YASKAWA

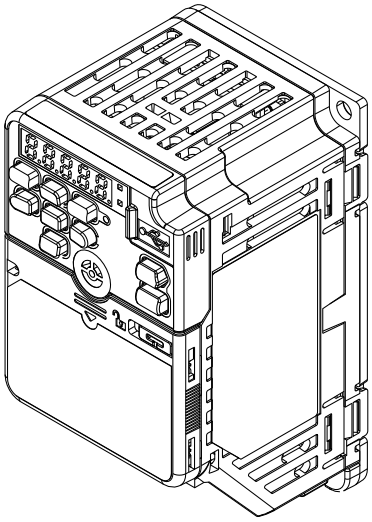
# YASKAWA AC Drive GA500

## Finless-Type Drive

# Installation Manual

| | |
|---|---|
| Type: | CIPR-GA50xxxxxAJxx |
| Models: | 200 V Class, Single-Phase Input: 0.1 to 3.0 kW |
| | 200 V Class, Three-Phase Input: 0.1 to 5.5 kW |
| | 400 V Class, Three-Phase Input: 0.2 to 5.5 kW |

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



MANUAL NO. TOEP C710617 0SA

**This Page Intentionally Blank**

# Table of Contents

# 1 Receiving

## ◆ Applicable Documentation

| Document | Description |
|---|---|
| YASKAWA AC Drive GA500 Finless-Type Drive Installation Manual | This manual gives information about how to install GA500 Finless-Type Drive. |
| YASKAWA AC Drive Manuals | Refer to the manual packaged with the drive for basic information about the drive.<br>Refer to the Technical Manual for more information about programming and parameter settings.<br>You can download the Technical Manual from the Yaskawa website shown on the back cover of this manual. |

## ◆ Glossary

| Terminology Used in this Document | Description |
|---|---|
| Drive | YASKAWA AC Drive GA500 Finless-Type Drive |

# 2 General Safety

## ◆ Supplemental Safety Information

**⚠ DANGER** *This signal word identifies a hazard that will cause serious injury or death if you do not prevent it.*

**⚠ WARNING** *This signal word identifies a hazard that can cause death or serious injuries if you do not prevent it.*

**⚠ CAUTION** *Identifies a hazardous situation, which, if not avoided, can cause minor or moderate injury.*

**NOTICE** *This signal word identifies a property damage message that is not related to personal injury.*

## ◆ Section Safety

| General Precautions |
|---|
| • Some figures in the instructions include options and drives without covers or safety shields to more clearly show the inside of the drive. Replace covers and shields before operation. Use options and drives only as specified by the instructions.<br>• The figures in this manual are examples only. All figures do not apply to all products included in this manual.<br>• Yaskawa can change the products, specifications, and content of the instructions without notice to make the product and/or the instructions better.<br>• If you damage or lose these instructions, contact a Yaskawa representative or the nearest Yaskawa sales office on the rear cover of the manual, and tell them the document number on the front cover to order new copies. |

## 3 Overview

Finless-type drives do not have cooling fins, which are the main heat-generating component of the drive. The finless-type drive uses the enclosure panel (metal plate) as a cooling fin to release the heat generated by the drive. This will let you install the drive in a smaller enclosure panel.

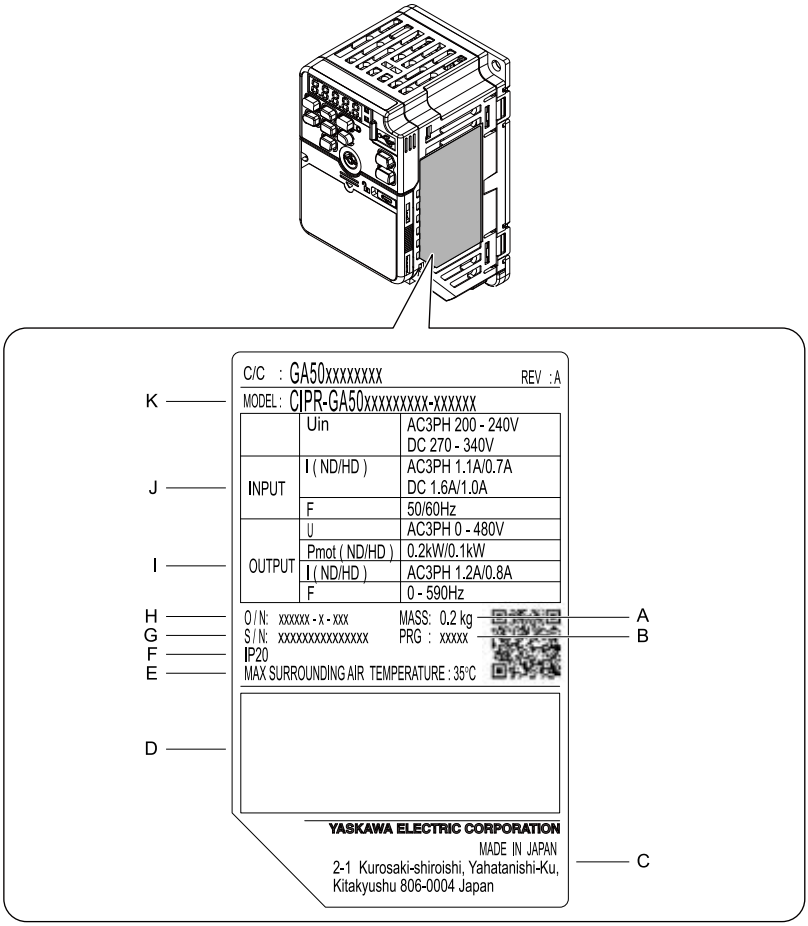
Finless-type drives are recognized components by UL (Underwriters Laboratories Inc.).

