the Servomotor rotation speed will not necessarily match the speed limit. (The Servomotor rotation speed varies depending on the load.)

Note 5. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

Note 6. With P control switch conditions, a change from PI control to P control is selected. This function is only valid for speed control.

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Note 7. Do not change the setting of bits 1 and E of setup parameter no. 1 (Cn-01) when a Servomotor with an incremental encoder is being used.

Note 8. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

■ Setup Parameters No. 2 (Cn-02)

Item	Bit no.	Factory setting	Setting	Explanation	Setting
Reverse rotation mode	0	0	0	Rotates in the CCW direction with a + analog command. (See note 5.)	0 =
			1	CCW direction is taken as reverse rotation.	
Origin error mask	1	0	---	No used.	1 = 0
Input command mode (see note 2)	2	0	0	CN1-11 and 12 are used as forward and reverse current command inputs (PCL, NCL).	2 =
			1	[Internal speed control settings] CN1-11 and 12 are used as speed selection command 1 and 2 inputs (SPD1, SPD2). CN1-15 is used as rotation direction command (RDIR).	
	3	0	---	Not used	3 = 0
	4	0	---	Not used	4 = 0
	5	0	---	Not used	5 = 0
	6	0	---	Not used	6 = 0
	7	0	---	Not used	7 = 0
	8	0	---	Not used	8 = 0
	9	0	---	Not used	9 = 0
	A	0	---	Not used	A = 0
Speed integration constant's units (HA/LA/V/W Models)	b	0	0	1 ms	b =
			1	0.01 ms	
Torque command filter time constant (HA/LA/V/W Models)	C	0	0	Primary filter	C =
			1	Secondary filter	
	d	0	---	Not used	d = 0
	E	0	---	Not used	E = 0
TREF switch (see note 3) (HA/LA/V/W Models)	F	0	0	Terminal TREF (CN1-1) isn't the analog current control.	F =
			1	Terminal TREF (CN1-1) is the analog current control.	

Note 1. Do not set bit nos. 1, 3 to A, d, and E of setup parameter no. 2 (Cn-02).

Note 2. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

Note 3. The TREF switch setting (bit F) is valid only for speed control. When this bit is set to "1," the voltage applied to TREF determines the current limit. (HA/LA/V/W Models)

Note 4. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

Note 5. Counterclockwise direction when viewed from the motor output shaft is CCW and clockwise direction is CW.

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6-4-2 Parameters when Using an Absolute Encoder

■ User Parameters

PRM No.	Parameter name	Factory setting	Unit	Setting range	With Motion Control Unit (See note 5.)	Setting
Cn-03	Speed command scale	300	(r/min)/V	0 to 2,162	300	
Cn-04	Speed loop gain (See note 1.)	80	Hz	1 to 2,000	Variable	
Cn-05	Speed loop integration constant	20	H/L: ms HA/LA/ V/W: ms or 0.01 ms	2 to 10,000	Variable	
Cn-06	Emergency stop torque	Maximum torque	%	0 to maximum torque	Variable	
Cn-07	Soft start acceleration time	0	ms	0 to 10,000	0	
Cn-08	Forward torque limit	Maximum torque	%	0 to maximum torque	Variable	
Cn-09	Reverse torque limit	Maximum torque	%	0 to maximum torque	Variable	
Cn-0A	Encoder divider rate (See note 2.)	1,000	Pulses/ revolution	16 to 1,024	Variable	
Cn-0b	Rotation speed for motor rotation detection	20	r/min	1 to 4,500	No	
Cn-0C	P control switching (torque commands)	200	%	0 to maximum torque	Variable	
Cn-0d	P control switching (speed commands)	0	r/min	0 to 4,500	Variable	
Cn-0E	P control switching (acceleration commands)	0	10 (r/min)/s	0 to 3,000	Variable	
Cn-0F	Position lock rotation speed	10	r/min	0 to 4,500	No	
Cn-10	Jog speed	500	r/min	0 to 4,500	Variable	
Cn-11	Number of encoder pulses (See notes 2 and 3.)	2,048	Pulses/ revolution	1,024	1, 024	1,024
Cn-12	Brake timing 1	0	10 ms	0 to 50	Variable	
Cn-13	Torque command scale	30	0.1 V/rated torque	10 to 100	No	
Cn-14	Speed limit (torque control mode I)	3,000	r/min	0 to 4,500	No	
Cn-15	Brake command speed	100	r/min	0 to 4,500	Variable	
Cn-16	Brake timing 2	50	10 ms	10 to 100	Variable	
Cn-17	Torque command filter time constant	4	100 μs	0 to 250	Variable	
Cn-18	Forward rotation external current limit	100	%	0 to maximum torque	No	