This manual shows you how to install the finless-type drive and obey the Conditions of Acceptability. Read and understand the safety information and precautions before you use the product.

## 4 Receiving

1. Examine the drive for damage or missing parts. Immediately contact the shipping company if the drive is damaged. The Yaskawa warranty does not cover damage from shipping.
2. Examine the drive model number to make sure that you received the correct model. Examine the model number in the “MODEL” section of the drive nameplate to make sure that you received the correct model.
3. Contact your supplier or Yaskawa sales office if you received an incorrect drive model or if the drive does not operate correctly.
4. When you operate more than one drive, check all drives and motors separately.

**NOTICE** *Do not operate a drive or connected equipment that has damaged or missing parts. You can cause damage to the drive and connected equipment.*




- **A - Weight**
- **B - Drive software version**
- **C - The address of the head office of Yaskawa Electric Corporation**
- **D - Accreditation standards**
- **E - Ambient temperature specification**
- **F - Enclosure Protection Design**
- **G - Serial number**
- **H - Lot number**
- **I - Output specifications**
- **J - Input specifications**
- **K - Drive Model**

**Figure 4.1 Nameplate Information Example**

## ◆ How to Read the Model Number

Use the information in Figure 4.2 and Table 4.1 to read the drive model numbers.

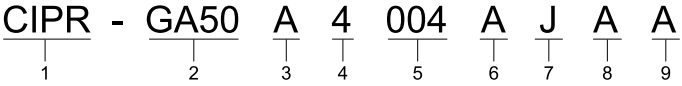



**Figure 4.2 Drive Model**

**Table 4.1 Model Number Details**

| No. | Description |
|---|---|
| 1 | Drive |
| 2 | Product series |
| 3 | Region code<br>• A: Japan<br>• B: China<br>• C: Europe<br>• T: Asia (Singapore, Taiwan, India, and Korea)<br>• U: Americas |
| 4 | Input power supply voltage<br>• B: Single-Phase AC 200 V Class<br>• 2: Three-Phase AC 200 V Class<br>• 4: Three-Phase AC 400 V Class |
| 5 | Rated Output Current |
| 6 | EMC noise filter (Finless-type drives do not have built-in EMC filters)<br>• A: Standard (No built-in EMC filter) |
| 7 | Enclosure Protection Design<br>• J: Finless (IP20/UL Open Type) |
| 8 | Environmental specification<br>• A: Standard<br>• K: Gas-resistant<br>• M: Humidity-resistant and dust-resistant<br>• N: Oil-resistant<br>• P: Humidity-resistant, dust-resistant, and vibration-resistant<br>• S: Vibration-resistant<br>**Note:**<br>Drives with these specifications do not guarantee complete protection for the environmental conditions shown. |
| 9 | Design revision order |

# 5 Conditions

Obey the installation conditions specified in this guide to take full advantage of the finless design of this drive.

## ◆ Installation Environment

The installation environment is important for the lifespan of the product and to make sure that the drive performance is correct. Make sure that the installation environment agrees with the specifications shown in Table 5.1.

**Table 5.1 Installation Environment**

| Environment | Conditions |
|---|---|
| Area of Use | Indoors |
| Power Supply | Overvoltage Category III (IEC60664) |
| Ambient Temperature Setting | -10 °C to +35 °C (14 °F to 95 °F)<br>• Drive reliability is better in environments where the temperature does not increase or decrease quickly.<br>• When you install the drive in an enclosure, use a cooling fan or air conditioner to keep the internal air temperature in the permitted range.<br>• Do not let the drive freeze.<br>• You can use finless-type drives at a maximum of +50 °C (122 °F) when you derate the output current. *1 |
| Humidity | 95%RH or less<br>Do not let condensation form on the drive. |
| Storage Temperature | -20 °C to +70 °C (-4 °F to +158 °F) (short-term temperature during transportation) |
| Surrounding Area | Pollution degree 2 or less (IEC 60664-1)<br>Install the drive in an area without:<br>• Oil mist, corrosive or flammable gas, or dust<br>• Metal powder, oil, water, or other unwanted materials<br>• Radioactive or flammable materials.<br>• Harmful gas or fluids<br>• Salt<br>• Direct sunlight<br>Keep wood and other flammable materials away from the drive. |
| Altitude | 1000 m (3281 ft) Maximum<br>**Note:**<br>Derate the output current by 1% for each 100 m (328 ft) to install the drive in altitudes between 1000 m to 4000 m (3281 ft to 13123 ft).<br>It is not necessary to derate the rated voltage in these conditions:<br>• When you install the drive at 2000 m (6562 ft) or lower<br>• When you install the drive between 2000 m to 4000 m (6562 ft to 13123 ft) and ground the neutral point on the power supply.<br>Contact Yaskawa or your nearest sales representative if you will not ground the neutral point. |
| Vibration | • 10 Hz to 20 Hz: 1 G (9.8 m/s$^2$, 32.15 ft/s$^2$)<br>• 20 Hz to 55 Hz: 0.6 G (5.9 m/s$^2$, 19.36 ft/s$^2$) |
| Installation Orientation | Install the drive vertically for sufficient airflow to cool the drive. |

*1 Refer to *Derating Depending on Ambient Temperature on page 18* for information.

**NOTICE** *Do not put drive peripheral devices, transformers, or other electronics near the drive. Shield the drive from electrical interference if components must be near the drive. Components near the drive can cause incorrect drive operation from electrical interference.*

**NOTICE** *Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.*

## ◆ Heatsink Plate Temperature

**⚠ CAUTION** *Burn Hazard. Do not touch a hot drive heatsink or external heatsink. Yaskawa recommends that you show a high temperature warning mark or warning sign on the external heatsink. If you touch a hot drive heatsink plate or external heatsink, it can burn you.*

Keep the drive heatsink plate temperature lower than the maximum temperature even when the ambient temperature is 50 °C (122 °F). Refer to Table 5.2 for the maximum temperature of the heatsink plate. When you operate the drive in an ambient temperature of 35 °C (95 °F) or higher, refer to *Derating Depending on Ambient Temperature on page 18* and derate the drive.

**Table 5.2 Maximum Temperature of the Heatsink Plate**

| Model | Maximum Temperature of the Heatsink Plate |
|---|---|
| B001 - B012 | 90 °C (194 °F) |
| 2001 - 2021 | 90 °C (194 °F) |
| 4001 - 4012 | 90 °C (194 °F) |

Refer to *Drive Watt Loss on page 12* for the drive watt loss data.

Refer to *Monitor Heatsink Plate Temperature on page 10* to monitor drive heatsink plate temperature.

### ■ Monitor Heatsink Plate Temperature

- When you use the drive keypad
  Set *U4-08 [Heatsink Temperature]* to show the drive heatsink temperature.


**Figure 5.1 *U4-08 [Heatsink Temperature]* (When the heatsink plate is 89 °C)**

- When you use a Multi-function Analog Monitor Output
  When you use terminal AM, set the parameters as shown in Table 5.3.

**Table 5.3 MFAO Settings**

| Parameter | Name | Setting |
|---|---|---|
| H4-01 | Terminal AM Analog Output Select | 408 (*U4-08*) |
| H4-02 | Terminal AM Analog Output Gain | 100.0% |
| H4-03 | Terminal AM Analog Output Bias | 0.0% |

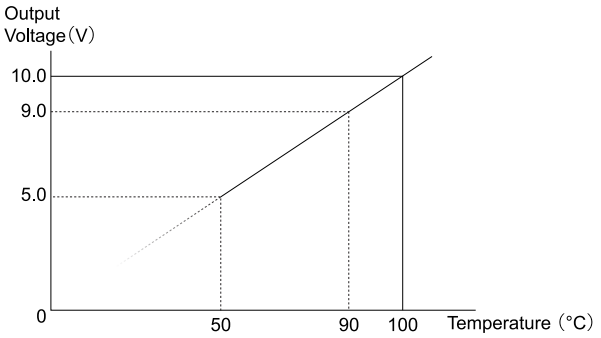



**Figure 5.2 Heatsink Plate Temperature Output on MFAO**

**Note:**
- The accuracy is ±5 °C (41 °F) for heatsink plate temperatures between 50 °C to 100 °C (122 °F to 212 °F).
- The installation environment has an effect on the temperature.

### ■ Overheat Alarm Level

If the heatsink temperature is more than the temperature set in *L8-02 [Overheat Alarm Level]*, the drive detects *oH [Heatsink Overheat]*. To enable this function, set one of *H2-0x [MFDO Function Select]* to *20 [Drive Overheat Pre-Alarm (oH)]*.

Use *L8-03 [Overheat Alarm Level]* to set the operation when the drive detects *oH [Heatsink Overheat]*.

Refer to the drive Technical Manual for more information.

## ◆ Surface Finish of Metal Surface

Make sure that the metal surface to which you will install the drive meets these specifications:

- Flatness: ≤ 0.2 mm (0.0078 in)
- Roughness: ≤ 25 S

**Note:**
A roughness of 25 S means that the average roughness "Ra" is 6.3 a and the maximum peak "Rz" is 25 µm.

## ◆ Thermal Compound

The thermal compound bonds the heating and cooling elements to each other and increases thermal transfer.

Apply the thermal compound between the heatsink plate and the mating surface. The applicable thermal compound is different for different external heatsinks. When you select and apply a thermal compound, contact the thermal compound manufacturer for additional information.

Table 5.4 shows an example of thermal compound selection.

**Table 5.4 Example of Thermal Compound Selection**

| Manufacturer | Type | Model | Application Amount (Thickness) |
|---|---|---|---|
| Shin-Etsu Chemical Co., Ltd. | Oil-based compound | X-23-7795 | 100 µm - 250 µm *1 |

*1 The thickness can change with the condition of the metal surface.

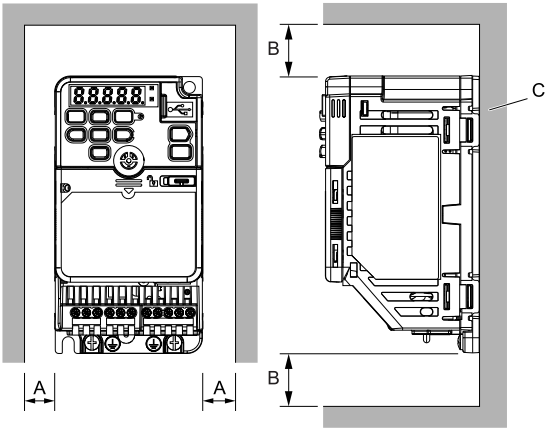
## ◆ Installation Position and Clearances

Use the clearances specified in Figure 5.3 to install the drive. Make sure that there is sufficient space for wiring and airflow.

Tightly push the drive heatsink plate against the metal surface (enclosure panel) for correct thermal transfer between the drive and the metal surface.

**Note:**

You cannot install finless-type drives side-by-side.