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PRM No.	Parameter name	Factory setting	Unit	Setting range	With Motion Control Unit (See note 5.)	Setting
Cn-19	Reverse rotation external current limit	100	%	0 to maximum torque	No	
Cn-1A	Position loop gain	40	1/s	1 to 500	No	
Cn-1F	No. 1 internal speed setting	100	r/min	0 to 4,500	No	
Cn-20	No. 2 internal speed setting	200	r/min	0 to 4,500	No	
Cn-21	No. 3 internal speed setting	300	r/min	0 to 4,500	No	
Cn-22	Speed conformity signal output width	10	r/min	0 to 100	No	
Cn-23	Soft start deceleration time	0	ms	0 to 10,000	0	
Cn-28	Compensating gain (HA/LA/V/W Models)	0	---	0 to 100	Variable	
Cn-29	Unit number setting (HA/LA/V/W Models) (See note 4)	0	---	0 to 14	Variable	

Note 1. Cn-04 (speed loop gain) is factory-set for three times the load inertia. Therefore, if the load inertia is extremely small, some oscillation may occur. If it does, then lower Cn-04 to 20 or less.

Note 2. After the settings for Cn-0A (encoder divider rate) and Cn-11 (number of encoder pulses) have been made, they become effective when the power is turned on again after having been cut off. (Check to see that the LED display has gone off.)

Note 3. Set Cn-11 to 1,024 pulses for an absolute encoder.

Note 4. Refer to the *Computer Monitor Software Instruction Manual (I513)* for OMNUC U-series Servo Drivers for more details on Cn-29 (unit number setting).

Note 5. In the *With Motion Control Unit* column, “variable” indicates parameters that can be changed as required by the application and “No” indicates parameters that are not relevant to operation.

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■ Setup Parameters No. 1 (Cn-01)

Item	Bit no.	Factory setting	Setting	Explanation	With Motion Control Unit (See note 9.)	Setting
Sequence input signal switching	0	0	0	Servo turned ON or OFF by Run command (externally input).	0	0 =
			1	Servo always ON.		
	1	0	0	Valid on the sensor ON input (externally input).	0	1 =
			1	Always regarded as high level internally regardless of the sensor ON input signal.		
	2	1	0	Enables forward drive prohibit input (POT).	1	2 =
			1	Permits always-forward drive.		
	3	1	0	Enables reverse drive prohibit input (NOT).	1	3 =
			1	Permits always -reverse drive.		
Sequence output signal switching	4	0	0	Takes TGON/CLIMT signal as motor rotation detection output.	No	4 =
			1	Takes TGON/CLIMT signal as current limit detection output.		
Processing at time of recovery from momentary stop	5 (see note 1)	1	0	Servo alarm set at time of recovery from momentary stop.	1	5 =
			1	Servo alarm automatically cleared at time of recovery from momentary stop.		
Abnormal stop	6	1	0	Motor stopped by dynamic brake.	Variable	6 =
			1	Motor stopped with free run.		
	7 (see note 2)	1	0	Dynamic brake OFF after motor stopped.	Variable	7 =
			1	Dynamic brake ON after motor stopped.		
	8	0	0	Method for stopping when over-travel occurs depends on bit no. 6 setting.	No	8 =
			1	When over-travel occurs, motor is stopped at the torque set by user parameter Cn-06 (emergency stop torque).		
	9	0	0	When over-travel occurs, motor comes to deceleration stop and servo turns OFF.	No	9 =
			1	When over-travel occurs, motor comes to deceleration stop and position is locked.		
Control mode selection	b, A (see note 5)	0, 0	0, 0	Speed Control	0, 0	A = b =
			0, 1	Speed Control with Position Lock Function		
			1, 0	Torque Control I		
			1, 1	Torque Control II		

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Item	Bit no.	Factory setting	Setting	Explanation	With Motion Control Unit (See note 9.)	Setting
P control switch conditions	d, C (see note 6)	1, 1	0, 0	The torque command value (Cn-0C) is taken as the condition.	Variable	C = d =
			0, 1	The speed command value (Cn-0d) is taken as the condition		
			1, 0	The acceleration command value (Cn-0E) is taken as the condition.		
			1, 1	No P control switching function.		
Encoder selection	ABS E	0	0	Incremental encoder	1	E = 1
			1	Absolute encoder		
Torque feed-forward function selection (HA/LA/V/W Models)	F	0	0	Torque feed-forward function disabled.	0	F =
			1	Torque feed-forward function enabled.		