**A - 30 mm (1.18 in) minimum**
**B - 100 mm (3.94 in) minimum**
**C - Metal surface (enclosure panel)**

**Figure 5.3 Installation Clearances**

## ◆ Drive Watt Loss

### ■ Heavy Duty Rating (HD): Carrier Frequency = 2 kHz

**Table 5.5 Single-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| B001 | 0.8 | 2 | 7 | 4 | 11 |
| B002 | 1.6 | 2 | 10 | 7 | 17 |
| B004 | 3 | 2 | 13 | 13 | 26 |
| B006 | 5 | 2 | 17 | 23 | 40 |
| B010 | 8 | 2 | 30 | 37 | 67 |
| B012 | 11 | 2 | 40 | 48 | 88 |

**Table 5.6 Three-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 2001 | 0.8 | 2 | 6 | 4 | 10 |
| 2002 | 1.6 | 2 | 7 | 7 | 14 |
| 2004 | 3.0 | 2 | 9 | 13 | 22 |
| 2006 | 5.0 | 2 | 13 | 22 | 35 |
| 2008 | 6.9 | 2 | 14 | 30 | 44 |
| 2010 | 8.0 | 2 | 17 | 37 | 54 |
| 2012 | 11.0 | 2 | 23 | 49 | 72 |
| 2018 | 14.0 | 2 | 26 | 61 | 87 |
| 2021 | 17.6 | 2 | 36 | 83 | 119 |

**Table 5.7 Three-Phase 400 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 4001 | 1.2 | 2 | 8 | 7 | 15 |
| 4002 | 1.8 | 2 | 10 | 10 | 20 |
| 4004 | 3.4 | 2 | 13 | 21 | 34 |
| 4005 | 4.8 | 2 | 15 | 29 | 44 |
| 4007 | 5.6 | 2 | 16 | 33 | 49 |
| 4009 | 7.3 | 2 | 21 | 45 | 66 |
| 4012 | 9.2 | 2 | 27 | 60 | 87 |

## ■ Heavy Duty Rating (HD): Carrier Frequency = Default Setting

**Table 5.8 Single-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| B001 | 0.8 | 10 | 8 | 5 | 13 |
| B002 | 1.6 | 10 | 10 | 9 | 19 |
| B004 | 3 | 10 | 14 | 16 | 30 |
| B006 | 5 | 10 | 18 | 28 | 46 |

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| B010 | 8 | 8 | 31 | 42 | 73 |
| B012 | 11 | 8 | 41 | 55 | 96 |

**Table 5.9 Three-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 2001 | 0.8 | 10 | 6 | 5 | 11 |
| 2002 | 1.6 | 10 | 7 | 8 | 15 |
| 2004 | 3.0 | 10 | 10 | 16 | 26 |
| 2006 | 5.0 | 10 | 14 | 27 | 41 |
| 2008 | 6.9 | 8 | 15 | 35 | 50 |
| 2010 | 8.0 | 8 | 18 | 43 | 61 |
| 2012 | 11.0 | 8 | 24 | 56 | 80 |
| 2018 | 14.0 | 8 | 30 | 82 | 112 |
| 2021 | 17.6 | 8 | 40 | 108 | 148 |

**Table 5.10 Three-Phase 400 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 4001 | 1.2 | 8 | 9 | 11 | 20 |
| 4002 | 1.8 | 8 | 11 | 16 | 27 |
| 4004 | 3.4 | 8 | 15 | 31 | 46 |
| 4005 | 4.8 | 8 | 18 | 42 | 60 |
| 4007 | 5.6 | 8 | 18 | 49 | 67 |
| 4009 | 7.3 | 8 | 25 | 65 | 90 |
| 4012 | 9.2 | 8 | 32 | 85 | 117 |

## ■ Normal Duty Rating (ND)

**Table 5.11 Single-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| B001 | 1.2 | 2 | 8 | 6 | 14 |
| B002 | 1.9 | 2 | 14 | 11 | 25 |
| B004 | 3.5 | 2 | 14 | 17 | 31 |
| B006 | 6.0 | 2 | 17 | 26 | 43 |
| B010 | 9.6 | 2 | 36 | 50 | 86 |
| B012 | 12.2 | 2 | 48 | 60 | 108 |

**Table 5.12 Three-Phase 200 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 2001 | 1.2 | 2 | 7 | 5 | 12 |
| 2002 | 1.9 | 2 | 9 | 9 | 18 |
| 2004 | 3.5 | 2 | 11 | 16 | 27 |
| 2006 | 6 | 2 | 14 | 25 | 39 |
| 2008 | 8 | 2 | 18 | 37 | 55 |
| 2010 | 9.6 | 2 | 25 | 51 | 76 |
| 2012 | 12.2 | 2 | 30 | 61 | 91 |
| 2018 | 17.5 | 2 | 35 | 82 | 117 |
| 2021 | 21 | 2 | 52 | 111 | 163 |

**Table 5.13 Three-Phase 400 V Class (Finless-Type Drive)**

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 4001 | 1.2 | 2 | 8 | 7 | 15 |
| 4002 | 2.1 | 2 | 13 | 12 | 25 |
| 4004 | 4.1 | 2 | 14 | 24 | 38 |
| 4005 | 5.4 | 2 | 16 | 32 | 48 |
| 4007 | 7.1 | 2 | 20 | 44 | 64 |

| Drive Model | Rated Output Current (A) | Carrier Frequency (kHz) | Drive Watt Loss (W) | | |
|---|---|---|---|---|---|
| | | | Interior Unit Loss | Heatsink Plate Loss ($P_{Loss}$) | Total Loss |
| 4009 | 8.9 | 2 | 28 | 58 | 86 |
| 4012 | 11.9 | 2 | 39 | 83 | 122 |

## ◆ Screw Sizes and Tightening Torques

Table 5.14 shows the screw size and tightening torque to safety the drive to a metal surface (enclosure panel).

**Table 5.14 Screw Sizes and Tightening Torques**

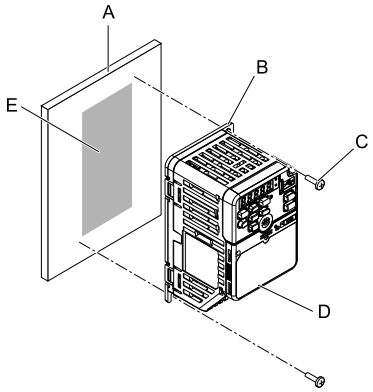
| Drive Model | Screw Size | Tightening Torque N·m (lbf·in) |
|---|---|---|
| B001 - B012 | M5 | 2.0 - 2.5 (17.7 - 22.1) |
| 2001 - 2021 | M5 | 2.0 - 2.5 (17.7 - 22.1) |
| 4001 - 4012 | M5 | 2.0 - 2.5 (17.7 - 22.1) |

**NOTICE** *Damage to Equipment. Tighten the screws to the specified tightening torque. Incorrect tightening torque can cause too much heat and damage to the drive.*

## ◆ Install the Drive

Tightly push the drive against the metal surface (enclosure panel) and make sure that you apply the thermal compound over the full heatsink plate of the drive.

Clean off the unwanted thermal compound from around the drive perimeter.




**A - Metal surface (enclosure panel)**
**B - Heatsink plate**
**C - Screw**
**D - Finless-type drive**
**E - Thermal compound**

**Figure 5.4 Install the Drive**

**Note:**

You can mill the metal surface to be more flat and use less thermal compound. Recommended flatness is 0.05 mm (0.00197 in) or less. After you mill the metal surface, tightly push the drive against it.

### ◆ Derating Depending on Ambient Temperature

When you install drives in an area where ambient temperatures are higher than the rated conditions, set *L8-12 [Ambient Temperature Setting]* and *L8-35 [Installation Method Selection]*. Derate the output current as specified in Figure 5.5.

| No. (Hex.) | Name | Description | Default (Range) |
|---|---|---|---|
| L8-12 (04B8) | Ambient Temperature Setting | V/f OLV **OLV/PM** AOLV/PM EZOLV<br>Sets the ambient temperature of the drive installation area. | 40 °C (-10 °C - +60 °C) |

| No. (Hex.) | Name | Description | Default (Range) |
|---|---|---|---|
| L8-35 (04EC) | Installation Method Selection | V/f OLV **OLV/PM** AOLV/PM EZOLV<br>Sets the type of drive installation. | 3 (0 - 3) |

#### 0 : IP20/UL Open Type

Use this setting to install IP20/UL Open Type drives.

Make sure that there is 30 mm (1.18 in) minimum of space between drives or between the drive and side of the enclosure panel.

#### 1 : Side-by-Side Mounting

Use this setting to install more than one drive side-by-side.

You cannot install finless-type drives side-by-side.

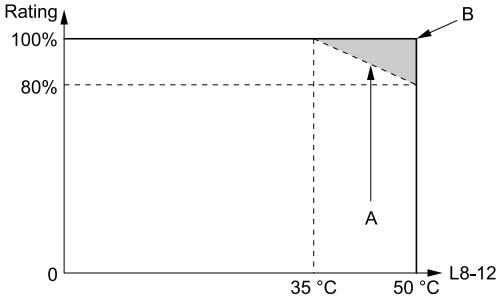
#### 2 : IP20/UL Type 1

Use this setting to install IP20/UL Type 1 drives.

You cannot install a UL Type 1 Kit (optional) on a finless-type drive.

#### 3 : External Heatsink/Finless

Use this setting when the heatsink (cooling fin) is outside the enclosure panel or when you install a finless-type drive.




**A - *L8-35 = 3 [External Heatsink/Finless]* (default setting)**

**B - *L8-35 = 0 [IP20/UL Open Type]* (0.5 m/s of airflow around the drive is necessary)**

**Figure 5.5 Derating Depending on Drive Installation Method**

# 6 Maintenance

## ◆ Part Replacement Guidelines

Table 6.1 shows the standard replacement period for replacement parts. When you replace these parts, make sure that you use Yaskawa replacement parts for the applicable model and design revision number of your drive.

**Table 6.1 Standard Replacement Period**

| Parts | Standard Replacement Period |
|---|---|
| Electrolytic Capacitor | 10 years *1 |

*1 If there is damage to parts that you cannot repair or replace, replace the drive.

**Note:**

Performance life estimate is based on these use conditions. These conditions are provided for the purpose of replacing parts to maintain performance. Unsatisfactory conditions or heavy use will make it necessary for you to replace some parts more frequently than other parts.