Note 1. If power is immediately turned back on after having been cut off, a momentary stop alarm may be generated. If bit no. 5 is set to "1," the alarm will be cleared automatically even if it is generated, and operation will resume.

Note 2. If set bit 6 to "1" and bit 8 to "0," the dynamic brake relay will turn OFF after the Servomotor stops, regardless of the setting of bit no. 7.

Note 3. In the torque control mode, the method of stopping for errors depends on the setting of bit no. 6. The setting of bit no. 8 has no effect.

Note 4. Outside of the speed limit range, a torque is generated in proportion to the difference with the speed limit value, in order to bring down the Servomotor rotation speed. At this time, the Servomotor rotation speed will not necessarily match the speed limit. (The Servomotor rotation speed varies depending on the load.)

Note 5. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

Note 6. With P control switch conditions, a change from PI control to P control is selected. This function is only valid for speed control.

Note 7. Change the setting of bit E of setup parameter no. 1 (Cn-01) when a Servomotor with an absolute encoder is being used.

Note 8. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

Note 9. In the *With Motion Control Unit* column, "variable" indicates parameters that can be changed as required by the application and "No" indicates parameters that are not relevant to operation.

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■ Setup Parameter No. 2 (Cn-02)

Item	Bit no.	Factory setting	Setting	Explanation	With Motion Control Unit (See note 5.)	Setting
Reverse rotation mode	0	0	0	Rotates in CCW direction with a + analog command. (See note 6.)	0	0 =
			1	Rotates in CW direction with a + analog command.		
Origin error mask	1	0	0	Origin errors are detected.	0	1 =
			1	Origin errors are not detected.		
Input command mode (see note 2)	2	0	0	CN1-11 and 12 are used as forward and reverse current command inputs (PCL, NCL).	0	2 =
			1	[Internal speed control settings] CN1-11 and 12 are used as speed selection command 1 and 2 inputs (SPD1, SPD2). CN1-15 is used as rotation direction command (RDIR).		
	3	0	---	Not used	0	3 = 0
	4	0	---	Not used	0	4 = 0
	5	0	---	Not used	0	5 = 0
	6	0	---	Not used	0	6 = 0
	7	0	---	Not used	0	7 = 0
	8	0	---	Not used	0	8 = 0
	9	0	---	Not used	0	9 = 0
	A	0	---	Not used	0	A = 0
Speed integration constant's units (HA/LA/V/W Models)	b	0	0	1 ms	Variable	b =
			1	0.01 ms		
Torque command filter time constant (HA/LA/V/W Models)	C	0	0	Primary filter	Variable	C =
			1	Secondary filter		
	d	0	---	Not used	0	d = 0
	E	0	---	Not used	0	E = 0
TREF switch (see note 3) (HA/LA/V/W Models)	F	0	0	Terminal TREF (CN1-1) isn't the analog current control.	0	F =
			1	Terminal TREF (CN1-1) is the analog current control.		

Note 1. Do not set bit nos. 1, 3 to A, d, and E of setup parameter no. 2 (Cn-02).

Note 2. The function of bits b and A is different when the input command mode is set for internal speed control settings (i.e., bit 2 of Cn-02 is 1). Refer to *3-5-3 Setting Internal Speed Control* for details. (HA/LA/V/W Models)

Note 3. The TREF switch setting (bit F) is valid only for speed control. When this bit is set to "1," the voltage applied to TREF determines the current limit. (HA/LA/V/W Models)

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Note 4. These parameters become effective only after power is reset. Confirm that the indicators go out before turning power back on. (Check to see that the LED display has gone off.)

Note 5. In the *With Motion Control Unit* column, “variable” indicates parameters that can be changed as required by the application and “No” indicates parameters that are not relevant to operation.

Note 6. Counterclockwise direction viewed from the motor output shaft is CCW and clockwise direction is CW.

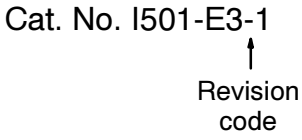
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Revision History

Omron U-Series
AC Servo Motors/Drivers
(30-750-W Analog Inputs)

User Manual

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to previous version.

Revision code	Date	Revised content
I501-E1-2A	September 1996	Revision
I501-E1-2B	November 1996	Revision
I501-E1-3	August 1997	Revision
I5021E1-3	August 1997	Revision
I501-E1-4	August 1998	Revision
I501-E3-1	August 1998	Removed Visual Index page. Removed references to OMNUC N115/116 and U43/U45i in Chapters 1, 2, 5, and 6. Chapter 4, added text on page 4-2.

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