- Ambient temperature: Yearly average of 35 °C (95 °F)
- Load factor: 80%
- Operating rate: 24 hours a day

# 7 Drive Exterior and Mounting Dimensions

## ◆ B001 to B004, 2001 to 2006

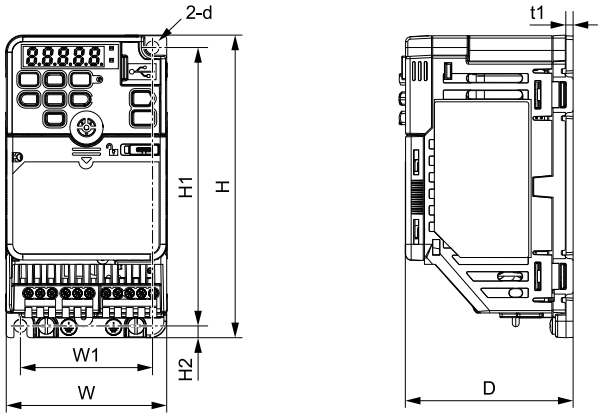



**Figure 7.1 Exterior and Mounting Dimensions**

**Table 7.1 Single-Phase 200 V Class (Finless-Type Drive)**

| Model | Dimensions mm (in) | | | | | | | Est. Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| | W | H | D | W1 | H1 | t1 | d | |
| B001 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |
| B002 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |
| B004 | 68 (2.68) | 128 (5.04) | 81 (3.19) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |

**Table 7.2 Three-Phase 200 V Class (Finless-Type Drive)**

| Model | Dimensions mm (in) | | | | | | | Est. Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| | W | H | D | W1 | H1 | t1 | d | |
| 2001 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |
| 2002 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |
| 2004 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |
| 2006 | 68 (2.68) | 128 (5.04) | 71 (2.80) | 56 (2.20) | 118 (4.65) | 3 (0.12) | M5 | 0.6 (1.32) |

## ◆ B006 to B012, 2008 to 2021, 4001 to 4012

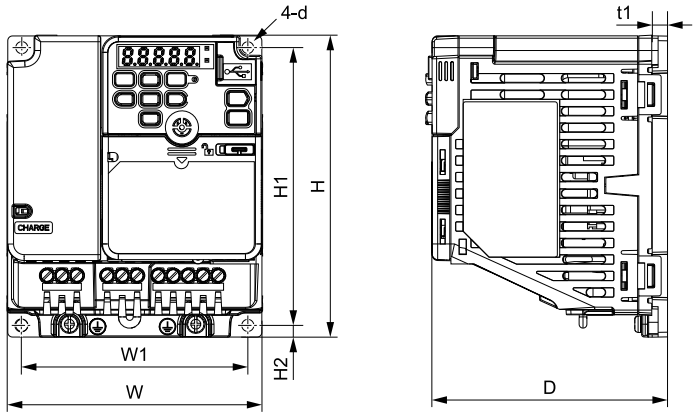



**Figure 7.2 Exterior and Mounting Dimensions**

**Table 7.3 Single-Phase 200 V Class (Finless-Type Drive)**

| Model | Dimensions mm (in) | | | | | | | Est. Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| | W | H | D | W1 | H1 | t1 | d | |
| B006 | 108 (4.25) | 128 (5.04) | 81 (3.19) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.9 (1.98) |
| B010 | 108 (4.25) | 128 (5.04) | 92.5 (3.64) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 1.0 (2.20) |
| B012 | 140 (5.51) | 128 (5.04) | 98 (3.86) | 128 (5.04) | 118 (4.65) | 4 (0.16) | M5 | 1.2 (2.65) |

**Table 7.4 Three-Phase 200 V Class (Finless-Type Drive)**

| Model | Dimensions mm (in) | | | | | | | Est. Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| | W | H | D | W1 | H1 | t1 | d | |
| 2008 | 108 (4.25) | 128 (5.04) | 72.5 (2.85) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.8 (1.76) |
| 2010 | 108 (4.25) | 128 (5.04) | 72.5 (2.85) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.8 (1.76) |
| 2012 | 108 (4.25) | 128 (5.04) | 81 (3.19) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.9 (1.98) |
| 2018 | 140 (5.51) | 128 (5.04) | 78 (3.07) | 128 (5.04) | 118 (4.65) | 4 (0.16) | M5 | 1.2 (2.65) |
| 2021 | 140 (5.51) | 128 (5.04) | 78 (3.07) | 128 (5.04) | 118 (4.65) | 4 (0.16) | M5 | 1.2 (2.65) |

**Table 7.5 Three-Phase 400 V Class (Finless-Type Drive)**

| Model | Dimensions mm (in) | | | | | | | Est. Weight kg (lb) |
|---|---|---|---|---|---|---|---|---|
| | W | H | D | W1 | H1 | t1 | d | |
| 4001 | 108 (4.25) | 128 (5.04) | 75 (2.95) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.8 (1.76) |
| 4002 | 108 (4.25) | 128 (5.04) | 75 (2.95) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.8 (1.76) |
| 4004 | 108 (4.25) | 128 (5.04) | 83.5 (3.29) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 0.9 (1.98) |
| 4005 | 108 (4.25) | 128 (5.04) | 100 (3.94) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 1.0 (2.20) |
| 4007 | 108 (4.25) | 128 (5.04) | 100 (3.94) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 1.0 (2.20) |
| 4009 | 108 (4.25) | 128 (5.04) | 100 (3.94) | 96 (3.78) | 118 (4.65) | 4 (0.16) | M5 | 1.0 (2.20) |
| 4012 | 140 (5.51) | 128 (5.04) | 78 (3.07) | 128 (5.04) | 118 (4.65) | 4 (0.16) | M5 | 1.2 (2.65) |

# 8 External Heatsink Selection

This section gives information about how to to select an applicable external heatsink.

## ◆ Necessary Data for External Heatsink Selection

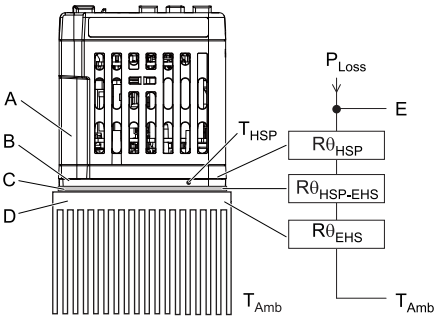
| Symbol | Description | |
|---|---|---|
| $P_{Loss}$ | Drive heatsink watt loss (W) *1 | |
| $T_{HSP\_max}$ | Maximum heatsink plate temperature<br>This is the temperature at the surface of the heatsink plate. Set *U4-08 [Heatsink Temperature]* to monitor the drive heatsink temperature. Maximum temperatures are different for different models.<br>• B001 - B012: 90 °C (194 °F)<br>• 2001 - 2021: 90 °C (194 °F)<br>• 4001 - 4012: 90 °C (194 °F) | |
| $T_{Amb}$ | Ambient temperature of the external heatsink | |
| $R\theta_{HSP}$ | Drive heatsink plate thermal resistance<br>This value is 0.05 K/W. | |
| $R\theta_{HSP-EHS}$ | You can use the formula to calculate thermal resistance between the drive heatsink plate and the external heatsink.<br>$R\theta_{HSP-EHS} = \frac{d_{Comp}}{\lambda_{Comp} \cdot A_{th}}$ | |
| | $A_{th}$ | Heat transfer area between drive heatsink plate and external heatsink<br>**Note:**<br>Heat generation across the drive heatsink plate is not equal because of the arrangement of internal components. The effective area for thermal transfer is only 70% of the drive heatsink plate area.<br>Use the H and W values of the drive exterior dimensions *2 to calculate the area of the drive heatsink plate. |
| | $\lambda_{Comp}$ | Thermal conductivity of the thermal compound |
| | $d_{Comp}$ | Thickness of the thermal compound (when applied) |
| $R\theta_{EHS}$ | Thermal Resistance of the external heatsink | |

*1 Refer to *Drive Watt Loss on page 12* for information.
*2 Refer to *Drive Exterior and Mounting Dimensions on page 20* for information.

## ◆ External Heatsink Selection Methods

Keep the drive heatsink plate temperature lower than the maximum temperature in all ambient temperatures. Select an applicable external heatsink for your application.

Figure 8.1 shows the thermal transfer principle from the drive heatsink plate to the ambient air of the external heatsink.




**A - Drive**
**B - Heatsink Plate**
**C - Thermal Compound**
**D - External Heatsink**
**E - Heatsink Plate Temperature**

**Figure 8.1 Thermal Equivalent Circuit Diagram**

## ■ Select External Heatsink by Thermal Resistance

Use the formula to calculate the maximum thermal resistance $R\theta_{EHS\_max}$ of the external heatsink.

$$R\theta_{EHS\_max} = \left( \frac{T_{HSP\_max} - T_{Amb}}{P_{Loss}} - R\theta_{HSP} - R\theta_{HSP\text{-}EHS} \right)$$

Select an external heatsink with a smaller thermal resistance than $R\theta_{EHS\_max}$.

Make sure that the dimensions of the external heatsink are close to the drive dimensions (H × W). If the thermal resistance of the external heatsink is large, but the dimensions of the external heatsink are near the external dimensions of the drive, select one of these external heatsinks:

- External heatsink with more fins
- External heatsink with longer fin shape

Consider the installation environment of the drive and correct the thermal resistance $R\theta_{EHS}$ of the external heatsink. Dust and unwanted material can decrease the cooling capacity of the external heatsink.

**Note:**

Apply correction factors to the thermal resistance values listed in the specification of the external heatsink in these cases. For details, contact the external heatsink manufacturer.
• The heatsink height and width dimensions are much larger than the drive heatsink plate dimensions.

• When you install multiple drives on one heatsink.

### ■ Examine Feasibility of the Selected External Heatsink

When you select an external heatsink, if installation conditions, for example installation space, limit your selection, use the formula to calculate the heatsink plate temperature and examine the external heatsink.

$$T_{HSP} = P_{Loss} \cdot ( R\theta_{HSP} + R\theta_{HSP\text{-}EHS} + R\theta_{EHS} ) + T_{Amb}$$

If $T_{HSP}$ value is lower than the maximum temperature of the heatsink, you can use the selected external heatsink.

Refer to *Monitor Heatsink Plate Temperature on page 10* to monitor drive heatsink plate temperature.

### ◆ External Heatsink Selection

The examples show applicable heatsink selection for drive model 2006 when *C6-01 = 1 [Normal / Heavy Duty Selection = Normal Duty Rating]*.

These are examples of calculations for the external heatsink from MIZUTANI ELECTRIC IND. CO., LTD.

- Universal Type Heat Sink EF Series, EF (98) L:150 (thermal resistance $R\theta_{EHS}$ = 1.6 K/W)
- Universal Type Heat Sink EK Series, EK (95) L:150 (thermal resistance $R\theta_{EHS}$ = 1.1 K/W)

**Table 8.1 External Heatsink Selection**

| Symbol | Value | |
|---|---|---|
| $P_{Loss}$ | 25.0 W | |
| $T_{HSP\_max}$ | 90 °C (194 °F) | |
| $T_{Amb}$ | 40 °C (104 °F) | |
| $R\theta_{HSP}$ | 0.05 K/W | |
| $R\theta_{HSP\text{-}EHS}$ | $A_{th}$ | H = 128 mm<br>D = 68 mm<br>$A_{th} = 0.7 \times 0.128\ m \times 0.068\ m = 6.1 \times 10^{-3}\ m^2$ |
| | $\lambda_{Comp}$ | 2.0 W/(m·K)<br>Thermal conductivity of Oil-based compound X-23-7795 from Shin-Etsu Chemical Co., Ltd. |
| | $d_{Comp}$ | 100 µm<br>Recommended compound thickness (when applied) |
| | $R\theta_{HSP\_EHS} = \frac{100\ \mu m}{2.0\ W/(m \cdot K) \times 6.1 \times 10^{-3}\ m^2} = 0.008$ K/W | |

### ■ Select External Heatsink by Thermal Resistance

Replace the value of Table 8.1 into the formula in *Select External Heatsink by Thermal Resistance on page 24*.

$$R\theta_{EHS\_max} = \left( \frac{90\ °C - 40\ °C}{25.0\ W} - 0.05\ K/W - 0.008\ K/W \right) = 1.94\ K/W$$

The thermal resistance of the external heatsink “EF(98) L: 150“ is 1.6 K/W, so you can use it. Yaskawa recommends the external heatsink "EK (95) L: 150" to prevent overheat if there is a temporary temperature increase or a decrease in the cooling capacity of the external heatsink because of dust and unwanted material.

### ■ Examine Feasibility of the Selected External Heatsink

The thermal resistance of the external heatsink “EF (98) L: 150“ is 1.6 K/W. You can use the formula to calculate the heatsink plate temperature.

$$T_{HSP} = 25.0\ W \cdot ( 0.05\ K/W + 0.008\ K/W + 1.6\ K/W ) + 40\ °C = 81.45\ °C$$

The temperature of the heatsink plate is lower than the maximum value of 90 °C, so you can use it. Because the thermal transfer area is 70% of the drive mounting area, and the environmental conditions can change because dust and unwanted material can decrease the cooling capacity of the external heatsink, Yaskawa recommends “EK (95) L: 150” heatsink to achieve $R\theta_{EHS}$ = 1.1 K/W ($T_{HSP}$ = 68.95 °C).

# Revision History

| Date of Publication | Revision Number | Section | Revised Content |
|---|---|---|---|
| November 2020 | - | - | First Edition |

# YASKAWA AC Drive GA500

## Finless-Type Drive

# Installation Manual


**DRIVE CENTER (INVERTER PLANT)**
2-13-1, Nishimiyaichi, Yukuhashi, Fukuoka,
824-8511, Japan
Phone: +81-930-25-2548 Fax: +81-930-25-3431
www.yaskawa.co.jp

**YASKAWA ELECTRIC CORPORATION**
New Pier Takeshiba South Tower, 1-16-1, Kaigan,
Minatoku, Tokyo, 105-6891, Japan
Phone: +81-3-5402-4502 Fax: +81-3-5402-4580
www.yaskawa.co.jp

**YASKAWA AMERICA, INC.**
2121, Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone: +1-800-YASKAWA (927-5292) or +1-847-887-7000
Fax: +1-847-887-7310
www.yaskawa.com

**YASKAWA ELÉTRICO DO BRASIL LTDA.**
777, Avenida Piraporinha, Diadema, São Paulo,
09950-000, Brasil
Phone: +55-11-3585-1100 Fax: +55-11-3585-1187
www.yaskawa.com.br

**YASKAWA EUROPE GmbH**
Hauptstraße 185, 65760 Eschborn, Germany
Phone: +49-6196-569-300 Fax: +49-6196-569-398
www.yaskawa.eu.com
E-mail: info@yaskawa.eu.com

**YASKAWA ELECTRIC KOREA CORPORATION**
35F, Three IFC, 10 Gukjegeumyung-ro,
Yeongdeungpo-gu, Seoul, 07326, Korea
Phone: +82-2-784-7844 Fax: +82-2-784-8495
www.yaskawa.co.kr

**YASKAWA ASIA PACIFIC PTE. LTD.**
30A, Kallang Place, #06-01, 339213, Singapore
Phone: +65-6282-3003 Fax: +65-6289-3003
www.yaskawa.com.sg

**YASKAWA ELECTRIC (THAILAND) CO., LTD.**
59, 1F-5F, Flourish Building, Soi Ratchadapisek 18,
Ratchadapisek Road, Huaykwang, Bangkok, 10310,
Thailand
Phone: +66-2-017-0099 Fax: +66-2-017-0799
www.yaskawa.co.th

**YASKAWA ELECTRIC (CHINA) CO., LTD.**
22F, Link Square 1, No.222, Hubin Road, Shanghai,
200021, China
Phone: +86-21-5385-2200 Fax: +86-21-5385-3299
www.yaskawa.com.cn

**YASKAWA ELECTRIC (CHINA) CO., LTD.**
**BEIJING OFFICE**
Room 1011, Tower W3 Oriental Plaza, No. 1,
East Chang An Avenue,
Dong Cheng District, Beijing, 100738, China
Phone: +86-10-8518-4086 Fax: +86-10-8518-4082

**YASKAWA ELECTRIC TAIWAN CORPORATION**
12F, No. 207, Section 3, Beishin Road, Shindian District,
New Taipei City 23143, Taiwan
Phone: +886-2-8913-1333
Fax: +886-2-8913-1513 or +886-2-8913-1519
www.yaskawa.com.tw

**YASKAWA INDIA PRIVATE LIMITED**
#17/A, Electronics City, Hosur Road, Bengaluru,
560 100 (Karnataka), India
Phone: +91-80-4244-1900 Fax: +91-80-4244-1901
www.yaskawaindia.in


YASKAWA


YASKAWA ELECTRIC CORPORATION





*TOEPC7106170S*

MANUAL NO. TOEP C710617 0SA <0>-0
Published in Japan November 2020
20-2-22
Original instructions.